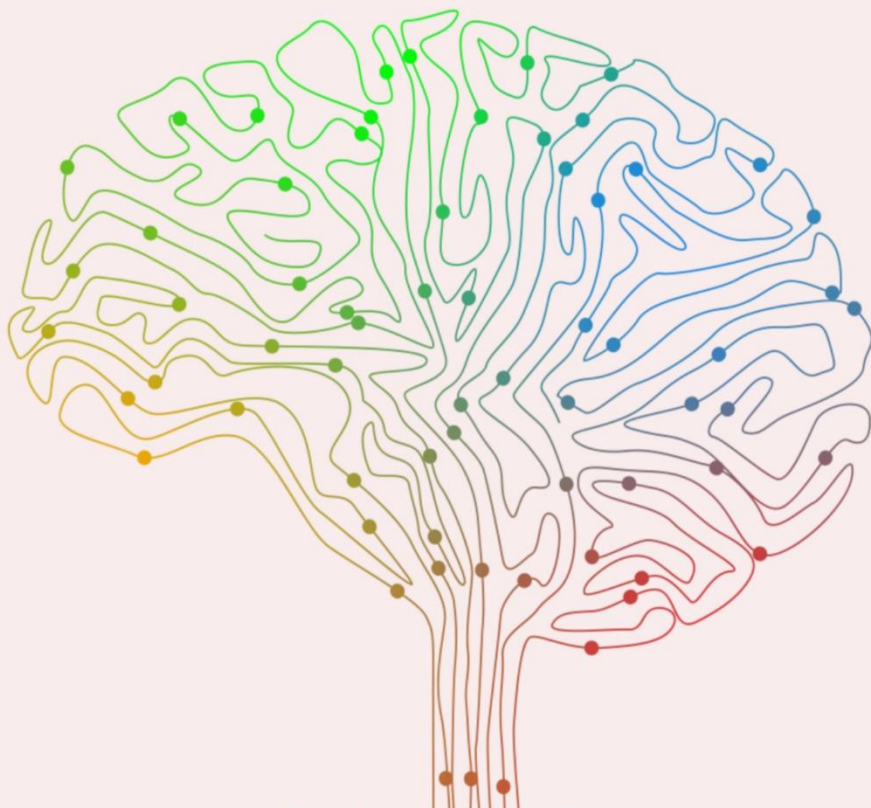


Journal of Innovative Exploration in Engineering & Technology

HOW TO TAKE YOUR IDEAS FROM YOUR BRAIN TO YOUR AUDIENCE



Faculty of Engineering
CHAITANYA(DEEMED TO BE UNIVERSITY)
Warangal, Telangana



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UNIVERSITY)**

**KISHANPURA, HANAMKONDA, WARANGAL 506 001
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MESSAGE

Over the past three decades Chaitanya Institutions have made steady and phenomenal progress in imparting quality education with several awards and accolades. Our vision is to take Chaitanya Deemed University (CDU) to greater heights with good digital governance and sound academic standards. Eventually, we want to make CDU a Center of Academic Excellence with creativity, productivity and accountability for knowledge society.

Our proposed Atal Chaitanya Incubation and Innovation Centre involves Engineering, Pharmacy, and other departments in thrust areas of farming, app development, manufacturing, etc. We are planning for BIRAC under Bio-Nest in collaboration with the University of Hyderabad involving the departments of Biotechnology, Microbiology, Biochemistry, Chemistry, Mathematics, Computer Science, Engineering Pharmacy, in thrust areas of agriculture, poultry, animal husbandry, food processing and value addition, biomedical engineering, etc. We were shortlisted for the DBT Skill Vigyan Program monitored by TSCOST. We have submitted the DBT Builder Program for financial assistance involving all the departments of science. We have also submitted proposals for CRG, Startup Grants and Matrix under SERB-DST. Departments of Engineering, Pharmacy, Computer Science, Commerce and Business Management have submitted Research Project Scheme (RPS) under AICTE Program. We have successfully conducted the second PhD Eligibility Test and have made admissions.

We have instituted the Chaitanyam to encourage high impact factor papers with original ideas and patent holders, and to promote serious and sustained academic work. Prof M. Sunder Ram (from Maths), Dr T. Narasimha Swamy and Prof M. Ravindar (both from Chemistry), Dr G. Kumara Swamy and Prof V. Mallikarjun (both from Pharmacy) received Chaitanyam-2021 Awards (with a gold medal and a certificate). We hope these awards will create healthy competition promoting serious and sustained academic work on our campus.

Earn-While-You-Learn Program is our latest initiative. Interested PG first year

students can register to work in the Softpath Company established at our university. The beginning salary is Rs 12,000 per month and it goes up based on the merit and work of the candidates. Aspiring students can email their bio-data to placements@cdu.ac.in.

Faculty-wise research journals are planned under the guidance of our Vice-Chancellor. Current English Review (CER), edited by Prof G. Damodar and Prof M. Rajeshwar as Editors and Dr D. Vidyanath as Assistant Editor, was launched in September 2021. It covers 18 critical and creative write-ups and reviews. We have applied for ISSN for the journal. The Journal of Bioscientia edited by Prof BS Anuradha and Prof S. Jeevan Chandra was launched on January 26, 2022. Cosmopolitan Journal of Innovations in Engineering and Technology, edited by Prof G. Shankar Lingam, and Dr N. Sateesh Kumar and the latest issue of Prakarsha, Journal of Management and Research edited by Prof P. Krishnamachary, Prof Ch. Rajesham and Prof P. Rajendar will be out shortly. Journal of Pharmacy and Drug Research, edited Dr K. Narasimha and Dr G. Kumara Swamy, is in the pipeline.

We have beyond classroom solutions. We want to go for futuristic solutions to facilitate our students to access our content anytime, anywhere, improve satisfaction and personalized learning outcomes, and give them the opportunity to learn with others. A Centre for Volunteerism as a step towards inclusiveness is being planned. All our M. Sc. students undertake Community Service and Project work as the part of the curriculum. They spend five days in rural areas, render community services and collect samples pertinent to agriculture, water, soil and community health. After thorough research, they submit the project reports to the departments concerned for evaluation. The paper/poster presentation in the conferences is a part of the curriculum for the PG students.

There is commendable participation of our students in extracurricular activities. Martyrs Day was observed on March 23, 2021 in the Engineering Department with a skit in the open theater. We inculcate competitive spirit among students by recognizing the first five class-wise toppers. There are regular interactive sessions with students and class representatives. NSS Unit is for beyond classroom experience, service and social education under the leadership of Program Coordinator, Dr D. Gopinath and Program Officer, Dr Aravind. As part of Azaadi ka Amrit Mahotsav, our University is conducting nine events such as (a) GK Test using Google Forms / Zoho (b) Essay writing on "Freedom Struggle Movements", (c) Elocution on "India's Progress in 75 Years" (d) Painting depicting "Pandemic Crisis" (e) Poetry on "Contemporary Issues" (f) Songs on "Patriotism" (g) Debate on "Our Progress in 75 years (For and Against)

(h) Short Concept Videos on Social Issues (i) Poster Designing showcasing "India in 75 Years". Events commence online from July 19, 2021 onwards. Prizes with certificates will be given on 75th Independence Day. Responding to the call by the Centre, our NSS Unit conducted various events as part of Azadika Amruth Mahostav. Samvidaan Diwas, Vaccination Drive four times, Voter Awareness, International Yoga Day, National Youth Day were observed. Our NSS volunteers took part in Swachh Bharat activities at Kazipet, distributed 150 bed sheets to the homeless people and organized some awareness programs in villages.

Our Mechanical Engineering faculty, Dr Srinivas Naik, Mr Harish and Mr Santhosh, have converted a petrol engine car into a battery operated eco-friendly electric car without gears. A motor of 48 volts, 700 watts and 500 rpm has been replaced with an engine of a Maruti 800 car. The weight of the engine was reduced by removing the gearboxes. The motor is connected to the drive shaft by a chain. The vehicle runs at a speed of 60 kmph. The car is economical and it costs just 20 paise per km. The conversion of the car costs two lakh rupees.

Coming to other innovations, a unique Chaitanya App was designed for teachers by Prof. G. Shankar Lingam and Mr. K. Praveen in 2020 for attendance, results, timetables and general information. Our mechanical branch staff members have designed a solar bike (see photo 4) and agri-cultivators. A cost-effective electronic bike has been designed by Mr G. Sagar. A digital electronic clock was designed by Dr Santhosh Reddy of ECE. The wing of ECE has also designed a Digital Display Board and devised Easy Vehicle Lifting Mechanism. The process of making transparent mementoes with a special material is in the pipeline.

We impart quality education by reviewing the impact of the existing programs and their relevance, restructuring of a few courses, consolidation of existing teaching programs, strengthening the learning process, strict adherence to the academic schedule, researching monitoring and assistance, encouraging national and international seminars, webinars, workshops, refresher courses, exhibitions, placement sessions, etc. Our pedagogy calls for hands-on experience, extensive laboratory and workshop exposure to link students to real world problems and situations. Students become industry-ready with good life and employability skills.

We have so far conducted 18 national and international webinars/ seminars on various topics. In addition to these, 60 standard online quizzes were conducted, and a hundred video lessons for YouTube Channel covering all branches were made available. All our 297 research scholars of two batches are enthusiastic to pursue their research

seriously from the date of joining their research program due to our good research facilities, weekly / fortnightly Regular Review Meetings (RRMs) and monthly and yearly reports by the scholars. The snapshots of RRM's have to be uploaded to the Chaitanya Research Group as a proof. Within ten months of joining the Ph.D program, our 139 research scholars of the first batch published 54 Research Papers in refereed journals during 2020-21.

Chaitanya has created a benchmark in Upgradation of Knowledge Through Interaction (UKTI) sessions to update the skills of teachers of various subjects. We have so far conducted 45 sessions and are now producing video lessons, making them available online for the benefit of all. To update the skills of teachers of various subjects, a daily interactive session was launched on April 27, 2020. All senior teachers have conducted the sessions with impressive PPTs. The Faculty Induction Program (Guru Dakshita) is done at the beginning of academic year. FDPs and Workshops are conducted to update their skills. We have initiated these UKTI sessions for the staff through Whatsapp for focus, clarity and readability. These sessions have exposed the teachers to the use of ICT and online teaching tools for better instruction.

Our university has developed adequate infrastructural facilities for the already existing and newly introduced academic programs during the past 5 years. Our laboratories are very well equipped and not short of anything. The teachers are at liberty to go in for any equipment that is useful for their laboratories. The University is equipped with HPLC, IPR Spectrophotometer, U.V. Spectrophotometer, PCR, Fermenter, Gel documentation system etc. The purpose of these instruments is to familiarize the students with the latest equipment so that they are not at sea when they encounter such instruments in industries or research institutions later.

Our university has been rated as one of the most sought-after colleges for the students of this region with the result that there has been considerable pressure on student admissions for all the courses. In view of the large number of academic programs, courses and course combinations and ever-increasing intake, the college has to live up to the expectations of the parents. A lot of emphasis has been placed on teaching, learning and evaluation.

I congratulate the department on bringing out this research journal.

Dr Ch. V. Purushotham Reddy
Founder & Chancellor



Prof. G. DAMODAR
Vice-Chancellor
Chaitanya (Deemed to be University)
Kishanpura, Hanamkonda, Warangal

Pleased to know that the Faculty of Engineering and Technology is bringing out this journal titled *Cosmopolitan Journal of Innovations in Engineering and Technology*, edited by Prof G. Shankar Lingam, and Dr N. Sateesh Kumar. I brought out *Current English Review*, a peer-reviewed and refereed journal of critical and creative writings and reviews, and it was launched in September 2021. Life Sciences brought out *The Journal of Bioscientia* edited by Prof BS Anuradha and Prof S. Jeevan Chandra on January 26, 2022. The latest issue of *Prakarsha, Journal of Management and Research* edited by Prof P. Krishnamachary, Prof Ch. Rajesham and Prof P. Rajendar will be out shortly. *Journal of Pharmacy and Drug Research*, edited Dr K. Narasimha and Dr G. Kumara Swamy, is in the pipeline.

In addition to the above research journals, a novel research-oriented initiative called *Chaitanyam* was instituted at our university to encourage high impact factor papers with original ideas and patents, and to promote serious and sustained academic work by the staff and research scholars. Universities are expected to undertake research related activities seriously and we understand them and implement them in the right earnest.

Ever since we got deemed to be university status in November 2019, we have been striving hard to take Chaitanya to greater heights. Our healthy practices so far include Academic Interphase Programs with TCS and IBM, good practices appreciated by AICTE, At-Home-ExamTM announcing the results on time, Best Paper and Patent Publication Awards, Beyond Classroom Solutions, *Vidyanjali*, a Centre for Volunteerism, unique Chaitanya App, Chaitanya At-Home-Library, Community Service and Rural Based Projects, Free-ships worth 1.10 crores last year, Implementation of some provisions of NEP 2020, Internationalisation of Higher Education, eight Inventions and Innovations including the battery-operated car, the introduction of latest courses including Agriculture and Nursing, Life Skills, DBT Skill Vigyan Program, NCC as a General Generic Elective, Interactive Sessions as *Deeksharambh*, Regular Research Review Meetings with Ph.D. scholars, State-of-Art

Labs, Study Tours of *Ek Bharat Shreshtha Bharath*, Sustainable Campus as SATAT, UKTI Sessions under *Guru Dakshita*, making video lessons available on YouTube, conducting online quizzes, Earn-While-You-Learn Schemes, University Social Responsibility Initiatives, encouraging patents, a proposal for Atal Chaitanya Incubation and Innovation Center, BIRAC under Bio-Nest in collaboration with University of Hyderabad, etc.

We have initiated a positive action to encourage research in post graduate courses project work is now included as a part of curriculum. Sectoral specializations like Tourism and Hospitality, Health Care Management for MBA, Net Programming, Multimedia Applications, Cloud Computing for MCA as in-house projects were introduced. Efforts are being made to have a much more and rigorous University–Industry nexus so that the batches of students get industrial experience along with academic programs by conducting meetings with the entrepreneurs in the region to impress upon the need to support the students’ training programs in their establishments so that they and others can employ them after completion of their courses.

