Samarth Educational Trust's

Arvind Gavali College of Engineering

Affiliated to Dr. Babasaheb Ambedkar Technological University, Lonere.
Approved by AICTE, New Delhi, Recognized by Govt. of Maharashtra, DTE Mumbai.

NAAC and NBA Accredited

PROPOSAL FOR AUTONOMOUS STATUS
A.Y. 2025-26

Name of Document	Particular
Achievements of Faculty Members	List of Faculty Achievements

Annexure No. 22

Dr. Sharad S. Mulik
PRINCIPAL

ARVIND GAVALI COLLEGE OF ENGINEERING EN-6545 SATARA

SAMARTH EDUCATIONAL TRUST
ARVIND GAVALI COLLEGE OF ENGINEERING
Approved by AICTE, New Delhi, Recognized by Govt. of Maha. DTE Mumbai &
Affiliated to MSBTE Mumbai ,Dr. Babasaheb Ambedkar Technological, University Lonere
AICTE ID: 1-4210711 AISHE Code: C-11245 DTE Code: EN-6545 DBATU Code: 6545 MSBTE Code: 1617
NBA Accredited NAAC Accredited
Address : Gat No.247, At.Panmalewadi,
Post.-Varye,Tal.& Dist.-Satara, Pin.- 415 015
Mob.: 9957100100, 9069700100
Email : agcenggsatara@gmail.com
Website: www.agce.edu.in

Ref. No.: AGCE/Office/2024-25/ **Date:27th Feb. 2025**

ACHIEVEMENTS OF FACULTY MEMBERS

The faculty of Arvind Gavali College of Engineering have demonstrated exceptional academic and research excellence. They have published numerous research papers, filed patents, presented at conferences, authored books, and secured external funding. These achievements showcase their expertise and dedication, enhancing the institution's reputation and research ecosystem, making it an ideal candidate for autonomous status.

Sr No	Activity	No of activities academic year wise					
		2023-24	2022-23	2021-22	2020-21	2019-20	2018-19
1	Number of Research Papers Published in Journals	17	27	08	13	11	07
2	Number of Patents Granted	05	05	02	02	01	
3	Number of Papers Published in National Conferences						
4	Number of Papers Published in International Conferences	01	50		02	34	40
5	Number of Books Authored	02		01	01		
6	Number of Book Chapters Authored		01				
7	Number of New Externally Funded Research Projects Received	31	24	25	21	16	14
8	Funds Received	5.74 Lakhs	11.26 Lakhs	4.98 Lakhs	6.98 Lakhs	4.83 Lakhs	3.10 Lakhs
9	Other Achievements	47	22	17	44	110	02
All faculty members achievement certificates Link for reference		View	View	View	View	View	View

Note: All faculty achievements documents are attached in the respective y[illegible] link above[illegible]ble for your reference.

ARVIND GAVALI COLLEGE OF ENGINEERING EN-6545 SATARA

Achievements of Faculty Members for the Academic Year 2021-22:

https://www.agce.edu.in/files/autonomy/af/2021-2022.pdf

1. Number of Research Papers Published in Journals:

Sr. No.	Name of the Faculty Member	Department	Award/Recognition	Details/Title of Paper
1	Dr. P. R. Bamane	Civil Engineering	Research Paper Publication	Study paper on use of eco bricks
2	Dr. P. R. Bamane	Civil Engineering	Research Paper Publication	Study on an innovative time cost quality trade-off modelling of building construction project based on resource allocation
3	Dr. G S Mirajkar	Electronics and Telecommunication Engineering	Research Paper Publication	Application of Deep Learning Techniques to Detect Deforestation Using SAR Data [Web of Science]
4	Dr. V. S. Hingmire	Electronics and Telecommunication Engineering	Research Paper Publication	Fault-Tolerant multi-path data communication mechanism in WSN based on optimization enabled routing [SCOPUS]
5	Dr. V. S. Hingmire	Electronics and Telecommunication Engineering	Research Paper Publication	Energy-aware multi path routing in WSN using improved invasive weed elephant herd optimization [SCOPUS]
6	Dr. V. A. Pharande	Mechanical Engineering	Research Paper Publication	Advantages of Digital Transformation in Indian Higher Education Sector [UGC CARE]
7	Dr. V. A. Pharande	Mechanical Engineering	Research Paper Publication	Rechargeable Electrical Energy Storage System Development for an Electrical Vehicle Retro Fitment Kit

ARVIND GAVALI COLLEGE OF ENGINEERING EN-6545 SATARA

8	Dr. Mahammadsalman Warimani	Mechanical Engineering	Research Paper Publication	Analytical Assessment of Blended Fuels for Pulse Detonation Engine Performance [SCOPUS]

2. Number of Patents Granted:

Sr. No.	Name of the Faculty Member	Department	Award/Recognition	Details
1	Dr. G S Mirajkar	Electronics and Telecommunication Engineering	Published Indian Patent	A Machine Learning Model for Venue Exploration and Recommendation
2	Mr. S. P. Patil	Mechanical Engineering	Published Indian Patent	Effective hybrid technique for logistics industries

3. Number of Papers Published in National Conferences: NIL

4. Number of Papers Published in International Conferences: NIL

5. Number of Books Authored:

Sr. No.	Name of the Faculty Member	Department	Award/Recognition	Details
1	Dr. V. A. Pharande	Mechanical Engineering	Published Book	Book Titled, “Total Quality Management” published by International Research Journal of Multidisciplinary Scope (IRJMS) ISSN: 2454 – 8499

6. Number of Book Chapters Authored: NIL

7. Number of New Externally Funded Research Projects Received:

Sr. No.	Name of the Faculty Member	Department	Award/Recognition	Details/Title of the Project
1	Mrs. Pol B. P.	Electronics and Telecommunication Engineering	Project Sponsored by Source Code Technology Pvt. Ltd.	Accelerometer Based Hand Gesture Controlled Robo-Car
2	Dr. Mirajkar G S	Electronics and Telecommunication Engineering	Project Sponsored by Source Code Technology Pvt. Ltd.	Gesture-Based Mouse and Keyboard
3	Mr. Hingmire V. S.	Electronics and Telecommunication Engineering	Project Sponsored by Squarewave Automation Technologies Pvt. Ltd.	Detection of Melanoma using deep Learning Techniques
4	Dr. Shinde D. S.	Electronics and Telecommunication Engineering	Project Sponsored by Aditya Control Systems	IoT Based Electricity Theft Detection System
5	Dr. Mirajkar G S	Electronics and Telecommunication Engineering	Project Sponsored by Aditya Control Systems	Crop Prediction and Leaf Disease Detection System
6	Dr. Shinde D. S.	Electronics and Telecommunication Engineering	Project Sponsored by Squarewave Automation Technologies Pvt. Ltd.	Sign Language for Deaf and Mute People
7	Mr. Chavan S. G.	Electronics and Telecommunication Engineering	Project Sponsored by Squarewave Automation Technologies Pvt. Ltd.	Military Spying Robot
8	Dr. Hingmire V. S.	Electronics and Telecommunication Engineering	Project Sponsored by DBATU VC RPG Scheme	Pyro-cycling: Electricity generation by plastic and dry garbage waste
9	Mrs. Mandhare R. M.	Computer Science and Engineering	Project Sponsored by Code-Neel Softwares	Online Medicine Donation Software
10	Dr. Mulla S. Y.	Computer Science and Engineering	Project Sponsored by Mythos Technology	Clinical Entity Extraction Using NLP
11	Dr. Mulla S. Y.	Computer Science and Engineering	Project Sponsored by Source Code Technology Pvt. Ltd.	Woman Security App
12	Dr. M. M. Shah	Computer Science and Engineering	Project Sponsored by InCodingtech	Computer Vision Based Virtual Mouse and Keyboard System

13	Mr. Gujar V. B.	Computer Science and Engineering	Project Sponsored by a java home	Plant Leaf Disease Detection Using CNN
14	Mrs. Mandhare R. M.	Computer Science and Engineering	Project Sponsored by ECS Software Technologies Pvt. Ltd.	RTO Service Management System
15	Mr. Gujar V. B.	Computer Science and Engineering	Project Sponsored by Mythos Technology	Online Personal Healthcare system
16	Dr. M. M. Shah	Computer Science and Engineering	Project Sponsored by Nebula Technology	Realtime Face Mask Detection
17	Mr. Gujar V. B.	Computer Science and Engineering	Project Sponsored by 2020Analytics Insight	Custom Named Entity Recognition Using Spacy
18	Mr. Pathak P. A.	Computer Science and Engineering	Project Sponsored by ECS Software Technologies Pvt. Ltd.	Real Estate Search Based on Data Mining
19	Dr. Mulla S. Y.	Computer Science and Engineering	Project Sponsored by Sygnius Infotech	Human Activity and Face Recognition Using Machine Learning and Deep Learning Model
20	Dr. Mulla S. Y.	Computer Science and Engineering	Project Sponsored by AB Software Solution	Sign Language Recognition Using CNN
21	Dr. M. M. Shah	Computer Science and Engineering	Project Sponsored by iResolve Services	Voice Vault Using Python
22	Mr. Pathak P. A.	Computer Science and Engineering	Project Sponsored by Oytie	Product Recommendation System Using Collaborative Filtering
23	Mr. Gujar V. B.	Computer Science and Engineering	Project Sponsored by Oytie	Dengue Malaria Prediction Using CNN
24	Dr. S. Y. Mulla	Computer Science and Engineering	Project Sponsored by DBATU VC RPG Scheme	Text2Query- An automatic question generation System
25	Dr. B. M. Nayak	Electrical Engineering	Project Sponsored by DBATU VC RPG Scheme	Pyro-cycling: Electricity generation by plastic and dry garbage waste

8. Funds Received During This Academic Year:

Sr. No.	Name of the Faculty Member	Department	Award/Recognition	Details/Funds Received
1	Mrs. Pol B. P.	Electronics and Telecommunication Engineering	Project Sponsored by Source Code Technology Pvt. Ltd.	Rs. 9000/-
2	Dr. Mirajkar G S	Electronics and Telecommunication Engineering	Project Sponsored by Source Code Technology Pvt. Ltd.	Rs. 14,000/-
3	Mr. Hingmire V. S.	Electronics and Telecommunication Engineering	Project Sponsored by Squarewave Automation Technologies Pvt. Ltd.	Rs. 26,500/-
4	Dr. Shinde D. S.	Electronics and Telecommunication Engineering	Project Sponsored by Aditya Control Systems	Rs. 27,000/-
5	Dr. Mirajkar G S	Electronics and Telecommunication Engineering	Project Sponsored by Aditya Control Systems	Rs. 26,200/-
6	Dr. Shinde D. S.	Electronics and Telecommunication Engineering	Project Sponsored by Squarewave Automation Technologies Pvt. Ltd.	Rs. 10,000/-
7	Mr. Chavan S. G.	Electronics and Telecommunication Engineering	Project Sponsored by Squarewave Automation Technologies Pvt. Ltd.	Rs. 21,000/-
8	Dr. Hingmire V. S.	Electronics and Telecommunication Engineering	Project Sponsored by DBATU VC RPG Scheme	Rs. 3,00,000/-
9	Mrs. Mandhare R. M.	Computer Science and Engineering	Project Sponsored by Code-Neel Softwares	Rs. 25,000/-
10	Dr. Mulla S. Y.	Computer Science and Engineering	Project Sponsored by Mythos Technology	Rs. 24,000/-
11	Dr. Mulla S. Y.	Computer Science and Engineering	Project Sponsored by Source Code Technology Pvt. Ltd.	Rs. 42,000/-
12	Dr. M. M. Shah	Computer Science and Engineering	Project Sponsored by InCodingtech	Rs. 30,000/-

13	Mr. Gujar V. B.	Computer Science and Engineering	Project Sponsored by a java home	Rs. 30,000/-
14	Mrs. Mandhare R. M.	Computer Science and Engineering	Project Sponsored by ECS Software Technologies Pvt. Ltd.	Rs. 26,500/-
15	Mr. Gujar V. B.	Computer Science and Engineering	Project Sponsored by Mythos Technology	Rs. 32,800/-
16	Dr. M. M. Shah	Computer Science and Engineering	Project Sponsored by Nebula Technology	Rs. 10,000/-
17	Mr. Gujar V. B.	Computer Science and Engineering	Project Sponsored by 2020Analytics Insight	Rs. 32,000/-
18	Mr. Pathak P. A.	Computer Science and Engineering	Project Sponsored by ECS Software Technologies Pvt. Ltd.	Rs. 20,000/-
19	Dr. Mulla S. Y.	Computer Science and Engineering	Project Sponsored by Sygnius Infotech	Rs. 35,000/-
20	Dr. Mulla S. Y.	Computer Science and Engineering	Project Sponsored by AB Software Solution	Rs. 25,000/-
21	Dr. M. M. Shah	Computer Science and Engineering	Project Sponsored by iResolve Services	Rs. 25,000/-
22	Mr. Pathak P. A.	Computer Science and Engineering	Project Sponsored by Oytie	Rs. 35,000/-
23	Mr. Gujar V. B.	Computer Science and Engineering	Project Sponsored by Oytie	Rs. 40,000/-
24	Dr. S. Y. Mulla	Computer Science and Engineering	Project Sponsored by DBATU VC RPG Scheme	Rs.2,60,000/-
25	Dr. B. M. Nayak	Electrical Engineering	Project Sponsored by DBATU VC RPG Scheme	Rs. 3,00,000/-

9. Other Achievements:

Sr. No.	Name of the Faculty Member	Department	Award/Recognition	Details
1	Mrs. R. M. Mandhare	Computer Science and Engineering	Attended AICTE Training and Learning (ATAL) Academy Online Elementary FDP	AICTE Training and Learning (ATAL) Academy Online Elementary FDP on "Innovation Management"
2	Mrs. R. M. Mandhare	Computer Science and Engineering	Attended AICTE Training and Learning (ATAL) Academy Online Elementary FDP	AICTE Training and Learning (ATAL) Academy Online Elementary FDP on "Smart City Solutions for Sustainable Future"
3	Mrs. R. M. Mandhare	Computer Science and Engineering	Attended Five Days Professional Development Program	Five Days Professional Development Program on 'Online Modalities & Professional Communication'
4	Mr. V. B. Gujar	Computer Science and Engineering	Attended Five Days Professional Development Program	Five Days Professional Development Program on 'Online Modalities & Professional Communication'
5	Mr. V. B. Gujar	Computer Science and Engineering	Attended One Week STTP on “Innovative and Inventive Problem Solving”	Innovative and Inventive Problem Solving
6	Mr. V. B. Gujar	Computer Science and Engineering	Attended Quiz Competition	Kargil Vijay Diwas Quiz Competition
7	Mr. V. B. Gujar	Computer Science and Engineering	Participated in Webinar	Webinar on “Innovation in Technology Adoption and Development of High Precision Slipring: A Case Study”
8	Mr. V. B. Gujar	Computer Science and Engineering	Attended AICTE-ISTE Approved FDP	Attended AICTE-ISTE Approved FDP on “Outcome Based Education and NBA Perspective”
9	Mr. V. B. Gujar	Computer Science and Engineering	Attended Webinar	Attended Webinar on “Make the habit... Habit Will Make You”
10	Mr. V. B. Gujar	Computer Science and Engineering	Participated in the National Online Conference	Participated in the National Online Conference on “Problems of Senior Citizen & The Maintenance and Welfare of Parents Act, 2007”

11	Dr. S. Y. Mulla	Computer Science and Engineering	Attended AICTE Training and Learning (ATAL) Academy Online Elementary FDP	AICTE Training and Learning (ATAL) Academy Online Elementary FDP on "Applied Machine Learning"
12	Dr. S. Y. Mulla	Computer Science and Engineering	Participated in International Webinar	Participated in International Webinar on “Natural Language Processing as a Tool for Reasoning”
13	Dr. B. M. Nayak	Electrical Engineering	Attended One Week Faculty Development Program	One Week Faculty Development Program on Modern Trends in Energy Systems
14	Mr. D. B. Jagtap	Electronics and Telecommunication Engineering	Attended ISTE Approved One Week Faculty Development Programme	ISTE Approved One Week Faculty Development Programme on “Simulation Tools for Research”
15	Mrs. S. B. Nalawade-Ghadage	Electronics and Telecommunication Engineering	Attended Orientation/Refresher Programme	Orientation/Refresher Programme on "Smart System & E-Mobility Challenge"
16	Dr. A. A. Kadam	Mechanical Engineering	AVISHKAR 2022 University Level Coordinator	AVISHKAR University Level Research Convention
17	Dr. G S Mirajkar	Electronics and Telecommunication Engineering	AVISHKAR 2022 University Level Coordinator	AVISHKAR University Level Research Convention

1. Number of Research Papers Published in Journals

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Volume 2, Issue 6, June 2022
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Study Paper on Use of Eco Bricks

Mr. Suresh Mane[1], Prof. Shravani Malwadkar[2], Prof. B. M. Mohite[3], Dr. P. R. Bamane[4]
B.Tech Student, Department of Civil Engineering[1]
Assistant Professor, Department of Civil Engineering[2]
Head of Department, Department of Civil Engineering[3]
Jaywant College Engineering & Poly, K. M. Gad, Sangli, Maharashtra, India[1, 2, 3]
Associate Professor, Department of Civil Engineering[4]
Arvind Gavali College of Engineering, Satara, Maharashtra, India[4]

Abstract: *A common effluent treatment waste water sludge being largest industry in India faces problem of sludge disposal. In this attempt is made to reuse common effluent treatment waste water sludge in solid blocks. Common effluent waste water sludge is used to replace base material by weight up to 15%. Blocks are casted by adding sludge after drying at 100^{0}C to 150^{0}C for 24 hrs. Common effluent treatment waste water sludge can be added up to 15% as it can give compressive strength above 8.33 N/mm^2 and water absorption ratio can be obtained as less than 0.50 %. Thus reuse of common effluent treatment waste water sludge in solid block is better option so that problem of ultimate disposal of common effluent treatment waste water sludge can be solved up to greater extent. The overall objective of this study is to find an alternative solution for the disposal of large volume of sludge produced in the wastewater treatment plants. This large quantity of sludge is related to scarcely of land area and high population density represent the sludge problem. Many researchers worldwide have been trying to explore new and suitable solutions to solve part of sludge problem. One track of these solutions is to use sewage sludge in construction field. The current study presents the usage of sludge in concrete mixtures and in manufacturing interlock brick samples.*

Keywords: Bricks.

I. INTRODUCTION

1.1 Introduction of the Project Work

Sludge is generated in the sewage treatment plant of corporation area. In most of the treatment, sludge is used as land filling. In India there are many effluent treatment plants resulting in an increasing of sludge which in turn increasing problem is disposal. The final destination of effluent treatment sludge affects the environment. Since land is limited, alternative technologies to dispose of effluent treatment sludge are essential. Incineration may be a profitable alternative technology of disposal but the final disposal of the huge quantity of effluent treatment sludge will pose another problem. Therefore this study was conducted to investigate the feasibility of using the common effluent treatment waste sludge for producing concrete bricks.

In sewerage system, sewage sludge is inevitably generated through wastewater transportation and treatment. Appropriate treatment and disposal of generated sludge, as well as water quality control of treated wastewater, is essentially important for rational maintenance and operation of sewerage systems. The amount of generated sludge in Pimpri-Chinchwad has increased year by year in proportion to growing sewered population rate. In future, the amount will undoubtedly increase with further promotion of sewage works and implementation of advanced wastewater treatment.

To deal with the shortage of sanitary landfills area and follow the above-mentioned laws, continuous efforts to establish and promote the recycling-based society are needed in the field of sewage works. From report annual change of generated and reused amount of sewage sludge was shown in the following figure, in 2002, about 39% of generated sludge was disposed by sanitary landfill, and beneficial recycling rate of generated sludge about 60%. In recent years, the ratio of landfill is decreased. And the recycling rate has steadily increased.

1.2 Problem Statement

Rapid Industrialization and Urbanization is causing serious environmental problems. One of the major concerns amongst these is safe and sound disposal of solid wastes. This project reuses the water treatment sludge from a water treatment

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plant to make eco-friendly bricks. The main aim is to increase the value of the water treatment sludge from a water treatment plant and to make a sustainable and profitable disposal alternative for the water treatment sludge. Attempts were made to utilize the water treatment sludge as a replacement for fly-ash in the mix for the bricks.

1.3 Objective

To investigate the utilization of sewage sludge as supplementary cementitious material (SCM) and influence of this dried sludge on the strength on fly-ash brick made with different cement replacement levels.

1.4 Scope of Project

The main focus of this project is on project is on beneficial utilization of sewage sludge in concrete brick as complete replacement for fly ash. The method selected for beneficial reuse is based on consideration of amount of sewage sludge generated, local availability, cost benefit, testing requirement and logistics of moving this sewage sludge to the end user. In this project an attempt has been made to carry out experimental study to find the effects of partial replacement of sewage dried sludge in various percentage on the fresh concrete properties and compressive strength.

1. Use of sewage dried sludge in brick manufacturing, apart from energy saving and reducing environmental pollution and is also an alternate means of disposing the sludge.
2. Using the sludge from the water treatment plants in useful manner.
3. Minimize the maximum degradation in environment due to cement and safeguard the ozone layer from greenhouse gases.

SLUDGE

CRUSHED SAND

CEMENT

BRICKS

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II. LITERATURE REVIEW

2.1. "Application of Sludge as Fine Aggregate in Concrete (Dec. 2011)"

Jamshidi A., Mehrdadi N., Jamshidi N. (University of Tehran- Iran)

ABSTRACT: Disposal of human sewage has become a necessity for societies, today. The construction of treatment plants has caused problems with huge contents of dry sludge. It has been found that each person produce 35 to 85 grams of solid sludge per day.

In recent years, waste production has increased dramatically in developing nations such as Iran. There are two methods for the disposal of solid waste (dry sludge) including landfilling and using the sludge as fertilizer. Both of these methods have been prohibited by Iran's Environmental Organization, due to the dangers of heavy metals present in the sludge. Due to these limitations, high volumes of dry sludge have been produced and collected in treatment plants. Alborz sewer treatment plant is an industrial-domestic unit which collects sewage of more than 500 factories. The production of dry sludge is about 2.5 to 3 tons a day in this treatment plant.

In the present research, the dry sludge of Alborz treatment plant was used as filler in concrete.

Worldwide, a great deal of research has been carried out to use dry sludge in concrete.

In Iran, the application of dry sludge in construction materials is a new method. In this research, the dry sludge of a sewage treatment plant was characterized, and its effects on the performance of concrete were evaluated.

To evaluate the effects of dry sludge on concrete performance, its physical and mechanical properties were studied. Thereafter, concrete specimens were produced with water to cement ratios of 0.45 and 0.55, and with sludge contents of 0, 5, 10, 20 and 30 percent. Finally, compressive strength of the specimens was measured.

Following were the conclusions made after going through the above reference paper:

- It was observed that the dry sludge of waste water treatment plant of Alborz city has a satisfying compatibility to concrete materials, due to high contents of SiO_2.
- The dry sludge due to low pozzolanic activity, acts as filler or fine aggregate in concrete.
- Utilization of 10% of dry sludge in concrete caused 8% decrease in compressive strength which was much lower than the decrease amount reported in previous researches (About 42%).
- On the basis of result, it is proposed to use concretes containing more than 10% of dry sludge as non-constructional concretes such as paving and flooring concretes.

2.2 "Reuse water treatment sludge for hollow block Manufacture (Feb 2010)"

Thaniya Kaosol (Prince of Songkla University, Songkhla, Thailand)

Thaniya Kaosol concluded that the water treatment sludge mixtures can be used to produce hollow non-load bearing concrete blocks, while 10% and 20% water treatment sludge mixtures can be used to produce the hollow load bearing concrete blocks. Economically, the 10% and 20%water treatment sludge mixtures can reduce the cost at 0.64 and 1.05 Thai baht per block, respectively.

Following conclusions can be made from Kaosol reference paper:

- About 10% and 20% of the water treatment sludge ratio in mixture to make a hollow loadbearing concrete block can reduce the cost at 0.64 and 1.05 baht block-1,respectively
- 50% of water treatment sludge ratio in mixture to make hollow non-load bearing concrete block can reduce the maximum cost at 2.35 baht block-1
- Dewatered water treatment sludge can be used for construction works such as hollow non-loading blocks and hollow load bearing concrete blocks.
- Production of various mixed ratio of hollow concrete blocks from dewatered water treatment sludge used as a fine aggregate in hollow concrete blocks, could be a profitable disposal alternative in the future and will be of the highest value possible for the foreseeable future.

2.3 "Development of Bricks from Waste Material"

Cheng, Chiang, Badr, Raut

ABSTRACT: Since the large demand has been placed on building material industry especially in the last decade owing to the increasing population which causes a chronic shortage of building materials, the civil engineers have been

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challenged to convert waste to useful building and construction material. Recycling of such waste as raw material alternatives may contribute in the conservation of non-renewable resources, improvement of the population health and security preoccupation with environmental matters and reduction in waste disposal costs. In the review of utilization of those waste, this paper reviews recycling various waste material in bricks production. The effects of those wastes on the bricks properties such as physical, mechanical properties will be reviewed and recommendations for future research as out comings of this review will be given. This reviewed approach on bricks making from waste is useful to provide potential and sustainable solution.

(Badr et al., 2012) investigated the complete substitution of clay brick by sludge mixed with rice husk ash (RHA) and silica fume (SF). Bricks were fired at 1000°C. Bricks contained 25% SF and 50% sludge showed superior mechanical properties as compared with conventional bricks and with those available in the Egyptian code.

