3rd

International Conference

On

"Recent Innovations in Engineering, Technology,

Management and Research"

(3rd ICRIETMR-2024) on 16th-17th July 2024

Bal Krishna
Institute of Technology

Venue:

Bal Krishna Institute of Technology, Kota

IPC-15, RIICO Institutional Area, Ranpur, Kota

(Rajasthan) (India)

Pin Code: 325003

www.bkitkota.com

Bal Krishna Institute of Technology, Kota

IPC-15, RIICO Institutional Area, Ranpur, Kota (Rajasthan) (India).
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3rd International Conference on
"**Recent Innovations in Engineering, Technology, Management and Research**"
(3rd ICRIETMR-2024) on 16th-17th July 2024
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Chief Editor

Dr. Dheeraj Nimawat

(Principal, BKIT Kota)

(Convener 3rd ICRIETMR-2024)

Message from Chairman

Man Mohan Joshi
(Chairman)

It gives me immense pleasure that Bal Krishna Institute of Technology, Kota is organizing an 3rd International Conference on Recent Innovations in Engineering, Technology, Management and Research (3rd ICRIETMR-2024). It is heartening indeed that with the passage of time BKIT is spreading its dimensions with new achievements and crossing the boundaries to excel. The youth is pursuing the new challenges with the emerging technologies thus widening their horizons. The innovative zeal of the BKITians is praise worthy.

It gives me great pleasure to inform you that more than 50+ Technical Papers were submitted from various IITs, NITs, ISRO, government and private institutes and universities, industries, research organizations from India and abroad for presentation. After reviewers comments we have selected around 20 technical papers. We have several invited talks by 04 Keynote speakers who are distinguished scientists/researchers/academician from domestic/abroad on various themes of Engineering and Technologies.

The aim of BKIT College is to make the students successful in multidisciplinary arenas of engineering and we try our best to achieve this goal. We promote the young students paving way for immense success through a wide spectrum of activities in the campus.

This international Conference provides a common platform for researchers, academicians, students and industrialists to exchange their views in different areas of research and development.

I hope that all the participant of this conference will have very pleasant and enjoyable experience in this event.

I congratulate all the participants of 3rd ICRIETMR-2024 for their golden future and successful career. BKIT Family would like you to carry sweet memories of 3rd ICRIETMR-2024 and I wish this two days International Conference all Success.

Best Regards,
Man Mohan Joshi
Chairman
Bal Krishna Institute of Technology, Kota
IPc-15, RIICO Institutional Area, Ranpur, Kota (Rajasthan) (India). Pin Code:325003

Message from Vice-Chairman

Aviral Joshi
(Vice- Chairman)

I am happy to learn that 3rd International Conference on Recent Innovations in Engineering, Technology, Management and Research (3rd ICRIETMR-2024) is being organized by Bal Krishna Institute of Technology, Kota during 16th-17th July 2024.

I welcome all the delegates from India and abroad for participating in 3rd ICRIETMR-2024 International conference at Kota. I am sure the practical experience, technical ideas, analytical results and innovations from delegates shared during the 3rd ICRIETMR-2024 conference would be valuable for institutes and industries.

This two days conference would help students, faculty and researchers working in the area of engineering and technologies to learn about the current situation of various smart technologies being used all over the world. Further it would be beneficial to explore ways by which one could contribute towards the growth of industry at all levels.

It is appreciable that Bal Krishna Institute of Technology, Kota (Campus) is enriched with dynamic, dedicated, highly competent and qualified faculty members. I extend my best wishes to all the members of organizing committee to achieve a grand success in 3rd ICRIETMR-2024.

Bal Krishna Institute of Technology believes in promoting the talents of the youth in the arena of Technical Education. The global scenario today lays emphasis on the need of talented young engineers equipped with various skills to face the modern competitive environment. We recognize this need and organize various events to provide exposure to the student and researchers so that they get opportunities to develop and create a niche for themselves. I hope that all the participants of this third International Conference will have a very pleasant and enjoyable experience. I congratulate all the participants of 3rd ICRIETMR-2024 for their golden future and successful career ahead.

Best Regards,
Aviral Joshi
Vice- Chairman
Bal Krishna Institute of Technology, Kota
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Message from Principal & Convener

Dr. Dheeraj Nimawat
(Principal & Convener)

Today's global community is exchanging knowledge and technology at phenomenal speed and at much reduced costs. It has now become crucial that the developing countries like India should encourage their youth to participate in national as well as international scientific and technological events.

In this environment of fast moving technology, Engineering and Technology have become the two sides of a coin. They are closely intertwined and so combined with each other, that to be effective we should view them together.

On behalf of the Organizing Committee, I have glad to announce this 3rd International Conference on Recent Innovations in Engineering, Technology, Management and Research (3rd ICRIETMR-2024) during 16th-17th July 2024 will provide an opportunity to the academicians, Researchers, R & D Experts and Industry Experts to present their work and ideas in our conference.

It is expected that the delegates of the conference from academic institutions (both faculties & research students), R&D organization as well as professional scientists and engineers will exchange their views through presentations and discussions.

To lead this world it is required to lead in Engineering and technology. With this message I am sure that the delegates, experts, students, researchers and industry persons, will all tremendously benefit from the deliberation of this conference. Your presence and deliberation will make this conference remarkably successful in all aspects.

I am very thankful to our Chairman and Vice Chairman for continuous motivation and support to organize such an international level event. I express my sincere thanks towards technical advisory boards for their technical association in organizing this international conference. I extend my thanks to the sponsors of this event for their cooperation. Finally my sincere thanks to the conference organizing team members, those who are making all efforts to make this event a grand success.

I hope that all the participants of this International Conference will have a very pleasant and enjoyable experience. I congratulate all the participants of 3rd ICRIETMR- 2024 for their golden future and successful career ahead.

Best Regards,

Dr. Dheeraj Nimawat (LMSESI, AMIE)
Principal & Convener 3rd ICRIETMR- 2024
Bal Krishna Institute of Technology, Kota
IPc-15, RIICO Institutional Area, Ranpur, Kota (Rajasthan) (India). Pin Code:325003
Mobile: 09461087970
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POLITECNICO DI MILANO

DIPARTIMENTO DI ELETTRONICA
INFORMATICA E BIOINGEGNERIA

(Prof. (Dr.) Cesare Alippi)

Message

It is indeed with a sense of delight that I convey this message of good wishes to 3rd International Conference on Recent Innovations in Engineering, Technology, Management and Research (3rd ICRIETMR-2024) organized by the Bal Krishna Institute of Technology Kota (India) the during 16th-17th July 2024 period.

I am sure that this conference will gather academicians and researchers from all over the world at one platform to share their knowledge, information and practical experience towards the aforementioned field.

As engineering is meant for innovation and creating the best, in this conference all researchers, engineers and academician can share their talents and expand their wings to further excel for the benefit of individual, society and thereby the whole nation.

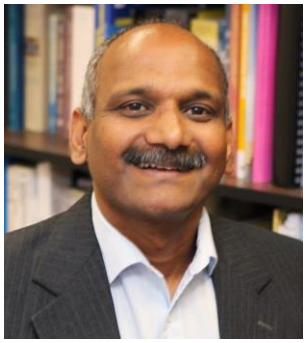
I extend heartiest congratulations to the organizers and a grand success to participants in the hope that the wheel of "3rd ICRIETMR-2024" Prestige will accelerate higher.

I pray for God's blessing cordially greet all the participants of the conference and wish them good luck in their path of success.

With Best Regards…

Prof. (Dr.) Cesare Alippi, IEEE Fellow, (past Vice-President IEEE Computational Intelligence Society)
Professor, Dipartimento di Elettronica, Informazione e Bioingegneria
Politecnico di Milano, Italy

UF WARRINGTON COLLEGE of BUSINESS



(Prof. (Dr.) Selwyn Piramuthu)

Message

It is a great pleasure to know that the Bal Krishna Institute of Technology, Kota (India) is organizing the 3rd International Conference on Recent Innovations in Engineering, Technology, Management and Research (3rd ICRIETMR-2024) during 16th-17th July 2024.

This conference will give an ideal opportunity for experts and amateurs to keep abreast of the latest trends and exchange ideas about exciting new developments. Such conferences keep us in contact with current flow and changes in the field. The conference is an interdisciplinary, multi-stage, and multi-sector environment with a strong focus and involving practitioners and young budding engineers on the ground.

It is a sort of challenge to motivate ourselves and to flourish our talent. In today's scenario, no-one can challenge the power of communication. One has to acquire the skills of sharing their knowledge, such conferences prove platform for all to share their learning.

Negative thoughts pull us down and keep us far from reaching new heights in our life.

Career progression calls for a positive attitude, those who not only manages his/her professional responsibilities well, but also radiates the optimism to others.

I wish your endeavors a grand success and hope this conference brings the best of everyone.

Best Regards…

Prof. (Dr.) Selwyn Piramuthu
Frank L. Weyenberg Term Professor
Information Systems and Operations Management (ISOM)
Warrington College of Business
University of Florida
100 Bryan Hall, PO Box 117150
Gainesville, FL 32611-7169

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(Prof. (Dr.) Bimal K. Bose)

Message

It is such a pleasure and excitement to know that you are organizing the Third International Conference on "Recent Innovation in Engineering, Technology, Management and Research)" (3rd ICRIETMR-2024) in Ranpur, Kota, India. Although my field of specialization is Power Electronics, I see the great importance of this broad area not only in India, but also to the whole world in the broad perspective. India has been a cradle of world civilization for many centuries. Now, India should take leadership in the world in the advancement of technology, research and management techniques.

I wish you all the success in the conference objectives.

Best Regards…
Prof. (Dr.) Bimal K. Bose, *D.Sc. (Honoris Causa), Life Fellow, IEEE*
Condra Emeritus Chair Professor in Power Electronics
Member, US National Academy of Engineering
610 Min Kao, 1520 Middle Drive
Department of Electrical Engineering and Computer Science
University of Tennessee
Knoxville, TN 37996-2100, USA
Formerly, Chief Scientist, EPRI- Power Electronics Applications Center

UNIVERSITY of GREENWICH

FACULTY OF ENGINEERING AND SCIENCE
UNIVERSITY OF GREENWICH, UNITED KINGDOM

(Dr. Chi Hieu Le)

Message

I would like to extend my warmest congratulations to the Bal Krishna Institute of Technology, Kota, for successfully organizing 3rd ICRIETMR-2024, the 3rdInternational Conference on Recent Innovations in Engineering, Technology, Management, and Research on July 16th-17th, 2024.

Building on the success of previous ICRIETMR conferences, 3rd ICRIETMR-2024 continued to provide a platform for fruitful discussions, sharing emerging research and innovations, and stimulating multidisciplinary collaborations in research and technology development, technology transfer, innovation and entrepreneurship.

ICRIETMR also offered students and early career researchers valuable opportunities to develop professional skills and international networks, enhancing their profiles and experiences in research and academia.

I wish all the best to the organizing committee and participants of 3rd ICRIETMR 2024.

Best wishes…

Dr. Chi Hieu Le
BEng, MEng, MSc, PGCHE, CEng, DrEng, FHEA, MIMechE
Associate Professor, Faculty of Engineering and Science
University of Greenwich
Central Avenue, Chatham Maritime
Kent ME4 4TB. United Kingdom

NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE

(Dr. Arokiaswami Alphones)

Message

First of all, I would like to extend my sincere congratulations to Bal Krishna Institute of Technology, Kota and the organizing committee to host the 3rd International Conference on Recent Innovation in Engineering, Technology, Management and Research" (3rd ICRIETMR-2024) during 16th – 17th July 2024. The conference is a premier international conference in India, providing an excellent platform for scientists, researchers, engineers, students and industrial practitioners throughout the world to present and discuss the latest technology advancement as well as future directions and trends in the field of engineering and technology.

In an era of internationalization, it is extremely important for all researchers to have such a forum to share experiences, discuss emerging challenges, exchange ideas and explore possible future collaboration. And I do believe 3rd ICRIETMR-2024 would be helpful to promote research and development activities and be beneficial not only to all attendee but local communities.

Finally, I wish a great success to this conference and a pleasant and happy experience to all participants.

Best Regards…

Dr. Arokiaswami Alphones (SMIEEE)
Associate Professor, School of Electrical & Electronic Engineering
Nanyang Technological University
50 Nanyang Avenue, Singapore 639798

NATIONAL INSTITUTE OF TECHNOLOGY, HAMIRPUR, INDIA

(Prof. (Dr.) Yog Raj Sood)

Message

"At the outset, I extend my heartfelt congratulations to the Bal Krishna Institute of Technology, Kota, for successfully organizing the 3rd International Conference on Recent Innovations in Engineering, Technology, Management, and Research (3rd ICRIETMR-2024)", scheduled for July 16th-17th, 2024.

In the present scenario, as national boundaries blur, technology advances rapidly on a global scale. Scientific information proliferates across various channels, necessitating the transfer of knowledge among diverse technical groups through discussions, presentations, and seminars. Creating a common platform through such inclusive conferences is imperative for scientists, researchers, engineers, students, and industrialists to share their insights and experiences on current trends and advancements in technical domains.

A multidisciplinary approach is commendable, as it motivates engineering scholars from different backgrounds to exchange ideas and perspectives, thereby fostering new avenues for collaboration and promoting research and innovation among professionals and non-professionals worldwide.

I extend my best wishes for the success of the convener and the entire organizing team of this international technical event, and I convey my sincere regards to all the participants."

Best Regards…

Prof. (Dr.) Yog Raj Sood, PhD (IIT Roorkee)
SMIEEE (USA), MIE (I), LMISTE
Professor (HAG), Department of Electrical Engineering
National Institute of Technology, Hamirpur, India, 177005
Former VC (JIIT, Noida) and Director (NIT Puducherry)
E-mail ID:yrsood2024@gmail.com

UNIVERSITY OF PERADENIYA, SRI LANKA

(Prof. (Dr.) K.A. Saman Susantha)

Message

It is with great pleasure that I extend warmest greeting to Chairman and organizing committee of Bal Krishna Institute of Technology, Kota for organizing 3rd International Conference on Recent Innovations in Engineering, Technology, Management and Research (3rd ICRIETMR-2024)"during 16th-17th July 2024.

This conference serves as a crucial platform for the exchange of ideas, insights, advancements, and innovations in rapidly evolving fields of engineering, technology and management. The conference brings together professionals, researchers, and experts from these fields, providing a platform for them to share cutting-edge advancements, discuss emerging trends, and explore potential solutions to pressing challenges. It also serves as a catalyst for the dissemination of new ideas and methodologies, fostering a culture continuous learning and improvement. Networking opportunities at this event enable participants to forge valuable connections, paving the way for collaborative research projects and industry partnerships.

Moreover, the conference serves as a forum for showcasing breakthroughs, enhancing visibility for ground breaking research, and facilitating cross-disciplinary interactions.

May the conference be a testament to the incredible achievements and potential within the realms of technology, engineering, and management. Good luck to all the participants in creating a memorable and impactful event.

Best Regards…
Prof. (Dr.) K.A. Saman Susantha,
D.Eng (Nagoya, Japan), M.Eng. (AIT), MIESL
Professor, Department of Engineering Mathematics
University of Peradeniya, Sri Lanka

NAZARBAYEV UNIVERSITY

NAZARBAYEV UNIVERSITY, ASTANA, KAZAKHSTAN

(Prof. (Dr.) Prashant Jamwal)

Message

I feel happy to note that Bal Krishna Institute of Technology, Kota is organizing 3rd International Conference on Recent Innovations in Engineering, Technology, Management and Research (3rd ICRIETMR) during 16-17 July 2024. I would like to congratulate the organizing team for this grand endeavor. I hope it will be a fructuous experience for all the attendees.

Globalization and technological revolution, quite apparently, have a great influence on the 21st century job market and professions, specifically related to science, technology and management. Life cycle for technologies and resulting products is becoming shorter and the exchanges of new science, research and techniques between countries is on increase. This rapidly changing technological environment needs to be managed well with novel approaches which will only surface through such an interdisciplinary conference.

In present scenario, scientific information is accumulating and flowing through various resources in a very large scale. It is suggestive to create a common platform through such generalized conferences for all the scientists, researchers, engineers, students and industrialists where they could share their ideas and experiences on the current trends and advancements in technical fields.

Best Regards…

Prof. (Dr.) Prashant Jamwal
Professor, Department of Electrical and Computer Engineering
School of Engineering and Digital Sciences
Nazarbayev University, Astana, Kazakhstan 010000

جامعة الشارقة
UNIVERSITY OF SHARJAH

(Prof. (Dr.) Ramesh Bansal)

Message

It is a matter of great pleasure to know that Bal Krishna Institute of Technology, Kota is organizing 3rd International Conference on Recent Innovations in Engineering, Technology, Management and Research (3rdICRIETMR-2024) during 16th - 17th July 2024.

It is expected that this conference will be very useful means for Researchers, Practicing Engineers and Scientists to share their research innovations.

I would like to extend my heartiest congratulations and best wishes to organizers of conference, authors and reviewers.

Best Regards…

Prof. (Dr.) Ramesh Bansal
FIET (UK), FIE (India), SM IEEE (USA), CPEngg (UK)
Professor, Electrical Eng. Department
Building M9, Room 209
College of Engineering, University of Sharjah
P.O. Box 27272, Sharjah, UAE
W: www.sharjah.ac.ae

OAKLAND UNIVERSITY
School of Engineering and Computer Science

(Prof. (Dr.) Subramaniam Ganesan)

Message

It gives me great pleasure to learn that an 3rd International Conference on "Recent Innovation in Engineering, Technology, Management and Research" (3rd ICRIETMR-2024) is organized on 16-17, July 2024 at Bal Krishna Institute of Technology, Kota IPC-15, RIICO Institutional Area, Ranpur, Kota (Rajasthan), India. I am very happy that the conference proceeding will be published with ISBN Number: 978-81-930823-5-5. This shows that the Institute is gaining international visibility and recognition. The topic for the conference is appropriate for 2024 and India.

It is a great achievement for the Institute and Organizing Committee of this international conference. I wish the conference a great success.

Best Regards…

Subra Ganesan

Prof. (Dr.) Subramaniam Ganesan
Director, Real Time & DSP Lab.,
Electrical and Computer Engineering Department,
115 Library Drive, Engineering Center, Room 440
Oakland University, Rochester, MI 48309, USA.
IEEE Distinguished Visiting Speaker (2005-2009) and Coordinator.
Fellow of ISPE; ReceivedISAM- Life Time Achievement Award
ASEE- Best Teacher Award; OU-SECS- N Khair - Best Teacher award; IEEE EIT- Best Paper Award
IEEE SEM CS chapter Chair, Region 4 and CS Society Board member
SAE, ASEE, ACM member

172A Ang Mo Kio Avenue 8 #05-01
SIT Building @ Nanyang Polytechnic
Singapore 567739

(Dr. Thaiyal Naayagi Ramasamy)

Message

At the outset, I would like to extend my heartiest congratulations to Bal Krishna Institute of Technology, Kota for organizing 3rd International Conference on "Recent Innovations in Engineering, Technology, Management and Research (3rd ICRIETMR-2024) during 16th-17th July 2024.

In present scenario, while the boundaries of nations are merging, technology is advancing rapidly in the whole world. Scientific information and knowledge sharing among the various technical groups through discussions, presentations, seminars etc. has become essential need of time. It is important to create a common platform through generalized conferences for all the scientists, researchers, engineers, students and industrialists where they could share their ideas and experiences on the current trends and advancements in technical fields.

Multidisciplinary approach is appreciable to motivate engineering scholars from various areas to exchange their ideas and views which will definitely open new doors to future collaborations promoting the research and innovations among professionals as well as non-professionals worldwide.

I wish the convener and whole team of organizers of this international technical event a great success and best wishes to all the participants.

Best Regards…

Dr. Thaiyal Naayagi Ramasamy, PhD(UK), PGCert, SFHEA, SMIEEE, LMISTE
Director of Education, Associate Professor & Senior Tutor
Newcastle University in Singapore
172A Ang Mo Kio Avenue 8 #05-01
SIT@NYP Building
Singapore 567739

3rd International Conference on Recent Innovations in Engineering, Technology, Management and Research (3rd ICRIETMR-2024) on 16th-17th July 2024

Keynote – 1	**Tuesday 16th July 2024**
TIME	11:00 AM - 12 NOON
Speaker	 **Prof. (Dr.) Subramaniam Ganesan**
University	**Oakland University, Rochester, MICHIGAN (USA)**
Key Note Topic	**" Embedded AI-System and STEM education "**

Speaker Profile:-

Dr. Subramaniam Ganesan is a Professor in the Department of Electrical & Computer Engineering (ECE), Oakland University, Rochester, MI 48309, USA. He is a senior member of IEEE, was IEEE Computer Society Distinguished Visiting Speaker, IEEE Region 4 technical activities member and Fellow of ISPE. He has received the Lifetime Achievement Award from ISAM, Lloyd L. Withrow Distinguished Speaker Award from SAE, Best Paper Award from ISAM, Best Teacher award from ASEE, and similar accolade from Oakland University. He is the editor-in-chief of the International Journal of Embedded Systems & Computer Engineering, as well as the International Journal of Sensors & Applications. He has been the session organizer on "Systems Engineering" panel at the SAE World Congress for the past 15 years. More details can be viewed from home page at: www.secs.oakland.edu/~ganesan.

His research interests are in Real-Time systems, Parallel Architectures, Mobile Computing, Automotive Embedded Systems and Signal Processing. He holds several patents in embedded systems.

Abstract:-

AI is revolutionizing STEM education by making it more personalized, efficient, and effective. As we continue to explore this intersection, the potential for further advancements remains exciting!

The speech will touch upon the following key points:

1. Introduction to AI and Embedded Systems.
2. What is Embedded AI (EAI).
3. Applications of EAI.
4. The role of EAI in IOT, Edge AI, IIOT.
5. AI's role in health care and Data Science for AI.
6. Present the AI chips, algorithm development tools, and the challenges in EAI development.

The keynote concluded by emphasizing the importance of AI-system in STEM education.

3rd International Conference on Recent Innovations in Engineering, Technology, Management and Research (3rd ICRIETMR-2024) on 16th-17th July 2024

Keynote – 2	**Tuesday 16th July 2024**
TIME	02:30 PM – 03:30 PM
Speaker	 **Prof. Vibhor Sharma**
University	**University of Wales Trinity Saint David, SWANSEA (UK)**
Key Note Topic	**" Harnessing Design Thinking "**

Speaker Profile:-

Vibhor Sharma has over 13 years of experience working with Automotive Industry and as an Academician. His journey has seen him contribute significantly to various facets of automotive design and education. Currently he is working as a Senior Lecturer in Automotive and Transport Design at University of Wales Trinity Saint David, Swansea, United Kingdom. Prior to this, he held the position of Head of Transportation Design Department at MIT Institute of Design – MIT Art Design and Technology University, Pune, India. He has diverse experience of working with Mahindra and Mahindra Automotives, Hyundai and Mahindra Odyssea. His involvement in projects such as Color & Trims design for Mahindra Trucks and Buses, Design Project for Hyundai and the design of leisure boat for Mahindra Odyssea showcases his versatility and adaptability across different domains within the automotive sector. Vibhor Sharma's expertise lies in several key areas including Automotive concept designing, Human-centric design, User study and Integrating technology into design solutions. This breadth of knowledge positions him as a valuable asset capable of addressing multifaceted challenges in the automotive design landscape.Currently, his research endeavors are centered around exploring the intricacies of customization practices in personal cars, reflecting his commitment to staying at the forefront of industry trends and consumer preferences.

Abstract:-

Since more than a couple of decades, many products are being manufactured considering the users at centre of the process. With this user-centric approach, products are becoming more and more experiential objects rather than just functional. It becomes imperative to design the products considering a higher level of appeal to the consumers. In the hierarchy of consumer needs, the products which are design considering emotional aspects in mind tend to be more successful than products which are designed only for functional objectives.

As per the 3 levels of design appeal, the first impact is visual appeal followed by behavioural and reflective appeal. It means that though the behavioural or functional aspect of any product is the core element but visual and reflective aspects can enhance the success of a product and ultimately the business.

Hence, design thinking is becoming more popular in the manufacturing industry to make the products more appealing to consumers. Design thinking is a human-centred approach which understands the user needs and leads to better products, services or processes and ultimately creates a business. It is an approach to innovation that draws from the designer's toolkit to integrate the needs of people, the possibilities of technology and the requirements for business success.

There are 5 important phases in the design thinking approach -

Empathise
Define
Ideate
Prototype
Validate

Though the later stages seem similar to most of the manufacturing processes, the first two are equally important and distinguished. Defining the problem appropriately while empathising with the consumer is a critical start in the design thinking approach.

Harnessing design thinking in manufacturing leads to creating products that resonate deeply with consumers, addressing their emotional and functional needs. By prioritising user experience through a structured, human-centred approach, businesses can develop innovative products that stand out in the market, thereby achieving greater success.

3rd International Conference on Recent Innovations in Engineering, Technology, Management and Research (3rd ICRIETMR-2024) on 16th-17th July 2024

Keynote – 3	**Wednesday 17th July 2024**
TIME	10:00 AM – 11:00 AM
Speaker	 **Prof. (Dr.) Rupam Kataki**
University	**Tezpur University, ASSAM (INDIA)**
Key Note Topic	**" Biowaste derived Bioenergy & Biomaterials for a Biobased Economy "**

Speaker Profile:-

Dr. Rupam Kataki has been working as a Professor in the Department of Energy at Tezpur University. Dr. Kataki is currently serving as a Professor, Department of Energy, and is a former Head of the Department. He received his BSc and MSc from Assam Agricultural University, Jorhat and PhD from Tezpur University. Dr. Kataki has research interests in the areas, viz. thermo-chemical conversion of biomass to biofuel and biochar, utilization of agricultural, agro-industrial, and waste biomass for recovery of fuels and chemicals, C-sequestration and soil amendment through biochar application, production of biodiesel, biooil, and value-added products through a biorefinery approach from indigenous tree-borne oil yielding species of NE India, waste water remediation and heavy metal removal through use of engineered biochar, industrial uses of biochar, and ecological and economical aspects of charcoal production in traditional kilns in NE India. He has to his credit about 140 publications including four edited books, book chapters, journals publication and full length papers in conference proceedings. He has been in the editorial board of a number of journals including SCOPUS indexed, International Journal of Renewable Energy Development (IJRED). He has reviewed for as many as 33 different journals and received Top Reviewer Award from Bioresource Technology in 2017. He is a regular reviewer of research proposals of Government funding agencies like UGC, DST, DSIR and CSIR-NISTADS. He has successfully completed a number of nationally funded research projects/consultancy including an Indo-European Union collaborative research project with several European and Indian PIs, and a couple of research projects and Consultancy projects are currently undergoing. He has so far supervised seven doctoral and 42 MTech thesis. He is also a member of the Board of Studies of Assam Science and Technology University. Dr. Kataki has been a Life Member of a number of scientific societies, and member of committees of Government at national, state and district level.

Abstract:-

Biowastes like agro-wastes, agro-industrial wastes, animal droppings and urban and industrial biowaste are produced abundantly in our country. Biowastes, once considered trash, are becoming a treasure trove for a sustainable future. Through processes like thermo-chemical and biochemical conversion processes, biowastes are converted into a array of different types of biofuels and biomaterials. Among thermo-chemical conversion processes, pyrolysis offers a powerful tool for transforming biowastes into a biobased economy's building blocks. This thermochemical process heats biowastes like manure, forestry trimmings, or even sewage sludge in an oxygen-free environment. The breakdown yields three valuable products: bio-oil, a store-house of different types of chemicals and a fuel which can be further catalytically or non-catalytically upgraded to petroleum like fuels; syngas, a combustible gas mixture usable for electricity generation; and biochar, a charcoal-like substance ideal

for soil improvement, C-sequestration, GHG mitigation, waste water treatment, super-capacitor and other bioelectronics application, catalyst etc.This sustainable approach diverts waste from landfills, creates renewable energy sources, and generates valuable biomaterials for a greener future and helps achieve a biobased economy.

3rd International Conference on Recent Innovations in Engineering, Technology, Management and Research (3rd ICRIETMR-2024) on 16th-17th July 2024

Keynote – 4	**Wednesday 17th July 2024**
TIME	01:00 PM – 02:00 PM
Speaker	 **Dr. Mahendra Lalwani**
University	**Rajasthan Technical University, KOTA (INDIA)**
Key Note Topic	**" Big Data Analytics in the Domain of Power Systems "**

Speaker Profile:-

Dr. Mahendra Lalwani received his B.E. (Electronics & Power Engineering) degree from Nagpur University, Maharashtra in 2001. He received his M.Tech (Power System) and Ph.D degrees from Malaviya National Institute of Technology, Jaipur (Rajasthan). He has more than 20 years experience in teaching and research. Currently, he is working as Associate Professor in Department of Electrical Engineering at Rajasthan Technical University, Kota (Rajasthan). He has published more than 50 research papers in various National & International Journals. He has authored 3 books in different areas of electrical engineering. He has supervised more than 15 PG scholars and research scholars. He is a life member of many professional bodies like ISTE, IETE, SESI etc. His research interest includes renewable energy systems and power quality events.

Abstract:-

Power system operations bring in large chunks of data hence it is peculiarly vital to manage, analyze, visualize, integrate and process it, while traditional technology of data processing is hard to fulfill this need. In the power system, big data fundamental concepts and characterizations will be overviewed during keynote speech including big data analytics. Big data attributes, traditional data big data analytics differences, their input, types, characteristics, techniques, and outputs will be addressed. Keynote speech also covers a comparison of big data and traditional data on the basis of various parameters and big data adoption challenges are briefed with fortunes and applications.

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FRESH CONCRETE PROPERTIES OF SELF COMPACTING CONCRETE FOR VARIOUS POWDER CONTENT

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Abstract: Construction is a process all over the world which is required in every age. Due to the strength, durability, and quality of concrete, its use as a construction material has increased over time. Self-compacting concrete (SCC) is an exceptional type of concrete that compacts under its own weight and does not require a separate vibrator. Therefore, it is used in such places where the reinforcement grid is dense. The objective of this study is to prepare a better performance mix for different construction conditions keeping in mind the codal provisions. Therefore, in this study, the properties of fresh concrete have been tested by designing different grades of concrete for various powder content and mineral admixture (MA) as per compressive strength method.

Keywords: SCC, Fresh Concrete, Grades of Concrete, Powder Content.

I. INTRODUCTION

Self-Compacting Concrete (SCC) was first developed in Japan in early 1980's, in order to reach durable concrete structures. Since then, several investigations have been carried out to achieve a rational mix design for a standard concrete.

Self-compacting concrete (SCC) consists basically of the same components as normal vibrated concrete, however, to obtain the requested properties of fresh concrete, in SCC a higher proportion of ultra fine materials and the incorporation of chemical admixtures, in particularly an effective super plasticizer, are necessary. Another reason for the widespread adoption of SCC is that it helps in reducing the damage caused by vibration at the work-place. Basic principles for the production of Self-Compacting Concrete are shown in figure 1 [1].

The present process of production of self-compacting concrete is mainly based on the experience of Japan and Netherlands in empirical mix design. The mix design for production of SCC has been designed keeping in mind the compressive strength for different powder contents to ensure that the predetermined properties of fresh and hardened concrete are reached.

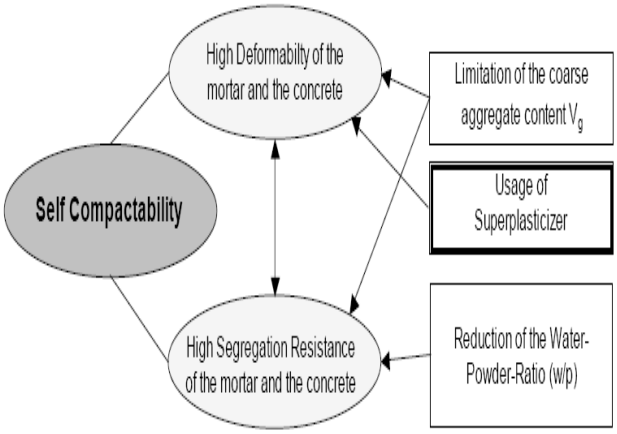

Figure 1: Basic principles for production of SCC.

II. EXPERIMENTAL INVESTIGATION

2.1 Materials

2.1.1 Cement

Ordinary Portland cement 43 grade confirming to IS 8112:1989 was used and its physical properties are given in Table 1.

Table 1: Physical properties of 43 grade OPC cement

Physical Properties	Requirement as per IS 8112	Results
Fineness (m^2/kg)	225 (minimum)	289
Soundness (Le Chatelier Method) (mm)	10 (maximum)	1
Initial setting time (minutes)	30 (minimum)	35
Final setting time (minutes)	600 (maximum)	378
Specific gravity	3.15	3.15

2.1.2 Fine Aggregate (FAgg)

Locally available river sand with 4.75 mm maximum size was used. The gradation curve is shown in figure 2.Its physical properties are given in Table 2 and river sand lie in zone – 1 as per IS 383.

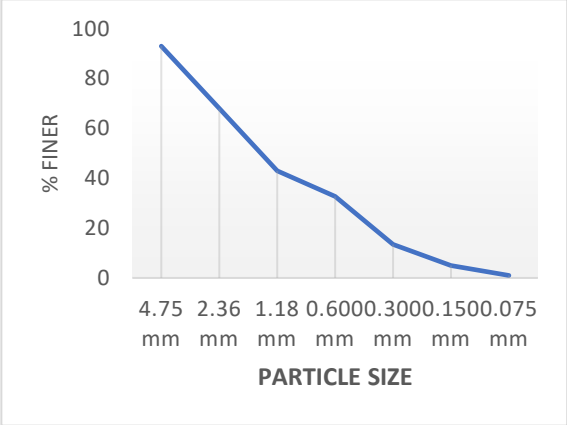

Figure 2: Gradation curve of river sand used as fine aggregate.

2.1.3. Coarse Aggregate (CAgg)

Locally available crushed stones with 12.5 mm maximum size were used. Its physical properties given in Table 2 and confirmed to IS 383.

Table 2: Physical properties of fine and coarse aggregate

Physical Properties	FAgg	CAgg
Specific Gravity	2.58	2.63
Water absorption (%)	2.04	0.5
Dry Density (kg/m^3)	1500	1580

2.1.4. Chemical admixture

Superplasticizer (SP) Melflux 2651 F used complies with IS 9103 and specific gravity of it as 1.08. Superplasticizer is used equal to 1% of the weight of cement.

2.1.5. Mineral admixture (MA)

Fly ash (FA) has been used as mineral admixture whose specific gravity was found to be 2.04.

2.1.6. Water

Water used was fresh, colorless, odorless and tasteless potable water free from organic matter of any type.

