Volume 9 September 2020

The Institution of Engineers (India)
8 Gokhale Road, Kolkata 700020

A Scientific and Industrial Research Organisation
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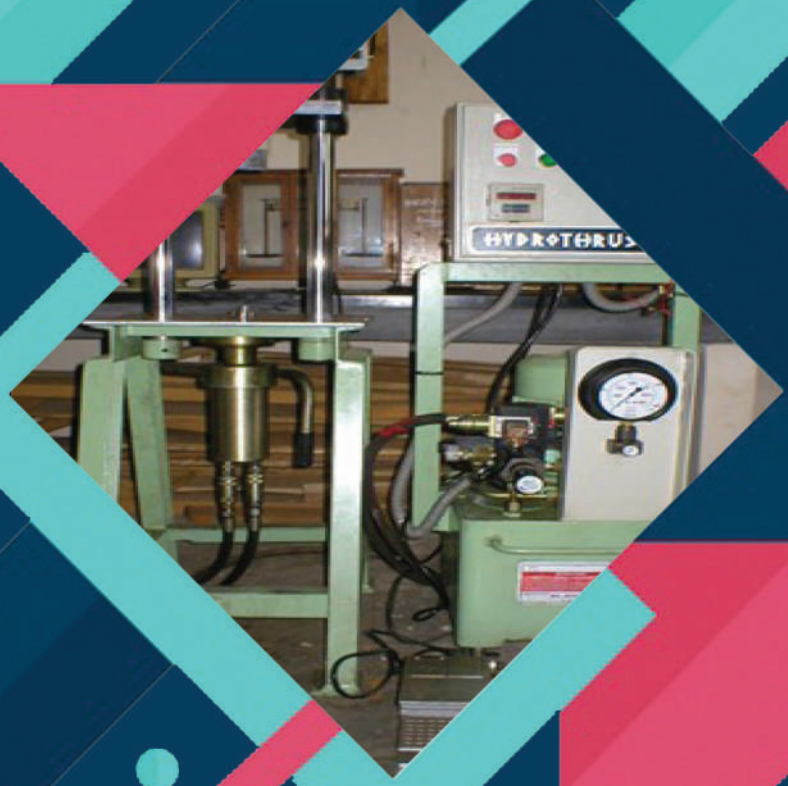


# Compendium on R&D Projects

## under the IEI Grant-in-Aid-Scheme

# The Institution of Engineers (India)

## Notification for

# R&D Grant-in-Aid

To promote appropriate technology, assist in building up design & research talents and, most importantly, to help in nurturing potential R&D venture amongst engineering students pursuing Diploma/UG/PG/PhD courses, The Institution of Engineers (India) had instituted the R&D Grant-in-Aid program way back in 2001.

Like every year, the Institution invites applications for funding R&D projects and research initiatives aimed at improving the life-style of common people from engineering students pursuing full time Diploma/UG/PG/PhD engineering program from AICTE/UGC/NAAC approved Institutions/Colleges/Universities. The application form and guidelines are available in our website https://www.ieindia.org. The projects should be carried out under the guidance of faculty members who are Corporate Members of IEI. Membership criteria for student(s), guide(s) and Institution(s) are as follows:

| Project Category | Student/Applicant Membership | Guide(s) Membership | Institutional Membership |
|---|---|---|---|
| 1. Diploma | Exempted [Membership of Student Chapter is desirable] | AMIE/MIE/FIE | Not Mandatory |
| | Preferably 'Student Member' (SMIE) | AMIE/MIE/FIE | Applicant's Institute should preferably be an Institutional Member with valid NIRF Rank |
| 2. UG (BE/BTech/AMIE/Equivalent) | 'Student Member' (SMIE) | AMIE/MIE/FIE | Applicant's Institute should preferably be an Institutional Member with NBA / NAAC Accreditation or valid NIRF Rank |
| 3. PG (ME/MTech/Equivalent) | AMIE/MIE/FIE | MIE/FIE | Applicant's Institute should preferably be an Institutional Member with NBA / NAAC Accreditation or valid NIRF Rank |
| 4. PhD | AMIE/MIE/FIE | MIE/FIE | Applicant's Institute should preferably be an Institutional Member with NBA / NAAC Accreditation or valid NIRF Rank |

The soft copy of the duly filled-up applications (in editable format), as per the proforma available in our website www.ieindia.org, should be sent through email to research@ieindia.org and one printed copy of the same should reach the following address:

**Director (Technical)**

**The Institution of Engineers (India), 8 Gokhale Road, Kolkata 700 020**

Applications received in format other than that available on our website will not be accepted. Application should be forwarded through the Guide, Head of the Department or Head of the Institution. Please note that preference will be given to project proposals received from Institutions who are members of The Institution of Engineers (India) and with NBA / NAAC Accreditation or valid NIRF Rank. Kindly go through the guidelines (visit link https://www.ieindia.org/webui/IEI-Activities.aspx#RnD-Initiative) carefully before filling up the application.

The grant is not intended for the faculty members who have access to other avenues of research funding. Proposals received will be scrutinized and the recipients of R&D Grant will be informed accordingly.

# Message from the

## *President*

I am glad to note that the Compendium on R&D Projects under IEI R&D Grant-in-Aid Scheme, Volume 9, for the year 2020-21 is being published. Apart from the content, which is truly enriching, it also important to see that students are gaining knowledge about fieldwork, laboratory applications and report writing.

The IEI R&D Grant-in-Aid scheme has been successful in inviting young researchers and providing them with the freedom to vigorously pursue with their concepts and ideas and come up with meaningful outcome with deep social impacts. It also helps them to gain an insight into the process of research, technical documentation, literature survey and develop a penchant for pursuing R&D as a career option. This augurs well for the knowledge based society and as a professional society it would be our endeavour to try and encourage more students to become agents of change, to think outside the box, and to participate in finding real answers and solutions to real life questions and challenges.

It is encouraging to see that some of these research outcomes have been published in reputed Journals/ Conference proceedings and speaks immensely about the success of this program. The ninth edition of the Compendium on R&D Projects under IEI R&D Grant-in-Aid Scheme is a compilation of 43 completed project addressing a wide area of research covering almost every engineering discipline. Our Compendiums are widely and ardently followed by the academic as well as the research fraternity and industry and with its wide reach-out provide the project teams a suitable platform to showcase their ideas and talent.

I believe that the present Compendium will bring in new enthusiasm and innovative thinking into R&D activities and script many more success stories in the days ahead.

Er Narendra Singh, FIE
*President, IEI*

## Message from Chairman
## Committee for Advancement of Technology and Engineering

I have the pleasure to present the Compendium on R&D Projects-Volume 9. The Institution of Engineers (India) has taken up the role of promoting R&D through funding and active participation in meaningful R&D venture. The initiative launched way back in 2001 has now manifested into a full-fledged program with over thousand beneficiaries across the country. The scheme has provided the students with opportunity to engage in formal and informal learning environments thereby assisting them to develop research acumen. I am pleased to mention that several research work carried out from these R&D funding have been widely acclaimed and has been published in IEI-Springer as well as other International Journals which speaks about the success of the program.

The Compendium on R&D Projects is a reflection of IEI funded research carried out in the frontier areas of technology. It is an initiative showcasing efforts put in by the students engaged with research within and/or beyond the formal curriculum with an aim to further improve their knowledge and understanding. The ninth volume is being brought out with the objective of showcasing the talent pool of engineering students that we are proud to nurture and support.

Prof Swapan Bhaumik, FIE
*Chairman, CATE, IEI*

## Message from Chairman
## Research & Development Committee

The Grant-in-Aid scheme was instituted by The Institution of Engineers (India) way back in 2001 with the objectives of nurturing innovative thinking and fresh talents in technology and engineering and thereby providing a student with the opportunity to develop their technical skills and gain insight into latest researches in the field. Our Grant-in-Aid Scheme allows students to develop professionally and personally. By virtue of membership, the beneficiaries stand to benefit from a wide array of services on offer from an age old professional body like The Institution of Engineers (India). Furthermore, the funding encourages them to think beyond financial constraints and come up with novel and unique propositions which results in meaningful outcome with impact. The research experience gained in the process gives an opportunity to gain a deeper knowledge of research techniques and processes, apply classroom learning in real-world contexts, explore academic literature, and form meaningful relationships with faculty members and professional researchers. We take pride in informing that our efforts have been duly recognized by the Ministry of Science and Technology, GoI who have identified the Institution as a Scientific and Industrial Research Organization (SIRO).

Like every year, it has been a pleasure to bring out the Compendium on R&D Projects under IEI R&D Grant-in-Aid Scheme, Volume 9, which provides an array of 43 fascinating and enterprising projects carried out with modest funding from IEI most of which have deep social implications.

Dr Wooday P Krishna, FIE
*Chairman, RDC, IEI*

सूचना का अधिकार
RIGHT TO INFORMATION

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(आईएसओ 9001:2008 प्रमाणित विभाग)
(AN ISO 9001:2008 CERTIFICED DEPARTMENT)

सत्यमेव जयते

भारत सरकार
विज्ञान और प्रौद्योगिकी मंत्रालय
वैज्ञानिक और औद्योगिक अनुसंधान विभाग
टेक्नोलॉजी भवन, नया महरौली मार्ग,
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GOVERNMENT OF INDIA
MINISTRY OF SCIENCE AND TECHNOLOGY
Department of Scientific and Industrial Research
Technology Bhavan, New Mehrauli Road,
New Delhi - 110016

F.No.11/97/1988-TU-V

Date: 18th March, 2019

The Secretary & Director General
The Institution of Engineers (India)
8, Ghokhale Road,
Kolkata - 700 020
West Bengal

**Subject :** **Registration of Research Institution, other than a Hospital, for the purpose of availing Customs duty exemption in terms of Government Notifications No. 51/96-Customs dated 23.07.1996; No. 24/2007-Customs dated 01.03.2007; No. 43/2017-Customs dated 30.06.2017; No. 45/2017-Central Tax (Rate) & 47/2017-Integrated Tax (Rate) dated 14.11.2017; No. 9/2018-Central Tax (Rate), No. 09/2018-Union Territory Tax (Rate) & No.10/2018-Integrated Tax (Rate) dated 25.01.2018; and State Tax (Rate) as applicable and all notification, as amended from time to time.**

## CERTIFICATE OF REGISTRATION

This is to certify that **The Institution of Engineers (India), Kolkata, West Bengal** is registered with the Department of Scientific and Industrial Research (DSIR) for the purpose of availing Customs duty exemption in terms of Government Notifications No. 51/96-Customs dated 23.07.1996; No. 24/2007-Customs dated 01.03.2007; No. 43/2017-Customs dated 30.06.2017; No. 45/2017-Central Tax (Rate) & 47/2017-Integrated Tax (Rate) dated 14.11.2017; No. 9/2018-Central Tax (Rate), No. 09/2018-Union Territory Tax (Rate) & No.10/2018-Integrated Tax (Rate) dated 25.01.2018; and State Tax (Rate) as applicable and all notification, as amended from time to time. The Registration is subject to terms and conditions mentioned overleaf.

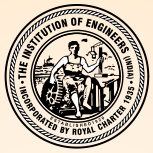
This Registration is valid upto **31.03.2022.**

Please acknowledge the receipt.

Yours faithfully,

Deshpande

**(Dr S.K. Deshpande)**
**Scientist - 'G'**



# The Institution of Engineers (India)

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(Established in 1920, Incorporated by Royal Charter 1935)

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***A Century of Service to the Nation***

# The Institution of Engineers (India)

Volume 9, September 2020


## Contents



## Compendium on R&D Projects under IEI Grant-in-Aid Scheme




**Publication Office**

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Email : technical@ieindia.org
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**Publisher**

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Secretary and Director General
for The Institution of Engineers (India)
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# Contents

# Cost Effective Design and Control of DC-DC Converter for Solar PV System

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## OBJECTIVES

The main objective of this project is to design and implement a DC-DC converter to encash cheap electricity from Solar PV system. The second objective is to create opportunity for the students who want to work on core sector and use their domain knowledge in developing a proper converter system. As, this institute in the remote location but having a number of small-scale business sectors, this technological development is likely to lead to some entrepreneurship possibilities as well. Last but not the least, successful completion of the project with IE(I) will be an achievement for the students.

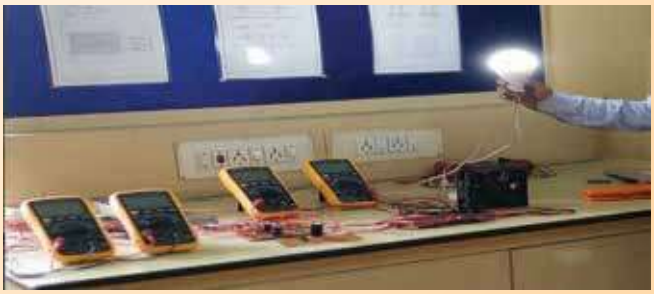
## ACHIEVEMENTS

1. The mentioned student had submitted the final year dissertation through this project by fulfilling the requirements to get their UG degree.
2. A research paper related to this project has been accepted and presented at IEEE International Conference UEM Green19 which was held during September 25-27, 2019.
3. After successfully completing the project, our college had been taken an initiative to install roof top solar system for our academic building and it is also successfully completed.

## PUBLICATION

A research paper related to this project has been accepted and presented at IEEE international conference UEM Green19 which was held during September 25-27, 2019.

**Experimental setup with load condition**



**After completion of project DC-DC Converter working**

# Extraction of Plastic Oil from Waste Plastics by Pyrolysis Process and using it as a Fuel for Diesel Generators in Rural Villages

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## OBJECTIVES

- To reduce dumped plastic waste and use them for energy generation
- To obtain plastic oil by pyrolysis process from waste plastics
- To provide fuel for Industrial and Automotive applications
- Developing an alternative to fossil fuel and thereby control pollution
- Blending with diesel to increase the efficiency and thereby controlling emission levels
- To control global warming and to compensate the depletion of fossil fuels.

## ACHIEVEMENTS

A semi batch pyrolysis setup was fabricated with reactor and condenser. Experimental investigation was carried out to analyse the amount of oil yield by the different plastics at different temperatures. By pyrolysis process without burning of plastics the alternate sources can be made effectively when compared to other methods. The relative by product and the pollution is minimised by this method. In order to achieve effective energy, the catalyst is added to improve the reaction rate at a higher level. The method is suitable to extract oil from mixture of plastics. The experiment shows the maximum oil yield from the low density polyethylene at 550°C. The result obtained shows at this temperature the bonds from the LDPE are broken completely and converted into gas phase in a short time. The percentage of un condensable gases are comparatively low.

The test result shows that the maximum yield obtained by LDPE is high, by varying other parameters and increase in the cooling temperature gives improved results. The long-time heating of this plastics and addition of catalyst give reduction in solid residue and allows conversion of all plastics into alternate resources.

Pyrolysis Reactor and Condenser

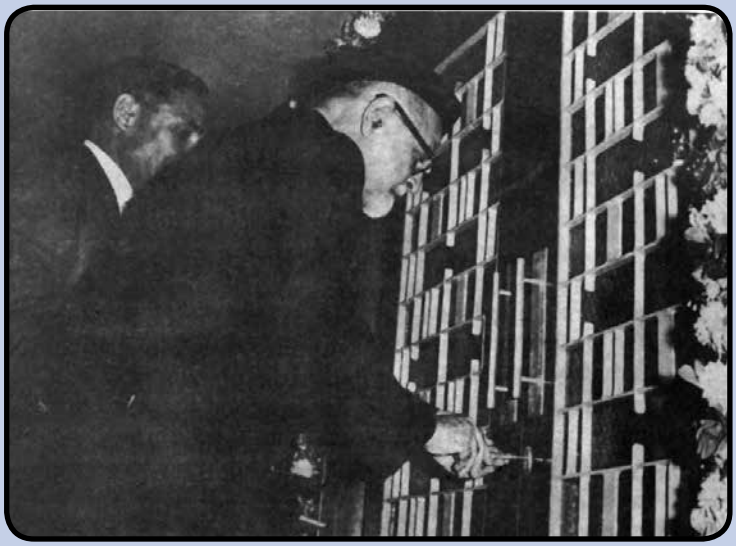
Pyrolysis Full Setup

## PUBLICATION


1. M. Rahul, et.al., "Extraction of Plastic oil from LDPE using pyrolysis method", International Conference on New innovation and automation in Mechanical Engineering (ICNIAME-2K18), ARM College of Engineering and technology, Chennai, 03-04, March 2018.

2. M. Rahul, et.al., "Extraction of Plastic oil from LDPE using pyrolysis", Third International Conference on Innovative & Emerging trends in Engineering & technology (ICIETET'18), Panimalar Institute of Technology, 09.03.2018.


## Legacy of IEI



**Dr Zakir Husain, President of India, opening the Main Door of the New IEI Headquarters Building**

# Integrated Secured Digitised Home using IoT based Sensors

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## OBJECTIVES

The objective is to implement a voice controlled complete home automation system using IoT based sensors. The voice command is processed using Natural Language Processing and then instructions are passed on to individual components causing them to switch ON or OFF.

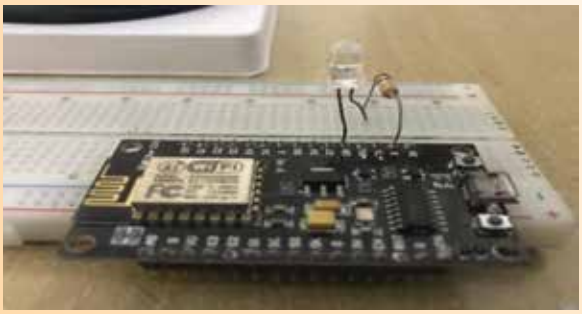
## ACHIEVEMENTS

The implementation of the home automation project is done successfully and is ready for deployment. The System not just accepts voice commands that are just in simple words like ON and OFF but can take in the statements and process them for identifying keywords for interpreting the instruction. This will be very useful for implementing a complete home automation system.

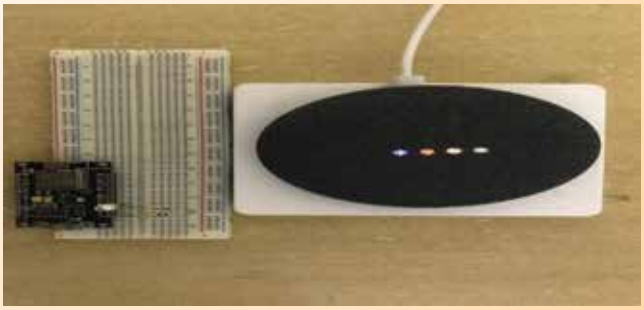
## PUBLICATION

A paper has been presented in "The International Conference on Automation, Signal Processing, Instrumentation and Control" (iCASIC 2020) on 28.02.2020 at Vellore Institute of Technology, Vellore.

The E-Proceedings have been sent to Springer Journal for publication.