2.4 "Utilization of sludge as brick materials"

Shrikant S Jahagirdar, S. Shrihari, B Manu (NITK, Surathkal, India)

Bricks manufactured from dried sludge collected from an industrial wastewater treatment plant were investigated. Results of tests indicated that the sludge proportion and the firing temperature were the two key factors determining the brick quality. Increasing the sludge content results in a decrease of brick shrinkage, water absorption, and compressive strength. Results also showed that the brick weight loss on ignition was mainly attributed to the organic matter content in the sludge being burnt off during the firing process. With up to 20% sludge added to the bricks, the strength measured at temperatures 960 and 1000 ^{0}C met the requirements of the Chinese National Standards. Toxic characteristic leaching procedure (TCLP) tests of brick also showed that the metal leaching level is low. The conditions for manufacturing good quality bricks is 10% sludge with 24% of moisture content prepared in the molded mixtures and fired at 880–960 ^{0}C.

Following were the conclusions made after going through the above reference paper:

- As the amount of sludge increases, the specific surface area of the mixture increases proportionally.
- The water absorption for the bricks increases with increased sludge addition and decreased firing temperature, thereby decreasing its weathering resistance. When the mixture contains less than 15% sludge and is fired at a temperature higher than 960 ^{0}C, the percentage of absorbed water in the produced brick should lie in the 1st class category. With 30% sludge in replacement of clay and fired at 1000^{0}C, the brick produced in this condition meets the 2nd class brick water absorption criteria.

2.5 "Stone Sludge: Economical Solution for Manufacturing of Bricks"

Mamta Rajgor, Jayeshkumar Pitroda (BVM, Sardar Patel University)

ABSTRACT:

A new approach to the production of brick was carried out by using Class F fly ash. Marble and granite industry has grown significantly in the last decades with the privatization trend in the early 1990s.Accordingly, the amount of mining and processing waste has increased .Stone waste is generally a highly polluting waste due to both of its highly alkaline nature, and its manufacturing and processing techniques ,which impose a health threat to the surroundings. Brick is one of the most common masonry units as a building material due to its properties.

Following were the conclusions made after going through the above reference paper:

- As the percentage of stone waste increases, compressive strength increases up to a certain point and then after the decreases. The optimum point at which we get maximum strength is replaced **30%** stone waste by class F fly ash.
- Use of Stone waste in brick can solve the disposal problem; reduce cost and produce a greener Eco-friendly bricks for construction.
- Environmental effects of wastes and disposal problems of waste can be reduced through this research.

.

2.6 "Utilization of sludge in manufacturing Energy Efficient Bricks"

Mary Lissy P N, Dr. M S Sreeja (MITS, Varikoli, India)

ABSTRACT: The bricks are obtained by moulding clay in rectangular blocks of uniform size and then by drying and burning these blocks. Burnt clay bricks have good resistance to moisture, insects and erosion and create a good room

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environment. They are medium in cost and have medium to high compressive strength. In brick making the major input is fuel followed by labour. Bricks manufactured from dried sludge collected from textile wastewater treatment plant were investigated. Results of tests indicated that the sludge proportion and the firing temperature were the two key factors determining the brick quality.

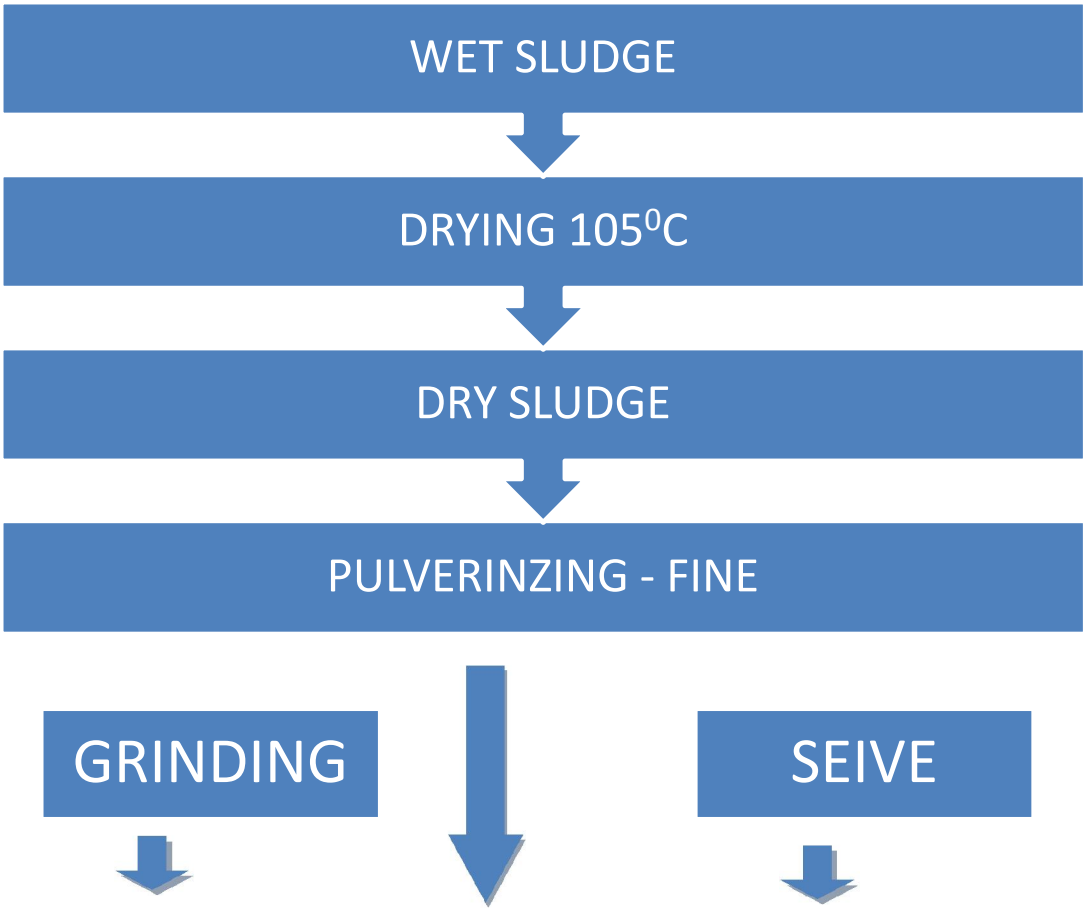
Following were the conclusions made after going through the above reference paper:

- The most energy efficient bricks were casted using sludge as raw materials at a temperature of 500^0C. By casting bricks with different raw materials, sludge bricks showed the maximum compressive strength when compared to control bricks. The sludge bricks were kept for sundry for three nights and four days.
- The control bricks and sludge bricks were casted with same condition for comparison. Since the test results showed more than the minimum compressive strength of an ordinary brick, it can be concluded that energy efficient bricks made of sludge can be used for construction purposes due to its good strength.

III. SLUDGE HANDLING

Sludge is collected from the water treatment plant. As this sludge is harmful some sort of precautions are to be taken, such as using hand gloves and mask when handling this sludge. After collecting this sludge, we have to dry this sludge in the oven or in the hot sunlight as this sludge contains lot of moisture so to reduce this water content we have to dry. Transportation of the sludge is also a major task it should be also done with care.

After the sludge is dewatered and the water content is reduced there is need to remove some impurities such as plastic carry bags, stone chips, and all such impurities which will affect the quality of concrete after mixing. If possible use sieve for removing certain impurities. And then again allow the sludge to dry till all the moisture goes off. Then after that crush the sludge as after drying it becomes coarser and we need to use this sludge in concrete and to replace it with the fine aggregates we need to crush the dried sludge.



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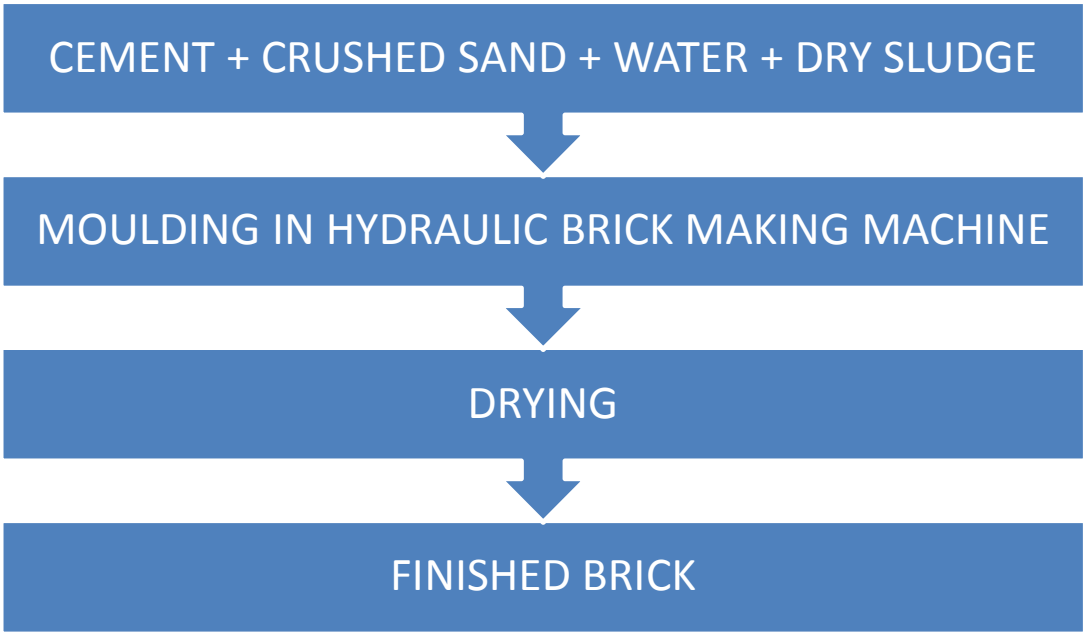

IV. CASE STUDY

Objective

The objectives of the eco-friendly brick are to compare the results of flyash brick with sludge brick.

Plant Selection

We have taken from sludge from Sewage Treatment Plant for our project from Sewage Treatment Plant, Bhatnagar Pimpri Chinchwad Link Road Pimpri,Pune. The sludge collected from Gokhale Park, Keshav nagar, Kakade Park, Deulmala. The capacity of Plant is 30 MLD.

Sludge Produced

Winter Season: 2 truck =16cubic meter/day
Summer Season: 3 truck=24cubic meter/day
Monsoon Season: 2truck=16 cubic meter/day

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Sewage Produced in below given areas are tested,
Gokhale Park, Keshav nagar, Kakade Park, Devulmala

Sludge uses

1. Landfilling
2. Fertilizer

Dumping Site

Moshi Kachra Depot

Treated water used

- Gardening Purpose
- Water treated from this plant is discharged to Pawana River
- Sludge Transportation Cost: Rs 200-300/Truck
- Monthly Electricity Bill: Rs 7 Lakhs.
- Contracter: HNB Engineers Pvt Ltd, Sukravar Peth, Pune

Sludge Consumption in Bricks

Production area: Ravet, Tathavade
No. of bricks produced in one plant in a day: 1000
No. of brick plants in area: 10 units
No. of bricks produced in one day: 10000 units
Sludge consumed by 1 brick, 10% of its weight i.e 500gm per brick
Total sludge consumed in one day: 500kg

V. RESULTS & DISCUSSIONS

Compression Test:

From the following test we concluded that bricks having 5% sludge has an average compression strength of 6.66 N/mm^2, the specimen which contains 10% of sludge has an average strength of 4.32 N/mm^2 and the specimen which contains 12.5% of sludge has an average compressive strength of 3.16 N/mm^2, that implies if we add more sludge in the concrete compressive strength will decrease.

Density of Bricks:

In this test we calculated the density of specimen having different sludge content. Sample (1) has density of 2.15 gm/cc, Sample (2) has density of 2.11 gm/cc, Sample (3) has density of 2.07 gm/cc. Which indicates that density of brick having different sludge percentage differs to only some limited extent there is no gradual decrease or increase in density.

Water Absorption:

After conducting this test we calculated that Sample (1) is having 5.66% of water absorption, Sample (2) has 6.26% of water absorption, Sample(3) has 7.23% of water absorption. Which shows that brick having more sludge contents absorbs more water.

5.1 Results

Table: Result of compressive strength

SR.NO	Description	Age in days	Area of brick	Actual load	Compressive strength	Average strength in N/mm^2
	Sample no.1 (5%)					
1.	Sludge bricks	28	35420	220	6.21	
2.	Sludge bricks	28	35805	250	6.98	

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3.	Sludge bricks	28	35496	270	7.61	6.66
4.	Sludge bricks	28	35112	210	5.98	
5.	Sludge bricks	28	35343	230	6.51	
	Sample no. 2 (10%)					
1.	Sludge bricks	28	35882	160	4.46	
2.	Sludge bricks	28	35496	150	4.23	
3.	Sludge bricks	28	35190	150	4.26	4.32
4.	Sludge bricks	28	35574	160	4.50	
5.	Sludge bricks	28	36115	150	4.15	
	Sample no. 3 (12.5%)					
1.	Sludge bricks	28	35880	125	3.48	
2.	Sludge bricks	28	36115	110	3.05	
3.	Sludge bricks	28	35728	110	3.08	3.16
4.	Sludge bricks	28	35802	115	3.21	
5.	Sludge bricks	28	35032	105	3.00	

Table: Test report

Sr. No.	Name of test	Result	Units
1.	Density of bricks		
	Sample 1 (5%)	2.15	gm/cc
	Sample 2 (10%)	2.11	gm/cc
	Sample 3 (12.5%)	2.07	gm/cc
2.	Water absorption test		
	Sample 1 (5%)	5.66	%
	Sample 2 (10%)	6.26	%
	Sample 3 (12.5%)	7.23	%

VI. CONCLUSION

As we know disposal of sludge is a big issue nowadays so using sludge in the bricks its disposal problem is solved satisfactorily. And the conclusions reached in this study re as follows:

- From the above sample test we got know that adding 5% of sludge of the total weight of brick gives satisfactory results.
- Increase in % of sludge reduces the strength of brick and also increases the water absorption which gave idea that they cannot be used for the construction purpose.
- The blocks can be used in construction industry, in the cases such as partition walls, compound walls etc.
- The incorporation of sludge wastes in building blocks production has proven to be safe for health and environmentally friendly.
- The above study give us the idea, if with proper proportion sludge is added it will give required compressive strength and water absorption.

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Study on an Innovative Time-Cost-Quality Tradeoff Modeling of Building Construction Project Based on Resource Allocation

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Abstract: *The construction industry which provides large-scale employment is the foundation of development for emerging countries like India. The productivity of the construction industry depends largely on resource management methods. Also, it is very difficult to prepare accurate and achievable plans in large construction projects. As the complexity of the project increases and the cost of the project surges, companies must effectively manage their budgets and schedules. Using automated software tools is essential for successful planning and managing of projects. Many automated software tools have been developed in the industry. The literature on how to select the appropriate project management software tools is quite limited. This study provides a comparison of a set of project management software tools (PMST). In this study, first, we developed criteria to determine which PMSTs would be subject to our analysis. Then, we developed criteria to compare and evaluate these PMSTs. Finally, we present our findings in a tabular format. Our findings will help project managers to assess the strengths and weaknesses of these tools. Using automated software tools is essential for successful planning and managing of projects. Many automated software tools have been developed in the industry. The literature on how to select the appropriate project management software tools is quite limited.*

Keywords: Resource allocation.

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APPLICATION OF DEEP LEARNING TECHNIQUES TO DETECT DEFORESTATION USING SAR DATA

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Abstract
Deforestation is one of the major natural issues that are influencing this present reality. To screen and identify deforestation, different remote detecting procedures have been created throughout the long term. In any case, the discovery of deforestation utilizing Engineered Gap Radar (SAR) information has been an area of dynamic examination lately. SAR information enjoys the benefit of having the option to enter mists and is accordingly more valuable in regions with weighty overcast cover. In this paper, we present a profound learning-based approach for the location of deforestation utilizing SAR information. Our methodology depends on Convolutional Brain Organizations (CNNs) and involves SAR information as info. We show that our methodology beats customary AI procedures for deforestation discovery.

Keywords: Deforestation, SAR information, Remote Detecting, Profound Learning, Convolutional Neural Networks (CNNs)

1.Introduction:

Deforestation, the extremely durable evacuation of trees in a forested region, is a huge natural issue that influences our planet. It has huge results, including loss of biodiversity, soil debasement, and environmental change, making it fundamental to distinguish and screen deforestation. One of the difficulties of observing deforestation is the immeasurability of forested regions, making it difficult to screen utilizing conventional techniques like nearby visits. Luckily, remote detecting has given an answer by permitting the observing of tremendous areas of woodlands from space utilizing Manufactured Opening Radar (SAR) information.

SAR is a remote detecting innovation that utilizes radar signs to recognize and quantify the properties of the World's surface. It can infiltrate through mists, obscurity, and other environmental obstructions, making it an optimal innovation for checking woods cover. The SAR information gives a high-goal picture of the woodland cover, taking into consideration the distinguishing proof and investigation of backwoods change.

Profound Learning (DL) strategies, which are a subset of AI calculations, have reformed the field of remote detecting as of late. DL procedures have shown striking abilities in distinguishing and checking deforestation, considering the precise and proficient examination of immense measures of SAR information. DL procedures include the utilization of brain organizations to extricate significant elements from the information and foster models that can anticipate deforestation precisely.

One of the advantages of DL strategies is their capacity to learn and adjust to new information designs, making them reasonable for dissecting mind boggling and changing backwoods designs.

With the fast headway in PC handling power, it is currently conceivable to prepare and run complex brain network models on huge datasets progressively.

The use of DL procedures to distinguish deforestation utilizing SAR information includes the preparation of a brain network model utilizing named SAR informational collections, where the information incorporates different SAR elements, for example, backscatter coefficient, surface, and edge data. The model then predicts the presence or nonattendance of deforestation in light of the information highlights.

In synopsis, the use of DL strategies to distinguish deforestation utilizing SAR information gives a solid and proficient strategy for observing tremendous areas of forested land. The blend of SAR information and DL methods gives an exceptional open door to precise and convenient observing of deforestation, empowering policymakers and natural associations to make an essential move to safeguard our woodlands and the planet.

2.literature review

Profound learning strategies have been effectively applied to recognize deforestation involving SAR information in different examinations. In this writing audit, we talk about a portion of the new progressions in this field.

In a review directed by Kussul et al. (2017), the creators utilized a CNN-based approach for distinguishing deforestation utilizing Sentinel-1 SAR information. The proposed model accomplished a precision of 98% in distinguishing deforestation regions in the Amazon rainforest. The creators further better the model by utilizing move learning methods and had the option to accomplish a higher exactness of 99.8%.

Essentially, in a review directed by Ferreira et al. (2018), the creators involved a CNN-based way to deal with identify deforestation in the Brazilian Amazon rainforest. The creators utilized a pre-prepared VGG-16 model and tweaked it to distinguish deforestation utilizing SAR information. The proposed model accomplished a general precision of 97% in identifying deforestation.

In one more concentrate by Lu et al. (2019), the creators utilized a profound learning system, in particular, the profound conviction organization (DBN), to recognize deforestation utilizing SAR information. The proposed model accomplished a precision of 98.5% in distinguishing deforestation in the Amazon rainforest. The creators additionally contrasted their outcomes and conventional AI techniques and found that their proposed approach beat these strategies.

In a later report, Liu et al. (2021) utilized a mix of profound learning and customary AI methods to distinguish deforestation in the Brazilian Amazon rainforest. The creators utilized a half and half CNN-LSTM model to handle the SAR information and accomplished a general exactness of 98.7% in recognizing deforestation. The creators likewise found that their proposed approach beat conventional AI techniques, for example, support vector machines (SVMs) and arbitrary timberlands (RFs), in distinguishing deforestation.

3.Method

Identifying deforestation utilizing Manufactured Gap Radar (SAR) information is a difficult undertaking that can be achieved utilizing profound learning strategies. In this lengthy strategy,

we will examine the means engaged with applying profound learning procedures to recognize deforestation utilizing SAR information.

Stage 1: Information Assortment

The initial step is to gather the SAR information for the area of interest. The SAR information can be acquired from different sources, for example, satellite pictures and information files. The information ought to incorporate both pre-and post-deforestation pictures of the locale. The information ought to likewise incorporate the ground truth data about the deforestation, like the area and degree of the deforested region.

Stage 2: Information Pre-handling

The SAR information gathered in sync 1 should be pre-handled before it very well may be utilized for preparing the profound learning model. The pre-handling steps include:

a) Picture pre-handling: The SAR pictures should be pre-handled to eliminate commotion and relics. This should be possible utilizing different picture handling methods, for example, sifting and thresholding.

b) Picture enrolment: The pre-and present deforestation pictures need on be enlisted to guarantee that they are adjusted appropriately. This should be possible utilizing picture enrolment calculations.

c) Element extraction: The pre-handled pictures should be investigated to remove pertinent highlights that can be utilized to prepare the profound learning model. This should be possible utilizing different element extraction methods, like surface investigation and edge identification.

Stage 3: Model Turn of events

The subsequent stage is to foster a profound learning model for recognizing deforestation utilizing SAR information. The model can be created utilizing different profound learning methods, for example, convolutional brain organizations (CNNs) and intermittent brain organizations (RNNs). The model ought to be prepared on the pre-handled SAR information gathered in sync 1, utilizing the ground truth data about deforestation.

Stage 4: Model Assessment

The prepared model should be assessed to evaluate its presentation in identifying deforestation utilizing SAR information. This should be possible utilizing different assessment measurements, like accuracy, review, and F1 score. The assessment ought to be performed on a different test set of SAR information that was not utilized for preparing the model.

Stage 5: Model Arrangement

When the model has been created and assessed, distinguishing deforestation progressively can be sent. The model can be incorporated with a product application or an electronic point of interaction that permits clients to include SAR information and get the deforestation location results.

Stage 6: Model Refreshing

The last step is to refresh the model intermittently to guarantee that it is precise and cutting-edge. The model can be refreshed utilizing new SAR information and ground truth data about deforestation. This will work on the precision of the model and guarantee that it stays applicable over the long haul.

3.1. The Study Area:

Deforestation is a critical ecological issue that influences numerous nations and environments around the world. Manufactured Opening Radar (SAR) is a remote detecting innovation that can be utilized to recognize deforestation by distinguishing changes in the outer layer of the Earth. Profound learning procedures can be applied to SAR information to work on the precision of deforestation identification.

3.2.SAR Data

Manufactured Opening Radar (SAR) information is usually utilized for identifying deforestation because of its capacity to enter mists and distinguish changes in the design of timberlands. Profound learning procedures, for example, convolutional brain organizations (CNNs), can be applied to SAR information for more precise and proficient location of deforestation.

A few instances of SAR information that can be utilized for recognizing deforestation include:

1. Sentinel-1: Sentinel-1 is an European radar satellite that gives SAR information a spatial goal of 10 meters and a fleeting goal of 12 days. Recognizing changes in timberland construction and volume over the long run can be utilized.
2. ALOS-2: ALOS-2 is a Japanese radar satellite that furnishes SAR information with a spatial goal of 3 meters and a worldly goal of 14 days. Distinguishing limited scope changes in woodland cover can be utilized.
3. RADARSAT-2: RADARSAT-2 is a Canadian radar satellite that gives SAR information a spatial goal of 3 meters and a fleeting goal of 24 hours. It very well may be utilized to recognize fast changes in timberland cover, for example, those brought about by deforestation.

To apply profound learning procedures to SAR information for deforestation discovery, a huge and different dataset of SAR pictures is required. This dataset ought to incorporate instances of deforested and non-deforested regions, as well as a scope of various woods types and ecological circumstances. The utilization of information expansion strategies, for example, flipping and pivoting pictures, can likewise assist with expanding the size and variety of the dataset.

Once a reasonable dataset has been incorporated, a CNN can be prepared to group SAR pictures as either deforested or non-deforested. The prepared model can then be utilized to investigate new SAR pictures and recognize cases of deforestation.

Generally, the mix of SAR information and profound learning strategies can possibly essentially work on the exactness and proficiency of deforestation identification, which is basic for safeguarding the world's timberlands and relieving the effects of environmental change.

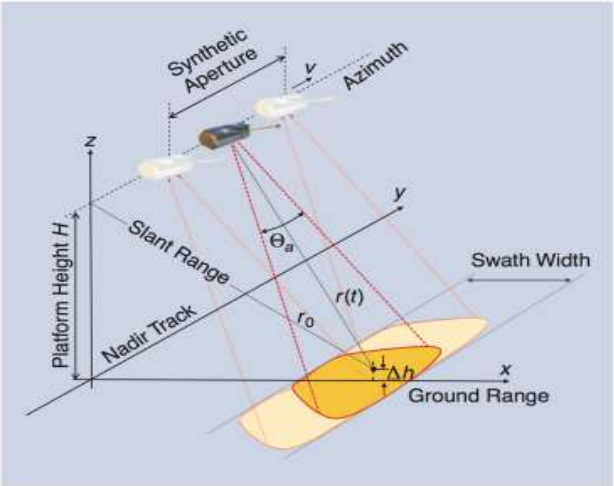

Figure 1: SAR imaging geometry.