Ten PhD courses in the Faculty of Science, Commerce and Business Management (1) Biochemistry, (2) Bio-technology, (3) Chemistry, (4) Commerce & Business Management, (5) Computer Science, (6) English, (7) Mathematics, (8) Microbiology, (9) Physics, (10) Statistics; Five PhD courses in the Faculty of Engineering (1) CS & Engg (2) ECE (3) EEE (4) ME (5) CE; Seven PhD courses in the Faculty of Pharmacy (1) Pharmaceutics (2) Pharmaceutical Analysis (3) Pharmacology (4) Pharmacy Practice (5) Pharmaceutical Chemistry (6) Pharmacognosy (7) Phytochemistry are offered at our university.

We have introduced the latest and emerging papers in subjects like Creativity and Innovation, Business Analytics, Business Informatics, Infrastructure Management, Data Base Management, Programming and Problem Solving Using Python, Ethical Hacking, E-Commerce, Web Programming, Immunology, Bioinformatics, Data Analysis, .Net Prog, Cryptography, Network Security, Software Testing, Artificial Intelligence, Research Methodology (in BBA), OOD in UML (in BCA), Heritage and Culture, Business Economics, Discrete Mathematics, Visual Data Base Application, CRBI (in B.Com.), Web Programming, Prog Concepts (Using C), Human Values and Ethics, Cell Biology, Genetics, Biodiversity, Plant Biotechnology, Animal Biotechnology, Enzymology, Concepts of Clinical Research, Advanced Programming in J2EE, Scripting Language, Mobile Application Development, ERP 7 Supply Chain Management, Design Patterns, Machine Language, Mobile Computing,

Communicative English, Bacteriology, Virology, Cell Biology, Classical Mechanics, Programming in C & MATLAB, Indian Constitution and Human Rights (in Int. M.Sc. Chemistry), Internet Technologies, Personality Development (in M.Sc. Courses), Nano Technology, Environmental Studies, Event Management (in BBA), Food & Beverage Mgt, Health Care Technology, Industrial Relations, Science and Civilization, Managerial Economics, Foreign Trade, Prog in C++, MIS, Office Automation, Operation research (in BCA), Digital Marketing, etc.

We have introduced Open electives like Food Technology, Nanotechnology, Biosafety, IPR, Tourism and Hospitality Management, Health Care Management, Fundamentals of Electronics, E-commerce, Computer Applications and Airline Management. These courses can be taken up by all the students of post-graduation to have an insight of the different fields which might help them in enriching their career prospects. We started offering B.Sc. Agriculture from the current academic year. We have got permission to start B.Sc. Nursing Course next year. Currently, we have about 6000+ students who belong to 14+ countries including India.

All our M. Sc. students undertake Community Service and Project work as the part of the curriculum. They spend five days in rural areas, render community services and collect samples pertinent to agriculture, water, soil and community health. After thorough research, they submit the project reports to the departments concerned for evaluation. The paper/poster presentation in the conferences is a part of the curriculum for the PG students.

Our library is well-equipped to meet the ever-growing needs of the teachers and learners right from internet support to audio-visual services with N-List, IEEE Gogotal, ALM, Sage DELNET Membership providing online access to the staff and students. Latest books are acquired from time to time from all sources. Students have access to massive open online courses in MP3 format based on MHRD model MOOCS, Commonwealth Education Services, cec.nic.in for all lessons. As students do not have access to the physical library during Pandemic, a Digital Library called "Chaitanya At-Home-Library" was launched. It is a new initiative with all prescribed e-books made available with the efforts of the Faculty on our University Website and on Chaitanya App.

We are committed and dedicated to our vision and mission and constantly evolve ourselves to the future needs and impart education that makes the world a better place to live in. The pillar of our strength is innovative teaching and learning experiences offered by experienced faculty backed with high quality resources. We offer academic

JEET 10

ambience, fruitful interaction and friendly support with excellent placements making life a celebration for every student. Our syllabus is skill-based and industry focused with contemporary curriculum, choice-based credit system (CBCS) and continuous assessment and grading pattern (CAGP). Social outreach programs, eco-friendly environment, diversified student community, education scholarships for deserving and meritorious students, internal quality assurance, enriching projects and internships, corporate linkages, global alumni network, learning management system, highly accomplished faculty members and levitating research culture are some of our salient features.

We always remember our core vision of empowering our future generations to be morally, ethically and intellectually strong with LOCF and following some provisions of National Education Policy 2020. To be with our university is an exciting and rewarding experience with opportunities for nurturing abilities, challenging cognizance and gaining competence.

Prof. G. DAMODAR
Vice-Chancellor

EDITORIAL

It is with great pride, enthusiasm, and anticipation that I invite you to read the inaugural issue of the Journal of Innovative Exploration in Engineering and Technology — “a new kind of research journal.”

An enormous amount of work has gone into the development of this journal and I believe you will see that effort reflected in this edition and in the impact it will have on the field.

It’s a cliché but a useful one in this case: We are a work in progress actively seeking ideas from campus and community in terms of structure, goals, and vision. We remain open to where we are going and how we will get there.

As we look at JIEET, it is important to keep in mind that it represents the collective thinking of a group of innovative individuals with whom I am privileged to work. First, we want JIEET to be the premiere academic journal in Engineering and Technology. We want it to look different, to be different, to be one journal that, will be as dynamic as the work going on in our disciplines, a rarity in academic publishing. Second, we want it to be a vehicle for a new type of conversation about engineering and Technology and its place in the academic review, tenure, promotion, and reward process. Third, we want JIEET to lead the way in defining scholarship in the academy, scholarship in which faculty, students, and community members participate from idea to presentation through distribution.

JIEET intends to be a leader in facilitating a new kind of discussion in the field of engineering and Technology which is transformative and that it is time for transformation in academia, JIEET will be at the forefront in strengthening relationships between communities and institutions of higher learning.

Dr. G. Shankar Lingam
Editor-in-Chief

CONTENTS

1. Sinterability and Densification behavior of Al- x% B₄C powder synthesized composites –*Dr. Suresh Gudipudi, Dept of Mechanical*
2. Stance and Rate Govern of a Drive System Using a Neural Processor in MATLAB / Simulink – *Dr. Chandramouli B, RatansingAktar, Dept of EEE*
3. Performance Analysis of Medical Image Fusion Using Wavelet Decomposition and Graph Cut Optimization - *SeetharamKhetavath, Dept of ECE*
4. Application of Optimal PSO MPPT Controller for Grid Connected PV System - *Dr. Donapati Ramakrishna Reddy, Dr. ChadaPrathyusha Reddy, Dept of EEE*
5. Magnetically reusable NiFe₂O₄ for dye degradation under Visible Light - *Monalisa Hazarika, Dept of ECE*
6. Programmable Network Services in Next Generation Software Defined Networks to prevent Security Attacks - *Dr. N. Satheesh Kumar, Dept of CSE*

SINTERABILITY AND DENSIFICATION BEHAVIOR OF AL- X% B₄C POWDER SYNTHESIZED COMPOSITES

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ABSTRACT

Particulate Metal Matrix Composites (PMMCs) are very useful as lightweight functional materials with high specific properties and low thermal expansion coefficients. Boron carbide B₄C reinforced Aluminium (Al) is the one among such PMMCs. The controlled porosity level of a composite can be obtained via powder metallurgy fabrication technique which is essential in biomedical, defense, and thermal management applications. The %B₄C was kept constant as 6. The green composites were made at uniaxial compaction pressure of 100, 160, 220, and 280MPa. Porosity was measured with Archimedes principle and theoretical density. The sinterability and densification behavior for high porous Al- 6% B₄C was explained with the detailed characterization results.

Keywords: Composite; B₄C; Density; Porosity; Powder metallurgy

INTRODUCTION

The mechanical properties of aluminum (Al) Metal Matrix Composites (MMCs) are highly demanded in the high technology industries like nuclear, friction, and computer hard discs [1]. These MMCs are also used in the defense sector, aerospace industry [2], and thermal management for electronic industry [3]. The various methods used to fabricate the MMCs are liquid metallurgy (Infiltration [4], stir-casting [5][6], squeeze-casting [7]), powder metallurgy [8][9][10], friction stir process [11], and laser based additive manufacturing technology [12][13]. The excellent control over the porosity level (customized porous) of the MMCs can be achieved via Powder Metallurgy (PM), which is the greatest advantage compared to the other fabrication methods. This

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customized porous level is a very essential feature for the composites which are found in biomedical (bone implant and scaffold with micro-pores for cell attachment and growth [13]), defense (ballistic performance [4]) and thermal management (removal of high heat flux [14]) applications. In addition to this customized porosity, the powder synthesized composites were reported for better microstructural properties due to well-distributed reinforcement (RF) particles along with better adhesion to the matrix material. Moreover, this PM method had a greater flexibility (in terms of the variation of process parameters) to achieve significant improvement of a required property of MMCs [9]. The fabricated composite properties can be improved further easily by secondary forming operations including extrusion, rolling, forging, and friction stir processing [15]. Boron carbide (B_4C) was reported for a variety of applications as a successful RF material in the composites [16].

Literature

Mohanty et al. [8] studied the effect of B_4C wt.% in the range 0 to 25 for density, electrical conductivity, hardness, and flexural strength. The decrease in trend for density and electrical conductivity, but improved hardness and strength (with some embrittlement) were observed compared to Al. The optimum mechanical alloying time (12h), compacting pressure (700MPa) and sintering temperature (635°C) of an Al-10% B_4C composite for improved density and bending strength were reported by Abinojar et al. [9]. Karako[17] suggested that the required wt.% of B_4C for improved fracture toughness and tensile strength is Ten and five respectively. The authors also performed some conventional machinability studies to evaluate machining properties and surface finish. The improvement in the mechanical properties of Al-15wt.% B_4C -1.5wt.% Cobalt hybrid composite was also observed by Ghasali et al. [18]. The high-temperature mechanical properties of Al alloy- B_4 MMCs were witnessed by Onoro et al. [10]. Apart from the physical and mechanical properties, the electrical properties of these MMCs are also affected by the very type of RF material and the processing conditions. Weber et al. [19] reported that the electrical conductivity would be decreased with the increased volume fraction of RF in the Al matrix. Chang et al. [20] developed models to predict

the electrical resistivity of MMCs and compared them experimentally. S. Chand et al. [21][22] studied the mechanical properties and erosion behavior of Al6061-B₄C-BN hybrid composites. The authors have achieved 249MPa and 184HV for maximum values of compressive strength and microhardness respectively at 8%B₄C-2%BN in addition to improved erosion efficiency.

MATERIALS AND EXPERIMENTAL

A. Fabrication of composite

The matrix and RF materials used in the present work were Al powder of 325 mesh (99.9% pure, make: SRL laboratory) and B₄C particles of 35 μ m average size (99.9% pure, Make: Supertek dies, Delhi). The size/ shape and the purity of these B₄C particles were examined through the SEM (Scanning Electron Microscope) micrograph and XRD (X-ray diffraction) pattern respectively as shown in Figure. 1(a) and 1(b). The Al powder and Xwt.% B₄C (0,4,5, and 6) particles were mixed thoroughly in a ceramic bowl manually for 30 minutes.

The composite powder mix was compacted (cross-section of 30 mm×30 mm) at room temperature in the metallic die under a 500kN capacity hydraulic press to obtain green specimens. The schematic of compaction is shown in Figure 2(a). The loading rate and the dwell during the compaction were set as 1mm/sec and 90 seconds respectively.

The same fabrication process was repeated to make these green composites at 100, 160, 220, and 280MPa compaction pressures. These green composite specimens were sintered in a tubular furnace under an argon atmosphere [8]. The SEM image and XRD analysis of sintered Al-B₄C is shown in Figure 1(c).

B. Characterization

Density: The theoretical (ρ_{th}) and experimental density (ρ_{ex}) of these sintered MMC specimens were measured by a rule of mix and Archimedes principle respectively. The relative density (ρ_{rel}) and percentage (%) porosity were from Eq. 1 and Eq. 2 respectively.

$$\rho_{rel}(\%) = \left(\frac{\rho_{ex}}{\rho_{th}} \right) \times 100 \quad (1)$$

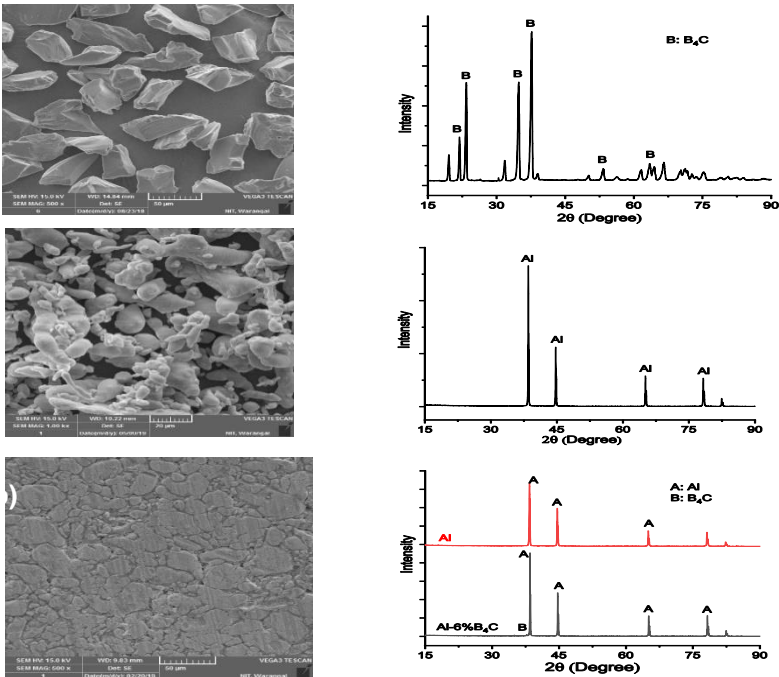
$$Porosity (\%) = \left[1 - \left(\frac{\rho_{ex}}{\rho_{th}} \right) \right] \times 100 \quad (2)$$

Microhardness: The micro-hardness was measured by Vicker's micro-hardness test (Model: Economet VH 1MD) at a load of 100g and a dwell of about 10 seconds by using Eq. 3. The microstructure was studied under the SEM (model: VEGA 3 LMU).

$$HV = \frac{2P \sin\left(\frac{\alpha}{2}\right)}{D^2} \quad (3)$$

Where, HV: Vicker's hardness number, P: load applied (kgf), α : Angle between the two opposite faces of diamond indenter (degrees), D: Mean diagonal length of the indentation (mm).