**LED relay connected to System**



**Prototype using Google Home Mini**

# Comparison of Thermo Mechanical Properties of Low Cost/ in-house Feedstock Filament of FDM with Organic/Inorganic Reinforcement in Thermoplastics for Energy Storage Applications

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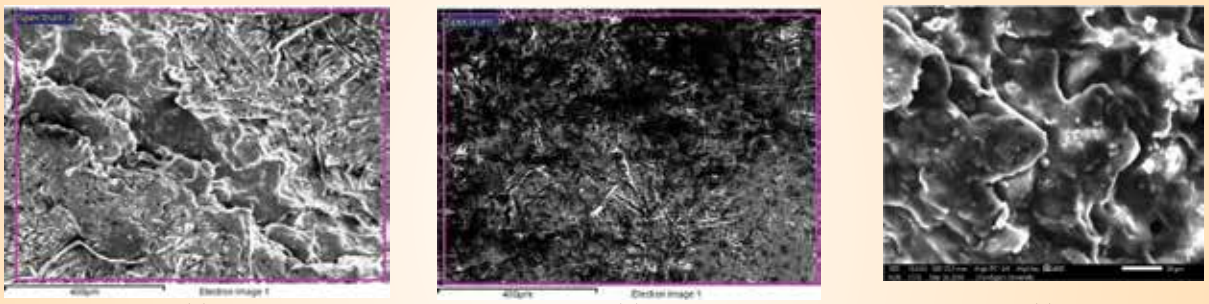

**(a)** **(b)** **(c)**

**SEM images (a) compositions (1-3); (b) compositions (2); (c) compositions (3)**

## OBJECTIVES

The work has been carried out with the following objectives :

i. To extract low cost graphene flakes form gaphene oxide by mechanical exfoliation method

ii. To establish the proportions of organic material (Nylon 6, paraffin wax and graphene flakes) and inorganic material (Nylon6+$NH_4Cl$+$ZnCl_2$ and Nylon6+$MnO_2$) based upon rheological testing (MFI)

iii. To analyze the distribution of blend by Fourier transform infrared spectroscopy (FT-IR) and scanning electron microscopy (SEM)

iv. To measure the thermal conductivity of Organic and Inorganic materials

v. To measure the thermal stability by differential scanning calorimeter (DSC) analysis.

## ACHIEVEMENTS

New feedstock filament materials for FDM have been successfully developed for the direct energy storage applications. The characterization of reinforced nanomaterial in polymeric material matrix (LiMnO, graphite and $NH_4Cl$ in Nylon 6) have been carried out in terms of melt flow index value (MFI), differential scanning

calorimeter (DSC) and finally, structural changes have been observed by FT-IR and SEM images. The following observations are recorded:

The 55%, 50% and 42% loading of LiMnO, $NH_4Cl$ and graphite respectively in Nylon 6 matrix have almost same MFI value and equal to standard ABS material. So these compositions can be considered as an alternative FDM feedstock filament materials and energy storage devices can be printed on FDM without any modification in hardware and software.

The DSC results indicates that, the decrease in the values of TC,Tm, Xm and Xc have been observed with the inclusion of reinforced materials in Nylon 6 matrix. Although the nucleation effect occurs in the matrix but the reinforcement slightly hinders the particle movement and diffusion of Nylon 6 molecular chains to the surface of the nucleus in the compositions.

Fourier-transform infrared spectroscopy study indicates chemical structure change observed with the inclusion of LiMnO, graphite and $NH_4Cl$ in Nylon 6. Further, FT-IR data confirms the reinforcements in Nylon 6 matrix.

Finally, the SEM images illustrates their uniform distribution of different reinforced materials in the mixture. Moreover, no lumps or agglomerations are observed.

The future work will be focused on the development of feedstock filament of developed compositions. The potential applications of this investigation will be the printing of functional parts of energy storage device such as dry cell, having tailor made geometry and capacity. Moreover, it will also cater to polymeric waste disposal in an economical manner.

## PUBLICATION

- One B. Tech major project.
- Book chapter on "Nanomaterial in Additive Manufacturing for Energy Storage applications"Handbook of Polymer Nanocomposites for Industrial Applications (Oxford: Elsevier) (Submitted).

## ACHIEVEMENTS

The outcome of this study is useful for reducing the plastic/polymer waste. The developed technology is in line with the Government of India initiative "Make In India" as this has led to the in-house development of alternative FDM wire feedstock filaments.

> Engineering is the science of economy, of conserving the energy, kinetic and potential, provided and stored up by nature for the use of man. It is the business of engineering to utilize this energy to the best advantage, so that there may be the least possible waste.
>
> *William A. Smith, 1908*

# Smart-Navigation System for Visually Impaired Persons (SMART NAV)

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## OBJECTIVES

The very clear objective of this project is to serve visually impaired persons. Survey shows that India is the home of largest number of blind people in the world. Out of the 38 million (approx.) blind people all over the world more than 15 million people are in India. This project gives direct benefit to the blind people in our society.

This system helps them to navigate independently. They do not need to ask anybody for help as they can make their own way. This system is not so complex and also user friendly. On entering the destination address from any location the system will not only help them to navigate but also make them aware about the obstacles present in the way.

The most important thing is that this system does not need any internet connection or mobile network access, which may be difficult for them to use. They just have to switch on the system from their source location and as per the given instructions the system will navigate them to the destination.

This system behaves like a friend on whom a blind person can trust that it will drop them at their location without any hesitation or creating any problem. This system makes the blind user smart and self-dependent that is why the system is named as SMART-NAV.

## ACHIEVEMENTS

This project SMART-NAV has been done in SEVEN phases.

Phase I (Designing of the system and component selection)

The system design is the first step of the project. The project was done step by step as per the block diagram and the hardware design was carried out according to the circuit diagram. After this part the necessary components are selected.

Phase II (Data collection)

Collection of data means collection of latitude and longitude of each and every position of the path. For this purpose we need Microcontroller unit, GPS module and SD card module. With the setup a test run was carried out in the college (CIEM) campus, which is large enough. The coordinates are taken around 20 meter distance for better efficiency. At each location the system is switched on and the GPS will get the co-ordinate of that location and that is saved to the SD card present in the SD card module.

Phase III (Making Database and Map)

After collection of all the data points, A CSV (Comma separated Value) file is made with all those points and the address responsible for that point is selected. Then, with GIS (Geographic Information System) concept, the

Diagram I: Complete project


Diagram II: GPS module Neo M8N

Diagram III: Voice recognition module

Diagram IV: SD card module

map is made with those points stored in the database in the form of .GPX format which is basically an XML file. This is the unique procedure applied to make the map rather using Google. The total map along the database is stored inside the SD card.

Phase IV (Voice recognition and synthesized audio output)

As per the system user will give the voice input and will get the voice output. For that purpose we need Speech-To Text and Text-To-Speech modules.

The Speech-To-Text module will able to detect the user's voice. For this purpose the module will be trained by the user as the system is bound to follow the instructions of the user only. When the user will provide the destination the data is searched from the database.

Phase V (Making the route)

The GIS algorithm is applied to make the shortest route for the user. The .GPX file contains the map data. Then user will give the destination address and that location will be searched and the route from source to destination will be created and as per the database for that particular route the direction information is provided to the user.

Phase VI (Obstacle detection)

Another important property of this system is to detect the obstacle and make the user aware about it. The most priority is given to this event of facing obstacle. For this ultra-sonic technology is used with the voice command. When an obstacle will be detected by the ultrasonic module, the system will vibrate to aware the user about the obstruction in front of him/her. The sensor can detect up to 4 feet range and its sector angle is about 30degree.

Phase VII (Final integrated testing)

After implementing the hardware setup the entire system is tested and this test is done several times in many ways as this is the final testing and the most important testing.

## RESULT AND DECLARATION

The project has been done successfully. This project can be commercialized and the project can be done on a single chip and the approximate price will be affordable for the common mass and the ultimate use of this project will be beneficial for the blind persons of our society.

# Infinity Printer

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**Project exhibition**

**Presented in project exhibition**

## OBJECTIVES

The main objective of this project is to make a 3D printer which is portable and the size of the model being printed is not limited by the bed size and frame of the printer, unlike the normal printers. Our main aim is to make an efficient printer with maximum accuracy and balance. This would open a gateway for infinite possibilities for building a 3D model. Existing 3D printers have a slower rate of fusion deposition but in this case we are using a technique there by increasing the rate exponentially. Wireless connectivity has been provided to the printing module to reduce the hassle of wires. The cost of this proposed product is also very much lower than the available conventional systems. Multiple colour slots are provided through a single nozzle which will allow the model to be printed in multiple colours. The requirement of support material is minimum.

## ACHIEVEMENTS

1)Selected as the best project at the Project Exhibition conducted by ASIET.

2)Best project design award at the APJ Abdul Kalam Innovation Challenge 2019.

## FABRICATION AND WORKING

After the study on different models of 3D printers available in the market, we came to the conclusion that the delta model of the 3D printer would be a better choice for the project model that we are considering. The reasons why we came to this conclusion is because the delta model would pave us a way to print models which are neither defined by the size of the frame nor the bed. Also, the movement of the hot end in the delta printer



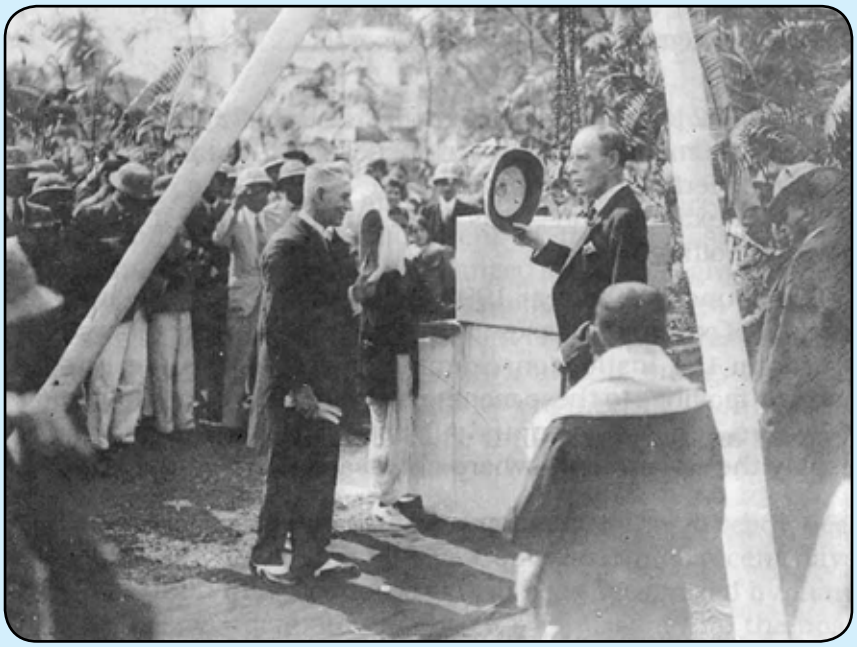
**LED relay connected to System**

is more adaptable compared to the Cartesian type 3D printer. The components that we used for making this project were finalized based on several researches on what could be the best possible components to be used so that we get optimum results. We chose double braided fishing lines for the strings which provided us with increased stability. We used half steps of the 'Nema' stepper motor for the operation, which gave us increased precision. After several mathematical calculations done by constant trial and errors we came to the conclusion to the exact values that needed to be entered into the program for its flawless working.

Several models were tested, and flaws and problems were rectified. All the components chosen for this project were done keeping in mind to reach our goal of making a frame less 3D printer without compromising in efficiency, precision, speed or print quality. We not only looked on the quality of the print but also the feasibility of the printer, that is the cost of the components used and the power consumption of the printer, for example there are other motors that could be used for the purpose, like the Nema 23 stepper motor, but instead we used the 'Nema' 17 which provided us with suitable amount of torque at low energy compared to the 'Nema' 23.

We successfully completed the construction of Infinity Printer. Trial prints had a precision of 1mm. Print had an infill of 25%. Trial print was of 300mm in height and 80mm in diameter. The print quality was comparable with a desktop 3D printer 'Ultimaker 2+ and was of good quality.

## Legacy of IEI



**Lord Irwin, Viceroy and Governor General of India, laying the Foundation Stone of the First Institution Building in 1930**

# Secure File Transfer Mechanism by Wireless Rubber Ducky Scripting using Raspberry PI

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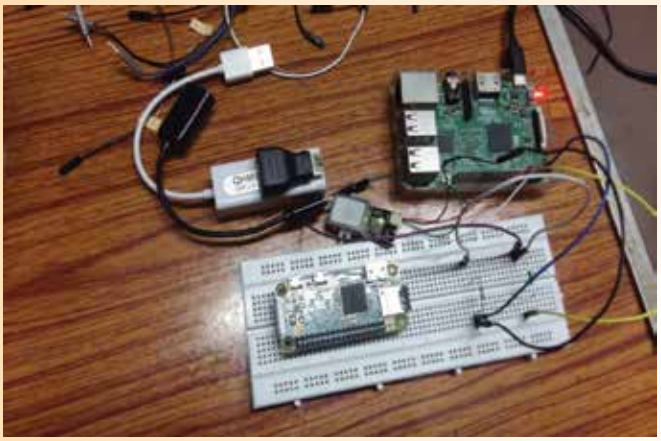

**The Physical setup of the project and components**


**Run the command from the attacker Computer and get connected with victim Computer.**

## OBJECTIVES

The objective of this project is to develop a wireless USB device which can bypass the security of the operating system and can access the files from the source computer and transfer it to the server computer.

This process would be performed in such a way that no Antivirus and Firewall can prevent the access to the file and also the user of the victim computer won't be aware about this process. Another aspect of this project is to monitor a system by tracing the malicious activities. So, this device could help to fight against the security threats mainly within an organization. This device could also be used as a penetration testing device or a loophole finder of a system as well.

The second objective of this project is to build a security system which can prevent this type of hacking of information from the victim computer. Device is also attached with the previous one and can be placed within the computer system.

This hardware device can restrict the unauthorized access of the intruder and allow the authorized user with biometric verification. So, this project can help the organization such as bank, military etc. where data confidentiality, integrity and authentication are of paramount importance.

## ACHIEVEMENTS

In the present work, we successfully install our vulnerability detector device module which is operated with the help of Raspberry Pi and monitored by security audit using an interface developed in python and shell programming. This process is ensured by looking up the security audit of the computer. The prerequisites involve insertion of the Raspberry Pi in the victim computer and wait for a while and when the Raspberry Pi start it's hotspot and we need to search and connect that network by selecting "P4wnP1" from Network and Internet section with the desired password. Thereafter, it interacts with putty software to control the Raspberry Pi by required IP address. This needs to be followed up by simply commanding FireStage1 from Putty application. Now to gain access of the victim's computer simply type 'shell' and now the command prompt is in the attacker computer. For stop the whole mechanism simply type 'exit'. A security audit can do several penetration testing as well as find the bugs from the systems or spy any kind of suspicious activity. In testing period we need only two computers and the Raspberry Pi. Illegal activities within a organization as well as the bug in the systems is rapidly increasing so to control all this parameters a security audit needs to be carried out using this device for monitoring this kind of activity. This device is very much environment-friendly for it's preloaded commands and tools. This project is developed with a small laboratory setup but it can also be implement for a big organization.

## Legacy of IEI

**His Excellency The President of India Dr Sarvepalli Radhakrishnan visited Hyderabad on 12th November 1966 and unveiled the Statue of Bharat Ratna Sir Mokshagundam Visvesvaraya erected in AP State Centre on the Raj Bhavan Road, Hyderabad**

# Lab View based Text Detection and Object Recognition Prototype for the Blind and the Dumb People

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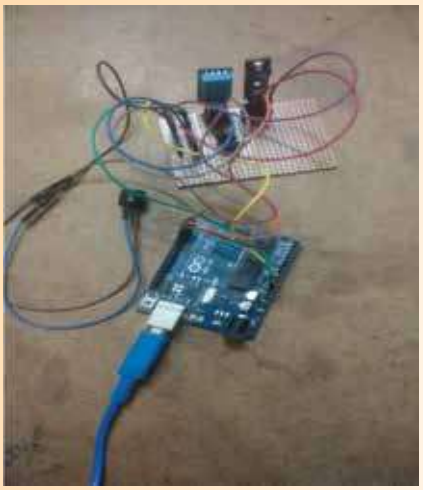


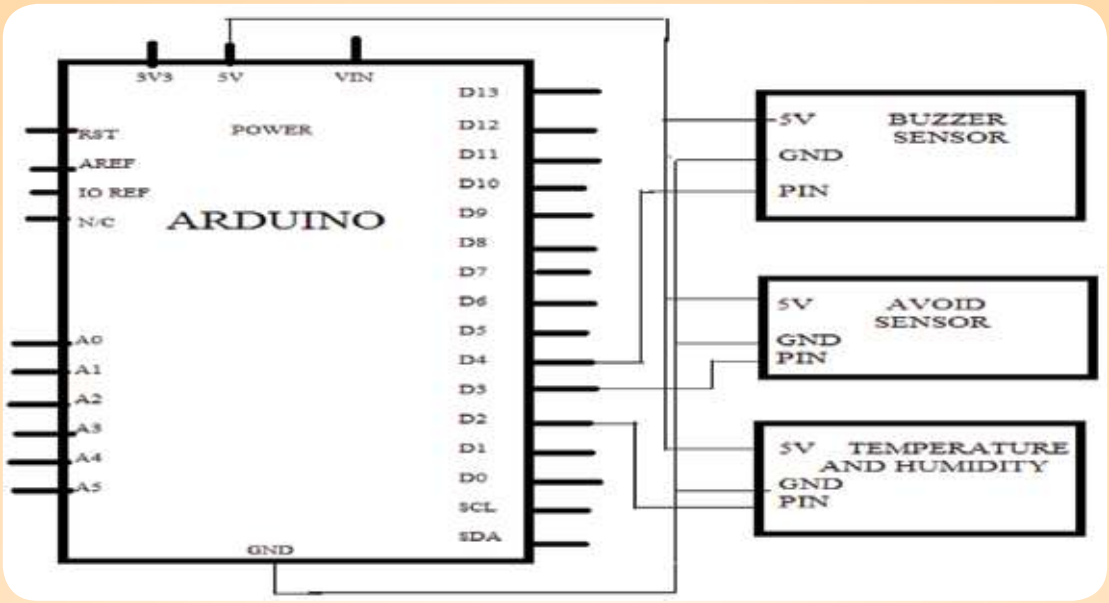
**Sensors kit interfaced with Arduino board**

**Output in LabVIEW front panel for DHT and Obstacle detection**

**Output in front panel for text to speech**

## OBJECTIVES

- Most of the people suffer with visual or auditory disabilities either because of weakness or lack of capacity to utilize the sensory organs such as eye and/or ear. These sensory organs basically have control over the remaining parts of the body. This predicament could be in-born or due to the age factor or sometimes meeting with may result from an accident. Disability affects the life of humans irrespective of its origin and reason. The disables require support from other people in their day to day activities.
- Sound source locator is inherently important for safety, survival and navigation of the physically challenged individuals. In addition to sound source locator the acoustic cues and the visual cues are needed for object detection, tracking and distance measurement etc.
- Object recognition and detection are considered most important help that we can provide through electronic travel aids for the blind since they need a totally independent travel kit that works on artificial intelligence
- Here the project is focused on the implementation of a hardware and software to recognize an object by using ultrasound technology
- Another objective of this project is to upgrade the object identification module to notify the temperature and humidity conditions of the location through buzzer.