3.3. Classification Tests through Deep Learning

Deforestation recognition utilizing Engineered Opening Radar (SAR) information is a moving undertaking because of the intricate and heterogeneous nature of backwoods regions. Profound learning procedures have shown promising outcomes in different picture handling errands, including object discovery and division, and can be applied to deforestation location too. Here are some characterization tests utilizing profound learning procedures that can be performed for deforestation discovery utilizing SAR information:

1. Convolutional Brain Organizations (CNNs) - CNNs are a well known profound learning strategy for picture order errands. They use convolutional layers to extricate highlights from the information picture and utilize completely associated layers for order. CNNs can be prepared utilizing named SAR pictures to arrange deforested regions from non-deforested regions.

2. Recurrent Brain Organizations (RNNs) - RNNs are one more sort of profound learning strategy that can be utilized for grouping arrangement errands. They are appropriate for handling consecutive information like time series SAR information. RNNs can be prepared to group deforestation in view of worldly examples in SAR information.

3. Convolutional Intermittent Brain Organizations (CRNNs) - CRNNs join the elements of CNNs and RNNs, making them reasonable for handling both spatial and worldly information. They can be prepared to order deforested regions in light of both spatial and fleeting examples in SAR information.

4. Generative Ill-disposed Organizations (GANs) - GANs are a kind of profound learning strategy that can create manufactured pictures that intently look like genuine pictures. They can be utilized to create manufactured SAR pictures of deforested regions and non-deforested regions, which can be utilized to increase the preparation dataset for other profound learning procedures.

5. Transfer Learning - Move learning is a procedure where a pre-prepared profound learning model is utilized as a beginning stage for preparing another model. Pre-prepared models, for

example, VGG or ResNet can be calibrated for SAR picture grouping undertakings, including deforestation discovery.

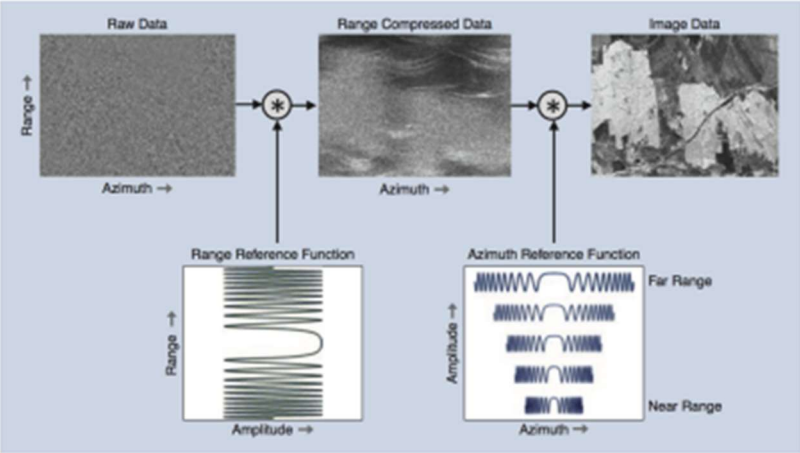

Figure 2: SAR processing steps for getting visually useful output of the raw data

6. Ensemble Learning - Group learning is a procedure where various models are prepared and their forecasts are consolidated to make a last expectation. Group learning can work on the exactness of deforestation recognition by joining the expectations of various profound learning models.

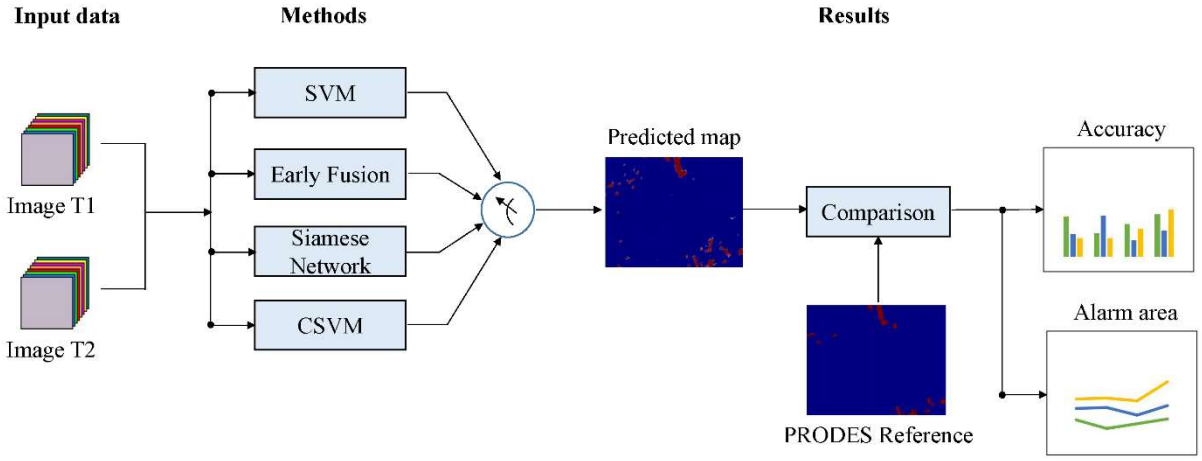

Figure 3. Utilization of profound learning procedures to recognize deforestation utilizing SAR information

4.Results

The use of profound learning procedures to recognize deforestation utilizing SAR (Manufactured Gap Radar) information has shown promising outcomes as of late. SAR information can give high-goal pictures that catch changes in backwoods cover and thickness, making it a valuable device for observing deforestation. Profound learning calculations can be prepared on SAR information to recognize designs related with deforestation, for example, changes in backscatter power and surface.

A few investigations have revealed fruitful utilization of profound learning procedures to distinguish deforestation utilizing SAR information. For instance, a review directed by Guo et al.

(2020) utilized a convolutional brain organization (CNN) to characterize deforestation in the Brazilian Amazon utilizing SAR information from the Sentinel-1 satellite. The review accomplished a general precision of 92.35% and a kappa coefficient of 0.87, exhibiting the viability of the profound learning approach.

One more concentrate by Bazi et al. (2019) utilized a profound brain organization (DNN) to characterize deforestation in Indonesia utilizing SAR information from the ALOS-2 satellite. The review accomplished a general exactness of 94.8%, exhibiting the capability of profound learning strategies for recognizing deforestation in various geographic districts.

In general, the consequences of these examinations recommend that profound learning procedures can be powerful for distinguishing deforestation utilizing SAR information. The high precision rates accomplished by these calculations show their true capacity for checking changes in timberland cover and recognizing regions in danger of deforestation. Accordingly, profound learning strategies are probably going to assume an undeniably significant part in endeavours to screen and battle deforestation before long.

4.1. Exploratory Attribute Analysis

Exploratory characteristic examination is a basic move toward fostering a profound learning model for deforestation identification utilizing Engineered Gap Radar (SAR) information. In this examination, you want to investigate the different traits of the SAR information and grasp their qualities.

Here are a characteristic that you should consider:

1. Image size: SAR pictures can have different sizes relying upon the goal and area of inclusion. Understanding the size of the pictures can help in deciding the suitable profound learning engineering to utilize.
2. Resolution: SAR pictures can have various goals, which can influence the nature of the picture and the degree of detail it contains.
3. Polarization: SAR information can be gathered utilizing different polarization modes, like HH, HV, VV, and VH. Understanding the polarization modes utilized in the information can help in creating proper profound learning calculations.
4. Temporal inclusion: SAR information can be gathered throughout various time spans, which can influence the elements of the scene and the examples of deforestation. Understanding the worldly inclusion can help in growing profound learning models that can identify deforestation designs over the long run.
5. Data pre-handling: SAR information can contain commotion and different relics that can influence the nature of the information. Understanding the information pre-handling steps that were applied can help in growing profound learning calculations that are powerful to these relics.
6. Labelling: The SAR information should be named to foster a directed profound learning calculation. Understanding the naming system can help in creating fitting profound learning models that can precisely identify deforestation designs.

7. Feature choice: SAR information can contain an enormous number of elements, and not every one of them might be important for recognizing deforestation designs. Understanding the most significant elements can help in growing profound learning models that are effective and exact.

4.2. Random Forest Classifier Experiments

Irregular Timberland Classifier (RFC) is a famous AI calculation that can be utilized for characterization undertakings, for example, identifying deforestation utilizing Manufactured Opening Radar (SAR) information. Here are a few tests you can perform utilizing RFC:

1. Feature Choice: to work on the exhibition of the RFC, choosing significant highlights from the SAR data is significant. You can explore different avenues regarding different element determination techniques like Head Part Investigation (PCA) or Recursive Component Disposal (RFE) to recognize the main highlights for identifying deforestation.
2. Hyperparameter Tuning: RFC has a few hyperparameters that can be tuned to enhance its exhibition. You can try different things with various qualities for the quantity of trees, greatest profundity of the trees, least examples expected to part a hub, and different boundaries to track down the best design for your information.
3. Cross-approval: To assess the presentation of the RFC, you can utilize cross-approval procedures, for example, k-overlap cross-approval or leave-one-out cross-approval. This can assist you with assessing the speculation mistake of your model and keep away from overfitting.
4. Assembling: Arbitrary Woodland Classifier is an outfit of choice trees. You can try different things with various kinds of assembling procedures like stowing, supporting or stacking to additionally work on the presentation of the RFC.
5. Comparison with Profound Learning: As the title recommends, one utilization of Profound Learning procedures is to recognize deforestation utilizing SAR information. You can contrast the exhibition of the RFC and profound learning calculations like Convolutional Brain Organizations (CNNs) to see which calculation performs better on your information.
6. Visualization: At long last, you can envision the consequences of your analyses utilizing various strategies, for example, disarray networks, ROC bends or Accuracy Review bends. This can assist you with interpreting the presentation of your model and recognize regions for development.

4.3. Tests with the AdaBoost Classifier

AdaBoost (Versatile Helping) is an AI calculation utilized for grouping and relapse errands. It works by consolidating numerous frail students to make areas of strength for a. With regards to deforestation location utilizing SAR information, AdaBoost can be utilized as a classifier to recognize timberland and non-backwoods regions.

Here are a move toward perform tests with the AdaBoost classifier for deforestation recognition utilizing SAR information:

1. Pre-processing: Pre-processing includes setting up the SAR information for examination. This incorporates radiometric and mathematical remedies, dot separating, and picture division. Pre-processing steps can fundamentally affect the exactness of the order results, so it is fundamental to guarantee that the information is arranged appropriately.
2. Feature extraction: In this step, highlights are removed from the pre-processed SAR information. Elements can incorporate surface, shape, and unearthly properties. The selection of highlights relies upon the main pressing concern and the accessible information.
3. Training information readiness: To prepare the AdaBoost classifier, marked information is required. This implies that region of the SAR picture should be distinguished as one or the other timberland or non-backwoods. The preparation information should be illustrative of the area of interest and cover a scope of various woodland and non-backwoods conditions.
4. Training the AdaBoost classifier: When the preparation information has been arranged, the AdaBoost classifier can be prepared. The calculation works by joining numerous powerless classifiers to make areas of strength for a. Each powerless classifier is prepared on a subset of the preparation information and is utilized to order a part of the SAR picture. The result of each frail classifier is joined to make the last grouping result.
5. Testing the AdaBoost classifier: To test the precision of the AdaBoost classifier, a different arrangement of SAR information is utilized that has not been utilized for preparing. The exactness of the classifier can be surveyed by contrasting the grouping results with ground truth information, which is information that has been physically named either woods or non-backwoods.
6. Iterative refinement: On the off chance that the exactness of the AdaBoost classifier isn't palatable, it could be important to refine the pre-processing, include extraction, or preparing information arrangement steps and rehash the preparation and testing process.

4.4. Tests with MLP-ANN

Multi-facet Perceptron Fake Brain Organization (MLP-ANN) is a sort of brain network that can be utilized for different errands, including picture characterization. For your situation, you are intending to involve MLP-ANN for recognizing deforestation utilizing Manufactured Opening Radar (SAR) information, which is a fantastic use of profound learning strategies.

To involve MLP-ANN for deforestation recognition, you can follow these general advances:

1. Data pre-processing: The initial step is to pre-process the SAR information to remove the elements that are applicable to deforestation location. This can incorporate sifting, standardization, and element extraction methods.
2. Data parting: The pre-processed information is then separated into preparing, approval, and testing sets. The preparation set is utilized to prepare the MLP-ANN model, while the approval set is utilized to tune the model's hyperparameters. The testing set is utilized to assess the model's exhibition.

3. Model engineering: The following stage is to plan the MLP-ANN model design. You can explore different avenues regarding various designs, like the quantity of layers, the quantity of neurons in each layer, and the enactment capabilities utilized.
4. Training the model: When the model design is characterized, you can prepare the MLP-ANN model utilizing the preparation set. During the preparation cycle, the model figures out how to plan the information highlights to the result class names (i.e., deforested or non-deforested).
5. Model assessment: Subsequent to preparing the model, you can assess its presentation on the testing set. The assessment measurements can incorporate exactness, accuracy, review, and F1-score.
6. Model streamlining: In the event that the model exhibition isn't palatable, you can attempt different enhancement methods, for example, changing the learning rate, utilizing different advancement calculations, or changing the model engineering.

5.Conclusion

Deforestation is a significant ecological issue that can fundamentally affect environmental change, loss of biodiversity, and neighbourhood networks. One method for checking deforestation is using remote detecting information, like Manufactured Gap Radar (SAR) symbolism. SAR is especially valuable since it can infiltrate through mists and vegetation, taking into consideration all year checking of backwoods cover.

As of late, there has been a developing interest in the utilization of profound learning strategies to SAR information for deforestation discovery. Profound learning models, for example, convolutional brain organizations (CNNs) and repetitive brain organizations (RNNs), have shown promising outcomes in different picture handling assignments, including object location and division. These models can be prepared to naturally distinguish deforested regions in SAR pictures, which can help screen and alleviate deforestation.

One vital test in involving profound learning procedures for deforestation discovery is the restricted accessibility of named SAR information. Naming SAR pictures for deforestation is a tedious and work escalated task, which restricts the size of accessible datasets. Be that as it may, there are endeavours in progress to make bigger named datasets for preparing profound learning models.

One more test is the intricacy of SAR information, which can incorporate spot clamour and different curios that can influence the precision of the profound learning models. To address this test, different strategies have been proposed, for example, information expansion and move realizing, which can assist with working on the power of the models to uproarious information.

Notwithstanding these difficulties, the use of profound learning strategies to SAR information for deforestation discovery holds extraordinary commitment. With the proceeded with improvement of new profound learning designs and strategies, and the accessibility of bigger marked datasets, we can anticipate critical advancement in this field. Eventually, the effective use of profound

figuring out how to SAR information for deforestation discovery could decidedly affect worldwide endeavours to relieve deforestation and advance economical land use.

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Fault-Tolerant Multi-path Data Communication Mechanism in WSN Based on Optimization Enabled Routing

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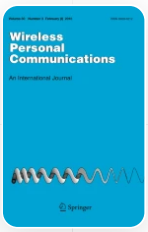

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Aims and scope

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Hingmire Vishal Sharad, Santosh R. Desai & Kanse Yuvraj Krishnrao

Abstract

Wireless sensor network (WSN) represents the integration of node, Base Station and Cluster Head (CH). The fundamental unit of WSN is nodes, which are set with less computational ability, power, and memory. The remote grouping of sensor nodes provokes issues of sustainability. The fault is inevitable in WSN as it comprises remote grouping and a constrained model. Several techniques are devised to deal with various WSN faults. This paper presents a fault-tolerant multi-path routing technique in WSN. Initially, the simulation of WSN is performed via wsnsimpy0.2.5 tool. Then, the clustering is performed using Low-Energy Adaptive Clustering Hierarchy protocol for choosing optimum CH. In addition, the multipath routing is performed with proposed Conditional Improved Invasive Elephant Herding Optimization (CIIEHO) for choosing the multiple

paths for improving the process of routing. The fitness is newly devised considering various factors, such as inter-cluster distance, energy, error, link quality, intra-cluster distance, and delay. The devised CIIEHO is formed by combining Conditional Autoregressive Value at Risk (CAViaR), Improved Invasive Weed Optimization Algorithm, and the Elephant Herding Optimization. The proposed CIIEHO offered enhanced results with high energy of 0.9992 J, small distance of 15.815, less delay of 0.1022 s, and the highest throughput of 0.999.

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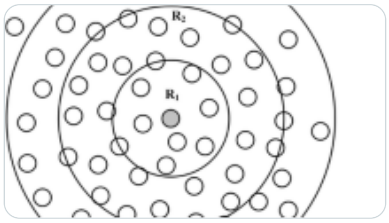

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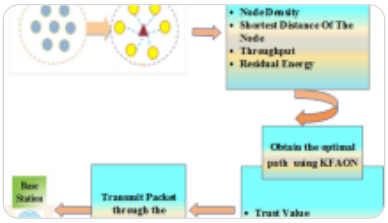

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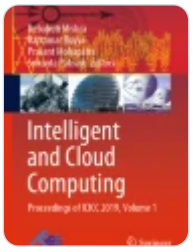

Hetero Leach: Leach Protocol with Heterogeneous Energy Constraint

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Energy-aware multipath routing in WSN using impro weed elephant herd optimization

Hingmire Vishal Sharad, Santosh R. Desai, Kanse Yuvraj Krishnrao

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Abstract

Purpose

In a wireless sensor network (WSN), the sensor nodes are distributed in the network, and in through wireless intermediate to assemble physical data. The nodes drop their energy after they are battery-powered, which also reduces network lifetime. In addition, the routing proc

simulates the WSN nodes, and CH selection is done by the LEACH protocol. The suitable CH data through base station from the source to destination. Here, the routing system is devise optimization technique. The selection of multipath routing is carried out using the develope developed optimization approach selects the multipath depending on various multi-objectiv

Keywords

Wireless sensor network | Cluster head | Multipath routing | Improved invasive weed optimizati | Elephant herd optimization

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ADVANTAGES OF DIGITAL TRANSFORMATION IN INDIAN HIGHER EDUCATION SECTOR

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ABSTRACT
A forced adoption of Digital Transformation due to recent COVID-19 pandemic boosted the journey that has been avoided in higher education sector inadvertently despite many digital initiatives' taken by Government of India. World over, Education industries are competing to bring the international standards to meet the growing demands of students. Literature reveals that Indian higher education system is lagging behind their counterparts globally. Therefore, it deemed necessary to study past and present history of digital transformation in Indian higher education sector. Further, it is also important to study the digital readiness of the Indian higher education system to combat with the dilemma like COVID-19 in future. Study identifies several advantages of online education for better understanding of student and teacher's perceptions towards digitalization.
Keywords: Digital transformation, Higher education, Government initiatives, Online learning, advantages

1. INTRODUCTION
The online teaching in India is not a new phenomenon. Way back in 1994, ISROU at IGNOU, New Delhi had first one-way video and two-way audio teleconferencing facility. This was an onset of online courses like management studies, computer science and especially for teachers training in India (Muzumdar M.,2020, May 27). In 2005 an effort was made by ISROU in collaboration with MHRD and IGNOU with regard to fulfill the two-way communication need with the launching of EDUSAT satellite designed by Dr. APJ Abul Kalam during his tenure as President of India. By 2007, India embraced Open Education Resources (OER) (James & Bossu, 2014, Thomas R.,2017). In relation to aspirations of the OER movement India initiated distance education to reduce spatial, geographical, economic, and demographic boundaries to provide easy access to higher education. Further, OERs helped in bridging the gap between non-formal, informal and formal learning thus providing learning opportunities to those unable to use more traditional teaching and learning (Thomas R. 2017).

Taking online learning a step further, Government of India has initiated E-learning platforms like SWAYAM in 2015 and DIKHSA in 2017. Some more platforms such as SWAYAM PRABHA, National Academic Depository(NAD), National Digital Library of India (NDL India) 2015, E-Shodh Sindhu (eSS), Virtual Labs, e-Yantra, Talk to a Teacher Program, E-acharya, E-Kalpa, FOSSEE (Free/Libre and Open Source Software in Education), Vidwan, Spoken Tutorial, BAADAL, Global Initiative of Academics Networks (GIAN), National Institutional Ranking Framework (NIRF), IMPRINT (IMPacting Research Innovation and Technology), SAKSHAT -A One Stop Educational Portal, Atal Ranking Institutions on Innovation Achievements (ARIIA), Know Your College, DigiLocker, The National Programme on Technology Enhanced Learning (NPTEL), OSCAR (Open Source Courseware Animatory Repository), ShodhGangotri (2011), Virtual Learning Environment, Text Transcription of Video Content, SOS tools, and e-PG Pathshala are the digital initiatives taken by

GOI in higher education (4).

These large number of initiatives promoted the use of ICT in all levels of education. ICTs in higher education are being used for developing course material, delivering and sharing content, communication between learners, teachers and the outside world, creation and delivery of presentation and lectures, academic research, administrative support, student enrolment etc. (Mondal A.,2012). The National Mission on Education through Information and Communication Technology (NMEICT) was launched in 2009 by Ministry of Human Resource Development (MHRD), Govt India, to strengthen the potential of ICT, in teaching and learning process for the benefit of all the learners in higher education Institutions in any time anywhere mode. It plans to focus on appropriate pedagogy for e-learning, providing facility of performing experiments through virtual laboratories, on-line testing and certification, on-line availability of teachers to guide and mentor learners, utilization of available Education Satellite (EduSAT) and Direct to Home platforms, training and empowerment of teachers to effectively use the new method of teaching learning etc. The introduction of open-source technologies has increased the attractiveness of virtual learning. It has reduced the fixed cost of investing in virtual technologies to stimulate or leverage their virtual learning mechanism significantly(6).

Digital transformation was already taking place in the higher education sector before Covid-19 hit, but the pandemic has speed up the process significantly. Today, mobile applications or virtual meeting platforms like Zoom, Google meet became the virtual meeting hubs. Educational institutions directed teachers to engage classes through online mode using the virtual meeting platforms like Zoom & Google meet is common practice employed by most of the institutions (Tari S.2021). New trends of digital technologies such as Internet of Things (IoT), Cloud computing, Blockchain Technology, Big Data, Artificial Intelligence and Machine learning have become an integral part of daily activities in modern education. With the advancement in technology i.e. Internet of Things, universities can resolve many challenges such as; keeping track of essential resources, develop access to information, build smarter plans, and design safer campuses. IoT systems have tremendous potential to bring significant values to higher education by engaging and motivating the students and staff, and to increase speed of learning (Aldowah H. et al.,2017).

The implementation of Block chain has gained momentum in India. In the direction to upgrade the education system using technology an educational institution named Saintgits Group of institutions, based in Kerala, is implementing a Blockchain-based scholarship processing program for its students. Another Kolkata-based Globsyn Business School (GBS) is using Blockchain to issue digital diplomas to the postgraduate students of its management programs. Using the platform, students can gain access to their certificates digitally (7). Recognizing the reality of digital transformation, the government has taken a step in the right direction. Union Budget 2021-22 has greatly highlighted the strengthening of the country's digital infrastructure for education by announcing the setting up of a National Digital Educational Architecture. The "Digital First" approach of the government to facilitate the entire gamut of educational activities will provide multifarious education eco-system architecture for expansion of digital infrastructure, and help make the education sector future-ready. It is expected that the government will increase the annual budget of education from the present 4.6 percent to 6 percent of GDP, and gradually hike it further, to create an ecosystem for research and development infrastructure in the education sector. (10). Budget 2021-22 allocated ₹93,224.31 crore to the Ministry of Education. It was an increase of over ₹8,100 crore from the revised estimates for the current fiscal and the Department of Higher Education was allocated ₹38,350.65 crore(11). In the most challenging phase of Covid-19 to migrate themselves easily into the digitally changed platform higher education institutes tied up with

the Edutech firms. Edtech firm is key stakeholder in Higher education system as with its own uniqueness worked on different strategies during COVID-19 to tackle and understand the changing market also to provide services and solutions to investors, academic institutions, the Government and of course the consumers i.e. the teachers and student community.

2. POST PANDEMIC COVID-19 DIGITIZATION SCENARIO

The COVID-19 pandemic had a severe impact on educational institutes worldwide. The closure of schools, colleges, universities and other higher-education institutes (HEIs) has affected millions of students. Despite apprehensions about online course delivery, institutions have adopted technology and digital methods to enable students to adjust to the new learning environment (PwC Survey 2021). They are shifting towards not only online delivery of learning materials and courses but also looking to digitally transform the education sector. There was a significant effect of pandemic on learning methods as well as students' perceptions towards the learning methods used. The prevalent methods of classroom learning and blended e-learning methods were replaced by web-assisted method of e-learning under the lockdown to contain the COVID 19 spread (Sharma A.et al.2021).

The HEIs have started conducting orientation programs, induction meetings and counseling classes with the help of different e-conferencing tools like Google Meet, Skype, Youtube live, Facebook live, WebEx etc. to provide support services to the students (Jena P.K.2020).Víctor J et al. (2021) revealed that the use of a plethora of technological tools and platforms to support online learning: web-based learning platforms, video-conferencing tools, Massive Open Online Courses (MOOCs), streaming conferences, instant messaging tools, and educational apps, among others, to support new methodologies to enable learning processes. This has given more flexibility to student then the traditional model of in-class learning and rigid traditionally curriculum structure. Nowadays, the advancement of web based technology is to develop the powerful software system such as LMS that is to enhance learning in a variety of environments. LMS is based on the principle of e-learning platform ultimately aim to effectively accomplish the instruction which could be optimized for supporting important instructional activities such as instructional management, interaction, evaluation and information guidance. Use of Video-Assisted Learning allow students to watch lectures at any time instead of real-time class. Although this medium was used before mass e-learning was needed, it was updated to suit modern needs because of the pandemic.