Fig. 1. SEM micrographs and XRD analysis of (a) B_4C Particles, (b) Al powder, (c) sintered Al-6% B_4C



RESULTS AND DISCUSSION

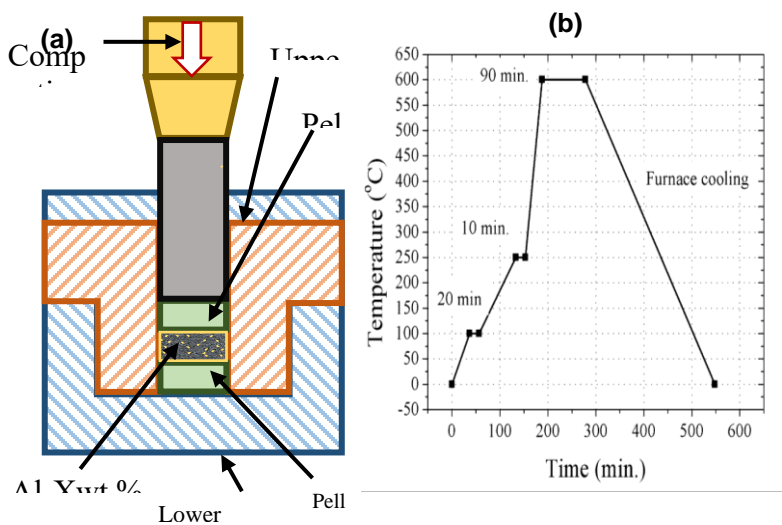


Fig. 2. (a) Theschematic of composite powder mix

The photographs of tooling accessories (Die-set) used for the fabrication and Al-x%B₄C MMCs (60mm×60mm cross section with varied thickness) are show in Figure 3. The measured porosity level and Vickers’s microhardness, HV are represent in Figure 4. The compressibility of the composite powder mix is directly affected by RF (B₄C) morphology, size, shape, friction, distribution of RF particulates, applied pressure, etc. Therefore, the green composites developed at various compaction pressures exhibit different density values which are governed by the densification mechanism and the deformation behavior of the powder mix. An increase in compression pressure increases the density by lowering the porosity between the particles.

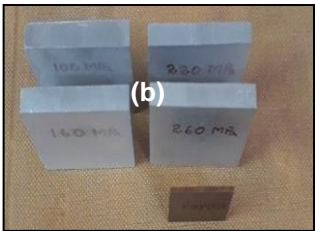
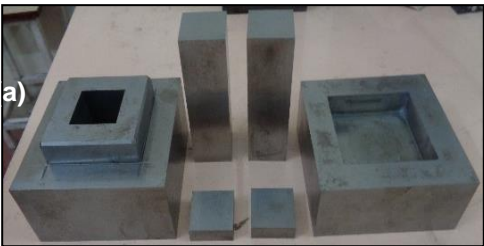


Fig. 3. Die-set for compaction and Al-6%B₄C MMCs (60mm×60mm cross section with varied thickness)

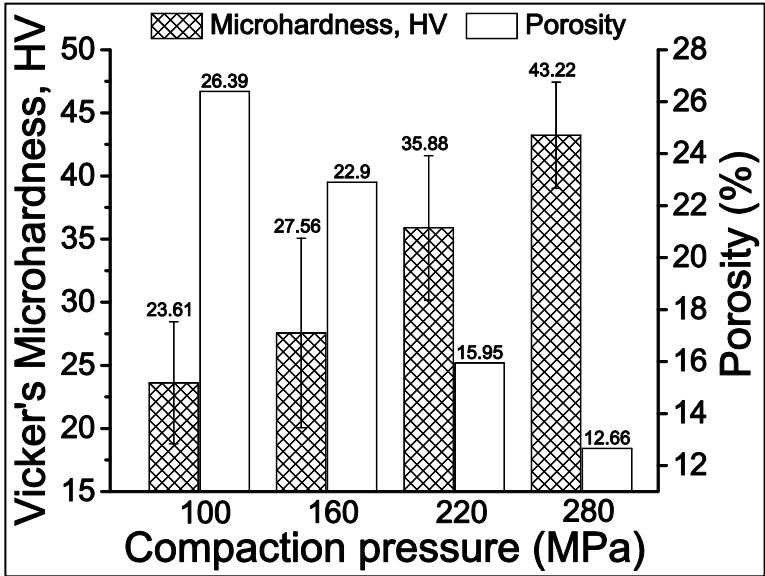


Fig. 4. The measured porosity level and Vickers’s microhardness of Al-6wt.% B₄C MMC at varied compaction pressure

The microstructure and the indentation size of the micro indenter on composites at various compaction pressures were shown in Fig. 5(a), 5(b), and 5(c). The variation in the porosity level and the microhardness of composite specimens fabricated at varied compaction pressures were shown in Fig. 5(a). At higher compaction loads, the particles in the composite mix are closely held together which results in the decreased particle spacing, good bonding, and elimination of any gaseous agents absorbed during mixing.

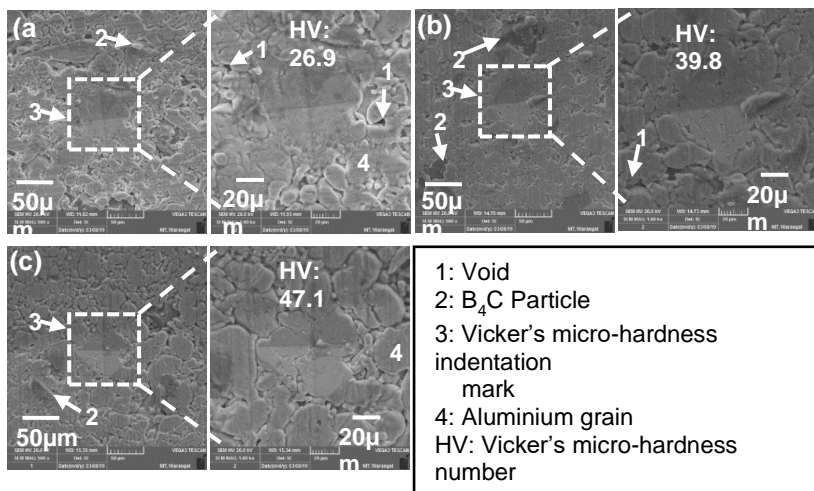


Fig. 5. SEM micrograph showing microstructure and Vicker's micro indentation mark of Al- 6wt.% B₄C composites fabricated at compaction pressures of:a.160 MPa; b. 220 MPa; c. 280 MPa

Therefore, the decreased trend of porosity can be observed in Fig. 5(a) as the compaction pressure increased from 100 to 280MPa. Vicker's microhardness value was found to be increased as compaction pressure increases. The reason is, while an indenter moves down the inter-particle spacing further reduced and the B₄C particle crowding occurred. Hence, at higher compaction pressure the load transfer capability from the matrix to RF is augmented. Less porosity and strain hardening due to plastic flow occurred in the localized region also cause an improvement of hardness.

CONCLUSION

The fabricating conditions (compaction pressures) showed significant influence on the density of Al-6w.% B₄C MMCs. The present study suggests that there is a need to control the compaction pressures (to achieve a required density value) during the fabrication of Al-6wt%B₄C composites.

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STANCE AND RATE GOVERN OF A DRIVE SYSTEM USING A NEURAL PROCESSOR IN MATLAB / SIMULINK

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ABSTRACT

The initiative entails the creation of a "Model commanded algorithm for Bldc." The study entails a review of the field on Neural architectures used in mobility and acceleration adjustment. The proposal entails the creation of a Bldc electrical machine as well as a pace & prevailing motion control using MATLAB/Simulink. A segmented for control signal just at Dc stockpile governs its duty cycle of Drive system throughout transient conditions in rated value. The suggested BLDC drive with amperage stability oriented PFC converter is constructed, patterned, and simulated in the Matlab-Simulink environment for such an compressors propelled by a 1.5 kW, 2000 rpm Bldc. The assessment statistics of the suggested pace control structure using the Gradient descent method, an ANN (Neural Network) idea, are provided to illustrate the enhanced efficacy of the offered drivetrain with the PFC functionality over a broad range of velocities and intake Signal volts. The system model must be properly built to encompass stance and motion monitoring of the Drive system. The research also includes numerical simulations of the Drive system.

KEYWORDS: ANN, BLDC motor, PWM, hall sensors, power factor correction (PFC)

INTRODUCTION

Because of the driveline outweighing qualities, there is a continual tendency to suggest intelligent monitoring techniques to increase the driveline effectiveness. Approaches like the d-q paradigm and ABC stage to ensure approaches have been created to evaluate the Speed control circuit in diverse circumstances. Because fit potentially broad usage, ADC controllers of

Sensorless electric machines are being explored. There is a constant desire to minimize the connection with the purchase and, as a result, the pricing with this powertrain. Inventive and creative is helpful because it eliminates wanders and allows for easy technical improvements by utilizing a modular engine. As a result, inside the manifest heyday, digitized manipulation is used for mobility tracking activities. Virtual actuators can be silicon chip, servo console, or Regression. This research paper focus on the servo controlled of Drive systems utilizing ANN actuators. Brushless Direct Current (BLDC) engines are one of the drive systems that are quickly acquiring steam. Control valves are employed in a variety of sectors, including utilities, automobile, aviation, marketing, medicinal, automated production gear, and diagnostics.

AGENCY & AUTHORITY SCENARIO

A engine is a Brushless dc actuator. It implies that the electric flux produced by the generator and those produced by the rotary both revolve simultaneously period. Propellers do not exhibit the "slip" which is common in drive system. Mono, multiple, and multiple BLDC types are available. A magneto seems to have a appropriate count many coil like its analog. Three-phase actuators are perhaps the most common & commonly utilized of all. These algorithm mainly is mostly concerned with three-phase machinery.

STAGNANT ENGINE

The Adjustable speed driveline blade is made up of piled durable materials with circuitry positioned in grooves linearly carved anywhere over interior perimeter. Its spindle is customarily similar even to an electric machine; nonetheless, the elements are connected differently. The majority of Drive systems have triple coils coupled in a starburst pattern. Either of such circuitry is made up of several loops that are coupled to make a wrapping. Each circuit is formed by slipping one or multiple loops into the grooves & uniting them. Some of these circuitry is dispersed around the perimeter of such spindle to establish evenly directivity. Rectilinear & oscillatory engines are the different sorts of coils.

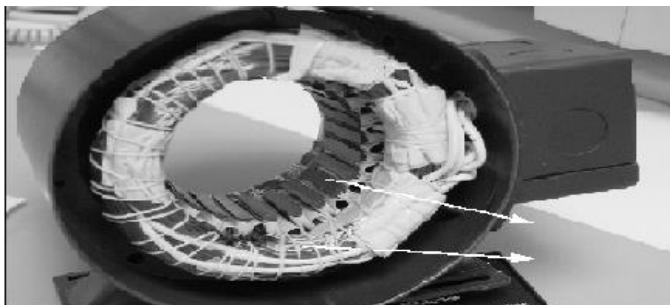


Fig. 1 Spindle of Drive Engine

REVOLUTIONARY SPINDLE

The spinning is comprised of ferromagnetic material and can have 2 to 8 polar tuples with consecutive North (N) & South (S) poles. The wire that used create a spindle was selected depending here on appropriate magnetization concentration in the blade. Connecting rods are usually made with pyrite atoms. Rich element composite poles are becoming increasingly prevalent as science evolves. Ferritic steels are less costly, and they have the drawback of maintaining a negative conductivity for a fixed quantity. In contrary, the metallic exhibits a large magnetostrictive permeability per unit, allowing the blade to bend deeper for the equivalent thrust.

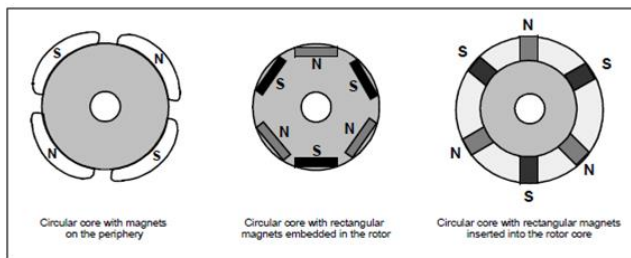


Fig.2 transversal passages of rotary magnets

HALL IMAGERS

A Brushless dc driveline commutation was governed electronically, as opposed to a series Dc motors. To turn the Engine drive, the coils must be activated in the correct order. It is crucial to know the control input in order to ascertain which wrapping will be powered after the invigorating procedure. Gyroscopes implanted in the shaft detect the rotor's location. Upon that pro extremity among

most Drive systems, three Hall devices are deployed with in blade. When the spinning electromagnets run close proximity to the Circuits, they produce a significant or weak pulse, signifying that the N or S side is traveling close to the scanners. The synchronized of transmission was investigated relying just on set - related Hall data.