**Prototype Implementation**

- The project also aims to design a prototype that helps the disables especially the blind and the dumb to walk free as a normal person identifying the objects as well as texts that comes on their way besides notifications of a temperature and humidity conditions of the concerned location.

## ACHIEVEMENTS

A module was developed which is helpful for the blind and the dumb people. The design using LabVIEW software and hardware sensors interfaced with Arduino board, achieved designed kit specifications and proved efficient for blind and dumb people with low cost equipment. With the help of this kit the persons with disability can be on their own and can also carry the kit along with them when in need. The project kit also gives the information about temperature and humidity report of their surroundings.

## DESCRIPTION

- The developed kit was tested using Arduino Uno board and sensors like obstacle sensor, temperature sensor, buzzer, text converter and Lab VIEW software.
- The blind people could identify an obstacle present in front of them with the help of a buzzer sound.
- The dumb people able to deliver their speech by entering the text in the software which is converted to speech and delivered through the speakers.
- Temperature and humidity could be identified by the device using temperature and humidity sensors.

# Development of Semi-Automatic Integrated Guidance System for Side Mirrors and Headlamps to Assist Drivers with enhanced Vision in Automobiles

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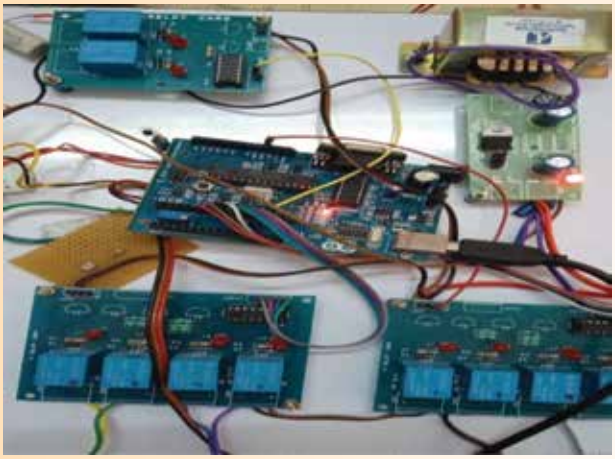

**Electronic Circuit of the Developed System**

**Driver Assistance System**

## OBJECTIVES

The developed driver assistance system reduces the number of accidents that are caused at night time in the Highways due to improper lighting. The developed system is sensor based and will regulate the heavy vehicle lighting without driver intervention. Even with inappropriate road conditions, poor visibility this assistance system is capable of adjusting itself and thereby avoids the accidents. The developed system is simple, efficient and a semi automatic system which can control the headlight and side mirrors of the vehicles automatically based on the surrounding road conditions. The developed system will have a microcontroller, which can be connected to the existing vehicles ECU and also it can function independently.

This microcontroller has control over the side mirrors and headlamps based on the input from the sensors which is used for predicting the road conditions. Six different road conditions in the night time were considered namely, high beam highway, high beam high speed, beam in fog, vehicle turning, junction passing and mountain climbing.

## ACHIEVEMENTS

a. Depending upon the side the driver turns the vehicle, the developed system turn the lamp and mirror accordingly.

b. When the vehicle is in inclined position, the head lamps get high beamed accordingly, so that the driver can have a clear view from his position.

c. There is a switch, which is used to diverge and converge the lamps at junctions and parking lot. It works similar to the cornering light.

d. Depending upon the climate conditions the luminosity of the lamps varies thus, easing the driver's vision. This is activated by using sensors.

e. The lamps are programmed to move in a 180-degree axis thus, the probability of any blind spots in front of the vehicles are reduced.

f. Since the system is semi-automated it does not need any special skill to operate the system.

g. Due to the option of cloud computing, the system doesn't need any physical inspections. This can be done with computers and smart devices.

## Legacy of IEI

**Pandit Jawaharlal Nehru, Prime Minister of India with Dr K L Rao, D P R Cassad at Delhi Centre**

# Real Time Waste Segregation

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**Complete system- Waste Segregator**

**Rotating Bin (Front View)**

**Rotating Bin (Top View)**

## OBJECTIVES

The rising population of India poses serious threats with regard to the availability of living space, utilization of natural resources and raw materials, education and employment. But another serious peril that follows is the escalating amount of waste generated each minute by an individual. Every city is grappling with the menace of ever increasing waste. An astounding 0.1 million tons of waste is generated each day in our country. Sadly, only 5% of this colossal amount of waste is recycled. In India, the collection, transportation and disposal of wastes are unscientific and chaotic.

A trend of significant increase in municipal solid waste generation has been recorded worldwide. This has been found due to over population growth rate, industrialization, urbanization and economic growth which have ultimately resulted in increased solid waste generation. Final destination of solid waste in India is disposal. Most urban solid waste in Indian cities and towns is land filled and dumped.

Our project deals with the topic i.e. waste segregation. An efficacious management needs to be materialized for better planet to live in. Hence, with our cost effective project proposal, we try to bring in the change. It deals with the minimization of manual labour for exclusion of waste into an automatic system. This system not only saves the manual segregators from the numerous health issues, but also proves to be economical to the nation. Besides, this system utilizes low cost components for the successful segregation of most types of waste. When installed in apartments or small colonies, it proves to be beneficial in sorting the waste at the site of disposal itself.

**So, the core objectives of our project are**

- Design a system to separate different types of waste from a mixture of waste, using centrifugal action
- Categorize separated waste into dry, wet, metallic and plastic
- Intimate to the concerned authority about the level of waste in the bins for easy waste management
- Addresses the challenge of separating wastes, even if they are packed inside a plastic kit

## ACHIEVEMENTS

As shown in the block diagram, the system consists of sensors such as inductive proximity sensor, capacitive proximity sensors and IR sensors and servo motor which is interfaced with Arduino UNO Board. Four types of materials are segregated namely metal, weightless plastic, weighted plastic and other organic dry wastes. Initially the waste will be in the form of mixed waste. Mixed waste is dumped into a roller which is continuously rotating and vibrating. The waste coming out from roller is made to fall in a conveyor belt which is activated when the waste cut the IR sensor. It will move the waste towards the corresponding direction for further detection. A delay is provided. The delay will help in effective sensing by the sensors. The waste is first detected by inductive proximity sensor. Inductive proximity sensor checks whether it is metal or non-metal.


If metal is detected a servo motor interfaced to the board will rotate 45 degree blocking its path and leading to a bin. And waste is then moved towards capacitive proximity sensor for detection of plastic. Weightless plastic will be separated by a rotating fan .Weighted plastic follows the same mechanism of metallic waste. Waste undetected will be considered as other organic dry waste. The main two types of sensors used are inductive

proximity sensor and capacitive proximity sensor for differentiating wet, dry and metallic waste. Two types of motors are used and they are stepper motor and servo motor. Stepper motor is used for controlling the operation of conveyer belt and servo motor is used for rotation of the bin which is placed at the lower portion. Even though there are large scale industrial waste segregators present, it is always much better to segregate the waste at the source itself. Generation of waste is an inevitable consequence of development and industrial progress. The economic value of waste is best realized when it is segregated. The benefits of doing so are that a higher quality of the material is retained for recycling which means that more value could be recovered from the waste. So this system helps in the proper management of waste. This L298N Based Motor Driver Module is a high power motor driver perfect for driving DC Motors and Stepper Motors. It uses the popular L298 motor driver IC and has the onboard 5V regulator which it can supply to an external circuit. It can control up to 4 DC motors, or 2 DC motors with directional and speed control. This motor driver is perfect for robotics and mechatronics projects and perfect for controlling motors from microcontrollers, switches, relays, etc. An H-Bridge is a circuit that can drive a current in either polarity and be controlled by Pulse Width Modulation (PWM). Pulse Width Modulation is a means of controlling the duration of an electronic pulse. In motors try to imagine the brush as a water wheel and electrons as the flowing droplets of water. The voltage would be the water flowing over the wheel at a constant rate, the more water flowing the higher the voltage. Motors are rated at certain voltages and can be damaged if the voltage is applied heavily or if it is dropped quickly to slow the motor down. Thus PWM. Take the water wheel analogy and think of the water hitting it in pulses but at a constant flow. The longer the pulses the faster the wheel will turn, the shorter the pulses, the slower the water wheel will turn. Motors will last much longer and be more reliable if controlled through PWM.

**Outcomes:** This system of waste segregation is able to

- Separate different types of waste from a mixture of waste
- Categorize separated waste into dry, wet, metallic and plastic
- Separate wastes, even if they are packed inside a plastic kit.

## PUBLICATION

Paper published in 2nd International Conference on Emerging Trends on Engineering Science, Technology and Management (ICETESTM-19), “Sensor Based Waste Segregations”, 2019 JETIR, Journal of Emerging Technologies and Innovative Research May 2019, Volume 6, Issue 5.

**Engineers participate in the activities which make the resources of nature available in a form beneficial to man and provide systems which will perform optimally and economically.”**

**L. M. K. Boelter**

# A Current Source Mode, Soft Switched, Single Inductor Dual Output Converter for Automobile LED Lighting Application

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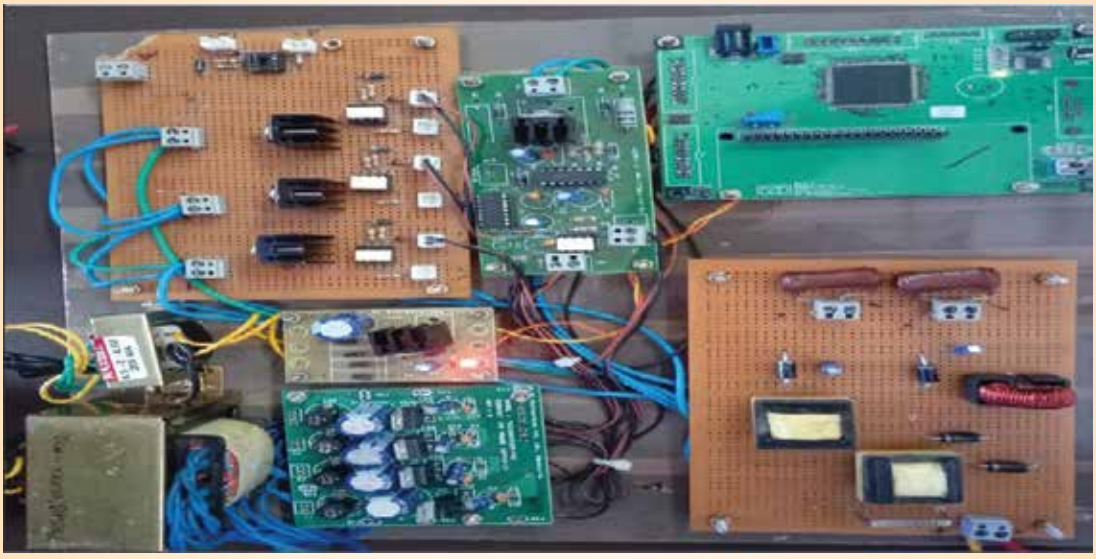
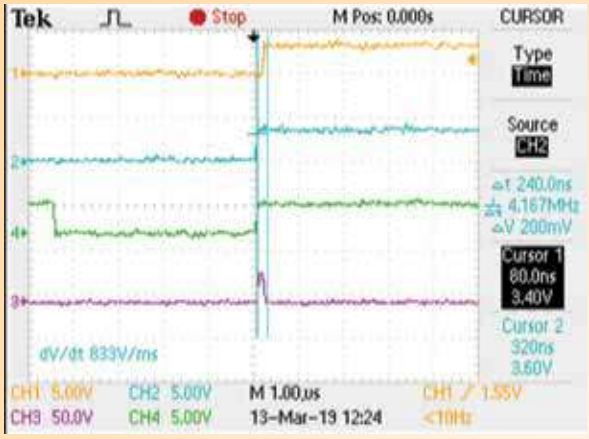


**Hardware layout**

## OBJECTIVES

- Single-inductor multiple-output (SIMO) light emitting diode (LED) drivers have the advantages of being compact, efficient, and low cost. However, the voltage-to-current transfer function of each output of the SIMO converter is not independent. The significant cross regulation issues necessitate the use of complex closed-loop control for achieving independent dimming function.
- This project proposes a current source-mode (CSM) SIMO DC–DC converter from duality principle, which is shown to be more suited for LED driving due to widened control range of the duty cycle and inherently inductor-less LED driving topology. The outputs of the CSM SIMO DC–DC converter are inherently independent, resulting in very simple control requirements involving only one closed loop controller for providing the constant current feeder, and several simple open-loop controllers for independent dimmable driving of LEDs.
- This project reduces the switching loss in the converter by introducing soft switching with zero voltage transition, initially for the main switch.




**Pulse Comparison of Switches $S_1$, $S_2$, $S_3$ and $S_4$**


**Voltage and Current Waveform across Main Switch with Zero Voltage Transition**

- Hence the objective of this project is to develop, A current source mode, single inductor dual output converter with zero voltage transition. The converter will have reduced switching losses and independent dimming possibility for each of the outputs with minimized cross regulation. The whole system is simple, reliable, and low cost.

## ACHIEVEMENTS

- In view of the driving requirement and characteristics of light-emitting-diodes (LEDs), the dual version of the traditional buck, the CSM converters are found to be highly suited for driving LEDs. The inherent absence of inductors and ease of control for independent dimming make the design of multiple-output converters much simpler.
- In addition, the simultaneous voltage step-up and step-down in case of multiple-outputs is possible. Thus independent control of output voltage for multiple output applications is achieved. It also simplifies the input power requirement, especially for portable devices. Soft-switching techniques applied to the PWM converters, reduces the switching losses.
- The proposed converter combines the advantages of the conventional PWM and the soft-switching resonant techniques.
- The proposed converter has an advantage of higher efficiency in comparison with the existing system. The proposed converter has been simulated and the results have been obtained accordingly.

## PUBLICATION

- Presented a paper on 'A Single Inductor Multi Output Converter for LED Automobile Applications' at SVCE Research Day on April 26,2019 and secured the first prize.

# Development of Multiple Nano particle Reinforced Aluminium Surface composite by applying Novel Offset Scribed- FSP Technique

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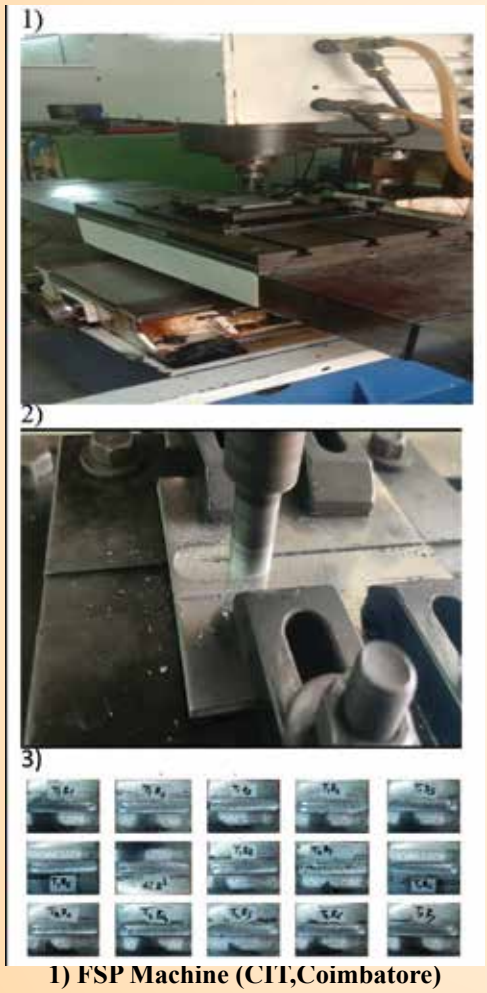


**1) FSP Machine (CIT,Coimbatore)**
**2) Carrying out FSP on plates.**
**3)FSPed Samples.**


**4) Cutting of specimen using wire EDM.**
**5) Surface roughness testing machine.**
**6) Specimen mounted for impact test.**

## OBJECTIVES

1. Development of scribed-FSP steel tool (EN24) with different scribe offset geometry.
2. Selection of proper process variables such as tool traverse speed, tool plunge depth, tool geometry etc. for optimum material flow.

3. Selection of multiple nano-particle deposition technique to produce surface composite.
4. Investigation of nano-particle distribution after FSP by high resolution microscopy.
5. Analysis of material flow patter under scribed-FSP tool using Finite Element Analysis.
6. Explore the effect of process variables on microstructural characteristics of the FSPed surface composite using optical and electron microscopy.
7. Explore the effect of process variables on wear characteristics of the FSPed surface composite.
8. Analysis of surface morphology after wear test of MNP surface composites.
9. Comparative analysis between single nano-particle (SNP) reinforced and multiple nano-particle (MNP) reinforced surface composites.
10. Prediction of the most suitable combination of FSP process variables on the basis of result obtained.

## ACHIEVEMENTS

Till date, only half of the characterization has been done.

Rest will be completed once situation is under control, further, on completion of full project 3 research papers and 1 patent application is supposed to be made.

The reason for the delay has been already mentioned and moreover due to covid-19 pandemic the delay has been prolonged.

The achievements made so far are:

1) Development of novel offset tool that is capable of making multi-vortex flow of material which results in better mixing and homogeneity.
2) There are hints of better tribological properties in the Offeset Scribed tool which will be confirmed from further tests.
3) The ideal mixture proportion is to be selected by taking all the mechanical test and concluding thereafter.

### Smart Brief

August 1 of every year is considered as the World Lung Cancer Day. Lung cancer persists to be one of the most regular cancers worldwide, claiming more lives every year than prostate, breast, and Colon cancers combined. It is calculated that lung cancer values for nearly one in five cancer deaths around the World. The American College of Chest Physicians (Commonly called as CHEST), alongside members of the Forum of International Respiratory Societies (FIRS), celebrates, commemorates, and supports those impacted by the lung cancer. FIRS join the grassroots efforts of the lung cancer association to raise awareness about the lung cancer and its global impact, generating an educational movement of learning lung cancer risks as well as early treatment globally.

# Modelling Attack Resistant Physically Unclonable Function Design and Testing on FPGA

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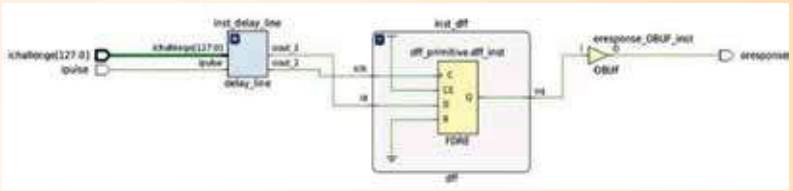
**Experimental setup of Basys-3 Artix-7 with Computer**



**Schematic Design of Arbiter PUF on Vivado**

## OBJECTIVES

Device identification and authentication are key issues of security today. Nowadays, cloning of ATM cards is a critical issue in the banking system and to prevent it, chip-based ATM cards are provided. Physical unclonable function (PUF) is the fingerprint of an electronic device which will prevent and provide a high security against cloning attack.