Recently, block chain technology is used to keep the record of student credentials, certificates and also to eliminate the need to verify degrees and other academic papers. Block chain ensures honesty and transparency in academic qualifications. Block chain technology can also address issues like plagiarism by storing all data on a block chain platform, which makes it almost impossible to modify any data without permission. In this way, block chain is laying the foundation for a transparent and better future. Growing Big Data Special techniques need to be applied to identify beneficial knowledge hidden within the collected data. This data can demonstrate the results of adopted techniques and allow educators to alter their curriculum and measure students' performance. Educational techniques and methods can be measured against students' performance, empowering teachers to see which methods are most effective. One of the main applications is use of Artificial Intelligence (AI) in education technology. AI is the automation of activities like grading as it can grade multiple choice questions and fill in the blanks without the assistance of an educator. It reduces mundane activity time of teachers and enables them to focus on other more important tasks. Another issue AI solves is the need for individualized attention in

an overcrowded classroom. AI can fill this gap by providing personalized tutoring to the students in need. AI programs can also create individualized learning tracks for every student and allow them to learn at their pace.

While all this sounds very attractive, technically reaching out to students in remote locations was not as easy as it sounded. Three relevant stakeholders, namely, academicians, technicians and students, had working in tandem to experience and utilize the transition. Students faced specific problems like connectivity and video issues due to the remoteness of their location and could not compromise the quantum of time required for machine learning (Mishra L.et al 2020). Educational institutes have analyzed the market trends in technology adoption and are using new-age technologies such as internet of things (IoT), artificial intelligence (AI) and data analytics. It is interesting to note that unconventional and technology led courses have become popular amongst both students and faculty members who are eagerly adapting to and building on this digital trend (PwC survey 2021). The pandemic has affected examination and admission processes, thereby making it difficult for students to get into HEIs. All HEIs are not equipped with digital infrastructure that enables them to conduct large-scale online admission tests. HEIs have started adopting new strategies like digital promotion and online examinations to continue imparting education during the pandemic. They are also engaging in digital promotion of the courses they offer.

3. TECHNICAL INFRASTRUCTURE

In order to make Indian higher education system self-reliant and globally competitive it is need of an hour to incorporate the emerging innovative technology trends in Indian higher education.Greenway,et.al., (2018) found that although the most important component reflected on the students in digital transformations in educational organizations is digital content, there will inevitably be transformations in hardware and software infrastructures when necessary. However, as in all organizations, two of the most significant difficulties experienced in the digital transformation process are financial impossibilities and people's resistance to embrace the technology.

Higher education institutions have been inundated by various infrastructures and platforms keeping in mind only its stakeholders. They have invested in dispersed systems, beacons, Bluetooth technologies, Wi-Fi, sensors, smart classrooms, and large ERP/SIS platforms that play a role with students, faculty, staff, and others who arrive on campus. Imagine if these technologies communicated in a manner that seamlessly initiated positive outcomes through intuitive and intelligent interactions (Deloite 2019). As campuses address the needs of their students, they may incorporate a smart campus strategy that will foster efficient practices. As part of developing a smart campus strategy, colleges and universities should move away from their focus on transactional process redesign and focus on leading practices and respective outcomes that will differentiate them from their peers (Deloite 2019).

Use of ERP tools by higher education system during pandemic made it easier to teach remotely and manage educational institutions than before. ERP software connect teachers, students effectively, thereby enhance the communication between parents and institution. It helps to maintain continuity of educational processes thereby helping students, staffs and of course institutions. This software completely digitizes administrative process which leads to less paperwork.Due to the large volume of data, the application of Big data analytics is essential in Higher Education. Big Data Analytics offers several benefits that would empower the stakeholders to make informed decisions to progress. These BDA approaches are proven to be relatively effective in quality improvement process of education and

eventually contribute to produce highly skilled professionals.

Two new ICT technologies such as Internet-of-Things and Cloud computing that are being increasingly implemented in the process of digital transformation in higher education. IoT has a great potential in eliminating all the barriers to education viz. language, geography, location and economic development. The amalgamation of education and technology leads to quicker and modest learnings, increased levels of knowledge and quality of students. IoT in higher education can provide classic functions used in any field associated with surveillance and control of various devices ensuring work conditions and operation. There is even mention of measuring brain waves in order to monitor the students‟ cognitive activities during the classes. Another interesting class of IoT devices is that of virtual reality headsets, augmented reality headsets and adaptive learning systems.

Cloud computing has significant potential improvements in IT applications and IT infrastructure in higher education institutions. It is advisable to the HEI's IT Management teams to pursue the right approach in commensurate with the strategic directions of the HEI. The future holds the capacity of producing technologies designed explicitly for teaching & learning by linking Artificial Intelligence with the developments in the domain of robotics and liberal use of sensor devices to monitor the surroundings and actions. Embracing Artificial Intelligence into smart classrooms would lead to generation of vast real time data from sensors and this would result in development of newer models learners' behavior in the broader environment of the classroom. The e-Learning systems are open, distributed and interconnected. Thus, the Cyber Security is a unique challenge as thousands of users access many systems through hundreds of networks in order to ensure that only authorized users will have access to the right information at the appropriate time and protect from cyber-attacks (Varma R.B.R.et al. 2021).

New Education Policy-2020 suggests the setting up of a National Educational Technology Forum (NETF) to provide a platform for the free exchange of ideas on the use of technology to enhance learning, assessment, planning, administration.

Through the NETF, new technologies like artificial intelligence, block chain, machine learning, smart boards, computing devices, adoptive computer testing for student development and other forms of educational software and hardware will be integrated into all levels of education to improve classroom process, support teachers' professional development, enhance educational access for disadvantaged groups and streamline educational planning, administration and management. NETF will also facilitate decision-making on the induction, deployment and use of such technologies by providing educational institutions, governments and other stakeholders the latest knowledge to consult and share the best practices, the draft said. The learning management system has become a vital aspect of every educational institutional. LMS also allows students to view multimedia lectures, communicate with their teachers and each other's in teaching the communities, download course material, take online quizzes and submit homework and assignment (Aini Zuriyati Abdul Kadir*and Nur Sukinah Aziz ,2016).
A digital campus is the need of an hour. According to Coursera's Gupta, the vast majority – about 70 per cent – of students using Coursera for Campus are accessing content on a mobile device. "We have to think of a digital campus, as well as the digital gadget at the remote point," said Dr K. S. Dasgupta, Director of the Dhirubhai Ambani Institute of Information and Communication Technology in Gujarat. According to Survey (2020) conducted by PwC As educational institutions continue to assess and

reassess their digital maturity, augmented reality (AR) and virtual reality (VR) based virtual laboratories, e-libraries and interactive e-learning platforms with multimedia-based content are becoming the new essential accessories for learning management systems (LMSs).

4. ADVANTAGES OF ONLINE LEARNING

Online learning became the default since 2020, but the approach most colleges have employed is simple "remote learning" via live Zoom classes, a method little evolved from video conferencing from the late-1990s. However, in the multi-billion-dollar market for fully online courses and degrees, a variety of powerful new platforms and technologies have emerged, grounded in cloud computing, enormous datasets, and artificial intelligence. MOOC platforms such as Coursera and EdX leverage data from tens of millions of learners and billions of course data points, using machine learning to automatically grade assignments and deliver adaptive content and assessments.

Machine learning, SMS messaging, and AI are also having a growing impact in optimizing student services and support. Like commercial businesses, many universities are beginning to deploy blended and fully AI-based chatbots to support students and answer questions —integrating with their learning management systems, enabling blended use cases that empower student service personnel with data, or using pattern recognition to help students navigate key admissions, enrollment and course deadlines. These approaches are also extending into digitizing campus services. More generally, many universities are investing in predictive analytics, enabled by the data generated by learning activity that takes place online. Although trend is not common in India, many Universities abroad are having B2B arrangements for offering credits to the students.

India has now emerged as the second biggest market for massive open online course (MOOC) in the world after the US.

Online learning environments allow for learning to occur in a setting that is not restricted by place or time (Gilbert, B., 2015). Majority of the students evinced a positive attitude towards online classes in the wake of pandemic. The online learning was found to be advantageous as it provided flexibility and convenience for the learners (T. Muthuprasad et.al 2021). Online learning is an effective tool to transfer knowledge and it has the potential for overtaking the conventional teaching method. One of the most dominant characteristics of Online learning is that it ensures ease of communication between teachers and students, and contributes in developing students' skills. It further contributes in providing scientific material to students in an interesting manner. Students prefer to use e-learning since it provides chances to enhance their learning and increase their abilities (Appanna S.,2008). Online learning offers an excellent way for students to broaden their educational opportunities and stay competitive in the ever demanding realm of education. Students embarking on the path of higher education through online coursework need to be self-motivated, independent, and responsible learners. Online learning environments allow for learning to occur in a setting that is not restricted by place or time. Online learning has the ability to disassemble barriers that have been constructed by poverty, location, disability, as well as other factors (Gilbert, B., 2015).

Online teaching tools offers significant benefits such as recording the classes/sessions, sharing voice/text messages, software's are available for both recording and editing audios, a tool for creating online spoken assignments (using images and videos), providing feedback to students, and so on. However, trial run version software's are limited to five voice threads such as the file once created cannot be deleted, zooming and other multi-rich presentations for content delivery options are not available, platform for creating websites, blogs and e-portfolios using drag-and-drop method (Naik, G. L., Deshpande, M., Shivananda, D. C., Ajey, C. P., & Manjunath Patel, G. C., 2021). For teachers, online

classes allow new method of teaching with access of advanced tools and technology involved in it and can reach to many students (Appana, 2020). Contrary, student can acquire knowledge of using different online tools and methods, pay much attention to recorded/live conversations of world class professionals, listen and watch classes many times and working at their own promptness (Arkorful & Abaidoo, 2015). The obvious advantages of online programs to the university include increasing enrollments and profits, extending university reach, increasing student technological skills, mitigating the projected shortfall in instructors, eliminating overcrowding of classrooms, reducing infrastructure cost, allowing students to work at their own pace and learning style, reducing faculty bias, and improving retention and graduation rates (Popovich & Neel, 2005).

6. SUMMARY

Covid-19 has accelerated adoption of digital technologies to deliver education. It encouraged all teachers and students to become more technology savvy. Any of these stakeholders reporting of adopting a proactive stance towards design and digital technology; starting to innovate and design better tools to meet the needs of digitalized basic education (N.liwari et al.2020). To successfully integrate ICT into the learning process, it is crucial to apply the systems thinking perspective to our studying and understanding of the classroom and the university as a whole. (Diana Kozlova, Marcel Pikhart,2021). In support with latest trends like ERP tools, IoT, Artificial intelligence and ICT, Block chain implementation in higher education will act as a catalyst to upgrade the existing crippled education system. The upcoming years won't be the same for educational institutions as it was used to be. Therefore, it is very important for educational institutions to upgrade and prepare themselves for future.

Block-chain based digital certificates to maintain the integrity of the education process is yet another useful application (Saxena A.et al.2020). Robust infrastructure where both digital and physical platforms play equally important roles would be the need of the hour in the new normal (PwC survey 2021). Considering that digitization of education remains one of the key areas of interest in India, overall, the government is vigorously working to make India a preferred destination for investment in infrastructure, digital technology, finance and biotechnology. Furthermore, being cost-effective helps the edtech industry to sustain the infrastructure and maintain a healthy system of education. Technology Enhanced Learning is set to influence modern education in India (10). It is a need of an hour to create and support a robust education system as India will have the highest youth population in the coming years and investing in digital infrastructure will also assist in achieving the country's commitment to the 2030 Sustainable Development Goal objectives, one of which guarantees quality education to all whilst facilitating the growth of an equitable and educated culture (10).

According to KPMG India and Google, the major drivers for online/blended education in India include (a) phenomenal growth in Internet and smartphone penetration (b) low cost of online education (c) digital-friendly government policies; and (d) escalating demand by working professionals and job-seekers for continuing education (Bansal, 2017). India was about 20 years behind the developed nation in introducing technologies (ICT) in public schools. Pre-pandemic, there was already widespread acknowledgment that the readitional education business model is seriously challenged. Acceleration towards technology driven world require new digital learning standards and infrastructure as well as regulation that is attentive to quality assurance encourages need for innovation digital campuses.
The digital-age education system calls for personalized and dynamic methods of learning, a better-equipped faculty, new parameters to gauge student and faculty performance, and innovative models of

funding. A broader and a more collaborative coalition among educational institutes, employers, students, professionals, regulators, and government entities can help bridge the existing gaps and drive reforms in the Indian higher education sector (Deloite 2020). In India, despite high political appreciation for technology and infrastructural development, the digital divide to access and availability of resources and content among government teachers and students exist. The distinct digital inequalities influenced by specific physical and cultural factors have established different educational technology pathways for the country. To overcome the vulnerabilities suffered by economically poor communities due to social inequalities and digital divide there is need to amalgamate higher education strategies by developing sound model for partnership among different institutions or universities. Adequate planning and implementation of best practices and innovative strategies is necessary for a university to successfully introduce and/or expand online education to surpass the barriers faced by various stakeholders.

Overall, study conclude as an optimistic scenario for Indian Higher Education as regards to Digital Transformation and there will be huge adoption of technology in education system in near future that will take India up on the global map.

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Rechargeable Electrical Energy Storage System Development for an Electrical vehicle Retro fitment kit

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Abstract: *- Lithium ion battery has emerged as the most preferred electrical energy storage device not only in handheld gadgets & portable consumer appliances but also for electrical vehicles. The cost and performance of electrical vehicles are strongly affected due to rechargeable Electrical Energy Storage System, appropriate selection of cell chemistry, type of cells & their arrangement made inside the battery. This paper is an outcome of a battery related literature review undertaken by author under an electrical vehicle conversion project. The paper moves on through six sections starting with rationale/ introduction, followed by quoting requirement of ideal rechargeable electrical energy storage system (REESS) and then comparative study of prevailing battery technologies also. Further it elaborates lithium ion battery technology as the technology of choice for REESS & describes steps in its (REESS) development. Authors conclude the paper with a case study of REESS development for an e-bicyle conversion and a discussion/ conclusion.*

Key Words: REESS, Battery chemistry, Battery technology, cell configuration, BMS, BTMS, Indian Driving Cycle (IDC), Energy consumption, Form factor, Battery pack

1. INTRODUCTION

Rechargeable Energy Storage System (RESS) has been, is and will remain an indispensible part of any motor vehicle for its' plying on roads [5]. Not only this but also an act of proper selection of an energy storage system minimizes individual and societal issues associated with use of a motor vehicles. Any Conventional motor vehicle contains a fuel tank as a rechargeable energy storage system in which chemical energy in a fuel is stored and the fuel is recharged after it exhausts. As a fuel tank appears empty we recharge it with a fuel at a fuel refilling station conveniently and either petrol, or diesel, or CNG, or LPG, or biodiesel, or ethanol, or methanol is recharged in fuel tank. If anyone studies reasons for a conventional vehicle for becoming popular means of transportation since the beginning of last century till recent past s/he gets answer in a kind of energy storage it avails in terms of fuel tank and fuel stored in it. It is a mass motorization that the world witnessed for over more than 100 years along with issues of uncontrolled proportion like energy depletion, environmental pollution, climate change and traffic accidents [1] for want of proper energy storage for an Electrical vehicle (EV).

The concern about environment pollution, rapid increase in fuel cost, depletion in fossil fuel reserves has been main motivation behind switching from traditional transportation to electrical transport. In a recent past under Paris Convention majority of nations in the world have agreed to reduce greenhouse gas emission to an extent that will restrict rise in global temperature in this century to 2^0C by submitting a document related to Intent of Nationally Determined Contribution (INDC) [2]. Vehicular pollution has been contributing substantially in continual rise of gases with high Global Worming Potential (GWP) in the earth atmosphere. Therefore switching to electrical mobility is the solution. However such switching, that appeared as cause of concern in the beginning of 20th century for want of proper battery, is demanding a lot of work in developing REESS [3] as convenient as that of conventional vehicles.

REESS requires a storage which gets recharged quickly and supply energy and power to an Energy Conversion System (ECS). The battery acts as a energy storage in this case and traditional batteries which are available to do so are with issues [3] of lower gravimetric and volumetric energy and power densities, more time they take for charging, less calendar life, more cost, memory effect etc. It is essential to deal with all these issues and develop REESS the way the energy storage system of conventional vehicle works. It will enable people to adopt electrical mobility wholeheartedly.

The following section explains requirement of ideal REESS which is guideline for achieving it.

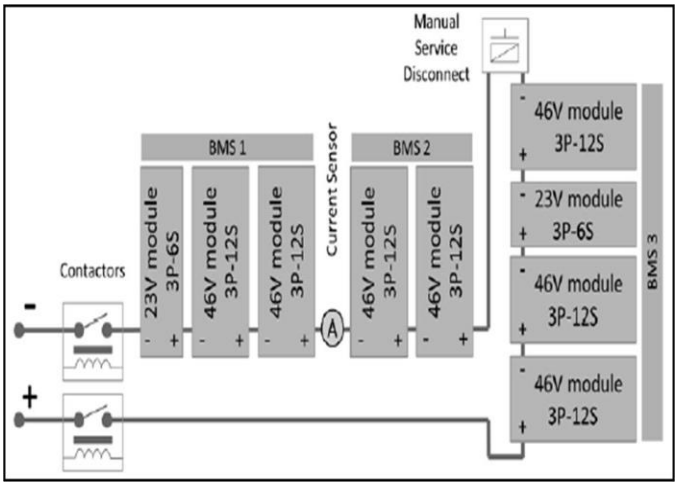

Fig.1 GM Chevrolet Volt Modular REESS - distributed BMS

Above fig 1 [4] shows the example of 368 V 288 cells 3P96S battery pack which contains 9 modules in which number cells are connected in series and parallel. Battery Management system used is distributed with a master and three slave BMS. There is one manual Service disconnect (MSD) and its output is given out through electromagnetic connectors.

2. REQUIREMENT OF AN IDEAL REESS FOR EVs

Electrical vehicles are zero emission vehicles (ZEV). They are quite in operation and by using them noise pollution of urban areas is also reduced. This is possible because of an electrical power train (EPT) that a part them. It is an electrical motor and a battery together which are subsystems of the EPT and are connected through a power controller. As no fuel burns in them and motor and battery are quite in operation hence both the pollutions are absent or are very small in EVs. These vehicles are known as battery electric vehicles (BEV) and a battery charging system (BCS) that connects a power grid with battery to charge it is equally important and a part of the EPT. REESS in a battery form is required to satisfy requirement explained below to be an ideal storage system [9]

2.1 Long life

In case of an electrical vehicle an Energy Storage System (ESS) is peculiar and different from a fuel tank as an energy storage system in ICE vehicles. Any storage system comprises of a container and energy stored in it. Here in the energy storage system for EVs a battery is a container and electrical energy is the energy to be stored while a fuel tank as an energy storage system has a fuel tank and petrol as a container and chemical energy in petrol as energy respectively. As we compare them we find that a capital expenditure (CAPEX) over a container part of REESS is more than that of RESS of ICE vehicles and an operation expenditure (OPEX) of REESS [17] is very small compared to that of filling petrol and adding chemical energy in the RESS of ICE vehicle. Therefore a battery as REESS, having cost almost 50% of EVs, should provide long life. It makes a battery vehicle affordable to people and helps in adoption EVs.

2.2 Less Cost

Making a motor vehicle affordable to a common person was found to be one of the important reasons for mass motorization of ICE vehicles. The same is valid today for EVs also and hence for achieving higher adoption. Even by offering [19] demand incentives on them Govt of India (GOI) is trying to increase adoption of EVs. Hence cost of REESS should be affordable to all.

2.3 High Energy and Power Density-

REESS should store more energy and power in small space and less mass. This enables us to keep its weight and volume small for given vehicle range and achieve better/ lower energy consumption in Wh/km.

2.4 High Voltage

A Power and Energy of any electrical storage increases with its voltage and current. So having high voltage makes every REESS powerful and energy rich at a given current capacity. Moreover more voltage is better for getting high torque in EVs

2.5 High Energy Efficiency

Energy efficiency is a measure of the extent of lost in a charging and discharging cycle. This loss should be least for REESS.

2.6 Good performance at extreme temperatures

REESS should work efficiently during wide temperature range as EVs are used not only at tropical zone but also in temperature zones and polar zones on either sides of the earth.

2.7 Minimum Self Discharge

There is a tendency in every battery to charge as and when it is kept for long time. REESS should have minimum self discharge for increasing its reliability

2.8 Good Safety

REESS experiences high charging & discharging cycles on the basis driving of a vehicle. Moreover they are high voltage systems. In case of discharging at higher rate a battery & a wire loom gets hot and some time start burning. REESS should be designed to take into account all these things.

2.8 Good Consistency

REESS should work consistently and supply current & power for proper, regular performance of a vehicle.

2.9 Easy to Assemble

Almost all batteries being used are getting assembled using cells to form a battery pack. It evolved many operations. An enclosure and lead are equally important.

2.10 Easy to Maintain

It should be easy to service & repair REESS to prevent breakdown and rectify faults. It should be serviceable a battery being costly item.

3. COMPARATIVE STUDY OF BATTERY CHEMISTRIES

As per Warner [2] batteries are either primary & Secondary based on whether are they chargeable or not. Primary batteries are not changeable but use once and throw type. Alkaline batteries used on house hold devices are of this type. However secondary batteries are rechargeable for number of times depending up on cycle life and they are important for use in REESS.

Depending upon chemistry of an anode and a cathode active material, electrolyte used and on the basis of popularity of Lithium batteries in all spheres of life, rechargeable batteries are classified into Non Lithium chemistry based and lithium chemistry based batteries. All these batteries are to be rated on the basis of the requirements stated in the section 2 for considering them in a REESS and rate/ grade batteries pack for a given automobile application. Table 1 shows comparison among various battery chemistries available till date

As per the details about each cell chemistry in a table 1[2]

3.1 Specific Energy & Energy Density

These properties convey about the extent of energy stored in mass and volume of a battery. As their value increases for given chemistry the battery size and mass for same energy capacity decreases than other having lower values. As per table the target values of PbA and NiMH are one third to half of the values of NMC and NMA. REESS need more energy to increase a range of EVs.

Hence it is not possible to build light weight and compact battery under Non lithium category of the battery due to their low specific energy and power and low energy and power densities. Better choice of battery chemistry to store more energy in a small volume and weight batteries are NMC and NMA

3.2 Specific Power and Power Density

These properties convey about the extent of power in Watt (W) stored in mass and volume of a battery. As their value increases for given chemistry the battery size and mass for same energy capacity decreases than other having lower values. As per table 1 their values for PbA and NiMH chemistries are very low compared to the values of LFP, NMC and NCA.

Hence it is not possible to build a light weight and compact battery using Non lithium category of the battery

due to their low specific energy and power and low energy and power densities. Better choice of a battery chemistry the one which store more energy in a small volume and weight and therefore batteries of choice are LFP, NMC and NCA

Table 1: Comparative study Battery Chemistries [2]

Battery chemistry	Chemical Description	Specific Energy Wh/kg	Energy density Wh/L	Specific power W/Kg	Power Density W/L	Cell voltage in V	Cycle life	Self dis-charge %month	Operat-ing temp. Range
1.Non lithium	Lead Acid (PbA)	**30-40**	**60-70**	**60-180**	**100**	**2**	**300-800**	**3-5**	-20 to +60
	Nickel Metal Hydride (NiMH)	**30-80**	**140-300**	**250-1000**	**400**	**1.2**	**500-1000**	**30**	-20 to +60
	Sodium Nickel chloride (NaNiCl)	100-120	160-190	150	-	2.6	1000	0	300-400
2. Lithium	Lithium Cobalt oxide (LCO)	120-150	250-450	600	1200-3000	**3.6-3.8**	>700	1-5	-20 to +60
	Lithium Manganese oxide (LMO)	105-120	250-265	1000	2000	**3.8**	<500	5	-20 to +60
	Lithium ferrous Phosphate (LFP)	80-130	220-250	**1400-2400**	**4500**	3.2-3.3	1000-2000	**<1**	-20 to +60
	Lithium Nickel Manganese Cobalt (NMC)	**140-180**	325	**500-3000**	**6500**	3.6-3.7	**1000-4000**	1	**-20 to +55**
	Lithium Nickel Manganese Aluminum (NMA)	80-220	**210-600**	1500-1900	**4000-5000**	3.6	>1000	2-10	-20 to +60

3.3 Voltage per Cell

The range of cell voltage among Non Lithium Batteries is from 1.2 to 2.6 while the same for lithium batteries is from 3.2 to 3.8. Hence it is possible to build a pack of requisite voltage using less number of cells of lithium category of batteries than those of Non lithium category.

3.4 Cycle Life

It measures number of charge – discharge cycle for which a given battery last from Beginning of Life (BOL) state to End of Life (EoL). There is vast difference between life cycles among two categories. Batteries of Non Lithium Chemistry type have their life cycles some times $1/10^{th}$ of those for certain Lithium chemistry batteries.

The lithium battery chemistry is with Max. Cycle life as per the table is NMC while battery with LTO anode chemistry, which is not a part of table, even has greater cycle life than NMC.

3.5 Self Discharge Percentage

It refers to tendency of battery to get discharged when it is stored on shelf or it is a part of a vehicle garaged for extended period of time. It creates inconvenience for Owner even some to replace battery i.e. REESS under such

circumstance. To avoid it is better to choose for a chemistry having very less self discharge percentage.