2.2 Mix Proportions

M30 and M40 grade self-compacting concrete for different powder content was designed using compressive strength based method [2]. The powder content that has been included in the design are those in which the design conditions of self-compacting concrete are satisfied [3] and the strength of the concrete does not exceed too much from their corresponding grade. The powder content was kept at 440, 470, 500, and 520 and 470, 490, 520, and 550 for M30 grade SCC and M40 grade SCC, respectively. Related data has been presented in Table 3 and Table 4 respectively. Apart from this, fly ash was used as a mineral admixture and its quantity was also kept at 25% to 50% for cement replacement [2]. While determining the mix proportion, water-cement ratio and quantity of superplasticizer were kept constant.

Table 3: Mix proportion for one cubic meter M30 grade SCC

M30 _ 25 MA								
S. No.	Powder Content (kg)	w/c ratio	Cement (kg)	MA (kg)	Cagg (kg)	FAgg (kg)	SP (1%) (kg)	Water (kg)
SCC1.	440	0.4313	296	99	673	1041	4	170
SCC2.	470		322	107	712	933	4.3	185

SCC3.	500		348	116	750	825	4.6	200
SCC4.	520		365	122	775	753	4.9	210
M30 _ 30 MA								
SCC5.	440		276	118	664	1041	4	170
SCC6.	470	0.4313	300	129	702	933	4.3	185
SCC7.	500		325	139	739	825	4.6	200
SCC8.	520		341	146	764	752	4.9	210
M30 _ 35 MA								
SCC9.	440		256	138	655	1041	4	170
SCC10.	470	0.4313	279	150	692	933	4.3	185
SCC11.	500		301	162	729	825	4.6	200
SCC12.	520		316	170	753	753	4.9	210
M30 _ 40 MA								
SCC13.	440		236	157	646	1041	4	170
SCC14.	470	0.4313	257	172	682	933	4.3	185
SCC15.	500		278	185	718	825	4.6	200
SCC16.	520		292	195	742	753	4.9	210
M30 _ 45 MA								
SCC17.	440		217	177	637	1041	4	170
SCC18.	470	0.4313	236	193	672	933	4.3	185
SCC19.	500		255	209	708	825	4.6	200
SCC20.	520		268	219	731	753	4.9	210
M30 _ 50 MA								
SCC21.	440		197	197	628	1041	4	170
SCC22.	470	0.4313	214	214	663	933	4.3	185
SCC23.	500		232	232	697	825	4.6	200
SCC24.	520		243	243	720	753	4.9	210

Table 4: Mix proportion for one cubic meter M40 grade SCC

M40 _ 25 MA								
S. No.	Powder Content (kg)	w/c ratio	Cement (kg)	MA (kg)	CAgg (kg)	FAgg (kg)	SP (1%) (kg)	Water (kg)
1.	470		319	106	735	1002	4.26	150
2.	490	0.3522	341	114	878	812	4.54	160
3.	520		362	121	786	848	4.82	170
4.	550		383	128	694	885	5.10	180
M40 _ 30 MA								
5.	470		298	128	726	1002	4.26	150
6.	490	0.3522	318	136	867	812	4.54	160
7.	520		338	145	775	848	4.82	170
8.	550		358	153	688	885	5.10	180
M40 _ 35 MA								
9.	470		277	149	716	1002	4.26	150
10.	490	0.3522	295	159	857	812	4.54	160
11.	520		314	169	764	848	4.82	170
12.	550		332	179	671	885	5.10	180
M40 _ 40 MA								
13.	470		256	170	706	1002	4.26	150
14.	490	0.3522	273	182	793	812	4.54	160

15.	520		290	193	753	848	4.82	170
16.	550		307	204	659	885	5.10	180
M40 _ 45 MA								
17.	470	0.3522	234	192	697	1002	4.26	150
18.	490		250	204	836	812	4.54	160
19.	520		265	217	742	848	4.82	170
20.	550		281	230	648	885	5.10	180
M40 _ 50 MA								
21.	470	0.3522	213	213	687	1002	4.26	150
22.	490		227	227	826	812	4.54	160
23.	520		241	241	731	848	4.82	170
24.	550		256	256	636	885	5.10	180

III. Results and Discussions

In this study, passing and filling ability of fresh self – compacting concrete were investigated for various powder content and fly ash content. The investigation was carried out according to appropriate criteria given by European standards. Box test results for M30 SCC has been shown in Table 5 and Figure 3, L – Box test results for M40 SCC has been shown in Table 6 and Figure 4.

3.1 L – Box tests

L – box test results are an indicator of the ability of concrete to pass through the bars. The result of L - box test is presented as ratio of height of concrete in horizontal section to that of vertical section.

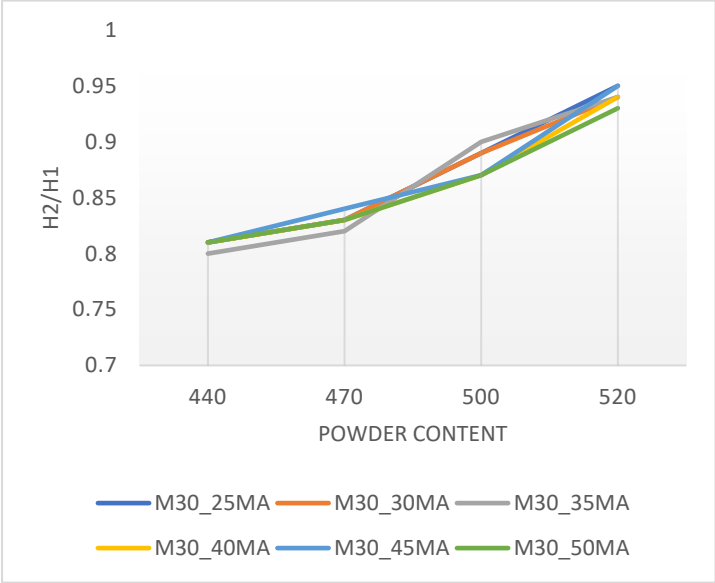

Figure 3: Graphical presentation of L – Box test results for M30 SCC.

Table 5: L – Box test results for M30 SCC

M30_25MA					
S. No.	Powder Content	w/c ratio	H1 (mm)	H2 (mm)	H2/H1
SCC1.	440	0.4313	121	98	0.81
SCC2.	470		133	110	0.83
SCC3.	500		135	120	0.89
SCC4.	520		124	117	0.95
M30_30MA					
SCC5.	440	0.4313	120	96	0.81

SCC6.	470		137	113	0.83
SCC7.	500		141	125	0.89
SCC8.	520		132	124	0.94
M30_35MA					
SCC9.	440		121	98	0.80
SCC10.	470	0.4313	137	112	0.82
SCC11.	500		139	125	0.90
SCC12.	520		131	125	0.94
M30_40MA					
SCC13.	440		124	100	0.81
SCC14.	470	0.4313	132	110	0.83
SCC15.	500		136	118	0.87
SCC16.	520		131	123	0.94
M30_45MA					
SCC17.	440		122	99	0.81
SCC18.	470	0.4313	133	112	0.84
SCC19.	500		138	119	0.87
SCC20.	520		127	121	0.95
M30_50MA					
SCC21.	440		124	101	0.81
SCC22.	470	0.4313	135	112	0.83
SCC23.	500		140	121	0.87
SCC24.	520		137	127	0.93

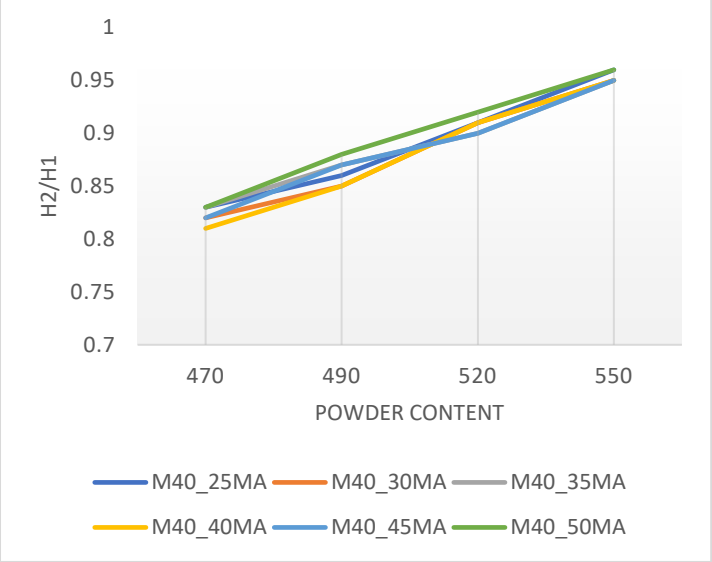

Figure 4: Graphical presentation of L – Box test results for M40 SCC.

Table 6: L – Box test results for M40 SCC

M40_25MA					
S. No.	Powder Content	w/c ratio	H1 (mm)	H2 (mm)	H2/H1
SCC1.	470	0.3522	122	101	0.83
SCC2.	490		128	110	0.86
SCC3.	520		133	121	0.91
SCC4.	550		142	135	0.96

M40_30MA					
SCC5.	470	0.3522	126	103	0.82
SCC6.	490		129	109	0.85
SCC7.	520		132	120	0.91
SCC8.	550		137	130	0.95
M40_35MA					
SCC9.	470	0.3522	121	100	0.83
SCC10.	490		129	112	0.87
SCC11.	520		127	115	0.90
SCC12.	550		137	130	0.95
M40_40MA					
SCC13.	470	0.3522	130	105	0.81
SCC14.	490		135	115	0.85
SCC15.	520		139	126	0.91
SCC16.	550		145	137	0.95
M40_45MA					
SCC17.	470	0.3522	125	102	0.82
SCC18.	490		134	116	0.87
SCC19.	520		140	126	0.90
SCC20.	550		142	135	0.95
M40_50MA					
SCC21.	470	0.3522	127	106	0.83
SCC22.	490		133	117	0.88
SCC23.	520		136	125	0.92
SCC24.	550		140	133	0.96

3.2 V – Funnel and V – Funnel T5 minutes Test

The V - funnel test is carried out to measure the filling ability (flowability), one of the aspects of the workability of self-compacting concrete. Apart from this, T5minute time will give the information about the segregation properties of self-compacting concrete. If the flow time at T5min is increased significantly, it indicates concrete segregation [4][5]. The values are shown in Table 7 and graphical represented in Figure 5 and Figure 6.

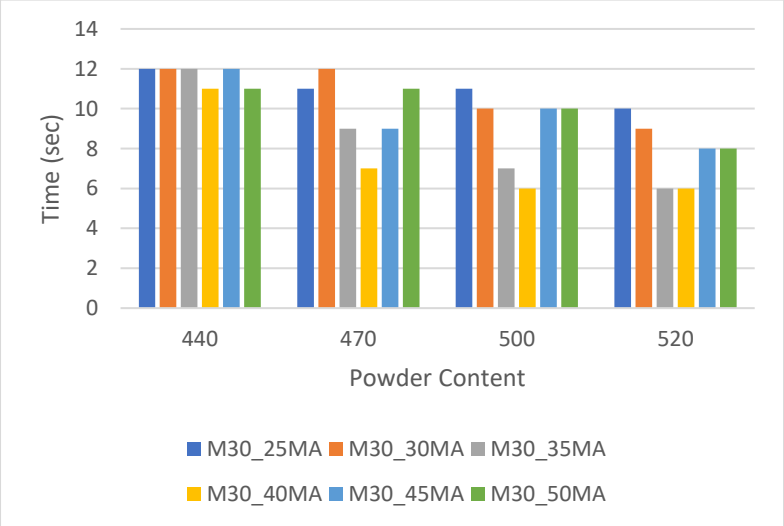

Figure 5: Graphical representation of V – funnel time for M30 SCC.

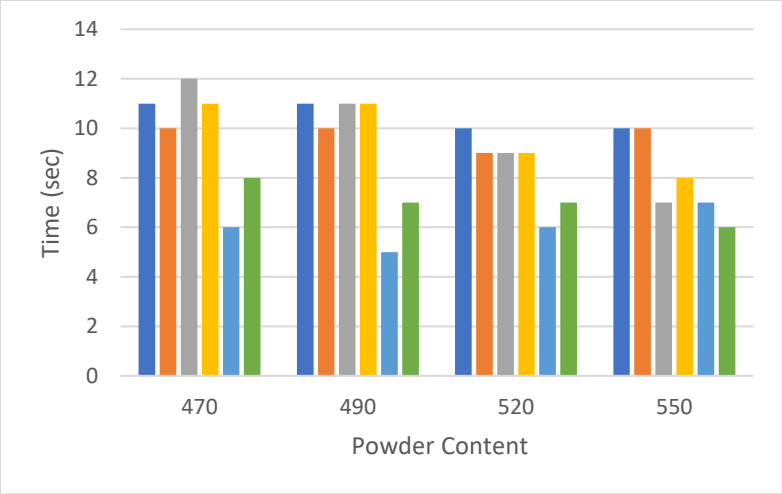

Figure 6: Graphical representation of V – funnel time for M40 SCC.

Table 7: V – Funnel test results for M30 and M40 SCC

Mix	M30			M40		
	Powder Content	V - Funnel (sec)	V - Funnel at T5minutes	Powder content	V - Funnel (sec)	V - Funnel at T5minutes
25% MA						
SCC1	440	12	19	470	11	19
SCC2	470	11	18	490	11	19
SCC3	500	11	17	520	10	18
SCC4	520	10	15	550	10	17
30% MA						
SCC5	440	12	18	470	10	17
SCC6	470	12	17	490	10	18
SCC7	500	10	15	520	9	15
SCC8	520	9	15	550	10	16
35% MA						
SCC9	440	12	19	470	12	18
SCC10	470	9	13	490	11	18
SCC11	500	7	12	520	9	15
SCC12	520	6	10	550	7	13
40% MA						
SCC13	440	11	17	470	11	17
SCC14	470	7	10	490	11	15
SCC15	500	6	11	520	9	13
SCC16	520	6	10	550	8	12
45% MA						
SCC17	440	12	17	470	6	9

SCC18	470	9	13	490	5	10
SCC19	500	10	14	520	6	11
SCC20	520	8	12	550	7	11
50% MA						
SCC21	440	11	17	470	8	12
SCC22	470	11	16	490	7	12
SCC23	500	10	15	520	7	11
SCC24	520	8	12	550	6	10

IV. Conclusion

Systematic and detailed studies have been done on many concrete mixes with different powder contents, leading to the following conclusions:

1. In both M30 and M40 grade SCC mixes shows a little bit reduction in workability, when the ratio of FAgg to TAgg is near to 0.60.
2. In workability of SCC mixes improves when quantity of FAgg and CAgg is nearly equal.
3. The results of the L-box test show that the passing ability improves with increasing powder content and the H2/H1 ratio values approach to 1.
4. Similarly, increasing the powder content improves the filling ability and also reduces the segregation of the concrete mix.
5. This investigation is preliminary and future work will address the possibilities of variations in the content of superplasticizer to conduct comprehensive investigation to obtain final conclusions.

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WIND TURBINE INTEGRATION TECHNIQUE TO CONVENTIONAL GRID: ASPECTS AND CHALLENGES

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Abstract: With the rapid development of large-scale wind power in our country, it has some negative effects on the safe operation of regional grid. There is a way to get the regional grid power integration capacity on an operating section considering limits of grid peak load regulation capacity. Then the wind turbines are able to be added to the regional grid dispatch and source schedule in one day. The increased installed wind power impact the transmission grid due to predicting production difficulty, grid capacity, the risk of untimely disconnection of wind farms and the quality electricity degradation. In order to ensure the stable operation and safe of the power grid after the large wind energy bases are connected, the operation control technology of the power grid after the large wind energy bases are connected will become more and more important. Therefore, it is necessary to study the operating characteristics and control strategies of large wind energy specific problems of power grids connected to wind power grids. The technical conditions for wind farms grid connected operation study, the impact of large wind energy, stability modes, and the control measures are included. This paper also proved the new strategy has effective control strategy to improve the access capacity of wind power and reduce the operating costs. Research results have demonstrated the wind farms composed of DFIG, control the power flow of the grid and a good performance at the level of voltage and frequency stability.

Keywords: Wind Power Integration Capacity, Economy Dispatch, Operation Characteristic, Control Strategies, Doubly Fed Induction Generator, Static Integration.

I. INTRODUCTION

Wind power has the characteristics of randomness and intermittent, and there is no way to realize its power arrangement and control like other conventional energy [1]. Large-scale and concentrated development of wind power will have a negative effect on the safe operation and power arrangement in the local power grid as well as larger regional power grid . Our power structure is mainly based on coal, the peak regulation means already limited. Along with large-scale and concentrated development of wind power, grid scheduling becomes more difficult. Wind resources and network resources are two premise elements of the development of wind power. Receiving, transmission and distribution of grid is essential for the large-scale and concentrated development of wind power. For intensive development of wind farms, large-scale wind farms are all through 11 kV lines directly into the system. According to the actual operation of grid this year, low-peak load regulation difficulty is the main reason for outage of wind turbine [4]. At

present and in the future, the power peaking is the main problems restricting wind power integration.

Wind turbine integrated to power grid without taking in to account its constraints impact the flow of active and reactive energy. Thus the constraints of integration and isolation of wind turbines must be studied for better control of the energy flow in the grid. [2]. The results[3]show that the integration of wind farm with a cascade STATCOM can solve the issue of grid stability, by improving grid smoothness, making full use of wind energy resources and improving economic productivity. Due to the development of wind turbines, it can now operate like to production plant based on fuel [3], and are able to generate active and reactive power based on decoupled method. A study shows that by utilizing the measured electric data such as bus voltage phasors, line parameters and according to the voltage quadratic equations of power flow used. Wind power produce peak output power and leads to reduced voltage regulation capability of the feeder, which may lead to voltage collapse without sufficient reactive power support.

Frequency stability is also important when the DFIG is integrated to the grid. Researchers [4] shows that voltage, current and frequency deviation between the wind system and the grid impact its stability and can cause an imbalance during synchronization of the wind farm. Indeed [5], the proposed architecture contributes to frequency regulation by developing a time to time strategy which starts from using droop controller-based Induction generator to converter based Double-fed Induction generator. Another result show that a new control system based on reduction model can offer a better result to regulate t voltage, current and frequency in case of default [7].

II. Electricity Generation by Wind Turbine

Wind power has characteristics of great randomness and intermittent, large-scale wind farm will have a serious negative impact on grid, so it is necessary for a specific grid to determine its maximum wind power capacity [6]. Wind power capacity of grid can be accepted in the field of power system planning and operation scheduling. In the field of grid operation control scheduling, wind power capacity index of grid is the largest power injection of grid-connected wind farm, which is the maximum active power of grid-connected wind farm injected to the grid.

There are many factors that can affect wind power capacity of grid, including grid factors and wind power.

For a known non-wind-electric power system at a certain time, it is required to determine the maximum wind power capacity based on the system power supply plan, real-time load, wind power volatility and reliability index of power generation [7]. Taking the power balance as the constraint condition, the wind power capacity depends on the regulation capacity of the conventional energy sources and the load condition of the system. Common conventional power plants are coal-fired power plant, thermal power plant, hydropower station, pumped storage power station, nuclear power plant, etc. According to the load capacity from large to small order, the sorting result is: pumped storage power station, hydropower station, coal-fired power plant, thermal power plant. The probability that output change rate of wind farm group is 0%~1.5% every minute is 99%, output adjustment rate of current domestic thermal power plant is 3-5% per minute, the peak rate of conventional thermal power units can catch up required conditions by wind farm [8]. Figure 1 shows the control strategy developed.

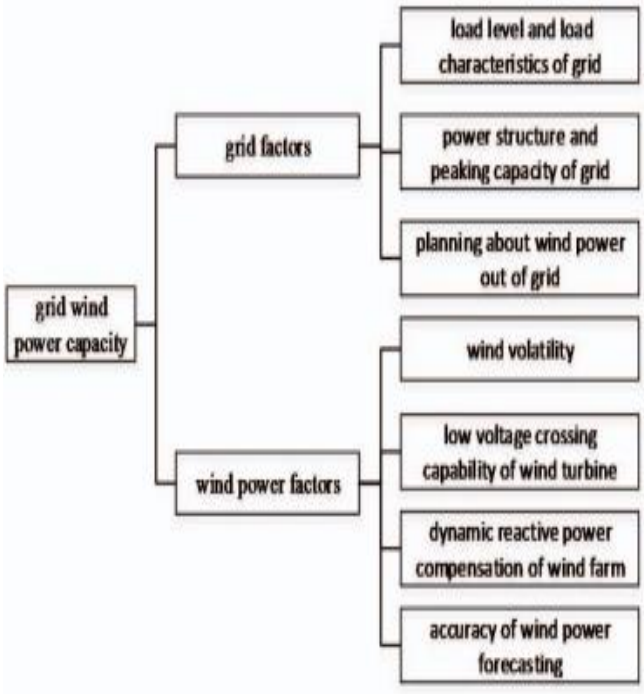

Figure 1: Wind power Potential scenario.

III. Control Strategy of Wind Farm on the Grid

In this control mode, the inverter control that has been created allows you to set at the connection node of the energy reducer the active and reactive power of set point. The order of the inverter is generated by a current regulation loop. Active powers and reactive are fixed via the currents produced by means of a control adapted to the primary source and the inverter of the voltage. So, the active and reactive power in the point of insertion of energy generators are controlled while respecting the limits of the system [9]. The various components of control scheme are shown in Figure 2 which indicates different kind of functions for proper power flow management of the system.

The active and reactive power flow control in the whole system consists of wind power plant connected to fossil fuel based grid.

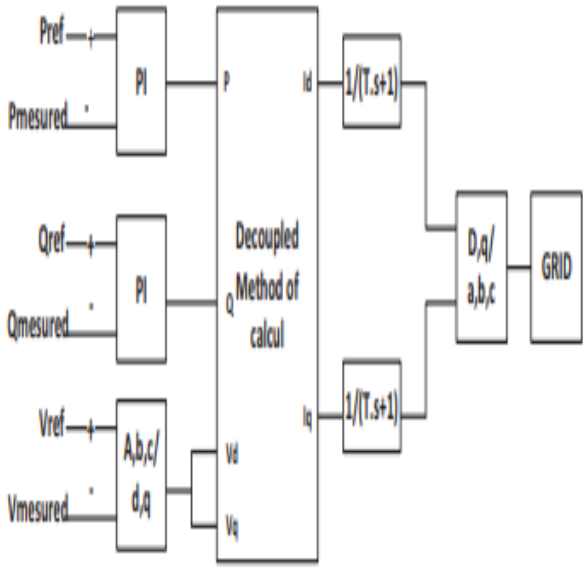

Figure 2: Control strategy of active and reactive power.

IV. Strategy of Integration of Wind Farm on the Grid

Wind farm energy becomes the most way of electrical generation as a renewable source; it becomes the future source of electricity production. With the high rate of penetration of the wind power, it becomes very difficult to integrate this source of energy in power systems efficiently and safely. The problem is these wind turbines based on induction generators, tend to inject large amounts of reactive power to the grid, potentially causing voltage stability problems for the grid operator, especially in the case of large load variation on distribution node. The increasingly high wind power penetration makes it necessary to use appropriate models and algorithms to integrate wind farms, assess the impact on the electricity grid, and improve the integration method by limiting grid injection constraints and isolation constraints and electrical system planning. As a result, the forecast of wind generation has become an important issue [10].

At present, the active power control mode of regional interconnected power grid in our country belongs to the second level dispatching system: the frequency deviation control of the tie line is usually adopted in each provincial control area, to maintain the local balance of active power in the control area of the province; straightening unit of regional power dispatching and communication center is usually assumed to be modulated by frequency modulation or by the adjustment of schedule curve, and it also takes on specific control tasks. Active power local balance control of provincial power grid requirements that the provincial network has a certain regulatory resources, when the province network accessing a large number of wind power, it is necessary to improve the control method [11] of the dispatching operation to the maximum degree of acceptance of wind power generation.

Based on specific mathematical equation of wind turbine system the simulink model is designed [11] as in Figure 3 using MATLAB.

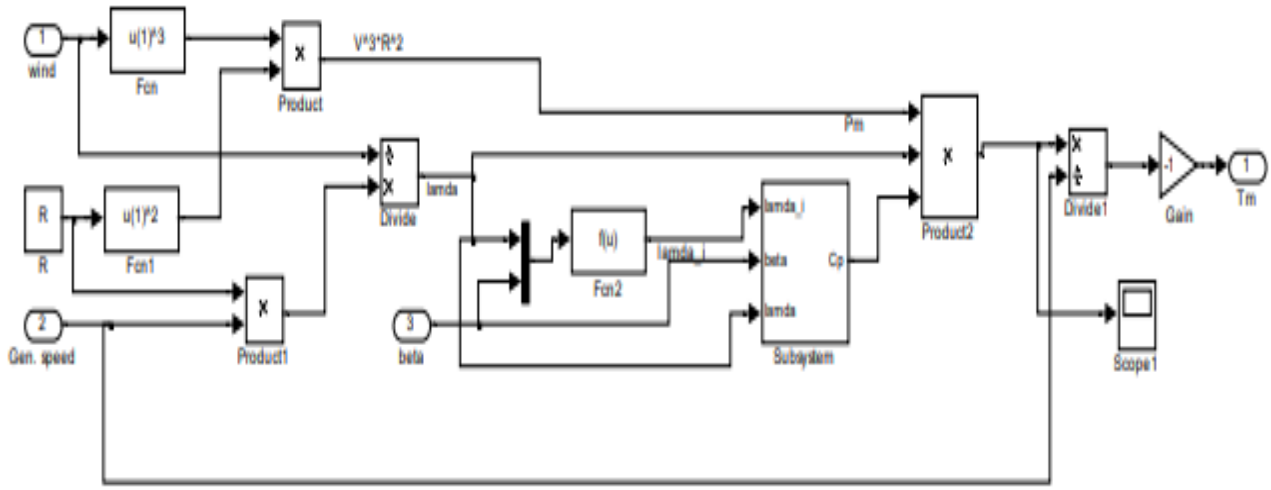

Figure 3: Simulink Model of Wind Power Plant.

IV. Proposed Design

Three phase 11 KV power generation system is designed in MATLAB connected to wind power electricity generation plant as shown in Figure 4 and the resulting simulation waveforms of voltage and current are shown in Figure 5. Three phase line to ground fault is created [12] in the grid line for a specific time of 0.2 seconds and the model is simulated. The resulting waveform is shown in Figure 6. The values of grid voltage and current under faulty condition are presented in Table 1 and compared with the values under normal condition of operation are presented in Figure 5. Three phase line to ground fault is created in the line and the model is simulated [13]. The resulting waveform is shown in Figure 6.

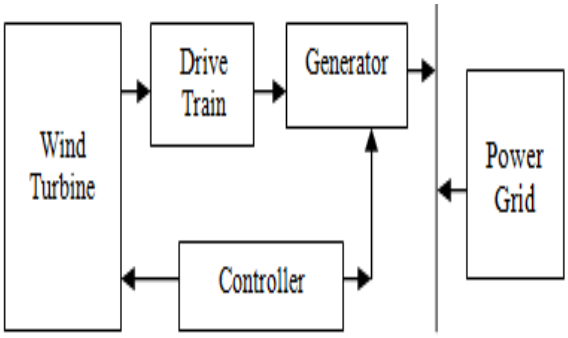

Figure 4: Wind Power Plant Integrated to Conventional Grid.

The values of grid voltage and current under faulty condition are presented in Table 1 and compared with the values under normal condition of operation. Conditions are presented in Table 1 and compared with the values under normal condition of operation in Figure 5. Three phase line to ground fault is created [14] in the line and the model is simulated. The resulting waveform is shown in Figure 6. The values of grid voltage and current under faulty condition are presented in Table 1 and compared with the values under normal condition of operation.

V. Results and Discussion

Three phase line to ground fault is created for 0.3 ms time in proposed 11 KV three phase generation systems connected to wind power plant connected to grid. Waveforms of voltage and current during healthy condition of power generation at three phase level is represented by Figure 5, whereas waveforms of voltage and current under fault condition are shown in Figure 6. Grid parameters in terms of voltage and current in healthy and faulty condition with and without wind power plant are tabulated in Table 1, which represents considerable improvement in the voltage and current when the grid is connected to wind power plant.

During fault from 0.1ms to 0.3ms the short circuit voltage increased and short circuit current is reduced with considerable amount in presence of wind power plant as compared to parameters without fuel cell plant. During fault from 0.1ms to0.3 ms the short circuit voltage increased and short circuit current is reduced with considerable amount in presence of wind power plant as compared to parameters without fuel cell plant.

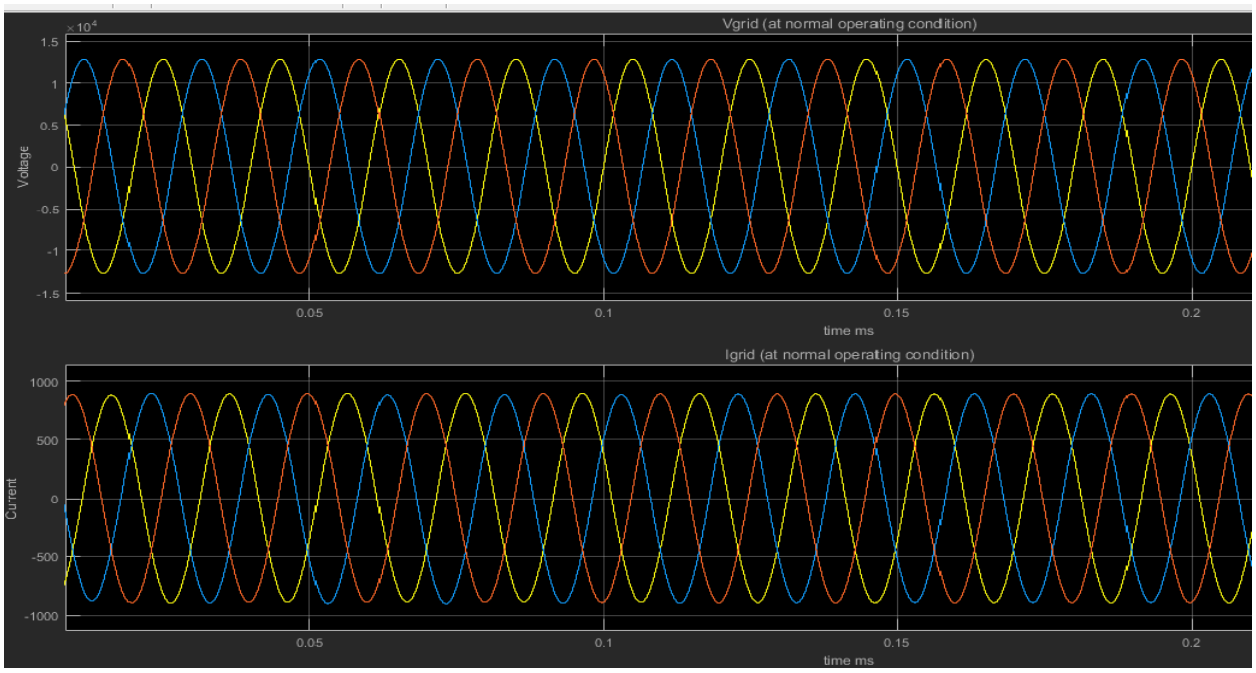

Figure 5: Three Phase Voltage and Current Waveforms.

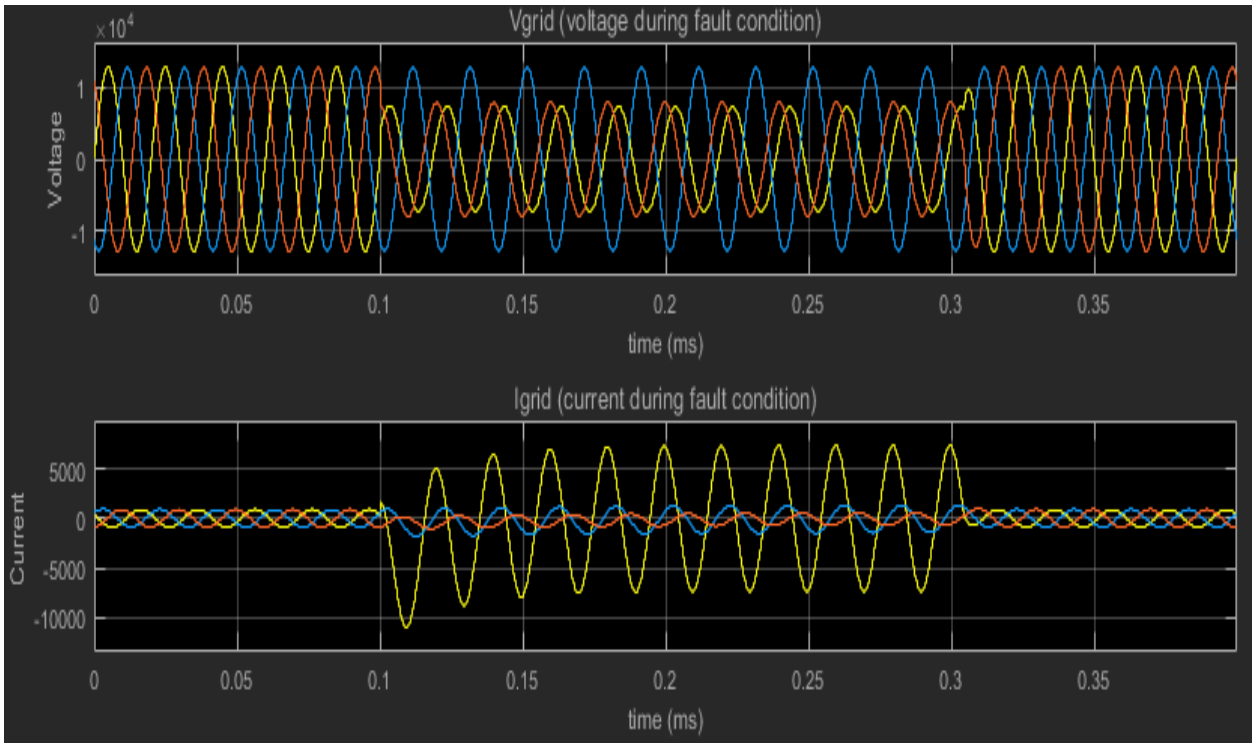

Figure 6: Fuel Cell connected Grid Voltage and Current Waveforms under Fault condition.

The value of voltage and current obtained at grid during healthy and faulty conditions with and without wind power plant are shown in Table 1.The overall voltage and current values are improved as the fault current is reduced and fault voltage is increased with integration of wind power plant to the grid.

