

**Proceedings of  
52nd Mid-Term Symposium**

**MTS-2021**

**30th April, 2021**

**Emerging Trends in  
ICT & Electronics**



**The Institution of Electronics & Telecommunication Engineers**

[www.iete.org](http://www.iete.org)



## 52<sup>nd</sup> Mid Term Symposium (MTS)

# Souvenir & Proceedings

April 30, 20210

Online

Zoom platform

Editor-in-Chief  
Shri N K Karnani

Editorial Team  
Dr Savita Sangam, Dr H S Gambhir,  
Shri Parag Walinjkar, Shri Sham Kamble

**The Institution of Electronics and Telecommunication Engineers**

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## **Editorial**

*It gives me immense pleasure to bring out proceeding of the IETE's 52<sup>nd</sup> Mid Term Symposium. It all began almost 4 months back when headquarter gave the responsibility to IETE Mumbai Centre to organize MTS- 2021. The theme was chosen "Emerging trends in ITC & Electronics".*

*Earlier it was proposed to organize this seminar offline at L&T Academy, Lonavala but due to increase in pandemic condition and Government guidelines it was decided to have the seminar Online. This has increased the work of local organizing committee multifold but with sincerity and hard work, we could bring out E- Proceeding.*

*We used social networking sites, websites, and other means to give wide publicity and spread the information about seminar. We received around about 70 papers out of which 40 papers have been selected for this conference on the basis of merit which were subject to strenuous peer review process comprised of expert reviewers and technical committee.*

*It was a huge responsibility to bring out the conference proceeding of the standard and reputation of IETE. Publication committee acknowledge and thankful to Shri Parag Walunjkar, Chairman IETE Mumbai centre for continuous encouragement and his association, since beginning, to bring out this publication.*

*I am thankful to Dr. J W Bakal, President IETE, Dr. Ashwini Kunte and Dr. K T V Reddy for giving us this opportunity.*

*We had worked immensely to keep up the reputation of IETE and are confident that the work published in this proceeding will give opportunity to engineers and scientists to share experience and views related to multifold development in Electronics Communication and Computer Technology.*

*I am also thankful to Dr. Savita Sangam, Convener TPC and her technical team who provided immense support and help in bringing out this proceeding.*

Narendra Kumar Karnani  
Convener, Publication Committee  
Vice Chairman, IETE Mumbai Centre

## **Chairman Speak**

*It all began in December 2020 when the IETE Mumbai Centre was asked to host one of the key events of IETE; 52nd Mid Term Symposium in the month of April 2021. Though the time was short and lot of things to do, the first and the most important was the brochure, inviting technical papers. We used social networking sites, WhatsApp, and Telegram groups to spread the information about the MTS. The support and guidance provided by IETE President Dr. J W Bakal and Dr. KTV Reddy, IPP motivated Mumbai Centre, particularly me, to deliver the best.*

*Organizing such an event was a huge responsibility, in the background of the pandemic situation in the country. It had been decided to hold the event in the hybrid form at L&T's Leadership Development Academy, Lonavala. Dr. Damahe a member of GC from L&T, extended full support in this regard. But, suddenly in late March, COVID situation in Mumbai became so dangerous, that there was no option for us but to go virtual/online.*

*I am happy to share that Shri S Kunte, CS, Govt of Maharashtra accepted to be the Chief Guest. On continuing efforts of Dr Shiv Kumar and President Prof Bakal, a renowned international expert from Malaysia Dr Navaneethan C. Arjuman, agreed to be a keynote speaker of MTS. This news elated the organizing team. To deliver guest lectures we got experts speakers, in their respective domain, from academics, research, as well as industry.*

*The most important work of the MTS was the selection, and review of contributory papers. The response to the call for papers from all the corners of India was good. The local technical team delivered excellent results, by working together. Here, a special mention is required for the reviewers of the papers. The technical team has put tremendous hard work, to bring out the proceeding of the 52nd MTS. It consists of the messages from IETE dignitaries, abstract of invited lectures, and contributory papers, which are key parts of the proceedings. I hope that readers, students, researchers, and practitioners of electronics, computer, and communication technologies may find it useful as a reading and reference material. I compliment the huge efforts of the reviewers and the editors to bring out the proceedings in such a short time.*

*I take this opportunity to acknowledge each and everyone who worked hard and contributed directly or indirectly to make the 52nd MTS successful. Thanks to my colleagues of IETE Mumbai Centre. It was a pleasure working for IETE under the guidance of Dr. M N Hoda and Dr. Nilesh Kasat. The synchronization with Prof Ashwini Kunte, Shri N K Karnani, Prof Suvarna Bhise, Dr. Savita Sangam, Prof Poonam Chakraborty, Prof Smita Lonkar, and the support from HQ and local staff ended every effort into success.*

*"Working in a team, in which each member is motivated with the same zeal, is an enriching experience to me."*

*Parag Walunjkar*  
Convener,  
52<sup>nd</sup> Mid Term Symposium  
Chairman, IETE Mumbai Centre

# Messages



**Sitaram Kunte**  
**Chief Secretary**



## MESSAGE

It is heartening to know that the Institution of Electronics and Telecommunication Engineers (IETE) is organizing its 52<sup>nd</sup> Mid-Term Symposium on the theme Emerging Trends in ICT & Electronic via digital mode on 30<sup>th</sup> April 2021. IETE is one of the most vibrant professional societies of the country engaged in the service of the Nation since 1953. The Institution, from time to time, conducts National and International conferences on topical themes of Science and Technology and allied areas.

I wish this Symposium a grand success and believe that it will provide an excellent platform to visionaries, academic researchers and practitioners around emerging technologies to share, deliberate, discuss and witness cutting edge research in this domain.

As countries around the world put up their best fight against the COVID-19. In these tough times, Information and Communications Technology (ICT) has emerged as a key means of both resolving challenges caused by the pandemic and responding to the new reality of the everyday. Government at the central and state levels has actively engaged with the private sector to develop ICT solutions, particularly identification, isolation, contact tracing, and treatment, to deal with the evolving situation in the country.

I look forward to an excellent Symposium with great entrepreneurs, researchers and experts who will share new and exciting ideas. Best wishes and Congratulations to the organizing team of IETE Mumbai Centre for taking a great initiative by organizing the symposium on such a significant theme.

A handwritten signature in blue ink, appearing to read "Kunte".

**(Sitaram Kunte)**  
Chief Secretary



## The Institution of Electronics and Telecommunication Engineers New Delhi, India

Prof (Dr) J W Bakal  
**President, IETE**

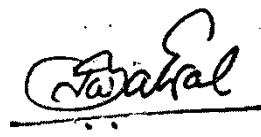


### M E S S A G E

As President IETE, it is indeed a matter of immense pride that IETE is organizing its 52nd Mid Term Symposium on a very significant theme "*Emerging Trends in ICT & Electronics*". The Institution has come a long way as a National Apex Professional Body and has always provided a helping hand to the Government in implementation of all its policies pertaining to National Development. IETE offers expert opinions on contemporary technological issues faced by the Government through its Conferences, Workshops, Seminars and Symposia.

Friends, as you all know the outbreak of Corona virus has created an unprecedented situation all around the world. ICT and Electronics have played a significant role in the effective management of the pandemic. ICTs have been the foundation and the "glue" behind the fight against the Covid-19 pandemic, and will continue to underpin emergency health response in future. ICT that has been deployed to combat Covid-19 and its impacts ranged from remote health monitoring, autonomous disinfection, contactless temperature guns, virtual doctor visits and chatbots through to mobile apps, hospital robots, drones, streaming services and remote working tools. Not only this, ICTs have also helped the business and industry recover from the fallouts of the pandemic and the lockdown. The Electronics and ICT had also held a significant role in keeping the education going during these critical times. In the face of the ongoing pandemic, thousands of schools, teachers and learners all over the world had switched to remote teaching and learning almost overnight. No doubt, ICT in our daily lives has always been unparalleled. But during the on-going Covid-19 pandemic, the importance of ICT is all the more comprehended by people across the globe.

I applaud the efforts and hard work of Mumbai Centre Chairman and his team for successful conduct of the Mid-Term Symposium. I am sanguine that the symposium will provide an effective platform to scientists and engineers to discuss, deliberate, understand and spread awareness in order to provide a holistic view of the role of Electronics and ICTs during this global pandemic.



( J W Bakal )

**Dr K T V Reddy**  
Immediate Past President, IETE



**M E S S A G E**

I am glad to know that The Institution of Electronics and Telecommunication Engineers (IETE) is organizing its 52<sup>nd</sup> Mid-Term Symposium on the theme ***Emerging Trends in ICT & Electronic*** via virtual conferencing on 30<sup>th</sup> April 2021. IETE was established in the year 1953 with the aim and objective of dissemination of knowledge in the field of Electronics, Telecommunications, Computer Science and IT. The Institution organizes conferences, workshops and seminars on contemporary technological issues and offers expert opinion to the government and stake holders on these subjects.

The globe is currently gripped by the deadliest and most widespread pandemic it has faced in over a century. Confronted by accelerating death tolls and widespread fear, societies around the world have also been forced to acknowledge points of stress in their economic and social fabrics that had long gone overlooked. In the midst of this turmoil, ICT has played an essential role in facilitating the safe relief and treatment of affected populations. ICT has also shown itself to be essential both to bolstering long-term resiliency against future pandemics and to resolving the secondary challenges that emerge within a socially distanced environment. However, involving ICT in pandemic relief and prevention carries with it its own set of challenges involving transparency, accountability, and privacy.

I congratulate the IETE team for picking up such a significant theme for its 52<sup>nd</sup> MTS and believe that the symposium will bring together experts from all across the country to present and discuss the most recent innovations, trends and concerns, practical challenges encountered and the solutions adopted in the implementation of these emerging technologies.

-sd-  
**(K T V Reddy)**

**Lt Gen (Dr) A K S Chandele, PVSM, AVSM (Retd)**  
Immediate Past President



**M E S S A G E**

*I am glad that the Institution of Electronics and Telecommunication Engineers (IETE) is organizing its 52<sup>nd</sup> Mid-Term Symposium on "EMERGING TRENDS IN ICT & ELECTRONICS" via digital mode on 30<sup>th</sup> April 2021. It gives me immense pleasure to note that the Institution, from time to time, conducts National and International conferences on topical themes of Science and Technology and allied areas.*

*As countries around the world put up their best fight against the pandemic, the ICT is playing a key role in this journey, from keeping in touch with friends, family members, and customers to fulfilling basic needs such as health and education. ICT and digital technologies have enabled people to easily and quickly share information during the crisis. Healthcare organizations and governments are making use of ICTs to improve public health by spreading news related to the COVID-19 virus to millions of people. Any breakthroughs, preventive measures, and medical advice that can help save lives are shared through networks and devices in a matter of seconds.*

*I convey my best wishes for the success of the Symposium and am sure that it will bring together the brightest engineers and scientists, from all over the nation, through collaboration and exchange of ideas.*

-sd-

**(A K S Chandele)**

## **Prof (Dr.) M N Hoda**

Chairman (TPPC) & Co-Chairman(PUBs)



### **M E S S A G E**

It gives me immense pleasure as Chairman Technical Programmes and Publicity Committee that IETE is organizing its 52<sup>nd</sup> Mid-Term Symposium on a very topical theme "**Emerging Trends in ICT and Electronics**". Due to the persisting pandemic the symposium will be conducted via digital mode on 30<sup>th</sup> April 2021. The Symposium is being hosted by IETE Mumbai Centre. IETE, one of the leading Professional Bodies of the country, holds national and International conferences, seminars, workshops and symposiums every year throughout India with the aim of technological growth of corporate and student members and various other stake holders in Govt, Industry and academia.

The great loss of life and economic damage COVID-19 has wrought across the world has not left India untouched. In these tough times, Information and Communications Technology (ICT) has emerged as a key means of both resolving challenges caused by the pandemic and responding to the new reality of the everyday. Government at the central and state levels has actively engaged with the private sector to develop ICT solutions, particularly identification, isolation, contact tracing, and treatment, to deal with the evolving situation in the country. ICTs and Electronics are also playing a significant role in helping businesses not just survive, but also to thrive, during these pandemic times. ICT is at the forefront and responsible for helping organisations transforming to digital modes of business. The Covid-19 crisis has demonstrated the essential role of connectivity worldwide and the importance of having telecommunications and ICT in place for coordination mechanisms to respond to it.

I look forward to an excellent Symposium with great entrepreneurs, researchers and experts who will share new and exciting ideas. Best wishes and Congratulations to the organizing team of IETE Mumbai Centre for taking a great initiative by organizing the symposium on such a significant theme.

-sd-  
**( M N Hoda )**

**Prof. (Dr.) Nilesh N. Kasat**  
West Zone Mentor & Co-chairman TPPC



**M E S S A G E**

It gives me immense pleasure to apprise that IETE is organizing its 52<sup>nd</sup> Mid-Term Symposium on 30<sup>th</sup> April 2021 through Web Conferencing on a very momentous theme "**EMERGING TRENDS IN ICT & ELECTRONICS**". The Symposium is being hosted by IETE Mumbai Centre. IETE is one of the most vibrant professional societies of the country engaged in the service of the Nation since 1953.

The theme chosen for this MTS is very relevant in the present times as COVID19 pandemic has already forced the organizations to adopt new ways of working. The COVID-19 crisis is an unprecedented one in the history of mankind and caught the entire world by a big unpleasant surprise. The major challenge for the entire global economy was to sustain the Business Continuity amidst the lock down, social distancing and other challenges. The pandemic has made the organizations change their trends and adopt digital technology to sustain. It is obvious that Information & Communication Technology has played a huge role in making this global pandemic more bearable. The businesses and people have embraced everything it offers and are utilizing it to maintain a sense of normality during these uncertain times.

I wish this Symposium a grand success and believe that it will provide an excellent platform to visionaries, academic researchers and practitioners around emerging technologies to share, deliberate, discuss and witness cutting edge research in this domain. It is my honour & privilege to congratulate Mumbai centre for hosting AIC (Annual IETE Convention) successfully during September 2020 and now MTS (Mid Term Symposium) in my tenure as a West Zone Mentor.

With Best Regards!

A handwritten signature in black ink, appearing to read "Nilesh N. Kasat".

**(Nilesh N. Kasat)**

**Ajay Kumar**  
Zonal Mentor (East)



**M E S S A G E**

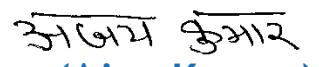
This year our flagship event: IETE Mid Term Symposium is being organized on April 30, 2021 at L&T Leadership Development Academy, Lonavala, Maharashtra, and will focus on the theme “Emerging Trends in ICTs & Electronics”.

We all know that technology today is evolving at such a rapid pace, enabling faster change and progress, causing an acceleration of the rate of change. However, it is not only technology emerging trends or top technologies that are evolving, but a lot more has changed this year due to the outbreak of COVID-19. It has made the IT professionals realize that their role will not stay the same in the contactless world now or tomorrow and they have to constantly be learning, unlearning and relearning not by desire but by necessity.

Advanced ICTs promise enormous benefits for Sustainable Development Goals (SDGs) and human rights, including smart agriculture, smart cities, environmental stewardship; Individual empowerment, better government, improved education. They also bring new challenges and potential risks along with it. The power of emerging technologies will be best harnessed if a human-centered design approach is used.

Like the earlier years, I hope this forum brings together professional experts engaged in policy formulation, practitioners, financiers, regulators and academicians and freely deliberate, discuss, debate and closely interact among themselves to find solutions to the current challenges, which are very sensitive to our country.

IETE earnestly hopes that this year Mid-Term Symposium will live up to the expectations of the enthusiastic participants.

  
**(Ajay Kumar)**

**Dr D C Pande**  
**Zonal Mentor (South) & Co-Chairman (BoRIS)**



**M E S S A G E**

The Institution of Electronics and Telecommunication Engineers (IETE) has always been a renowned and credible Institution which was established in 1953 in the pursuit of advancement in Science and Technology and Endeavour to embrace quality education. I am really proud that this esteemed Institution has successfully completed more than 67 years of its service to the Nation through dissemination of scientific knowledge to the masses. IETE is organizing its 52<sup>nd</sup> Mid-Term Symposium on 30<sup>th</sup> Apr 2021 on the theme “EMERGING TRENDS IN ICT & ELECTRONICS”.

ICT is playing a critical role in improving health care for individuals and communities. In the middle of all the chaos and confusion the virus brings, it seems that information& communication technology has a crucial role in maintaining a sense of normality. There is growing consensus that the impact of information and communications technologies (ICTs) on health systems in India could be substantial or even revolutionary. By providing new and more efficient ways of accessing, communicating, and storing information, ICTs can help bridge the information divides that have emerged in the health sector in developing countries—between health professionals and the communities they serve and between the producers of health research and the practitioners who need it.

I am sure the Mid- Term Symposium would be a success and would provide a useful platform for interaction to Government and Healthcare Industry towards evolving fruitful recommendations.

-sd-  
**( D C Pande)**

## **Shri R K Vyas**

Zonal Mentor (North) and Co-Chairman(AC)



### **M E S S A G E**

I am glad that IETE is holding its 52<sup>nd</sup> Mid-Term Symposium on 30<sup>th</sup> Apr 2021 via digital conferencing on the theme “EMERGING TRENDS IN ICT & ELECTRONICS”. Being associated with the Institution as Governing Council Member and Zonal Mentor (North), I am proud that the Institution has always worked for the mission of National Development in the field of Electronics, Telecommunication and allied areas.

One of the biggest fields that ICT is making a difference during the COVID-19 pandemic is in health care. Technology has played a huge part in improving standards in world health organizations, hospitals, testing facilities, and laboratories. We often overlook just how widespread IT is in the medical field. Digital health has become an important part of the medical world and plays a vital role during these difficult times. ICT and digital technologies have enabled people to easily and quickly share information during the crisis. Healthcare organizations and governments are making use of information technology to improve public health by spreading news related to the COVID-19 virus to millions of people.

I am confident that the 52<sup>nd</sup> Mid-Term Symposium will be a splendid success and its recommendations emerged will be forwarded to the Government and other agencies for implementation. I convey my best wishes to the organizing team for their committed and dedicated efforts in organizing this symposium.

-sd-

**( R K Vyas)**

# about **IETE**



# The Institution of Electronics and Telecommunication Engineers (IETE)

## About IETE

Established in 1953, the Institution of Electronics and Telecommunication Engineers (IETE) is India's leading, recognized, professional society devoted to the advancement of Electronics, Telecommunications, Computers and Information Technology, Computer Science and other related disciplines. IETE serves more than 1,25,000 Corporate, Students and ISF Members through its 63 Centres spread all over India including one at Kathmandu (Nepal) and one Professional Activity Centre (PAC) at Perth, Australia. The Institution promotes and conducts basic engineering and continuing technical education programmes for human resource development. It also holds National Conferences, Seminars and Workshops every year throughout India with the aim of technological growth of corporate & student members and various other stake holders in Govt, Industry and Academia.

The Government of India, Ministry of Science and Technology, Department of Scientific & Industrial Research has recognized IETE as a Scientific and Industrial Research Organization (SIRO) and the Institution has also been notified as an Educational Institution of National Eminence by the Government of India.

## OBJECTIVES

- Promotes and conducts basic engineering and continuing technical education programs for human resource development
- Provides forum for discussion on national policies and to provide suitable inputs to policy makers.
- Organize conferences, symposia and workshops involving all concerned professionals, students and industry association for the advancement of the discipline.
- Stimulates research and development in the discipline.
- Brings out quality publications for all levels of readership.
- Honors outstanding professionals.
- Facilitates inter-disciplinary interaction with other organizations and individuals within and outside the Country for the promotion of the discipline.
- Undertakes socially relevant programs with Electronics, Telecommunication and IT as tools.

## OUR RESOURCE - MEMBERS

IETE offers a variety of Membership grade from student member to Honorary Fellow. As members progress in the professional field over the years they become eligible for more advanced membership classification.

### ➤ Corporate Members

- **Honorary Fellow (HF):** A coveted honour conferred on eminent personalities who have made exceptional contribution in the field of Science and Technology.

- **Distinguished Fellow (DF):** Highest class of elected membership: only eminent Life Fellows are eligible for nomination and election.
- **Fellow (F) :** Engineering Degree in related discipline and professional Competence and Recognition.
- **Member (M):** Engineering Degree in related discipline and work experience.
- **Associate Member (AM):** Based on pass in Graduateship examination AMIETE or equivalent Engg Degree.
- **Chartered Engineer (IETE) :** Fellow for at least 5 years or Member for 10 years and a practicing engineer.

➤ **Student Members**

- Student (PGCS) : Registered for ALCCS Exams, (Post Graduate Level)
- Student (SG) : Registered for AMIETE.(Graduate level)
- Student (SD) : Registered for DipIETE (Diploma level)
- Student (ISF-G) :Belonging to IETE Students' Forum at Engg. Colleges.
- Student (ISF-D) : Belonging to IETE Students' Forum at Polytechnics.

➤ **Organisational Members (Org Mem):** Open to Institutions/ Organizations/Companies engaged in broad areas of Electronics, Telecommunications, Computer Science and Information Technology.

Membership forms for Corporate Membership, Organizational Members can be downloaded from IETE Website : <http://www.iete.org>

## IETE INDUSTRY INTERACTION

IETE has always been closely associated with the Industry by promoting such interactions through seminars, workshops and discussions. Industries join IETE directly as organisational members and their representatives find a place in the Governing Council of the Institution.

## APEX FORUM

IETE organises Apex Forums to provide a platform for exchange of meaningful ideas, on contemporary issues of national interest, amongst :

- Policy makers/implementers.
- Industry Leaders.
- Leading Academicians/Research Organizations.
- Eminent Professionals.

Recommendations/Action plan resulting out of these deliberations is shared with all stakeholders for consideration.

## PROFESSIONAL MANPOWER DEVELOPMENT

Recognizing that information and knowledge are primary resources, IETE has been engaged from the very beginning in creating technical force of professionals for different levels in relevant engineering disciplines. As a result, new career opportunities

have opened up for student members through IETE examinations, viz Diploma(DipIETE), Graduatship (AMIETE), Post Graduate level(ALCCS) and Dual degree or integrated programmes. The regulations/Syllabi for all these are drafted by various specialists members from IITs and various other institutions of repute and are revised periodically. These examinations are recognised by Govt. of India for superior and sub-ordinate services and AICTE for those enrolled upto 31<sup>st</sup> May 2013.These certificatation courses are also recognised for higher education by large number of Universities and Institutions. The IETE examinations are :-

- **DipIETE (since 1987) (Diploma Level)**
  - Comprises of Sections A & B, practical examinations and project
  - Eligibility: 10<sup>th</sup> Pass & Higher Qualification (Science) and engaged professionally.
- **AMIETE (since 1959) (Degree Level)**
  - Examination recognized by the Govt of India, UPSC and a large number of Universities/Institutions.
  - Permitted to appear for GATE;ME/M. Tech. examinations.
  - Comprises of Sections A & B, practical examinations, project and seminar.
  - Eligibility: 10+2 with PCM & Practical Experience or higher Studies (Science) or Diploma in Engg and engaged professionally.
- **Advanced Level Course in Computer Science (ALCCS) (since 1982) at Delhi, Hyderabad, Ahmedabad, Mumbai & Pune.**
  - Recognized equivalent to M. Tech in Computer Science.
  - Unique 6-semester part-time evening programme.
  - Comprises theory, laboratory sessions, and project work in Industry/user agency.
  - Eligibility: BE,AMIETE,AMIE, MCA, M. Sc (CS, Electronics, Physics, Mathematics, Statistics, Operations Research)

### **CONTINUED KNOWLEDGE UPGRADATION : A RACE AGAINST OBSOLESCENCE**

Developing and improving technical and professional competencies, particularly in the working environment, is the greatest challenge that professionals face today. To help members avoid technological obsolescence and to achieve the mission of advancing the profession, IETE offers access to latest developments and brain-storming sessions through

- Annual IETE Convention (formerly Annual Technical Convention) : On the theme of current technological interest.
- Mid-Term Symposium : On current technological theme.
- International Conferences.
- Memorial Lectures : Bhabha Memorial Lecture, Vikram Sarabhai Memorial Lecture, Sir J C Bose Memorial Lecture, Sir C V Raman Memorial Lecture.
- Zonal Seminars at (North, South, West & East Zones) alongwith Zonal Congress.
- Apex Forums.
- Symposia, Fora, Workshops, Contact Programmes, Round Table Conferences.
- Opportunity to publish and review technical papers.
- Academic-Industry interactions.
- IETE Students' Forum (ISF).

- EDUSAT elan (e-learning).
- IETE Students Day.
- Convocation Day.
- IETE Foundation Day.
- Skill Development Programmes.
- World Telecommunication & Information Society Day.
- National Technical Paper Contest.
- Innovation Meet.

## PUBLICATIONS

IETE publications have made significant strides in response to the developments in the fields of Electronics, Telecommunication, Computer Science and Information Technology. We are committed to removing the barriers and practices that often hamper the timely and effective communication of new research findings. IETE is showcasing its achievements in attracting growing numbers of submissions, publishing high-quality research papers, supporting transparency and reproducibility, as well as the careers of new researchers, and exploring new publication formats. IETE has talented academic editorial teams ably led by respective Editors-in-Chief. IETE journals are receiving encouraging response from the research community and their impact factors are increasing consistently.

These publications contribute significantly in achieving the laid down objectives of the Institution. The Institution has its wide and prominent visibility due to these regular publications which include three IETE Journals, Newsletter and Proceedings. Our journals viz. IETE Journal of Research (JR), IETE Technical Review (TR) and IETE Journal of Education (JE) are the prime resource for disseminating state-of-art, current and futuristic scientific and technical knowledge to a wide cross-section of readership of academia, industries, R&D organizations, libraries, professional engineers and students' community. The IETE Journals are available online ([www.ietejournals.org](http://www.ietejournals.org)). The members are sent the publications digitally.

**IETE Journal of Research** is published bi-monthly and covers scientific and technical papers describing original research or novel product/process development work being carried out in India and abroad in the areas of electronics, telecommunications, computer science engineering and information technology. Occasionally special issues are brought out on new and emerging research areas.

**IETE Technical Review** is also published bi-monthly and covers state-of-the-art review papers and in-depth tutorial papers on current and futuristic technologies keeping in view the interest of students, engineers, scientists, academicians and managers who are desirous to keep themselves abreast of the latest research and developments in the areas of electronics, telecommunications, computer science engineering and information technology. Occasionally special issues are brought out on new and emerging research areas.

Both these journals are a part of '**Web of Science**', a coveted place amongst the International Journals of Science and Technology.

**IETE Journal of Education** is a half yearly publication. The journal provides supplementary resources to the students for preparing for their examinations and broadening their understanding of concepts.

**IETE Newsletter** is published four monthly. It covers important events and technical activities of Centres/Sub-Centres and IETE-Students-Forums established in engineering colleges throughout the country including calendar of proposed events and other useful information of IETE Corporate Members.

## **EXCELLENCE & AWARDS**

IETE recognizes outstanding achievements amongst its members and other professionals in the broad areas of Electronics, Telecommunication, Computers, Information Technology and related disciplines through annual/biennial awards. These awards and recognition play vital role in improving the visibility of the Institution and also fulfillment of our role of giving recognition to the professionals who have excelled in their work in the fields of interest to IETE. IETE confers 24 (twenty four) main awards for outstanding achievements, 08 (eight) corporate awards for excellence of performance, 08 (eight) awards for best technical/ research articles published in our journals during the calendar year and academic awards for IETE student members for their academic excellence in various examinations and 03 (three) prizes for the best Technical Papers selected in the IETE National Technical Paper Contest. To make the existing procedure for selection of Awardees for IETE Awards more transparent, fair and systematic, there is a ‘Jury of Experts’ constituted for each award. This Jury, consisting of five experts, is selected from reputed Institution /Universities /Engineering Organizations based on their subject expertise, academic/research and managerial experience. Each award is finally ratified by the Board of Awards (BoA).

Based on the merit an awardee is selected for recognition of excellence in the field of developments. In case of few awards, lectures are delivered by awardees at IETE Centre nearest to their location. To give wider publicity to attract good response to IETE awards, “Call for Nominations” is published in Nov-Dec and Jan-Feb issues of IETE Journal of Research and Technical Review. In addition, brochures and “Call for Nominations” for IETE main awards, corporate awards and National Technical Paper Contest are made available on IETE website.

## **SKILL DEVELOPMENT**

Keeping in view that Skill Development is an imperative to national growth and advancement, IETE is moving more vigorously into this domain. IETE has taken initiatives in various Skill Development programmes such as

- Conduct of 60 ESDM workshops throughout the country, sponsored by Dept of Electronics & Information Technology (DEITY) at IETE Centres/Colleges.
- Trained 50+ Defense Personnel on Optical Fiber Communication Network course sponsored by the Directorate General of RE-settlement of Defense.

- Trained 150+ trainees under Govt schemes like PMKVY & STAR Scheme Pan India.
- Promoting Cyber Security/Cyber Laws through free seminars/guest lectures/workshops at different colleges so far 500+ students benefited.
- IETE certified 50+ candidates for Cyber Security/Cyber law & Cyber Forensics Course.

## **RESEARCH FELLOWSHIP**

One of the prime and salient objectives of IETE is to stimulate Research and Development in the areas of interest to IETE. The institution endeavours to achieve the worthwhile objective by following two-pronged strategy:

- Encouraging research in the discipline by publishing Journal of Research which reports fundamental and applied research work being undertaken in the country and abroad. Publication is internationally recognized.
- By sponsoring research projects.

Under IETE Research Fellowship Scheme, IETE has sponsored nine research projects at IIT Delhi, Chennai, Guwahati, MS University Vadodara, Andhra University Visakhapatnam and Tezpur University Assam, which have been successfully completed leading to the award of Ph.D degree to the researchers. Research Fellowship grant is Rs 16,000/- per month in addition to the contingency grant of Rs 12,000/- per annum.

## **STIPEND SCHEME FOR HIGHER STUDIES (M TECH) FOR IETE GRADUATES**

IETE provides one stipend per year on merit basis for IETE graduates pursuing M. Tech/ME/ALCCS studies in Electronics, Telecommunication, Computer and IT disciplines. Monthly stipend is Rs 10,000/- per month.

## **COMPUTER TRAINING PROGRAMME FOR THE VISUALLY CHALLENGED**

As part of our social responsibility, IETE trains visually challenged persons in handling computer to make them more acceptable in society. No fee is charged from such students. Training is imparted in Computer fundamentals, Internet browsing and Microsoft Office.

## **LECTURE AND CONTENT DELIVERY**

IETE uses latest trends in the delivery of lectures with the aim of "Reaching the Unreached". Through e-lan portal of IETE, more than 1100 video lectures can be viewed. IETE has also embarked on a programme of interactive class rooms, where lectures are delivered from teaching end at IETE Noida Centre and simultaneously received at Ahmedabad, Bengaluru, Bhopal, Chandigarh, Hyderabad, Pune, Palakkad, Mankapur, Imphal and Delhi in interactive mode.

## **VENTURING INTO COOPERATION & PARTNERSHIP**

The Institution recognises that its future leadership in an electronic environment depends heavily upon sharing of resources. Accordingly, the Institution :-

- has signed Memorandums of Understanding with the Institute of Electrical & Electronics Engineering Inc, (IEEE), USA; IEEE Communication Society (IEEE ComSoc) USA; Institution of Electrical Engineers (IEEE), UK ; Hungarian Scientific Society for Telecom (HTE); IEEE MTT-S; IGNOU ; Institutions of Engineers (India) (IE(I)); Christian Medical Association of India (CMAI); Computer Society of India (CSI) and C-DAC, National Institute of Electronics and Information Technology (NIELIT); Global ICT Standardization Forum for India (GISFI) ; Electronics Sector Skills Council of India (ESSCI); Telecom Sector Skill Council (TSSC); Sedulity Solutions & Technologies; Techno India Group; Reliance Jio Infocom Ltd & Redefine Dimensions Convergence Pvt Ltd.
- is a nominated member in the Board of Governors of Engineering Council of India, an important national body constituted for the purpose of coordinating the activities and responsibilities of all professional societies both inside the country and abroad.
- is represented as one of the members of the Council of the National Institute of Electronics & Information Technology (NIELIT), a autonomous scientific society under the administrative control of Ministry of Electronics & Information Technology (MoE&IT), Government of India, and also one of the members of the Council of the Association for Security of Information Systems (ASIS), a national level body, which promotes the general advancement of Information Systems Security and allied subjects.
- is represented in Bureau of Indian Standards (BIS), Electronics & IT Division (LITD) Council and its following sub committees :-

  - LITD – 2 Reliability of Electronics & Electrical Components & Equipment
  - LITD –7 Audio, Video & Multimedia Systems & Equipments.
  - LITD -14 Software & System Engineering.
  - LITD – 16 Computer Hardware, Peripherals & Identification Cards.

- supports the Govt's initiative in formulation of policies such as National Education Policy, National Telecom Policy etc.
- has signed Memorandum of Understanding with AKGEC Skill Foundation (ASF) on 24<sup>th</sup> Apr 2019 with the aim to collaborate and take collective steps to develop technical skills in the students of IETE to make them industry ready.
- has signed Memorandum of Understanding with CISCO Academy Support Centre signed on 9<sup>th</sup> Feb 2019 for communal growth and promotion of mutual interests.
- has signed Memorandum of Understanding with IETE, Microchip Academic Program and Eduvance on 9<sup>th</sup> Feb 2019 with an aim to set up a joint skill development centre to provide a platform for exploiting state of art technology, providing technical training, development of intellectual property and providing facilities for the development of products and solutions.

- has signed Memorandum of Understanding with Jetking Infotrain Ltd on 17<sup>th</sup> May 2019 to enhance, enable and foster employability through skill development by Jetking for the students of IETE and ISF students in the IETE learning centres on a pan India level.
- has signed Memorandum of Understanding with PC Training Institute Ltd on 13<sup>th</sup> Jan 2020 intend to cooperate for training for future technologies and intend to disclose certain confidential information relating to the business to each other subject to the terms and conditions mentioned in the Agreement.
- has signed Memorandum of Understanding with Cyber Peace Foundation, NGO on 21<sup>st</sup> May 2020 to encourage research in the field of Cyber Security, Cyber Defence and Internet Engg and Governance, Setup Cyber Peace Research Centre & Centres of Excellence, Introduce new courses on cyber security, cyber crime investigations, internet engineering and governance subject to prior approval of Academic Council of University and other legal requirements.
- has signed Memorandum of Understanding with Society for Electronic Transactions and Security (SETS) on 25<sup>th</sup> Feb 2020 to provide guidance/strategy to propagate awareness of Cyber Security to society and to educate the team with advanced trends in Cyber Security and also train the trainers programmes for Cyber Security and Critical Infrastructure Society.
- has signed Memorandum of Agreement with Instrumentation Automation Surveillance and Communication Sector Skill Council (IASC-SSC) on 12<sup>th</sup> Jun 2020 for collaboration on conducting skill projects in creation on livelihood on unemployed youths and up-skilling projects for MSME industries on Industry 4.0 outcome based Trainings, Assessments and Certification on Qualification Packs (QP) and National Occupational Standards (NOS) for trained Candidates under various skill development projects.

## **IETE HQ**

The IETE HQ is well organized to meet the needs of membership activities and to conduct the affairs of IETE under the direct supervision of the Governing Council. It has a full-time Secretary General, number of officers and is adequately staffed. It functions from its own building at New Delhi. IETE HQ is a modern towering RCC structure of 6 floors with novel architectural design which includes an auditorium with seating capacity of 327 and a well stocked library . It is a landmark in the Institutional Area of Lodhi Road, New Delhi.

## JOIN THE PROUD IETE FRATERNITY

The IETE has completed more than 62 years of dedicated services to the nation. We have our own physical infrastructure at 37 Centres . We have our own information infrastructure as well, linking IETE HQ with all the Centres. IETE provides its members the following privileges:

- A space to interact with peers as well as eminent professionals and mobility in the membership growth.
- Free personal subscription to Newsletter and one Journal (IETE TR/JR) as per choice.
- Invitation to attend and participate in numerous local/regional/national/ international technical programs at concessional rates.
- Participation in meetings with R&D/Industry/Leaders and others to discuss scientific/technical/professional issues.
- Opportunity to review technical papers, write articles and participate in IETE Committees.
- Opportunity to participate as speaker and also as delegate in various seminars, workshops and technical lectures on topical subjects and cutting edge technologies.
- Access to India's most comprehensive source of publications in Electronics, Telecommunications, Computers etc. at IETE HQ and at Centres/Sub-Centres.
- Availability of tech-literature and other facilities on reciprocal basis at concessional rates from other societies with whom IETE has a MoU.
- Interaction with experts in the discipline from Industry, MNC's, Government and NGO's for professional advancement.

Besides many of the above benefits, student members of IETE would gain :-

- Free subscription to IETE Journal of Education.
- Opportunity for acquiring higher education viz. DipIETE, AMIETE and ALCCS.

## SPECIAL DISCOUNTS OFFER

Decision has been taken by the GC to extend the following discount offers till **June 30, 2021**.

**A. COVID Discount offer (for Life Corporate, Organizational and ISF Membership)**

- Applicable only for **new applications** in various categories
- 25% Flat Discount on Membership Fees
- No discount for Members applying for Transfer to Higher Category

**B. BULK Discount offer (for the Centers)**

- Applicable for Organizational membership, received in Bulk quantity from Centre
- 10% discount – for 03 and above Membership Forms
- 25% discount - for 05 and above Membership Forms
- Bulk discount will not be given where ever Covid discount is granted.

**Note:** Only one discount (Either COVID or BULK) shall be applicable at a time.

## The Governing Council 2020-21

### PRESIDENT



Prof (Dr) J W Bakal

### IMMEDIATE PAST PRESIDENTS



Prof (Dr) K T V Reddy



Lt Gen (Dr) A K S Chandele, PVSM, AVSM (Retd)

### VICE PRESIDENTS



Prof (Wg Cdr ) P Prabhakar (Retd)



Prof (Dr) A K Saini



Dr M H Kori

### SECRETARY GENERAL



Shri Pankaj Kumar Sharma

### HONY TREASURER



Shri Viney Kakkar

### ELECTED MEMBERS



Prof (Col) S L Kapoor (Retd)



Prof (Dr) V Gunasekhar Reddy, DIG of Police (Retd)



Brig V K Panday (Retd)



Gp Capt R C Goyal



Dr M N Hoda



Dr Shiv Kumar



Dr D C Pande



Shri Ajay Kumar



Wg Cdr K C Bhardwaj (Retd)



Dr Ashwini Kunte



Shri R K Vyas



Maj I M Kapoor (Retd)



Prof (Dr) Nilesh N Kasat



Shri Daya Lobiyal



Dr Niranjan Prasad



Prof Baswaraj Gadgay



Shri G Ramesh



Dr S Arivazhagan (Org Rep Member)

## The Governing Council 2020-21 (Cont...)

### NOMINATED MEMBERS



Shri Bhuvansing A Damane



Prof (Dr) Udhav V Bhosle



Lt Gen (Dr) Rajesh Pant

### EX-OFFICIO MEMBERS (Chairpersons of the Centers)



Shri Satyanandan C  
Bengaluru



Dr P K Singhal  
Bhopal



Shri B B Rishi  
Chandigarh



Dr N Venkateswaran  
Chennai



Col Ashok K Bhanot  
Delhi



Dr K Gnaneshwar Rao  
Hyderabad



Shri Jyotsna Kumar  
Mandal  
Kolkata



Shri Parag B  
Walinjkar  
Mumbai



Shri Subhash Chander  
Jain  
Noida



Dr R D Kharadkar  
Pune

# about Host Centre

## **52<sup>nd</sup> Mid Term Symposium**

Host Centre

### **IETE Mumbai Centre**

The Institution of Electronics and Telecommunication Engineers (IETE) was founded in 1953, It is a leading professional society devoted to the advancement of science and technology of Electronics, Telecommunications and IT, serves its 73,000 members (both individuals and industries/organizations) through its 64 centers spread all over India and abroad. Taking into account the institution's well formulated objectives and active membership, Government of India, Ministry of Science and Technology, soon recognized IETE as a Scientific and Industrial Research Organization (SIRO).

Within two years of the establishment of IETE activity with HQ in Delhi, a small group of professionals in electronic industry, consumer electronics, industrial electronics and telecommunication engineers started Bombay Centre in October 1955 with Shri. D.D. Lakan Pal as the Chairman. The centre had regular meetings and organized seminars of topical interest with due support from the industry. Senior members like S/Shri. D. D. Lakan Pal of Murphy, P.M. Agharwala of Bombay Telephones, K. Kalyansundram from the industry (Godavari Sugar Mil) an Padmashri M. M. Wagle led the centre till 1968. Due to frequent transfers of the office bearers and such other problems with the key members in the executive committee, the functioning of the centre was disturbed for about four years and the continuity of activities suffered.

Mean while the membership base of IETE Mumbai centre had widened to about 165 as corporate members. By mid 1972 IETE thus contacted senior members to revitalize the centre as the student activities needed support. The Mumbai centre's activities thus restarted under the chairmanship of Padmashri M. M. Wagle from Bombay Telephones (now MTNL) and due support from Shri P G Damle of Overseas Communications Services (now VSNL) and other active members. The centre has been conducting regular activities since 1972 and the names of office bearers (year wise) as per the available records are given in the last.

With the growth of corporate membership to 634 members including 3 Distinguished Fellows and 212 Fellow members, the activities of Mumbai Centre have been growing in line with the directions of IETE HQ. The Centre was arranging regular technical lecturers as a part of continuing education program for the members which have been very well attended.

Then executive committee of the centre took keen interest to organize regular coaching classes at VJTI. A special effort was also made to setup a good library at VJTI. Since Mumbai centre had a large number of corporate members from the industry disciplines including Electronics industry units, Bombay Telephones, Railways, OCS and Defense etc. A need was felt for continued education programs to enhance the technical competencies of the corporate membership in working environments. IETE Mumbai centre, therefore devoted attention to such programs including regular invited Technical lectures from experts and arranged a number of half-day/one day seminars as well as national level conferences of topics of current interest regularly.

It may be appropriate to mention some of these topical seminars e.g. "Medical Electronics" in 1976 which gave our institution a place of honor in Industry at National level. Leading medical consultants and manufactures of Medical Electronic equipment in India participated in good number in the two days seminar and our corporate members interacted fruitfully with the delegates. The "Marine Electronics" seminar in 1980 was also applauded as a successful event by the marine engineering professionals and well covered by the print media. Similarly a 2-day seminar on "Telecom Management for Business and Industry" in December 1989, proved to be truly of national character where the members of the telecom commission, DOT and industry professionals in telecom management participated actively to discuss the national policies for fast growth of telecommunication and data communication in India.

The 40th Annual Technical Convention organized in September 1997 was a big success. The deliberation of seminar were noted and put up by the Government as well as the industry in the private sector for due implementation. The Mid Term Symposium in April 2003, on "Wireless and Wire Line Future Scenario" was greatly appreciated by the entire telecom industry which had foreseen a rapid growth from 2002 onwards. The Symposium was considered to be a fruitful professional activity to contribute well to the growth of Telecommunication services in India through meaningful interactions and timely executive of action points as recommended at the symposium.

In 2000, the Centre started its own website by the initiative of Prof. S. S. S. P. Rao and since then it has been regularly updated by Shri Q. Bakir. Since year 2010 Shri P. B. Walinjkar used to update the website regularly till last year.

Printed News Letters and annual report in printed booklet of the Centre started on a regular basis in 2000 under the editorship of Dr. T.S.Rathore then Secretary. In the year 2011, Shri. P.B.Walinjkar Honorary Treasurer of the centre started e-news letter rather than printed one. He took lot of initiatives to bring out News-letters regularly up to three volumes.

In December 2001, the First International Conference on Quality, Reliability and Control (ICQRC) was held jointly with IIT Bombay. There was a heavy rush of papers for the conference and the sessions had to be run in parallel for two days. 84 papers were presented and all of them were published in the Conference Proceedings. It was for the first time in the history of Bombay Centre that the full texts of the papers were included in the Proceedings. The inaugural address was delivered by Rear Adm'l D S P Verma, VSM, ASD.

In February 2005, an International conference on Next Generation Networks was held as a part of Silver Jubilee celebration. Consequently an International conference on Emerging Trends in telecommunication Convergence was held in January 2007. The 4th International conference on Nano Technology and Health Care Application was held in October 2007. It was a great achievement that in a year we had two International conferences. During that tenure Dr. T. S. Rathore was Chairman and Dr. K. T. V. Reddy & Smt. Ashwini S. Kunte were Hon. Secretary and Treasurer respectively.

After a gap of 12 years Mumbai centre got the opportunity to organize the 52nd Annual Technical Convention on "Technology & Terror -Roll of ICT in War Against Terror" in September 2009. Shri E Sreedharan known as the 'Metro Man' was the Chief Guest and Dr. Srikumar Banerjee, Director, BARC was the guest of honour for ATC. Response for this convention was incredible and it was a big success.

In 2012 fifth international conference organized by IETE Mumbai Center on Advances in Computer and Communication Technology (ACCT-2012). Scientists from CERN, Geneva included in the Advisory and Technical Program Committee. Inclusion of an invited talk by Shri David Colladas P from CERN Geneva has raised the level of this International conference. Shri N. K. Karnani, TPC convener and Shri P.B. Walinjkar, Convener Publication Committee edited the conference proceedings wherein full texts of all the selected technical papers were printed. Dr. J.W. Bakal, Chairman and Smt. Ashwini S. Kunte, Hon. Secretary has extended whole hearted support for making it viable.

The first ISF (IETE Student Forum) was established in 1999 at Vivekanand College of Engineering, Chembur. Today the number of forum has grown to 33, which have been established in various colleges in Mumbai and all are active in organizing various technical events. Seeing the magnitude of the activities of IETE Mumbai Centre, its Sub Centre of Navi Mumbai was upgraded to Local Centre on 21st February, 2009 by President IETE Lt. Gen. Ashok Agarwal PVSM (Retd.). Present TPC convener of Mumbai Centre Shri N. K. Karnani was the 1st Hon. Secretary of Navi Mumbai Centre.

IETE Mumbai Centre poised on growth path after acquiring its own premises at Chembur. Dr. K T V Reddy then Chairman of Mumbai Centre was pioneer in acquiring the premises for Mumbai Centre. Dr J W Bakal, then Honorary Secretary was in tune with the Chairman for this cause, who became Chairman of the centre subsequently. Support of founder member Dr. P. B. Parikh remains always inspiring. Mumbai Centre has given two very dynamic and result oriented Presidents to IETE, and they

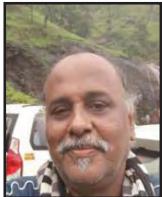
are Dr. K T V Reddy and Dr J W Bakal. Mumbai centre started ALCC course under the leadership of Dr Bakal.. The centre used to organize tutorial classes, laboratory and computer facility for ALCC, AMIETE and Dip IETE Students.

On September 28 & 29, 2013 the centre organized 56th Annual Technical Convention –ATC on “*Growth of Technologies in Electronics, Computers and Telecom: Indian Perception*” under the leadership of Dr Ashwini Kunte as a first lady chairperson of the centre. It was a pride moment as Shri Prithviraj Chavan, Hon’ble Chief Minister, MS was present as a chief guest of the function along with Dr Pal, President IETE. The Mumbai centre bagged Best Centre Award this year.

On October 27, 2018 Dr K T V Reddy then President inaugurated Centre of Excellence in Embedded Systems at IETE House. On this occasion Dr S S Thakur, Chairman of the centre signed MoU with M/s Eduvance for providing skill development courses/workshops for the IETE student members. Microchip had sponsored a software license and hardware worth Rs 20 Lakhs to the centre.

In the Pandemic situation since May 2020, the centre organized free online webinars on latest topics of interest like AI, ML etc. in association with Pantech Solutions. This initiative received very good response from student community. Under the leadership of Er Parag Walinjkar as a Chairman of the centre, Pantech started conducting online short term training and Internship programs on revenue sharing basis with IETE Mumbai. He also started online Technical lectures as a Webinar series with the help of motivated team of EC members.

Credits:



N K Karnani,  
Vice Chairman IETE Mumbai



Parag Walinjkar,  
Chairman IETE Mumbai

# IETE Mumbai Centre

## Executive Committee (2020-22)

### CHAIRMAN



Mr. Parag Walinjkar

### IMM PAST CHAIRMAN



Dr S S Thakur

### VICE CHAIRMANS



Dr. H. S. Gambhir



Mr. N. K. Karnani

### HON. SECRETARY



Mrs. Suvarna Bhise

### HON. TREASURER



Mrs. Smita Lonkar

### MEMBERS



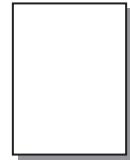
Mrs. Savita Sangam



Mr. Sham Kamble



Mrs. Madhuri Rode



Mr A C Gurav



Mrs. Shaista Khan

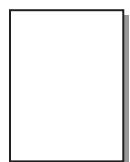
### CO-OPTED MEMBERS



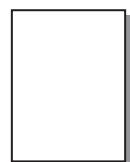
Mr. Atul Wad



Dr. Bhavesh Patel



Mrs. Poonam Chakraborty



Ms. Sneha Khare Jondhale



## Invitation

52<sup>ND</sup> Mid Term Symposium

# MTS-2021

April 30, 2021

'Emerging Technologies in ICT and Electronics'

### Keynote Speaker



**Dr Navaneethan**  
Director, NLTVC Education  
Sdn Bhd, Malaysia

### Chief Guest



**Shri. Sitaram Kunte**  
Chief Secretary  
Govt. of Maharashtra

### Dignitary



**Dr J W Bakal**  
President, IETE

### Invited Speakers



**Dr Satyanarayana**  
Senior Scientist, TIFR



**Shri Mukund Sathe**  
Director, e-Stone Information Technology



**Dr Ajay Agarwal**  
Sr. Principal Scientist, CSIR

Organised by

**The Institution of Electronics and Telecommunication Engineers (IETE)**

#2, Institutional Area, Lodhi Road, New Delhi 110003

Tel: +91 11 43538855, 43538821/22, Tel Fax: +91 11 24649429, sec.gen@iete.org, www.iete.org

hosted by

**IETE Mumbai Centre**

Online on **Zoom**

**Live Streaming**



## Chief Guest



**Shriman Sitaram Kunte**  
Chief Secretary, Govt. of Maharashtra

*Shriman Sitaram Kunte is a 1985-batch Indian Administrative Service officer. He succeeded Mr. Subodh Kumar as the Municipal Commissioner of Mumbai on May 1, 2012. He is presently the Chief Secretary of the Government of Maharashtra.*

*Shri Sitaram Kunte has headed several departments in the Maharashtra Government. He was head of Maharashtra Housing and Area Development Authority and served as an additional municipal commissioner in the BMC*

*\*source Wikipedia*



IETE's  
52<sup>nd</sup> Mid Term Symposium

# MTS - 2021

April 30, 2021

## Programme

- |       |   |
|-------|---|
| 9:15  | Join zoom meeting   |
| 9:55  | Sarasvati Vandana   |
| 10:00 | Welcome address by Shri Parag Walinjkar, Chairman, IETE Mumbai Centre |
| 10:05 | Inaugural Address by Chief Guest Shri Sitaram Kunte*                  |
| 10:15 | Address by Dr Nilesh Kasat, Zonal Mentor (West)                       |
| 10:25 | Address by Dr Hoda, Chairman, TPPC                                    |
| 10:35 | Release of MTS Proceedings  |
| 10:40 | Address by Dr J W Bakal, President, IETE                              |
| 10:50 | Keynote Lecture by Dr. Navaneethan from Malaysia                      |
| 11:40 | Vote of Thanks  |
| 11:45 | Technical Session I-A, I-B and I-C                                    |
| 13:10 | Lunch break   |
| 14:30 | Technical Session II-A, II-B and II-C                                 |
| 16:15 | Valedictory session   |
| 17:15 | Vote of Thanks  |

\*Subject to availability of the Chief Guest

# IETE's 52<sup>nd</sup> MTS – 2021

## Program Schedule

TIME	DESCRIPTION
9:15	Registration
09:55	Sarasvati Vandana
1005	Welcome speech by Chairman IETE Mumbai
1010	Address by Chief Guest Mr Sitaram Kunte, Chief Secretary Govt of Maharashtra
1020	Address by Dr Kasat Zonal Mentor (W)
1030	Address by Dr Hoda, Chair TPPC
1040	Release of e-Proceedings of MTS
1050	Address by Dr J W Bakal, President IETE
1055	Key note Lecture: <i>Securing IPv6 Enterprise Network</i> by Dr Nava
1140	Vote of thanks

SESSION – I ICT and Computers			
1145	A	B	C
1145	Introduction of Session Chair	Introduction of Session Chair	Introduction of Session Chair
1145	Invited Lecture by Dr Ajay Agarwal	Invited Lecture by Shri Mukund Sathe	ORAL PAPER- PID18 ORAL PAPER- PID26 ORAL PAPER- PID27
1215	ORAL PAPER- PID37	ORAL PAPER- PID04	ORAL PAPER- PID31
1225	ORAL PAPER- PID16	ORAL PAPER- PID20	ORAL PAPER- PID35
1235	ORAL PAPER- PID39	ORAL PAPER- PID41	ORAL PAPER- PID36
1245	ORAL PAPER- PID49	ORAL PAPER- PID30	ORAL PAPER - PID42
1255	ORAL PAPER- PID21	ORAL PAPER - PID48	ORAL PAPER – PID 28
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BREAK FOR LUNCH			
SESSION – II Electronics			
1430	A	B	C
1430	Introduction of Session Chair	Introduction of Session Chair	Introduction of Session Chair
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1640	REMARK/FEEDBACK BY EXPERT/JUDGE-3 (Prof P Prabhakar, VP)		
1650	REMARK/FEEDBACK BY EXPERT/JUDGE-4 (Dr Kori, VP)		
1700	DECLARATION OF BEST PAPER AWARDS <i>Best Paper-1 (ICT &amp; Computer) Best Paper-2 (Electronics)</i>		
1710	CONCLUDING REMARK BY PRESIDENT IETE		
1720	VOTE OF THANKS		

# Invited Lectures



## Keynote Speaker



### Dr Navaneethan C. Arjuman

*Dr Navaneethan C. Arjuman* is currently the Expert at International Telecommunication Union (ITU) an agency under United Nation. He is also the Director at NLTVC Education Sdn Bhd. He was the Senior Trainer/Researcher with ITU/UN IPv6 and IOT Centre of Expertise at Malaysian University of Science and Technology (MUST).

He holds PhD in the field of Cyber Security from University Science Malaysia. He holds 1st Class Honours degree in Communication and Signal processing from Staffordshire University, United Kingdom.

He was awarded as the IPv6 Evangelist by IPv6 Hall of Fame in year 2020. He is also the Global Coordinator of Global IPv6 Forum's IPv6 Education Certification Logo Program. He is also the currently the Co-chair of IPv6 Working Group of Asia Pacific Advanced Network (APAN). He is also the IPv6 Global Forum's Certified Trainer for Certified Network Engineer for IPv6 (CNE6), Certified Security Engineer for IPv6 (CSE6), Certified Network Programmer IPv6 (CNP6) and Certified System Administrator for IPv6 (CSA6). He was the Certified Senior Trainer at ITU-MUST IPv6 and IOT Centre of Expertise for courses such as Certified IoT Fundamental, Certified IPv6 Fundamental, Certified IPv6 Deployment for 5G Network, Certified IoT Security etc.

He is also former Lecturer at Taylor's University in Malaysia. He has also served as CEO and Director of KHEC Systems Sdn Bhd and KHEC Solutions (India) Pvt Ltd. KHEC Group is IT solutions provider that has office both in Malaysia and India. Prior to this appointment, he has served as CEO and Director of iNetmon Sdn Bhd. He also served as Senior Manager at BayCom Sdn. Bhd., provider of Satellite Services prior his appointment with iNetmon Sdn Bhd. Prior to his appointment with Baycom, he was a Senior Executive with Maxis Communications Bhd (prominent telecommunication company in Malaysia). He also served as a Lecturer in Sedaya International College (now known UCSI University) prior to his appointment with Maxis Communications Bhd. He is also has served as Assistant CAD/CAM Manager at Saeilo Japan Sdn Bhd and Assistant Sale Manager at BMC Systems Sdn Bhd.

He is currently the Secretary of IPv6 Forum Malaysia the IPv6 Forum's Chapter in Malaysia. He is also former treasure and currently committee member of Malaysia Smart Industry Association.

## Keynote Lecture

### Securing IPv6 Enterprise Network

Dr Navaneethan C. Arjuman  
Director, NLTVC Education Sdn Bhd

The Internet World has been using the Internet Protocol version 4 (IPv4) for the last three decades. Despite its tremendous success, IPv4 is showing signs of strain especially in its depleted IP address space and its growing security concerns. IPv6 preserves everything good in today's Internet, and adds much more, such as virtually unlimited IP address space to connect everyone and everything, stateless auto-configuration, seamless mobility, automated network management, end to end security and new optional service levels.

Securing IPv6 Enterprise network is great challenges because globally many Enterprises have not embraced the IPv6 technology to the fullest scale. Now more and more global nations have committed to migrate their existing network to support IPv6. For an example, the United States of America government has firmly announced last year that they will only support IPv6 stack beyond 2025. Even though in principle the IPv6 offer better security features compare to IPv4 but these major transition exercises will expose more security vulnerabilities globally that have not seen in the past 20 years of the IPv6 implementation. So this talk will cover the current IPv6 security issues and anticipated new IPv6 security threats when the enterprises fully implement IPv6.

## Invited Speaker



### Dr. B. Satyanarayana

*Dr. B. Satyanarayana* did his B. Tech in Electronics and Communication Engineering from J.N.T. University, Hyderabad and Ph.D. in Physics from IIT Bombay. He is working in the Department of High Energy Physics, TIFR since 1983 – and is currently a Scientific Officer (H) and Coordinator of INO Project. He is also a Visiting Professor at the Applied Science Department of the American College, Madurai. His areas of interest include ‘Detectors and Instrumentation for high energy and nuclear physics experiments’. Dr. Satyanarayana has published about 250 research papers and proceedings in national and international journals and conferences, besides scores of invited talks. His very first paper won the best paper award by Institution of Electronics and Telecommunication Engineers (IETE). Recently he was honoured with Homi Bhabha Award in Science Education (HBASE-2020) and has been selected as AICTE-INAE Distinguished Visiting Professor at the Symbiosis Institute of Technology, Pune.

Dr. Satyanarayana is a Fellow of Institution of Electronics and Telecommunication Engineers (IETE) as well as Institute of Engineers (IE). He is a member of the Governing Council of Instrument Society of India (ISOI) as well as a Member of Indian Physics Association (IPA). He guided a large number of doctoral, master and undergraduate students. He served on many of doctoral and expert committees as well as academic councils, boards of studies and advisory boards on colleges, universities and many national organisations of eminence. He is on the editorial and refereeing teams of several prestigious science and engineering journals.

Dr. Satyanarayana is a Senior Member of IEEE. He is currently an Executive Committee member and Chair of the IEEE Bombay Section. He previously served as the Vice Chair, Secretary, Chair of Technical and Professional Activities Committee of the Section as well as the Chair of its Signal Processing Society. He also served an Executive Committee member as well as Vice Chair (Technical Activities) of the IEEE India Council. He won IEEE Bombay Section’s Outstanding Volunteer Award for 2014 and IEEE Head Quarter’s MGA Achievement Award for 2016.

## Invited Lecture

### Advances in VLSI Based Signal Processing and Applications

Dr. B. Satyanarayana  
Senior scientist, TIFR

Digital electronics has witnessed an explosive growth over the past 20-30 years. Catalyzed by applications in computing, communications, cell phones, radio, data links, digital audio, consumer goods and so on, this field is still growing very rapidly. Many traditional analog applications as well as huge range of complex functions are increasingly getting easier to implement by digital and VLSI electronics.

Deep-submicron technologies made billions of transistors on a single die possible, potentially running at gigahertz frequencies. The number of transistors per chip and the local clock frequencies for high performance microprocessors will continue to grow exponentially in the near future. There are several difficult and exciting challenges facing the design of complex ICs. As technology scales, important new opportunities emerge for VLSI IC designers. Understanding technology trends and specific applications is the main criterion for designing efficient and effective chips. To continue its phenomenal historical growth and continue to follow Moore's law, the semiconductor industry will require advances on all fronts – from front-end process and lithography to design innovative high-performance processor architectures, and SoC solutions. The roadmap's goal is to bring experts together in each of these fields to determine what those challenges are, and potentially how to solve them.

## Invited Speaker



### Mr Mukund Sathe

(CTO & Director, e-Stone Information Technology and Founder Director, THE DEAL APP)

Mukund is an industry veteran with 30+ years of experience in multiple industries. He served as a Scientific Officer in Bhabha Atomic Research Center (BARC) working on Nuclear plants, worked in design engineering for Refineries and Chemical Plants, managed large scale IT accounts and businesses in HR, Telecom, Public Services, Finance and Education domains.

Mukund is a Chemical Engineer with post graduate diploma in Software technology and holds Project Management Professional (PMP®) certification from Project Management Institute, USA. He is also member of the executive committee of Institute of Electrical and Electronics Engineers (IEEE) Bombay chapter and part of Business Networking group BNI. Mukund is CTO and director at e-Stone Information Technology and also Founder Director of THE DEAL APP, a technology product start-up.

In his lecture he will try to throw light on some of the qualities any software firm looking in fresh talent. e.g. what does companies look for in fresher candidates? Technology? Programming languages? Smartness? Communication? Does the marks/grade matter?

Let's find out answers from industry veteran who might give you some hints about preparing for industry.

## Invited Speaker



### Prof (Dr) Ajay Agarwal

Ajay Agarwal is Senior Principal Scientist, at CSIR Central Electronics Engineering Research Institute, Pilani and Associate Dean, Engineering Sciences at Academy of Scientific & Innovative Research (AcSIR), New Delhi. Earlier, as Member of Technical Staff he served Institute of Microelectronics, Singapore for over 9 years and SCL, Chandigarh & USHA India, Faridabad for over six years. He is involved in the development of Nanotechnologies, MEMS, micro fluidics and Microsensors.

His engagement with semiconductor industries and research institutes is for over 3 decades. He has ~290 research publications in peer reviewed journals or international conferences, 86 invited/ plenary/ keynote talks and over 35 patents (granted or filled). He has supervised 15 Ph.D. students so far.

He is Senior-member of IEEE, USA since 2006 and Vice-Chairperson, IEEE Rajasthan Subsection; Life Fellow & Chairman, Pilani of IETE (India) and Semiconductor Society of India; Life Fellow of MSI (India), & The Institution of Engineers (India), and member IAAM-International Association of Advanced Materials, Sweden & MRS, Singapore [till 2009], etc. and Associate Editor, Healthcare Technology Letters, etc.

Prof. Agarwal is bestowed with various awards including Outstanding Engineering Services to Society Award 2021, The Institute of Engineers (India) Rajasthan State Centre, Jaipur; 2020 CSIR Technology Award (Innovation); 2013 DST-UKIERI Thematic Partnerships Award, India; 2008 National Technology Award, Singapore; 2009 Excellence Award, IME Singapore; "Collaboration Development Award" British High Commission, Singapore for year 2005 and 2006, Super Kaizen (4 times) and Best Kaizen (7 times) at USHA (India) Ltd., etc. His biography is included in the Who's Who in the World, which profiles the most accomplished men and women in the world since 2010 and in Who's Who in Asia since 2012.

## Invited Lecture

### Miniaturized Sensors for Industry 4.0

Ajay Agarwal

Sr. Principal Scientist, CSIR-Central Electronics Engineering Research Institute,  
Associate Dean (Engineering Sciences), Academy of Scientific & Innovative Research, &  
Chairman, IETE, PILANI (RAJ.) – 333 031 INDIA  
Email: dr.ajay123@gmail.com

The first Industrial revolution initiated in late 18<sup>th</sup> century which marked by a transition from hand production methods to machines. Since then various technological developments have been continuously utilized in the industries to improve industrial production, in terms of quality and quantity. In early last decade, the Industry 4.0 initiated in Germany, which aim to combine hardware, software, and cyber-physical systems, and emphasizes the advances in communication and connectivity. The various physical and chemical sensors are likely to be vital in achieving such objectives.

Nanotechnologies in consort with micro-fabrication and micro-electromechanical systems (MEMS) have enabled novel nano-dimensional materials, structures and eventually devices which find several industrial applications, which are likely to play an important role in Industry 4.0.

Among various nano-materials realized, CNT, Nano-Gap and Nanowire based bio-chemical sensors are most utilized for the sensitive applications. Nano-Gap sensors works on two principles; either on the '*change of the conductivity*' of the sensing layers between the nano-electrodes when exposed to analytes or based on '*Electro-magnetic enhancement*' using micro Raman spectroscopy. Nanowire sensors work on the principle of '*Field Effect Transistor*' (FET) where charges associated with the chemical molecule or the biological specie is attached on the nanowire surface and acts as chemical or bio-gate; the devices are hence termed as CHEM-FET or BIO-FET. MEMS based gas detectors, as environmental analyser are also being explored for various industrial applications. The sensor realization technologies details and their applications will be discussed.

# Contributory Papers

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# Design and Optimization Of Hybrid Multiplier and Comparative Study Of Various Multipliers

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**Abstract** – Recently all digital signal processing and machine learning applications will be given priority by multiplying the area, delaying, power and improving overall performance with parallel implementations. In this case, this multiplication number will have a number of arithmetic additions and subtractions, with critical paths and more power consumption, it will require more logic sizes. In order to solve this problem, this proposed work will present an extensive optimization of radix-4 multiplication circuits using a modified booth algorithm with SQRT carry select adder to improve overall performance and reduce the logical size of critical paths compared to the Wallace tree multiplier. Finally, in Verilog HDL, this work will be presented and synthesized in Xilinx FPGA and comparative terms of region, delay and power have been shown.

**Keywords** — Full adders, Half adders, Carry save adders, Carry select adders, Partial products.

## I. INTRODUCTION

Multiplication is an extremely important procedure, compared with addition, subtraction and division, in many applications such as signal processing, digital device design, filtering design, etc. Multiplication is used in various domains.

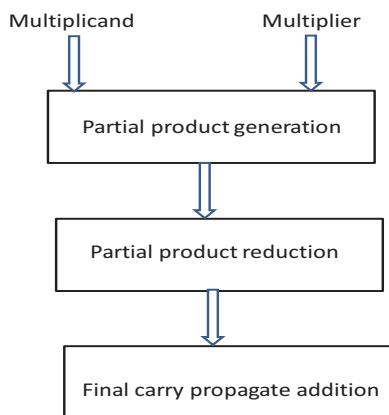


Fig1. General multiplication stages.

several modifications were been developed and used in various applications, such as the Wallace multiplier, Array multiplier, etc. Made to the booth multiplier to improve performance.

## 2 ARRAY MULTIPLIER

The digital combination circuit that uses the full and half adders array to multiply two binary numbers. This range is used to add different product terms almost simultaneously. A range of AND gates is used to form the different product terms before the Adder array.

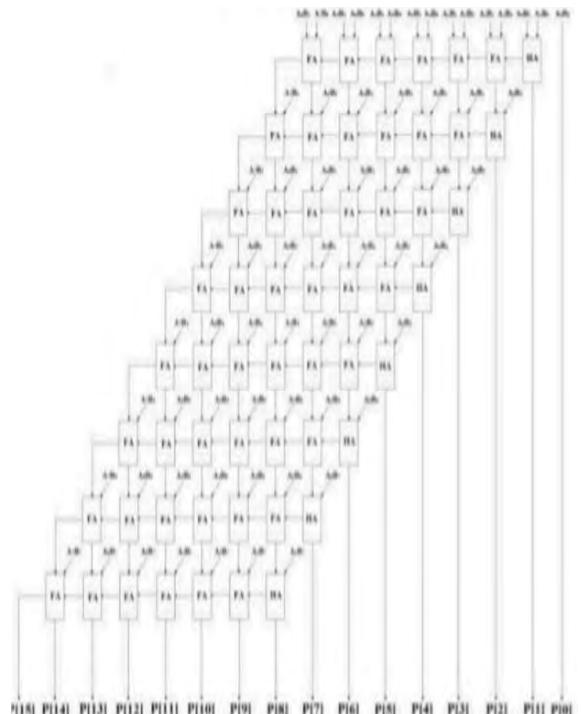


Fig2: Block Diagram of Array Multiplier

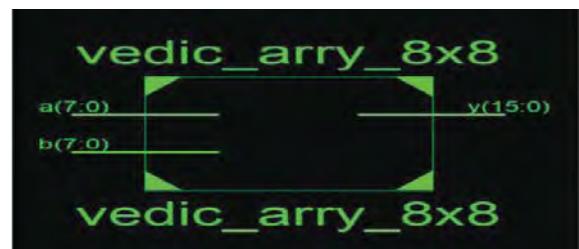


Fig3: Block Diagram of Array Multiplier

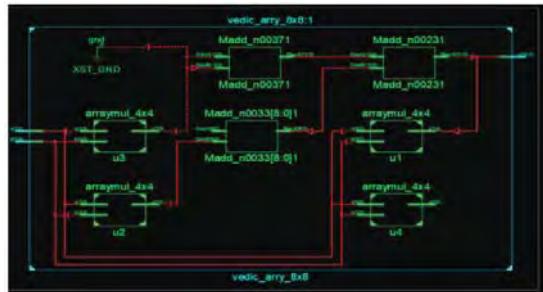


Fig4: RTL Diagram of Array Multiplier

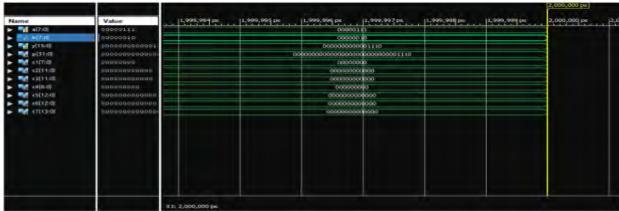


Fig5: Simulation output of Array Multiplier

### 3 BOOTH MULTIPLIER

Booth's algorithm is an algorithm that increases two signed notations of complement by 2 binary numbers. Booth has used desk calculators which were quicker than addition, to improve their speed. The algorithm of the Booth study of computer architecture is of concern.

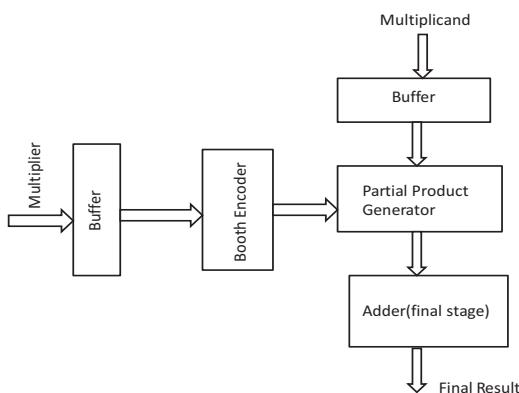


Fig6: Block Diagram of Booth Multiplier

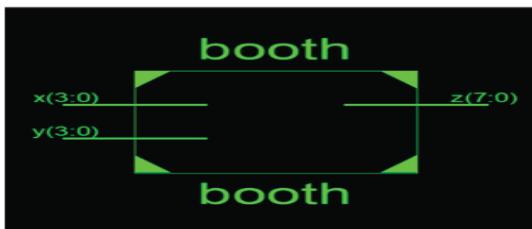


Fig7: Block Diagram of Booth Multiplier

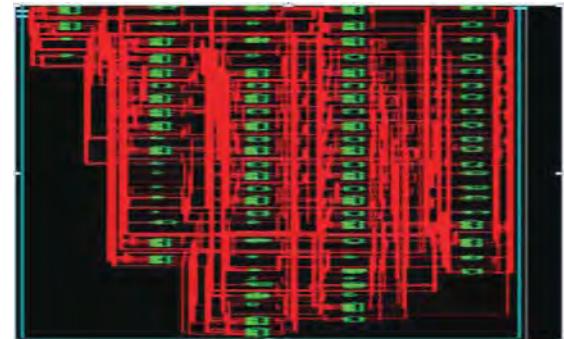


Fig8: RTL Diagram of Booth Multiplier

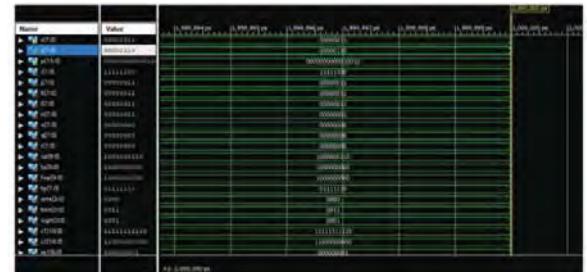


Fig9: Simulation output of Booth Multiplier

### 4 WALLACE MULTIPLIER

A Wallace-tree is a powerful hardware implementation of a two integer digital circuit. The multiplier for the Wallace tree is a high speed multiplier. The combined parallel use of a carry save tree to sum up the partial product bits would usually be called the Wallace tree.

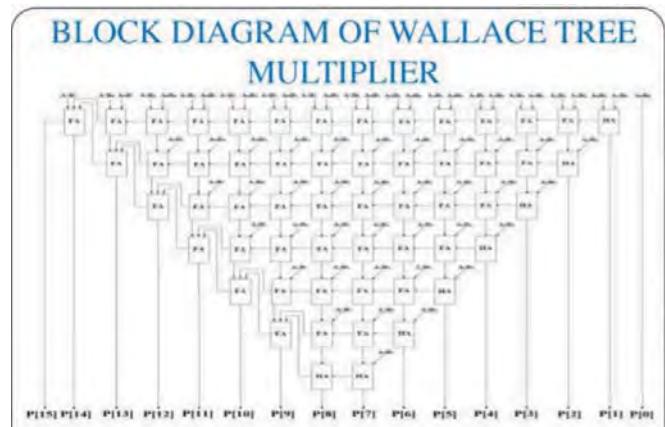


Fig10: Block Diagram of Wallace tree Multiplier

The Wallace Tree has three steps:

1. Multiply each bit, by a bit, of one argument.
2. Reduce to two layers of complete and half additives the number of partial products.
3. Put the wires into two digits and connect them to the regular adder.

In comparison to the naivety addition of part products with every day vendors, the Wallace tree benefits from its agility. It has reduction layers that is limited to every layer of propagation time. It takes time for partial products to be naively added. Since the partial products are produced, the last added amount is not too slower to multiply.

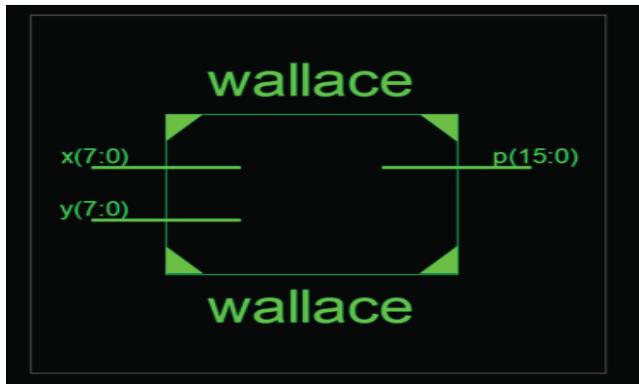


Fig11: Block Diagram of Wallace tree Multiplier

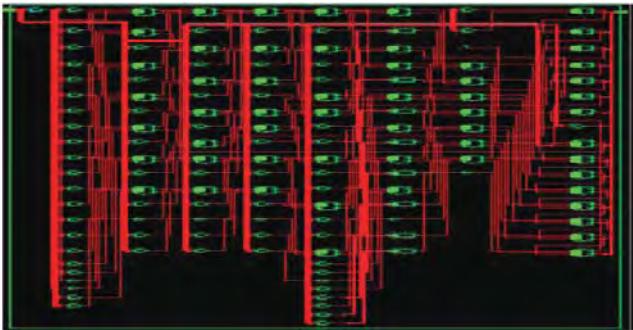


Fig12: RTL Diagram of Wallace tree Multiplier

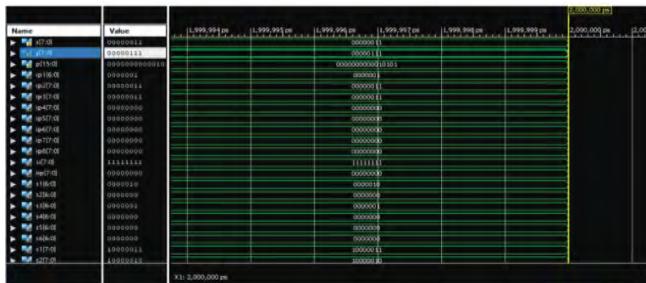


Fig13:Simulation output of Wallace tree Multiplier

## 5 HYBRID MULTIPLIER

This hybrid multiplier has been proven above and above the traditional Wallace multiplier from a performance point of view, and thus therefore above the conventional stand multiplier. Various methods are still recommended for further

Speeding.

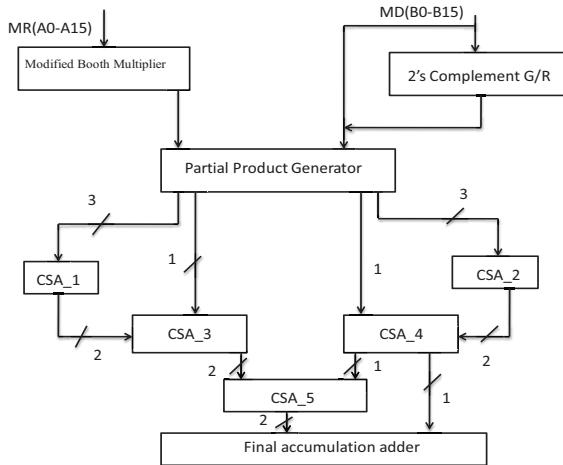


Fig14: Block Diagram of Hybrid Multiplier

5.1 Hybrid multiplier architecture are three stages.

I. Modified Booth Stage.

II. Wallace tree Stage.

III. Final accumulation Stage.

### I.MODIFIED BOOTH MULTIPLIER:

In this block diagram the first phase of the hybrid multiplier architecture consisting of the modified stand,2 generator complement and partial product generator.

### II. 2's COMPLEMENT GENERATOR:

The first step of the hybrid multiplier architecture consisting of the modified stand, 2 generator supplement and partial generator of the product.

### III. FINAL ACCUMULATION ADDER:

In this block diagram the final stage is final accumulation adder. This stage is used as final addition stage which consists of combination of RCA (ripple carry adder) and multiplexer.

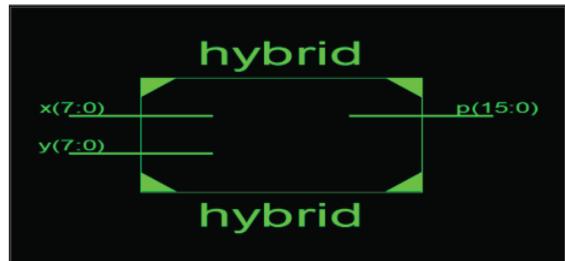


Fig15: Block Diagram of Hybrid Multiplier.

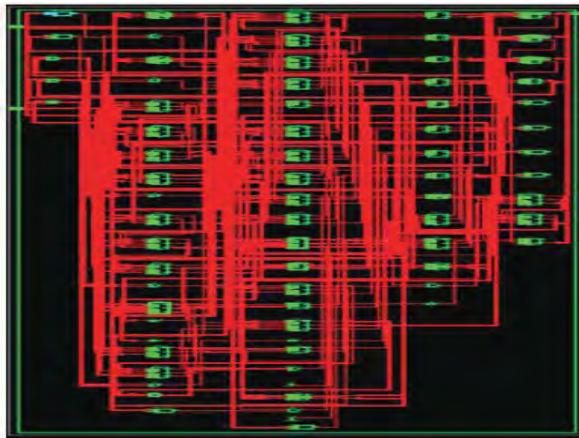


Fig16: RTL Diagram of Hybrid Multiplier

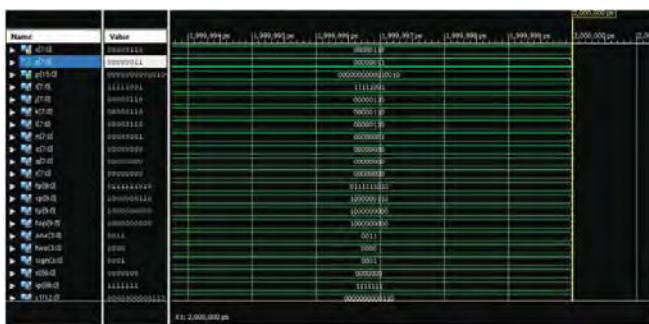


Fig17: Simulation output of Hybrid Multiplier

## 6. COMPARATIVE STUDY

The work proposed indicates a comparative study of the array, booth, wallace and hybrid multiplier's design.

Parameters	Array multiplier	Booth multiplier	Wallace multiplier	Hybrid multiplier
Power	0.078W	0.085W	0.085W	0.079W
Delay	5.5ns	5.952ns	6.013ns	5.427ns
Area	53,200	53,200	53,200	53,200
Signal power	0.00028w	0.00035w	0.00041w	0.00022w
Data power	0.00028w	0.00035w	0.00041w	0.00022w
I/O power	0.00014w	0.00564w	0.00564w	0.0014 w

## 7. CONCLUSION

Array, Booth, Wallace, Hybrid and Wallace Multiplier was built in an 8-bit version. The modules built have less power consumption, less space and less delay. Comparison table between all the multipliers are given with all the parameters.

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# Design and Simulation of Clock and Data Recovery Circuit (CDR) in 180nm CMOS Technology

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**Abstract-** This paper discusses the need for a clock and data recovery circuit and a methodology to extract a clock from the received data. Communication systems that use synchronous detection face various problems in detection. Firstly, the locally generated clock cannot be exactly synchronized with the data. Therefore, it faces the Quadrature null effect which reduces Signal to Noise Ratio. Secondly, the phase offset in which signal faces in the channel cannot be recovered by the receiver clock. Therefore, asynchronous detection is preferred over synchronous detection where the clock is recovered from received data itself. Present CDR circuits use mixed-signal processing devices for design. They use both analogs as well as digital components.

In this project of Clock and data recovery initially, the clock is extracted by detecting the incoming training sequence from the receiver. By doing this, the frequency of the clock is roughly estimated. Then this received clock is fine-tuned so there is no phase difference between the receiver clock and transmitter clock. This phase difference is detected by a linear phase detector which will help to reduce the phase difference between the input signal and the output signal which is fed back to the extracted clock so that it is completely phase aligned. With the help of this extracted clock, data is sampled simultaneously, which gives the required data. A Current starved Voltage-controlled Oscillator (CSVCO) was designed to have a frequency of 2.4 GHz when 1V control voltage is provided. This whole project was implemented on Cadence Virtuoso in 180nm technology.

**Keywords**— CSVCO, VCO, PFD, PLL, CDR, Frequency divider, CMOS.

## I. Introduction

In communication system, coherent detection at receiver end, it is very crucial that clock generated at the receiver must be exactly synchronised with the received clock to prevent offset and signal loss. It is not practical to transmit the required sampling clock signal separately from the data. Therefore, it is preferable to switch to non-coherent detection where the clock is extracted from data itself and sampling is done according to the extracted clock, this is known as data recovery. Clock and

Data recovery is a method to recover clock and remove noise which gets added in the channel due to multipath and other similar effects. This purpose is achieved using this kind of circuit which traces input sequence in real time and adjusts its frequency according to the changes in incoming signal due to noise as shown in Figure 1.

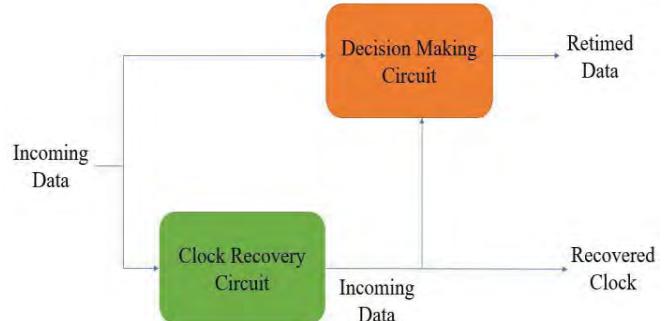


Figure 1: Block Diagram of Basic CDR

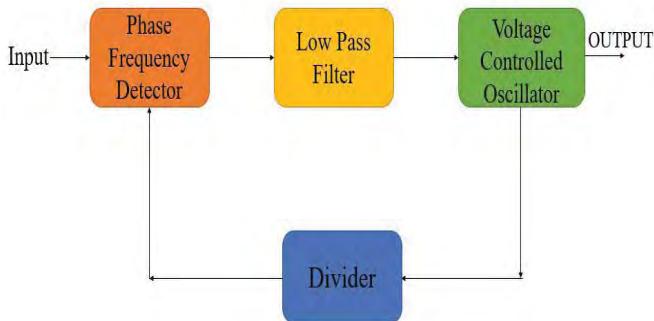
Clock and Data recovery is a method to recover clock asynchronously. This purpose is achieved using a circuit which traces input sequence in real time and adjusts its phase according to the changes in phase of the incoming signal due to noise. Clock and data recovery is a method, which eliminates the requirement of synchronous detection at receiver end by extracting clock from data itself. It can be used in wired communication channel but can also be used with wireless standards with proper modifications in hardware as shown in Figure 1. [1]

A PLL is used to derive a clock from the received data. A PLL has a negative feedback control system circuit. The main aim of a PLL is to reproduce a signal which is phase aligned with the reference signal. This is achieved after many iterations of comparison of the reference and feedback signals. In this lock mode the phase of the reference and feedback signal is zero. After this, the PLL continues to compare the two signals but since they are in lock mode, the PLL output is constant.

Phase-locked loops can be used in various applications such as frequency synthesizers, carrier recovery circuit, Frequency division, carrier synchronization and frequency Demodulation. PLL synchronizes the frequency and various types of PLLs are part of the modern communication systems. PLLs contain Phase frequency detector (PFD), Low pass filter (LPF),

Current starved oscillator (CSVCO) and frequency divider. [2] The basic block diagram of the PLL is shown in the Figure 3. In general, a PLL consists of four main blocks: [6]

1. Phase Frequency Detector (PD or PFD)
2. Low Pass Filter (LPF)
3. Voltage Controlled Oscillator (VCO)
4. Divider



**Figure 2:Basic structure of Phase locked loop**

The basic PLL is shown in the Figure 2. It is basically a flip flop consisting of a phase detector, a low pass filter (LPF), divider and Voltage Controlled Oscillator (VCO).

### Proposed Structure of CDR

In this paper an attempt was made to design Clock and data Recovery circuit. Proposed structure of CDR contains PLL as the main component. The CDR for high performance application has been designed using 180 nm CMOS technology and Simulated by Cadence Virtuoso software. The proposed voltage-controlled oscillator (VCO) was designed for getting optimized 2 GHz frequency. A design has been done with 180 nm CMOS technology and 1.8 Volt supply voltage.

### Working Principle:

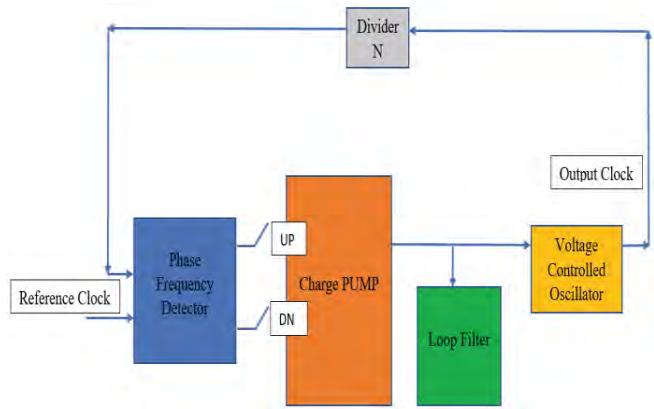
Let the input signal ( $V_i$ ) with an input frequency ( $f_i$ ) is passed through a phase detector as show in Figure 11. A phase detector is kind of a comparator circuit which compares the input frequency  $f_i$  with the feedback frequency  $f_o$ . The phase detector provides an output error voltage  $V_{error}$ , which is a DC voltage. This DC voltage is then passed on to an LPF. The LPF removes the high frequency noise and creates a consistent DC level,  $V_f (=f_i-f_o)$ .[7]

The output of the comparator which is a DC signal is passed on to the VCO as an input. The output frequency is varied according to the input provided by the PD output. Both the VCO output frequency and the reference frequency are

compared and varied till the output frequency becomes equals to the input frequency.