An Arbiter PUF (APUF) is a delay based strong PUF. An APUF is physically unclonable but a number of researchers have shown that if an adversary gets partial information of a challenge response pair database then using machine learning approach, they can predict the response of an unknown challenge with a high prediction accuracy of 99%. So, a modelling attack resistant PUF is highly required.

## ACHIEVEMENTS

We have designed the APUF circuit using 2x1 MUX for 8 and 16 stages. We have simulated the APUF circuit using Vivado design suit by output analysis. The APUF circuits design were downloaded using VHDL using Vivado design suit tools into the Artix-7 FPGA Kit. We have successfully deployed the FPGA hardware using VHDL and generated a simulation of our APUF circuit. Furthermore, we implemented the machine learning algorithm of logistic regression(LR) and support vector machine(SVM) in tensorflow using python, and got the accuracy of around 98.12 % for LR and 99.98% for SVM.

# Design and Fabrication of a Small Model of Bladeless Wind Turbine using Vortex Flow

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**Full view of the model**

**During experiment and recording of the reading**

## OBJECTIVES

Present technological advancement created high demand for electricity. However, in order to meet the higher demand, we cannot can't end up using more and more fossil fuel as this will have detrimental environmental effects. Traditional wind turbines are the devices which extract energy from wind; however this proven set up has got some drawbacks. Firstly, it is not economical in view of installation, running and maintenances Secondly, substantial wind is required to rotate the blades. Thirdly, heavy noise produced by rotor blades, which reduces the efficiency of the system, and also becomes vulnerable for the birds.

Researchers and developers are therefore looking for avenues to produce efficient wind turbines that will be efficient producing greater current at lower speeds. Our objective is to design and fabricate a model that generates electricity from wind energy and from different vibration. The proposed model is easy to install and economical. Also it can be placed over or near the area where vibration is present such as offshore, beside

railway tracks etc. The proposed model is simple in construction and made up of easily available materials. The model is based on the fundamental principle of von Karman vortex-shedding effect which states that an oscillating flow takes place in a fluid such as, air or water flowing past a bluff body at certain velocities, depending on the size and shape of the body. Due to this effect if any object placed in the direction of wind it oscillates. Due to relative motion between the upper and lower part of the model, any vibration from base also can be utilized to generate electricity through the alternator. Also, the proposed model has been designed in such a way that apart from the fluid flow other types of vibration can also be used to vibrate the mast.

## ACHIEVEMENTS

The philosophy of the proposed model is based on the phenomenon of oscillation of a long slender object placed in wind flow. Besides, wind energy being a clean source of energy and owing to its abundance in nature, a wind energy based model was conceived and designed. Very simple mechanism of spring mast equilibrium was first planned. Due to wind thrust, the equilibrium of spring mast assembly gets disturbed. However, the system tries come back to the equilibrium position through oscillation induced by the spring. Faraday's law states that the absolute value or magnitude of the circulation of the electric field E around a closed loop is equal to the rate of change of the magnetic flux through the area enclosed by the loop. The induced emf causes a current to flow without a potential difference due to separated charges. Attaching a pair of conductor coil with the mast assembly and placing it between a pair of magnet induces some amount of emf in the conductor coil. During the experiment an average range of 9 – 24 mV emf was induced in the circuit. A resistive coil of resistance 0.6 W/m was attached with the circuit in the parallel connection. The set-up was subjected to wind velocity in the range of 0.5-5.5 m/s. Also selection of spring plays a crucial role in oscillating frequency of the mast. Higher spring constant may produce higher determining the oscillating frequency with a shorter time period. Besides producing electricity in a pollution free manner, the proposed model comes with added benefits like simple circuitry which is economical and does not requires skilled technicians. Efficiency is also much better when mechanical energy is being converted to electrical energy compared to solar cells. Due to less mechanical components involved the frictional losses are also very less. In near future the project can be modified to various typical applications such as charging of mobile cells, domestic lighting or may be used for electric vehicles etc., where storage of that induced voltage should be defined very clearly. In future the work, supplemented with minor modifications, can be used for a wide range of applications.

## PUBLICATION

Deb A, Karmakar S, Priyadarshi P, Kumar P and Mahto P, Vortex flow wind turbine : An experimental study, Enlisted in Reason-A Technical Journal (ISSN-2277-1654).

Engineering is an activity other than purely manual and physical work which brings about the utilization of the materials and laws of nature for the good of humanity.

R. E. Hellmund

# Design and Fabrication of Power Electronic Interface for Fixing and Removal of Bearing and Coupling in Mechanical System using Induction Heating

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**Buck Converter With Uncontrolled Rectifier**

**Fluke 434 Series II Energy Analyzer**

## OBJECTIVES

Maintenance of electrical machines is an important aspect in all the industries. Periodic maintenance of the electrical machines is an indispensable process for proper functioning of the machines. The very first procedure and a time consuming work faced by the servicing industry is dismantling of bearings and couplings from the machine. The existing mechanical procedure to dismantle the bearing and coupling from the machines can be destructive, dangerous and cumbersome which involves using Pullers, Jigs, Inflammable Gas, Hammers, etc. The electrical heating methods are notably clean, convenient and can be precisely controlled. This project has the objective of providing a safe, hygienic, frugal and non-destructive device for the removal and fixing of bearing and coupling at maintenance industries.

The present work aims at designing a marketable product, single phase high frequency power electronic converter interface for producing high frequency current to heat the workpiece (bearings and couplings).

The objectives of this project are

- To have high power density for large heating surface and high temperature heating achieved
- To control the product using a low cost microcontroller without compromising its efficiency

- To get uniform heating with high degree of controllability and repeatability
- To reduce conduction loss by applying generated heat directly to package to improve efficiency and to save energy
- To ensure safety (no shock hazard) by implementing magnetically conductive package for eddy current production
- To have low maintenance requirements and user friendliness.

## ACHIEVEMENTS

Proper mounting and removal of bearings requires more time and manpower. The bearing damage is caused by using traditional removal methods like mechanical puller and gas heating which reduces the bearing life. Therefore, to reduce the risk of incorrect mounting and damage, an idea is proposed which makes use of portable induction heaters for bearing mounting applications. The proposed model utilizes solid state advanced power electronic converter, which saves time and reduces the working cost for heating the job without damaging. Besides, it is a safe, hygienic, frugal and non-destructive method for removal and fixing of bearing and coupling for use in maintenance industries. The research findings are summarized as below-

- Accurate electric current control helps in controlling the working temperature (heating the coil) using solid state power converter
- Housing of induction coil over the bearing periphery enables shorter heating time and less energy consumption
- Bearing supporter mallows heating of larger size bearings and reduce the risk of the bearing toppling during heating
- Temperature control helps in preventing bearing overheating
- LCD display and control panel forges to vary the frequency which makes the heater easy and safe to use
- Thermal over heating protection reduces the risk of damage to the induction coil and the electronics, enhancing reliability and safety
- This experimental approach investigation is valuable for the researchers to enhance the competence of power converter design for further investigations and to find better results.

"To give real service, you must add something which cannot be bought or measured with money"

Sir M Visvesvarayya

# Renewable Power Generating System using Highway Vertical Wind Turbine and PV Panel

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**Hybrid PV and Aluminium bladed vertical axis wind turbine**

**Hybrid PV and plastic bladed vertical axis wind turbine**

## OBJECTIVES

The main objective of the proposed project is to use the maximum amount of wind energy from vehicle running on highways. A considerable amount of pressurized air from vehicles is used to rotate the highway vertical axis wind turbine (HVWT) which converts the kinetic energy by generator. A solar panel is also used to generate power. The generated power by HVWT and PV panel are stored in a battery and this stored energy can be used for highway lighting, toll gates, traffic lights or other purposes for Indian National Highway during night time. The main motto of this project is to reduce the pollution generated by burning of fossil fuels and to save the conventional energy reserves of earth and provide uninterrupted power to highway appliances apart from the intermittent nature of wind and solar energy.

## ACHIEVEMENTS

The proposed project "Renewable power generating system using Highway vertical wind turbine and PV panel" would be a model for power generation using highway wind energy. The hybrid set up will generate power and charge the battery which ensures the continuous supply of power to the load which may be light, traffic signal, etc. This highway power generation unit will create awareness about the utilization of highway wind energy and vertical axis wind turbine usage for low power generation. Two models of vertical axis wind turbines were made and their performance was analyzed.

# Automatic Helmet Detection System

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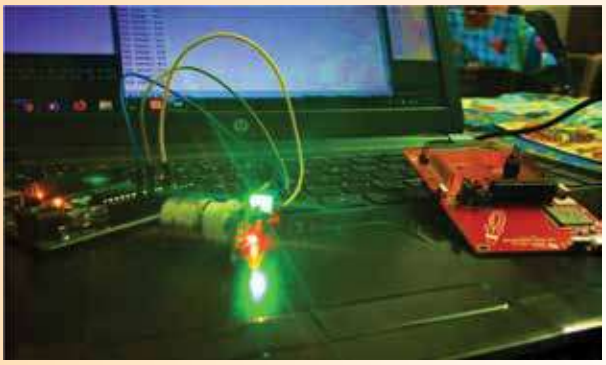
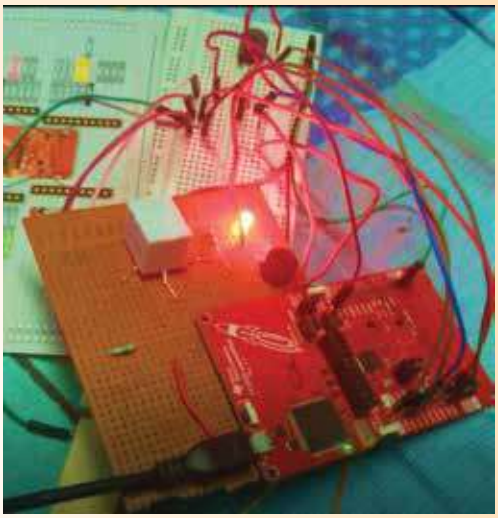


**Testing of the Sensor**



**Inner Circuitry**

## OBJECTIVES

In India more than 37 million people are using two wheelers. Since, usage is high, accident percentage of two wheelers are also high compared to four wheelers. Two wheelers have a high rate of fatal accidents than four wheelers. The impacts of these accidents are more serious when the driver involves in a high speed accident without wearing helmet. It is highly dangerous and can be fatal. So wearing a helmet can reduce the number of accidents and may save many a lives. This proposal aims to bring down the number of fatal accidents by developing a system that has the ability to detect whether the driver of the two wheeler is wearing a helmet. The system will prevent the start of the two wheeler if it detects that the driver is not wearing any helmet.

**Work Procedure:**

At very basic our whole system is divided into two parts. One is bike part and another is helmet part

**Helmet Part:**

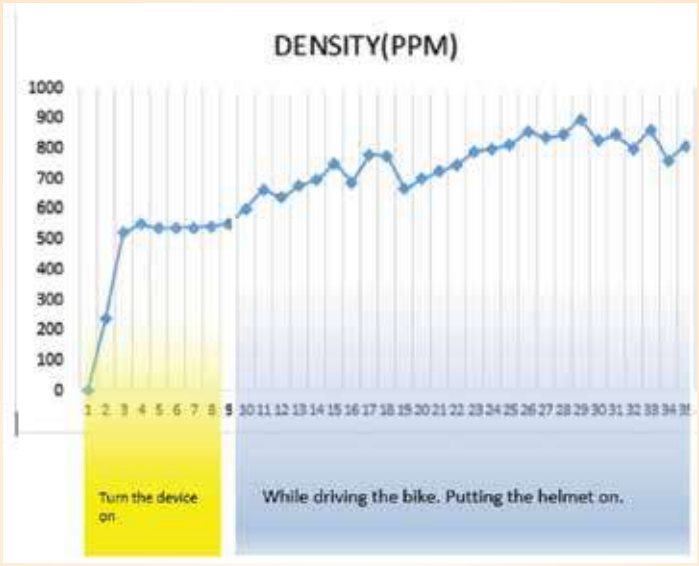
At first switch on the system. Then set the value of i and sum as 0. After that a loop will continue. While i is less than 5 then only read the value of $CO_2$ and store that value into a variable sensorvalue. After that the sensorvalue is converted into ppm value and stored into a variable ppm. Then all the values of ppm are added and stored as a variable sum. After that the loop variable i is increased. After the loop condition fails, average

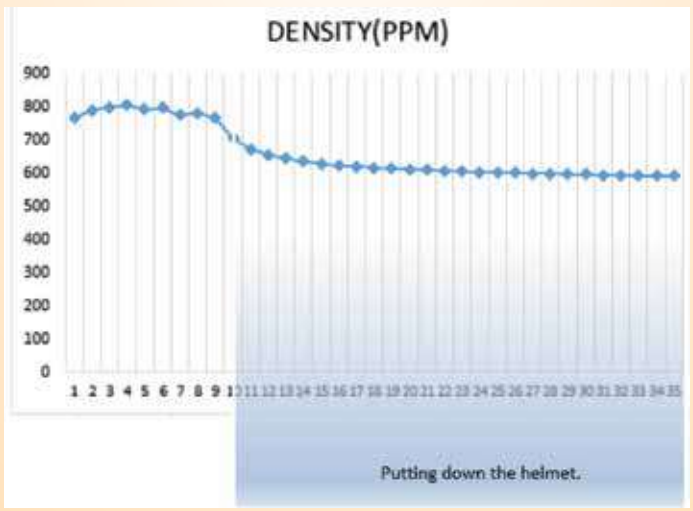
value is calculated using 5 consecutive sum values and stored as a variable avg. The value of avg is sent to the receiver.

**Bike Part:**

At first the average value from sender is received in the bike system. Then average value which is a variable avg, is stored into a variable cvalue. After that the threshold variable will be initialized as 500. After that if the value of cvalue is greater equal to the value of threshold, then only the relay will be set on and the bike will be started, else a buzzer will be set o to warn the user to wear the helmet.

**Experimental Analysis:**




## PUBLICATION

The paper was presented in Technical Paper Presentation at NIT Durgapur Organized by AISSEC, ISTE Student Chapter.

# Fabrication and Experimental Analysis of Active Inclined Stepped Solar Still (Arduino Programmed) with Thermal Energy Storage

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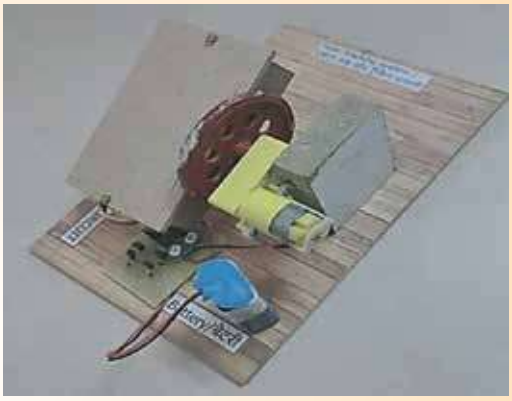
**Solar Still with parabolic trough collector**



**Solar tracker with 2 LDR sensors and a servo motor and the corresponding Arduino circuit (Proto Type)**

## OBJECTIVES

A modification in the design of conventional solar stills has been employed in this project to have an enhanced productivity. Different from conventional solar stills the inclined solar stills are inclined at an optimum angle with respect to ground which varies according to the latitude of the location, in order to have direct incidence of solar radiation or solar intensity which improves the productivity of the solar still. There are various techniques of improving the productivity of an inclined solar still.

The objective of this project is to develop a modified design model and techniques to have an enhanced productivity of the still which produces distillate, pure and potable form of water for human consumption from impure water by employing the following methods -

1. Stepped type basin-The basin over which water flows is made in the form of steps so that the thermal inertia of water mass is reduced subsequently as minimum water is retained, thereby the production per unit area can be increased.
2. Wick material over stepped basin-In order to maintain a uniform and thin layer of water film the wick material, which is a black cotton fabric, is chosen, as fabric demonstrates capillary action by virtue of which it absorbs water and spreads it all over the basin surface along the fabric.

3. Thermal Storage-As solar energy is intermittent in nature. Therefore, there is a need for storage of energy. This can be solved by using thermal energy storage device by phase change materials (PCM). Thermal energy storage is of three types i.e., latent heat storage, sensible heat storage, and chemical energy storage. Latent heat is the heat required for change of phase whereas sensible heat accounts for change of temperature. Latent heat storage is widely used for thermal energy storage because it is reliable and retains heat for larger duration of time during its phase change when compared to sensible heat storage devices. This helps in maintaining thermal stability during the working of solar still. Latent heat storage using phase change materials is commonly and widely employed recent means of storing thermal energy. The most promising PCMs available are paraffin wax, stearic acid, palmitic acid, meristic acid etc. Therefore, this thermal energy stored using phase change material during sunlight(charging) is utilized after sunshine period(discharging).
4. This project involves the usage of solar collector which is a parabolic trough collector used for the purpose of preheating of feed water which is impure and not suitable for consumption, before being sent in to the distiller chamber or still chamber in the form of the inclined stepped type solar still which has thermal energy storage and wick material. This makes the solar still set-up as an active solar still. An active solar still is a still which uses an external device to heat the using source the same solar energy, before being sent in to the chamber for distillation. Here, because of collector, the rate of evaporation is increased.
5. Fabricating a suitable Arduino board to the PTC so that the PTC tilts according to the maximum solar intensity.

## ACHIEVEMENTS

1. The total productivity of Active Inclined Stepped Solar Still with thermal energy storage is 7.41 kg/m$^2$/day.
2. The total productivity of the still with sponge cubes is 7.68 kg/m$^2$/day which is equivalent to 3.64% increase in output over Active Inclined Stepped Solar Still with thermal energy storage.
3. The total productivity of the still with sponge cubes and a fan is 7.962 kg/m$^2$/day or 7.45% increase in output over Active Inclined Stepped Solar Still with thermal energy storage.
4. The total productivity of the still with sponge cubes, fan and magnifying glass is 8.08 kg/m$^2$/day or 9.04% increase in output over Active Inclined Stepped Solar Still with thermal energy storage.
5. Maximum distillate productivity is obtained when all the accessories or modifications, i.e. sponge cubes, fan, magnifying glass and water sprayed for condensation are considered at once and its value is 8.187 kg/m$^2$/day or 10.49% increase in output over Active Inclined Stepped Solar Still with thermal energy storage.
6. Productivity of solar still has increased with the addition of each modification.
7. The distillate yield of the still is greater than that of conventional solar still and active inclined stepped solar still with thermal energy storage.
8. The Total Dissolved Solids (TDS) value has decreased from input 5.1% saline water with 4580ppm to output distillate with 42.4 ppm, satisfying with the standards.

Therefore, this solar still with mentioned modifications showed an increase in distillate productivity. It is a viable option for producing potable water in an economical and environment friendly way and will prove handy in solving the problem of water crisis and energy demand.