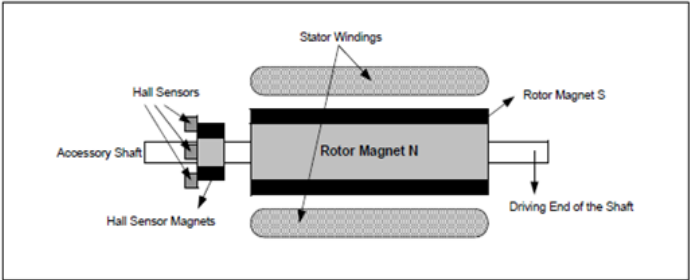


Fig.3 Sagittal portion of a Drive system

ENGINE DRIVES COMPUTATIONAL SCULPTING

Quantitatively, the Actuator may be accomplished in 2 instances: the ABC cycle varying paradigm and the d-q axis paradigm. Because curvilinear flux in such a Motor drive suggests that indeed magnetic force between coils is quasi, therefore translating to the d-q axis provides no utility, and hence the ABC stage dynamic paradigm is selected. The engine is believed to be star-connected with a secluded neutrality in the existing scheme. In developing the engine, the governing equation:

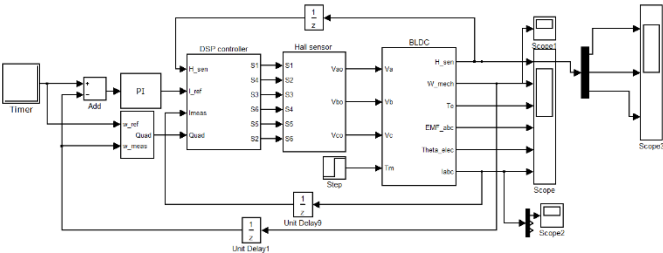


Fig.4 simulink model of BLDC drive system

REFERENTIAL MODERN ENGINE

In the hysteresis band, the appropriate power flow are fed. The benchmark thrust & spine characteristic define the amplitude of current controller. The

tavern detector and the application environment decide whether stream was arriving or outbound. Tables 1 (Front driving and rear driving) and 2 (Backward driving and forward braking) indicate the control signals for various consistent activities:

$h_1 \ h_2 \ h_3$	I_a^{ref}	I_b^{ref}	I_c^{ref}
1 0 1	0	I^*	$-I^*$
0 0 1	I^*	0	$-I^*$
0 1 1	I^*	$-I^*$	0
0 1 0	0	$-I^*$	I^*
1 1 0	$-I^*$	0	I^*
1 0 0	$-I^*$	I^*	0

Table.1 Advanced Driving & Reversal Stopping Baseline Eddies

$h_1 \ h_2 \ h_3$	I_a^{ref}	I_b^{ref}	I_c^{ref}
1 0 1	0	$-I^*$	I^*
0 0 1	$-I^*$	0	I^*
0 1 1	$-I^*$	I^*	0
0 1 0	0	I^*	$-I^*$
1 1 0	I^*	0	$-I^*$
1 0 0	I^*	$-I^*$	0

Table.2 Return Cruising with Upward Deceleration Baseline Eddies

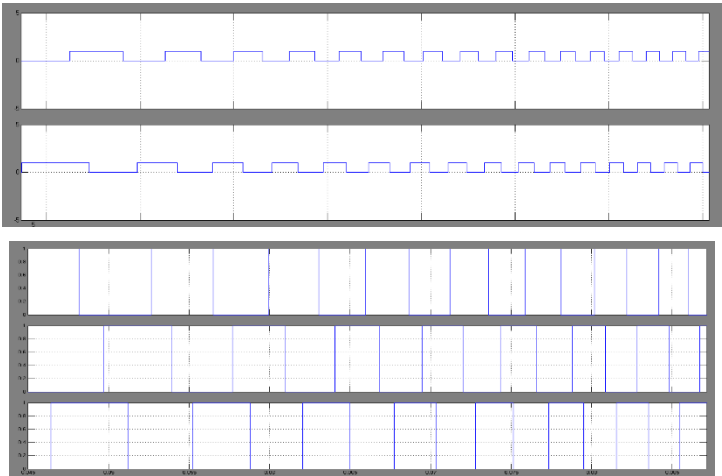


Fig .5 Atrium detectors and limiting outputs

ARTIFICIAL NEURAL NETWORK (ANN)

Neural nets must be one of those concepts which become popular in the modern technological era. Numerous folk understand of them, but few understand what they are. This tutorial will present you to the fundamentals of machine learning, including their purpose, essential features, nomenclature, categories, and applications.

The phrase "neuron" is a biological term, therefore what we call "neural pathways" should be called "Synthetic Neuro Layers" (ANNs). However, I shall use the two words effectively all across the article. A true neurological connectivity is made up of axons, which have been the microscopic cells that make up our minds. A connectivity can be made up of a few thousands to few more billion neurons linked in a variety of ways. For both design & behavior, Ann models aim to replicate such organ systems. There is one minor issue: we don't fully understand how natural NNs function! As a result, the design of neurons varies widely depending on the kind. What we are doing known is the fundamental neuron's anatomy.

THE SYNAPSE

Although it has been hypothesized that nervous system contains anywhere from 50 to 500 distinct neuronal populations, they are largely merely effector cells based on the basic axon. Brain cells, the nucleus, the axonal, and nerve cells constitute the basic cell. Neural attachments are neuronal links; they really aren't structural interconnection, but rather tiny intervals that permit electromagnetic signals to travel from nerve terminals. These impulses are subsequently

structures (Kohonen networks) to links that simulate metabolic characteristics (Boltzmann machines). However, there is a system communication design. The matrix is made up of numerous "layers" of synapses, including an encoder, convolutional units, & activation functions. These intake stages receive the data and transfer it to the convolutional nodes . Such lower units do all relevant computations & report the signal to the activation function, that (surprise) sends the message to the receiver. To prevent misunderstanding, I shall not delve deeper into the engineering subject. Can see Generation5 blogs for further information on various learning algorithms. This is a prevalent misconception. Even after talking approximately axons, intelligence, and building, we still don't know what human brains accomplish!

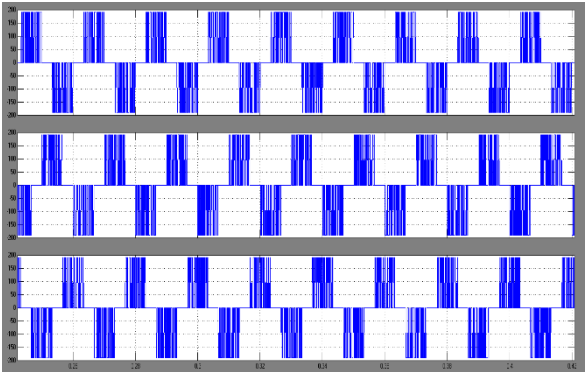


Fig 8: Phase voltages (V_a , V_b , V_c)

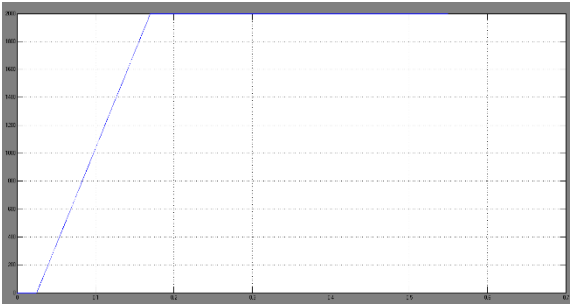


Fig.9 Pace of Engine drive

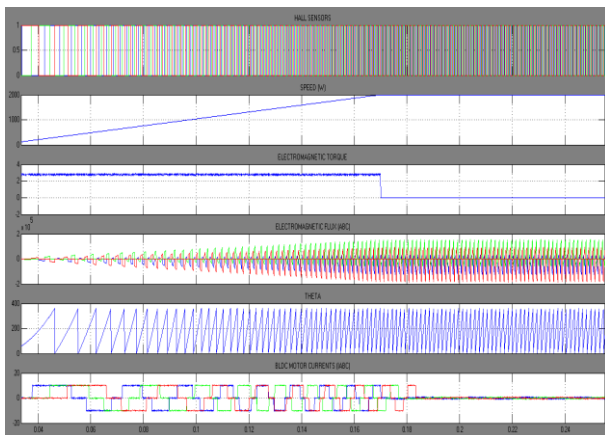


Fig 10: (a) hall sensors output (b) pace of drive (c) Thrust (d) electro mechanical flux (e) rotor angle theta (f) stator currents (Iabc)

THE RAMIFICATION OF NEURONS

Trend analyzers and template associations were two types of multilayer circuits that are intended to operate with styles. The channels are able to categorize a matrix (subset). My ONR software, for contrast, captures an image of a numeric and produces the digit proper. Alternatively, my PDA32 software can take a location and categorize as either category A or category B. More implementations include defense radars, which can classify acoustic signal as hostile units or foliage. Neurons are built to operate with motifs; they can be categorized as form learners or trend collaborators. The networking can categorize a column (a group consisting). For illustrate, my ONR application takes a picture of a numeric then generates actual number directly. Alternatively, my PDA32 application may categorize a location either as category A or category B. More utilizations could been spotted within tactical transponders, whereby radiation signals can be categorized as hostile units or trees.

CONCLUSION

A unique pace control framework of a PMBLDCM drive is verified for the turbine demand of a heating system, which employs the benchmark rate as just a comparable control signal at the DC link. The speed control is proportional to

the voltage control at the DC connection. During switching cycle, the segmented inserted inside the benchmark energy levelling across DC connection efficiently restricts the engine power to the required amount .BLDC motors have benefits over brushed DC actuators and inducing engines. They feature improved speed versus torque characteristics, high dynamic responsiveness, high effectiveness, extended working life, ease of operation, greater speed bands, durability, and so on. Furthermore, the strength provided to the unit capacity is greater, making it suitable in situations where economy & lightness are essential issues. Since it combines both circuitry under a single device, the ANN allows the construction of a reduced & better refined version. The functionality of the created ANN-based driver of the Speed influence has demonstrated that the methodology developed to assess that activity of the Brushless drive system performs well in reducing latency.

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PERFORMANCE ANALYSIS OF MEDICAL IMAGE FUSION USING WAVELET DECOMPOSITION AND GRAPH CUT OPTIMIZATION

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ABSTRACT

Image fusion is a well-recognized and a conventional field of image processing. Image fusion provides an efficient way of enhancing and combining pixel-level data resulting in highly informative data for human perception as compared with individual input source data. In medical image processing, image fusion is important for identifying the medical disorders. Medical image process involves desegregating of numerous images into one fused image. By doing this uncertainty is minimized and redundancy also reduced in resulting with more valuable information from the original images. On comparison to the original images, output images contain more valuable data. The Proposed multimodal graph cut approach based on Discrete Wavelet Transform (DWT). It combines spine (Magnetic Resonance Imaging) MRI and Computed Tomography (CT) images for evaluating the spine disorders from the original images. The obtained images are further undergoing on the analysis of Peak Signal-to-Noise Ratio (PSNR), Mean Square Error (MSE) and fusion latency. The experimental results prove that the propose system achieves enhanced performance than the other existing fusion methods.

Key words: Image fusion, DWT, MRI, CT images, PSNR, MSE, Fuzzy reasoning and Fuzzy rules.

INTRODUCTION

Magnetic resonance images (MRIs) acquired with similar protocols but on different scanners will show dissimilar intensity values for the same tissue types .The prime goal of image fusion is to generate a single fused which provides more reliable and accurate information than any one individual image and which gives higher amount of distinguishability amongst the features in the

images. In general, the fusion process uses a sequence of important data to combine a digital image with more information than a single synthesized image, which is better for visual quality perception. We are collecting data from multiple photos and combining it here. Those input images could come from a variety of sensors. With the availability of multi-sensor data in disciplines such as remote detection, medical image processing, and machine sensation, image fusion has emerged as a promising and important study subject. [1,3]. In other words, the image fusion technique merges numerous input photographs taken from the same scene to create a single fused image that retains all content information while also retaining key features from each original image.

When compared to each individual image, the resulting fused image must have greater meaningful information content. As far as we know, no picture fusion method has been reported that includes multi-direction and multimodal input images at the same time. MRI of the spine describes the intricacies of useful soft-tissue containing the spinal nerves and discs, fluid of cerebral spinal, and the spinal cord in the case of spinal cord problem and injury. (2), (6) Computed Tomography pictures clearly show skeletal features, notably the cortex of bone, allowing for the evaluation of faulty joints. When both MRI and CT scans are available, radiologists frequently choose them next to each other. This gives them all of the uncommitted image information. However, their use is limited to visual quality correlation between these two MRI and CT pictures, since it is difficult to determine if the contraction of a spinal canal is caused by a bone or tissue. Spectral color information is presented in both CT and MRI images. (4), (5)

The images should be mentally modified and combined together to adequately represent the concerned bone and soft-tissue structures. The image fusion technique uses digital image processing techniques to combine multi-modal input images. This method of images fusion adds to more precise data and increased utility. Furthermore, it is stated that fused information provides robust functional performance such as increased confidence, reduced ambiguity,

increased dependability, and improved classification. [7]. Such image fusion is a procedure that aims to desegregate divergent and complimentary data in order to improve the information displayed in the original images as well as the interpretability. This technique aids in the accurate interpretation of data and its application. As a result, we provided a new image fusion strategy for medical pictures based on Graph cuts in our work, which overcomes the limitations of several previous approaches. [8,9].

RELATED WORK

Miles et al. [10] proposed a novel CT/MR spine image fusion method based on graph cuts, in which both soft-tissue and bony details can be evaluated on a fused single image. They used three schemes: the first is squared error, which promotes the result to be similar to the MRI input images with an orientation to hard MRI edges. The second is the squared error, which promotes the result to be similar to the CT input images, with an orientation to the hard CT image edges, and the third is a prior, which prefers smooth results by encouraging adjacent pixels to have standardized fused-image measures. Its fusion procedure was evaluated for approximately 50 pairs of CT or MR images obtained from 20 patients, establishing a very militant performance when compared to conventional methodologies.

Shen et al. [11] presented an algorithm for medical image fusion using the cross-scale fusion rule for multi-scale disintegration established fusion of volumetric medical oriented images. Such an approach was developed for the joint diagnosis of medical information from various imaging modalities, as well as for the effective fusion of color images. Using locality information, an optimum set of co-efficient from the representations of the original image's multi-scale process is efficiently determined. The simulation results show that the fusion approach achieves better results than other conventional approaches. Salah et al. [12] proposed a multi-region graph cut image partitioning technique based on kernel mapping of input picture data. The picture information is implicitly translated using a kernel function, allowing the piecewise constant model of the graph cut idea to be used. When taking advantage of the processing

advantages of graph cuts, their approach provides an effective option for complicated picture modelling of source image information. A comparative and quantitative performance evaluation was carried out on a large number of studies using synthetic grey level information as well as raw photos from the Berkeley database, and the results were evaluated.

R. J. Sapkal and S. M. Kulkarni [13] presented an image fusion approach based on Wavelet Transform that allows for multi-resolution analysis in Wavelet Transform. Such a system uses a pixel-based algorithm for estimates, which necessitates fusion based on accepting the highest assessed pixels from original image estimations. The maximum pixel measures are utilized to create a binary decision map, which is then used to rebuild the fused image and display the answer using the inverse wavelet transform. The spectral quality of the wavelet-sharpened input images is significantly improved.

Michopoulou et al. [14] presented a fusion algorithm based on atlas-based segmentation and the atlas-robust-fuzzy c-means technique. The atlas-robust-fuzzy c-means technique aggregated prior knowledge of anatomic by using a stiffly shown probabilistic disc atlas, as well as clustering of fuzzy techniques with smoothness restraints. Furthermore, such a technique might be used in computer-assisted spine surgery, with the dice resemblance exponents of such an approach being 91.6 percent for convention and 87.2 percent for fallen discs, according to the experimental results.

Boykov et al. [15] suggested two methods based on a graph cut approach for finding a local minimum measure quickly in two scenarios of extreme moves, such as expansion and swap motions. Those actions change the labels of a large number of pixels at the same time. When compared to the swap algorithm, the expansion algorithm finds a label within a recognized factor of the worldwide minimal measure, although the swap algorithm deals with a lot more universal energy work. According to simulation results, the proposed approach represented ground truth input images with 98 percent accuracy over actual information.