Thus, the PLL goes through the 3 stages which are locking stage, capture stage and free running stage.[4]

The free running stage means when there is no input voltage is applied. When the input is applied to the PD, it starts to compare it with the free running signal and produces an error signal. In this stage the input frequency is compared with the VCO output frequency and tries to capture the input signal. This stage is known as the capture stage. When the locking of the signal is achieved, the comparison between the two signal stops and the locking stage is reached. In this stage output frequency is locked and is in the same frequency and phase with the input signal. This stage is known as the phase locked state. [10]



**Figure 3: Architecture of PLL**

The architecture of a PLL is shown in Figure 3. The PLL comprises of several components and they are [10]

- (1) Phase frequency detector (PFD)
- (2) Charge pump (CP)
- (3) Loop filter (LP)
- (4) Voltage-controlled oscillator (VCO)
- (5) Frequency divider (FD)

### II. Phase Frequency Detector

This comparator circuit converts the phase into dc voltage signal by comparing the incoming signal frequency and the VCO output frequency. It produces an error signal which is directly proportional to the phase difference between the two signals. There are various type of the phase detector i.e. analog and digital. The positive edge triggered D flip flop is used as the phase detector. [2]

**Some of the common phase detectors are:**

- Ex-OR Phase detector
- Hogge's Phase detector (DFF based)

- Binary Phase detector (Alexander Phase Detector)

The working of the DFF PD is described as below:  
When there is a Phase difference between the two signals, two output are generated UP and DOWN signals. If the reference signal is leading in phase when compared with the input clock signal, UP signal goes high and DOWN signals low. On the contrary, if the input signal leads the reference signal DOWN signal is activated and becomes high simultaneously UP signal low

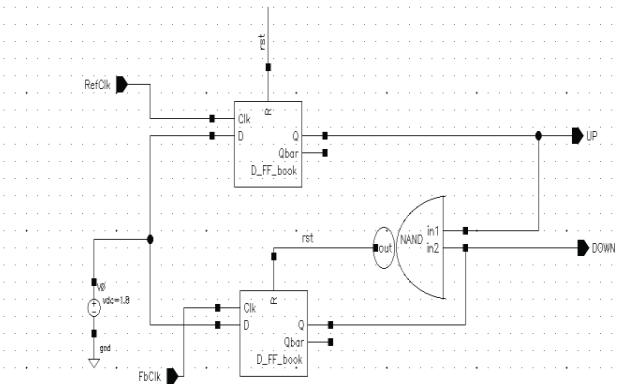


Figure 4:Schematic of DFF based PFD

This PFD circuit compares the input frequency and the feedback signal, produces the difference of the phase between both the inputs.

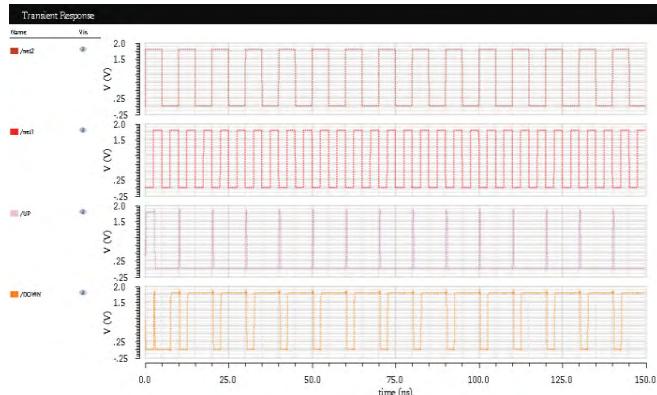


Figure 5:Output of PFD when both the signals have diff frequency and Phase

In this the two inputs of the phase detector which are reference input and the feedback from the VCO of different frequency are compared as shown in Figure 5. In this case the frequency of the VCO is higher as compared to the frequency of the incoming signal. These two signals are compared using PFD.

The phase difference between reference signal and feedback signal is compared as shown in Figure 5. By comparing the

two signals this down signal will be activated and fed to the charge pump.



Figure 6: Output of PFD when both the signals have same frequency and Phase

### III. Charge Pump and Low pass filter

Charge pump is placed next to the PFD. It is an important block in the whole PLL system. It is used to convert the phase or frequency difference information between the two-input signal into a voltage, which is used to tune the Voltage controlled Oscillator VCO. The charge pump receives the outputs of PFD as an input and provides a unique output which serves as the input to the loop filter. Charge pump circuit provides a constant value of current which is insensitive to the power supply variation. The amplitude of the current always remains constant but the sign of polarity varies depending on the value of the UP and DOWN signal given by the output of Phase Frequency Detector. [8]

### IV. Frequency Divider

Frequency divider, divides the output of VCO frequency to produce a frequency, which is nearly equivalent to the input signal frequency. It divides the clock signal of VCO and then applied to phase frequency detector that compare it with input data. It divides the clock signal of VCO and generates clock. [6]

### V. Voltage Controlled Oscillator

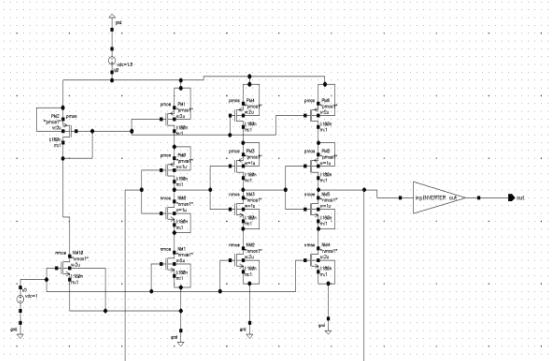


Figure 7:Schematic of CS-VCO

An oscillator is a circuit which generates a periodic output without any input provided to it. In this project the current starved voltage-controlled oscillator (CSVCO) is used because the frequency of oscillations can be controlled with the control voltage  $V_{ctrl}$ . Here the number of inverter stages are 3 (odd number). The simplified view of a single stage current starved oscillator is shown in the Figure 7.

## Calculation

### Aspect ratio

**STEP 1:** The drain current of a short channel MOSFET operating in saturation region is given by:

$$I_D = W \cdot v_{sat} \cdot C'_{ox} \cdot (V_{GS} - V_{THN} - V_{DS,sat}) \dots 1$$

**STEP 2:**

$$Wn = \frac{I_D}{[V_{sat} \cdot Cox \cdot (V_{GS} - V_{THN} - V_{DS,sat})]} \dots 2$$

**STEP 3:** By putting the values in equation 2

$I_d = 1\text{mA}$  (Biasing current)

$V_{sat} = 1.8\text{ V}$

$Cox = 50\text{ fF/m}^2$

$$Wn = 1\text{ um} \quad \text{and} \quad Wp = 2\text{um.}$$

**STEP 4:** Where  $t_1$  is charging time and  $t_2$  discharging time

**STEP 5:** For the calculation of no. of stages

Since we have,  $(W/L)_{pmos} = 2u/180n$ ,  $(W/L)_{nmos} = 1u/180n$  and

$Cox = 50\text{ fF}/\text{um}^2$  So,  $C_{total}$  from eq-2 is

$$\begin{aligned} C_{total} &= 2.5 \times 50\text{ fF/m}^2 \times (1+2) \times 0.18\text{ um}^2 \\ C_{total} &= 67.5\text{ fF} \end{aligned} \dots 3$$

The number of stages, using equation, is given by

$$N=3$$

## Design of CSVCO

**STEP 1:** To determine the design equations for use with the current-starved VCO, the total capacitance on the drains of M2 and M3 is given by

$$\begin{aligned} C_{tot} &= C_{out} + C_{in} \\ C_{tot} &= C'_{ox} (W_p L_p + W_n L_n) + \frac{3}{2} C'_{ox} (W_p L_p + W_n L_n) \end{aligned} \dots 1$$

**STEP 2:** This is simply the output and input capacitances of the inverter

$$C_{tot} = \frac{5}{2} C'_{ox} (W_p L_p + W_n L_n) \dots 2$$

**STEP 3:** The oscillation frequency of the current starved VCO for N

$$f_{osc} = \frac{1}{N(t_1 + t_2)} = \frac{1}{N \cdot C_{tot} \cdot VDD} \dots 3$$

Transistors NM0 and PM0 are designed to work as an inverter whereas PM2 and NM10 as constant current sources. The current sources, PM2 and NM10, restricts the amount of current provided to the inverter, NM0 and PM0; In this way current is starved for the current. The desired centre frequency

of the designed circuit is achieved which is 2 GHz with a supply of 1.8 V. as shown in Figure 7.[3]

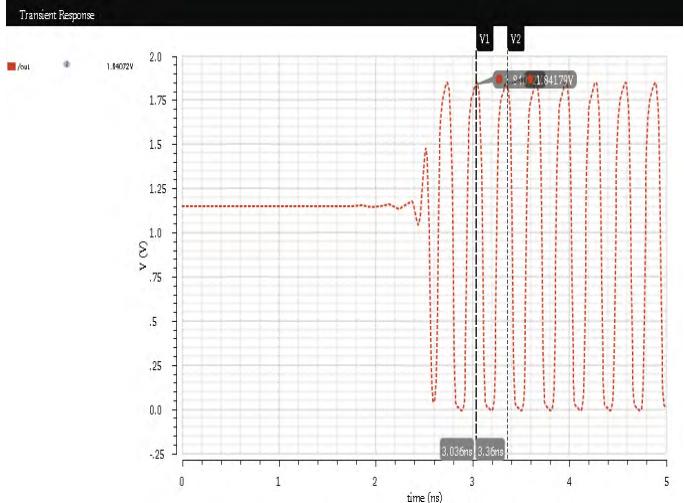


Figure 8: Simulation of CS-VCO producing 2.45GHz with Vctrl 1V

The dc level output of a low-pass filter is applied as control signal to the voltage-controlled oscillator (VCO). The VCO frequency is adjusted till it becomes equal to the frequency of the input signal. During this adjustment, PLL goes through three stages-free running, capture and phase lock.[9]

### Lock Range

Once the PLL is in lock state what is the range of is called as lock in range. This is also called as tracking range or holding range. [8]

In this case a locking range of 200 MHz is achieved as desired from our specification.

### Capture Range

When the PLL frequency is initially changing, the frequency varies and holds on to the constant value when the phase and frequency differences becomes almost zero. This is called as capture range. This is directly proportional to the LPF bandwidth.[15]

### From the Simulation we can infer that

- A 3-stage current starved VCO is designed in Virtuoso such that it generates a desired frequency range of 0.2-2 GHz as shown in Figure 9.
- The dc level output of a low-pass filter is applied as control signal to the voltage-controlled oscillator (VCO). [3]
- The VCO frequency is adjusted till it becomes equal to the frequency of the input signal. During this adjustment, PLL goes through three stages-free running, capture and phase lock.

The following Frequency of oscillation were obtained w.r.t. the control voltage in Table 1.

Control Voltage (V <sub>ctrl</sub> )	Frequency (F <sub>osc</sub> ) in GHz
0.4	1.04
0.8	1.89
0.9	2.12
1	2.43
1.2	2.73
1.5	2.80
1.8	3.12

Figure 9:Control voltage versus Frequency of Oscillation

By varying the Control voltage, the frequency of the oscillator can be varied. Here when the control voltage of 1V is applied the desired frequency of the output 2.4 GHz is obtained with the locking range of 200MHz.

## VI. Applications

- Clock recovery from received data.
- For synchronization purposes; in space communications for coherent demodulation.
- Used to demodulate frequency-modulated signals.
- In radio transmitters, a PLL is used to synthesize new frequencies which are a multiple of a reference frequency.

## VII. Conclusion and Future scope

Most of the high-speed serial interfaces don't have any accompanying clock, the receiver needs to recover the clock in order to sample the incoming data. With the help of this project an attempt was made to design Clock and data Recovery circuit. The Oscillator for high performance application CDR is designed in CMOS 180 nm technology and Simulated by Cadence Virtuoso software. The proposed voltage-controlled oscillator was designed for getting optimized 2 GHz frequency with locking range of 200MHz. The design has been done with 1.8 Volt as supply voltage. From the project it was inferred that the lock time of the PLL mainly depends upon the type of PFD architecture used, the parameters of the charge pump and loop filter. Better locking time can be achieved if the proper PFD architecture is selected, charge pump and the loop filter are properly biased.

It is also stated the value of frequency deviation can be minimised by properly choosing the transistor size. In future different orders of PLLs can be implemented which provides better range and faster locking time.

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# High Performance Ternary Logic Gates Using GNRFET

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**Abstract** - This research paper focuses on the design of GNRFET based inverters and universal gates in ternary logic. The ternary logic is considered to be better than two valued logic as it offers faster computations, reduced chip area, and smaller interconnects. Hence, it is possible to design in future integrated circuits with low-complexity, energy-efficient circuits and high-speed. A new approach is proposed for designing ternary logic circuits using graphene nanoribbon field-effect transistors (GNRFETs). In GNRFETs, the threshold voltage ( $V_{th}$ ) is varied with the GNR width ( $W$ ), described by the number of dimer lines ( $n$ ). The various inverters such as standard, negative, and positive inverters are developed along with the NAND & NOR gates. The industry standard HSPICE simulator is used to simulate the proposed logic circuits for performance analysis and functional verification. Additionally, the performances of the proposed circuits are compared with the CNTFET based circuits. From the analysis, it is noticed that the GNRFET-based logic circuits shows performance improvement up to 32.6% over the CNTFET based circuits.

**Keywords** — GNRFET, MVL, Ternary Logic Gates.

## 1 INTRODUCTION

TRADITIONALLY, binary logic is used to perform digital calculations. Recently, it is commonly used because of these major benefits over binary logical, including high bandwidth, decreased interconnect range, smaller chip area, faster logical and arithmetic operations. The logic of Ternary has been significant [1-3]. The logical states 0, 1, and 2 in ternary logic describe voltage levels 0V,  $V_{DD}/2$ ,  $V_{DD}$ , respectively. A 32×32 bit binary and ternary multiplier is compared in [3]. Multiplication was made using 3-stage supplements of binary tree supplementing schemes. The results reveal that the Ternary Logic Multiplier lowers binary logic power and the chip area by up to 50%. This improves the output over the binary logic by ternary logic. The literature presents a comprehensive study of the complementary ternary logic circuits of the metal-oxide semiconductor (CMOS) [4, 5].

Multiple threshold devices are the key prerequisite for building ternary logic gates. The body bias effect can be used in CMOS technologies to include multi-threshold devices. However, it is a challenging during the manufacturing process to supply varying bias voltages to the MOS transistor body regions. The MOS transistors scaling has also pose many problems in the nano meter scheme, such as large power density and high leakage current. The literature thus offers various novel machines, including quantum dot gates [6], reversible logical gates [8] and single-electron transistors, for designing ternary logical gates. GNRFETs have captivated the designers to improve the ternary logical gates, in particular due to its broad medium-free track, Ballistic transport and mobility of carrier [9, 10]. There have been several studies for the implementation of CNTFET logical gateways, but we have suggested our concept of using GNRFET to construct ternary logical circuits.

The properties of GNR and CNT are compared in [16]. For transistor configuration, the GNR exhibits better properties than CNT. GNRs also have success over CNT, as their boundaries are smooth and their deficiencies are lower [17]. The use of GNRs with different widths can implement multi-threshold devices. Furthermore, by increasing the GNR

channel, the driving potential of the transistor current can be increased. Hence, GNRFET is the promising solution to CNTFET, high efficiency.

This paper provides a thorough examination of the fabrication of ternary logical gates utilizing GNRFETs. In numerical expressions the GNR dimer lines, width, bandgap and threshold voltages are described. There is also discussion about the impact of GNR dimers on V-I characteristic. Depending on this analysis, universal logical gates are indicated by ternary inverters. The GNRFET ternary inverter's VTC curves are discussed. Compared to CNTFET circuits, the efficiency of the GNRFET bases on ternary logic gates.

The remainder of the analysis is organized as follows: Section 2 presents the brief review of ternary logic gates. The process for using GNRFET for the implementation of multi-threshold devices is clarified in Section 3. Section 4 addresses the ternary logic circuits proposed and the results analysis of them. The last portion of the conclusion is Section 5.

## 2 REVIEW OF TERNARY LOGIC GATES

In the binary logic for ternary logical functions, the third value may be added. The operation of ternary logic inverters, simple logical gates, and universal logical gates can be used to illustrate the following.

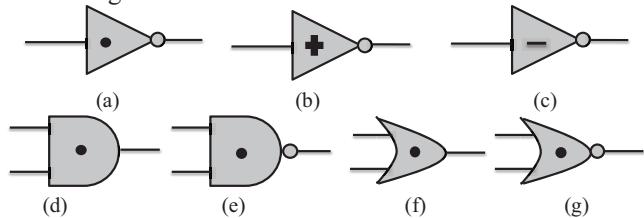


Fig. 1. Symbols of ternary logic gates (a) STI, (b) PTI, (c) NTI, (d) AND, (e) NAND, (f) OR, and (g) NOR.

### 2.1 Logic gates

The ternary inverter's primary function is defined as

$$\bar{a} = 2 - a \quad (1)$$

where  $a$  ternary input vector is,  $a = 0, 1, 2$ . Three inverters in the ternary logic exist depending on the inverter functionality: Three types are STI, NTI, and PTI inverters have been developed. The STI feature is defined (1). The NTI generates high output at 0 input, and the PTI provides high output if the input is either  $V_{DD}/2$  or 0. For the other input logical states, the output is 0. The two inputs, NAND Gate, NOR Gate and NAND gate are given below: The following:

$$\begin{aligned} AND: a \cdot b &= \min(a, b) \\ NAND: \overline{a \cdot b} &= \overline{\min(a, b)} \\ NOR: a + b &= \max(a, b) \\ OR: a + b &= \max(a, b) \end{aligned} \quad (2)$$

Fig. 1 demonstrates the symbolic representation of ternary logic inverters and other logical gates.

## 3 TERNARY LOGIC BASED GNRFET

GNR is a single sheet of carbon atoms, where a 2D honeycomb lattice structure bundles the atoms. Tensile strength and High conductivity are given by the  $sp^2$  bonding in graphene. The graph-based transistors are known as electronic devices of next generation, as are the large coefficient and the large medium-free path of thermal expansion. Depending on the number of dimer bars, the GNR one level chair is used as either a semiconductor or a conductor ( $n$ ). In  $n = 3p$  or  $n = 3p + 1$  and in  $n = 3p + 2$  the GNR armchair displays a semi-conductor property [25].

TABLE I  
DESCRIPTIONS PARAMETERS FOR THRESHOLD VOLTAGE

Parameter	Description	Values
$e$	Electron Charge	$1.602 \times 10^{-19} C$
$a$	C-C bond distance	0.142 nm
$v_f$	Fermi velocity	$10^6$ m/s
$h$	planck's constant	$6.5 \times 10^{-16}$ eV.s
$n$	number of dimer lines	$3p, \alpha=0.27$ $3p+1, \alpha=0.47$ $3p+2, \alpha=0.066$ where $p$ is an integer

The remaining parameters are defined in Table I. Where,  $W$  and  $E_g$  are respectively the GNR width and the bandgap. QuantumATK calculations with all the corresponding  $n$  values are conducted for confirmation of the results. With the parameters mentioned in the armchair edge GNR is chosen to calculate the bandgap. For the measurements, the Atomistix Toolkit -Semi-Empirical (ATK-SE) : expanded Huckel calculator is used to test 11 sampling point of the bandgap, the Brillouin 20-point zone route per section with all ranges above the Fermi stage.

TABLE II  
PARAMETER DETAILS OF GNR FOR SIMULATION

Parameter	channel length	Value
lattice constant		2.64 Å
hopping amplitude		—
nearest neighbour		2.8 eV
Third nearest		0.07 eV
next nearest		0.1eV
Fermi velocity		$1 \times 10^6$ m/s
channel length		32nm

The GNRFET's threshold value is determined as

$$V_{th} = \frac{E_g}{3e} \quad (3)$$

The GNR ( $E_g$ ) bandgap can be indicated as

$$E_g = 2|\alpha|\Delta E \quad (4)$$

$$\Delta E = \frac{\hbar v_f \pi}{w} \quad (5)$$

$$w = (n + 1) \frac{\sqrt{3}}{2} a \quad (6)$$

The bandgap was seen to be inversely commensurate with dimer lines. The GNR bandgap is also considered to be small  $n = 3p + 2$ , and it behaves like a metal.

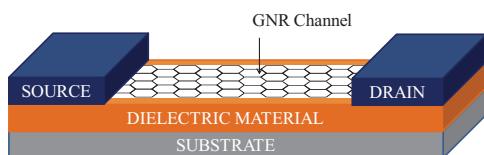


Fig. 2. Structure of GNRFET.

GNRFET is the same as the regular MOS field effect transistor and is seen in Fig. 2. Three GNRFET terminals are

placed at source and drain terminals, with strongly doped GNR layers, while the undoped GNR plate is located at the gate terminal. Drain and source terminals are doped in GNRFETs, Donors or recipients. Donor reservoir doping is known as GNRFET n-channel, while the GNRFET p-channel is known as the Doping Reservoir. In [26], detailed review of GNRFET n-channel modeling will be given.

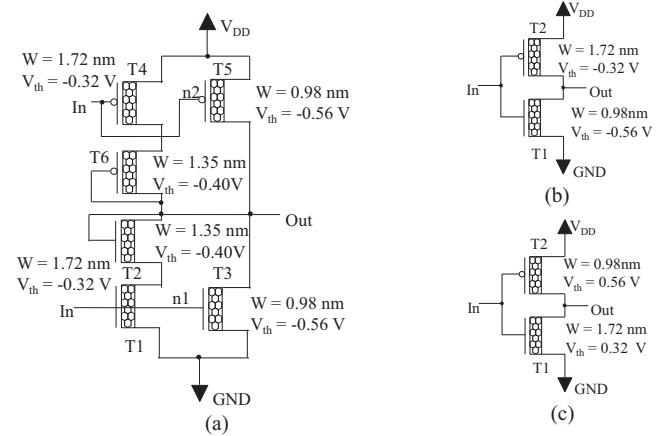


Fig. 3. GNRFET-based on circuits (a) STI, (b) PTI, (c) NTI

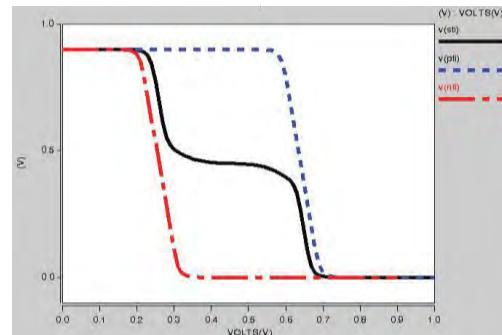


Fig. 4. VTC curves of the proposed ternary inverters

The GNR diameter is measured as 0.98 nm from (9) for six dimer lines and the threshold voltage is 0.56V from (6). It is found that the threshold voltage is inversely proportional to the number of dimer lines. The GNR transistors verify the calculated values for simulations of both type n and type p-channel.  $V_{th}$  is seen in the p-type channel GNRFET's negative axis. The GNRFET has a greater ON current ( $I_{ON}$ ), a bigger transconductance ( $gm$ ), and a higher cut-off frequency ( $f_t$ ). Simulations will be checked to determine these parameters for the GNRFET method. For the GNRFET with  $n = 12$ , the measured  $I_{ON}$ ,  $gm$ , and  $f_t$  values are  $150\mu A$ ,  $627\mu s$ , and  $159\text{THz}$ , respectively.

#### 4 DESIGN AND OPERATION GNRFET BASED

This section deals with and processes of the GNRFET ternary logic gates. The proposed circuits often contrast with CNTFET-based circuits when it comes to the delay of propagation and dissipation of electricity.

The GNRFET SPICE model implemented in [26] is used in the simulation of ternary logical portals based on GNRFET. For the construction of the special, circuit-conforming GNRFETs for simulations, this SPICE model is used. Non-idealities in this model of a practical interface and parasites are considered such as interaction effects with the Schottky-barrier, quantum confinement effects on circumferential and axial directions, GNR load screening effects, average-free finite dispersion paths,

back-gate effect, doped drainage/sources zones, gate resistance and capacitance. Moreover, the entire electronic trans-capacity network offers highly efficient, complex and intermittent efficiency with H-SPICE Simulations.

### 3.1 Inverter

Fig. 3 with six GNRFETs modeling the STI (a). By correctly change size the multi-threshold devices are used.  $V_{DD}$  values are 0.9V, so logic 0 is 0V stress, logic 1 is 0.45V tension, and logic 2 has 0.9V tension. The suggested STI has the advantages of robustness including the prevention of broad resistance and the reduction of static dissipation with low consumption of power.  $n$  in SPICE scheme and the GNRFET MOS model is adjusted from [26] for transistors T1, T2 and T3 to the 13, 10 and 7. The widths of the transistors T1, T2 and T3 are determined from (9) 1.72nm, 1.35nm, 0.98nm and 0.32V, 0.40V and 0.56V. The threshold vol of T4, T5, and T6 for p-GNRFETs are  $-0.32V$ ,  $-0.40V$ , and  $-0.56V$ . The GNRFET transmission properties should be checked to assess the transistor shift status at various GNR width. The switching status of the transistor is decreased by increasing the channel width.

The T3 and T1 OFF, T4 and T6 transistors transform to  $V_{DD}$  when the voltage of the IN in a proposed STI inferior to 0.32V is charged by the OUT voltage. As the voltage is over, 32V, T4 and T1 switch on and T6 and T3 turn on OFF. The transistors T5 and T2, connected to diode, decrease the voltage from n2 to n1. The production tension is thus logical 1. The T4 and T6 transistors are out of operation with an IN voltage of  $>0.56V$  and out of operation voltage of T3 (GND). The inverter curve STI VTC is shown in 4. The transition from high to low from medium to high input voltage will be the same. The STI circuits get via the H-SPICE simulation reaction, as shown in Figure. 5.

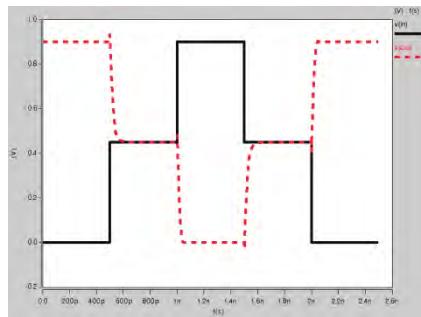


Fig. 5. Transient response of STI.

In addition, in terms of delays and power dissipations, the proposed STI output is being checked. Delay and dissipation of power are known to be very significant indicators in digital circuits. In addition, in relation to delay and power dissipation, the proposed STI output is being checked. For the proposed STI, the average propagation delay and power dissipation is 41ps and  $0.96\mu W$ .

In the suggested circuit of PTI shown in Fig. 3b, the T1 and T2 threshold voltages are respectively 0.56V and  $-0.32V$ . T1 is turned OFF and T2 is turned ON until the IN voltage applied is  $<0.56V$ , so the OUT is charged to  $V_{DD}$ . The output becomes 0 V when the input voltage reaches  $>0.56V$ . The circuit diagram of the proposed NTI circuit is shown in Fig. 3c. T2 and T1 have threshold voltages of 0.32 and  $-0.56V$  of the NTI circuit transistors. When the input tension is  $<0.32V$ , the output is loaded up to 0.9 V by T2, or 0V. The

VTC curves of the suggested ternary inverters are seen in Figure 4. Figure 6 shows the PTI and NTI transient answers. The cumulative PTI and NTI propagation is 16.8ps and 17.1ps. The PTI and NTI total power dissipation is  $0.26\mu W$  and  $0.25\mu W$ .

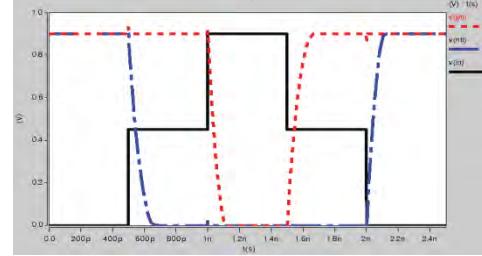


Fig. 6. Transient response of PTI and NTI.

### 4.2 UNIVERSAL GATES

This section provides the definition for the universal NAND two-input, NOR ternary logical gates. Figure 7 shows the circuit representations of the universal logical gates. There have been three different threshold voltages of 1.72nm, 1.35nm, 0.98nm and 0.32V, 0.40V, 0.56V. Fig. 7c shows the quality of the two ternary NAND, NOR logic gates.

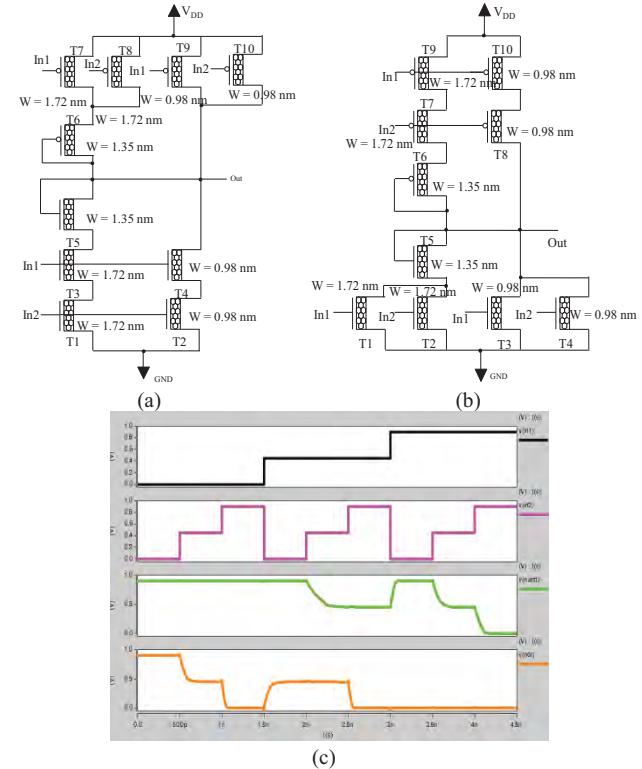


Fig. 7. Schematic circuit representation are (a) Ternary NAND gate, (b) Ternary NOR gate, (c) Transient response of NAND and NOR gates.

### 4.3 Comparative Study

To illustrate the feasibility of the method, the efficiency contrast is evaluated between GNRFET- and CNTFET-based ternary circuits. The unit threshold voltage in CNTFETs is adjusted by changing the CNT diameter. Three distinct 1.487nm, 0.783nm, and 1.01nm diameter CNTs are used and their threshold voltages are 0.28V, 0.55V, and 0.42V, respectively.

These multi-threshold CNTFET modules are used to use the ternary logic gates on the model [27]. The comparable findings show that there are low propagation delays in the

GNRFET-based circuits relative to the CNTFET, total 32.6% reductions. In Table III it is noted that the circuit fields of both circuits are smaller than those of the CNTFET circuits. The GNRFET and CNTFET circuits are seen in Fig. 8 as a delay in propagation and dissipation of power.

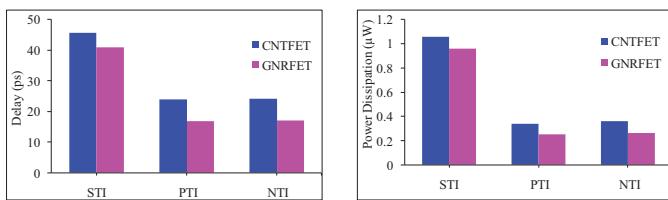


Fig. 8. Performance comparison for GNRFET and CNTFET based circuits (a) transitional delays and (b) power dissipation.

TABLE III

COMPARISON OF CIRCUIT AREA BETWEEN GNRFET AND CNTFET CIRCUITS

Design	GNRFET circuit area, m <sup>2</sup>	CNTFET circuit area, m <sup>2</sup>
STI	$2.1056 \times 10^{-16}$	$6.85 \times 10^{-16}$
NTI	$7.264 \times 10^{-17}$	$21.79 \times 10^{-17}$
PTI	$7.264 \times 10^{-17}$	$21.79 \times 10^{-17}$
NAND	$3.5584 \times 10^{-16}$	$8.235 \times 10^{-16}$
NOR	$3.5489 \times 10^{-16}$	$8.236 \times 10^{-16}$

Moreover, the suggested GNRFET STI production is also compared to [23]. The relation reveals that 73.09% of delays and power dissipation over the inverter was improved by 41.77% with the expected STI [23]. The suggested circuit structure thus has advantages like robustness. The benefit of large resistors is reduced, resulting in less power dissipation.

## 5 CONCLUSION

The logic gates and circuits are designed using the emerging GNRFETs. The GNRFET threshold voltage was exposed to be equal to the number of dimer lines. Based on the findings of this report, multi-threshold GNRFET circuits are proposed. The ternary logic gates, which include inverters and logic gates was implemented using GNRFETs. As an addition, using the decoder block in H-SPICE, many of the logic circuits in the diagram have been extensively simulated. The findings verified the correctness and the respective functions of the suggested ternary circuits. In addition, with the CNTFET, the outcomes of the suggested GNRFET circuits are compared. The comparative findings show that the STI, PTI, NTI, circuits based on GNRFET have decreased propagation delay, power dissipation, and circuit area with an average decrease of 20.06%, 16.47%, and 61.42%, respectively. The proposed GNRFET-based architectures would play an important role at both gate and circuit level in the performance of ternary circuits.

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# Automatic Wheelchair with Object Detection and Avoidance Using IR Sensor

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**Abstract—** The Automated Wheelchair assists the physically disabled person to operate the wheelchair automatically via joystick. The aim of this proposed system is to operate and drive the wheelchair using joystick and to avoid the obstacles automatically coming in its path. It allows the user to move and travel independently, with the help of joystick from where the motors are driven. The micro-controller is basically used in the proposed system due to its high efficiency features & synchronizing the data with different types of devices. The whole apparatus is carried out in an economical way and is cost effective such that it can overcome financial barriers and can be afforded by all. The design consists of following components Motor drivers, BLDC motors, Arduino uno, battery, battery charger, Joystick, Wheelchair, Jumper wires, IR Sensors, etc. Basically, we are using IR Sensor in order to avoid obstacles and accidents and a joystick in order to operate the wheelchair automatically and to reduce the daily labour work and dependency on others and to be independent.

**Keywords-** Arduino; BLDC Motors; Joystick; IR Sensor.

## I.INTRODUCTION

Wheelchair is a vital vehicle for handicapped and physically disabled person to move from one place to another [1]. The wheelchair is classified into the following types: the self-controlled wheelchair and helper-controlled type wheelchair [5]. The user drives the self-controlled wheelchair by using their physical force imparted by their upper limbs using a wheel setup equipped at the rear wheel [3]. Whereas the helper-controlled type is a supporting as well as automated controlled device where the user can operate the wheelchair independently, for instance, we have developed the product where the user is using a joystick in order to move from one place to other or around [7].

Disability is the deterioration or the damage caused which substantially affects a person's life activities [6]. A person who is physically disabled or too old needs a wheelchair to perform various functions. The user can move the wheelchair manually by setting up the wheelchair in motion by using hands [2]. However, it is a difficult task to move the wheelchair manually. Hence there is a need of automated wheelchair which can be controlled by using joystick [4]. Thus, we aim to design and implement a smart wheelchair which will assist the movement of the user so as to help them live a life independently [8]. This proposed system is a simple implementation of the discussed approach. Commands are taken from joystick, processed and driven to the wheelchair and the wheelchair acts accordingly [9]. We have implemented an IR sensor on the wheelchair for

the detection of obstacles coming in its path and in order to avoid accidents.

The proposed system aims at controlling a wheelchair with the help of joystick. It allows a disabled person to move around freely and independently, by using a joystick which is interfaced with motors on the wheelchair [9]. The wheelchair is built by using a micro-controller which is selected due to its low cost, versatility, high performance and efficiency [5]. The system has been designed and implemented in a cost-effective and economical way so that if our proposed system is commercialized and materialized in bulk amount, then majority of the people from different parts of the world would be benefited from it [2].

The main objectives of Proposed system are to provide assists to physically disabled and elderly people who can't move properly are dependent on others; to develop a joystick-controlled automatic wheelchair in order to help the disabled people to be independent in life [4] and to avoid any kind of obstacles coming in the path of the wheelchair [6].

## II.RELATED WORKS

We know that the population in the world is growing at a rapid rate and is multiplying at an exponential rate. In India, according to recent survey we found out that about 120.5 million people are disabled in which 41.325% are physically disabled [2]. Unfortunately, due to various medical conditions and accidents or due to old age, people are not able to walk and are thus dependent on others. Thus in order to solve this problem, we have developed this automatic wheelchair product in order to help them and make them completely independent [16]. The graphical representation of various types of disability in India is represented in the given figure:[9]

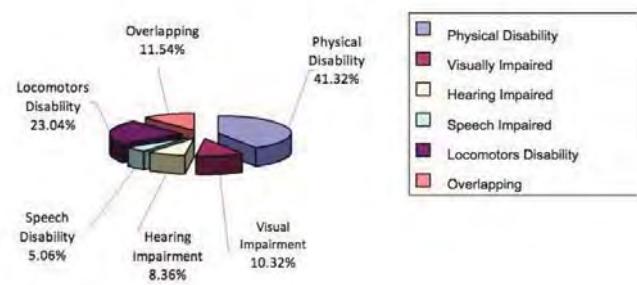


Figure 1: Disability Specific Data

The figure shows the graph for all types of disability like Physically Disability, Visual Impairment, Hearing Impairment.

Speech Disability, Locomotors. Disability and overlapping. Among all these disabilities, the rate of Physically Disabled patient is high as compared to other disability. Most of the physically disabled patients make use of wheelchair as their only medium to travel around, but they are dependent on others as the wheelchair needs to be moved by another person[1].

Wheelchair Automation will help overcome this problem by making the disable patient independent of other's help and can move freely with the help of a simple joystick control[4].

### III.PROPOSED METHOD

Wheelchair are categorized in three sections namely self-controlled wheelchair, helper-controlled wheelchair and the last is automatic-wheelchair. As our country is a developing nation so everything is becoming automated. But along with development in automation the cost of automation products is touching the sky. We thought of working on wheelchair that can be controlled with the help of Joystick[5].

The automatic wheelchair available in the market are way too expensive. Not everyone can afford a costly automatic Wheelchair. So, we came up with an idea of a low cost self-assistive Wheelchair[4].

Hence we came to know about BLDC Motors through research and surveys. It is basically an electric motor that is incorporated into the hub of a wheel and drives it directly. It simplifies the work and is easy to interface. Hence the idea of developing this proposed system was proposed.

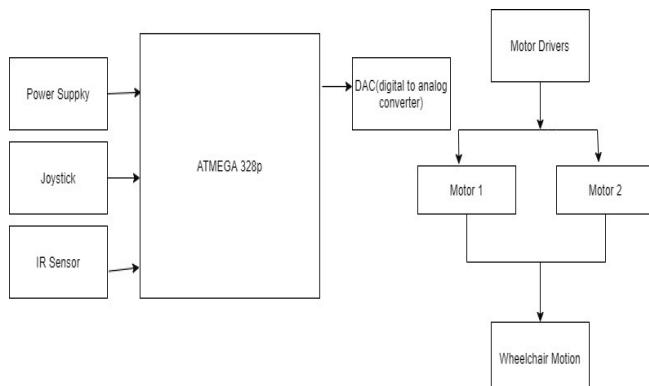


Figure 2: Block Diagram

Automated Wheelchair is cost effective and economical joystick assistive wheelchair which is operated by joystick commands. The input to the system is given through a joystick by the user, which is transmitted to the micro-controller. The micro-controller process and detects the input command signal and then takes the required decision to move the wheel-chair in the required direction that is left, backwards, front and in the right direction. This data signal is based on a Data to Analog converter also known as DAC which is a system that converts the digital signal to the analog signal. Motors are used to rotate the wheels appropriately in the required direction as per given or defined by the user.

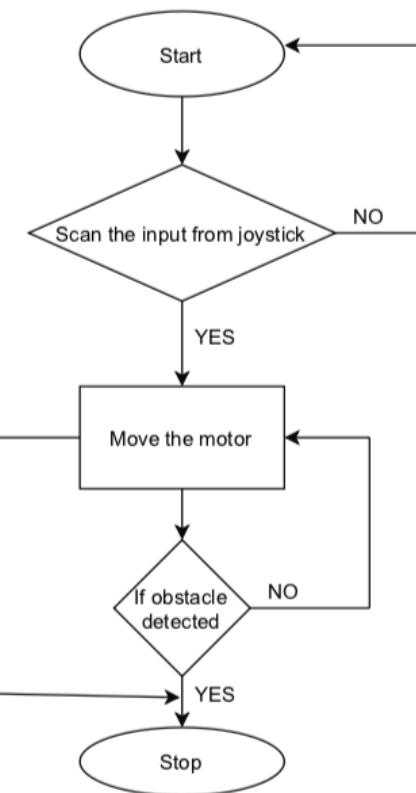


Figure 3: Flowchart

The DAC later passes the signals to motor drivers and the IR sensor is used in order to avoid obstacles in the path and if any object is detected in the path then it automatically stops.

### IV. HARDWARE MODULES

#### 1. Arduino uno

Arduino is an open-source development board which consists of an inbuilt microcontroller. It is generally used for interfacing different types of sensors and actuators [4]. The microcontrollers can be programmed using C and C++ programming languages [7].

Specification:

Microcontroller used: ATMEGA 328p

Operating voltage: 5V

Analog pins: 6

Digital pins: 14

Frequency clock: 16 MHz

#### 2. BLDC Motors:

They are the type of motors which primarily runs on DC supply provided either by an inverter or by a power supply [7]. The BLDC motor is used to generate an AC current to run each phase of the motor via closed loop controller. The controller is used to provide input to the motor windings which ultimately controls the speed and torque of the motor [3].

Features are as follows:

1. Operating Voltage: 24-36V
2. Operating Power: 250-500W
3. Motor type used: Brushless gearless hub motor
4. Operating speed: 200 - 550 rpm

### 3. Motor Driver

A motor driver is nothing but a current amplifier which works on the principle of current amplification where it converts a low-current input signal into high-current output signal which is required for the operation of the motor [5].

Specifications:

1. Operating Voltage: 24V DC power supply
2. Operating Power: 250W
3. It has Anti-coaster features with over current protection
4. Automatic identification of the Hall sensor

### 4. Battery

The battery used in our proposed system is a lithium-ion or Li-ion battery which is a type of rechargeable battery [8]. When the battery is charging, the Li ions moves from the negative part of electrode to the positive. It generally uses a type of lithium compound as one of the electrode materials as compared to the metallic lithium which is basically used in a non-rechargeable lithium battery [9]. The electrolyte which is used to allow ionic movement, and the two electrodes present are the main components of a lithium-ion battery cell [5]. Specification of the battery used is

1. Operating voltage: 36V
2. Operating Power: 4.8Ah/172.8WH.

### 5. Battery Charger

A battery charger is a device which transmits energy in a secondary cell or rechargeable battery as soon as electric current passes through it, sometimes the input supply is set according to the desired rating which is suitable for the battery [2].

Specifications:

- Input operating Voltage: 100-240V
- Operating frequency: 50/60HZ
- Output operating Voltage: 42V
- Output operating current: 5A
- Operating Power: 273W
- Efficiency: 80%

### 6. Joystick

A joystick is a device used as a input for the desired command. It consists of a stick which rotates on a base and is used to report the angle or the direction to the device which is controlling it. A joystick which is also known as the control column, is one of the most important and key control devices available [7].

### 7. IR sensor

An IR sensor is one of the most commonly used electronic device which is used to measure and detect the infrared radiation in any kind of surrounding environment [9]. It is generally used to detect any type of obstacle coming in its path

or the direction in which it is transmitting the radiated waves [2]. It can be used in any sort of security applications like home security, Smart Industrial applications, etc.

## V. IMPLEMENTATION OF THE PROPOSED SYSTEM

The below given figures represents the implemented part of the proposed system which is developed and designed by us.



Figure 4: Side View



Figure 5: Back View



Figure 6: Front View

Comparison between existing systems and our proposed system is as follows:

Parameters	Existing system	Proposed system
1.Cost	Very expensive	Cost effective
2.Battery backup	Very poor	Strong battery backup as we have provided 1 battery to each wheels
3.Technology used	Either Bluetooth or joystick	Bluetooth and joystick
4.Maintainence	High	Low
5.Weight carrying capacity	100-120 kg	150-180 kg
6. Additional	--	Use of IR sensor for object detection and avoidance in the same system...

## VI. CONCLUSION

This proposed system contributes not only to the self-dependency but also independency of the physically challenged and old aged people. It not only reduces the manual effort but also makes the user comfortable and independent. Thus, the only thing required to ride the wheelchair is to have a command on the joystick and IR sensor for object detection. Besides that, the development of this proposed system is done in a cost-effective manner and is thus affordable. The user just has to give commands by pressing the buttons present on joystick. Finally, we hope that this kind of the proposed system would contribute to the evolution of the wheelchair technology and to the welfare of the society.

## VI. REFERENCES

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# Portable, Versatile and high Precision Laser Engraver

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*Abstract- Nowadays technology is increasing rapidly, the usage and the implementation of CNC systems in industries and educational institutions are exponentially increasing but at a greater cost. Our main goal is to design a CNC Laser Engraver that is also a compact, cheap and low power unit that is also easy to operate in order to reduce complexity, cost and manual work. The idea of open source laserGRBL – arduino based laser engraver is to use the Open Source LaserGRBL that loads the G-code coordinates of an image that is given by user and sends those coordinates to the arduino which in turn signals the hardware components i.e. stepper-motor and laser to engrave onto the surfaces for example wood, Acrylic or plastic. The engraver will be able to engrave vector graphics in two (X & Y) axes of motion. Most of the engravers are designed in bi-directional movement and square type models. Whereas in this laser engraver, axes movements are mounted on each other and a belt driven mechanism is used for engraving. Laser engraver uses a very fine matrix of dots to form images, such that a line may appear continuous to the naked eye, it in fact is a discrete set of points.*

**Keywords-** Laser, CNC, LaserGRBL, engraver, G-code, arduino.

## I. INTRODUCTION

The CNC (Computer Numerical Control) is used in controlling machine tools. Laser Engraver is one of the tools that use CNC for the control of its tools. The

Laser Engraver can be called as a printer for multiple surfaces. The Laser Engraver is a device which engravings an image, text, picture etc. by burning the surface of the material it is engraving on and creating a permanent mark which cannot be removed easily. The laser engraving industry is used from engraving on drink glasses to engraving on fine medical devices used in surgeries. The goal here is to create a general purpose laser engraver with minimum cost, power and technical operating demands.

Ordinarily a laser etcher would cost in thousands or even lakhs of rupees, cumbersome and colossal to fit. That is the reason behind why many do not actually select to utilize a laser engraver on individual or limited scope premise. Thus if a laser engraver however advantageous as a printer may be made, an ever increasing number of individuals would begin utilizing the gadget and another period of innovation and accommodation can be brought to the overall buyer.

The thought behind this task is to make a little two axis CNC machine which can imprint 2D and grey scaled pictures or pictures with assistance of a high watt copying laser module on a superficial level which can be a paper, wood, acrylic. It utilizes two stepper motors as direct actuators on every hub X, Y. While etching, the legitimate synchronization of this hub for example stepper motors is the most difficult errand. As proposed,

the machine will be worked inside a little design. Whole design will be constructed from acrylic or aluminium segments. To keep the least weight conceivable, aluminium will be preferred.

## II. RELATED WORK

This section presents, in brief, existing literature related to the use of various CNC Laser Engravers available in the market.

Sonali Dhanwade et al have done research on building up a composing machine which helps the students or office people to compose. It is utilized to compose the characters, words from reports with the assistance of equipment and programming. They use UNO arduino, servo motor, GRBL shield, motor driver and benbox programming, stepper motor (taken from old DVD). The primary benefit of this proposed framework is to simply perceive the record from the PC which needs to compose on paper utilizing this essayist machine with no problem. It will lessen the responsibility just as your time. They centre around diminishing the size of the equipment so the absolute framework will decrease. [1]

Infantantoabishek.J et al have done research Mini CNC Engraver Machine which is like a CNC processing machine. It decreases worksheet build up and recurrence of blunders. They have 3 dimensional (X, Y & Z axes) working territories of 230mm x 290mm. This machine can etch on plastic, steel, aluminium, wood and so on It gives the better exactness precision at serious advancement cost. With the assistance of G code, it gives better profitability and decreases the responsibility likewise it gives the data about the places of all the stepper engines on the PC screen so we can without much of a stretch begin or stop the framework engine at whatever point we need. [2]

R. Balathangam et al have done the planning and advancement of an arduino controlled composing robot. The principle objective of this machine is to create a composing robot by discoursomposing robot visual fundamental programming e acknowledgment strategy. In this cis utilized and for discourse acknowledgment, arduino microcontroller has been utilized. To begin with, the client is to take care of the message by means of a mic that will be sifted by speaker and low pass channel. At that point, the simple sign is given to the PC with Microsoft visual fundamental studio. Utilizing discourse to message

transformation calculation simple sign changed over into text rely upon the client's information. At that point the changed over text will ship off the arduino regulator utilizing sequential link. [3]

Kajal and Kranti (2016) implemented the programmed smaller than expected CNC machine for PCB drawing and penetration. The framework is intended to create the minimal effort CNC to bore and increment the adaptability of the machine. The whole cycle is utilized by G-code. They recognized that the development of stepper engines should be possible by changing over the machine code into beats. This should be possible by utilizing G-code interfaced with ATMEGA 328. The G-code with the equipment arrangement gives better precision and diminishes the responsibility. [4]

Lin li “The advances and characteristics of high power diode laser materials processing”. The creator presents an audit of the immediate uses of high force diode lasers for materials preparing including binding, surface change, welding, scribing, sheet metal bowing, checking, etching; paint stripping, powder sintering, union, brazing and machining. An audit on high-power diode laser applications for materials preparing has been done. These highlights incorporate better surface completion, less warmth influenced zone, better shaft assimilation, better morphological attributes, more predictable and repeatable outcomes, less breaks and less porosity age. The shortcomings of the powerful diode lasers incorporate high shaft, bar retention reliant on work piece tones and the trouble to deliver high-top fueled short-beat pillar straightforwardly (Q Switching) [5]

## III. PROPOSED APPROACH

The first approach to the Portable, Versatile and high Precision Laser Engraver was to make a low cost, low power high precision laser engraver for small scale and cost effective workload such as small DIY art workshops and engineering institutes. So a laser engraver with a low cost controller such as the arduino uno with a cnc shield for controlling the assembly with A4988 motor drivers were used for this design. The arduino acts the brain of the system as the system read the G-code and plots using the laser according, each and every pixel of the drawing is stored by the arduino and is then sent to the system in the form of coordinates and the cnc shield is used as a bypass for the arduino as it cannot handle the amount of power the system draws and hence the power is drawn from the shield with the

amount prescribed by the arduino uno. As every motor has a different construction hence to drive the Nema 17 stepper motor the A4988 motor drivers are used, which also enable enhanced motor driving techniques such as micro stepping.

The cnc assembly moves from the above configuration the engraver of this system which is a 500 mW diode type laser engraver which is a compact type of laser which engravers on various surfaces which will be proposed further. The laser was subjected to a 3 hrs of back to back engraving hence it is safe to say that the laser can at least have a 3 hour engraving session without any cooldown.

The Laser is 55cm in length, 35cm in breadth and 18 cm in height. It weighs around 7 kgs and all over a rectangular shape, hence it justifies the portability statement that it carries. The laser can engrave on a variety of surfaces such as cardboard, wood, MDF and acrylic which are the main materials mainly used in small scale application hence justifying the versatility department.

The laser is very precise as it engraves 1 mm for 3 times which can be changed according to the requirement and also the speed of the motor is kept such that it engraves 500mm/min. We can increase the speed, but it deteriorates the image engraved. Thus for current laser it is recommended to use normal speed.

#### Hardware:

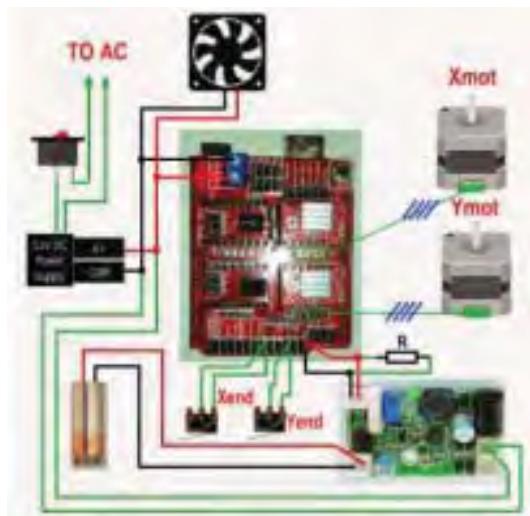


Figure 4: Circuit Diagram

- The system comprises various parts such as arduino uno, CNC shield, Stepper motor, Limit switches and Laser Diode with the TTL controller.

- It also has a lot of mechanical parts such as screw rods, coupling shafts, Acrylic body, pillow block bearing, steel rods, linear bearing slider etc.

- The arduino processes the code and sends a signal to the CNC shield which provides power to the motor according to the signal given by the arduino uno.

- The arduino uno then commands the stepper motor to move the assembly with the help of a screw rod on which the laser is mounted and the assembly moves according to the design.

- The TTL signal from the CNC shield to the TTL controller gives 0 as for laser being off and 1 for laser being on. The default is always 0 as for the laser being off.

- The limit switches warn the assembly of its maximum position.

#### Software:

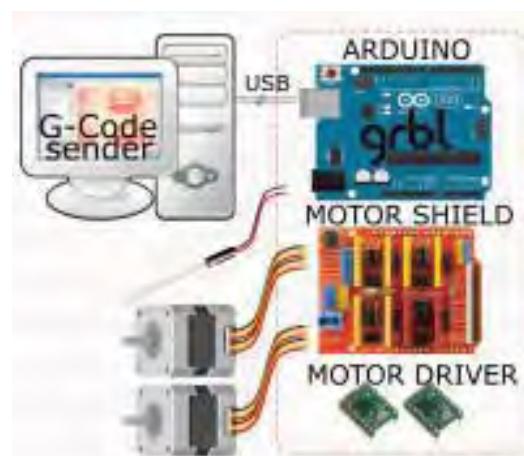


Figure 5: Working

The working of this software is as follows:

- It takes an image as input and loads it onto the software to display.



Figure 6: Import Image

- The user can then set different parameters to tune the image. Different parameters like speed of the stepper motors, power of the laser and control the laser along with the movement of stepper-motors.

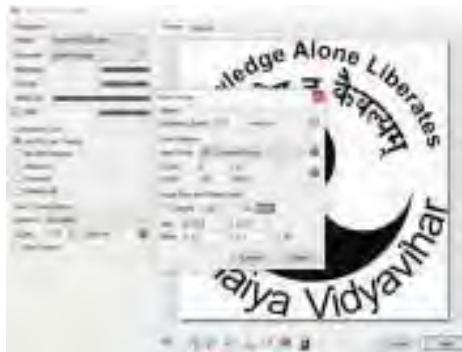


Figure 7: Configuring Laser and Image Specifications

- The software then internally converts the image into the G-Code coordinates that are then fed to the arduino that controls the Laser and stepper motor.

Example G-Code:

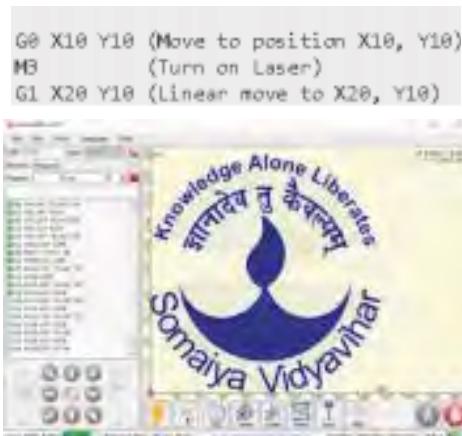


Figure 8: On-going Engraving Process

- The arduino then transfers the G-Code coordinates onto the Laser along with the set of instructions for example where to start, intensity required and so on.

- The result obtained is a beautifully engraved intricate and precise image that is customized to the needs and satisfaction of the user.

#### IV. RESULTS

In this section, the results are observed through engraving onto the different surfaces.

The outcome acquired is a wonderfully engraved complex and an exact picture that is modified to the requirements and fulfilment of the user.



Figure 9: Cardboard



Figure 10: MDF



Figure 11: Wood



Figure 12: Acrylic

As shown in figure 9, 10, 11 and 12 the surfaces used are cardboard, MDF, wood and acrylic respectively. The results obtained are exactly the same as the design provided in laserGRBL software.

All the above results were obtained in a span of 23-30 mins of time. The machine was set for engraving at 300 DPI for 20\*20 cm which results in image of 1600\*1600 pixels.

From the Observations made the circuitry has negligible consumption and the stepper motor take 12 volts 0.4 amps which leads to a consumption of 4.8 watts and as the system has two motors it gets to a 9.6 watts rating. The laser has a power rating of 500 mW which intotal leads to system consumption of 10.1 watts.

If we take it for financial basis the engraver runs for about 10 paisa/hour.

## V. CONCLUSION

By assembling the Laser Engraver it can be concluded that the CNC machine is cost effective, accurate and easy to operate. It operates on two axes of motion in order to engrave vector graphics or text on a given surface. It engravess on basic surfaces which are used in day to day life like cardboard, wood, Acrylic and MDF. It can be used for basic designing and text writing on surfaces which are needed for various applications. With a lot of new technologies being developed nowadays, this open source laserGRBL – arduino based laser engraver serves to provide a good platform for future development for the Laser Engraving system and even other systems.

## VI. FUTURE WORK

Future plan of work will be implementing the system using the whiteboard concept where the users will be able to draw their desired designs inside the software itself and not take any help from other external design softwares. For the laser to engrave on glass a high power laser is required. Further a more efficient and reliable laser that will be beneficial for long term usage and will be cost effective.

## VII. ACKNOWLEDGEMENT

We would like to thank the University of Mumbai for partly funding the open source laserGRBL – arduino based laser engraver. We would also like to extend our sincere gratitude to K. J Somaiya Institute of Engineering and Information Technology for supporting us in every way possible by providing all the necessary facilities and equipment to build the open source laserGRBL – arduino based laser engraver. We would like to thank Dr. Milind Nemade, Head of Electronics Department for bringing out the best in us, always motivating us to deliver the best possible outcome in terms of technological aspect. We would also like to express special thanks to the guide – Mrs. Sejal Shah for mentoring us throughout the planning and building of the open source laserGRBL – arduino based laser engraver. Her advice and knowledge helped to overcome some of the hurdles beforehand and also helped to have an overall thorough understanding of the open source laserGRBL – arduino based laser engraver to be built.

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# UNDERWATER ULTRASONIC COMMUNICATION

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**Abstract—Underwater wireless communication has emerged to be important for a variety of significant reasons ranging from marine military and security to commercial activities and monitoring. Surprisingly, very little analysis has been performed to develop an underwater device node with communication practicality. In an underwater atmosphere, a typical RF-based communication is not acceptable. Consequently, it has been concluded that rather than a radio or electromagnetic wave, acoustic transmission ranks primary among the technologies deployed given the ability of sound to travel far in water. Wireless underwater communications uses water to carry an acoustic signal from one transceiver to another. This paper will discuss the design and implementation of a low cost, low power rudimentary system of underwater**

**communication using ultrasonic sensors. It further discusses the benefits, limitations, significance and applications of the same.**

**Keywords—Acoustic communication, underwater, ultrasonic sensor, arduino**

## I. INTRODUCTION

Underwater wireless communications present new and distinct challenges when compared to wired and wireless communications through the atmosphere, requiring sophisticated communication devices to achieve relatively low transmission rates, even over short distances. Indeed, the underwater environment possesses a number of distinguishing features that make it unique and rather different from terrestrial radio

propagation where traditional communication systems are deployed. Underwater, several phenomena may influence communications, such as salt concentration, pressure, temperature, amount of light, winds and their effects on waves, just to mention a few. Despite all challenges, wireless communications certainly play an important role in practical underwater systems. Monitoring different phenomena in the underwater environment are relevant in many different applications.

There are three main technologies available for underwater wireless transmissions. One technology is radio-frequency (RF) communication, which features high data throughput at short range and suffers from mild Doppler effect. The other technology is optical transmission, preferably in blue-green wavelength, which requires line-of-sight positioning. Another technology, which is the most employed one, is acoustic communication. This latter technology is the one that allows the longest range of communication, but achieves low throughput, is highly impaired by Doppler effects and is affected by large delay spread that leads to severe intersymbol interference. In all these technologies, it is important to consider both the implementation costs associated with a target data throughput for a prescribed communication range, as well as the relative transmission power that might lead to environmental impacts.

## II. METHODOLOGY

### A. Block Diagram



Fig. 1 Block Diagram of Transmitter

The above block diagram is the transmitter section of the communication system, which consists of a 5V power supply to power up the Arduino uno. The Arduino then transmits a 40KHz square wave which is modulated and eroded for transmission of data. It uses binary to ascii conversion of data and for every 1, a 4 msec delay is provided whereas for every 0, a 2 msec delay is provided. Interspace characters are given a delay of 10 msec. The serial output is given to the ultrasonic sensor transducer, which transmits the signal underwater.

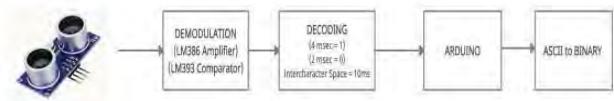
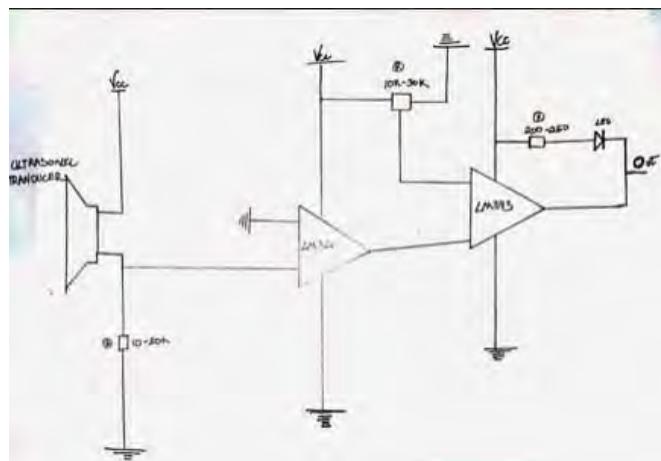


Fig.2 Block Diagram of Receiver

In the receiver section of the communication system, a demodulation circuitry is installed which consists of a LM386 Amplifier, to amplify the received signal. And it consists of a LM393 comparator. The decoding block detects the counts based on the delay it is given. For 4 msec, it detects a 1. For 2 msec it detects a 0. And for 10 msec, it detects an interspace character. Then it is given to the arduino and converted back to binary from ASCII. The ultrasonic receiver is composed of five components: an ultrasonic sensor, an amplifier, an envelope detector, and two comparators. The ultrasonic sensor receives the transmitted signals and sends them to the amplifier. Because the received signals are a minute signal, to process them in the next step, they have to be amplified. So, the amplifier amplifies the received signals. Then, the comparator 1 removes the noise from the amplified signals and sends the signals to the envelope detector. The envelope detector detects the original signals from the amplified

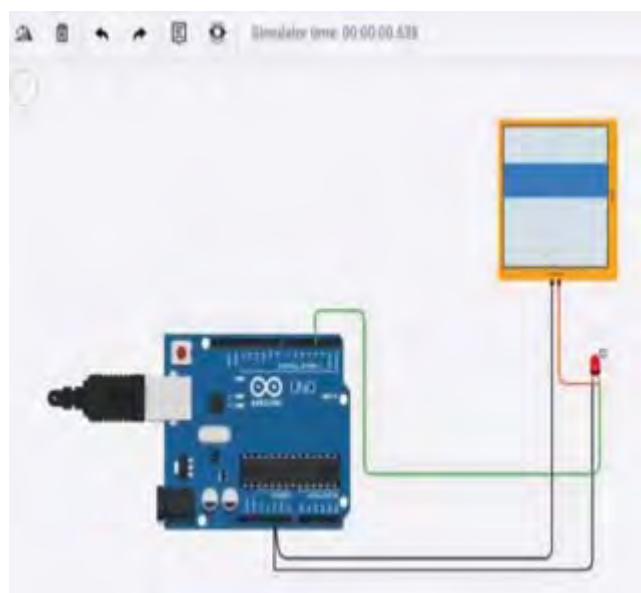
signals. Finally, the comparator 2 transforms these analog signals into digital signals and sends them to the PC.



*Fig. 3 Ultrasonic Data Receiver*

The above figure is a circuit diagram of the ultrasonic receiver section which consists of comparator ICs and amplifiers to filter out the noise and receive a smooth amplified signal at the other end.

#### B. Arduino



*Fig. 4 TinkerCad Simulation Of Arduino Transmitter*

The microcontroller selected for this experiment was the Arduino Uno version 3 due to its ability to be programmed in the ANSI C programming language, low cost and common availability. The Arduino family of microcontrollers is by default configured to only support 9600 samples per second due to a slowing of the sampling clocking which is controlled by a parameter called prescale. The Arduino integrated development environment (IDE) is a cross-platform application used programming language as Java, and is derived from the IDE for the Processing programming language and the Wiring projects. The Arduino IDE comes with a software library called Wiring, which makes many common input/output operations much easier.

### III. BENEFITS

- Underwater acoustic modem has some advantages such as easy integration
- Rapid placement and low cost
- It acts as a selective novel node for underwater networks and a kind of underwater or overwater communication relay as well.
- Acoustic waves are used in carrying information and are effective over long distances.
- Low absorption
- It is a widely used technique in underwater environments due to the low attenuation (signal reduction) of sound in water.

### IV. LIMITATIONS

- The main drawback of this technique is the bandwidth efficiency
- Channel characteristics including long and variable propagation delays.

- Multipath and fading problems.
- High bit error rate.
- Networks designed for quick ratification and communication do not work underwater and will “time out” waiting for responses.
- This is because acoustic signals move more slowly than radio waves

## VII. CONCLUSION

Acoustic communication plays an important role in underwater applications such as environmental monitoring, disaster prevention, and resource detection. Previously, existing acoustic modems were commercial acoustic modems. However, they are usually bulky and expensive. They are not designed with low-power and they consume large amounts of energy. The rationale behind the proposed model in this paper is to design a small-scale, low power and affordable communication system for underwater. However, the implementation is still in progress and would be tested in the near future. Consequently, a conclusion can be drawn that after the thorough survey of various underwater technologies and possible solutions, there are still challenges to overcome in order to have an effortless and smooth communication system under water.

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**High Data Rate Acoustic Modem for Underwater Applications [Online]**

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# Design and Comparative Study of Different Shaped Patch Antenna for 5G Application

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**Abstract**—This paper, presents the comparative performance study of the three different basic shapes of antenna patches. The rectangular, square and circular shapes are taken into consideration. The two vertical slots are introduced in patch to improve gain and directivity. The antennas is designed specific to radiate at C band frequency that is 3.4-3.8 GHz, which is adequate for 5G application. The low cost dielectric substrate epoxy utilized is FR4. The outcomes of antenna parameters like the return loss, the radiation pattern, total gain and the directivity are analyzed on frequency band and are compared. After Simulation the various antenna parameters are studied.

**Index Terms**—5G , Patch antenna, Antenna Array , slots, C-band, S11 Parameter

## I. INTRODUCTION

A Microstrip patch antennas are extensively utilized within the RF frequency region due to their simplicity and compatibility with PCB technology, making them is simple to make either as sole elements or as series elements of arrays. The available designs of patch antenna are rectangular, circulars, dipoles, triangular, squares, and ellipticals with rectangular and circular shapes the foremost common as in Fig. 1.

The stupendous increase in mobile data, technologies are approaching from 4G i.e., fourth generation to 5G, fifth generation. The data rate of 5G is nearly 100 times better than by all means 4G, 5G must be able to handle far more traffic at good speeds than the communication that makes up today's phone networks.

Microstrip printed antenna is operated by distinct feeding source mechanisms such as micro strip line feeding, proximity coupled feeding, coaxial feeding, and aperture coupled feeding. Among all the feeding mechanisms the micro strip line source feeding is considered as the easiest one to operate the antenna. The feeding line length enables the match impedance antenna with SMA connector.

## II. ANTENNA DESIGN

### A. Rectangular Patch Antenna

The configuration of the rectangular design of patch rect. antenna for 5G implementation is seen in Fig.2. The overall size of the design is 35mm × 32mm × 1.6mm (L × W × H) and printed on Flame Retardant 4(FR4), with a relative

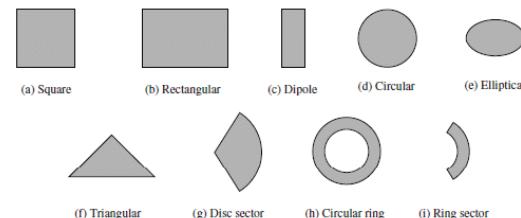


Fig. 1. Microstrip Antenna shapes

permittivity of 4.4, and a tangent loss of 0.02. With two rectangular vertical slot present on it. Table I lists the dimension of rectangular patch. Microstrip line feeding is designed in proposed microstrip antenna.

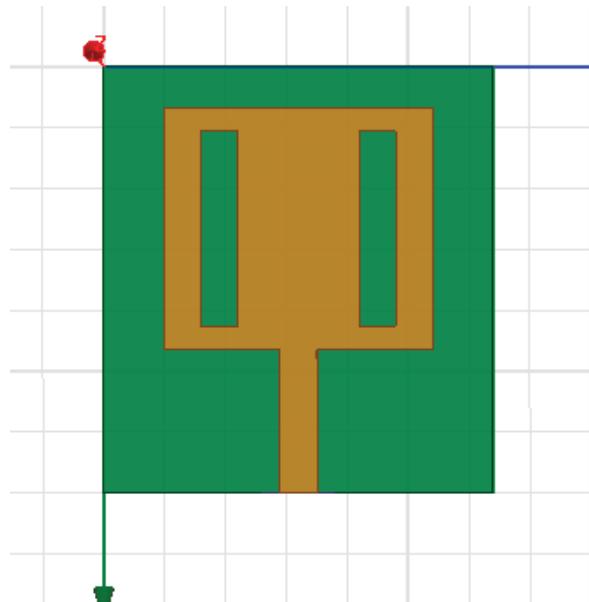


Fig. 2. Geometry dimensions of Rectangular Patch Antenna

### B. Square Patch Antenna

As shown in the Fig.3 , square microstrip patch antenna with substrate dimension of 35mm × 32mm with FR4 material

TABLE I  
DIMENSION OF RECTANGULAR PATCH ANTENNA

Parameter	Values(mm)
Length of patch (Lp)	19.8
Width of patch (Wp)	22

TABLE II  
DIMENSION OF SQUARE PATCH ANTENNA

Parameter	Values(mm)
Length of patch (Lp)	20.4 mm
Width of patch (Wp)	20.4 mm

having a dielectric constant 4.4, loss Tangent of 0.02. Height of substrate is of FR4 standard size i.e. 1.6mm. Dimension of square patch is 20.4mm×20.4mm.Two vertical slots introduced on the patch. Feeding method used is microstrip line feeding. Dimension of the intended design is listed in table II .

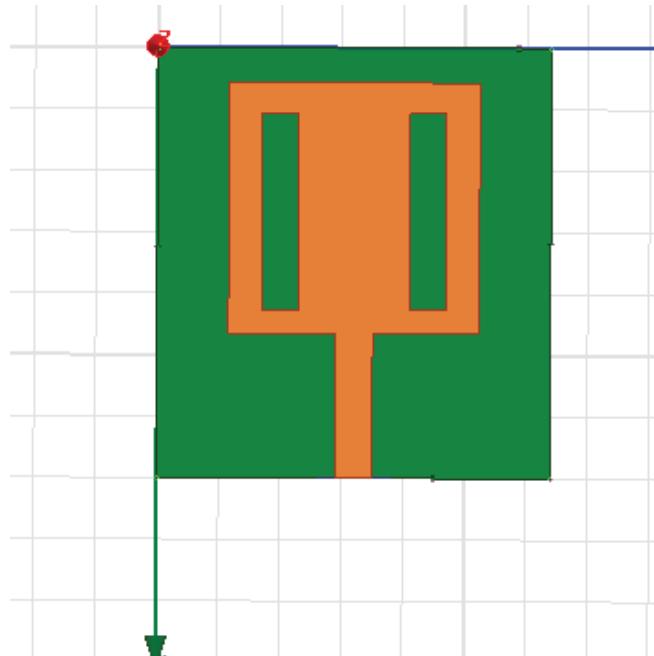


Fig. 3. Geometry of Square Patch Antenna

### C. Circular Patch Antenna

The schematic layout of the patch proposed Circular Antenna is seen in the Fig.4 and. The patch design is to be on FR-4 epoxy substrate, dielectric constant and thickness is 4.4 and 1.6 mm resp. Thus radius of our circular designed patch is 11.2mm and two vertical slots are cut from the patch. The

signal is fed through a microstrip line feeding.The dimension of the design listed in Table III.

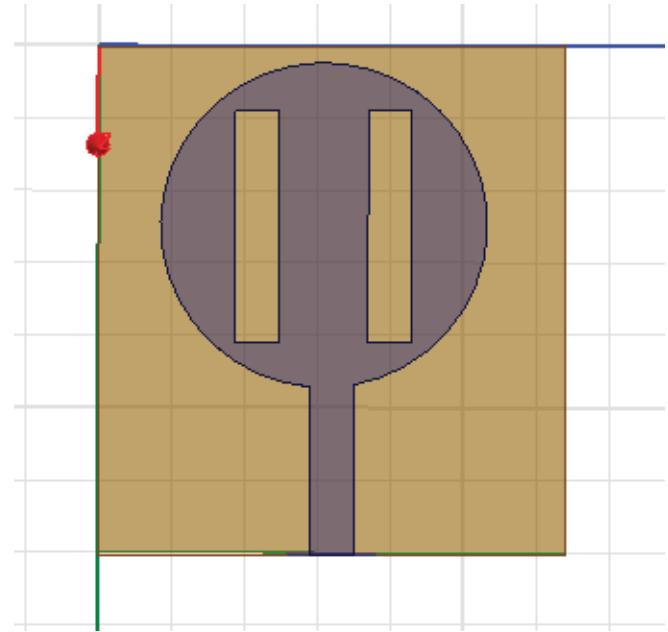


Fig. 4. Geometry of Circular Patch Antenna

## III. SIMULATION RESULTS AND DISCUSSION

### A. Return Loss

It is a parameter which signifies the amount of energy that is “lost” to the free void space and doesn’t return as reflection. The fig.5 shows, return loss of rectangular patched antenna that is -18.0998 dB at 3.6 GHz. The fig.6, return loss of squares patch antenna, which is resonating at frequency of 3.8 GHz freq and return loss of -17.7530 dB . For circular patch antennas the return loss is -5.1962 as its shows in fig.7 which is resonating at frequency of 3.68 GHz.

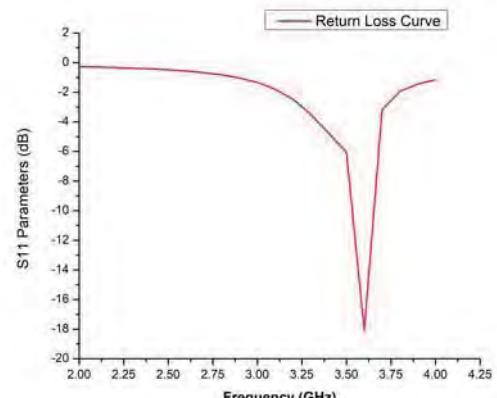


Fig. 5. Return loss of Rectangular Patch Antenna

TABLE III  
DIMENSION OF CIRCULAR PATCH ANTENNA

Parameters	Values(mm)
Radius of patch (Rp)	11.2

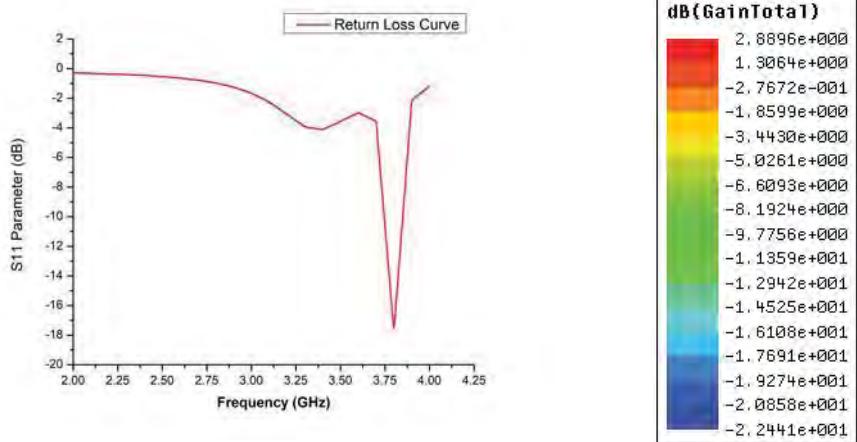


Fig. 6. Return loss of Square Patch Antenna

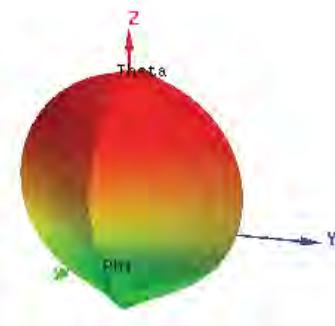


Fig. 8. Gain of Rectangular Patch Antenna

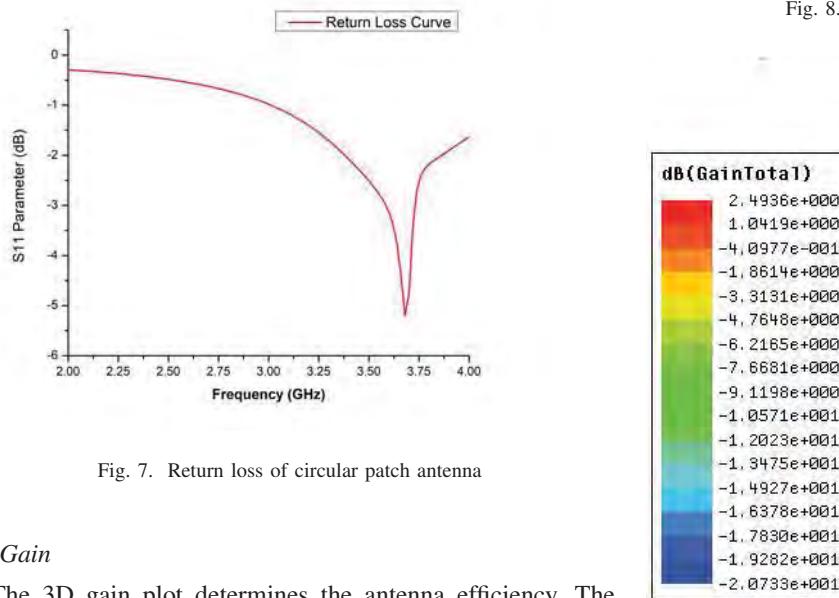


Fig. 7. Return loss of circular patch antenna

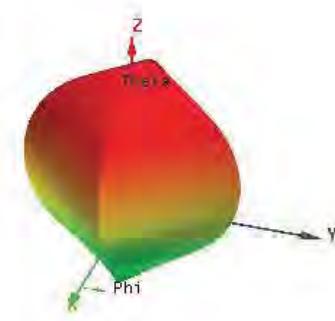


Fig. 9. Gain of Square Patch Antenna

### B. Gain

The 3D gain plot determines the antenna efficiency. The rectangular microstrip patch antenna achieves a gain of 2.8896 dB as in fig.8 . The gain achieved at square patch microstrip antenna is 2.4936 dB as in fig.9 . Circular microstrip patch antenna produces gain of 2.4045 dB as in fig.10 .

### C. Directivity

A amount of the focusing of radiation at the direction of maximal. The rectangular microstrip patch has a directivity 5.8853 dB as in fig.11 . The directivity at square patch microstrip antenna is 5.8984 dB as in fig.12 . Circular microstrip patch antenna gives a directivity of 6.0848 dB as in fig.13 .

### D. Radiation Pattern

An omnidirectional pattern has been shown by the proposed antennas which is desirable for mobile communication. The Radiation pattern of Rectangular Antenna Patches in fig.14 . And the radiation patterns of square microstrip patch and circular microstrip antenna as seen in fig.15 & fig.16 .

### IV. COMPARITIVE ANALYSIS

A comparison study table of different designs of patch antennas is shown in table IV. The comparison of parameters alike return loss, proposed gain and proposed directivity is completed on their performance on various shape designs of patch antenna. The table gives the parametric outcomes of the antenna.

### V. CONCLUSION

Different design approaches of various shapes are presented and studied for 5G applications. The performance parameter of rectangular, square and circular shape patch designed antenna are studied. The physical parameters of these 3

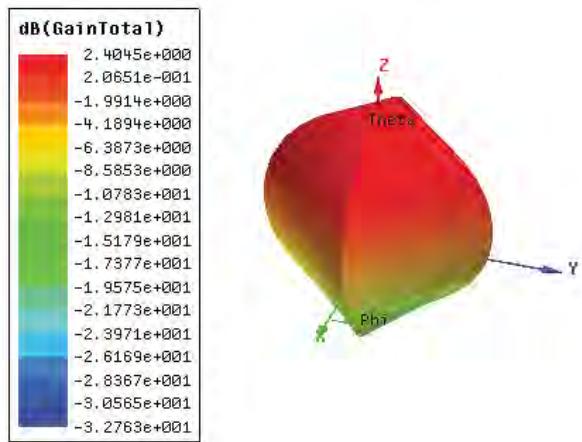


Fig. 10. Gain of circular patch antenna

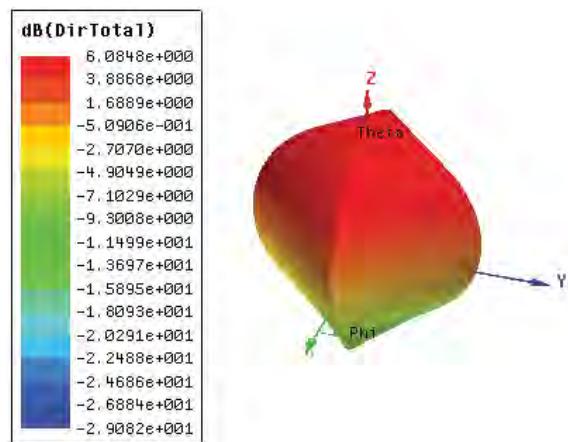


Fig. 13. Directivity of circular patch antenna

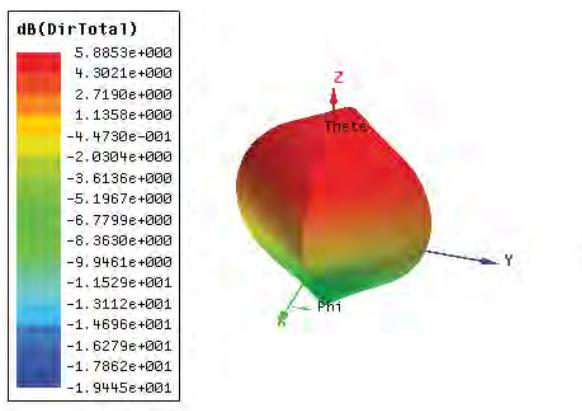


Fig. 11. Directivity of Rectangular Patch Antenna

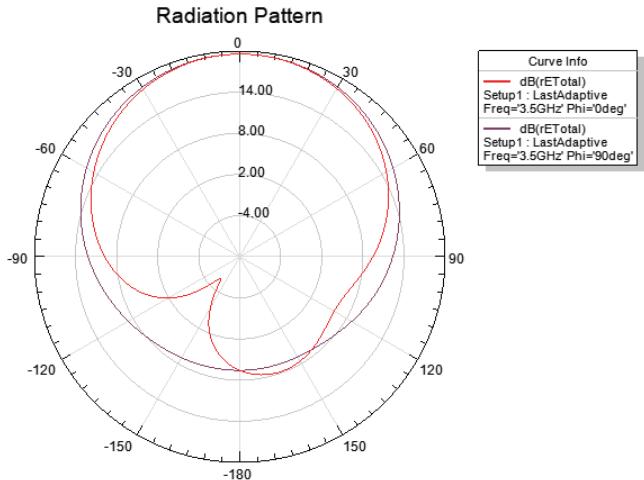


Fig. 14. Radiation pattern of Rectangular Patch Antenna

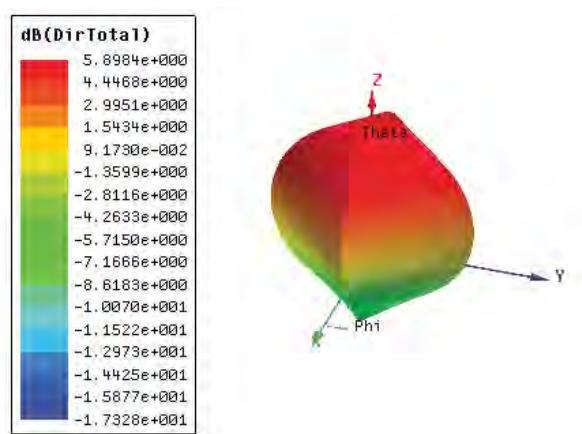


Fig. 12. Directivity of Square Patch Antenna

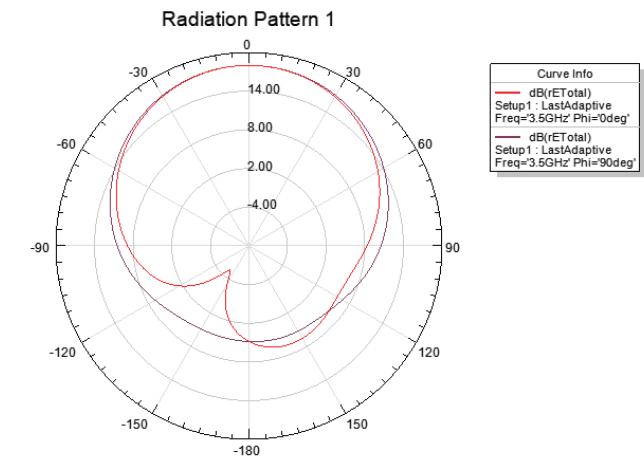


Fig. 15. Radiation pattern of Square Patch Antenna

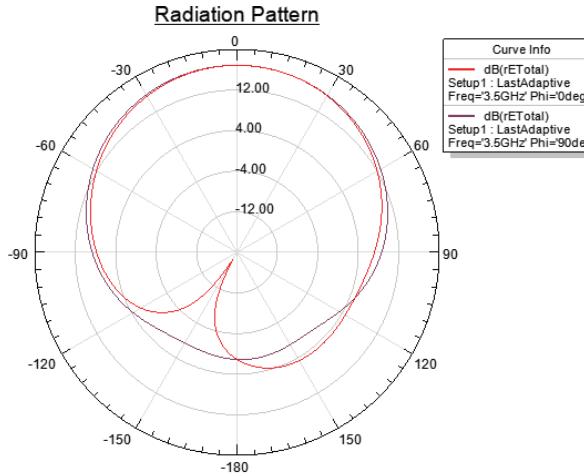


Fig. 16. Radiation pattern of circular patch antenna

TABLE IV  
COMPARISON OF MICROSTRIP PATCH ANTENNA OF VARIOUS SHAPES

Parameters	Rectangular Patch	Square Patch	Circular Patch
Resonating frequency (GHz)	3.6	3.8	3.68
Return Loss (dB)	-18.0998	-17.7530	-5.1962
Gain (dB)	2.8896	2.4936	2.4045
Directivity (dB)	5.8853	5.8984	6.0848

shapes of antennas are studied and presented in result section. These different shaped-antennas produce varying characteristics as the design parameters are changed. The various shapes of patch for microstrip antenna have different parametric values in terms of the return loss , gain, directivity and radiation pattern.

Among the tested shapes, the rectangular designed patch is resonating at the frequency of 3.6 GHz , having good return loss of -18.0998 dB . The gain obtained is 2.8896 dB and directivity is 5.8853 dB .While, the square microstrip patch antenna has a resonating frequency of 3.8 GHz and the return loss of -17.7530 dB . The gain is 2.4936 dB and directivity is 5.8984 dB .For circular microstrip patch antenna, the resonating frequency is 3.68GHz which has return loss of -5.1962 dB , the overall gain and the directivity is 2.4045 dB and 6.0848 dB .

The designed rectangular patch antenna has higher Gain and better directivity as well as return loss is less as it is shown in tables, which shows that this antenna is very suitable for 5G communications. This antenna has efficient antenna parameters, miniaturized size and at comfortable structure.