# Performance Investigation on Solar Distillation System using Air Conditioning Unit with Reject Water as Working Fluid

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**Schematic view of double slope still experimental setup**

**Schematic view of core still before installation**

## OBJECTIVES

**1. To design a solar double slope distillation system:** Primary objective of this work is to design a solar double slope distillation system, a device which converts non-drinkable water in to drinkable water.

**2. To conduct experiments with air-conditioning reject water:** From the literature survey it is observed that, water rejected from the outlet of air conditioning (AC) process consists of relative drinking water quality.In order to improve such relative water quality further, it is also proposed to conduct experiments with ac reject water available in our surrounding building.

**3. To conduct experiments with variable mass flow rates:** An important parameter which influences performance of any thermo-fluid system is mass flow rate. Such a proposed system is to be tested under different combinations of mass flow rates between 0.5 kg/min to 2kg/min.

**4. To formulate fuzzy model:** Fuzzy model based performance predicting are highly flexible, accurate, efficient, reliable etc in comparison with remaining prediction techniques. Such model is designed with an objective to obtain/identify effective combination of performance deciding parameters. It is proposed to design a fuzzy inference system for predicting and validating performance of solar flat plate distillation system under study.

## ACHIEVEMENTS

A real time solar double slope distillation still kit for UG and PG students.

Awareness among student community to save and drink ac reject water.

Area occupied is optimal in comparison with remaining stand-alone solar system.

First fuzzy logic expert system model for predicting solar double slope distillation still performance is developed.

## PUBLICATION

A research article titled "Predicting The Thermal Performance of Double Slope Solar Still using Fuzzy Inference System", submitted to Journal of Thermal Science and Engineering Applications, The submission id is: TSEA-20-1087.

# *Legacy of IEI*

Smt Pratibha Devisingh Patil, President of India lighting the lamp to mark the General Assembly 2007 of the World Federation of Engineering Organizations (WFEO), hosted by The Institution of Engineers (India) at New Delhi

# Design, Development and Fabrication of Equal Channel Forming Dies with Environment Friendly Lubricants

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## OBJECTIVES

To design, develop and fabricate equal channel forming dies for processing materials with environment friendly lubricants

To perform finite element analysis in order to generate the strain rate distribution in the materials processed with environment friendly lubricants

To check the agreement of the strain rate distribution of the processed materials obtained from the finite-element simulation model with the experimental investigations.

## ACHIEVEMENTS

1. An equal channel forming die with 1350 channel angle with necessary hold devices considering industrial safety precautions is fabricated successfully.
2. Experiments conducted with aluminum alloy AA6061 in the die with natural and synthetic lubricants indicated the minimum pressing tonnage, the most sought after variable by pressing industry.
3. The minimum pressing tonnage capacity for pressing aluminum is achieved with castor oil as lubricant.
4. Simulated results for strain rate distribution in the processed components are in line with experimental results.
5. Castor oil as lubricant for equal channel angular pressing get processed with low tonnage load, improved strain rate distribution and microstructure distribution.

**Adopted Procedure and Results:**

The purpose of Equal Channel Angular Pressing (ECAP) is producing ultra-fine grain materials. In practical applications, it is important to understand and predict effect of different process parameters on deformed parts. One of the most important process parameters is friction coefficient that controls the load characteristics of the press. Behaviour evaluation of different lubricants in the ECAP process is the aim of this project. The challenge for researchers for industrial applications is to correlate the power capacity of the machine required with different eco-friendly lubricants.


This project attempts to reduce and control bad frictional effects, prevent die failures and decrease press tonnage in ECAP process. The selection of a suitable lubricant is crucial for processing metallic materials by SPD processes like ECAP. The goal of this study was to experimentally determine the load required and power capacity of industrial presses suitable for SPD processes with a special focus on eco-friendly/biodegradable lubricants.

It is observed from the experimental investigations that castor oil as lubricant for Alumnium alloys in ECAP provides least extrusion pressure of 70 tonnes amongst the other lubricants tested. The other observations made during the experimentation are safflower oil consumes 100 tonnes, servo gear oil takes 75 tonnes and engine oil utilizes 92 tonnes of load respectively. Without lubrication, the power requirements are as high as 450 tonnes. From the analysis, it can be concluded that castor oil provides better results with minimum load requirements and thus the press capacity required by the industry is reduced.

# IoT Based Plant Health Monitoring System

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**Image of the Hardware set up used in the Project**

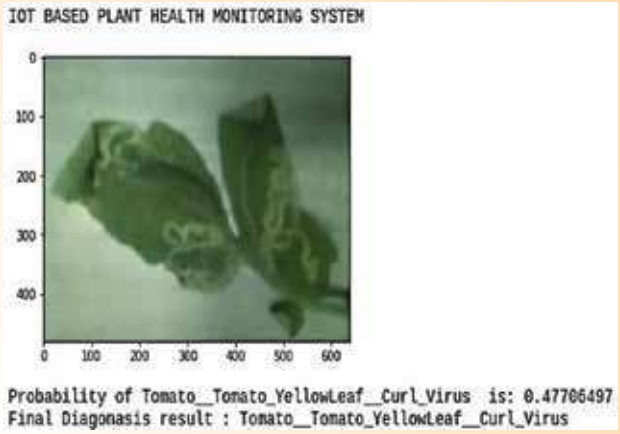


**Image of the output after processing**

## OBJECTIVES

The aim of this project is to develop a system for plant monitoring and disease detection using the concept of IoT and Image processing with the help of deep learning technique. The camera with high resolution captures the image in such a way that it subtends its maximum view of the plot. The images captured by the camera will be processed and compared with trained datasets i.e., images of diseased and healthy plants using deep learning technique with the help of CNN algorithm, which will train the control unit to distinguish between healthy and unhealthy plant. The output includes display of numerical value which denotes the percentage or probability of diseases present in the plant for every real time image input from the camera. The predicted output will be updated in the server by IoT. If any variations in data or disease is detected, the required information of that plant will be recorded and will alert the farmers through notifications popping up in the phones of farmers. This proposed model will be helpful for farmers and gardening purposes that will enable the observation and management of the field without any user intervention and contributes to smart agriculture and empowers farmers with the decision tools and automation technologies that seamlessly integrate products, knowledge and services for better productivity, quality, and profit.

## ACHIEVEMENTS

Patent Published- Patent Application Published, Application Number- 202041017340, Publication Date- 05/06/2020, and Title: Design and Development of IoT assisted Plant Health Monitoring System.

# Performance Improvement of Solar Powered Water Pumping System for Rural Application by using Fish Search Optimization MPPT Technique

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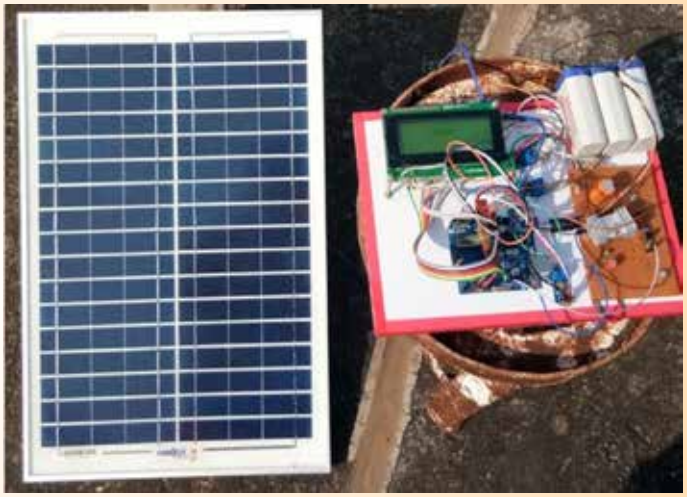
**Experimental setup for conducting the PV test**



**Experimental set up for the real time test conducted**

## OBJECTIVES

The aim of this research work is to investigate an efficient maximum power point tracking technique to increase the performance of Solar Powered water pumping system. The system consists of a PV array, Boost converter, inverter, permanent magnet synchronous motor and water pump. With the change in the atmospheric condition the output characteristics of the PV array changes. With the direct connection of the PV array to the load, the operating point seldom lies at the maximum power point which reduces the overall performance of the system. Hence, load matching and need of maximum power point tracking system will be taken into consideration. For increasing the system efficiency different MPPT techniques and DC-DC converters are studied and investigated. The new proposed MPPT method is implemented for a photovoltaic water pumping system.

## ACHIEVEMENTS

The proposed system is implemented in MATLAB/Simulink and even the proposed MPPT method is validated by conducting real-time experiment considering various environmental factors. The proposed system consists of the photovoltaic array as input source where solar radiations directly hit the array surface converting solar

energy into electrical energy, DC-DC power converter, motor and pump as shown in figure. A maximum power point tracker is included in the system for achieving high-efficiency system performance and increasing the amount of energy extracted by the load. In this project synchronous motor which is an AC motor is used as a permanent magnet. Therefore, the design of the three-phase inverter is also considered for converting DC power to AC power.

**PUBLICATION**

"PV Based DC-DC Converter Design Using MPPT For Stand-Alone System" published in International Journal of Scientific & Technology Research, Volume 8, Issue 12, December 2019.

## The Institution of Engineers (India)

Recognized as Scientific & Industrial Research Organization by
Ministry of Science & Technology, Govt. of India

## IEI R&D Grant-in-Aid Scheme

### Terms & Conditions

1. The usual terms and conditions of sanctioned R&D projects remain same in conjunction with the notification of inviting proposals for IEI–Research and Development Grant.
2. Approval of the proposal and the grant being released is for the specific project sanctioned and should be exclusively spent on the project within the stipulated time.
3. Any un-spent balance out of the amount sanctioned must be surrendered to the Institution of Engineers (India) through a Cheque / Demand Draft drawn in favour of "The Institution of Engineers (India)", payable at Kolkata.
4. The grant sanctioned should be utilized for expenses incurred under permissible heads as enumerated under 'Details of Financial Requirement' in Application Form. The fund should not be used for traveling expense or any scholarship purpose under any circumstances.
5. The beneficiary Institute / Organization has to furnish Half-yearly Progress Report of the work for PG & PhD Project Proposals.
6. On completion of the project, one copy of Project Report, Project Completion Report (PCR) and two original copies Utilization Certificate (UC) on the sanctioned work must be sent to IEI. Also, Compendium Proforma must be submitted in soft copies (in .doc/.docx format) along with an Audio/Visual Demonstration of The Prototype/Model/Process in CD or Google Drive File Link. In the title page of the Project Report, the following should be mentioned:

   **"The Project has been funded by The Institution of Engineers (India), 8 Gokhale Road, Kolkata 700020 under R&D Grant-in-Aid scheme"**
7. The institute / Organization will not entrust the implementation of the work for which the grant is being sanctioned to another institution nor will it divert the grant receipts to other institute as assistance.
8. IEI reserves the right to terminate the project at any stage if it is convinced that the grant has not been properly utilized or appropriate progress is not being made and in that instance, the entire amount sanctioned should be refunded.
9. The project becomes operative with effect from the date on which the grant is transferred to the beneficiary account. This date should be intimated by the appropriate authorities of Institution / Organization to IEI. It will, in no case be later than one month after the receipt of the grant.
10. If the Project Guide wishes to leave the granted Institution / Organization where the project is based, the Institute / Organization / Project Guide has to inform the same to IEI for further necessary action.
11. IEI should be acknowledged in case of any paper presentation / patent application in the same manner as mentioned in sl.no.6

# Performance Investigation of Li-ion Battery Cooling with Vapour Compression Refrigeration System

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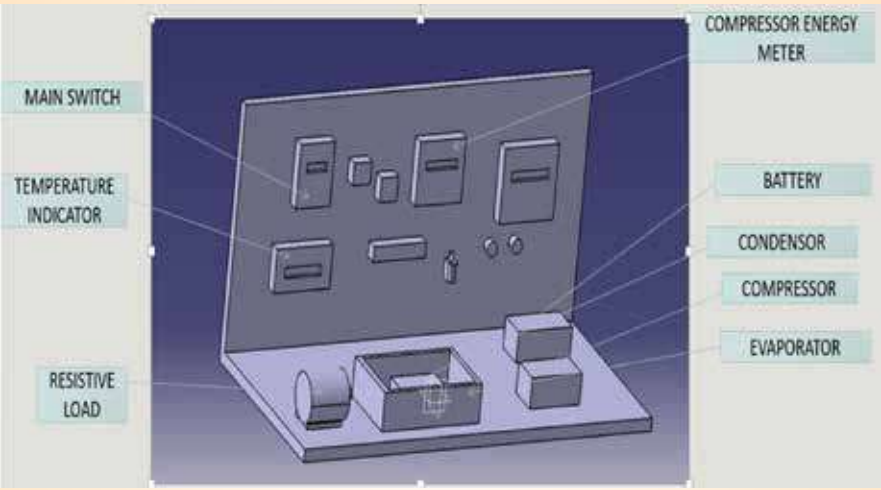


**Proposed Layout**

**Working Model**

## OBJECTIVES

- To find out the causes of the battery deterioration.
- Study and analyze the effect of temperature rise on battery in automobile.
- To design and fabricate the cooling system for the battery cooling to keep it in optimum range of temperature.
- Connecting a load to discharge the battery and study the varying parameters like temperature and voltage.
- To investigate the performance of battery by experimentation.

## ACHIEVEMENTS

An overview of the battery system is presented based on literature studies and a working model of the proposed Battery Cooling System is constructed in which the Li-ion battery is heated and then subsequently cooled. The following conclusions can be presented based on the experimentation.

- Temperature impacts the life, performance, health and safe operation of batteries in Hybrid Electric Vehicles and Electric Vehicles.
- In order to get good battery performance, the ideal operating temperature range of the Li-ion battery is 20°C to 25°C.
- Also, temperature difference between battery cells should be controlled within 5°C.
- Cooling of the battery by using a simple VCC System can be a solution where the battery heats up above 45°C.
- To achieve a better efficiency of the Battery Cooling System, it should be integrated with the vehicle AC system.

## *Legacy of IEI*


Shri Pranab Mukhejee, President of India, in the Inaugural Session of 27th Indian Engineering Congress at New Delhi in 2012

# Photovoltaic fed Brushless DC Motor based Organic Oil Extractor

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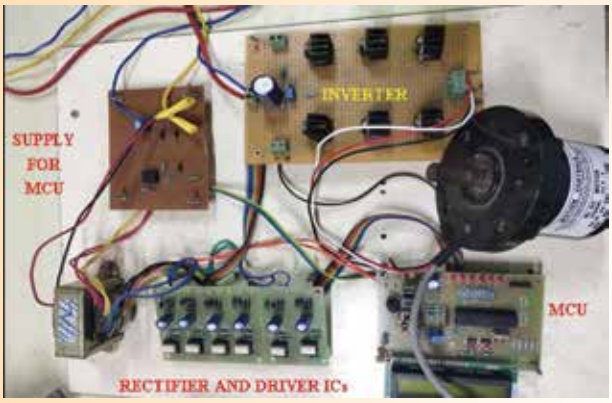



**BLDC Drive Unit**

**Worm gear set up with BLDC**

**Worm Gear**

**BLDC Shaft with Worm Gear**

**Fixing Worm Gear BLDC Set-up Within Oil Extractor**

**Open View of Oil Extractor Machine**

## OBJECTIVES

This project aims at designing and developing photovoltaic aided brushless DC motor based oil extractor which can be used in all houses. The oil extractor has become an important need in all houses since the quality of oil bought from market is poor and because of this health issues are predominant in recent past.

The extractor in market are based on DC motor which results in less efficiency and other grinding issues and moreover it can be run only by utility grid. When powered by utility grid, new power quality issues like harmonics and decrease in power factor are unavoidable.

To overcome the prevailing issue, a new BLDC motor drive unit has been designed and developed.

The BLDC motor shaft is to be coupled with worm gear and the seed groove. And the whole driver unit is run by photovoltaic panel. Since, photovoltaic panels are used the BLDC driver unit is embedded with a conventional maximum power tracking scheme.

The developed unit is to be assembled and tested.

## ACHIEVEMENTS

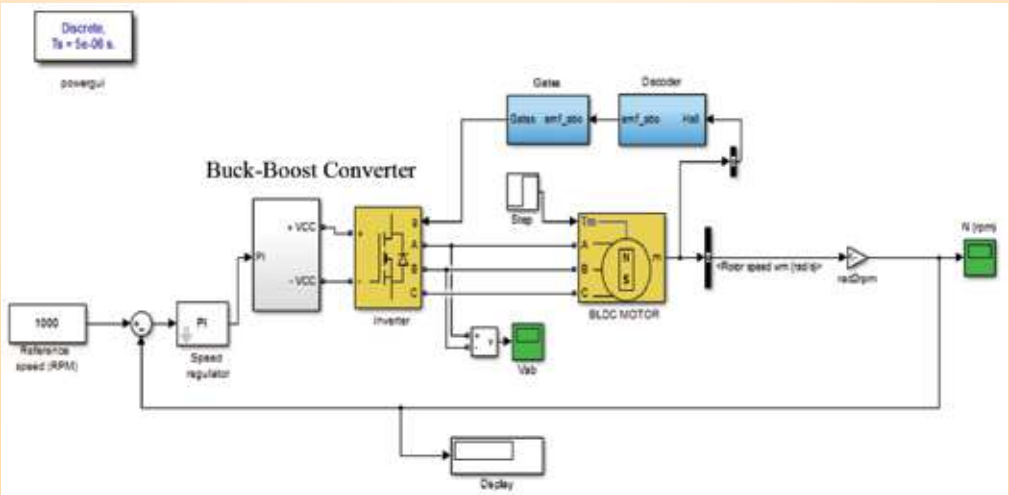
The achievements of this project are as follows:

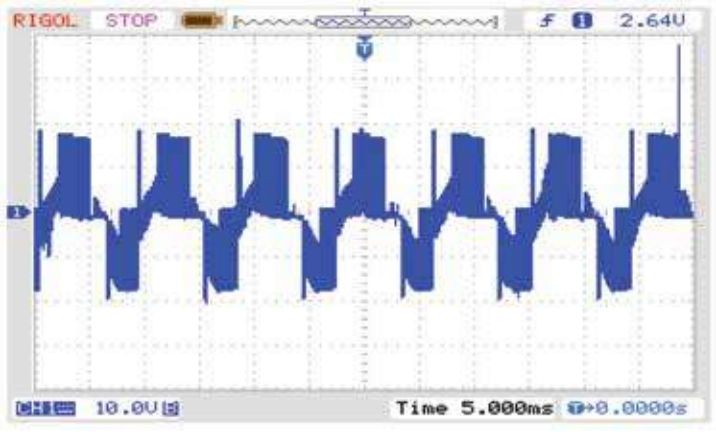
1. The market study and literature review on oil extractor was conducted, the study reveals that the present oil extract machine has a typical DC drive unit which results in poor crushing when the millets are collectively poured and the torque exerted to the groove is also insufficient.
2. To overcome the above issue and to make the project an energy efficient one photovoltaic powered BLDC drive is used.