Table 1: The Comparative study of voltage and current values at different operating conditions

Grid Voltage and Current	Not integrated with fuel cell plant	Integrated with fuel cell plant
Voltage at healthy condition	11.0 KV	11.31 KV
Current at healthy condition	600.9 A	589.2 A
Voltage at Faulty condition	6.326 KV	6.829 KV
Current at faulty condition	3746.23 A	3715.2 A

VI. CONCLUSION

The work presented in this paper a new active power control strategy based on grid connected wind power capacity. Economization of waste wind power is realized in the dispatch scheduling model is presented. The power grid wind power capacity takes power supply structure of regional power grid into consideration. We can achieve the optimal consumption of wind power by power grid in the day, through solving the optimization model. The development of research on control strategies for large wind energy bases needs to closely integrate the actual needs of large wind energy bases connected to the power grid, solve practical problems encountered in wind power connect to the power grid and improve the power grid stability. The double fed induction generator can be used to control voltage and frequency regulation by regulating voltage in node and controlling active and reactive energy in power grid. It offer many advantages on power grid such as voltage regulation in node which is a cheaper solution than the conventional power plant and it can participate to grid stability by injecting the reactive power based on the decoupled regulation. Three phase 11 KV power generation system is designed in MATLAB connected to wind power electricity generation plant. Results obtained verify the validity of proposed system.

ACKNOWLEDGMENT

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APPLICATION OF KEY TECHNIQUES OF INDUSTRY 4.0 ON HOLISTIC SUPPLY CHAIN MANAGEMENT: A SYSTEMATIC REVIEW

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Abstract: Backing the industrial development through information technology is not new, but empowering the industrial revolution through the advanced technology trends such as Internet of Things (IoT), Cloud Computing (CC), Big Data (BD), advanced Communication Technologies (5G and 6G), Cyber Security etc. had driven 4th Generation of Industries referred as Industry 4.0.The intelligent industrialdevelopmentis backed with intelligent product development, flexibility in production, short lead time production, better and improved quality product development, etc., which enable the competitive capacities in the industries for sustainability. Followed with the development of intelligent product manufacturing, industries successively developed intelligent supply chain system through integrated supply chain objects which can able to sense and act according to the market requirement in technology enabled smart environment. This intelligent supply chain helps to overcome several challenges associated with the manufacturing companies in Industry 4.0. So, that Industry 4.0 application on holistic SCM integration had drawn significant attention of researchers from both academic and industry for critically evaluating the factor that can drive supply chain performance and organizational performance in totality. In order to comprehend the Supply Chain objects integration in context to Industry 4.0 applications, this paper presents the extensive literature on Industry 4.0 and Supply Chain Integration, and associated topics. The paper discusses the research works done in this regard around the Globe incorporating various levels of integration of SCM with Industry 4.0.

Keywords: Industrial Development, Supply Chain Management, Industry 4.0, Organization and Supply Chain Performance, Technology Advancement.

I. INTRODUCTION

Industrial revolution backed with the advanced technology platforms and applications had driven the market significantly by pushing industries for vertical and horizontal integration of digitalization for multi-dimensional growth and resulting into the advent of fourth Industrial Revolution-Industry 4.0 (Piccarozzi, Aquilani & Gatti, 2018; Salam, 2019). Principally, Industry 4.0, German Initiative is aimed to upgrade the manufacturing processes through several technologically rich intelligent systems and make the system intelligent in all the aspects. In this generation intelligent manufacturing processes are under transformation through Internet of Things, Cloud Computing, Big Data, Cyber Systems etc (Lee et al., 2015; Lasi et al., 2014). Primarily, Industry 4.0 is based on horizontal and vertical integration of different systems related to manufacturing settled on background

of real-time data transactions, flexible manufacturing, safe data transmission, and customized product development, block or batch processing etc for advanced customized production (Thoben et al.,2017; Li et al.,2017). Other than the horizontal and vertical integration of manufacturing system (Alcacer & Cruz-Machado, 2019), Industry 4.0 projects are also driven through peer-to-peer digital integration (Bag et al., 2018).

Industry 4.0 enabled industries have the capacity to regulate all the physical processes through digital twinning of the smart and technologically enabled real-time systems of the physical world and integrated environment of human, machines, sensors and others (Wang et al., 2016).This digital twinning integrates the embedded technologies of the manufacturing systems with the technologically rich and intelligent manufacturing processes to direct the path for technology enabled intelligent manufacturing which have the capacity of transforming the business value chains, supply chains, manufacturing value chains, and trading models. Such transformation results into significant advantages in manufacturing processes through intelligent production and consequentially this is inevitably generating the demand for the comprehensive integration of all the business process including supply chain (Rashid & Tjahjono, 2016). This transformation through effective integration of systems for resulting into intelligent system lead into greater profitability, optimized cost, need specific customization, intelligent customer support, improved supply chain followed with holistic control over all the processes intelligently. Intelligent product development and supported processes particularly supply chain relies on real-time information system and technologies to attain flexibility and smartness in the processes to address the dynamicity of the market (Shen & Norrie, 1999).

Industry 4.0 concept model make sure that all the business processes followed with the related information flows should be available all the time during the holistic industrial process when it is required especially during the supply chains, cross industry manufacturing and supplies, and channeling of the information throughout the different intelligent platforms (Wan et al., 2017; Wang et al., 2016).In order to attain the unrespectable transformations in each facet of the business process substantial amount of investment and significant time for effective planning is needful. In view of the fact that several companies want to draw the competitive benefits over others and want to be on the top, aggressively intelligent advanced methodologies are required to be incorporated in each dimension of the business processes and allied supply chain operations (Swift et al., 2017).Multi-dimensional development of the intelligent production and supply chain needs several supporting technologies and platforms for the different business processes and business needs to enable the optimality in decision making particularly based on previous datasets of experience and business capacities (McFarlane et al., 2003).

Supply Chain Management (SCM) defines the extent of the collaborative association and commitment for the high degree information transfer of the organization with its customer, suppliers, distributors or the supply chain partners (Huang and Huang, 2019). The principal objective of the SCM is to manage distribution channel partners for effective and efficient distribution of supplies of product, information and finance for prompt service and delivery of the product (Flynn et al., 2010; Zhang et al., 2015). In Industry 4.0 where the role of intelligent system is to advance the manufacturing process followed with the supply chain as value chain, the role of SCM become imperative to study as technologically backed SCM would not be limited up to premeditated configuration of functions and processes but also stretched till managing the flow of information associated with organization growth from several technological means to draw the optimum competitive advantage (Chen et al., 2009; Kumar et al., 2017). Other dimension of this competitive advantage is integrated cross-functional system of all the supply chain processes and activities concerned with the stakeholders of the SCM (Bruque et al., 2015). Such integration of the functional and operational processes and activities of SCM with its channel partners can ensure timely flow of the information intelligently through several technological means and result into full exploitation of the potential benefits of the process (Fabbe-Costes & Jahre, 2008; Naslund & Hulthen, 2012). For the intelligent system conceptualization flow of organizational and supply chain information followed with the infrastructural, physical, and financial, market related etc. should be integrated with the SCM (Rai et al., 2006).

Technology enabled direct communication channel in manufacturing and supply chain system, helps to make the flexible and optimal decisions for the business processes in timely manner. Some such technologies such as Artificial Intelligence (AI), Neural Networks and Robotics, helps to develop a collectively intelligent system which can work on basis of their precious experience and past data. Same concept of developing the intelligent systems for the manufacturing as well as supply chain can be developed through integrating the block chain, cloud computing, IoT, Machine Learning, Deep Learning, Data Analytics etc.So, Industry 4.0 enabled supply chain management like the other manufacturing processes also needs continuous integration of technological developments (Rahman et al., 2020). The principal objective of Industry 4.0 for the organizational perspectives can only be attained when deeper transformation of all the business process aspects is ensured either related with manufacturing and supply chain or not, followed with workforce and infrastructure (Ku et al., 2020).

In order to understand the more detailed and comprehensive outlook of the Industry 4.0 and its application for SCM detailed theoretical framework is required. This theoretical base of the Industry 4.0 and SCM will help the researcher and practitioners from the academia and industry to understand the major issues to be taken into consideration and practices for the advancement of the intelligent system driven value chain for future. So, this Systematic Literature Review (SLR) paper will help to establish the significance of the Industry 4.0 applications for the SCM. The presentation of the SLR is directed through following research questions:

Explore the Industry 4.0 applications in the Supply Chain Management.

Explore the research outlook for the Industry 4.0 and Supply Chain Management with the future directions.

For more detailed insight into the Industry 4.0 and its application in the holistic SCM integration followed with the intelligent manufacturing value chain, this literature review paper incorporates 152 papers of related subject area and scope.

II. RESEARCH METHODS

SLR method of presenting the review in systematic order was followed for presenting the review over Industry 4.0 applications for the SCM in this paper which incorporates five different steps proposed by Denyer and Tranfield (2009). Proposed five steps which need to be followed sequentially are: (a) Defining the Research Question(s), (b) Identifying the Relevant Studies from Scholarly Databases, (c) Selecting and Evaluating the Relevant Research Studies, (d) Analysis and Synthesis of the Studies, and (e) Result Presentation and Discussion of Findings of Review. This sequential process helps to synthesize the available studies pertaining to the study area, which provides scientific knowledge to researchers to strengthen practices and knowledge base of the subject area. Empirical and theoretical support to the SLR method is given by many researchers, so that SLR technique is used to present the appropriate results through offering distinct and unequivocal summary of studies related to Industry 4.0 intelligent application for SCM which will lead into identifying several gaps pertained to the study area.

Defining the Research Question(s): This step relates identifying the research questions to be answered through the research work (Seuring & Muller, 2008; Denyer & Tranfield, 2009; Scheidegger et al., 2018).

Identifying the Relevant Studies from Scholarly Databases: This step is related with finding the relevant databases of the scholarly works followed with the identifying the basis keywords that should be the part of the prior studies. For the present research work well reputed academic databases namely Scopus, Academia, ResearchGate are used. Major syntaxes used for search purpose were Industry 4.0, SCM, SCI, Industry 4.0integration or application with SCM, Intelligent System, and Value Chains etc.

Selecting and Evaluating the Relevant Research Studies: On the basis of the primary search based on the syntaxes a good number (213 research papers) of research works were found from the scholarly database. After reviewing the abstract, methodology followed, conclusion draw, and practical implications etc of the paper specifically, 152 research works were finalized to be incorporated in this literature paper. So, after exclusion of the several papers total relevant papers relating Industry 4.0 applications with SCM the relevance percentage was found 71.36%.

Analysis and Synthesis of the Studies: Studies are evaluated on basis of Dimensions Covered, Operational Scope and Variables (Rai et al., 2006; Fabbe-Costes and Jahre, 2008). On the basis of the grouping criterion erstwhile literature over the Industry 4.0 applications

with SCM lead into conceptualize theoretical framework.

Result Presentation and Discussion of Findings of Review: In this step results are presented on the basis of the Dimensions Covered, Operational Scope and Variables. This step will also incorporate all the major conclusions drawn from the detailed review work done over Industry 4.0 and it application with SCM.

III. KEY NOTIONS

Manufacturing sector of any nation is the backbone of the national economy and have the significant capacity to drive all the economic variables and can also influence the citizens' livelihood. Hence, any of the transformative changes in any of the dimension or facet of the manufacturing industry either political, economical, technological etc. can significantly affect the business models, approaches, concepts and can lead into complexity for sustainability particularly when complexity is driven by the technological aspects. Lack of adaptability for any such changes may significantly affect the business operations and competitive stake benefits over the rivalries (Luthra & Mangla, 2018). The need to be adapted with the technological advancement is produced through the innovations happening due to generation changes, evolving market conditions and consumer expectation from the market, so, confronting the aspects of managing the new technologies integration with conventional organizational processes results into complexities for the businesses. As, integrating the new technologies with the business process from manufacturing to supply chain offer versatility, responsiveness, and competitive benefits to the business through intelligent system, so it seems inevitable (Oberg & Graham, 2016). Technological adaptability is seen as the powerful tactical tool to ensure the sustainable efficiency and matching the radical changes at all the levels (Chavez et al., 2017). Fourth Industrial Revaluation (4 IR) seek for aggressive technological transformation to be done in all the processes of the business to make them intelligent and for this extensively developed methodological processes are followed particularly when integration of recent technologies such as Robotics, AI, Neural Networks, Analytics, Big Data, IoT, Block chain etc are integrated is to be done (Uchechi et al., 2020).

A. Industry 4.0 Key Techniques:

Industry 4.0 is the basic of the exponential transformational processes happening in the industries and allied business value chains which is somehow related with the technological evolution. From the first Industrial revolution of 18th Century, several mechanical, electrical, technological and other industry specific happened in the successive years. From the implementation of the scientific management practices and theories in later 18th Century, manufacturing industries started observing the acceleration in the production, supplies and other business value chain and that was the 2nd Generation of Industrial Revolution. The major transformation observed in this generation was related to the batch and bulk production in manufacturing units. From the 3rd Industrial revolution integration of the new technologies in manufacturing, packaging, supplying, office works etc conceptualized, which was driving the customized and timely completion of the business processes and more specifically regulating the updated timeliness in the business processes (Machesa et al. 2020).

In the 4th Industrial Revolution which is still the focal point of the several researchers and had gained the global attention because of growth in the technological dimensions pertained to the Industrial value chains and technologically enabled intelligent system. This generation revolution in the industries is not just related with enabling proficiencies in the business processes but also related with the ability to make the organizations smart and intelligent, in all the aspects followed with the ease in moving products through intelligent supply chains and logistics where the flow of information can be regulated smartly all through the participants and system of supply chain (Baur & Wee, 2015).Advanced ICT tools and methods of communications are critically enabling the interactivity, responsiveness, timeliness and simultaneous transferability of the information through the different nodes of the value chain (Chopra & Meindl, 2014) and such advancements plays vital role in SCM (Apiyo & Kiarie, 2018).For the exploratory study related to the technology integration in the business processes of the organization to improve the intelligence and smartness in the methods there is absolute need of dwelling the exposition of the advanced technologies which can lead into improved and smart business practices and smart supply chain performance. Industry 4.0 industrial occupational environment embraces industry based high-tech

innovations through integrating the technically rich smart machines and advanced communication technologies in the different process and value chains of the business/ industry. It is notable that for the higher complex process systems and business value chains a concrete and technically concrete framework is to be implemented for system transformation (Handley, 2000). It is not easy to integrate the Industry 4.0 technologies with the complex business processes and supply chain as it seek for the sophistication in organizing and harmonizing all the interconnected supply chain components, and particularly in context to the technology integration complex procedure of implementation with cost factors is imperative (Oberg & Graham, 2016).

Zhang (2015) expressed that the SCM is one very imperative factor that can overall affect the performance of smart and intelligent manufacturing as an application of Industry 4.0. For streamlined supplies from manufacturer to the supplier and from supplier to the end consumer there is absolute need of integrating the smart and advanced technologies in the manufacturing and supply chains. The smart SC can manage the inputs for manufacturing, multi functioning of the production, customizability of the goods, deliver of the goods, and responsiveness of the SC network. In this review paper under the background of Industry 4.0 intelligent applications for SCM few major advanced technologies were reviewed namely Cloud Computing, Big Data, 3D Printing, Machine Learning & Artificial Intelligence, Internet of Things, Cyber Systems, and Automated Guided Vehicles & Unnamed Aerial Vehicles.

A.1: Cloud Computing:

Cloud computing refers by offering the computational techniques and services through different visualized and versatile resources over the Internet (Xu, 2012; Armbrust et al., 2010). This integrated global technology platform is having the capacity to perform high computing with massive storage capacity, and that offers the organizations to expand their data-based activities effectively over different platforms (Mitra et al., 2017). For the intelligent SC the cloud computing is very helpful as it can help to process the historical data promptly and help in making the decision for value chains. The versatility of computational resources makes cloud computing fascinating for entrepreneurs, as it permits businesses to begin with small capacity resources and further allows integrating advanced resources as additional resources for any additional help request (Zhang et al., 2010). The Cloud architecture is made out of public, private, community, and hybrid and followed the three different delivery conveyance models namely SaaS, PaaS, and IaaS (Mell & Grance). Business organizations of various types and scales are taking on distributed computing to expand their computational ability without putting additional financial resources for licensed software copy, integrating new technology framework, and training of the work force (Saxena & Pushkar, 2016). Despite the benefits offered by the cloud computing there are several significant concerns related to the cloud computing reliability are:

Ongoing Technological Transformations and Concept evolution Concern (Tan & Ai, 2011).

Data Protection, Privacy and Security Concern (Chaves et at., 2011; Hajivali et al., 2013; Banyal et al., 2013).

Data Management and Resource Allocation Concern (Maguluri et al. 2012; Abu et al., 2013).

Data and Process Load Balancing (Randles et al., 2010; Nuaimi et al., 2012).

Adaptability and Accessibility Concern (Moreno-Vozmediano et al., 2013).

Cloud Compatibility and Migration Concern (Moreno-Vozmediano et al., 2013).

Interoperability and Exchange between Clouds (Chauhan & Babar, 2011;Khajeh-Hosseini, 2010).

Even after several reliability concerns the benefits which can be drawn in organizational context integrating the Cloud Computing with the business processes and value chain is strongly recommended. In this context Branger & Pang (2015) mentioned that cloud computing enabled manufacturing and supply chain can offer intelligent decision making to all the processes and value chains and can be identified as the effective model and driver variable for observing the shift towards the 4th Industrial Revaluation. Xu & Feng (2018) expressed that cloud computing technology can smooth the data sharing and exchanges between the system participants or components capably, in this manner can help in advancing the decision making for the complex business and supply chain processes.

A.2: Big Data:

With an antagonistic drive for the application of the Internet and related technology advancements, datasets and information packets are turning out to be an ever

increasing number of available and omnipresent in numerous businesses, bringing the issue of enormous information or Big Data (Manyika et al., 2011). Big Data analytics is global digital trend in which useful decision is taken through several analytical techniques to facilitate the data-driven decision making from the enormous amount of data. The set of enormous amounts of data is produced through recording the several operational and functional activities happening in different business areas, channels, intelligent devices, log documents, sensory and automatic devices, web interactions, online applications etc (Rich, S., 2017). As a result of recording all the operational functional activities of all business processes result into gradual development of the Big Data through staking of information bit by bit. Integration of IoT with the business applications had smoothen the collection of Data, and also helped to process the information properly when system needs the right set of information at the right time, so timeliness and promptness of the information can be ensured (Lee et al., 2013). For advanced decision making over the Big Data there is utter need of having the greater Data Analytic software (Barton & Court, 2012), with the application of Big Data analytics as mentioned by the researchers of academia retailers had achieved 15%-20% on their return on investment (Perrey et al., 2013). In many businesses, working over the customer relationship management data through data analytics can help to improve the customer loyalty and satisfaction (Fosso-Wamba et al., 2015), as data analytics can help to measure the customer need trend. Moreover, a more profound investigation of different information sets from machines and cycles can lead to understand the efficiency and intensity of organizations (Lee et al., 2014) more effectively and rationally. By handling large information, a producer can find critical parameters that greatly can affect quality or yield variability (Brown et al., 2011). Some of the typical applications of Big Data Analytics from different sector are performed: for improving search and ad-serving algorithms (Davenport, T.H., 2012), for assessing the mechanical health of the engine (Lee et al., 2014), for reducing the flaws in the processes (Brown et al., 2011), for improving the patient outcomes (Wang et al., 2016), for ensuring the number of returns (Armes & Refern, 2013), etc. So, Big Data analytics in the literature has been recognized as a technological advancement which can help in making the optimal decisions over the voluminous amount of dataset and with the technology large dataset can be accumulated and can be used timely. There is no uncertainty for Big Data analytics applications and usability which can lead the business process towards optimality in all the aspects such as capacity, enhanced customer services, enriching the value chain experience, development of new supply chain models, ensured return of investment, eliminating risk in a system etc.

A.3: Internet of Things:

IoT is the interconnected objects over the internet platform for easy communication and sharing of data with each other, the objects can the hardware as well as software too. In other term IoT refers the interconnection between different computer systems services in which different physical objects are implanted with electronic sensors, actuators, or other advanced digital gadgets so they can be arranged and associated for sharing of resources and information (Xia et al., 2012). As a general rule, IoT can offer high level network of physical objects, frameworks, and system administrations, empowering inter-communication to intra-communication and information sharing between the networks. The IoT is currently imagined as a bigger combination of state of the technological art innovations, for example, omnipresent remote/ wireless standards, AI & ML, Robotics and data analytics over Big Data (Xu et al., 2014). This infers that countless customary manufacturing and supply chains are significantly affecting by the different technological means of IoT innovation, as it is being implanted into several day-to-day routine activities also. RFID gives one such model, it has been accounted for that almost 20.8 billion gadgets have been inter connected and really taking advantage of RFID technology by 2020 (Lund et al., 2014). Such a shift will impact the vast majority of industry, and particularly manufacturing and its value chains namely Supply Chain. RFID has been utilized for recognizing different items in stockrooms, shop floors, logistics and distribution organizations, retailers, and disposal/reuse stages (Wang et al., 2010). After recognizable proof, such items have savvy detecting capacities so they can interface and cooperate with one another through unambiguous types of interconnectivities, which might create a voluminous amount of information from their developments or detecting ways of behaving. The interconnectivity

between intelligent items is predefined; such articles are given explicit applications or logics, for example, in the production process or systems they trail behind being furnished with RFID tags (Guo et al., 2015). So, IoT with different types of interconnected technological advances have been broadly utilized in industry for appraising their functional and operational benefits. Some typical applications of the IoT are:

For value-added services such as social watch and pervasive healthcare (Li et al., 2011).

Sharing of data or information developers, push for open and dynamic resources provisioning (Gubbi et al., 2013).

Quality life improvement followed with the determination of societal impacts (Whitmore et al., 2015).

Cross platform connection and easing the interpretation of sensory data (Gyrard et al., 2015).

Improving energy efficiency, managing the traffic congestion, in totality driving the development of urban IoT (Zanella et al., 2014).

Improved data transmission, and helping the telecom operators for data transmission (Zhu et al, 2010).

Improved collaborative work and productivity of the stakeholders (Patel & Cassou, 2015).

Energy management, and support to the energy data integration though energy data analysis (Shrouf & Miragliotta, 2015).

Real-time information management, in manufacturing through information integration services (Zhang et al, 2015).

So, it could easily be identified that IoT technology has been broadly in application in different domains and scopes such as smart cities, energy sector, manufacturing and assembling, societal and healthcare. The principal objective of the IoT integration differs and varies according to the different application area, so different sector observes different improvements. IoT technology drive has unlimited potential capacities where data or information sets can be applied to produced optimal actionable decisions through data analytics and pioneering background to achieve payoffs for supply chain participants or stakeholders (Jazdi, 2014).

A.4: Cyber-physical System (CPS):

In CPS mechanism of the machines is monitored, regulated and calculated through the advanced algorithms. CPS is a system through which networked objects and software are firmly entwined for empowering various components of the system to interact with one another in a heap of ways for data or information exchange (Baheti & Gill, 2011; Lee, 2008). CPS includes various trans-disciplinary techniques like robotics, mechanical designing & engineering, methodological science, production frameworks, and software engineering. With the driving effect of these technologies the machines become enabled with the capacity to dynamic interaction, visualization and atomicity in decision making. One of the key specialized strategies is embedded frameworks, which empowers an exceptionally planned and joined interconnectivity between actual objects and their computational components (Tan et al., 2008). In CPS the intelligent devices such as smart sensors generate data can help to interpret the complex situations faster and lead into implementing the hassle free technology integration in various units of the SC. Intelligent Sensors in real time will inform the customers and supplier about the flow of products and services from peer to peer and generate the log data for every point which can help to understand the issues related to the supply chain and further help to improve the feasibility and capacity of SC in all aspects.

A CPS-empowered framework, in contrast to a conventional embedded framework, contains network organized device interconnectivity that are planned and created with actual information sets and output result, alongside with cyber twined services like computational control algorithms and capacities. Hence, number of sensors assumes to be played significant roles in CPS. For instance, numerous sensory gadgets are generally utilized in CPS to accomplish various purposes, for example, contact screens, light sensors, and power sensors. By and large, incorporating unique subsystems is tedious and exorbitant, and the entire framework should be kept functional and utilitarian. The heterogeneity and intricacy of CPS applications bring few difficulties in creating and planning high-certainty, secure, and genuine frameworks and control strategies (Derler et al., 2012).Integrating the different applications of CPS in various business domains become common now days, such as in Festo Motion an intelligent combination of different engineering applications such as mechanics, electronics and control system etc. Digital pneumatics incorporates subsystem

with capacity of self-adopting and adjusting (Klotz & Duwe, 2017). An immense number of remote sensor networks can regulate natural perspectives so the data from the climate can be controlled, monitored and overseen for decision-making (Ali et al., 2015). Some typical applications of the CPS are:

Real time Cyber-Physical Testing Environment and its implementation in RTDS and OPNET (Chen et al., 2014).

Proposal for key design methods for CPSs at Children Keeper Service, Korea (La & Kim, 2010).

Integrated Simulation Networks for Water Distribution Networks (Lin et al, 2010).

Real time Hybrid Civil Structure testing and virtualizing CPS components (Huang et al. 2010).

Developing the Simulation model for energy handling issues (Meng et al., 2011).

Proposal for parallel programming models for autonomous vehicles model for CPS (Kim et al., 2013).

In Digitalized Pneumatics for advancing flexibility and conditional monitoring (Klotz & Duwe, 2017; Wang & Haghighi, 2016).

In model-based architecture for validation in medical (Silva et al., 2014).

For analysing the features of interconnected networks (Wan et al., 2013).

Therefore, CPS technologies are the area of keen interest for both academia and industry professionals to explore the feasibility and competitive advantages for the industry. Multi and interdisciplinary collaboration in between different industry experts and cyber-physical system experts are jointly advancing the technological aspects progressively.

A.5: 3D Printing Technology:

Super advanced programmed automatic fabricating is conceivable through the application of 3D printing. 3D printing or added substance fabricating offers new potential in manufacturing and assembling frameworks as items can be made accessible to clients on demand. 3D printers could be sent to manufacturing and assembling sites where parts can be immediately manufactured or assembled (Okwu et al., 2020). Most manufacturing and assembling organizations are as of now introducing the creative innovation of 3D printing to their production practices and processes for making the completely advanced and programmed manufacturing or assembling. This process depends on a programmed production process where items are made quicker and simpler than at any other time and which permit shoppers get simple access to the items made by producers. Stocking is extremely difficult since the specific number of items required intermittently can be made accessible. Additionally, customized models can be made accessible to clients. The utilization of 3D printing at various degree of store network will upgrade service and product delivery, reduced applied costs and stock development, incremented adaptability in manufacturing, assembling and item individualization will expand (Muller & Voigt, 2018; Holmstrom & Gutowski, 2017).

A.6: Information and Communications Technology:

ICT means extended and advanced IT that features advanced communication technology and the different advanced media platforms, as well as other different computational advancements that can store, send, and control information or data (Hashim, 2007) across different platforms of communication channel. ICT incorporates large number of software engineering and transmission techniques or methods, for example, remote or wireless frameworks, middleware applications, and general media frameworks. It emphasizes over information transmission through different electronic media like wired or remote media platforms, and plays very vital role in intelligent manufacturing and supplies, where production and assembling activities and navigation vigorously depend on the different sets of information or data. ICT has been found to particularly affect firm, to such an extent that better ICT for plant administrators, managers and laborers offers additional independence and a more extensive range of control (Bloom et al., 2014). For instance, ICT is viewed as one of the effective elements in manufacturing and assembling followed with its value chains particularly for supply chains, since it assists organizations in further developing their business nimbleness, adaptability, and efficiency.

One more prominent application of ICT is associated with the data recourse management and results in cost reduction and the increment in client satisfaction (Colin et al., 2014). In this information technology edge, all the industrial segments have Internet-based networks and interconnected platform for timely data transmission. This quick development has made ICT turned into a cornerstone of manufacturing and assembling system

units, where the fast and versatile production or manufacturing and delivery of profoundly redone items are empowered by help from computerized and virtual production, simulation etc (Ketteni et al., 2015). Following are some typical application areas of ICTs:

For the professional development of teachers' ICT application in education (Yusuf, 2015; Adholiya et al., 2019).

More diversified product development and precise decision making in foresight (Keller et al., 2014).

ICT enabled training programmed and effect on job satisfaction, overall ICT helps in enriching the quality of professional activities (Limbu et al., 2014).

Improvement in tourism and hospitality services through ICT (Law et al., 2014).

ICT application in environmental monitoring and management activities helps in increasing the awareness for eco-system services (Lin et al., 2017).

Improvement in the learning capacity and skills through ICT (Button et al., 2014).

ICT application in the area of women healthcare and monitoring of primary health care (Matta-Machado et al., 2017).

ICT system for emergency medical services and improved assistance in medical services through wider data accessibility (Xu et al., 2014).

ICT for improving industrial decision making such as customization of product and product quality (Brettel et al., 2014).

So, it can observe that ICT as an extension of advancement of computer technologies and their application in all possible dimensions are enriching the industrial development and all the value chains associated with it. ICT application enables the system to be integrated with the other advanced technology platforms through several means.

A.7: Machine Learning and Artificial Intelligence:

Machine learning computation technique is the study of algorithms and simulated intelligent behaviour of the machine or intelligent machine systems driven through artificial intelligence or neural networks (Machesa et al. 2020). Not very many organizations are very prevailing, taking into account of the continuous pattern towards computerization or robotization and supported propels in the computing generation, Artificial Intelligence (AI) is quickly evolving the patterns of activity of operations suppliers.

A.8: Automatic Guided Vehicles (AGV) and Unmanned Aerial Vehicles (UAV):

One of the very helpful technological advances of Industry 4.0 that will help to improve supply chain intelligently through autonomous devices like chat bots, robots etc. For the automobile industry the most advanced application of AI enabled robotics is ground robot-programmed guided vehicles or flying robot-automated aerial vehicles and sensors-based auto driver mode vehicles. For the intelligent SC, the application of AGVs for product distribution in assembling settings of manufacturing process followed with the supplies of material between the different units and SC partners will be of extraordinary monetary benefit since with the Industry 4.0 application they are intelligently modified to work independently and intelligently (Leo´nczuk et al., 2019). AGVs can be carried out in processing plant or manufacturing unit settings as the material dealing or management gadgets or delivery specialists for moving things starting with one area then onto the next. Automated Unmanned Aerial vehicles (UAV) will enable the external value chain particularly SC of organization to customers will be especially helpful either for moving raw components to plants or for delivering the finished or final products to clients at different areas (Zhang et al., 2022).

B. Intelligent Supply Chain Management:

From the literature reviewed the notion of SC driven by the Industry 4.0 has been wisely and widely presented, but the definition and concept part was found incoherent and deficient. It is because most of the definitions and concepts were referring the integration of technologies in the SC rather than conceptualizing the terminology for the intelligent or smart supply chain followed with its characteristics and application scopes. The drivers of advanced supply chains are particularly Industry 4.0 driven streamlined and intelligent logistics and supply chain (Barreto et al., 2017; Harris et al., 2015), intelligent or smart warehouses (Liu et al., 2018). Other aspects of the smart or intelligent SC were driven by the digital data communication and analytical models used for the real time data analyses and based on data repositories (Ivanov, Dolgui, et al., 2019; Ivanov, Tsipoulanidis, et al., 2019) to give the more competitively beneficiary results for sustainability. It was also noticed that Industry 4.0 is all about the integration of the modern and smart technologies related

to all the business processes to transform the conventional processes into technologically rich processes and that last up till all the value chains of the business, so the SC as the value chain for the business also enabled through the integrated modern business technologies such as IoT, Big Data, Data Analytics, Block Chain etc., and that are driven the SC into intelligent or smart SC (Wang & Ranjan, 2015). Few researchers proposed that Smart or Intelligent SC should incorporate the characteristics such as interconnectivity, instrumentation, and intelligence (Butner, 2010) followed with the adaptability (Leo´nczuk et al., 2019) and automation, innovativeness, technology enabling, timeliness (Wu et al., 2016).

Intelligent Supply Chain application of Industry 4.0 should be defined as a Supply Chain that can integrate all the participants of the manufacturing process and supply process in a streamline and self-organized manner with the capacity to transform the value chain according to the environmental changes that are important for intelligent business decisions. So, an Intelligent or Smart Supply Chain should incorporate the characteristics such as integrative capacity, intelligence capacity, adaptability, self-optimization, transformability, interconnectivity, automotive and timeliness in the execution minimally. So, Intelligent Supply Chain is need to dynamic in all the aspects which can extend its richness both through horizontal and vertical integration of the value chain components, along with the technological innovations and business innovations happening in Industry 4.0.The 4th Generation Industry revolution observed drastic developments because of the pioneering integration of ICT and advanced technologies such as Artificial Intelligence (AI), Internet of Things (IoT), Block Chain (BC), Cloud Computing (CC), Machine Learning (ML), Robotics, Machine Optimization, Digital Twinning, Big Data (BD) etc, and helped the supply value chain to evolve from the single partner/ flow intelligence to multi-dimensional partnering/ network intelligence, this all is promoted trough the digitalization and advanced communication technologies which are supporting the timeliness and conceptualizing the major drawing benefit of the intelligent SCM across different businesses/ industries. Zhang et al. (2022) presented the framework of smart hierarchical supply chain incorporating different levels and scopes with different ICT technologies and innovative frameworks which can be drive the technological efficacy of the smart SCM. The major technologies and drivers incorporated at different levels are:

Level 0: This level of the framework incorporates advanced ICT technologies (IoT, Block Chain, Big Data, etc.), Artificial Intelligence (Neural Networks, Optimization, Intelligent Decision, etc.) and Machine Language and other technologies (Robotics, Digital Twin, Web 4.0, etc.).

Level 1: This level of the framework incorporates smart units (material, information, finance, etc.), Smart Driver (Pricing, Facility, Sourcing, Inventory, Information, Transportation, etc.), and Smart Decision (Strategy, Tactics, Operations, etc.). This level primarily improves the operational and functionality of SC from single partner/ flow intelligence to multi-dimensional partnering/ network intelligence. Thus, the level is overall responsible for incorporating the smart function groups, visibility and integrating the real-time applications to improve value chain optimization.

Level 2: This level of the framework incorporates implementation of intelligent decisions in all the flows, levels of connected or interlinked stakeholders of the SC. Principally the Smart SC is interconnected with all the partners of SC, intelligent and enabled with smart devices, innovative and should be enabled with the self-organizing and optimizing techniques to offer the timely responses to the changes happening in business climate and supply chain environment. So, the SSC would be able to demonstrate the greater operational efficiency through responsiveness, efficiency, resilience and flexibility.

Level 3: This level of the framework incorporates the business, sector, industries than can be supported by the smart supply chain framework, as the Smart Supply Chain and Industry 4.0 conceptual methodology of performance is similar so for any sector or industry where Industry 4.0 is smartly in execution the value addition can be done by expanding the applications of technological smartness to their value chain particularly supply chain (Zhang et al. 2022).