PROPOSED METHOD

Figure 1 describes the proposed fusion algorithms block diagram. It contains the input images spine MRI and CT images. The pre-processing stage is done separately for both MRI and CT images. The two pre-processing output blocks are taken as the input to wavelet decomposition block then graph cut fusion takes place. After the Inverse Discrete Wavelet process, final fused images are obtained.

Image pre-processing

The image pre-processing procedure removes noise from the original/source/input images and converts the current heterogeneous image into a homogeneous image for subsequent processing. The Anisotropic Diffusion Filter (ADF) is used for preprocessing in this case. Both MRI and CT pictures are susceptible to noise, which is present in digital image processing and can occur at any time during the digitization and transmission of an image. The adjacent pixels in the output image include extra samples of the same measure as the source pixel, forming the similar feature. This is visibly unreliable around the edges, resulting in blurred details. In this research, we used ADF to do picture de-noising and smoothing. In this case, the adjacent pixels are ordered in order of brightness, and the median measure becomes the new measure for the fundamental pixel. Certain types of noise, such as impulse or shot noise, in which a small number of independent pixels cause high values, can be effectively blocked by AD filters.

Source Image Wavelet Decomposition process

Using the wavelet method, image fusion decomposes the original/source images into estimation and elaborated coefficients at the required level using DWT. Using a fusion pattern, the estimation and elaborated coefficients of both input pictures are fused. A binary decision map is generated based on the maximum assessed pixels between the estimations, which provides the decision pattern for fusion of estimation coefficients in the two original images A_1 and A_2 .

Graph-Cut Optimization

The problem with the proposed method is similar to effective graph-cut optimization process. Each and every pixel in that image is given a distinct label, with corresponding data and smoothness costs allotted to the links in that graph. Let $G_r = \{V, E_x\}$ be a weighted graph in which V contains a pair of nodes for each and every pixel in α and for each and every label in L_a . Each pair of nodes 'a' and 'b' has one edge $E_{\{a,b\}}$ and every pair of nodes 'a' and 'b' and a cut $C_u \in E_x$ is a set of image edges distinguishes the image label nodes from one another. The cut C_u with the very low cost is the minimal-cut trouble and the cost of such minimal cut $|C_u|$ is equal to the total of the image edge weights of C_u . It is critical to establish the pixel weights of that graph properly in order to calculate minimal-cost cuts efficiently.

A swap procedure starts with a single labelled graph and determines whether each node with a measure in a, b should be i) current label or ii) be updated to another label in that pair given an afforded pair of labels, 'a' and 'b'. Every swap is performed in a global and precise manner by finding the minimal cut on a binary image graph with only two labels. This technique can be extended to a multi-label type by repeating it across the whole set of possible label pairings. At each phase, the minimal cut is chosen, with the final label expressing a minimum of the energy purpose.

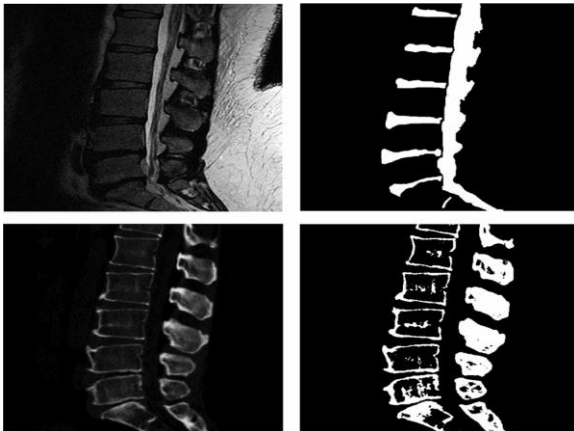


Figure 1: Input image for evaluating fusion algorithm. Top left image is the sample MR image, top right image is the soft tissue mask, bottom left is the sample CT image and bottom right is the bone detail mask.

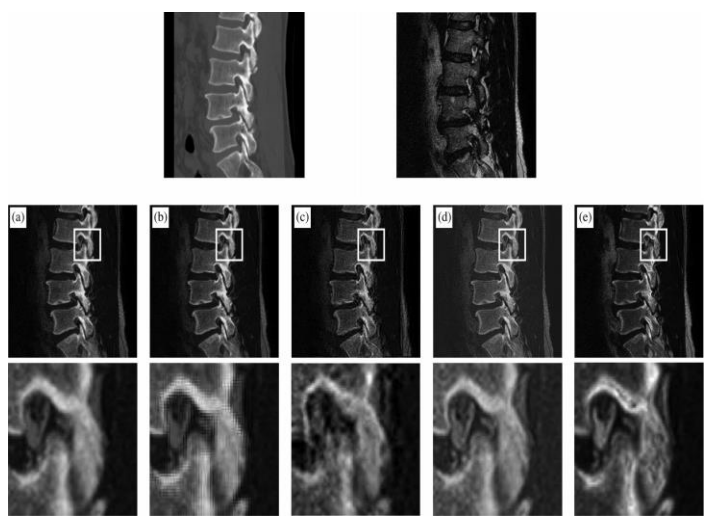


Figure 2: Sample fused Images: input CT is [resent in top left, top right is input MR image. The second row contains averaging method, discrete wavelet transform, contourlet, Piella’s variational method, and our proposed graph-cut method. The last row contains Magnified images within the region of interest indicated in the images above.

EXPERIMENTAL RESULTS

Mean Intensity of Tissue Mask (Left Slices)

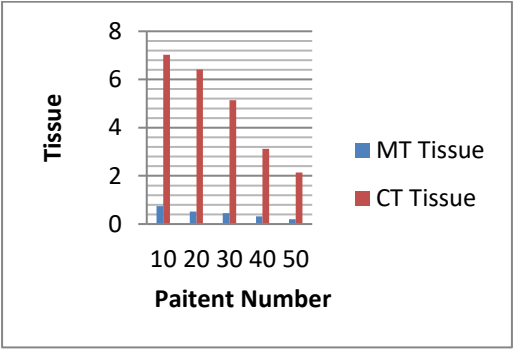


Figure: 3 Total patient's vs Comparison of CT Tissue and MT Tissue

Mean Intensity of Tissue Mask (Right Slices)

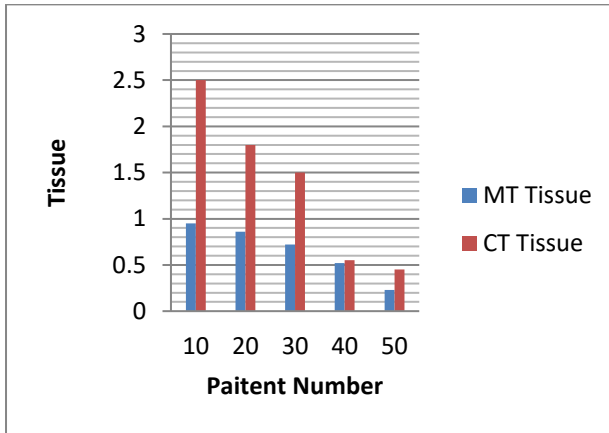


Figure: 4 Total patient's vs Comparison of CT Tissue and MT Tissue

CONCLUSION

Medical image fusion combines different modality of medical images to produce a high quality fused image with spatial and spectral information. In this work, medical image fusion process is improvised for achieving high quality fusion image with proper spatial and spectral information. This work carried out with analyzing the spine images and this approach can be further used on the multiple applications of medical diagnosis. We propose, multi modal graph cut technique using DWT for combining the spine MRI as well as CT images in order to detect the disorders. On the observation the proposed system achieves PSNR of 65.45 and fusion latency of about 0.39sec. The future scope is carried out with fuzzy logic and reiterative neuro- fuzzy for merging the medical images to achieve more enhanced accuracy in results.

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APPLICATION OF OPTIMAL PSO MPPT CONTROLLER FOR GRID CONNECTED PV SYSTEM

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ABSTRACT

Despite the global financial difficulties, the renewable energy industry has remained resilient and has managed to hold its own. This shows that the industry is well-equipped to meet the demands of a clean and secure energy economy. The rapid growth of the global economy has created an opportunity for the renewable energy industry to expand at a fast pace. However, to truly meet the world's energy needs, governments need to support the industry in various ways. The world's energy supply is heavily dependent on fossil fuels. By 2030, oil will still be the main fuel used globally, accounting for approximately 80% of the primary energy. In this paper Optimal MPPT Controller is proposed with Particle Swarm Optimization (PSO) Algorithm. The proposed controller is modelled in MATLAB/SIMULINK. The Results shows the Effectiveness of the Controller.

Keywords: PSO, MPPT, PV System

INTRODUCTION

With a huge energy resource base, India is capable of sourcing fossil fuels and non-conventional sources of energy. Coal is the main source of energy for the country, accounting for over 50% of India's total consumption. The country's dependence on oil imports is expected to increase significantly, as it is a major source of energy. Gas consumption is also expected to increase by 38% in 2016-2020. In 2016, India is expected to import about 200 million tons of coal, which is significantly higher compared to the 90 million tons that it imported in 2015. Despite the abundance of coal, it is still constrained by high ash content and environmental concerns. [1]

Despite the huge potential of India's renewable energy market, its operation is still in its infancy. In many ways, it is still behind the standards of developed nations. Despite the huge potential of India's renewable energy market, the country's high energy needs are still being met primarily by petroleum and coal. Non-permanent service to the power grid is also harmful to the environment. The rising price of crude oil has affected the country's economy, which means that various power sources need to be developed in order to meet the country's growing needs. This is also expected to mean that the country has to transition from using coal and crude oil to renewable energy. [2]-[4]

This transition will involve the use of various renewable resources such as wind, solar, and tidal power. Aside from these, various power generation systems such as wind turbines and biomass can also be utilized. Coal-based generation contributes to India's total energy generation, which is about 68.6% of its total capacity. This is also due to the presence of captive power plants with a total capacity of 1MW. With the implementation of various policies, India's total power demand is expected to increase to 400,000 MW by 2030. To meet this target, the country needs to add 215,000 MWs of new generation by 2030. [5]-[8]

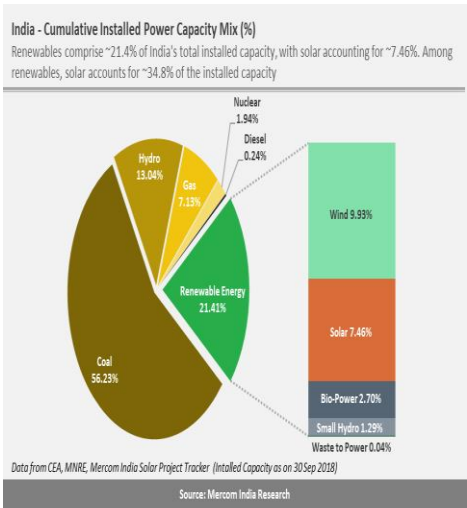


Figure. 1 Installed Power Capacity in India

With a potential to generate up to 60,000 MWs of solar power, India can easily meet its electricity needs. It can also produce 50,000 MWs of hydroelectric

power through local waterways. In order to meet its target, India needs to add 50,000 MWs of nuclear power by 2030. This resource can be utilized in conjunction with wind and solar power, which can generate up to 20,000 MWs of electricity. Converting the various waste streams in the country into electrical power can be achieved through the use of mixed cycle technology. This method would involve the use of gasification and the elimination of pollutants from the electricity supply. [9]-[10]

PARTICLE SWARM OPTIMIZATION

Particle swarm optimization is a computational technique that involves trying to improve a given candidate solution by moving particles around in a search-space according to a simple math formula. Each particle is guided to its best known position in the search space. As long as other particles are finding better positions, the swarm will move toward the best solutions. This algorithm was refined and it was observed that it was performing well. A comprehensive review on its various applications has been published by Poli and Bonyadi. PSO is a metaheuristic approach that can search large spaces of potential solutions. PSO does not use the gradient of the problem being studied, which means it does not require the use of other methods such as descent gradient.

The basic concept of PSO is that a population of particles is organized into groups called swarms. These particles are then moved in the search-space according to the simple formulae provided by the algorithm. After the positions of the swarms are determined, the algorithm will then guide the movements of the particles in the search space. The function takes a given candidate solution and outputs a real number that represents the objective function value of that particular solution. The goal is to find the solution that satisfies the global minimum. The flow chart of PSO algorithms is shown in Fig. 2.

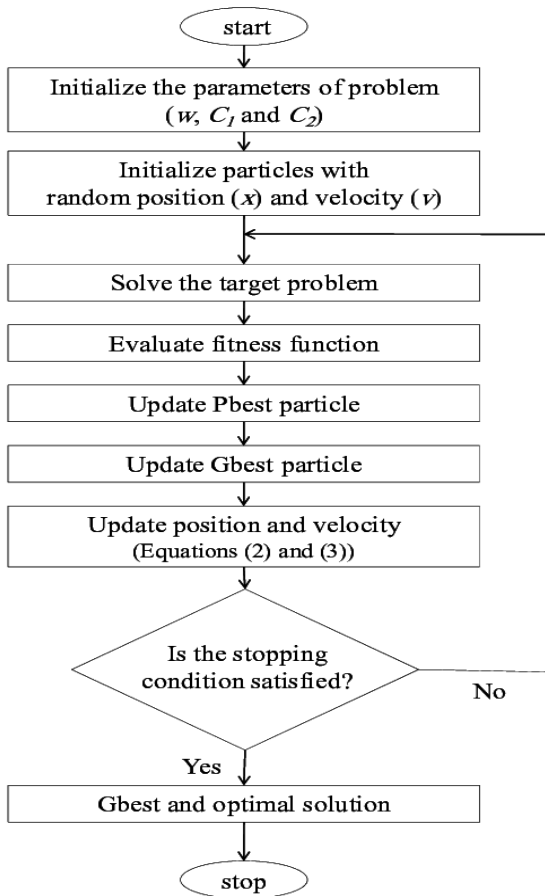


Figure. 2. Flow Chart of PSO Algorithm

RESULTS AND DISCUSSION

In this paper PSO MPPT Controller is proposed and implemented in MATLAB under following cases.

- Case: 1 Constant solar irradiance and ambient temperature
- Case: 2. Variable/Partial Shaded condition

Case 1: Constant solar irradiance and ambient temperature

In this case the following are the conditions

- Solar irradiance is 1000 W/m².
- Ambient Temperature is 25 °C.