Step by step procedure to achieve the objectives:

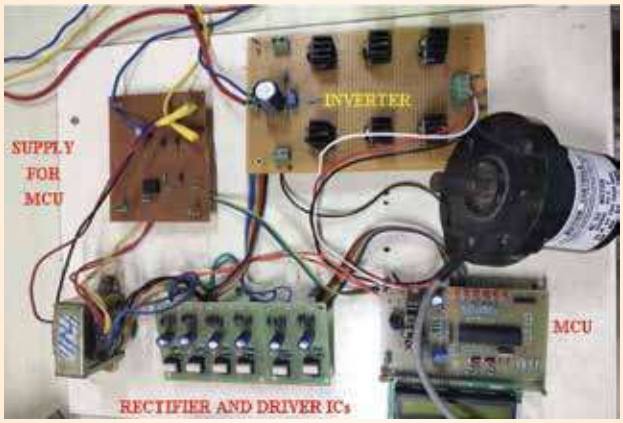
- The worm gear arrangement is carefully chosen dismantling unusable parts by doing job works
- Simulation on the BLDC unit is duly completed and the hardware for BLDC inverter- drive unit is designed and developed. The inverter unit essentially consists of six MOSFETS whose triggering pulses are fed by a dsPIC2011 microcontroller. The pulses from the microcontroller will be of less voltage and driver unit with TLP250 is used to drive the low voltage pulses (5V) to high voltage (15 V). The source for the BLDC is given through a 100W PV panel and tested.

Simulation Results:

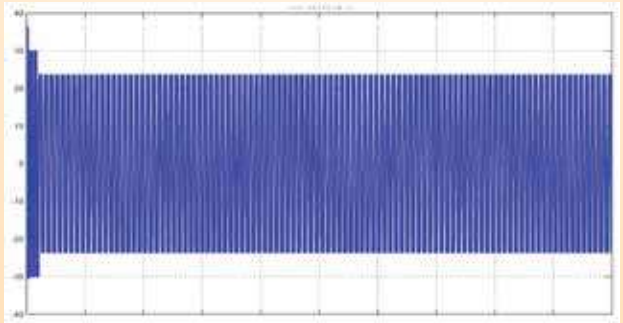




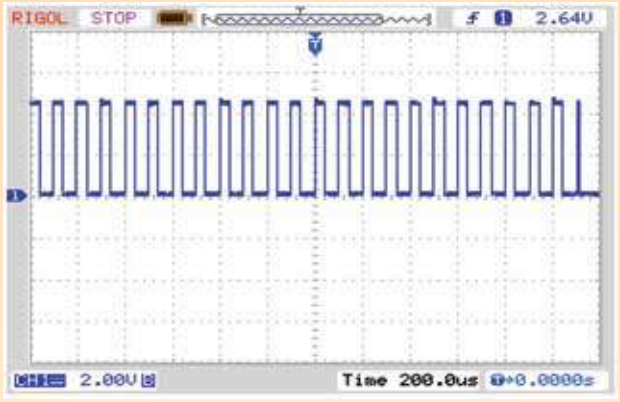

- The BLDC unit needs to be fitted with worm gear. Therefore, a detailed job work is done through milling in lathe and both are merged .The developed model has to be retrofitted with casing and other arrangements to make that as a new product.



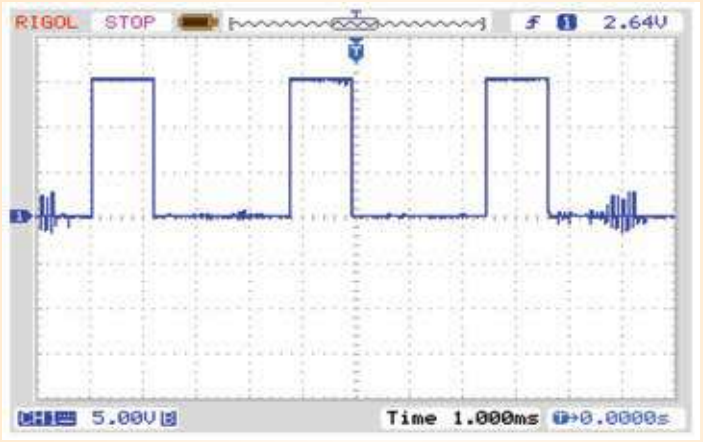

**The developed prototype for BLDC drive**



**Back EMF Waveform**




**Pulse width for Upper Leg MOSFET( variable)**




**Pulse width for lower Leg MOSFET( Fixed)**

Overall the project has achieved its target of proposing a new BLDC driven oil extractor. The deliverables of the project will be patented and research articles are expected to emerge out of the work. Further value addition to the project can be done by a control actuator which facilitates proper delivery of millets.

"The vitality of a scientific community springs from many sources but more importantly, its capacity to identify, attract and nurture gifted individuals."

**Shri Narendra Modi**
Hon'ble Prime Minister of India

# Segregation of e-waste through Machine Learning

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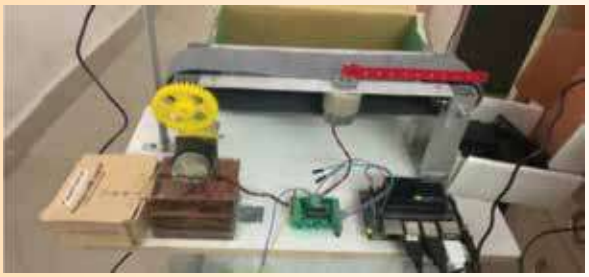

**Complete Setup of the Project**

**E-Wastes Containment Near River**

## OBJECTIVES

E-wastes refer to electronic wastes that are generated from mobile phones, computers, fax machines, printers etc. Based on a report given by Global E-waste Monitor, India produces about 2.5 million tons of E-wastes. According to the survey in 2016-2017, India recycled only 0.037 million tons of E-waste. The crucial information is that about 95% of India's wastes is recycled in unceremonious sector. According to the recent survey only 20% of E-wastes are recycled in the world. This occurs due to the poor extraction techniques and the unavailability of recycling management ideas. E-wastes are increasing day by day at a rate of 35% in the country.

This ever-increasing waste is very complex in nature and also a rich source of metals such as Neodymium, Indium, Palladium, Tantalum, Platinum, Gold, Silver, Aluminum and Copper which can be recovered and brought back into the production cycle. Therefore, the need of proper E-waste segregation and management is required to recover these wastes.

The proposed system is based on Image processing and Convolutional Neural Network with Deep Learning (DL) algorithm. The objective of the project is to train a neural network and classify the E-wastes that are recyclable and hazardous. Then, the E-wastes that contain the rare materials are separated from the recyclable wastes. This system can guarantee effective machine-driven waste management and can speed up the method of segregation without human intervention.

DL is one of the machine learning techniques which imitates the works of human brain in processing the data and in creating patterns for the use in decision making which predicts an output from the input given. DL Algorithms use neural network to find associations between a set of inputs and outputs. The main objectives of this work are-

- To segregate rare materials from the crushed and shredded E-wastes
- To separate hazardous materials like Mercury, Cadmium, Beryllium and Lead which are present in various Batteries, Cathode ray tubes, PCB's etc.
- Recycle the reusable materials like Platinum, Gold, Silver, Copper, Palladium, Plastics.

## ACHIEVEMENTS

Electronic waste (E-waste) is generated when electronic and electrical equipments turn into out of condition for their original use or have crossed their expiry date. E-wastes are increasing day by day due to rapid growth of technology and technical innovations. About 50 million tons of E-waste was generated globally in 2019. In reducing the explosive growth of electronic industry which affects the lifecycle of the environment, proper segregation and management of electronic wastes are the main cause. Most of the waste electronic items are stored at households as people do not know how to discard the wastes. For proper recycling, appropriate segregation and management of e-waste is an important issue. This work aims to categorize the e- wastes into precious and non-precious according to the materials present in these e- wastes. As deep learning has become more popular for its efficiency in classification problems, a deep neural network, ResNet-18 architecture is proposed to be used in this work. Hence, pretrained models are trained for basically classifying wastes into eight categories as Precious metals and Non-Precious metals. Using a pretrained network for training 1000 images requires small GPU and comparatively less time when compared to creating a network from scratch. So RESNET-18 algorithm is used which takes an input image (using webcam), process it using the model and also with the processor and predict the categories of Resistor, Capacitor, Regulator, LCD, Relay, Circuit board, Node MCU, Battery. With the help of some hardware equipment's like Raspberry Pi, Jetson nano developer kit, Conveyor belt, Webcam and Segregator it shows the real time model. The objective of this project is to categorize and separate the commonly disposed waste into Precious and Non-Precious according to the metals presence in them using an USB Webcam and machine learning techniques. The steps involved in this process are,

- E-wastes on the conveyor belt flow at a given speed, wherein the speed of the belt is controlled by the processor which gives command to start or stop the flow of the belt using Python program
- The USB webcam connected with the processor magnifies the wastes that are in motion with the conveyor belt. The image captured by the camera is configured by the processor through Machine Learning of ResNet 18
- In context of materials, it gives information on the texture of the material and instructs the segregator which is on the other side of conveyor belt with two bins (Precious metal and Non-Precious metals) placed aside as mentioned above, to pick up the waste on the conveyor belt. This is done once when any of the classified waste is configured by the processor instructs the segregator to drag the Non-Precious metals to the left side of the conveyor belt. For Precious metals the wastes flow in a manner and gets to the bin1 easily.

When E-Wastes are made to flow in a conveyor belt, the processor predicts the output using ResNet-18 by the

display shown through the webcam. It presents the object with a label name corresponding to it and also with a percentage which shows the accuracy of the component in comparison with the original image used for training in the train folder. After detection, the Raspberry Pi sends information to the segregator of conveyor belt to separate Non-Precious metal and Precious metal. A pretrained model is trained for classifying wastes into eight categories. TensorFlow with ResNet-18 model makes up the process and is an effective tool for machine learning and deep learning. Average accuracy of 93% is obtained using this method.

E-waste is a major threat to our current generation. Many developing countries exports E-wastes to India for recycling which is of about 80%. Due to incomplete infrastructure, poor awareness, lack of guidelines and knowledge, there is a major gap between current recycling and collection facilities and quantum of e-wastes generated. Solutions urge to address the secure disposal of the domestic waste, provide appropriate frame work for recycling process. The proposed technique will assist in overcoming the existing problem and thereby contribute to environmental sustainability.

## PUBLICATIONS

- Presented a paper on the topic of "E-waste Segregation and Management through Machine Learning at IEI sponsored All India Seminar on"Artificial Intelligence: An Application Perspective", 05-06 September, 2019.
- Abstract for a book chapter has been accepted with Title: "Deep Learning based Automatic Classification of E-waste for Efficient Waste Segregation" under the book chapter "Smart Intelligent Systems for Industrial Applications", Scrivener Publishing, Wiley.

## *Legacy of IEI*

Shri Atal Bihari Vajpayee, Hon'ble Prime Minister of India, greeted by Shri G P Lal, President of the Institution on the occasion of World Congress on Sustainable Development during January 20-23, 2000

# Physicochemical Studies of Type - I/II Heterostructure Assemblies for Electrochemical Water Splitting/Dye Degradation Applications

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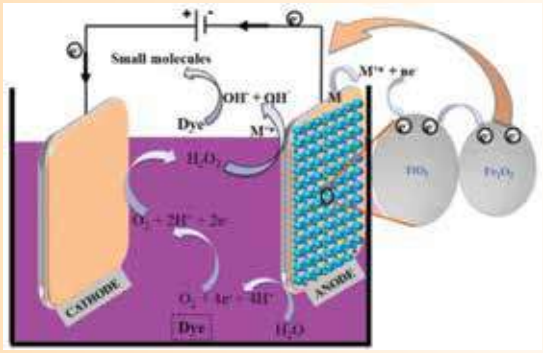
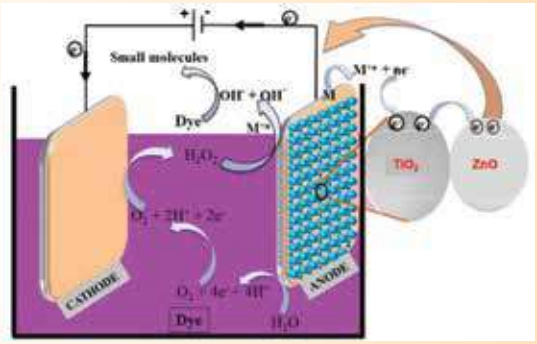



**$TiO_2/Fe_2O_3$ Type-I Heterostructure assemblies for dye degradation studies**




**$TiO_2$/ZnO: Type-II Heterostructure assemblies for dye degradation studies**

## OBJECTIVES

The main objective of present project work is to form Type-I/Type-II Heterostructure assemblies for electrochemical dye degradation and water splitting reaction studies. The detailed objectives are as follows:

- Synthesize $TiO_2$, ZnO, $Fe_2O_3$ metal oxides nanoparticles and their Heterostructures via sol-gel method
- Fabrication of electrode assemblies on Titania (Ti), Stainless Steel (SS), Indium Tin Oxide (ITO), Carbon paper and Fluorine doped Tin Oxide (FTO) substrates
- Characterization of the synthesized nanoparticles/nanocomposites/Heterostructures using UV-Vis spetroscopy, SEM, TEM, XRD, FTIR and EDAX.
- Study the crystalline structure/electronic charge effects of individual oxides and their composite assembly
- To study the application of these synthesized nanoparticle assemblies for Electrochemical dye degradation (crystal violet dye)

- Water splitting reaction studies using synthesized composite/Heterostructure assemblies
- Understanding the molecular mechanism of dye degradation.

## ACHIEVEMENTS

This project is aimed to synthesize and fabricate Type-I/II Heterostructure assemblies for dye degradation and water splitting studies. We have chosen $TiO_2$, $Fe_2O_3$, ZnO semiconductor nanoparticles to fabricate Type-I/II Heterostructure assemblies. We successfully synthesized and fabricated the electrodes on Titania (Ti) substrate and carried out different electrochemical measurements for crystal violet dye and water splitting studies. The experimental results reveals that Heterostructure assemblies perform better than individual electrode assemblies for both applications. The project work resulted in two International Journal Publications (Ira. J. Chem. Chem. Engg, 39, 169-177, 2020, &J. Inst. Engrs-Series E, 100 (2), 189-198), and seven National Conference Proceedings. Further, two articles are under review for publication. The outcomes of this project work not only helps us to understand the molecular mechanism of Heterostructure assemblies for degradation of complex dyes but also provides design of low cost Heterostructure assemblies for various catalytic, photocatalytic and photo-electrochemical applications.

## PUBLICATION

**International Journals:**

1. Pooja Sree Palukuru, Vishnu Priya Devangam A, and Dilip Kumar Behara, "N, S-codoped $TiO_2/Fe_2O_3$ Heterostructure assemblies for Electrochemical Degradation of Crystal Violet Dye Degradation", Ira. J. Chem. Chem. Engg, 39, 169-177, 2020
2. Sudha Maheswari M, Jalajakshi T, and Dilip Kumar Behara, "$TiO_2/Fe_2O_3$ : Type-I Heterostructures for Electrochemical Crystal Violet Dye Degradation", J. Inst. Engrs-Series E,100 (2), 189-198, 2018.
3. Jalajakshi T, Sudha Maheswari M, and Dilip Kumar Behara, "$TiO_2$/ZnO: Type-II Heterostructures for Electrochemical Dye Degradation Studies", submitted to "Macedonian Journal of Chemistry & Chemical Engineering" (Just Accepted)
4. Vishnu Priya Devangam A, Pooja Sree Palukuru, and Dilip Kumar Behara, "Multi element doped $TiO_2$/ZnO: Type-II Heterostructures for Electrochemical Crystal Violet Dye Degradation Studies", submitted to "International Journal of Nano Dimension" (under review)

**National Conferences:**

1. Dilip Kumar Behara, Pooja Sree Palukuru, and Vishnu Priya Devangam "Doped Metal Oxide Heterostructures (N, S-$TiO_2/Fe_2O_3$ ) for Electrochemical Crystal-Violet Dye Degradation Studies", 32nd Indian Engineering Congress, The Institution of Engineers, India IE(I), Technical Volume, Page No: 362-367, 21-23 December 2017, Chennai.
2. Dilip Kumar Behara, Vishnu Priya Devangam, and Pooja Sree Palukuru, "Doped Metal Oxide Heterostructures (N, S-$TiO_2$/ZnO): Catalytic/Electro-Catalytic Studies", 32nd Indian Engineering Congress, The Institution of Engineers, India IE(I), Technical Volume, Page No: 368-373, 21-23 December 2017, Chennai.
3. Sudha Maheswari M, Jalajakshi T, and Dilip Kumar Behara, "Physicochemical Studies of $TiO_2/Fe_2O_3$ / ZnO Heterostructure Assemblies for Electrochemical Water Splitting/Dye Degradation Applications", 31st Indian Engineering Congress, The Institution of Engineers, India IE(I), Technical Volume, Page No: 298-304, 15-18 Dec 2016, Kolkata

4. Vishnu Priya Devangam, Dilip Kumar Behara, "Importance of Cyclic Voltammetry in electrochemical Dye degradation reactions- Ashort review ", Two day National Conference on Pollution control strategies in chemical and related industries (PCSCRI-2017), 10-11 March 2017, SV University College of Engineering, Tirupati, AP

5. Pooja Sree P, Dilip Kumar Behara presented paper on "An Overview of Electro-Kinetics in Dye Degradation Reactions", Two day National Conference on Pollution control strategies in chemical and related industries (PCSCRI-2017), 10-11 March 2017, SV University College of Engineering, Tirupati, AP

6. Jalajakshi T, SudhaMaheswari M, and Dilip Kumar Behara, "$TiO_2$/ZnO: Type-II Heterostructures for Electrochemical dye degradation studies", Two day National Conference on Pollution control strategies in chemical and related industries (PCSCRI-2017), 10-11 March 2017, SV University College of Engineering, Tirupati, AP

7. SudhaMaheswari M, Jalajakshi T, and Dilip Kumar Behara, "$TiO_2$/$Fe_2O_3$: Type-I Heterostructures for Electrochemical dye degradation studies", Two day National Conference on Pollution control strategies in chemical and related industries (PCSCRI-2017), 10-11 March 2017, SV University College of Engineering, Tirupati, AP.

**M. Tech Thesis generated:**

1. Sudha Maheswari (14001D8111)

**Title of the Project:**

- $TiO_2$/$Fe_2O_3$: Type-I Heterostructures for Electrochemical Crystal Violet dye degradation

2. T. Jalajakshi (14001D8106)

**Title of the Project:**

- $TiO_2$/ZnO: Type-II Heterostructures for Electrochemical dye degradation

3. Pooja Sree Palukuru (15001D8108)

Title of the Project:

. • Physicochemical Studies of N, S codoped$TiO_2$-$Fe_2O_3$ Heterostructure Assemblies for Electrochemical Dye Degradation Studies

4. Vishnu Priya A. Devangam (15001D8116)

**Title of the Project:**

- Doped Semiconductor Heterostructure (N, S $TiO_2$/ZnO) Assemblies for Electrochemical Crystal Violet Dye Degradation Studies.