IV. DISCUSSION

There are no differences in the opinions that another global information communication architecture incorporating several data engineering methods and worldwide network has arisen where individuals and devices can interconnect for powerful and ceaseless

interaction. This has prompted exclusive requirement of data privacy, security, and customization and has changed the general daily routines with the machines and the global networks. At present, the conventional way to deal with the supply chain system is really well known, especially in developed and developed countries. The 4th Industrial Revolution unrest has driven the current technological and mechanical advancements and data network framework to facilitate the interconnection. A worldwide network has arisen, which permit immediate and consistent communication among people and machines. This is bit by bit affecting the manner in which we think and do our everyday activities.

Various technological advancements help the 4th Industrial Revolution, which incorporate Big Data, 3D printing, IoT, AI & ML, Robotics, Cybernetics, Mechatronics etc. These technological advancements are helpful to work with supply chain management operations effectively. There is no difference of opinions that the advancements upheaval will incredibly improve Supply chain network configuration, design, process cycles, engineering and component management. Taking into account product delivery perspective, the utilization of autonomous and remotely operated frameworks will work with delivery process convenient inbound and outbound activities.

The supply chain network advancement can be supported and advanced totally by the new Industry 4.0 technological advancements. Advanced computational, mechanical, electronic and other new technologies can empower the procedural capacity of conventional supply chains to shift toward smart, associated, proficient and amazing supply chain network and operations management (Dallasega et al., 2018). Table 1 presents brief the applications of Industry 4.0 technological advances to procedural development of SCM in three different categories: (a) Design Techniques, (b) Tactical Source and (c) Tactical Network.

Table 1: Supply Chain under Industry 4.0

Design Techniques: New Techniques leads into designing new conditions.	
Author(s)	Identification of Supply Chain under Industry 4.0
Ghobakhloo (2018)	Sums up the standards and innovation patterns embraced decisively for Industry 4.0 in manufacturing.
Berman (2012)	Points that 3D printing can change the product designing process. 3D printing breaks as far as possible in the creation cycle, doesn't need assembly, and is prudent and proficient to plan and modify the items.
Majeed & Rupasinghe (2017)	Examine the activities to oversee better and enhance and computerize processes in an Enterprise Resource Planning (ERP) framework using RFID in the apparel design and footwear industry.
Saberi et al. (2019)	Recognize and classify four blockchain adaptation hindrances in production and supply chain network. Blockchain driven SCM is actually at the beginning phases of development.
Maqueira et al. (2019)	Uncovered that distributed cloud computing can assist the effective management of supply chain from participant end.
Gunal & Karatas (2019)	Simulation strategies can uphold the production and supply chain network and activity processes.
Tactical Source: Technologies can create the better connectivity between suppliers, manufacturers, retailers and customers and facilitate the flow of information.	
Xing et al. (2016)	Proposed a cloud-based life-cycle to assist the impression evaluation and resource management in Green Supply Chain.
Mladineo et al. (2017)	Considered a cyberphysical network to assists the organizations with settling on the partners' determination choices to plan virtual venture netwrok.
Ben-Daya et al. (2019)	IoT is essential and empower Industry 4.0 innovation.
Birkel and Hartmann, (2019)	IoT needs the trust and sharing of information in Supply Chain Network, and risk to the data ought to likewise get high considerations.
Sun et al., (2020)	Utilization of IoT could bring high working costs, the integration are connected with cost, incomes and

	transportation efficacy.
Tactical Network: New technologies carry both benefits and challenges for the SCM.	
Zhao et al., (2017)	Big data develops the information procurement and information quality in SC.
Kouhizadeh and Sarkis, (2018)	Blockchain can facilitate inter and intra organization activities in the SCM and can also help in environmental friendly manufacturing.
Panetto et al., (2019)	Industry 4.0 advancements require redid SC network, sustainable assembling process, integrated complex systems, and control on digital networks.
Sundarakani et al., (2019)	Cloud computing can really decrease costs, further develop production network strength, adaptability, and boost the utilization of resources to improve effectiveness of SC.
Eyers et al., (2019)	3D printing affects SC and develops the abilities of coordinating and electing the manufacturing partners followed with the supply chain partners.

Source: Review

While, Industry 4.0 and advanced ICTs offers the further development of the SC performance and capacity, there are many challenges to accomplish the objectives. Table 2 present the challenges for the applications of Industry 4.0 in development of SCM in three different categories: (a) Challenges for Availability and Quality, (b) Challenges for Intelligent Need for Smart System, and (c) Challenges for Information Sharing and Trust Networking.

Table 2: Challenges for Supply Chain under Industry 4.0

Challenges for Availability and Quality: Matching the pace of rapid development in SC in accordance with Industry 4.0 is imperative challenge.	
Author(s)	Difficulty Identified
Moktadir et al., 2018	Showed that the absence of advanced infrastructure for technology integration is the most major problem for Industry 4.0 execution.
Zhang, 2015	Gap between the skills of man power according to the industry 4.0 standards. Training, education, and knowledge updates are very important.
Wiengarten& Longoni, 2015	Capacity expansion with the continuous evolving technology in manufacturing capacity and SC.
Challenges for Intelligent Need for Smart System	
Zhang, 2015	Without suitable materials / parts and quick conveyance to clients, the creation in brilliant production line just doesn't work.
Karadayi-Usta, 2019	Smart industrial facility/services need much smarter network/planned operations and SC activities.
Okwu &Tartibu, 2020	SSC is data driven with constant real-time visibility, and is need to be connected, streamlined, and astute. SSC Needs high collaboration and coordination, should be designed for advanced business world, Individualization and expanded product variety may be troublesome, shorter life cycle adds trouble to obtainment, Decentralization can expand office and conveyance cost.
Challenges for Information Sharing and Trust Networking: Higher data sharing ends results into privacy and transmission issues.	
Simchi-Levi & Wu, 2018	New advancements, as IoT, CPS and different IT frameworks, give the techniques/devices to divide the data between various ends in supply chains. However, there are hindrances for data sharing.
Wamba et al., 2017	Trust among the organizations and participants, data confidentiality.
Luo et al., 2018	Reliable source and physical objects participating in the data transmission is also a hindrance.
Datta, 2017	The integrity of both the cyber and physical components in industries relies on complex distributed supply chains,

Source: Review

V. CONCLUSION

Industry 4.0 is the driving significant development pattern and trend in the worldwide manufacturing, assembling and allied value chains. Manufacturing and logistics industries need to follow advanced technological changes to remain into the cutthroat competition and similarly to accomplish the sustainability. Such advancements driven through Industry 4.0 ensured acquiring the natural, social and monetary benefits. This review work study is centered on industry 4.0 advancements and the advantages of integrating the technological innovations into SC activities. The review showed the significance to applying the ICTs into supply chains is very much recognized however the application and related research are still in a beginning phase. It ought to be noticed that the list of introduced subjects isn't comprehensive in light of the fact that different phrasings might be utilized to allude to Industry 4.0 and supply chain network. There are various technological advances jumping up, yet the essential few have been examined, Industry 4.0, in the event that actually carried out in Supply Chain Management, will extraordinarily further develop efficiency in manufacturing and assembling activities as products will be delivered on time from supplier to the customer. The technological advancements have significant effects on Smart Supply chain. Different benefits to be acquired from the new technological innovations incorporates better resource management, lower cost, better deals and in general improvement in monetary performance of the organization. To accomplish every one of these, there will be need for tactical preparation, improvement in technology infrastructure, worldwide standard administration, business process changes and best information for worldwide practices.

The literature presented in the paper helps scholars to understand the crucial insights over the industry 4.0 roles in advancing Supply Chain which leads in improved productivity, delivery of products, cost optimization, process efficiency and holistic performance of manufacturing system. The literature helps the scholars to update their academic knowledgebase for the study area. Furthermore, the literature also presents out of the ordinary course of information about Industry 4.0 and SCM to the academia and industry practitioners betrothed in data driven SCM.

The survey additionally showed that the examinations about utilizing new ICT on essential choice are relative not exactly on functional and strategy choices. Furthermore, in light of the fact that our attention is on the advancement of intelligent supply chain network and a few emerging ICT trends, we didn't dive profound into every individual innovation related to Industry 4.0 and its application in SCM. In this manner, a further coordinated survey for each arising innovation and their effect on SCM and operations will be a future work. Moreover, it may be advantageous to concentrate on the effects of various methodologies and research projects on new technology application in supply chains to make them compatible with industry 4.0 standards or intelligent smart chain.

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ENHANCING ENGLISH SPEAKING SKILLS AMONG TECHNOCRATS: NEED FOR EMPLOYABILITY

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Abstract: English, as we know is the language which connects people from different regions, cultures and nations. Effective English Speaking skills are a must in this era of globalization because if we know English we can communicate effectively and it also enables us to establish and maintain both personal and professional relations successfully. This paper focuses upon the various problems faced by technocrats in seeking employment due to lack of good English speaking skills and mainly the measures to be undertaken for enhancing English Speaking Skills among Technocrats, so that they can get employment in the existing scenario. This paper also highlights the prospects and needs of English for employability for technocrats in India. A reasonably high degree of aptitude and excellent communication skills in English today enhance student's employability significantly. The best graduates with good communication skills in English compete effectively in the job market and have better prospects of employability and sustainability. In the current environment, technocrats having good English speaking skills will have better chance of employment, successively leading to a better lifestyle, money, power and status.

Keywords: Communication, Employability, Enhancing, Globalization, Speaking Skills.

I. INTRODUCTION

Speaking, as we all know is an interactive process where information is shared. Speaking skills can broadly be separated into formal and informal types and we use both of these types in a variety of contexts throughout our life. Informal speaking skills are normally used while communicating with friends and family, helping us to form emotional connections. Formal speech, on the other hand, is necessary for seeking employment, clearing interviews, for communicating with officials both inside as well as outside the organization, giving presentations, involving in various important discussions etc. Effective English Speaking skills play a pivotal role in this era of globalization as it allows us to communicate effectively and enables one to establish and maintain both personal and professional relations successfully. The fact that the British ruled most parts of the world a few years ago, and gave a common language to the world. India and English language have become inseparable due to British colonization and English has become the second language to many educated Indians. Furthermore, it has become a linking language among educated Indians. English is the comprehensive language of communication and a key factor in helping business to succeed. It allows for smoother communication between companies, customers and team members, irrespective of their indigenous language. In today's globalized economy, English has become a lingua franca, allowing people to communicate and work together across borders. This means that learning English for employability is a highly desired skill. It has helped the world in sharing

any kind of information fast and clear without any translation. The importance of English language especially in India cannot be ignored as it also reciprocates as a status symbol.

Today's job market in India is quite demanding and challenging. Engineering graduates are expected to possess employable qualities when they appear for job interviews. Candidates are expected to voice their ideas in English without any ambiguity and fear. English communication skill is one of the most important employability requirements in modern India.

II. Statement of the Problem

The pitiable English speaking skill of the technocrats is a matter of grave concern as this lack minimizes the employability of the youth. Many engineering graduates in India do not get employment due to their poor communication skills and lack of confidence. Employers look for time management, multitasking, ability to work under pressure, and oratory skills as the basic bench mark before even going ahead with the final level of interview – the HR or face to face interview. The poor communication skills of the educated young technocrats are a matter of serious concern, as they curtail the employment opportunities. Unfortunately, more number of engineering graduates in India finds it a taunting task to speak or write in English with fluency and accuracy [1].

III. Objective

The objective of this paper is to develop and enhance English speaking competency among technocrats so that they can get employment easily and can compete in the current international scenario. English as we all know is a valuable skill to be possessed in this globalized world, as it can lead to more success and open up new opportunities. These days' organizations often look for candidates with exceptional communication skills and good command over English. This is because the majority of organizations have a clientele which would prefer an English-speaking person. Hence, the need of individuals who are not only technically sound but are proficient in English is considerably higher. Therefore, it will not be erroneous to say that aspirants with good command over English are at a higher chance of getting hired in a company than those with just technical proficiency. The objective of this paper is to develop and enhance English speaking skills among technocrats, so that they can get employable.

IV. Literature Review

English proficiency is one of the most crucial employability skills since it is the language that is used in the corporate world. With English being the main international language for business communication, employers are more likely to hire individuals with strong English speaking skills. This is because they can communicate effectively with their customers and colleagues and are able to understand any instructions given in a foreign language [2].

Rajendra Babu Vemuri, Sai Krishna Kota and D. Radhika have thrown light through their research study on "Need of enhancing employability skills through English for Engineers". The number of technocrats graduating from Indian universities is very high. All these technocrats need to work in an international scenario and there is a great need to survive them in this global village. But lack of training in their respective fields as well as in English communication, they often have trouble in finding suitable placements. So language skills play an important role in every aspect of life specially at the time of campus recruitments [3]. V. Subbulakshmi, in her research study, "English for Engineering College" has stressed on the need of developing specialized syllabi to meet the needs of Engineering students [4]. It is thus seen that, during campus interviews and other hiring processes, companies look for potential employees who not only have good academic qualification and aptitude but also fluency in English.

V. English is a Globally Popular Spoken Language

English is the world's most commonly spoken language among foreign speakers. Throughout the world, when people with different languages come together, they commonly use English to communicate. Communication skills are very much essential for one's professional growth. The ability to express fluently in both written as well as oral form of language is very much essential for the career growth. English is no doubt the actual universal language. In this era of mass communication, the

concept of a universal language becomes more significant. English, being one of the simplest and easiest natural languages has been acknowledged as the universal language as against Latin, Greek and French. For about a vast community of about 375 million people, it is a native language and for others it is second language adopted by the speakers. It is an official language in more than 50 nations and a lingua franca, or common language, in many more. English, as we all know, connects us with more globally recognised companies. English is the language of the work- force and is necessary for everyone who wants to express oneself at national and international levels. As a matter of fact, Kishore, Varma K., and Devi V. Radha have also stated in their research article that this popular language has become a passport to high society and visa for employability in modern job environment. It is high time the language teachers developed creative methods of teaching English [5].

VI. EMPLOYABILITY

Employability is the ability to remain employable as a result of the relevant skills one possesses. These skills tend to be non-technical skills that help make one an impactful employee. Each job requires some combination of technical and workplace skills sometimes even referred to as soft skills. Employability skills refer to a set of transferable skills and key personal attributes which are highly valued by employers and essential for effective performance in the workplace. Employability is defined by Yorke M. (2006) as a set of achievements – skills, understandings and personal attributes that make graduates more likely to gain employment and be successful in their chosen occupations which benefits themselves, the workforce, the community and the economy [6]. A person is considered employable only when he gets the necessary qualification, experience, interest, learning attitude and expertise in the field where he wants to seek employment. A person has to remain employable throughout one's career. The weightage ascribed to English speaking skills and other soft skills for acquiring a job is thus quite high.

VII. ENGLISH SPEAKING SKILLS AND EMPLOYABILITY

English language skills and employability are interrelated. Employability and English are intrinsically linked. The better the skills an individual has in English, the higher their scope of employability is. It is also a known fact that employment retention and career enhancement are the next challenges, post securing an employment. Effective communication skill in English is one of the biggest factors affecting employability. English is the dominant business language and it has become almost a necessity for people to speak in English if they aspire to enter a global workforce. Research from all over the world shows that cross-border business communication is most often conducted in English as it is the most widely used language of communication, thus employers prefer candidates who are fluent in it. In today's competitive employment market, employability and English go with each other. English makes technocrats more employable by expanding their employment opportunities. English connects them with more globally recognised companies, as a result they can share their technical knowledge very easily. Effective English speakers have a better chance of finding employment because they can overcome the language barrier more readily.

Furthermore, they can more readily stay up with the latest trends and advancements in their industry. English facilitates accessing information. They can communicate with others internationally and can follow new trends, new gadgets, and technology. In the changed scenario of globalisation, liberalisation and free movement of people, more and more multinational companies are coming to India. Consequently, English has gained importance as one of the basic requirement to be employable in the corporate sector. With more business houses going global and working in competitive environments due to the transformed world economy, the need to acquire or inherit competencies becomes crucial to merely survive in the market. This truth applies to both the employer and the employee. With English being the business communication language of most companies, the skill to communicate in English with clients, both overseas and domestic is required. Communication in English, not merely helps in understanding and framing correct sentences but also gives us the ability to apply interpersonal skills, presentation skills or negotiation skills. English is the most preferred mode of communication and a vital factor in deciding one's employability quotient.

Proficiency in English guarantees jobs across sectors. The ability to use a language efficiently is very much required to remain employable. Globalisation has encouraged the domestic companies to think beyond their nations. People don't mind taking challenging and rewarding overseas assignments these days. As English is spoken in most of the countries, language is no more a barrier for people who intend to settle down in other countries.

VIII. MEASURES TO ENHANCE ENGLISH SPEAKING SKILLS

English speaking skills can be an innate talent for some, while others need to strive to develop it. English is a link language, world language, International language, business language, language of commerce and trade. Ramu Yarlagadda1 et.al. have mentioned in their research article that we are living in the digital world of information communicative technology and we cannot deny the fact that English is a tool of empowerment for employability because this language is a gem of all the fields of business world whether it is a soft ware companies, engineering, medical, science, aviation, education, humanities etc every where the process starts in English [7]. The importance of English speaking skills cannot be undermined in the existing scenario. The following measures may be undertaken at Engineering Colleges, in order to develop and enhance English speaking skills among technocrats.

To incorporate Bridge Course: There is a need to conduct bridge courses in the beginning of the technical course to level the gap between high- and low-proficiency learners. Students coming from rural background, though technically sound, lacks the art of speaking. Consequently, in spite of having good knowledge, they fail to express it. Hence a bridge course is to be incorporated at the initial level for such type of students, so that they can develop the spoken skills.

- *To emphasize more on the practical aspect:* The focus should be placed on practical dimensions of evaluation. Self-introduction, group discussion, presentations, and quizzes should be integrated as a part of examination and evaluation. Unlike other content subjects, language as a skill subject should be taught practically.
- *Vocabulary Development and Enhancement:* To develop our speaking skills, we first need to know the right words. Vocabulary development is where students comprehend the meanings and pronunciations of words essential for communication. When they understand what a word means, they can then check what the word or sentence means. This is very important to keep up a conversation. If they can make out what the other person is saying and they reply by making use of correct words, they are almost halfway communicating effectively.
- *Focus on Pronunciation*: Technocrats should be encouraged to make use of digital tools and online dictionaries, so that they can learn the right pronunciation. These online dictionaries and tools use technology that speaks words aloud and one can pick up the right pronunciation. Knowing the pronunciation helps to send the right message and ensures that audience understands the message delivered correctly.
- *Accentuating on grammar:* More stress should be laid on the correct usage of grammar such as understanding of tenses and the correct way to structure sentences. Grammar helps us to convey information in a way that the listener will understand.
- *To emphasize on learning new vocabulary in phrases*: Although learning new words and their pronunciation is always beneficial, some words need to be learnt in phrases to be of much use when speaking in English. For example, a cup of coffee might be more useful than just learning "coffee".
- *To improve teaching methodologies*: The teaching methodologies of faculty members need to be enhanced as large number of students want more interactive sessions to improve their language skills. A teacher of English should prepare the learners to make use of English as per the situational context. Their focus should be diverted to communicative language teaching.
- *Latest technology-enabled teaching aids to be used:* The traditional mode of teaching should be updated, and the latest technology-enabled teaching aids should be used to motivate the learners. A properly equipped language lab should be installed in all the colleges, and short-term courses should be made compulsory for all the graduating students of Engineering.

- *To focus on practicing self-talk*: This involves getting them to talk loudly in English to themselves. This could be before completing a task, such as "shall we go and grab a coffee?" or "I need to go to the gym tonight." This will help the students to overcome their hesitation.

IX. CONCLUSION

It can thus be interpreted that English Speaking skills are becoming increasingly important in the global job market. Those who have strong English speaking skills are more likely to have increased job opportunities, improved communication and negotiation skills, increased confidence, better social networking abilities, increased mobility, and an increased chance of promotion. Thus it is evident that proficiency in English is a must today ensuring primary source of employment.

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SENSING AND MODULATING HUMAN DEEP BRAIN FOR PSYCHIATRIC DISORDER

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Abstract: Deep brain machine interfaces allow for communication between external devices and deep brain areas, in contrast to traditional brain-machine interfaces, which are primarily focused on programming the cerebral cortex. Their goals are to restore function, control devices, and enhance treatment outcomes by detecting and modifying deep brain neural activity. An overview of several deep brain stimulation and recording methods that can be used as deep brain–machine interfaces is given in this article. We present two popular interface technologies for clinical applications, technological advancements, and brain connectivity research: stereotactic electroencephalography and deep brain stimulation. We talk about the possibility of creating more useful and successful systems for the treatment of neurological and mental illnesses, including closed-loop deep brain–machine interfaces.

Keywords: Deep Brain–Machine Interface, Sensing and Modulation, Deep Brain Stimulation, Stereotactic.

I. INTRODUCTION

Brain-machine interfaces, sometimes referred to as brain-computer interfaces, offer new ways for people to communicate with the outside world and other equipment. They assist in modifying, restoring, and enhancing human mental or physical functions[1,2]. As depicted in Fig. 1, study of physical technologies such as electrical, magnetic, ultrasonic, optical, and others to interact with the brain at various levels. The primary focus of research on the brain-machine interface has historically been the cerebral cortex. Researchers capture and integrate brain activity across multiple cortical regions to comprehend human intents, empower paralyzed individuals to operate robotic limbs and prosthetics, and support individuals with disabilities in effectively communicating [3, 4]. Additionally, they work to establish neural interventions as a means of diagnosing and treating neurological, psychiatric, and brain ailments [5-7]. Neurotherapeutics mostly target subcortical areas (e.g., the thalamus, hippocampus, substantia nigra, etc.) [8,9], which contribute to various cognitive, affective, social, and critical life functions[10]. In a number of neurological and psychiatric illnesses, deep brain structure interaction is both required and useful for treatment. Deep brain regions, such as the brain stem, diencephalon, thalamus, and basal ganglia, support a variety of essential bodily processes, from perception and movement to thought and consciousness, as demonstrated in Figure 2. For our life, they are primitive and essential. Numerous neurological and

psychiatric illnesses, including Parkinson's disease, Alzheimer's disease, depression, obsessive-compulsive disorder, etc., are linked to structural and functional abnormalities of deep brain areas. With an emphasis on comprehending and modifying neural activity in deep brain areas, the Deep Brain Machine Interface (DBMI) is a rapidly developing field of study with enormous practical potential.

In addition to recording and decoding, therapeutical stimulations can be delivered by DBMIs to modify brain pathologies and deep structures. The goal of advanced DBMI technologies is to accurately configure stimulation parameters that can precisely govern brain states, as well as to record and decode deep neural processes with great spatiotemporal resolution. The creation of DBMIs with long-term efficacy remains difficult because to our inadequate understanding of the fundamental mechanisms and the flexibility and plasticity of the central nervous system.

Electrical BMIs have drawn the greatest attention from researchers in this sector because they directly record electrical impulses from brain tissues, which provide information about neuronal communication [11]. We begin by providing an overview of the present state-of-the-art neural electrical activity-based brain mass index (BMI) technologies and how they are being used to sense and manipulate deep brain regions. Then, we introduce two popular DBMI systems: stereotactic electroencephalography (sEEG) and deep brain stimulation (DBS), with an emphasis on the most recent developments in technology and practical clinical uses. The therapeutic efficacy and potential of DBMIs as potent platforms for brain research are discussed. We also go over the closed-loop architecture for DBMI systems, including an overview of the advancements in both technology and medicine for closed-loop DBMIs.

II. Brain-Machine Interfaces from Surface to Deep Brain

Neural electrical activity-based brain-machine interfaces (BMIs) capture and/or modulate these brain dynamics directly; as our understanding of brain functions deepens, we are witnessing a new trend in BMI research that expands interest and focus from interacting with the cortical areas of the brain to deep brain structures, regardless of the deployed interface technology. Electrical activities in our brains underlie the coordination of human thoughts, emotions, and behaviour.

Electro-encephalography(EEG), Transcranial electrical stimulation (TES), electrocorticography (ECoG), micro-electrode recording (MER), stereotaxic electroencephalography (sEEG), and DBS are the primary methods of electrical sensing and modulation for the human brain. Examples of non-invasive EEG recordings and TES non-invasive stimulation patterns are displayed in Figure-3.While MER is primarily employed for subcortical recordings, ECoG is typically used for cortical recordings. Both DBS and SEEG have the ability to record and stimulate.

In Figure 1, major electrical, magnetic, ultrasonic, and optical approaches are listed on the horizontal axis. These approaches include electroencephalogram (EEG), electrocardiogram (ECoG), endovascular approach (EA), TES (transcranial electrical stimulation), sEEG (stereotactic electroencephalography), deep brain stimulation (DBS), microelectrode recording (MER), microelectrode array (MEA), TMS (transcranial magnetic stimulation), MEG (magnetoencephalography), functional magnetic resonance imaging (fMRI), TUS (transcranial ultrasound), fUS (functional ultrasound), fNIRS (functional near-infrared spectroscopy), and laser therapy. The vertical axis shows the range of depths that each approach from the surface to the deep brain goes. The color scale denotes the spatial resolution, while the opacity shows how each strategy is applied at different depth levels. The primary applications of EEG, ECoG, MEA, MEG, fMRI, fUS, and fNIRS are sensing; however, ECoG and MEA electrodes may also be used to administer stimulation on occasion. The primary uses of TES, TMS, TUS, and laser treatment are for modulation. In both modalities EA, sEEG, DBS, and MER can be employed. Deep structure of brain and their functions are shown in Figure 2.

In EEG electrodes applied to the scalp, EEG is a non-invasive technique to measure electrical activity that is often detected from the surface of the brain. For the past few decades, EEG has been the most often used BMI interface modality. EEG-based BMIs have been used in robotic controlling, cognitive and behavioral research, and neuro-rehabilitation. There have been outstanding examples of neuro-prosthetic

implantation and communication restoration for people with disabilities. These tools aid in the identification of neurological and mental illnesses as well as neuro-rehabilitation [12–13]. EEG-based BMI systems typically use evoked or event-related potentials and brain oscillations as neural signals. Recently, there has been an emphasis on utilizing deep learning frameworks in EEG-based decoding techniques [14–16].

Innovative algorithms, high-density recordings, and new signal-processing techniques have all contributed to expanding the possible uses for EEG-based BMIs. In the forefront of recent research, a number of studies have demonstrated evidence of neural source activity reconstruction from subcortical areas using EEG [17,18], giving us a potential method for non-invasive deep brain recording.

TES is a non-invasive method of electrical brain stimulation that is administered through the scalp to modify cortical excitability and functional connectivity, whereas EEG is intended for recording [19]. It is being used more and more to treat a range of neurological and mental conditions, including depression, Alzheimer's disease, and motor dysfunction following a stroke. Transcranial alternating current stimulation, one of the main TES modalities, can cause an electrical field to form in deep brain structures when it is administered with small, high-definition electrodes at low intensities, according to a recent study involving epileptic patients who also had intracranial recordings [20]. Studies on animals and models suggest that efforts in designing stimulation waveforms and pulses, as well as optimizing electrode configuration, may also help DBS with TES [21].These findings show that non-invasive methods may be used to modify deep brain networks depicted in Figure 3. As a closed-loop system for non-invasive clinical interventions, EEG and TES might likewise be merged [22].

Because of the resistances and filtering effects of the dura mater, scalp, brain, and cerebrospinal fluid result in low spatial resolution and attenuated signals, even though the temporal resolution of the EEG and TES is quite high. Intracranial interfaces guarantee a significantly greater signal-to-noise ratio and localization accuracy because their contacts are positioned directly on brain tissues. Electro-corticography (ECoG) is a non-invasive method that uses electrode arrays usually on the surface of the cerebral cortex and occasionally subcortical areas to map functional areas and identify seizures. It can be subdural or epidural. In conventional ECoG, local field potentials are recorded using macro-electrodes with a diameter of 1-4 mm and an inter-contact gap of 5-7 mm.

The strong relationship between high-frequency brain processes and cognitive functions makes them particularly interesting, even if scalp EEG cannot record them. Micro-ECoG electrodes, which have recently been introduced, have shown higher spatial resolution with reduced invasiveness. Their sizes range from 10 to 300μm [23]. Depending on the electrode distribution in non-epileptogenic areas—such as speech, visual spelling, motor control and imagination, auditory and memory paradigms—a variety of ECoG-based BMI settings are suggested [25–26]. By utilizing ECoG electrodes to administer direct electrical stimulation, the bidirectional BMI paradigm is made possible, opening up new avenues for the treatment of neurological disorders [26].

Although ECoG's architecture restricts its capacity to delve deeply into the brain, Both Microelectrode Recording (MER) and Microelectrode Array (MEA) record local field potentials and spike trains by inserting high-impedance electrodes into brain tissue. For high-dimensional multi-unit recordings and the decoding of human intentions and functional activities, MEAs are typically positioned on functional cortical areas. This lays the groundwork for various BMIs, including voice neuroprosthesis, robotic arm control, text typing, and sensory restoration [8,27]. Stereotactic targeting allows for the acquisition of microelectrode recordings from the deep brain, but MEAs are primarily utilized for surface recording. Both single channel and multichannel recordings are possible with MER; the latter seeks to improve the localization of sub regions based on particular electrophysiological activity patterns and the identification of structural boundaries. When MER is linked to a stimulator, MER provide both monopolar and bipolar stimulation.

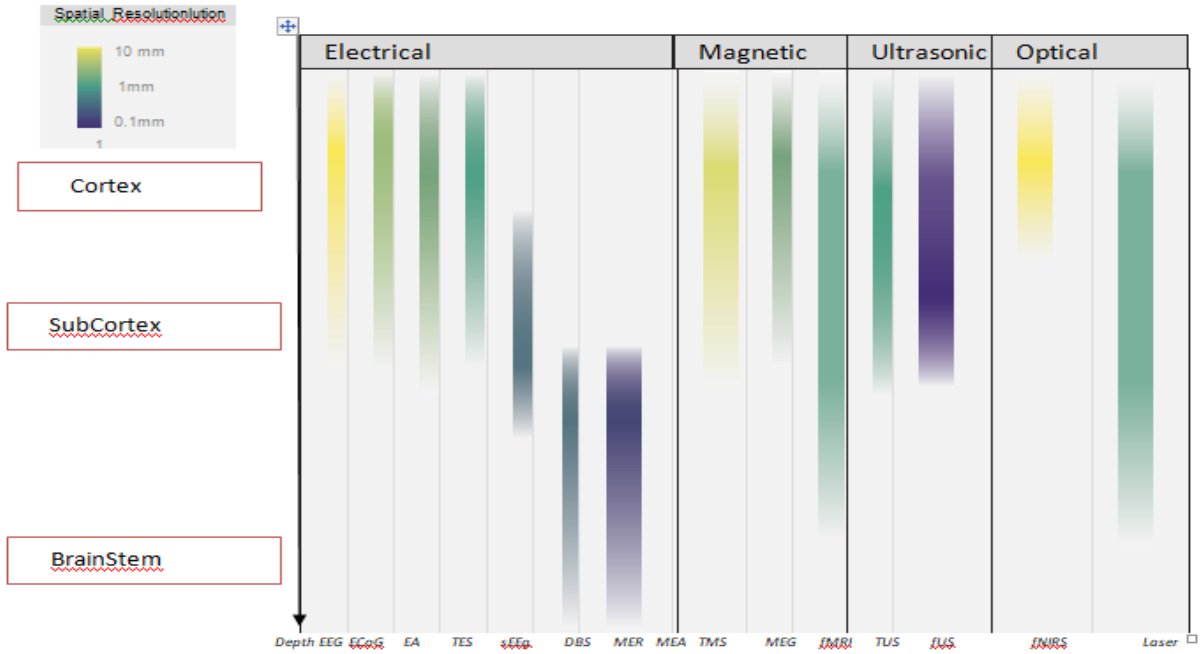

Figure 1: Typical methods for using depth distribution and spatial resolution to sense and control the human brain.

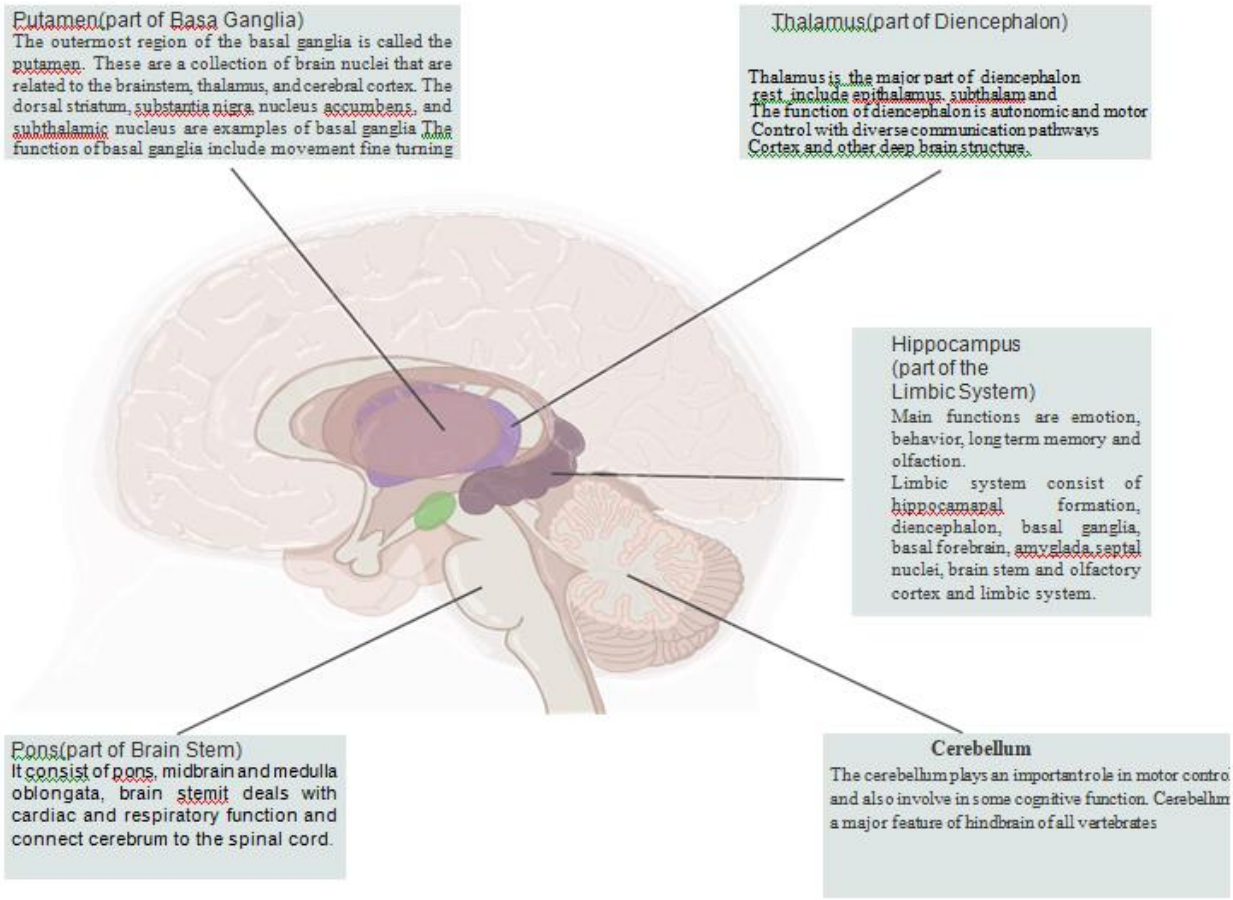

Figure 2: Deep Structure of Brain and their functions.