In future, Antenna will be fabricated, and the results will be measured (such as S parameter radiation pattern) based on this study. And simulated result will be compared to fabricated results.

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# Hardware Accelerators: A Review

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**Abstract**— “Need for speed” has become the moto of today’s gen z and y community. Consequently, the need for faster processing has emerged in the market. There is only so much that a x86 CPU (normally available in PCs) can do. In order to go one step further, hardware accelerators have come into picture. In simple words, a Hardware Accelerator is a piece of hardware which can be used in addition to the normal processor or CPU to speed up a particular task. Hardware accelerators have been extensively researched upon. Various hardware choices and methodologies have been developed. In this paper we give an overview of different research carried out in the field of hardware acceleration. More than the actual application accelerated, we discuss the accelerator architecture and methodology in depth. After reviewing and performing a comparative study, we go on to discuss which particular hardware design is most feasible and what changes, if any, can be made to the existing designs.

**Keywords**—Hardware accelerators, Field Programmable Gate Array (FPGA), Graphical Processing Unit (GPU), Central Processing Unit (CPU), speed-up

## I. INTRODUCTION

In a standard desktop PC, all the tasks are handled by the CPU. This CPU is what is called as a general-purpose CPU (GPCPU) and it is a sequential processor. This entails that at any given time, the CPU will be working on a single task. Now, this occurs at very high clock speeds (3.5GHz to 4.0GHz in a normal PC) which is fast enough for general computer operations.

There are certain other applications (engineering related) like image processing [4][8], neural networks [5][6] and various other machine learning algorithms which are again time intensive and heavy for the GPCPU to process. Outputs will be generated just fine; but the time taken for it will be very high. Most of these algorithms contain an extremely high number of arithmetic operations. Since the GPCPU is sequential, performing these numerous operations takes time. Hence, for such cases, a hardware accelerator must be used. It is a piece of hardware which has an extensively parallel and deeply pipelined architecture that permits fast parallel processing thereby reducing the processing speed and boosting up the overall system performance significantly.

A hardware accelerator is basically a chip or a board which will be externally connected to the PC or the GPCPU. As the CPU goes on with assigned tasks it may encounter an application which is time intensive. Such an application will then be offloaded by the CPU onto the accelerator via specified interface. The hardware will then go on to perform the application in a parallel fashion which takes much less time than the CPU. The output of this application will then be returned to the CPU, again via a specified interface and the results will be utilized. This is the general working principle of a hardware accelerator [2].

In this paper, we present an overview of different research studies carried out on system enhancement by using

hardware accelerator. Via this review we aim to classify different hardware platforms used for accelerator design and determine which ones are best suited. We will also establish which design methodology is most appropriate for design of a hardware accelerator.

The remainder of this paper is organized as follows. Section II describes the need and guidelines for accelerator incorporation. It also describes the various applications that can be enhanced with addition of an external accelerator. It also classifies the accelerators based on the hardware and software tools used and also the methodology followed. Section III compares the various researches reviewed and section IV concludes the paper.

## II. LITERATURE OVERVIEW

### A. Need for Hardware Acceleration

A major obstacle to be overcome in the design of embedded and VLSI circuits is the problem of computational complexity. In other words, major VLSI synthesis and design applications are not extremely complex in method but are simply computationally vast [1]. Many a times tens of thousands of computations may have to be performed in order to generate output of a particular design. Computer aided tools (CAD tools) have been developed in order to make this process simpler. However, with advancements in technology they too lack the ability to achieve significant performance improvement [1]. Even if significant speed-up is achieved through specialized hardware, another hurdle when it comes to embedded system design is to find the perfect tradeoff between power consumed and speed-up achieved [2]. In order to achieve speed-up and overall improvement in performance, the only effective option that remains today is to incorporate an external piece of hardware that can take over whenever a computationally vast operation needs to be performed. This piece of hardware is a “Hardware Accelerator” and this accelerator can improve system performance dramatically. Incorporation of an external accelerator removes a significant amount of load from the host processor.

Before incorporating a hardware accelerator in the design, there are two aspects that have to be considered: Speed-up and Power consumption [1].

$$\text{Speedup} \leq p/(1+f.(p-1)) \quad [1]$$

p = speedup achieved by the accelerator as compared to non-accelerated function; f = fraction of execution time that was not accelerated

$$\text{Dynamic power} = CV^2 fA \quad [1]$$

C= parasitic capacitance; V= supply voltage; f = frequency; A= activity factor

Equation (1) and (2) have to be taken into consideration before designing a hardware accelerator. These equations

can be used to determine the ideal ratio of speed to power for the desired application.

#### B. Applications that need acceleration

A variety of applications can be improved upon by addition of an accelerator. Most of the applications are algorithms which are computationally and time intensive. Convolutional Neural Network (CNN) which is a major deep learning architecture [4]. In CNN algorithms vast number of computations are done in layers until the required output is determined. These computation steps can be sped up through hardware acceleration. Another branch of computationally vast algorithms is image processing because more often than not, image processing applications make use of machine learning techniques.

In [3] the authors have described use of hardware accelerators for improvement of password recovery algorithms. The most common method used for password recovery is the brute-force recovery. In this method all possible password options are tried out until the correct one is discovered. The length, type of characters, encryption algorithm and nature of the forgotten password also play important roles in determining the password. Naturally, this process entails a large number of iterations and calculations in each iteration.

Real time traffic sign detection has piqued interest in today's world with development in autonomous vehicles and so on. Security cameras now a days generate huge amounts of big data which is stored in offline databases. This data along with real time footage can be used for real time traffic sign detection. For real time applications it is imperative that the detection and processing of the sign is fast. Given the amount of data, achieving high processing speeds is difficult. Hence, authors in [4] have suggested the use of a hardware accelerator to speed up traffic sign detection and processing. They have used image processing and in that, machine learning algorithms to train their detection model. Hardware acceleration platforms for machine learning algorithms have by far been only developed for one particular application. In other words, one accelerator can only be used to train one neural network. Research in [6] has presented a hardware accelerator design which can support acceleration of multiple networks and an automatic mapping flow such that the users only need to provide network description files and test image for acceleration of a specific network. The computations done at various layers are internal and handled by the accelerator.

Image processing has also contributed significantly in improvement of medical imagery. Medical scans such as Computed Tomography (CT), Single Photon Emission Computed Tomography (SPECT) e.t.c. require high performance computation solutions to assist in emergency medical procedures. Maximum Likelihood Expectation Maximization (MLEM) is a very effective medical imaging reconstruction algorithm. However, this algorithm has very long execution time and so it is not readily used due to its impracticality in real time. Authors in [8] have suggested a hardware accelerator platform that can reduce this execution time and make the use of this algorithm practical.

Authors in [5] have proposed deflate compression and decompression algorithms with incorporation of hardware acceleration. Deflate compression is one of the data compression techniques which is comparatively lossless. In order to utilize bandwidth and available storage space effectively, data compression is necessary. The amount of compression achieved is inversely proportional to the speed of execution. This means that algorithms which provide efftive lossless high data compression tend to be slower than those that provide low compression. In order to counter this issue, a hardware accelerator has been incorporated in the algorithm design in [5].

Certain financial applications such as risk valuation require large data and high-speed processing. In order to deal with this, a system with hardware acceleration for three different risk valuation algorithms is proposed: Black and Scholes method, Black-76 method and Binomial method; in [7].

#### C. Hardware and Software tools

##### a. Hardware Tools

Hardware acceleration can be achieved using three types of hardware: Graphical Processing Unit (GPU), Application Specific Gate Array (ASIC), Field Programmable Gate Array (FPGA). All the researchers have initially implemented their applications on a CPU only platform. Upon realising the impracticality of CPU only approach, they have migrated to other hardware options.

[3] and [4] have implemented their application using a GPU as their acceleration hardware. In [3], a NVIDIA GTX 750 Ti GPU has been used while in [4], NVIDIA GRID K520 GPU has been used. GPUs were specifically designed to accelerate computer graphics workloads. They are now finding their way in the AI industry by becoming much more programmable than they used to be. GPUs run on software and running software takes time. However, on the hardware side GPU is highly parallel with thousands of threads running at the same time which compensates for this software speed. However, this speed comes at a price. In both cases [3][4] it was observed that GPU is effective but it consumes a lot of power. Such a high energy footprint makes the application of GPU as hardware accelerator in most applications unfeasible. Research in [3] and [4] was further shifted to FPGA implementation.

In [2], Altera's Cyclone III FPGA Development Kit has been used as the hardware accelerator platform. In [4], Xilinx ZC706 evaluation board has been used. In [5], Xilinx Virtex UltraScale+ series FPGA has been used. Similarly, in [7], Xilinx Kintex UltraScale XCKU060 FPGA has been used while [8] makes use of Virtex7 VC709 FPGA. All the research in these papers suggest a FPGA only implementation. While the application program to be accelerated runs on the FPGA, the host controlling the FPGA works on an external processor. This external processor is generally the desktop PC connected to the FPGA board. For the

processor, [4] has used Intel core i7, [7] has used Intel core i5 and [8] has used Intel Xeon 5138 processor.

Xilinx Zynq-7000 SoC provides a very unique architecture which is a hybrid between a CPU and a FPGA. It comprises of two blocks: Processing System (PS) and Programmable Logic (PL). The PS is basically the CPU which is ARM dual core processor in case of Zynq-7000. The PL consists of memory controllers, buffers and processing elements and basically acts as the FPGA. Work in [3] and [6] has made use of this Zynq-7000 SoC. Since the CPU and the FPGA are on the same board, the host as well as the kernel runs on the same board. This eliminates external processor dependency while improving the execution speed due to small physical distance between CPU and FPGA.

#### b. Software Tools

For GPU operation, NVIDIA CUDA was used by [3], [4] and [6]. For FPGA only as well as hybrid CPU-FPGA operation, Xilinx VIVADO and SDK were used. VIVADO is a software tool by Xilinx for system design. Custom Intellectual Properties (IPs) can be made or IPs from the vast IP library can be used to combine into the target system design. Software application development is done in the SDK. As of November 2019, Xilinx SDK has been replaced by Xilinx Vitis which is similar in application to the SDK.

Use of FPGA is generally avoided because it is difficult to program. It requires Hardware Description Language (HDL) programming. Two commonly used HDLs are VHDL and Verilog. These languages have a very rigid syntax and are difficult to debug or make design changes to. The Xilinx High Level Synthesis (HLS) tool makes FPGA programming much simpler. [5], [6], [7] and [8] have made use of Xilinx HLS to generate their application IPs. In HLS, a program can be written in a high-level language like C or C++ which is more user friendly and easy to debug. This program is translated into its HDL description internally by the HLS tools and this HDL description is then converted to basic RTL description which is used by the FPGA.

#### D. Methodology

Methodologies of accelerator design for almost all the reviewed applications is similar. The only difference is with the type of hardware board used and the type and number of IPs created for the application.

The system proposed in [4] for traffic sign detection contains four components: an accelerator (FPGA), CPU (intel core i7), Direct Memory Access (DMA) and an external memory DRAM. Except for the DRAM all other components are on the SoC chip. A high-level C program runs on the CPU and this is the host program that controls and configures other hardware components. According to the code running on the CPU, the DMA transfer data from the DRAM to the accelerator. At the accelerator cascade classifiers are applied for traffic sign detection. The accelerator contains four major function modules: image scaling and integration, image cropping, classification and image block integration. The image data received by the accelerator from the DRAM is sequentially processed by each of these four modules and traffic sign information is outputted. For further performance

improvement these four stages are performed in a pipeline. Once the detection is done the data will be transferred by the DMA to the DRAM from where it will be retrieved by the host. For actual detection, the cascade classifiers are trained to detect different types of traffic signs.

In [5], two encoders have been designed for deflate compression and decompression: Limpel Ziv 77 (LZ77) encoder and a Huffman encoder. Both these encoders act as IP cores within the design. They are written in C++ and synthesized in Vivado HLS to form IP blocks. These IP blocks are then imported into the main system design where they are connected using AXI-Stream bus interface. Architecture of the hardware accelerator system has not been discussed in this research. However it is safe to assume that the procedure once the IPs are designed remains fairly constant and similar to the previous work.

In [7], a system with hardware acceleration for three different risk valuation algorithms has been proposed: Black and Scholes method, Black-76 method and Binomial method. Separate kernels were written for each of the three algorithms using HLS tools. At the final stage, integration of all three kernels was done using the Xilinx SDAccel tool. This tool provides a framework wherein a system consisting of host program running on the CPU and kernels running on FPGA can be developed. PCIe bus interface is used for communication between modules within this system. There are 5 different functions within the host: initialization function, termination function and three functions for the three algorithms. First step is to execute the initialization function. This function enables read/write between the accelerator and the memory which is also reserved depending on how many packets are required for communication during this step. This step happens only at the startup of the system and is not run before every execution due to its large execution. Depending on which accelerator is to be used to process data, the corresponding method function must be called. This function transmits the necessary data to the kernel and receives the result values. Multiple kernels can be executed parallelly though pipelining. When the execution are completed the results are written into the on-board RAM and then transferred to the host. When the execution is over, termination function is executed which releases the memory buffers and frees the CPU.

In MLEM accelerator proposed in [8], using Vivado HLS a custom IP for MLEM was designed in C++ language along with its testbench. This C++ program was verified using the testbench and synthesized into RTL logic. The RTL logic was then exported as an IP block. This IP block was then integrated with the overall design. The design is validated and bit stream is generated. This bit stream was then exported to the SDK for software programming. In Xilinx SDK a C++ software application for MLEM was generated to send data to the IP core and to retrieve results. The received reconstructed image data was stored and transferred to MATLAB environment to view.

In [3], algorithms for password recovery are proposed. The system design consists of a cryptographic accelerator (on-board PL), a CPU (on-board PS) and an external memory card (SD card). The accelerator and the CPU are both placed on the hybrid SoC board and are connected to a high speed AXI-bus. Tens of thousands of computations are required to authenticate one password. For different applications different authentication computations have to be performed and for that

different hardware implementations on the FPGA are required. Each of these hardware implementations act as IP cores and together become the accelerator library. The data required for FPGA reconfiguration is stored in the SD card. The host program is written in C language and it runs on the CPU. The host controls the selection of the algorithm that needs to be accelerated and directs the accelerator to run that particular IP. The output data is stored into the SD card from where it is retrieved by the host.

Accelerator system design for multiple CNN in [6] has not been described in depth. The required data is stored in the external SD card. To accelerate CNN on the hardware, two kinds of files are needed to be downloaded to the SD card, which are .elf file and .bin files. The .elf file is composed of bitstream which is extracted from the .c file. The accelerator system consists of a PL and a PS. PS runs the host while the PL performs acceleration. the PL consists of memory controller, buffers and processing elements (PEs).

### III. COMPARATIVE STUDY AND DISCUSSION

TABLE I.

Sr. no.	Author	Proposed Algorithm	Tools used	Hardware
1.	Paulo Possa et al.	CPU – Accelerator interface exploration [2]	Catapult C from Mentor Graphics	Altera NIOS II microprocessor SoC, Altera's Cyclone III FPGA Development Kit
2.	Peng Liu et al.	Hybrid CPU-FPGA based accelerator for password recovery [3]	Xilinx Vivado, Xilinx SDK , NVIDIA CUDA	NVIDIA GTX 750 Ti GPU, Spartan 6 LX150 FPGA, Xilinx Zynq 7000 XC7Z030-3 FPGA,
3.	Weijing Shi et al.	Hardware accelerator for CNN traffic sign detection [4]	MATLAB, OpenCV, NVIDIA CUDA, Xilinx power estimator	Xilinx ZC706 evaluation board, intel core i7, NVIDIA GRID K520 GPU
4.	Morgan Ledwon et al.	Hardware accelerator for Deflate compression and decompression algorithm [5]	Vivado HLS	Xilinx Virtex UltraScale+ series FPGA
5.	Yuchen Yao	A FPGA-based Hardware Accelerator for Multiple Convolutional Neural Networks [6]	Vivado HLS	Xilinx Zynq 7000
6.	Ioannis Stamoulias et al.	Hardware accelerator for Black and Scholes, Black 76 and Binomial methods for financial applications using HDL as well as HLS [7]	Vivado HLS, Xilinx SD/Accel	Xilinx Kintex UltraScale XCKU060 FPGA, Alpha Data ADM-PCIE-KU3 board, intel core i5.
7.	Murali Ravi et al.	Hardware accelerator for MLEM algorithm [8]	Vivado HLS, Xilinx SDK, MATLAB	Virtex7 VC709 FPGA , Intel Xeon 5138 processor

Fig. 1.

Table I. displays all the seven reviewed papers and their respective applications. It also displays the tools which were used and the hardware platforms used during experimentation. All the reviewed works have shown that the use of FPGA is superior as compared to GPU and CPU when it comes to the application of hardware acceleration. [3] and [7] also show use of DSP as an acceleration hardware. However due to lack of parallelism it does not contend as a viable hardware option. It is also observed that a hybrid CPU-FPGA design platform shows a better performance than a CPU only or a FPGA only design platform [2]. Xilinx Zynq 7000 SoC provides this hybrid architecture and is the most widely used and most effective hardware platform. It is better than a FPGA only execution for two reasons. One, because it eliminates the need for an external processor or PC to run the host program. Second, being on the same silicon chip, the distance between the CPU and the FPGA is minimal. This reduces the time taken for signals to travel between the two. Zynq SoC is more expensive as compared to standalone

FPGA boards. But it provides much better performance and is easy to use. Hence it should replace most of the FPGA only implementations.

None of these papers have considered ASICs as a hardware option. It is given that ASIC is not a feasible choice due to its cost. They take a very long time to be developed and are much more expensive as compared to FPGAs and GPUs. However, ASICs are designed very specifically for one particular application and so they provide the best speed-up, power consumption and overall performance that can be possibly achieved for that particular application. If a task specific solution is required, for example [3], [4] and [8] where the application is singular and constant throughout with minimal need for reconfiguration, then an ASIC becomes a better choice.

### IV. CONCLUSION

In this paper, we have reviewed eight different research papers all discussing the need of external hardware accelerators for enhancement of their respective applications. After reviewing all the above research, it can be concluded that with latest technological developments the speed and energy saving offered by conventional and standalone CPU systems is not enough; especially in case of high intensity applications. Incorporation of an external hardware support for acceleration of such applications is a must and in that FPGA is the best option going forward. All the papers displayed substantial increase in speed-up, performance and decrease in power consumption upon addition of a hardware accelerator.

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# Malware Intrusion Detection for System Security

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*Abstract - With the improvement of web innovation, network assaults are getting increasingly more sourced and muddled. This makes it hard for the conventional malware discovery frameworks to viably recognize strange traffic. Intrusion Detection System is an application which is utilized to investigate all organization traffic and caution the clients if there has been any unapproved access or endeavors. Dissimilar to firewalls which basically screen network traffic and decide if it ought to be permitted or not, Intrusion Detection System centers around traffic that is on the inner organization for distinguishing any dubious or harmful action. The investigation of an association's organized traffic supplements antivirus programs those sudden spikes in demand for customer PCs. The analysis of an organization's network traffic complements decentralized antivirus software that runs on client computers. It permits associations to implement a security strategy on their whole network. This methodology makes it conceivable to malware location into network or cloud administrations. Malware discovery frameworks can precisely recognize organization traffic, giving organization security.*

**Keywords:** System & Network security, Malware intrusion detection systems, Malware detection, Machine learning.

## I. INTRODUCTION

Malware like viruses, worms and spyware are very harmful for the computer and its network. Malware causes the computer to slow down, can cause the computer to crash and it also confiscates users' privacy [6]. So for keeping the system safe an intrusion detection system is needed to detect such attacks before it can harm any part of the computer.

### 1.1 Issues in current Malware or Antivirus Software's

Detection of malware on a system has become difficult because current malware programs hide their presence on infected systems [5]. Because of that no antivirus software can detect and stop all possible malware or viruses. Most of the anti-malware software detects the malware by identifying them after comparing them with the already detected malware from the past. So for detecting a malware, a combination of more than one method is needed. The analysis of an organization's network traffic complements decentralized antivirus software that runs on client computers. It permits associations to implement a security strategy on their whole network. This approach

makes it possible to encapsulate malware detection into network devices or cloud services.

### 1.2 Need of new malware detection system

Malware recognition frameworks can precisely recognize organization traffic, giving organization security. With the improvement of web innovation, network assaults are getting increasingly more sourced and convoluted, making it hard for conventional malware location frameworks to successfully recognize strange traffic [8]. It blends with customer-based antivirus which instructs the network-traffic investigator, which can assist with identifying polymorphic malware dependent on network-traffic.

## II. RELATED WORK

Malware behaviour is an important part of detecting it's malicious nature. Most of the studies are focused on finding the malware using available or collected data sets. Our work focuses on finding a solution after referring to some of the already worked methodologies.

Many of the studies have focused on finding the malware from one network or system. Unfortunately, the malware can't be detected by following one method because of it's sophisticated nature. The approach should be using more methods on finding the malware or detecting it at the network. The below survey's are based on studies already done and finding a better solution.

### 2.1 Survey 1:

Giuseppe Della Penna, Luca Di Vita, and Maria Teresa Grifa's[1] research are focused on the use of machine learning techniques for malware detection. This methodology presents various benefits, most importantly, its capacity to consequently distinguish the malware qualities by noticing a bunch of preparing tests, and sum up these outcomes to identify new variations without having really seen them before [1]. This method follows a classifier to store the features of the malware and such classifiers is generally controlled by the nature of the hidden preparing dataset, and having an excellent dataset requires gathering genuine malware traffic information, keep it refreshed, and make this information really usable by an AI calculation [1].

Since networks in associations (particularly for noxious traffic) these days are consistently scrambled, it is unimaginable to expect to examine the parcel payload. Subsequently, highlights should be separated from recognizable attributes of the traffic like the parcel proportion, length, or convention[1]. Such qualities are normally accumulated in time windows to remove undeniable estimates that really address the highlights.

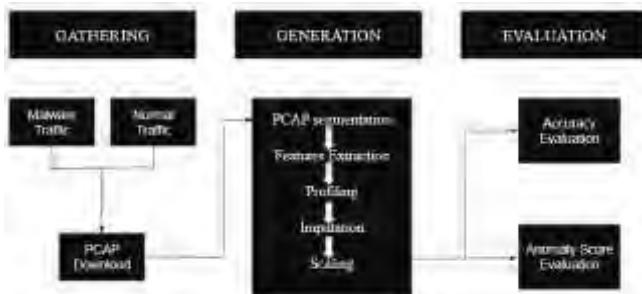


Figure 1. Block Diagram of KDD'19

To construct the underlying dataset, i.e., to remove the traffic highlights, they bunch the contained bundles dependent on the source address (division) and afterward process the highlights on these gatherings [1]. The arrangement of highlights and identifies with a particular fragment turns into a line of the dataset. They acquire a dataset with the attributes that appeared in Table I. It is important that the dataset is adjusted, i.e., the circulation of malware.

TABLE I. Composition of the MTA-KDD'19 dataset

Sample Type	Sample Count	Percentage
Malware	39544	55.3%
Legitimate	31926	44.7%
Total	71470	100%

## 2.2 Survey 2:

Minghui Gao, Li Ma, Heng Liu, Zhijun Zhang, Zhiyan Ning, and Jian Xu's [2] Anomaly recognition frameworks can precisely recognize noxious organization traffic, profound neural organization is an innovation accomplished by extraordinary outcomes as far as inconsistency locates, and it can accomplish programmed identification. In any case, there still exists misclassified traffic in the expectation aftereffects of profound neural organizations [2]. The profound neural organization can mine the profound component data of organization traffic, just as arrange obscure assault traffic. Since the profound neural organization actually has a slight bogus rate, after grouping, they channel the arranged traffic through coordination to eliminate the typical traffic that is misclassified as noxious traffic [2].

The framework can distinguish, arrange, and produce alerts for strange traffic in the organization, with a lower bogus caution rate. The location framework additionally had a decent identification impact in a multi-class test climate [2]. This two-level discovery framework that orders and helps the channels network traffic to get a higher exactness and less bogus and encouraging points regarding the location results. The design of the profound neural organization actually has a great deal of space for advancement and expanding the exactness rate.

Apriori is essentially used to figure the affiliation rules between discrete highlights. Consequently, erasing countless nonstop highlights remembered by the organization's traffic highlights [2]. Just the discretized

highlights and marked highlights are put aside for ensuring in affiliation rule mining. The prepared outcomes are shown in Table II.

TABLE II. The results of data pre-processing of the Apriori association algorithm.

Land	Logged_in	Protocol_type	Service	Label
land	logged_in	UDP	aol	Attack
no_land	no_logged_in	TCP	auth	Normal

## III. SYSTEM OVERVIEW

By comparing the malware detection systems [1-2] and based on the efficiency, reliability, security, availability and determining that not one model can give a perfect protection against the sophisticated malware. So to find a solution for a better working malware detection system, which we designed using Machine Learning. And for this a dataset was collected by using the program to determine the features of the data which will be used to detect the files that contain viruses or malware. While one program helps to detect the malware present in the system, the other program helps to detect malicious traffic entering the system. It uses a blacklist, which contains all the sites which can be harmful to the system. The below Figure III. Shows the block diagram of the Malware Detection System. There are six blocks in the system Sensor, Malware List, System, Detect, Classifier and Features.

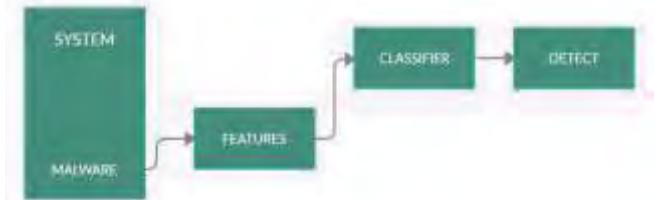


Figure 2. Block Diagram of Malware Detection System

### 3.1 System & Malware

Here a file containing malware is present, which can harm the system. So for detecting such a file, and to know its malicious nature, this file is run through an algorithm to extract its features..

### 3.2 Classifier and Features

The network traffic is collected from the system logs. A dataset with the required features are taken from the dataset and used for the detection of malware with respect to the features taken from the set [2].

After collecting these features from the dataset, the features were trained to the Machine Learning Algorithm. The features from the data set were extracted using Decision Tree and Random Forest.

## IV. FLOW CHART

A flow chart is a representation of a process in a form of step by step layers, and to understanding the complicated process of our work. The whole process is

divided into two parts, each is shown below. The figure, explains the process of detecting the malware contained sites on the web. While figure 5, explains the process of detecting the malware which might be present inside a file on the system.

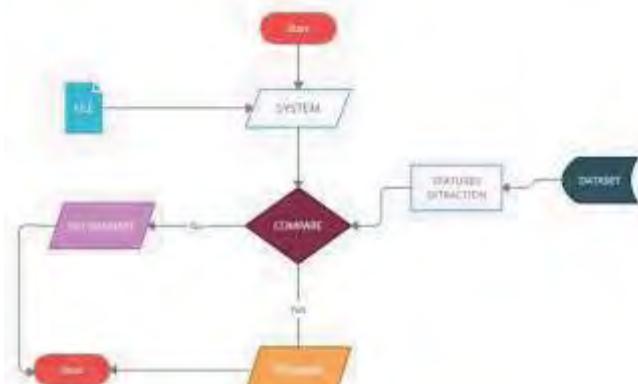


Figure 3. Flow Chart

The process begins after a file is downloaded into the system from a safer site which has less chance of containing any malware and also a site which isn't present inside the Blacklist which was explained earlier. But to protect the system and increase the security another layer of malware detection is done by detecting the malware in the file. This is done by using a dataset which contains different software files and its features, it also contains malicious features which help in detecting. These both features are extracted and used to compare it with the file's features. After comparing these features it determines if the file contains malicious features or legitimate features, if it contains no malicious features then it indicates no malware and if yes, it contains malware then it indicates that malware is present in the file. Using this method the system is protected from malware files.

```
C:\Users\91772\Documents\Malware Intrusion
The file Setup.exe contains malware

C:\Users\91772\Documents\Malware Intrusion
The file Sublime.exe contains none malware
```

Figure 5. Scanning of files

By using both methods the system can be protected from any attack from outside the system or inside the system. And by using ML techniques these methods can be updated regularly.

## V. RESULTS

The dataset is used to collect the features which are required to train the Machine Learning algorithm and use it to detect the malware inside a file. There were 54 total features taken from the dataset which were relevant and most possible to get infected and to detect such features, the Machine Learning algorithm is used. The 54 features collected are shown in below figure 6.

```
15 features identified as important:
1. feature ImageBase (0.087936)
2. feature Machine (0.081949)
3. feature MajorSubsystemVersion (0.079726)
4. feature SizeOfOptionalHeader (0.076504)
5. feature ResourcesMaxEntropy (0.074269)
6. feature Subsystem (0.072795)
7. feature DllCharacteristics (0.072301)
8. feature Characteristics (0.055454)
9. feature SectionsMaxEntropy (0.049357)
10. feature ResourcesMinEntropy (0.047828)
11. feature VersionInformationSize (0.045341)
12. feature MajorOperatingSystemVersion (0.043917)
13. feature ResourcesMinSize (0.020489)
14. feature SectionsMeanEntropy (0.019537)
15. feature SectionsMinEntropy (0.019254)
```

Figure 6. Collected Features

The features from the data set were extracted using Decision Tree and Random Forest. After performing both the algorithms the efficiency was taken out from both the methods which is shown in the figure 7.

```
Now testing algorithms
DecisionTree : 99.065556 %
RandomForest : 99.391525 %

The algorithm RandomForest with a 99.391525 % of success
Saving feature list in classifier directory...
Saved
```

Figure 7. Efficiency of the Algorithms

After checking out the efficiency, the most efficient algorithm will be used to detect the malware in the system. The features extracted by the algorithm will be saved in the directory named classifier. The detection of malware is done on the latest files which have been downloaded on the system, it scans the files and gives an indication of malware present in that file. This thus protects the system from unwanted files stored in the system and goes unnoticed by other software's.

## VI. CONCLUSION

Using ML (Machine Learning) for the detection of malware and considering raw representations of the input data, there are different forms of traditional, shallow-based approaches, our models operate with raw bytes as input, without requiring any type of expert domain knowledge and input features it can provide a very powerful approach. The proposed ML architectures, capable of learning features out of the raw inputs. Our results show that using Raw Flows as input for the ML models achieves much better results than using Raw Packets and achieving detection performance which is comparable - or even better, than the obtained by expert-domain knowledge. Malicious traffic detection systems will reduce the infrastructure damage threats that come from the internet or intranet by utilizing publicly available black lists. In this way of approach we are not relying on the signatures that are being given to the end user by the AV provider. Because we are updating our definitions with various AV reports and our custom definitions to block the content.

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# Comparison of different handwritten Hindi text recognition approaches

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**Abstract-** Handwritten text recognition has been gaining a lot of importance in the recent years due to its wide range of applications. Hindi is one of the most commonly used and known languages of India. Its script i.e., Devanagari has been in regular use from 7<sup>th</sup> century CE. There has been a lot of research being conducted on this language from the past few years. Many popular approaches are used for handwritten Hindi character recognition. In this paper, we compare three different recognition approaches which are Support Vector Machine, General regression neural network, and Multilayer perceptron for a particular database in an attempt to determine the most efficient approach for handwritten Hindi character detection

**Keywords-Support Vector Machine, General regression neural network, Multilayer perceptron**

## I. INTRODUCTION

Character recognition tasks associated with any language could be of 2 types: Online character recognition and offline character recognition. In online character recognition, characters are recognized at the moment they are written. In the case of offline character recognition, text in the image is recognized. This text could be some printed data or handwritten data. In this paper, we are comparing three different recognition approaches for offline handwritten Hindi character recognition. They are Support Vector Machine (SVM), General regression neural network (GRNN) and Multilayer perceptron (MLP). Support vector machine is supervised machine learning model which is mostly used for classification purposes. Radial basis function network is an artificial neural network which has radial basis function as its activation function. General regression neural network is a kind of radial basis network which is used for function approximation. Multilayer perceptron is a feed forward artificial neural network

## II. LITERATURE SURVEY

Saurabh Farkya et al [1] proposed Hindi text to speech conversion using SVM. This was

implemented in i5 and i7 processor and their timing to generate output was 66.25s apart. M.Hanmandlu et al [2] proposed Fuzzy Model based recognition of handwritten Hindi characters. When the concept of learning rate was introduced, the accuracy here was improved by 25 folds. Binny Thakral et al [3] proposed cluster based segmentation approach along with vertical and horizontal projection for segmenting overlapping and conjunct characters. Dayashankar Singh et al [4] proposed neural network based handwritten Hindi character recognition system. Keerthi Prasad G et al [5] proposed 2 approaches to implement online handwritten Hindi character recognition on handheld devices. They are Principal Component Analysis (PCA) and Dynamic Time Wrapping (DTW) approach. Wang-Zhou Dai et al [6] proposed LASIN approach that combines Logical Abduction and Statistical Induction for concept extraction which is used for handwritten character recognition. Ujjwal Bhattacharya et al [7] explained the use of a multistage cascaded recognition scheme, using wavelet-based multi-resolution representations and multilayer perceptron (MLP) classifiers for mixed numeral recognition. A.Bharath et al [8] proposed Hidden Markov Models (HMM) based Lexicon-Driven and Lexicon-Free Word Recognition for Online Handwritten Indic Scripts

## III. METHODOLOGY

A brief overview of the methodology used in our approach is given in the diagram shown below

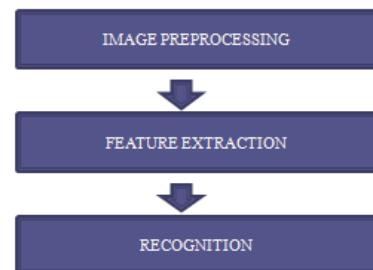


Fig 1.Handwritten Hindi text recognition

We start with the preprocessing operation, which involves filtering and binarization of the input image. Then some of the important features of the image are extracted. Followed by which the extracted features are used to recognize the character written on each image.

#### IV. BASIC OPERATIONS PERFORMED ON IMAGE

Preprocessing starts with Histogram equalization which is done to enhance the image. In order to remove any noise present in the image, median filter is applied. This image is then converted to binary format using Otsu thresholding.

#### V. FEATURE EXTRACTION

Image intensity profile, 2D-Wavelet transform, eccentricity and Histogram of oriented gradients (HOG) features are the main features extracted from the binarized image. To obtain image intensity profile, we divide image into different zones. Compute the sum of pixels in each zone and divide it by its area. 2D-Wavelet transform provides vertical, horizontal and diagonal components of the image. Whose mean values are computed and stored as feature vector. HOG feature with a cell size of 8\*8 is computed.

#### VI. RECOGNITION

Three different recognition approaches are used to recognize the character in a given image.

1. Support vector machine (SVM) is a machine learning approach which has been used to recognize individual characters.

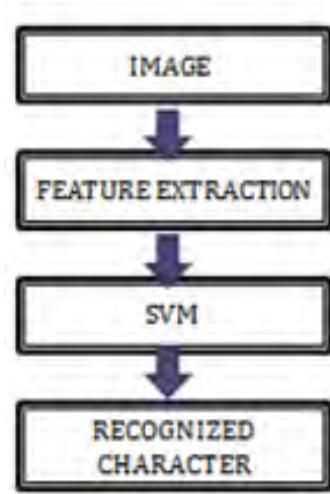


Fig 2.SVM based Hindi character recognition

SVM classifier generates a unique number corresponding to each character. If the generated number matches the target class then it is said to be a match else the system is said to have failed to recognize the character. The database created by the author in the paper [9] has been used for training and testing.

Table 1: Accuracy of each category for SVM recognition approach

Sample	Train/Test Sample	Accuracy in %
Numeral	2113/586	98.46
Vowel	2294/539	94.99
Consonant	6495/900	90.4

2. General Regression neural network is a kind of Radial basis function network which can be designed very quickly. A net has been created using in built MATLAB functions. This net generates unique number corresponding to each character. If the generated number matches the target class then it is said to be a match else the system is said to have failed to recognize the character.

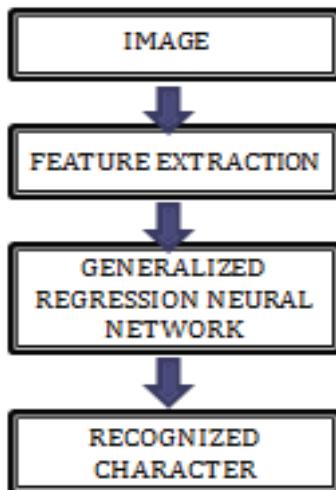


Fig 3.General Regression neural network based Hindi character recognition

Table 2: Accuracy of each category for GRNN recognition approach

Sample	Train/Test Sample	Accuracy in %
Numeral	2113/586	11.95
Vowel	2294/539	11.13
Consonant	6495/900	2

3. Multilayer perceptron is an artificial neural network which is trained multiple times with different parameters to create a net which generates a unique number corresponding to each character. If the generated number matches the target class then it is said to be a match else the system is said to have failed to recognize the character. The net is created with traingda network training function. Epoch of 3000 has been considered.

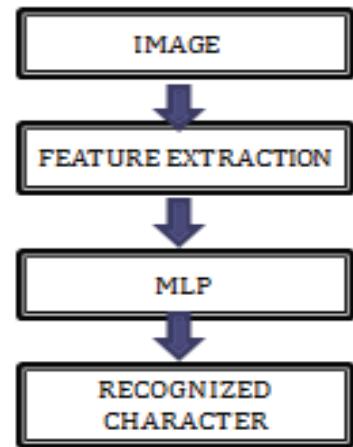


Fig 4.MLP based Hindi character recognition

Table 3: Accuracy of each category for MLP based approach

Sample	Train/Test Sample	Accuracy in %
Numeral	2113/586	42.66
Vowel	2294/539	27.4
Consonant	6495/900	6

## VII. RESULT

Hindi consonants, vowels and numerals are classified with an accuracy of 94.61% by SVM which exceeds the average accuracy obtained from the other 2 recognition approaches

## VIII. CONCLUSION

Hindi character recognition system has been designed using MATLAB 2015a which extracts Hindi characters from the image and recognizes them. Out of all the three recognition approaches SVM has offered maximum accuracy for the given database, with the specified features. Hence, it is considered to be the most efficient approach for Hindi character recognition

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# Face Recognition based Attendance System

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**Abstract**— Among various big problems these days, authentication considered to be an important and severe issue. In the world where data protection is the utmost necessary various techniques are being employed for authentication. Human Face Recognition is considered as a recognized technique for authentication at various places. Video tracking or surveillance, protection of network and interaction with human machines are some of the fields where biometric verification is largely used. As compared to various other biometric techniques being used human face recognition technique has certain other advantages because face recognition is implemented passively. The camera can take images of moving objects and from a certain distance as well. This article proposes a method of face recognition consisting of four stages which involve skin color detection for face detection and HAAR Cascade algorithm, alignment using face features normalization process, classification using Linear Binary Pattern Histogram (LBPH) algorithm accompanied with OpenCV, and the feature extraction process. The classification report and the accuracy is check with the integrated dataset that comprised of created dataset along with Olivetti dataset.

**Keywords:** *Face Recognition, HAAR Classifier, LBPH algorithm, OpenCV*

## I. INTRODUCTION

As technology is evolving day by day and at an exponential rate, the ways of our living should also evolve along with the technology. In this era of technology, the methods of our teaching as also been developed like the digital classroom has been introduced, online seminars and live session are being taken. As the classroom has been upgraded, but still one thing is taken old ways that are our attendance. The attendance is still taken manually, and it takes a lot of time for the teacher to take every single attendance. So, to improve this, the automatic attendance system has been proposed. This automatic system is based on the biometrics system.

The following are the different type of biometrics system:

### PHYSIOLOGICAL:

- a. Finger-scan
- b. Facial Recognition
- c. Iris-scan
- d. Retina-scan

### BEHAVIORAL:

- a. Voice-scan
- b. Signature-scan
- c. Keystroke-scan

Among the following method for an automatic system in this paper, the facial recognition method has been used.

Face Recognition innovation is steadily advancing into a widespread biometric system since it requires very fewer efforts from the user end is the comparison to other biometric alternatives and also provides high accuracy. Face recognition is a widely used technique to distinguish the

appearance of people whose images are saved in the dataset. Face recognition has always remained a significant focus of research because of its non-meddling nature and because it is people's facile method of personal identification. Face Recognition for the attendance system is getting advanced as it requires very fewer efforts for the user with respect to other biometric systems. [1]

The machine automatically learns how to identify or verify a person from any source using the facial recognition system. It compares the selected facial features from the image and a facial database for recognition. Fig.1 provides the facial recognition flow chart. The facial recognition implementation includes the following three stages:

- Image Acquisition
- Image Processing
- Image Identification

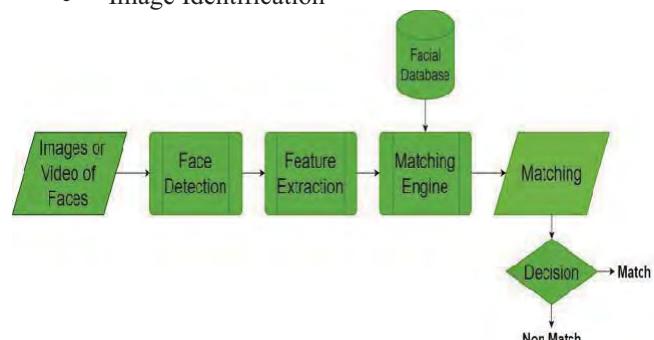


Fig. 1. Flow Chart of Facial Recognition

### A. Image Acquisition:

Facial-scan technology captures faces from any static camera and generates images of sufficient quality and resolution. High-quality images are required for final verification and define the facial characteristics which can be used in the future authentication process.

### B. Image Processing:

Only the facial part of images is used and color images are converted to black and white to initialized comparisons based on grayscale characteristics. After that, the presence of the face must be detected. After the face is detected, the localization and normalization process is used to bring the dimensions of the live facial sample in alignment with the one in the dataset.

### C. Image Identification:

The facial-scan systems recognize the face in the same manner a person identify each other. There is a certain feature on face that does not change over time, these features are used for the facial-scan recognition. The feature is the eye socket, etc. this feature is used in image identification.

Every face has at least 80 distinguishable parts called nodal points. Here are a few nodal points below:

- Distance between the eyes
- Structure of the cheekbone
- Width of the nose
- Length of jawline
- Depth of eye sockets

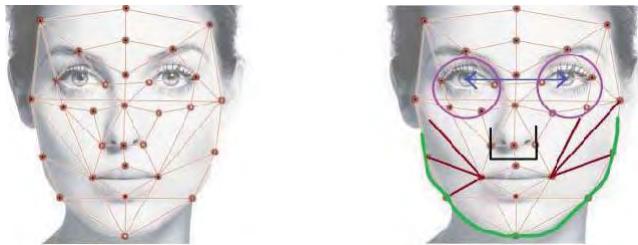


Fig. 2 Different Nodal Points

The basic method of facial recognition is known as feature-based matching which is used by most of the face recognition software. The method compares this parameter and bases on the matches, it determines the result.

## II. PROPOSED METHODOLOGY

The face recognition-based attendance system is the modern way of taking attendance in a classroom. In a single take, it can take attendance of the whole class. This system is made in python3.6 using OpenCV 3.4.12 version library. The system has a GUI to make the system user friendly. The system is made by using the Voila Jonas algorithm, which is very efficient in face recognition using the HAAR cascade classifier. For face detection, the LBPH algorithm is used.

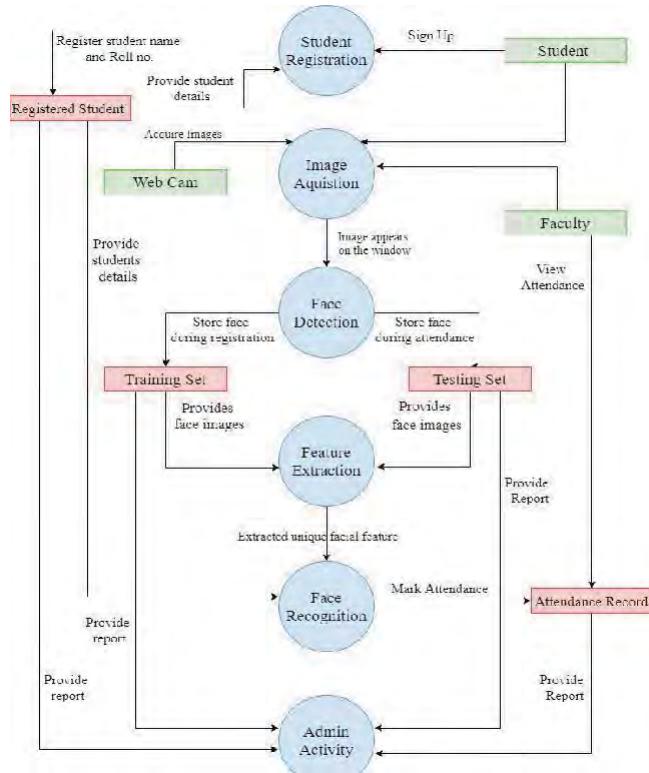


Fig. 3 System Architecture

For the algorithm putting into practice, OpenCV Library has been used which is developed to deliver aid in building systems that involve image processing. OpenCV library has many in-built packages that afford assistance in face detection and recognition and implements tasks taking up a few processing times and providing augmented proficiency [2].

Fig.3 shows the system architectural representation of the face recognition system. It has two phases of operation: training phase and test phase. In the training phase, features are extracted from preprocessed faces and stored in a database. During the test phase, the same feature extraction is applied, and the machine learning algorithm is used to recognize the test face with the stored template face in the database.

### A. Face Detection:

Face detection is the first step in face recognition. There are various approaches used for face detection. The face detection approaches divided into four key categories: Feature invariant, Knowledge-based, Template matching and Appearance-based approaches. These methods can be used for both localization and detection. To date, the Viola-Jones face detector method has the most accuracy in face detection in research. Face detection using the Viola-Jones method falls into four key features:

1. Haar-like features
2. Adaboost training
3. Integral image
4. Cascading classifier

In this project, the Haar feature has been used for face detection.

#### 1) Haar feature selection:

Haar Cascade is an AI object discovery calculation used to distinguish objects in a picture or video and dependent on the idea proposed by Paul Viola and Michael Jones in their paper "Rapid Object Detection using a Boosted Cascade of Simple Features" in 2001. Every human face shares a couple of undifferentiated properties. Haar-like features are utilized to identify the distinct property of a black and light of the picture. Haar features are used for finding these regularities. There are certain properties common in faces of human are:

1. The eyes have less brightness compare to nose bridge.
  2. The upper cheeks are less dark than the eye region.
- Facial features are match using following composition property:
- Value: Intensities of pixels are oriented.
  - Size and Location: mouth, eyes, bridge of the nose.

If an image is given, we will take a 24X24 window and apply each Haar feature to that window pixel by pixel. The value is calculated applying Haar features is.

$$\text{Value} = \sum (\text{pixels in the black area}) - \sum (\text{pixels in white area})$$

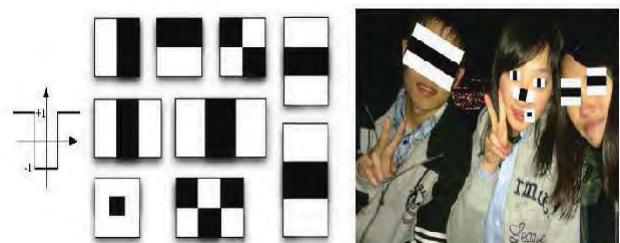


Fig. 4 HAAR feature and Capture feature in face detection [12]

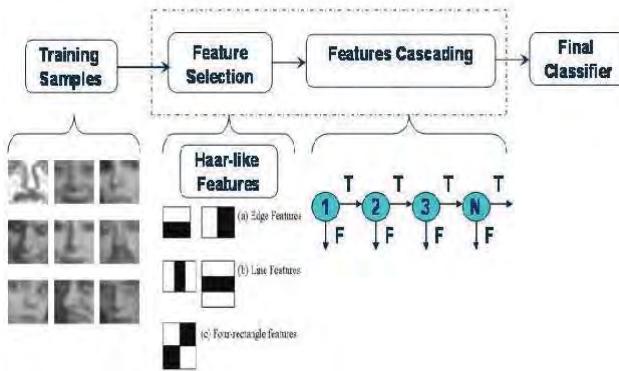


Fig.5 Overall Architecture [15]

### B. Face Feature Extraction:

Face recognition techniques are mainly of two types one which uses geometric features like cheeks, mouth, eyes, eyebrows, nose, etc. known as Feature-based, other uses texture features which are applied on the whole face or certain regions known as Appearance-based. The Face Feature Extraction is divided into three categories:

1. Holistic Approach
2. Feature-based Approach
3. Hybrid Approach

In this project Holistic approach has been used because it uses the face for extraction of the feature. The Holistic Approach has also three types:

- a) Eigen Face Recognizer
- b) Fisher Face Recognizer
- c) Local Binary Pattern Histogram (LBPH)

Table 1. provides the difference between all the three methods:

Table 1. Comparison of different algorithm

Criteria	Fisher Face	Eigen Face	LBPH
Principle of Dataset generation	Component-based	Component-based	Pixel-based
Confidence Factor	100-400	2000-3000	2-5
Basic Principle	LDA	PCA	Histogram
Threshold	400	4000	7
Background Noise	Medium	Maximum	Minimum
Parameter	Processing time and large storage is high	Sensitive to light and Difficult with Poses	Security
Efficiency	Moderate	Low	High

### 1) Local Binary Pattern Histogram (LBPH):

LBPH algorithm was used for face recognition because it requires less computation due to that it is used in the real-time process. The LBPH concept does not take the whole image it just reviews the local features. For example, in the case of face recognition, it checks only the eye, face, and mouth features.

LBPH takes the center pixel as a point of reference and compares it with other nearby pixels to develop the image. The neighbor pixel's value is considered 1 if its intensity is equal to or greater than center pixel value otherwise it is value will be 0. There would be 28 possibilities of combinations taking 8 pixels surrounding the center one is referred to as the LBP Code [3].

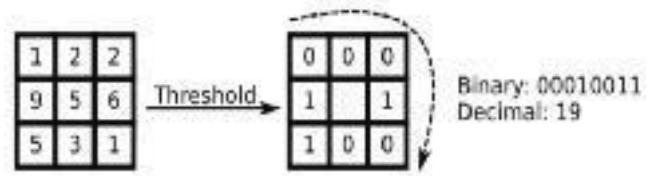


Fig. 6 LBPH for 3x3 neighbor pixels [13]

The equation of LBPH operator is given below:

$$LBP(x_c, y_c) = \sum_{P=0}^{P-1} 2^P S(i_p, i_c) \quad (1)$$

where  $(x_c, y_c)$  are the center pixels with  $i_p$  as the intensity of pixels of neighbor and intensity  $i_c$ . Symbol function ( $S$ ) defined as:

$$S(x) = \begin{cases} 1 & \text{if } x \geq 0 \\ 0 & \text{otherwise} \end{cases} \quad (2)$$

The below figures will explain the method:

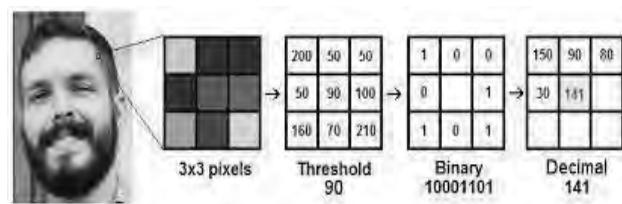


Fig. 7 LBPH extracting a single point of the face [14]

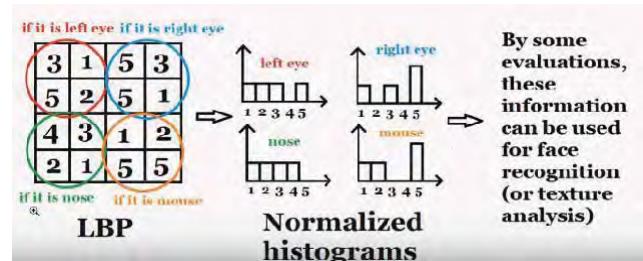


Fig. 8 Histogram of LBP

### III. EXPERIMENTAL RESULTS

The technology used and how it interacts with each other is shown below using a flow chart.



Fig. 9 Technology flow chart

The system uses a GUI for the better experience a user can have and with ease, it can use the system. The GUI is made using Tkinter in python.



Fig. 10 GUI of System

In the system, you have to first provide your details like student registrations. There is another facility provided for the admin panel to see which students have been registered by providing the Login ID and Password. After getting registered the students have to take pictures of them by clicking on Take Image button. These images will be our dataset.

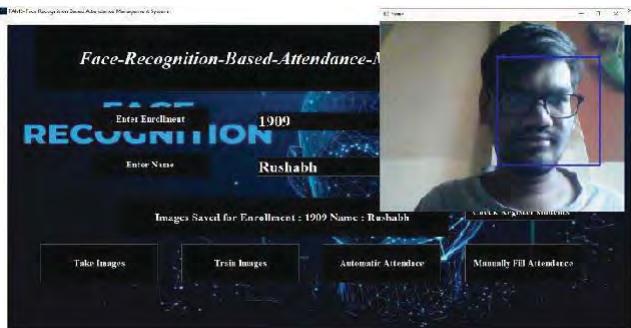


Fig. 11 Capturing the Images



Fig. 12 Created Dataset

After creating the dataset we will train the dataset and it will generate a .xml file that will contain the facial extraction details. This is generated by using the LBPH algorithm. After training the data we will test the data. Now in this system, there are two options for taking attendance, i.e. Automatic Attendance and Manual Attendance.

In automatic attendance the system first you have to provide the name of the subject for which attendance has been taken after that click on fill attendance than the system will automatically compare the face of the student with the dataset and the attendance will be registered. The attendance will be stored in the excel file with the file name as the subject's name with the date. In the excel file the ID, Name, Date and Time will be stored. In manual attendance, the system will connect with the MySQL database and the data will be stored there.

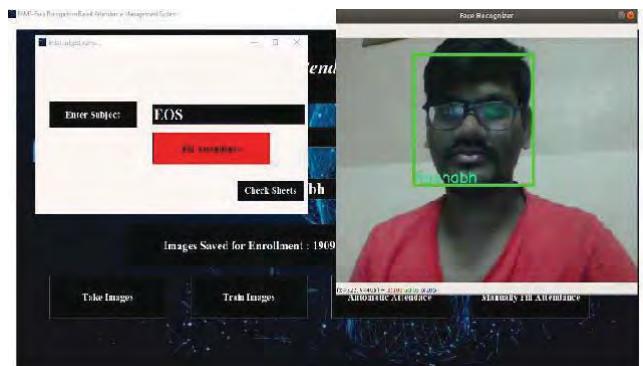


Fig. 13 Automatic Attendance

	precision	recall	f1-score	support
0	1.00	1.00	1.00	2
1	1.00	1.00	1.00	2
2	1.00	1.00	1.00	2
3	1.00	1.00	1.00	2
4	1.00	1.00	1.00	2
5	1.00	1.00	1.00	4
6	0.80	1.00	0.89	4
7	1.00	1.00	1.00	2
8	1.00	1.00	1.00	2
9	0.80	0.80	0.80	1
10	1.00	1.00	1.00	4
11	1.00	1.00	1.00	1
12	1.00	0.83	0.91	5
13	1.00	1.00	1.00	2
14	1.00	1.00	1.00	4
15	1.00	1.00	1.00	3
16	1.00	1.00	1.00	1
17	1.00	1.00	1.00	3
18	1.00	1.00	1.00	1
19	1.00	1.00	1.00	3
20	0.67	1.00	0.80	2
21	0.80	0.80	0.80	1
22	1.00	1.00	1.00	1
23	1.00	1.00	1.00	2
24	1.00	1.00	1.00	3
25	1.00	1.00	1.00	3
26	1.00	1.00	1.00	2
27	1.00	1.00	1.00	2
28	1.00	1.00	1.00	2
29	1.00	1.00	1.00	4
30	1.00	1.00	1.00	2
31	1.00	1.00	1.00	1
32	1.00	1.00	1.00	3
33	1.00	1.00	1.00	3
34	1.00	1.00	1.00	3
35	1.00	0.75	0.88	4
36	1.00	1.00	1.00	5
37	1.00	1.00	1.00	3
38	0.50	1.00	0.67	1
39	0.67	1.00	0.80	2
<b>accuracy</b>			0.96	100
<b>macro avg</b>		0.92	0.92	100
<b>weighted avg</b>		0.95	0.95	100

Fig. 14 Classification report based on integrated dataset

Fig. 14 provides the report that is based on the integrated dataset which had faces of create dataset and Olivetti dataset. The integrated dataset has 400 images that has faces of 40 people each had 10 different side images. The accuracy of the system is 96%. That is why the LBPH algorithm is used for higher accuracy.

#### IV. CONCLUSION

The paper aims to develop an automated attendance system to be used in educational institutions, which can produce more accurate results than the manual attendance sheet. After conducting several tests and based on observation certain conclusions were made. The accuracy of the face recognition was about 96% and it can recognize and identify face about 30cm from the laptop camera with sufficient intensity of light. The face recognition accuracy is still considering if there is variation in the intensity of light or the distance from the face to the camera changes from 30 to 80cm. Based on the results it can be said that the system works quite well in the classroom. The recognition process can be more accurate and robust if there are certain improvements in the algorithm of facial feature extraction or the recognition process.

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# RPA: A Business Automation & Reality

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**Abstract—**Progressively, most firms, enforced multiple IT tools and processes that usually had a mixture of automated and manual steps that repeatedly required a lot of personnel, generated human errors, decreased motivation, degraded productivity and a huge amount of operational expenses. The automated steps performed, had their drawback thanks to the implementation of multiple IT automation solutions increasing price and integration timelines and continuous fixing of code to accommodate underlying business logic changes. If any organization changes its rules, it either must employ new workers who will work with new rules or it must offer coaching to existing employees to map the requirements of the latest rules. Both of these ways are labour-intensive. By the utilization of Robotic Process Automation, the corporate places effective employees who can also act like human workers. RPA is a widespread topic within the company world since it possesses the power to understand and adapt their user's performance; better client satisfaction increased productivity and quality and reduces prices. the utilization of Artificial Intelligence is developing terribly and has already affected the lives of thousands of individuals. The increasing use of automation has changed our lives. From our homes to our offices; everything is automated, we've implied automation to virtually every static operation possible. With the assistance of RPA, we can bring automation to varied dynamic operations also. RPA has recently emerged as a game-changing technology. Since its beginning, it's found its manner across multiple industry domains, extending the use cases and continues to evolve with business necessities. This paper delves into RPA's application in business, its edges and future.

**Keywords —**RPA, ML, AI.

## I. INTRODUCTION

The term Robotic Process Automation (RPA) integrates robotics, stating software means mimicking humans in process automation and workflow. RPA is generally implemented in more process aware systems. To put it candidly, RPA is a relatively new piece of technology, using bots that have the ability to imitate the natural or manual path taken by human beings. These 'bots' are programmed using repetitive rules and are usually very articulate [1]. Today's business processes have shifted scenes to Enterprise Resource planning, Customer Relationship Management, database and spreadsheets combined with already manual intensive work like printing and flipping through books. These tasks unite together to transfer big amounts of data throughout the scene. This is where RPA comes in, all these repetitive and highly organizational tasks can be performed by a computer. As a result, providing workers with more time to do other value-added activities. This is the Robotic Process Automation (RPA) promise that has appeared in the last five years as an automated tools and frameworks series which is capable of automating tasks on business processes based on rules.

Business problems are not solved using Robotic Process Automation and it's not an application that can be worked upon. It is a Technology which will work in place of human beings to make the processes easier and more work could be put into human intensive processes. RPA is a technology that eliminates human presence in all business models, automates the tasks and performs them with better efficiency and at a faster speed.

Enterprises/Organizations with successful RPA adoption and efficient business processes and product management

processes have had the beneficial effects on their strategic priorities, workforce efficiency and customer support. RPA is of special importance to sectors that have historically been swift to implement emerging innovations, in special process-oriented information systems (banking and insurance). RPA technology stipulations are increasingly booming and up to 90 percent of large and moderate-sized firms are projected to go for RPA solutions by 2020. Given the market presence of a significant number of RPA vendors and goods, much hyperbole persists over what RPA means for organizations, as well as confusion regarding how this tool will be successfully used.

The various suggestions and frameworks proposed for the selection and application of RPA solutions by suppliers and consultants which do not usually provide unbiased information. Around the same time, a scholarly study in the field has not long ago started to grow.

As stated by the Google Trends Report, 'RPA' only started to become a fashionable subject (score: 25/100) in March 2017, but increased to a score of 100 by September 2018, suggesting the peak pre-eminence of the word. It, thus, it appears to be important to consider the state of the art, to reach a consensus on the application of the concept, to recognize key innovations and patterns and to become aware of the gaps in our information on the effective adoption of RPA.

In either case, the usage of RPA by businesses has the listed advantages:

- RPA is effortless to customize, hence developers don't require programming expertise.
- RPA software is not intrusive, relying on existing frameworks, without the need to build, upgrade or improve costly projects.
- RPA is safe for the enterprise, RPA is a versatile framework designed to satisfy the company's IT specifications with regard to durability, scalability, auditability and management of transition.

## II. BACKGROUND & EMERGENCE

When it began a couple of years back, Robotic Process Automation (RPA) was still very much rising in the industry. The developers or the engineers were still required to be explained what RPA was; It's rising nowadays but, it's seen that a lot are now grasping the actuality of RPA (specifically the hype) specifically business, incorporations all around the globe who mainly focus on automation.

	<b>Phase</b>	<b>Period</b>	<b>Focus On</b>	<b>Management Of Organization</b>	<b>Technology</b>	<b>Tools</b>
			Specialization	Functional Hierarchy	Mechanization	Scientific Management
1	Industrial Age	1750-1960	Productivity Performance	Line production	Standardization	Financial Modeling
			Cost Reduction	Orders/Controls	Data Storage	
2	The First Wave Process Requirement	1970-1980	Quality Management	Diversification of companies	Automation	Total Quality Management
			Continuous Flow	Fusions and acquisitions	Information Technology Management	Statistical Control
			Task efficiency			
3	The Second Wave - Re-engineering	The 90's	Process Innovation	Flat Organizations	Enterprise Architecture	Activity Based Costing
			Best Practices	Addition of value for customers	Customer Relationship Management	Six Sigma
			Better & Faster	Excellence of the operation	Enterprise Resources Planning	Process Redesign
			Business over the Internet		Supply Chain Management	Re-engineering Methods
4	The Third Wave - Process Management	2000's and ahead	Evaluation	Network-centered organizations	Enterprise Application Integration	Balanced Scorecard Basics
			Adaptability	Hyper-competition	Architecture Oriented on services	Business Process Management Methods
			Agility	Market Growth	Performance Management Software	Outsourcing
			Continuous Change	Process effectiveness before efficiency	Business Process Management	

Table 1: Past Four Phases of Technologies

## III. HISTORY OF TOP 3 RPA TOOLS

The reason why Robotic Process Automation (RPA) is so much in use right now is because of the utilization of numerous innovations to tackle business issues. It began by utilizing the modest inheritance innovations as screen scratching joined with the Automation work process programming. With the coming of Artificial Intelligence (AI), the intellectual angles likewise have fired appearing in tools. Diverse suppliers have taken various ways mechanically and have developed into AI magnificent creations that we all can see. All the developers or the organizations have completed their projects with the early onset clients by contributing for their bots thus improving the workforce.

The following are the top 3 tools:

### 1. Blue Prism

Blue Prism wanted to create an "outsourced workforce." for Business Process Outsourcing companies. Blue Prism reported to have invented the term "Robotic Process Automation". At the start, they made it known that they would concentrate their efforts on building a digital workforce. The original decision was to solve the issue by building a robot that would be a group of robots that would help to minimize jobs. Subsequently, Blue Prism is centered on the earth. Their GUI was very similar to that of Microsoft Visio. This was accomplished in order to arrange the activities performed by the bot.

## 2. Automation Anywhere

Automation Anywhere was discovered back in 2003 and began as Tethys Solutions. The word "Tethys" is a Greek term meaning goddess of water. Automation Anywhere is a tech organization that uses software bots to complete tasks and builds RPA. The product still appears to have been launched in 2009. They had a built-in ROI calculator, too. The user interface of RPA is greatly influenced by this, as the studio where the workflow setup takes place, and the Control Center used to set up the bots is loosely based on this. Automation Anywhere has an IQ Bot that is a mix of RPA and AI.

## 3. UiPath

UiPath is a tech corporation that offers a forum for Robotic Process Automation. It is the first platform that puts together process mining and robotic process automation. According to study, "Hyperautomation" is defined as a mixture of RPA and process mining, AI, ML and Analytics. UiPath began to develop automatic libraries and SDKs, which became very popular and used by major industries including IBM, Microsoft and Google. 2012 was a successful year for UiPath as it unveiled the first desktop application exclusively for the RPA industry, which was dubbed the UiPath Desktop Automation product. UiPath was ranked 5th in 2017 and improved to 1st in 2018. It was ranked 3rd in the Forbes Cloud 100 in 2019. Later, it was ranked 1st in the Deloitte Technology Fast 500 on 6 November 2019. UiPath was ranked 2nd overall in the Financial Times 1000, rating FT1000: America's fastest-growing 2020 businesses in April 2020. In addition, in June 2020, UiPath was named CNBC Disruptor 50 2020.

Parameters for choosing the right RPA Tool [2]:

1. *Data:* It should be easy to write and read data through different systems.
2. *Task:* Rule-based and Knowledge-based process configuration must be simple and easy.
3. *Interoperability:* The tool(s) we use must be compatible to different computer systems or software to exchange and make use of information. It must carry out the same tasks as performed by a human user.

Property	Automation Anywhere	Blue Prism	UiPath
Popularity	Least	More	Most
How will I learn?	Trial version available for 1 month	Free Edition Not available	Free community edition available
Learning Curve	Required Programming Skills	Easier than Automation Anywhere.	Ease to use

Table 2: Short Comparison of Top 3 RPA Tools [2]

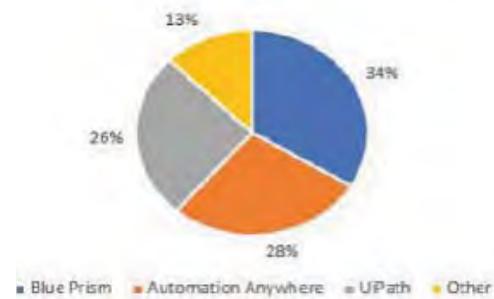


Fig 1: Popularity of Tools in term of uses [2]

When it comes to comparing the three, Automation Anywhere, Blue Prism and UiPath, we consider three parameters: Popularity, Learning Curve and availability. Starting with the UiPath, it is the most popular of the rest followed with Blue Prism and then comes Automation Anywhere. The reason why UiPath is popular is because of the fact that it is free and available to everyone whereas on the other hand, Automation Anywhere does not have any free edition which the newcomers don't really appreciate. Automation Anywhere provides a trial version of 1 Month which looks like an adequate deal. Coming to the difficulty of learning, UiPath is the easiest to use whereas Automation Anywhere requires programming skills and is the same for Blue Prism but is considered easier. Below is a picture which is of a survey conducted to test how many functionalities a tool can handle; It showed that out of 50, UiPath covers 25 fully and 5 partially, Automation Anywhere has the capacity of handling 35 functionalities and Blue Prism can operate with around 40 functionalities.

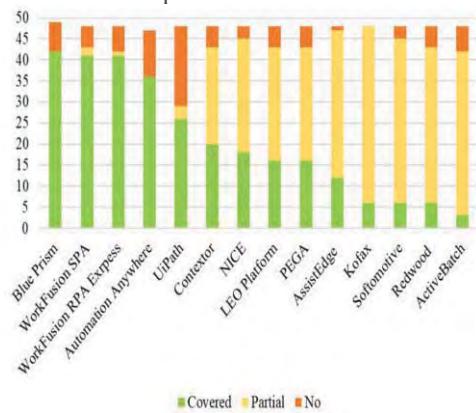


Fig 2: Functionalities Summary by Tool

#### IV. LITERATURE REVIEW OF RPA

RPA has helped by creating a 30% decrease in expenses related to both human resources and process of transactions [1], [3], [6], [7], [8]. The fact that the robots work around the clock is what led to drastic changes in the productivity [11], [12]. Also, companies can get their employees to focus on more important work and give the rest to the robot is also a plus-point [7]. Based on the literature analysis, we present three organizational characteristics that affect the readiness/suitability for RPA; business drivers, the nature of existing technology and degree of maturity. If a business revolves around the principles of efficiency, cost reduction, improved quality and better compliance goals, then RPA is really an option to consider. This also counts the companies which believe in the principle that the employee should focus on the main work. In the end the end goal of RPA is to not eliminate human activities but to merge robots with humans for enhanced speed and accuracy [4], [14], [15]. Moving on to Nature of Existing Technology, here it is believed that RPA can be used in organisations which have a bunch of systems, which need to be interlocked into one system as one may lack some functionalities or abilities which the RPA can change and thus make it very easy to manage [4], [5], [10], [16]. Degree of RPA Maturity is when the company in which the RPA developer is, has the resources to support the work, thus the developer can return at a mature level. This works best 2 ways as the companies' customers also need to be up-to-date with the required technical requirements [5], [9], [13].

#### V. CURRENT FORM

RPA has the ability to execute rule-based procedures that involve repetitive functions, structured information and deterministic effects, such as, passing on information from different types of services for example, mail, spreadsheets, portable document format etc. to frameworks like ERP. A majority of applications created for RPA are designed to automate undertakings of SBP's which includes of approving the offer of insurance expenses, producing service bills, paying medical care protection claims, etc. [17]

In the IT line, each "robot" is equivalent to one software approval. This robot is implemented via front-end rather than conventional programming across IT frameworks, and interacts via back-end with other IT frameworks, so it is conceivable to coordinate [17].

As per the Institute of Robotic Process Automation (IRPA), RPA innovation isn't an aspect of an organization's data innovation foundation but instead sits on top of it [17].

Following are a few points that will help explain why RPA is a better option than and BPMS:

1. RPA runs the length of pre-existing frameworks and accesses the stages through the presentation layer; therefore, zero hidden frameworks programming rationale is involved.

2. RPA developers don't actually need to learn programming to make robots, they can do the job just by doing a simple task called drag and drop. After that they have to connect those drags and its done [17].

3. RPA doesn't make another application and doesn't store any value-based information, so there is no need of an information model or a data set like BPMS frameworks. Then again, RPA is likewise not the same as cognitive automation.

As said by Willcocks and Lacity, the use of Cognitive Automation (CA) can be done to automate assignments and choices that include programs to decipher information bringing about a whole lot of likely solutions, rather than RPA, which utilizes rules to deal with organized data. Results produced by the CA is probabilistic which means that in RPA it is a solitary outcome. A study done by Capgemini proposed that RPA programming permit can have a market price between one-third to one-fifth of the cost of the Full-Time representative (FTE).

Willcocks and Lacity further continued that only a single robot also has the power to perform organized errands which can be the same as the job of 2-5 workers. While the benefits of investment funds reported by businesses with RPA, nothing of any odd market measure is appropriate for its utilization.

Fung recommends a few models of business measure for RPA [17]:

- Decreased cognitive prerequisites; a task that doesn't need abstract judgment, imagination or translation abilities.
- High volume; errands that are performed as often as possible.
- Access to numerous frameworks, measures that expects admittance to products applications and frameworks to play out the activity.
- Limited special case taking care of; errands that are profoundly normalized with restricted or no exemptions to deal with.
- Human blunder; errands that are inclined to human mistake because of physical work.

As per these rules, the solid contender for RPA is back-end of a company who follow measures which are more normalized compared to the front-end of a company, which in turn needs to take care of various exemptions [17].

## VI. MACHINE LEARNING & ARTIFICIAL INTELLIGENCE

To achieve wider adoption, RPA needs to become 'smarter' so that it can support increased complications and roles that are less well known [1], [35]. The importance of ML and AI strategies for possible applicability, advanced functionality and RPA extensibility is illustrated by several writers. [1], [8], [11], [18], [19], [20], [23], [25], [27], [29], [31], [32].

Tornbohm and Dunie envisaged [1], [32] that "RPA tool vendors will either partner for AI functionality, or they will continue to invest in developing AI-style capabilities, either charged as extras or integrated to work with the basic tool". Sooner or later ML and AI approaches will direct the RPA technologies of the future and there is minuscule to just zero data about how these innovations could be performed.

Together with ML and Chatbots, natural language processing will replace CRM operations that currently require direct human contact. [1], [11], [26]

Kristian [1], [24] foresees a use case where "The initial assessment of customer requests in a web portal would be done by a neural network trained with machine learning and the following rules-based process of completing the request can be completed with RPA".

The joint term Machine Intelligence is used by Kashyap [1], [32] to combine machine learning, deep learning, cognitive analytics and RPA into one umbrella.

## VII. RPA CENTRIC FIELDS

In the future, Intelligent Robotics (IRPA) is another way in which RPA can be paired with cognitive and deep learning strategies, assimilating natural language generation, computer vision, cloud integration and self-development. [1], [15], [21], [22], [28], [33].

The capability to use analytics to construct 'smart' knowledge bases that recognize distinctive and more complicated patterns and advanced control capabilities would place potential active RPA implementations [1], [34]. The robotic creation of bots which will be used in the future will be merged with Artificial Intelligence to grasp, decide on and take an action on a request [1], [34].

Artificial Intelligence can also be used in assistance with the code of the bot or can also help in making no-code automation development for foremost advanced RPA vendors [1], [8].

The vendors on the market could also help in developing and incorporating their own AI subsystems, which will be beneficiary for their future help, or can also leverage different AI service providers like IBM Watson or Microsoft Azure cubic centimetre [1], [34].

Process mining can also be used in to support the invention of processes amenable to automation therefore these processes can also be used as a base for training of the future bots [1], [35], [36].

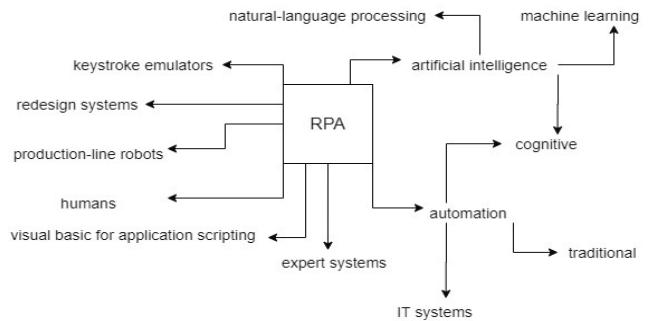


Fig 3: An RPA-centric concept graph, showing the fields connected to RPA.

## VIII. HYPE CYCLE

This goes back in 1995 when an analyst from Gartner named Jackie Fenn developed a framework called "Hype Cycle" which grabbed a lot of attention. Her saying was that almost every technology goes through a few cycles and the framework she found also went through five cycles which are as following [37]:

1. *The Technology Trigger:* In this cycle, the technology managed to grab a lot of recognition from the entrepreneurs, media, companies even though it is still a prototype and the commercial flux is yet to occur.
2. *Peak of Inflated Expectations:* The innovation is found to be successful here, generating a lot of excitement. This is due to the influence of social media and also to the urgency of enterprises that are constantly searching for technological products.
3. *Trough of Disillusionment:* This can be the most depressing cycle of all the cycles as the excitement of the technology starts to dial down due to numerous reasons like meeting expectations and whatnot. This causes the stock market to plummet and the customers realize that the technology isn't really delivering the ROI that was anticipated.
4. *Slope of Enlightenment:* Although, the framework just gets better and better which makes the impact to be stronger but the social media attraction and the fact that it was a hot-topic, got lost.
5. *Plateau of Productivity:* Here the framework got its recognition and there are standards for its customers use.

Even though this framework works fabulously, it's still isolated from perfection. As mentioned in the stages, it appears like RPA is on the tip of the second cycle and easily at the start of the third cycle thanks to the fact that it already

exists for 2 decades, but it's only been seven years that its usage began to accelerate.

UiPath's layoffs aren't merely a consequence of this growth-at-all-costs outlook, though [37].

In recent years, RPA is positioned as variously a self-contained solve-all for the inefficiencies, a technology which requires zero maintenance and it is a replacement for human workers. These are nothing but mere conclusions of a hype machine [37].

Recently a Forrester report revealed that RPA is still in the stage of expansion in the market phase, with a lot of leading RPA customers emerging from everywhere, which in turn increases the growth of the RPA developers.

Within the past year, the customers have voiced that RPA is a solution to a lot of their problems and also integrating it with Artificial Intelligence or Machine Learning opens a lot of new doors. Thus, this is just the beginning [37].

## IX. FUTURE OF RPA

Everest believed that right now RPA is in a virtuous cycle, which basically means that the actual worth, of RPA, is prompting a lot of wealth than which is actually funded, which in turn obviously increases the overall financial value. Now that the critical capital is also mashed, it is clearly visible that the devices will be ended up improving and a lot of new qualities and features would be seen.

Following are a couple of patterns which seem likely to be imbibed:

### 1. Broader Adoption:

As said initially, attention to RPA has expanded multi-crease. An ever-increasing number of endeavours are embracing and actualizing RPA.

### 2. Increased Intelligence:

Now that the future is right around the corner, a lot of technical aid like a way to process unstructured or scattered data or something like a very smart automation which is capable of handling primary judgements etc. can be incorporated.

### 3. Discovering and Mining:

Some difficulties met while actualizing RPA includes finding, short-listing and organizing the processes that are ready for automation. Merchants have been including this element and more could take action accordingly.

### 4. Bots as Administration:

It seems as though bots would be conveyed as cloud administrations as a characteristic movement. One of the most amazing fact about the tools of RPA is that it can function even from the cloud however it isn't broadly utilized. When it comes to the tool vendors, some portion of it will be obtained by

Microsoft Azure or Amazon AWS, later on, and then be transported as administration with some serious Artificial Intelligence capacities.

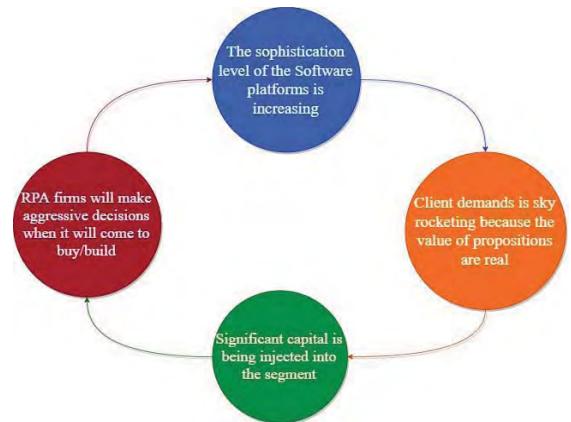


Fig 4: RPA Virtuous Cycle

## CONCLUSION

Companies aim to achieve their strategic objectives which includes of many goals like reducing the costs, speeding up the speed of the process, reducing the errors done and upgrading their productivity by investing in RPA technologies. RPA just resides on the top of current frameworks and accesses the presentation layer across multiple platforms.

To sum up the future of RPA, it will be in the same direction as of the Intelligent Robotics, where intelligent AI and strategies can be combined with that of DL, which would create different technologies like computer vision and natural language generation.

Looking at all results and listening to leading organizations in different domains points us in a direction that RPA is meeting all exception and, in many cases, even exceeding it. To successfully deploy RPA, the companies need to focus on the larger ground things like, processing the management and automating the decision-making.

Businesses need to have a strong work ethic bonding with the experts or the developers and need to have a more graceful or an agile thinking approach.

Without a group of people who are aware of the engagement between the processes of RPA, all the work done will go down the drain.

In the same way, if a business decides to not adapt to the new tools and technologies as per the requirement, which is thus needed for the long run, the efforts of the workspace and all the money involved will be good for nothing.

This is the time for every one of us to move above the puff created for RPA and we should all start to look at things that matter and we believe that Robotic Process Automation, coupled with an engaged workspace who are enthusiastic about their work, is the solution for businesses to drive for long in the future.

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# Early Flood Detection System using Internet of Things

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**Abstract-- Early flood detection is an intelligent system that senses various natural factors to predict the occurrence of floods by analyzing real-time data. This project aims to minimize the damages and losses of human life caused due to floods using the Internet of Things. The casualties caused by floods can be reduced if we can obtain and analyze the prior condition and receive an alert message on detection of threat. The system has a microcontroller for synchronizing data. Other components used in the device are an Ultrasonic sensor, Water flow Sensor, Rainwater Sensor, Temperature and Humidity Sensor, Zigbee, Wi-Fi Module, and Jumper wires. Adafruit cloud server and MQTT application are used for viewing real-time data. Buzzer and LED are used to create an alert at the base station, so the safety process can be initiated.**

**Keywords:** Floods, Zigbee, Cloud server, Wi-Fi, IoT, MQTT.

## I. INTRODUCTION

Floods typically develop over a period of time, when there is excessive rainwater to fit in the rivers or reservoirs and water spreads over the adjacent land. The flooding events are unlikely to change, however, its impact can be reduced up to certain extent. Efficient forecasting and early warning systems can help alleviate the effects of flooding. The concept of Internet of things helps in collecting real time information from a wide range of environmental factors [3].

The aim of this project is to develop and design a flood detecting system that can detect threat beforehand and send an alert. This is achieved by measuring various natural factors such as water level, water flow, temperature, humidity and rainfall. The sensors used for measuring the above parameters are connected to Arduino. The sensors continuously detects these parameters and based on the result if the values exceeds the predefined threshold, the microcontroller triggers alert system [5]. The real time data is updated on the Adafruit cloud server via Wi-Fi that can be viewed by any user using MQTT Application. The alert signal can help the rescue team to take the necessary steps for safety. Hence this project can prove beneficial in developing countries like India, Brazil, etc. which are flood prone as it is compact and cost-effective [8].

## II. LITERATURE SURVEY

We know that floods in our country occur frequently and cause huge damages. According to a survey we found that, India has faced approximately 650 disasters between 1915 and 2015. From this 650 disaster events nearly 302 were caused by floods with a yearly average of 3 events. This accounts to approximately 47% of total disasters occurred in country. The summary of deaths and economic damage is as given in table:

Flood Subtype	Events count	Deaths	Damage ('000US\$)
Others	132	33611	11898059
Riverine Flood	143	29810	41404929
Flash Flood	23	7436	416200
Coastal Flood	4	569	275000
	<b>302</b>	<b>71426</b>	<b>53994188</b>

Table 1: Flood and related damages in India during 1915-2015

These floods are classified as Riverine, Flash, Coastal and other floods. Thus in order to reduce the damages caused by riverine floods and flash floods due to over spilling of reservoirs we have proposed this early flood detecting system using IoT to detect the flooding condition before hand and alert everyone. Flooding can prove hazardous even in its initial stage as only 15 centimeters of rapid-flowing water is enough for knocking off a person from his/her feet. It disrupts public as well as private transport, communication links, drainage systems and sewage spills, which represents a serious health hazard by giving rise to bacteria, mould and viruses that cause various diseases and trigger allergic reactions. If we study the flooding events trend issued by CRED we notice that in previous five decades i.e. between 1965 and 2015 there is continuous rise in floods in India [10].

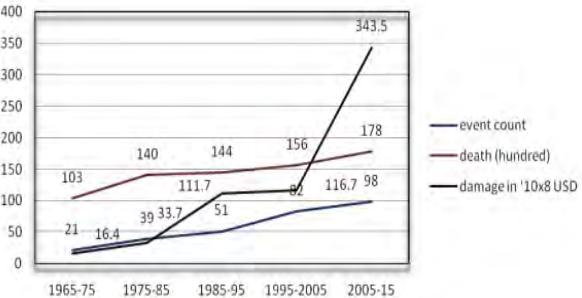


Fig 1: Decadal change of floods and its effect of lives and economy

This rising graph of deaths and damages can be reversed by using the developed early flood detecting device for detecting and alerting pre-event. The device uses sensors for this purpose and a modern approach of Internet of Things to update real time data and alert users on their personal smart devices.

### III. PROPOSED METHOD

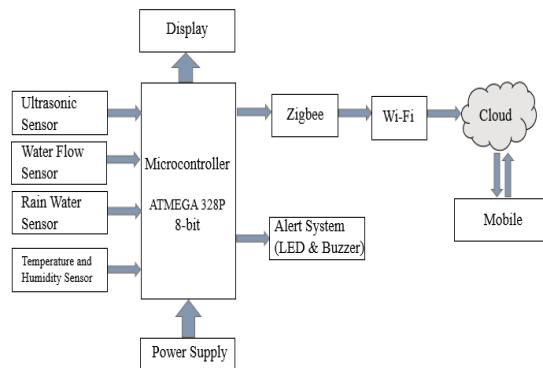


Figure 2: Block Diagram

The above block diagram (Figure 1) is a prototype based on the parameter of water level which proves essential in detecting flood occurrences especially in flood prone areas. The development board used is Arduino UNO as it is most commonly used open source development board with ATMEGA 328p microcontroller operating on 5V power supply. Arduino UNO is cheap which makes system cost effective and is easy to program. Sensors are interfaced with Arduino to generate output data. The sensors embedded are Ultrasonic Sensor, Water Flow Sensor, Temperature & Humidity Sensor and Rain Water Sensor that will obtain the readings of various natural parameters and store values in microcontroller. The microcontroller is programmed using C/C++ language in Arduino IDE software. The ultrasonic sensor used is HC-SR04 which measures distance by ultrasonic sound wave principle and has a sensing range of 2-400 centimeters. It generates an alert when the water level rises above threshold value. Second sensor ingrained is YFS-201 [Water Flow Sensor] which calculates the flow of water body. Flow rate is calculated using Hall Effect principle i.e. by number of rotations done by the rotor as the water passes through the valve. For calculating temperature and humidity, system uses DHT-11 sensor i.e. Temperature and Humidity sensor. It measures temperature from a range of 0 to 50 degree Celsius with 2-degree accuracy and humidity range from 20 to 80 % with  $\pm 5\%$  accuracy. The fourth sensor is Rain Water Sensor that works similarly as an Op-amp for detecting rainfall and comprises of two modules viz. a rain board for detecting rainfall and a control module for converting the obtained analog input to digital value. When there is rainfall the board gets wet which reduces the

resistance value and resistance increases when it is dry. The operational amplifier compares the resistance levels and decides whether to give output high or low. The analog data obtained from sensors is stored in Arduino and is supplied to connecting Zigbee for transmitting to cloud. A receiver Zigbee is situated at a remote location (base station) which can be far up to maximum 0.3 kilometers. The system has Zigbee S2C modules that use radio frequency for wireless data transmission. Zigbee uses a transmission frequency of 2.4GHz and requires low power supply of 2.1V to 3.6V. The data received by receiver Zigbee is uploaded to cloud through a Wi-Fi module. ESP-32 Wi-Fi module with a 240MHz clock frequency and 512kb RAM is used for uploading data. The real time data is uploaded to Adafruit cloud server which updates data without any manual interaction. This data can be viewed using Message Queue Telemetry Transport (MQTT) Application which is available on Play Store for free, hence can be installed on any compatible device. All this information is sent in the form of packets, thus saving data; and also a log of data will be maintained so that it would be useful for any future reference. The residents in vicinity can view this real time data and receive an alert by installing the application on their mobile phones. A buzzer and LED alert system is connected to system which activates if microcontroller analyses the water level has risen above threshold value and alert government officials or private organizations for immediate evacuation and safety protocols.

### IV. HARDWARE AND SOFTWARE



Figure 3: Arduino Uno & Ultrasonic Sensor [HC-SR04]



Figure 4: Water Flow Sensor [YFS-201] & Temperature and Humidity Sensor [DHT-11]



Figure 5: Rain Water Sensor & Zigbee S2C

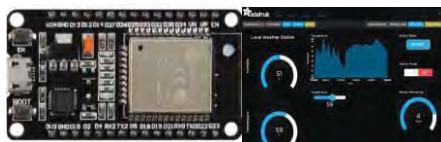


Figure 6: Wi-Fi Module & Adafruit Software

## V. CONCLUSION

Currently it is really difficult and impossible for the mankind to know how and when a natural disasters like floods can occur in world, but it is possible for us to detect when there is flooding condition or when the dam is overflowing. One of the main reason for occurrence of floods is the rise in water level. In the proposed system, we consider to check the water level in dams, rivers or near coastal area by simply installing some sensors. We continuously obtain the data values from these sensors and transmit wirelessly via Zigbee to base station. This data is uploaded to cloud server and can be viewed by any android device like mobile phones. Hence, if the sensor value exceeds threshold value (set according to user's requirement) then the system automatically triggers an alarm system comprising of LED and buzzer, which will help us to detect the possibility of flood. Thus, the proposed system will ultimately help in the evolution of IoT Technology and will be used for the welfare and betterment of the society. The early evacuation and protection will reduce the damages which will directly help in increasing country's economy.