The results in this case are shown in Fig. 3

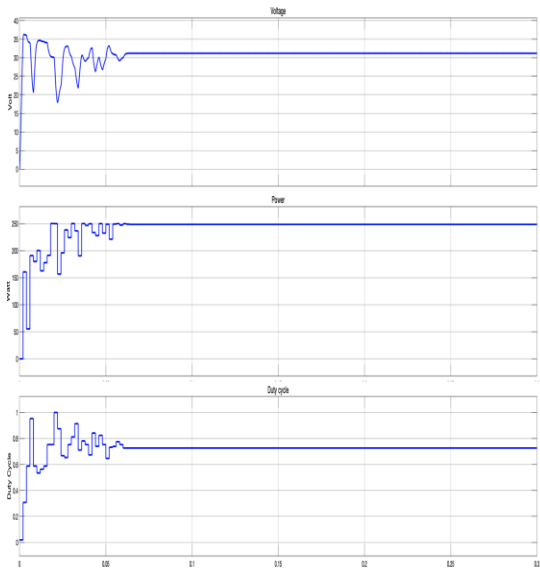


Figure. 3 Performance of Proposed PSO MPPT under Constant Conditions

Case 2: Variable/Partial Shaded condition

In this case the following are the conditions

- Solar irradiance is 300, 800, 700 W/m².
- Ambient Temperature is 25 °C.

The results in this case are shown in Fig. 4

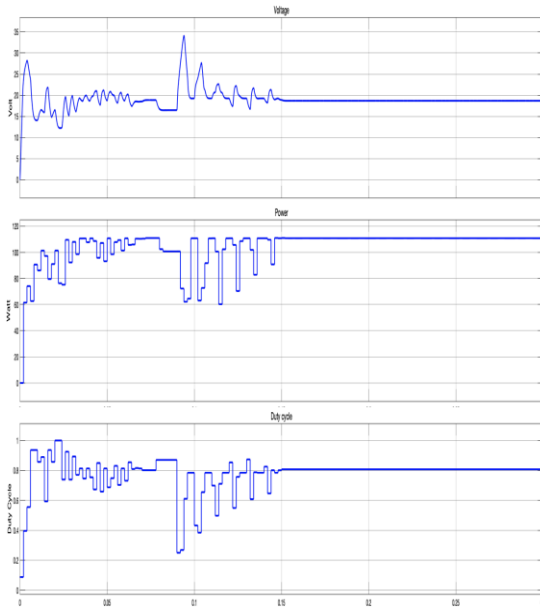


Figure. 4 Performance of Proposed PSO MPPT under variable/partial Shaded condition

From the above result the proposed PSO MPPT controller shows its Mark Performance.

CONCLUSION

This paper presents an PSO-based method for monitoring MPP in constantan variable/partial shaded radiance levels. A boost converter topology was also used to improve the searching technique. The proposed algorithm involves taking the linear decreases and increasing the number of step sizes to get the particle search velocity up. This method achieves its goal by avoiding an excessively small step size that can make local optimum traps unavoidable. The simulation results show that the proposed method can detect the maximum power point of a solar system. It can also be utilized for high-quality setups. Finally the results validated the effectiveness of the proposed PSO MPPT controller.

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MAGNETICALLY REUSABLE NiFe_2O_4 FOR DYE DEGRADATION UNDER VISIBLE LIGHT

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ABSTRACT

At present, the synthesis of active photocatalytic materials under visible light is a challenge to be considered in technologies. Like TiO_2 Transition metal of spinel ferrite shows a remarkable activity under visible light, which shows the future application on photocatalytic reactor. In the present research, nanoparticles of NiFe_2O_4 were synthesized by co-precipitation hydrothermal method and their structural, morphological magnetic characterization were carried out through X-ray diffraction, scanning electron microscopy and VSM. The photocatalytic properties of nickel ferrite (NiFe_2O_4) nanoparticles were evaluated by studying the photodecomposition of methyl orange as organic pollutant and showed a good photocatalytic activity. The nanoparticle exhibits ferromagnetism and can be readily recovered by external magnetic field. The recycling photocatalytic experiment shows that the NiFe_2O_4 possesses good photocatalytic reusability.

Keywords: NiFe_2O_4 , Photocatalysis, VSM

INTRODUCTION

An important class of magnetic material known as ferrites has received considerable attention from the researchers as the ferrites possess synergistic magnetic and semiconducting properties suitable for various applications. Successful conversion of ferrites to the nanoscale through various routes has opened up new possibilities that have enhanced the range of applications of ferrites in the area such as information, energy, sensor, and bio-technology and Photocatalytic [1]–[5].

Modern dyes are typically difficult to treat because they are made resistant towards water, sunlight, detergents and other basic chemicals thus making them

essentially more. Azo dyes such as methyl orange (MO), are used in textile, pharmaceuticals and paper printing industries and about 15% of them are discharged into the effluent streams [6]–[8]. These azo dyes are poisonous, teratogenic and carcinogenic to human beings and causes series of environmental issues to various life forms [8]–[10]. Therefore, removal of such pollutants becomes a major concern in wastewater effluent treatment before discharging to receiving water. The activity such as photocatalysis have been applied for complete removal of dye pollutants in waste water treatment [11]. Upon light illumination, electrons in the valence band (VB) gets excited to the conduction band (CB), leaving the same quantity of holes in the VB. This leads to the formation of an electron-hole pair. Further charge separation and migration of the generated charge carriers towards the surface of catalyst can then lead to redox reactions with organics. The high oxidative potential of the hole (h^+) (VB) in the catalyst allows direct oxidation of pollutant MO to reactive intermediates. Very reactive hydroxyl radicals can also be formed by the decomposition of water [12], [13]. Magnetic ferrites such as Mn, Cu, Ni, Co, Zn[14] involved much interest due to their broad applications in new technologies fields including high density magnetic recording media, microwave devices, high sensitivity sensors, biomedical industries and photocatalytic activity[15], [16]. $NiFe_2O_4$ is a well-known ferromagnetic material with an inverse spinel structure [17], [18]. This compound is represented by the formula $(Fe^{+3})(Ni^{+2}Fe^{+3})O_4$, half the atoms of iron occupy the tetrahedral (A) sites, and the other half plus magnetic atoms occupy the octahedral (B) sites. In this structure the tetrahedral site (A site) is fully occupied by Fe^{3+} while the octahedral site (B site) is occupied by Ni^{2+} and Fe^{3+} ions. Nickel ferrite exhibits diverse kinds of magnetic properties such as super paramagnetic, paramagnetic or ferrimagnetic behavior depending on the particle shape and size [19]. There are several methods to prepare spinel ferrite $NiFe_2O_4$ such as sol-gel, Combustion, Co precipitation, hydrothermal. However in this work we have attempt to explore the characterization of nickel ferrite synthesized by hydro-thermal method. The photocatalytic activity of the $NiFe_2O_4$ was evaluated by the degradation of Methyl Orange (MO) under

visible light and the possible photocatalytic mechanism was discussed.

EXPERIMENTAL SETUP

We have synthesized by Co-precipitation hydrothermal technique to produce fine grains of NiFe_2O_4 . The analytical grade of $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ (99.5%), $\text{NiSO}_4 \cdot 5\text{H}_2\text{O}$ (99.8%) were mixed in the required molar ratio and added to 6M NaOH (97%) solution with constant stirring at room temperature. The mixture was put in the autoclave and then heated to 180°C for 20 hrs. When the reaction got completed the precipitate was filtered and washed several times with distilled water. Finally, the precipitate was collected and heated at 80°C for 13 hrs. Sample were analyzed by diffractometer (XRD) (Rigaku x-ray diffractometer) using $\text{CuK}\alpha$ radiation and wavelength $\lambda = 1.5406 \text{ \AA}$. Materials morphology was examined using a Field Emission Electron Microscope model Carl Zeiss. The magnetic properties of nanocomposites were studied by vibrating sample magnetometer (VSM) at room temperature (Lakeshore 7410). Photocatalytic activity of the nano composites was studied using UV–visible spectrometer (Cary 100 series UV-Vis spectrophotometer).

RESULTS AND DISCUSSION

A. Structural and Morphological analysis

The diffraction pattern of the NiFe_2O_4 is shown in Fig.1 where it match Software was employed to index diffraction peaks, and verify the material phase using database PDF-2. In this Figure, it is possible to see that the unique phase in the material belongs to the NiFe_2O_4 diffraction pattern. From the diffractogram obtained from each phase, the crystal size was calculated using the Scherrer's equation. The estimated crystallite size was around 9.8 nm. This value is significantly smaller, compared to the value reported by Camargo [20].

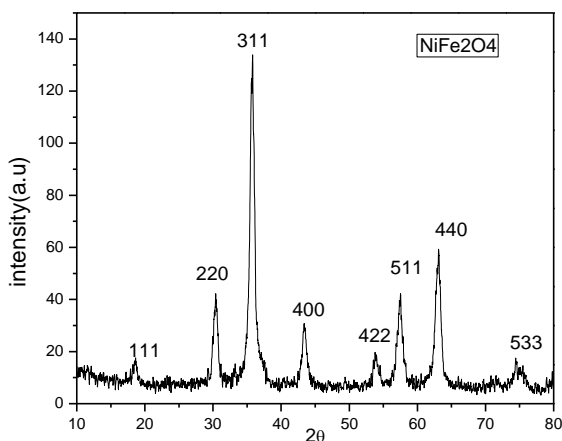


Fig. 1. NiFe₂O₄ X ray diffraction pattern

FESEM studies were carried out by using Carl Zeiss. To avoid the charging effect, the samples are coated with gold. It determined the morphology and the size distribution of the NiFe₂O₄ nanoparticles. The images of NiFe₂O₄ synthesized particles are shown in Figure 2. In these images agglomeration of the particles in nanometer sizes can be seen. The existence of high dense agglomeration indicates that pore free crystallites are present on the surface. As the nanoparticles possess high surface energies, they tend to agglomerate and grow into larger assemblies.

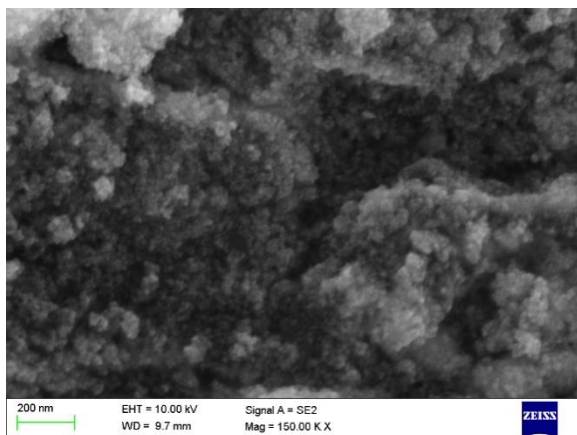


Fig. 2. FESEM image of NiFe₂O₄

B. Magnetic measurements

The magnetic behavior of NiFe₂O₄ nanoparticles was

Investigated using VSM. The high coercivity values account for the slower rate of growth of crystallite size that takes place during the heating process. It is not only the temperature but also the morphology that seems to significantly influence the magnetic properties. The increased value of the coercivity could be attributed due to the magnetic spin orientation along the axis that eases magnetization [21]. On account of the grain boundaries and free surface, the magnetic properties improved [22]. Figure 3 shows the magnetic hysteresis loops of the NiFe₂O₄ nanoparticles at room temperature. The magnetic parameters, namely retentivity, coercivity, and saturation magnetization of the sample were measured to be 0.0036915 emu/g, 12.015 Oe, and 3.0445emu/g respectively.

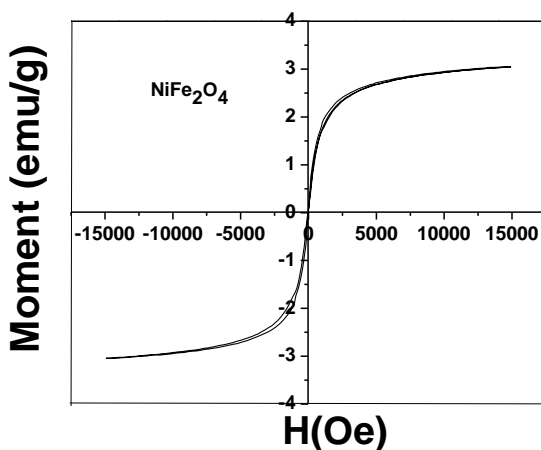


Fig. 3. Magnetic properties of NiFe₂O₄ nanoparticles

C. Photocatalytic Activity

The photocatalytic properties of NiFe₂O₄ nanoparticles were analyzed by constantly monitoring the photocatalytic degradation of Methyl orange (MO) in aqueous solution under visible light irradiation as shown in figure.4. It was observed that the intensity of the absorption peak of MO decrease as the irradiation time increases, and ultimately vanished after 90 min.

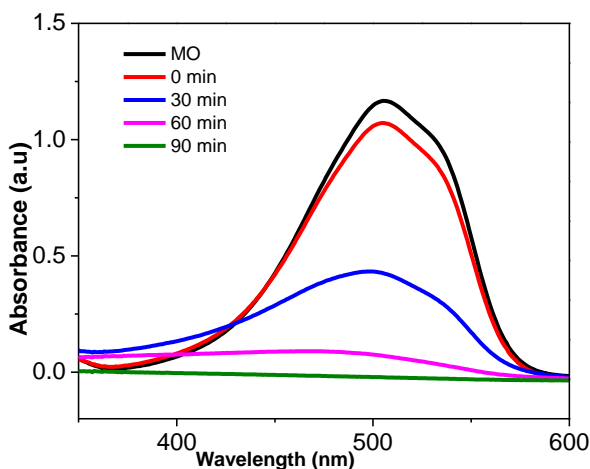
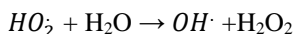
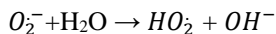
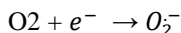
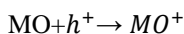


Fig. 4. Photocatalytic activities of sample toward the degradation of MO under visible light.

The mechanism of dye degradation is shown in figure.5. In heterogeneous photocatalysis, when catalyst is irradiated with visible light having energy greater than or equal to the band gap of catalyst, an electron from valence band shifts to the conduction band leaving a hole behind. Valence band hole reacts with water molecules to give OH. radicals and conduction band electron combines with adsorbed oxygen to give superoxide radical anion which further results in the formation of OH. radicals. The OH. radical is a strong oxidizing agent and thus oxidizes dye molecules and leads to its complete mineralization [23].