# Tribological Performance of Carbon Nano Tube (CNT) Reinforced Natural Fiber Hybrid Composite

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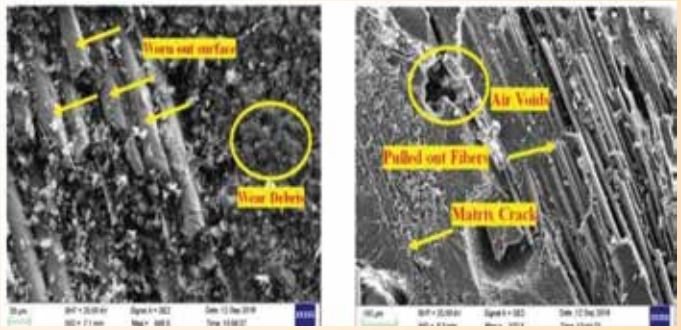
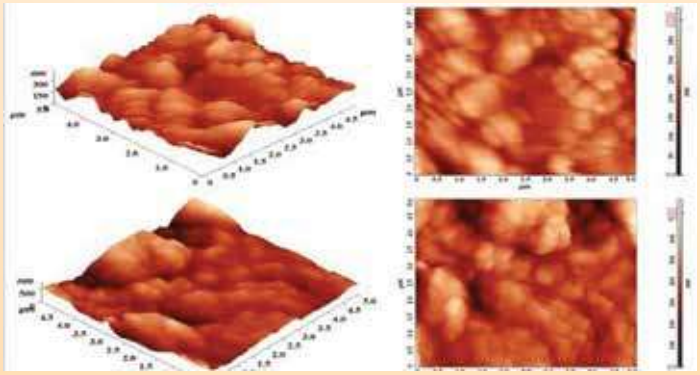
**Fabricated Specimens**

**Pin on disc set-up**




**Microstructure**



**3D Roughness**

## OBJECTIVES

As multi-walled carbon nanotubes (MWCNTs) filled polymer composites reinforced with natural fibres are ruling gradually increased applications, a considerable volume of investigation has focused on enhancing their mechanical and wear properties. This research presents the wear behaviour of the banana- glass fibre reinforced hybrid composites. The epoxy resin diffused with MWCNT by ultrasonicator had used as the matrix face for natural fibre-reinforced composites. The wear performances of the banana- glass fibre reinforced hybrid composites filled with MWCNT is measured using a pin-on-disc wear testing machine. Taguchi's L18 orthogonal array has employed for the experimental design by considering thecontrol parameters such as sliding speed, load, temperature and wt. % of MWCNT. The worn surface morphology is studied through the atomic force microscope (AFM) and scanning electron microscopy (SEM).

This work involves

i. Fabrication of Banana-Glass Fibre Hybrid Composites using epoxy resin which is filled with MWCNT

ii. Evaluating the microstructure of fabricated hybrid composites

iii. Investigating the Wear performance of the hybrid composites

iv. Study of Worn surface morphology using SEM.

## ACHIEVEMENTS

- Banana-Glass Fibre Hybrid Composites has been successfully fabricated by using Compression Moulding technique. The hybrid composites were fabricated by applying MWCNT epoxy resin. The weight of MWCNT is varied with 0%, 0.5% &1% into epoxy resin without agglomeration using Ultrasonicator.
- The improvement in the interfacial bonding among matrix and filler and the disintegration of during elevated loading resulted in superior friction properties.
- The morphology of worn surfaces through SEM after the wear tests revealed significant debonding in every specimen. It is also observed that the specimens displayed matrix breakage, pull out and fiber fracture.
- The surface roughness of MWCNT filled banana composites decreased from 65.9nm to 34.07 nm.
- MWCNTs can efficiently reduce the wear due to adhesion, which was the advantage of thin transfer film formation, thus efficiently reducing the COF and enhancing the wear resistance.
- Banana-Glass Fiber Hybrid Composites can be implemented for wear resistant applications in automobile industries.

**With engineering, I view this year's failure as next year's opportunity to try it again. Failures are not something to be avoided. You want to have them happen as quickly as you can so you can make progress rapidly.**

***Gordon Earle Moore***

# Development and Study on Strength Parameters of Low Cost Bio-Mineralized Steel Slag Bricks

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**Carbonation chamber (Fabricated)**

**Bio-mineralized Bricks**

## OBJECTIVES

Burnt clay red bricks are made of clay which is collected from fertile land or the topsoil and also causes air pollution by way of burning. In this project, the bio blocks are developed by using industrial by-products such as steel slag. India is having a huge slag production capacity of 10-12 million tones per annum at existing steel plants. Steel slag has been used as a raw mix component up to 10 in the manufacture of cement clinker. This consumption is meager when compared to the production of steel slag. A large amount of steel slag was deposited in residue storing yards which occupied farmland, silted rivers and polluted the environment for many years. The development of bio-blocks gives a solution for effective utilization of by-products steel slag and eradicates the hazardous dumping. Each year approximately 1.5 trillion bricks are produced worldwide. Traditional clay brick manufacturing utilizes a firing process that consumes fossil fuel, and is responsible for approximately 800 million tons of global $CO_2$ emissions every year. No burning process is involved in the bioblock developing process, which consequently excludes fuel requirement, unlike red bricks.

- The components of Bio-brick are steel slag, lime sludge, bacteria and carbon-di oxide.
- Steel industry waste (steel slag) and lime sludge are converted into a solid & strong material by mineralization.
- The mineralization in Bio-brick is done by using non- pathogenic bacteria.
- Mineralization in Bio-brick is accelerated by artificial supply of carbon-dioxide.
- Zero utilization of cement is achieved in Bio-brick production.
- No water for curing is required in Bio-bricks.

## ACHIEVEMENTS

- As the steel industry wastes are available at low cost/no cost, the production cost will be considerably lesser than burnt clay bricks and fly-ash bricks.
- With less investment itself, the production can be started, as there is no cement and no water for curing in development of Bio-brick.
- Less workmanship and less skill is required.
- As Salem being one of the most attractive city in Tamil Nadu, its new construction projects is a huge market for bricks.
- Salem is one of the city selected under SMART CITY projects that will be a new market opening.
- Bio-brick will be an alternate for fly ash bricks because outer surface or shell of fly ash brick is hard compared to inner core, in case a chase is cut to lay conduits and pipes, the chances of development of cracks later in the plaster are high.

## PUBLICATION


- Arivoli. M & Nandakumar. D, "Strength development in steel slag bricks using MICP process" at International Conference i4CE'19, PSG institute of Technology and Applied Research, March,2019.
- D. Nandakumar and M. Arivoli, "Eco friendly bio mineralised steel slag bricks using MICP process", Journal of Applied Science and Computations, Vol. VI, No. IV, 1019-1024, 2019 (UGC approved)
- D. Nandakumar and M. Arivoli, "Strength development in bio mineralised steel slag bricks using MICP process", International Journal of Innovative Technology and Exploring Engineering, Vol.9, 2020. 10.35940/ijitee.D2073.029420 (Scopus).

# Deposition of Metallic Nano-Films using an Indigenous Magnetron Sputtering Setup

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**Fig 1: Magnetron Sputtering Setup**
(Courtesy: https://sites.google.com/view/iem-amrl/facilities )

**Fig 2: Sputter Deposition of Transition Metal over glass substrate**
(Courtesy: https://sites.google.com/view/iem-amrl/facilities )

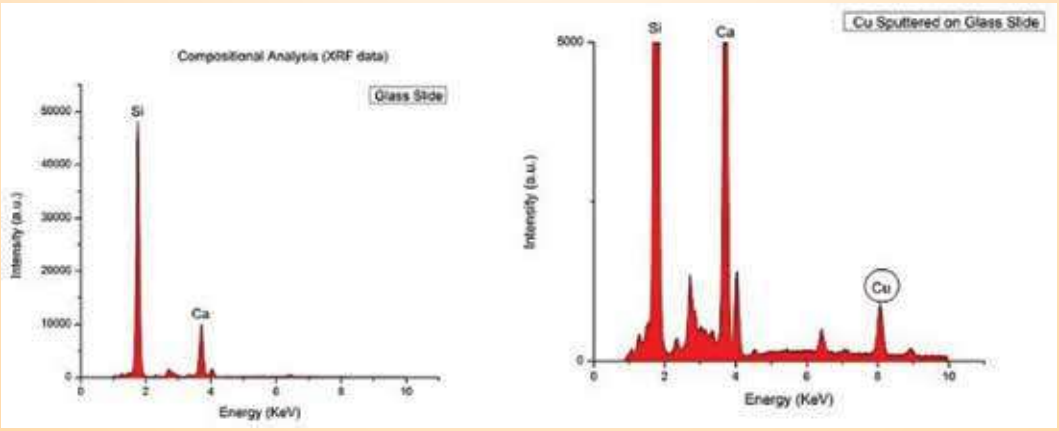


**Fig 3: Compositional Analysis of glass slide before and after Cu sputtering**

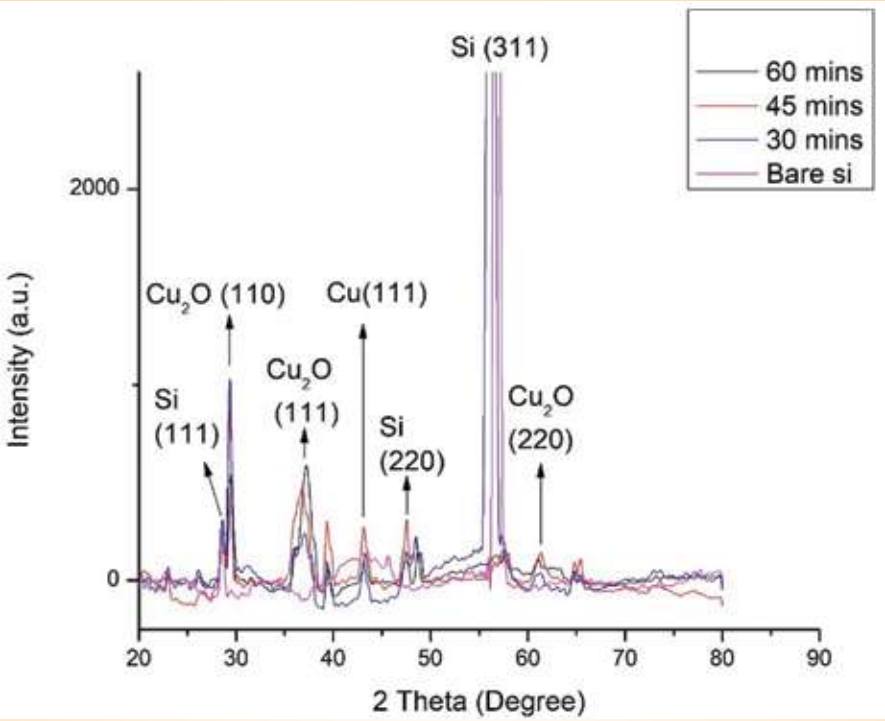


**Fig 4: XRD pattern of the deposited thin film at three different times on Silicon substrate**

## OBJECTIVES

The main objective of the proposed project is to synthesize metallic nano-film over a suitable substrate using sputtering method. A DC magnetron sputtering set-up has been designed indigenously and currently it is in an advanced stage of development. It consists of a non-magnetic stainless-steel Tee-shaped sputtering chamber, a sputter-head with a target mounting assembly and a substrate handling facility. In magnetron sputtering, concentric magnetic assembly creates a magnetic field which guides the electrons generated by a DC plasma discharge created between the negatively biased electrode (cathode) and the ground electrode. In such plasma discharge the energetic electrons collide with the inert gas molecules to create positive ions. The positively charged ions bombard negatively biased target materials to eject the atoms from the target materials and depositon a substrate kept at its vicinity under controlled a environment. The thickness of the deposited layer can be controlled by varying the applied voltage to the target assembly. The purity of the deposited material is usually achieved under a fine vacuum condition. Another objective of this project is to study metal deposition rate by changing the deposition parameters e.g., Voltage applied to the target, target to substrate distance, deposition time, working pressure etc. The crystal orientation, surface morphology, phase transition characteristics of the deposited thin film layer will be carried out using XRD, SEM, AFM under the collaboration with UGC-DAE-CSR Kolkata Center, IIEST Shibpur etc. Main objectives of this project are:

1. To deposit transition metal layers on Silicon substrate by using sputtering set-up.
2. Studying the deposition rate by changing related parameters.
3. Deposition of various nano-structured metal films by changing the parameters.

4. Characterize the structural and surface properties of the developed thin metallic layer by using SEM, X-Ray Diffraction etc. from collaborating institutes.

## ACHIEVEMENTS

A DC magnetron sputtering set-up has been indigenously designed and developed in Institute of Engineering & Management, Kolkata. Using this set-up, copper layer has been deposited on the substrate.

- A Tee shaped, 100mm diameter non-magnetic stainless-steel sputtering chamber has been designed and successfully developed. Fig. 1 shows the developed magnetron sputtering chamber. This chamber consists of a substrate handling facility, gas inlet ports along with vacuum gauges and a sputter-head. This sputter-head consists of a closed field magnetic assembly and a target mounting facility. A concentric magnetic assembly consists of a coin shaped ferrite magnet and an annular ring-shaped permanent ferrite magnet formed the closed balanced magnetic field which is essential for uniform deposition of the metal nano-film.
- A 100 ltr/min double stage rotary vane vacuum pump along with gauges has been used for vacuum the chamber. A fine vacuum of ~6 X $10^{-3}$ mbar has been achieved within 30 minutes from pump down starting. An Argongas filled cylinder with pressure regulator has been installed and connected to the gas inlet port of the chamber through a nylon pipe.
- An in-house DC 0-450V, 200 mA regulated power supply has been developed and utilized for sputter deposition of metallic nano film.
- A commercial Copper sheet of 1mm thickness has been used as a target material and glass slide has been used as a substrate. A negative voltage was applied to the target and the substrate was kept grounded. The discharge was observed at -100V voltage and 10mA current. A stable DC discharge has achieved at -300V voltage and 30mA current. The magnetic field generated from the magnetic structure inside the magnetron sputter head traps the DC discharge plasma between target and substrate. The $Ar^{+}$ ions generated from ionization of Ar molecules in the presence of the DC plasma sputtered-out the target metal atoms and deposited it on the substrate. Fig. 2 shows the DC discharge glow during sputter deposition of metal.
- The copper deposited samples were characterized by using X-Ray Fluorescence spectrometer (XRF) and X-Ray Diffractometer (XRD) at UGC-DAE CSR Kolkata Center. XRF was used for qualitative compositional analysis. Fig. 3 shows the XRF data analysis. Form the data it has been observed that the copper is deposited on the substrate by sputtering. The crystalline structure of the deposited metal was characterized by XRD. Fig. 4 shows the XRD data. It is observed that Cu [111] is deposited along with various crystalline structure of $Cu_2O$. XRD result confirmed the deposition of 11.983 nm grain size of Cu[111] on the substrate.

## PUBLICATION

Tamojit Saha M.Tech Thesis: "Design and Implementation of Transformer Coupled DC-DC Power Supply", 27th June, 2019.

"Copper Thin Film Deposition by An Indigenous Unbalanced Type DC Magnetron Sputtering System", Soumik Kumar kundu, Samit Karmakar, G. S. Taki, arXiv preprint arXiv:2001.08974.

# Intelligent Early Forest Fire Detection System with Self Energy Harvesting Wireless Sensor Network

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**Testbed**

**Sensing Environment Parameters**

## OBJECTIVES

The objective of this project is to design a self-energy harvesting specific wireless sensor network based test bed for early forest fire detection. The mote with several sensors and energy harvesting solution was designed and implemented. The layered architecture of the proposed early forest fire detection system, using energy harvesting wireless sensor network, was designed along with its overall block diagram. Homogenous sensor devices capable of detecting temperature, smoke and relative humidity value of its surrounding were deployed in remote areas. This information is routed to the computer of monitoring center through efficient routing algorithm via the intermediate relay sensors. The collected data was analyzed and managed by the computer/ mobile. The analytical results were then sent to the relevant department as the policy-making basis by which the department will make the decision of fire fighting or fire prevention. Finally, a series of tests has been carried out to analyze the performance of the developed methodology in the real time.

## ACHIEVEMENTS

The developed hardware model will improve the fire detection resolution to detect forest fires. The fire detection system could be well used for other applications such as fireworks industry, large buildings, banking and sensitive organization like Defense centers. The issues in the design of the routing algorithm and validating the performance in delivering the information about the forest fire places to the end users obtained from the sensor using test bed studies are the main goals of this project. The created test bed prototype will be useful in the actual design of the hardware for earlier detection of forest fires. Detecting forest fires are of high research interest in both national and international levels in order to safeguard the natural resources.

## PUBLICATION

Bhuvaneshwari G & Mohaideen Pitchai K, 'An Energy Efficient Routing Mechanism in Software Defined Wireless Sensor Network for forest fire monitoring applications' published in the International Conference on Recent Advances in Engineering and Technology, Sri Krishna College of Engineering and Technology, Coimbatore, 08- 09 February 2019.

## Legacy of IEI

**Prime Minister Smt Indira Gandhi being received at the 12th World Energy Conference**

# Tribological Performance Evaluation of Non-asbestos Organic Brake Pad Materials

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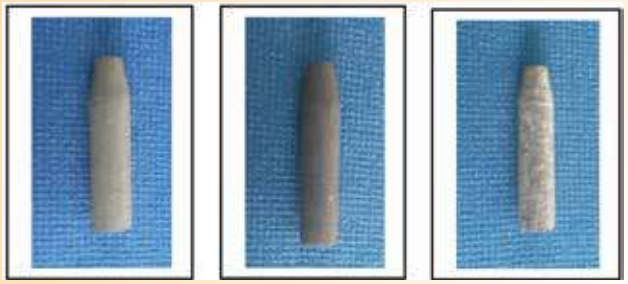
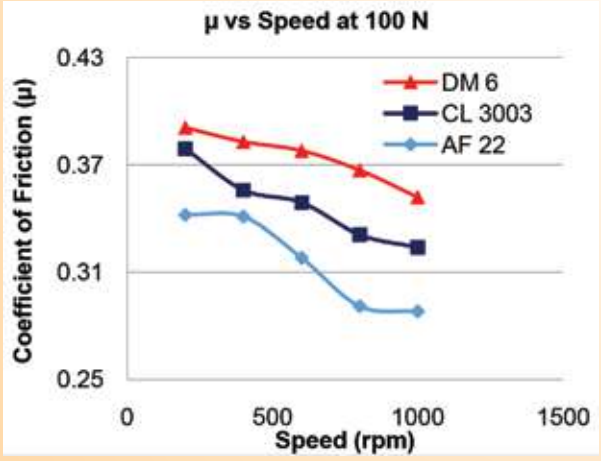
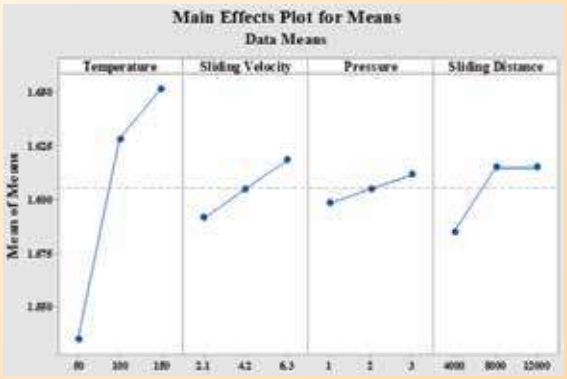


**Pin Samples of 3 Different Brake Materials**


**Pin-on-Disc Apparatus**




**Experimental Results**




**Experimental Results**

## OBJECTIVES

The primary objective of this project is to evaluate tribological performance of a non-asbestos (NA) brake pad material and its comparison with existing asbestos material.