## VI. FUTURE SCOPE

The data can be displayed on LED display boards for road travelers for safety reasons could be installed at strategic locations. Further improving the system by adding different sensors such as wind sensor, atmospheric pressure sensor etc. it will be able to predict more accurately. By future modifications we would be able to predict how much area surrounding the river bank can be affected due to water level so the residents can be evacuated as early as possible. The power supply source can be altered with renewable sources which will reduce the electricity cost and a continuous supply will be maintained.

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# SMART MIRROR: A NEW WAY TO LIFE

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**Abstract:** Every possible thing these days has an adjective smart attached with it e.g. smart city, smart home, smart TV, smart parking system, etc. Use of enough technology and you can turn a simple day-to-day equipment like a mirror into a smart mirror that will be able to perform various tasks apart from working as a normal mirror. This document proposes a design along with the implementation that will make a normal mirror into an interactive gadget. The mirror will be loaded with various modules that will give the user certain information required throughout the day. Date and Time, Weather Forecast, Upcoming Holidays, News Headlines, etc. Apart from these basic modules the mirror can interact with the user with the help of a Telegram Bot using the Telegram mobile application. The user can play YouTube videos and control the videos using the telegram app. The mirror also has a COVID-19 tracker. It shows the number of COVID-19 total cases, new cases, deaths and recovered cases for various countries.

**Keywords—** Smart Mirror; Raspberry Pi; Internet of Things, Interactive Devices

## I. INTRODCTION

Smart Mirror is a mirror that gives some data like news features, climate estimate, date and time, and so on. An ever-increasing number of gadgets are getting associated with the internet as time is passing. There are a great many gadgets right currently associated with the internet. For a long time, gadgets are beginning to get smarter and smarter and internet was associated with every one of these gadgets. This is the means by which the idea of 'Internet of Things' appeared. This article targets investigating different fields where this innovation can be applied. It targets actualizing this innovation into a day by day utilized thing like a wall mounted mirror and make it a Smart Mirror.

Smart Mirrors have been made for a considerable length of time, to install different "smarts" into human life to improve the living. The smart mirror thought intended to include innovation into individuals' lives by putting it where everybody's standard in the end meets. Family Smart Mirrors: In purchaser applications the center capacity essentially spins around two significant things: Be a general information center, got from survey one's appearance just as joined with other valuable data and give some style and solace benefits, notwithstanding mirror reflectivity and different capacities. By associating IoT to the mirror it is conceivable to execute different application administrations. Different sort of data can likewise be given to the client on the premise to IoT. Smart mirror diminishes and conceivably kills the requirement for the client to set aside a few minutes for their little necessities from their day by day schedule. The mirror provides the access to all the required things that a normal person needs every morning i.e. weather, news headlines. Fig 1 shows the average hours spent by a person in front of a mirror every week. A person spends more than 6 hours every week in front of the mirror. So, if a mirror can do your tasks

when you are using it then with this average 260 hours of work can be done while using a mirror. Let us assume that we have 10 hours/day work to be done. So mathematically a smart mirror would save your 26 days by doing the work for you when you are using it. Congratulations you have gained leave of extra 26 days because you own a smart mirror!



Fig 1. Average time spent in front of mirror every week [1]

## II. EXISTING WORK

Previously, a lot of work has been done in the field of smart mirror using the concept of IoT. Beginning from the pioneers, Michael Teeuw in 2014 [2] proposed a 'Magic Mirror' with Raspberry Pi. This mirror was built on a Raspberry Pi 2 and used a monitor as the display. It was an open source modular smart mirror platform. "MagicMirror" focuses on a modular plugin system and uses Electron as an application wrapper.

Hannah Mittelstaedt [3] made a home mirror. It was posted on reddit website. The mirror used a smartphone as the display screen. It was an android tablet so features of android were used to display time, weather, date and reminders. The software used android widgets but can be modified easily as it is open source. Anyone can modify it and develop a new version. Home Mirror is a kind of smart mirror that is easier to build than other mirrors as it requires just two main components, any android mobile phone or a tablet and a mirror. However, this too lacked any kind of intelligence or interaction. Ryan Nelwan [4] in 2016 developed a smart mirror much similar to the one developed by teeuw's touch feature which was a first of its kind. It was mostly as a source of an entertainment system in which a user can use the touch controls to run different programs or control music but did not have artificial intelligence. Smart Washbasin [5] displays different information in a washbasin mirror such as weather forecast, mails, the calendar and the user's weight measured through a built-in-scale in the base portion and the water temperature and pressure. Smart Mirror for home environment [6] allows to control all the smart devices at home. It relays on face recognition for authenticating the user

and displays personalized information (news, mail, messages etc.). It is possible to control it without touching the screen surface, since it is equipped with proximity sensors able to track the hands position and motion.

### III. SYSTEM DESIGN

The framework is planned to keep in mind the necessary administrations utilizing ideal parts. An acrylic two-way mirror is the first and the most significant part of this plan. It will give the reflection on the front surface (reflection surface) and a straightforward layer on the back surface. A standard LCD screen will be deployed underneath the mirror and it will show the segments of the 'smart' some portion of the Smart Mirror. A System on Chip (SoC) microcontroller, Raspberry Pi 3B is used here. It has the computation capability and ability to control different devices. It is basically a computer and can be ported on to any monitor via HDMI. The data for the modules is fetched at real time from cloud servers. The user can interact with the modules via Telegram mobile app. The user must send commands to a Telegram Bot already created. This bot can control the mirror and certain modules like YouTube videos that are streamed on the mirror. The bot can also send alerts on the mirror. It can shutdown/reboot the mirror and show/hide apps. Fig 2 shows the architecture of the system.

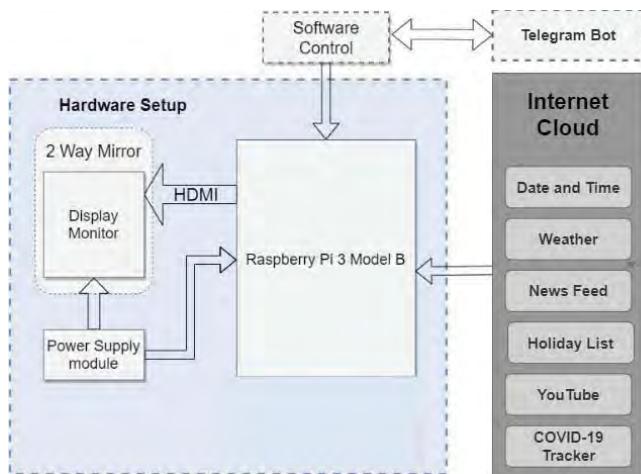


Fig 2. System Level Block Diagram

### IV. IMPLEMENTATION

When the mirror is turned on it will display date and time and time based compliments. The mirror will also display weather forecast for a place that has been configured. The news feed will keep showing latest news that gets updated automatically every few minutes. The user can also check out the list of upcoming public holidays on the screen. The also displays the COVID-19 tracker. The tracker displays the total cases, deaths, new cases, and recovered cases. The tracker also has a line a graph that gives the user an idea about the rate of increase of the cases of the novel corona virus, COVID-19. The mirror will continue to display the above modules all the time. It also continuously waits for commands from Telegram Bot. The bot can interact with the modules and the functionality of the mirror.

The smart mirror will perform the following tasks:

1. The mirror will display the date and time.
2. The mirror will display different modules like weather, upcoming holidays, news, etc.

3. Smart mirror can communicate with commands from the Telegram mobile application via Telegram Bot.
4. Mirror will play YouTube videos on the screen which can be controlled dynamically at real-time.
5. COVID-19 tracker will continuously display the corona virus cases with a line graph showing the day-by-day increase in the cases for few countries.

### V. RESULTS AND DISCUSSIONS

Smart mirror will require access to internet all the time to provide the adequate information to the user in form of services and modules.

#### Default Modules

##### a. Date and Time

The *Date and Time* module is one of the few default modules that are included in the MagicMirror software. As evident from Fig 4, this module shows the current date and time based on the configuration done in the config.js file (Fig 3). The information will be updated continuously in real time.

```

modules: [
    {
        module: "clock",
        position: "top_center"
    }
]

```

Fig 3. Date and Time configuration

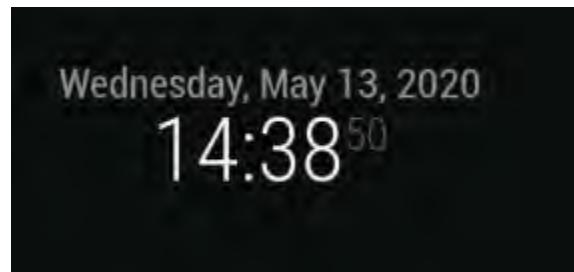


Fig 4. Date and Time Module

##### b. Weather Forecast

The *weatherforecast* module is one of the few default modules that are included in the MagicMirror software. As can be seen from Fig 6 this module shows the forecast of the forthcoming week's weather. It includes an icon (cloudy, rainy, sunny, overcast, etc.) to display the current conditions, the maximum temperature and the minimum temperature. The weather forecast module fetches the data from openweathermap.org website. The website offers an API that can be called whenever the data is to be fetched. The configuration is shown in Fig 5.

```

modules: [
    {
        module: "weatherforecast",
        header: "Weather Forecast",
        position: "top_right",
        config: {
            location: "Mumbai",
            locationID: "1288945",
            apiid: "XXXXXXXXXX"
        }
    }
]

```

Fig 5. Weather Forecast configuration

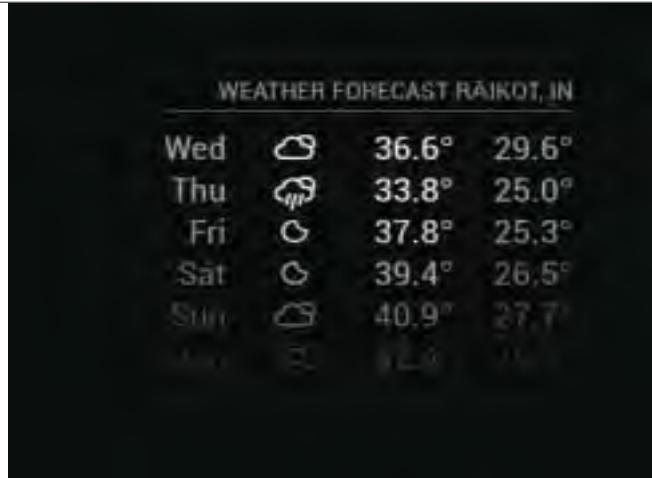


Fig 6. Weather Forecast Module

#### c. Upcoming Holidays

The *calendar* (upcoming holidays) module is one of the few default modules that are included in the “MagicMirror” software. As shown in Fig 8 this module displays events from a public .ical calendar. It can combine multiple calendars also. The list is fetched from the calendarlab.com website which provides publicly accessible lists of holidays for almost all the countries. The configuration is shown in Fig 7.

```
modules: [
  [
    {
      module: "calendar",
      header: "India Holidays",
      position: "top_left",
      config: {
        calendars: [
          {
            symbol: "calendar-check",
            url: "webcal://www.calendarlabs.com/ical-calendar/ics/38/India_Holidays.ics"
          }
        ]
      }
    }
]
```

Fig 7. Calendar configuration



Fig 8. Calendar Module

#### d. News Feed

The *newsfeed* module is one of the few default modules that are included in the MagicMirror software. This module shows news headlines based on an RSS feed. Scrolling through news headlines is time-based (updateInterval is set for fetching a new headline from the newspaper). It can also be controlled by sending specific notifications to the module. Based on the notifications, the module fetches the headlines accordingly from the newspaper and displays on the mirror.

The configuration settings and the running module are shown in Fig 9 and Fig 10 respectively.

```
modules: [
  {
    module: "newsfeed",
    position: "bottom_bar",
    config: {
      feeds: [
        {
          title: "DNA India",
          url: "https://www.dnaindia.com/feeds/india.xml"
        }
      ],
      showSourceTitle: true,
      showPublishDate: true,
      broadcastNewsFeeds: true,
      broadcastNewsUpdates: true
    }
  }
]
```

Fig 9. News Feed configuration



Fig 10. News Feed Module

#### YouTube

MagicMirror also has support for YouTube [7] player that can be configured at runtime as shown in Fig 11 and controllable by Telegram Bot.

- An embedded video can be played MagicMirror as shown in Fig 12
- Play and load videos not only statically by configuration but also dynamically at runtime.
- YouTube iFrame APIs are supported in most of the cases.
- Can be controlled by MMM-TelegramBot commands

```
module: "MMM-YouTube",
position: "bottom_center",
config: {
  verbose: false,
  defaultQuality: "default",
  width: "800px",
  height: "600px",
  volume: 100,
  disableCC: false,
  showPlayingOnly: false,
  defaultLoop: false,
  defaultShuffle: false,
  defaultAutoplay: false,
  onStartPlay: {
    type: "Id",
    id: "WOr0Fv9C5dU",
    shuffle: false,
    loop: false,
    autoplay: true
  }
}
```

```

playerVars: {
  controls: 0,
  hl: "en",
  enablejsapi: 1,
  showinfo: 0,
  rel: 0,
  cc_load_policy: 0,
},
telegramBotCommand: {
  YOUTUBE_LOAD_BY_URL: "yt",
  YOUTUBE_CONTROL: "yc",
  YOUTUBE_LOAD_PLAYLIST: "yl"
},
outNotifications: {
  "-1": "UNSTARTED",
  "0": "ENDED",
  "1": "PLAYING",
  "2": "PAUSED",
  "3": "BUFFERING",
  "5": "VIDEO CUED",
}
}

```

Fig 11. YouTube configuration



Fig 12. YouTube Module

### Telegram Bot

MagicMirror can be controlled via the Telegram Bot [8] and modules within the Mirror. To create a telegram bot, we must take help of another Bot! BotFather is the telegram bot that helps to create a bot as per our requirements. The bot has a predefined API key associated to itself. This key will be used to link the bot to the mirror. The user can now send commands to the mirror via the Bot.

1. search for BotFather in your telegram mobile application or navigate to <https://telegram.me/botfather>
2. Send command to BotFather to create a new bot - /newbot as shown in Fig 13
3. Give any name to the bot that has been created, give a username (username should end with bot e.g. MyMagicMirrorBot, mystupidslave-bot, etc)
4. After created, you can get API Token. It looks like 11xxxxxxxx:AAxxxxxx1vawxxxxxxxxxxxxxx  
xxbm. Remember that.
5. Enter the above API key in the Telegram Bot's config file along with the user's telegram userid as can be seen in Fig 14

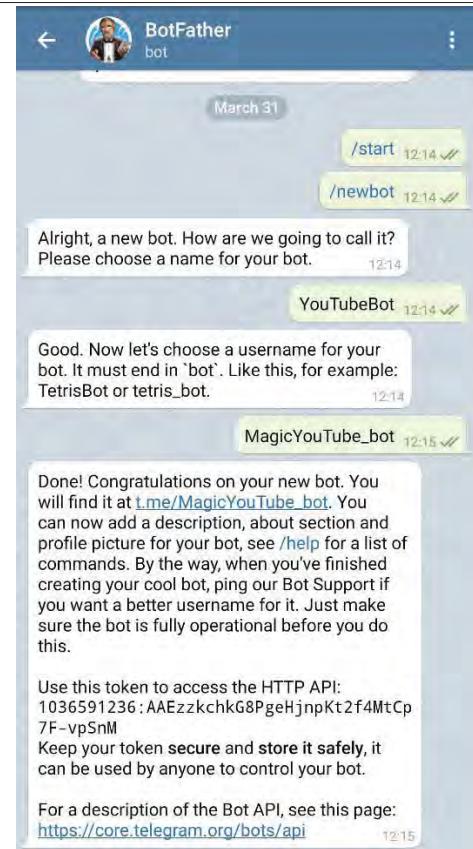


Fig 13. BotFather - New Bot creation



Fig 14. Telegram Bot configuration

Every time the mirror gets started as shown in the Fig 15 user will get a message from the Bot on the telegram mobile application as can be seen in Fig 17. The user can then send commands to the mirror for controlling as shown in Fig 18. Fig 16 shows the whole mirror with default modules.

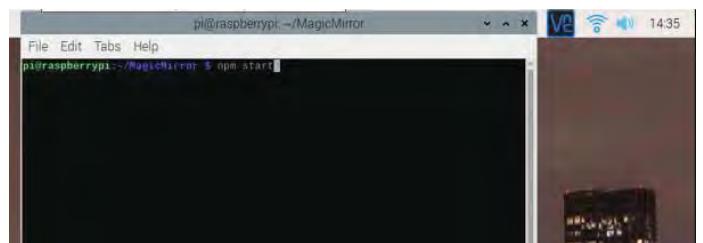


Fig 15. Starting Magic Mirror



Fig 16. Magic Mirror with Default Modules



Fig 17. Message received in Bot and List of commands serviceable

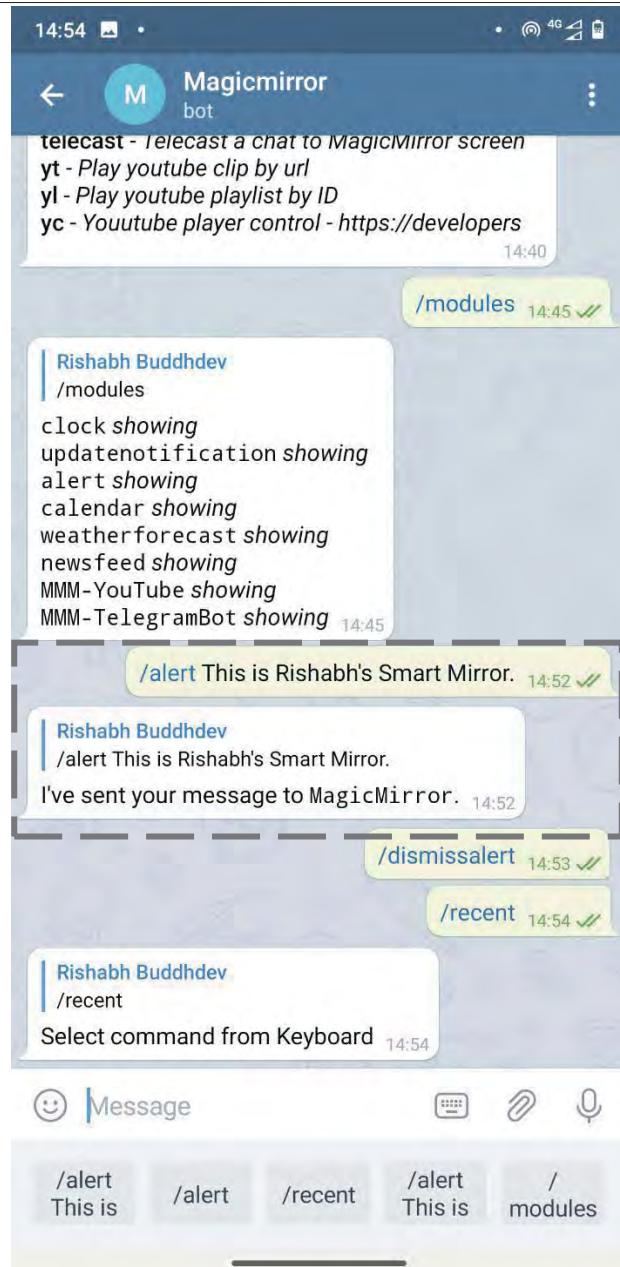


Fig 18. List of modules in the MagicMirror and. /alert command

Fig 19 shows the response by the MagicMirror when the user sends alert from the Telegram Bot to the Mirror. Also the YouTube module can be controlled by the Telegram Bot, The user can start a video by using /yt command as show in Fig 20. The user can also control the videos with commands like /yc oauseVideo, /yc nextVideo, /yc mute, /yc unmute, etc. as shown in Fig 21.



Fig 19. Alert received on the Mirror

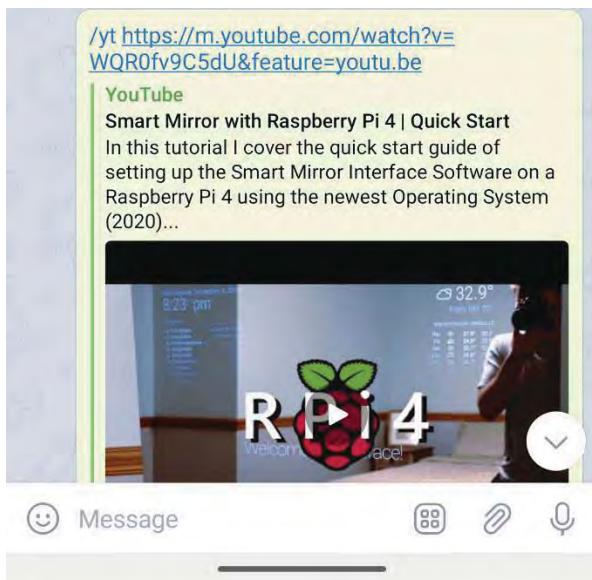


Fig 20. Playing YouTube video via TelegramBot

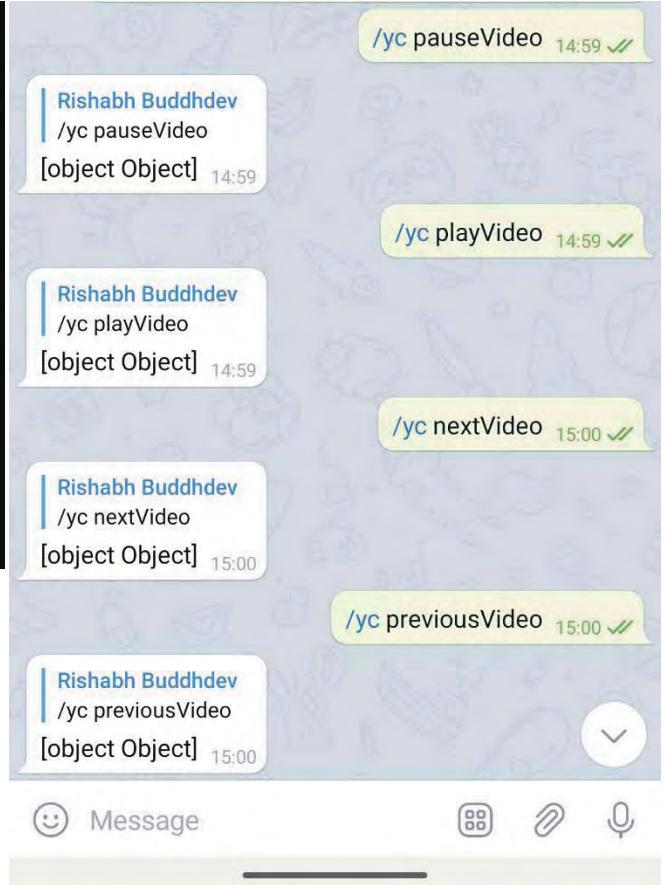


Fig 21. Controlling YouTube videos via TelegramBot

### COVID-19 Tracker

This is a MagicMirror helper module for tracking COVID-19 [9] cases worldwide. As shown in Fig 23 the mirror will display a table with total COVID-19 cases, deaths, recovered cases, etc. till now for a list of countries. Also the module will display a line graph for the same as can be seen in Fig 24. Fig 22 shows the configuration of the COVID-19 module where select the countries to be displayed. Also, we use the API provided by rapidapi organization for fetching the data for this module.

```
{
  module: "MM-COVID19",
  position: "bottom_left",
  config: {
    updateInterval: 1000,
    worldStats: true,
    delta: true,
    lastUpdateInfo: true,
    countries: [ "USA", "China", "India", "Spain", "Italy" ],
    headerRowClass: "small",
    infoRowClass: "small",
    rapidapiKey : "https://rapidapi.com/.html"
  }
},
```

Fig 22. Covid19 configuration

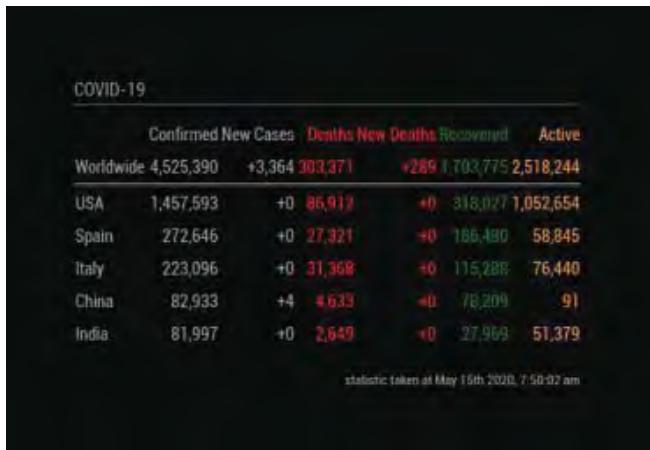


Fig 23. COVID-19 Module

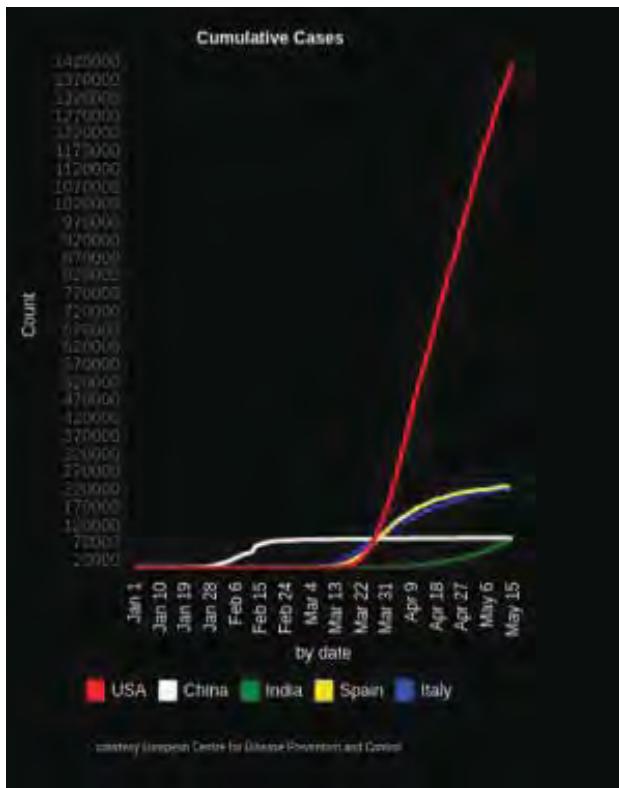


Fig 24. COVID-19 Line graph

## VI. CONCLUSION AND FUTURE WORK

Here an interactive mirror is shown that provides date and regional time corresponding to the location. The mirror will also greet the user based on the time of the day. Along with that the mirror will also display few compliments from time-to-time. The mirror will display the weather forecast for the upcoming week of the user's location. The mirror can interact with the user with the help of voice commands from the user via USB mic and voice output via USB speaker. For the interaction Google assistant has been installed in the mirror. It will listen to the user and respond accordingly. User can also play music or YouTube videos on the mirror.

In future this mirror can be used to build a smart home network by adding a motion sensor like PIR sensor so that the mirror will only get activated when someone comes in front of the mirror. We can connect the home appliances like air-conditioner, lights, fans, etc. So that these appliances can be controlled via smart mirror. Home surveillance system can

also be connected to the mirror by displaying the output of the door camera on to the mirror.

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# *Braille Keyboard: A Teaching Device for the Visually Impaired*

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**Abstract—**Braille System Keyboard with voice output explores a compact device which helps visually impaired people to self-learn the alphabets, special characters and numbers. Also, using this they can communicate in the real world. The Braille system keyboard is a portable device, which consists of six buttons in accordance with Braille Lipi and it can be connected to desktops and laptops. The heart of this whole system is the Arduino Board which has pins for interfacing various devices and is programmed using a programing language. The circuit also contains a SD Card containing the audio files of alphabets, numbers, punctuation marks, typing keys, articles, conjunctions, prepositions, prefixes and suffixes which is used for giving the audio output with help of an output speaker.

The methodology and the principle used in this System is that the keyboard is a device made of logical switches and uses Braille system technique for sensing the characters. In this system, the push buttons are aligned as per the Braille language i.e., alphabets, numbers, punctuation marks, typing keys, articles, conjunctions, prepositions, prefixes and suffixes.

**Keywords—**Open-Source Software, Braille, Arduino Board, Push Buttons, SD Card Module, Visually Impaired

## I. INTRODUCTION

Braille is a system used by visually challenged persons that uses a combination of raised dots representing the letters of the alphabet, numerals, punctuation marks and symbols. Braille was invented by Louis Braille in 1824 who was also a blind person. Many modifications were made in Braille such as the 'slate and stylus', 'Braille notetaker' etc. One of the recent modifications was in the form of 'Braille System Keyboard'. Braille system keyboard is a device which consists of logical switches and it uses the Braille system technique which senses the characters. In this system, the push buttons are well placed according to the Lipi Braille language i.e., alphabets or numeric/special characters.

In this era, technology has made things easier for people like us, with no disabilities, and for the people having disabilities things are becoming possible unlike earlier times. Estimated 285 million people around the world are visually impaired and among these, 39 million are blind and 246 million have a low sight vision. Also, among these the percentage of visually impaired having a low income is 90%. What makes the communication easy for a visually impaired person with the sighted person is that, the conversion of Braille language to voice is the only way. This language helps them to become literate. This keyboard has six smooth buttons for giving the input, computer screen to display the output and

an audio jack to which speaker or earphones can be connected to give an audio output. The design is such that it gives the visually impaired person a clue by touching the pushbuttons to know where to orient themselves in accordance to the side of the keyboard.

One of the group members is into social service of teaching in an NGO. An idea struck the mind, of helping the visually impaired persons in a technological way and was shared with the rest of the team members. This motivated us to make something that will help the visually impaired and progress in technology. This idea was implemented to make a compact, user friendly and an affordable Braille keyboard system. This keyboard will improvise the computational capabilities of the visually impaired persons.

## II. PAST WORK

As per the literature surveys we got to know that the previous models were not feasible for everyone to use because their system had components which made it rigid and thus the user didn't have the flexibility to use the resources which were already available to him such as earphones, speakers and PC screen. This led to a significant rise in the cost of their systems [3]. So, in our system we have tried to replace few components and peripherals which would satisfy the requirements of the overall system, which in turn would give the user an option to use the resources available at his place, thus reducing the overall cost of the system significantly.

The previous systems lacked to have the feature of typing keys, articles, conjunctions, prepositions, prefixes and suffixes which caused significant delay in the output [4]. So, we aimed to remove these constraints of these systems and added these extra features. This added feature will help the visually impaired people by reducing their efforts to press the pattern of each alphabet to get the required typing keys, articles, conjunctions, prepositions, prefixes and suffixes which will indeed increase the speed of operation. Also, we have attempted to add an additional feature of saving the text files as the previous system couldn't save the data typed by the user. So, we are giving an option to the user to save their files which he/she can access anytime for future reference. This project is made as compact as possible. It is designed and implemented in such a way that the cost remains low and is thus affordable by each and every strata of the economy.

### III. PROPOSED WORK

#### A. Block Diagram with Working Principle

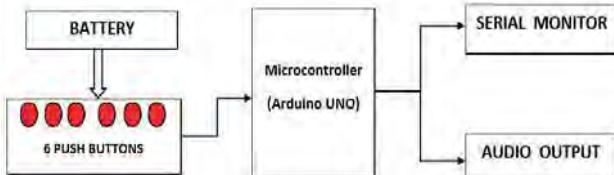


Fig 1: Block Diagram

This keyboard is interfaced with a micro-controller, such that a blind can type all the alphabets, numbers and punctuation marks as per the braille Lipi. As it contains only six buttons, it can be easily understood by blind people rather than searching for keys on traditional braille keyboards which existed before. The keyboard is operated with a 5V power supply which is obtained by connecting the 9V battery with a 7805-voltage regulator IC. Based on the different combination of inputs from the six push buttons, the microcontroller will give a relevant output on the screen. The system operates in two modes, one is the number mode, and the other is the alphabet mode. The user can switch to any of the modes as per the requirement. A SD Card module is connected in the circuit, which contains the audio files of all the alphabets, punctuation marks, numbers, typing keys, prepositions, suffixes, prefixes and conjunction. The circuit in turn has an output audio jack which gives voice output of whatever is being typed. All the alphabets, punctuation marks, numbers, typing keys, prepositions, suffixes, prefixes and conjunctions typed by the person then gets documented in a word document using an Open-Source Software so that the teacher or the colleague can have a record of the same.

#### B. System Design

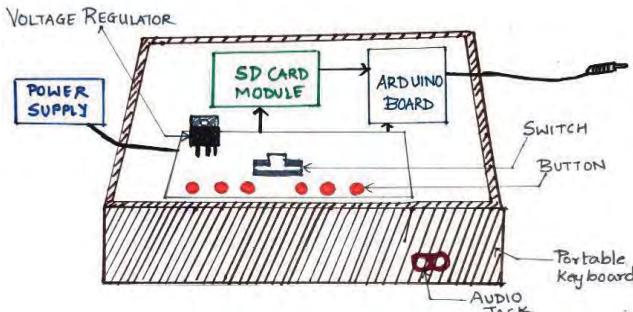


Fig 2: Design of System

The Braille keyboard is an extensive system and requires careful planning and designing of various parts of the system. This is the proposed design of how the keyboard looks like and it is designed to make it as user friendly as possible.

#### C. Algorithm

- (1) Start
- (2) Import "SPI.h", "TMRpcm.h", "SD.h" packages.
- (3) Declare "Pin 10" as chip select pin for SD card.
- (4) Use tmrpcm library.

- (5) Declare inputs
  - (i) A0 as pushbutton 1
  - (ii) A1 as pushbutton 2
  - (iii) S3 as pushbutton 3
  - (iv) S4 as pushbutton 4
  - (v) S5 as pushbutton 5
  - (vi) S6 as pushbutton 6
  - (vii) S7 as slide switch
- (6) Declare i, j, k, l, m, n and o as integer for input pins.
- (7) Declare "Pin 9" as speaker pin.
- (8) If SD card not connected
  - Display "SD Fail".
- (9) Otherwise go to step (10)
- (10) If o==Low
  - (i) If i==High and j==Low and k==Low and l==Low and m==Low and n==Low
    - (ii) Display "A".
    - (iii) Set volume to 5.
    - (iv) Play audio file "A.wav".
    - (v) Else . . . {similar for alphabet till Z, symbols punctuation marks, prefixes, suffixes, conjunctions, prepositions and typing keys}
- (11) Otherwise, if o==High
  - (i) If i==Low and j==High and k==Low and l==High and m==High and n==Low
    - (ii) Display "A".
    - (iii) Set volume to 5.
    - (iv) Play audio file "0.wav".
    - (v) Else . . . {similar for numeric till 9}
- (12) End

#### D. Flowchart

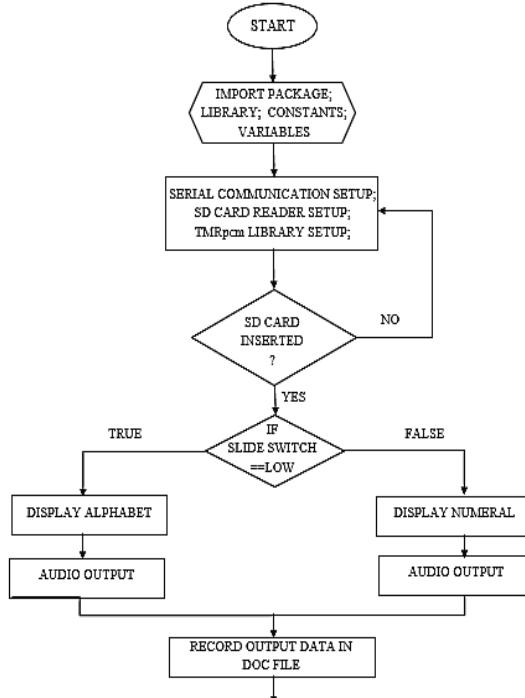


Fig 3: Flowchart

#### IV. LIST OF COMPONENTS

- A. Arduino Uno
- B. SD Card Module
- C. Slide Switch
- D. Audio Jack 3.5mm
- E. On/Off Switch
- F. Push Buttons
- G. Voltage Regulator

#### V. EXPERIMENTAL RESULTS

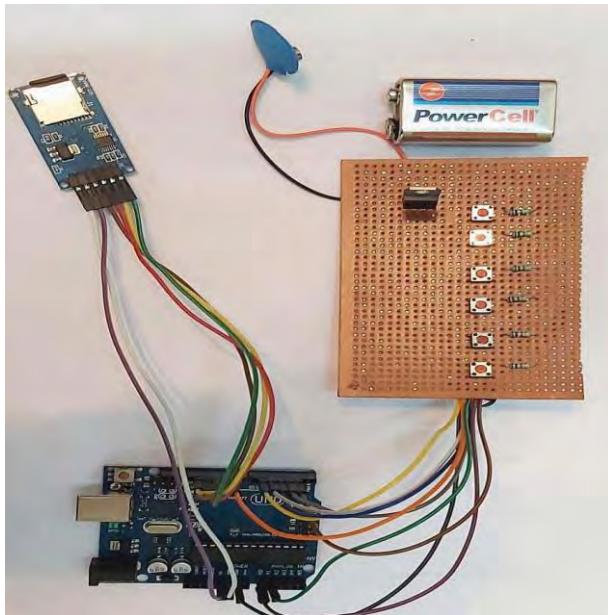


Fig 4: Working on PCB

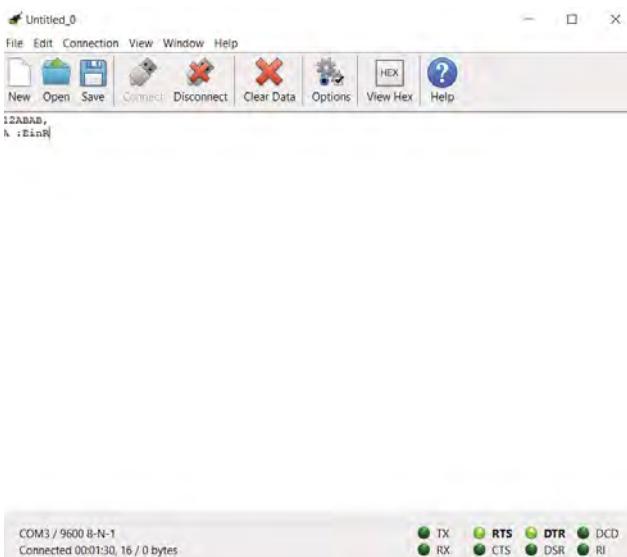


Fig 5: Display Output on Arduino IDE

The Braille keyboard is powered using the 9 V battery, which in turn is connected to a voltage regulator to give a constant 5 V supply. The system consists of six push buttons arranged linearly, which represent the Braille Lipi language. This output is then given to the Arduino board. The corresponding audio file is retrieved from the SD card and is given as audio output through speaker/earphone. At the same time, it performs serial communication through which the output is displayed on the screen and gets saved as a text document for record and evaluation purpose.

#### VI. CONCLUSION

The project is a design and an implementation of a novel technology using computer to help visually challenged person to communicate with the outside world in ease. It is an inexpensive, compact and a user-friendly device that can be connected on any computer device. Voice output along with display has been incorporated for maximizing desired objective. With the help of this system, the gap between visually impaired persons and the sighted will be decreased significantly.

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# Property Price Prediction Using Regression Algorithms, Chatbot Using NLP

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Shivajirao S. Jondhale College of Engineering, Dombivli, India

*Abstract- The role of computer has become more intrusive in the recent days. For our day to day task we use various technologies without even recognizing it. The field of machine learning, deep learning, AI aims to automate the system and provide fluid services to us with least human intervention. In this present paper we aim to provide prices of a property based on its features. Our aim is to deploy the model on internet so anybody can get information regarding the property they want. We used various machine learning regression algorithms to solve our use cases. In our case Random forest regression performed the best and gave us 92% accuracy. In this paper we present the working principle & basic concepts as well as application in various sectors in our case with Property Price Prediction. In our system we provide a efficient and accurate answer based on dataset of FAQ using NLP in AI. We used HTML, CSS, bootstrap, Flask for our front end application.*

**Keywords-** Linear Regression, Ridge regression, SVR, K-neighbour Regression, Random forest Regression, Ada boost regression, Gradient boost regression, XG Boost regressionn, machine learning, Chatterbot, corpus, NLP, Flask.

## I. INTRODUCTION

The process of learning or getting experience is nothing but going through past activities. By considering events that has happened in the past we can make a more conscious decision that may lead to correct decision making. This kind of behaviour is not only found in humans but also in animals. A chimp can display a wide range of emotions, and recognize them in mirror and can learn sign language. This all is possible because of learning. Similarly in case of machine learning we use past data to make a firm prediction regarding the future. There are two types of learning techniques in machine learning. They are Supervised machine learning and Unsupervised machine learning. Supervised machine involves learning from data which is well labelled and unsupervised machine learning involves learning from data which is not labeled. In unsupervised machine learning the main aim is to find pattern in the unlabeled data. In our case we are performing supervised machine learning. Price forecasting can also be done in the similar way by using the existing data. From the past data we can see the trends in the data and with this we can make a firm decision. Nowadays peoples interaction with machines have become common.

Be it real estate agent or customer, real estate chatbot prove to be effective to both when it comes to saving time, money & additional resources. With a large number of property under preview, real estate receives a lot of enquiries so chatbot can instantly address such queries. Our aim is to create a front end app with machine learning regression model for price forecasting and chatbot using nlp for user assistance.

## II. LITERATURE SURVEY

The value of real estate property is mostly affected by its location and area. However by playing with different attributes and try out some of the of them in our use cases proved to be useful. However they cannot be seen directly. We need to perform various EDA techniques with visualization using various data visualization techniques like bar plot, scatter plot etc. However EDA also involves various non graphical techniques for dealing with various factors in data, like dealing with outliers using z-score, IQR etc. This is explained in detail in the paper by Mathieu [1] with each and every use cases distinctly visualized. The importance of EDA and its effect on performance on machine learning algorithm is evident. EDA helps us to utilize the maximum information of the available data. However the main aim is to create a robust generalized model and for this we also need to know various techniques. The paper by Alisha [2] explains various terms like hyper parameter optimization and tweaking the machine learning algorithms to squeeze the maximum score. Their approach on the problem statement was inspiring and effective. The flow of development and the way to analyse the performance using various metrics was also explained.

Just like any emerging technology, chatbot will only become widely adopted if it's shown that they can solve real problems. Now that we understand the main problems consumers have with traditional online experiences, let's look at if (and how) chatbot can actually solve these problems. In our survey, we provided a brief description of how chat bots work and the types of tasks which is explained in paper by Mohammad Waseem[8]. Every time a chatbot gets the input from the user, it saves the input and the response which helps the chatbot with no initial knowledge to evolve using the collected responses. With increased responses, the accuracy of the chatbot also increases.

### III. SYSTEM DESIGN AND ARCHITECTURE

#### A. Data Collection

The first step in every use case for machine learning is to get the appropriate data set. This involves web scraping to collect data from different source from the internet. It can also be done using API, some sites provide API keys for data extraction. There are many open source public data libraries on internet like UCI machine learning repository, Google data set search engine , and Kaggle from where we found our required data.

#### B. Data Pre-processing

The data we get from various sources are not always ordered or structured, it may have missing values , it can have character data type. So before feeding it to the machine learning algorithm we need to clean the data and this is done using Exploratory data analysis techniques.

#### C. Training the models

After the above step is completed we divide our data into three sets mainly Training set, Test set, Validation set (Optional).We apply various machine learning models on training set and select the best models as our primary model. We then tune its parameter using various hyper parameter optimization techniques.

#### D. Testing and integration with UI

Once model is created it is tested on test set and validation set before deployment. We need to check for bugs before deploying the website on the server.

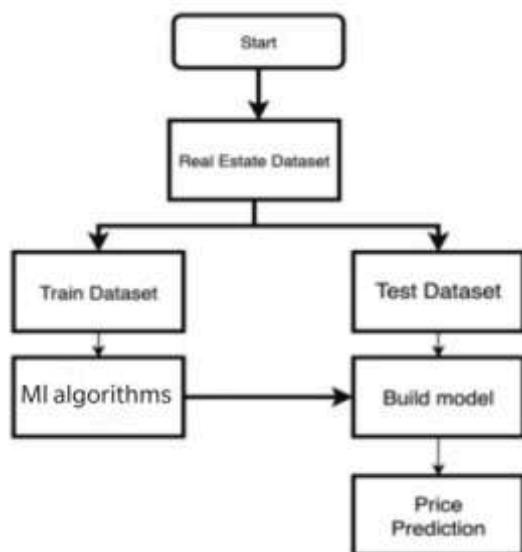


Fig 1. Generic Flow of Development

#### E. Natural Language Processing

Natural Language Processing, also known as NLP, is an area of computer science and artificial intelligence concerned with the interactions between computers and human (natural) languages, in particular how to program computers to fruitfully process large amounts of natural language data. Like the example with Amazon's Alexa assistant would be able to provide little to no value without Natural Language Processing (NLP).

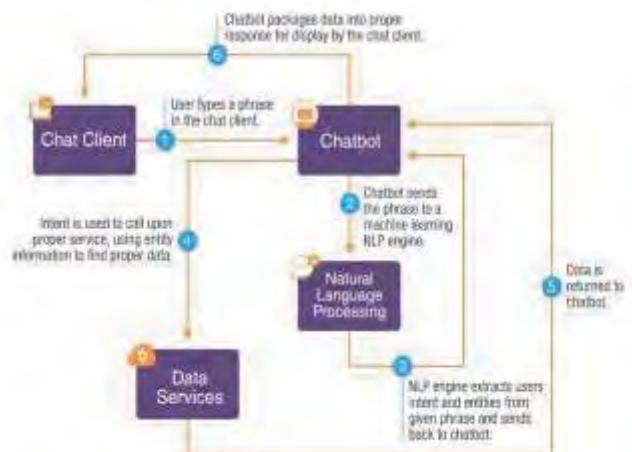


Fig 2. Chatbot Flow Diagram

### IV. METHODOLOGY

#### A. Data Collection

We wanted to build a model which can predict the prices of property of our locality. So for making such model we required data which has prices of property of our locality. We considered various data sets that were on the web. In the end we found a data which was perfect for our use case and had property prices of Mumbai, Thane and other locations. The data was uploaded on Kaggle[3]. The data had 6345 rows and 16 columns.

#### F. About Data

The data contained 6345 rows and 16 columns. The data had attributes like Area, Location, Number of rooms, Gymnasium availability, Lift availability, Car parking availability, Security availability, Children's garden availability, Clubhouse availability, Intercom connection availability, Garden availability, Indoor games availability, Gas pipeline connectivity, Jogging track availability, Swimming pool and the Price of the respective property. Out of the 16 attributes two are continuous attributes (Area, Price) and 13 attributes are discrete numerical attributes and one attribute is object type (Location).The data for the Chatbot is acquired from the dataset of property of the areas you are looking for in your budget.

#### G. Data Pre-processing

The attributes Price and Area were highly skewed. These attributes were continuous random variable. We converted them into Gaussian distribution or Normal distribution by log transformation .The distribution of data before and after log transformation is given below.

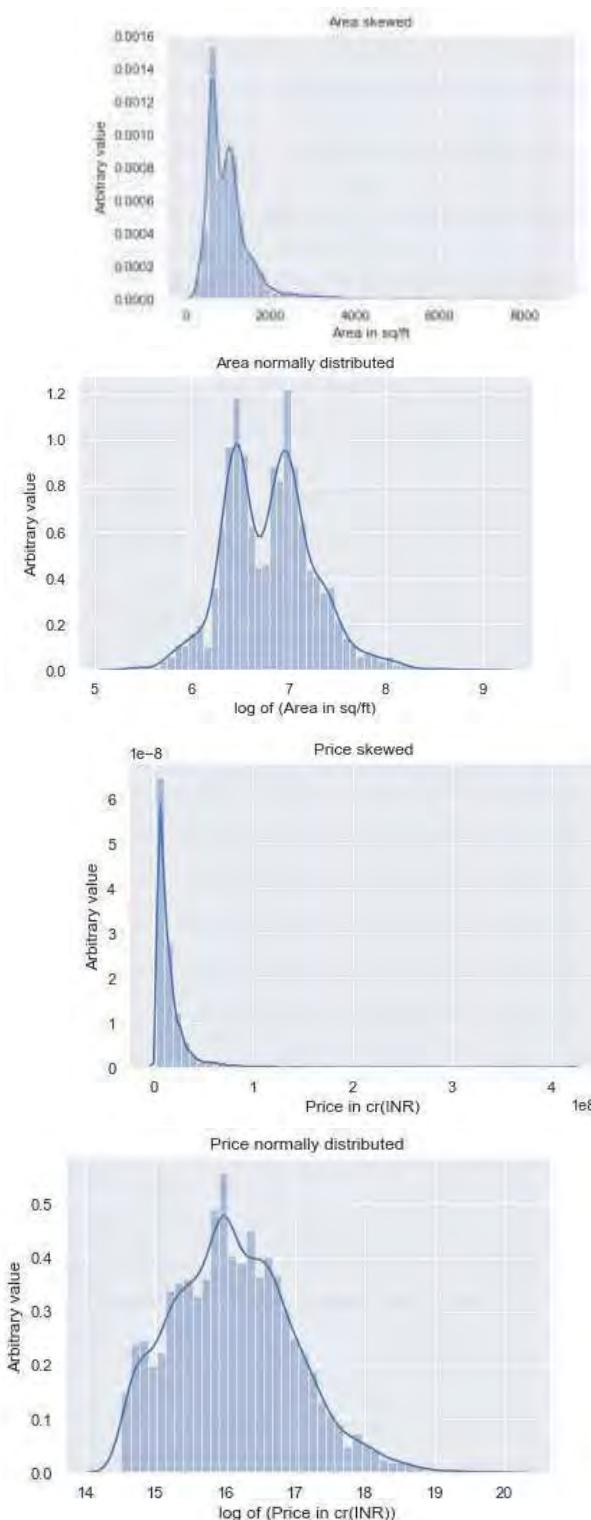


Fig3. Distribution of attributes Area and Price

This stage involves cleaning the data so that it can be given to a machine learning algorithm. First we check if there are any missing values in the data set and if present we use mean encoding if missing values are small and median encoding if outliers are present or we can also use random sample imputation or ken imputation. Machine learning algorithms only deal with numerical data. So we need to convert our categorical data, object data type into numerical data type. This can be done by using one hot

encoding , target encoding ,mean encoding etc. In our case there were no missing values in our data set. However the location attribute had high cardinality. For dealing with high cardinal attribute we cannot use one hot encoding as one it leads to increase in numbers of columns and higher number columns leads to curse of dimensionality which drops the accuracy of machine learning models. So in order to encode location in number we used a different approach where we first created a new attribute that was called per square foot and as the name suggests it has information about per square foot prices of the property. We obtained this attribute by dividing Price of property by Area of property. In order to encode location we formed a bucket of location based on their per square foot price and took the median of that bucket. One the basis of rank the location which has lowest per square foot price was labelled 0 and the highest was labelled 410 as there were 410 different locations in our data. This encoding method was effective as the lowest encoded location was evidently less priced in real life and the high encoded location was a very posh location in Mumbai. The effectiveness of the encoding can be proved with a visualization of scatter plot between Location and Price.

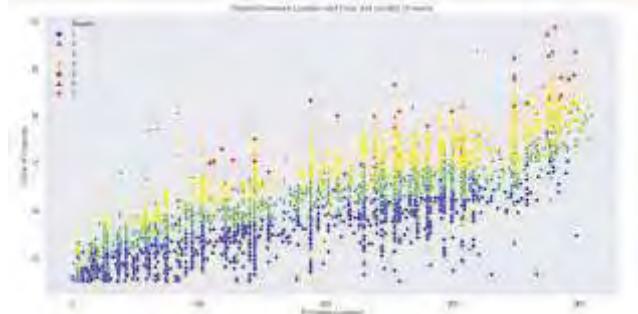


Fig4. Scatter plot Between Attributes Location and Price

The different symbols in the graph represents amount of rooms in the property. It is evident that price of property increase as we move from left to right on x-axis thereby proving that location effects the price of property. In the graph it is also seen that property having more number of rooms are much more costlier however after 4 to 5 count they are effectively same.

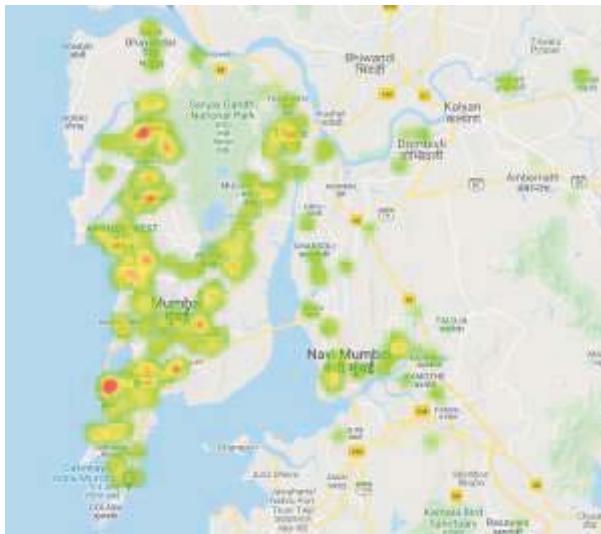


Fig5 . Heat map of price distribution based on location

The above figure is a heat map which helps us to visualize distributions of prices based on physical or actual locations. As you can see the locations in south Mumbai have red gradient specifying higher prices of property in that locality. While other properties have yellowish and green gradient which indicates lesser prices. From the map it is also clear that properties are built nearer to roads and railways as these factors affect the prices of property greatly!

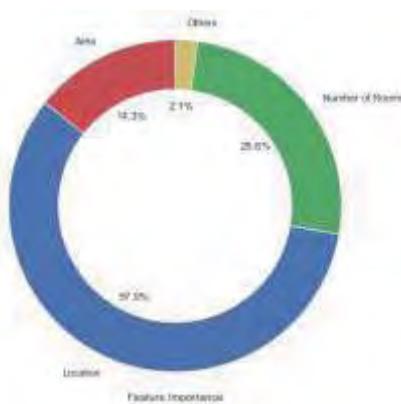


Fig 6. Feature importance

From the above pie chart we can say that the attributes Area , Location and Number of Rooms plays very vital role in predicting the price of the property[4]. While all other attributes only contribute 2.1 % as suggested by the pie chart .

#### *H. Training the model*

After data pre-processing we split our data into training set and test set with 70% training set and 30% test set. We now use various regression based machine learning algorithms like linear regression, Ridge regression,

Random Forest regression, Ada boost regression, Gradient boost regression, XG boost regression. All the algorithms performed well however Random Forest and XG Boost came close .We performed hyper parameter tuning with randomized search in order to get best parameter for the machine learning algorithm. Chatbot is trained using a module known as Chatterbot corpus that helps to train the data.This is because each corpus is just a sample of various input statements and their responses for the bot to train itself with.

#### *I. Results*

We tried various mentioned machine learning algorithms [5] and the score ( $r^2$ score) we got was given below. These scores are mean of cross validation scores. The method we used for cross validation is KFold [6] as we are dealing with regression problem statement and it is much suitable for this use case.

Linear Regression: 0.910573103242809  
 Ridge Regression: 0.9105814781156265  
 SVR: 0.7426253391736471  
 K -Neighbour: 0.8601602072824667  
 Ada Boost: 0.8119448550989302  
 Gradient Boost: 0.9247354894991864  
 XG Boost: 0.9245608777424721  
 Random Forest: 0.9243831670710094

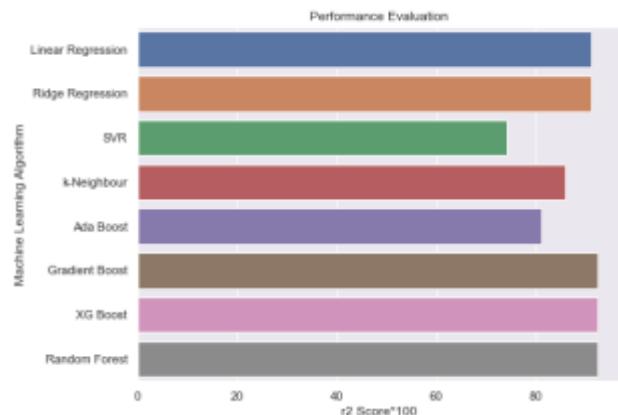


Fig7. Performance Evaluation

The scoring is done by using  $r^2$  score [7].This score is the average score given by the model using K fold cross validation techniques. We got low bias and low variance suggesting that model is generalized model.Random Forest regression , XG Boost regression , Gradient Boost regression performed equally well but we selected random forest as our final choice because we found its output for certain inputs were better compared to the other to algorithms.

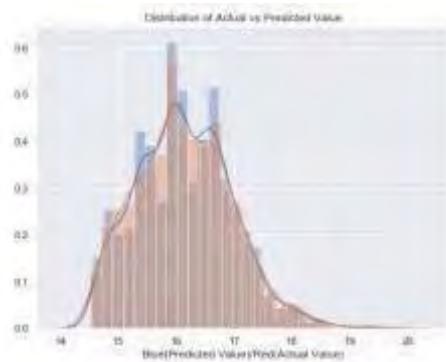


Fig 8. Distribution of actual vs. predicted values

From the graph above we can say that the prediction is actually good as it follows normal distribution or Gaussian distribution. There is almost no difference in distribution of data thereby confirming that model is performing well.

#### J. Testing and integration with UI

After creation of model and achieving good accuracy score, the next step is to deployment of model on a web page so anybody can use it. For deployment purpose we will use FLASK. It provides tools and technologies for developing a web application. We will make a Flask chatbot. Flask is a micro framework used for web development. We will follow the process given below:

- 1) Make a web app using the flask.
- 2) Make a directory for the templates.
- 3) Train the bot.
- 4) Make conversation with the bot.

So flask can carry out the entire all the back end task while we need to design front end using html, css and bootstrap.



Fig 9. Output 1



Fig 10. Output 2

#### K. Future Scope

For the future we will consider to make our site much more user friendly, elegant and provide more information by suggesting users real estate properties based on their prediction. We would like to increase the area covers by our model and to make it nationwide. To improve data set by including much more information like nearest schools, hospital, shopping mall, air quality index and many more attributes. This way we can evaluate even more precisely as these factors affects the prices very effectively!. [10] Future intelligent chatbot should,

- 1) Implement improved NLP techniques
- 2) Learn to understand human context in conversation and respond accordingly with emotions or personalised content.

#### V. CONCLUSION

In this paper, we tried various regression based machine learning algorithms and came to conclusion that random forest regression performed best. Our data set contained various information regarding properties in Mumbai, Thane and other regions instead of simply the area, location and Price. The prices predicted by the model were extremely close to real prices listed online and known by the people. Most of the existing system does not have various attributes like we have in our data set making it much more reliable for the user. Every customer or user need appropriate answer and so database is used so that purpose can be solved. There are many NLP applications and programming interfaces and services that help in development of chatbot. Having the ability to improve itself with every interaction will likely improve the Chabot's capability of understanding the context of user's input, which would help the chatbot generate more accurate, relevant response. Our system gave an average accuracy of 92% which is considered great for predicting the prices of real estate properties.

#### VI. ACKNOWLEDGEMENT

We would like to thank the open source community for providing solutions to various problems we faced in our tasks. We sincerely wish to thank the project guide Prof. Poonam Narkhede for her encouraging and inspiring guidance helped us to make our project a success. Our project guide made sure we were on track at all the times with her expert guidance, kind advice and timely motivation which helped us to determine our project. We would like to thank our project coordinator Dr. Uttara Gogate for all the support she provided with respect to project. We also express our deepest thanks to our HOD Prof. Pramod Rode whose benevolent helped us by making the computer facilities available and making it true success. Lastly, we would like to thank our college principle Dr. J.W.Bakal for providing lab facilities and permitting to go with our project. We would also like to thank our colleagues who helped us directly or indirectly during our project.

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# Development of LEG Contamination Monitor using Arduino Uno

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**Abstract -** The radioactive laboratory mandatorily uses contamination monitors, to monitor the presence of radiation on the unwanted surface. The Beta and Gamma contamination monitor shows readings (counts in preset time) and if the readings are more than the safe limit (threshold) value then triggers the alarm. The commercially available contamination monitors are useful above 45-60KeV gamma energy and cannot efficiently monitor the contamination due to the I-125 radioisotope, which has gamma energy of 35KeV. The paper is about the indigenously developed low-energy gamma contamination monitor, for monitoring contamination due to I-125 radioisotope. The monitor is designed around a special detector, its electronics, and easily available affordable Arduino UNO board. The code has developed considering user requirements, giving due flexibility of desired controls. The complete unit has been assembled and tested successfully.

**Keywords—**Contamination Monitor, Arduino UNO, gamma radiation.

## I. INTRODUCTION

In laboratories handling radioactive substances, contamination monitors are unavoidable and important equipment used to detect the presence of radiation on the unwanted surface/place. Depending upon the type of radioisotope handled, these monitors are used to detect the contamination due to alpha, beta, and gamma radioisotopes. Beta and Gamma contamination monitors use a most commonly available detector called end-window GM Tube. GM detector offers the advantage that their dose-rate readings are linearly proportional to count-rate output. Though GM detectors are not efficient, used extensively because of their low cost. To detect contamination due to alpha radiation, a scintillation detector (ZnS(Ag)) is most commonly used. These monitors display radiation level (counts) and turn ON the visual and audible alarm if more than the safe limit (threshold). The portable equipment can also be used for doing surveys of radiation contamination, to maintain radiation safety in the laboratory [1].

In general, the scintillation (NaI(Tl)) or GM detector-based commercially available contamination monitors are useful above 45-60KeV gamma energy. these monitors cannot be used to monitor the contamination due to the I-125 radioisotope, which has a gamma energy of 35KeV. The imported equipment that can be used for low energy contamination monitoring costs about Rs 5 Lakhs each. This

has motivated the indigenous development of a low-energy gamma contamination monitor.

## II. DESIGN REQUIREMENT

To develop a Low Energy Gamma (LEG) contamination monitor. The problem statement was further divided into count the signal pulse for a preset time, and trigger the alarm. This means that if the measured counts are more than the threshold value, then display a message 'CONTAMINATED' and turn ON the buzzer. If the measured counts are less than the threshold value, then display a message 'CLEAR' and turn OFF the buzzer. Also, the time interval of 1 to 100 seconds and Threshold counts for alarm should be user-programmable.

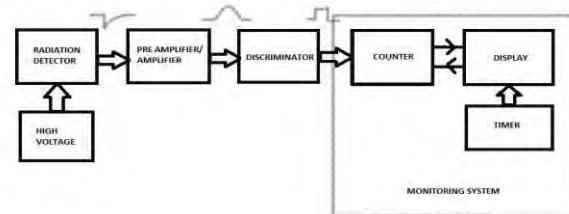


Figure 1: Block diagram of LEG contamination monitor

The basic building blocks of the LEG contamination monitor are shown in figure 1. To convert gamma radiation into the electrical signal, a High voltage (700V DC) is applied to the gamma detector [2]. The signal is amplified by an amplifier and passed through the discriminator to select the true signal and shape it to a rectangular pulse of 5V amplitude. The choice of a suitable scintillation detector to detect the lower energy of gamma radiation was important for this development. A scintillation detector having a beryllium window of 2-inch diameter and 1-inch-thick was selected for the development [3]. It gives better efficiency to I-125 gamma radiation of 35KeV that is of interest and converts the gamma radiation into an electric pulse signal. Arduino UNO board has an ATmega328P microcontroller which has been used as a counter and timer. It counts input pulse for a preset time, controls the display, and triggers the conditional alarm. It has 14 Digital I/O Pins and 6 Analog Input Pins which can draw a 40mA of DC Current per I/O Pin shown in figure 2. It has 32KB Flash Memory, 2 KB SRAM, and 1 KB EEPROM [4].

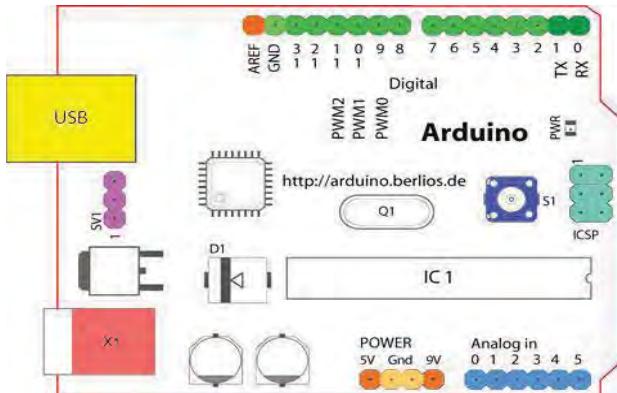


Figure 2: Arduino UNO board

A 2.4" TFT LCD module, having a bright backlight (4 white LEDs) and a colorful 240X320 pixels, used as a display device [5]. For user input and control, a resistive touch screen that comes pre-installed with the module, as a bonus, has been used. This has removed the need for a separate keypad and provided a touch screen input feature to the user. The 2.4" TFT LCD shield was selected because interfacing it with the Arduino UNO board is simple, as it directly seats on the board avoiding separate wiring, as shown in figure 3. Only, the processed rectangular pulse signal of the detector was wired, to digital I/O pin '0' of the Arduino UNO board.

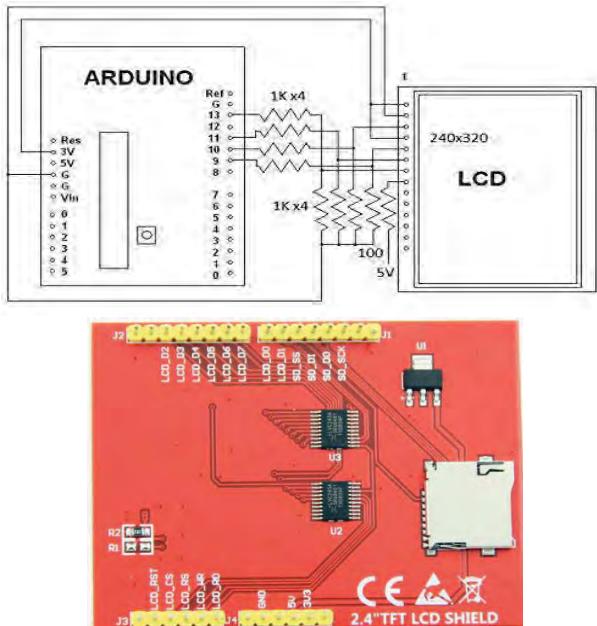


Figure 3: TFT LCD module and its wiring with Arduino board

Based on the user requirements, an algorithm was developed first. Using the algorithm prepared a flowchart to implement the code step by step, as shown in figure 4. For writing the code in C language and to compile and upload it into the Arduino an open-source software ‘Arduino IDE’ was used. Using this, the microcontroller of the Arduino UNO board programmed to measure the incoming pulse rate and to display the message “CONTAMINATED” or “CLEAR” once the counting is over, depending on the threshold value.

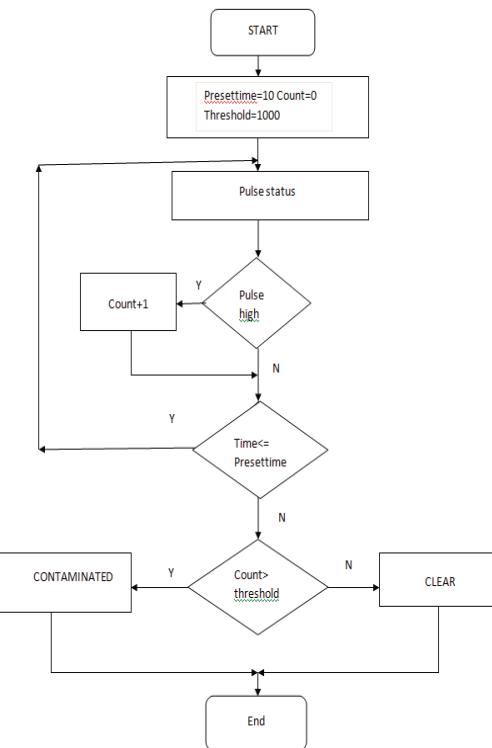


Figure 4.: flowchart of the code used for LEG contamination monitor

### III. RESULTS AND DISCUSSION

In the first stage of testing, only the count and alarm part of the code was tested. For this, a rectangular pulse signal was generated using a pulse generator, same as that of the signal of pulse processing electronics output, and fed to the Arduino board without TFT display. The counts and conditional result was displayed on the serial monitor to verify the correctness of the code. A software counter was implemented and by varying the pulse frequency from 1Hz to 1000Hz, tested for its performance. It was observed that there is a counting error of  $\pm 1$  count at 500 counts per 10 seconds, and as the frequency of the pulse increases the error increases to  $\pm 2$  counts. This error is within the acceptable limit of measurement as per the design consideration. After the satisfactory test results of the counting, the TFT display code was integrated into the earlier tested code.

A simple GUI was designed, as shown in figure 5, to set the ‘threshold’ value and the counting ‘time’ value by the user. The default value of these parameters was set in the code and provided a start/stop button on the screen, as per user requirement. Radiation Counts were displayed and updated every second, once the start button is pressed. After the counting is over, if radiation counts are more than the set threshold value displayed the message ‘CONTAMINATED’ on a red background and triggered the alarm, else displayed the message ‘CLEAR’ on a green background. The whole unit with the LE gamma scintillation detector, pulse processing electronics was then tested successfully for its operation, using a reference gamma source (Cs-137, 2 $\mu$ Ci).



Figure 5: GUI for the LEG contamination monitor

#### IV. CONCLUSION

From the obtained test results, it is concluded that the prototype of the LEG Contamination Monitor is developed

successfully. The development using LE scintillation detector, its electronics, Arduino UNO board, and building easy user interface on graphical TFT display cum touch panel achieved its aim as mentioned in the problem statement. The prototype is working satisfactorily as the required solution to the stated problems. The total cost of the LEG contamination monitor is about Rs. 75,000/- which is less than 20% of the cost of the imported equipment used for a similar purpose.

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- [5] [www.mcufriend.com](http://www.mcufriend.com) for TFT display

# A REVIEW ON EFFICIENT AND INTELLIGENT DRAINAGE MANAGEMENT SYSTEM FOR SMART CITY

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**Abstract**— Water plays the most vital role within our life. India has announced a project of making 100 smart cities. For making a smart city one needs to consider many parameters such as smarter way of water utilization, smart electricity, smart transportation etc. As most of the cities in India have adopted underground drainage system, it is very important that this system should work in a proper manner to keep the city clean, safe and healthy. If they fail to maintain the drainage system the pure water may get contaminated with drainage water and can spread infectious diseases. Drainage management is the practice of using a water control structure in a main, sub main, or lateral drain to vary the depth of the drainage outlet. In recent times, certain actions are taken to improve the level of cleanliness in the country. A lot of stinking and sewage problems cause bad hygienic conditions that lead to human illness and deadly diseases. To avoid these problems, an intelligent drainage management system is need to design where it can overcome these in an innovative and efficient way. This paper reviews a work developed by researchers for implementation of intelligent drainage system. This idea can be implemented for smart buildings, cities, colleges, hospitals, public spots and bus stand.

**Keywords**— *Drainage System, Smart City, IoT, Sensors*

## I. INTRODUCTION

Most of the cities adopted the underground drainage system and it should be in a proper manner to maintain

cleanliness of the cities. If the drainage maintenance is not proper, the pure water gets contaminated with the drainage water infections and diseases may get spread. If drainage gets blocked during the rainy season, then it will create problems in our life. The traffic gets jammed, then the total green environment becomes clumsy, totally it changes the environment in different directions. So, it is the main responsibility of the municipal corporation to clean the drainage and garbage bin instantly and moreover public also should take care of their city. Hence, there should be a facility in the city's corporation, which alerts the officials about blockages in sewers, their exact location and also if the manhole lid is open automatically.

An integral part of any drainage system is the access points into it when it comes to cleaning, clearing, and inspection. Underground drainage consists of sewage system, gas pipeline network, water pipelines, and manholes. Hence detection and repairing of the blockage become time consuming. It becomes very inconvenient to handle the situation when pipes are blocked completely. Due to such failure of drainage line people face a lot of problems. Today's drainage system is not high-tech. So whenever there is blockage it is difficult to figure out the exact location of the blockage. Also, early alerts of the blockage are not received.



Fig 1. Water overflow on to the roads

Fig 1 shows if drainage is not maintained properly then what consequence faced as shown above. If drainage is not maintained properly the following problem may face:

1. Overflow of drainages leads to water flow on to roads, resulting diseases.
2. Overflow of drainages leads to stagnation of water on roads leading to damage of roads.
3. Damages roads bring hell to earth to those who suffer from back ache, pregnant women etc.
4. Damaged roads also lead to accidents less in day light and more in night.
5. If drainage system is not up to mark, investment on roads gets wasted.
6. Improper drainage system also leads to contamination of water, leading to water borne

diseases.

7. Improper drainage system, flooding of roads lead to traffic jams resulting loss of valuable man hours, loss of revenue and employment.
8. Improper drainage system leads to dislocation and woes to population.

Removing storm water and household waste water is an important environmental health intervention in every smart city for reducing diseases. Poorly drained storm water forms stagnant pools that provide breeding sites for disease vectors. Because of this, some diseases are more common in the wet season than the dry season. Household waste water may also contain pathogens that can pollute groundwater sources, increasing the risk of diseases such as lymphatic filariasis. Poor drainage can lead to flooding, resulting in property loss, and people may even be forced to move to escape floodwater.

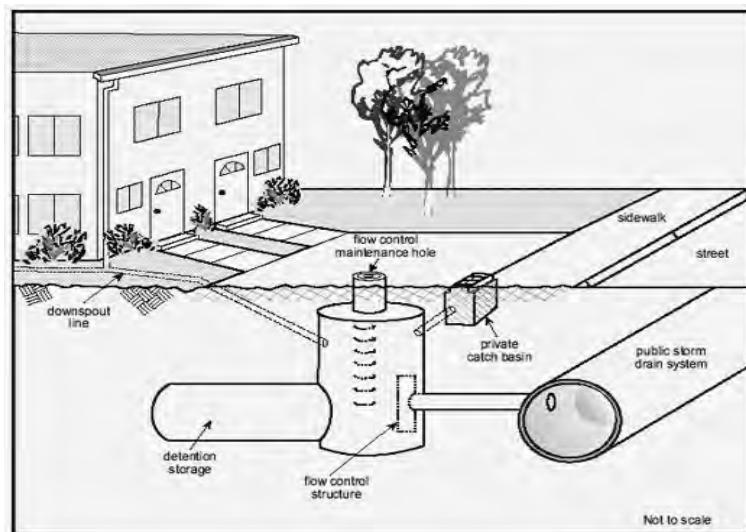


Fig 2: Good maintained drainage system

Flooding may also damage water supply infrastructure and contaminate domestic water sources. As we can see the above figure shows the good maintained drainage system. So, the steps are required to be taken to maintain good drainage system. Some of the steps are as follows:

1. Silt in the drains should be cleaned regularly. If necessary, machines should be employed, the silt removing operation should aim at 0% overflow or leakage of drains.
2. Whenever drainage covers are arranged in the middle of the road, it should be strong work, wherein drainage manhole is very strong and filling around it is very strong. Passing of vehicles on it should not damage its construction.
3. Whenever new drainage connection is given to household the filling between drainage hole and residence where connection is given should be strong.
4. Steps to reduce rain water overflow both on roads as well as in drains.

5. Underground drainage system should be efficient and easily manageable.
6. Urban authorities should have proper control over the functioning; designing should help in reduction in maintenance.

## II. RELATED WORK

Intelligent drainage system is developed by various researchers with help of embedded system design and sensors, which is further described below.

Aditya Dinesh Gupta et.al. [1] presents a review research that exhibits the current state-of the-art of the ongoing SWT along with present challenges and future scope on the mentioned technologies. A conclusion is drawn that smart technologies can lead to better water resource management, which can lead to the reduction of water scarcity worldwide. The design and development of a prototype Smart Sewer Asset Information Model (SSAIM) [9] for an existing sewerage network is presented. The SSAIM, developed using Industry Foundation Class version 4 (IFC4) an open neutral data format for BIM, incorporates

distributed smart sensors to enable real-time monitoring and reporting of sewer asset performance. A terminology for MPC of urban drainage systems [15] and a hierarchical categorization where we emphasize four overall components: the “receding horizon principle”, the “optimization model”, the “optimization solver”, and the “internal MPC model”. This review highlights methods, challenges, and research gaps in order to make MPC of urban drainage systems accessible for researchers and practitioners from different disciplines.

The use of smart sensors for monitoring both the storm water and wastewater networks [16] of the scientific campus of the University of Lille in the North of France. This campus stands for a town of around 25 000 users. For each network, the paper presents the monitoring system, analysis of the recorded data and how this analysis resulted in enhancing our understanding of the network functioning as well as its improvement. Javier Rocher et.al. [17] shows the application of a level sensor and a rain sensor for monitoring the separated sewerage. The level sensor is used for knowing if there is a critical level of water in the sewerage. The rain sensor is used to know if it is raining. The combination of this information allows the identification of three scenarios.

Most of researchers developed effective drainage or sewage management system with the help of microcontroller and various sensors, their implementation is summarized in the table 1 given below.

Table 1: Implementation of drainage system by various researchers

References	Methodology	Microcontroller/ Sensors Used	Limitation
Nathila Anjum. G. et.al. [2]	proposed model provides a system of monitoring the water level and atmospheric temperature and pressure inside a manhole	Arduino Uno Microcontroller, Flow sensor, level sensor, temperature sensor and gas sensor	Lack of data monitoring on internet via user-based application
G. Sunitha et.al. [3]	Proposed Smart underground sewage and solid waste management system in which simply monitoring the level using an ultrasonic sensor, it generates signals to the required departments	Node MCU, Ultrasonic sensor	Failed to detect precise level using Ultrasonic sensor

L. Nikhil Sai et.al. [4]	Proposed system would track the level of water, flow of water and harmful gas in the sewage system	Node MCU, Gas Sensor, Ultrasonic Sensor, Flow Rate Sensor	Need to calibrate the gas level for controlling, flow rate sensor unable to measure proper heavy flow with large capacity
Gaurang Sonawane et.al. [5]	Proposed model represents the application and design function of a smart and real-time drainage and manhole monitoring system with the help of Internet of Things	AVR ATmega328, Water Level Sensor, Gas Sensor, Blockage Sensor	No dedicated Wi-Fi based microcontroller device for internet connection
S. Ravichandran et.al. [6]	Proposed drainage system describes the design and mechanism of locating the blockage and removing the same in the drainage system using internet of things	Microcontroller, level sensor, gas sensor, temperature and pressure sensor	No user friendly application for user to monitor real time data
Yan Pang et.al. [7]	Proposed model uses various machine learning techniques to model the nonlinear relationship between rainfall and drainage water level nearby and predict the water level with lead time up to 10 minutes in advance	Rain gauge and water level sensor	No hyper-parameter tuning of machine learning algorithm to further improve accuracy
V. Vani et.al. [8]	Proposed system presents with flow sensor and ultrasonic sensor which detects leakage and	Raspberry PI, Ultrasonic Sensor, Water Flow	Failed to detect precise level using Ultrasoni

	overflow respectively with the help of Wireless Sensor Network (WSN) which is based on ZigBee technology and Internet of Things (IOT) and an alert is sent through the mobile app	Sensor	c sensor and flow sensor unable to measure proper heavy flow with large capacity
R. Priya et.al. [10]	Proposed system developed for water supply management with sensor devices	Arduino Uno, Ultrasonic Sensor	Need to manage the water usage
Jyoti Jadhav et.al. [11]	Proposed model present ideas to make the cities smart and in that we are implementing smart drainage system which gives the solutions to avoid many problems which are beneficial for the society	PIC Microcontroller, Chamber crack detection sensor, Water level sensor, Choke up sensor, Water quality checker	Insufficient data management and no monitoring of data over internet
Ankita Karale et.al. [12]	Proposed system represents the implementation and design functions for monitoring, detecting and managing underground drainage system with different approaches	Arduino Uno, Ultrasonic Sensor, Gas Sensor	No user-friendly graphical application provided
K. Viswan adh et.al. [13]	Proposed model represents the implementation and design functions for monitoring and managing underground drainage system with different approaches. It also gives a description of water wise system and detection method to detect	Node MCU, Flow Sensor	Used flow sensor not suitable for real time applications

	leakage defects in sewer pipeline		
Arulan anth T. S. et.al. [14]	Proposed system which is developed to monitor the water level, water flow and gases	ARM 7, Flow sensor, Liquid Level Sensor, Gas Sensor	No user-friendly UI applications for mobile version
Yash Narale et.al. [18]	Proposed system of Underground Drainage Monitoring Using IoT	ARM 7, Flow Sensor, Level Sensor, Temperature Sensor, Gas Sensor	No suitable microcontroller used for IoT

### III. CONCLUSION

Efficient drainage management systems are useful for making cities clean. The waste water or drainage water can be also provided to the farms using proper water purifying technique. This review has summarised the work carried out by various researchers related to drainage system, associated problems, and their solutions, in the last two decades. This can help researchers working in intelligent drainage system to identify their problem statements and make efficient system to tackle the problems in it.

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# Lyrics Based Classification of Songs

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**Abstract - Text classification is a supervised machine learning technique, which is used for automatic classification of massive data in cloud storages. This paper mainly focuses on the concepts of data pre-processing, feature extraction, and text classification to evaluate the model and problem of classification of songs. The goal of our research is to classify music genre solely based on lyrics of a song using various classification models. For this, a set of songs from the various categories such as rock, pop, classical etc. are chosen and the model is trained to classify songs based on their categories. The results shown are based on the more frequent words in the respective category. The proposed method performs classification and calculates accuracies for the different algorithms for the given dataset. The dataset consists of lyrics collected from three different genres such as country, pop and punk rock having more than 800 songs in total. Then we test the classifier model by giving full lyrics of a particular song.**

**Keywords - Machine Learning, Natural Language Processing, Text Classification, Lyrics Classification.**

## I. INTRODUCTION

Text classification is one of the vital tasks in supervised machine learning [1], which is used to assign some tags or categories based on the given texts or documents. Text classification is the heart of all variety of software which process text data. One of the primary functions of text classification is to assign the categories automatically to the songs based on lyrics by using Natural Language Processing [2]. The main application is in email spam detection, a sentimental analysis. Text classification [3] uses many classifiers for a successful classification some of them are Naive Bayes, Ridge Model, K-Nearest Neighborhood, Decision Tree, Random Forest. Natural language processing, commonly shortened as NLP, is a branch of artificial intelligence that deals with the interaction between computers and humans using natural language. The graphical user interface (GUI) is the point where human-computer can interact and communicate in a device. This may include the presence of a display screen, keyboard, a mouse, and a desktop. It is also the way through which a user interacts with the application or with a website. The GUI of this application builder using web languages like Hyper Text Markup Language (HTML), Cascading Style Sheet (CSS), BOOTSTRAP and deployed using Flask framework.

## II. LITERATURE SURVEY

Text classification is an essential task in supervised

machine learning. The automatic classification of music is an important and well-researched work. We provide a user interface that will enable the user to input the lyrics of a particular song and our program will predict its genre based on the content of the song. Since manual text summarization is a time expensive and generally laborious task, the atomization of the task is gaining increasing popularity and therefore constitutes a strong motivation for academic research. Automatic text summarization is a common and main problem in machine learning and natural language processing (NLP). Ridge Model:

Linear regression is probably the most popular method to solve regression problems. We use its regularized version called ridge regression. This is known to alleviate problems associated with matrix inversion in linear regression and is also less prone to over fitting thanks to regularization. It finds a linear solution to the problem

$$\arg \min_w w^T \sum_{i=1}^n (y_i - (w^T x_i + b))^2 + \lambda \|w\|^2 \quad (1)$$

Where  $x_i$  represents the  $i$ , the individual and  $y_i$  is the phenotype target value. We use a recently proposed method to automatically set  $\lambda$  and the R Package Ridge to run this method. [4]

### Logistic Regression:

Logistic regression model (LRM) is a regular and effective method of statistical analysis for two-class regression analysis. It has extensive application in such fields as economics, sociology, and medicine etc., but it is less in the field of information processing. Logistic regression is a nonlinear model therefore the parameters of the model are estimated by maximum likelihood generally. It is proved that maximum-likelihood estimation of logistic regression has the characteristics of consistency, asymptotic validity and asymptotic normality. [5]

### Decision Tree:

Decision tree algorithms calculate similarity scores extensively and accurately. This has been shown to be efficient for scenarios where the synergy between elements is low. To overcome the problem from the order of classes in rule learning, Complexity-based Parallel Rule Learning algorithm is suggested [6]. In a different setting, multi-class classification is tried by com- Text Classification Techniques 120 binning kernel density estimation with k-NN [7]. This improves the weighting principle of k-NN, increasing the accuracy of classification. It has also been proven efficient for

complex classification problems.

#### K-Nearest Neighbor:

K-Nearest Neighbor (k-NN) works on the principle of closest training samples, those data points that are close to each other belong to one particular class, commonly called instance-based learning. Spark also supports in-memory operation, cloud integration and streaming algorithms. Some of the other existing learning strategies for this problem are, re-sampling, cost-sensitive learning and learning algorithm-specific approaches. The extension of this work could be carried out for multiple rare class situations and rank instances based on posterior probability of each class. K-NNs are most popular for classifying examples based on the context of data points through majority voting. This method is highly suitable for small datasets. [8]

#### Gaussian NB:

Naive Bayes is a machine learning algorithm whose classification efficiency is proved in applications such as document categorization and e-mail spam filtering [9]. Naive Bayes is a specific way of handling constant features in class to cation, using a Gaussian distribution to represent the probability of the features conditioned on the classes. [10] Thus each attribute is defined by a Gaussian probability density function as

$$X_i \sim N(\mu, \sigma^2) \quad (2)$$

The Gaussian PDF has a bell shape and is need by the following equation

$$N(\mu, \sigma^2)(x) = \frac{1}{\sqrt{2\pi\sigma^2}} e^{-\frac{(x-\mu)^2}{2\sigma^2}} \quad (3)$$

where  $\mu$  is the mean and  $\sigma^2$  is the variance. In Naive Bayes, the parameters needed are in the order of  $O(nk)$ , where  $n$  is the number of attributes and  $k$  is the number of classes. Specifically, we need to de fine the normal distribution  $P(X_i | C) (N(\mu, \sigma^2))$  for each common feature. With the parameters of such a normal distribution can be obtained

$$\mu_{Xi|C=c} = \frac{1}{N_c} \sum_{i=1}^{N_c} x_i \quad (4)$$

$$\sigma^2_{Xi|C=c} = \frac{1}{N_c} \sum_{i=1}^{N_c} x_i^2 - \mu^2 \quad (5)$$

where  $N_c$  is the number of examples where  $C=c$  and  $N$  is the number of total examples used for training. It is easy to use such relative frequencies to calculate  $P(C = c)$  for all classes.

$$P(C = c) = \frac{N_c}{eN} \quad (6)$$

#### Multinomial NB:

The MNB is a probabilistic generative approach building a language model that assumes conditional independence among linguistic features. It is simple and can be flimsily scaled for very large numbers of classes, unlike discriminative classifiers. It is normally robust even when

assumptions of the MNB are violated. Being a probabilistic model, it is very easy to extend for structured modeling tasks, such as multi-documents and multi-label classes. Therefore, neither sense of history nor sequential order is introduced in this model. With real practicing, this assumption does not mean for textual data, although the probability estimates are of low quality because of this over simple model, classification decisions of the MNB based on Bayes' decision rule are surprisingly good. The MNB combines efficiency with good accuracy, hence it is often used as a baseline in text classification. [11]

#### Random Forest:

A random forest is a classifier consisting of a collection of tree-structured classifiers, where independent random vectors are distributed as identities and each tree votes a unit for the most popular class on input  $x$ . A random vector is generated that is independent of previous random vectors with the same distribution and a tree is generated using the training test. For random forests, an upper limit is created to obtain the normalization error in terms of two parameters which are given below:

The accuracy of individual classifiers

The dependency between the individual classifiers

The normalization of error for random forest consists of two sections. These segments are defined below:

Strength of individual classifiers in the forest.