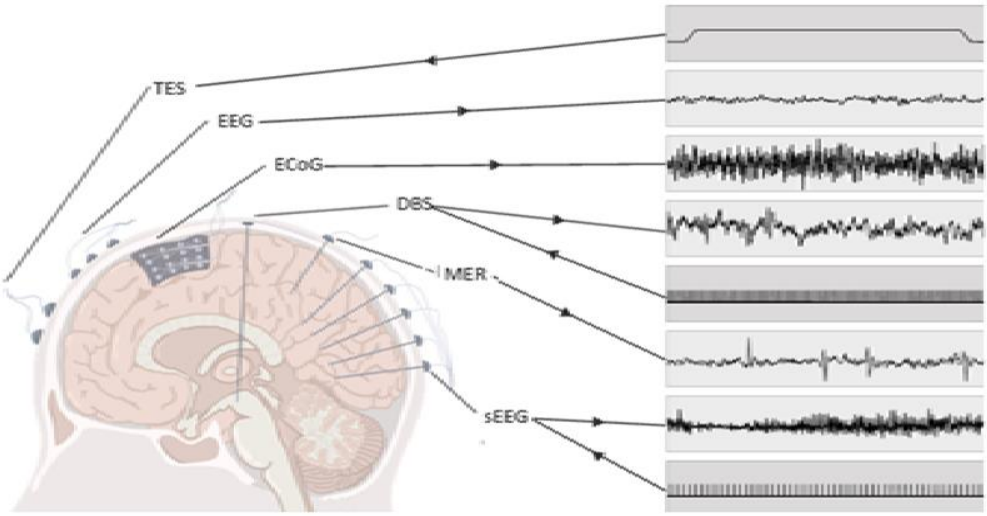

Figure 3: Electrical Signal from the brain in different modalities and simulation approach to the brain for brain machine approach.

III. Key Factors for the Development of BMI

Key Factors for the development of BMI includes low invasiveness, high-quality neural signal transmission with adequate temporal and spatial resolutions from various cortical and deep brain locations, and relatively extended recording and stimulation intervals. In modern clinical practice, the most popular interface technologies that meet these criteria are DBS and stereotactic electro-encephalography (sEEG). We therefore place particular attention on these two BMI technologies, go into great depth about their systematic construction and clinical uses, and offer insights into their important roles in future advancements and scientific study.

IV. Deep Brain Machine Interface is to Understand Various Brain Activity

The DBMI plays a key role in the study of deep brain activity, particularly in diseased conditions. Guidance for deep brain sensing and interpretation has been offered by prior knowledge of neuroanatomy and neuro-pathophysiology. Technological developments in artificial intelligence and brain-machine interface may be able to record dynamic brain network activity [30,31]. A platform for directly examining alterations in brain connectivity before and after modulation is provided by the technology of MRI-compatible DBMI[32]. The development of sensing methods in DBMIs and simultaneous recording of several sites' electrophysiological data has further enhanced the dynamics of the brain network's temporal resolution. In addition to advancing our knowledge of disease causes, these investigations add to our understanding of neural network modulation. This will help us develop next-generation closed-loop systems by optimizing biomarkers, implantation targets, and modulation patterns.

Two well-liked methods for simulating the structural tractography and functional connectivity of the active human brain are diffusion MRI (dMRI) and functional MRI (fMRI) [33]. When DBS and sophisticated computational techniques are used, dMRI and fMRI can show how DBS affects the connection patterns in the human brain. Brain connection patterns associated to DBS effects have been investigated using high-quality normative connectivity data obtained from diffusion weighted imaging or resting-state fMRI in healthy patients. The volume of tissue activated (VTA) by DBS is used as a seed to generate the probabilistic tractography map for structural connectivity based on the normative connectome, while temporal correlation analysis between voxels sampled from VTA and every other voxel in the brain is carried out for functional connectivity. The significance and predictability of certain relationships with clinical outcomes can then be assessed using a variety of statistical techniques and machine-learning algorithms, resulting in the Subsequently, a range of statistical techniques and machine learning algorithms can be employed to assess the significance and forecast ability of certain

associations with clinical results, ultimately resulting in the determination of the most effective neurological target networks [34]. These research paradigms have been applied to a number of pathological conditions, such as Alzheimer's disease, Parkinson's disease, essential tremor, dystonia, Tourette syndrome, OCD, depression resistant to epilepsy treatment, and dystonia. This has opened up new research directions in the hopes of optimizing pre-surgical targeting and post-surgical modulation. Previous attempts at simultaneous DBS and MRI scanning have primarily used 1.5T MRI due to safety concerns. Current developments in DBS that is MRI-compatible allow for the stimulation to function with 3T MRI. Exciting results have been obtained using an On/Off Stimulation paradigm in conjunction with different electrode configurations or frequencies during MRI scanning. Long-term observations revealed a correlation between motor improvement and frequency-dependent activation of the GPi–thalamus–cerebellar circuit and deactivation of M1–putamen.

In the same subject, the levels of activation for bipolar and monopolar stimulation differ significantly [35]. These findings show that precise individual modulation is cerebellum [28] achievable with DBS. In future deep brain machine interface achieve great impact in the treatment of various psychiatric disorder as presented in Table 1 [27].

Table 1: Clinical Application of DBMI

Disease	**Targets**
Schizophrenia	Prefrontal cortex, Basal ganglia, and the Hippocampus
Bipolar Disorder	Hippocampus, Prefrontal cortex, Gray matter, and Neurotransmitters
Depression	Amygdala, Hippocampus, and the Dorsomedial Thalamus.
Post-Traumatic Stress-Disorder (PTSD)	Hippocampus, Amygdala, and Medial Prefrontal Cortex.
Obsessive Compulsive Disorder(OCD)	Prefrontal Cortex (Orbitofrontal and Anterior Cingulate Cortexes), Basal Ganglia, and Thalamus
Psychosis	Posterior Hippocampus and Prefrontal Cortex
Alzheimer	Entorhinal cortex and Hippocampus
Autism	Hippocampus and Amygdala
Anxiety	Amygdala

V. Deep Brain–Machine Interface In Closed-Loop

Research on brain-machine interfaces faces a significant barrier in closing the sensory-control loop. The two most used clinical DBMIs, DBS and sEEG, offer long-term, secure interfaces for interpreting and adjusting brain activity. These devices were created to treat neurological and mental problems caused by abnormal brain activity. These systems are used in typical clinical protocols [6], however their stimulation is not affected by biomarkers associated with disease. Instead, it is an open-loop system. With the increasing utilization of DBS and sEEG devices in clinical treatments, the possibility of closed-loop applications is becoming increasingly apparent. Closed-loop neurostimulation may lead to real-time efficacy enhancement and side effect minimization. The temporal adjustment of neuromodulation in treatment is necessary because the neuronal target population may adapt to prolonged stimulation, for example, through changes in neuroplasticity. By closing the DBMIs' sensing-modulation loop, brain activities might be controlled based on temporal feedback.

A closed-loop DBMI system typically consists of three modules:

(i) an algorithmic module that maps input sensing signals to the output stimulations;
(ii) an output module that delivers stimulation patterns to modulate deep brain activities
(iii) an input module that measures biomarkers related to internal or external diseases. Creating a method for simultaneous stimulation and sensing is the first step towards creating closed-loop DBMI systems.

The responsive neurostimulation (RNS) device is another useful closed-loop DBMI system that was authorized in 2013 [36] for the treatment of partial-onset medication-resistant epilepsy. It continually tracks neural activity at the epileptic foci or via an electrocorticography strip on the surface of the brain, and when a seizure begins, it provides therapeutic stimulation [37]. Long-term data, such as treatment verification in medication-resistant epilepsy, have been amassed with increased use of the RNS system. This has led to more accurate prediction, tailored stimulation, and efficient network identification. The

list of indications for besides epilepsy has expanded due to recent studies that show closed-loop modulation for major depression that is resistant to treatment [29].

There are three main areas where closed-loop DBMIs face challenges. The primary problem in the initial phase is identifying biomarkers while detecting and interpreting deep brain signals. The optimization of the stimulation parameter is the primary emphasis of the second section, which is encoding and stimulation. The final section, control, focuses on how to appropriately stimulate using the decoded signals.

VI. Conclusion and Future Scope

Our basic functions, such as sensory, motor, cognitive, and conscious thought, depend on deep brain structures. Consequently, deep brain–machine interfaces offer unique tools for directly recording deep brain activities, studying deep brain functions and networks, and modulating pathological deep brain states. Interacting with deep brain structures is inevitable for the treatment of many neurological and psychiatric disorders. For numerous disorders, he clinically applicable DBS and EEG-based DBMIs provide additional therapeutic alternatives. Even though there are still many obstacles to overcome in terms of long-term safety, interaction efficacy, accessibility, and other public concerns about neuro-ethics and regulations, DBMs could help more neurological patients and people with disabilities in the future as innovative interacting technologies and advanced control methods develop. They would also advance our knowledge of neural networks and brain functions.

Acknowledgment

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ADVANCED APPLICATIONS OF REMOTE SENSING AND GIS IN NATURAL RESOURCE MANAGEMENT

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Abstract: A limitless possibility to filter and guide regular resources at multiple-transient, multiple-spooky, and multiple-spatial assurance is provided by remote sensing and geographic information systems (GIS). For trademark resource managers, an understanding of the specific capabilities of a steadily expanding selection of image sources and assessment techniques is vital. In this review, we compile the many uses of distant identification and GIS tools that may be used to the organisation of natural resources (cultivation, water, forest, soil, and regular dangers). The knowledge will help basic resource managers better understand and work in tandem with distant distinguishing experts to develop and use remote sensing science to achieve checking aims.

Keywords: GIS, Oceansat, Remote Sensing, Resourcesat, RISAT, Saral, Sensors.

I. INTRODUCTION

Geospatial Technology refers to any technology used to capture, process, and store geographic information. GIS is one form of Geospatial Technology. GPS, remote sensing, and geofencing are other examples of Geospatial Technology.

Remote sensing- remote sensing is a technology for gathering information and analysing an object or phenomenon without physical contact.

GIS (Geographic information System**)-** A geographic information system (GIS) is a computer system that analyses and displays geographically related information. It uses data associated with a unique location.

These are a few more geospatial technologies:

GNSS (Global Navigation Satellite System)

- Survey
- 3D modelling

Several disciplines, including geography, hydrology, ecology, oceanography, glaciology, and geology, utilize this technique. It is a technology to collect and analyse non-immediate geospatial data using electromagnetic radiation sampling.

II. HISTORY OF REMOTE SENSING

History of remote Sensing in World:

In the 1840s, balloonists used the newly developed photo-camera to capture images of the ground, which is when remote sensing got its start. The famous pigeon fleet, which functioned as a novelty in Europe, was perhaps the most unique platform at the turn of the century. During the First World War, aerial photography developed into a useful reconnaissance tool, and during the Second World War, it reached its full potential. The installation of automatic photo-camera systems on the seized German V-2 rockets launched from White Sands, New Mexico, marked the logical beginning of the introduction of remote sensors into space. The potential for mounting film cameras on orbiting spacecraft was realised with the launch of Sputnik in 1957.The first cosmonauts and astronauts travelled across the world with cameras in hand to take

pictures of certain places and potential targets. Sensors tuned to obtaining black and white TV-like images of the Earth were mounted on meteorological satellites that began to fly in the 1960s.

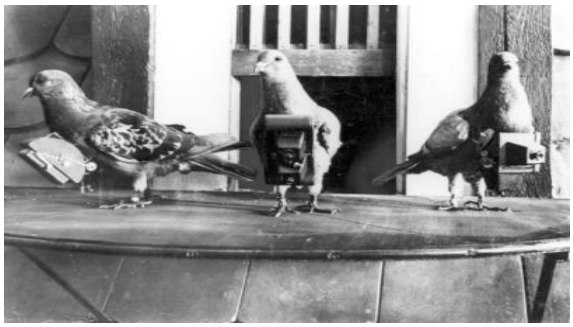

Figure 1: Pigeons with cameras from 1903. (Source- NASA)

History of Remote Sensing in India:
In 1975, national remote sensing agencies (NRSA) were founded. After the Bhaskara-1 and Bhaskara-2 satellites' successful demonstration flights, which were launched in 1979 and 1981, respectively, India's remote sensing programme began with the creation of its own Indian Remote Sensing (IRS) satellite programme. After the launch of IRS-1A in 1988, the Indian Remote Sensing (IRS) satellite system was put into operation. The biggest civilian remote sensing satellite constellation in the world, IRS has eleven operational satellites and offers imageries in a range of geographic resolutions, spectral bands, and swaths. The National Natural Resources Management System uses information from Indian remote sensing satellites for a variety of resource survey and management applications. Earth observation satellite-04 is known as EOS (formerly known as RISAT) commenced on February 14, 2022.

III. Principal of Remote Sensing and GIS

Principal of Remote Sensing:
Radiant radiation that is reflected or replicated by objects or surface material is detected and recorded in order to identify and differentiate between objects or surface characteristics. Several items that came into contact with it left differing amounts of energy in various electromagnetic spectrum areas. This relies on the characteristics of the substance (structural, chemical, and physical characteristics), the roughness of the surface, the angle of incidence, the intensity, and the wavelength of the radiated radiation. In essence, remote sensing is a multidisciplinary science that integrates elements of a number of fields, including optics, spectroscopy, photography, computer, electronics, and communications, satellite launch, etc.

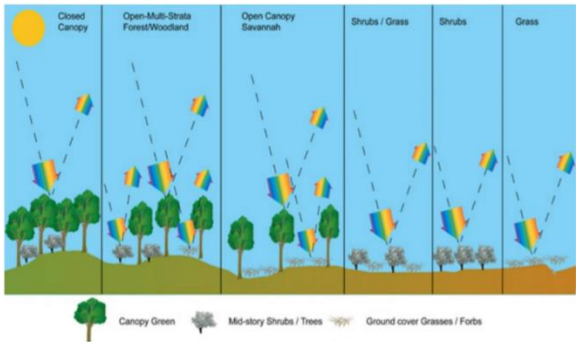

Figure 2: Principle of Remote Sensing.

The Remote Sensing System, which combines all of these technologies into one functional unit, operates independently. A remote sensing process has several steps, and each one is crucial for its efficient execution. Stages in Remote Sensing: Emission of electromagnetic radiation, or EMR (sun/self-emission); Transmission of energy from the source to the earth's surface, as well as absorption and scattering; Interaction of EMR with the earth's surface: reflection and emission; Transmission of energy from the surface to the remote sensor; Output of sensor data.

Principal of GIS:
GIS Datas— Following are the different types used in GIS:
Vector Data: Vector data may be compared to instructions on how to render data. The easiest way to picture it is as a spreadsheet with columns for your usual data and an additional column labeled "geometry" that is always present. This column holds one or more coordinates that specify how to represent the point, line, or polygon on the earth's surface as a point, line, or polygon.
Raster Data: Raster data is literal if vector data is abstract. A bitmap picture, like a TIFF or JPEG, is considered raster data. Typically, topographic maps, elevation models, aerial photography, and satellite images all utilize this format.
Vector Point Data: A point's position is specified by a single set of coordinates. Features of a point are described by its attributes. Although having dimensions in the physical world, points are thought to have none. Power poles, phone poles, and buildings are a few examples of point data.
Vector Line Data: Point data is transformed into vector line data when these points are joined, however it should not be contained. It makes use of a

collection of ordered coordinates. There are several lines and points in a line feature. Each line, node, and vertices allow the attachment of attributes. Thus, each line may include several table rows of attribute values. Road lines, topography lines, electricity lines, and object outlines are a few examples of vector line data.

Vector Polygon Data: Data is said to as polygonal when lines are joined to form an enclosed shape. Polygon ought to be sealed. The beginning and ending points must to be in the same locations. Examples of vector polygon features include city limits, political boundaries, and school boundaries.

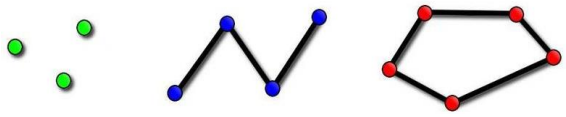

Figure 3: Vector Polygon Data.

GIS Layers—

1. Mapping Reality: Spatial Reference Frameworks.
2. Spatial Data Models for Storing Mapped Data.
3. Collecting Geographic Data: Spatial Data Acquisition Systems.
4. Turning Geographic Data into Useful Information: Spatial Data Analysis.
5. Consuming Geographic Data: Geo-visualization and Information Delivery.

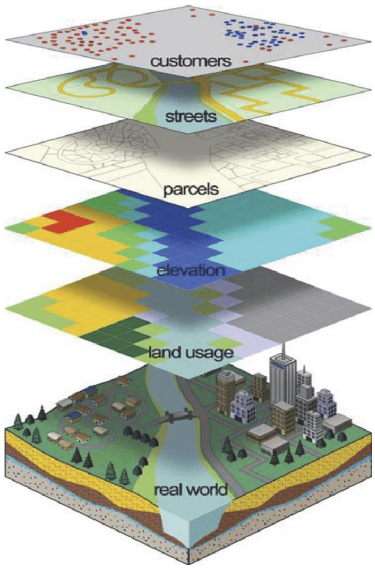

Figure 4: Layering in GIS.

IV. Classification of Remote Sensing

1. With respect to type of energy resources:

Passive Remote Sensing- It uses sensors to identify electromagnetic radiation reflected or released from natural sources, such as solar radiation and earth thermal emission.

Active Remote Sensing- It employs sensors that look for reflected responses from objects that have been exposed to artificially created energy. Example: radar and lidar.

Figure 5: Active and Passive Remote Sensing.

2. With respect to Wavelength regions:
   1. Visible and reflective Infrared Remote Sensing.
   2. Thermal Infrared Remote Sensing.
   3. Microwave Remote Sensing.

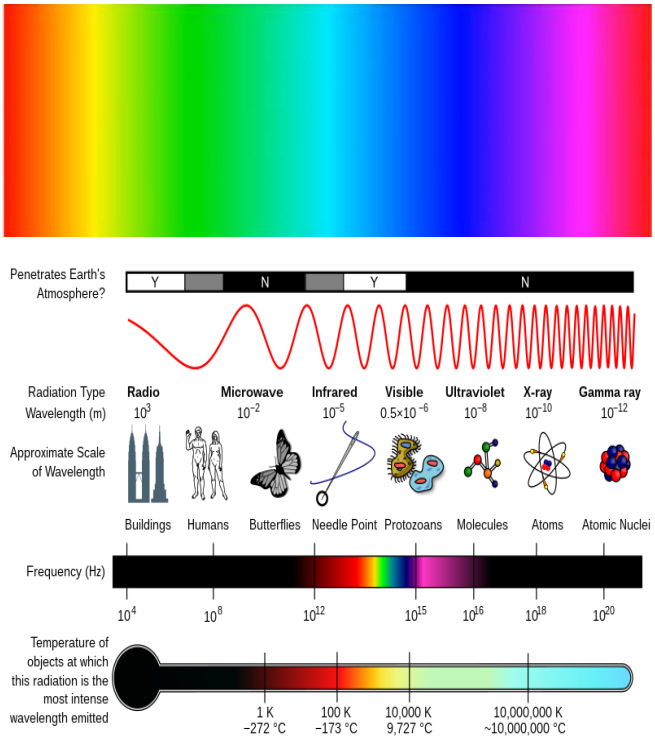

Figure 6: Electromagnetic Spectrum.

Elements of Remote Sensing:

A. Energy Source
B. Radiation & Atmosphere
C. Interaction with Targets
D. Recording of Energy by Sensor
E. Transmission & Reception
F. Interpretation and Analysis
G. Application

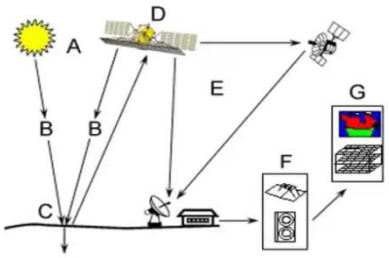

Figure 7: Elements of Remote Sensing.

V. COMPONENTS OF REMOTE SENSING AND GIS

Components for Remote Sensing:

1. A stand for the instrument.
2. object or a target
3. an apparatus or sensor (to observe the target)

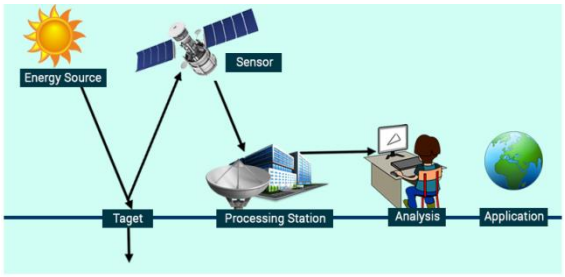

Figure 8: Components for Remote Sensing.

Components of GIS:

A functional GIS combines five essential elements: tools, software, information, people, and processes.

Hardware: A GIS runs on hardware, which is the computer. Currently, GIS software can be utilized with a variety of hardware platforms, including standalone desktop PCs and networked computer servers.

Software: GIS software offers the features and resources required to store, process, and present geographic data. A database management system (DBMS), tools that facilitate geographic query, analysis, and visualization, and a graphical user interface (GUI) for quick access to tools are among the most important software components.

Data: The data may be the most crucial element of a GIS. You can either acquire geographic data on your own or buy it from a commercial data supplier, along with supporting tabular data. The majority of businesses utilize a database management system (DBMS) to store, manage, and organize their data. A GIS can even employ one to manage spatial data.

Methods: A well-designed plan and business rules—which are the models and operational procedures particular to each organization—are the foundation of a successful GIS.

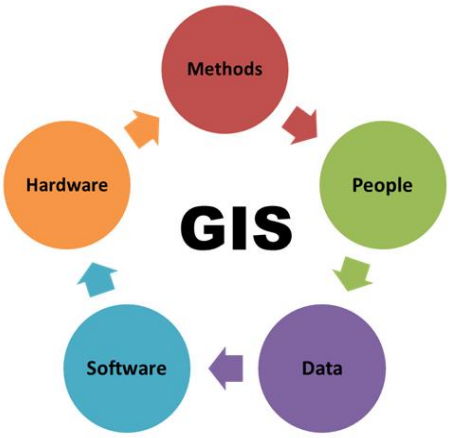

Figure 9: Components of GIS.

Major Sensors of Remote Sensing:

A sensor is an observational tool that employs a satellite as a platform to view broad swaths of the earth's surface.

- Cameras
- Microwave radiometer and Scanners
- Lasers, radio frequency receivers
- Radar system, sonar, thermal devices
- Seismographs, magnetometers
- Scintillometer

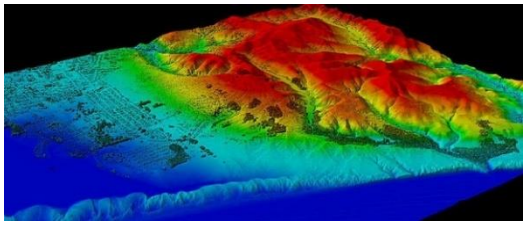

Figure 10: View from lidar Sensor.

Figure 11: Space satellites for remote sensing.

Types of Remote Sensing Satellites:
Theme-based satellites:

1. Land resources based.
2. Oceans resources based.
3. Large scale mapping.

Examples:

1. Land resources based- resourcesat, RISAT, etc.
2. Ocean resources based- Oceansat, saral (Indo-France), etc.
3. Large scale mapping- cartosat-3, etc.

Important centers of remote sensing:

1. National Remote Sensing Centre(NRSC):
   - One of the centres of the Indian Space Research Organization is the National Remote Sensing Centre, or NRSC, which is situated in Hyderabad, Telangana (ISRO).
   - Established in 1974.
   - HQ: Hyderabad, Telangana.
2. Indian Institute of remote Sensing: (LIRS)
   - In the fields of remote sensing, geoinformatics, and GPS technology, the Indian Institute of Remote Sensing is a leading institution for research, higher education, and training.
   - Established in 1966.
   - HQ- Dehradun, Uttarakhand

VI. Applications of Remote Sensing

- Whether
- Forestry
- Agriculture
- Surface changes
- Biodiversity

Primary applications of remote sensing:

1. Gathering images of the planet from space, like landsat.
2. Identification of land use and land cover.
3. Monitoring climate change.
4. Identifying possible landslides.
5. Estimating the snowpack, like lidar.
6. Making a reference map for visuals, like google maps.
7. Petroleum and mineral specialists.

Application of remote Sensing in Agriculture:

1. Crop conditions identification.
2. Enhancing agricultural precision.
3. Measuring the moisture content of the soil.
4. Predicting crop production.
5. Calculating crop damage and crop output.
6. Crop recognition.
7. Stress detection and crop condition analysis.
8. Drought surveillance.
9. Analysis of crop health.

VII. Conclusion

Crop health assessment is the use of remote sensing techniques in scientific and practical research is expanding beyond their traditional usage as a method for acquiring data that users may later evaluate.

Nowadays, a variety of simulation models, including hydrologic, climatic, ecological, and economic models, employ remote sensing data on natural and anthropogenic factors, such as plant cover, land use, topography, and hydrography, as input. Models that help scientists better understand processes like deforestation and land use conversion are developed by combining surveys of demographic and socioeconomic data with classified pictures of land use and land cover.

Geographic information systems also rely heavily on data from remotely sensed imagery and the by-products of imaging processing (GIS). In fact, the majority of complete image analysis software programmes now include GIS functions for change detection overlays, local spatial analysis methods, conversions between raster (pixel-based grids) and vector (points, lines, and polygons defined and displayed on the basis of two-dimensional Cartesian coordinate pairs) data structures, as well as other less directly image-related procedures. Due to their requirement, GIS software packages work with raster data and pictures in a variety of formats and are progressively adding analytical features that were previously only available in dedicated image analysis products.

Remote sensing is unable to offer measurements of human and environmental phenomena, such water quality, vegetation composition, soil qualities, or plant health, with the same level of detail as field-based sampling. Yet, remote sensing has the capacity to see and map vast regions of the earth's surface at various times and to gather data for places that would otherwise be challenging or impossible to sample owing to physical or economical restrictions when combined with field surveys.

As a result, remote sensing has emerged as an important research and application tool in a variety of fields, including engineering, geology, geography, urban design, forestry, and agriculture.

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APPLICATION OF VIBRATION ANALYSIS OF FUNCTIONALLY GRADED PIEZOELECTRIC MATERIALS

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Abstract: The application of vibration analysis of functionally graded piezoelectric materials (FGPMs) is a critical aspect in the design and optimization of advanced engineering structures and devices. Functionally graded materials exhibit spatial variations in their material properties, providing unique opportunities for tailoring mechanical and electrical characteristics. Piezoelectric materials, known for their ability to convert mechanical energy into electrical energy and vice versa, play a pivotal role in the development of sensors, actuators, and energy harvesting devices. This research focuses on the dynamic behavior of FGPMs under various mechanical and electrical excitations. The study employs a comprehensive analytical and numerical approach to investigate the vibration characteristics of FGPM structures. The material properties of the FGPMs are assumed to vary continuously through the thickness in accordance with predetermined distribution functions. The governing equations of motion are derived considering the coupled electromechanical field equations, and appropriate boundary conditions are applied. Analytical solutions for specific cases are obtained, and numerical simulations are conducted to explore the dynamic response of FGPM structures under different loading conditions. The findings of this research contribute to a deeper understanding of the influence of material grading on the vibration response of piezoelectric structures. Moreover, the study provides valuable insights into the design and optimization of FGPM-based devices for applications in aerospace, robotics, and energy harvesting. The developed analytical and numerical methods can serve as a foundation for further research in the field of smart materials and structures, enabling the development of innovative technologies with enhanced performance and functionality.

Keywords: Application, Vibration, Functionally Graded Piezoelectric Materials (FGPMs), Optimization.

I. INTRODUCTION

1.1 Piezoelectric effect:

arge that is proportional to a mechanical stress. It is an interaction between mechanical and electrical system. The direct piezoelectric effect is the development of the electric charge is described by [1]:

$$P_i = d_{ijk}T_{jk} \quad (1)$$

Where, P_i is a component of electric polarization, it is described by charges per unit area, d_{ij} are the component of piezoelectric coupling coefficient and T_{jk} are the component of applied stress.

The piezoelectric effect is the phenomenon of some crystalline material to develop an electric ch The converse effect of an electric field to the piezoelectric is the development of the mechanical strain, is described by:

$$S_{ij}=d_{ijk}E_k \quad (2)$$

The crystals that exhibit piezoelectricity have no centre of symmetry within the crystal. This feature of the crystal exhibits the property of polarity that is the direction of charges in one direction. In non-natural material piezoelectricity actuate through a process of electric polarization. The word polarization means

the electric charges moves perpendicular to the electric field. When DC field applied to the piezoelectric material, this polarised the ceramic and aligning the molecules dipole in the direction of the applied field and provides it with piezoelectric properties.

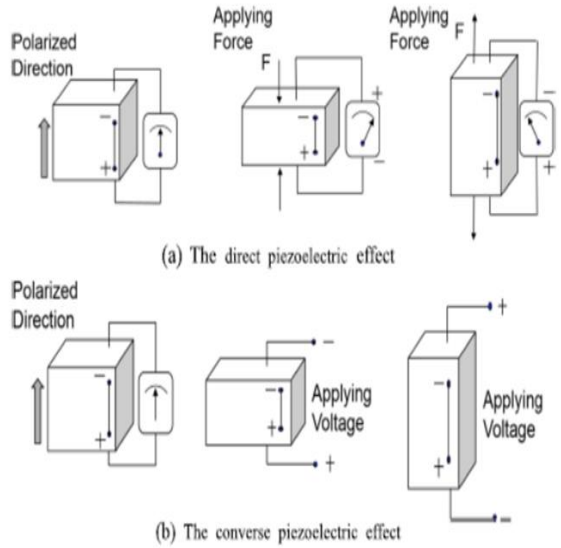

Figure 1: Direct and converse piezoelectric effect [1].

The constitutive relation obtained for piezoelectric by coupling between the mechanical and the electrical parts of a piezoelectric system.

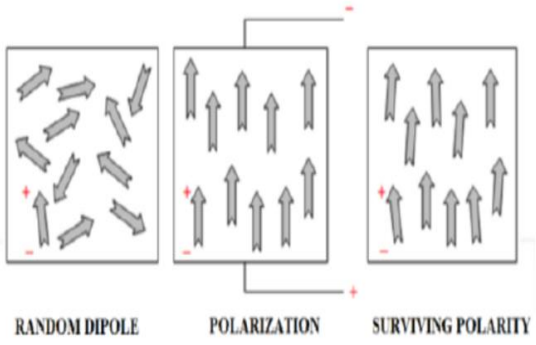

Figure 2: Polarization of piezoelectric material [1].

$$T_{ij} = C^{E}_{ijkl} S_{kl} - e_{kij} E_k \quad (3)$$

$$D_i = e_{ikl} S_{kl} + \varepsilon^{s} E_k \quad (4)$$

T_{ij}, S_{kl}, D_i and E_k are components of the mechanical stress tensor, component of the mechanical strain tensor, component of the electric flux density and the component of the electric field vector. E_{ikl} and ε^s are the components of the piezoelectric constant tensor and components of the dielectric constant tensor [1].

1.2 Types of piezoelectric material:

PZT is one of the widely used piezo-ceramic material. PZT has a peroskite crystal structure each unit of which consists of a small tetravalent metal ion in a lattice of large divalent metal ions. In the case of PZT, the small tetravalent metal ion is usually titanium or zirconium. The large divalent metal ion is usually lead. Under conditions that confer tetragonal or rhombo hedral symmetry on the PZT crystals, each crystal has a dipole moment [7].

If piezoelectric material is deformed, an electric charge is generated which is known as the piezoelectric effect. If electric field is applied to a piezoelectric material, deformation of the material occurs this effect is known as inverse piezoelectric effect. Piezoceramic are preferred choice because they are physically strong, chemically inert and relatively in expensive to manufacture.

Soft piezoceramic powders are typically used when high coupling and high charge sensitivity are important such as in sensor, for accurate inspection of automobiles, structural and aerospace product.

Hard piezoceramic are used when high characteristic is required and used in the application of generation of ultrasonic or high voltage in ultrasonic cleaners, sonar device etc. Important characteristic is the present of high piezoelectric charge constant (d_{33}), a higher mechanical quality factor that reduces mechanical loss and low mechanical loses. Mode of vibration of piezoelectric material always in the thickness direction when considered circular thick plate.

Table 1: Piezoelectric material properties of the material PZT-5 and PZT-4 [2]

		PZT-4 Yang and Xiang [23]	*PZT*-5 Yang and Xiang [23]
Elastic modulus (GPa)	C_{11}	81.3	60.6
	C_{55}	25.6	23.0
Piezoelectric constant (C/m^2)	e_{31}	−5.2	−6.5
	e_{15}	12.7	17
Dielectric constant (10^{-11} F/m)	$\in_{11}$	1300.9	2770
	$\in_{33}$	1150	3009
Pyroelectric constant (10^{-5} C/m^{2}K)	P	5.48	2.5
Density (Kg/m^3)	ρ	7500	7500
Thermal conductivity (W/Km)	λ	2.1	1.5
Thermal expansion (10^{-6}1/K)	α	2	10
Specific heat (J/km)	c_P	339.45	776.53

1.3 Introduction of FGPM:

In addition to their impressive mechanical and electrical capabilities, anisotropic materials like piezoelectric materials can also convert electrical energy into mechanical energy. As a result, their use in various applications, such as sensors, actuators, micro-electromechanical systems (MEMS), active vibration control, and precision position control, has grown significantly. For these applications, it is often desired to achieve larger displacements or deflections, which is typically achieved through a multi-layer stacking method. However, this approach can lead to excessive stress concentration at the interfaces between layers, resulting in a deterioration of bonding strength and potential splitting or peeling off at low or high temperatures. To counteract these undesirable effects, functionally graded materials (FGMs) are utilized in combination with piezoelectric materials. These materials, known as functionally graded piezoelectric materials (FGPMs), exhibit properties that vary according to mathematical functions such as power law, sigmoid law, and exponential law. This allows for a continuous and smooth transition of properties between the layers of the FGPM material, reducing stresses at the interfaces and enhancing the reliability and longevity of the material. Functionally graded piezoelectric materials (FGPMs), whose material properties vary continuously along a specific direction, have been developed. In FGPM, the obvious interface disappears and damage due to stress concentration at the interface is effectively avoided. Research on FGPM and the corresponding structures made from FGPM has attracted the interest of scientists all over the world [3-8].