Self discharge percentage in lithium batteries is lower than NLBs and in case of LFP is further low for making its choice in case a use of the vehicle of that kind

3.6 Operating Range of Temperature

As per Warner [3] for a given battery there are three temperature ranges viz. survival, operational and optimal. They are derived out of a field and a plant testing experience of manufacturers. The survival temperature range conveys that it is not possible for a battery to survive if it works beyond while optimal one ideal range of temperature for safe working a battery. Practical use of a battery is done within operating temperature range for getting more from battery and within safe zone.

3.7 Maintenance

We can compare battery chemistries on the basis of cost per kWh of battery over period of time. Non Lithium battery like a Lead acid battery evolved over last 100 years and finally we have it as a maintenance free battery.

Comparatively Lithium chemistry based batteries require more maintenance and more costly than those of non lithium based chemistries

4. LITHIUM ION BATTERY TECHNOLOGY FOR REESS

Lithium ion battery Pack technology means a technology of cells as well a technology of pack. It is two tier technology which supports development of REESS not only for motor vehicles but also for other mobility solutions like aircrafts, ferries, rails etc. The cells as shown in are building blocks of a battery pack and a pack requires to follow systematic procedure to develop it into strong, reliable, light weight, compact energy storage system suitable REESS for EVs. Let us study cell level lithium ion battery technology in the beginning

4.1 Lithium ion Battery Cell as a Technology

Lithium ion cells as shows in **Fig 2** are similar in size and shape to normally use and throw primary cells like AA, AAA, type used in domestic appliances and portable gadgets. The shapes of these cells are cylindrical, prismatic and pouch and they are available in different sizes and capacities. The outer casing of these cells is of either metallic or plastic material, where metals used are steel or aluminum. There are many companies in their production and due to their extensive use in wide spheres they are produced in millions with Giga capacity. Table below shows details about cells

Table 2: Details about Lithium Ion Cell used in REESS

Sr. No	Cell form factor	Sizes	Leading companies	Application
1	Cylindrical	18650, 21650, 32650, 37650	LG Chem, Samsung, A123, BYD,	All models of Tesla
2	Prismatic	18 x 36 x 65	LG Chem, Samsung, A123, BYD,	Toyota Prius, Ford
3	Pouch-polymer	Tailor made	LG Chem, Samsung, A123, BYD,	GM Volt, Nissan Leaf

The cells of different shapes have voltage (V) as per their battery chemistry only but current capacity (Ah) varies with size and chemistry of cells. We get cell catalogue/data sheet from every cell manufacturer from which we get different values related to the cells they produce.

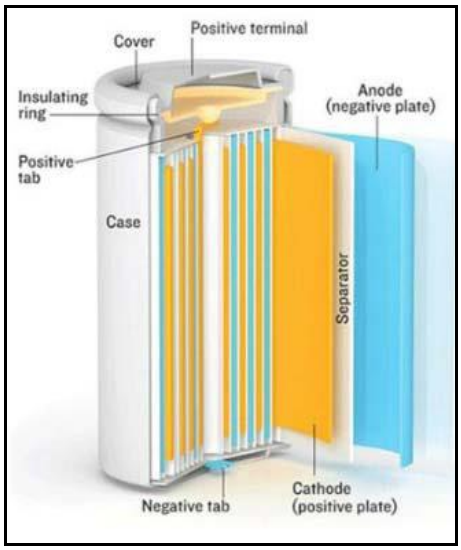

Fig. 2 Internal Structure of Cylindrical Li Ion Cell

Before we enter into discussion about pack technology let us get conversant with important key terms used in describing battery status. Following are some terms applicable for both cells and packs [3, 4]:-

4.1.1 Nominal/ peak Voltage – It is voltage of a cell in normal situation and when a cell is charged 100%

4.1.2 Nominal/ peak Capacity- It is measured in Ah or Wh and is a measure of amount of current/ energy in a cell/ a pack Nominal capacity is discharging at 1C rate

4.1.3 Energy- It is measured in watt hour (Wh) and is also called energy capacity of a battery which indicates an extent of power battery delivers over a period of time.

4.1.4 Power- It is measured in Watt and is nothing but rate of doing work

4.1.5 SOC- It is measure of the extent of energy and power left in battery at a given instant. As per battery use SOC changes from 90% to 10%. It is normally made available on dash board

4.1.6 SOH-It refers to current state of a cell with reference to state at the Beginning of Life (BOL) and how long it takes to reach End of Life (EOL) state

4.1.7 SOA-It is nothing but safe operating area or zone and it about extreme values of temperature, current and voltage within which a cell operates for a purpose and

4.1.8 DOD- It is a measure of discharge has occurred at the time of testing cell.SOC = 1-DOD

4.1.9 BOL- It refers to the battery energy, capacity, and power when it is first built or is at the beginning of its life

4.1.10 EOL-It is a state when battery energy and power reaches to 80% to that at BOL

4.1.11 C-rate- It conveys the way a cell or a pack discharges/ charges in a given situation. 1C rate means with that amount of current a battery charges or discharges battery takes 1 hour to get fully charged or fully discharged. Higher C-rate means fast charging/ discharging and lower C-rate means slow charging/ discharging

4.1.12 High Voltage (HV)- If a given system voltage is above certain value like 60 V then the system is termed as HV system and system voltages above that value are high voltages

4.1.13 Cycle- As a battery passes through a sequence of charging followed by discharging it completes a cycle

4.2 Lithium ion Battery Pack as a Technology

A battery pack is a system [3, 4] comprises interconnected subsystem. It is a cell assembly, a Battery Management System (BMS), a battery Thermal Management System (BTMS), a wiring loom with fuses, switches, circuit breakers and connectors and finally a casing that are put together to form a battery pack. Battery pack is nothing but a REESS that stores electrical energy in chemical form during charging and as it starts discharging the chemical energy stored is released back in the original form.

The pack as per S. Santhanagopalan et al [4] comprises of four systems viz. an electrochemical system, a Thermal system, a Mechanical system, and an Electronics and control system and hence there is a technology behind building every one of them. Let us start discussing them here:-

4.2.1 Electrochemical Technology

It is a technology of connecting cells together and finally connecting a whole cell cluster to a charger on one side to ECS on another. The battery pack is expected to provide energy and power to an EV and it should as per its (EV) requirements. In order to achieve this it is required to select a cell with proper chemistry and eventually of proper voltage and current capacity. Then the cells selected are to be arranged in series and parallel configuration/ topology as per the voltage and current capacity requirement of the pack.

By getting four things for a pack viz. voltage (Vp), energy (Ep) and cell voltage (Vc) and capacity (Ahc) it is possible to formulate the pack. Pack formulation is nothing but arrangement of cells in series and parallel called a pack configuration/ topology. Among them number of cells in series (nS) are calculated using nS = Vp/Vc relation and those in parallel (mP) are calculated following mP = Ahp/Ahc relation. Here Ahp is a current capacity of the pack for the calculating which we have a one more relation Ahp = Ep/Vp. There are two topologies viz. P before S and S before P

topology, which are used usually. In this way a pack is formulated out of number cells and we get that number by multiplying mP by nS. The connections among cells in parallel and series are carried out by either of the joining process [15] viz. spot welding, laser welding, soldering etc. The figure explains the way the cells are connected

Fig. 3 Cylindrical Cell Configuration with cell Holders

We get two terminals namely +ve and -ve at the pack level as per fig and they need to connect to a target load and a battery charge. For which there is arrangement of a wiring loom containing wires, connectors, switches and circuit breakers. It is required to choose all of them based on voltage and current rating of a target pack. Moreover there is a Battery Control Module [5,6] called BMS which plays a role of cell balancing, switching on and off the supply during charging as well as discharging.

4.2.2 Thermal Technology

This is a nothing but cooling and heating system for a battery pack the role of which is to maintain pack temperature within operation temperature range of cells and further observe inter-cells variation in temperature within a predefined limit [11]. It is done to avoid degradation of cells, thermal runaway, explosion and fire. During fast charging and severe discharging during acceleration and ascending grade as large amount of heat is generated the provision of cooling is made. In cold weather working of an EV pack cells loose effectiveness as well degrade due to lithium plating and avoid that there is a provision of heating of the pack. Therefore this system is known as BTMS and further it takes care of thermal management of a power control and an ECS i.e. motor which are parts of electric power train

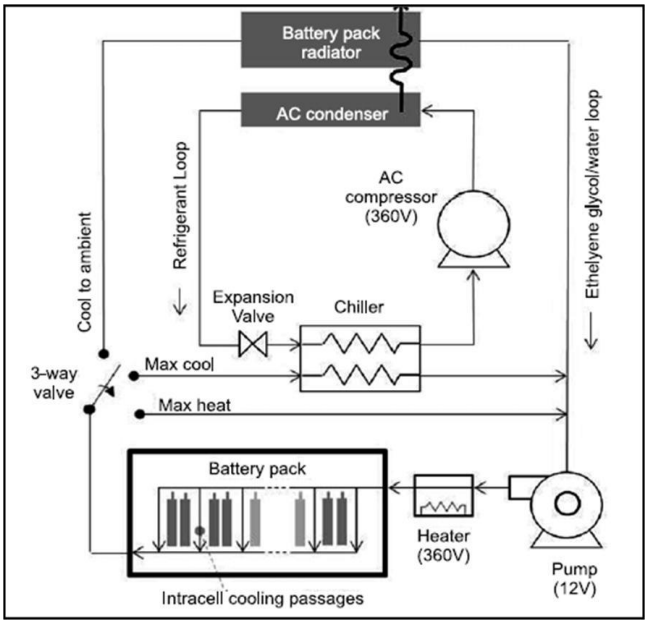

Fig 4 Active Battery Thermal management System

There are basically two thermal management systems (TMS), passive and active, that are used in EVs. Air, coolant, refrigerant and Phase Change Material (PCM) are used as per Fig to carry away or to bring heat from all entities either naturally or forcefully.

This system is vital for four wheeler and commercial vehicles that work in such a way that demand large amount of current in discharging and frequent super/ fast charging

4.2.3 Mechanical (PACKAGING) Technology

Provide a proper enclosure to a battery pack is equally important in mobility application in general and surface mobility in particular. While vehicle moves on road its each and every part is subjected to shock, vibrations and also crush and damage due an abusive conditions inside and outside and battery pack is equally prone to all of them. The casing also plays a role of providing channel to BTMS. Moreover it is required to avoid in grassing of dust, water etc inside to avoid short circuit and pre-mature failure of certain parts

Hence mechanical technology of case strength design, damping vibration etc used

4.2.4 Electronics and Control Technology

Any system in modern motor vehicles, being mechatronics based, never completes without sensing parameters, communicating them and plant control. As every battery pack needs to support achieving more range and battery life on one side and safety on the other and as they are conflicting conditions it is essential for it to operate in close loop. It is required to measure rate of charging and discharging current and voltage, temperature of cells, modules and packs, State of Charge/ health (Sox) and depth of discharge (DOD) at cell and battery pack levels, communicate them for a display and processing within battery or to vehicle control systems and energize and de-energize relays and switches via controller to control battery pack functioning. BMS with varied functionality plays important role in this system

This is a vital technology for battery pack.

5. DEVELOPMENT OF REESS FOR A TARGET VEHICLE

Development of a REESS, as per [4,7] that takes place following steps discussed below: -

5.1 Identification Energy and Power at BOL of REESS

In order to develop a REESS for a given vehicle it is essential to identify vehicle energy and power requirements. The range expectation from a target vehicle and its energy requirement for plying a kilometer distance are two things are needed to arrive at its energy requirement. To identify an energy the vehicle consumes during its 1 km travel we have to take in to account vehicle dynamics and driving cycle of that vehicle. There are driving cycles available for testing vehicles and same can be used in this activity. Under vehicle dynamics we calculate four forces viz. Aerodynamic drag, Rolling resistance, Gradient resistance/ climbing force and force for accelerating to which vehicle is subjected. The details are given below: -

Table 3: Formulae for Vehicle Dynamics

S. No	Force	Formula
1	Aero-dynamic Drag	½*Cd*Af*ρa*(Vv+Va)^2 Cd– Co-eff. of drag Af- frontal area of vehicle ρa – air density Vv –Vehicle velocity Va- Air velocity
2	Rolling Resistance	Cr*m*g*cosΘ Cr– co-eff. of rolling resistance m- mass of vehicle g-gravity acceleration Θ- Road gradient
3	Climbing Force	m*g*sinΘ Usual notation
4	Force for acceleration	M*a a vehicle acceleration

The values of all the vehicle parameter are used in a spreadsheet prepared on the basis of a driving cycle applicable to the target vehicle. In our country following driving cycles are used

i. Indian Driving Cycle – 2W and 3W
ii. Modified Indian Driving cycle 4W

In this exercise we get energy over a cycle with distance covered under different conditions of vehicle operation viz. moving on a leveled road, ascending or descending grade and accelerating at a given value. Considering appropriate condition we can calculate peak, average, and RMS value of energy required. Considering the discharge of battery to take place between 90% and 10% SOC and efficiency of drive train of vehicle as 95% we are required to arrive at Beginning of Life energy. This takes into account the extent of energy vehicle shall get at End of Life (EOL) stage.

5.2 Selection of Battery Cells and Cell Topology

The selection of a cell is done as per a nature of vehicle, its duty cycle, life of a battery expected, range etc. The vehicles are classified as follows: -

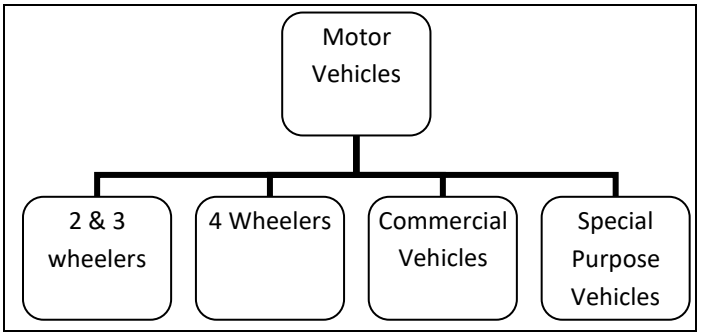

Fig. 5 Classification of Motor vehicles

Even we have to into account a kind of electrical vehicles [4] viz. Micro, p-assist, HEV, PHEV or BEV into which the vehicle is getting convert while deciding cell. We have also take in consideration cost, cycle life, operating temperature range, maintenance cost per kWh of a battery, etc in deciding whether to go for Spinel, olivine, or layered transition metal oxide cathode cell and graphite or lithium titanate as anode. This exercise is very important and one is expected to take more time.

Once chemistry of cell is selected we have to decide on the basis of energy, power, voltage and current requirement form of a cell which has bearing on all succeeding development activities. Then a cell manufacturer is decided based on availability of form and current capacity and also the need of the pack. The branded cells [3, 5] give consistent performance but are costly while many non standard cell manufacturers give cell with less cost but with less assurance of getting desired performance. One has to exercise trade off in this act. We get data of sheet along with the cell which is of great help in identification cell topology of a battery pack. Here we get nominal, peak, minimum values of cell parameters using which we can decide mPnS configuration.

Finally entire cell cluster is required to arrange in series and parallel topology using proper cell holders and the cells are to be connected to each other using bus bar, nickel strips, wires using joining technologies like spot welding, lacer welding, mechanical fasters, soldering etc.

5.3 Selection of BMS and BTMS

Battery Management System (BMS) is an indispensible for proper functioning of lithium ion battery pack. BMS is a brain behind entire functioning. So its selection is important. In case of small battery pack one can go for centralized topology of BMS while for large battery where more control at cell level is vital and is not possible in earlier topology one should go for distributed on with master and slave BMS

5.4 Selection of pack casing

There is no standardization in battery shape and batteries are developed on the basis of space availability in vehicle. The kind of battery decides shape of casing and they are made out of stamped steel sheets, aluminum, fiber glass, plastic, composite material. The sealing standards need to be considered

5.5 Selection of wiring loom along with its entire element

Loom of a battery comprise of a main contractor, a pre-charge contactor, a high-voltage interlock loop (HVIL), a Manual Service disconnect (MSD), fuses, bus bars, cell interconnect boards, and low- and high-voltage wiring harness. They should be selected based on the type of system, a system having voltage equal or above are High voltage and those having voltage less than 60V are low voltage system. This entire assembly is called as High Voltage front End (HVFE)

5.6 Fabrication of REESS.

Fabrication of REESS required following equipment and machines [8]

i. Spot welding machine for LIB pack
ii. Nickel strip cutter
iii. Solder gun
iv. Cell holders
v. Cell tester
vi. Heat Gun
vii. Multimeter
viii. General tools

Material required

i. Lithium ion battery cells
ii. Nickel strip
iii. BMS with wire plug
iv. Electrical wire of proper current capacity
v. Heat sink
vi. Solder and wax
vii. Hot glue
viii. Cleaning oil, cloth and cotton waste

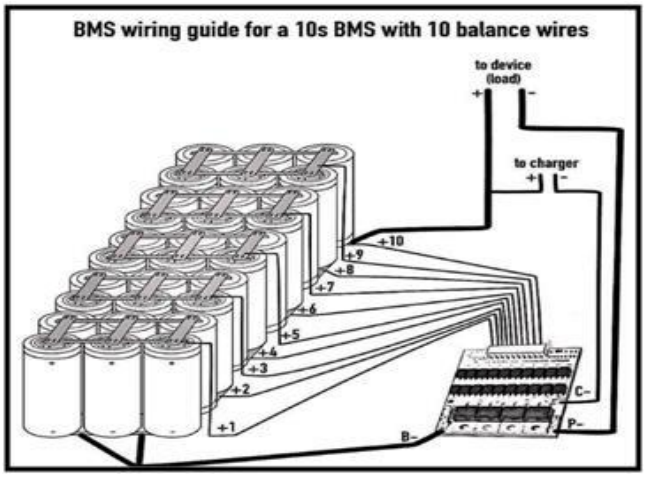

Fig.6 Electrochemical System of REESS

5.7 Procedure

i. Matching cells – for SOC using a cell tester and if required charging cell for reaching required voltage

ii. Cell alignment and containment- using Cell holder as shown in Fig. 3

iii. Connecting BMS –Connecting charge and discharge wires, Connecting the balance wires as shown in fig. 6

iv. Performing final quality and performance check- for getting voltage current and continuity along cell using multimeter

v. Sealing the battery- Heat shrink, hard case etc

6. A CASE – Development of REESS for E-BICYCLE CYCLE RETRO FITMENT KIT

Let me put before you a case of developing REESS for retro kit to convert normal bicycle into e-bicycle. A bicycle is a manually operated vehicle which is considered as a mother of all motor vehicles. As per Eckermann [2] G. Daimler and V. Maybach, pioneers of automobile industry converted wooden bicycle into their first motorcycle by mounting Grandfathers' clock engine. Many e-bicycle and retro fitment kit are available in market. This is an attempt to optimize a battery pack for a Bicycle.

6.1 Identification of Energy Requirement

Considering battery data as follows and using vehicle dynamics we can calculate energy requirement

Table 4 Details of Bicycle		
Sr. No	Description	Value
1	Mass of Rider (Mr) in kg	68
2	Mass of bicycle (Mb) in Kg	7.5
3	Range to be achieved	50
4	Max. Bicycle Speed in Kmph	25
5	Average wind speed Kmph	05
6	Gradability in Θ	10
7	Air density in kg/m3	1.225
8	Coefficient drag (Cd)x Frontal area of Bicycle (Af)	0.321
9	Coefficient of Rolling resistance(Cr)	0.008

As per formulae given under values of forces acting on bicycle are as under

Table 5 Forces acting of Bicycle		
Sr. No	force	Value
1	Aerodynamic drag (Ra) in N	13.6525
2	Rolling resistance (Rr)	5.925
3	Climbing Force (Rg)	128.613
4	Total Resistive force to be overcome by bicycle rider (Rt)	148.19 N
5	Power required (Rt) in W	1036.45

As a bicycle doesn't have any driving cycle the energy requirement of bicycle is calculated empirically considering energy consumption of bicycle as 15Wh/km. Hence energy requirement of battery is 50x15 = 750 Wh. By considering energy will be used from 90% to 10% of battery SOC for getting more cycle life and less degradation of REESS.

Calculated EBol = 0.9868 kWh = 1000kWh. Summary about bicycle is as follows

i. Power requirement (W) 1036.45
ii. Energy requirement (Wh) 1000.00
iii. System Voltage (V) 36 V
iv. Nominal Voltage of battery (V) 36 V
v. Current Capacity of battery 27.78

6.2 Selection of Cells and Cell Topology

Among cell chemistries suitable for mobility viz. LFP, NMC and NCA Lithium ferrous Phosphate cell is selected based on considerations given below:-

i. Less cost
ii. More cycle life
iii. High specific power and power density
iv. Available in appropriate form factor
v. Supplier of Indian origin
vi. Energy efficiency
vii. With proper C-rate

Manufacturer of cell chosen is of Indian origin SCION Energy [18] with data sheet of cell as below: -

Table 6: Data sheet of a cylindrical Cell

Sr. No	Cell Details	Specification	Figures
1	Manufacturer	SCION Energy	
2	Cell Chemistry	LiFeO4	
3	Form factor	Cylindrical 326500	Φ32 mm L 65
4	Nominal Voltage	3.2 V	
5	Current Capacity	5000 mAh	5 Ah

Hence the pack topology that needs to satisfy energy and power requirements of battery pack can be calculated as

i. No of cells in parallel (m) (Ahp/Ahc) = 27.78/5 = 5.556 ~ 6

ii. No of cell in series (n) (Vp/Vc) = 36/3.2 = 11.25~ 12

iii. Need of Pack Configuration = 6P12S

iv. No of cells required = 72

6.3 BMS and BTMS Selection

Based on cell chemistry and the calculated pack configuration it requires LFP 12 S 35 Ah BMS from standard make. The details available of BMS manufactures are available on net. This BMS will have 13 balancing leads and it can support peak discharging current of 35Ah. It will take care of charging, discharging, and temperature rise in pack

As the bicycle system is low voltage (<60V) and chances of high heat generation are very rare passive Battery Thermal Management system is more than enough to this pack. The battery can dissipate heat in environment using convective mode of transfer.

6.4 Battery Pack Case

Heat shrink of proper quality is used to wrap the cells and BMS inside and then that pack will be inserted in plastic container of appropriate shape and size. The outer case is such that the same can be mounted on a down tube of a target bicycle and should be able to fix quickly.

7. CONCLUSION

A good REESS achieves many things in performance of any Electrical vehicle and also it is cause of concern in case not properly developed. It degrades and experiences thermal away, explosion and fire if it is abused due to high rate of discharge. Hence it is very important and sensitive system not only in producing a new EV but also in converting an ICE vehicle into an EV. It is a technology in itself and is new as compared to traditional battery technology used in PbA battery. Hence the effort to disseminate to information this paper is prepared

ACKNOWLEDGEMENT

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BIOGRAPHIES

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Analytical Assessment of Blended Fuels for Pulse Detonation Engine Performance

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ABSTRACT

A pulse detonation engine (PDE) is possible to be a next-generation high-performance propulsion system in aerospace-related applications. To generate power or thrust, PDE uses repeated detonations. The current study evaluates the PDE performance with alternative and blended fuels in the Zeldovich–von Neumann–Doring (ZND) model. Parameters such as temperature ratio, pressure ratio, detonation velocity, and specific impulse were determined analytically for the fuels. The computed detonation parameters and specific impulse were compared with those available in NASA's open-source program, Chemical Equilibrium with Applications (CEA), to ensure the results' sufficient validity. It was found that the highest specific impulse was achieved with hydrogen at an equivalence ratio of 1. Analytical values of all the parameters were in an acceptable range as defined by NASA CEA. As compared to pure butane and propane, their blends yielded higher values (1 to 10 percent) of specific impulse. Propane and butane are safe, non-toxic, clean-burning fuels, great energy sources, and can be used as alternative fuels in PDE.

1. Introduction

Nowadays, major environmental issues include pollution from the automobile and aerospace industries, waste disposal, global warming, and deforestation [1]. The world's fuel demand and consumption have been drastically increased due to rapid technological and industrial developments [2]. Alternative and renewable energy sources are unquestionably needed as soon as possible. Commercial airliner jets have shifted their goals to using fuels that are either entirely different from traditional fossil fuels or are mixed with efficiency enhancing substances [3,4].

Such alternative fuels offer a future eco-friendly cleaner utilization with much less dependency on crude oil. Using biofuels reduces emissions significantly [5]. Turbofan, ramjet, and turbine engines used in aircraft are built on deflagration and are employed in quite optimized forms today. The

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defence and industrial sectors are likely to see the biggest growth in demand for unmanned surface vehicles [6]. Further improvement in efficiency is difficult to achieve in deflagration-based engines [7]. A combustion system is one in which fuels are burnt in a chamber [8]. Pressure-gain combustion (PGC) is an alternative approach to traditional combustion in a gas turbine [9]. PGC can be used in detonation engines to eliminate problems associated with deflagration-based engines. In detonation, combustion occurs at supersonic speed. The pressure rises across a detonation front as the specific volume declines [10].

In Europe, a wave rotor is also called a dynamic pressure exchanger [11]. Four-port gas turbine cycle wave rotors are shown in Figure 1. According to the flow path shown in Figure 1, two dissimilar fluids can interchange energy through direct contact and axial displacement. This is because when two gases with different pressures and temperatures come into contact for a brief period, their pressures are equal until they are combined by unstable wave mechanisms [12].