The correlation between them in terms of raw margin function [12]

#### 3. Procedural Diagram

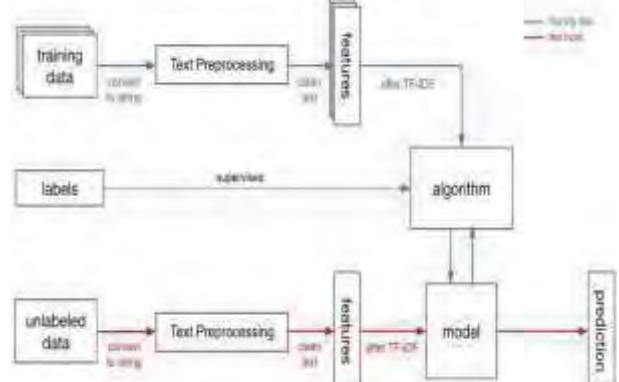


Fig 1. Procedural Diagram

The process of getting music genre category is explained using the diagram in Fig 1.

Basic Algorithm for Text Classification: -

Step 1: -Loading of dataset.

Step 2: -Text Cleaning and pre-processing.

Step 3: -Feature extraction.

Step 4: -Splitting the dataset into training and testing set.

Step 5: -Fitting the Models.

Step 6: -Determining accuracies of different models.

Step 7: - Deploying the machine learning models using Python's Flask web framework.

#### III. RESULT

Fig 2 and Fig 3 show user interface where user have to

write the lyrics of the song in input field below “Enter Your Text” Label. Then Scrolling down to select classifier and how many sentences are there in your input and click on Get Classify. User will get the genre of the input song as shown in Fig 5.

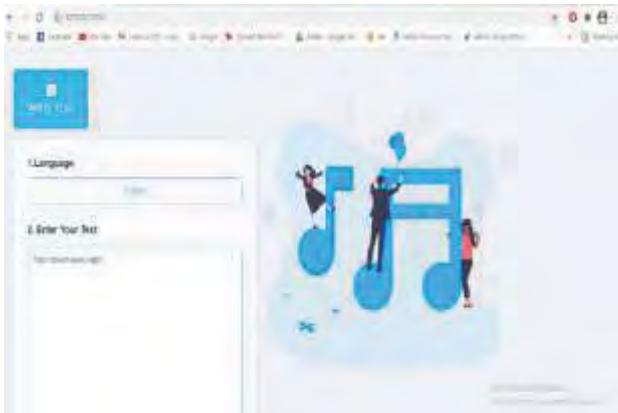


Fig 2. Input

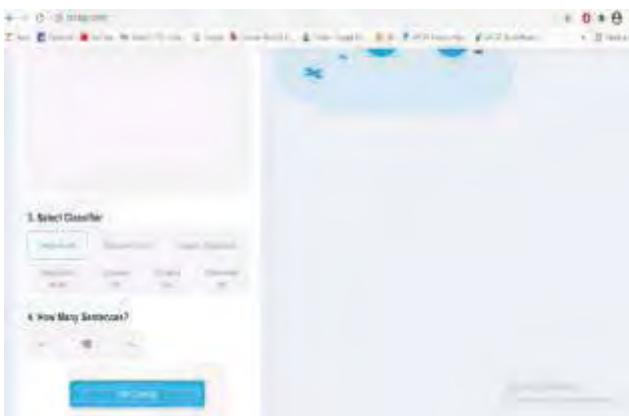


Fig 3. Classifier

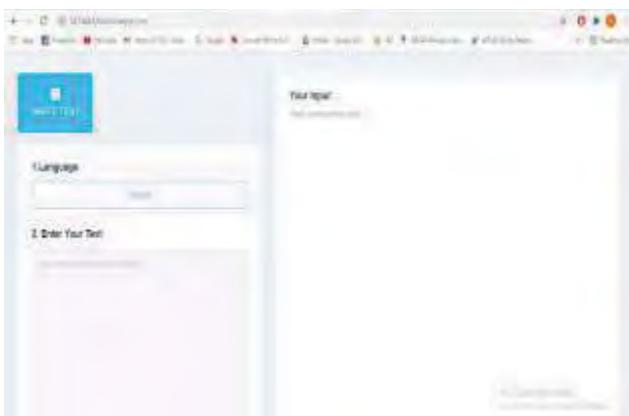


Fig 4. Output

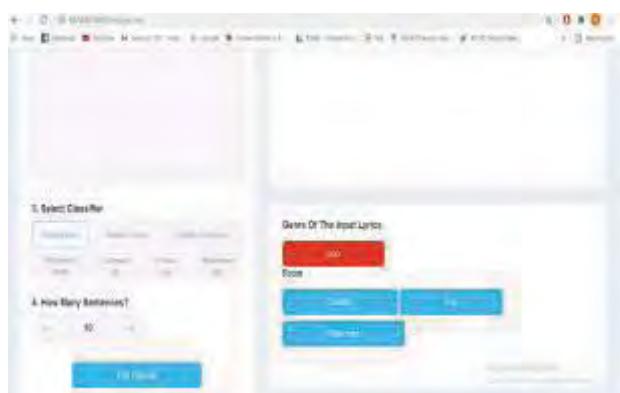


Fig 5. Getting Genre

The accuracies of the various models are compared using a graph shown in Fig. 6.

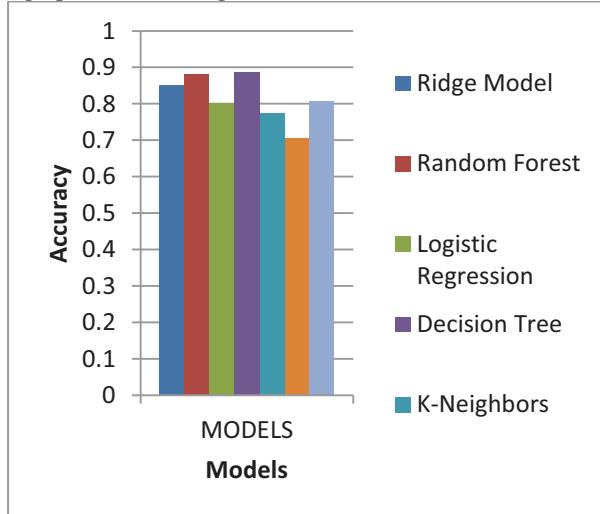


Fig 6. Accuracy

#### Result Analysis

From the graph in Fig. 6, we can conclude that Random Forest and Decision Tree models have good accuracies as compared to other models having more than 90% accuracy. In our project it helps to find accurate lyrics for the mentioned category.

Decision Tree is mostly preferred for solving Classification problems. It is a tree-structured classifier, where internal nodes represent the features of a dataset, branches represent the decision rules and each leaf node represents the outcome. The logic behind the decision tree can be easily understood because it shows a tree-like structure. Random Forest is an ensemble of decision trees. In simple words, it builds multiple decision trees and merges them together to get a more accurate and stable prediction.

#### IV. CONCLUSION

In this paper, a method using various classification models to classify music genre category of the songs based on lyrics is proposed. The proposed approach can be used for automatic music classification in commercial music download services. Creating a dataset was a tedious and time-consuming task, partly because it was created manually and partly because of doubt about inserting some songs into the dataset. In our future research, it would be interesting to examine how the

model behaves in a more accurate root words for Hindi songs.

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# Text Summarization Using Latent Semantic Analysis Approach

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**Abstract**—Text summarization is commonly used by several websites and applications to create news feed and article summaries. It has become very essential for us due to our busy schedules. We prefer short summaries with all the important points over reading a whole report and summarizing it ourselves. Text summarization solves the problem of presenting the information needed by a user in a compact form. There are different approaches to creating well-formed summaries. One of the newest methods is the Latent Semantic Analysis (LSA). In this paper, we propose a method of the text summarization using Latent Semantic Analysis approach. Latent Semantic analysis is a technique that uses vectorial semantics, for analysing relationships between documents and the terms they contain by producing a set of concepts related to documents and terms. It looks at all the documents as the whole. Using this technique we have tried to overcome the limitations in traditional methods.

**Keywords**—Abstractive Summarization, Extractive Summarization, Latent Semantic Analysis, Summary Evaluation.

## I. INTRODUCTION

The growth in electronically available documents makes it difficult to obtain the necessary information related to the needs of a user. Summarization is a technique to shorten long texts such that the summary has all the important points of the actual document. By using the summary produced, a user can decide if a document is related to his/her needs without reading the whole document.

In the studies of Das and Martins [1], the aspects of a summary are defined as follows:

- First, a summary can be created using single or multiple documents.
- Second, a summary contains all necessary information and it does not include redundant information.
- Third, a summary is short, at least shorter than half of the original document.

Text summarization systems can be categorized as extractive or abstractive according to the way the summary is created. The extractive approach involves picking up the most important phrases and lines from the documents and combines all the important lines to create the summary whereas abstractive approach involves summarization based on deep learning where new phrases and terms, keeping the meaning same. The first studies on document summarization started in the late 1950s, and were based on surface level information. Later, statistical approaches, more semantic-oriented analysis such as lexical chains and algebraic-based methods such as Latent Semantic Analysis (LSA), were developed for text summarization. In this paper, we present a generic extractive text summarization system based on LSA.

### Latent Semantic Analysis:

Latent Semantic Analysis is an algebraic-statistical method that extracts hidden semantic structures of words and sentences. It is an unsupervised approach that does not need any training or external knowledge. LSA uses the context of the input document and extracts information such as which words are used together and which common words are seen in different sentences. A high number of common words among sentences indicates that the sentences are semantically related. The meaning of a sentence is decided using the words it contains, and meanings of words are decided using the sentences that contain the words.

In order to see how LSA can represent the meanings of words and sentences the following example is given.

Example 1- *Three sentences are given as an input to LSA.*  
*d0: 'The girl walked to house'.*  
*d1: 'The girl took the cat to her house'.*  
*d2: 'The cat went to the house'.*

After performing the calculations we get the results , we can see that d1 is more related to d2 than d0; and the word ‘walked’ is related to the word ‘girl’ but not so much related to the word ‘house’. These kinds of analysis can be made by using LSA and input data, without any external knowledge.

### Term Frequency-Inverse document frequency:

TF-IDF is a statistical measure that evaluates how relevant a word is to a document in a collection of documents. This is done by multiplying two metrics- how many times a word appears in a document, and the inverse document frequency of the word across a set of documents. The lower the value, the less specific it is to document.

### II.RELATED WORKS:

Text summarization is an active research area of natural language processing. Text summarization method can be categorized according to how they are created and which approach is used for creation of summaries [1]. Summaries can have different forms [2]. Thus, there are various text summarization approaches in literature. The first study on summarization which was conducted in 1958 was based on frequency of words in the documents. After this study many other approaches arose based on simple features like terms from key- words, frequency of the words and position of the words /sentences. Also, various summarization techniques are based on extractive and abstractive methods and its types are present [3]. The algorithms of Baxendale and Edmundson [4] are examples of approaches based on simple features. There are graph -based summarization approaches for text summarization. As stated in Jezek and Steinberger [5], well known graph based algorithms were developed to understand the structure of Web. In recent years, algebraic methods such as LSA, Non -negative Matrix Factorization (NMF) and Semi-discrete Matrix Decomposition have been used for document summarization. Among these algorithms the best known is LSA, which is based on singular value decomposition (SVD). There is risk involved in picking up sentence as a representative of whole document set [6] for generating summary. So, its important to adopt a crucial method for picking(selecting)sentences for summary

### III.IMPLEMENTATION

The application provides a strong single document automatic summarization system. We have used unsupervised, extractive based technique of LSA. The following Fig. 1 is the implementation steps of our system:

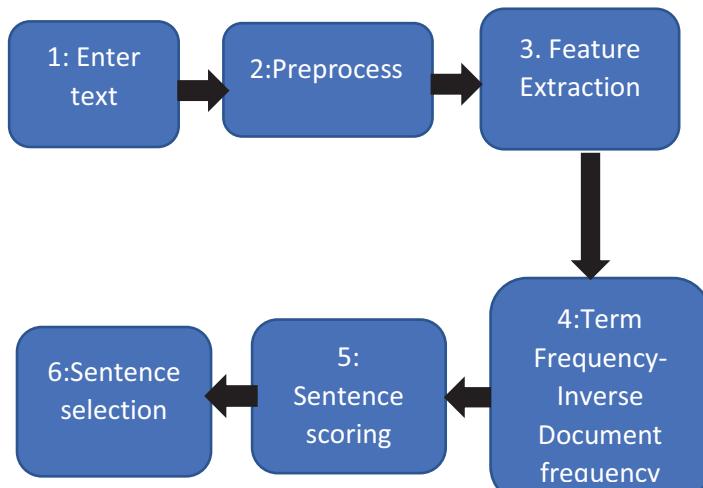


Fig. 1. Implementation of the system.

**Step1:** Loading the text document is the primary step for

beginning with the summarization process. Pre-processing is done on the input document. Pre-processing includes tokenization.

**Step2:** The next step is Tokenization. It is a method of converting a stream of characters into a stream of processing units called tokens by splitting the words from sentence into their units and then remove the punctuation marks, parenthesis, quotes, whitespace positioning, etc. so that sequence of tokens can be obtained. As the input document is in paragraph form, sentence is done to separate the sentences in the documents.

**Step3:** Tokenization is followed by sentence organization. Here, the tokenized sentences are allotted with a number. Ex-

{'The girl walked the house.': 0, 'The girl took the cat to her house': 1, 'The cat went to the house.': 2}

**Step4:** Feature extraction is done in this step. First step is to give the tokenized sentences to TFIDF vectorizer. It is used to extract the important words from the documents. A higher value means word is more frequent in the sentence but less in the document.

**Step5:** Now, we will have the numerical representation of those text words where first term indicates the sentences, second term indicates the word and the values against them are TFIDF values for that word, which indicates their significance. Ex-

(0, 0)	0.3240189532314803
(0, 6)	0.5486117771118656
(0, 1)	0.4172333972107692
(0, 3)	0.6480379064629606
(1, 2)	0.3048579738619217
(1, 4)	0.3048579738619217

**Step6:** After getting the important words, the sentence scoring is done, the sentences having maximum relevant words are given maximum score. Finally, each sentence has a score. To generate a summary of the top n sentences with the highest score are given as output. Here, n is the no. of sentences required in the summary by the user.

### IV.RESULTS

The Text summarizer using LSA works on the principle that words which are close in meaning will appear in similar pieces of text. As the system is extractive based, every line and word of the summary actually belongs to the original document which is summarized.

The original document is tokenized to give sentences and create bag of words without stop words. They are put in TFIDF vectors to give the important words in the document. Sentence scoring is done on the basis of the presence of relevant words. So, after sentence scoring step, the output produced is the top n important sentences from the input text document. Our system gives summary based on required number of sentences in the summary. Following are the example text we had given as input to our system for generating summary.

#### Example 1:

*Chandrashekhar Azad famously known as 'Azad' was born on 23 July 1906 in the present-day Alirajpur district of Madhya Pradesh. He was 15 years old when he joined Gandhiji's Non-Cooperation Movement. Hailed as the face of revolutionary in India, his patriotism and courage inspired the youth to join India's struggle for freedom. He quickly rose into prominence and became one of the main*

strategists of the Hindustan Republican Association. Azad was a fearless man who chose to make the supreme sacrifice by taking his own life to escape imprisonment and torture at the hands of the British. The park in Allahabad where Chandra Shekhar Azad died on 27 February 1931, has been renamed Chandrashekhar Azad Park, and the Colt pistol that he used is displayed at the Allahabad Museum.

#### Summarized text:

Chandrashekhar Azad famously known as 'Azad' was born on 23 July 1906 in the present-day Alirajpur district of Madhya Pradesh. Azad was a fearless man who chose to make the supreme sacrifice by taking his own life to escape imprisonment and torture at the hands of the British. The park in Allahabad where Chandra Shekhar Azad died on 27 February 1931, has been renamed Chandrashekhar Azad Park, and the Colt pistol that he used is displayed at the Allahabad Museum.

#### Example 2:

The magnificent tiger, *Panthera tigris* is a striped animal. It has a thick yellow coat of fur with dark stripes. The combination of grace, strength, agility and enormous power has earned the tiger its pride of place as the national animal of India. Out of eight races of the species known, the Indian race, the Royal Bengal Tiger, is found throughout the country except in the north-western region and also in the neighboring countries, Nepal, Bhutan and Bangladesh. To check the dwindling population of tigers in India, 'Project Tiger' was launched in April 1973. So far, 27 tiger reserves have been established in the country under this project, covering an area of 37,761 sq km.

#### Summarized text:

Out of eight races of the species known, the Indian race, the Royal Bengal Tiger, is found throughout the country except in the north-western region and also in the neighbouring countries, Nepal, Bhutan and Bangladesh. So far, 27 tiger reserves have been established in the country under this project, covering an area of 37,761 sq km.

#### Summary evaluation:

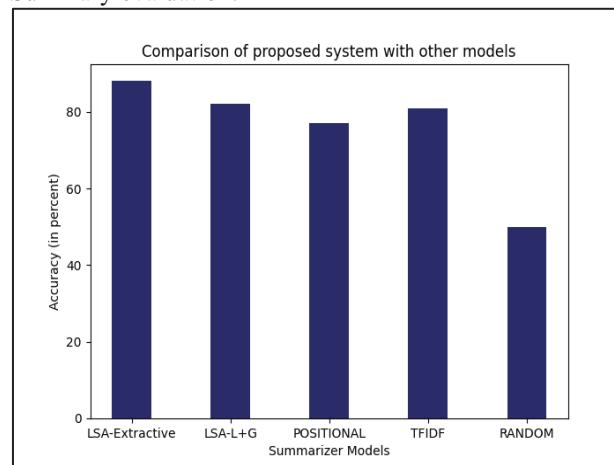


Fig. 2. Graph of comparison between our system and the other summarizers.

We have evaluated our summarizer against the other

summarizers as shown in Fig. 2. by calculating the precision of the summary generated. We have compared our LSA based method against Gong-Liu LSA, Positional Method, TFIDF, RANDOM methods of the previous researches. We have plotted the accuracy of summaries generated by our system and the other systems.

To calculate accuracy, first compared our system's generated summary against the summary from automatic summarizers and then the formula is used :

$$\text{accuracy} = \frac{\text{No. of similar word}}{\text{Total words in summary}}$$

For example1 accuracy is:

$$\text{Accuracy} = 70/80 = 0.875$$

Our system of summarizer based on LSA has 87% accuracy. This accuracy is mapped against different traditional summarizers.

#### V.CONCLUSION

Finding out the information related to the needs of a user among large number of documents is a problem that has become obvious with the growth of text-based resources. In order to solve this problem, text summarization methods are proposed and evaluated. We have used an unsupervised, extractive based algebraic-statistical approach - the Latent Semantic Analysis method. The system gives summary as per requirement of number of sentences by the user. As, the model is extractive based, the summary contains the similar words as original text. The system has 87% accuracy as compared to other traditional summarization methods. The model can further be upgraded by employing other approaches to generate summary.

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# SURVEILLANCE ROBOT FOR OBJECT DETECTION USING RADAR IN MILITARY

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**Abstract**— Robot in a military context is a powered machine that senses, thinks in a non-mechanical sense then and acts. Object detection is a technology related to computer vision and image processing that deals with detecting the instances of semantic objects of a certain class (such as humans, buildings, or cars) in digital images and videos. This project focuses on the design and build of a semi-autonomous, unmanned robotic system used for basic military tasks. The robot has the ability to detect, and communicate any intruder in its arena and report it to the user. This reduces the risk of being caught and proves smart work. The robot being small and mobile takes pictures, records conversations and sends videos back to the ground stations from areas that are difficult to access for the soldiers. We use radar communication to this surveillance robot to ensure safety to the military camp where any unwanted object/ activity entering the perimeter of the will be detected and communicated to the authority as an intruder. The project is cost efficient and environment friendly.

**KEYWORDS :** Military, RADAR, Robot, Surveillance, intruder

## I. INTRODUCTION

In today's world the monitoring of military areas is essential due to increased attacks of the enemies but the quality of that monitoring i.e. surveillance is not that much satisfactory, this results in the increasing ratio of lives of the soldier in danger. Because of that it is necessary to improve the quality of the surveillance through effective surveillance. This is done more effectively by high quality video transmission. In this paper the quality of video is improved using Closed Circuit Cameras. For all this there is a need of the ground[1].

Robot which is able to move on the hills, muddy areas. By using Closed Circuit Cameras various technical advancements are took placed in surveillance. Lots of crime scenes has been solved by using this technology but still, the crime rate has not reduced because of immobility of the surveillance equipments. In this paper design and development of the robot is done which will move from one place to another, it has capability of capturing real-time images and videos required for the surveillance. The main constraint in surveillance is mobility of the robot. This robot is also capable of doing housekeeping.[7]

The robot is basically electro-mechanical machine or device that is controlled either by computer program or with electronic circuit to perform variety of physical tasks. With the gradual development in technology scientists come up with new ideas and inventions of robots. In the today's life robot are becoming indispensable part of human life. Surveillance is major thing when we are going to secure anything as it is tedious job peoples are getting boarded becuase of that it will might risky to observing all these things we are going to make a robot which is continuously monitor thing. This robot continuously

watch and sending a live streaming of it to a authorized person. Because of that monitoring the work will be some what easy and it will bee made accurate because of technology.[2,3]

The military is undeniably the primary customer of new advances and improvements in strategy, and is also often the sponsor of new improvements when it comes to envisioning new innovations in military settings. Numerous basic military technologies deployed out of the blue are now advanced to the piece of industrial robots. In any case, the importance of military autonomy and modern mechanical autonomy is still quite different. The military has special, robotic equipment while, in modern terms, the robot is a larger amount of a smart, adaptable, large-scale manufacturing machine. Cost and development of the specialized capacity of the innovative robot will build the enthusiasm of the military customers.[4]

## II. PROJECT SPECIFICATION

The basic aim of the project is to conduct surveillance in the areas where throughout monitoring is required. Also, the basic concept of the project is to reduce the usage of RF sensors to promote better propagation and exchange of information via Ultrasonic sensors. Another thumb rule concept of the project is to reduce the components by allowing a digital server to store all the necessary data and monitor it whenever we want.

## III. HARDWARE IMPLEMENTATION

### A. Node MCU

NodeMCU is a low-cost open source IoT platform. It initially included firmware which runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which was based on the ESP-12 module. Later, support for the ESP32 32-bit MCU was added. NodeMCU is an open-

source firmware for which open-source prototyping board designs are available. The name "NodeMCU" combines "node" and "MCU" (micro-controller unit). The term "NodeMCU" strictly speaking refers to the firmware rather than the associated development kits.

#### B. Ultrasonic Sensor

The HC-SR04 Ultrasonic (US) sensor is a 4 pin module, whose pin names are Vcc, Trigger, Echo and Ground respectively. This sensor is a very popular sensor used in many applications where measuring distance or sensing objects are required. The module has two eyes like projects in the front which forms the Ultrasonic transmitter and Receiver. The amount of time during which the Echo pin stays high is measured by the MCU/MPU as it gives the information about the time taken for the wave to return back to the Sensor.

#### C. Chassis Model

Aluminum Chassis comprise the body of a robot. Roll cages, bumpers and other body accessories can also be found in this category. The components of a robot are the body/frame, control system, manipulators, and drivetrain. At the most basic level, the chassis of an automobile consists of only the frame. A chassis is the skeletal framework of a vehicle on which most of the mechanical parts like tires, axle assemblies, steering, brakes, and the engine are fastened. A vehicle frame, on the other hand, is the main structure of the chassis. All the other components, including the chassis, are fastened to the frame.

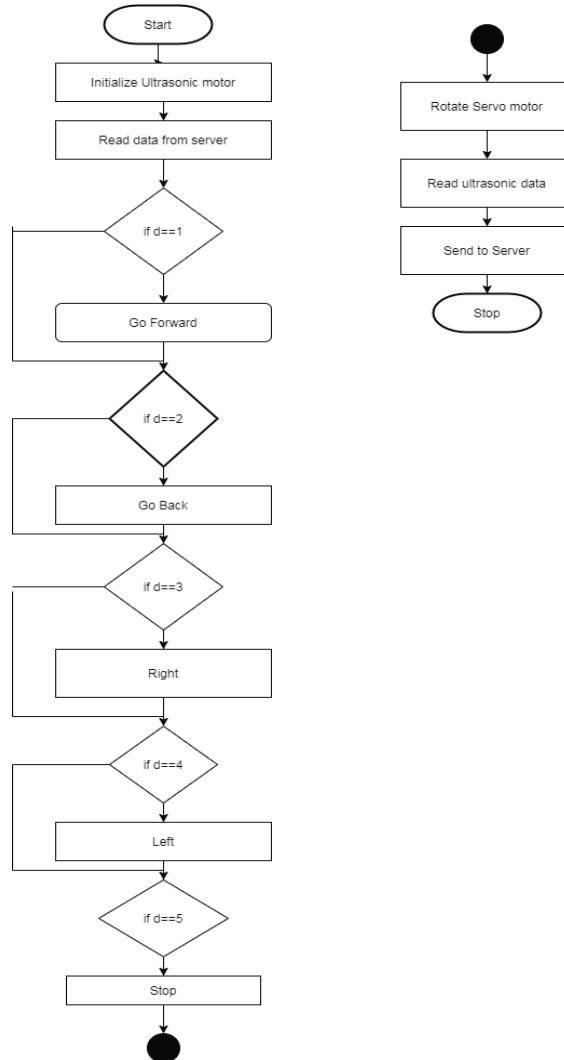
#### D. L293D

The L293D is a popular 16-Pin Motor Driver IC. As the name suggests it is mainly used to drive motors. A single L293D IC is capable of running two DC motors at the same time; also the direction of these two motors can be controlled independently. L293D IC is a typical Motor Driver IC which allows the DC motor to drive on any direction. This IC consists of 16-pins which are used to control a set of two DC motors instantaneously in any direction. It means, by using a L293D IC we can control two DC motors. As well, this IC can drive small and quiet big motors. An H-Bridge is nothing but an electronic circuit. Using such a circuit, you can supply current in two directions. The L293D is an H-Bridge with two possible outputs. Meaning, you can connect two things to it and you can control the direction of current flow in both. Half an H-bridge will connect an output pin to either Vcc or Ground or disconnect it. Using one you can turn a DC motor on or off or apply braking but can't reverse the motor. To reverse a DC motor you need both halves of an H-bridge

### IV. METHODOLOGY

Considering the following flowchart, we describe the working of the surveillance robot. The robot works with two simultaneous operations being, the controls of the robot and the movement of the RADAR sensor. When the power supply is switched on, the controller is in the ON state allowing the robot to start its basic operations. The robot then initializes the ultrasonic sensor and is ready to read the data from the server. This data will be available

on the GUI webpage created for the robot where the camera from the mobile phone will get access to any intruder and serve as data to the ultrasonic sensor.



**Fig. 4.1 Flowchart of the working of robot**

The first simultaneous process of the robotic movement is initialized. Whenever the condition internally is fulfilled, the robot changes its direction according to the control given to it via the control keys by user. There are namely five conditions for the movement of robot. When the processor gets the data,  $d==1$ , the controller reads it as forward condition and allows the robot to move in forward direction, while when the processor gets the data,  $d==2$ , the controller reads it as reverse/ move back direction and allows the robot to move in backward direction. The other condition of the robot being the left and right movement, when  $d==3$ , the robot is supposed to move right, whereas it moves left when  $d==4$  and finally stops when  $d==5$  is entered. Meanwhile the robot simultaneously performs the second action while it is still in movement under the user's control. The second action is to continuously rotate the servo motor that has the ultrasonic sensor attached to it.

This rotation allows the sensor to move at 180 degrees about its axis and sense any incoming intruder/

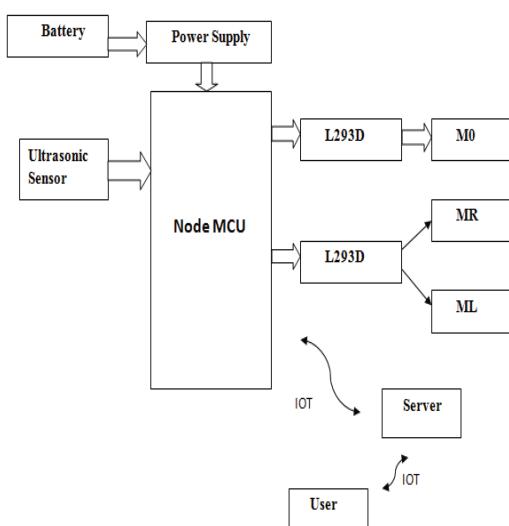
material/object. While the rotatory motion, the sensor must continuously read the data and send it to the server that stored information of all the detected objects in its range. While the rotatory motion, the sensor must continuously. Read the data and send it to the server that stored information of all the detected objects in its range. That is how both the processes are simultaneously in action by connecting them with the connector (Black DOT in the flow chart)

## V. BLOCK SCHEMATIC

Power supply unit starts its function when it steps down the required voltage to drive the Node MCU from the 12V battery.

The node MCU then starts its function. There are two L293D motor drivers connected to the node MCU that will start the motor drivers. The function of motor driver is to produce rotatory motion to the devices connected to it. One motor driver can drive two separate components.

The first motor driver will drive the left wheel and the second motor driver will drive the right wheel. The other motor driver is connected to the ultrasonic sensor that will be mounted on to pro produce 180-degree rotation to the sensor to detect the objects in its range.

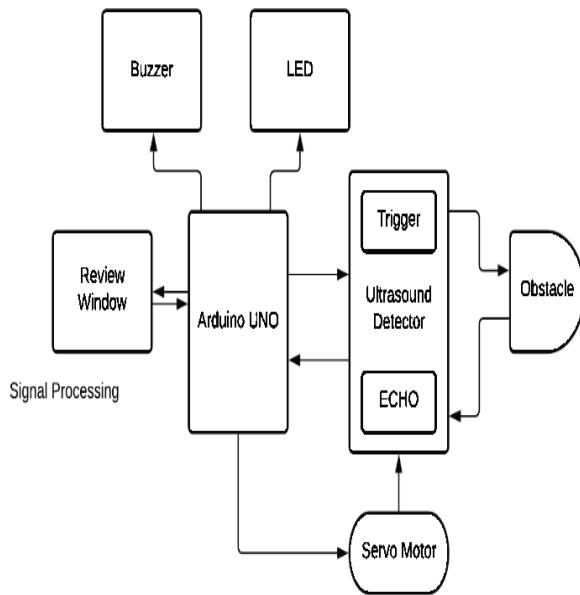


**Fig. 5.1 Block Diagram of Robot**

The ultrasonic sensor mounted on top will read the data present in its range and send it to the server using IOT. This data in the server can be accessed by the user anytime using the GUI portal via IOT. All data stored can be accessed and monitored simultaneously.

The camera used for monitoring is the mobile camera that will have an app which when placed on the robot with its camera on, will help user to see and detect any intruder live. This mobile camera technology makes it easy to access the data and also reduces the linkage of an actual camera module which when spoilt can result in failure of the robot while, the mobile camera as an external source

will help user to connect any mobile camera when in need, not limiting its use to a single restricted mounted camera module.



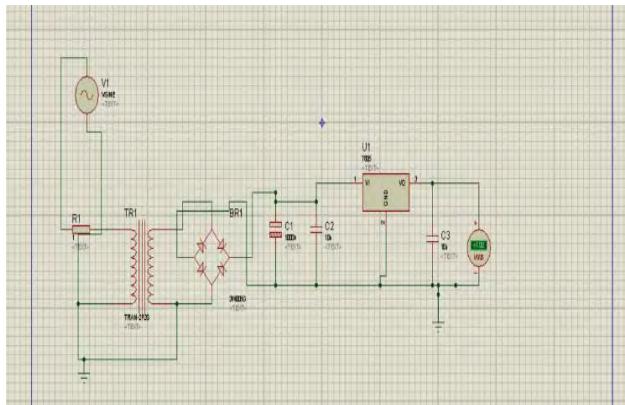
**Fig 5.2 Block Diagram of RADAR**

The working of the Ultrasonic sensor requires some specifics on its detection. Radio Detection and Ranging (RADAR) has proven to be an effective tool for urban sensing and through-wall imaging. Nowadays detecting object in the border region continuously is difficult. RADAR techniques are used to detect the objects in the border region with the combination of thermal radar and ultra sound radar.

Whenever an object is present in front of the radar, the sounds waves, that travel continuously are suddenly hit by the object and do not pass further producing an echo back to the sensor. This makes the trigger active and calculates the distance from which the echo started. So the object distance is measured and its presence is marked by a led bulb or a buzzer.

## VI. DISCUSSION AND RESULT

Looking at the above simulation, we can say that the successful working of the power supply will result in the motion of the robot. We have a basic power supply here that has the basic principle of stepping down the voltage from the battery and regulate it to each and every component according to its usage. For eg. The L293D need 4 volts to drive the motor and move the components attached to it, for which the step down transformer unit takes the required voltage from the 12V power supply and regulates it with the help of voltage regulator to continuously supply the L293D with the 4V. In the above simulation, the load are all those components connected to the regulator that need the required voltage to drive itself and work in the circuit.



**Fig. 6.1 Simulation of power Supply for robot**

## VII. APPLICATION

- 1) As the main function of the robot is to collect information, it can be used during war, to collect information of the enemy terrain. This can help the army to safely devise a plan for counter attack or how to proceed further.
- 2) It can be used during the times of disaster. This robot can do the surveillance in the areas where human beings are finding difficult to go. So, this robot will provide the information regarding the situation. According to the information provided by the robot, Disaster management team will take the appropriate measures.
- 3) Accuracy in the information through the camera live feed, this robot will act as a Spy. This will prove to be of a monitoring purpose

## VIII. EXPECTED RESULT

- 1) This type of robot can perform difficult and repetitive works for humans. Dangerous and risky tasks that involve human involvement can be minimized with the help of this spy robot.
- 2) It can be used in the areas where there is danger to human presence, and also in the places where there is danger to humans in shattered surroundings such as war fall-out or collapse of a building with people inside it.
- 3) Because of its small size and wireless camera, the robot can enter and exit from spaces where human reach is not possible. Also, the Camera is controlled by the user who can control the direction of view as per the need to execute a task.
- 4) Accuracy in the information via live updates that acts as a spy robot. This will prove to be of a monitoring purpose.
- 5) Object detection in the described range with accurate precision and communication.

- 6) As we are using a camera, it can also be used during low lighting condition to make the surveillance process easy in.
- 7) The main task of this project is to make surveillance robot which can be controlled by the GUI application

## IX. FUTURE SCOPE

- 1) We can also add gas sensor, thermal image sensor, robotic arm etc. to make it suitable for different applications.
- 2) We can also add automatic pistol or any other weapon to this robot so that it can destroy that suspicious material.
- 3) This system can be further developed according to the area of application by enhancing the performance and by adding more features.

## X. CONCLUSION

With the above explanations, we can conclude that, the military surveillance robot will be functional with the help of the mentioned components and the flowchart explained. The scope of the project has wide angles and can be enhanced with any of the suggestions mentioned.

## XI. ACKNOWLEDGEMENT

We would like to express our gratitude to Dr. D.Y. Patil Institute of Technology and Savitribai Phule Pune University for helping us throughout and providing us an opportunity to learn and present our project.

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# Wi-Fi Based Secure Wireless Communication Using RSA

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**ABSTRACT--** Many people are choosing digital security at their home to keep it safe from invaders so that they can access it from anywhere, but secure wireless communication is a challenging problem due to the shared nature of the wireless medium. After analysing and decrypting the messages, hackers can illegally capture or steal important information, such as credit card, usernames/passwords, carried in the messages. So there's an important need for how one can secure their data from these invaders. In the existing system retrieval of information is done through an intermediate node and by providing a key mechanism. The Random Symmetric Algorithm (RSA) technique can be used for providing better security for valuable data. Wi-Fi based secured wireless communication using RSA encryption will allow us to communicate wirelessly with security features. The data transfer during communication between two systems will be encrypted using RSA encryption which is highly secure. [1] The data can be decrypted with the correct key only otherwise, it will return some garbage value.

**Keywords—**Random Symmetric Algorithm, Encryption, Decryption, Key Mechanism

## I. INTRODUCTION

In our increasingly connected world, we rely upon many different flavours of wireless. As consumers

and workers, wireless technologies allow us the freedom to move around and yet remain connected. Wireless technology allows our everyday transactions; such as wireless ticketing, credit card transactions, etc. to be convenient and speedy. As we know the large-scale adoption of cellular phones for voice communication, can now also be used to send text messages, access the internet, conduct money transactions, and so on. [1,2] However, for the transmission of such sensitive information over the wireless medium, ensuring security is a critical issue since the network access is open to all and there is no physical barrier that can separate an attacker from accessing the network. The transmission of the signal through air and the mobility of users bring the era of the wireless network. Thus, the issue of privacy and security concerns becomes most important with wireless networks. Although various techniques are employed for the improvement in the security of the high-speed data being transmitted, the most important method used to provide confidentiality is the data encryption and decryption techniques i.e. Random Symmetric Algorithm (RSA). RSA is a public key cryptographic algorithm in which no one can harm the confidentiality of the message as the message can only be decrypted by the intended

receiver's private key which is only known to that receiver. RSA can hence overcome the weakness of other conventional security methods i.e. authenticity and confidentiality.

## II. PROPOSED MODEL & BLOCK DIAGRAM

Following fig.1 shows the proposed model for Wi-Fi based secure wireless communication .The proposed model consist of Atmega32 Microcontroller, Wi-Fi module ESP8266, 16\*2 LCD, 4\*4 keypad. Data Encryption & Decryption is done with the help RSA Algorithm. [3]The Random Symmetric Algorithm (RSA) is a public key cryptographic algorithm in which two different keys are used to encrypt and decrypt the message. In RSA public-key cryptography each user has to generate two keys a private key and a public key.

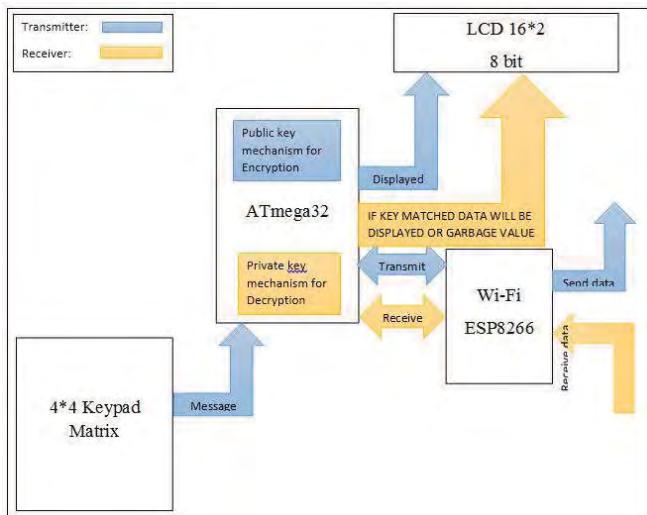


FIG. 1. BLOCK DIAGRAM OF TRANSMITTER AND RECEIVER

The public key is circulated or published to all and hence others are aware of it whereas, the private key is secretly kept with the user only. A sender has to encrypt the message using the intended receiver's public key. Only the intended receiver can crack the message, which makes it impossible for a third person to crack the message. In between the communication, no one can harm the confidentiality of the message as the message can only be decrypted by the intended receiver's private key

which is only known to that receiver. Flow of model is like taking data input from keypad which is encrypt with help of micro-controller and public key & transmit through transmitter with help of Wi-Fi module & receive with help of receiver, decrypt the encrypted data with help of micro-controller using private key.

## III. SYSTEM SPECIFICATIONS

- ATmega32 Microcontroller
- 16x2 LCD Display
- Wi-Fi Module (Esp8266)
- 4\*4 Keypad

ATmega32- [4] It is a powerful microcontroller because of its in system self-programmable flash on a monolithic chip, provides a high flexible and cost effective solution to many embedded control applications. The AVR microcontrollers are based on the advanced RISC architecture. ATmega32 is a low power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. AVR can execute 1 million instructions per second if cycle frequency is 1MHz.

### SENDING COMMANDS ON LCD

Select:

RS = 0 >> selects command register

RW=0>>selects write operation

E >> make enable pin from high to low

### SENDING DATA ON LCD

Select:

RS = 1 >> selects data register

RW = 0 >> selects write operation

E >> make enable pin from high to low.

The ESP8266 development board comes with the ESP-12E module containing ESP8266 chip having Tensilica Xtensa 32-bit LX106 RISC microprocessor. This microprocessor supports RTOS and operates at 80MHz to 160 MHz adjustable clock frequency.

### PROGRAMMING ESP8266 WITH THE ARDUINO IDE

Connect GND with GND.

Connect TX with Microcontroller's RX pin.

Connect RX with Microcontroller's TX pin.

Connect EN, RST and VCC with 3.3V power source.

#### IV. TESTING PARAMETERS:

As we have seen from the proposed model, by doing comparison we came to know that AES(Advanced Encryption Standard)is comparatively fast. It is really beneficiary when one needs to handle large amount of encrypted data. But due to being a symmetric algorithm it have some undoubted limitations that makes it somewhere a not so ideal algorithm, because both the transmitter and receiver is required to use the same key which may lead to critical key management issues that means a number of peoples if gets the only key the data will be hacked due to the same key requirement [5].

Sr. No.	Features	AES	RSA
1.	Cryptography	Symmetric	Asymmetric
2.	Key	Single	Two- Public and private
3.	Speed	High	Low
4.	Security	Less	More
5.	Works better	When we have a constrained environment.	When we have two physically or geographicall y different end-points
6.	Block Size	128 bits	Variable
7.	Key length	128,192 or 256 bits	Depends on number of bits in the modulus n where $n=p*q$
8.	Memory Utilization	Requires moderate memory space	Requires more memory space

TABLE NO. 1. COMPARISON OF AES AND RSA

[6]Whereas RSA method can overcome this key management issue simply by using two different keys at the transmitter end for Encryption and at the Receiver end for decryption, but its speed will not be that convenient to AES in doing large amount of data, so it will be best for being used in Digital Signatures, Email encryption and Browsers, where this important limitation will be carried by RSA algorithm.

#### V. ALGORITHM AND KEY MECHANISM

Start:

{//Send Message By Transmitter

While (True)

{//Checks For Right Key

If(Key Matches)

//Continue;

//Print Message;

Else

{//Print Garbage Value;

//Report The Error;

} } }

1. Type message by 4\*4 keyboard matrix.

2. Message displayed on LCD.

3. Atmega32 generates public key and private key, sends message to Wi-Fi module.

4. Transmitter Wi-Fi module transmits message as wireless communication.

5. Receiver Wi-Fi receives message.

6. Message got decrypted by private key via atmega32.

7. If key matches for correct message LCD will display message or garbage value will be displayed.

##### A] KEY MECHANISM:

In asymmetric cryptographic method, the key at transmitter side that is for encryption is made public which is different from decryption key at receivers end unlike Symmetric method. The user is required to make and process a public key on the basis of two large prime numbers, also with a supplementary value which are hidden.

So, the main point is message or data can only be received or decoded by the receive who knows the exact value of prime numbers that is the secret code and shared with indented receiver.

In RSA, the encryption and decryption expressions are in the exponential form[7]:

$$M' = M^e \bmod n \dots \text{Encryption, Public key } (e, n)$$

$$M = M'^d \bmod n \dots \text{Decryption, Private key } (d, n)$$

Steps to generate public key( $e, n$ ) & private key( $d, n$ )

1. First, select two prime numbers  $p, q$ .
2. Now calculate  $n = p \times q$ .
3. Calculate  $\phi(n) = \phi(p \times q)$   
 $= \phi(p) \times \phi(q)$   
 $= (p-1) \times (q-1) \dots \phi(a) = (a-1)$  if  $a$  is a prime number.
4. Select  $e$  such that  $1 \leq e < \phi(n)$  and also ' $e$ ' should be co-prime to  $\phi(n)$ .  
Now we will determine the value of  $d$ . The value of  $d$  can be calculated from the formula:  
 $ed = 1 \bmod \phi(n)$
5. In the expression above we know that  $e$  and  $\phi(n)$  are the co-prime numbers so in this case  $d$  is the multiplicative inverse of  $e$ . To calculate the value of  $d$  use the formula:  $d = (\phi(n) * i + 1) / e$
6. Now we have generated both the private and public key.

From above we can say, first part is key generation. The keys are generated with using prime numbers factorizing algorithm. Once key generated then second part we can do encryption using public key. And finally after transmission the third part is decryption which is done with the help of private key.

#### B] EXAMPLE:

Suppose A wants to send his/her some confidential data to B. And they decided to use RSA, A will have public and private key generated by RSA algorithm. A must know B's public key for encryption and B must use his/her private key for decryption. B will send his/her public key to A via reliable but not secret route. B's private key will be never shared with anyone nor with A also.

Once A gets B's public key he/she will do encryption of message M and send it. That message

M will be turn to cipher text C by encryption and that C will be send over to B. Now B can recover M using private key by decryption of C.

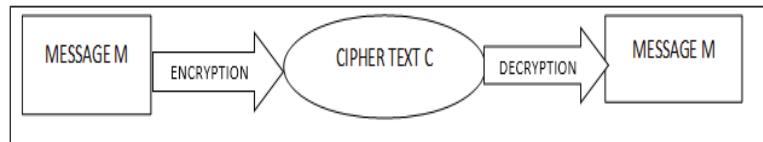


FIG. 2. CONVERSION

#### VI. EXPECTED RESULT:

The following are the expected outcomes we may obtain from the Data encryption/decryption technique using RSA :

- A) As soon as the system is started, user will be able to enter message in the system. The maximum limit of message is 32 character. After that system will ask for key, the key limit will be 16 character it can be either number or alphabet.
- B) When the key will be entered, key will send the encrypted message to receiver end. Then the other system will ask key to view the message. If the user has entered correct key that matches with the key at transmitter side, the message gets decrypted.
- C) If key is being entered by any third person and it enters wrong key it will show garbage value, thus securing the wireless communication. This is two way communication system where we can transmit as well as receive at both ends
- D) By looking at the comparative analysis we must consider that whether RSA process time is bit slow in comparison to other methods, the usage of two different keys makes it more reliable to use it on large distance areas physically because the correct text will be within the user who will enter the key and the message already in built in private key[8].
- E) RSA -asymmetric cryptography contains more active functions than AES.
- F) So in conclusion, due to the limitations in symmetric cryptosystem, RSA has a slightly bigger advantage that solves the problem of

distributing the secret key. RSA should be widely used for key management and digital signature applications.

## VII. CONCLUSION

Encryption and decryption using RSA is the best method for securing data. The proposed RSA shows a better result as RSA is reliable as factorizing the product of two large prime numbers is quite difficult. Breaking RSA encryption can be tough as it is having pair of keys for security unlike AES having only one public key. And there are still no published methods to crack the message or data if a large enough key is used in RSA. It will take less time and it is impossible to break the encryption algorithm without knowing the exact key value only the creator of the public key can also generate the private key required for decryption. Though AES is fast, RSA is most secure one we can say for security.

## VIII. ACKNOWLEDGMENT

The authors would like to sincerely thank you Dr. D. Y. Patil Institute of Technology (DIT), Pimpri, Pune and Savitribai Phule Pune University.

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# Review of High Voltage Protection, Standards & Mitigation For Electronics System

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**Abstract—** High Voltage (HV) is classified as 1000V and above for DC and 1500 V for AC. The sources of high voltage are lightning, Lightning Electromagnetic Pulse (LEMP), Electro Static Discharge (ESD), Switching Transients etc. HV power supplies are required for electronics components like Power Amplifier (Klystron), Cathode Ray Tube (CRO). Transient HV may induced by various phenomenon of Lightning Effects, ESD and Sensitive electronic circuits / Components are prone to damage against these HV effects. These components are to be designed to withstand these HV transients and induced effects. Electronics to work in (LEMP), Electro Magnetic Pulse (EMP) etc to be protected, these effects can be mitigated with Radiation Hardening (RadHard) Design, which are used in Space Electronics and Military electronics systems against nuclear or manmade EMP. Aviation industry or Space Vehicles electronics various Standards of Lightning Effects are to be followed for Safety and Certification ,few are DO-160, MIL-461E, SAE 5415, IEEE Standard 510-1983 etc. HV Transients requires mitigation else it will damage electronics and reliability will be the issue for certification requirements. Various techniques are being used like Surge Protector Devices (SPD), Arrestors, Grounding, Bonding etc to be incorporated in design and installation. The Paper is Review of few practices on HV protection and mitigation of Electronics Systems and also focuses on requirement of changes in the existing standards as electronics are changing.

**Keywords—** ESD, Electrical Overvoltage Stresses (EOS), Lightning Impulse, Max Generator, Human Body Model (HBM), Machine Model (MM) & Charge Coupling Device (CCD) Model

## I. INTRODUCTION

HV has damaging effects on electronics; sources of HV may be from HV Power supply, Overvoltage Stresses, Switching Transients, ESD event or Lightning effects. Natural Lightning contains a very large amount of energy impulse surges classified into direct lightning surges & induced lightning surges. Protection against a direct lightning surge is difficult, but protection against induced lightning is possible. Switching surge is a transient HV surge induced in a switch / relay during its on /off operation when switching off, causes rapid current change and inductance of the circuit or wiring. Voltage generated by an open/close surge is very high, and in some cases, it generates spark, heat or radiates an electromagnetic wave caused by a large damping oscillation current generated by floating static capacitance of inductance and contact. This HV surge may cause a malfunction of an electronic circuit, and in some cases, lead to the destruction of a component and emission of an electromagnetic wave through damping oscillation causes EMI, thus requiring suppression measures for an open/close surge. Load dump is a surge generated by cutting the battery connection off on an automobile. ESD is a phenomenon where a charge is stored in a small floating capacity on a human body or substance then discharged to a nearby object, and is classified as one type of surge as shown in Figure-1.

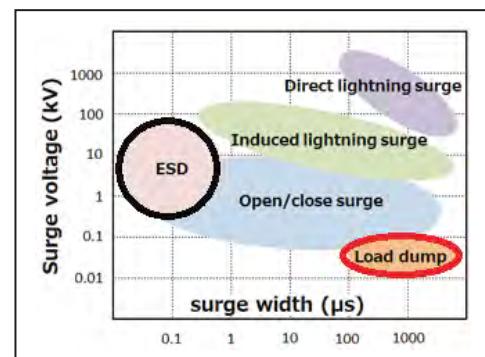


Figure-1(Surge Voltage Vs Time)

ESD duration time is short with little energy, but because it generates transient HV as high as several KV, it can generate a malfunction of electronic circuits or damages electronic components. For the evaluation and testing method of an ESD, HBM or MM is generally used and protection is possible by utilizing the components based on these assumptions [4]. EMI/EMC can be effectively mitigated with RadHard designed electronics as shown in Figure-2.



Figure-2(Radiation Hardening)

## II. ESD

ESD event is caused by high discharge current, which also produce electromagnetic fields over a broad frequency From (dc) to the low GHz & “Corona effects” before and during a discharge[5]. ESD intruder, is often a human, any object that is moved, such as a chair, an equipment cart, a vacuum cleaner & the victim is usually an electronic equipment or subassembly and is, although not always, at local static ground potential. It may also be the case equipment is “victim of itself” [6].

### A. Source of ESD: Triboelectric Charging

Triboelectric charging happens due to friction and depends on temperature, humidity and its combination for example when an IC slides during shipping tube static electricity is generated due to friction between the tube and lead of the IC. In a normal day, a person generates huge amounts of static electricity electrostatic charge can be generated in material by induction and conduction.

### B. ESD Models: HBM, MM, CDM

- HBM** simulates a person becoming charged and then the discharge occurring via a bare finger through the circuit under test to ground. This is most common used in working condition / LAB.
- MM** simulates a charged manufacturing machine, discharging through the device to ground. The machine will have a conductive surface and therefore the resulting current levels can be much higher but for a shorter time.
- CDM** test is the most accurate component-level test as far as simulating real world events. CDM testing simulates ESD charging followed by a rapid discharge, similar to what is seen in the automated handling, manufacturing, and assembly of IC devices. Unfortunately, this test also gives results that can differ from lab to lab and lot to lot.

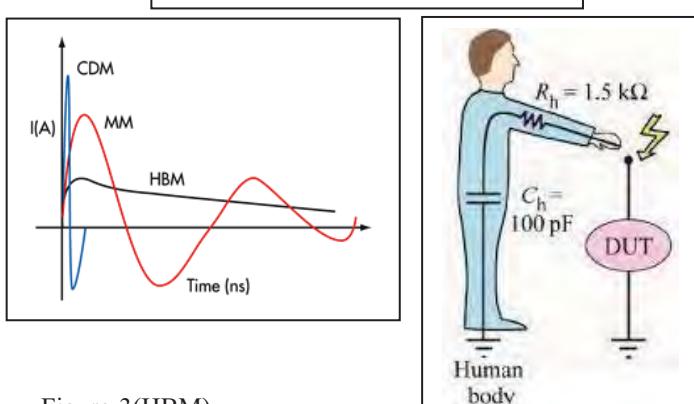
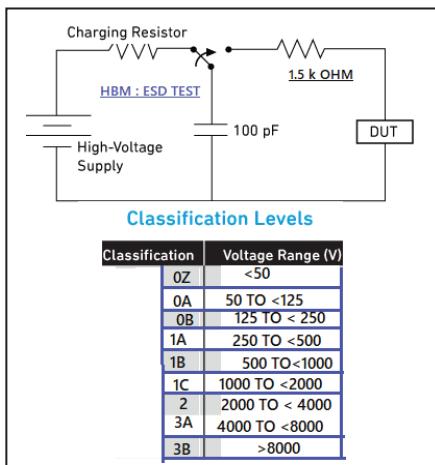


Figure-3(HBM)

### C. ESD Standards

DO-160 of RTCA standards for environmental conditions & test procedures for airborne equipment [7] [8].

- Section 17: Voltage Spike
- Section 19: Induced Signal Susceptibility
- Section 22: Lightning Induced Transient Susceptibility
- Section 25: ESD, Some of the electronic components with their ESD susceptible Voltages are tabulated as Table-I

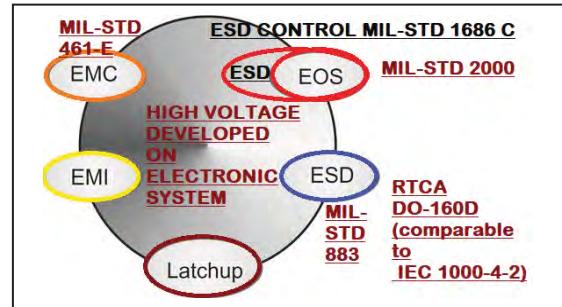


TABLE -I. Electronic Device Vs ESD Damage

SI No	Electronic Device	ESD Damage
1	MOSFET	10-200 V
2	Recording Heads	10-800 V
3	VMOS	30-1800 V
4	NMOS	60-500 V
5	GaAsFET	60-2000 V
6	EPROM	100-500 V
7	Laser Diodes	100-1700 V
8	JFET	140-7000 V
9	SAW	150-500 V
10	CMOS	150-3000 V
11	Op Amp	190-2500 V
12	PIN Diodes	200-1000 V
13	DRAM	200-3000 V
14	Schottky Diodes	300-2500 V
15	Film Resistors	300-3000 V
16	Bipolar Transistors	300-7000 V
17	SCR	500-1000 V
18	ECL	500-2000 V
19	Schottky TTL	500-2500 V

### D. Protection Against ESD

Protection against ESD must be done at following level

- At component level
- At circuit board level
- By software and noise cancellation features
- At internal packaging & wiring level
- At housing/cabinet level
- At installation and environment level

### E. Methods for ESD protection

- Shielding
- Grounding

- Bonding
- Electronic Hardening
- Switching Impulse
- EOS
- SPD, HV induced in electronics can be suppressed by Surge Protectors /Suppressors

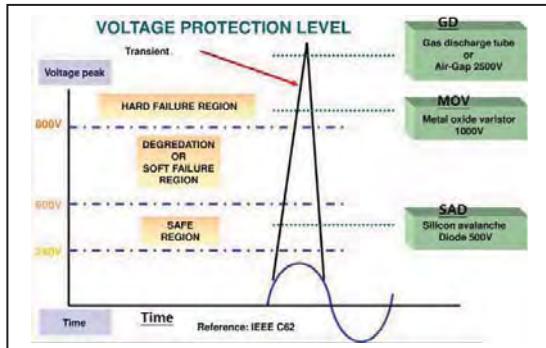


Figure-4(Transients)

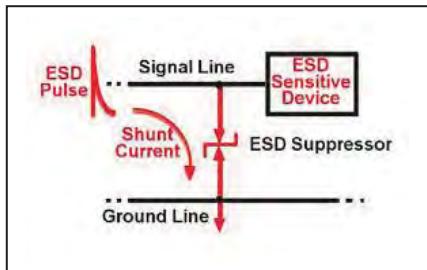


Figure-5(Shunt ESD Suppressor)

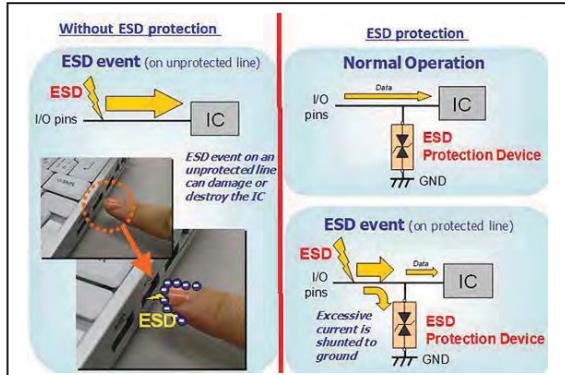


Figure-6(ESD protection)

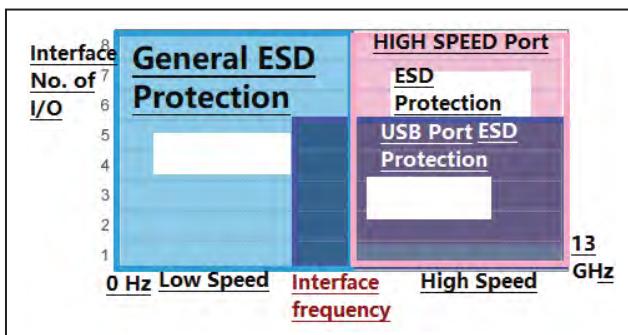


Figure-7(I/O Port Protection)

#### F. ESD testing Gun

ESD gun for testing immunity is based on HBM model of 8 KV is good for Lab working and testing.

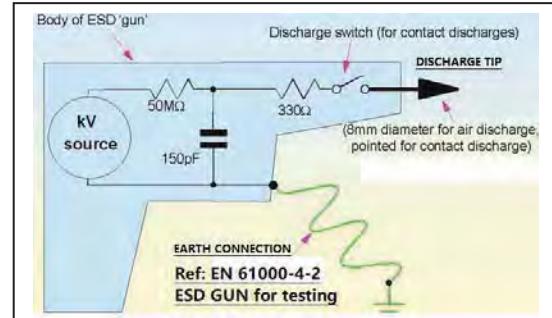
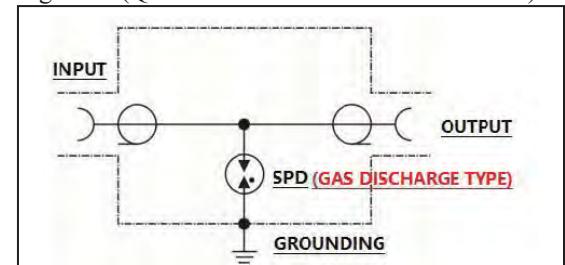


Figure-8 (ESD Gun for LAB)

#### G. Shielding, Bonding & Grounding

Shielding , bonding and grounding is one of the important way to mitigate HV Surges[1-3].

- Shielding by metal / plastic enclosures will protect from radiation and conduction induced by indirect Effects of HV lightning / LEMP. A standard like MIL-461 E defines the protection. 20-40 dB of shielding is good.
- Bonding ensures very low impedance path and make equi-potential of all connected structures. There are bonding cables which electrical binds every structure so that charges flow freely and then can be discharge centrally or locally. Static Wicks are the best example in aircraft.
- Grounding is very important for electrical circuit; it also acts reference point. HV / Charges (accumulated) or short circuit voltages / current are grounded for protection of electrical/ Electronic equipments. RF component is protected by RF, SPD as shown in Figure -9 (Quarter stub between LPZ0 to LPZ 3)

Figure-9(RF,  $\lambda/4$ , SPD)

- Power line protection, power line of electronic equipment shall have Class B & C Type 2-stage protection. Stage 3 protection is also required for protection of power/signalling/data lines. Class 'B' and class 'C' type protection devices shall preferably be pluggable type to facilitate easy replacement.

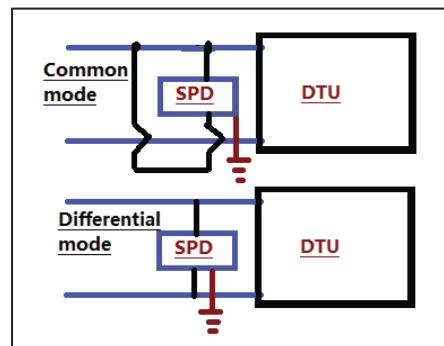


Figure-10 (Common &amp; Differential mode SPD Protection)

Grounding stick / Crowbar is used to discharge static charge, turn off the equipment and wait for 30 seconds to one

minute (or for as long as metering shows significant voltage is present). This allows charged capacitors to be drained by bleeder resistors (high-value resistors connected directly across the capacitors). If practical, disconnect the power source for the equipment and insure it can't be turned on again while you're working on it.



Figure-11(Crowbar)

HV lightning events are modeled as different waveform as tabulated below for study & testing of direct or indirect effects. As per the lightning current Class of SPD are needed for protection as per Figure -12.

TABLE-II. WAVEFORMS

Sl No	Waveform		Subhead
	Impulse		
1	1.2/50 $\mu$ s	Standard lightning impulse Voltage IEC 60060-1, IEC 61180-1, IEC 61180-2, IEC 60335-1	Uoc, SPD Type-III
2	10/350 $\mu$ s,	Standard Lightning EMP	I <sub>imp</sub> , SPD Type-I
3	8/20 $\mu$ s	Standard switching EMP	I <sub>max</sub> . In, SPD Type-II
4	1.2/50 $\mu$ s &8/20 $\mu$ s	IEC 61000-4-5	Combined Waves
5	10/700 $\mu$ s, 5/320 $\mu$ s	ITU-T K20 , ITU-T K21, ITU-T K44, IEC 60950	Telecom Waves
6	0.5/100kHz	IEC 61000-4-12	Ring Wave
7	10/350 $\mu$ s 8/20 $\mu$ s 10/1000 $\mu$ s	IEC 61643-11	Current Impulses

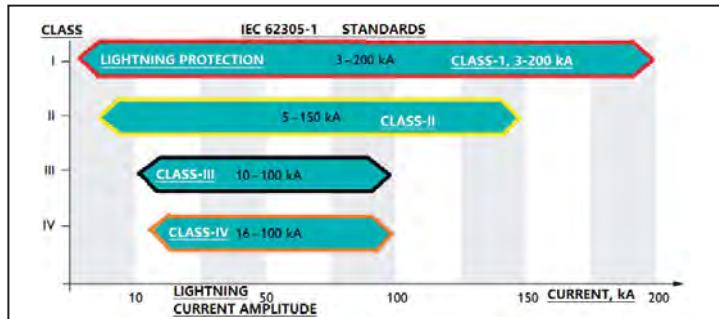


Figure-12(SPD Class Vs Current)

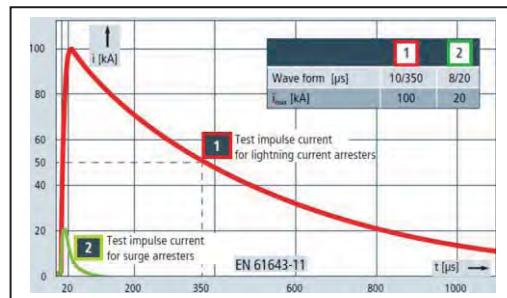


Figure-13 (Waveforms [10/350μs, 100 KA] [8/20 μs, 20KA])

#### IV. SAFETY SYMBOLS

Symbols for caution, danger should be placed at prominent place written in local and English language with first aid procedure and First aid Box to be displaced at HV zone.

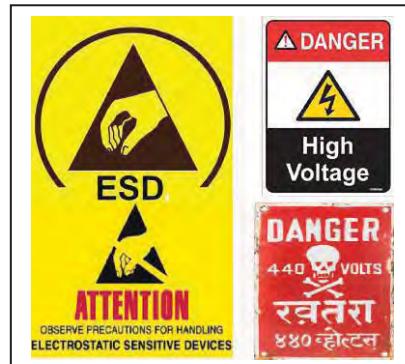


Figure -14(HV symbols at work area)

#### V. MONITORING SYSTEM

Lightning and its effect are dangerous for high buildings and infrastructure so Lightning monitoring System (LMS) is installed which will detect the lightning and indicates warning by principle of Polarization change due to Faraday's Effect caused by LEMP.



Figure-15 (LMS on high Structures)

#### VI CONCLUSION

HV causes over stresses on electronic circuits & systems which has damaging effects. HV may produced by direct or indirect effects of lightning, ESD, LEMP, switching transients etc. Various Safety standards IEC, SAE, ISO, RTCA, MIL 461-E defines protection & mitigation from these HV effects on electronics systems. Electronics circuits for Space applications are always exposed to EMP from

solar effects; Radiation Hardening is only option for reliability and long survival of electronics in harsh environment. These EMPs are also generated in War scenario to damage enemy electronics so military electronics and systems also require protection like electronic hardening or EMI/EMC. Building installed with sensitive electronics to be protected by SPDs as per zone and Type / Class. The protection for EMI/EMC for RF circuits, electronic circuits and Power circuits are different so the test waveforms are also different which are simulated in HV lab by Max Generators. Zone classification is very important as type and class of SPD installation will depend on Zoning as shown in Figure-16. All high raised buildings / structures like Power plant Chimneys should be installed with Lightning Monitoring System (LMS) with lightning counters.

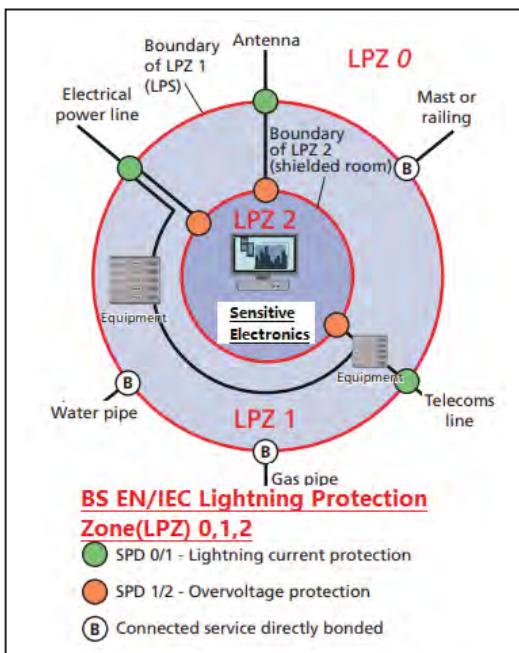


Figure-16

## VI REQUIREMENT OF CHANGES IN STANDARDS

Electronics is becoming sensitive with multi-layered, GaN technologies, miniaturization, so protection and mitigation techniques require re-look in terms of ESD, EMI /EMC and Grounding/ bonding /shielding etc. Reliability parameter is also increasing for mission critical electronics like Space / Military Avionics. Installation of sensitive electronics requires Zone planning and SPD as per Zone of protections. High speed ports /Pin protection to be included in HV safety standards. Zoning also requires change as enclosures of electronics are changing with shielding effect is more effective. Maintenance of SPDs and Lightning Arrestors is a gray area, so LMS is better option which should be made essential for high structures.

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# Resume Rater Using Pandas and Machine learning.

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**Abstract:** A resume is a document used and created by a person to present their background, skills, and accomplishments. Resumes can be used for a variety of reasons, but most often they are used to secure new employment. As resumes are first step to create impression on employer, it is important that the resume includes all the relevant information. There are many platforms to build resume but it will be more useful for candidates if their resumes can estimate the jobs suited for them. Keeping these necessities as objectives, we are going to develop a system, which can build as well as rate the resume, based on the contents of the resume. We have used Neural networks model of machine learning and logistic regression algorithm to develop the system.

**Keywords:** Resume, Machine learning, Logistic Regression.

## I. INTRODUCTION

A resume is a tool for marketing yourself. It is a document created and used by a person to reflect achievements, awards, education, experience and any other outstanding accomplishments that align with your career path and goals. Resumes, are most often used to secure new employment. A resume is not just an important tool for your job search but also a first chance to set an impression on employer. Resume help employers make hiring decisions and help you get your first interview. Employers use resumes to get a deeper understanding of candidate skills, strengths and experience. Without a favorable initial impression, a prospective employer is likely to stop considering you as a suitable candidate for the job on offer and move on to other candidates who have provided better resumes. For this reason, resume writing is often referred to as one of the most crucial steps taken during a job search.

So, it's important to create a strong, impactful and genuine resume. We have developed a model that not only creates an appropriate resume but also rates the resume and the candidate comes to know which job profile suits him best.

The "Resume Rater" overrides the problems prevailing in practicing manual system. Resume

rating application determine the capability of a candidate to be qualified for a job. The successful rating for the candidate's resume would help him in getting his desired profession. The efficient pre-defined hypothesis helps to rate the resume in such a way that every important parameter is considered. We have created the Resume rating system using unsupervised method like Logistic Regression out of many machine learning algorithms.

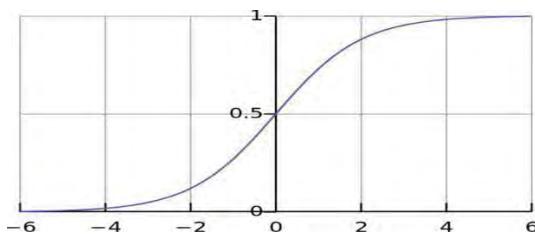
## A. Data Pre-Processing

Data preprocessing is very essential step in this entire journey of the data. The dataset which is used is most of the times is in non-homogeneous form which contains missing data, noisy data and unwanted data. This data has to be cleaned and transformed into a usable format. We used pandas python library which is fast, flexible and powerful. In pandas the dataset is loaded into our working environment and then transformed to the file type compatible for the operations on the dataset. In pandas the datasets can be cleaned using the different inbuilt pandas functions which help us to clean the data very precisely. We can select the specific row or column of the dataset or the number of rows or columns with condition on the data. With pandas in our project, we compared two datasets and the third dataset was obtained. This third dataset have the values of the skills which are satisfied as per the given criteria. With pandas we determined the skills percentage of the user which are essential for our ML model to process the data and rank the profiles as per user's interest.

## B. Machine learning

Machine learning is a subset of artificial intelligence, it is the study of computer algorithms that improve automatically through experience. Performing machine learning involves creating a model, which is trained on some training data and then can process additional data to make predictions. Though there are various types of models, we are using supervised learning algorithm. The data set is used as the base for

predicting the classification of other unlabeled data with the use of machine learning algorithms. With supervised learning you can use labelled data, which is a dataset that has been classified, which help the algorithm to determine its target. We have used logistic regression as our machine learning algorithm. In logistic regression the dependent variable can be either one or zero it is called as binomial classification. Logistic regression is also called as sigmoid function, it forms an S shaped curve. Below is the logistic function with an input q:



$$\sigma(q) = \frac{e^q}{e^q + 1} = \frac{1}{1 + e^{-q}}$$

Figure1: Logistic function

## II. RELATED WORKS:

Resume rater is a fairly well-studied problem in literature right from the 2000s. Most of the researchers concentrate on rating on only qualifications rather than skills, experiences, ethics for resume rating but with advent of neural networks, the limitations of traditional models are ruled out. Neural Networks is a research area of machine learning. There are different techniques to implement the neural networks. A framework of Complex Network Classifier (CNC) by integrating network embedding and convolutional neural network can be used to tackle the problem of network classification. CNC can not only classify networks with high accuracy and robustness but can also extract the features of the networks automatically. In neural network, a three-layered feedforward network with N 1 hidden units gives exactly N input-target relations. Similarly, logistic regression is a method of machine learning. Logistic regression is supervised learning classification algorithm used to predict the probability of target variable. It is a powerful analytical technique for use when the outcome variable is dichotomous and can be used for classification.

A Tesseract OCR Model is an optical character recognition engine with the ability to recognize languages. It can be used for the line finding, features/classification methods, and the adaptive classifier. This can also be used to scan and retrieve data.

## III. IMPLEMENTATION:

We have created the Resume rating system using unsupervised method like neural networks out of many machine learning algorithms. For creating and rating a resume the system considers various categories like- Skills, Qualifications, technical knowledge, Past experience etc. Both the resume types- entry level and professional resume can be created. Entry level resumes mainly focuses on academic accomplishments whereas professional resume focuses on work experience and qualifications. The system implements as follows:

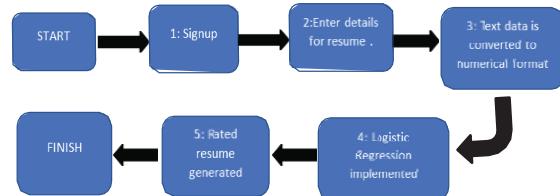


Figure2: Implementation of the system.

**Step 1:** User has to sign up first. Then user can login with the credentials. This helps user to login afterwards and access his resume to make changes to it.

**Step 2:** User has to enter his details regarding academics, skillset, work experience, projects, internship, courses/certification. The details entered by the user is used to create the resume as well as rate the resume on the basis of the key decision-making parameters.

**Step 3:** Processing is done in this step. The entered data present in the text format is converted into numerical format with the help of the Pandas library and one-hot encoding. One hot encoding is a process by which numerical categorical variables are converted to a form that could be provided to ML algorithms. This conversion is helpful for machine learning algorithm to process further. This processed data is stored in database.

**Step 4:** After creation of resume and processing of the data, the next step is rating the resume. The key decision-making parameters like -skills, experience, education, projects are used for rating the resume. For rating purpose logistic regression algorithm is used to see the skills

compatibility with the roles. The algorithm gives the number of skills matching with the roles in our dataset.

**Step 5:** The user will get his resume with the rating on the side. The rating will have the list of the top matches with the respective roles. The user can change the template from the given options.

#### IV. RESULTS:

With the help Logistic Regression algorithm, the model works on its own to discover patterns and information from the input without being supervised previously. The Resume Rater System accepts user data as input and develop resume based on the details given. The system also gives an advantage of uploading the physical or virtual resume and rate it. The application tries to minimize the errors by providing error message while entering an invalid data. For rating the resume, the data in the resume is converted to numerical format using pandas and Logistic regression. The decision key parameters are used for rating the resume using Logistic regression. This is done to match the skills with various job roles. The output of the system is the resume along with the list of most suitable jobs for the user. The system gives highly professional resume with the user's choice for templates.



Figure3: Final Result generated by our system.

#### V. CONCLUSION:

A resume is a formal document that a job applicant creates to itemize his or her qualifications for position. Thus, resume is a first chance to set an impression on employer. So, it's important that the resume is in standard format with relevant information. Keeping this necessity in mind, this project has tried to overcome the limitations of the existing resume creating applications with an unsupervised approach. Resume Rater that not only creates resume but also rate an applicant

based on the contents of the resume like qualification, skills, experience etc. This model of resume rater used machine learning methods of prediction to predict the suitable job for the applicant. This system not only avoids sloppy mistakes but also it is time efficient, quick and easy to access. The system can further be upgraded by improving the Logistic Regression algorithm, giving more customizable options regarding templates.

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# Xenia – A Smart Tour Planning And Recommendation Using Crowdsourced Data

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**Abstract—**Tourism is one of the most important sectors to improve for any country that wants to develop its economy. Tourism nowadays is promoted by advertisements and served better using mobile and web applications. One such major service is Tourism apps which promotes tourism by providing users with services like travel booking, stay accommodations and information about the tour. But as world is diverse with languages and education this tourism app has difficulties reaching all users and serving them to the best. This study is going to address such problems and also provide a system that will solve these problem by an application that uses technologies like AI, NLP and recommender systems to solve such problems. The main goal of creating this app is to provide the user the right recommendation and make their tour planning sophisticated rather confusing. Also, this project is going to provide business to the locals in exchange for precious data of that particular place.

## I. INTRODUCTION

Mobile applications now play an important role in all areas of business and privacy. The travel and tourism industry is no exception because a large part of its success is based on these mobile applications. Paper maps, guidebooks, and other items are no longer in use, having been replaced by interactive and fantastic smartphone applications for the travel and tourism industry that offer a variety of features. This app provides expert guidance for the tourists in planning their tour ahead of the time. This app includes a smart recommender system which fetches the data from different tourists and their reviews and recommends the best location, restaurants and accommodation to the user. Also this app will help the local businesses to grow their business by simply providing their precious experience about the place to us. This crowdsourced data will be most accurate and this app will then be able to recommend the customers the best choices which totally depend on facts and experience.

## II. LITERATURE SURVEY

P. Mate and H. Chavan [1], they proposed framework is an Android based Mumbai City Guide application which intended to handle area put together persistent inquiry with respect to the street organization. Someone when visit places, for example, Hotels, Colleges, Hospitals, and Schools don't

have to employ an exceptional individual who give direction. On the off chance that all the data should be accessible on a cell phone with the client altered configuration, at that point it's useful to deal with their significant time successfully and effectively.

S. Bhattacharya [2], proposed a methodology that a local escort application called Mobile Campus on android based versatile stage for SRM University grounds. Close to handle correspondence (NFC) is a bunch of guidelines for PDAs and comparable gadgets to set up radio correspondence with one another by contacting them together or bringing them into closeness, typically close to a couple of centimeters. This local area expert application incorporates usefulness like finding current area of clients, showing college grounds map, course heading of college transport and gives little depiction and contact data of significant puts nearby.

Brown & Chalmers [3] composes that "sightseers intentionally make arrangements that are not exceptionally organized and explicit, so they can exploit evolving conditions." Although the arranging of conduct among voyagers shift this is profoundly pertinent for versatile travel applications. A voyager that makes definite arrangements has a lesser requirement for data "at this very moment" contrasted with explorers that do some arranging or practically no arranging in regard to what to do while they are at the objective.

U. Thakur [4], they proposed tools like expanded reality (AR) hold a tremendous potential in pulling in and holding guests. The ascent in shrewd cell phones just lifts this further as it gets conceivable to have data and visit age readily available.

Nowadays' cell phones are utilized to give various capacities notwithstanding ordinary voice correspondences. The capacities of advanced mobile phones empower the area based increased reality benefits a reality as referenced by J. Choi, B. Jang, G. J. Kim [5].

R. A. Abbaspour and F. Samadzadegan [6] built up a Context-Aware versatile local escort framework dependent on help situated architecture(SOA). PTG sends a solicitation dependent on the setting of client to a list. Administration merchants work together to track down the correct

administrations and afterward, PTG and specialist organization haggle as to arrange of the solicitation and some other convention issues.

Tourism is the biggest business in the worldwide world economy utilizing around 200 million individuals and serving 700 million sightseers around the world. By 2020, the quantity of vacationer appearances all throughout the planet is required to increment by more than 200%. The travel industry is additionally answerable for creating an expected 11% of the worldwide (GDP) [7]. Despite the fact that, there is incredibly advanced travel data gave to the vacationers on the Internet and through the applications. Notwithstanding, there is no application for a vacationer to straightforwardly get the set of experiences or some other data related with any landmark or spot by its image. To find out about any spot or landmark the vacationers visiting that spot need to utilize guides [8].

Mobile Tourism is a term that begins to show up over the most recent twenty years. It includes utilizing cell phone as electronic local area expert. The vacationer needs to look through data about a Point of Interest (POI) from his versatile. He can get the data from the web through an internet browser, yet this requires a consistent remote association with the web.

Overall the writing on explorer data needs and utilization of portable applications and gadgets in situ is dispersed and divided. Nonetheless, a few if the examination on data sources in the arranging stage is likewise valuable in situ. In the arranging stage a portion of the data search relates the decision of objective, how to arrive and convenience.

This study first attempt to enroll every one of the limits and difficulties experienced while using ideas of NLP to build up a local area expert framework. This model depict different best in class NLP and ML applications that offer such support, having their own arrangement of disadvantages, and give a concise prologue to proposed framework.

### III. PROPOSED APPROACH

Tourism has become one of the major sector of revenue generation in the country, as promoting tourism has a direct impact on a country's economy. In the era of AI and WEB 2.0 tourism takes advantage of technology such as mobile applications and web applications, but not all users out there has the skill to operate this app to the fullest one such problem is lack of good customize recommendation system, and as the user database increases day by day people need an app robust enough to serve them. Also, need some application which will help the local businesses to grow their business by providing the useful data and experience to the customer. This data will eventually be recommended by recommended system to the users.

#### A. Phase 1

Xenia is a tour recommendation app that will help users to book tours and guide them through the tour. This app takes into account of the user's preference and suggests yours by using a recommender system. The user can then choose the tour based on the information that is provided like tour expense, ratings, review, the best time to visit, images and videos, and a short description. The design of this app have a user-friendly UI and run smoothly. Users can authenticate this app by creating a local account or using google sign in, this way it provides each user their personalized

recommendations.

After choosing the tour the user can then navigate to the tour and choose "Start tour", then virtual tour guide will direct them by using live interactive maps, where this app provides information of each check point within the tour packages, and the user can then visit these checkpoints and complete the tour.

This app also provide a shopping tab that users can use to shop in the place where they visit, this tab will show the user's item based on the places they visit, E.g. : local products in Manali during their stay. This app uses flutter and dart programming for building UI and logics.

#### B. Phase 2

This app is powered by a recommender system that provides each user their own personalized tour recommendations, also keeps a database of user's preferences like

##### Preference Keywords:

Climate: Spring, Rainy, summer and winter.

Average expense: How much will the user be willing to pay for the Trip?

Preferred method of travel: By Flight, By Car, By Public Transports like Train or Bus, etc.

Average time: Duration for the trip

By using these keywords app recommends users to visit their personalized tour destinations.

The design of the backend is using NLP to get recommendation based on the reviews past users had during their stay in a hotel or travelling a tour. It uses topic modelling methods like NMF and LSA to extract features from a tour's past reviews. It also considers other data like tweets about the tour, climate, the best time to visit and average expenditure during the tour.

By using Twitter tweets and latest reviews in the recommender system ensures that the database is updated to current affairs about the tour as outdated data can provide false data about the tour.

#### C. Phase 3

This model provides business to local shop owners and restaurant through Xenia as they can use this platform to provide advertisement to users, this will help user to have better experience in during their tour, as they can use these advertisements to choose the best hotels or place to stay, and store will provide user to shop local products without spending time on shopping for local items and spend more time on tour.

This business model provides mutual benefits to both user and local shops and restaurants,

App collects data from local shop owners and restaurants like:

##### Questions (examples):

- a. What are the best places to visit around their locations?
- b. What is the best food to eat around their location?
- c. What are the in demand items to shop around their location?
- d. What precautions to take?

This type of crowd source data will help both the recommender system and the users to get more relevant information about the tour.

#### D. Natural Language Processing (NLP)

Natural language processing (NLP) is the crossing point of software engineering, semantics and AI. The field revolves around correspondence among algorithms and people in characteristic language and NLP is tied in with causing algorithms to comprehend and create human language. Utilization of NLP strategies incorporate voice controlled AI like Amazon's Alexa and Apple's Siri, yet in addition to things like machine interpretation and text-filtering. Following are Some NLP Techniques:

##### a) Parsing

What is parsing? As per the word reference, to parse is to "determine a sentence into its segment parts and depict their syntactic jobs."

That really nailed it, yet it very well may be somewhat more thorough. Parsing alludes to the conventional investigation of a sentence by an algorithm into its constituents, which brings about a parse tree showing their syntactic connection to each other in visual structure, which can be utilized for additional handling and comprehension.

##### b) Stemming

Stemming is a method that comes from morphology and data retrieval which is utilized in NLP for pre-preparing purposes.

Essentially, stemming is the way toward diminishing words to their promise stem. A "stem" is the piece of a word that stays after the evacuation of all joins. For instance, the stem for "contacted" is "contact." "Contact" is likewise the stem of "contacting", etc.

##### c) Text Segmentation

Text segmentation in NLP is the way toward changing content into significant units like words, sentences, various points, the hidden expectation and that's only the tip of the iceberg. For the most part, the content is sectioned into its segment words, which can be a troublesome assignment, contingent upon the language. This is again because of the intricacy of human language. For instance, it functions admirably in English to isolate words by spaces, aside from words like "icebox" that have a place together however are isolated by a space. The issue is that individuals in some cases additionally compose it as "ice-box."

#### E. Natural Language Processing (NLP)

Topic Modeling falls under unaided AI where the archives are handled to acquire the relative points. It is a vital idea of the customary Natural Processing Approach due to its capability to get semantic connection between words in the archive groups. Likewise, it has various different applications in NLP [9].

A portion of the notable ways to deal with perform theme demonstrating are

1. Non-Negative Matrix Factorization (NMF)
2. Latent Semantic Analysis (LSA)
- a) Non-Negative Matrix Factorization (NMF)

Non-Negative Matrix Factorization is a measurable technique to decrease the element of the info corpora. It utilizes factor examination technique to give nearly less weightage to the words with less lucidness. For an overall case, consider an information grid V of shape m x n. This strategy factorizes V into two lattices W and H, with the end goal that the element of W is m x k and that of H is n x k. The representation for the same is shown in Fig. 1. For the circumstance, V address the term archive grid, each line of lattice H is a word inserting and every section of the network W address the weightage of each word get in each sentence (semantic connection of words with each sentence). It is easy to track down a commonsense application with a model underneath.

However, given that all of W and H's entries are positive, the expectation is that all of W and H's entries are positive.

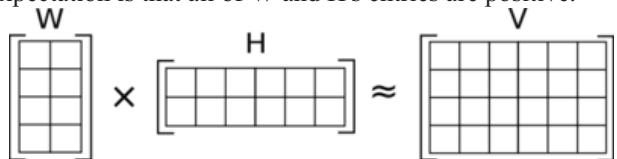


Fig. 1. Non Negative Matrix Factorization.

Presently, take a gander at the system for the situation. Assume this model has a dataset consisting of surveys of superhuman motion pictures. In the archive term lattice (input network), it has singular records along the lines of the grid and every interesting term along the segments. In the event that, the survey consists of writings like Tony Stark, Iron Man, Mark 42 among others. It very well might be gathered under the point Iron Man. In this technique, every one of the individual words in the report term grid are considered. While factorizing, every one of the words are given a weightage dependent on the semantic connection between the words. However, the one with most elevated weight is considered as the theme for a bunch of words. So this cycle is a weighted amount of various words present in the records.

##### I. Math behind NMF

As referenced before, NMF is a sort of unaided AI. The principle centre of solo learning is the measurement of distance between the components. The distance can be estimated by different strategies. Some of them are named as Generalized Kullback–Leibler divergence, frobenius standard.

###### 1. Generalized Kullback–Leibler divergence

It is a factual measure which is utilized to evaluate how one appropriation is not quite the same as another. Closer the estimation of Kullback–Leibler uniqueness to nothing, the closeness of the relating words increments. At the end of the day, the divergence value is less. Allow us to take a gander at the troublesome method of estimating Kullback–Leibler divergence. The Equation (1) for ascertaining the divergence is given by.

$$kl\_div(x, y) = \begin{cases} x \log(x/y) - x + y & x > 0, y > 0 \\ y & x = 0, y \geq 0 \\ \infty & otherwise \end{cases} \quad (1)$$

###### 2. Frobenius Norm

The other technique for performing NMF is by utilizing

Frobenius norm. It is characterized by the square foundation of amount of supreme squares of its components. It is otherwise called euclidian standard. The equation (2) is given beneath.

$$\|A\|_F \equiv \sqrt{\sum_{i=1}^m \sum_{j=1}^n |a_{ij}|^2} \quad (2)$$

A streamlining cycle is compulsory to improve the model and accomplish high exactness in discovering connection between the points. There are two sorts of improvement calculations present alongside scikit-learn package.

Coordinate Descent Solver

Multiplicative update Solver

NMF in action

For what reason would it be advisable for us to hard code everything without any preparation, when there is a simple way? Bundles are refreshed day by day for some demonstrated calculations and ideas. This model has a scikit-learn package to do NMF. It will utilize the 20 News Group dataset from scikit-learn datasets. Furthermore, it will initially import every one of the necessary packages.