The piezoelectric effect is one of the most commonly used transfer mechanisms in multi scale electromechanical applications such as sensors, actuators, and energy conversion devices, making piezoelectric vibration energy harvesting attractive. There is a wide range of piezoelectric materials, from piezoceramics, and perovskite-structured lead zirconate titanate (PZT), to piezoelectric polymer films, and polyvinylidene fluoride (PVDF). Among piezoelectric materials, piezoelectric ceramics (PZTs) are currently the most promising for piezoelectric vibration energy harvesting devices because of their ability to generate large power, effective electromechanical coupling, and high mechanical stress under applied electric fields.

1.4 Application of FGPM:

Piezoceramic materials are used in the important field as in the actuators for micro positioning and nano positioning, sensors, conventional vibration detectors, ultrasonic transmitter and receiver for flow or level measurement, object identification and monitoring. They also used in electro acoustic application such as sound transducer and microphones and also as sound pick-ups in the musical instrument [9].

1.4.1 Aerospace Industry-

Piezoelectric materials are used in microprocessors for satellites as given in Figure 3 (a), where they are used to determine the position and stabilize the satellite. The interferometer can be used in the field of optical meteorology, quantum mechanics, seismology, plasma research, and so on. The piezoelectric actuators are used to have a perfect alignment of mirrors inside the interferometer in Figure 3 (b).

It operates at a low voltage having no electromagnetic interference (EMI). Piezos are used to monitor the condition of a structure, during which the integrity of the mechanical structures is checked. This is very important in cases where security is an important issue, for example, an aircraft that requires scheduled service and assembly of selected parts (Figure 4). The sensors used to monitor the condition of the structure are mounted or integrated into structures that are constantly monitored.

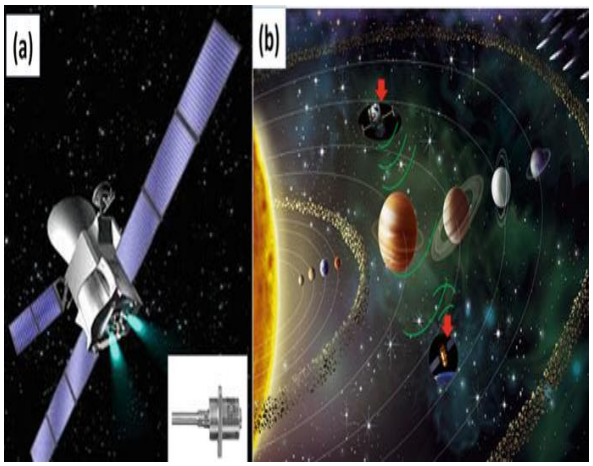

Figure 3: (a) Micro-thrusters of satellites (b) Showing the interferometry used in space [9].

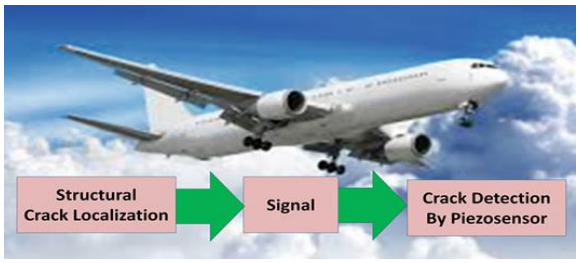

Figure 4: Piezoelectric materials used in (a) Structural health monitoring & (b) Active vibration damping [9].

1.4.2 Marine Industries-

Piezos uses underwater imaging system modulators as shown in Figure 5 (a). Their objective is to detect substances underwater and knowing the texture at the bottom. They are also used to know the signs of lakes, oceans, and so on. Piezoelectric materials are used for sonar underwater communications, where you can use sonar sound waves. Acoustic wave is the most convenient underwater communication for sending and receiving data underwater as shown in Figure 5 (b).

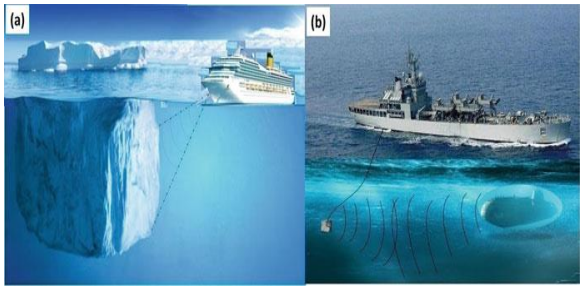

Figure 5: (a) Underwater imaging & (b) Underwater communication [9]

1.4.3 Automobiles-

Engine manufacturers are constantly faced with the challenges of controlling engine parameters. In unfavourable conditions, petrol engines tend to knock which is called detonation. Detonation is very hazardous for the engine. The control system can detect detonation well before so that necessary changes can be done beforehand as shown in Figure 6 (a). Piezoelectric devices have a high-frequency response. It doesn't require blowers, diaphragms, or any type of mechanical connection in combination with a voltage sensor or displacement sensor. Hence piezoelectric pressure sensors are used to measure dynamic pressure changes and provide more accurate results than conventional sensors. By using piezoelectric actuators that control the small valves inside the fuel injection nozzles such precise control of the high-pressure fluid is Possible. Different piezoelectric sensors in different general positions are shown in Figure 6 (b).

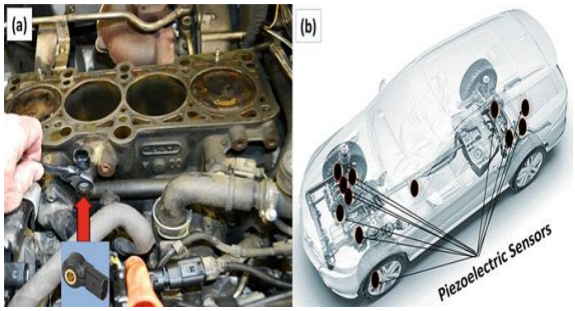

Figure 6: (a) Engine knock sensors and (b) various piezoelectric sensors in automobile [9].

1.4.4 Electrical and Electronics-

The ink jet printer incorporates piezoelectric actuators as the printer head. It uses a diaphragm type head which changes the geometry of an ink well so that it will produce various shapes of ink droplets on the paper. This is the most versatile type of printer in the market. Figure 7 (a) shows the piezoelectric material used in a continuous ink launch system. Figure 7 (b) shows piezoelectric speakers, appears in almost every application that needs to produce sound from electronic gadget efficiently. The speakers are very efficient and use very little power. These are used in mobiles, ear buds, toys, musical greeting cards, and many more. They can produce more sound in a smaller frequency range. Buzzers are used in many electronic devices, humidifiers, electronic toothbrush, and so on.

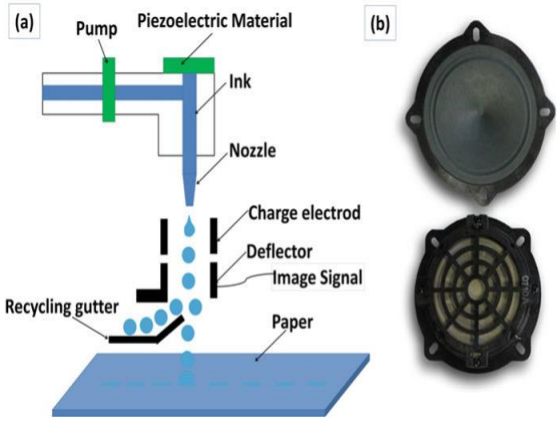

Figure 7: (a) Piezoelectric material used in a printer and (b) piezoelectric speakers [9].

1.4.5 Biomedical-

Piezoelectric materials are broadly used in medical appliances like ultrasound scanners for medical imaging. In pregnancy monitoring, an ultrasound scanner is used as shown in Figure 8 (a). Piezoelectric transducers are also used for ultrasonic dental scalers for removal of scaling, which is more efficient than traditional scale removal (Figure 8 (b).). In this scaling removal process, the piezoelectric actuator changes its size when induced with electric energy. The scalar vibrates against the tooth, creates sound energy, and in turn removes the scaling.

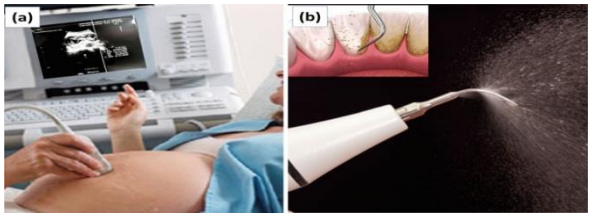

Figure 8: Ultrasound scanners for medical imaging of pregnancy monitoring and (b) ultrasonic dental scalers removal of plaque and calculus [9].

High-Intensity Focused Piezo Ultrasound (HIFU) used for non-contact tissue ablation is given in Figure 9 (a).. The ultrasound-based ablation of tissue, for example for the removal of tumors in the prostate or uterus, is carried out extracorporeal and is, therefore, noninvasive. For this therapy, HIFU is projected into the body with the help of piezoelectric elements. I Ceramic offer a wide range of piezo components that can be used to build HIFU transducers: discs, plates, and focus bowls are manufactured in customer-specific geometries and electrode designs. The resulting focus elements are suitable for use in strong magnetic fields, for example, in MRT applications. Targeted drug delivery using HIFU enables the release or activation of drugs at a specific site in the body Figure 9 (b).

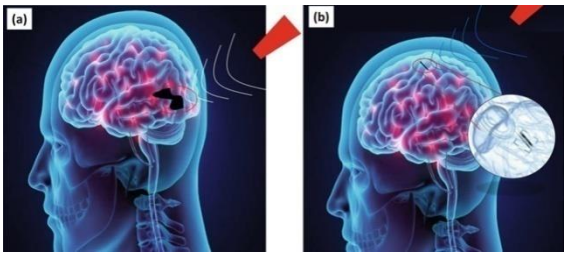

Figure 9: (a) Non-contact tissue ablation and (b) targeted drug delivery [9].

1.4.6 Energy Harvest-

Some industry demands electrical energy by the application of force, vibration, pressure, and so on. The electrical energy produced can be used or stored for future use. This is called energy harvesting. Energy harvesting can be done from any piezoelectric type. Inventors come up with new ideas of energy storage in piezoelectric devices, from shoes (Figure 10 (a)) that surround foot movements to heat to keep feet warm, and cell phones that charge outside of movements, from your body (Figure 10 (b)), highways that create street lights (Figure 10 (c)), contact lenses (Figure 10 (d)) that capture energy when you blink, and even devices that generate energy from the pressure of the falling rain. The shoe with a built-in piezoelectric transducer has a spring system that vibrates when someone walks. It leads to the storage of energy in the battery. Similarly, in the case of a cell phone, each time it is charged excess energy is stored and at the need, it is discharged. The Footstep micro-controller-based power generation system is operated by a direct piezoelectric. This is used to generate tension with the power of the steps. The energy harvesting process is very essential in public places like bus stops.

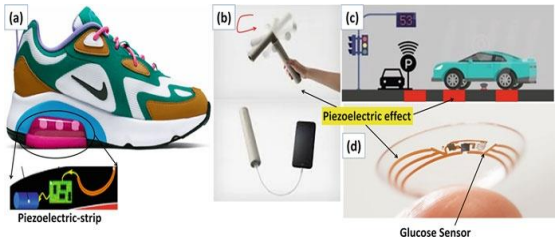

Figure 10: Piezoelectric energy harvest in (a) Shoes, (b) Cell phones, (c) Roads that power streetlights, and (d) Contact lenses [9].

1.4.7 Household and other Application-

The piezoelectricity has extensive applications in various household appliances. It is used in music assets. In a piezoelectric igniter, a bottom is used to release a spring-loaded hammer, which in turn strikes a rod-shaped piezoelectric ceramic. Due to the high strain rate in piezoelectric material high voltage is created, which is enough to surpass the spark gap. Hence spark starts and fuel ignites (Figure 11 (a)). Many acoustic instruments (Figure 11 (b)) utilize piezoelectric pickups to convert

acoustic vibration to electrical energy. Generally, the piezoelectric material is placed in between the instrument body and its support. In the case of the violin, as the strings vibrate, they generate electrical signals. Some microphones use piezoelectric materials to convert sound vibrations into electrical output (Figure 11 (c)). These microphones usually have high output impedance's, which have to happen when designing their respective preamplifiers. A somewhat unusual application of piezoelectricity integrates piezoelectric fibers into the neck of a tennis racket (Figure 11 (d)) along with a microcontroller in the handle. When the tennis player shoots the ball, it loses the frame of the racket and generates an electrical output that is powered, reversed, and returned to the fibers.

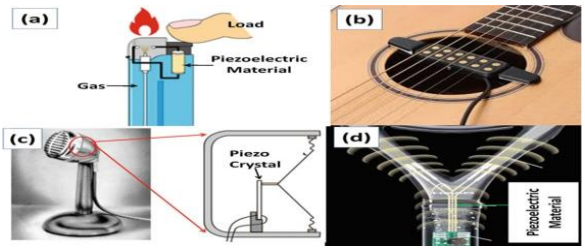

Figure 11: (a) Piezoelectric igniter, (b) Instrument pickups, (c) Microphones, (d) Tennis Racquets [9].

II. CONCLUSION

The conclusion behind vibration analysis of functionally graded piezoelectric materials lies in gaining a deeper understanding of the mechanical and electrical behavior of these materials under dynamic loading conditions. Functionally graded materials (FGMs) have varying material properties across their volume. Analyzing the vibration characteristics helps in optimizing the design of these materials for specific applications, such as sensors, actuators, or energy harvesters.

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EXPLORING THE CREATIVE ABILITY OF PROMPT ENGINEERING

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Abstract: The advent of Artificial Intelligence (AI) has spurred the emergence of unique professions, one of which is prompt engineering. This research paper titled "Exploring the Potential of Prompt Engineering in India: A Study on the Future of AI-Driven Job Market and the Role of Higher Education" delves into the potential of India to become a global hub for prompt engineers. Prompt engineering, a novel field which combines natural language processing, machine learning, creativity, and linguistic expertise, involves designing effective prompts for large language models (LLMs) like ChatGPT. These models then generate responses based on the given inputs, finding applications in various sectors such as customer support, content generation, finance, healthcare, and education.

Keywords: Prompt Engineering, Artificial Intelligence (AI), Engineering Education in India, Higher Education, Skills and Opportunities, Future of AI.

I. INTRODUCTION

The dawn of the 21st century has seen a rapid progression in technological advancements that have transformed the way we live and work. A significant catalyst of this transformation is Artificial Intelligence (AI), a technological revolution that has swept across industries, influencing everything from customer service and healthcare to finance and education.

Evolution of Prompt Engineering: The study will first explore the concept of prompt engineering, tracing its evolution and understanding its role in the broader AI development landscape. It will review global practices and advancements in the field, setting a benchmark against which India's progress can be assessed.

Assessing the Current Scenario of Engineering Education in India: The research will delve into the present state of engineering education in India. It will analyze how equipped Indian universities are to adapt to the evolving needs of the technology industry, particularly in terms of AI and prompt engineering.

Identifying Skill Requirements and opportunities: The research will identify the essential skills and qualifications necessary for a career in prompt engineering. It will also explore the opportunities available for fresh graduates in this field, both within India and globally.

Examining the Role of Indian Universities: The study will examine how Indian universities can play a pivotal role in cultivating prompt engineers. This will involve an analysis of the current curriculum, faculty capabilities, infrastructure, and collaborations with the industry. The research will also identify the challenges faced by these universities and recommend solutions.

Projecting Future Demand and Implications: Lastly, the study will forecast the future demand for prompt engineers in India and globally. It will analyze the economic and technological implications of this demand, providing insights into the potential impact on job markets and economic growth. By fulfilling these objectives, the research will provide a comprehensive understanding of the potential of prompt engineering in India. It will offer insights that

can guide policymakers, educators, and industry leaders in making strategic decisions to harness the benefits of this emerging profession.

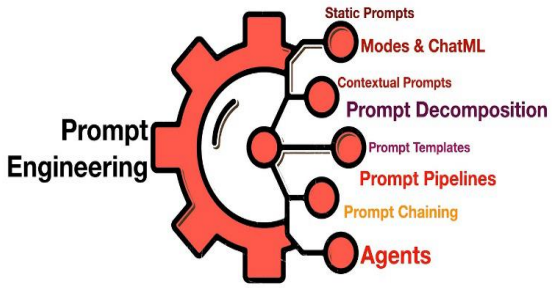

Figure 1: Prompt Decomposition.

II. Role of Prompt Engineering in AI Development

Prompt engineering, an essential discipline within the realm of artificial intelligence (AI), plays a pivotal role in AI development. This discipline focuses on the crafting of effective prompts to guide large language models (LLMs) like OpenAI's GPT-3, producing relevant and useful outputs. This comprehensive analysis delves into the role of prompt engineering in AI development, capturing its importance, key contributions, and future potential. The evolution of AI from rule-based models to self-learning models has necessitated the rise of prompt engineering. As AI models become more sophisticated and capable of understanding and generating human-like text, the need for skilled prompt engineering becomes paramount. Essentially, prompt engineering serves as the "user interface" for these complex AI systems.

Research Design:

In the realm of artificial intelligence (AI), the research design in prompt engineering offers an intriguing blend of traditional research methodologies with the nuances of AI development. It provides a structured approach to investigate how different prompts affect the performance of AI models. This comprehensive exploration delves into the methodology of research design in prompt engineering, outlining its key components, the process involved, and its crucial role in ensuring robust and valid AI development. At the heart of research design in prompt engineering is the research question – this forms the basis around which the design is built. The research question could be focused on understanding how the structures of prompts influence the outputs of AI models, or how different prompt strategies can mitigate the biases in AI responses. Next is the selection of the research design type, typically exploratory, descriptive, or experimental, depending on the research objectives. An exploratory design could be used to gain insights into new prompt strategies. A descriptive design might delve deeper into existing prompt methods and their effects, while an experimental design would be apt for testing hypotheses about the relationship between different prompts and AI outputs.

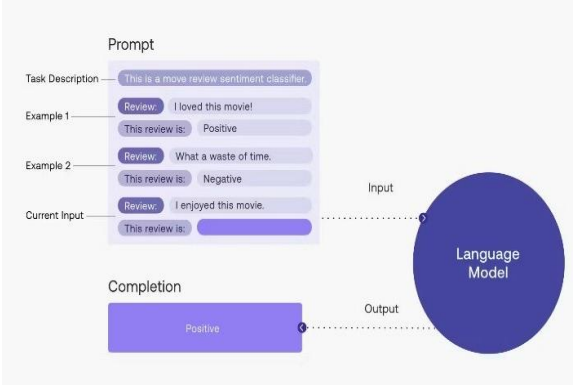

Figure 2: Process of Prompt.

Data Collection:

Data collection is a critical component in the field of prompt engineering, a domain within artificial intelligence (AI) that focuses on crafting and optimizing prompts to enhance the performance of AI models. This comprehensive exploration delves into the methodology of data collection in prompt engineering, outlining its key components, the process involved, and its crucial role in ensuring robust and valid AI development. Starting with defining data requirements, the research question and objectives guide the type of data needed in prompt engineering. For instance, if the research question aims to understand how different prompts influence an AI model's responses, the data needed would be the AI responses to various prompts.

Data Analysis:

Data analysis is a fundamental pillar in the field of prompt engineering, an area in artificial intelligence (AI) that emphasizes the development and optimization of prompts to improve AI model performance. This detailed exploration delves into the methodology of data analysis in prompt engineering, outlining its key components, the process involved, and its crucial role in ensuring robust and valid AI development.

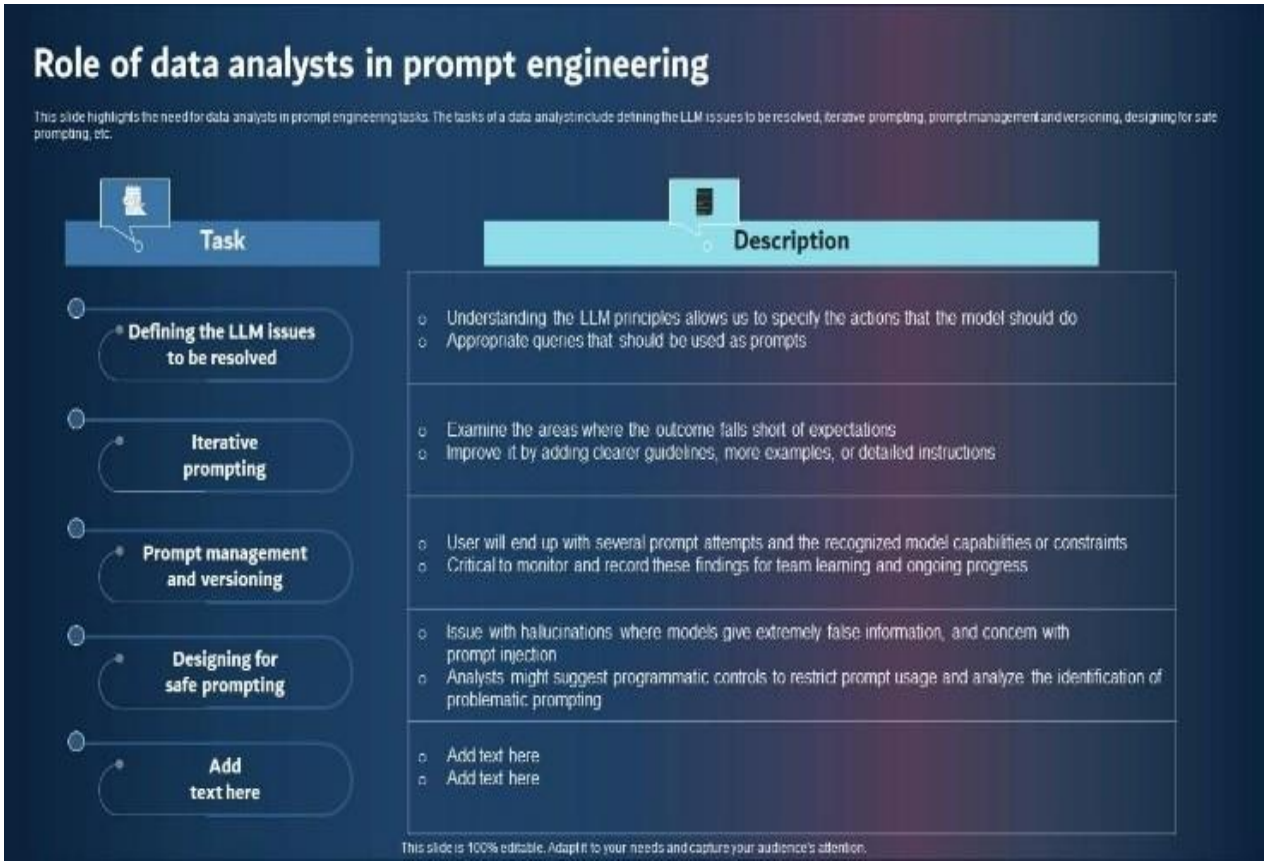

Figure 3: Role of Data Analyst.

III. Current Scenario of Engineering Education in India

India, with its vast talent pool and rapidly developing technology sector, possesses immense potential in the field of prompt engineering, an area in artificial intelligence that focuses on developing and optimizing prompts to improve AI model performance. This comprehensive exploration delves into the current scenario of engineering education in India, outlining its strengths, challenges, and how it can contribute to the future of prompt engineering.

The Initiative for Prompt Engineering Courses in Indian Universities:

India, with its burgeoning talent pool and rapidly evolving technology sector, holds tremendous potential in the field of prompt engineering, a specialized domain within artificial intelligence (AI) that emphasizes the development and optimization of prompts to enhance AI model performance. This detailed exploration delves into the initiative for introducing prompt engineering courses in Indian universities, outlining its significance, potential impacts, and the way forward.

IV. The Potential of India as Major Exporter of Prompt Engineers

India, known for its large reservoir of engineering talent and fast-growing technology sector, holds promising potential to become a major exporter of prompt engineers - professionals specializing in the field of prompt engineering, an area within artificial intelligence (AI) that emphasizes on developing and optimizing prompts to enhance AI model performance. This in-depth exploration delves into the potential of India in this regard, outlining its strengths, challenges, and potential strategies to harness this potential.

The Future of Prompt Engineering:

Prompt engineering, a specialized domain within artificial intelligence (AI) that focuses on the development and optimization of prompts to enhance AI model performance, is charting a promising future. With advancements in AI and machine learning technologies, the scope and potential of prompt engineering are expanding. This detailed exploration delivers into the future of prompt engineering, outlining its potential developments,

significance, and the challenges to be addressed. In the coming years, prompt engineering is set to play a pivotal role in the evolution of AI. The ability of a system to understand and respond to prompts effectively is central to its performance. For instance, AI-powered virtual assistants like Siri, Alexa, and Google Assistant rely heavily on prompt engineering to comprehend user requests and generate appropriate responses.

Industry Demand for Prompt Engineers:
As businesses increasingly adopt artificial intelligence (AI) for various applications, the demand for specialized roles in this field is growing. One such role is that of prompt engineers, professionals who develop and optimize prompts to enhance the performance of AI models. This detailed exploration delves into the industry demand for prompt engineers, outlining its significance, the factors driving this demand, and the challenges to be addressed.

Scope and Applications of Prompt Engineering:
Prompt engineering, a specialized realm within artificial intelligence (AI) that focuses on the creation and optimization of prompts to improve the performance of AI models, is expanding its horizons. The scope and applications of prompt engineering are growing with the advances in AI technology and the increasing adoption of AI across various sectors. This comprehensive exploration delves into the scope and applications of prompt engineering, outlining its key areas of application, the factors driving its expansion, and the challenges to be addressed.

Becoming a Prompt Engineer: Skills and Opportunities:
Artificial intelligence (AI) is an ever-expanding field, creating a wide array of specialized roles, one of which is prompt engineering. These professionals are responsible for developing and optimizing prompts to improve the performance of AI models. This comprehensive exploration delves into the journey of becoming a prompt engineer, outlining the skills required, the opportunities available, and the challenges to be addressed. The first step towards becoming a prompt engineer is gaining a strong foundation in AI and machine learning. This involves understanding AI algorithms, machine learning models, and techniques. A degree in computer science, data science, or a related field is often a good starting point. However, the role of a prompt engineer goes beyond just technical skills. They also need a strong understanding of natural language processing and human-computer interaction. This involves understanding the nuances of human language and how to translate them into prompts that an AI system can understand and respond to.

Essential Skills for Prompt Engineers:
Prompt engineering, a specialized role within the field of artificial intelligence (AI), involves the creation and optimization of prompts to enhance the performance of AI models. The job of a prompt engineer is a blend of technical prowess, linguistic understanding, and creative problem-solving.

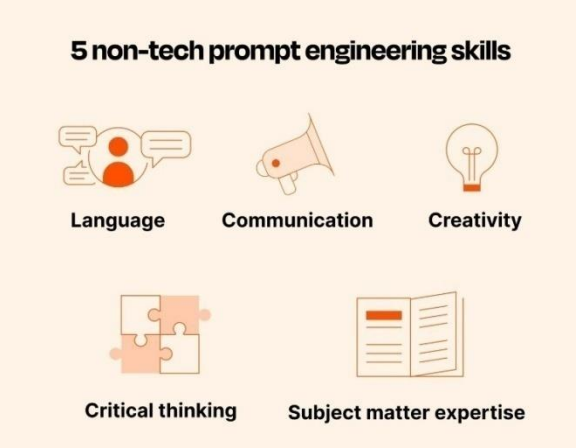

Figure 4: Non-tech prompt engineering skills.

Opportunities for Fresher in Prompt Engineering:
Prompt engineering, a specialized role within the field of artificial intelligence (AI), is a relatively new career path that's rapidly gaining traction. As businesses increasingly adopt AI technologies, the demand for professionals who can guide and optimize the performance of AI models such as prompt engineers is rising. This exploration will delve into the various opportunities available for fresher in the field of prompt engineering.

Projected Demand for Prompt Engineers in the Future:
As artificial intelligence (AI) continues to permeate various sectors, the demand for specialized roles within this domain is on the rise. One such role is that of a prompt engineer, responsible for creating and optimizing prompts to guide the responses of AI models. This comprehensive exploration provides insights into the projected demand for prompt engineers in the future, outlining the influencing factors, potential growth areas, and challenges to be addressed.

V. The Role of Indian Universities in Cultivating Prompt Engineers

In the ever-evolving realm of technology, the demand for specialized roles, such as prompt engineers within the field of artificial intelligence (AI), is exponentially growing. This comprehensive analysis discusses the role of Indian universities in cultivating prompt engineers and the implications of their efforts. With the rapid adoption of AI technologies in diverse sectors, the demand for prompt engineers is on the rise. This has underscored the significance of educational institutions, particularly universities, in nurturing the talent required to meet this demand. Indian universities, renowned for their strong emphasis on engineering and technology disciplines, are uniquely positioned to play a pivotal role in cultivating prompt engineers. They have the potential to provide students with the foundational knowledge, technical skills, and creative problem-solving abilities that are integral to this role.

Economic and Technological Implications:

The widespread adoption of advanced technologies, such as artificial intelligence (AI) and machine learning, has profound economic and technological implications. This comprehensive analysis delves into these implications, offering an insightful discussion based on accurate and current data.

Prompting refers to the process of crafting well defined and structured input queries or prompts for artificial intelligence models. This allows them to produce desired outputs or responses and fine tune the behavior of these models for specific tasks and applications.

Prompt engineering can be used to translate project documents and communications into multiple languages. This can help to ensure that all stakeholders, regardless of their native language, have access to the information they need. Generate personalized emails and messages for stakeholders.

VI. Challenges and Recommendations for the Future

As we venture further into the era of technological advancements, several challenges emerge that require critical attention and strategic planning. This discussion outlines the challenges and offers recommendations for navigating the future effectively.

Challenges:

Technological Disruption and Job Displacement- As automation and artificial intelligence (AI) technologies become increasingly prevalent, many jobs, particularly those involving routine tasks, are at risk of displacement. McKinsey Global Institute estimates that 375 million workers worldwide may need to change their occupational categories by 2030 due to automation.

Cybersecurity Threats- The surge in digital connectivity has significantly increased the potential for cyber threats. According to Cybersecurity Ventures, the global cost of cybercrime is projected to reach $10.5 trillion annually by 2025, highlighting the urgency of addressing this issue.

Ethical Dilemmas- The rise of AI has also brought about ethical dilemmas related to privacy, transparency, and bias. For example, the use of AI in decision-making processes can lead to biased outcomes if the underlying algorithms are trained on biased data.

Digital Divide- Despite the rapid digitization, a significant portion of the global population still lacks access to basic digital services. The United Nations reports that as of 2021, 2.9 billion people, or 37% of the world's population, do not use the internet, exacerbating social and economic inequalities.

VII. Conclusion

In this in-depth exploration of the potential of prompt engineering in India, we have traversed through its current scenario, its burgeoning future, and the consequent role of higher education. The journey through these diverse yet interconnected aspects brings us to a point of reflection and synthesis. Prompt engineering, a burgeoning field within the broader landscape of artificial intelligence (AI), holds significant promise for the future of the tech industry, both globally and in India. This discipline's primary role revolves around creating and refining prompts to guide AI models like GPT-4 effectively. The research conducted and presented in this report underscores the immense potential India holds in the realm of prompt engineering. With a robust foundation in engineering education and a rapidly growing tech industry, India is uniquely positioned to become a major exporter of prompt engineers. The study revealed that the introduction of prompt engineering courses in Indian universities could significantly enhance this potential. By integrating these specialized courses into their curriculum, universities can equip students with the necessary skills to excel in this promising field.

This conclusion summary of the research presented in the paper. It encapsulates the key findings and implications, offering a holistic view of the potential of prompt engineering in India and the consequential role of higher education. The intention behind this research paper is to inspire further exploration and action in this promising field and contribute to shaping a future where AI technologies like prompt engineering drive progress and prosperity.

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HEAVY METALS IN ROAD DUST AND THEIR SOURCE ATTRIBUTION AT AN INDUSTRIAL CITY KOTA, RAJASTHAN

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Abstract: Considering the role of industrial activities, vehicles emission, traffic flow densities as sources of heavy metal pollution and climate change atmospheric activities such as wind and runoff in transporting them heavy metals in road dust the present study analyses concentrations of selected heavy metals such as anthropogenic origin metals (Cu, Pb, Cd and Zn) and crustal origin metals (Ca and Fe) in 47 dust samples obtained from road environment of houses in the industrialized Kota city, India in summer months (March, April, May and October, 2022). The chemical analysis revealed the concentrations of heavy metals in the order of Ca >Fe > Zn > Pb > Cu > Cd. Meteorological conditions such as temperature, relative humidity, wind velocity and wind direction during summer months were found influencing the metals concentration. Wind rose indicates the sampling sites facing predominant North wind direction from point source Kota Thermal Power Plant (KTPP) in summer (21.20%) were closest to the source and hence encountered highest metal burden. Statistical analysis by Pearson's correlations, enrichment factor and principal component analysis indicates that coal-based Kota Thermal Power Plant is the major source of heavy metals besides other industrial activities in the study area.

Keywords: Enrichment Factor, Heavy Metals, Kota Thermal Power Plant, Pearson's Correlations, Principal Component Analysis, Road Dust.

I. INTRODUCTION

Road dust comprising of solid particles get deposited on hard road surfaces, such as cement and sidewalks in urban areas [1]. Road dust has a significant role as a "sink and source" of heavy metals due to their escalated levels and frequent interactions of dust with the atmosphere through resuspension and atmospheric deposition of particulate matter [2-3].

Thus, Road dust contributes greatly to atmospheric pollutants in these areas [4-5] which can be inorganic, organic, or a complex mixture of both. These pollutants might be originated by construction and demolition activities, mining and mineral processing, agricultural activities, sea spray, wind-blown dust, automobiles and transportation related activities on the road. Coal combustion and mining activities are known to cause adverse impacts in the atmosphere [6].

Various mining operations such as crushing, grinding, excavating, smelting, and refining cause large quantities of dust laden with high levels of heavy metals which after being released in air get deposited as road dust[7-8].

Among the many inorganic pollutants originating from anthropogenic activities, heavy metals such as Cadmium (Cd), lead (Pb), copper (Cu), zinc (Zn), are

of a major concern due to their toxic and potentially carcinogenic characteristics. These metals cause serious effects on human health as it adversely such as affects the nervous system, kidney function, immune system, reproductive, liver function, the cardiovascular system.

These heavy metals which are abundant in urban road dust [9-11] enter easily through ingestion, inhalation, and dermal contact [12] due to their small particle size and inherent mobility in windy weather and pose a significant health risk to living beings [13-14].

Kota City is having several small- and large-scale industries including DCM Shriram Consolidated Limited (DSCL), Multimetals Limited, Chambal Fertilizers and Chemicals Limited (CFCL), Shriram Fertilizers and Metal India, Shriram Rayons and a number of Kota stone mining units along with point source KTPP [15].