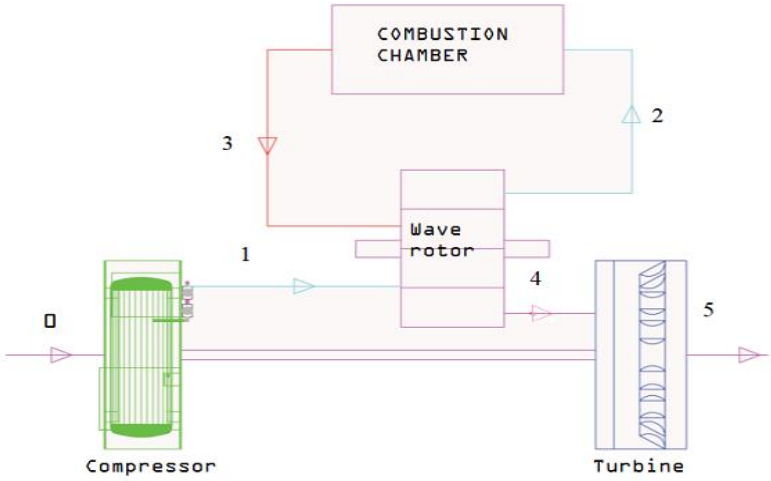

Fig. 1. Gas turbine cycle schematics using a four-port wave rotor

Thermodynamic pressure gain can be obtained practically in RDE [12]. Figure 2 shows that a typical, continuously rotating detonation wave (CRDW) is maintained around a cylindrical core in the annulus. CRDW runs circumferentially close to the head-end with a frequency that varies for a few to dozens of kHz, detonating the blends of fuel supplied through many micro-nozzles from the bottom of the combustion chamber. At high speed, the combusted gas will then be exhausted [13]. The gases that are produced are extended and leave the combustion chamber. The feed pressure is more than sufficient for new reactants to re-establish and flow into the combustion compartment, and subsequently, the detonation wave has passed. As soon as the detonation finishes a whole revolution, there essentially is adequate fresh fuel mixture to sustain the detonation wave.

The phenomenon of the pulse detonation engine is shown in Figure 3. During the filling process, the detonation chamber occupies a uniform mixture of fuel and air. The initiation of detonation starts, possibly at the chamber's closed-end. Behind the detonation wave, a high-pressure region is shaped. Blow down happens when the gases leave the detonation chamber, and work is done [14]. Pulsed detonation engines are an exciting novel propulsion technology that can be applied across subsonic, supersonic, and hypersonic flights [15]. Experiments and computational researchers have demonstrated using a simple PDE cycle to obtain competitive specific impulse values. As a result of these encouraging results, several PDE applications have been proposed. Several civil and military applications were investigated [16]. A pulsed detonation engine's first flight took place in January 2008 [17]. It was suggested that PDE could be used as cost-effective replacements for small gas turbine engines, as potential combustion replacements on existing large-scale gas turbines [18].

Among the engines that work in agreement with the Humphrey cycle is a pulse jet engine that was used during World War 2 for German flying bomb v-1 [19].

Hydrogen, ethylene, kerosene, or JET-A were the most common fuels for PDE until recently. The literature on selected fuels for PDE is limited. The novelty of our study is that this research focused on both pure and blended fuels. The blended fuel equation is first time tested analytically for the PDE, according to the author's literature review. So, this study aims to assess the thermodynamic properties of pulse detonation engines like pressure ratio, temperature ratio, and detonation velocity. Moreover, efforts have been made to determine the specific impulse for three pure fuels, namely hydrogen, propane, butane, and the blended fuels composed of butane, propane, and hydrogen, with a 50 percent contribution of each.

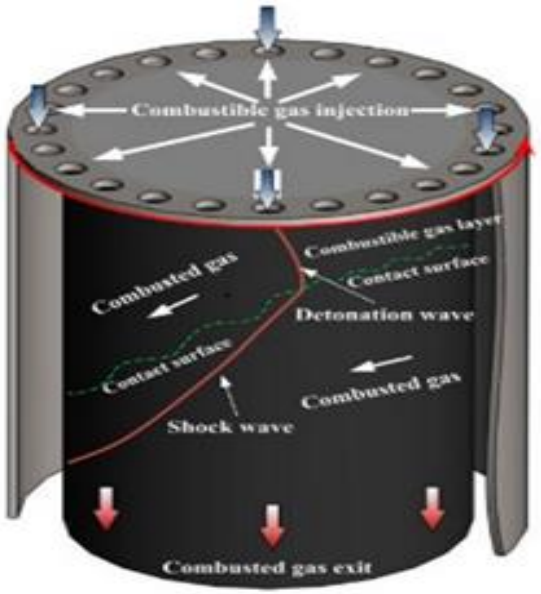

Fig. 2. A typical continuously rotating detonation wave [13]

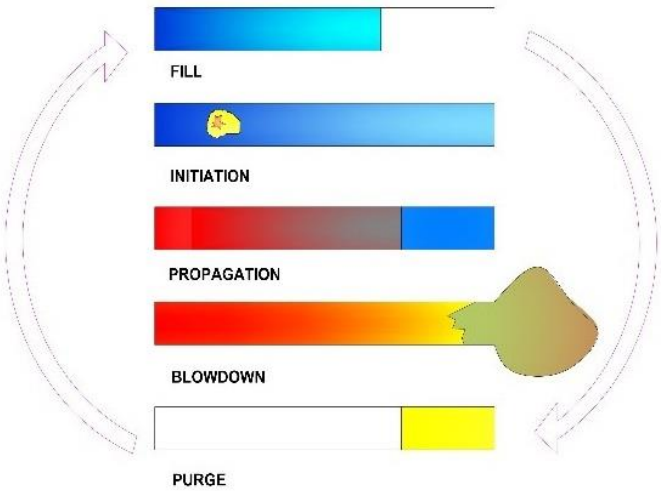

Fig. 3. The working process of the pulse detonation engine

Various studies have already been conducted to understand the pulse detonation engine. Kailasanath and Patnaik [20] idealized the solution to PDE's performance using one-dimensional, unstable numerical simulation. They discovered that lowering the pressure at the tube's exit to ambient levels is a crucial issue that affects the impulse. A higher specific impulse can be accomplished with a more gradual reduction. Mukesh and Rajan [21] found a need for a higher fuel-air blend supply in the detonation tube to sustain the PDE operation at a higher frequency. Thus, PDE is successfully operated at an equivalence ratio of 1, 1.39 for 1 and 2 Hz, respectively. The PDE has, therefore, proven to be better than other air respiratory engines. Azami *et al.,* [22] revealed that specific volume and Mach number ratios are significantly affected by the initial temperature effects. Meanwhile, differences in initial mass flux mainly impact the ratios of temperature & pressure. The observed difference in mass flux may result in considerable limitations on fluctuations in the initial pressure.

Hitch [23] observed that the PDE obtained specific impulses beyond those typically associated with ramjets operating in the same flight condition. Significant performance improvements can be achieved by adding a divergent exhaust nozzle to prevent severe losses from expansion. Wintenberger, Austin, Cooper, Jackson, and Shepherd [24] found that the particular impulse of a fixed composition is approximately independent of the initial pressure and temperature. Alam, Sharma, and Pandey [25] used two varieties of fuels to analyze the difference in shock propagation, flame temperature, and velocity. They concluded that deflagration to detonation (DDT) depends on the length of the flame. Also, in the ethylene-air mixture, the static pressure and flame velocity are higher than in the ethane-air blend.

Srikrishnan & Dash [26] inspected the reaction of blockage on deflagration transition to detonate at different input pressures. The stoichiometric kerosene-air mixture is used during the analysis. The computational fluid dynamics (CFD) analysis of 2D blockage flow transition to detonation concluded that blockage shape and position significantly impact output velocity. Detonation depends on input pressure and substantial turbulence. Furthermore, the chemical enthalpy and burning rate also further affected the formation of detonation waves. Researchers like Khan *et al.,* conducted several test on rocket and jets flow [27]. Peace and Lu [28] conducted a numerical assessment of the PDE. The addition of diverging conical nozzles was analyzed to increase the thrust and impulse. Moreover, the specific impulse increased and appeared to increase the nozzle expansion area ratio to the range of 2.25-2.5. It was also found that the propulsive efficiency improved by up to 21% by introducing diverging conical nozzles.

Kasahara, Hasegawa, Nemoto, and Yamaguchi [29] made a pulse detonation rocket called Todoroki and used a horizontal sliding check to validate the thrust measurement model. They reported that the stability of the PDE's operation relies on the ratio of the purge gas's thickness and the diameter of the tube. The model's expected thrust was within 4% of variation when compared to the experimental results. Harris *et al.,* [30] compared specific impulse (Isp) with ramjet over different flight Mach numbers. The results of all patterns were identical, demonstrating that the Isp from a PDE is greater than that of a ramjet for beneficial thrust levels over a broad range of Mach numbers.

Ma, Fuhua, Choi, and Yang [31] researched thrust chamber dynamics in a single-tube air-breathing PDE. On PDE, the repeated operation was analyzed analytically as well as numerically. They concluded that as compared to the conventional steady systems, For PDEs, the intrinsic inconsistency of the flow conditions at the nozzle exits and the internal flow deficit related to chamber shock dynamics are special. In most cases, performance surges with declining close-up valve time for an assumed cycle period and purge time. A larger purge time decreases the specific thrust but raises the specific impulse for a specified cycle time. Wintenberger *et al.,* [24] developed the analytical model and validated it against experimental results. By varying the initial pressure, equivalence ratio, and

nitrogen dilution. Endo and Fujiwara [32] investigated the efficiency of pulse detonation engines. Simple formulas for the impulse density per one cycle operation and the time-averaged thrusts have been derived based on the simplified theoretical analysis. Numerically the efficiency estimates for an idealized PDE investigated by Cheatham and Kailasanath [33] used JP-10 used as fuel. Results show that liquid-fueled PDEs are comparably efficient to gas-fueled PDE devices with small enough droplets and sufficient fuel pre-vaporization. A quasi 1-D finite-rate CFD chemical model was created and implemented by C. I. Morris to research pulse detonation rocket engine (PDRE) gas dynamics and performance [34]. He selected four different PDRE geometries, which were then checked for single-shot performance and analyzed for blowdown time characteristics. The results show that the performance of a baseline detonation tube can be improved with both direct extensions and converging divergent nozzles. However, optimized C-D nozzles typically increase their performance more effectively than straight extensions, particularly with higher pressure ratios.

Baklanov *et al.,* [35]; less feed is used to fill the combustion chamber valve with fuel and oxidant. They discovered that using a pre-combustion chamber with annular obstacles reduces the duration of DDT. Recently carlos Xisto *et al.,* [36] developed a model for anticipation of NOx production in pulsed detonation combustors. The model is built using CFD data for various combustor inlet pressure, equivalence ratio, and temperatures. They discovered that detonation in lean mixes considerably reduced NOx emissions. Another method for reducing NOx production is to use stratified charges, which divide the tube into sections. The pulse detonation engine was studied by V. B. Nguyen *et al.,* [37]. Jet-A liquid fuel is considered as a fuel, while air as an oxidizer. The data suggest that the mass fraction of pre-vaporized fuel is critical to the success of the DDT process. The effect of thermodynamic detonation parameters on the performance of the pulse detonation engine is determined through analytical and computational study by warimani *et al.,* [38]. They concluded that methane, kerosene, and a 50 percent blend of hydrogen + methane, hydrogen + kerosene, and methane + kerosene might be utilized as alternate fuels for PDE to avoid the issues caused by hydrogen fuel. Table 1 shows the chemical and physical properties of fuels. Hydrogen having the lowest molecular weight, and gasoline having the highest value. Heavy hydrocarbons are less sensitive to detonation. The flame velocity of propane, butane, Liquefied petroleum gas (LPG), and gasoline are almost the same but hydrogen having a comparatively higher flame velocity. It's also worth noting that the gas density of hydrogen is the lowest of any gas, necessitating further safety measures to prevent fuel leakage.

Table 1
Chemical and physical properties of fuels [39–42]

Fuel	Hydrogen	Propane	Butane	Liquefied petroleum gas (LPG)	Gasoline
Chemical formula	H_2	C_3H_8	C_4H_{10}	C_4H_{10} (60%) &C_3H_8 (40%)	C_8H_{18}
Molecular weight(g/mol)	2.016	44.097	58.12	44.09	114.23
Gas density (kg/m^3) @ STP	0.090	1.901	2.48	1.89	748.9
Flame velocity (m/sec)	3.06	0.45	0.44	0.4	0.35
Ignition temperature (K)	845	766	560.9	510	275
Ignition energy (10-5 J)	2.0	30.5	10	10	24

2. Numerical Methodology

2.1 One-Dimensional Analysis

It is necessary to build an empirical prototype to determine the theoretical limit on PDE's efficiency and to identify several performance loss mechanisms. Since PDEs work in an unsteady flow in the combustion chamber, an analytical model is essential. While the structure of actual

detonations is exceptionally three-dimensional, a one-dimensional analysis offers substantial insight. The first attempt to describe the detonations based on a one-dimensional approach is still valid today as it provides a framework for creating a more detailed understanding. Pulse detonation engine thermodynamic assessment is analyzed by referring to a one-dimensional (1D) model built on the Chapman–Jouguet (CJ) and the Zeldovich, von Neumann, and Doring (ZND) theories. The detonation waves compress the gas in front of it, resulting in a considerable increase in pressure and temperature after the combustion process. This process is called the one-dimensional Chapman-Jouguet theory and the ZND model.

2.2 Assumptions Considered for One-Dimensional Analysis

This modeling was only for the case of ideal combustion. As shown in Figure 4, the control volume is chosen. The upstream and downstream boundaries are located in the regions where there are not at all temperatures or species concentration changes. We can perform a reasonably rigorous analysis with the following assumptions: (1) the flow is one-dimensional and steady; (2) the area is constant; (3) the combustion and flue gases are modeled to ideal-gas law; (4) specific heats are constant, and Cp and Cv are equal; (5) the body forces are negligible; and (6) adiabatic conditions are prevailing throughout the detonation process (i.e., there are no heat losses to the surroundings).

The fundamental conservation law can be written as the flow under consideration is conserved in one dimension and steady. Figure 4 shows the flow with constant volume.

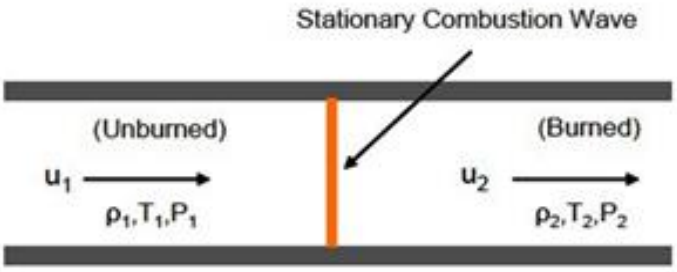

Fig. 4. One-dimensional detonation wave in the constant area duct [43]

The speed at which the unburn mixture enters the detonation wave is approximated as one-dimensional for an observer moving with the one-dimensional detonation wave as depicted in Eq. (1).

$$V_D = v_{x,1} \; and \; velocity \; of \; burned \; gases = \; v_{x,2} \tag{1}$$

The governing equations that define the flow and reaction progress in the pulse detonation engines are with a single step & irreversible reaction in this research.

2.3 Detonation Parameters

The detonation parameters like pressure ratio, temperature ratio, & detonation velocity of the alternative fuels are premeditatedly referred to by Turns [44]. Turns [44] shows that the specific heat of the unreacted mixture can be obtained. Before looking for these properties, we need to determine the unreacted and reacted mixtures' composition by the expression given below.

$$C_xH_y + a(O_2 + 3.76N_2) \rightarrow xCO_2 + \left(\frac{y}{2}\right)H_2O + 3.76aN_2 \quad (2)$$

where $a = x + \left(\frac{y}{4}\right)$

We can denote the exact chemical reaction by balancing the amounts of C, H, O, and N on the left and right sides of the equation. After the equation has been balanced, we can find the thermochemical properties by using the equations mentioned below.

Specific heats at constant pressure at both states 1 and 2 are given in Eq. (3) and (4).

$$C_{p,1} = \frac{\sum_{state1} X_i \hat{c}_{p,i}}{MW_1} \quad (3)$$

$$C_{p,2} = \frac{\sum_{state2} X_i \hat{c}_{p,i}}{MW_2} \quad (4)$$

The gas constant R_2 can be evaluated using Eq. (5)

$$R_2 = \frac{R_u}{MW_2} \quad (5)$$

The specific heat ratio γ_2 can be calculated using Eq. (6)

$$\gamma_2 = \frac{C_{p,2}}{C_{v,2}} = \frac{C_{p,2}}{C_{p,2} - R_2} \quad (6)$$

By referring to Turns [1], enthalpies-of-formation can be obtained to calculate the heat of formation, q, as mentioned in Eq. (7). Enthalpies-of-formation is converted into a mass balance.

$$q \equiv \sum_{state1} Y_i h_{f,i}^0 - \sum_{state2} Y_i h_{f,i}^0 \quad (7)$$

With the heat of formation known, the detonation velocity and temperature at state 2 can be calculated by using Eq. (8) and (9), as shown below

$$v_D = \left[2\gamma_2 R_2(\gamma_2 + 1)\left(\frac{\hat{c}_{p,1}}{\hat{c}_{p,2}}T_1 + \frac{q}{\hat{c}_{p,2}}\right)\right]^{\frac{1}{2}} \quad (8)$$

$$T_2 = \frac{2\gamma_2^2}{\gamma_2 + 1}\left(\frac{\hat{c}_{p,1}}{\hat{c}_{p,2}}T_1 + \frac{q}{\hat{c}_{p,2}}\right) \quad (9)$$

The properties at state 2′ can be determined by employing the ideal-gas normal-shock equation. These properties are used to compare states 1 and 2. The specific heat ratio of the mixture and the Mach number at state 1 are required to determine all the properties at state 2' using Eq. (10). We assume $\gamma = 1.3$ and Mach number at state 1

$$M_{a1} = \frac{V_{x1}}{C_1} = \frac{V_{x1}}{\sqrt{\gamma R_1 T_1}} \quad (10)$$

After obtaining the Mach number at state 1 and the specific heat ratio, all the properties at state 2' can be evaluated using Eq. (11), (12), and (13).

$$\frac{P_{2\prime}}{P_1} = \frac{1}{\gamma+1}\left(2\gamma Ma_1^2 - (\gamma - 1)\right) \tag{11}$$

$$\frac{T_{2\prime}}{T_1} = (2 + (\gamma - 1)Ma_1^2)\frac{2\gamma Ma_1^2 - (\gamma-1)}{(\gamma+1)^2 Ma_1^2} \tag{12}$$

$$\frac{\rho_{2\prime}}{\rho_1} = \frac{(\gamma+1)Ma_1^2}{(\gamma+1)Ma_1^2+2} \tag{13}$$

The Mach number at states 2 and 2' can be determined using Eq. (16) to determine the aircraft's motion—whether it is in subsonic or supersonic regime.

$$n = 2\ and 2' \tag{14}$$

$$V_{x,n} = \frac{\rho_1}{\rho_n}V_{x,1} \tag{15}$$

$$M_{a,n} = \frac{V_{x,n}}{\sqrt{\gamma_n R_n T_n}} \tag{16}$$

2.4 Equations Used for the Blended Fuels

The blended fuel equation set is taken from the mathematical model presented in Yildiz and Çeper [45]. The chemical equation used to describe the combustion reaction is expressed by Eq. (17).

$$frcC_nH_m + (1 - frc)C_\propto H_\beta O_\gamma + \left(\frac{\delta}{\Phi}\right)(O_2 + 3.773N_2) \xrightarrow{yields} X_1CO_2 + X_2CO + X_3H_20 + X_4H_2 + X_5O_2 + X_6N_2 + X_7H + X_8O + X_9NO + X_{10}OH \tag{17}$$

where frc is the fraction of the selected fuel; C_nH_m&$C_\alpha H_\beta O_\gamma$Is the selected hydrocarbon-based fuels, n, m, α, **δ**; and Φ represent the number of atoms of carbon, hydrogen, and oxygen in the fuels, respectively. Furthermore, x_1-x_{10} denotes the number of moles for each product. In this research, CO2, CO, H2O, H2, and O2 are considered combustion products.

$$\delta = frc\left(n + \frac{m}{4}\right) + (1 - frc)\left(\alpha + \frac{\beta}{4} - \frac{\gamma}{2}\right) \tag{18}$$

2.5 Specific Thrust and Specific Impulse

$$F_{sp} = (1 + f)V_e - V_\infty \tag{19}$$

F_{sp} is the specific thrust, f is the overall fuel to air ratio of the blend of the reactants different for fuel, which was calculated using the formula, V_e is exit velocity of the engine, and V∞ is the axial velocity (636 m /s). The V_e value is determined using Eq. (8), as explained in section 3.3. The same detonation velocity is considered here. The specific impulse I_{sp} can be determined by Eq. (20).

$$I_{sp} = \frac{F_{sp}}{fg} \tag{20}$$

where I_{sp} is the specific impulse, f is the overall fuel to air ratio of the blend of the reactants and purge air, g is the gravitational constant.

3. Results and Discussion

3.1 Validation of the Model

In comparison to the current investigation's findings, experimental evidence for the detonation of hydrocarbons is very small. Only restricted evaluations are made due to the lack of sufficient data. Furthermore, no information was existing for the blended fuels used in this analytical model. According to the author's literature survey, before, no one has conducted an analytical investigation of the detonation using blended fuels, which is used here (Table 2). The equations used are unique to PDE. However, the above model was tested first against the Turns [44] case study before employing it in the current research. The blended fuels equation was obtained from Yildiz and Çeper [45]. Specific impulse for hydrogen-air validated by Wintenberger *et al.,* and Fuhua Ma's article [24,46]. Wintenberger *et al.,* [24] found that fuel-based specific impulse for hydrogen-air is in between 3000 sec to 5000 sec. F.Schauer *et al.,* [47] results for fuel-based specific impulse were in between 4200 to 7100 sec using hydrogen-air. And specific impulse for propane-air validated with Wintenberger *et al.,* [24].

Table 2
Validation of hydrogen fuel with available literature

Fuel	Parameter	Analytical Model	S. Yungster & K. Radhakrishnan [48]	K. Kailasanath [49]	B. D. Taylor *et al.,* [50]	E. C. Maciel *et al.,* [51]
Hydrogen	Pressure ratio (P_2/P_1)	24.10	23	20	31.47	14
	Temperature ratio (T_2/T_1)	15.60	10	-----	10	12.16
	Velocity(m/s)	2524.36	2400	2380	2020	1996

3.2 Validation of the Model Analysis of Fuel Blends and its Comparison with NASA CEA Data

In this analysis, NASA's open-source software (CEA) was used to estimate the detonation parameters of various alternative and blended fuels. CEA is a program that computes chemical equilibrium product concentrations from any variety of reactants and finds the transport and thermodynamic properties for the product mixture. As shown in Figure 10, 11, and 12, the pressure ratio, temperature ratio, and velocity have been plotted for hydrogen, butane, propane, and blends with a combination of 50% of each. The corresponding values taken from NASA CEA are also shown to compare with the current study's analytical results. Butane and propane are compared with hydrogen to generate a new kind of alternative fuel. Butane, or C_4H_{10}, is a natural gas alkane derivative that can be used either as two distinct structural isomers, n-butane or isobutane or as a combination of the two.

Meanwhile, propane possesses a molecular formula of C_3H_8 and a melting temperature of 85.45 K, the lowermost of all recognized organic compounds. Figure 5, 6, and 7 show the ZND structure for selected fuels. ZND considered that the fuel mixture's compression takes place immediately at the front of the shock wave. In the induction field, an increase in temperature results in mixture ignition.

The mixture then burns until it ultimately converts into a combustion product. This leads to the generation of a shock wave and a thin chemical reaction area, which is called a detonation wave.

Figure 5, 6, and 7 demonstrate the pressure ratio, temperature ratio, and density ratio for hydrogen, butane, and propane fuels. The pressure ratio, temperature ratio, and density ratio of the hydrogen are 24.09, 15.60, and 1.811. Hydrogen has the highest values in comparison to the other pure and blended fuels. All the values of fuels are within the required range of properties of detonation.