Presently, this system will change over the record into a term-document matrix which is an assortment of the multitude of words in the given report.

Characterizing term document matrix is out of the extent of this article. To sum things up, the algorithm parts each term in the record and appoints weightage to each word.

#### a) Latent Semantic Analysis

The Latent Semantic Analysis model is a hypothesis for how meaning portrayals may be gained from experiencing enormous examples of language without unequivocal headings regarding how it is organized [10].

The issue at the hand isn't directed, that is this system don't have fixed marks or classifications appointed to the corpus. To separate and comprehend designs from the archives, LSA naturally follows certain suppositions:

1) Meaning of Sentences or Documents is an amount of the importance of all words happening in it. Generally speaking, the importance of a specific word is a normal across every one of the archives it happens in.

2) LSA expects that the semantic relationship between words are available not unequivocally, however just idly in the huge example of language

#### Mathematical Perspective

Latent Semantic Analysis (LSA) involves certain numerical activity to get knowledge on a document. This calculation frames the premise of Topic Modelling. The centre thought is to take a matrix of documents and terms and decay it into a different document-topic matrix and a topic-term matrix. The initial step is creating an archive term grid utilizing Tf-IDF Vectorizer. It can likewise be developed utilizing a Bag-of-Words Model, yet results are meagre and don't give any importance to the matter. Given m documents and n-words in the vocabulary, this model can develop an  $m \times n$  matrix A where each line addresses a document and every segment addresses a word.

$$w_{i,j} = tf_{i,j} \times \log \frac{N}{df_i} \quad (3)$$

Equation (3) represents Term Frequency- Inverse Document Frequency (Tf-IDF) Score

Naturally, a term has a huge weight when it happens as often as possible across the report yet rarely across the corpus.

This study has structured a record term grid, A utilizing this transformation method (tf-IDF) to vectorise the corpus. (As it were, that the further model can measure or assess since it doesn't chip away at strings at this point!).

In any case, there is an unobtrusive disadvantage, this model can't construe anything by noticing A, since it's a noisy and sparse matrix. (At times too enormous to even consider evening figure for additional cycles). Since Topic Modelling is inherently an unsupervised algorithm, it needs to determine the latent topics in advance.

It is analogues to K-Means Clustering with the end goal that it determines the quantity of clusters beforehand. For this situation, it plays out a Low-Rank Approximation using a Dimensionality reduction technique using a Truncated Singular Value Decomposition (SVD) Singular value decomposition is a procedure in linear algebra that factorizes any matrix M into the result of 3 separate matrices:  $M = U * S * V$ , where S is a diagonal matrix of the singular values of M.

Truncated SVD decreases dimensionality by choosing just the t largest singular values, and just keeping first t columns of U and V. For this situation, t is a hyper parameter that this model can choose and acclimate to mirror the quantity of subjects it needs to discover.

$$A \approx U_t S_t V_t^T \quad (4)$$

Equation (4) represents Truncated SVD: U and V are Orthonormal Matrices, S being Diagonal Matrix. The Pictorial Representation is shown in Fig. 2.

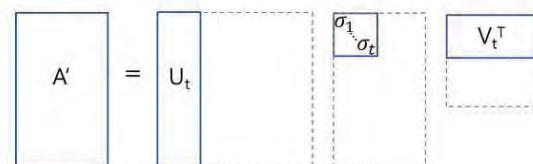


Fig. 2. Pictorial Representation of Truncated SVD.

With these document vectors and term vectors, this recommender system can now effectively apply measures, for example, cosine similarity to assess: The similarity of various reports.

The similarity of various words.

The similarity of terms (or "inquiries") and documents (which gets valuable in data recovery, when need to recover entries generally pertinent to hunt question).

#### IV. RESULTS

This study aimed to develop the android application named Xenia. This app will help the tourist in a very effective way by recommending the smart options to them. Also, it will help the local businesses by providing them the advertisement in exchange for useful data for the recommender system.

Some Screenshots of the Xenia App is as follows:

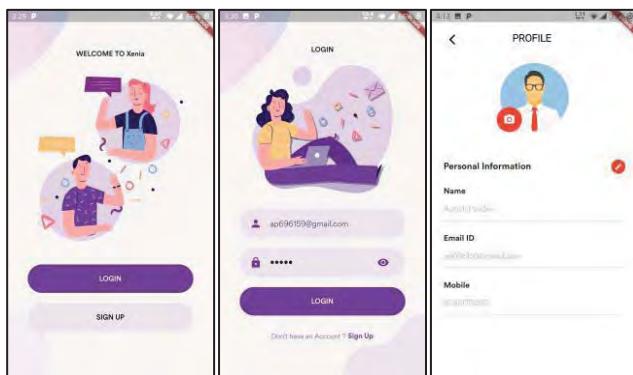


Fig. 3, Fig. 4, Fig. 5. Sign up Screen, Login Screen and Profile Screen.

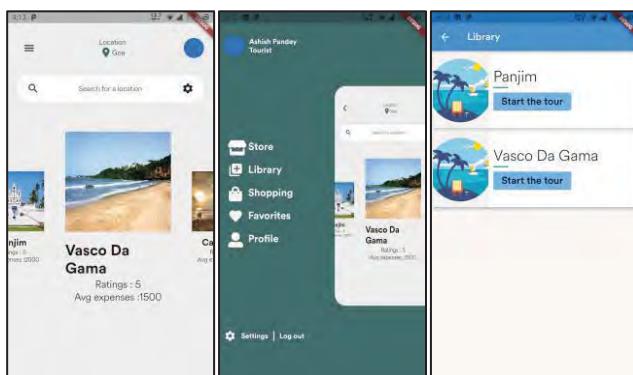


Fig. 6, Fig. 7, Fig. 8. Home Screen, Menu Tab and Library Screen.

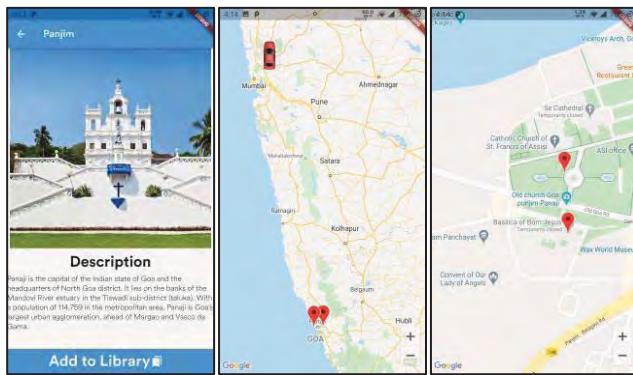


Fig. 9, Fig. 10, Fig. 11. Description Screen, Navigation Screen and Recommendation Screen.

#### V. CONCLUSION

This paper presented the design and implementation of a mobile application called Xenia, with which mobile users can get valuable recommendation on planning their trip. As shown in the result, this app has very informative UI which starts from login screen. The next screen will include store, by which user can shop the tour plans and add it in the library. Then it has Shopping and Favorites tabs. The screen shot of the maps and guides is also attached. By Xenia, users can get detailed information about important tour locations in text and pictures. In particular, this application can provide user location-based, review based and climate based recommendation for tour planning. This app also provides a business model for local stores, hotels and restaurants in exchange for the genuine data of that place. This project will also help in growing the local businesses and the valuable data side by side using crowdsourcing. The recommender system will be getting day by day as its data is totally gathered from locals of that place itself. The ultimate goal of this project is to give the user a one-of-a-kind informative and interactive experience and allow them to have all features they desire in the palm of their hand by covering every possible approach of providing information and recommendations.

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# PERCUSSION TRANSCRIPTION BY SUPERVISED LEARNING

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**Abstract**— *Labeling of tabla strokes is a timbre recognition problem that identifies the rhythmic structure underlying the melody of the music piece. Segmenting the stroke from the audio and labeling it is crucial for automatic transcription of tabla performances that can serve as a pedagogic tool for music learner. In this work onset detection that relies on the broadband nature of the drum stroke and the percussion transcription of the strokes in tabla audio in North Indian classical music are implemented. Classification of strokes using straight forward method of decision logic based on stroke acoustics and also by decision tree is presented.*

**Keywords-** MIR, transcription, percussivity, decision tree, onset, tabla

## I. INTRODUCTION

Melody and rhythm form the basic elements of music representation. Rhythmic pattern of any composition in Indian classical music is described by the *Taal* system. Understanding the rhythmic structure underlying the melody is essential in various MIR applications. The automated transcription of percussive events could be utilised to simplify the rhythm transcription. It can allow a music learner to play the music piece in the absence of notation, like Indian classical music that is mainly passed on through oral tradition.

Although research in the Music transcription field is predominately shaped by the transcription of melody, it should be noted that the rhythm established by the percussive instruments is an essential concept of musical structure. Tabla is a percussive instrument widely used in North Indian classical and semi classical music. Labeling of Tabla strokes provides a low level description of the rhythmic structure of a musical piece. Most of the music indexing and retrieval are focused on western music while few works are dealing with recognizing the percussion strokes of North Indian classical music.

The proposed approach is based on segmenting the audio by finding the onsets, wherein each segment consists of a *tabla* stroke and identifying the strokes based on the presence of a bass stroke and the strong partial corresponding to the stroke.

Finally, labeling the strokes of audio according to the syllable or *bol* associated with each stroke and validating the result with manually annotated audio clips.

Comparative evaluation of automatic classification of drum sounds has been presented in Herrera and Yeterian [1]. In their work, preliminary set of 50 descriptors have been considered and then refined to get a reduced set of 25 relevant features. Different classification techniques like, instance-based, statistical-based and tree-based have been used and tested by tenfold cross validation. As labeling tabla strokes is a timbre recognition problem, relevant descriptors would be the features describing the spectral shape. But, including all the spectral descriptors would definitely introduce redundancy and hence there is a need for proper selection of features. P.Chordia [2] has used Principle Component Analysis (PCA) that uses an orthogonal transformation to convert a set of observations of possibly correlated variables into a set of values of linearly uncorrelated variables called principal components to reduce the initial features. Herrera and Yeterian [1] have used algorithm-independent methods like, Correlation-based Feature Selection(CFS), that evaluates the subsets of features instead of evaluating individual features, ReliefF, that evaluates the relevance of an attribute by repeatedly sampling an instance and considering the value of the given attribute for the nearest instance of the same and for the nearest different class. They have reported best results for CFS while using with decision tree approach to classification of features.

## II. TABLA ACOUSTICS

The Tabla is a percussion instrument used in North Indian music consisting of a pair of drums, *Dayan* (Right hand wooden treble drum) and *Bayan* (metallic bass drum). Each of the tabla stroke is associated with a mnemonic syllable or *bol*. **Ta**(or **Na**), **Tin**, **Tun**, **Ti**, **Te** are *dayan bols* and **Ge**, **ke** are *bayan bols*. A stroke from the *dayan* can be combined with a stroke from the *bayan* by playing them simultaneously to form a compound stroke like *Dha* or *Dhin*.

### A. Tabla bols of Tintal

Tintal is the most common tal of North Indian music which is played on Tabla. It has a symmetrical structure of four vibhags

(measures) of four *matras* each. The characteristic pattern of bols (theka) of Tintal is as shown below [3]

```
Dha dhin dhin dha | dha dhin dhin dha |
x           2
dha   tin   tin   ta | ta   dhin dhin dha |
O           3
```

Tabla *bols* of *Tintal* can be categorized as ‘Dha’, ‘Dhin’, ‘Ta’ and ‘Tin’. Ta and Tin are in the *khali* section of *Tintal*, where only the right drum, *dayan* is played. Dha=Ta+Ge and Dhin=Tin+Ge, where Ge is the *bayan* (left drum) *bol* [2], [4].

#### B. Acoustic features of strokes of *Tintal*

Narrowband spectrogram with window length of 40msec is shown in Fig 1. Manually marked *bols* of the strokes are shown below the spectrogram.

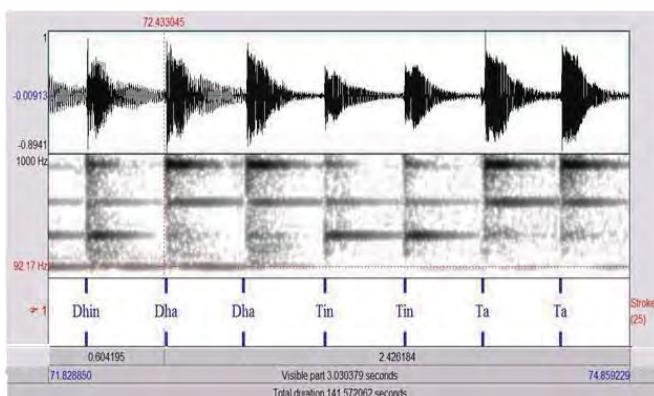


Figure 1: Narrowband spectrogram of strokes of *Tintal*

Region up to 1000Hz is zoomed in as the strokes can be discriminated in this region of the spectrogram. Dha and Ta strokes are similar except the additional low frequency Ge component. Likewise, Dhin stroke also contains an additional partial corresponding to the Ge component, compared to the Tin stroke.

For playing the *dayan* strokes Ta and Tin, the third finger damps the fundamental by resting on the head. For Ta, the index finger strikes the rim, while for Tin the index finger strikes the head of the drum. *Khali* strokes Ta and Tin are slowly decaying strokes. The difference in these strokes is due to the location of strongest partial among the harmonics. Ta has a strong partial near 1KHz, but Tin has a strong partial below 500Hz [5].

For playing the *bayan* stroke Ge, the index finger strikes the head at far the edge of patch. Hence, Ge is an open stroke on a low pitched *bayan* drum. Due to this, the compound strokes Dha and Dhin decay slowly compared to Ta and Tin.

### III. DATABASE DESCRIPTION

Two solo tabla recordings of good audio quality downloaded from tablaradio.com, are in *Tintal* with 16 beats. They have

pressure variations on the left drum. Third recording is a tabla-lesson in *Tintal* by artiste Venkat. These recordings are down sampled to 16Khz, and converted to mono channel.

Strokes that are labelled by careful hearing and based on the spectrogram observation serve as a ground truth and also for training the model in case of a decision tree approach. Acoustic features and the number of strokes used in the database are given in Table 1.

Table 1: Database description

Stroke	Strongest partial (in Hz)			# of strokes
	Tabla lesson	TL31	TL27	
Ta	909.8	818	731	18
Tin	351.3	547	491	18
Dha	909.8	818	731	54
Dhin	351.3	547	491	54
Total strokes	32	48	64	144

## IV. EXPERIMENTATION AND DISCUSSION

#### A. Segmentation

Picking up strokes from the audio is an essential step towards successful transcription. For tabla audio, segmentation needs to find the onset points. Here, a fast and efficient way to decompose a spectrogram using a simple technique which involves percussive feature detection is implemented.

The onset of a note is a single event that marks the beginning of the transient period, wherein the excitation is applied and quickly damped, leaving only the slow decay of the signal at the resonant frequency of the body [6].

#### Onset Detection

Each frame of a short-time Fourier transform (STFT) of the signal is analysed and a percussive measure is assigned to it, to get the percussive temporal profile. The magnitude STFT of the signal is taken, and the log difference of each frequency bin between consecutive frames is then calculated. This measure effectively indicates how rapidly the spectrogram is fluctuating. If the log difference exceeds a user specified threshold, it indicates a percussive onset and a counter is incremented. The final value of this counter, corresponding to each frequency bin is taken to be the measure of percussivity of the current frame. Once all frames have been processed, a temporal profile which describes the percussion characteristics of the signal will be available [7].

Let's assume that,  $X(k, m)$  is the absolute value of the complex STFT, where  $m$  is the time frame index,  $k$  is the frequency bin index. Log difference of the spectrogram with respect to time can be expressed as,

$$X' (k, m) = 20 \log_{10} \frac{X(k, m-1)}{X(k, m)} \quad (1)$$

for all  $m$  and for  $1 \leq k \leq K$ . To detect the percussive presence, percussive measure can be defined as,

$$Pe(m) = \sum_{k=1}^K P(k, m) \quad (2)$$

where,

$$\begin{aligned} P(k, m) &= 1 && \text{if } X'(k, m) > T \text{ and} \\ P(k, m) &= 0 && \text{otherwise} \end{aligned} \quad (3)$$

Here,  $T$  is a threshold that signifies the rise in energy measured in dB which must be detected within a frequency bin to consider it as a percussive onset.  $P(k, m)$  is assigned '1' if the threshold condition is met otherwise zero. So,  $Pe(m)$  represents a count of number of bins that are positive going and exceed the threshold. We can note that the actual energy present in the signal is insignificant here; and only the measure of how percussive or broadband the event is needed. Hence, compared to the standard energy based onset detection system, the detection function implemented here can deal with low energy onsets as long as they are broadband in nature.

Onset detection algorithm is tested on the tabla lessons recording by Venkat that is sampled at 16 KHz and converted to mono channel. Results of onset detection algorithm is shown in Fig 2. Percussive count is characterizing the tabla onsets fairly well.

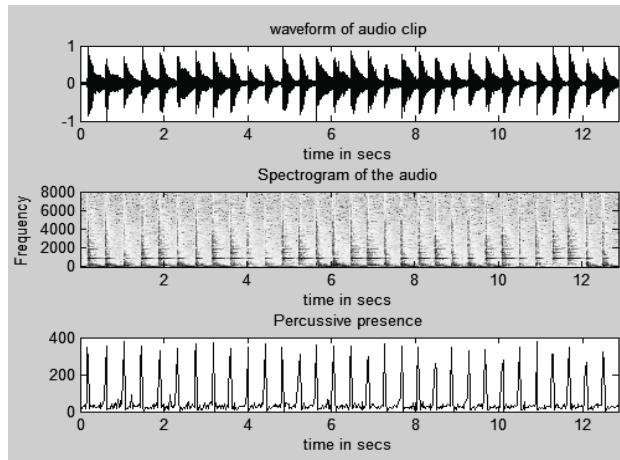


Figure 2: Waveform, spectrogram and the percussive count of a tabla recording

### B. Features for classification

Acoustics of tabla strokes (Fig 1) indicate distinguishable strong partials for each *bol*. Also, the bass component, Ge in Dha and Dhin strokes distinguish them from the *khalī* strokes Ta and Tin. These indicate a straight forward and simplistic approach of defining energy in a well-chosen set of bands as features representing the strokes of tabla.

Power spectra of various isolated strokes of Tintal are computed to decide about the boundaries of the energy bands. Manually

marked stroke onsets are taken as reference for the segmentation of the audio into strokes.

As a first step, FFT of the frame  $X(k)$  of 40 msec size, after the attack period (after two frames) is computed. Power spectrum  $P_{xx}(k)$  is calculated as,

$$P_{xx}(k) = X(k) * \text{conj}(X(k)) \quad (5)$$

Normalized power spectra can be calculated as,

$$P_{xx}\text{nor}(k) = P_{xx}(k) / P_{xx\max} \quad (6)$$

where  $P_{xx\max}$  is the maximum of the power spectrum of the frame. Normalized power spectra of different strokes of tabla, for the recording 'TablaLoop31' is shown in Fig3.

The spectrum of each stroke has been divided into 4 bands of frequency. The boundaries were decided after several trials to get significant results. Band boundaries have been decided as,  $B1 = [100; 150]\text{Hz}$ ;  $B2 = [300; 400]\text{Hz}$ ;  $B3 = [500; 600]\text{Hz}$ ;  $B4 = [700; 850]$ .

The energy within in the bands has been calculated as,

$$E_{band} = \sum_{k=k_0}^{k_1} P_{xx}(k) \quad (7)$$

where,  $P_{xx}(k)$  represents the power spectrum of a particular bin. Band energy is normalized as,

$$E_{band\text{nor}} = E_{band} / E_{overall} \quad (8)$$

where,  $E_{overall}$  is the overall energy calculated as,

$$E_{overall} = \sum_{k=1}^N P_{xx}(k) \quad (9)$$

$[E_{b1}, E_{b2}, E_{b3}, E_{b4}]$  of the stroke serve as the features for each stroke.

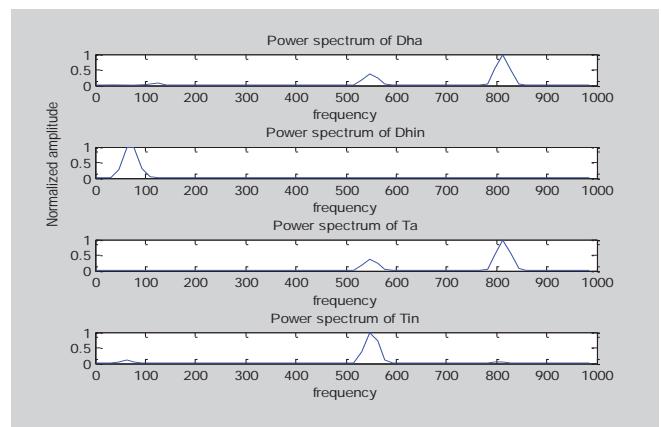


Figure 3: Normalized power spectra of strokes of Tintal

### C. Classification Technique

Decision logic derived from careful observation of power spectra of different strokes and the energies in four bands that is used to come up with proper decision rules and thresholds as shown in the Fig. 4. The accuracy of the system has been calculated as 56.67%.

```

If EB1 > T1
  If EB4 > T2
    Stroke is 'Dha'
  Else
    Stroke is 'Dhin'
  End
Elseif EB4 > T3 & EB3 > T4
  Stroke is "Ta"
Elseif EB3 > T5
  Stroke is "Tin"
end

```

Figure 4: Decision logic used in approach I

Algorithm derived stroke labels are written into a \*.TextGrid file and can be compared with the ground truth marked in the upper tier as shown in Figure 5.

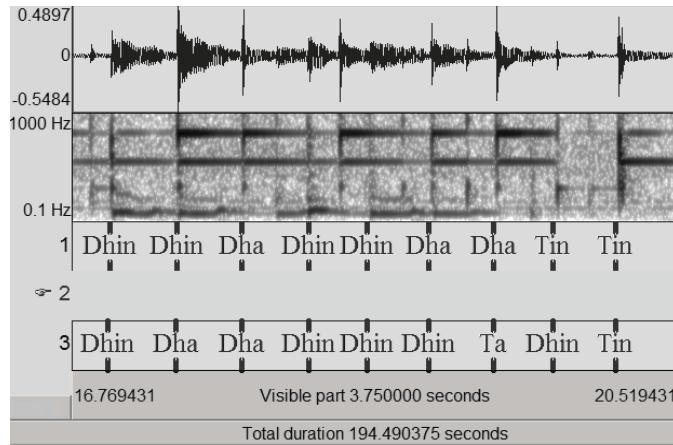


Figure 5: Ground truth labels of strokes in the upper tier and the algorithm returned labels in the lower tier.

#### Decision Tree for Classification

The results of the above approach that is based on limited number of observations of representative strokes of different categories of Tintal points to a need for better algorithm that can come up with a decision logic derived from a good number of strokes comprising training set automatically.

Classification And Regression Tree (CART) analysis is used over here. Classification tree created using strokes from both TL31 and TL27. In the tabla recording, which is an actual performance, second Ta (13th beat) of each cycle is a variation from the usual Ta and the bol of this double stroke is *Tita*. While segmenting the stroke, the algorithm is taking in only Ti part of the double stroke. Due to this variation, pruning logic may be neglecting Ta stroke.

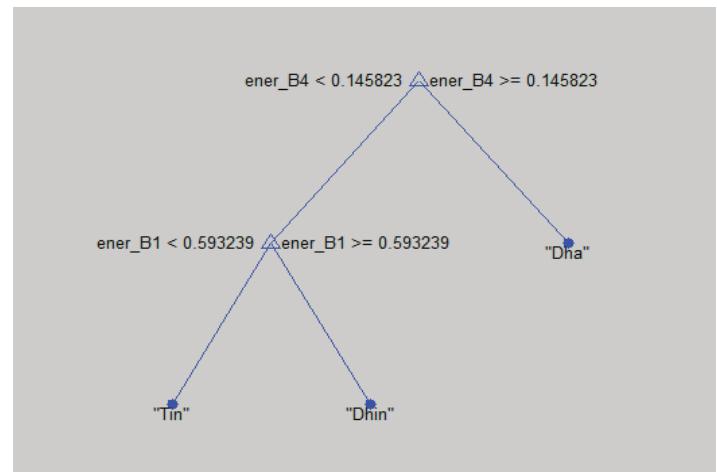


Figure 6: Subtree created by pruning to the best level

Accuracy of 90% is got by using a full tree and 75% is got by using a subtree pruned to the best level as shown in Fig 6. Comparison of decision tree predicted stroke labels and the manually marked labels is shown in the confusion matrix of Table 2.

Table 2: Confusion matrix for decision tree approach

	Dha	Dhin	Ta	Tin
Dha	11	0	0	1
Dhin	0	12	0	0
Ta	1	0	3	0
Tin	0	0	1	3

Table 3: Cross validation of the decision tree model

Approach	I	II	III	IV
Dataset for training	32 strokes of TL31 & 16 strokes of TL27	16 strokes of TL31 & 32 strokes of TL27	48 strokes of TL31	64 strokes of TL27
Dataset for evaluation	48 strokes of TL27	32 strokes of TL27	64 strokes of TL27	48 strokes of TL31
Accuracy	87%	87%	55%	50%

Evaluation of the classification tree model for different sets used in training and testing in cross validation mode is tabulated in Table 3. As expected, training of the model using dataset comprising a combination of strokes from different performances is giving better results.

## V. CONCLUSION AND FUTURE WORK

Onset detection that makes use of broadband nature or the ‘percussivity’ of the onset, is independent of the actual energy present. This proved to be a promising step towards segmentation of the audio. Labeling of *tabla* strokes using a decision tree approach, wherein the decision logic is derived from the energies in four bands as features showed fairly good results. The limitations of availability of a simple solo *tabla* performance which is not improvised much hindered the testing of the algorithm across many performances.

The variation in the rendition of strokes has been ignored in the present work. Including these variations and also other acoustic features in attack and decay region can bring in the robustness to the decision logic. The work can be extended to percussion transcription of a polyphonic audio that uses *tabla* as an accompaniment with lead melody. This will establish a rhythmic framework that is needed in many Music Information Retrieval applications.

## ACKNOWLEDGMENT

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# Contactless Heart Rate Analyzer

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**Abstract**— An irregular heart rate reflects the high risk of cardiovascular diseases, hence it's a major indicator of cardiac health. The traditional ways rely on physical contact and may bring inconvenience in practice. For example, a patient may feel uncomfortable when he has to wear the adhesive equipment for a long time, especially elderly people or newborns. Also, in the existing systems results are not stored for future reference. The proposed system will be a contactless heart rate estimation technique using webcam. For contactless measurement a photoplethysmography method will be employed. According to the change in blood volume in human face the reflected light intensity changes, from these changes the photoplethysmography (PPG) signal can be acquired which will be used for heart rate estimation. User's face will be detected from the input video. For extracting PPG signals, Region of Interest (ROI) will be selected from the detected face. Further, video magnification will be used to amplify the subtle changes in the intensity of the reflected light from the user's face will be detected. The reflected light intensity variation gives the PPG signal for heart rate estimation. The recorded data will be then classified as normal or abnormal. From the classified data, if the results are continuously abnormal then the user will get an alert. The proposed system is a real time application which would work without the use of additional hardware units for non-invasive heart rate measurement and storage of results in easily interpretable classified format for future references & generating alert in real time.

**Keywords**—Heart rate, contactless, webcam, photoplethysmography (PPG), Region of Interest (ROI), alert

## I. INTRODUCTION

Heart rate refers to the number of heartbeats per minute, which is one of the important indicators of heart health. Measuring the heart rate is an easy way to gauge our health. Each person's heart rate determines their fitness level. Normal heart rate may vary from person to person and a usually high or low resting heart rate can be a sign of trouble. Traditionally, the heart rate can be measured by using a stethoscope or electrocardiogram, or even by feeling the pulse. In addition, a growing number of wearable devices are invented to detect human heart rate. However,

these methods rely on physical contact, which makes the measurement inconvenient for some patients. At present, the current standard techniques for heart rate measurement like electrocardiograms (ECG) are uncomfortable and hinder the patient. Other, more comfortable techniques like pulse oximetry or sphygmology have their very own penalties in addition to a lower accuracy compared to the standard. An example for the disadvantage when using the pulse oximetry is the measuring error or complete malfunction when the patient has cold hands or a circulatory disorder.

According to the studies conducted on the disease burden trend it is found that about 62.5 million people lost prematurely due to cardiovascular diseases. 7.1% of the total death rate reported in 1990 is due to heart rate and in 2016 the death rate is increased up to 12.2%. In order to reduce the death rate earlier detection of the heart disease is required. Regular monitoring of heart rate is important in such situations. A regular heart rate for an adult is between 60 and 100 beats per minute. Recent studies suggest a heart rate higher than 76 beats per minute there is a higher risk of heart attack.

The proposed system is a contactless system for real time heart rate analysis from user's facial video without the use of additional hardware units. The resulting heart rate of the user would be stored in a classified format as high, low or normal thus maintaining easily accessible records of the user. If the results are continuously abnormal, then the system will trigger an alert.

## II. RELATED WORKS

Considerable researches have been conducted previously on heart rate measurement. Litchman.A. et al. proposed an ECG system which consists of two main parts. The first part is an analog amplifier with maximum gain of 1800. The analog amplifier is powered by the battery to prevent network interference and consists of three parts - the first amplification stage, the second amplifier stage and the active filter [1]. Only one amplifier could be used, but it would also amplify the undesirable interference that is always present while scanning bio signals. J Kiljander. et al. developed a

system in which a deep CNN approach for automatic feature extraction from pre-processed ECG signal and multilayer perceptron network that makes the actual classification based on the features crafted by the CNN layers [2]. As a dataset, the freely available MIT-BIH Arrhythmia database is being used. A key part of this evaluation process is the inter-patient paradigm for data division, which means that data from a patient used in the test phase is not used to train the model. Ato. Biniyam. et al. designed a low-cost portable device that can extract and display the heart rate by counting the pulse generated by the infrared sensor [3]. The infrared transmitter LED and a photodiode sensor is used to get the signal by placing the fingertip in between them. P. Bansal. et al. developed a system in which a real-time heart rate measurement technique called Photo- Plethysmography (PPG) is implemented using simple infrared transmitter and receiver circuit [4]. The main component that is used to detect heart rate in this device is an infrared (IR) sensor. The user is required to place his fingertip gently on the IR transmitter. Meddah. K. et al. proposed the development of an embedded ECG monitoring system [5]. By integrating the acquisition of the electrocardiogram (ECG) and its processing on the same embedded hardware, it is possible to perform real-time monitoring of this kind of patient. Tayyaba Tariq. et al. developed a system in which the patient doesn't need to visit a cardiologist. The patient is enumerated and registered with more than one cardiologist. The patient wears the heart beat detector sensor bracelet which uses IOT amenities [6]. C.Wang. et al. demonstrated a method to measure the human heart rate by capturing human faces instead of physical contact using a webcam [7]. The basic methodology used is capturing the reflected light intensity variation as a PPG signal for estimating human heart rate. a webcam embedded in a laptop is used to shoot facial videos.

The existing systems and the traditional ways rely on physical contact, exclusive hardware and no records are maintained. Also, these systems generate results in a form which can't be easily interpreted by the users and as also records are not maintained these results can also not be used by any clinical staff for analysis if they don't keep a continuous check on the patient.

### III. METHODOLOGY

Photoplethysmography (PPG) is the fundamental process being used in this system to obtain the human heart rate without physical contact. When human skin is exposed to light, the reflected light from the human face. When the heart contracts, the amount of absorbed light increases with the blood volume rising, and the detected light intensity gets lower. When the heart dilates, the blood volume decreases and the amount of absorbed light becomes smaller, so the intensity of the reflected light becomes higher. Thus, the periodic change in blood volume coincides with the change in heart rate and can be used to acquire the PPG signal. By this method heart rate is acquired without physical contact. Figure. 4.1 represents the block diagram of the proposed system.

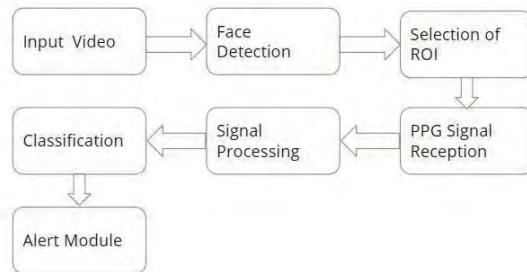


Fig. 1. Proposed Diagram of Contactless Heart Rate Analyzer

#### A. Face Detection

Open CV Library is used for face detection as it provides good accuracy.

#### B. ROI Selection

Human face skin covers complex blood vessels and is used to reflect PPG signals. The tracked ROI includes pixels whose color values change as blood circulate. The data measured from the forehead is considered to be most accurate and hence it can be chosen as ROI to extract PPG signals.

#### C. Heart Rate Estimation

Power spectrum analysis of the three independent source signals will be performed. Where the unnecessary high-frequency signals will be removed, considering normal human heart rate, frequencies from 0.8-2 Hz (48-120 bpm) can be selected. The power spectrum of the signals is to be obtained by the Fast Fourier Transform (FFT). After the FFTs of all the signals are calculated, the one with the largest amplitude in the interval (0.8-2 Hz) is chosen as the PPG signal. The heart rate can be calculated from the frequency of the selected signal that corresponds to the highest power in the spectrum within the operational frequency (0.8-2 Hz) by multiplying it by 60. Thus, heart rate can be acquired in beats per minute (bpm).

#### D. Classification

The data generated in this proposed system will be heart rate in bpm (beats per minute) which can be stored in a database according to the category and thus this stream of data can be further used to easily analyze & visualize a patient's record for later reference. The data is also classified according to the standard range of heart rate. The normal heart is defined between 60-100 bpm. The maximum limit of heart rate is higher than 100 and the minimum limit is less than 60.

#### E. Alert Module

The signal data which is converted into heart rate (bpm) can then be classified into normal and other abnormal categories and the results can be stored to the database of the webapp. If the results are high or low than normal than the user will be notified in real time and if the readings are continuously abnormal then the user will be sent an alert so that they can consult a medical professional with the visualized records immediately.

#### IV. IMPLEMENTATION

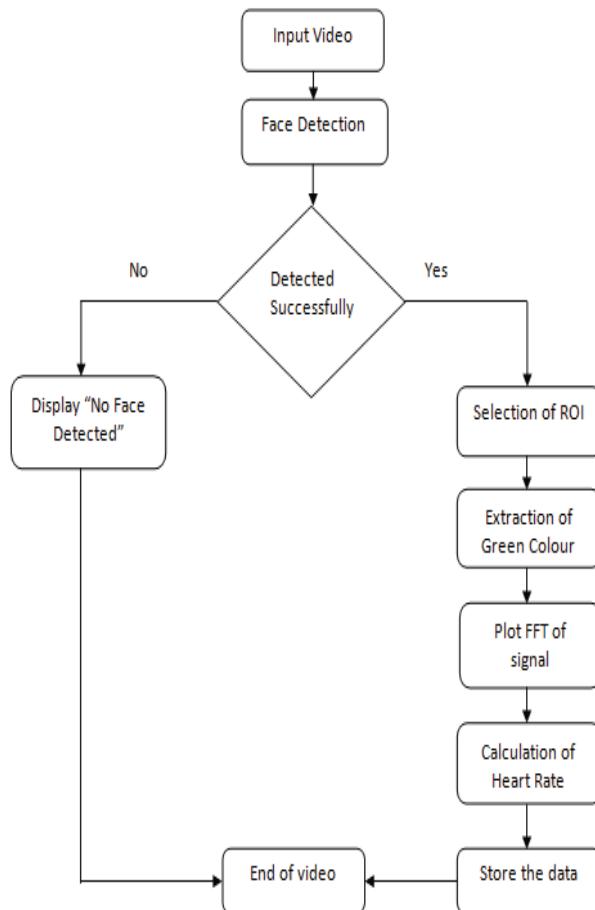


Fig.2. Work flow of system

##### A. Hardware Implementation

The hardware implementation consists of a webcam unit Webcam Unit:

A webcam embedded in a laptop is used to shoot facial videos under ordinary light conditions at a minimum resolution of 1280 x 720 at 30 frames per second.

##### B. Software Selection

The implementation of the project is carried out using Python and its libraries. Considering all the major factors such as cost, efficiency, availability, performance.

##### C. Face and ROI Detection

First the video is captured through the Webcam. Then get the frame from the captured video then preprocessing this frame by resizing it and converting it to grayscale. Then the face is detected from the video ,after that the next step is to apply the facial landmark predictor to the face. In this system the dlib 68-point landmark detector is used. The 68-point detector localizes regions along the eyes, eyebrows, nose, mouth, and jawline. The cropped face image is stored and calculated by the bounding box coordinates for this cropped image. Using the box, get an RGB cropped face image. Then the rectangle is plotted around the cropped face. X and Y coordinates of landmark points are stored in an array (shape array). Using cropped face image & shape array, cropped ROIs are obtained.

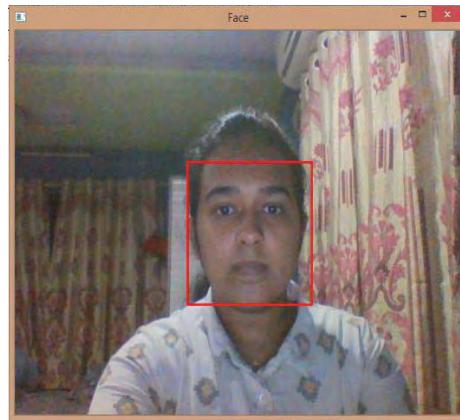


Fig.3. Face Detection

In the captured video, In case if the face is not detected as entire face is not pointing towards the webcam or because of insufficient light then the "No face detected" message will get displayed.

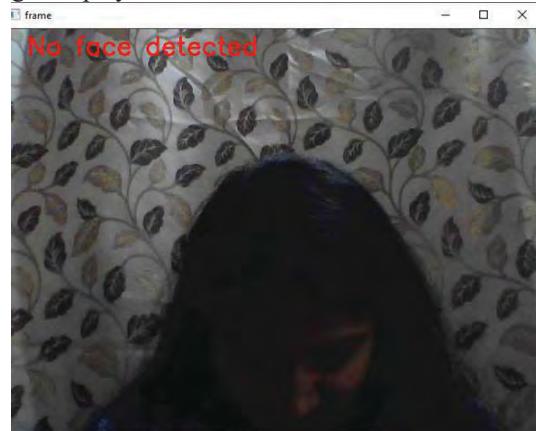


Fig. 4. No face detected

##### D. Signal Acquisition

The selected ROIs are the left and right cheeks of the user's face . A rectangle is drawn around both the ROIs.

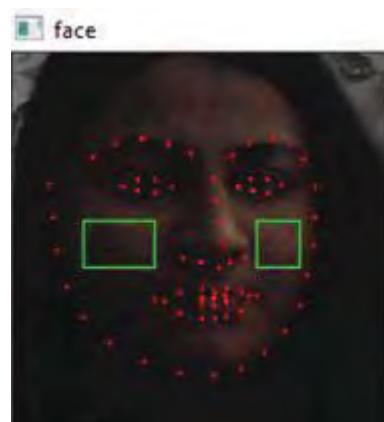


Fig. 5. Selection of ROIs

Green colour is extracted from the pixels of both the cheeks and the average value of the extracted green colour is calculated . The mean value of the green colour is saved into the data buffer.

The value of fps is calculated as follows:

$$fps = \frac{L}{T_f - T_0} \quad (1)$$

Where,

L - Length of data buffer

$T_f$  - Time at which the last frame was processed

$T_0$  - Time at which the first frame was processed

$$time = \frac{1}{video\_fps} \times n \quad (2)$$

Where,

n - No. of frames processed

$\frac{1}{video\_fps}$  - Sampling time period at which the

frames are being captured

#### E. Signal Processing

The obtained green colour signal is processed. For each frame, the average value of all the green pixels of ROI is calculated in each frame. Signal detrending is performed on the data buffer to remove the unwanted trend from the acquired signal by subtracting the mean from the data. This trending in the signal can be due to external noise and lighting conditions which make the signal drift from the horizontal axis making it difficult to analyze the signal further. If detrending is not applied, the amplitude scale of the acquired, PPG signal keeps on changing as the signal is not aligned along the horizontal axis and there can be rapid fluctuations in the calculated heart rate.

Interpolation is performed on the detrended signal as the time taken to process each frame would be slightly different which would cause the extracted green colour data samples to be unevenly spaced along the time axis. This would cause the readings of the frequency of signal to change because of external noise and changes in lighting conditions. This in turn would affect the heart rate readings acquired from signal frequency in minutes. So linear interpolation is applied on the detrended signal.

The interpolated signal is then normalized, as the normalized signal becomes less sensitive to variations in input. In this system the input may vary depending upon lighting conditions and slight movements of the user which can cause errors. A butterworth band pass filter is applied to get signal between the frequencies 0.8 to 3Hz as the range of the human heart rate to be measured is from 48 to 180 bpm. Finally, FFT analysis is performed on the normalized signal. The FFT plot gives the amplitude of the spectral components of the signal on the y axis to the corresponding frequencies in minutes on the x axis.

The values of possible signal frequencies are calculated and stored as a list as the maximum signal frequency would be half of the sampling frequency (in this case fps) and minimum would be zero. Hence, fps is multiplied by evenly spaced values from 0 to L/2 (i.e. idx) and thus frequency in mins is calculated as shown in the equation below

$$Freq.\ in\ minutes = \frac{60 \times fps \times idx}{L_f} \quad (3)$$

Where,

idx - 0 to L/2

#### L<sub>r</sub>-Length of FFT

The frequency component with the highest amplitude in the FFT plot will be selected as the heart rate in bpm. The fps and HR(bpm) is displayed on the frame displaying the user's detected face. The Heart rate in bpm is stored in a text file.

#### F. Classification

The recorded heart rate values are compared continuously with standard heart rate values (50 bpm to 120 bpm-Normal) to be classified as normal or abnormal and the status of the user is displayed as 'Normal' or 'Abnormal' according to the number of readings classified as normal or abnormal per hundred readings.

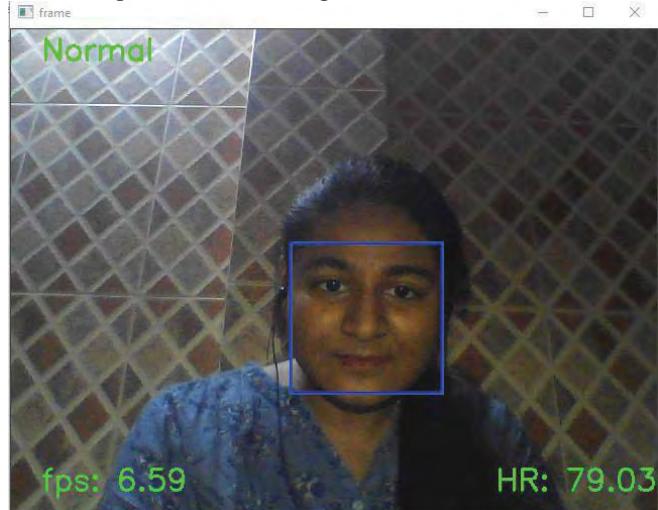


Fig. 6. Classification

#### V. RESULTS AND DISCUSSIONS

The original signal captured through webcam is shown in the Fig. 7 below which is further detrended and interpolated to get the interpolated data and then further normalized. The normalized signal is filtered through a butterworth bandpass filter to pass the frequencies 0.8Hz to 3Hz as they correspond to 48bpm to 180bpm which is the possible range of human heart rate. The filtered signal is shown in Fig. 9 on which FFT analysis is performed to get the user's heart rate.



Fig. 7. Original Signal

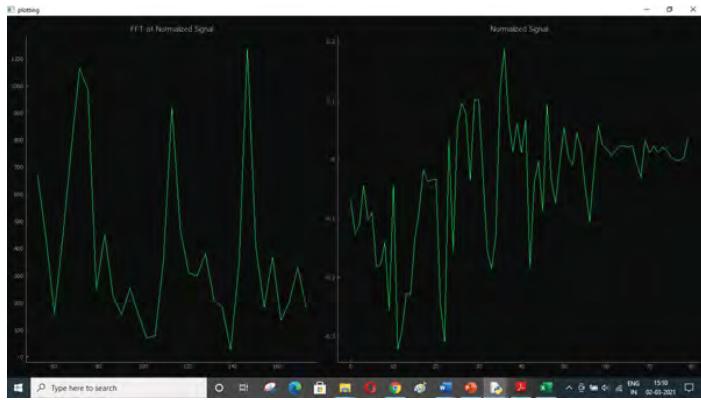


Fig. 8. Normalized Signal

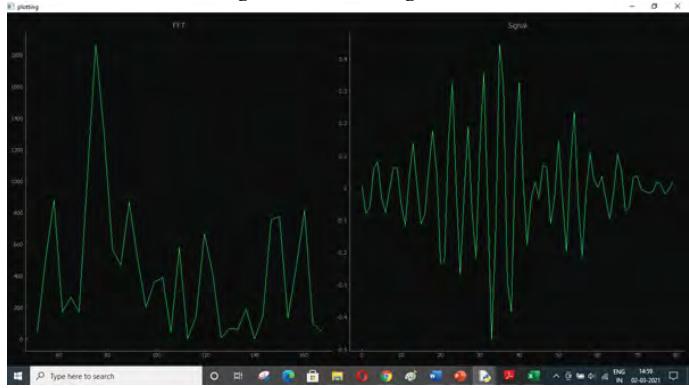


Fig. 9. Filtered Signal

## VI. CONCLUSION

The traditional ways of heart rate measurement rely on physical contact which might cause inconvenience to the patients especially elderly people and who have very delicate skin. Most of the systems for assessing heart health of a person require an additional hardware unit which would be exclusively designed for this purpose. Hence the proposed system is a non-contact-based system without the need of any additional hardware which can analyze the Heart Rate and the user's data. This system can also detect abnormal readings and report them in real-time and maintain records in an easily accessible format for future references. The detection of the user's face is implemented through facial video from which ROI is extracted and further the PPG signal i.e., the reflected green color is extracted and the heart rate is calculated by processing the acquired signal. The calculated heart rate is stored in a text file.

## VII. FUTURE WORK

This system is a web application-based system that will require internet connectivity for the user to login and upload the data to the database of the system. Also, the alert module used to send an alert to the user in case of continuous abnormal readings will also require internet connectivity. This limitation can be overcome in future by developing a system which wouldn't require continuous internet connectivity. The proposed system involves only face detection and manual login by user for storing user data, so

in future face recognition can also be implemented to recognize the user automatically and store the data in the user's records. Also, this system involves monitoring of a single user at a time so in future it can also be added with the functionality of detecting & monitoring multiple users at the same time. Also, the proposed system is not designed for mobile devices due to the varied range of camera specifications and other hardware specifications involved, so in future this system can be designed to work on various another commodity hardware's as well.

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# Dependent and Independent Task Scheduling using Non-Linear Programming Model for Cloud Computing Environment

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**Abstract—** Cloud Computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (i.e. networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. Task scheduling is important in order to achieve high efficiency in cloud computing. Most scheduling algorithms consider CPU and memory requirement of task resources without taking into consideration the bandwidth requirement. This paper proposes task scheduling algorithm that uses non-linear programming model for both independent and dependent tasks to reduce the total execution time of all tasks by considering the bandwidth requirement along with CPU and memory requirement of the task resources.

**Keywords—** *Cloud Computing, Task scheduling algorithm, Bandwidth*

## I. INTRODUCTION

National Institute for Standard Technology (NIST) defines “Cloud Computing is a model for enabling ubiquitous, convenient, and on-demand network access to a shared pool of configurable computing resources (networks, servers, storage, applications and services), that can be rapidly provisioned and released with minimal management effort or service provider interaction”.

In a nutshell, cloud computing is a model for resource-sharing amongst multiple users, located over large geographical area over the internet.

A cloud user can request for resource for immediate use, and the cloud provider is accountable to provide the requested resource to user on-demand without breaching or violating the Service Level Agreement (SLA). To efficiently and effectively allocate resources, it is essentially to adapt and use efficient scheduling algorithms.

## Scheduling Algorithms:

Scheduling is the process of allocating tasks to available resources on the basis of tasks' qualities and need and in some cases tasks' priority. The main goal of scheduling is to increase the utilization of the resources without affecting the services provided by cloud.

Cloud task scheduling is a NP complete problem. In the process of task scheduling, the users submit their jobs to the

cloud scheduler. The cloud scheduler inquires the cloud information service for getting the status of available resources and their properties and hence allocating the various tasks on different resources as per the task requirements. Cloud scheduler will assign multiple user tasks to multiple virtual machines. Good scheduling always assigns the virtual machines in an optimal way.

Scheduling algorithms are commonly applied by cloud resource manager to optimally dispatch tasks to the cloud resources. There are relatively a large number of scheduling algorithms to minimize the total completion time of the tasks in distributed systems. Actually, these algorithms try to minimize the overall completion time of the tasks by finding the most suitable resources to be allocated to the tasks. It should be noticed that minimizing the overall completion time of the tasks does not necessarily result in the minimization of execution time of each individual task.

An ideal scheduling algorithm should be capable to handle the resource allocation related problems such as resource contention, resource fragmentation, resource scarcity, and over-provisioning of resource. However, when the number of tasks increase, it becomes difficult to schedule resources to fulfil rapid resource demand while handling all the aforementioned problem. Cloud provider should choose the most efficient best suited scheduling algorithm that fulfils the resource demands.

## Scheduling Parameters:

There are few basic scheduling parameters that should be considered when trying to find the most efficient scheduling algorithm.

### 1) Execution Time

Execution time is the burst time required for the execution of a task. This also includes the time taken for provision of system services for task execution i.e. the wait time.

### 2) Response Time

Response time is the total time elapsed between the submission of request till response receipt. Response time of the system should be minimum.

### 3) Makespan

The makespan is the total length of the schedule (e.g., when all of the jobs have finished processing). It is the maximum time taken to complete all jobs/tasks. An ideal scheduler will be the one with minimum makespan.

#### 4) Throughput

Throughput is the rate at which the requests are processed, i.e. the number of tasks completed per unit time.

#### 5) Resource Utilization

Resource utilization is tracked by the amount of busy resources. An ideal scheduler should do maximum utilization of resources.

#### 6) Load Balancing

Load balancing improves the distribution of tasks across more than one computing resources. This is important to distribute the workload across various resources as opposed to a single resource.

#### 7) Fault Tolerance

Fault tolerance refers to the ability of a system to continue operating without interruption when one or more of its components fail.

#### 8) Energy Consumption

Reducing power consumption and improving performance should be one of the parameters considered for an ideal scheduling algorithm.

#### 9) Scalability

Scalability in cloud computing refers to the ability to increase or decrease resources as needed to meet changing demand.

#### 10) Performance

Performance is calculated in terms of time and cost. A task should be completed in less time and with minimum cost of service.

#### 11) Quality of Service (QoS)

Quality of Service denotes the levels of performance, reliability, and availability offered by an application and by the platform or infrastructure that hosts it. Service level agreements (SLAs) are drafted between providers and users specifying QoS targets and economical penalties associated to SLA violations.

Generally, the traditional scheduling algorithms do not take into consideration the bandwidth requirement of task resources. This leads to increase in total execution time of the tasks. The objective of this paper is to analyze the non-linear programming model for scheduling tasks posited in the research papers Task Scheduling in Cloud Computing [1]

and BANDWIDTH-AWARE DIVISIBLE TASK SCHEDULING FOR CLOUD COMPUTING [2] for independent tasks by considering the bandwidth requirement and analysis. Also, the aim is to apply the non-linear approach for scheduling of dependent tasks in order to reduce the total execution time of all tasks.

The remainder of the paper is organized as follows: Section- II discusses the existing algorithms and approaches for task scheduling. Section- III describes the dependent and independent task scheduling using non-linear programming model for cloud computing environment .Section- IV discusses the implementation and results and finally Section- V concludes the paper.

## II. RELATED WORK

This section briefly discusses the various researches and algorithms proposed by researchers to overcome the problem of scheduling and resource allocation. Abdul Razaque et al. [1] proposed a non-linear programming model for task scheduling that considers bandwidth to reduce the total execution times of tasks thereby reducing the resource wastage. This algorithm is proposed for independent tasks. Weiwei Lin et al. [2] proposed a heuristic algorithm for divisible task scheduling in bandwidth-bounded cloud-computing environments. The idea is to use non-linear programming model to schedule independent task taking into consideration the network bandwidth along with CPU power and memory. S. Sindhu et al. [3] explored two scheduling algorithms are explored, Longest Cloudlet Fastest Processing Element (LCFP) and Shortest Cloudlet Fastest Processing Element (SCFP), for scheduling tasks in private cloud environment. The objective of the paper is to get minimum timespan by considering the processing requirement of a task and computational capacity of the resource.

Syed Arshad Ali et al. [4] compared some recently developed task scheduling algorithms based on some various Scheduling parameters. Algorithms such as Particle Swarm Optimization and Cuckoo Optimization are nature based algorithms, DVFS-enabled Energy-efficient Workflow, Green Energy-efficient and Adaptive Energy-efficient algorithms are based on energy consumption. It is observed that most of the algorithms improve resource utilization and system performance. A few have successfully improved energy consumption and quality of service. Mohammad Masdari et al. [5] did an in-depth analysis of the existing PSO-based scheduling algorithms in cloud computing environment. The paper provides a comparative study of various scheduling algorithms based on parameters such as cost, execution time, makespan, load balancing, etc. Sujit Tilak et al. [6] surveyed survey various algorithms based on parameters along with tools. The primary observation presented in the paper is, the existing algorithms do not consider reliability and availability, while they do help reduce execution time, the total execution time of tasks needs to be reduced.

Rajveer Kaur et al. [7] discussed several existing algorithms for job scheduling. It is observed that First Come First Serve (FCFS) algorithm is most effective only for batch process. The major disadvantage of this algorithm is average time is more. In algorithms such as Shortest Job First and Priority Algorithm, the disadvantage is that some jobs will

wait longer causing starvation. In round-robin scheduling algorithm, no priority is given to important jobs. Nora Almezeini et al. [8] explained the concept of scheduling in cloud computing and its levels. Along with discussing scheduling policies and their affect on executing tasks, the paper also studies various scheduling algorithms. Teena Mathew et al. [9] studied existing task scheduling algorithms. The paper considers some heuristic, energy efficient and hybrid methods for study and tabulates the comparative studies along with scheduling parameters. Mahendra Bhau Gawali et al. [10] proposed a heuristic algorithm that performs task scheduling and allocates resources efficiently by improving the turnaround time and response time. The proposed system maximizes utilization of bandwidth along with CPU and memory. Gopika Venu et al. [11] presented several traditional scheduling algorithms and their modified forms. This comparative study helps understanding various scheduling algorithms and selection of based suited algorithm for the cloud computing environment.

Most of the existing task scheduling algorithms improves energy consumption and execution time of a task by taking into consideration the computing power and Storage requirement. Though, it can be observed that the total execution time of the tasks is increased and can be improved to avoid resource wastage. To achieve decreased total execution time, it is necessary to introduce an efficient scheduling algorithm that considers bandwidth requirement along with the CPU and storage requirements of task resource.

### III. DEPENDENT AND INDEPENDENT TASK SCHEDULING USING NON-LINEAR PROGRAMMING MODEL FOR CLOUD COMPUTING ENVIRONMENT

#### Non-Linear Programming Model:

Let's consider  $n$  physical hosts,  $H_1, H_2, \dots, H_n$ , each hosting a set of virtual machines(VMs) with corresponding virtual machine monitor. The algorithm uses the model originally designed for heterogeneous distributed computing environment, namely, bounded bandwidth multi-port communication model. In this model, let's consider  $n$  virtual machines  $v_1, v_2, \dots, v_n$ , with computing power (time required to compute a task) as  $c_{p1}, c_{p2}, \dots, c_{pn}$  respectively.

Consider scheduling node  $v_0$ , and incoming bandwidth of VM as  $b_i$ , where  $1 \leq i \leq n$ .

Assume, cloud computing platform has an outgoing bandwidth  $B_0$ . Dynamic bandwidth  $b'_i$  is assigned to each VM such that  $b'_i \leq b_i$ . Hence, the total outgoing bandwidth of all VMs is  $\sum b'_i \leq B_0$ .

Let's consider ' $N$ ' equal-sized tasks to be scheduled. The non-linear programming model for task scheduling will follow below constraints:

1. The total number of tasks executed by all nodes should be equal to  $N$ .  $x_i$  denotes the number of tasks assigned to node  $v_i$ .

$$\sum_{i=1}^n x_i = N$$

2. The number of tasks assigned to each node should be less than or equal to  $N$ .
 
$$0 \leq x_i \leq N, \text{ where } 1 \leq i \leq n$$
3. The computing power and bandwidth of each node should be greater than 0.
 
$$0 \leq c_{pi}; 0 \leq b_i, \text{ where } 1 \leq i \leq n$$
4. If  $c_{pi}$  is less than  $1/b_i$ , let  $c_{pi} = 1/b_i$ ; else  $c_{pi}$  is unchanged.
 
$$\text{i.e., } c_{pi}' = \max(c_{pi}, 1/b_i)$$
5. Computing time spent by each node  $v_i$  on tasks should be less than or equal to the total time of computation of all task (without including the start time).
 
$$C_{pi} * x_i \leq T - 1/b_i, \text{ where } 1 \leq i \leq n, x_i \geq 1$$
6. Sum of bandwidth in transferring tasks should be less than or equal to  $B_0$ . i.e.,  $\sum b'_i \leq B_0$ .

For Independent Tasks:

Algorithm:-

1. Submit tasks for scheduling
2. Build a non-linear model that follows the constraints mentioned above.
3. Check if a VM is available.
  - a. If yes, move to step 4.
  - b. If no, wait for the next available VM.
4. Check if the VM has required bandwidth available for computing the task.
  - a. If yes, move to step 5.
  - b. If no, go back to step 3 and wait for next available VM.
5. Execute the task.

Figure 1 describes the flow of the scheduling algorithm for independent task.

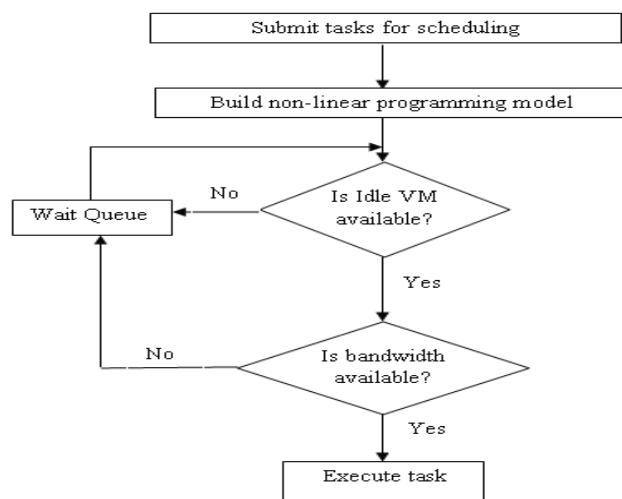


Figure 1. Flowchart for Independent Task Scheduling

### For Dependent Tasks:

Assume priority assigned to each task based on dependency of tasks on each other. Let's consider a map of each task with dependent task.

Algorithm:-

1. Create a map of tasks to be submitted for scheduling with dependent task, such as  $\{(t_1,0),(t_2,t_1),(t_3,t_1)\dots\}$
2. Submit tasks for scheduling
3. Build a non-linear model that follows the constraints mentioned above.
4. Check if a VM is available.
  - a. If yes, move to step 5.
  - b. If no, wait for the next available VM.
5. From the map created in step 1, get the task on which the current task is dependent.
6. Check whether the dependent task is executed.
  - a. If yes, move to step 7.
  - b. If no, go back to step 4 and wait for next available VM.
7. Check if the VM has required bandwidth available for computing the task.
  - a. If yes, move to step 8.
  - b. If no, go back to step 4 and wait for next available VM.
8. Execute the task.

Figure 2 describes the flow of the scheduling algorithm for dependent tasks

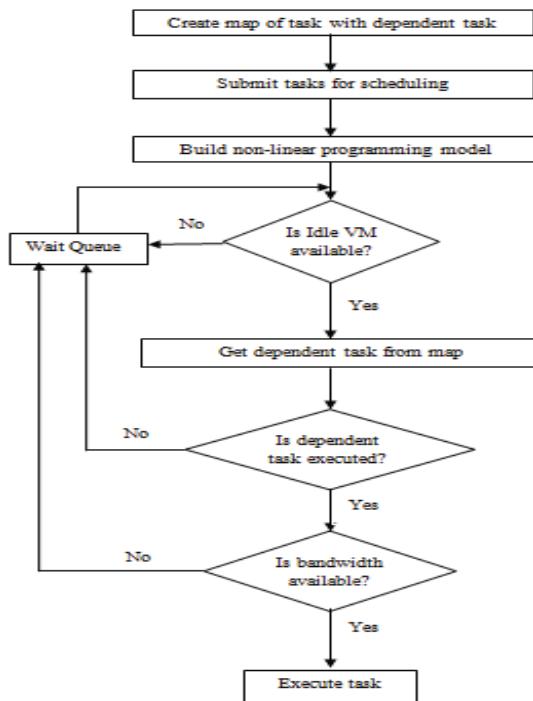


Figure 2. Flowchart for Dependent Task Scheduling

### IV. IMPLEMENTATION AND RESULTS

To evaluate the efficiency of the proposed algorithm is simulated with CloudSim [12].

Figure 3 shows the result of task scheduling without taking into consideration the bandwidth requirement. Here, x-axis represents the number of tasks scheduled and y-axis represents the time needed for the execution of tasks. The total time needed to execute 200 tasks is 1610 milliseconds.

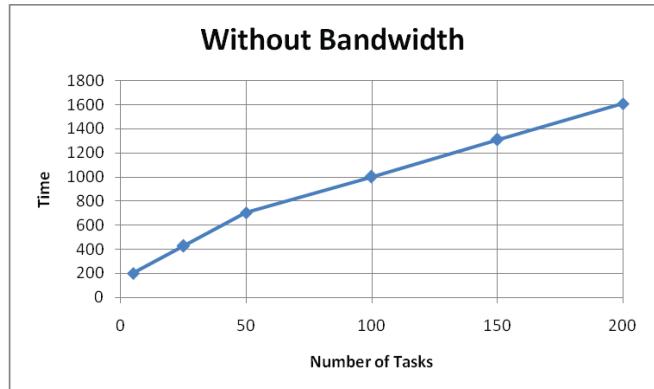


Figure 3. Time needed for tasks execution without bandwidth consideration

Figure 4 shows the result of task scheduling by taking the bandwidth requirement into consideration. Here, x-axis represents the number of tasks scheduled and y-axis represents the time needed for the execution of tasks. The total time needed to execute 200 tasks is 503 milliseconds.

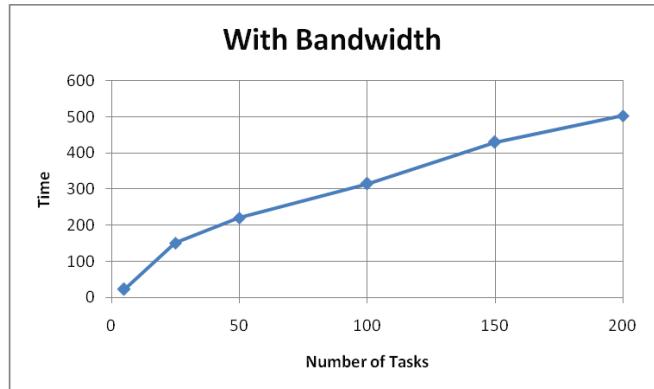


Figure 4. Time needed for tasks execution with bandwidth consideration

It can be observed that the total execution time of the tasks by considering the bandwidth requirement of task resource is reduced by almost 3 times that of the total execution time without considering bandwidth for tasks. For dependent tasks, though there is some additional overhead of creating a map of tasks to be scheduled with the dependent task, there is significant reduction in the total execution time. The algorithm does this by developing a non-linear programming model which will optimize the task allocation on the basis of task resource requirement. Building a non-linear programming model will generate a negligible overhead.

## V. CONCLUSION

This paper proposes a task scheduling algorithm for both dependent and independent tasks using non-linear programming model which considers bandwidth along with computation power and memory to reduce the total execution time of scheduled tasks. Decreasing the total execution time of all tasks helps reduce the resource wastage. For independent tasks, the improvement in total execution time is significant and improves the efficiency in task scheduling. For dependent tasks, though there is an additional overhead generated due to creation of map of tasks to be scheduled with dependent tasks, the algorithm is much more efficient than without considering the bandwidth requirement of task resources. As a future work, the focus will be to improve the algorithm in order to reduce the overhead due to creation of map as well as to optimize the energy consumption in task scheduling.

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# VHDL implementation of pipelined processor

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**Abstract -** This paper presents the design and implement a basic five stage pipelined 32 bit CPU. Particular attention will be paid to the reduction of clock cycles for lower instruction latency as well as taking advantage of high-speed components in an attempt to reach a clock speed. Pipelined architectures have their advantages over conventional processor design and In this paper, using a four- stage pipelining in architecture of a contemporary processor.

**Keywords-** Processor, Datapath, ALU, register file, pipeline

## I. INTRODUCTION

Pipelining is the process of accumulating instruction from the processor through a pipeline. It allows storing and executing instructions in an orderly process. It is also known as pipeline processing. Pipelining is a technique where multiple instructions are overlapped during execution.

There are five stages in a pipeline .

- Instruction Fetch
- Instruction Decode
- Execution
- Memory Access
- Write Back

This paper discusses design principles and issues for a pipelined dataflow processor architecture. Here it is shown that how the principles of pipelined instruction execution can be effectively applied in dataflow computers, yielding an architecture that avoids the main area of pipeline gaps encountered during program execution in many conventional processor designs.A five stage pipeline was chosen because it represents a standard view of the division of the CPU workload.

Basic background on the CPU to be designed is provided. A breakdown of the important functional units, along with the reasoning behind the design decisions behind each one follows. Simulation and synthesis results are included as an indication of the success of this exercise.

Instr. No.	Pipeline Stage					
1	IF	ID	EX	MEM	WB	
2		IF	ID	EX	MEM	WB
3			IF	ID	EX	MEM
4				IF	ID	EX
5					IF	ID
Clock Cycle	1	2	3	4	5	6

Table 1

## II. METHODOLOGY

A compatible Central Processing Unit (CPU) was designed, tested, and synthesized as shown in figure 1. The processor had the following attributes:

- 5 stage pipeline
- Hazard Detection and correction
- Data Forwarding to reduce stall cycles

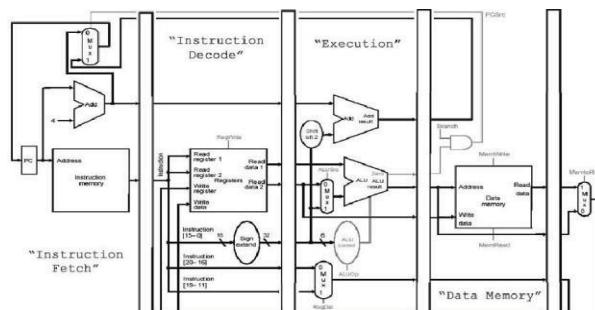


Figure 1. Pipeline Processor [1]

In order to allow the simulation of the CPU program data files were created and read into the instruction memory of the CPU. A small amount of memory for both data and instructions was also included to prove the concept and functionality of the CPU while also maintaining focus on the optimization of control and data path units of the main CPU design. The processor designed was a traditional five stage pipeline design. The stages were Instruction Fetch, Instruction Decode, Execute, Memory Access, and Write Back.

The Instruction Fetch stage is where a program counter will pull the next instruction from the correct location in program memory. In addition the program counter was updated with either the next instruction location sequentially, or the instruction location as determined by a branch.

The Instruction Decode stage is where the control unit determines what values the control lines must be set to depending on the instruction. In addition, hazard detection is implemented in this stage, and all necessary values are fetched from the register banks.

The Execute stage is where the instruction is actually sent to the ALU and executed. If necessary, branch locations are calculated in this stage as well. Additionally, this is the stage where the forwarding unit will determine whether the output of the ALU or the memoryunit should be forwarded to the ALU's inputs.

The Memory Access stage is where, if necessary, system memory is accessed for data. Also, if a write to data memory is required by the instruction it is done in this stage. In order to avoid additional complications it is assumed that a single read or write is accomplished within a single CPU clock cycle.

Finally, the Write Back stage is where any calculated values are written back to their proper registers. The write back to the register bank occurs during the first half of the cycle in order to avoid structural and data hazards if this was not the case.

The CPU included a hazard detection unit to determine when a stall cycle must be added. Due to data forwarding, this will only happen when a value is used immediately after being loaded from memory, or when a branch occurs. The hazard detection unit presents the Program Counter from updating with its next calculated value, clears out the Instruction Fetch registers, and forwards a No-op through the rest of the pipeline. A diagram of the hazard detection unit and its influence on the CPU as a whole is shown in figure 2.

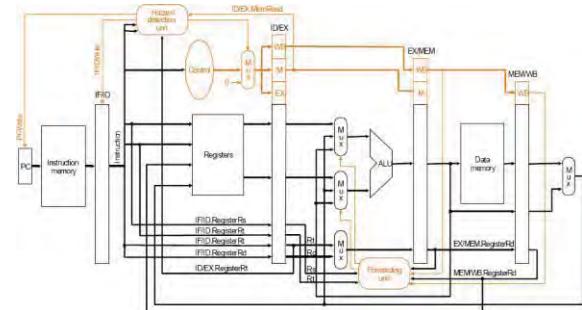


Figure 2. Hazard Detection Highlighted [1]

Data forwarding is required to eliminate the majority of the stall cycles. Without a forwarding unit, any time a value is used immediately after being calculated a stall cycle must be added. In addition, any time a value is fetched from memory, two stall cycles are introduced. This is shown in figure 3.

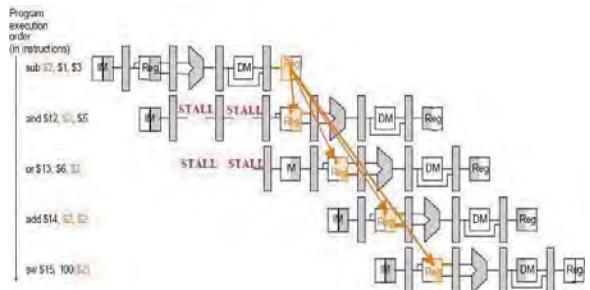


Figure 3. Data Forwarding [1]

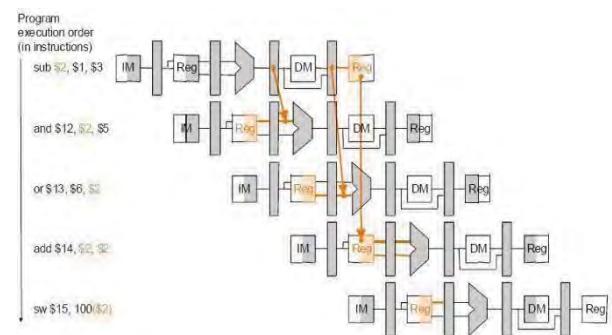


Figure 4. Stall Cycles Removed

### III. IMPLEMENTATION

The overall CPU block is responsible for tying all of the stages together as well as providing the access to the outside world that the test bench uses to load instruction memory and monitor the register bank for test verification. Because the individual stages were made responsible for buffering their own individual outputs, it was not necessary for the CPU to contain any “glue” logic, it was simply necessary to correctly connect the different stages together. The designers and authors of the CPU itself and the individual stages can be seen in Table 1. The CPU is composed of the five different stages: Instruction Fetch, Instruction Decode, Execution, Data Memory, and the Writeback stage.

The instruction fetch stage has multiple responsibilities in that it must properly update the CPU's program counter in the normal case as well as the branch instruction case. The instruction fetch stage is also responsible for reading the instruction memory and sending the current instruction to the next stage in the pipeline, or a stall if a branch has been detected in order to avoid incorrect execution. The instruction fetch stage is composed of three components: instruction memory, program counter, and the instruction address adder. The instruction memory also takes inputs from the outside world that allow the loading of instruction memory for later execution.

The unit responsible for maintaining the program counter itself consisted of a 32-bit register for the address and an update line that would allow the address to update or not. This update line was necessary because for some hazards it is necessary to stall a cycle so it is required to ensure the same instruction will be executed on the next cycle.

The instruction memory unit was designed to model a small amount of cache and therefore was made to be accessed within a single CPU cycle. The instruction memory was sized at 1k bits and could therefore at maximum contain 32 separate instructions. In a real system this would be much larger to accommodate much larger instructions or would be attached to a much larger memory hierarchy. The instruction memory handled the reading or writing of a value into instruction memory within a single CPU cycle.

The final piece of the instruction fetch stage was the instruction memory address adder. This piece of purely combinational logic was responsible for adding 4 to address that was currently being read in the instruction memory. Whether or not this result was actually used to update the program counter was controlled by the hazard detection unit in the instruction decode stage.

The Decode Stage is the stage of the CPU's pipeline where the fetched instruction is decoded, and values are fetched from the register bank. It is responsible for mapping the different sections of the instruction into their proper representations (based on R or I type instructions). The Decode stage consists of the Control unit, the Hazard Detection Unit, the Sign Extender, and the Register bank, and is responsible for connecting all of these components together. It splits the instruction into its various parts and feeds them to the corresponding components. Registers Rs and Rt are fed to the register bank, the immediate section is fed to the sign extender, and the ALU opcode and function codes are sent to the control unit. The outputs of these corresponding components are then clocked and stored for the next stage.

The Control unit takes the given Opcode, as well as the function code from the instruction, and translates it to the individual instruction control lines needed by the three remaining stages. This is accomplished via a large case statement

The hazard detection unit monitors output from the execute stage to determine hazard conditions. Hazards occur when we read a value that was just written from memory, as the value won't be available for forwarding until the end of the memory stage, and when we branch. The hazard detection unit will introduce a stall cycle by replacing the control lines with 0s, and disabling the program counter from updating. When a branch is detected the hazard detection unit will allow the PC to write, but will feed it the branch address instead of the next counted value.

The sign extender is responsible for two functions. It takes the immediate value and sign extends it if the current instruction is a signed operation. It also has a shifted output for branches.

One of the primary pieces of data storage in the CPU is the register bank contained within the instruction decode stage. This bank of registers is directly referenced from the MIPS instructions and is designed to allow rapid access to data and avoid the use of much slower data memory when possible. The register bank contained in the CPU consisted of the MIPS standard 32 registers with register 0 being defined as always zero. The registers are defined as being written in the first half of the cycle and read in the second half. This is done to avoid structural hazards when one instruction is attempting to write to the register bank while another is reading it. Setting the register bank to this configuration also avoids a data hazard because a value that was just written can be read out in the same cycle.

The execute stage is responsible for taking the data and actually performing the specified operation on it. The execute stage consists of an ALU, a Determine Branch unit, and a Forwarding Unit. The execute stage connects these components together so that the ALU will process the data properly, given inputs chosen by the forwarding unit, and will notify the decode stage if a branch is indeed to be taken. The alu is responsible for performing the actual calculations specified by the instruction. It takes two 32 bit inputs and some control signals, and gives a single 32 bit output along with some information about the output – whether it is zero or negative. This was accomplished by a large case statement dependent on the input control signals.

The forwarding unit is responsible for choosing what input is to be fed into the ALU. It takes the input from the decode stage, the value that the alu has fed to the Memory stage, and the value that the Alu has fed to the write back stage, as well as the register numbers corresponding to all of these, and determines if any conflicts exist. It will choose which of these values must be sent to the ALU. For example, if one instruction uses a value that was calculated in the previous instruction, the forwarding unit would ignore the basic input value, and instead forward the output of the memory stage to the input of the alu instead.

The Memory stage is responsible for taking the output of the alu and committing it to the proper memory location if the instruction is a store. The memory stage contains one component: the data\_memory object. It connects the data memory to a register bank for the write back stage to read, and also forwards on information about the current write back register. This register's number and calculated value are fed back to the forwarding unit in the execute stage to allow it to determine which value to pass to the ALU.

The data\_mem object is a simulation of actual memory. It is a 1k block of cache that acts as data storage. This memory is responsible for storing both words and bytes, so it must implement optional sign extension for bytes. It must handle both read and write operations as requested.

The writeback stage is responsible for writing the calculated value back to the proper register. It has input control lines that tell it whether this instruction writes back or not, and whether it writes back ALU output or Data memory output. It then chooses one of these outputs and feeds it to the register bank based on these control lines.

#### IV. SIMULATION

For simulation, a number of instructions were fed into the CPU and the outputs of registers 0 through 5 were monitored. The instructions that were tested included register based and immediate adds, subtracts (both signed and unsigned), multiplication (signed and unsigned), reading and writing data memory.

This paper gives information about executing different parts of the processor and then connecting them through a pipeline registers resulting in a successful pipelined processor.

Following are the simulation results for ALU, Register memory and Data memory. Similarly we have done for MUX, Sign Extender, Controller, etc.



Figure 6 : ALU simulation

Each and every operations in alu are assigned to different address and the output of operation are assigned to result x.

In ALU , operations such as Addition , subtraction , bitwise or , bitwise and , nor , less than are given.



Figure 7 : Register memory



Figure 8 : Data Memory

In data memory there are 2 control inputs in Mem Write and Mem Read. Inputs are Write data, mem read, Mem Write and output is Read data.

If Mem Write is 1 , then that means the need to write , we need to assign something to data memory.

#### V. CONCLUSION

Due to pipelining , Instruction throughput increases, faster ALU is designed. Pipelining helps in increasing the clock frequencies than the RAM.

MIPS processor is widely used RISC processor in industry and research area. In this paper, we have successfully designed and synthesized a basic model of pipelined MIPS processor. The design has been modeled in VHDL and functional verification policies adopted for it. The simulation results show that maximum frequency of pipeline processor is increased from 100MHz to 200MHz

In this paper implementation of a part of project has been shown with some work with pipeline registers yet to be completed.

#### FUTURE WORK

This paper presents a comparative performance analysis and finding longer path delay at different pipeline stages using different technologies device. Our future work includes changing the processor architecture to make it capable of handling multiple threads and supporting network security application more effectively.

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# Development and Evaluation of a Web-Based Simulation for Computer Graphics for Distance Learning - *PIVI*

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**Abstract**—In this paper, we presented a web-based simulation lab named, PIVI (Perception in Virtual Illustrations), that provides a virtual learning experience. This virtual lab is based on the Computer Graphics subject in which the focus has been given to the line drawing algorithms. The straight line is the most basic operation performed in computer graphic systems. By giving the required coordinates to the system, the rasterization of the line can be done for which various line drawing algorithms are used. This lab provides a simulator particularly for Digital Differential Analyzer (DDA) and Bresenham line drawing algorithms. To implement this system, the languages such as Hyper Text Markup Language (HTML), Cascading Style Sheet (CSS) and JavaScript are used along with the NetBeans Integrated Development Environment (IDE) as a code editor and Turboc to generate the graphs. Adopting this virtual platform, we endeavor to achieve both theoretical and practical perception.

**Keywords**— Line, DDA, Bresenham, Simulation

## I. INTRODUCTION

PIVI (Perception in Virtual Illustrations) is a website specially designed for students to understand the concepts of computer graphics more efficiently. Basically, this website is based on the concept of virtual labs. In today's era, the education system is changing significantly. Teachers focus on virtual and effective teaching techniques. Such web enabled techniques are designed for remote operation, viewing and to enhance the teaching quality. There are many websites available, which have presented virtual labs in different fields. We referred to some of the popular labs in the field of engineering such as- “Virtual Labs”, the MHRD, Govt. of India initiative which Provided remote-access to Laboratories in various disciplines of science and engineering for students [1]. “Vlabs Dev”, Indian Institute of Technology Bombay, Powai which presented a learning system for students which includes lab manuals, documentation and the technologies for building a high-quality simulator [2]. After going through them we decided to develop an efficient system of our own.

PIVI lab is a web-based simulator for Computer Graphics. This system contains simulation for two basic line drawing algorithms namely- Digital Differential Analyzer (DDA) and Bresenham line drawing algorithm. Both the algorithms are explained thoroughly with the proper theory and procedure.

The simulation part contains the coordinate canvas on which the user has to plot the points after solving the given questions using required algorithms. User can reset the canvas again and again and incase of any doubts, the user can see the solution provided in the system where he/she can also see the final graph of the plotted points. Pre-test and Post-test is also provided for a better learning experience. So, with help of this system, we aim towards easing the conventional ways of learning and teaching as well.

## II. PROPOSED SYSTEM

### A. Algorithm and Working

The homepage of the website shows the list of experiments i.e., DDA and Bresenham line drawing algorithms. User has to select the experiment to be performed and go through the theory, procedure, pre-test based on that experiment. After referring to it and understanding the concept, the user has to perform an actual simulation. Detailed solutions of simulation questions are provided along with the graphs.



Fig. 1 Block Diagram describing the flow of simulation.

The above block diagram gives the clear view of the simulation where the given question has to be solved by using the respective algorithm by the user. Then the user has to plot the obtained points on the simulation canvas. If the plotted point is correct, it will turn blue with an alert box indicating two points, one correct and one incorrect. Otherwise, it will turn red with an alert box indicating the chosen point is wrong. This process continues till all the points are plotted on the canvas. In case of any uncertainty, the user can refer to the provided solution along with a graph of the line.

#### B. Implementation

For the web development part of the system, Hyper Text Markup Language (HTML) and Cascading Style Sheet (CSS) are used. Javascript is used to develop pre-test and post-test. Netbeans Integrated Development Environment (IDE) is used as a code editor of the whole system. To generate the graphs of the given lines, TurboC is used.

#### C. Layout

This system is divided into two categories: DDA and Bresenham line drawing algorithm.

- Home Page

Web page showing the homepage of the website with the title and menu bars at the top of the page is given in the fig. 2.



Fig. 2. Home page of the website

- Experiments Page

Web page containing the list of experiments the user ought to perform is depicted in the fig. 3. Here, DDA line drawing and Bresenham line drawing algorithms are listed.

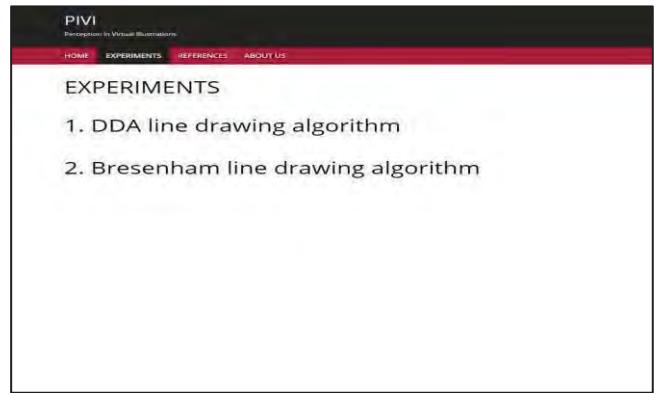


Fig. 3. Experiment's page of the website

- Content of an experiment

Web Page containing the contents of the experiment, i.e. Aim, Theory, Pretest, Procedure, Simulation and Post-test, after selecting the desired experiment which the user ought to perform is shown in the fig. 4.

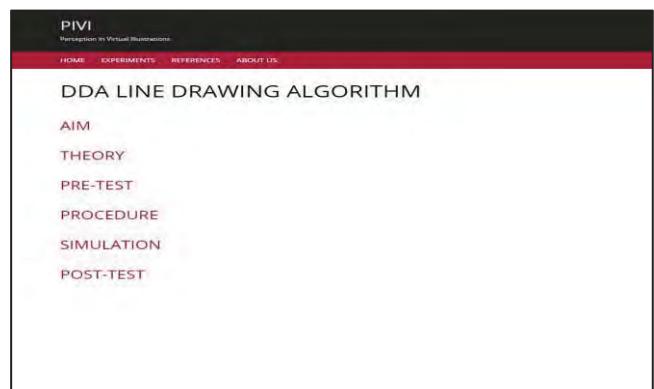


Fig. 4. Webpage displaying the contents of the experiment.

- Pre-test

The Web Page containing the Pretest of an experiment is given in fig. 5. It is to check the basic knowledge if the user ought to give. Also displaying the score, after performing the test. Here, in this figure, it is the DDA line drawing algorithm Pretest page.

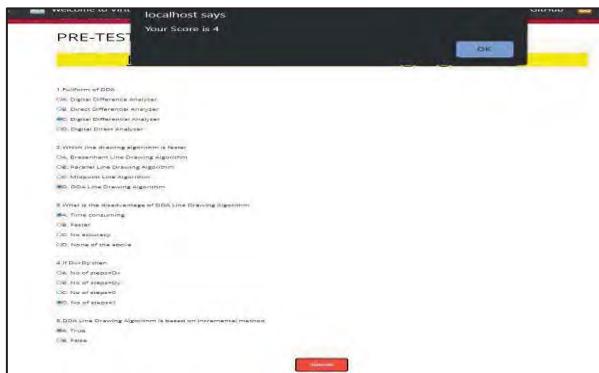


Fig. 5 Pre-Test of DDA

- Simulation

Web page containing the simulation / canvas of the experiment, where the user can actually plot points on the canvas, after theoretically calculating them as can be seen in fig. 6. User can perform this simulation as many times he wishes by clicking the “Refresh” button. Also, the “See Solution” button is provided if the user wants to see the solution. The experiment in the figure is the DDA line drawing the algorithm.

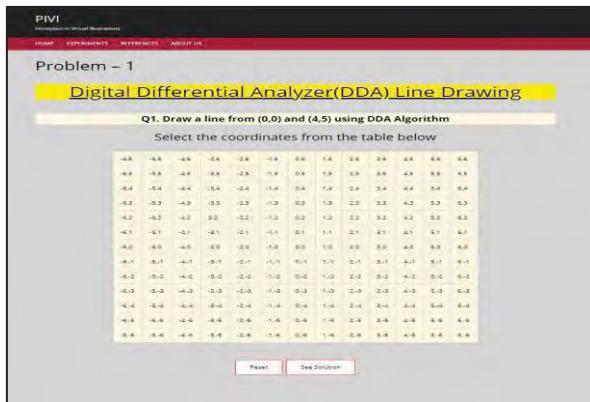


Fig. 6 Simulation of DDA

- Working of Simulation

Web page containing the working of the simulation canvas is shown in fig. 7. Plotting (selecting) points on the canvas after theoretically calculating them and getting to know how a line is actually plotted in the pixel screen. Blue cell indicating- correct point plotted and red cells indicating- incorrect point. In both cases (correct or incorrect points plotted), an alert message is popped, displaying respective messages.

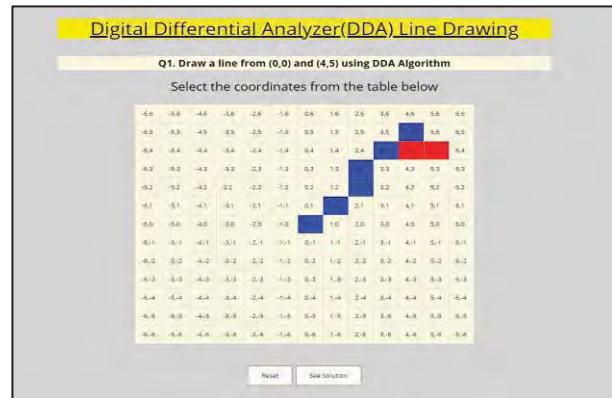


Fig. 7 Working Simulation

- Solution Page

A web page containing the detailed solution of the simulation question along with the graph is shown in fig. 8. Here, it is the DDA line drawing algorithm’s solution of First(I) Quadrant.

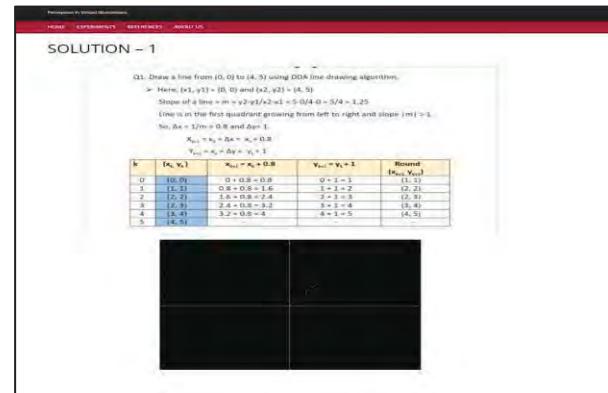


Fig. 8 Solution Page.