The stability of the NiFe₂O₄ was studied by extracting the material with an external magnet and recycling it. From the figure the maximum degradation time is shown at 90 min. First cycle is the fresh NiFe₂O₄ used for the degradation of MO. Second and third cycle are the reusable NiFe₂O₄ after the first and second cycles respectively.

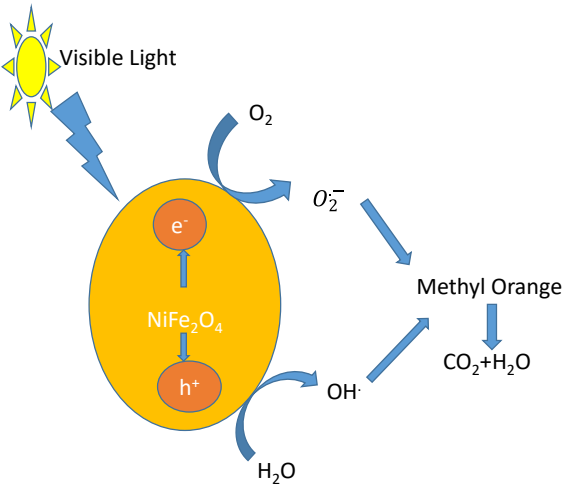


Fig. 5. Schematic illustration of the photocatalytic mechanism using NiFe₂O₄ nanoparticles under Visible light

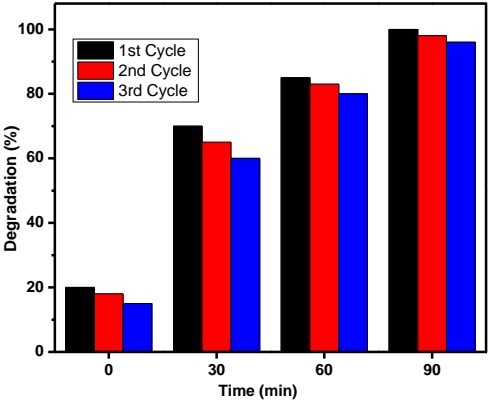


Fig. 6. Cycle runs for the photocatalysis

CONCLUSION

A magnetically recyclable NiFe₂O₄ nanoparticles was Prepared by hydrothermal method. The synthesized spinel cubic ferrite shows the decomposition rate of Methyl Orange (MO) reached 99% after irradiation of 90 min.

ACKNOWLEDGMENT

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PROGRAMMABLE NETWORK SERVICES IN NEXT GENERATION SOFTWARE DEFINED NETWORKS TO PREVENT SECURITY ATTACKS

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ABSTRACT

The Software Defined Networks is a recent research area that has the initiative in the programmable network technologies and standards developed around 2010. These technologies are associated with networking software, using open interfaces to connect resources. The software defined networks are used to control the entities of the network by centralizing the control plane. The functioning of the network and its security has to be checked by the administrator manually, which may leads to great burden on the network administrator. In this paper we list the various security attacks on software defined network controllers that violate the network topology and also mounted by compromised network entities like end hosts and soft switches. The SDN's are having the ability to provide network virtualization, greater control over network entities and dynamic network policy at reduced operational cost. There are some protocols like Open Flow to do this task. The next generation of research should involve in integration of all connectivity, processing resources and storage under new management interacting with controlling devices for on demand networking and services along with continuous updates and features. This brings into focus relatively key topics such as how to create the conditions for effective and continuous updating and changing the network functions without reinventing each time architectural aspects and related when we deal about security attacks. This paper presents architecture and the key challenges of programmable enabled networks as the next generation Software Defined Networks (SDN). This paper also looks the problem of detecting security attacks on topology of the network and traffic.

Keywords—*Programmable networks, Next generation SDN*

INTRODUCTION

Softwarization is a technical transformation which will affect the design, Implementation, deployment, and operations of infrastructures, deeply integrating network nodes and IT systems. It fully exploits the nature of software like flexibility and rapidity, for both network functions and services. This transformation will enable new architectural models, in turn implementing automated operations process while dealing with innovative information and communication technology.

In the existing networks, it is very difficult to integrate the new functionality or services without affecting already available functions and it is a cost-effective process. This functionality comes with separate hardware components. To address this issue, network function virtualization is a recent initiative. It is transforming the way how operators architect their networks towards deploying network services onto virtualized industry standard servers. NFV [1] can be deployed in the network as required and is used to deliver the network functions as software that can run as virtualized instances, without installing hardware equipment for each new service. NFV is very useful to reduce the hardware cost and operational cost. The more flexible services are to be expected to deploy which can be scaled up and down very quickly. From the architecture perspective, the NFV can be seen as complementary to technologies such as SDN, Cloud computing, Virtualized network functions might run in an operator's cloud environment.

SDN maintains and redirect the traffic by considering the assistance given by controller and this can be achieved by configuring routers and switches flow tables. The main functionality of the remote controller in the networking infrastructure is adding, updating, and deleting flow rules. There are several opportunities for understanding flow configurations of physical topology [2] and can be achieved at the centralized controller who can configure flow paths for optimal utilization of network resources and to enhance the experience of the user.

In SDN architecture, the control layer is logically centralized to a software-

based controller which maintains the global view of the network. The controllers allow the flexibility to configure, manage, secure and to optimize network resources through automated and dynamic software programs. OpenFlow provides freedom to the users in exploiting new opportunities over the existing networking infrastructure. OpenFlow at the current stage will not support mobility [3].

The cloud community started to address networking requirements in OpenStack [4] but continues to put the priority on intra datacenter networking. Cloud users can control and manage their applications but have no control on the connectivity and networking of their dedicated and distributed cloud services. Networking providers, users need more flexibility in deploying, configuring and instantiating cloud networking services to manage more easily and efficiently their resources. To provide control over the connectivity, SDN can be used as a solution [5] to handle inter cloud networking. SDN is a network architecture and design that decouples data plane forwarding from control and management plane functions.

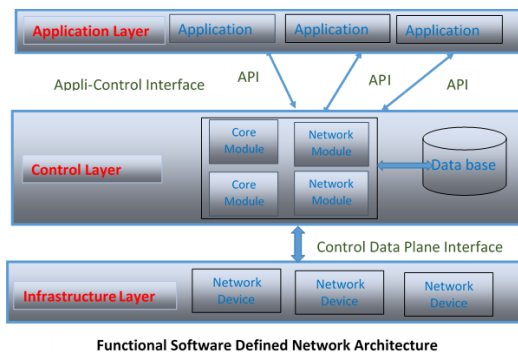
The integration of internet and programmable infrastructures and traditional communication technologies has been always a challenge for network and service operators for service deployment and management.

SECURITY ISSUES OF SDN

Integrity, confidentiality, availability, authentication are the minimum requirements for secure data transmission, so that the data transmitted across the network will be protected from malicious or unauthorized attacks. In general, SDN architecture control the network with the help of two individual components called a centralized controller and ethane switches. To enforce the global policy the first component is used and second one used to forward the packets depending on the rules available in flow table. For the programmability, the control plane, and data plane to be separated by this simplified network. Ethane is a new architecture which is used especially in enterprise networks, and it provides powerful and simple management method to provide strong security. Unlike the switches using today, the ethane has all

the complex functionality including routing, naming and security checks are performed by centralized controller. The controller has to give permission for each flow in the network by verifying the flow whether it is permissible according to network policy. If the controller allows a flow, it computes a route for the flow to take and adds an entry in each of the switches along the path. Most prior work has looked at development and analysis of SDN security applications and controllers and real time verification of network constraints separately. The solutions of these works are not effective against the threats in SDN due to compromised end hosts or switches, which can be used to control the entire network or part of it. The major problems identified in controlling the network are

- The operational semantics of OpenFlow based SDN lower the barrier for mounting sophisticated attacks on both control and data planes, since they allow any unmatched packets to be sent to the controller.
- Attacks that effect traditional networks may also affect SDN's because the traditional defenses assume switches to be intelligent, whereas separation of control and data planes forces SDN switches to be dumb forwarding entities that forward packets based on the rules installed by the SDN controller and which needs redesign.
- The enterprise network administrators often use programmable soft switches, like Open vSwitches [12] to provide network virtualization. These are like Hardware switches and must have direct connectivity to the controller to provide required functionality.



The SDN architectures which are using now are providing various services

like Network function virtualization (NFV). It is possible to identify the various challenges related with application, control, data layer and their interfaces based on the security issues with SDN. The ethane architecture will be closely associated with SDN and OpenFlow, even then it is having several drawbacks [7]. The use of transport layer security when there is a mutual authentication between the switches and controllers are described by Open Flow switch specification [8]. The authors are not specified the standard of TLS and they found that, due to less use of TLS leads to insertion of fake rule, and rule modification.

The IEEE software defined networking argues that one key area of this exercise is the introduction of new functional node as an intersection point of these functions in order to create a future proof architecture [11].

Some authors try to present overall security of SDN with the help of high level analysis [9]. The result of this paper is due to the nature of the centralized controller and programmability of the SDN, there is a possibility for new threats which requires new responses from the network.

The research network and testbed ProtoGENI [10] has also analyzed by some authors and they discovered that the numerous attacks between users, flooding attacks to the internet were possible in the network.

Some authors tested most popular controllers like OpenDaylight [13], POX [14] and Floodlight [15] and found them vulnerable to diverse attacks originating within the software defined network. It is possible to implement defense against known attacks or specific vulnerabilities, such patching does not provide protection against unforeseen security threats. In this context we are proposing self-managed network programmable services to detect security attacks on topology of the network and forwarding data.

ANALYSIS OF SECURITY ATTACKS

To find the required target in the network, the attackers use different techniques like virtual internet Protocol addressing. In this technique, the OpenFlow controller is used to manage a vector of IP addresses which are assigned to hosts with in the network and hiding the real IP addresses from the

outside world.

The various layers and their interfaces of SDN are Application Layer, Application – Control interface, Control layer, Control-Data interface, Data layer. The layers and interfaces between the layers were affected based on the different security attacks.

Application Layer: This layer will be affected by unauthorized applications, insertion of fake rule and policy enforcements.

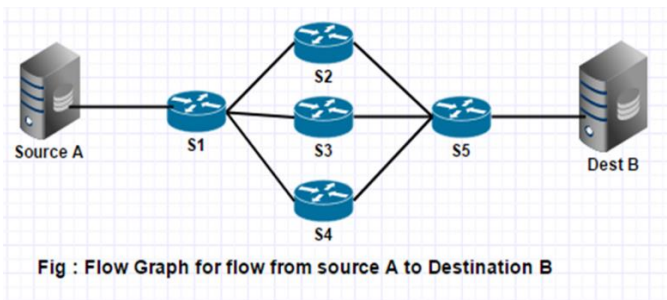
Application-Control Interface: This interface will be affected in case of unauthorized applications, insertion of fake rule and policy enforcements.

Control Layer: This layer will be affected by unauthorized controller access, unauthorized application, Flow rule modification to update packets, controller hijacking, insertion of fake rule, policy enforcements, controller switch communication flood and lack of TLS or other authentication technique adoption.

Control –Data Interface: This layer will be affected in case of unauthorized controller access, Flow rule modification to update packets, controller hijacking, controller switch communication flood and lack of TLS or other authentication technique adoption

Data layer: This layer will be affected in case of unauthorized controller access, side channel attack on input buffer, packet process timing analysis, Flow rule modification to update packets, controller hijacking, controller switch communication flood, switch flow table flooding and lack of TLS or other authentication technique adoption.

A flow is a directed traffic pattern observed between two endpoints with distinct MAC addresses over specified ports. A flow graph is a graph representation of a traffic flow with edges as the flow metadata and switches being the nodes in the graph.



PROGRAMMABLE NETWORK SERVICES

The architecture of SDN introduces programmable network services for the use in the network. These Intelligent programmable services should support the existing intrusion detection systems (IDS) and Prevention system (IPS). There is need of new methods and techniques to be introduced to enhance the programmability features in SDN by enabling the dynamic adjustments for managing detection and prevention of attacks.

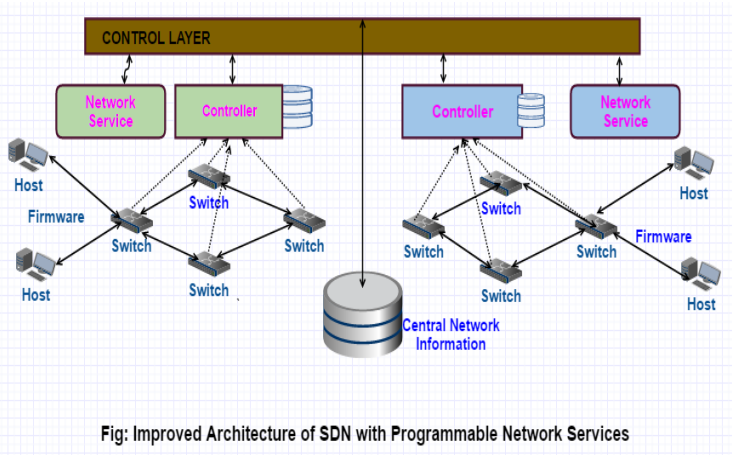
This architecture consists of network software formed by network applications, services which is different from traditional architecture. The Network applications and services can serve multiple controllers. It may consume one or more services to accomplish a certain task. The information available in individual controllers is also available in controllers of central network information base.

The network software module can used to customize the SDN controller based on the user needs. The different SDN controllers may have different features, depending on what modules and what services they choose. The programmable network service architecture provides various services and service chaining. The controller having the software program inside, will reduce the latency and over traffic.

The next generation software defined network should be integrated with storage, processing the resources and various connectivity's under new management interacting with control systems to provide on demand networking and services with continuous update of features. A programmable network services will be deployed on the existing connection oriented and

connection less networks and its devices. The interfaces and mechanisms that enable control and exchange of information between layers. The functional decomposition simplifies the implementation that is driven by the envisioned functionality, such approach is completely different from that of OpenFlow which does not decompose the layers into functional blocks. The key component of the programmable network services design is the description of services provided by each layer.

The physical resource or infrastructure layer has to sink with heterogeneous environments. It has two main functions. It provides a uniform view of different technological network and computational resources, and it has intrinsic autonomic and programmable management of the resources, which provides a fast reaction time for management operations and facilities scalability of the programmable network solution in case of distributed management implementation.