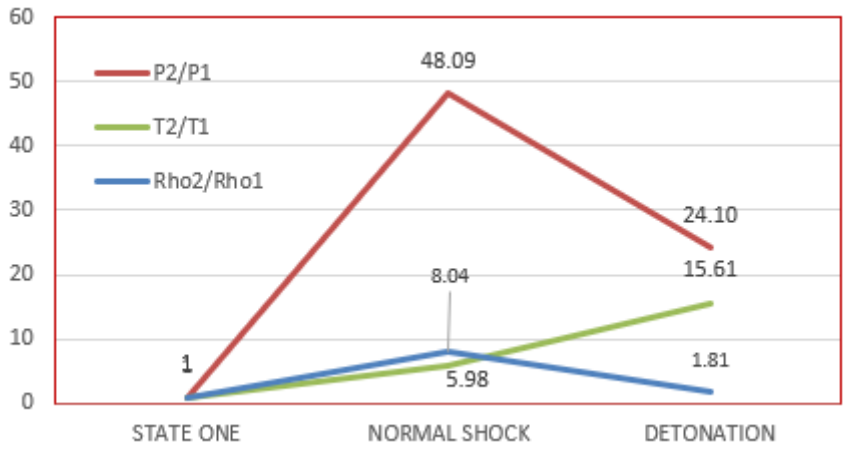

Fig. 5. ZND structure of hydrogen

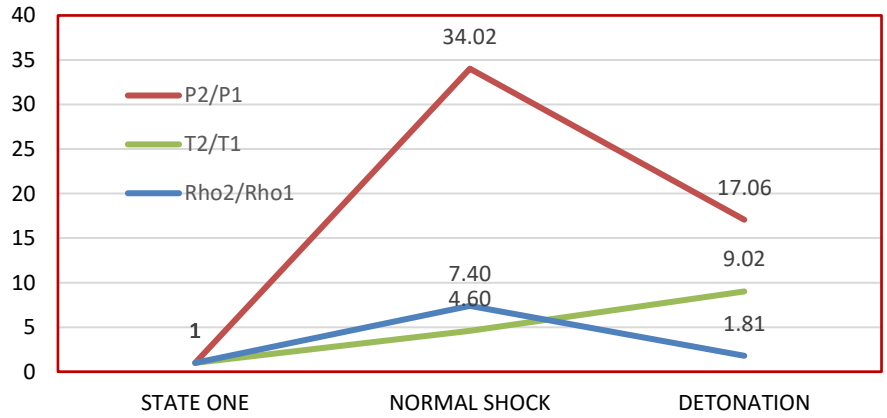

Fig. 1. ZND structure of butane

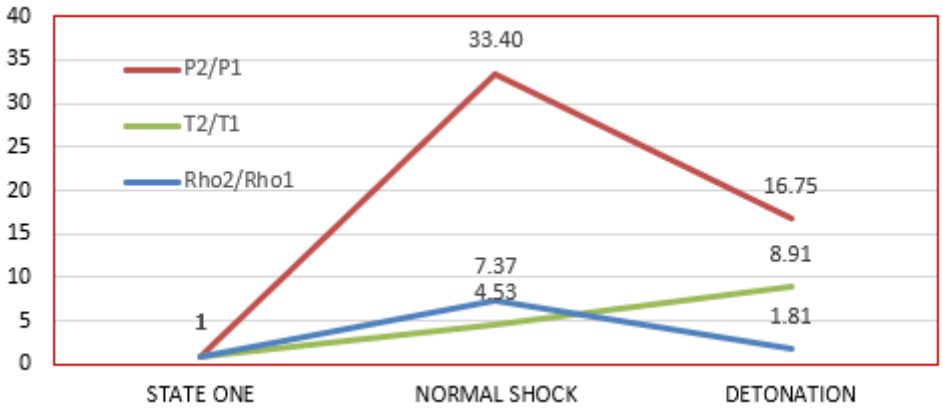

Fig. 2. ZND structure of propane

As shown in Figure 8 and 9, it is worth noting that heat release rate and air to fuel ratio play a vital role. As illustrated in Figure 8, the specific impulse of fuel depends on the heat release rate. As heat release increases, specific impulse also increases. Other than hydrogen, all other fuels have similar specific impulses and heat release rates. Figure 9 reveals that the air-fuel ratio of fuel is critical to the engine's efficacy. If the air-to-fuel ratio is the lowest possible, the fuel-specific impulse would be the maximum. Since hydrogen has the smallest air-to-fuel ratio (0.029), the specific impulse is the maximum. Since all other fuels have nearly identical air-to-fuel ratios, their specific impulses are nearly identical.

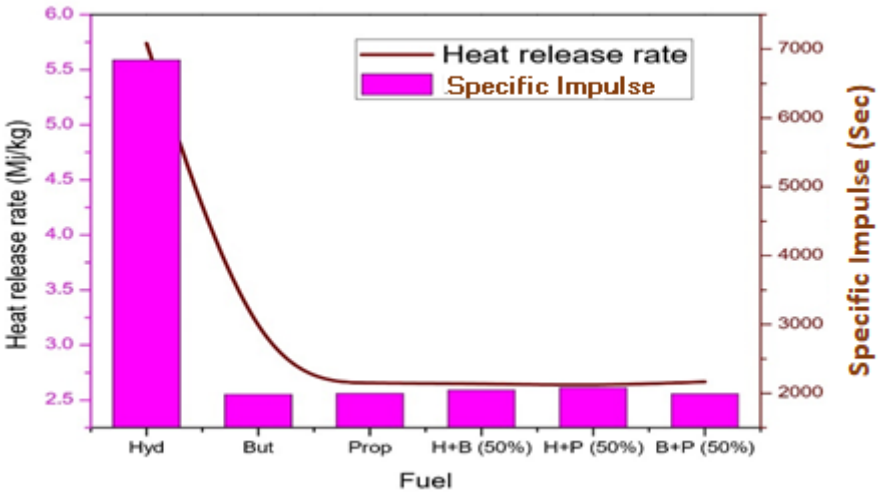

Fig. 8. Effect of heat release rate on detonation velocity

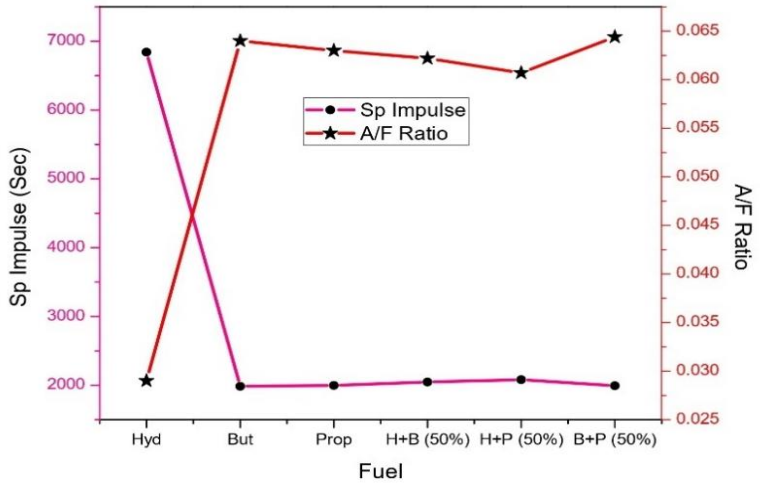

Fig. 9. Effect of air to fuel ratio on specific impulse

As shown in Figure 10, the percentage difference or percentage error between the analytical results and the NASA CEA results are significantly less, which indicates that the results from the recent study are within the acceptable range. Still, only hydrogen values are higher due to higher heat release (5.7 Mj/Kg) and lower air to fuel ratio (0.029) than other fuels. In the analytical results, the highest pressure ratio (24.09) was recorded for hydrogen. Whereas the lowest value of pressure ratio (16.07) obtained was for the blend of 50% hydrogen and propane. Regarding the accuracy of the results, the hydrogen-propane and hydrogen-butane combination showed the slightest error than

the corresponding NASA CEA values. The standard detonation pressure ratio value is 13-55, and it can be noticed that all the values were within this range.

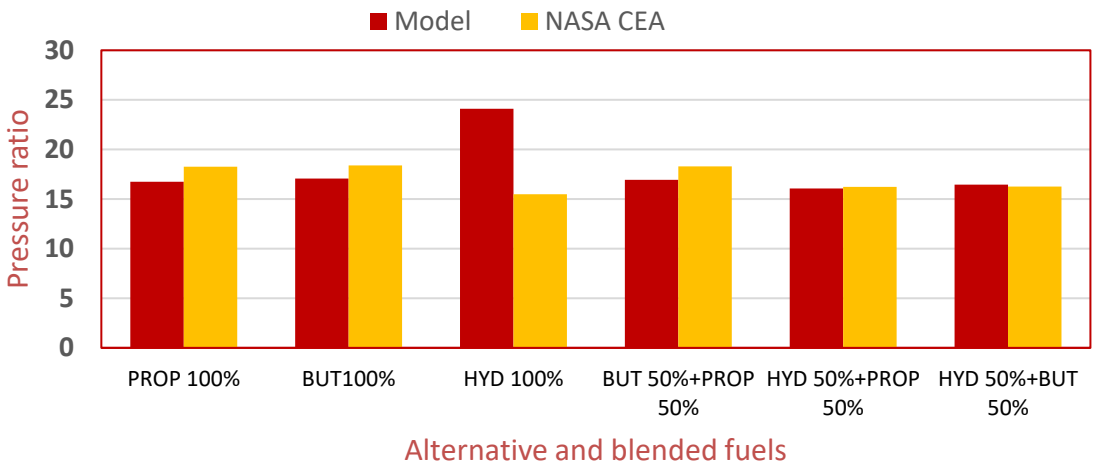

Fig. 10. The pressure ratio of alternative and blended fuels

Figure 11 shows the trend of temperature ratio for different fuel blends. Compared with NASA CEA values, the numerical results experienced a 10.46 % variation within the acceptable range accept hydrogen. The standard detonation value for temperature is 8 to 21. All fuel blends achieved a temperature ratio of more than 8. Numerically, the highest temperature ratio was 15.61, which was observed with pure hydrogen. On the other hand, the lowest value of the temperature ratio was 8.73, which was achieved with a blend of 50% hydrogen and 50% propane.

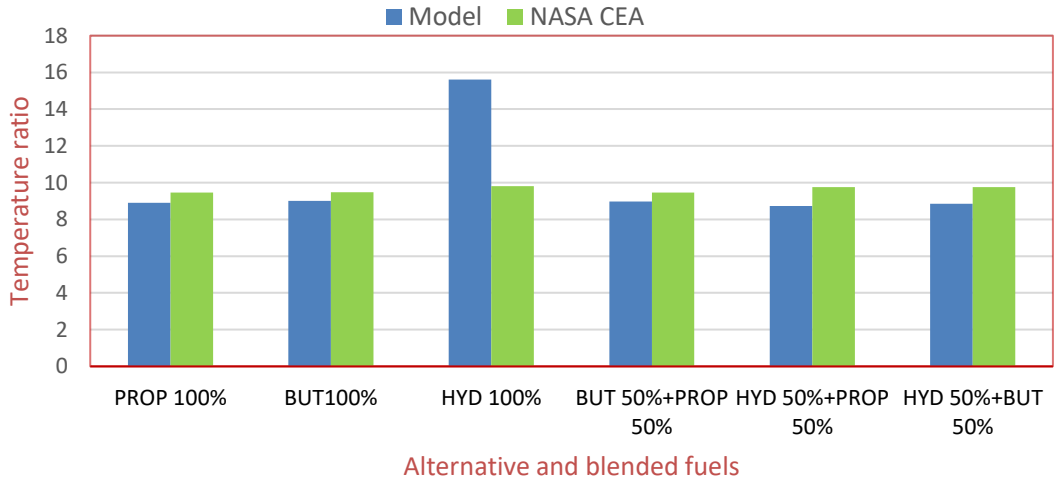

Fig. 11. Temperature ratio of alternative and blended fuels

Figure 12 shows that the detonation velocity is plotted for fuel blends and the corresponding NASA CEA values. It is seen that the highest detonation velocity was 2524.37 m/s, which was numerically obtained with hydrogen. The higher velocity of hydrogen fuel or hydrogen was designated as the best fuel since there is no carbon dioxide (CO_2), carbon monoxide (CO), or soot in it. Still, only water was generated in the burning of hydrogen fuel. On the contrary, the lowest value of 1769.58 m/s was achieved with a blend of 50% hydrogen and 50% propane. The maximum percentage difference or error between the analytically obtained values and NASA CEA values was 7.40 %, within the acceptable range.

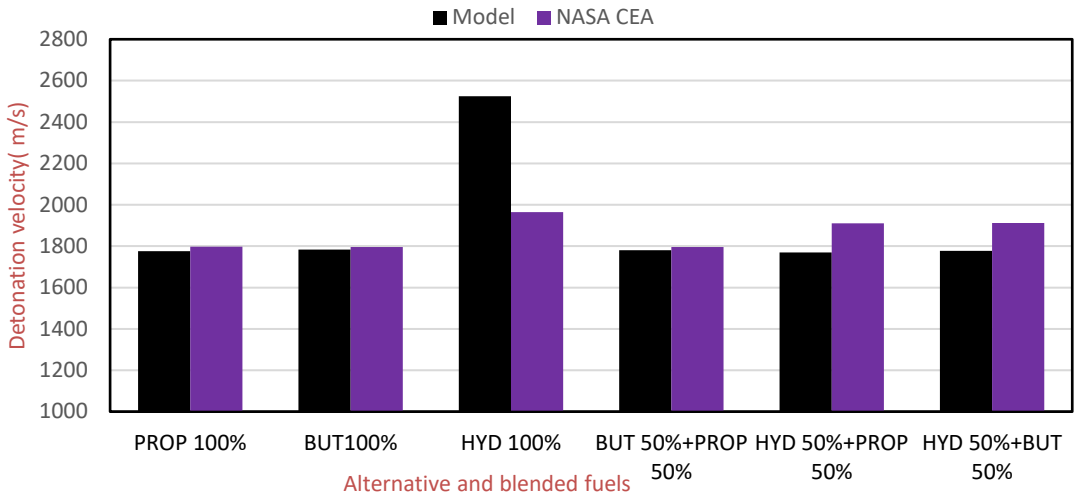

Fig. 12. The velocity ratio of alternative and blended fuels

3.3 Performance Analysis of Alternative and Blended Fuels

Figure 13 represents the trend of specific impulses for all the fuel samples. It is found that the maximum specific impulse of 6842.17 seconds was experienced with pure hydrogen fuel because, as said before, there is no formation of carbon dioxide (CO_2) in it. It thus justifies why hydrogen is considered the best fuel for PDE, as mentioned in many earlier studies. Compared with pure butane and propane, relatively higher values of specific impulse are found with their blends. Hydrogen has a much higher energy release than other hydrocarbon fuels. That is the reason behind hydrogen's best performance for aerospace applications. Also, it has wide flammability limits and a short ignition time. Furthermore, it has excellent diffusivity and gives a higher specific impulse due to its low molecular weight.

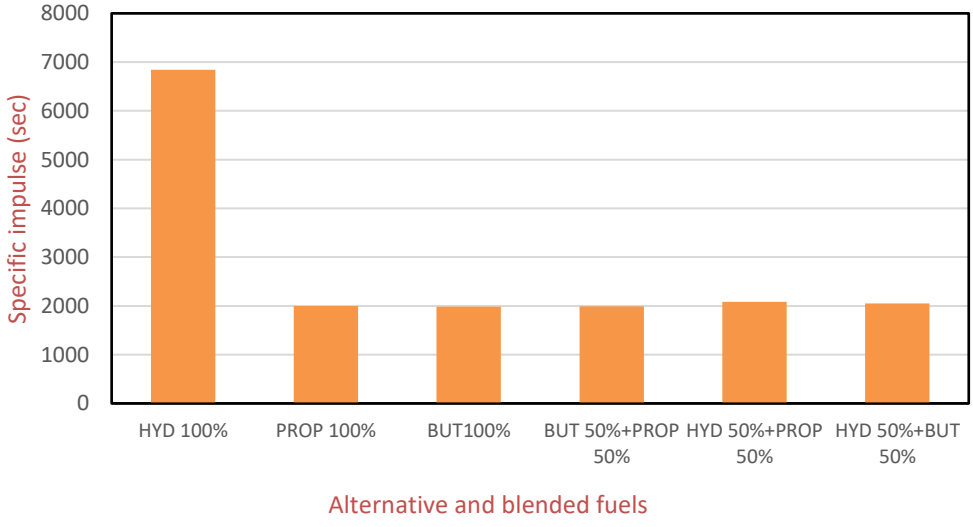

Fig. 13. The specific impulse of pure and blended fuels

4. Conclusions

Analytical pure fuel like hydrogen, butane, propane and its blend of 50 % of each fuel were selected to study the thermodynamic performance in a simple PDE combustor. PDE thermodynamic

assessment is analysed by referring to a one-dimensional (1D) model built on the Chapman–Jouguet (CJ) and the Zeldovich, von Neumann, and Doring (ZND) theories. Parameters such as temperature ratio, pressure ratio, detonation velocity, and specific impulse were determined. The implemented analytical model is benchmarked via available numerical, experimental, and NASA CEA results. The following conclusions can be drawn:

i. A one-dimensional analysis has been used to study the detonative parameter and the propulsive output of a pulse detonation engine. PDE fueled by pure fuels like hydrogen, propane, butane, and the blended fuels butane 50%-propane 50%, hydrogen 50%-butane 50%, and hydrogen 50% and propane 50% were tested. The model predictions have been compared with the conclusions of NASA CEA and several pieces of literature available. These indicate a good correlation that is within 15% error.
ii. This research's novelty lies in the equations used for blended fuels for PDE—that is, they are used for the first time for PDE. Among all the three pure fuels, the highest specific impulse was achieved with the hydrogen of 6842.17 sec.
iii. Pure butane predicted excellent pressure ratio values, temperature ratio, and detonation velocity with 17.06, 9.02, and 1782.86 m/s, respectively. These butane fuel values are near to the detonation values of hydrogen fuel. No considerable changes in pressure ratio, temperature ratio, and detonation velocity were observed with butane and propane when compared with each other.
iv. Propane and butane are both safe, non-toxic, clean-burning fuels and are excellent sources of energy. Thus, there are no long-term adverse environmental effects with butane and propane. They can be used as alternative fuels in PDE. This initial approach has produced good results for the further development of a realistic pulse detonation engine.

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2. Number of Patents

पेटेंट कार्यालय
शासकीय जर्नल

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(57) Abstract :
ABSTRACT Our Invention A Machine Learning Model for Venue Exploration and Recommendation is a with the rise of demand for scalable standalone system for venue's exploration and recommendation plays an increasingly important role, for accurate and speedy Venue's exploration, recommendation and analysis system can help tourism and hospitality sector to solve all the uncertainty associated with Service, information and supply and reduce cost associated with is and produce best results. Most of the business organizations associated with tourism and hospitality sector heavily depend on information base and demands venue's exploration, recommendation, prediction of trends. The accuracy in venue's exploration and recommendation provides a big impact in business. Data mining, collaborative filtering and k-means methods are very actual tools in extracting hidden knowledge from an enormous dataset to enhance accuracy and efficiency of their commendation.

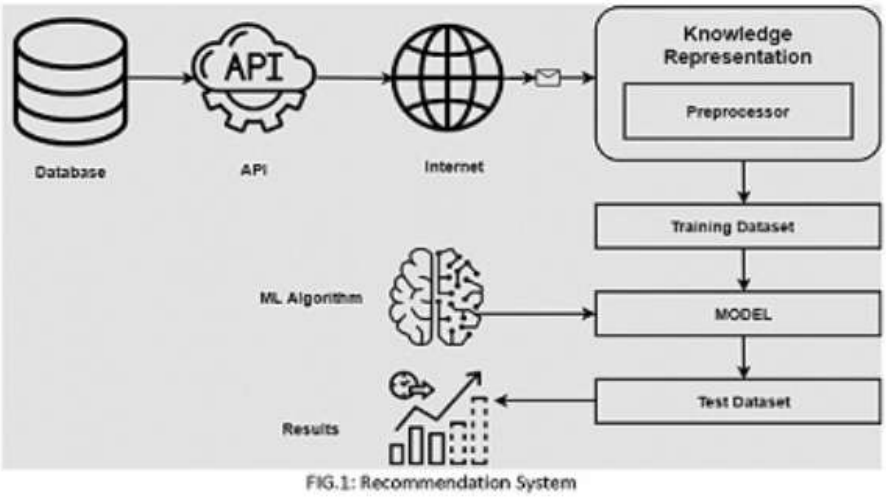

FIG.1: Recommendation System

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(61) Patent of Addition to Application Number :NA
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(57) Abstract :
Abstract: The present invention is an effective hybrid technique for logistics industries: comprises of, an estimator to identify the location of the vicinity, thereby, information of a vicinity is stored, thereby, code is placed on the specific location and therein, placing the items on the desired location along with better positioning the moving object. The object is identify at the initial stage. Initial identification provides to know which code to be selected. Code identification is achieved by moving to the desired location. Movement is enhanced after picking the appropriate code. Desired path has to be selected by calculating the location, speed and hindrances. Path control should be enchanted by calculating the entire length. Path should be short and hindrances free. Need to follow the path to reach the desired location.

No. of Pages : 9 No. of Claims : 10

5. Number of Books Authored

Total Quality Management

Prof. (Dr.) Vilas Pharande
Prof. Nitin Kisan Deshmane
Prof. (Dr.) Gopal Jahagirdar
Prof. (Dr.) Pranjali S Unkule

ISSN : 2454-8499

7. Number of New Externally Funded Research Projects Received

8. Funds Received During This Academic Year

AUTOMATE ENGINEERING

Office Address:101 / first floor, Malhar Pride, Shree Control Chowk, Narhe
43 Contact No: - +91 77689 99659,
Email: connect.automate@gmail.com

Date – 13/06/2022

To,
Principal ,

Arvind Gavali College of Engineering Satara

Regarding Industrial Project Sponsorship for **Electrical Engineering** Students.

Respected sir,

This is to certify that **Ms. Mahamulkar Prajakta Kalyan (PRN NO- 1965451293022),Ms. ChavanPranita Hanmant (PRN NO- 1965451293044), Ms. Yadav Snehal Ashok (PRN NO- 1965451293057),Mr. Mohite Raviraj Dhananjay (PRN NO-1965451293038)** Studying in the final year of **Electrical Engineering** Department at your institution, is being sanctioned to complete his engineering project in our Organization.

The Project Details are as under,

Title - Child Safety Wearable Device External
Project Guide : - Mr. Akhilesh Deo Approx. duration: 4 to 5 months.
Approximate cost sanctioned for the project in Rupees 12k

Hope this is in-line of your requirements. You may communicate us on our E-mail ID For any query.
Thanking You,
For AUTOMATE ENGINEERING

Authorized Signature

An ISO 9001 : 2015 Certified Company
AG ELECTRO SERVICES
(AG ELECTRIC MOTORS)
Plot No. 6, Koyana Industrial Estate, Pune Bengaluru Highway NH4, KARAD - 415110 (Maharashtra) INDIA
Tel : +91 - 2164 - 241126 Email : gopal@agelectricmotors.com, shrudh...@agelectricmotors.com www.agelectricmotors.com

AGES/2619/21-22/Sponsorship

Date: 13/02/2022

To,
The Principal
Arvind Gavali College of Engineering
Satara.

Subject: Sponsorship Letter for Project work.

Dear Sir,

We are pleased to allocate sponsor project on **"E-Lite BICYCLE"** to below listed students of **Arvind Gavali College of Engineering, Satara**. Department of Electrical Engineering.

Sr No.	Name of the Student
1	Shubham Rajendra Jamdade
2	Mayuresh Pandurang Ghadage
3	Shubham Mohan Patil
4	Nishant Kiran Tawate

Yours Sincerely,

AG ELECTRO SERVICES KARAD 415110

Mr. Adarsh Shah
(HR Head)
AG ELECTRO SERVICES

LOGICON
TECHNOSOLUTIONS

Logicon Technosolutions PrivateLimited

15B/1, D1 Block, MIDC Chinchwad,
Pune - 411019,
Contact No: - +91-20-67306400,
Email: sales@logicontech.com

Date – 13/06/2022

To,
Principal,

Arvind Gavali College of Engineering Satara

Regarding Industrial Project Sponsorship for Computer Engineering Students.

Respected sir,

This is to certify that,
Ms. Shubhangi Uttam More (PRN NO- 516545201811242100 72),Ms.
Ashwini Sayaji More (PRN NO-516545201811242100 67), Ms. Gauri
Mohan Pawar (PRN NO- 516545201811242100 68),
Ms Kiran Suryakant Yadav (PRN NO-516545201811242100 69)
Studying in the final year of Computer Engineering Department at your institution, is being sanctionedto complete his engineering project in our Organization.

The Project Details are as under,

Title - IOT Based Smart Irrigation System To Provide Ideal Condition For Crops.
Project Guide : - Mr. Akhilesh Deo Approx. duration: 4 to 5 months.
Approximate cost sanctioned for the project in Rupees 22,000/- .

Hope this is in-line of your requirements. You may communicate us on our E-mail ID For any query.
Thanking You,

For COMPUTER ENGINEERING

Amrapali Bankar,
HR Executive

Pune

Authorized
Signature

KD Automation

Manufacturers of Process Control Instruments ,Whole Range In signal converters
All types of Level Controllers, MCC, APFC,Distribution panels,Single/three Phase Control panels, Custom Build Instruments

DATE:05/01/2022

To,
Arvind Gavali College of Engineering,
Computer Department, panmalewadi,
Varye, Satara.

Subject: Latter approving the project Sponsorship's.

Student Name: Miss. Anuradha Popat Patil

Sponsor Name: KD Automation, Pune

I agree to pay all Expenses for the above student at Arvind Gavali College of Engg. Satara. These funds will replenish and cover his/her expenses including Project and project Related work. Please feel free to contact me for I will gladly extend my help in the best possible manner.
This Sponsorship will cover the student beginning on 15 Dec 2021
With allotment of this Sponsorship, student may utilize company resources. All Right Regarding the application are reserved to company and college maintain the Confidentiality.
Sincerely.

Sponsor Signature
Sponsor Name: KD Automation, Pune
Sponsor City: Pune.
Sponsor Mail.Id: kd_automation@yahoo.in
Sponsor Mb.No:9822625619.

KD AUTOMATION PUNE

Works :Sr no 12,1/2,Rohan Apartment,Near Prathemesh Nagari,Anand Nagar, Sinhgad road pune 51
Tel No. 020 24340486 E-mail: kd_automation@yahoo.in

MH11

MH11CODERS

Address: - Above
Vaibhav Surgical, Civil
Hospital Road, Powai
Naka, Satara.
415002.