### III. CONCLUSION AND FUTURE SCOPE

#### A. Conclusion

So, we tried to build an efficient and errorless virtual learning system. In which, we have provided a coordinate canvas for simulation with the questions all the four quadrants and detailed solutions to each of the question along with their graphs. We have included the colour indicators on the canvas for better visualization. Due to the four-quadrant canvas, this simulator has the smaller range of coordinates. Also, we were unable to implement the feature of user defined points. Since in these times almost everything is getting digitized, with this simulation, it would be our step towards digitizing education.

#### B. Students Response

We asked a few volunteers to answer a questionnaire which was conducted through Google forms. This analysis is used to compare our work with some other pre-existing simulations. The questions that we asked were, Which simulation provides a better user-friendly environment? Which simulation did you find to be more accurate? Which simulation provided a better understanding? Which

simulation would you rate better and recommend it to your friends? Our system received positive feedback from these volunteers. They found our simulation user friendly and was more accurate. It gave them a better understanding of the concept. And they would recommend our simulation to their friends and other students. Hence, it comes to a conclusion that people were satisfied with our proposed work and would like to use and recommend it to other people.

#### C. Future Work

In the future by adding more experiments and their simulations, a complete learning system for the subject

Computer Graphics can be achieved. Also, different techniques can be found to overcome existing limitations such as a smaller range of coordinates of the simulation canvas and a feature of user defined points.

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# Predicting Residential Energy Consumption Using CNN-LSTM Neural Networks

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**Abstract -** The rapid increase in human population and development in technology have sharply raised power consumption in today's world. It is important to precisely predict the energy consumption in advance for stable power supply.

To predict the energy consumption of electricity a hybrid technique of convolutional neural network (CNN) and long short-term memory (LSTM) neural network is used. This network can extract complex features of energy consumption. The first step involves efficient pre-processing to verify, cleanse and set the data. The second step consists of a CNN with an LSTM network that obtains the input in sequence form and processes it. LSTM is used to fit and predict household electric power consumption. The performance is then evaluated using error metrics.

The results obtained by CNN-LSTM neural networks are evaluated and compared with other conventional methods on the basis of error metrics such as MSE & MAE, to evaluate which method is best for predictions and has less margin of errors.

**Keywords – CNN, LSTM , MSE**

## I. INTRODUCTION

Reducing the wastage of energy is very important in order to conserve it for future use. Accurate energy prediction system is needed for that. The output prediction for residential power consumption would be calculated based on the following input factors:

1. Sub-metering 1: Energy sub-metering No. 1 (in watt-hour of active energy). It corresponds to the kitchen, containing mainly a dishwasher, an oven and a microwave (hot plates are not electric but gas powered).
2. Sub-metering 2: Energy sub-metering No. 2 (in watt-hour of active energy). It corresponds to the laundry room, containing a washing-machine, a tumble-drier, a refrigerator and a light.

3. Sub-metering 3: Energy sub-metering No. 3 (in watt-hour of active energy). It corresponds to an electric water-heater and an air-conditioner.

Here is the pie chart below showing the energy consumed by meters.

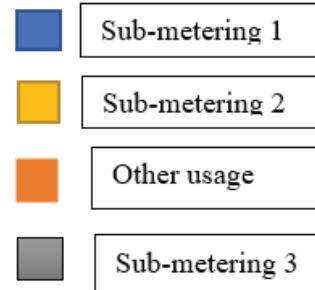
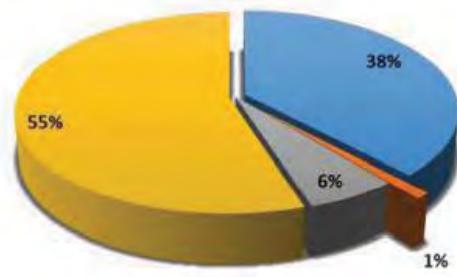


Fig.1. Pie chart

In the past few years, statistical methods have remained popular for modelling power consumption and energy consumption prediction. Zhaoxia et al. [1] developed a model based on the occupants' behavior, and analyzed the relationship between the behavior and devices that consumed energy. Cai et al [2] accurately classified the energy consumption ratings for 16,000 residential houses on the basis of data collected from the entire region. They summarized the electricity usage patterns using data mining techniques and performed clustering using the k-means algorithm, where the

electricity usage was divided using the centers of the obtained clusters, and applied SVM for classification.

Deep-learning-based methods are used due to their excellent results and applications in the field of computer vision and energy consumption.

Cui et al.[3] modeled the load among the distributed network via voltage disturbance. Another method presented in used a deep recurrent neural network with LSTM for the forecasting of aggregated power load and photovoltaic power, and then applied a particle swarm algorithm to optimize load dispatched by the connected grid. Kim et al [4] used a hybrid approach combining a CNN with LSTM for short-term ECP. They further modified the algorithm by combining it with an ANN to give further improvement. To forecast energy use in a public building, Ruiz et al.[5] used an Elman neural network and optimized the model weights using the genetic algorithm. The approaches mentioned above provide rough directions and features for ECP or PC, such as weather information and power data information that are used to calculate power energy demand through efficient prediction. These methods are also less proficient in the prediction of PC, due to their disorganized data usage.

The CNN-LSTM model predicts irregular trends in electrical energy consumption that could not be predicted in existing machine learning methods. To reduce errors generated from statistical machine learning approach, deep learning methods such as CNN-LSTM models are used for more accurate prediction.

An efficient energy prediction system using the combination of CNN and LSTM has been developed in this paper.

## II. PROPOSED METHODOLOGY

We combine a CNN with LSTM in the proposed method as a series connection network to predict energy consumption. This network extracts and learns complex features from the PC variables and stores them in a cell state memory before forwarding them to the next layers. The upper layers of the network consist of CNNs, and these layers obtain several variable values such as power, voltage, and sub-metering, while other characteristics such as the time, date are modeled as meta information. The variable values collected through database are obtained via an input CNN layer, where the output layer extracts local higher-level features into a multi-layer LSTM that consists of several hidden layers and an output layer. The hidden layers comprise of a convolutional layer, a ReLu (rectified linear unit) layer, and a pooling layer. Subsequently, this convolution operation extracts prominent

information from a multivariate time series sequence and this is passed to the next layer. Furthermore, LSTM acts as series connection after CNN, and retrieves long short-term information of input sequences related to PC and process them in both the forward and backward directions. This preserves long-term information memory units that update the hidden state of the previous layer. The output obtained from the CNN layers is then fed into the gate units. It should be noted that unlike traditional RNN approaches, this network works well for the prediction of PC, and addresses the vanishing gradient problem. This network contains memory cells that update its status by the activation function to regulate continuous values.

### A. CNN-LTSM Neural Networks

**Convolutional neural networks** are composed of multiple layers of artificial neurons. Artificial neurons, a rough imitation of their biological counterparts, are mathematical functions that calculate the weighted sum of multiple inputs and outputs an activation value.

**Long short-term memory (LSTM)** is an artificial recurrent neural network (RNN) architecture used in the field of deep learning. Unlike standard feed forward neural networks,

LSTM has feedback connections. It can not only process single data points (such as images), but also entire sequences of data (such as speech or video). For example, LSTM is applicable to tasks such as unsegmented , connected handwriting recognition ,speech recognition and anomaly detection in network traffic or IDSs (intrusion detection systems).

### B. Data Preprocessing

This section provides a detailed discussion of the process of data collection and refinement. To collect energy data, smart meters are installed at the edge of the main board where the wires from all appliances are brought to a single point. Data are typically collected monthly or annually, which introduces abnormalities and noise into the data due to climate, metering problems, and individual mistakes or measurement errors. These data need to be refined before being passed to the training process. For this purpose, various smoothing filters can be applied to clean the data .We removed the noise by considering the previous time resolution values and applying a moving average filter that is widely used by researchers for smoothing. The data are also usually scattered and need to be brought into a given range, so the data mean is calculated in order to give same range of values for each sample. Fig.2 illustrates the data resampling over the days for mean.

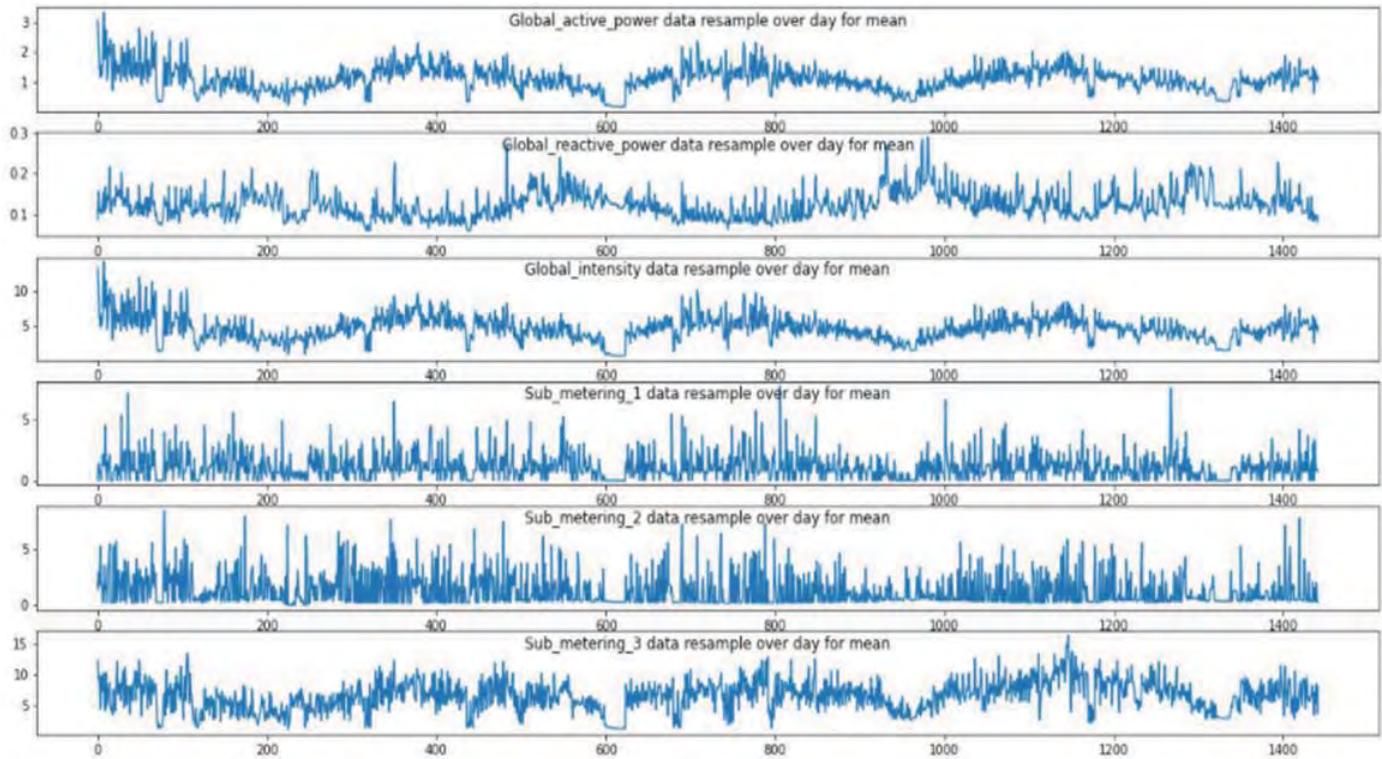


Fig.2.Data resampling over days for mean

### C. Network Architecture

The architecture structure and use settings are changed, using different variables according to the layer adjustment and network performance. Modifications to the size of the kernel, the number of filters and number of strides are performed during the experimental evaluation, and broadly confirm its effect. This setting affects the rate of learning and the network performance, which depend on the nature of the learning data. The network consists of convolutional layers, pooling layers, LSTM layers and a dense layer. The optimum settings at which the network performed best are applied, the number of filters in the convolutional layer is 64, with the kernel size of three, followed by an activation layer. Each convolution layer is followed by a max-pooling layer with kernel size two. A time-distributed layer is then applied, followed by an LSTM layer, with 70 neurons in the first layer and 100 in the second. Finally, we add a dense layer for the final output.

The LSTM model setting for the proposed network is done in the following way -

- (1) 100 neurons in the first visible layer
- (2) dropout 10%
- (3) 1 neuron in the output layer for predicting Global active power
- (4) The input shape will be 1 time step with 7 features
- (5) The mean squared error loss function and the efficient adam version of stochastic gradient descent
- (6) The model will be fit for 50 training epochs with a batch size of 70.

Figure.3. is the block diagram containing the input and network constraints which are used in the proposed model.

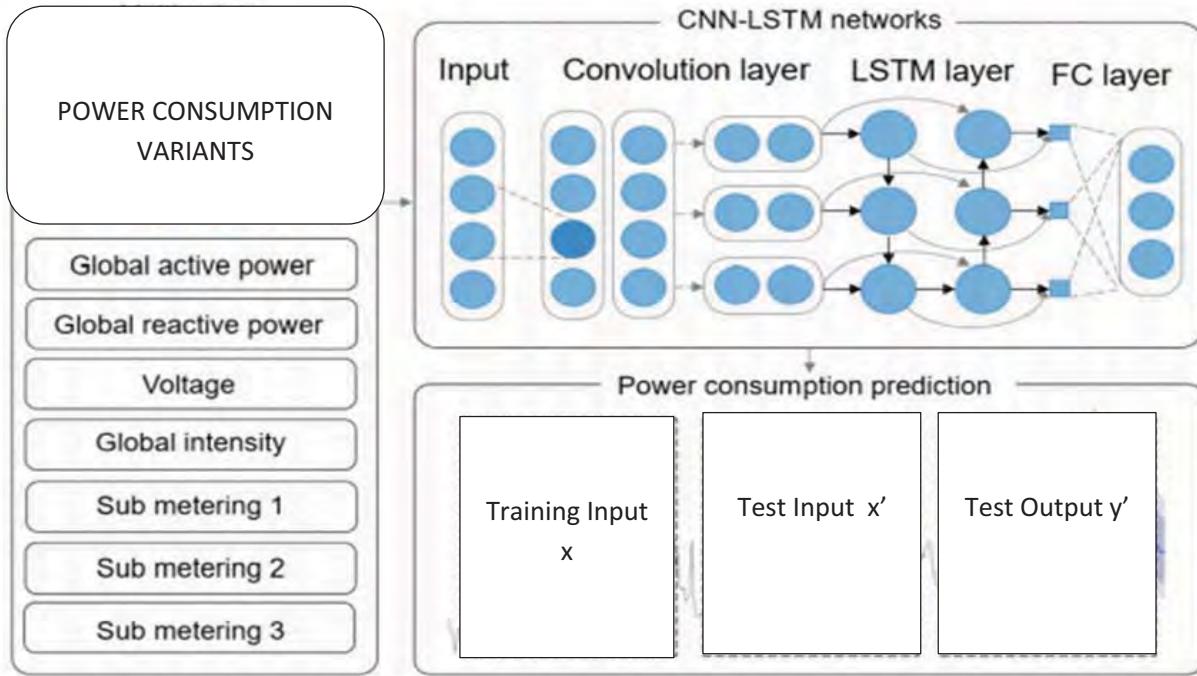


Fig.3. Block Diagram

### III RESULTS

For prediction data set containing residential energy consumption of entire year along with readings from the random months of another year were used. The proposed CNN-LSTM model is evaluated on standard metrics: Mean Square Error (MSE), Mean Absolute Error (MAE) ,and Root Mean Square Error (RMSE) . RMSE is the percentage of difference between predicted and testing variables, MAE represents the percentage of difference between the predicted variables, MSE represents the average square value between the testing and predicted variables. The training and validation losses for kaggle dataset are shown in Fig.4.A significant low model loss was achieved for both train and test dataset.

There are a total of 2,075,259 records in our dataset, with null and redundant values that are removed in the preprocessing step. Next, we normalized the input data to train the proposed model efficiently. For training purposes, 75% of the data are used from each dataset, while the remaining 25% are used for testing. Further, we compared the efficiency of our model with different Traditional machine learning and deep learning methods on the basis of evaluation metrics. Table 1. shows evaluation metrics for the proposed method.

From below observations the proposed method of CNN-LSTM showed better results compared to other methods . There was 10% reduction in Mean Square Error compared to deep learning method and 2% reduction in Mean Absolute Error.

TABLE 1. Evaluation Metrics

	Methods	MSE	MAE	RMSE
Deep learning methods	Kim, T.-Y et al [6]	0.35	0.33	0.59
	Le et al. [7]	0.29	0.39	0.54
	Marino et al. [8]	-	-	0.74
Traditional machine learning models	SVM [9]	-	1.12	1.25
	PROPOSED(CNN & LSTM)	0.25	0.31	0.50

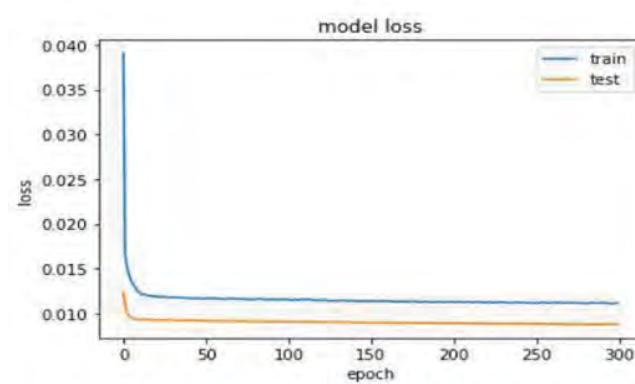


Fig.4. Model Loss

#### A. Evaluation Metrics

#### B. Final Output

Figure.5. shows the final output with the plot of actual power consumption along with the predicted power consumption of CNN-LSTM model. The predicted power consumption is close

to actual power consumed this ensures the better performance of the model and hence the model can be used for real time prediction also.

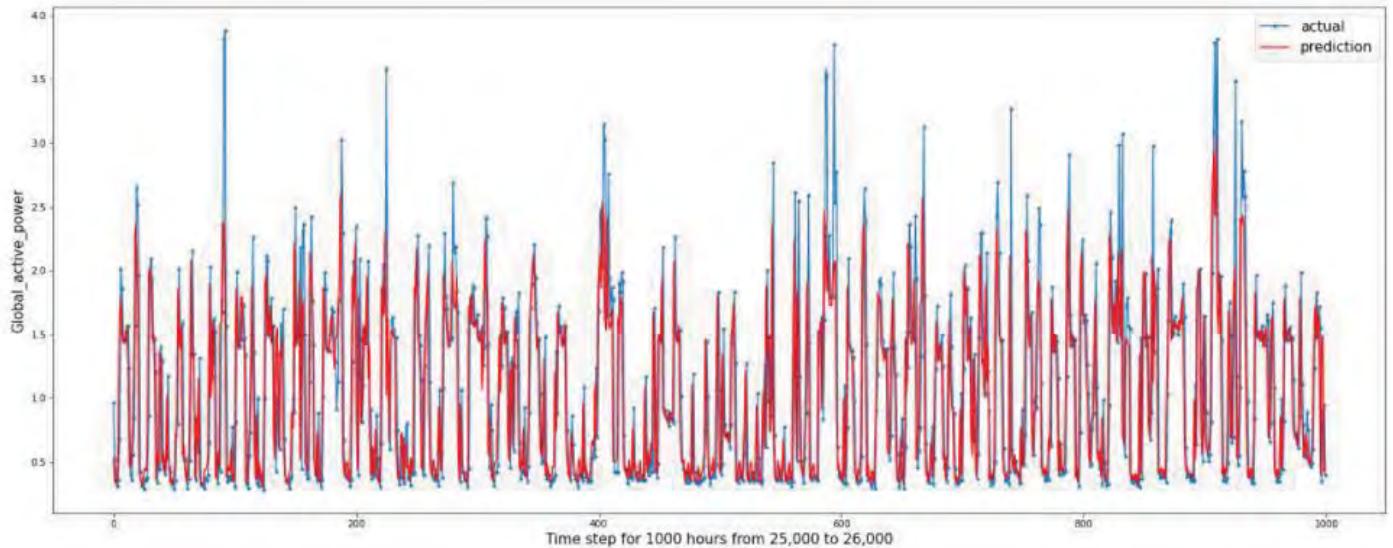


Fig.5.Final Prediction Output

#### IV CONCLUSION

A framework for the prediction of electricity consumption in residential buildings has been developed in this paper. It is evaluated using dataset from the kaggle household electricity consumption prediction. Initially, the input data are preprocessed to remove missing, redundant and outlier values. Different normalization techniques for better representation of the input data are applied which yields an effective model. Further, a hybrid CNN with LSTM model is developed. The experimental results of the proposed hybrid model outperform other state-of-the-art models for electricity consumption prediction, in terms of different performance metrics such as MSE, MAE, and RMSE.

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# Interfacing of TFT Display with machines

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**Abstract—** This paper discusses the interfacing of TFT display with controller, also the tools used for development of GUI for display and various selection parameters used are discussed. We will also be discussing about the two software's used that are STM32cube IDE and touch GFX which will help us to make our application industry ready.

## I. INTRODUCTION

Now a days, various machines, automobiles, security systems, use display which displays the functions and certain variables of the systems which gives the user information about the working of system. We have compared different displays and microcontrollers on basis of various properties. In this paper we have discussed various techniques to interface microcontroller with TFT display. After interfacing microcontroller with display, by using touch GFX software we have also used widgets which are used to operate machines. The visual that a TFT LCD display produces is sharper than a CRT monitor. Every pixel in a TFT LCD is active, preventing flickers and distortions. This means that you can get a clearer picture, which is necessary for work. Blurry images on a screen can affect a person's productivity.

**TFT DISPLAY PHYSICAL SIZE:** THE SCREEN SIZE IS THE FULL VIEWABLE SIZE OF THE SCREEN. THIS IS MEASURED DIAGONALLY FROM CORNER TO CORNER.

In order to interface we need to understand different interfacing parameters:

**Resolution:** TFT displays have a certain number of pixels making up their liquid crystal matrix, and so each TFT has a “native resolution” which matches this number. Resolution of the TFT displays is standardized. Based on the application and the clarity of the required image, resolution of Display can be selected.

**Aspect Ratio:** The aspect ratio of a TFT display describes the ratio of the image in terms of its size. The aspect ratio can be determined by considering the ratio between horizontal and vertical resolution. Here are few examples with aspect ratios.

- 4:3 = Screen with 1600(H) x 1200(V) pixels resolution
- 5:4 = Screen with 1280(H) x 1024(V) pixels resolution
- 16:10 = Screen with 1920(H) x 1200(V) or 1560(H) x 1440(V) pixels resolution

**Refresh Rate:** The refresh rate of a display relates to how often the whole screen is refreshed by a display controller. This is fired down the screen at a certain speed which is determined by the vertical frequency set in graphics card.

**Color Depth:** The number of bits required to represent a color is called the ‘Color Depth’. For example, a color depth of 16 bits means it requires 16 bits to represent a color, and therefore, we can represent 216 different colors.

**Viewing Angles:** The angles are related to how the image looks as viewer move away from the central point of view, as it can become darker or lighter, and colors can become distorted as viewer move away from his central field of view. Because of the pixel orientation, the screen may not be viewable as clearly when looking at the screen from an angle, but viewing angles of TFT's vary depending on the panel technology used.

**Refresh rate (in Hz):** is the number of times per second that the display panel is refreshed. A display must be refreshed minimum 60 times per seconds (60 Hz) since lower refresh rate creates bad visual effects.

**565 colour Scheme:** In this scheme, there are 5 bits of Red, followed by 6 bits of Green and 5 bits of Blue. Green is given more bits because of the property of the human eye, which can distinguish more shades of Green than Red and Blue.

## II. BASIC GRAPHIC CONTENT

This section describes a basic embedded graphic system, the display module categories and the display technologies.

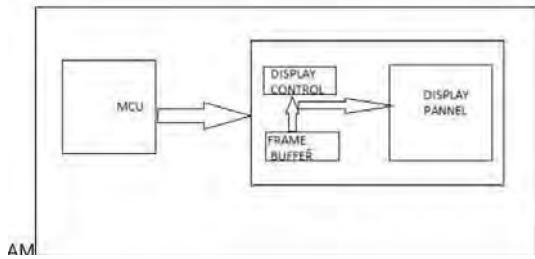
### Basic embedded graphic system

A basic embedded graphic system is composed of a microcontroller, a framebuffer, a display controller and a display glass.

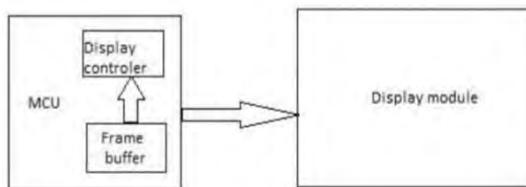
### Display module categories

The display modules are classified in two main categories, depending on whether they embed or not an internal controller and a GRAM:

- A. The first category corresponds to the displays with an on-glass display controller and a GRAM (see the figure below)*

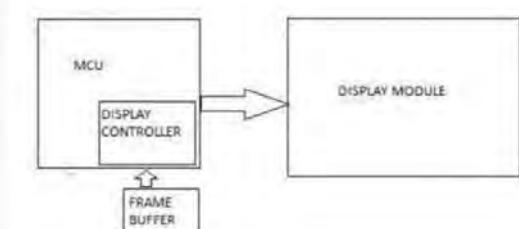


- B. The second category corresponds to the displays with an on-glass display with no main controller and that have only a low-level timing controller.*



We have selected the above category display module in our application as our RAM requirement was fulfilled.

And we also have, Display module without controller nor GRAM and with external framebuffer



### III. SELECTION OF COMPONENTS

As we have already selected TFT display according to our requirements, now we have to select a controller according to the requirements.

**Frame Buffer size** and its location. Frame buffer is basically a memory which stores further image data which is to be displayed. Here is short example for how to calculate frame buffer size.

#### FRAME BUFFER SIZE:

Frame buffer size = number of pixels × bits per pixel.

We are using display of size  $480 \times 320$  which is equal to the no of pixels.

Our color depth is 16 bits.

$$\text{Frame buffer size} = 480 \times 320 \times 16$$

$$= 2,457,600 = 300 \text{ KB}$$

#### FRAME BUFFER SIZE FOR OUR PROJECT 300 KB OR MORE THAN THAT.

CHECKING CONSIDERING REQUIREMENTS:	DISPLAY MEMORY	COMPATIBILITY BANDWIDTH
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In general, a small size framebuffer located in the internal RAM does not require a high bandwidth. This is because a small size framebuffer means low pixel clock, hence low LTDC required bandwidth.

#### DETERMINING PIXEL CLOCK AND LTDC REQUIRED BANDWIDTH:

Pixel clock = total screen size × refresh rate

$$= 480 \times 320 \times 60$$

$$= 9.216 \text{ MHz}$$

LTDC required band width = pixel clock × BPP

$$= 9.216 \text{ MHz} \times 16$$

$$= 147.456 \text{ MHz}$$

#### LTDC:

- LTDC is a master on the AHB
- Architecture that performs read access on internal and external memories.
- It has 2 independent layers with its own FIFO
- LTDC controls autonomously fetches graphical data at the speed of AHB bus from frame buffer. Then graphical data stored in one of the FIFO internal layers then driver to display.
- LTDC reframes the data belonging to an image from the frame buffer while DMA2D prepares next images
- DMA2D used to offload the CPU from graphics intensive tasks.

**Taking in consideration the above parameters we have selected the STM32F401 microcontroller**

**Selection of Display Driver:**

**Display Driver:**

Driver ICs are critical components of TFT-LCD panels. Driver IC receives image data and delivers precise analog voltages or currents to activate the pixels on the display. When voltage is applied to the liquid crystal within each pixel cell, the liquid crystal is bent, thereby changing the intensity of light that passes through each individual pixel.

**Following parameters are considered before selecting a display driver**

Interface (TE-Signal and DPI) When the DBI is selected, display data is written in synchronization with the TE signal which is generated from the internal clock to prevent flicker on the panel. When the DPI is selected, externally supplied VSYNC, HSYNC, and DOTCLK signals will drive the chip. Display Data (DB [23:0]) is written in synchronization with those synchronous signals after Data Enable (ENABLE). This enables updating image data without flicker on the panel.

**A. Address Counter (AC)**

The Address Counter (AC) assigns an address to the internal GRAM. When the index of the register for setting a RAM address in the AC is written to the IR, the address information is sent from the IR to the AC.

**B. Graphic RAM (GRAM)**

The GRAM is used to store the display pattern data with a maximum of 345,600 bytes for 320 (RGB) x 480 display resolution.

**C. Grayscale Voltage Generating Circuit**

The Grayscale Voltage Generating Circuit generates a liquid crystal drive voltage that corresponds to the grayscale level setting in the Gamma correction register. The ILI9488 can display 262k colors at maximum.

**D. Supply Circuit**

LCD drive power supply circuit generates VREG1OUT, VREG2OUT, VGH, VGL, and DC VCOM levels to drive the TFT LCD panel.

**E. Oscillator**

The ILI9488 includes an RC oscillator circuit. Command settings are used to change the frame frequency.

**F. Panel Driver Circuit**

The LCD Driver Circuit has a 960-channel source driver (S1~S960) and a maximum of 480 gate lines (G1~G480). When 320 (RGB) pixels of data are input, the display pattern data is latched. The voltage is output from the source driver according to the latched data.

**G. MIPI-DSI Controller Circuit**

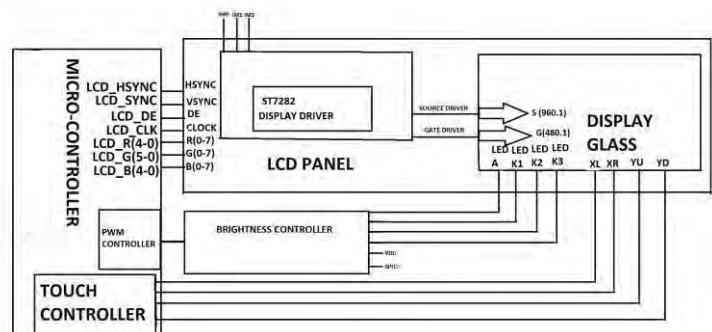
The MIPI-DSI Controller Circuit consists of a D-PHY controller, Protocol Control Unit (PCU), Packet Processing Unit (PPU), ECC generating circuit, internal data/command buffer, and analog trans receiver. The D-PHY controls communication with the analog block, and the ECC generating circuit generates the ECC to check the outgoing data stream for accuracy of the receiving data packet. The PCU controls outgoing and incoming data streams, and the PPU controls packet distribution and merging.

**The display drivers' ICs need to drive 960 column outputs and 240 row outputs.**

- NV3035GTC is a single chip digital driver for 320RGB×240 dot color TFT-LCD panels. It contains 960 channels source driver and 240 channels gate driver
- 8-bit/24-bit digital (RGB) data interface (supports maximum 16M colors display with dithering function.)
- CLKIN frequency: 6.4MHz – 24-bit mode

**Taking in consideration the above parameters, we have selected the NV3035GTC Display Driver.**

**IV. SYSTEM DESIGN**



**H-SYNC and VSYNC SIGNALS:**

- a). H-SYNC is "Horizontal Sync", it is a pulse that synchronizes the start of the horizontal picture scan line in the monitor with the picture source that created it.
- b) V-SYNC is the equivalent vertical synchronization, it ensures the monitor scan starts at the top of the picture at the right time.

Enable:

A data enable input signal. It should be DGND when not in use. For landscape mode, ENAB requires a longer cycle at 320 DCLK whereas in portrait mode, ENAB requires only 240 DCLK.

DB [23:0]: This are digital input output pins.

RESX: This is digital input pin.it is a reset input signal. Initialize the chip with low input. be sure to execute power on reset after supplying power.

CSX: It is a digital input signal. It is a chip select input signal

- If signal is low chip is selected and accessible.
- If signal is high chip is not selected and not accessible.

Fix to IOVCC level when not in use

D/CX: It is a digital input signal pin. It is Data or command selection pin.

- If low: command is selected.
- If high: data is selected.
- Fix to IOVCC level when not in use

WRX/SCL: It is a digital input pin. WRX pin serves as a write signal. SCL pin serves as serial clock in serial interface. Fix to IOVCC level when not in use.

RDX: It is a digital input pin .it serves as read signal. Fix to IOVCC level when not in use.

SDA: It is a digital input output pin. It is a serial data input or output bidirectional pin fix DGND level when not in use.

SDO: It is a digital output pin.it serves as serial data output pin. Leave open when not in use.

IM0, IM1, IM2 Pins:

These pins are used to select the modes.

**Integration of cube ide with touch GFX:** We can create widgets with the help of touch-GFX which will display the information. It is very easy to make the widgets in touch-GFX with help of above information we can easily make the application used in industries for displays used in machines. Example of application we prepared using following process:



## V. CONCLUSION

- We learned to design a UI with touch-GFX., Interfacing of stm-32 device with display screen. & Selection of proper device as per requirement of project
- TFT panels are frequently used in digital radiography applications in general radiography. A TFT is used in both direct and indirect capture as a base for the image receptor in medical radiography. ... AMOLED displays also contain a TFT layer for active-matrix pixel addressing of individual organic light-emitting diodes.
- It is used in machines to display the current working conditions, modes in which it can work, physical conditions, etc.
- In automobiles to display the functions and modes of driving .it is used to display the condition of parts. It can be used as a display in various aspects of life.

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# Design of a Monitoring System for Smart Dustbin using IOT

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**Abstract-** *Smart Dustbin (SD) is an automatic dustbin which is controlled using voice commands and button controls. The commands will be given through an android app which will be connected via Bluetooth to the system. In the voice command the speech is recognized by the microphone of the android device and is processed by the voice module. The system recognizes the command and following action is performed. The SD follows the commands and the lid of the dustbin is opened automatically by a servo-motor. The level of the garbage is sensed by the Ultrasonic sensor. When the dustbin is half-filled, green light will be indicated. When fully filled it will indicate red light and the dustbin will not follow any commands until it is emptied. There will be camera which will guide the user when any obstruction will come. The objective of this project is to design a portable dustbin for better hygiene and efficiency.*

**Keywords**—Smart Dustbin (SD), WSN, Android Bluetooth controller (ABC), Arduino UNO.

## I. INTRODUCTION

Maintaining a hygienic environment in our surrounding is quite challenging task that we all are facing today. Especially in the pandemic situation, there's a need of a smart dustbin that can be controlled by a single button or simply by giving voice inputs. It will be fitted with a camera, which will guide through obstructions. Certain places like Hospitals, Offices, restaurants etc. need a smart dustbin to avoid physical contact. Through this paper we propose sophisticated way of waste management with monitoring garbage level. We present WSN based smart dustbin which can reduce human efforts to an extent and make housekeeping easier. After observing the covid situation, we need to avoid the traditional method for

waste management as it takes more human involvement. And current scenario is to avoid physical contact as much as we can. Also waste management was always been an issue for all of us because most people don't take efforts to throw garbage inside the dustbins. Everything is becoming automatic based on our comfort, so making an automatic dustbin will also help to make living easier and better. Even our Prime minister started a mission "Swacha Bharat Abhiyan" after seeing Waste management becoming a big problem. [1]

Being a part of country like India where rapid urbanization and increasing population growth has made effective disposal of solid waste more difficult. In order to reduce environmental pollution, we need to focus on proper and efficient waste collection system and the SD seeks to serve just that purpose. The placement of the traditional dustbin is a major issue as that needs to be placed at a certain interval, which increases the number of dustbin for which the cost increases and efficiency decreases. To address these issues, SD is developed to bring down the cost of garbage collection system and enhance the effectiveness.

## II. SYSTEM ARCHITECTURE

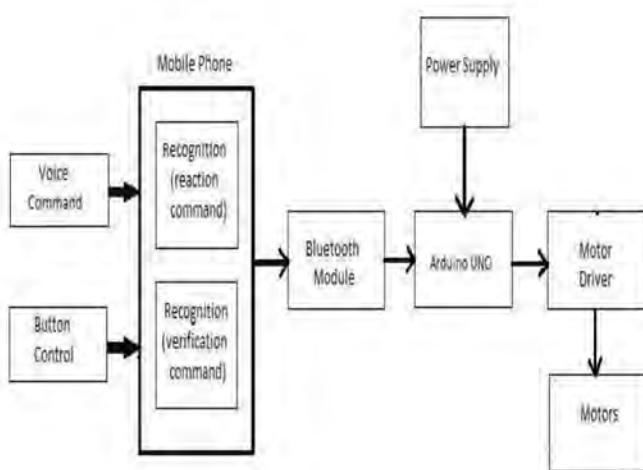
SD is divided into sections

- A. Robotics section
- B. Garbage level sensing

### A. Robot Design

The first section consist of bluetooth device, Arduino UNO, DC motor, Servo motor, camera. The SD can be paired with phone by using an app "Android Bluetooth Controller" (ABC) which is available on Google Playstore. Once we pair our working model with ABC, we can give our voice commands to SD

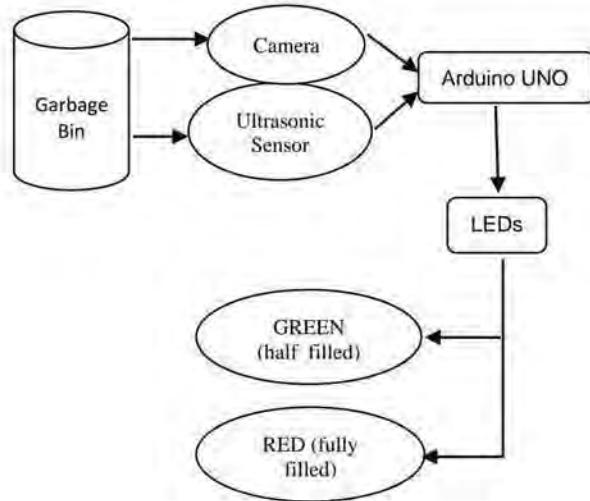
like "move forward, backward, left, right or stop". Also Graphical User Interphase can be used to send the instructions to SD. The input signal will then goes to Arduino UNO. The Arduino UNO will process the input signal or instructions in such a way that it will make an appropriate decision, like movement of motor in the given direction. In this way the DC motor will help us in moving Dustbin towards the user. If the SD is a bit far away from the user, then the camera can be used to guide through the path of the dustbin. The camera footage will be displayed through the mobile application. After reaching the user, the lid of the dustbin will open automatically by the help of the servo-motor. All the user has to do is throw the garbage without touching the dustbin. (Refer Fig. 1)



**Fig. 1 Block Diagram of the Robot [2]**

### B. Garbage Level Sensing

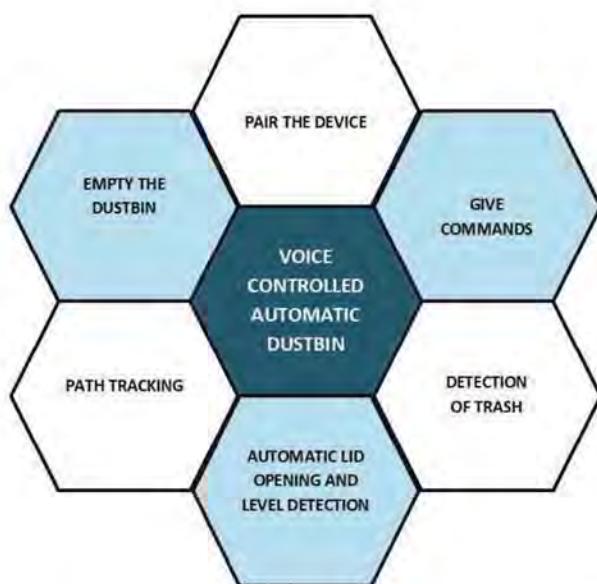
Our second section involves the ultrasonic sensor and LEDs. When the dustbin will reach the user, the ultrasonic sensor will sense the garbage. Then the lid of the dustbin will be opened automatically. The user then can throw the garbage into the dustbin. The view taken by or recorded by the camera can be helpful to see the path. This view can be helpful to guide the dustbin in proper direction. And after sensing the garbage the lid will be opened with the help of the servomotor. This will lead to the contactless waste management. This part will also sense the garbage level of the dustbin. When the dustbin gets full it will indicate red light and after that it will stop moving. Otherwise it will show green light. And it will continue its work till the green light doesn't turn into red. This will ensure the garbage bin doesn't overflow and garbage being thrown out of the bin. (Refer Fig. 2)



**Fig. 2 Block Diagram of the Dustbin**

### III. METHODOLOGY

When the user pair up with the SD with his smartphone, the user can be able to give commands to the SD. The user can also send the instruction to the device via Graphical User Interface (GUI) input or by Character User Interface (CUI) Input. Now once commands are sensed by the Arduino Uno it will start processing the instructions. If the commands given are "MOVE FORWARD, LEFT, RIGHT, BACK or STOP " then it will show the movement in the respective direction using DC motor. Once this Dustbin will reach to the user the Ultrasonic sensor will start its work. It will sense the waste in the given range. The user has to take the waste closer to the lid of dustbin, and SD will open the lid automatically by using Servomotor. All these steps will keep repeating for different users until the RED led glows. For disposing the waste the SD is added with a feature LEVEL INDICATOR. The level indicator will show the GREEN LED when there is empty space left in the dustbin. When the Dustbin gets full the RED LED will be triggered. We may add the feature of locking the dustbin with a password when the RED LED glows so that no one can add extra garbage. For now we have planned it in such a way that it will not move when the RED light glows neither it will pair up. To handle it in our house or in some crowded place we have fixed a camera to see its path continuously and guide it in proper direction. This camera will help a lot at our house when the dustbin is in different room. As the LED opens and closes automatically, it will maintain the hygienic environment around us. And SD will result in an effortless housekeeping. [3]



**Fig. 3 Block diagram of proposed SD**

#### IV. EXPECTED OUTCOME

Smart Dustbin which can be controlled by simply using your phone or by giving voice command. When the user call the dustbin by using “ANDROID BLUETOOTH CONTROLLER”, the Arduino UNO will respond to that by moving the motors in the given direction. Also it will stop at given point, so that the user can throw the garbage. The lid will open automatically, as the ultrasonic sensor sense the waste hold by the user in the given range. Using servomotor it will open the lid. And the DC motor will help the SD to move. While performing all these tasks it will also indicates the level of garbage inside the dustbin. The level of the garbage is sensed by the Ultrasonic sensor. When the dustbin is half-filled, green light will be indicated. When fully filled it will indicate red light and the dustbin will not follow any commands until it is emptied. Now if the dustbin is placed away from the user, then user might face problem to call the dustbin, so at that time camera will be used to guide. The camera placed in the dustbin will guide the user by giving its front view which can be seen on smart phones through an android app.

#### V. APPLICATION

SD can be used at different places such as hospitals, offices, restaurants etc. All the patients who are advised for complete bed rest can use this to throw their waste. It can be used mainly in covid situation so that we don't need to touch the dustbin or keep it open. Also for the doctors who are dealing with the covid patients can't rely on the traditional method of waste disposal, as they need to go to the dustbin to throw the

waste (mask, injections, syringes etc.). The SD can be called at your place to throw the waste. This makes the waste management easier. For our senior citizens, physically disabled people who can't take much efforts to go to the dustbin can use this. We can use it at our homes to reduce human efforts and make housekeeping easier. No matter where we are, we need a hygienic surrounding around us and for that SD will play a vital role. The camera fixed in SD will be helpful to track its path to remove it from more complex situations. Now if SD is coming to you and suddenly somebody comes in between then the ultrasonic sensor will sense the object in its range and will stop. Also the dustbin can't be over filled as it will stop its working after indicating the red light. Some crowded public places like railway stations, airports, malls can use this device with a bigger size container so that it can collect more garbage. [4]



**Fig. 4 Garbage detection by ultrasonic sensor [5]**



**Fig. 5 Automatic opening of dustbin lid [6]**

## VI. CONCLUSION

SD is step towards modern method of waste management system. It aims to put a step forward in “Swacha Bharat Abhiyan” by government of India. SD is WSN based robot with a simple design. You can just operate a dustbin by sitting away from it. The features of a SD are its mobility, automatic lid opening and closing, we can see its path using that camera, garbage level sensing. All these features reduces human efforts and take waste management to a different level in comparison to the traditional method. It can be enhanced for better results in speed. Also charging port can be added for recharging the battery after its exhaustion. It also enhances the method of waste management system.

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# An Ultra-Low Power, Nano-scale Design For Sequential Circuit Using QCA

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**Abstract** — Lot of research has been going on for implementing digital systems at nanoscale level. Quantum-dot based Quantum Cellular Automata (QCA) is a promising as well as emerging technology for implementing of digital systems at nanoscale. Considering the roadmap of silicon, the high rate of shrinkage in dimensions of typical MOS circuits, genuine difficulties endanger this innovation. A quantum-dot cellular automaton (QCA) is an outstanding and conceivable answer for substitution of CMOS technology. Sequential circuits contain combinational circuits and memory elements which store binary information. Latches and Flip-flop circuits are the basic components of computerized circuits, along these lines. By taking full advantage of the unique feature of this technology, it is possible to have device which functions consuming ultra-low power and very high operating speeds. The area and energy of the sequential circuits has to be minimal for speed applications. Traditional implementation of JK flip-flop circuits requires more cells and consumes more energy. In this work, we have selected few basic flip-flops and studied them well. Using the computational tools “QCA Designer” proposed for designing QCA based digital circuits; we have designed the QCA circuits of D-Flip Flop. The correctness of the proposed circuits is also verified using simulation results obtained using QCA Designer. New designs for different QCA sequential circuits are presented. Analysis of energy was performed using the CAD tool, QCA Designer-E. The proposed designs are compared with the previous QCA works and conventional CMOS technology. The simulation results confirm that the novel QCA architectures work properly and can be simply used in designing of QCA sequential circuits.

**Keywords**— QCA, QCA Designer, Sequential

## I. INTRODUCTION

CMOS (complementary metal oxide semiconductor), this technology is used to design integrated circuits, sequential circuits etc, but it consumes more energy. Using CMOS technology, more power dissipation is required to design any circuit. Nowadays, there are few low power technologies include Reversible logic, adiabatic logic, and Quantum-dot Cellular Automata (QCA) technology [9]. QCA is transistor less computation paradigm. However, researchers are trying to build large and complex digital circuits whose designs can be exploit in the IC fabrication. The implementation of QCA is in the early phase and the novel design of logical digital gates with minimized QCA cells is in progress. Using QCA technology, researchers are doing multiple experiments to achieve fault-tolerant, area efficient and manufacturable QCA designs. A deep study is going on the manufacturing process and defect elimination of QCA [16]. There are multiple limitations of MOSFET based VLSI circuit design, such as tunneling currents, sub-threshold leakage, quantum

effects, fabrication cost, interconnect delay. To overcome these limitations, the researchers found a new technology that uses both quantum mechanics and cellular automata. The best replacement of the CMOS based VLSI technology is a Quantum-dot Cellular Automata (QCA). This is a new technology that operating at the quantum level. Lent et al implemented automation physically using quantum-dot cells in 1993. In 1997, QCA cell was first fabricated [24]. The scaling of CMOS devices at nanoscale affects the performance of several factors like heat dissipation and leakage currents. In CMOS technology, as multiple devices are packed into the same area, the heat generated can no longer dissipate and results in damage of the chip. So that many novel technologies, like QCA, have been extensively researched and developed at nanoscale to replace conventional transistor based VLSI technology. Among several other alternatives, Quantum Dot Cellular Automata (QCA) performs computation and routing information at nano domain. The unique feature of QCA is that logic states are represented by a QCA cell. A QCA cell is the basic element of QCA technology. It is a nanoscale device capable of transferring data by two state electron configurations. The advantages of QCA over conventional CMOS technology include lesser delay, high density circuits and low power consumption which permits us to perform quantum computing in near future [18].

## II. QCA TECHNOLOGY

### A. QCA Cell

The basic element of QCA technology is QCA cell. The primitive cell in QCA technology, as shown in Fig.1 (b). It is a square-shaped cell. It contains four quantum dots at each corner of the cell. Out of these, it contains two electrons in each cell, which occupy two dots of the cell. Due to the coulombic repulsion between the electrons, the electrons tend to occupy the position which has lower repulsion force between them. So that electrons can occupy stable states. The best position to have lower repulsion is the diagonal position within the cell. There are two methods possible for the placement of electrons as shown in Fig.1 (a). Therefore, two polarities are possible. If the electrons occupy the position as shown in Fig.1 (a) then it corresponds to polarization "1" i.e. logic 1 and if is arranged as shown in Fig.1 (a) then it is in polarization "-1" i.e. logic 0 states. These two electrons can quantum mechanically tunnel between dots, but not cells [7]. Without any interaction from outside, due to Coulomb force that interacts between them, these two electrons will try to separate from each other as far as possible. So the electrons

will be located diagonally inside the potential wells, because the diagonal is the largest possible distance for them to reside[24].

1.00



-1.00

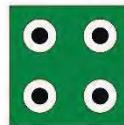


Fig 1(a) : Logic Value 1 and 0

fig 1(b): Basic Cell

In CMOS technology, the information is passed by the flow of electric current, whereas in QCA technology, QCA operates by the Coulombic interaction that connects the state of one cell to its neighbor cell state [7].

### B. QCA Wires

It is the array of QCA cell through which information is passed. QCA wire is used to transmit information from one cell to another cell. In QCA wires cells are coupled with each other and it consists a chain of cells. Due to Coulomb interaction present between cell logic values are passed from one cell to another cell. In this polarization of cell is traveled to down of the wire. As a result indicates that arrangement system is settled to down at the ground state of wire. If polarization of one cell changed due to electron repulsion then adjacent cell changes its state [7].

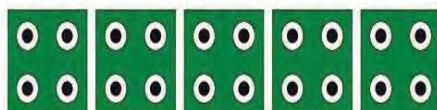


Fig 2 (a) 90 degree



Fig 2(b) 45 degree wire

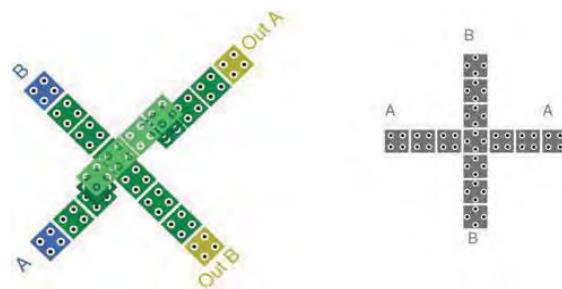


Fig 3(a): Multilayer

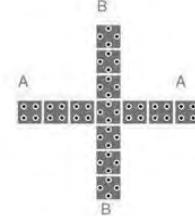


Fig 3(b) : Coplanar

To transmission of information correctly through wire we have to give clock signal [24]. Co-planar crossover and Multi-layer crossover are the two main types of crossover as shown in fig. These structures have limitations in terms of noise between interaction cells. Clock is not in form of separate wire in QCA cell which is in conventional circuits. To manage barrier in QCA cell Clock is used. It controls the motion of electrons between quantum dots in QCA cell [16].

### C. Majority Gate

It is one of the fundamental gate in QCA technology as shown in fig. Majority gate is 3 input majority function. Output is dependent on majority input. Let us assume A, B and C are three inputs and Boolean function of this majority gate is,

$$M(A, B, C) = AB + AC + BC \dots\dots\dots(1)$$

Now, If we fix polarization of one input to logic "0" that we can say B, Then equation becomes as follow,

$$M(A, 0, C) = A \cdot 0 + AC = AC \dots\dots\dots(2)$$

Hence equation 2 is simply AND operation between A and C inputs value equals to "1" then,

$$\begin{aligned} M(A, 1, C) &= A \cdot 1 + AC + 1 \cdot C = A + C + AC \\ &= A(1+C) + C = A + C \end{aligned} \dots\dots\dots(3)$$

Equation 3 shows that it is the OR operation between A and C. Hence by changing the value of any input majority gate can function as AND gate and OR gate[7].

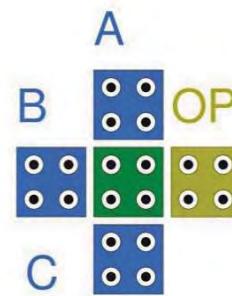


Fig 4 : Majority Gate Structure

### C. Inverter Gate

There are many ways available to do it in QCA paradigm out of which one is shown in fig. The signal which is comes from left it splits into two parallel wire and gets inverted at the point of convergence[7]. When two pairs shifted vertically or horizontally the becomes orthogonal to each other and complements from one pair to other pair[21].For example an input logic "1" is shown to be inverted in fig 5

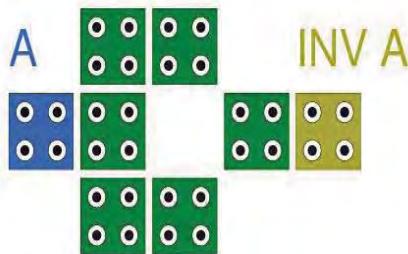


Fig 5 : Inverter

### D. QCA Clocking

Clock signal plays an important role in QCA technology. It acts as control signal. The flow of information from input to output is controlled using this signal. The quantum dot cellular automation clocking schemes depends on potential barriers. When we have low range of potential, then the electrons are said to be at no operation. When we increase the potential barrier at that time the electrons initialize to localize, and the tunneling rate will also reduced. When the electrons gets localized they starts to do polarization [3]. After applying the clock signal to the circuit, the electrons present in QCA cell may either pushed to the four corner dots or pull them into the two middle dots. When the electrons are in the middle dots, the cell is said to be in the "null" state and when the electrons are in the four corner dots, the cell is in an active state. The cell is used to represents binary "0" and "1" if and only if it is in an active state [23]. The QCA clocking signal is used to control the signal propagation along with the QCA cells arrangement. Then it is also used to maintain synchronization of the digital circuits. The QCA technology has 4 clock signals namely clock0, clock1, clock 2 and clock3. They have 90 degree phase shift in between. It contains 4 clock phases as follows :

- SWITCH: During this phase the inter-dot barriers are slowly raised and the computation takes place. According to QCA cell arrangement. The state of polarization of cell is decided in this phase.
- HOLD: In this phase, the inter-dot barriers are kept high and the QCA cells retain their states of polarization.
- RELEASE : The barriers are lowered and the cells are allowed to relax to unpolarized states during release phase.

- RELAX: In this phase, the barriers are kept low and the cells remain in unpolarized state [13].

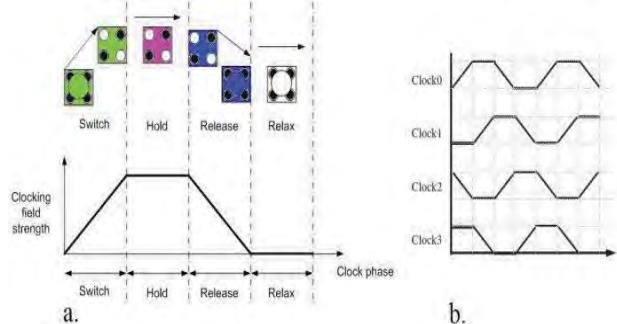


Fig6(a) Four Phases of QCA Clock (b) Clock Zone Signals

### III. D Flip-flop

In D flip-flop, D stands for Data. Flip-flop is a storage device. It store 1 bit at a time. It can store two binary values i.e. binary 0 and binary .The D flip flop is the most important flip flop from other clocked types. It ensures that at the same time, both the inputs, i.e., S and R, are never equal to 1. The Delay flip-flop is designed using a gated SR flip-flop with an inverter connected between the inputs allowing for a single input D (Data) as shown in figure 7. This single data input, which is labeled as "D" used in place of the "Set" input and for the complementary "Reset" input, the inverter is used.

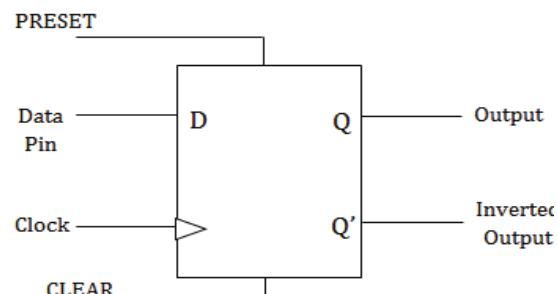


Fig 7: Symbol of D flip-flop

In D flip flop, the single input "D" is referred to as the "Data" input. When the data input is set to 1, the flip flop would be set, and when it is set to 0, the flip flop would change and become reset. It is shown in following truth table . In table, symbols ↓ and ↑ indicates the direction of the clock pulse.

Clock	D	Q	Q'	Description
↓ » 0	X	Q	Q'	Memory no change
↑ » 1	0	0	1	Reset Q » 0
↑ » 1	1	1	0	Set Q » 1

Fig 8 :Truth table of D Flip-flop

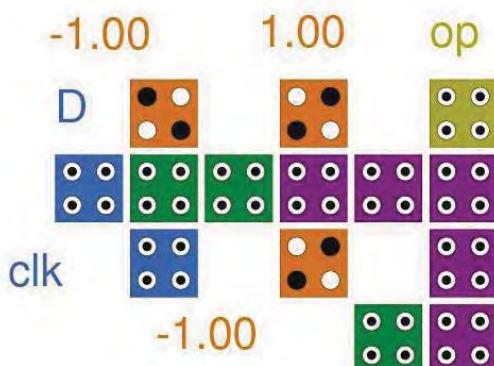


Fig 9:Circuit Diagram of Proposed D Flip Flop

The efficiency in the proposed design is due to removal of unnecessary cells and designs occupying less area. On implementing the design, the cell count decreases drastically which further decreases the area occupied by circuit and the power dissipated by the circuit. **CLK** represents the clock, **D** is the data input and **Op** represents the output. The simulation results of the D flip flop are shown in the Fig. 10 and the expected output is obtained.

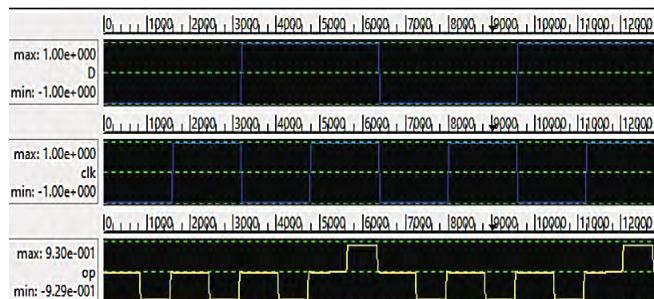


FIG 10. Simulation results of D Flip-flop

In Table 1 below , the cell count, latency and energy dissipation of both previous papers and the proposed architecture of D flip flop is recorded. From Table , it can be inferred to that the proposed design is 33% and 22% more efficient in terms of cell count when compared with the designs proposed in [3] and [4] respectively.

\*\*\*\*\* Energy Dissipation in eV \*\*\*\*\*  
 $E_{bath\_total}$ : 3.4868e-004 2.7531e-004 3.2822e-004 1.1550e-003 3.4868e-004 2.7531e-004 3.2822e-004  
 $E_{clk\_total}$ : 8.8860e-004 -2.1532e-004 -3.6067e-005 4.9419e-004 8.8860e-004 -2.1532e-004 -3.6067e-005  
 $E_{Error\_total}$ : -1.3621e-005 -4.9569e-005 -5.3254e-006 -1.4362e-004 -1.3621e-005 -4.9569e-005  
Total energy dissipation (Sum\_Ebath): 5.17e-003 eV (Error: +/- -4.93e-004 eV)  
Average energy dissipation per cycle (Avg\_Ebath): 4.70e-004 eV (Error: +/- -4.48e-005 eV)

Fig 11 :Energy Dissipation of Proposed D Flip Flop

DFF	Cell Count	Area ( $\mu\text{m}^2$ )	Latency (clock cycles)	Energy Dissipation (eV)
[1]	30	0.03	4	0.0121
[2]	26	0.02	4	0.0133
[3]	21	0.024	4	0.01206
[4]	18	0.0162	4	0.00598
<b>Proposed</b>	<b>14</b>	<b>0.0131</b>	<b>2</b>	<b>0.00517</b>

Table 1 :Performance analysis of D flip-flop

The designed structure occupies the area of  $0.0131 \mu\text{m}^2$  and dissipates energy of amount  $0.00517 \text{ eV}$ . Hence it is considered to be efficient when compared with the previously designed structures.

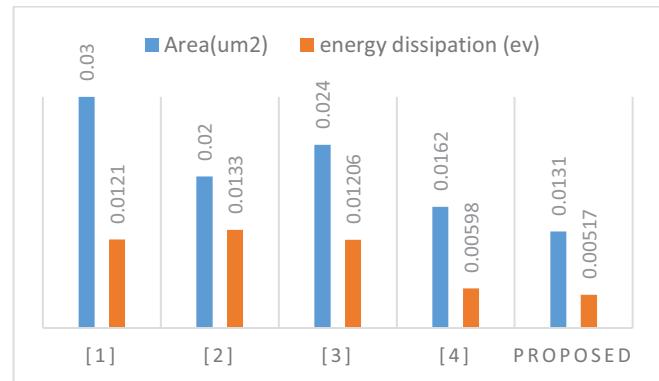


Fig 12 :Comparison of various QCA based D flip-flop circuits.

#### IV. JK Flip-flop

The JK flip flop is one of the most used flip flops in digital circuits. The JK flip flop is a universal flip flop having two inputs 'J' and 'K'. The JK flip flop work in the same way as the SR flip flop work. The only difference between JK flip flop and SR flip flop is that when both inputs of SR flip flop is set to 1, the circuit produces the invalid states as outputs, but in case of JK flip flop, there are no invalid states even if both 'J' and 'K' flip flops are set to 1. JK flip-flop is as shown in figure 13.

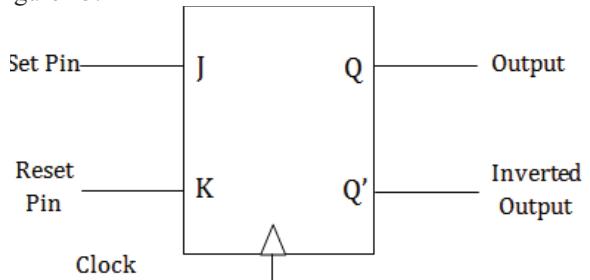


Fig 13 : symbol of JK flip-flop

The JK flip flop work as a T-type toggle flip flop when both of its inputs are set to 1. When both of the inputs of JK flip flop are set to 1 and clock input is also pulse "High" then from the SET state to a RESET state, the circuit will be toggled.

The JK flip flop is an improved clocked SR flip flop. But it still suffers from the "race" problem. This problem occurs when the state of the output Q is changed before the clock input's timing pulse has time to go "Off". We have to keep short timing plus period (T) for avoiding this period. Truth table of JK flip-flop is as shown in Fig 14.

Same as for SR Latch	Clock	Input		Output		Description
		J	K	Q	Q'	
Toggle action	X	0	0	1	0	Memory no change
	X	0	0	0	1	
	-↓	0	1	1	0	Reset Q>>0
	X	0	1	0	1	
	-↓	1	0	0	1	Set Q>>1
	X	1	0	1	0	
Toggle action	-↓	1	1	0	1	Toggle
	-↓	1	1	1	0	

Fig 14:Truth table for JK flip-flop.

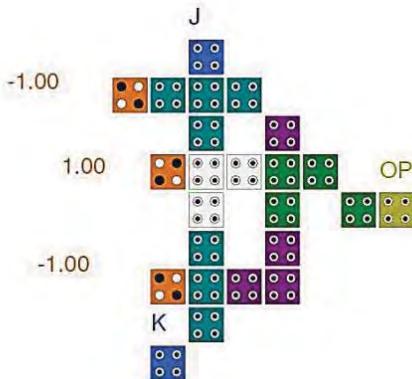


Fig 15:Circuit Diagram of Proposed JK Flip Flop

From the JK flip-flop circuits available in [9], it was noticed that there were many unnecessary cells. The proposed arrangement requires only 24 cells and an area of 0.04  $\mu\text{m}^2$ . The proposed JK flip-flop can be used in the design of digital system, which will results in less energy dissipation.

Simulation results of JK flip-flop circuit is illustrated in Fig.16

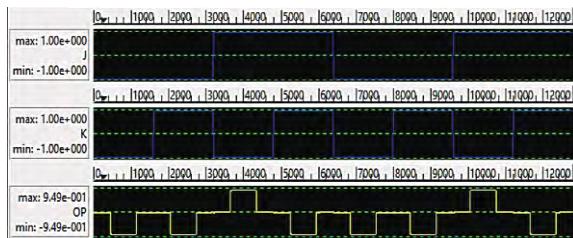


Fig 16: Simulation results of JK Flip-flop

Simulation results were obtained using QCA Designer and QCA Designer-E. The proposed QCA based JK flip-flop circuit is compared with the reference QCA based architectures in the literature w.r.t. cell count, area and energy dissipation. The results are tabulated in the Table . It can be inferred from the Table , that JK flip-flop in [9] consists of cell

count of 26, occupies 0.06  $\mu\text{m}^2$  area and an energy dissipation of 0.0113 eV. Unnecessary cells in the JK flip-flop circuits were reduced, because of this reduction, the area as well as energy dissipation has been down as you can see from table 2.

```
E_bath_total: 6.7669e-004 9.8694e-004 6.6982e-004 2.8686e-004 4.7392e-004 9.8691e-004 6.6982e-004 2.86
E_clk_total: -1.2532e-004 -5.2149e-004 1.5427e-004 2.9836e-004 3.6910e-004 -5.2232e-004 1.5427e-004 2.98
E_Error_total: -6.5044e-005 -9.2550e-005 -6.8411e-005 -1.4250e-005 -4.2624e-005 -9.2515e-005
```

Fig 17 :Energy Dissipation of Proposed JK Flip Flop

JK flip flop	Cell count	Area ( $\mu\text{m}^2$ )	Energy Dissipation (eV)
5	119	0.15	0.0546
6	80	0.11	0.0229
7	56	0.10	0.0210
8	31	0.08	0.0194
9	26	0.06	0.0113
Proposed	24	0.04	0.00717

Table 2 :Performance analysis of JK flip-flop

The proposed JK Flip-flop circuit needs only 24 cells and occupies 0.04  $\mu\text{m}^2$  area with an energy dissipation of 0.00717 eV. The below Fig. illustrates area and energy comparison of various JK Flip-flop circuits. There is a 7.69 % reduction in cell count, 33% reduction in area and 36.54% reduction in dissipation of energy in proposed architecture compared with [9]. The results informed that the proposed circuit is compact.

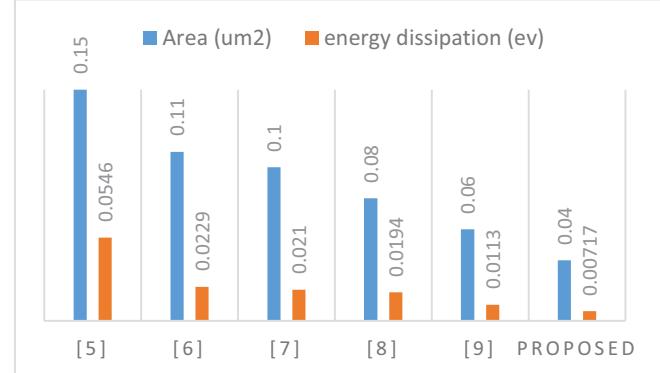


Fig 18 :Comparison of various QCA based JK flip-flop circuits.

## V. Conclusion

Sequential circuits are mostly used to design digital circuit. They consume more power and area. By using QCA designer tool, QCA based D and JK flip-flop circuit have been designed which gives effective results. To estimate energy in circuits QCA designer-E is used which is a CAD tool .To analyze functions of JK and D flip flop circuits QCA designer 2.0.3 tool is used .As compared to reference circuit JK flip flop circuit has less energy consumption and circuit

complexity is also less .There is the future scope that proposed JK flip flop may be used to design T flip flop, counters etc. which results in less power and energy consumption and cell count is also reduce. In this paper author described QCA computing technology and provided detail information as compared to current state of technology .The presented designed layouts are significantly smaller than reference circuit. The size measurement done with the help of Reduced QCA cell count. By using one of the unique feature of QCA ,we are able to do layout of circuit in single layer by eliminating requirement for complex connection which are found in CMOS .We had taken care that all designs are clocked using simple clocking layout as possible.

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# Sun Tracking Solar Panel

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**Abstract**—As each day is passing by our environment is running out of non-renewable energy resources. To hold up to our future we need to prioritize the use of renewable energy. Here's where solar energy comes into picture. Solar power is the most important key to a sustainable and clean future.<sup>84</sup> Terawatts of power is received by the Earth from which 12 Terawatts of power is consumed by world each day. Sun tracking Solar Panels will help in tracking more energy from the sun as it will adjust itself with direction of the sun rays, giving maximum absorption rate. Till date it is observed that placing the solar panel perpendicular to the sun maximizes the absorption of the solar energy, but by designing a solar panel with moves with the sun's direction can give us even better output, hence maximizing the energy conversion. One can achieve this tracking movement by a coupled stepper motor and solar panel so as to always maintain its face at a 90-degree angle with the axis of the sun to gain maximum output energy. This can be done by the use of a programmed microcontroller (AT89C51) that will help deliver stepped pulses for 12 hours at regular time intervals to help the stepper motor rotate the mounted panel in a specific direction and then return to the initial point for the upcoming day light as desired. To follow the sun, this model can be further enhanced by using a Real Time Clock. Hence with the implementation of Solar panels we are moving a step forward towards cost effective, reliable and everlasting renewable energy resource. This could be very good for the climate. Now that is something bright to write about!

**Keywords**— AT89C51, Sun tracking, Solar panels, Stepped Pulses.

## I. INTRODUCTION

Technological improvements will ensure that Solar energy becomes even cheaper in the coming years. We can easily say that by 2030, solar energy will become one of the most important resources for electricity production in the larger parts of the world. Ensuring a Positive impact on the climate change as well as the environment. Due to decrease in the non-renewable energy resources, there is an increase in the use of renewable energy for the production of electricity. The solar energy absorbed by the panels is converted into electrical energy which is further stored in the battery. The efficiency of solar panels has improved dramatically with record breaking power outputs over the last few decades. This optimistic trend is expected to be continued through 2030. Solar panels must absorb solar radiations

to the maximum for using the solar energy efficiently. In order to achieve maximum result, the panels should be continuously placed with respect to the direction of the sun, which can be done by constantly rotating the panels according to the direction of the sun. Solar panels are comprised of a single solar cell which functions similar to a substantial semiconductor utilizing a huge area of p-n junction diode. With each installation of solar power system there is decrease in the amount of fossil fuels required for the generation of electricity, which in turn helps in reducing the contribution of pollutants to global warming. Use of efficient trackers can improve yield which can make a big difference to the income from a massive plant. [1,2]

Advantages of solar tracking systems:

- Increase in the output of the solar panels.
- The efficiency of the panel is maximised.
- Increase in the power per unit area.
- Helps absorb energy throughout the day

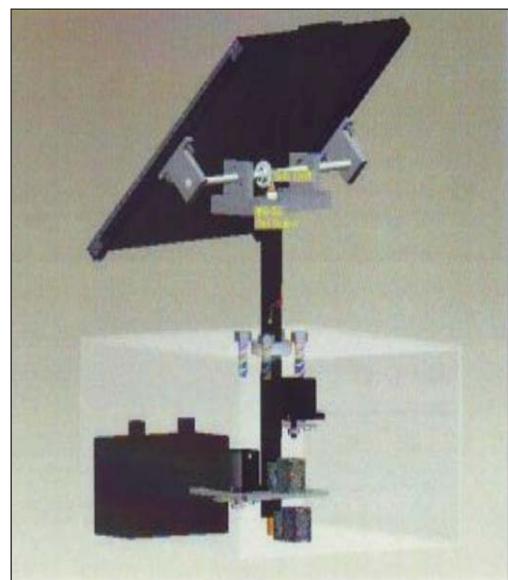


Fig. 1: Solar Panel

## II. PROPOSED MODEL

Fig2. shows the proposed model of Sun Tracking Solar Panel. There are various methodologies and aspects utilized in tracking the sun axis. The given model contains basic combination of electronic circuits. In this model solar panel, stepper motor, microcontroller (89C51), transformer, rectifier, relay and voltage regulator are used. A step-down transformer is utilized to convert higher voltage into lower voltage and further output is given to the bridge rectifier. AC to DC conversion is carried out by the rectifier. The output of which is given to the regulator. ICLM7805 is used to regulate the voltage, followed by the microcontroller. Stepper motor is the most important component as it is used to administer the panel towards the sun. In order to generate DC voltage, solar panel is used. The above model is using +12V DC for stepper motor while +5V DC power as the input. [3,5]

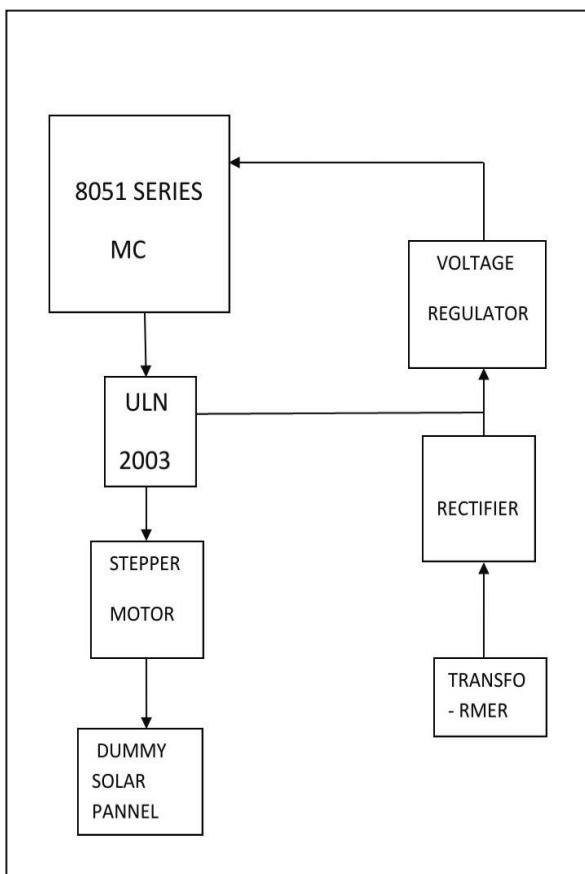


Fig. 2: Block diagram for Sun tracking solar panel

Let's discuss the two main components of sun tracking solar panel in detail.

### A) Relay Driver ULN2003

- Relay driver application is ULN.
- It acts as an electromagnetic switch integrated circuit.
- ULN2003 is a monolithic high current and high voltage Darlington transistor arrays.
- For high current capability, the Darlington pairs are paralleled.
- The ULN functions as an inverter.

- If the logic if the input is high, then its corresponding output value will be low.[2]

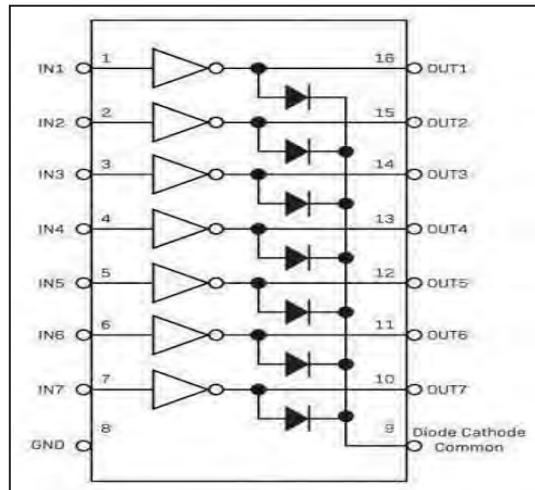


Fig. 3: ULN2003

### B) Stepper motor

- A stepper motor consists of a brushless synchronous electric motor which divides a full rotation into a large number of steps.
- Operation of stepper motor is different from that of DC brush motors.
- On the other hand, stepper motors have multiple “toothed” electromagnets which are arranged around central gear-shaped piece of iron.
- In order to pivot the motor shaft, at first one electromagnet gives power, which magnetically draws the gear’s teeth to that of electromagnets.
- Accordingly, the consecutive electromagnet is switched on and first one is switched off, the pinion wheels pivot slightly to line up with the succeeding electromagnet and the process continues.
- One of the advantages of stepper motor is that it provides good control over rotors rotational speed.
- The permanent magnets in the rotor leads to high torque at low operating speeds and robust performance

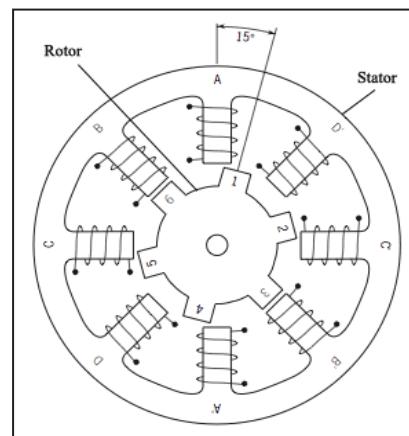


Fig. 4: Stepper motor

### III. WORKING

The given model consists of a solar panel placed on a time programmed stepper motor which navigates the sun's axis in order to receive a great amount of sunlight incident on the solar panel at any given time during the day. This works better than the LDR system which may not be precise always, like on cloudy days when there aren't radiations of the sun, this system won't work efficiently. On the other hand, sun tracking solar panels are directed towards the sun to maximise energy capture, these devices change their orientation throughout the day according to the path of the sun. As these trackers follow the sun horizontally as well as vertically, they help maximise solar energy generation. As non-sustainable energy resources are diminishing, utilization of the use of renewable energy resources is expanding. The utilization of sun-based board to change over Sun energy into electrical energy is extremely famous, however because of the advancement of sun from east to west, the static sun-arranged board will undoubtedly not be able to make ideal amount of energy. This after advancement is cultivated by coupling a stepper motor to the sun-arranged with the end goal that the barricade keeps its face reliably inverse to sun to deliver maximum amount of energy. This is cultivated by using a modified micro controller to pass on wandered beats in periodical time frames for 12 hours for the stepper motor to turn the mounted board one way and a while later re-visitation of the starting point for following daylight as needed board one way and afterward return to the beginning point for following sunshine as wanted.

The microcontroller required in this model is from the 8051 family. [3,4]

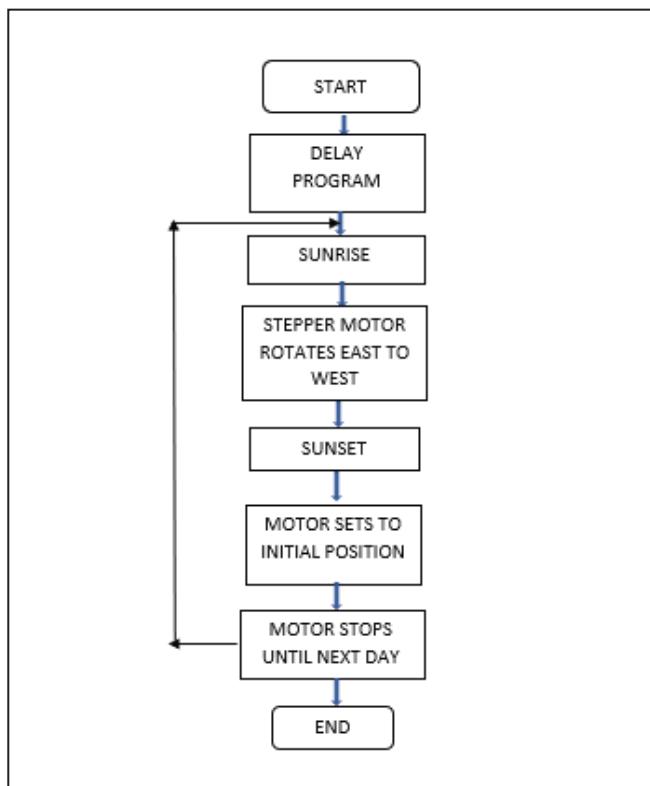


Fig. 5: FLOWCHART

### IV. BENEFITS OF SOLAR TRACKING SYSTEMS

Sun based trackers produce more power than their fixed partners because of an expanded direct openness to sun-based beams. There are various sorts of sun powered tracker, like single-pivot and double hub trackers, which can help you track down the ideal fit for your extraordinary place of work. Establishment size, nearby climate, level of scope, and electrical necessities are extremely significant contemplations that can impact the sort of sun-based tracker that is best for you. Sun powered trackers produce greater power in generally a similar measure of room required for fixed slant frameworks, making them ideal advancing area utilization. The suns powered energy can be reused as it is non-inexhaustible asset. The maximum electrical energy is generated by trackers. This likewise sets aside cash as there is no compelling reason to pay for energy utilized (barring the underlying arrangement cost)

Helps in expanding the sun-oriented energy ingestion by consistently following the sun. Given below is the percent full power throughout the day. It is observed that with the help of trackers maximum electrical output is gained than in the case of fixed solar panel systems. [3]

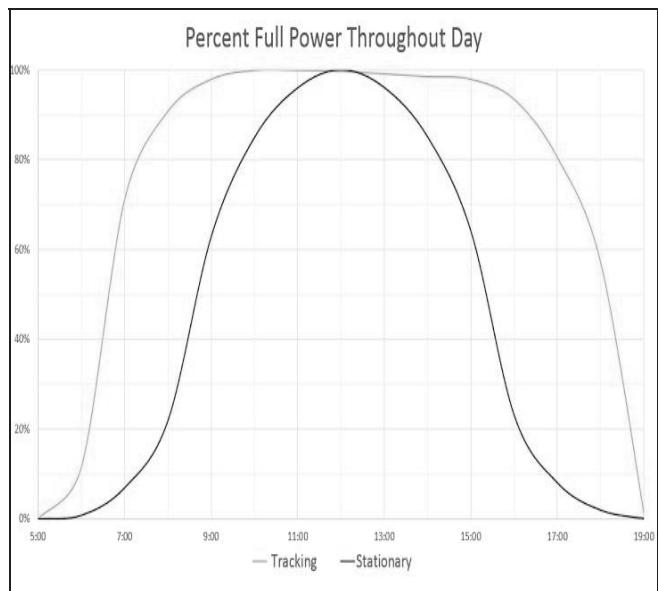


Fig. 6: Percent full power throughout the day

The Maximum electrical energy is generated by trackers than fixed systems due to maximum subjection to the solar radiations. Depending on the chorographic location of trackers the increase can be 10 to 26%.

Degree of the latitude, weather, installation size should be considered for specific solar installations. [4,5]

### V. CONCLUSION

In this venture, the sun global positioning framework is created in view of 89C51 microcontroller. The microcontroller 89C51 dependent circuit is used in the given model with a base number of segments and the utilization of

stepper engines empower accurate following of the solar radiations. It is observed that the global positioning of the sun's framework can gather most extreme energy than a fixed board framework gathers and high productivity is accomplished through this tracker, it very well may be said that the proposed sun following framework is an attainable strategy for amplifying the light energy gotten from sun. This is a productive global positioning framework for sunlight-based energy assortment.[5]

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# A Survey on Indoor Positioning Systems: Methods, Technologies & Parameters

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**Abstract—** This paper is a survey to understand the technologies used to implement Indoor Positioning Systems (IPS). IPS are becoming more and more popular amongst researchers' communities and are improving in terms of accuracy and reliability. Although Global Positioning System (GPS) is an extensively used technology in this day and time, the GPS signals are not capable of passing through building walls and other obstructions, this invites the need for a local navigation and positioning system which will operate inside a GPS signal absent environment. The Real-Time Locating System (RTLS) allows to track a user or an asset where it is necessary. This data helps the user to navigate around an unknown indoor environment without much hustle and in terms of asset tracking the assets can be managed in a warehouse and supply chain management with greater ease. Furthermore, as we move on with the study, we come to realize that Received Signal Strength Indication (RSSI) based positioning methods using Wi-Fi or Bluetooth Low Energy (BLE) are the most commonly used methods. The Wi-Fi and BLE based methods are comprehended.

**Keywords**—RSSI Wi-Fi, RSSI BLE, Indoor Navigation, Real-Time Locating System (RTLS), Indoor Positioning, Indoor Localization, Trilateration, Triangulation, Fingerprinting

## I. INTRODUCTION

It is very easy to find the location for outdoors and open space locations as there are various options available. Our survey is based on the indoor positioning system. An Indoor Positioning System is a network of connected devices that provides location data and navigational data of the user or an asset in a GPS absent environment. There is a large variety of techniques and devices used to provide indoor positioning such as Wi-Fi, BLE, etc. Nowadays Wi-Fi is being used in various public, private & government sectors. Because of its low cost, wide range of network, easily accessible features, it is high on demand. We exploit the wireless signals of the most common wireless standard used in indoor environments and the localization accuracy can vary. In this regard, we are investigating the feasibility, accuracy and efficiency of various wireless technologies in tracking indoor location based on RTLS and distance. RTLS is employed in the

industries. It allows automation in identifying and tracking assets and the supply chain management systems, packaging industries, warehouses and much more. These systems work on low power, wireless sensors with an integrated miniature antenna. In our case, reference sensors are typically fixed on wall corners to cover a wider area of the observed environment, in which mobile tags move. However, walls strongly influence the radiation properties such as their uniformity compromising the localization accuracy.

## II. LITERATURE SURVEY

Our literature survey is focused upon technologies involved in implementing RTLS using the most feasible methods.

TABLE I. LITERATURE SURVEY

Sr No	Title	Technology used	Remarks
1.	Wi-Fi-based indoor positioning system using Smartphones. [2]	Wi-Fi	The smartphone-based indoor positioning is more precise than the Ekahau RTLS system.
2.	Improving Indoor Positioning via Machine Learning. [8]	Bluetooth Low Energy (BLE) & Machine Learning	Machine learning algorithms are effective on RSSI filtering than traditional algorithms using BLE.
3.	UWB Localization System for Indoor applications: Concept, Realization and Analysis. [1]	Hardware small Ultra Wideband transceiver	Wi-Fi fingerprinting is more suitable than the Uniwide system.
4.	Improving Indoor Localization using Bluetooth Low Energy Beacons. [4]	Bluetooth Low Energy	The indoor localization accuracy can be improved by 23% and the variance can be reduced using beacons.

5.	Estimate distance measurement using NodeMCU ESP8266 based on RSSI Technique. [6]	Wi-Fi	Using the curve-fitting direction of the target node cannot be defined.
6.	Indoor Positioning System using Bluetooth Low Energy. [5]	Bluetooth Low Energy	Distance estimation accuracy is more of BLE tags than of Wi-Fi.
7.	Open-Source Indoor Navigation System Adapted to Users with Motor Disabilities. [3]	Open-source technologies (GIS)	The indoor GIS system is capable of showing views of the nodes along the path.
8.	The Effects of Interference On The RSSI Values Of A ZigBee Based Indoor Localization System. [7]	Wi-Fi & ZigBee	RSSI value will not be affected by the microwave oven's interference.
9.	Analysis of an Indoor Positioning Systems. [9]	BLE	In IPS, BLE is the most favourable wireless technologies than Wi-Fi.
10.	Multimodal Approaches for Indoor Localization for Ambient Assisted Living in Smart Homes. [10]	BLE	Besides various machine learning approaches Random Forest can be implemented for its optimal learning method.
11.	Indoor positioning and wayfinding systems: a survey. [11]	Wi-Fi, RFID, Bluetooth, Computer Vision & UWB	Wi-Fi or BLE based systems work efficiently even if one or two nodes of the system fails.
12.	A review of technologies and techniques for Indoor Navigation Systems for the visually impaired. [12]	Computer vision, radio-based sensors & inertial sensor system.	Fully accurate systems are very costly and wherein cheaper systems are not much accurate.
13.	A Survey of Smartphone-based Indoor Positioning System using RF-based Wireless Technologies. [13]	RF-based wireless technologies	The Fingerprinting localization technique of the Indoor Positioning System is proved to be more efficient than others.
14.	The Study of the Weighted Centroid Localization Algorithm based on RSSI. [14]	Wireless Sensor Network (WSN)	Weighted Centroid Localization Algorithm is reliable and less complex.
15.	Performance Comparison of Indoor Positioning Schemes Exploiting Wi-Fi APs and BLE Beacons. [15]	Wi-Fi and BLE	Adjusting parameters like indoor environment, weights of WCL algorithm and Wi-Fi & BLE hybrid system can increase position accuracy.
16.	A Location Estimation Algorithm Based on RSSI Vector Similarity Degree. [16]	Wi-Fi and Bluetooth	An algorithm to calculate distance using RSSI values to minimise error has been presented.

Various Indoor Positioning Systems (IPS) technologies are observed in the survey. Wi-Fi and BLE based IPS are being used in a wide range of applications. Other technologies like Wi-Fi positioning system (WPS), Geomagnetic technology, fingerprinting, Visual Light Communication (VLC), Near-field Communication (NFC), Radio Frequency Identification (RFID), Pedestrian Dead Reckoning (PDR), Computer Vision, Inertial Measurement Unit (IMU), Proximity-based technology, Weighted Centroid Localization (WCL), etc. are used based on client requirement & other characteristics required for an IPS.