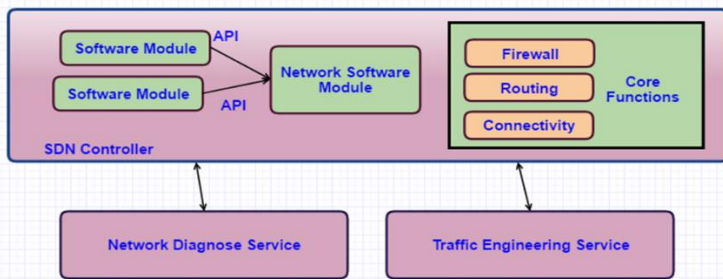


Fig : SDN Controller with integrated software modules and core functions

The virtual networks which are utilizing physical resources can be created according to the virtual programmable network layer mechanisms. These virtual networks acquire their properties based on the needs of customers and services. The networks have embedded self-managed mechanisms that can control and monitor the underlying physical resources, through utilizing in an intelligent manner the low level control and monitoring components of the physical resource layer. The self-management operations include self-configuration, performance optimization, and self-healing. The performance optimization can be realized with efficient usage of physical resources and programmable virtual networks. All these facilities aid in the scalability of programmable network services.

The application providers and end users can use specific virtual networks according to their needs to provide high quality, personalized, QoS aware, and secure services. The programmable network layer would be able to create the virtual network and instantiate the requested user's functionalities at the required locations to provide the desired QoS.

It has to be noted that the aforementioned programmability and self-management of different layers of programmable network services requires the ability to send, execute and monitor the execution code and therefore the management operations should be extended appropriately. In order to get that we need centralized or distributed execution environment.

The services which can be deployed in programmable network services are

- New services may be rapidly deployed
- Incorporating the features of existing services

- Improving the network resources
- Scalability and cost reduction in network service management
- Independence of network equipment manufacturer.
- Integration of information networks and its service
- A need of coordination from the interfaces to provide inter domain communication by allowing networking function.
- Authentication for other operators

Service module mechanisms for communication and programmability deployed by different operators for the same service.

PROGRAMMABLE NETWORK SERVICES TO DETECT ATTACKS

The present internet architecture has many problems to support, verify in detecting security attacks. The typical security systems are based on securing hosts or installing specialized network devices like middle boxes to detect anomalies into the network. These solutions become ineffective when the host require constant updates and effort from the network administrator like selecting the traffic to be filtered.

The software program in the SDN serves as a middleware connecting the network applications, services, central network information center and the various controllers in the middle layer called Network software and control layer.

The network hosting virtual environments and virtual Machines to overcome the problem of having several execution environments implemented in various technologies, and providing different abstractions, interfaces etc. The creation of required network of execution environments and set of virtual machines which are managed as one to realize and activate network software features. The virtual environment puts a common layer for management on top to support the installation and configuration of services code in various ways. This allows external clients to interact with services through the interface of the virtual environment in a generic way and interactions will be mapped to specific interfaces of the execution environments, the partitioning of resources. The service provider can manage its own virtual network to access

the virtual environments available with respective service provider.

A virtual network will be formed by several virtual environments belonging to the same service provider but running on different network nodes to deploy services and make them available to customers. We also need to consider when we want to know the environments belongs to what virtual networks. i.e The approach of deploying and managing services which are not depending on the technology of the execution environment, how to manage nodes in easy manner for service providers as well as network providers, how to partition the resources among several service providers, account of resources usage per service provider and delegation of service management to the service providers.

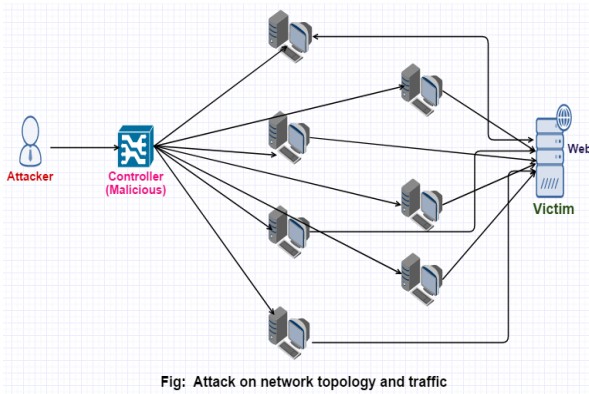
Programmability for detecting attacks

The new network services to detect security attacks in fast manner needs a dynamically deployed network devices such as routers, switches and application servers. Dynamic programming is used to create a new functionality at time by inserting executable code into the network element. The basic idea is to enable third parties such as operators and service providers to inject application specific services into the network. Application may utilize this network support in terms of optimized network resources to become network aware. The network programming provider's unprecedented flexibility in various communications. The viable architectures for programmable networks must be engineered carefully to achieve suitable tradeoff between flexibility, performance, security and manageability.

The programmable network services to detect security attacks should cope with heterogeneous environments providing uniform view of different technological networks and computational resource.

The programmability checks whether the packet matching a flow rule or not. If it is not matching a flow rule must be sent by the switch to the controller. This opens up the possibilities for malicious hosts to tamper with network topology and data plane forwarding. The malicious data can forge packet data that would then be relayed by switches as messages and frequently processed by the controller or implement denial of service (DoS) attacks on the controller

and switches and channel mechanisms to extract information about flow rules. The soft switches can not only initiate all the host-based attacks but also trigger dynamic attacks on traffic flows passing through the switch.



SDN controllers process a variety of protocol packets like LLDP, IGMP, ARP, sent by switches to construct its view of the network topology. Controller's process LLDP messages for topology discovery and IGMP messages to maintain multicast groups, where as it forwards ARP requests and replies enabling end hosts to build up ARP caches facilitating network communication.

If any fake topology attack can be launched on an SDN controller to poison its view of the network by sending any sort of message. These malicious messages could be generated by untrusted switches themselves or by end hosts, which can send the message across network links between the switches. When the controller tries to route traffic over these links, it results in packet loss, and if this link is on critical path, it could even lead to a blackhole.

Topological constraints like both network invariants as well as administrator specified, can be verified using the metadata. Once the default invariants have been verified, the metadata are compared against all applicable policies, and any deviant behavior is flagged. All such verification is deterministic and fast due to incremental flow graphs, which allows verification to proceed over the last edge or metadata that was added to the graph.

Malicious hosts and switches can mount DoS by flooding the network with

traffic to arbitrary hosts to exhaust resources on vulnerable switches and/or the SDN controller, thereby affecting in the data plane. In general, the flow rules are stored in switch's content addressable memory (SCAM), which is the fastest associative memory. Malicious hosts may target a switch's content addressable memory to perform directed DoS attacks against other hosts. Malicious hosts may send arbitrary traffic and force the controller into installing a large number of flow rules, there by exhausting the switch's content addressable memory. Meanwhile no other flow rules can be installed on this switch, until the installed flows expire. If this switch is on a critical path in the network, then it may result in significant latency or packet drops. Verification of forwarding constraints in the data plane required the validation of both packet and flow level metadata, which may be either deterministic or probabilistic depending on the nature of constraints involved.

The attackers often break into the network to leverage internal vantage points, and subsequently launch attacks on the internal network. Our goal is to verify onset of attacks on the network topology, data plane forwarding and detect violations of policies within SDN's.

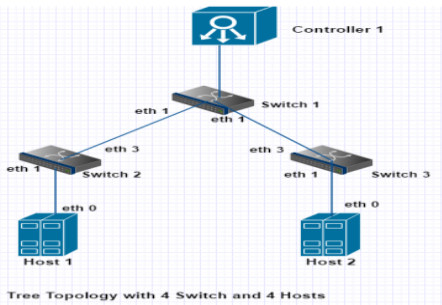
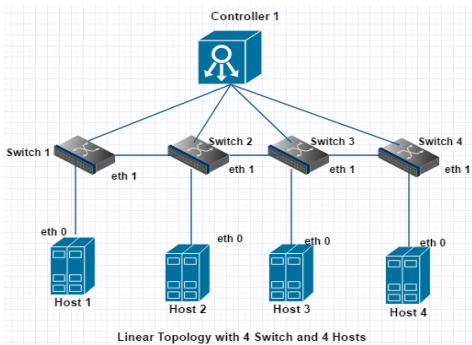
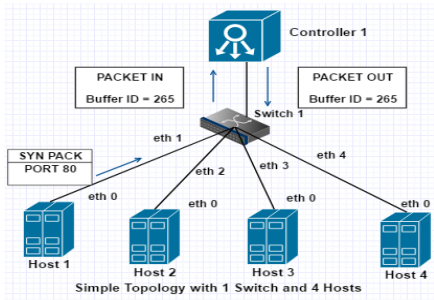
We also considered the following issues to detect the security attacks in programmable network environments

- i) Control of Virtual wireless resources
- ii) Mapping virtual resources to the wireless resources
- iii) Control of virtual wireless resources
- iv) Control of virtual resources for smart objects
- v) Mapping virtual resources to smart objects resources
- vi) Uniform automatic and optimized management
- vii) Scalable programmable delivery infrastructure as systems inter orchestration for big data and service networks
- viii) Energy management and optimization

CONCLUSION & FUTURE WORK

We considered the network topologies like simple topology with one switch and four hosts, linear topology with four switches and four hosts, finally we

considered tree topology with 3 switches and two hosts. The programmable network services are enabled to test the security attacks on the topologies and data transmitted. Due to the limited internet facilities we limited to the topology and data traffic.



EVALUATION

The possibility of debugging and testing new designs in a real environment is difficult and expensive. Even through the current network simulators are very expensive and some are not supportive for simulation, the network simulation

is the first step to evaluate the implementation. However, the current network simulators are expensive and don't offer support to simulate.

Tools used to evaluate the performance are Mininet Emulator, Omnet, Wireshark 2.2.5, OpenFlow Controller. We consider an enterprise SDN setup with minimum traffic across network entities. We assume a trusted controller but not on either switches or end hosts. i.e. the switches can lie about everything except their own identity, since the switches connect with the controller over separate connections. More security attacks were detected when the packets are transmitted in tree topology when we compared with other two topologies, simple and linear topologies.

The following image shows that the four terminals are running in parallel.

In first window floodlight controller is running with the command bellow.

\$ java -jar target/floodlight.jar

In the second window we created topology in mininet. The third and fourth windows are used to run Sflow virtualization.

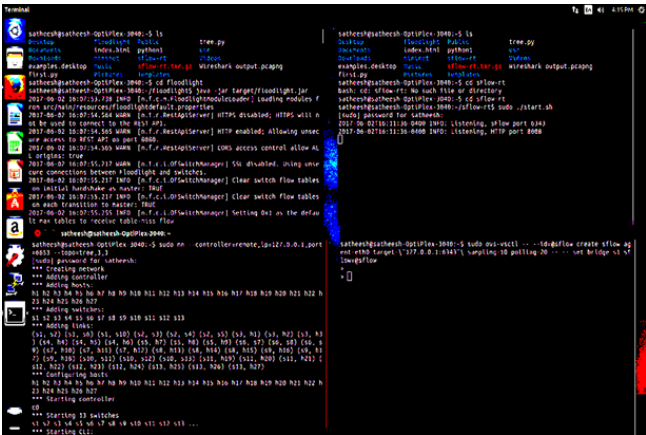


Fig R1: Four terminals for running floodlight controller, mininet and sflow

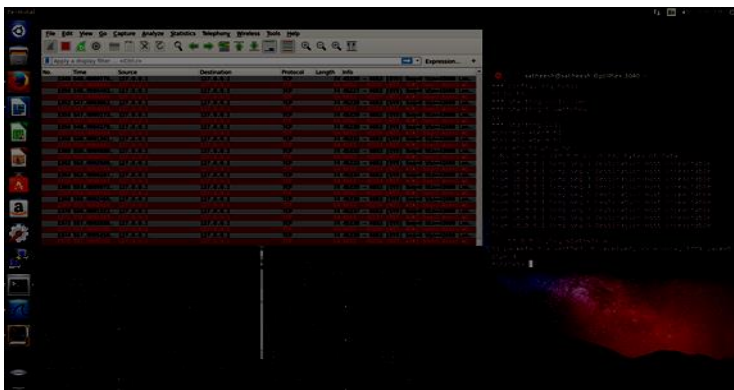


Fig R2: Attacks on the topology and traffic

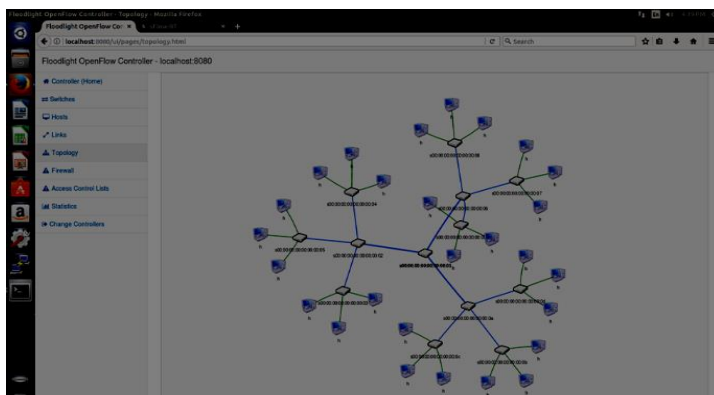


Fig R3: Simulation result for topology created in mininet

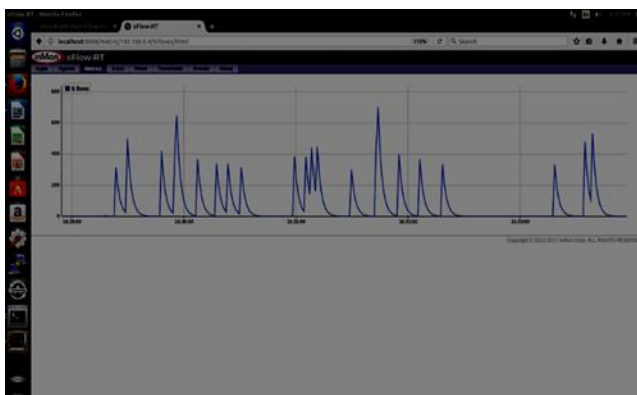


Fig R4: Figure showing flow analysis

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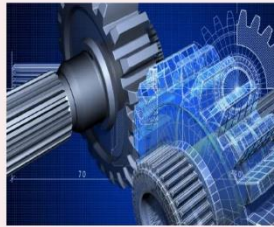
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