To,

The principal,

Arvind Gavali College of Engineering, Satara

Subject-: Sponsorship Letter

Respected Sir, Madam

We would like to hereby confirm you that **Miss. Kajal Umesh Nazarkar, Miss.Pranali Shivaji Mahamuni, Miss.Ankita Ramdas Shendage, Miss.Pranita Sanjay Patil** are the students from your college who have been selected for carrying out the final year project "**Student Attendance System Using Barcode Scan**". They will work with our organization **Mh11Coders Technology, Satara** from August 2021 for exactly 8 months. This Project has been sponsored by **Mh11CodersTechnology**.

The working schedule of their project will be 2 days a week from 11.00 am to 6.00 pm. The details and scope of this project will be provided to them from the beginning of their tenure at the company facility. Upon successful completion of the project. Approximate cost sanctioned for the project in Rupees 20k. We will be required to submit a copy of detailed report before completion of the project with a sample model which is required to be submitted at the time of external examination held at the college.

Thanks & Regards

MH11 CODERS SATARA

Authorized Sign

MH11CODERS, Satara

oytie

Date-13/06/2022

To

Principal,

Arvind Gavali College Of Engineering Satara

Regarding Industrial Project Sponsorship for Computer Science and Engineering Students

Respected Sir,

This is to certify that **Mr. Darshan Madhav Chavan (PRN NO- 51654520181124210037), Mr. Shreyash Santosh Sonawane (PRN NO- 51654520181124210065), Mr. Nishant Rajendra Kadam (PRN NO - 51654520181124210035), Mr.Alfarahas Farukh Momin(- 51654520181124210033)** Studying in the final year of Computer Science and Engineering department at your institute, is being sanctioned to complete his engineering project in our organization.

The Project Details are as under,

Title : Online Import and Export Product System

Project Guide: Miss. Mansi Gaikwad.

duration: 4 to 5 months.

Approximate cost sanctioned for the project in Rupees 25k

Hope this is in-line of your requirements. You may communicate us on our E-mail ID For any query.

Thanking You

Yours Truly,

OYTIE PRIVATE LIMITED

Deepa Bisht

HR Director

Office address

Aurora towers East wing, office no 313, 3rd Floor, MG Road, Camp, Pune- 411001, Maharashtra.

Registered address

Flat 403, Skylight Building, Colony No 5, Gandhinagar, pune-411031, Maharashtra

AXOLOTLS INNOVATIVE TECHNOLOGY

Office Address: Bk, Office 001, Harshvardhan Pride, NH 4 Highway, Navale Bridge Vadgaon, Narhe, Pune, Maharashtra 411041
Email: axolotlsindia@gmail.com
Phone: 097648 23404

Date – 13/06/2022

To,
Principal ,

Arvind Gavali College of Engineering Satara

Regarding Industrial Project guide for **Computer Science and Engineering** Students.

Respected sir,

This is to certify that **Ms. Attar Sujan Samir (PRN NO- 516545201811242100 41),Ms. Borate Swapnali Dilip (PRN NO- 516545201811242100 54), Ms. Hivarkar Komal Arjun (PRN NO - 516545201811242100 53), Ms. Sul Supriya Arjun (PRN NO-516545201811242100 63)** Studying in the final year of Computer Science and Engineering Department at your institution, is being sanctioned to complete her engineering project in our Organization.

The Project Details are as under,

Title - Student Grievance Redressal System
Project Guide : - Mr. Sudhakar Jadhav Approx. duration: 5 to 6 months.
Approximate cost sanctioned for the project in Rupees 10k

Hope this is in-line of your requirements. You may communicate us on our E-mail ID For any query.
Thanking You,
For AXOLOTLS INNOVATIVE TECHNOLOGY

Authorized Signature

LUNAR WEBVENTURES
Shankar Heights,Sanewadi Lane 1, Pune,
Four Seasons, Aundh, Pune - 411007

Date – 15/06/2022

To,
Principal,

Arvind Gavali College of Engineering Satara

Regarding Industrial Project Sponsorship for **Computer Science and Engineering** Students.

Respected sir,

This is to certify that **Mr. Shinde Harshad Prashant (PRN NO- 1965451242014), Mr. Bendre Pratik Umesh (PRN NO- 1965451242017), Mr. Tapase Yogesh Harish (PRN NO- 1965451242033), Mr. Dongare Swaroop Mangesh (PRN NO-51654520181124210038) Studying in the final year of the Computer Science and Engineering** Department at your institution, is being sanctioned to complete his engineering project in our Organization.

The Project Details are as under,

Title - A Secret Vault using AES SHA256 Algorithm
External Project Guide: - Mr. Sidhant Jadhav Approx. duration: 4 to 5 months.
The approximate cost sanctioned for the project is Rupees 20k

Hope this is in line with your requirements. You may communicate with us on our E-mail ID For any query.
Thanking You,

For Lunar Webventures
Authorized Sign

PROPRIETOR
LUNAR
WEBVENTURES

PRISTINE
TECHNOLOGIES

Address:- Office Number
18, Radha Residency,
Dange Chowk,
Tatawade, Pune.
411033.

To,

The principal,

Arvind Gavali College of Engineering, Satara

Subject-: Sponsorship Letter

Respected Sir, Madam

We would like to hereby confirm you that **Miss. Shivani Sunil Pardeshi, Mr. Shubham Bharat Gaikwad, Miss. Shilpa Ram Kamble, Miss. Nilam Dattatray Mane** are the students from your college who have been selected for carrying out the final year project "**Hand Sign Elevator**". They will work with our organization **Pristine Technology, Pune** from August 2021 for exactly 8 months. This Project has been sponsored by **Pristine Technology**.

The working schedule of their project will be 2 days a week from 11.00 am to 6.00 pm. The details and scope of this project will be provided to them from the beginning of their tenure at the company facility. Upon successful completion of the project. Approximate cost sanctioned for the project is Rs 80,000 . We will be required to submit a copy of detailed report before completion of the project with a sample model which is required to be submitted at the time of external examination held at the college.

Thanks & Regards

Pristine Technology Pune

Authorized Sign

Pristine Technology, Pune

Contact – 7020757594, 7083917887.

Jijau IT Solution & Services Opc Pvt. Ltd.'S,
www.3staritsolution.com
3 Star IT Solution & Services℠
Simple Solution For Complex Connection.....
CIN:U74900PN2018OPC177122

Date – 15/06/2022

To,
Principal .

Arvind Gavali College of Engineering Satara

Regarding Industrial Project Sponsorship for ComputerEngineering Students. Respected sir,

This is to certify that,
Mr. Metkari Vishvanath Tatoba (PRN NO- 51654520181124210034),
Mr. Shinde Akash Gopinath (PRN NO-51654520181124210049),
Mr. Bane Saurabh Nathaji (PRN NO- 51654520181124210027),
Mr. Nikam Shubham Pratap (PRN NO-51654520181137210053)

Studying in the final year of Computer Engineering Department at your institution, is being sanctioned to complete his engineering project in ourOrganization.

The Project Details are as under,

Title – Artificial Agriculture.

Project Guide : - Mr. Mayur Kumbhar. Approx. duration: 6 to 7 months.
Approximate cost sanctioned for the project in Rupees 21,000/- .

Hope this is in-line of your requirements. You may communicate us on our E-mail ID For any query. Thanking You,

For COMPUTER ENGINEERING

Director
(Mr. Rohit Bhole)

CEO
Mr. Rohit B. Bhole
Jijau IT Solution & Services OPC Pvt. Ltd.

Molacha Odha,26 Sambhajinagar,Medha Road,Behind Jayka Hotel,Satara 415001.
+91 9665713423 / +91 9960599437
3staritsolution@gmail.com

TECHNOTRONICS
TECHNOLOGIES
OEM of food machineries
P-61, Additional MIDC, Satara - 415004

Ref : TT/2022-23/SL/01

Date: 28 June 2022

Subject: Sponsorship for 'Academic Project' for final year

To whomsoever it may concern

Technotronics is a well established firm that has been in the bakery machine manufacturing business at Satara, Maharashtra. The team hardly works to empower students in schools and colleges that accelerate innovation while improving education quality at ground root level.

We hereby sponsor a Bachelor of Engineering-dissertation to.

1) Rohit Kailas Madhave
2) Pawan Vijay Desai
3) Prasad Dilip Bhandari
4) Aman Akbar Attar

of Arvind Gavali College of Engineering, Satara under guidance of academic guide Prof. Mr. Kharage A.B For the completion of project work Technotronics will help in a technical manner. Students will work under the supervision of Mr Shahrukh Patel who has been a designated person of technotronics.

The work is expected to be completed in the academic year of 2022-23

For Technotronics Technologies.

MUTHA ENGINEERING PVT. LTD.

Works : H-21, Old M.I.D.C., Satara - 415 004. (M.S.) INDIA
Phone : +91 2162 244464, 244465 Fax : 245170
E-mail : mepl@muthagroup.com
Web Site : www.muthagroup.com

HRD/SRLTR/052022/12

Date: May 08, 2022

Subject: Providing sponsorship

This is to certify to below mentioned students, from Arvind GavaliCollege of Engineering, Satara. For successfully completed Project in our organization from 19TH OCT, 2021to 25TH APRIL 2022. and completed the project "DESIGN AND MANUFACTURING OF PULL BACK COLLET CHUCK" at MUTHA ENGINEERING PVT LTD SATARA.With provided all relevant data as well as expenses related to project of Rs.81,542/-, Other expenses regarding their accommodation and travelling not the responsibility of the organization.

This is for information only.

Name Of Students

1) NadafSahilShekhlal
2) Panaskar Pratik Chandrakant
3) GhorpadeHarshadaRamdas
4) MadaneAkankshaManik

For Mutha Group

Shakuntala Pawar
Head - HR

With best wishes,

For Mutha Engineering Pvt. Ltd., Unit I

GS PEB & CIVIL WORKS PVT. LTD.

- **Office** : Jai Ganesh Vision Complex, 'B' Wing, 2nd Floor, Office No. 264,265,266, Akurdi, Pune -411 035
- **Factory** : Plot No. A- 30/3, Nighoje, Behind Mahindra Company, Phase IV, Chakan MIDC, Pune - 410 501
- **Mob. No.** : 7507778565 / 66 /68, • **E-mail** : groupsuryapeb@groupsurya.in, • **Website** : www.groupsurya.in

SURYA GROUP SURYA

To,

Principal,

Arvind Gavali College of Engineering,

Satara.

Subject: Sponsorship for the project.

Student Name: Yogesh Pol, Pratik Shinde, Zhishan Mujavar, Suraj Jadhav.

Dear Sir,

We are sponsoring the project (thesis) "**Design & Development of RF controlled Fire Fighting Robot**". We provide 100% funding for the project. As per our agreement students will hand over the project to our company. (We Are Giving some technical training)

Your sincerely,

Authorized Signatory,

For GS PEB & CIVIL WORKS PVT. LTD.

Dated 21st October 2021

GS PEB & CIVIL WORKS PVT. LTD.

Sri Sai
Civil & Techno Engineers Pvt. Ltd.

Tel : 022-2781 046
022-4970 796
CIN-U74999MH2015PTC27105

Date – 25/05/2022

To,

Prinicipal ,

Arvind Gavali College of Engineering Satara

Subject :- Regarding Industrial Project Sponsorship for **Mechanical Engineering** Students.

Respected sir,

This is to certify that **Ms. Adhishri Shivaji Pawar (PRN NO- 1965451612059), Ms. Aishwarya Chandrakant Salunkhe (PRN NO- 51654520181124210050), Ms. Arti Devidas Paramane (PRN NO-51631820181124210001),Mr. Niranjan Shahaji Waghmare (PRN NO-1965451612097)** Studying in the final year of Mechanical Engineering Department at your institution, is being sanctioned to complete their engineering project in our Organization.

The Project Details are as under,

Title – Wireless River Trash Collector

External Guide – Mr. Mahesh Pophale..

Approx. duration: 5 to 6 months.

Approximate cost sanctioned for the project in Rupees 17k

Hope this is in-line of your requirements. You may communicate us on our E-mail ID For any query.

Thanking You,

Pophale

ACG

14th June 2022

Letter of Authentication

This is to certify that **Mr. Rushikesh Madhukar Jagtap et al.**, from Arvind Gavali College of Engineering, Satara. Has successfully completed Project in our organization from 1st **January** 2022 to 31st March 2022. He has completed the project "PROCESS IMPROVEMENT USING DMAIC METHODOLOGY" at ACG Capsules, Shirwal. Successful Completion of this project results Compliance Improved From 84% to 89%. The costing for the project was Rs 14600/-

During this period, we found him to be sincere and hard working

We wish all the very best for his future endeavours

For ACG Associated Capsules Pvt. Ltd.,

Vivek Rajpara
Project Mentor – Senior Engineer
Operational Excellence.

9. Other Achievements

No: ATAL/2021/1630670972

ALL INDIA COUNCIL FOR TECHNICAL EDUCATION

Nelson Mandela Marg, Vasant Kunj, New Delhi – 110 070

AICTE Training and Learning (ATAL) Academy

Certificate

This is certified that **Mandhare Rajani Mahendra**, **Assistant Professor** of **Arvind Gavali College of Engineering,Satara** participated & completed successfully AICTE Training And Learning (ATAL) Academy **Online Elementary** FDP on "**Innovation Management**" from **06/09/2021** to **10/09/2021** at **Dr. Babasaheb Ambedkar Technological University Lonere Mangaon Raigad**.

Advisor-I, ATAL Academy
Mamta Rani Agarwal

Coordinator

No: ATAL/2021/1626788958

ALL INDIA COUNCIL FOR TECHNICAL EDUCATION

Nelson Mandela Marg, Vasant Kunj, New Delhi – 110 070

AICTE Training and Learning (ATAL) Academy

Certificate

This is certified that **Mandhare Rajani Mahendra**, **Assistant Professor** of **Arvind Gavali College of Engineering,Satara** participated & completed successfully AICTE Training And Learning (ATAL) Academy **Online Elementary** FDP on "**Smart City Solutions for Sustainable Future**" from **02/08/2021** to **06/08/2021** at **BMS College of Engineering**.

Advisor-I, ATAL Academy
Dr. Mamta Rani Agarwal

Coordinator

Samridhi Sarwajanik Charitable Trust's

Jhulelal Institute of Technology
Department of Applied Science & Humanities
&
Internal Quality Assurance Cell,
Rashtrasant Tukadoji Maharaj Nagpur University

jointly organizes

Five days Professional Development Program on 'Online Modalities & Professional Communication'

...An Administrative Training Program

Participation Certificate

This certificate is presented to **Mrs Rajani Mahendra Mandhare** of **Arvind Gavali College of Engineering Satara** for attending as well as satisfactory and timely submission of all the scheduled quizzes and feedback in the Five days ***Professional Development Program on 'Online Modalities & Professional Communication'*** held during **14th-18th February 2022**.

PDP-OMPC/PC-065

Dr. Debashis Bhowmick
Vice-principal &
Member IQAC, JIT

Dr. Smita Acharya
Director-IQAC
RTM Nagpur University

Samridhi Sarwajanik Charitable Trust's

Jhulelal Institute of Technology
Department of Applied Science & Humanities
&
Internal Quality Assurance Cell,
Rashtrasant Tukadoji Maharaj Nagpur University

jointly organizes

Five days Professional Development Program on 'Online Modalities & Professional Communication'

...An Administrative Training Program

Participation Certificate

This certificate is presented to **Vijay Bhanudas Gujar** of **Arvind Gavali College of Engineering,Satara** for attending as well as satisfactory and timely submission of all the scheduled quizzes and feedback in the Five days ***Professional Development Program on 'Online Modalities & Professional Communication'*** held during **14th-18th February 2022**.

PDP-OMPC/PC-028

Dr. Debashis Bhowmick
Vice-principal &
Member IQAC, JIT

Dr. Smita Acharya
Director-IQAC
RTM Nagpur University

AISSMS
COLLEGE OF ENGINEERING
ज्ञानम् सकलजनहिताय
(Accredited by NAAC with grade A+)

Certificate of Participation

This is to certify that

Mr. Vijay Bhanudas Gujar from **Arvind Gavali College of Engineering Satara**

has participated in AICTE Quality Improvement Scheme (AQIS) sponsored

one week online Short Term Training Program on

"Innovative & Inventive Problem Solving"

organised by Department of Production Engineering, AISSMS COE, Pune during 29th June to 04th July 2021.

Dr S H Wankhade
Head, Department of
Production Engineering

AISSMS COLLEGE OF ENGINEERING PUNE

Dr D S Bormane
Principal
AISSMS COE, Pune

STTP-IIPS-P2-2021000155

AISSMS
COLLEGE OF ENGINEERING
ज्ञानम् सकलजनहिताय
Accredited by NAAC with "A+" Grade

CERTIFICATE OF PARTICIPATION

This is to certify that

Mr. Vijay

Bhanudas Gujar Of *{{organization}}* has successfully participated in the "**KARGIL VIJAY DIWAS**" Quiz Competition organised by **Department of Electrical Engineering**, in association with **ISTE Students Chapter.**

Mr. Rahul Shinde Faculty Co-ordinator	Mr. Nitin Mawale Faculty Advisor	Dr. Mrs. A.A. Godbole HOD, Dept. of Electrical Engineering.	Dr. D.S. Bormane

<<certificate id>>

AISSMS
COLLEGE OF ENGINEERING
ज्ञानम् सकलजनहिताय
(Accredited by NAAC with grade A+)

TRIZ Association of ASIA

Certificate of Participation

AISSMS_Webinar_2021000355

This is to certify that

Vijay Bhanudas Gujar from **Arvind Gavali College of Engineering**

has participated in webinar on

"Innovation in Technology Adoption and Development of High Precision Slipring: A Case Study"

organised by Department of Production Engineering and Institution of Engineers (India), Kolkata Students' Chapter, AISSMS COE, Pune in association with TRIZ Association of Asia on 18 July 2021.

Mr Nitin Shekapure Assistant Professor, Production Engineering	**Mr N P Mavale** Coordinator, Institution of Engineers Students' Chapter	**Dr S H Wankhade** Head, Production Engineering.	**Dr D S Bormane** Principal

Amar Seva Mandal's

Govindrao Wanjari College of Engineering & Technology,Polytechnic,Nagpur

AICTE-ISTE Approved

Faculty Development Programme

On

"Outcome Based Education and NBA Perspective"

CERTIFICATE

This is to certify that, **MR.Vijay Bhanudas Gujar** has participated in Faculty Development Program on **"Outcome Based Education and NBA Perspective"** from 02/03/2022 to 04/03/2022.

Mr. R. S. Kuhite
Polytechnic Coordinator,
& FDP Coordinator,
GWCET,Polytechnic,Nagpur

Dr. S. A. Chavan
Principal & Convener,
GWCET,Polytechnic,Nagpur

Dr. Ambedkar Institute of Technology

An Autonomous Institution, Aided by Government of Karnataka, Affiliated to VTU, Belagavi
BDA Outer Ring Road, Near Jnana Bharathi Campus, Mallathahalli, Bengaluru- 560056, Karnataka

Jointly Organized by

Department of Electronics & Communication Engineering

and

Institute of Engineering & Technology,Dr. Ram Manohar Lohia Avadh University, Ayodhya, UP

In Association With

ISTE Dr.AIT Students Chapter

TEQIP – III

CERTIFICATE OF PARTICIPATION

This is to certify that **Mr. Vijay Bhanudas Gujar** from **Arvind Gavali College of Engineering** has participated in the webinar on **" Make the habit... Habit will make you "** held on **06/07/2021** organized by the Department of Electronics and Communication Engineering at Dr. Ambedkar Institute of Technology, Bengaluru.

Dr. Ramesh S.
Professor & Head
Dept. of ECE

Dr. M.Meenakshi
Principal

Coordinators :

Dr. Shilpa K.C
Assistant Professor
Dept. of ECE

Ms Shwetha N
Assistant Professor
Dept. of ECE

Mrs Sangeetha N
Assistant Professor
Dept. of ECE

Citizens Educations Society's

Shri Bhayyaji Pandharipande National Institute of Social Work

Certificate

OF PARTICIPATION

this certificate is proudly awarded to :

Vijay Bhanudas Gujar

AS A PARTICIPANT IN THE NATIONAL ONLINE CONFERENCE ON "PROBLEMS OF SENIOR CITIZEN & THE MAINTENANCE AND WELFARE OF PARENTS ACT, 2007" ORGANIZED BY SHRI BHAYYAJI PANDHARIPANDE NATIONAL INSTITUTE OF SOCIAL WORK, HANUMAN NAGAR, NAGPUR ON FEBRUARY 26, 2022.

Prof. Laxmi S. Dakhole
ORGANIZER

Dr. A. S. Barde
PRINCIPAL, BPNISW

No:ATAL/2021/1624694213

ALL INDIA COUNCIL FOR TECHNICAL EDUCATION

Nelson Mandela Marg, Vasant Kunj, New Delhi – 110 070

AICTE Training And Learning (ATAL) Academy

Certificate

This is certified that **Samina Y. Mulla**, **Assistant Professor** of **Arvind Gavali College of Engineering Satara** participated & completed successfully AICTE Training And Learning (ATAL) Academy **Online Elementary** FDP on " **Applied Machine Learning**" from **2021-07-21** to **2021-07-25** at **Indian Institute of Technology Ropar**.

Adviser-I, ATAL Academy

Digitally Signed

Coordinator

Ref. No. Dr. AIT-FA/IRC/IW-1/09-08-2021

Dr. AMBEDKAR INSTITUTE OF TECHNOLOGY

An Autonomous Institution, Aided by Government of Karnataka, Accredited by NAAC and Affiliated to VTU, Belagavi
BDA Outer Ring Road, Mallathalli, Bengaluru-56

&

INSTITUTE OF ENGINEERING TECHNOLOGY

Dr. RML Avadh University, Ayodya

CERTIFICATE OF PARTICIPATION

This certificate is proudly presented to Ms.Samina Y Mulla, of Arvind Gavali College of Engineering Satara for participating in International Webinar on "Natural Language Processing as a tool for Reasoning" on 09th of August 2021.

Dr. Nandini Prasad K S
Dean (Foreign Affairs), Dr A.I.T, Bengaluru

Dr. M Meenakshi
Principal, Dr. AIT, Bengaluru

AISSMS
COLLEGE OF ENGINEERING
ज्ञानम् सकलजनहिताय
Accredited by NAAC with "A+" Grade

DEPARTMENT OF ELECTRICAL ENGINEERING

ONE Week Faculty Development Program on

Modern Trends in Energy Systems

Date: 7th February - 11th February 2022

Certificate

This is to certify that ***Prof. Dr. B. M. Nayak***
Of ***Arvind Gavali College of Engineering, Satara***
has Successfully attended the One Week Faculty Development Program on ***Modern Trends in Energy Systems*** *Organised by Department of Electrical Engineering in association with*
IETE, IEI, IEEE.

Mrs. V. N. Tarange Faculty Co-ordinator	Dr. Mrs. A. A. Apte Faculty Co-ordinator	Dr. Mrs. A.A. Godbole Head, Dept. of Electrical Engg	Dr. D.S. Bormane Principal, AISSMS COE

Certificate

This is to certify that ***Dayanand Bajirao Jagtap***
has successfully Completed ISTE approved One Week Faculty Development Programme on **"Simulation Tools for Research"** held during 08-02-2022 to 14-02-2022 organized by **Sharad Institute of Technology, College of Engineering, Yadrav, Ichalkaranji.**

Mr. A.L.Jamadar	Ms.P.D.Ghate	Dr. S. A.Khot	Mr. Anil Bagane
ISTE Secretary	**Dean, FDP**	**Principal**	**Executive Director**
SITCOE, Yadrav	**SITCOE, Yadrav**	**SITCOE, Yadrav**	**SITCOE, Yadrav**

Certificate

This is to certify that ***SANSKRUTI BHARATBHUSHAN NALAWADE*** has successfully completed the AICTE-ISTE approved Orientation/Refresher Programme on ***"Smart System & E-Mobility Challenge"*** held during **10.02.2022** to **16.02.2022** organized by ***Yashwantrao Bhonsale Polytechnic, Sawantwadi, Maharashtra.***

Director (FDC) **AICTE, ND**	**Executive Secretary** **ISTE, ND**	**Program Coordinator** **YBP, Sawantwadi**	**Principal** **YBP, Sawantwadi**

Dr. Babasaheb Ambedkar Technological University, Lonere

State Technical University, Maharashtra Act No. XXIX of 2014

AVISHKAR 2022

Certificate

This certificate is presented to

Mr. Arjun Arun Kadam

for working as coordinator for University level Avishkar 2022 held at

Arvind Gavali College of Engineering, Satara

on 24th December 2022.

Dr. S. V. Khobragade
Coordinator, Avishkar
Dr. Babasaheb Ambedkar Technological University, Lonere

Dr. Babasaheb Ambedkar Technological University, Lonere

State Technical University, Maharashtra Act No. XXIX of 2014

AVISHKAR 2022

Certificate

This certificate is presented to

Dr. Gayatri Mirajkar

for working as coordinator for University level Avishkar 2022 held at

Arvind Gavali College of Engineering, Satara

on 24th December 2022.

Dr. S. V. Khobragade
Coordinator, Avishkar
Dr. Babasaheb Ambedkar Technological University, Lonere