The contamination characteristics of heavy metals in Road dust in Kota, as well as the association between dust-borne metallic elements are not well understood and the metal pollution status of Road dust in this area is quite limited.

In an effort to supplement and obtain more information regarding Road dust pollution in Kota, we have decided to carry out the present research work.

The main objectives of this study include: (i) To determine the composition of road dust in terms of crustal (Ca and Fe) and anthropogenic (Cu, Pb, Cd and Zn) metals at selected 47 sampling sites covering entire Kota city area; (ii) to identify possible sources of heavy metals associated with road dust using Enrichment factor, Pearson correlation coefficient and Principal Component Analysis; (iii) to study the effect of climate on the concentration levels of heavy metals as a function of distance from KTPP and meteorological parameters such as temperature, relative humidity, wind speed and wind direction. The study has indicated the influence of coal based thermal power plant and industrialization of the rapidly growing city on the concentration levels of heavy metals in road dust.

II. Materials and Methods

A. Study area:

Applying some certified standards, 47 sampling sites were chosen through the Global Positioning System. Figure 1 shows location of all the chosen sampling sites. Sampling was performed in the summer months (March, April, May and October, 2022) at these sites.

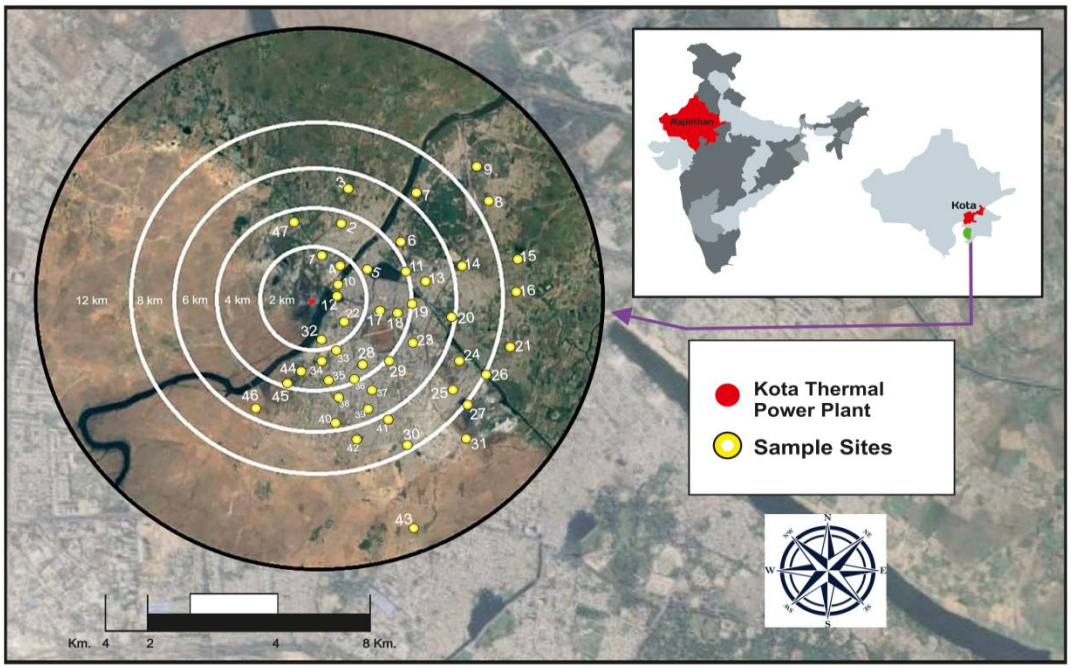

Figure 1: Location of sampling sites of Kota city in the study area.

B. Road Dust Sample Collection and Analysis:

With the aid of household vacuum cleaners, 188 (47 samples * 4 months of sampling period) residential road dust samples (one sample from each sampling sites per month making it 47 samples per month) were collected. Each sample was placed in an unused dust container and the brush was cleaned beforehand using a plastic spatula. Each dust sample was

collected and immediately placed into a labelled airtight polyethene package for secure storage and transit [16].

C. Total heavy metal digestion:

After the samples were run through 300 BSS (< 53 µm) sieves, they were digested for further process. Total metals extraction was carried out through Nitric acid (HNO3) digestion [17]. Following digestion, the concentrations of 6 selected metals (Fe, Zn, Cu, Cd and Pb) has been determined using Direct Air – Acetylene Flame method (AAS-Shimadzu-6300) while Flame Photometer (Systronics -128) method was used for Ca metal. Precision and accuracy of analysis and the digestion procedure were monitored with the help of internal standards, certified reference material and quality control blanks.

D. Monitoring of meteorological parameters:

Automated Weather Station (model number: DCPAWS02) mounted at the Kota Aerodrome, India provided the meteorological data during the measurement period (January, 2022 to October, 2022). The wind speed, ambient temperature and humidity data (Table 1) were recorded hourly and averaged over the 24 hours operation time of samplers. Wind rose in Kota city during the sampling period were shown in Figure 2.

Table 1: Meteorological conditions all through the study period

Meteorological conditions	Measurements
Temperature (°C)	31.64 ± 12.85
Relative humidity (RH) (%)	38.31 ± 15.26
Wind speed (m/h)	1.7± 1.2
Rainfall (mm)	1.61

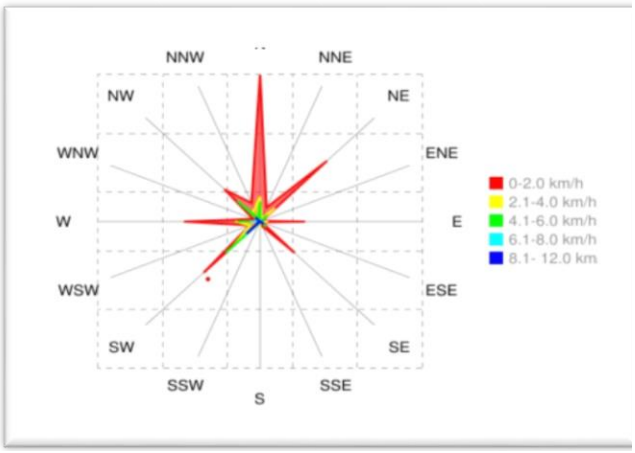

Figure 2: Wind rose in Kota city during the sampling period

E. Statistical analysis:

Statistics were performed from the data using SPSS 22.0 and MS-Excel 2021.

III. Result and Discussion

A. Metal analysis:

Concentrations of Cu in the collected road dust samples are shown in Figure 3, which indicates the highest average copper concentration (0.891225 mg/L) at Sampling Site S_1. The lowest average copper concentration (0.353975 mg/L) dust recorded in Sampling Site S_{43}.

Concentrations of Pb in the collected road dust samples are shown in Figure 4, which indicate highest average lead concentration (2.596975mg/L) at Sampling Site S_1 while, the lowest average lead concentration in dust (0.7169mg/L) was found in Sampling Site S_9.

Concentrations of Cd in the collected road dust samples are shown in Figure 5. Highest average cadmium concentrations (0.0714 mg/L) at Sampling Site S_1 while, the lowest average Cd concentration was (0.03435mg/L) found at sampling site S_{43}. Long-term exposure to cadmium is associated with renal disfunction and bone damage [18].

Concentrations of Zn in the collected road dust samples are shown in Figure 6. The highest average content of Zn (6.065025 mg/L dust) was found at Sampling Site S_1. Sampling Site S_{10}, too, was found to face high Zn concentration (6.05315 mg/Ldust) while, the lowest average Zn concentration (2.697525 mg/L) dusts found at sampling site S_{43}.

Concentrations of Fe in the collected road dust samples are shown in Figure 7. The highest average Fe concentration was (91.48258 mg/L)dust found at Sampling Site S_{11} (residential area), and Sampling Site S_3while, the lowest average Fe concentration (80.46893 mg/Lin dust) was found at sampling site S_{32}.

Concentrations of Ca in the collected road dust samples are shown in Figure 8. The highest average Ca concentration was (776.06 mg/L) found at Sampling Site S_3, and Sampling Site S_{11} while, the lowest average Ca concentration (1801.818 mg/Lin dust) was found at sampling site S_{32}.

Thus, it is obvious from the results shown in Figure 2 to Figure 7 that the average concentrations of analysed metals Cu, Pb, Cd, Zn, Ca and Fe were highest in sampling sites S_1(0.891225mg/L), S_1(2.596975 mg/L), S_1(0.0714 mg/L), S_1(6.065025 mg/L), S_3(2776.06mg/L) and S_{11}(91.48258 mg/L) respectively and lowest in S_{43}(0.353975 mg/L), S_9(0.7169 mg/L), S_{43}(0.03435 mg/L), S_{43}(2.697525

mg/L), S_{32}(1801.818 mg/L) and S_{32}(80.46893 mg/L) respectively.

As the present research aims at determining the pollution load of copper, lead, cadmium, zinc, calcium, and iron under meteorological observation, it is worth mentioning here that the higher concentration of Cu, Pb, Cd, Zn at S_1 sampling site is due to closest distance of this site to the point source KTPP and lower concentration of Cu, Cd, Zn metals are found at S_{43} sampling site due to its farthest location from KTPP. But the concentration of Pb is found to be lowest in S_9which is characterised by mainly residential area having less sources of traffic emission along with the opposite blow of predominant wind direction (North) towards that site.

During the sampling period, high average temperature (46.66°C), low relative humidity (38.31%) and high average wind speed (15m/h) (Table 1) caused lower concentrations of anthropogenic origin metals (Cu, Pb, Cd and Zn) while crustal origin metals (Ca and Fe) are found to be in higher concentration owing to their more deflation and transport caused by high wind strength.

Ca and Fe, mostly found in the local soil, are mobilized or resuspended before being assimilated in the study area. Higher concentrations of Ca metal are due to its abundance in the earth's crust and soil, while Fe is found as oxide, such as limonite, siderite etc. [19-20].

Neighbouring industrial activities as well as coal combustion at KTPP cause worrying levels of Cu, Cd, Zn, and Pb. Enhanced concentrations of Zn and Pb are due to their being more volatile and lower melting points, hence they get readily transferred to air by the power plant's coal combustion operations [21].

In addition to emissions from KTPP, lubricants, rubber tire remnants, and corrosion of vehicle components could be the source of Zinc particles found in the ambient air. According to our analysis, Zn concentration was found to be greatest in the total fraction, followed by Pb, Cu, and Cd, which is consistent with the order reported by previous research [22-24]. Because lead has a longer half-life in the atmosphere than other elements besides being present in fly ash emissions from KTPP, its persistent presence in road dust is more likely the result of past vehicle emissions (prior to the ban of Pb containing fuel) [25].

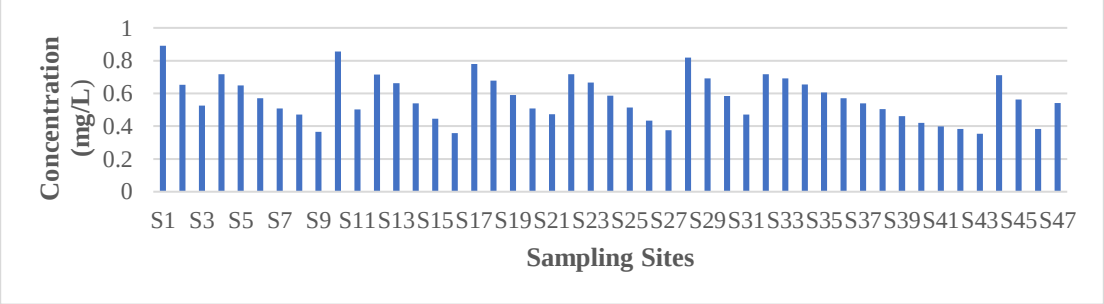

Figure 3: Average concentrations of Cu in road dust in Kota City.

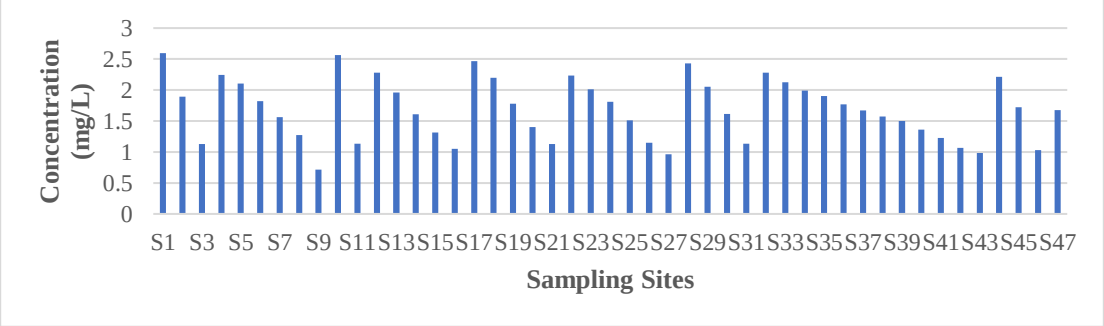

Figure 4: Average concentrations of Pb in road dust in Kota City.

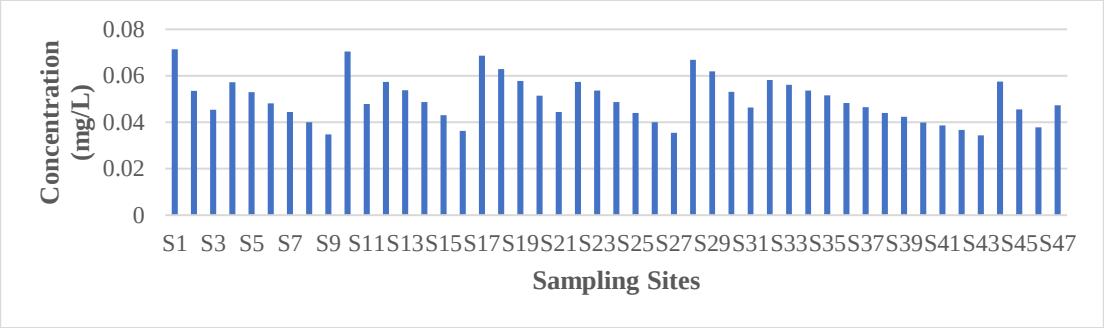

Figure 5: Average concentrations of Cd in road dust in Kota City.

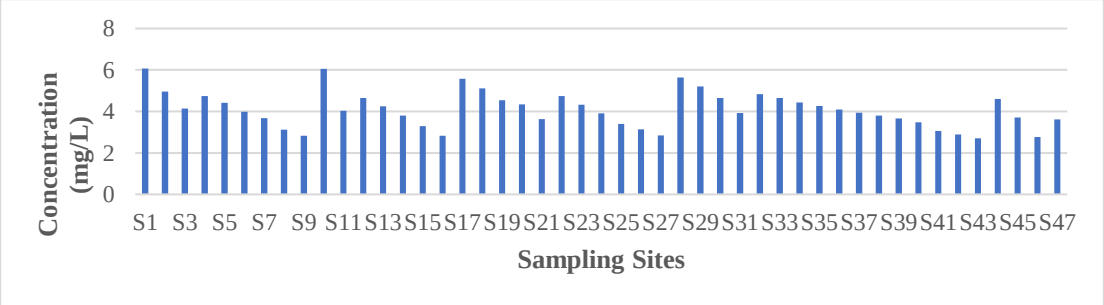

Figure 6: Average concentrations of Zn in road dust in Kota City.

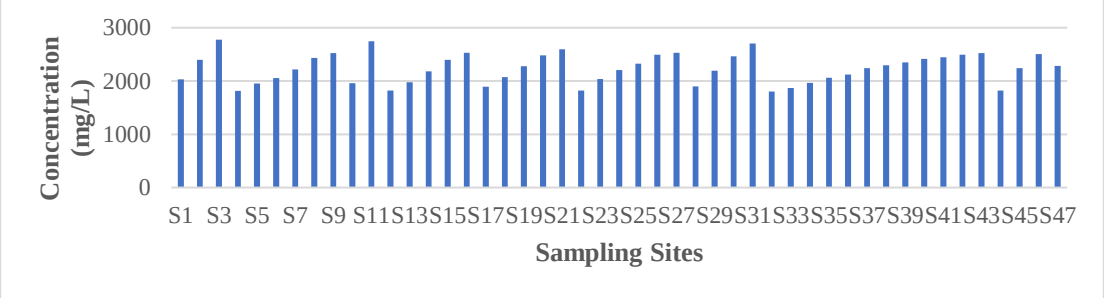

Figure 7: Average concentrations of Ca in road dust in Kota City.

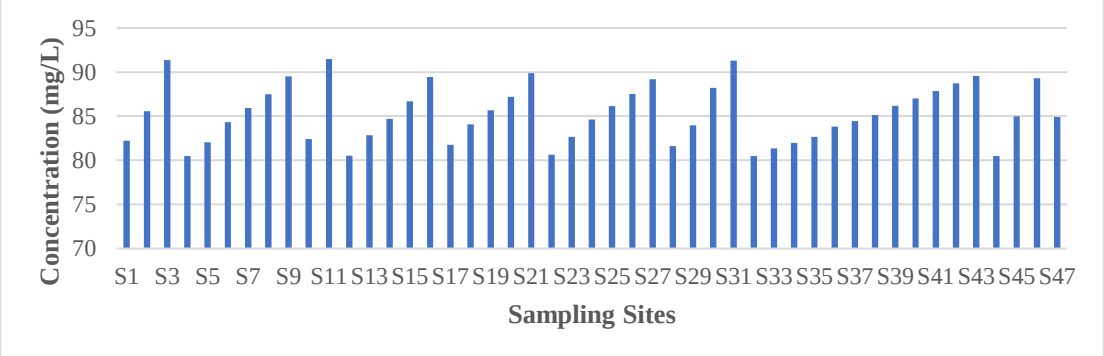

Figure 8: Average concentrations of Fe in road dust in Kota City.

B. Pearson's Correlation Analysis:

The correlation coefficient of heavy metals in road dust showed the positive correlation between Pb – Cu (0.828), Cd-Cu (0.639), and Zn-Cu (0.806), Cd-Pb (0.768), Zn-Pb (0.806), and Zn-Cd (0.846) suggesting their common origin i.e. point source KTPP mainly beside other common industrial activities. Similarly, a positive correlation observed between Ca-Fe (0.894) indicates that these metals have a common source, possibly natural soil.

Table 2: Correlation coefficients between the concentration values of metals analysed during sampling period (* significant at 5% level)

Metal	Cu	Pb	Cd	Zn	Ca	Fe
Cu	1.000					
Pb	0.828	1.000				
Cd	0.639	0.768	1.000			
Zn	0.806	0.806	0.846	1.000		
Ca	-0.623	-0.841	-0.642	-0.551	1.000	
Fe	-0.439	-0.724	-0.616	-0.463	0.894	1.000

C. Enrichment Factor:

The Enrichment Factor Analysis (EF) facilitates the identification of anthropogenic sources for a given element in addition to its primary natural source. Assuming that the contribution of calcium (Ca) from anthropogenic sources to the atmosphere is minimal, Ca has been utilized as a reference element for EF evaluations [26]. This study applied the following EF calculation formula:

$$EF = \frac{\left(\frac{X}{C}\right)_{\text{road dust}}}{\left(\frac{X}{C}\right)_{\text{earth crust}}} \quad \text{---------- (1)}$$

Where x and (the concentration of the metal of interest and concentration of the reference metals respectively).

The EF values fall into five categories: no enrichment to minimal enrichment (EF < 2), moderate enrichment (2 < EF < 5), significant enrichment (5 < EF < 20), very significant enrichment (20 < EF < 40), and extremely significant enrichment (EF > 40)[27-30].

Figure 9 to Figure 13 show the mean enrichment factors (EF) on the basis of average heavy metal concentrations in the samples. The elements with the greatest EF values were Cd, Cu, Pb, and Zn, all of which had EFs significantly more than 2. This implies that there was moderate anthropogenic contamination of the road dust samples and the transportation of fly ash from coal combustion operations at KTPP can be associated with the higher EF values of metals Cu, Cd, Zn, and Pb[31].

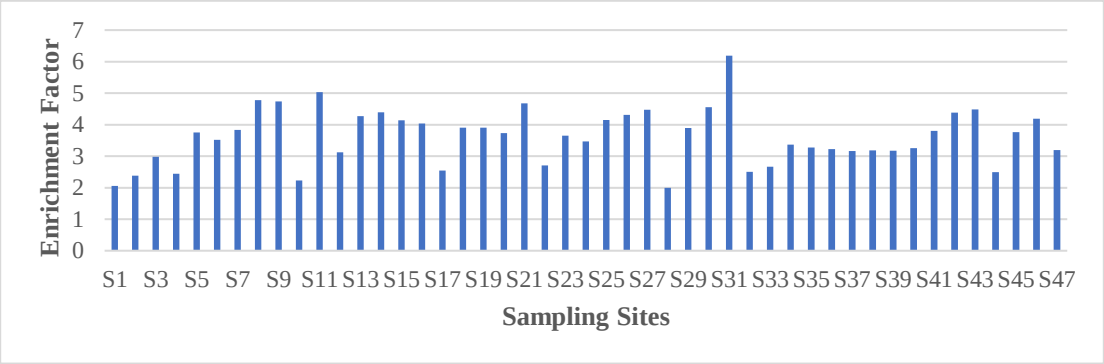

Figure 9: Enrichment factor of Cu in road dust in Kota City.

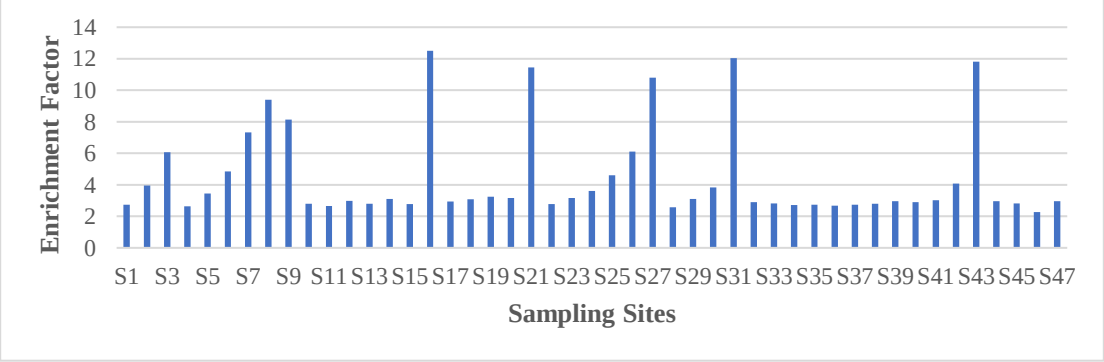

Figure10: Enrichment factor of Pb in road dust in Kota City.

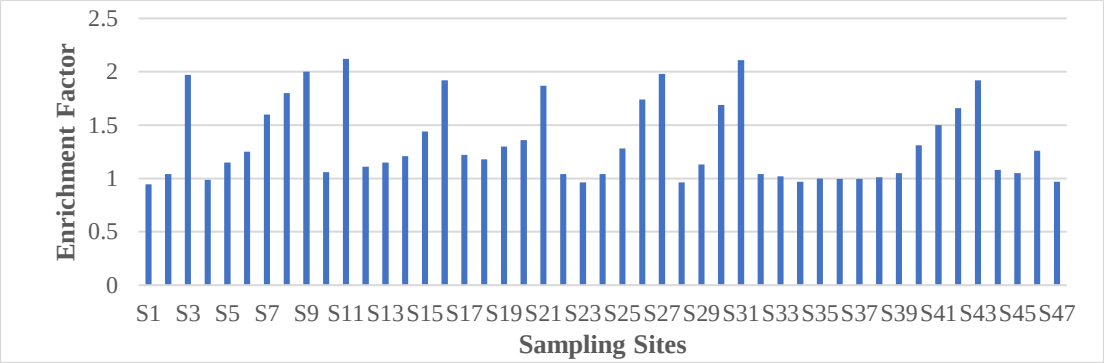

Figure 11: Enrichment factor of Cd in road dust in Kota City.

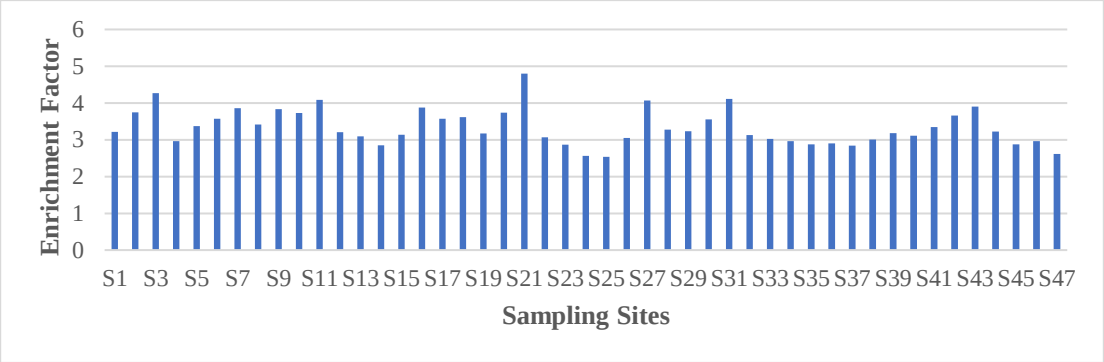

Figure 12: Enrichment factor of Zn in road dust in Kota City.

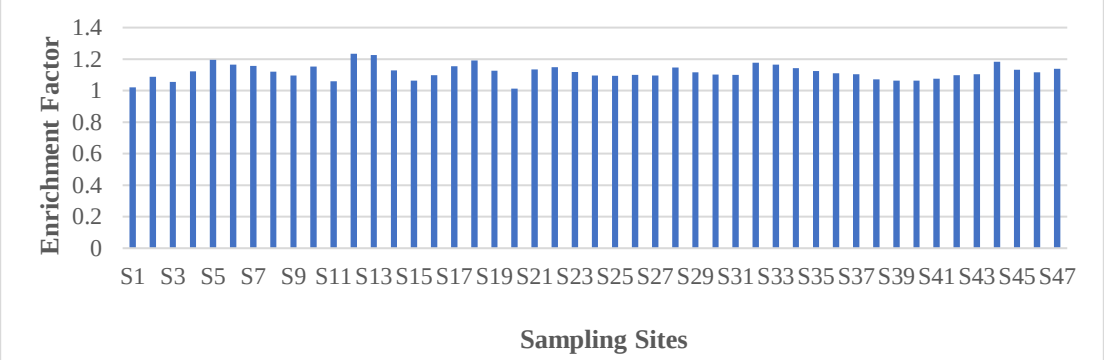

Figure 13: Enrichment factor of Fe in road dust in Kota City.

D. Principal Component Analysis:

Principal component analysis (PCA) accounts for statistical variance by deriving the least number of major factors. It is useful in reducing the dimensionality of the large data sets and in clarifying the relationship between the variables [32-33]. To further identify pollution sources of road dust in the present study, PCA was carried out with varimax rotation. The results of principal component analysis (PCA) showed that only two eigen values were >1 which explains over 91.30% of variance. The results in rotated component matrix (Table 3) showed that all the analysed six metal species are explained by two factors (varimax factor 1 and 2). The first factor (VF 1), which explained over 49.80 % of variance, showed high loading of the heavy metals such as Cu, Pb, Cd and Zn indicating the influence of anthropogenic activities mainly coal combustion at KTPP. VF 2 that accounted for 39.54 % of the layout variance showed high loading of Ca and Fe indicating the influence of crustal aerosols [34].

Table 3: PCA displaying loading of 6 variables with two varimax factors (VF) in road samples

Variables	Component	
	VF 1	VF 2
Cu	0.869	-0.268
Cd	0.771	-0.433
Pb	0.739	-0.610
Zn	0.939	-0.226
Fe	-0.236	0.948
Ca	-0.394	0.889
% of variance	73.08%	18.22%
Cumulative (%)	73.08%	91.30%

IV. Conclusion

In this study, we illustrated heavy metal contamination in road dust samples collected from 47 sampling sites in Kota City, Rajasthan during summer months viz. March, April, May and October, 2022 and threw a light on their possible source. The higher concentration of anthropogenic origin metals Cu, Pb, Cd and Znat S_1 sampling site are due to closest distance of these sites to the point source KTPP and lower concentration of Cu, Cd, Zn are found at S_{43}sampling site due to its farthest distance from KTPP and Pb at S_9 sampling site because low vehicular activities. Thus, the proximity of the sampling sites to the point source KTPP, main roads and industrial places is found to influence the road heavy metal levels in a negative way.

During the sampling period, high average temperature, low relative humidity and high average wind speed caused lower concentrations of anthropogenic metals while crustal metals are found to be in higher concentration owing to more deflation and transport of crustal metals caused by high wind strength.

The high enrichment coefficients, positive correlations and PCA showed that heavy metals viz. Cu, Cd, Zn and Pb have similar source in the city and particularly can be related to point source coal-based Kota Thermal Power Plant besides other industrial activities and traffic load.

Therefore, it is of critical importance to assess the air quality in terms of heavy metal burden in Kota City to avoid any potential health risks and the pollution sources should be seriously considered in the city planning efforts by the relevant authorities.

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INDUSTRY 4.0 AS AN ENABLER FOR SUSTAINABLE MANUFACTURING: AN EMERGING RESEARCH AREA

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Abstract: The Industry 4.0 practices emerged with sustainable manufacturing (SM) is a new paradigm which is creating the world's new industrial value. Awareness, digitalisation, global regulations and policies are increasing pressuring manufacturing sector to transform towards sustainability. Now, the research community and industrial sector are connecting Industry 4.0 with the ideals of sustainability to transform the next industrial revolution. Industry 4.0 technology facilitates the management to optimize the production processes and supply chain components. The aim of present investigation is to know the current status of information regarding the relationship between Industry 4.0 practices and sustainability. The objective will be achieved through (i) mapping and summarising of existing literature in these two area and (ii) analysing possibilities and research scope. This study concludes that Industry 4.0 practices supports to circular economic objectives in the perspective of sustainability by attaining ecological and economical advantages. Triple bottom line research focuses primarily on the adoption of Industry 4.0 technologies, sustainable supply chain and sustainable manufacturing.

Keywords: Enablers, Industry 4.0, Sustainable Manufacturing, Smart Factories.

I. INTRODUCTION

It is understood that manufacturing industries have contributed to social welfare as they develop and implement new technologies and services to providing tailored, customer specific products without compromising safe working conditions for people. Nonetheless, the existing mode of production is unsustainable from an environmental standpoint [1-3]. In this setting, an increasingly awareness of society and public sector, and governmental policies and regulations are pressuring the manufacturing sector to transition towards economical, environmental, and social sustainability [4-6]. This is a valid requirement, as it has been demonstrated that production focused solely on profit results in societal, economical and environmental problems, such as poor working conditions, unequal income, over exploitation of ecological services and depletion of environmental stocks. While oblivious to the real constraints of the ecosystem, the purported entitlement to human wellbeing has carry out in the unsustainable utilization of resources will impact both present and future generations [6-8].

Sustainability is the fundamental business strategy for the future [9]. It includes encouraging sectors like smart manufacturing, low-impact industrialization and energy-efficient construction [10]. That's where Industry 4.0 is based on fast

improvement in production system with information technology [11-12].

Industry 4.0 occurs in this complicated path of severe global environmental concerns as a result of the convergence of the availability of revolutionary information technologies and demand of competitive and flexible production process [13]. The industry 4.0 was primarily centred on increasing productivity, profitability, and competitiveness, rather than on solving ecological concerns associated with production [14-16]. Additionally, Industry 4.0 presents intrinsic difficulties that must be overcome in order to be successful. Some crucial needs, such as standardisation of system platform, and protocol, digital security, workforce availability, organisational transformations, research and development, and the adoption of relevant regulatory frameworks[17-19].

This digital revolution in which intelligent factories, intelligent products, and intelligent services are connected through internet of things, significantly boost the manufacturing sector at the moment [20-22]. This transition to Industry 4.0 creates enormous prospects for attaining sustainability in production through digital technology infrastructure [23-26].

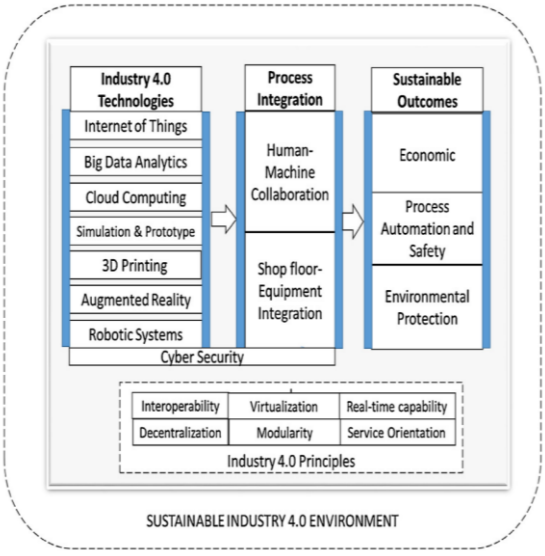

Figure 1: A framework for Sustainable Industry 4.0 [27].

Figure 1 shows the sustainable framework developed by one of the authors. The key enables technologies of industry 4.0 help the industries to reach the sustainability. The human machine integration and machine to machine integration improve the performance of any organization. Table 1 shows the industry 4.0 technologies support the sustainable manufacturing.

II. Background of Industry 4.0 and Sustainable Manufacturing

Industry 4.0, also known as the Fourth Industrial Revolution, refers to the integration of advanced digital technologies and automation into the manufacturing industry. It represents a significant shift in the way products are designed, produced, and delivered. Industry 4.0 leverages technologies such as the Internet of Things (IoT), artificial intelligence (AI), big data analytics, robotics, and cloud computing to create smart and interconnected manufacturing systems [28-29].

The concept of Industry 4.0 emerged in Germany in 2011 as part of a high-tech strategy for manufacturing known as "Industrie 4.0." It aimed to modernize the manufacturing sector by harnessing the potential of emerging technologies to drive efficiency, productivity, and innovation. The term Industry 4.0 gained widespread recognition and has since become a global phenomenon [30-31].

The digital revolution also known as 3rd Industrial Revolution, brought automation and computerization to manufacturing [32]. Industry 4.0 based the foundation of the Digital Revolution by integrating physical systems with digital technologies, creating cyber-physical systems (CPS). These CPS consist of interconnected machines, devices, sensors, and software that interact and collaborate with . This connectivity enables real-time data collection, analysis, and decision-making, significantly improved efficiency, flexibility, and responsiveness in manufacturing system [33-35].

The Industry 4.0 applications gives multiple benefits, including enhanced productivity, reduced costs, improved quality control and increase agility. It also enables new business models, such as mass customization and servitization, where manufacturers provide integrated services along with their products [36-38]. Industry 4.0 technologies can revolutionize manufacturing industries across sectors, promoting innovation and economic growth. However, it also presents barriers such as data security, privacy, workforce up skilling, and the need for infrastructure upgrades [39-41].