Parameters observed are location precision, maintenance, safety, cost, reliability, mapping methods, complexity, scalability & robustness are considered in implementing the IPS.

### III. PROBLEM DEFINITION

Satellite navigation has become a common tool to obtain navigational data from a place to another. This tool is ideal for obtaining routes to travel on a scale of kilometres. The location data is obtained through geostationary satellites deployed to locate a user on the globe. The location can only be determined until and unless the satellites maintain a line of sight with the user, hence ideal for outdoors. Since the satellites cannot maintain a line of sight with the user's device indoor, hence GPS cannot be used to get localization data for navigation in an indoor environment. This paper gives us an idea about the existing technologies used for indoor localization and the Future scope of this technology. In this proposed method, we are going to achieve and compare real-time localization using technologies like Wi-Fi and BLE.

A real-time locating system (RTLS) as the name suggests is a service, which is used to determine the location of the asset/user in a given environment in, real-time. The proposed system should consist of an indoor positioning system, which will allow a user to obtain navigational data to navigate in a closed environment, like in building floors, closed arenas, cinema halls, hospitals, etc. To achieve RTLS there are various methods which include triangulation, Trilateration, Round trip time (RTT), Time difference of Arrival (TDoA). For our case, we have considering evaluating Wi-Fi-based IPS and BLE based IPS using the trilateration method as it is widely available in indoor environments. The relationship between the RSSI and distance of both the systems will determine the initial level of accuracy, and then the complexity and cost-effectiveness will be compared. Based on the study and based on our study we can henceforth determine the optimal IPS for different application cases.

### IV. EXISTING SYSTEMS

The indoor positioning system can be divided into two groups:

- Active Group [11] [12]

This group of methods includes Radio based solutions like Wi-Fi-based localization WPS (Wi-Fi positioning system), Wi-Fi radio fingerprinting, these two methods can be used in an indoor environment with fewer infrastructural obstacles which may cause problems in the efficiency of the system due to the physical properties of the radio signals.

They are sensitive to metal and densely built non-metal materials with higher metal content in them like concrete. For

dense environments, there are other methods like RFID based localization where RFID tags are placed across the indoor space which corresponds to the location in that space. BLE based systems can also be used in such environments, which may require a permanent instalment of electronic infrastructure, which is very costly.

- Passive Group [11] [12]

This group of methods is based on IMUs (Inertial Measurement Units) and Dead reckoning algorithms. With the help of these sensors such as accelerometer, gyroscope, magnetometer, barometer location data can be retrieved which can be somewhat precise. The start point will be precise. Then the path followed based on the differences manifested in the sensors during the navigation but it can get more and more imprecise as we further navigate.

Now there comes a need for an external navigation marker, which will mark the position of the user in the space, placed in a feasible position and would be significant in the indoor space.

Available commercial solutions

1. Redpin
2. Indoorlocation.io
3. JOSM – It is a solution to provide an Open-Source indoor map creation tool
4. Step Inside (Senior Ltd.) [9]
5. INSOFT [9]
6. Indoor Atlas [9]
- Analysis of existing Methods using RSSI based systems: [2] [4] [11] [12] [13] [16]
1. Triangulation: Here if we consider that the coordinates of the access points are already registered and the angle between north and the AP, we can obtain the location of the user using Triangulation. This method is expensive since it requires directional antennas. We can observe more NLOS (Non-line of sight) error in this method since the system operates in a dense environment, with a lot of obstruction.
2. Trilateration: This method can give us accurate results in an ideal environment. Using the time taken to send a packet from the client to the AP is considered to calculate the position of the user, but there are many factors, which affect the time of arrival of the packet. However, if the device operates at a minimum 1GHz we can obtain a good level of precision. We can consider RSSI as well to achieve this solution but RSSI alone will not be sufficient to achieve optimum results given the signal propagation errors are high a radio signal in a closed environment.
3. Fingerprinting: The indoor space will be surveyed based on Wi-Fi signal strength across the area and recorded. The given results will generate a floor map with the signal strengths across the indoor space. Then these pre-recorded values can be used to compare with the values, which the client get at a certain position, which will correspond, to the values on the generated indoor space.
4. Round trip time: Round-trip time (RTT) is the duration in milliseconds (ms) it takes a network request to go from a starting point to a destination

and back again to the starting point. RTT is an important metric in determining the health of a connection on a local network or the larger Internet and is commonly in use by network administrators to diagnose the speed and reliability of network connections.

- Conclusion:

The feasible solution for our research is to use Wi-Fi and BLE protocols and a trilateration method to find the location of the user in the proposed IPS.

## V. PROPOSED SYSTEM

Based on the above survey we have shortlisted to work on range-based systems which are Wi-Fi and BLE. In an RSSI based IPS, the distance between the user node and the stationary node must be known that can be calculated using the following formula. [16]

$$\text{RSSI} = A - 10n \log(d) \dots\dots\dots(1)$$

$A$  indicated the signal strength which is received from reference nodes

$n$  is a Constant dependent upon the Environmental factor.

Range 2–4, low to-high strength as explained above

$d$  is the distance from the stationary node to the user node

therefore,

$$d = 10^{((A-\text{RSSI})/10n)} \dots\dots\dots(2)$$

After calculating the distance from each stationary node to the user trilateration can be performed.

Given the distances from the user node to the stationary nodes (at least three) we can locate the user in 2d space by using trilateration. [13]

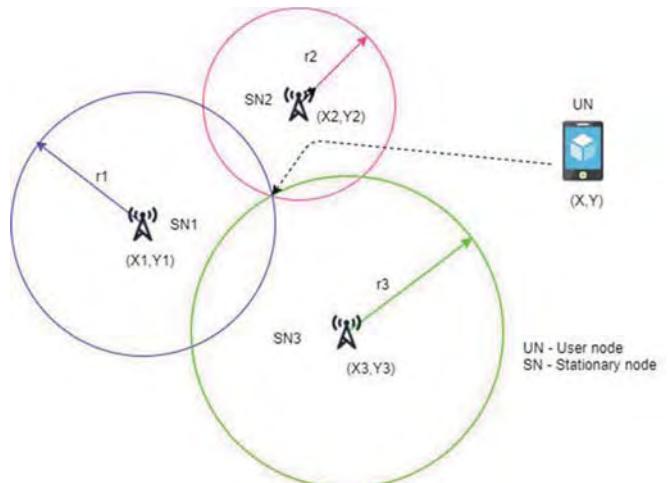


Fig. 1. Trilateration.

Fig 1. Is a representation of a system where the pointing device is our user node and the circles are the all possible distances the device could be from each stationary nodes respectively.

The Stationary nodes SN1 is at (X1,Y1), SN2 at (X2,Y2) and SN3 at (X3,Y3). The point of intersection of all the three circles will be the coordinates (X,Y) of the user node. The relationship between the SNs and their distances can be written as:

$$(X - X1)^2 + (Y - Y1)^2 = r1^2 \dots\dots(3)$$

$$(X - X2)^2 + (Y - Y2)^2 = r2^2 \dots\dots(4)$$

$$(X - X3)^2 + (Y - Y3)^2 = r3^2 \dots\dots(5)$$

By solving the above equations we get the coordinates of the UN.[4]

$$\begin{bmatrix} X \\ Y \end{bmatrix} = (A^T A)^{-1} A^T b \dots\dots(6)$$

Where,

$$A = 2 \begin{bmatrix} X3 - X1 & Y3 - Y1 \\ X3 - X2 & Y3 - Y2 \end{bmatrix} \dots\dots(7)$$

$$b = \begin{bmatrix} (r1^2 - r3^2) - (X1^2 - X3^2) - (Y1^2 - Y3^2) \\ (r2^2 - r3^2) - (X2^2 - X3^2) - (Y2^2 - Y3^2) \end{bmatrix} \dots\dots(8)$$

Hence we complete the trilateration process and get the coordinates of the user node(UN).

However, if we compare Wifi and BLE based IPS we can observe Wifi is cost-effective since it is widely available and saves installment cost. On the other hand, BLE takes 1/3 time to receive RSS data, is more accurate in terms of determining the position and very low powered compared to Wifi. In terms of range, Wifi beats BLE by nearly 40% extra transmission range [13].

## VI. CONCLUSION & FUTURE SCOPE

IPS being an emerging technology, we have studied different types of methods to implement this system. From all the types Wi-Fi-based and BLE based systems are the most feasible solutions. Based on the preferences and requirements which type of system is to be used can be determined. Wi-Fi-based IPS can be used where a cost-effective solution is necessary and infrastructure required to implement this system is already present, in places like Universities, Shopping complexes, parking lots etc. BLE based IPS can be implemented where the positioning should be more precise and the cost is not an issue, in places like warehouses, assembly line, supply chain management, etc. However, this topic can be revisited as technology keeps evolving. This survey was an attempt to understand the nature of IPS and its effectiveness in an indoor environment. This topic can be further explored by implementing IPS using trilateration algorithms and can be studied in-depth with regards to scalability, feasibility, accuracy and power efficiency.

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# Survey on Classification Algorithms in Machine Learning

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**Abstract—** Supervised learning problems can be classified into regression problems and classification problems. A problem is said to be a regression problem when outputs are continuous whereas a classification problem is when outputs are categorical. There is a wide range of machine learning applications where classification techniques are used. So, this study attempts to compare different types of classification algorithms. We will discuss some of the major types of classification methods, including Bayesian networks (BN), Naïve Bayes (NB), Stochastic gradient descent (SGD), Decision tree (DT), k-nearest neighbor (KNN) classifiers, Neural network, Random forest (RF), Logistic Regression (LR), Support vector machines (SVMs) and their advantages, disadvantages, and applications. The purpose of this study is the comprehensive review of various classification methods in machine learning. This work is useful for both Academia and newcomers in the field of machine learning to further strengthen the basics of classification methods.

**Keywords—** Machine Learning, Classification Algorithms, Machine Learning Applications

## I. INTRODUCTION

Machine learning, by definition [1], is a field of computer science that evolved from the study of pattern recognition and computational learning theory in artificial intelligence. This is the training and construction of algorithms that can be learned and predicted from datasets. These steps work by building a model from an example input to make data-driven predictions or selections, rather than following the instructions of a solid static program [2]. With hundreds of statistics-based algorithms built into machine learning, choosing the right algorithm or combination of algorithms for your job has always been a challenge for anyone working in this area. However, it is important to understand three comprehensive categories of machine learning before considering a particular algorithm. These three categories are

1. Supervised
2. Unsupervised
3. Reinforcement.

In supervised learning, make predictions using a known dataset, also known as a training dataset. The training dataset contains input data and response values. From there, the algorithm attempts to build a model that can predict the response value of the new dataset. The program is "trained" in a predefined set of "training examples" to promote the

ability to reach accurate conclusions when given new data. Supervised techniques can be further divided into two main categories. Classification and regression. In regression, output variables take continuous values, but in classification, output variables take class labels [3]. Classification is used to classify a record. It is used for questions which can have only a limited number of answers (fix no of output (1/0)). Regression algorithms are used to calculate numeric values.

Unsupervised learning is an independent learning process. For unsupervised learning, not all variables and data patterns are categorized. Instead, the machine should use an unsupervised learning algorithm to reveal hidden patterns and create labels. This approach is based on absolute error measurement because there is no supervisor. This is useful if you need to learn how to group (cluster) a set of elements according to their similarity (or distance scale). Unsupervised Learning can be further divided into Clustering and Anomaly detection algorithms. Anomaly detection is a technique for identifying rare events or observations that can be suspicious because they are statistically different from other observations. Clustering is used to find structure behind problem. Clustering is similar to a classification algorithm but uses a different type of dataset. Classification uses labeled datasets, while clustering uses unlabelled datasets.

Reinforcement learning is based on feedback provided by the environment, even in the absence of a real supervisor. However, in this case, the information is more qualitative and does not help the agent determine accurate measurements of the error. In reinforcement learning, this feedback is usually called reward (negative feedback is sometimes defined as a penalty) and helps to understand whether a particular action taken in a given condition is positive.

Classification of input data is a very important process in machine learning, such as whether the email is genuine or spam, and whether the transaction is fraudulent, etc. hence, we will go through the most commonly used classification algorithms in Machine Learning.

## II. CLASSIFICATION ALGORITHMS

Classification is the process of classifying a particular dataset into classes that can be run on both structured and unstructured data. The process starts by predicting the class of a particular data point. Class is usually referred to as target, label, or category.

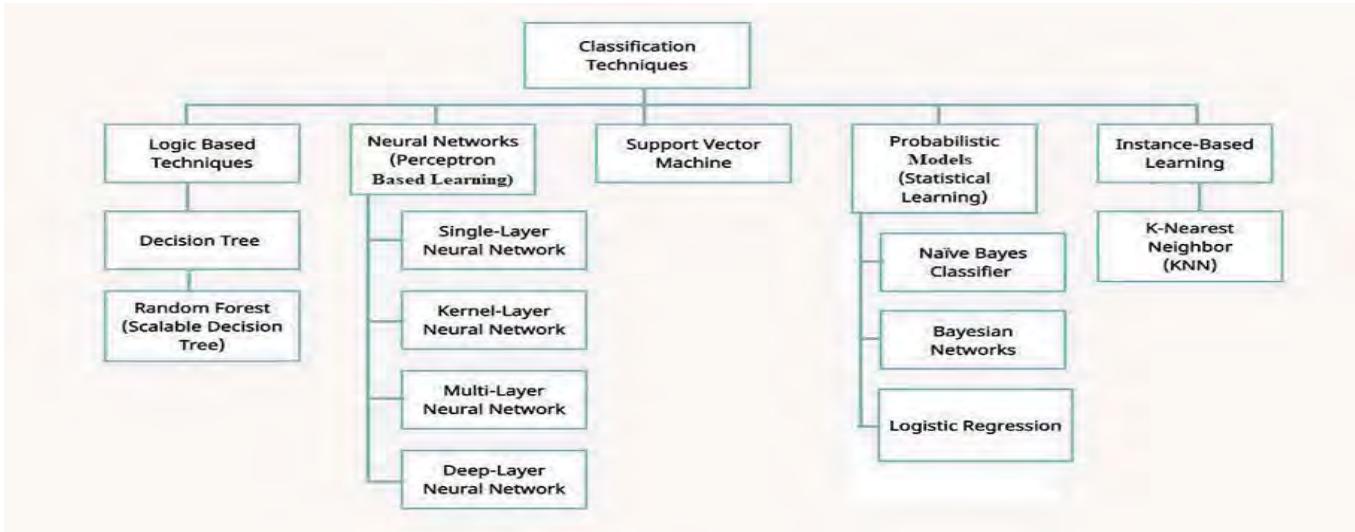


Fig. 1. Classification algorithms

#### A. Probabilistic models for classification

Statistics-based algorithms generalize problems with help of distributive statistics and look into the distribution structure to continue the predicting task. Here, Naïve Bayes has been explained as a popular example of statistics-based algorithm. This is a collection of classification techniques based on Bayesian theorem of probability. [4]

Graphical model [5] is a probabilistic model in which a graph shows a conditional independent structure between random variables. Graphical models provide an easy way to visualize the structure of stochastic models and can be used to design and motivate new models.

##### 1) Naïve Bayes Classifier

The naive Bayes classifier generates probabilities for all cases. Then predict the highest probability of outcome. The naive assumption is that the features are independent and that the classification of all pairs of features is independent of each other. [4] The naive Bayes classifier is a simple stochastic classifier based on applying Bayes' theorem with a strong (naive) independence assumption.

Advantages	Disadvantages
A small size of training data is sufficient here to estimate the required parameters Classifier is very fast Can be used to solve diagnostic problems efficiently [4]	Known to be a bad estimator [4]

##### 2) Logistic Regression

This is a classification function built using classes and using a single multinomial logistic regression model with a single estimator. Logistic regression usually indicates where boundaries between classes exist, and certain approaches also indicate that the probability of a class depends on the distance from the boundary. This means that the larger the dataset, the faster it will move towards the extremes (0 and 1). These statements about the probability of making logistic

regression more than just a classifier. Logistic regression uses the concept of predictive modeling as regression. Therefore, it is called logistic regression and is used to classify samples. Therefore, it corresponds to the classification algorithm

Advantages	Disadvantages
highly interpretable easy to use easy to normalize, & is regularized, very efficient [6]	cannot solve nonlinear problems relies heavily on the proper display of data vulnerability to overfitting [6]

##### 3) Stochastic Gradient Descent

After explaining the basics of logistic regression, it is useful to introduce an SGD classifier class that implements a very well-known algorithm that can be applied to several different loss functions. The idea behind stochastic gradient descent is to repeat weight updates based on the gradient of the loss function. Stochastic gradient descent is a very popular algorithm used in many machine learning algorithms, and most importantly, it forms the groundwork of neural networks.

Advantages	Disadvantages
Computation is fast For larger datasets, the parameters are updated more frequently, resulting in faster convergence	noisy steps computationally expensive

##### 4) Bayesian Networks

Bayesian Network (BN) refers graphical model for probability associations between a set of variables [7]

Hidden Markov Model

Here, we introduce the hidden Markov model, which is a special case of the Bayesian network. In the hidden Markov model, the hidden states are linked as a chain and dominated by the Markov process. The observable values are then generated independently given the hidden states that form the sequence. Hidden Markov models are widely used in speech recognition, gesture recognition, and part-of-speech tagging, and hidden classes are interdependent. Therefore, the class label of an observation depends not only on the observation, but also on the adjacent states.[5]

### Markov Random Fields (MRF)

Next, we look at another major class of graphical models that are written in undirected graphs and specify both factorization and a set of conditional independence relationships. The Markov Random Field (MRF), also known as an undirected graphical model, has a set of nodes, each node corresponding to a variable or group of variables, and a set of links, each connecting a pair of nodes. [5]

### Conditional Random Fields (CRF)

So far, we have explained the Markov network representation as a joint distribution. One notable variant of MRF is the Conditional Random Field (CRF). In this case, each variable may be conditioned on a set of global observations. More formally, the CRF is an undirected graph, and its nodes can be divided into two disjoint sets of observation variable X and output variable Y. These can be parameterized as a set of factors in the same way as a regular Markov network. The main advantage of CRF over HMM is its conditional nature, which relaxes the independence assumptions that HMM requires to ensure manageable inference.[5]

Advantages	Disadvantages
Flexible applicability: can be used to solve both regression and classification problems Handling missing data Smoothness characteristics: Minor changes in the Bayesian network model do not affect the behaviour of the system	noise lack of information awareness of changing attributes for class variables

## B. Logic based learning

Logic-based algorithms address the problem of step-by-step data streaming by letting the logic work at each step. Here decision tree has been overviewed as a classical example of logic-based algorithm.

### 1) Decision Tree

Decision tree algorithms are most commonly used algorithms in classification. Decision tree provides an easily understandable modeling technique and it also simplifies the classification process [3]. The decision tree is transparent mechanism it facilitates users to follow a tree structure easily in order to see how the decision is made. The core objective of decision tree is to produce a model that calculates the value of a required variable based on numerous input

variables [3]. Usually, all decision tree algorithms are constructed in two phases [3]:

- (i) tree growth; in which training set based on local optimal criteria is splitting recursively until most of the record belonging to the partition having same class label
- (ii) tree pruning; in which size of tree is reduced making it easier to understand.

ID3, C4.5, CART are examples of widely used decision tree algorithms.

In decision tree learning, ID3 (Iterative Dichotomiser 3) is an algorithm invented by Ross Quinlan that is used to generate decision trees from datasets[8]. A tree is built using the decision tree technique to model the classification process. When the tree is built, it applies to each tuple in the database, and as a result, that tuple is categorized. [8] It is one of the most widely used algorithms in the fields of data mining and machine learning because of its effectiveness and simplicity [9]. The ID3 algorithm is based on information gain

C4.5 is a popular algorithm for decision tree formation. This is an extension of the ID3 algorithm that minimizes the shortcomings caused by ID3 [3]. The decision tree generated by the C4.5 algorithm can be used for classification. For this reason, C4.5 is also known as a statistical classifier [8]

CART stands for Classification and Regression Trees (Breiman et al., 1984). This is characterized by the fact that it builds a binary tree. That is, each internal node has exactly two output edges. Splits are selected using towing criteria and the obtained tree is pruned by cost and complexity pruning. When provided, CART can take into account the cost of misclassifying tree leads. Users can also provide prior probability distributions.[8]

Advantages	Disadvantages
Ease of interpretation [10] can easily handle heterogeneous data simple fast require less data pre-processing, can process both categorical and numeric data.[4]	risk of overfitting can lead to complex tree structures that are not well generalized. Noise Impact Accuracy is often not state-of-the-art [10]

### 2) Random Forest

As the name implies, "Random forests are classifiers that contain a large number of decision trees in different subsets of a particular dataset and take an average to improve the predictive accuracy of that dataset." Instead of relying on one decision tree, it gets the predictions from each tree based on the majority of the predictions and predicts the final output.

It is based on the concept of ensemble learning. This is the process of combining multiple classifiers to solve complex problems and improve model performance. Many trees can outperform the performance of individual trees by reducing

the errors that typically occur when considering a single tree. If one tree doesn't work, the other tree may work. This is an additional benefit, and this ensemble formed is known as Random Forest. [11]

Advantages	Disadvantages
Can handle large, high-dimensional datasets.	High calculation cost.
Improve model accuracy and prevent overfitting issues.	Difficult to interpret
robust and versatile algorithm.	Creating forecasts is often very time consuming [11]
Can be used to handle missing values in specified data [11]	

### C. Support Vector Machine

**Definition:** This represents a dataset item or record with "n" features plotted as points in n-dimensional space separated into classes by the widest possible margin known as a hyperplane. The data items are then mapped to the same n-dimensional space, and predictions of the categories to which they belong are obtained based on the aspects of the hyperplane to which they belong. [4]

SVMs are considered one of the most prominent and useful techniques for solving problems related to data classification and learning and prediction. Given a series of training examples, each marked as belonging to one of two categories, the SVM training algorithm builds a model that predicts whether the new example will fall into one of the categories. [3]

There are many types of SVMs, including linear, polynomial, and sigmoid.

Advantages	Disadvantages
memory efficient [12] can handle a variety of classification problems, including high-dimensional problems that are not linearly separable [3]	not suitable for large datasets [12] does not work very well if the dataset is noisy [12] training time is so long [4]

### D. Artificial Neural Network

Artificial neural networks, also known as neural networks, are a common machine learning technique for processing data through layers of analysis. A typical neural network can be divided into an input layer, a hidden layer, and an output layer. The data is first received by the input layer, where a wide range of features are detected. The hidden layer then analyses and processes the data. Based on previous calculations, the data is streamlined by going through each hidden layer. The final result is displayed as an output layer.

Neural networks are applied when you do not know the exact nature of the input-output relationship. An important feature of neural networks is that they learn the relationship between inputs and output during training.

#### 1) Single-Layer Neural Network

It has one input layer and one output layer. The simplicity of these networks makes them suitable for introducing the internal behavior of neural networks. Some standard single-layer networks widely used for classification problems are perceptron, Adaline networks, and linear vector quantization (LVQ). [5]

#### 2) Kernel-Layer Neural Network

We used the term kernel-based neural network for classes of neural networks that use the kernel within the architecture. A well-known example of this type is the radial basis function network. Radial basis function networks (RBFNs) implement a two-layer architecture featuring a hidden-layer kernel unit and an output-layer linear unit. [5] RBFNs can achieve powerful classification functions with a relatively small number of units. As a result, RBFNs have been successfully applied to various data classification tasks such as handwritten digit recognition, image recognition, speech recognition, process failure detection, and various pattern recognition tasks

#### 3) Multi-Layer Neural Network

A Multilayer Perceptron (MLP) consists of an input layer and an output layer, with one or more hidden layers of non-linearly activated nodes or sigmoid nodes. This is determined by the weight vector and the network weights need to be adjusted. This is a classifier that finds network weights by solving quadratic programming problems using linear constraints, rather than solving non-convex, unconstrained minimization problems as in standard neural network training.

#### 4) Deep-Layer Neural Network

Deep learning techniques aim to learn and leverage the capabilities of neural networks to generate internal feature representations of the data in hidden layers. The output layer can be thought of as a spatial classification machine that spans the output of the last hidden layer. More hidden layers and more units within those layers generate a stronger network with the ability to generate a more meaningful internal representation of the data.

Advantages	Disadvantages
Store information throughout the network work with incomplete knowledge Fault Tolerance Parallel processing function [13]	Hardware Dependencies Network unexplained behavior Determining the proper network structure [13]

### E. Instance-Based Learning

"Instance-based learning" that delays the generalization process until the classification task is performed. This algorithm is tagged as "lazy" and is widely known as the lazy learning algorithm. The KNN or K-nearest neighbor algorithm is a popular case of instance-based learning. KNN is one of the most understandable and very simple classification algorithms. Despite its simplicity, it can produce very competitive results. It can handle classification and regression type prediction problems [4]

### 1) K-Nearest Neighbors

A supervised learning technique used to classify new data points based on their relationship to nearby data points. Methods in another class can be associated with statistical methods. These are called nearest neighbor methods or, in some cases, memory-based methods. The k-nearest neighbor classifier considers the k-nearest neighbor points and uses the majority of the signs to classify the samples.

Advantages	Disadvantages
Powerful for noisy training data and works well with large training data [4] Simplicity, transparency, easy to understand and implement [3]	for each new instance, all distances from the K-nearest neighbors have to be calculated multiple times, which increases the calculation time. To reduce the error rate, you need to determine the value of K correctly. [4] Computational complexity memory limitations poor run-time performance for large training sets irrelevant attributes can cause problems [3].

### III. CLASSIFICATION ALGORITHM'S APPLICATIONS

TABLE I. APPLICATIONS OF CLASSIFICATION ALGORITHMS

Classification Algorithms	Applications
Naïve Bayes Classifier	recommendation system [14] text classification [15] spam filtering [16]
Logistic Regression	medicine [17] social sciences [18]
Bayesian Networks	Traffic accident detection [19] Signature verification [20]
Decision Tree	Air traffic control systems [21] financial analysis [22]
ID3	Predict student performance [23] Fraud detection application [24] Tolerance-related knowledge acquisition [25]
C4.5	Debtor's decision to apply for a loan [26] Predicting software defects [27] Thrombosis Collagen disease [28] Question pool selection [29]
CART	intrusion detection [30]
Random Forest	Classify fraudulent and non-cheating.[31] Examine stock market trends.[32] Remote sensing.[33] Medicine [34]

Support Vector Machines	face detection, [35] image classification, [36] handwriting recognition, [37]
Artificial Neural Networks	Typed character recognition [38] Image processing [39] Aircraft navigation [40] Speech synthesis [41]
K-Nearest Neighbours	recommended systems [42] search applications [43]

### IV. MACHINE LEARNING APPLICATIONS

Three of the most important applications that utilize machine learning are image processing, speech recognition, and text interpretation.

#### 1. Image Recognition

The most important requirement for a machine when it comes to image processing is - similar to human vision and thinking - to be able to interpret the images made available to it and to recognize various objects on these. This process is also called labelling and this is one of the most widely applicable areas of artificial intelligence

#### 2. Speech Recognition

Voice/speech recognition allows machines to interpret human speech and voices from other sources. This enables us to handle our smart devices more quickly and more comfortably, and to give our devices the ability to recognize sounds.

#### 3. Text interpretation

The process of text interpretation basically means information retrieval from large amounts of text-based data. Natural language processing (NLP) is essential for this procedure, which enables the machine to understand and process everyday language manifestations. Without this, computers might be able to understand the meaning of each word, but NLP helps machines to interpret words in context

TABLE II. MACHINE LEARNING APPLICATIONS

Application Domain	Applications	Used Classification methods
Image Processing	Image processing and machine learning in the morphological analysis of blood cells [44]	Neural Networks, Decision Trees, and Support Vector Machines
	Horizon Detection Using Machine Learning Techniques [45]	SVM, J48, and naive Bayes classifiers
	Image Processing and Machine Learning for Automated Fruit Grading System [46]	Support vector machines, K-Nearest neighbour Artificial Neural Network, C4.5
	Image Processing-Based Detection of Pipe Corrosion Using Texture	Support Vector Machines

	Analysis and Metaheuristic-Optimized Machine Learning Approach [47]	
Speech Recognition	Automatic bird species recognition based on birds vocalization [48]	hidden model, K-neighbour Markov Nearest
Text Interpretation	Multi-class Document Classification using Support Vector Machine (SVM) Based on Improved Naïve Bayes Vectorization Technique [49]	SVM, Naïve Bayes
	Sentiment Analysis on Twitter Data [50]	SVM, Naïve Bayes
	Machine Learning Methods For Spam E-Mail Classification [51]	Bayesian classification, k-NN, ANNs, SVMs

## V. CONCLUSION

In this study various popular classification techniques of machine learning have been discussed with their basic information, advantages, disadvantages & applications. The discussed classification techniques can be implemented on different type of data set i.e., health, financial, educational etc. It is difficult to find out which technique is superior to other because each technique has its own merits, demerits and applications. The selection of classification technique depends on user problem domain. So, we can conclude special features of different classification techniques from above study.

Naive Bayes classifier has been widely used in many classification problems, especially when the dimensionality of the features is high. SVM has capability to deal with wide variety of classification problems includes high dimensional and not linearly separable problems. KNN is used in search applications where “similar” items are searched by the user. Neural networks are used when the exact nature of the relationship between inputs and output is not known. A key feature of neural networks is that they learn the relationship between inputs and output through training. Logistic regression is used extensively in numerous disciplines, including the medical and social science fields. Decision trees can deal with both categorical and numerical data, it may have an overfitting issue. Random forest enhances the accuracy of the model and prevents the overfitting issue. It is capable of handling large datasets with high dimensionality. The most interesting feature of Bayesian Networks, compared to decision trees or neural networks, is most certainly the possibility of taking into account prior information about a given problem, in terms of structural relationships among its features. Stochastic gradient descent

is a very common algorithm used in various machine learning algorithms, and most importantly, it forms the basis of neural networks. Naïve Bayes Classifier, Support Vector Machine, and Logistic Regression algorithms are good to use for small datasets. Stochastic gradient descent and K-Nearest Neighbours algorithms are effectively working for large datasets. From Table II, Support Vector Machine and decision tree classifiers are commonly used algorithms in the image processing domain. In-text interpretation Support Vector Machine and Naïve Bayes have commonly used classification algorithms. So according to Table I and Table II Support Vector Machine has wide range of applications but it is especially good for image processing and naïve bayes is good for text interpretation. In this study, we have compared classification methods theoretically. We can apply them on different types of data sets having different types of input types like images, text and voice and properties and can attain a best result by knowing that which algorithm will give the best result on a specific type of data set. We can compare them practically to check the efficiency of each algorithm and decide which algorithm is best for which application.

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# COLLEGE COMMITTEE E-VOTING SYSTEM

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**Abstract—** The College Committee E-Voting system provides online voters registration forms for students where student registers and are allowed to log in as either students or delegates or candidates. Each registered user has a password to log in. The system provides an interactive platform where voters and candidates interact and thus candidates perform their campaigns. The system allows preliminary voting and the results are graphically represented in percentage. This system also allows the candidates to be liked by users and the most liked candidate is the most popular. The system compute and gives the election results for all the posts and provides reports for the whole election process. The main objective of this system is to design, develop and implement an efficient, user friendly, interactive web based College E-voting system. The methodology used for our college committee e-voting system is waterfall method and framework used is ASP.NET open source technology

**Keywords—** E-Voting, Committee, College Online voting, Unique Voter ID, Election, Admin

## I. INTRODUCTION

An election is a formal decision-making process by which a population chooses an individual to hold a public office. Nowadays, elections are becoming online. But if the voting system is made online, the security is the major concern. The web-based internet voting system provides security to vote when it is transmitted from voting client to voting server. Election is a mechanism by which people choose their representatives at regular intervals and change them if they wish to do so. In an election the voters make many choices. They can choose the one who will make laws for them. They can choose who will form the government and take major decisions.

Our project implementation presents a polling system that provides the college management an easy way of maintaining the whole election process to be carried out in an effective way. It overcomes the problems of unnecessary time-consuming tasks. Every college has an officially recognized committee which enhances the development and operations of the college as a whole.

College Committees hold the election annually for the candidates representing positions like Chairperson, Vice Chairperson and other members. Hence, our college e-voting system project offers a web-based system where admin will register candidates and maintain results. Admin can update the candidate's details and delete the previous elections.

## II. LITERATURE SURVEY

Our literature survey is focused upon technologies involved in implementing online voting systems using the most feasible methods. The evaluation of selected paper and their patterns is presented in the Table No. 1. We have analyzed the methods and implementation process and have concluded the result in the Table No. 1.

TABLE I. LITERATURE SURVEY

Sr No	Title	Technology used	Overview
1.	Student Online Voting System [1]	Open source Technology	Self-explanatory GUI and Xampp server is used.High security and user friendly system .
2.	Student Online Voting System [2]	Wi-fi	With MySQL ,Waterfall methodology is implemented
3.	Online Voting System [3]	OTP Authentication	Security provided by OTP verification and requires Java Virtual Machine
4.	Online Voting System [4]	Open Source	Minutiae Based Algorithm and NetBeans are required. Election is eco-friendly.

5.	M-vote : A Reliable and highly secure Mobile Voting System [5]	Wi-Fi	High security via Advanced encryption standard algorithm is opted. Authenticity and simple user interface is presented
6.	An efficient and securable online voting system [6]	Wi-Fi	With the advent of technology and Internet in our day to day life
7.	An Efficient Online Voting System [7]	Open-source technologies (GIS)	This online voting system is highly secured, to work on Ethernet and allows online voting
8.	Online Voting System Using Biometric Verification [8]	Biometric Authentication	Use of a reliable wireless connection. Keeps a check on Rigging and other malpractices
9.	Blockchain-Based E-Voting System [9]	Ethereum private blockchain	blockchain and smart contract technology and its capabilities as a service for implementing an e-voting system.
10.	Secure online voting system.[10]	face recognition and finger print	voter identification and authentication techniques are essential for more secure platform mechanisms to overcome vulnerabilities

After reviewing the thesis for each paper mentioned in Table No. 1, we found the various applications and methodology used for implementing a voting system. Respectfully, all authors and publishers had organized various methodologies , algorithms, database secured systems to make the voting system as robust as possible .They have completely presented the voting systems a high maintenance , some working independently systems ,some hardware dependent vote systems . Overall analyzing the advantages and disadvantages of the voting system ;the objective of providing an effective platform for the election process.

To cope up with the maintenance cost and make the voting process simple and understandable to the end user and administrator, we have designed our web-based College E-Voting System. Our approach categorizes the system into Administrator and Users in the election. Administrators hold the responsibility of registration of candidates and access the Vote result of the election conducted. Users will have to register and poll the choice of candidate for the position of committee members. Users will access the system with the unique voter ID allotted to him/her after registration. The voter id is permitted once only and cannot be misused in any possible methods. Here the administration holds the vital role as the mediator to the system will be under the control of administrator

### III. PROBLEM DEFINITION

This election of candidates for college committee can be held through an interactive website. Conducting the election for committee candidates will be solved by administering an election website which will be under the college administration Team. The election for the college committee can be approached through an interactive website, Initially, admin registration with a password controlled by the college administrator, the voter's registration along with their details is set and a unique voter ID is provided to each registered student the voter above eighteen years are eligible for the registration as voter for the committee election.

### IV. EXISTING SYSTEMS

In the present system there are no such application level system provisions in the college to carry out the voting and procedure as a whole. Also in the present status, there is no such application in use for automated system for voting according to the voting structure existing in the college. All the step by step procedures are carried out

by the authorized authorities according to the positions allotted. The fact is all the procedures are carried out manually, starting from the registration process to result publishing. The college needs to do this process manually & wastes lot of time and money. Thus the present system proves itself to be an inefficient one. The existing system is not web based. The user or person must want to go to the polling station for casting their votes.

### DRAWBACKS IN EXISTING SYSTEM

The problems of the existing manual system of voting include among others the following:

**1. Expensive and Time consuming:** The process of collecting data and entering this data into the database takes too much time and is expensive to conduct, for example, time and money is spent in printing data capture forms, in preparing registration stations together with human resources, and there after advertising the days set for registration process including sensitizing voters on the need for registration, as well as time spent on entering this data to the database.

**2. Too much paper work:** The process involves too much paper work and paper storage which is difficult as papers become bulky with the population size.

**3. Errors during data entry:** Errors are part of all human beings; it is very unlikely for humans to be 100 percent efficient in data entry.

**4. Loss of registration forms:** Some times, registration forms get lost after being filled in with voters' details, in most cases these are difficult to follow-up and therefore many remain unregistered even though they are voting age nationals and interested in exercising their right to vote.

Short time provided to view the voter register: This is a very big problem since not all people have free time during the given short period of time to check and update the voter register. Above all, a number of voters end up being locked out from voting.

### V. METHODOLOGY

In our College Committee voting system, we use a waterfall model implementation process. Starting with the requirements, design implementation ,verification and maintenance of the college committee voting system .

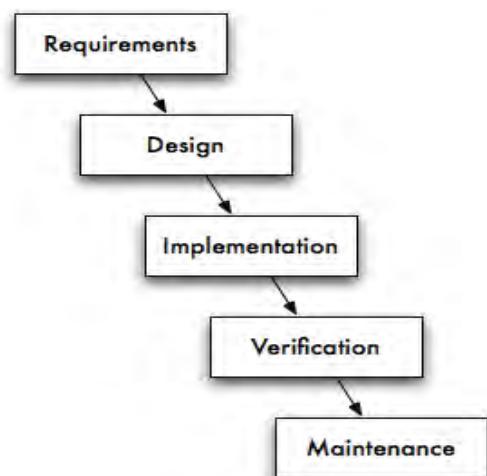


Figure 1.Waterfall Model

## 1. Requirements

### I) Hardware

- i. Intel Core i3 Processors (3M cache 2.00GHz)
- ii. Hard Disk-Min 1GB
- iii. Internet Enabled
- iv. Memory-512 MB

### II) Software

- i. Microsoft Visual Studio 2015
- ii. Microsoft SQL Server
- iii. SQL Configuration Manager
- iv. Web Browser

### III) Technologies used

- i. Visual Studio 2015
- ii. Azure services
- iii. HTML, CSS, JavaScript, C#
- iv. ASP.NET

## 2. Designing

The website designed using the ASP.NET which is an open source, server side web application framework designed for web development to produce dynamic web pages. In our project, College committee voting system we have used asp.net framework to create dynamic content driven website.

## 3. Implementation

The code written for the home, admin and user page is saved in the format of .aspx files. These are the main files run during the execution of the program. For code execution we have used Visual Studio Code IDE (Integrated Development Environment) which runs the program and displays its output on a web browser i.e. Google Chrome in order to keep the visualization of web pages in format.

## 4. Verification

College Committee Voting system controls authorization process via the administration of the college. The responsible admin for the process of election would be taking charge with his/her password. The candidates standing for the positions like chairperson or other will be successfully registered only through admin with their details such as first name, last name, date of birth, email and position. The voters are eligible for electing committee candidates if he/she is above eighteen years and will register by filling the details such as first name, last-name of birth, email and password. After successful registration of the voter, a unique voter ID will be mailed to him/her. This voter ID is system generated and is allotted uniquely for all registered voters. The credentials of admin and users are hence secured with our college committee voting system.

## 5. Maintenance

The database for the complete system is stored in the Microsoft SQL Server database. The management of the data collected time to time is SQL configuration manager.

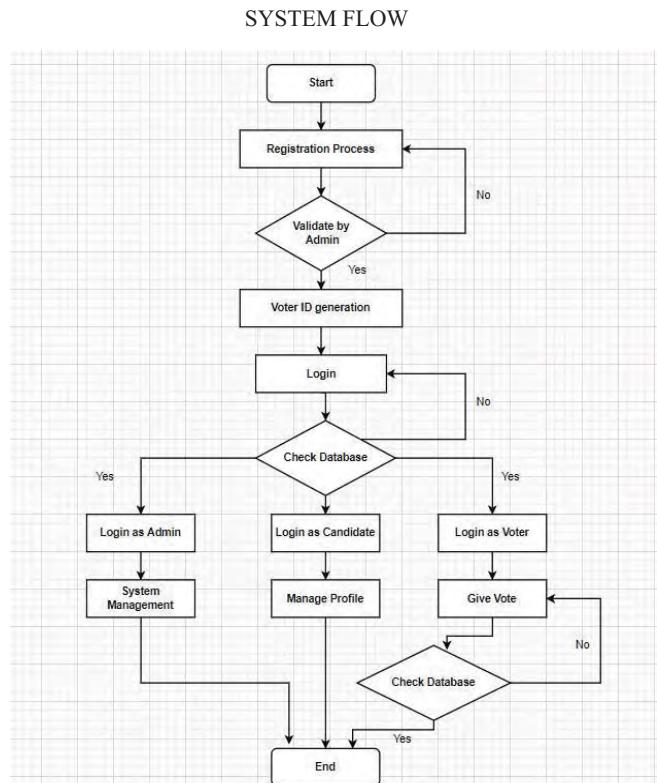


Figure 2. System Flow

Registration process is carried out by users it is validated by the administrator. Users are allotted a unique voter ID. The users once registered will be log in by their voter ID and their password. The details of the credentials stored in the database will be checked through the data stored in the SQL database. The system has login for the admin panel, users panel where admin will be in-charge of College committee voting system management. Candidate stood for the election will be also managing the profile as and when required. Voter or user will be logged in for posting their votes with the data stored in the SQL manager system. This will yield the result of process of voting to the admin of the system.

## VI. IMPLEMENTATION DETAILS

The new implemented voting system has two main panels: The voter and administrator sections. The voter (which can be found at home, in a special polling station or any other device have the function of performing the Authentication and voting). The administrator performs the function of voter and candidate registration, authorization and validation of voter, database and counting and the result.

The main advantages of the new protocol are the following:

1. System voting transparency by the administrator (publication of Voter ID key, etc.).
2. Inured to technical troubles like interruption of access, etc, uncomplicated recovery.
3. Possibility of configuration for different voting models by policies and Greater performance.

Furthermore, it is assumed that a trustworthy college administrator would be up taking the responsibility of managing the voting admin in the college committee voting system. Apart from that, the accessibility to the college in the voting procedure plays a special role, which means that the voting result can be monitored, although casting of the votes has to be secret as a matter of course Accessibility to the college is necessary for all voting stages and is performed by the administrator but also by any voter of the college.

## VII. RESULT

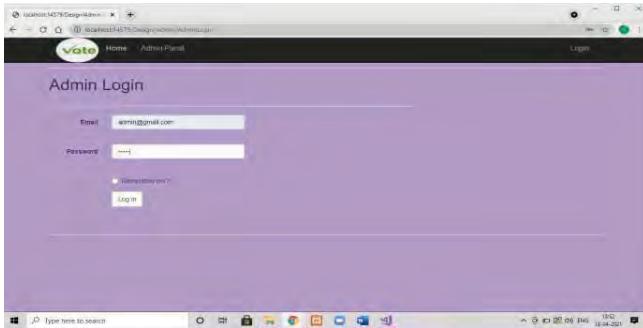


Fig. 3. User/Admin Login Page

This is where a new user/voter starts; the individual is required to provide a username and password which he/she filled in when registering as a voter. When this is provided the system validates the user if the entered information tallies with what is in the database. He/she is then logged in otherwise the voter/user isn't logged in.

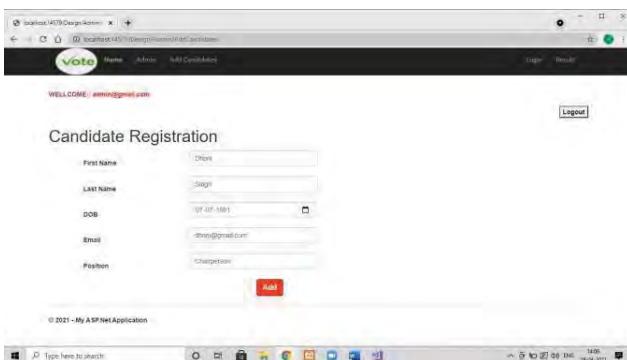


Fig.4. Manage Candidates Page

This page enables the admin to add or remove the candidates that are contesting in the election.

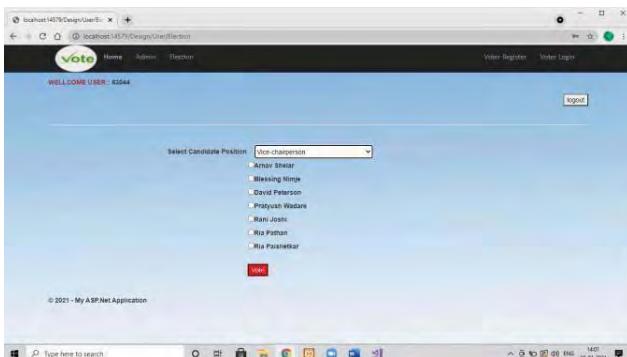


Fig.5. Manage Positions Page

This page ensures that the admin is able to add or remove positions that are to be contested in the election.

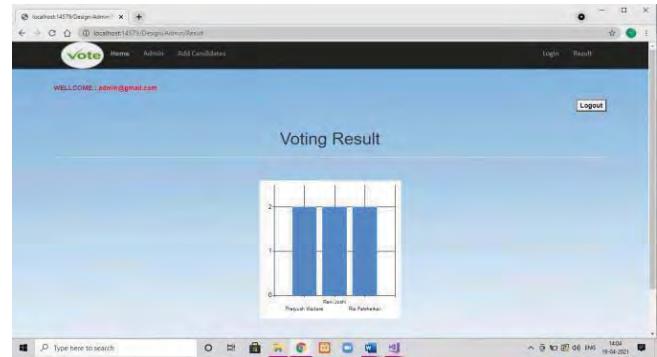


Fig.6. Vote Tallying

Vote tallying is done by the administrator. The admin logs in the system with the details above and navigates to the "Poll Results" page. The admin chooses which position he/she would like to know the results of. In this case, the developer chooses the "Chairperson".

## VIII. CONCLUSION

This project designed and implemented a college committee voting system using voter id generation that has been used in authentication on voters in a voting period college as a case study. This has provided an accurate and efficient result to college voting. The registration and verification of voters were done by the administrator of the system. Voter's registration was done by collecting their data, names, email id & password. After these entries the system used these inputs to generate a voter id system generated token was sent to the voter's emails ID. On the day of voting, the students will get logged into the system by filling his/her portal with the password and the unique voter id password to get access to vote for their preferred candidate. The system didn't not allow multiple voting with the same token. As voting proceeded, the system counted the number of votes for a candidate and at the same time the total number of voters and after voting the system displayed the result panel.

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# Structure Design Engineering for Optimal Analog Performance of Nanowire Junctionless MOSFET

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**Abstract:** Analog performance of silicon nanowire junctionless MOSFET (SNW-JL-MOSFET) in the sub-20 nm regime is investigated using a device simulator, namely ATLAS. It is observed that optimal selection of structure parameters of SNW-JL-MOSFET attains higher drain current, peak transconductance and output conductance. This proposed architecture also provides better analog frequency parameters and switching speed of the device and is very useful for circuit design. The gate dielectric material optimization of the structure is attained via broad device simulation. In this manuscript, a study is carried for the SCEs like SS, DIBL and significantly for analog parameters like transconductance and output conductance..

**Index Terms--** Charged Plasma, Dielectric Constant, Tunnel Field Effect Transistor (TFET), Triple Gate (TG), Neutral Biomolecule.

## I. INTRODUCTION

Gate All Around (GAA) Field Effect Transistor (FET) using silicon nanowire has appeared as a high performance device to down-scale the upcoming nanoscale semiconductor device due to higher packaging density, best gate controllability, as well as good potential to counter Short Channel Effects (SCEs) [1-3]. Although with all the advantages, GAA nanowire FET has a disadvantage of high series resistance occurring as an abrupt junction develops between densely doped source-drain plus minutely silicon body [4-7]. The idea for such problem is the formation of Junctionless (JL) nanowire FET [7]. Due to carrier transport mechanism, the JL-FET based devices are addressed as accumulation mode devices. However, the conventional FET based devices are simply named as inversion mode devices. The JFET is developed by heavily doping of the source, drain and channel regions uniformly throughout [8]. However due to heavily doping of the channel, the JL-nanowire undergoes a problem such as minimum drive current (as of less carrier mobility) [9] or less transconductance[7][9][10]. JL nanowire FET possesses higher sensitivity due to heavy doping towards random dopant fluctuations (RDFs) [11] [12]. A solution to these problems, as proposed by Ramond et.al. [13] is GAA charge plasma dopingless FET nanowire. On introducing an n/p-type in pure type silicon, development of source-drain

region becomes feasible with usage of suitable work functions. This concept removes doping requirement and clears doping control issues, namely sharp doping fluctuation and doping profile. Furthermore, charge plasma is also applied to bi-polar transistors [14][15], tunnel FET (TFET) [16-18] and MOSFET [19][20] which reduced the thermal expenditure and provides better drive current, sub-threshold slope, as well as on-off current ratio. It also gives highly immune structure towards varying parameters in RDF in comparison to junctionless counterparts.

The construction of multiple gate FET (MGFET) and 3-D structures say dual gate (DG), Omega/FinFET and GAA-FETs got an upper edge over the planner structure with sharp CMOS-scaling. In addition, the GAA-based MOSFET is regarded as final entity for downscaling of device less than 50 nm [5] that provides higher packing density, steeper sub-threshold slope as well as high current driving ability. The GAA-FET critically contracts SCEs because silicon layer is fully covered by entirely gate and thus, it controls channel's electrostatic potential effectively [5-9]. However, scaled devices got advantages of higher series resistance which occurs by construction of immediate source or drain junction [10,11]. The significant solutions like Schottky-Barrier source or drain or JL-MOSFETs are extensively proposed for investigations [12]. The JL-MOSFET shows highly doped source or drain or channel regimes in a uniform manner, thus show no PN junction creation within the source or drain and channel. However, highly concentrated doping of channel decreases the carrier mobility, which affect the device drive current as well as transconductance [13-15]. All these disadvantages made the doped source-drain regions to be replaced with Schottky Barrier metal source or drain that offers raised on-current as well as improvement in transconductance to JL MOSFETs

The low work function of the gate regime related to device drain has considerably lowered electric field and hot carrier effects. And, from the fabrication view point complicated and robustly amalgamated work-function of two metals considered as gate electrode. As it depends upon a ion etching method to patterning the non-matching gate metals togetherly.

Also, the dual material gate technology has enhanced the device immunity over the SCEs [18]-[19]. The new engineering stretched to DG MOSFET further improved device performance [20]-[21]. The integration of the gates is

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made possible via flow of fully-silicided metal (FuSi) [22]–[23], wet etching process [24], interdiffusing metal [25]–[26], selectively patterning and implanting of gate workfunctions. A finely thick dielectric layer covering finely thin SiO<sub>2</sub> layer for constant EOT has critically reduced the tunnel gate current.

## II. Proposed Device Structure

Fig. 1 depicts silicon nanowire junctionless mosfet (SNW-JL-MOSFET) and the experimented ON current characteristic.

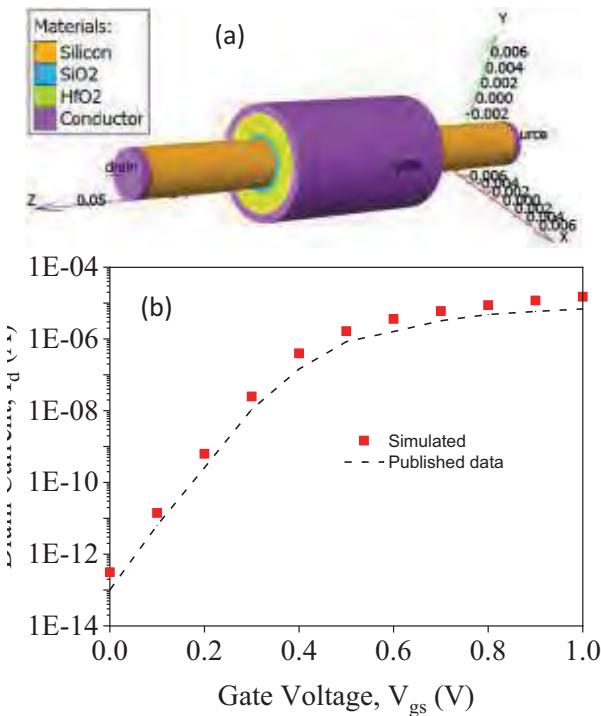


Figure 1. Cross-section of a) SNW-JL-MOSFET b) Experimented characteristics [26] of conventional nanowire structure.

The device simulations are performed via ATLAS simulator [15] for performance computation of silicon nanowire junctionless MOSFET (SNW-JL-MOSFET), as shown in Fig. 1. All these architectures with gate length L = 20 nm, radius of Si film = 2.5 nm and oxide thickness t<sub>ox1</sub> = 0.4 nm (SiO<sub>2</sub>) and t<sub>ox2</sub> = 2.1 nm (HfO<sub>2</sub>) with high-k gate dielectric are acquired by setting metal work-function gate to have the same I<sub>off</sub> with drain bias of 1.0 V. The source/drain and channel regions are highly doped with n-doping concentration (N<sup>+</sup>) =  $1 \times 10^{19}$  cm<sup>-3</sup>. The geometrical limitations used for simulation of proposed device (NW-JL-MOSFET) are determined in Table I.

The mobility models modulated for simulation are concentration dependent based on mobility as well as high-

field reduction model [24]. The model for recombination used here is Auger. The Shockley-Read-Hall generation/recombination model plus band gap narrowing [19] are also employed. To include the quantum confinement effect, in actual the Bohm quantum model (BQP) is accounted [18].

TABLE I.  
DEVICE VALUE OF CPB-TG-TFET

Parameters	Values
Gate Length, (L nm)	20 nm
Source Length (L <sub>S</sub> nm)	10 nm
Drain Length (L <sub>D</sub> nm)	10 nm
Gate oxide, (t <sub>ox</sub> nm)	HfO <sub>2</sub> (2.1 nm) + SiO <sub>2</sub> (0.4nm)
Silicon film doping, N <sup>+</sup> (cm <sup>-3</sup> )	$1 \times 10^{19}$
Gate/Metal work function (eV)	3.9 eV

**Calibration characteristic:** The simulated characteristics are in agreement with the experimented outcome of conventional nanowire reported in [26] as depicted in Figure 1(b).

## III. RESULTS AND DISCUSSIONS

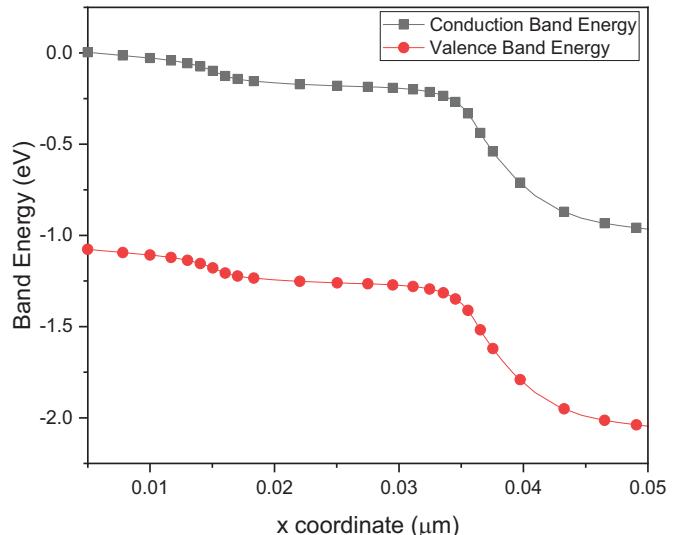


Figure 2 Energy band diagram of a SNW-JL-MOSFET when V<sub>gs</sub> = V<sub>ds</sub> = 1 V.

Junctionless transistors are basically the variable resistors controlled via a gate electrode. The channel made using silicon nanowire is heavily doped which can be fully depleted to switch the device into off state. The electrical characteristics of device are similar to normal MOSFETs, with distinguished concept. The conduction mechanisms in Junctionless Nanowire Transistors (gated resistors) is in contrast to inversion-mode and accumulation-mode.

The SNW-JL-MOSFET is considered the ultimate option for downscaling of device < 30 nm [4], thus offering higher packing density, steeper sub-threshold slope and higher current driving capability. The optimal value of

subthreshold slope of the proposed device is 63mV/decade with drain modulated barrier lowering factor below 32 mV/V.

MOS devices as represented in Fig. 2 shows the energy band diagram of SNW-JL-MOSFET for ON state ( $V_{gs}=1$  V,  $V_{ds}=0$  V). Fig. 2 shows the device with substrate doping  $1 \times 10^{19}$  cm $^{-3}$  with energy barrier width within intrinsic channel alongwith partially depleted n-layer. Insertion of n-layer with high doping concentration, obstruct the electric field of source regime from exerting into channel. Thus, a good quantity of electrons are shifted within drain, indicating n-p insertion layer with fully doped probably acting like electron source instead of energy barrier. The effect is highly pronounced when negligibly few electrons are present at  $V_{gs}=0$  V in comparison to electrons from n-p layer are negligibly involved in current conduction with  $V_{gs}=1$  V.

Fig. 3 depicts the  $I_d$ - $V_{gs}$  transfer characteristics of silicon nanowire junctionless mosfet (SNW-JL-MOSFET) at two different drain to source region voltage (which is  $V_{ds} = 50$  mV and 1 V) when gate to source voltage from 0 to 1 V. In Figure 3, the leakage current ( $I_{off}$ ) is deviating from  $10^{-15}$  A to  $10^{-17}$  A for two different drain voltage. Fig. 4 depicts that  $I_d$ - $V_{gs}$  transfer characteristics of silicon nanowire junctionless mosfet (SNW-JL-MOSFET) at three values ( $V_{ds} = 0.8$  V, 0.9 V and 1 V) when  $V_{ds}$  from 0 to 1 V.

However, from Fig. 3 and 4, it is found that rising dielectric permittivity over single layer of oxide,  $I_{on}$  and leakage current rises w.r.t fringing field effect. In case high-k at inter-facial oxide layer (SiO<sub>2</sub>), a reduction is found in device gate leakage current. The gate capacitance coupling increase which causes the leakage current to reduce [16]. Standby power of CMOS is effected by the sub-threshold or the leakage current. The drain current of the junctionless nanowire is in direct proportion to nanowire cross-section and channel doping concentration but not for the gate oxide capacitance. Fig. 3 shows that  $I_{on}$  current at  $V_{gs} = V_{ds} = 1$  V in junctionless nanowire transistor with  $L_g = 20$  nm, varies with device width and doping concentration.

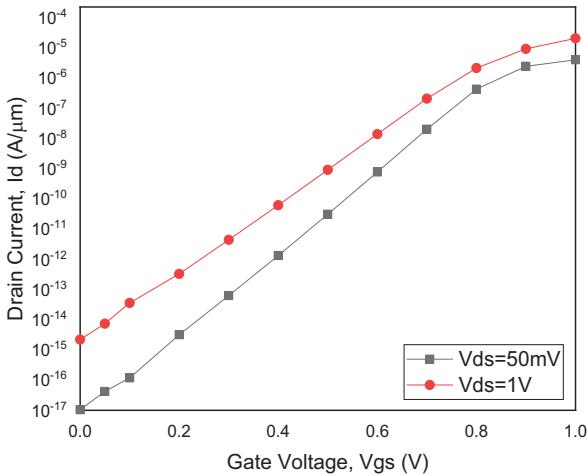


Figure 3. Drain current ( $I_d$ ) vs.  $V_{gs}$  for two drain voltage i.e.  $V_{ds} = 50$  mV and  $V_{ds} = 1$  V.

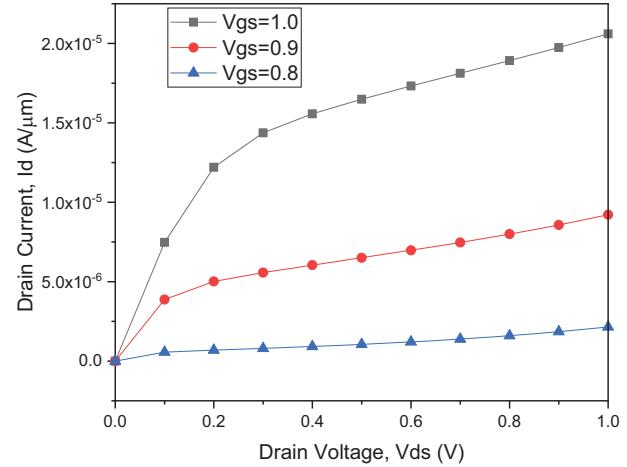


Figure 4. Drain current ( $I_d$ ) Vs. ( $V_{gs}$ ) at.  $V_{ds} = 50$  mV and  $V_{ds} = 1$  V.

### I. Device Analog performance

The crucial parameter including trans-conductance ( $gm$ ), and output transconductance ( $gd$ ) are analyzed and discussed here from viewpoint of analog circuit analysis.

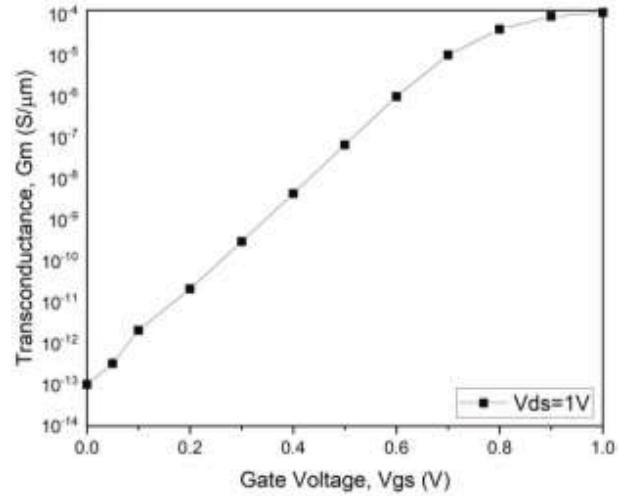


Fig. 5. Transconductance ( $gm$ ) vs.  $V_{gs}$  at  $V_{ds} = 1$  V.

In Fig. 5, the transconductance ( $gm$ ) at  $V_{ds} = 1$  V is varied for different values of  $V_{gs}$  is presented. The  $gm$  of MOSFET which determined amplifier gain as shown in Eq. (1). An improvement in  $gm$ , gives the higher carrier transport efficiency for given gate stack configuration is essential for the analog application.

$$g_m = \partial I_d / \partial V_{gs} \quad (1)$$

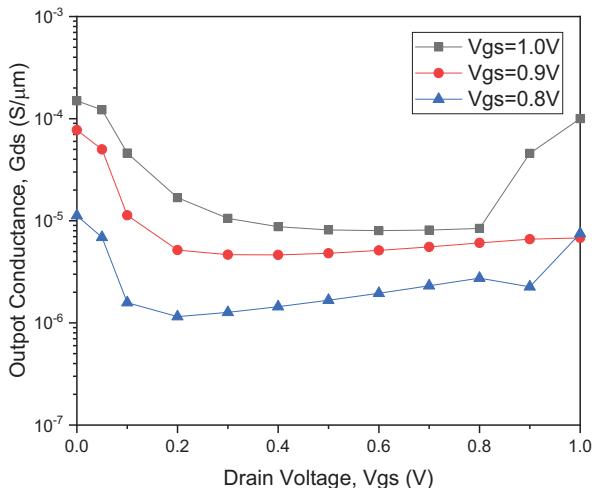


Fig. 6. Output Conductance ( $G_{ds}$ ) vs. gate to source voltage for different value of  $V_{ds} = 0.8, 0.9$  and  $1\text{V}$ .

In Fig. 6, the output conductance ( $G_{ds}$ ) Vs. gate-to-source voltage at different value of  $V_{ds} = 0.8, 0.9$  and  $1\text{V}$  is presented. For computing output conductance  $G_{ds}$ , formula in Eq. (2) is utilized.

$$G_{ds} = \partial I_d / \partial V_{ds} \quad (2)$$

The drain current rises with increase in dielectric permittivity over single layer configurations which eventually causes higher  $g_d$  for such configurations. The analog circuits, especially CMOS needs low output conductance ( $g_d$ ) transistors to receive higher gain. High  $g_d$  means, lower output resistance which results in higher  $I_d$  with  $V_{DS}$  in saturation domain. The device component are associated with increase, namely channel length modulation and DIBL. On the other hand, an increase in gate length of proposed structure decreases the  $g_m$  and consequently reduces the  $g_m/g_d$ .

#### IV CONCLUSION

This paper describes the conduction mechanisms in transistors based on junctionless nanowire. These devices do not function properly in inversion mode or accumulation mode, exceptionally in full/partial depletion. The threshold voltage depends on nanowire doping, EOT, width and thickness. Additionally, the ideology of a bulk multi-gate MOSFET is proposed without any lateral source/drain junction. Its demonstrated that JNT for shorter gate lengths can show lower leakage currents plus short channel behavior at shorter gate lengths. The gate dielectric material optimization of the device is achieved through via extensive device simulation. In paper, an investigation is carried for SCEs and significantly for analog parameter (FOMs) like transconductance and output conductance. It is found that single oxide layer gate dielectric devices with gate stack is improved the device performance and analog performances of the proposed structure. So the SNW-JL-MOSFET is

considered as a suitable option for Analog and RF circuit designing.

Author wants to thanks Dr. Kapil, Assistant Professor, ECE, UIT H.P. University Shimla for guiding the work and for various technical discussions.

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# Traffic Management System using Image Processing

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**Abstract—With the rising population, the number of private transports is also increasing. 1214 road crashes occur every day in India. 377 people die every day, equivalent to a jumbo jet crashing every day. The reason for these accidents is due to poor management of traffic. To overcome this problem, a very smart and innovative traffic management system that allows to control and manage traffic very efficiently is developed. It reduces unnecessary waiting for drivers when there are no vehicles in the other lane. This system contributes a lot in preventing accidents at signals due to unnecessarily waiting. An algorithm is specially designed for pedestrians crossing the highway. The approach of this project is to capture the traffic with the help of a good quality camera and a very high-performance low power consumption microcontroller. This processor helps to recognize the vehicles, pedestrians and calculate the time required using the algorithm with a very fast response time and high accuracy. The algorithm is developed by considering the average time which is taken by vehicles to pass. The objective of this system is to minimize accidents and unnecessary traffic by converting the static signals into dynamic and managing time very efficiently such that the lane having more vehicles will get more time to pass.**

**Keywords—Dynamic signals, IoT (Internet of Things), Application, Hardware, Internet of Things, Embedded Systems, Image Processing.**

## I. INTRODUCTION

With increasing traffic and multilane roads the static signals are proved inefficient. Due to long waiting times drivers often become impatient resulting in disobeying of traffic rules and regulation, which eventually leads to accidents. Traffic management system provides a dynamic traffic signal system which is capable of assigning the waiting time with reference to the traffic present on the road.

The system is significantly different from the existing system as it allocates time as per the demand and not just a constant time. This time is completely based on the number of

vehicles present on the lane. A very high quality and cost effective camera is used to capture the vehicles and to process the image. We have kept resolution to optimal as it affects the framerate[1]. Identification of vehicles and counting them to predict the required time is done in milliseconds which makes our system very fast. To avoid counting vehicles which are on the opposite lane or parked far away, a frame is created which covers the main area of traffic. All the vehicles present inside the frame will be counted as traffic. Displaying the number of seconds left for a signal is done using an LCD[4].

The system is very compact in size and can work smoothly without any human intervention. The power required for the system is very low. The initial cost of implementation is not very high and can work upto 10 years. Very low maintenance is required for this system.

Traffic management system focuses on reducing road accidents as the daily count of death cases due to road accidents is alarming. It is important to improve the existing system to prevent accidents.

Traffic system is improvised in such a manner that there is no need to break rules in a hurry.

Not only it helps in reducing the accidents, but also controls and manages the traffic very efficiently.

On Highways, it allows the pedestrian to pass only when the pedestrians are present. If there are no pedestrians then the signal will always be green for cars.

Maintenance of this project is minimal. Thus, helping traffic police by reducing their stress.

This paper includes all the component diagram, flow charts in order to properly explain the importance and functioning of both the systems. They will help in better understanding of the system proposed.

## II. COMPONENT DIAGRAM

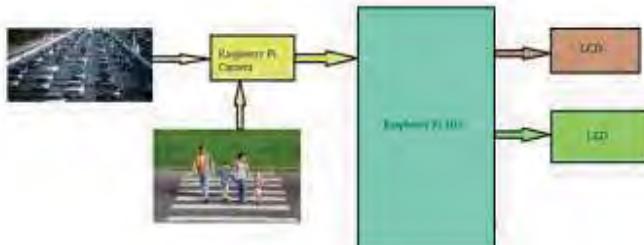


Fig 2.1 Component Diagram for the system

As we can see in the component diagram above, Raspberry Pi 3B+[2] will have all the input and output operations. Raspberry Camera will identify the cars and pedestrians on the road and send the data accordingly. Meanwhile, LCDs and LEDs will act as output devices. LEDs are the actual traffic signals which will glow Red, Green and Yellow to instruct the drivers/pedestrians on what is to be done. On the other hand, LCDs will give some visual texts just to give a better understanding to the drivers/pedestrians.

## III. ALGORITHM

To use a model with TensorFlow Lite, you must convert a full TensorFlow model into the TensorFlow Lite format which is known as quantization as it increases its speed and reduces its memory consumption. As you cannot create or train a model using TensorFlow Lite. So, you must start with a regular TensorFlow model, and then convert the model. One can do that using TensorFlow's keras library. Once we have our trained models, we can start with our algorithms for traffic management.

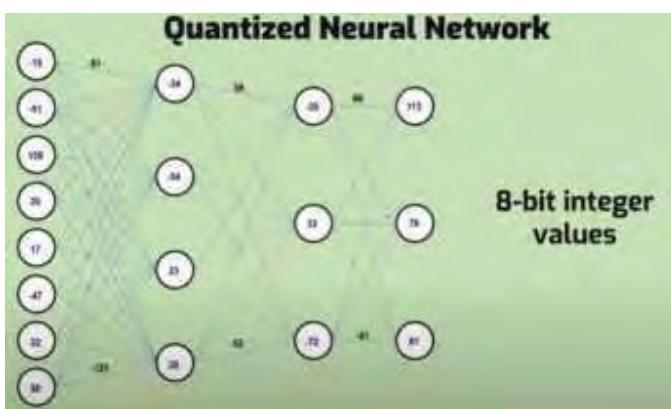


Fig 3.1 Quantized Neural Network [17]

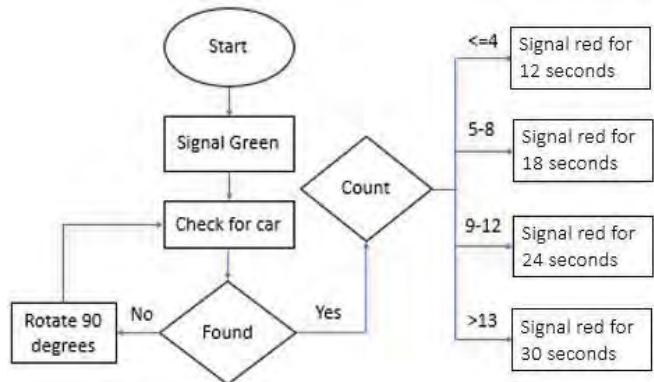


Fig 3.2 Flowchart for counting cars

Above flow chart shows the flow of our traffic signal management system. Once our system starts it will give a green signal to the first lane for predefined time. Then it will check the number of cars in the second lane, accordingly it will allocate green signal to that lane dynamically. The motor will rotate and check the number of cars present in the third lane and the process will continue. While counting the number of cars our system can be compromised due to the parked cars and if the camera captures cars from other lanes. So, a box has been provided onscreen which will only count the vehicles inside that box.

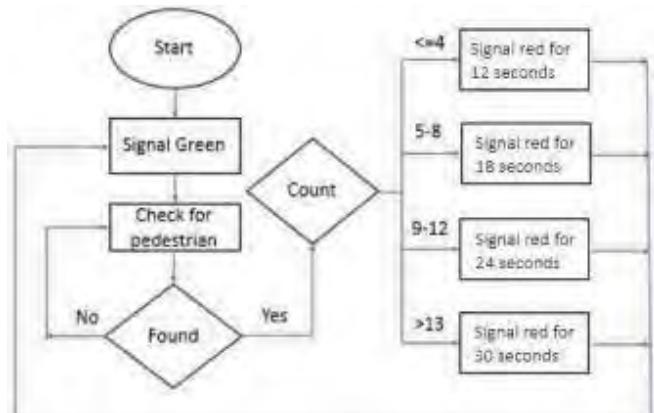


Fig 3.2 Flowchart for counting pedestrians

Above flow chart shows the flow of our pedestrian detection system. In our pedestrian crossing system, the signal for cars crossing the road will be green. Our system will constantly be checking for pedestrians and only when a pedestrian is detected on one side it will communicate with the system on the other side of the road and the signal will turn red for pre-defined time. While checking for pedestrians our system can be compromised if our camera starts capturing pedestrians randomly walking on the road. So as to avoid that a box has been provided on screen which will capture only the pedestrians waiting near the crossroad.

#### IV. COMPONENTS

##### A. Hardware Components used.

- a. Raspberry Pi 3B+ : It is a microcontroller on which this project was scripted.
- b. Raspberry pi camera : It is an externally attachable camera with 5 MP resolution.
- c. LCD : It is used for displaying text
- d. LED : It is used as a prototype signal.
- e. Stepper Motor : It is used to rotate the device.
- f. Jumper wire : It is used for connection.

##### B. Software used.

- a. Raspbian OS : It's a Debian based operating system belonging to the Unix-Like family.
- b. TensorFlow: It's a free open source library for numerical computation and high scale machine learning focusing on deep neural networks.[16]
- c. OpenCV: OpenCv(Open Source Computer Vision Library) is an open source library used in computer vision containing hundreds of computer vision algorithms. It uses NumPy for numerical operations and can easily be integrated with different libraries like SciPy and Matplot[7].
- d. Keras: It's an open source library which provides an interface for artificial neural networks.

#### V. METHODOLOGY

Initially, the signal is green for the S1 road and during that point of time, a raspberry pi camera is capturing the traffic in the S2 lane. In the figure given below, assume the blue arrow as a raspberry pi camera. The raspberry pi will be facing at road S2 until the timer of S1 is not finished. Once the green light turns red in S1 lane, raspberry pi camera will calculate the time T1 required for the vehicles in lane S2 to pass, set the timer accordingly and rotate 90°[5][6].

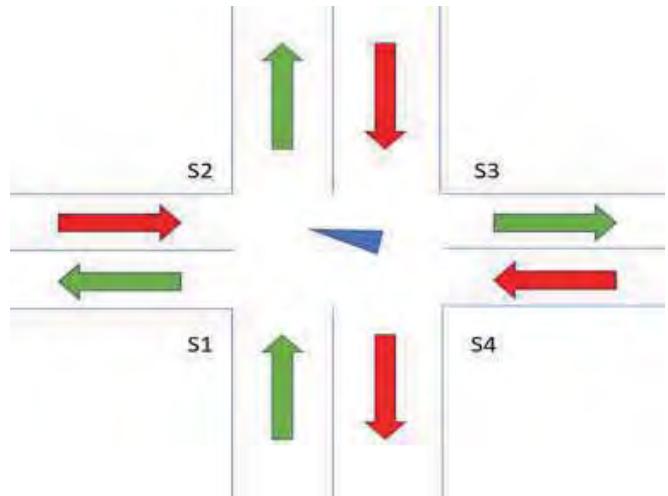


Fig 5.1 Representation of Initial Camera position

As previously mentioned, the camera will rotate 90°, that is towards the north direction (S3 lane). Again the vehicles on S2 lane will be allowed to pass for the time T1 which was calculated by raspberry pi and now raspberry pi will start capturing images and calculate the time for S3 lane.

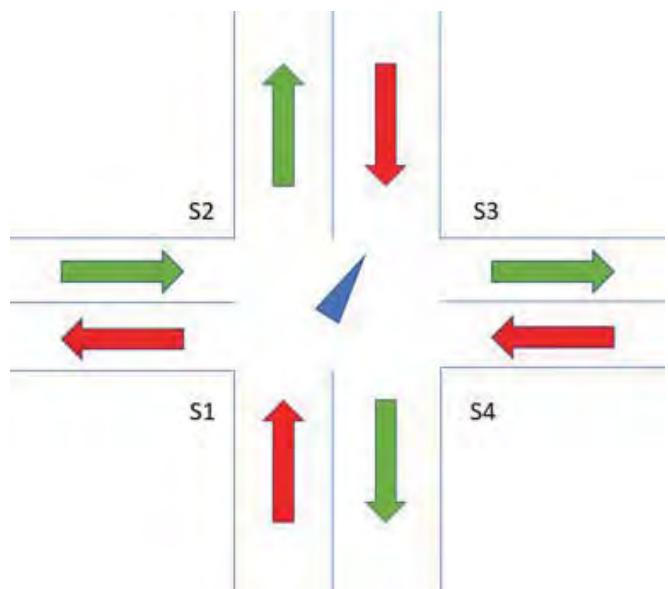


Fig 5.2 Representation of Camera position turned 90 degree

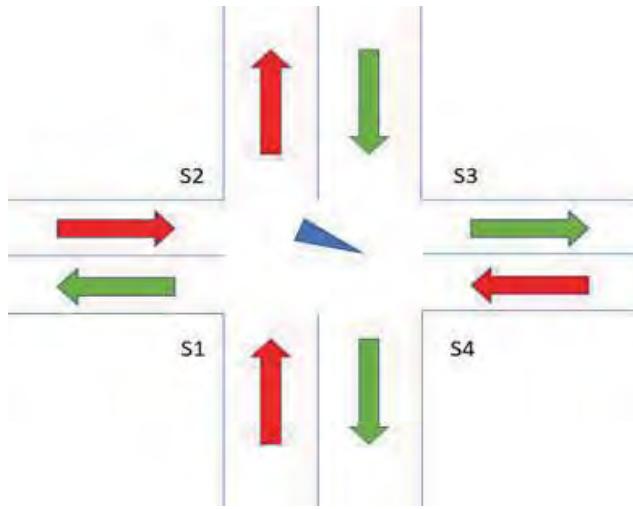


Fig 5.3 Representation of Camera position turned 180 degree

Similarly, the cycle will go on, raspberry pi will capture the images, calculate the time and set the timer for that lane and rotate to another signal. It will also take into consideration that if there are no vehicles detected then it will keep the signal green for minimal time and then rotate. Later our system can be connected to self-driving cars which can calculate the fastest route more effectively[3][13].

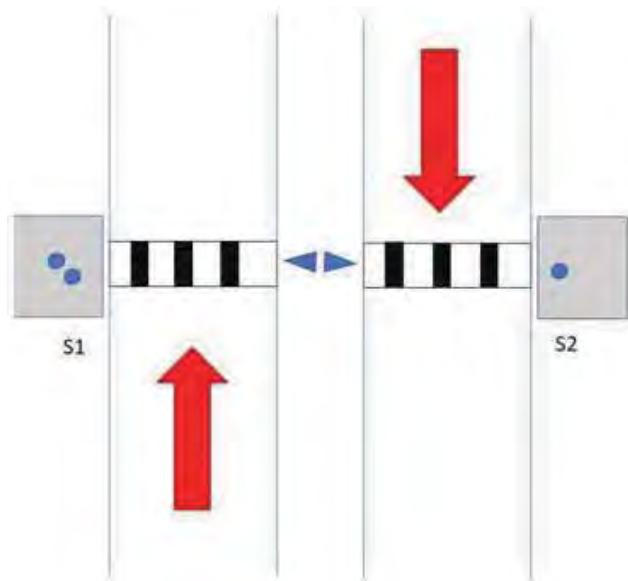


Fig 5.4 Pedestrian approach in red light

Once the pedestrians are detected by the camera, the signals will turn red for vehicles for timer T which will be calculated by the raspberry pi depending on the number of pedestrians present and once the timer ends, the signal will turn green.

#### Pedestrian Signal

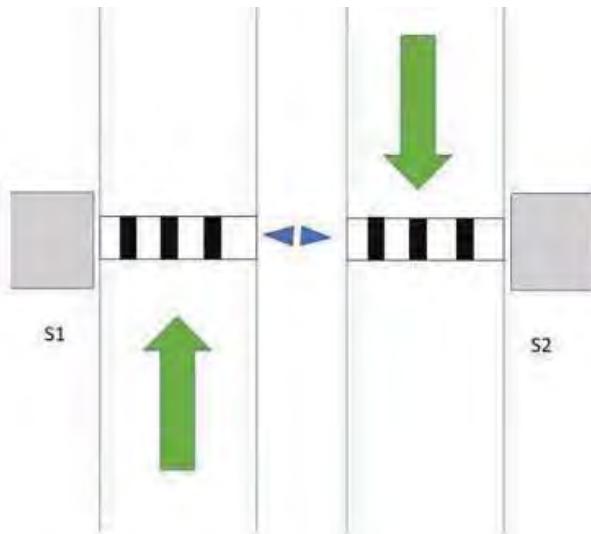


Fig 5.4 Pedestrian approach in green light

Consider the blue arrows as the cameras which are facing in opposite directions to check whether there are any pedestrians waiting to cross the road. Initially, the signal is green for vehicles as there are no pedestrians present.

#### VI. FUTURE SCOPE

Our system can further be integrated with AI for a better traffic management system[9][14]. We can even prioritise the emergency vehicles like police, firebrigate, ambulance [11][12][8]. We can even add an emergency button for pedestrians who want to change the traffic signal quickly [10].

#### VII. CONCLUSION

In this project, a dynamic traffic management system to control the traffic is developed. This system has been developed with a highly accurate model for capturing and identifying vehicles. The processor of this system is an ARM Cortex-A53 64-bit Quad-Core Processor System-on-Chip operating at 1.4GHz. From the test results, it is observed that the system performed well and gave accuracy of 93.33% with extremely fast response time. Capturing images and identification of vehicles was successfully performed using Raspberry pi and libraries such as OpenCV, keras, TensorFlow, which was performed on Raspbian OS. Various other hardware components were also utilized while building this model. The algorithm for dynamic allocation of time and displaying it were also performed. The system can work smoothly after providing a power supply of 5 Volts. The system is extremely compact and easy to use. The system is very cost effective and therefore, it is ready to be utilized in real-life application.

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# IETE's 52<sup>nd</sup> MTS

## Details of TECHNICAL SESSIONS

session	SESSION INCHARGE	PAPER ID	Title of the Paper	FIRST NAME	LAST NAME	AREA OF SPECIALIZATION	
<b>SESSION – I 11:45-13:00HRS</b>							
<b>SESSION - IA ZOOM MEETING</b>							
IT-1	IT=25 min CP = 8min		INVITED TALK <i>Miniaturized Sensors for Industry 4.0</i>	Dr AJAY AGARWAL			
IA-1		37	Percussion Transcription by Supervised learning	VINUTHA	T P	SIGNAL PROCESSING	
IA-2		16	Malware Intrusion Detection For System Security	ASHWINI	KATKAR	COMPUTER	
IA-3		39	Dependent and Independent Task Scheduling using Non-Linear Programming Model for Cloud Computing Environment	SAMPADA	BHOSALE	COMPUTER	
IA-4		49	Survey on Classification Algorithms in Machine Learning	PRACHI	KOTHAWADE	COMPUTER	
IA-5		21	RPA: A Business Automation & Reality	NISHITA	PANCHAL	COMPUTER	
<b>SESSION - IB GOOGLE MEET</b>							
IT-2			INVITED TALK <i>Current Trends and Requirements of Software Industry</i>	MUKUND SATHE			
IB-1	IT=25 min CP = 8min	4	Automatic Wheelchair with Object Detection and Avoidance Using IR Sensor.	SHEETAL	JAGTAP	COMMUNICATION	
IB-2		20	Face Recognition based Attendance System	RUSHABH	MEHTA	COMP	
IB-3		41	Development and Evaluation of a Web-Based Simulation for Computer Graphics for Distance Learning	PRUTHA	KUDTARKAR	COMPUTER	
IB-4		30	Lyrics Based Classification of Songs	UTTARA	GOGATE	COMP	
IB-5		48	A Survey on Indoor Positioning Systems: Methods, Technologies & Parameters	UTTARA	GOGATE	COMMUNICATION	
<b>SESSION - IC GOOGLE MEET</b>							
IC-1	IT=25 min CP = 8min	18	Traffic Management System using Image Processing.	SIDDHANT	KADAM	COMP	
IC-2		26	Braille Keyboard: A Teaching Device for the Visually Impaired	ANANT	DEV	COMPUTER	
IC-3		27	Property Price Prediction using machine learning, chat bot using NLP	MAYUR	PATEL	COMPUTER	
IC-4		31	Text Summarization Using Latent Semantic Analysis Approach	SNEHA	PANDE	COMPUTER	
IC-5		35	Resume Rater Using Pandas and Machine learning.	CHAITNAYA	SATPUTE	COMPUTER	
IC-6		36	Xenia – A Smart Tour Planning and Recommendation Using Crowdsourced Data	VIKRANT	NALAWADE	COMPUTER	
IC-7		42	Predicting Household power consumption using CNN & LSTM	PRATIK	GODE	ELECTRONICS	
IC-8		28	Development of LEG Contamination Monitor Using Arduino Uno	P B	WALINJKAR	ELECTRONICS	
<b>Tech SESSION – II 02:30 – 04:00</b>							
<b>SESSION - IIA ZOOM MEETING</b>							
IT-3	IT=25 min CP = 8min		Invited Talk <i>Advances in VLSI Based Signal Processing and Applications</i>	DR SATYANARAYANA		VLSI	
IIA-1		3	High Performance Ternary Logic Gates Using GNRFET	RAMA KANTH SINGH RASAPUTHRA		VLSI	
IIA-2		1	Design and optimization of Hybrid Multiplier and Comparative study of Various Multipliers	SYED KHASIMUNNISA		VLSI	
IIA-3		2	Design and Simulation of Clock and Data Recovery Circuit (CDR) in 180nm CMOS Technology	ANKIT DHAMA		VLSI	
IIA-4		19	Comparison of different handwritten Hindi text recognition approaches	EESHA POONJA		MICRO-ELECTRONICS	

IIA-5		24	Smart Mirror - A New Way to Life	RISHABH BUDDHDEV	EMBEDDED SYSTEMS
IIA-6		51	Structure Design Engineering for Optimal Analog Performance of Nanowire Junctionless MOSFET	DEEPAK KUMAR	VLSI

#### SESSION - IIB GOOGLE MEET

IIB-1	IT=25+5min CP = 8+2min	14	Design And Comparative Study Of Different Shaped Patch Antenna For 5G Application	PREMANAND	VELIP	ELECTRONICS
IIB-2		15	Hardware Accelerators: A Survey	NIDHI	SINGBAL	MICRO-ELECTRONICS
IIB-3		46	Sun Tracking Solar Panel	ANUJA	SAMUEL	ELECTRONICS
IIB-4		29	A Review On Efficient And Intelligent Drainage Management System For Smart City	APEKSHA	BAND	ELECTRONICS
IIB-5		32	Surveillance Robot For Object Detection Using RADAR In Military	KRITHIKA	RAJARAM	ELECTRONICS
IIB-6		33	Wi-Fi Based Secure Wireless Communication Using RSA	PRIYA	MHAMUNKAR	ELECTRONICS
IIB-7		44	Design of a monitoring system for smart Dustbin using IOT	RIYA	BARAPATRE	ELECTRONICS
IIB-8		45	An Ultra-low Power Nano-scale design for sequential circuits using QCA	KALPANA	WAGHMARE	ELECTRONICS

#### SESSION - IIC GOOGLE MEET

IIC-1	IT=25+5min CP = 8min	40	VHDL Implementation of pipeline processor	HRITIK	GAIKWAD	ELECTRONICS
IIC-2		13	Underwater Ultrasonic Communication	SHIKHA	TRIPATHI	COMMUNICATION
IIC-3		23	Early Flood Detection System using IoT	MITHIL	MODI	ELECTRONICS
IIC-4		38	Contactless Heart Rate Analyzer	SWATHI	GAITONDE	ELECTRONICS
IIC-5		34	Review of High Voltage Protection, Standards & Mitigation For Electronics System	ADARSH	TIWARI	COMMUNICATION,
IIC-6		10	Portable, Versatile and High Precision Laser Engraver	JAY	BHANUSHALI	ELECTRONICS
IIC-7		43	Interfacing of TFT Display with machines	HRITHIK	GAVANKAR	ELECTRONICS
IIC-8		50	College Committee E-Voting System	POONAM	NIMJE	



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