The adoption of Industry 4.0 technologies offers the capability to merge the efficiency of mass production with the modularity of customization. This, in turn, results in decreased resource consumption, improved quality, reduced lead times and increased efficiency, [42-44]. However, the role of I4Ts in the digitization of production comes with notable challenges at technological, organizational, and managerial levels [45].

III. Link between Industry 4.0 and Sustainable Manufacturing

Sustainable manufacturing refers to the process of producing goods in an environmentally and socially responsible manner, while also ensuring long-term economic viability. It involves integrating sustainable practices into various stages of the manufacturing process, including design, production, distribution, and disposal [46-47]. The goal of sustainable manufacturing is to minimize the negative impact on the environment, conserve resources, reduce waste and emissions, and promote social well-being. One of the key principles of sustainable manufacturing is resource efficiency [48]. This involves optimizing the use of raw materials, energy and other resources throughout the manufacturing process. By using implementing energy-efficient technologies, renewable energy sources, and adopting closed-loop systems that recycle and reuse materials, manufacturers can reduce their ecological footprint [49].Another important aspect of sustainable manufacturing is minimizing waste and emissions. This can be achieved through strategies such as lean manufacturing, which aims to eliminate waste by streamlining production processes and reducing unnecessary resource consumption. Additionally, implementation of cleaner production methods and the use of eco-friendly materials can help reduce emissions and hazardous waste generation [50-51].Sustainable manufacturing also focuses on promoting social responsibility within the industry. This includes ensuring safe and healthy working conditions for employees, fair labor practices, and respect for human rights. Manufacturers are encouraged to engage in responsible sourcing by selecting suppliers that adhere to ethical standards and contribute to local communities [52-54].

IV. Literature Review

Manufacturing sustainability is more about advancing industries in a socially and environmentally responsible manner than it is about reducing carbon emissions and pollution. Sustainability can be regarded important to company strategy, as underlined in the United Nations' Agenda 2030 of Sustainable production, which includes smart manufacturing, low-impact industrialization and energy efficient buildings [55]. Qureshi et al. (2023) conduct a survey of 420 SMEs and the empirical analysis impact shows a positive and substantial impact of advanced manufacturing technologies on both operational readiness and technological readiness [56]. Yavuz et al. (2023) surveyed 302 industries and applied structural equation modelling on the data and results indicate that the effect of Industry 4.0 at sustainable performance is arbitrated by sustainable operations practices [57]. Abdullah et al. (2023) fuzzy DEMATEL The study explores the interrelationships among MSOs (manufacturing strategy outputs factors) for implantation of I4.0. The results indicates that the most influential factors on MSOs are cost, quality, and performance [58]. Kumar et al. (2023) applied Interpretive Structural Modelling for ranking of barriers of industry 4.0 The findings indicate that the most influential barriers are the inadequacy of resources and shortage of employee expertness [59]. Merroun (2022) Statistical study of 63 SMEs and 82 for large companies questionnaire, analysis and interpretation Research investigated the difference between SMEs and large enterprises of Europe in achieving environmental sustainability goals in context to Industry 4.0 [60]. Gupta et al. (2022) structural equation modelling. The study suggests that SMEs incorporated with Industry 4.0, such as advanced robotics to reduce human involvement, smart logistics that adapt to production capacity changes, and virtual can achieve productivity and operational excellence with greater efficiency for the organizations [61]. Matsunaga et al. (2022) conducted systematic review and real-time monitoring and simulation. The study suggest that application of cyber physical systems and smart manufacturing leverage energy optimization [62]. Ghobakhloo and Fathi (2021) conducted a content-centric qualitative analysis of the present Industry

4.0 research work in order to determine the major energy sustainability issues of Industry 4.0. Moreover, the interpretive structural modelling technique is used to map the identified interrelationships between various energy sustainability issues. It has been concluded that energy sustainability is supported through Industry 4.0 mechanism comprised of ten interdependent functions [63]. Nara et al. (2021) examined Triple Bottom Line and industry4.0 practices based framework for sustainability. A sustainable development-based methodology for assessing the impacts of Industry 4.0 technology on sustainability indicators using fuzzy TOPSIS multi-criteria evaluation. Results indicated that cyber-physical systems, the internet of things, sensors, and deployment of big data are catalysts for sustainability [64]. Fallahpour et al. (2021) established a new integrated model for supplier selection management that takes into account sustainability and Industry 4.0criteria and creates decision-making framework to investigate providers individually in an uncertain setting. The fuzzy best worst method and the two-stage fuzzy inference system (FIS) were suggested to evaluate the selection of suppliers [65]. Bag et al. (2021) created a conceptual model for attaining sustainability in operations of the supply chain. A poll of 200 South African manufacturers yielded 200 responses. The partial least squares structural equation modelling (PLS-SEM) was used to test this model. The study revealed that utilizing Industry 4.0 practices expected to improve the sustainability of supply chain operations by reducing waste and pollution and optimizing resource consumption rate [66]. Ghobakhloo (2020) emphasised the prospect of contextual relationship among sustainability and industry4.0. The study examined important sustainability functions for Industry 4.0 using an interpretive structural modelling approach and discovered that manufacturing efficiency and business model innovation are the most significant sustainability functions [67]. Luthra et al. (2020) analysed the drivers of Industry 4.0 for sustainable diffusion in Supply Chains (SCs). The DEMATEL approach with a grey background is used to assess the impact of the selected drivers and to construct an interrelationship diagram. Collaboration and transparency across the supply chain and Government-supportive policies were cited as pin point key drivers of I4.0 [68]. Vrchota et al. (2020) conducted a systematic literature review on how manufacturing sustainability can be achieved through traditional green procedures as part of Industry 4.0. The study offered Sustainability Green Industry 4.0 framework that assists in structuring and assessing traditional green manufacturing in connection to sustainability and Industry 4.0 [69]. Bányai et al. (2019) addressed the use possibilities and optimization potential of Industry 4.0 technology in garbage collection solutions. This garbage collection process is mathematically modelled and a binary bat algorithm is utilised. The study finishes with the mathematical modelling of traditional and cyber-physical waste management system, which makes it possible to describe the impact of Industry 4.0 technologies such as RFID, big data analysis cloud and fog computing on their development and operation [70]. Birkel et al. (2019) suggested a risk framework tied to the Triple Bottom Line of sustainability in the perspective of Industry 4.0. The research included a literature analysis and 14 in-depth expert interviews. The conclusion of the study is that risks can be connected with technical risks, such as technological integration, cyber security risks, such as data security, political and legal a risks, such as unresolved legal transparency around data ownership [71]. Franciosi et al. (2018) conducted the literature survey to evaluate the importance of maintenance for sustainability in manufacturing, while focusing on the industry4.0 practices and its enabling technologies. The investigation provides light on the growing attention in "maintenance & sustainability" over the past few years and the enormous potential of enabling technologies 4.0 in this context [72]. Bonilla et al. (2018) analysed and revealed the influencers and barriers of sustainability in Industry 4.0 from four different contexts: integration and compliance with the sustainability goals; operation and technologies; deployment and long-term perspective. The investigation revealed both positive and negative anticipated outcomes, with a slight preponderance of positives that can be deemed beneficial secondary effects of Industry 4.0 operations [73].

V. CONCLUSION

I4.0 practices and Sustainability are gaining attention by research community and manufacturing sector. In the literature it is found that Industry 4.0 primarily explored from a technological standpoint, ignoring sustainability challenges associated with this new paradigm. Additionally, Industry 4.0 enables firms to maximise automation in their processes. Automated devices equipped with intelligent sensors can do monotonous, arduous, and possibly hazardous operations that operators would ordinarily be responsible for, so freeing up these workers to perform higher-value duties and enhancing workplace safety. Administratively, intelligent automation can also improve the accuracy of regular data entry and report generation, permitting manufacturers to enhance productivity and optimise internal operations. This paper contributes to a variety of research avenues about SM in digital manufacturing. It has been determined that the researches and studies in this field is rising significantly. The study concludes that now a day's manufacturers view sustainable manufacturing practice not just a social liability, but also as a key business concern. With the aid of Industry 4.0 technology, manufacturing sector can drive sustainability throughout the value chain to serve their own interests as well as those of their stakeholders.

Finally Some of the key areas for further research are as follows:

- Circular Economy Models: Research ways to implement circular economy principles in manufacturing, including product design for recyclability, remanufacturing, and the development of closed-loop supply chains to reduce waste and extend product lifecycles.
- Internet of Things (IoT) for Sustainable practics: Investigate how IoT technologies can be utilized to improve energy efficiency, monitor resource consumption, and improve overall sustainability in manufacturing facilities.
- Life Cycle Assessment (LCA): Advance methodologies for conducting comprehensive life cycle assessments of products to better understand their environmental footprints and identify potential areas for improvement.
- Digital Twin for Sustainability: Study the application of digital twin model in resource optimization, waste reduction, and predicting potential environmental impacts during the product development and manufacturing phases.
- Blockchain for Traceability and Transparency: Investigate the implementation of blockchain technology to verify and track the sustainability claims of products, ensuring transparency and authenticity in sustainable manufacturing practices.

By addressing these research directions, the manufacturing industry can promote responsible consumption and production, and progress toward a more ecological conscious and sustainable future.

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ENHANCING USER EXPERIENCE USING REACT.JS

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Abstract: This paper analyses the noteworthy contribution of React.js towards augmenting the user experience (UX) of online apps. React.js is a robust JavaScript toolkit that has become popular because of its ability to it can generate dynamic and interactive user interfaces. React.js enhances rendering efficiency and enables continuous updates through the use of virtual DOM and component-based architecture, resulting in a more responsive and seamless user experience. This paper delves into various techniques, state management, reusable components, client-side routing, and other React.js best practices and strategies for enhancing user experience. It also looks at how React.js affects scalability, accessibility, and general development productivity. This paper shows how using React.js enables developers to construct user-centric, intuitive, and engaging online applications through case studies and real-world examples.

Keywords: React.js, User Experience, UX, Virtual DOM, Component-Based Architecture, Rendering Performance, State Management, Reusable Components, Client-Side Routing, Accessibility, Scalability, Development Productivity.

I. INTRODUCTION

In the dynamic landscape of web development, developing appealing and immersive user experiences (UX) has become a top priority. Developers are always looking for new frameworks and technologies to match the growing user expectations for seamless interactions and user-friendly interfaces. React.js is one of these tools that has become extremely popular and has influenced the development and user experience of online apps. React.js has revolutionized UX design and development standards with its declarative concepts, effective rendering methods, and component-based architecture.

The fundamental feature of React.js is its unique approach of manipulating the Document Object Model (DOM) by using the concept of a virtual DOM. React.js achieves unmatched performance advantages by reducing expensive re-renders and effectively upgrading only the essential components by retaining an in-memory copy of the actual DOM. This optimization ensures a more smooth and seamless user experience across devices and browsers in addition to improving the responsiveness of online applications. React.js's component-based architecture, which separates user interface elements into modular, reusable parts, it's fundamental property. This iterative method to interface development promotes code reuse, streamlines maintenance, and expedites development processes. By building these reusable components, developers may create complex user interfaces (UIs) that minimize repetition and promote consistency and scalability.

Beyond its technical advantages, React.js makes a substantial contribution to web applications'

accessibility, ensuring inclusiveness for users with a range of needs and abilities. React.js's ecosystem of community-driven tools and strong support for accessibility improvements enable developers to design interfaces that are simple to comprehend, functional, and accessible for all users, regardless of their disability. We explore in this paper the various ways that React.js enables developers to improve the user experience in online apps. We examine the fundamental ideas and methods that support React.js-driven UX design, from maximizing rendering performance to promoting accessibility and code reuse. We demonstrate how React.js acts as a creative spark, allowing people all around the world to create user-friendly, entertaining, and inclusive digital experiences through case studies and real-world instances.

II. REACT.JS

React.js is recognized as a key component of modern web development, providing programmers with an extensive toolkit for designing dynamic and interesting user interfaces for an extensive variety of applications. Web application development and user experience have been completely transformed through its declarative concepts, robust rendering methods, and component-based architecture. Let's look at a few practical uses of React.js being applied for bettering user interactions and the user experience in general. React.js has emerged as a key component of modern web development, providing programmers with an extensive toolkit for developing and designing dynamic and captivating user interfaces for a wide range of applications. Web application development and user experience have been completely transformed by its declarative terminologies, effective rendering methods, and component-based architecture. Let's look at some real-world instances of React.js being used to improve user interactions and the user experience in general. React.js has widespread use in social media networks, where it powers elements like the news feed. React.js is used to enable smooth scrolling through updates, like posts, and real-time engagement with content, which promotes deep connections and interactions. React.js is also used by top e-commerce companies to build dynamic shopping cart experiences. Users can review product details, add goods, and change quantities employing React.js without having to refresh the page, making for a seamless and uninterrupted shopping experience. React.js also plays a key role in optimizing controls for online video playback, assuring a smooth watching experience on a wide range of screens and devices. React.js is also used by travel booking sites to improve search and filtering features, making it easier for customers to identify and reserve lodging based on their preferences and travel schedules. React.js is used by ride-sharing apps to expedite the reservation process in the transportation industry. Encouraging ease and efficiency, users may track drivers, examine fare predictions, and request rides in real-time. Additionally, React.js is used by project management solutions to generate interactive task boards, which enable users to collaborate, prioritize, and arrange tasks with ease. These illustrations highlight React.js adaptability and potency in improving user experiences in a variety of applications, from social networking and e-commerce to streaming services, travel booking, transportation, and project management.

III. DISCUSSION

These papers give useful insight into the nature of and the claims made for asynchronous online discussion, as well as the conditions under which users are more likely to engage with each other. React.js is widely used in many different industries, which is evidence of how effectively it works to improve user experiences in web apps. With React.js, developers can improve rendering efficiency, expedite development workflows, and create intuitive interfaces that promote usability and engagement. React.js features include virtual DOM, component-based architecture, and state management. Real-time interactions and smooth updates are two important aspects of React.js's impact on user experience. React.js's virtual DOM reduces the need for unnecessary re-renders, which speeds up page loads and creates smoother transitions, all of which enhance responsiveness and user experience.

Additionally, the component-based architecture of React.js encourages code modularization and reusability, empowering programmers to create scalable and maintainable applications. This approach improves the user experience by reducing

up development cycles and ensuring coherence and consistency across the application's many components. Furthermore, by offering strong support for accessibility features and best practices, React.js enables developers to handle accessibility challenges. React.js helps to create inclusive digital experiences that appeal to a wider audience by improving the readability, operability, and comprehension of online apps for users with varying requirements and abilities.

Overall, the paper demonstrates how React.js encourages creativity in UX design by giving programmers the tools they need to build dynamic, appealing and easily accessible online apps that adapt to users' changing requirements.

IV. Conclusion

In conclusion, React.js proves to be an essential component to enhancing user experience (UX) in web apps, transforming the way interface design and interaction are handled by developers. With the help of React.js' robust capabilities, which include virtual DOM, component-based design, and state management, developers can construct dynamic, responsive, and user-friendly interfaces that put accessibility, usability, and performance first.

React.js's widespread use in a variety of sectors and applications attests to its adaptability and efficiency in meeting users' changing requirements and expectations. Whether used for project management, social networking, e-commerce, streaming services, booking travel, or transportation, React.js makes it easier to create fluid and captivating user experiences that appeal to people all over the world.

React.js offers faster page loads and smoother transitions by optimizing rendering efficiency and eliminating needless re-renders, improving the perceived speed and overall responsiveness of web apps. Because of its component-based architecture, which encourages code modularity, scalability, and reusability, developers may create applications more quickly and with consistency across various application components.

Furthermore, because React.js has strong support for accessibility features and best practices, it is essential for promoting variation and accessibility in online applications. React.js helps to create inclusive digital experiences that appeal to a wider audience by improving the readability, operability, and comprehension of online apps for users with varying requirements and abilities.

React.js, in its most basic state, acts as a spark for creation in UX design by enabling developers to push the limits of functionality and creativity while producing smooth and enjoyable user experiences. React.js is at the vanguard of pushing growth and creating the future of web development as the digital landscape changes, offering even greater breakthroughs in UX design and user interaction.

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REVIEW PAPER ON AFRICAN VULTURE OPTIMIZATION TECHNIQUE

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Abstract: A metaheuristic is a high-level, problem- independent algorithmic framework that offers a collection of rules or tactics for creating heuristic optimization algorithms (Sörensen and Glover, 2013). Although there are many more, notable examples of metaheuristics include genetic/ evolutionary algorithms, tabu search, simulated annealing, variable neighborhood search, (adaptive) big neighborhood search, and ant colony optimization. A metaheuristic is a problem-specific implementation of a heuristic optimization algorithm that follows the rules outlined in a metaheuristic framework. Glover (1986) first used the phrase, which combines the Greek prefix meta- (meta, beyond in the sense of high-level) with heuristic (from the Greek heuriskein or euriskein, to search). As implied by their name, metaheuristic algorithms are optimization techniques developed in accordance with the principles outlined in a metaheuristic framework.

Keywords: APSO, AVOA, Path Planning, Mobile Robot, Obstacle Avoidance.

I. INTRODUCTION

The development of autonomous mobile robots employing metaheuristic algorithms is quickly gaining popularity in the control and computer sciences. Autonomous mobile robots are now focused on avoiding obstacles and determining the shortest path to the target. The key shortcomings of traditional approaches are the inability to move the robot in a dynamic and unknowable environment, the impasse in local minimum and complex surroundings, the inability to predict the speed vector of obstacles, and the non-optimality of the route. The African Vultures Optimization (AVOA) is a modern path- planning technique that is demonstrated in this article. It is used to navigate a mobile robot in both static and dynamic situations with a moving target. The suggested online optimization method is utilized in three distinct contexts, one of which has an unidentified static obstacle, a dynamic target, and an environment containing dynamic obstacles that are unknown. A local minimum problem in a setting with static impediments can be resolved using the suggested method. The two steps of the online optimization method—reading sensor data and path calculation—are carried out, and the results are provided based on computer simulations of various uncharted settings. The proposed algorithm was compared to two existing algorithms in the study.

According to Sörensen and Glover (2013), a metaheuristic is a high-level, problem-independent algorithmic framework that offers several recommendations or tactics for creating heuristic optimization algorithms. Numerous other metaheuristics exist, but some notable ones are ant colony optimization, tabu search, simulated

annealing, variable neighborhood search, and genetic/evolutionary algorithms. A metaheuristic is also a problem- specific implementation of a heuristic optimization algorithm that follows the rules outlined in a metaheuristic framework. Glover (1986) came up with the phrase by combining the heuristic prefix with the Greek prefix meta- (meta, beyond in the sense of high- level) (from the Greek heuristic or euriskein, to search). As implied by their name, metaheuristic algorithms are optimization techniques created using the principles outlined in a metaheuristic framework.

As the name suggests it is always heuristic in style. This sets them apart from exact methods, which do have proof that the best solution will be found in a limited amount of time (though frequently a prohibitively long one). To find a solution that is "good enough" in a computing time that is "small enough," metaheuristics are therefore created. They are therefore not affected by the combinatorial explosion, a phenomenon where the computing time needed to find the best solution to an NP-hard problem grows exponentially with the size of the problem.

In comparison to more conventional (exact) techniques for mixed- integer optimization, like a branch and bound and dynamic programming, metaheuristics are a practical and frequently superior alternative. Particularly for challenging metaheuristics are frequently able to provide a better trade-off between the quality of the solution and the computing time when dealing with complex problems or large problem instances. The program models the foraging and navigational behavior of African vultures and is known as the African Vultures Optimization Algorithm (AVOA).

The method initially determines the fitness function of all solutions (initial population) to split vultures into categories. There may be up to N no. of vultures in an environment; many vultures can physically be segregated into two groups. The first and best vultures are the best and second-best vultures, respectively, when referring to the best solution.

One of the top two vultures in each performance is moved or replaced by the population of other vultures. This algorithm separates groups because the primary natural function of vultures—group living to find food—can be formulated. Each set of a vulture different in capacity to consume food is that of vultures. Vultures have the propensity to eat and spend hours searching for food, which makes them escape from the hungry trap. At the formulation stage of our anti-hunger compromises, the vultures aim to keep their distance from the worst and come up with the best answer, presuming that the population's worst proposal is the weakest and hungriest.

The feeding and orienting habits of African vultures served as the basis for the development of the AVOA meta-heuristic algorithm. Vultures are classified into two groups depending on their physical strength and behavior in nature. Vultures also spend hours seeking for food due to their drive to eat, which helps them escape the hunger trap. Additionally, two of the greatest solutions are regarded as the best and strongest vultures. The general steps of this method are outlined in this part, which can be used as a reference for more information.

1.1 *How to determine the Best Vulture in Each Group*

The first and second vultures are chosen for global optimization in the AVOA algorithm depending on the fitness function. The option of selecting the vultures is then demonstrated by additional solutions using the following formula.

$$R(i) = \begin{cases} Best\ Vulture_1 & if\ p_i = \alpha \\ Best\ Vulture_2 & if\ p_i = \beta \end{cases} \quad \ldots(1)$$

Before the search operation, the parameters in Equations (1) and (2) are quantized. These parameters have values that range from 0 to 1, and their combined importance is equal to 1. Additionally, use the roulette wheel to select any of the finest options. When is nearly one, exploitation grows? The equation provides a mathematical formulation for the vulture vigor rate, which is determined by vulture behavior, a shortage of energy, and aggressive behavior while in quest of food.

$$F = (2 \times rand_1 + 1) \times y \times \left(1 - \frac{It_i}{maxIt}\right) \quad \ldots.(2)$$

F in Equation (2) denotes the vulture's level of satiety. It displays the maximum iteration number at this time. It is the overall number of repetitions, while y is a random value between 1 and 1 that varies with each iteration. When the value of y is

less than 0, the vulture is hungry; otherwise, there are no vultures; rand1 is a random number between 0 and 1. The value of the variable F strikes a balance between exploration and exploitation in the AVOA algorithm. The exploration phase begins when the value of |F| exceeds 1; otherwise, the exploitation phase begins.

II. Literature Review

The following highlights the primary contributions of this study:

Melanoma detection using a hybrid convolutional neural network is a novel meta-heuristic algorithm and a network.

- A diagnosis system that uses a convolutional neural network (CNN).
- A fresh iteration of the African Vulture Optimizer for CNN's best configuration.
- SIIM-ISIC Melanoma dataset verification.
- Compare the method's effectiveness against a few new techniques to demonstrate its efficacy.

The exploration ability and exploitation ability of these meta-heuristic optimization algorithms are still challenging to balance, even though academics from around the world have suggested a range of meta-heuristic optimization algorithms based on biological habits or natural theory.

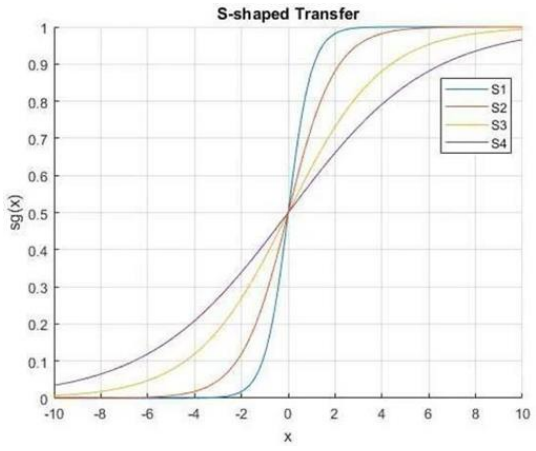

Figure 1: A graphic view of various types of S-shaped transfer functions.

Therefore, depending on the existing meta-heuristic optimization techniques and the difficulties at hand, researchers propose various improvement methods.

The exploration and exploitation mechanisms in AVOA are more thorough than those in other meta-heuristic algorithms. By employing a random technique, it is possible to boost both the exploitation and exploration abilities of thenexploitation mechanism. This method can guarantee that AVOA has fast convergence, avoids falling into local maxima, and isn't very divergent.

AVOA offers a more distinct exploration mechanism and exploitation mechanism than other metaheuristic optimization algorithms. However, AVOA still has certain drawbacks, including the ease with which it might adopt a locally optimal solution and the imbalance between its capacity for exploration and exploitation. Three innovations are included in the suggested TAVOA in this research to increase the adoption of AVOA and improve its impact. To recognize the diversity of the population and prevent the algorithm from settling on a locally optimal solution, the population is first initialized using a tent chaotic map. Second, the method can find a better solution early on by fully utilizing the past optimal vulture knowledge, which enables it to be used in more engineering domains. Third, the time- varying mechanism is made to balance TAVOA's capacity for exploration and exploitation so that the algorithm may produce a more effective result.

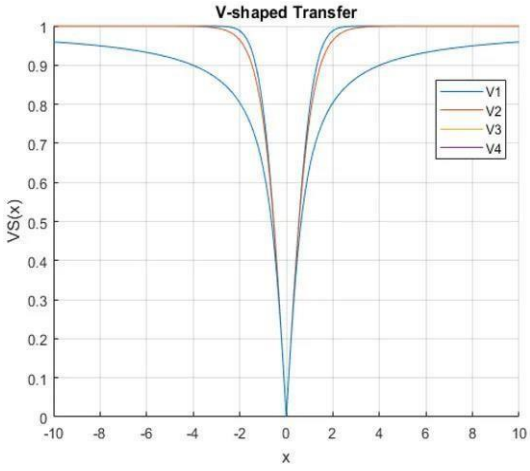

Figure 2: A graphic view of various types of V-shaped transfer functions.

III. Application

3.1 Clustering application:

One of the crucial research areas in data analysis is data clustering. Clustering is an unsupervised classification technique used to categorize data objects into distinct groups, or clusters. Several meta-heuristic techniques can be utilized to address this problem so that the similarity of the data inside

each cluster and the difference between the cluster data are high. The African Vulture Optimization Algorithm (AVOA) and Harmony Search (HA), two innovative algorithms, are combined in this study. On the UCI machine learning repository's clustering dataset, the suggested algorithm is put into practice. The outcomes of the suggested method are also contrasted with those of existing meta- heuristic algorithms. The results of the tests indicate that the suggested approach has good and superior performance compared to other optimization techniques.

3.2 Use with an AC system:

As shown in current regulators that are connected to a pulse-width modulation (PWM) controller that is responsible for producing the firing pulses to the VSC, the 100 kW AC system in this study is made up of three voltage sources, a transformer, and a universal bridge that serves as a voltage-source converter (VSC).

3.3 The implementation of the tal conductance:

This approach in conjunction with PI controllers for monitoring the MPP of PV and wind systems. Additionally, the AVOA was introduced for fine-tuning the system's proposed PI controllers.

3.4 Use of an Improved-African Vultures optimization algorithm to estimate parameters in a three-diode solar photovoltaic model:

This method proposes a new efficient technique for selecting the best unknown variables in Solid Oxide Fuel Cell (SOFC) stack models. The main idea behind this paper is to minimize the sum of squared error values between the empirical voltage and current profiles and the method's obtained voltage and current profiles. The Modified African Vulture Optimizer is a new improved metaheuristic that defines the minimization process (MAVO). The MAVO algorithm is intended to modify the algorithm in order to achieve better results in terms of convergence and accuracy. Two scenarios based on pressure and temperature are used to determine system consistency.

Finally, the effectiveness of the technique has been determined by comparison with a number of other procedures. The findings show that the minimum SSE value at various temperatures is 1.87 e4, and the minimum MSE value at various temperatures is 1.24 e3. This suggests positive outcomes for the suggested technique as a reliable identification system. The final results show that the suggested strategy outperforms the compared strategies in terms of efficacy. The Modified African Vulture Optimizer is a new improved metaheuristic that defines the minimization process (MAVO). The MAVO algorithm is intended to modify the algorithm in order to achieve better results in terms of convergence and accuracy. Two scenarios based on pressure and temperature are used to determine system consistency.

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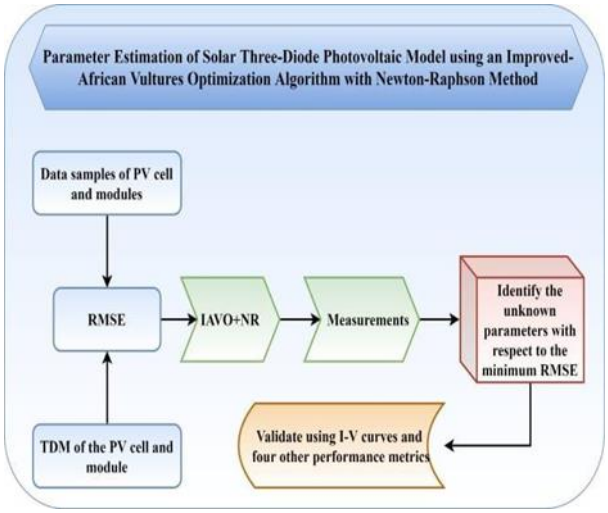

Figure 3: A Improved-African Vultures optimization.

3.5 An optimization method for African vultures based on chaotic tent mapping and time-varying mechanisms:

One of the best techniques for resolving challenging engineering issues is the use of metaheuristic optimization algorithms. However, a metaheuristic algorithm's performance is influenced by its capacity for exploration and exploitation. Therefore, an enhanced African vultures optimization algorithm based on tent chaotic mapping and time-varying mechanism (TAVOA) is presented in order to further enhance the African vultures optimization algorithm (AVOA). A tent chaotic map is first created to initialise the population. Second, the person's previous ideal position is noted and used to update their location. Third, a time-varying method

is created to balance the ability to explore and the ability to exploit. In addition, TAVOA performs well when compared to the six metaheuristic optimization algorithms in real-world engineering design issues.

The ability of a metaheuristic algorithm to explore and exploit data, however, affects how well it performs. In order to improve the African vultures optimization technique even more, a new approach based on tent chaotic mapping and time-varying mechanism (TAVOA) is proposed (AVOA). The population is initially initialised on a tent chaotic map. Second, an update to the person's location is made using the information from their prior ideal position. Third, a time-varying approach is developed to strike a balance between the capacities for exploration and exploitation. TAVOA's efficacy and efficiency are assessed using

Comparing AVOA and five other state-of-the-art metaheuristic optimization algorithms to three common real-world engineering design problems, 28 CEC 2013 benchmark functions, and 23 fundamental benchmark functions.

3.6 Shell and tube heat exchanger optimization algorithm using African vultures:

Engineering design sectors have discovered the adaptability of meta-heuristic optimization methods, which are inspired by nature. Their versatility is also utilised in a variety of structural, thermal, and Internet of Things design applications. Waste heat recovery from the power generating and thermal engineering organisations is a crucial essential point to lower the pollution and support the government norms with the extremely rapid advance in industrial modernization. The heat exchanger, however, is the element used in numerous heat recovery procedures. The most widely used designs for the heat recovery process are shell and tube heat exchangers (SHTHEs), which are among the options. Therefore, when developing the heat exchanger, cost reduction is the key consideration.

When the design parameters and best-optimized value (lowest cost of heat exchanger) are accomplished using the AVOA, all limitations are confirmed. The cost optimization of the plate-fin and tube-fin heat exchanger case studies revealed that the AVOA is capable of pursuing the best results among the others.

3.6 Design of an African Vultures Optimization Algorithm-Based Resilient Wide-Area Damping Controller:

When improperly dampened, low-frequency oscillation modes might jeopardise the steady and uninterrupted operation of power systems. Data from Phasor Measurement Units (PMUs) can now be used to create a Wide-Area Damping Controller (WADC) to dampen these oscillation modes thanks to the recent development of Wide-Area Measurement Systems. However, the installation of the WADC is challenging due of the PMU data's susceptibility to cyber-attacks that could jeopardise the reliability of the power system. In this paper, a WADC robust design approach is suggested that is based on an optimization issue. The optimization issue will be resolved using a metaheuristic known as the African Vultures Optimization Algorithm. Case studies demonstrate how the designed controller improves the system's dynamic performance.

3.7 African vultures optimization algorithm for distributed generation and capacitor bank deployment and sizing in radial distribution system:

Due to rapid industrialization and population expansion, load demands are always increasing, pushing system parameters like bus voltage and line current to the limit. As a result, line losses increase and the voltage profile of the system at the consumer site weakens. The integration of distributed generators (DGs) and capacitor banks (CBs) in the radial distribution systems (RDS) will help because they serve as sources of active and reactive power to the loads.

Effective equivalent circuit model construction and accurate parameter identification are necessary to characterise the real electrical behaviour of photovoltaic cells and photovoltaic modules.

African vultures optimization was used in this study to address the parameter extraction issue that came up when modelling single and double diode-based photovoltaic cells as well as single diode-based photovoltaic modules. and four different tactics in the exploitation phase, the African vultures. By employing two separate techniques in the exploration phase optimization algorithm effectively balances the optimization process. To assess the effectiveness of the parameter extraction, the root mean squared error between the simulated and

measured output current was computed. The acquired findings were also contrasted with several parameter extraction techniques that were widely used in the literature. The African vultures optimization algorithm has proven to be a dependable and robust method for extracting solar cell and module parameters.

3.7 African vulture optimised weighted support vector machine technique for pulmonary illness diagnosis:

Smoking, asbestos, secondhand smoke, and other types of air pollutants are the main causes of pulmonary illness, a condition that affects the lungs and other respiratory organs. Emphysema, fibrosis, pneumothorax, asthma, lung cancer, chronic obstructive pulmonary disease (COPD), and other pulmonary illnesses are a few examples. Lung disorders and respiratory diseases are additional names for pulmonary diseases. Using CT scan and x-ray pictures, numerous approaches are used to forecast pulmonary illnesses. The best prediction has not yet been reached, as several current works only forecast one specific disease. The African vulture optimization (AVO) algorithm-based weighted support vector machine methodology was thus offered as a novel solution.

From the NIH chest x-ray dataset, the suggested approach in this paper predicts emphysema, fibrosis, pneumothorax, and normal types. Following data capture, the X-images are preprocessed to achieve the appropriate size and to eliminate unwanted noise. After sending the preprocessed pictures to the SVM for feature extraction, the AVO is utilised to enhance the SVM in order to produce a kernel function. The emphysema, fibrosis, pneumothorax, and normal classes from the dataset are accurately predicted by the suggested w-SVM.

Approach-

Pseudo-code of SCA algorithm.

Initialize a set of search agents (solutions)(X)Do

Evaluate each of the search agents by the objective function

Update the best solution obtained so far (P = X∗)

Update r1, r2, r3,and r4

Update the position of search agents using Equation

While (t< maximum number of iterations) Return the best solution obtained so far as the global optimum.

IV. Conclusion

In this study, an improved African vulture's optimization algorithm (TAVOA) is presented to replace the existing AVOA. Based on tent chaotic mapping and time-varying mechanisms, TAVOA can be used in more fields and produce better results than AVOA.

An IAVOA that combines the traditional AVOA 534 with quasi-oppositional learning and the adaptive differential evolution operator 535 has been presented. Benchmark functions of various types and dimensions were simulated to examine the exploration, development, and convergence performance of the algorithm to validate the performance of the IAVOA.

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