The objectives in details are:

- To study frictional characteristics of brake pad materials of variable composition of additives.
- To study wear performance of these materials using pin-on-disc apparatus at elevated temperature.
- To compare characteristics of asbestos and non-asbestos brake pad materials.
- To study material characterization by using EDS, SEM, XRD and TGA.
- Analysis of results through appropriate DOE (Design of Experiments).

## ACHIEVEMENTS

There has been remarkable advancement in the field of brake friction materials. The performance of brake linings depends on the brake design, material composition, operating speeds, pressure and temperature. Asbestos friction materials are found to be harmful to human health. Asbestos based friction materials are increasingly being replaced with non-asbestos brake pad with desired performance and wear characteristics. A research is being carried out to study tribological performance of non-asbestos based brake pad materials in foreign countries. Majority of the researchers evaluate thermal, metallurgical, physical properties of brake pad materials, however, hardly any work has been carried out on tribological properties together with thermo mechanical properties of brake pad materials.

In this project, authors first ranked important properties which are to be evaluated for the purpose of selection of brake pad material using AHP. Thereafter, attempts have been made to evaluate tribo characheteristics of different brake pad materials. For experimentation pin-on-disc apparatus (DUCOM TR-20LE) was used to evaluate friction and wear characteristics of brake pad materials. The different materials having variable combinations of fibers, friction modifiers, abrasives and fillers were tested for its friction and wear characteristics. Three different brake pad materials like asbestos, metallic and brass based were tested. For frictional studies Taguchi orthogonal array was used to establish the correlation between parameters those affects the coefficient of friction and wear.

Microstructural analysis using Energy Dispersive Spectroscopy (EDS) equipped with Scanning Electron Microscopy (SEM) were done in order to verify material and its ingredients. X-ray Diffratometer (XRD) used to confirm the material elemental composition of respective braking materials.

A multi-attribute decision making (MADM) method is used for a complex problem of selection of newly developed brake pad materials. Ranking of alternatives are done based on preference system i.e. purely objective, subjective and combination of them. Based on the results, Periwinkle Shell based brake pad material is the potential alternatives to asbestos based commercial brake pad materials. Further investigation on simulated test conditions are proposed as a scope for future work.

Friction and wear behaviour of non-asbestos brake pad materials were evaluated under dry sliding contact conditions at elevated temperatures using a pin on disc tribo-tester. The EDS spectrum depicted the elemental composition of the material in order to compare and confirm the material. Scanning electron microscopy measures the segmental section of CL-3003 compound and block images for non-asbestos materials.

Coefficient of friction has been found in the range of 0.20 to 0.59 for this material under consideration and can depict good frictional properties suitable for braking operations. Ranking of the parameters have been done, and it was found that in order to determine coefficient of friction sliding velocity contributes largely (86.35 %)

followed by temperature (6.53 %), pressure (3.80 %) and sliding distance (3.33 %). Wear rate largely depends on temperature (87.95 %), followed by sliding distance (6.92 %), sliding velocity (4.10 %) and pressure (1.03 %).

The parameters under considerations showed their effect on friction and wear. Also the analysis showed that these parameters are statistically significant. Further, in depth study for interaction effect of parameters is desirable. However, detail research involving this material with influencing parameters and system variables to evaluate wear rate, stopping distance etc. have to be undertaken using simulative test conditions to predict the commercial use of such brake pad materials in a specific braking operation.

**FUTURE SCOPE**

Braking has lot of applications in moving elements have largely variable contact conditions and materials. However, this study will lead to evaluate friction and wear characteristics of brake materials pertaining to the application not restricted to automobiles. Also non-asbestos linings of superior quality need to be developed and data regarding the properties of non-asbestos products need to be generated.

**Awards and Recognitions:**

i) Received 3rd Prize of ASM India 2019- Masters Award with auspicious hands of Dr Raghunath Mashelkar, at the 3rd Materials Day for his distinguished Masters research held at Hotel President, Cuffe Parade, Mumbai on 19th October 2019.

## PUBLICATIONS

1. Hendre K. N., Bachchhav B. D., "Critical Property Assessment of Novel Brake Pad Materials by AHP", Vol. 13, Issue. 3, pp 148-151, September (2018).

2. Hendre K. N., Bachchhav B. D., "Tribological Behaviour of Asbestos and Non-asbestos Brake Pad Materials" 5thMechanical Engineering Post Graduate Student's Conference, June (2019).

3. Hendre K. N., Bachchhav B. D., "Screening of Organic Brake Pad Materials Using MADM Technique", Advances in Intelligent Syst., Computing, Vol. 949,: Advanced Engineering Optimization Through Intelligent Techniques, Book Chapter DOI: 10.1007/978-981-13-8196-6_40, Springer Nature, (2019).

4. Kishor N. Hendre, Bhanudas D. Bachchhav., "Friction and Wear Characteristics of Rubber Resin-Bonded Metallic Brake Pad Materials", International Journal of Engineering and Advanced Technology (IJEAT), Vol: 8, Issue: 6, (August 2019), pp. 1312-1316. [ISSN 2249 – 8958], Blue Eyes Intelligence Engineering & Sciences Publication. [DOI 0.35940/ijeat.F8514.088619].

5. Kishor N. Hendre, Bhanudas D. Bachchhav, Harijan H. Bagchi., "Frictional Characteristics of Brake Pad Materials Alternate to Asbestos", International Journal of Engineering and Advanced Technology (IJEAT), Vol: 9, Issue: 2, (December 2019), pp. 694-698. [ISSN 2249 –8958], Blue Eyes Intelligence Engineering & Sciences Publication. [DOI: 10.35940/ijeat.B3170.129219].

# Women Anti-Harassment Device

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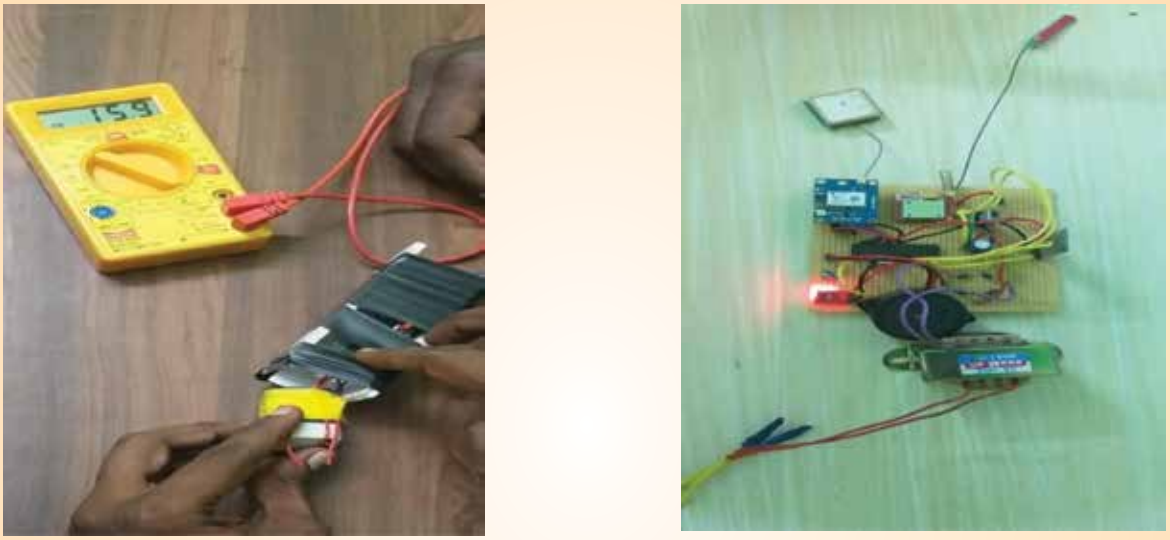

**Circuit Connection of Women Anti-Harassment Device**

## OBJECTIVES

Women harassment is the fourth most common crime against women in our country. Women safety is the major concern all over the world. Women safety has become mandatory for all women from birth to death. Hence, the major objective of our project is to protect the women victim of the society from the abusers.

It is a control system equipped with an electronic weapon which is used to activate an electronic shock attacker. The device is made in fashionable belt or smart band which carries the Arduino microcontroller. In the device the inputs are obtained from touch sensor bluetooth voice module, GSM module, GPS. The two inputs received are touch sensor and bluetooth voice module. When either of these inputs are activated, alert message along with victim's location is shared to the pre-defined numbers. A shock generating kit can be used to make the abusers unconscious for a short duration. Through this way victims can protect themselves against danger.

**Features:**

- Exact location of the victim can be tracked using GPS Module.
- It can be made as an easily portable/wearable handy device.
- Shock generating kit can be used as self-defensive tool to protect oneself from the abusers.

# A Case Study for Measurement of Temperature of Coal Pipe of Pulverized Coal-Fired Boiler System using the Modified Bridge Network

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**Ceramic tiles damaged due to coal pipe de-choking work**


**RTD mounted on coal pipe for temperature measurement**

## OBJECTIVES

This project deals with a method for measurement of temperature of coal pipe of coal mills using modified AC Wheatstone bridge network. RTD sensor and Distributed Control System (DCS) may be used in the measurement system. This developed system may be implemented in thermal power plant. The proposed hot air temperature measurement system through coal flow pipe can eliminate the problem of choking of coal flow pipe. Presently, there is no arrangement of continuous measurement of the temperature of a coal pipe carrying pulverized coal to the boiler in a thermal power plant. As the pulverized coal flows through the long coal-pipe with the help of flow of hot air as a carrier, the temperature of the coal pipe can be used as an indicator of the coal flow through the pipe to the boiler. Low temperature indicates improper flow of pulverized coal through the pipe. Hence, in absence of continuous measurement of temperature, the flow profile of the pulverized coal through the coal pipe cannot be ascertained. Sometimes, the pipe gets choked with the coal dust flowing through it and remains unattended for a long time. For de-choking of the large sized coal pipe, the flow of pulverized coal through it has to be suspended and more man power, as well as, more maintenance cost is required. As a result, the power generation is hampered causing loss and the economical figure of the power house is affected.

## ACHIEVEMENTS

In the boiler design, pulverized coals are forced to flows within the long coal-pipe with the help of hot air and we cannot predict the flow profile of pulverized coal through coal pipe. Again there is no arrangement to get update on the coal pipe temperature also. As a consequent, coal pipe gets choked due to improper coal flow

and it remains undetected for a long time. Once the coal pipe is choked we may require huge manpower with huge cost to de-choke the coal pipe and as a result loss of power generation and it also affects the economical working of the power plant. Therefore, by measuring the coal pipe temperature on regular basis, it is possible to minimize the losses. Automation has been developed for the measurement of coal pipe temperature and the automation has been adopted by the modified bridge network. A scanner has been used for the channel scanning purpose and the data logger will serve the purpose of channel scanning. RTD output signal has been scanned by that data logger. Here, four numbers of coal mill have been taken for consideration and individual mill will have four coal pipes. Therefore, we measured 16 numbers of coal pipe temperature. We procured 16 numbers of RTD and all are surface mounted. RTD has been fixed on the individual coal pipe very carefully before entering the burner area. A central control junction box has been created where all RTDs signals have been connected and then it has been fed to the temperature scanner unit. After that a communication between Data logger or Temperature Scanner to DCS system through a single pair cable has been established. To provide uninterrupted measurement of process value i.e., coal pipe temperature, a programme or logic has been developed on DCS software.

Uninterrupted power supply is a basic demand in this new age. It can be provided by modernization of the power houses. The availability of the equipments is essential for uninterrupted power generation in the power plants. Each and every small parameter plays a vital role. In this study, the temperature of coal pipe has been measured and monitored for a long time without any interruption. It is found that if the temperature of the coal pipe becomes less than 65$^{o}$C, the alarm is enunciated in the control room and the necessary corrective measures can be taken without any delay. Thus, the choking of the coal pipe can be prevented by continuous monitoring of the temperature of the coal pipes. This directly increases the availability of coal mill for uninterrupted power supply. Hence, the best efficiency of the boiler can be achieved by maintaining proper coal flow to it.

## PUBLICATIONS

"Temperature Measurement of Coal Pipe of Coal Mills by a Modified Bridge Circuit".

International Journal of Engineering and Advanced Technology (IJEAT) ISSN: 2249 – 8958, Volume-9 Issue-2, December, 2019.

## *Legacy of IEI*

Mohammad Hidayatullah, Vice President of India, Mother Teresa and Shri Jyoti Basu, Chief Minister of West Bengal during the Diamond Jubilee Celebration of The Institution of Engineers (India) in 1980

# Development of Face Recognition Techniques orom Video under Changing Environment

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## OBJECTIVES

The objective of this project is to develop new methods for face recognition from video sequences to solve the major concerns of face recognition under changing environment. In face recognition complications arise due to the fact that the object undergoes changes in pose relative to the viewing camera, changes in illumination relative to light sources, and may even become partially or fully occluded.

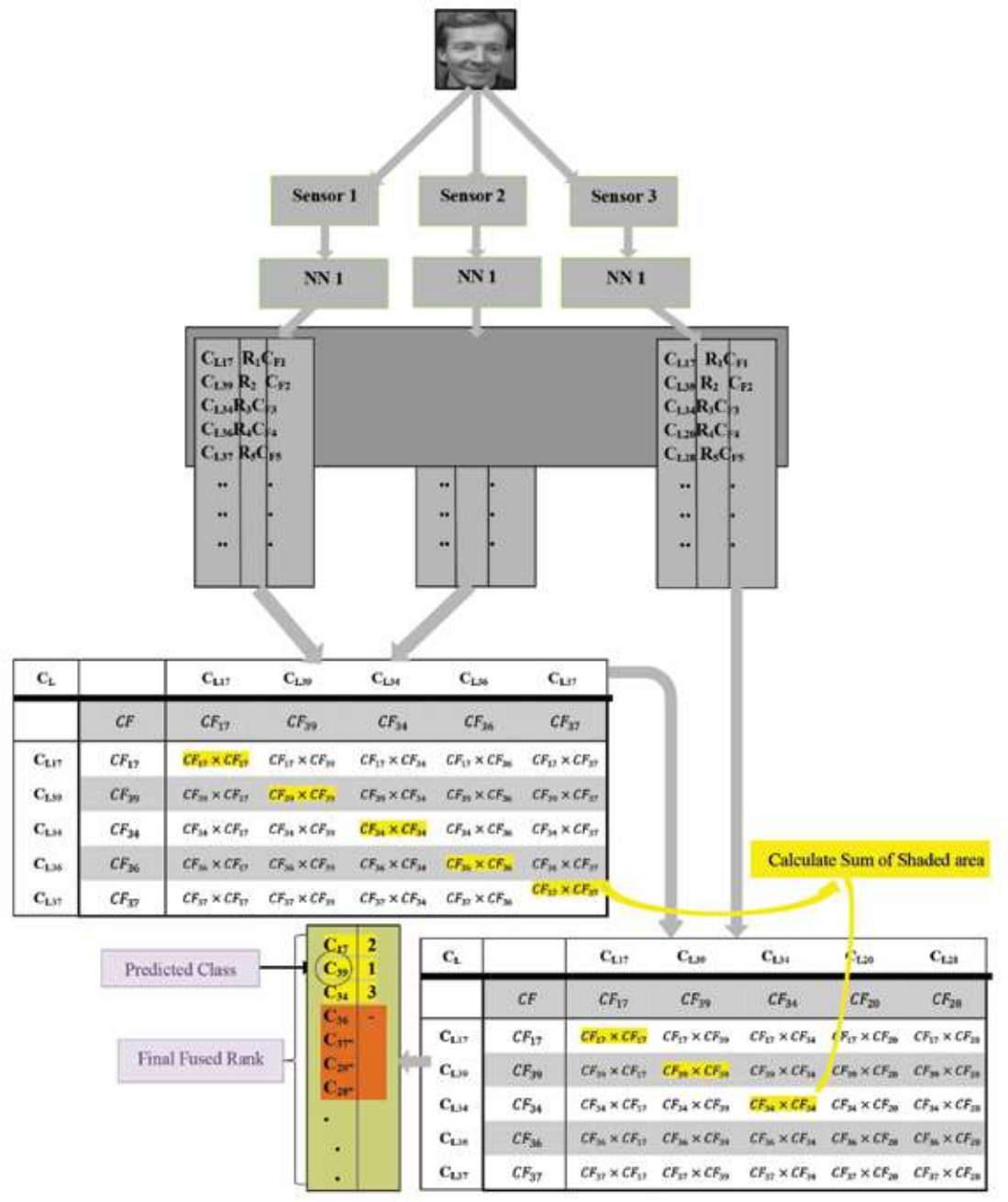
In this project, efficient feature extraction techniques using neural networks (NN) with evidence theory for face recognition are presented. This approach is established to reduce the computation periods required by these NN. The performance of single/ multiple biometric authentication system can be improved by applying evidence theory in treating uncertainty factor. Conventional ranking is upgraded using some associations among the outputs (belief confidence factors) of a classifier. Then, the final result is attained after fusion of classifier outputs (belief confidence factors) combining them with evidence theory. The face database is usually severely affected by various degradations such as, illumination, noise and pose variations etc. which affect the overall recognition accuracy. The outcome establishes that the proposed fusion method attains superior recognition accuracy than other feature extraction and other related fusion approaches.

## ACHIEVEMENTS

In computer vision, face recognition is an attractive and challenging research field for machines to recognize people based on their digital face images, has been fuelled by many academic scientists and industrial developers for over two decades. In several security applications face recognition is used such as, access control to authorized areas, computer, airports, identity verification/management for criminal justice system, disaster victim identification, etc. The other applications where the face recognition can be used are as follows: querying person's identity in still/video databases, human machine interaction applications, smart card solutions (enhanced ATM's security, ePassport), and targeted advertising. The face recognition problem still has many challenges that need to be redressed with more powerful methods even though numerous systems have been proposed over the last two decades. The proposed work has several new dimensions mentioned below:

- Proposed face recognition method using rank level fusion is very accurate
- Vanish-penalty rank and fuzzy weight is considered in the proposed method
- Reduce the time of computation and increase recognition accuracy compared to other related fusion method.

In spite of the outstanding outcomes delivered by the proposed method, there are various unanswered questions



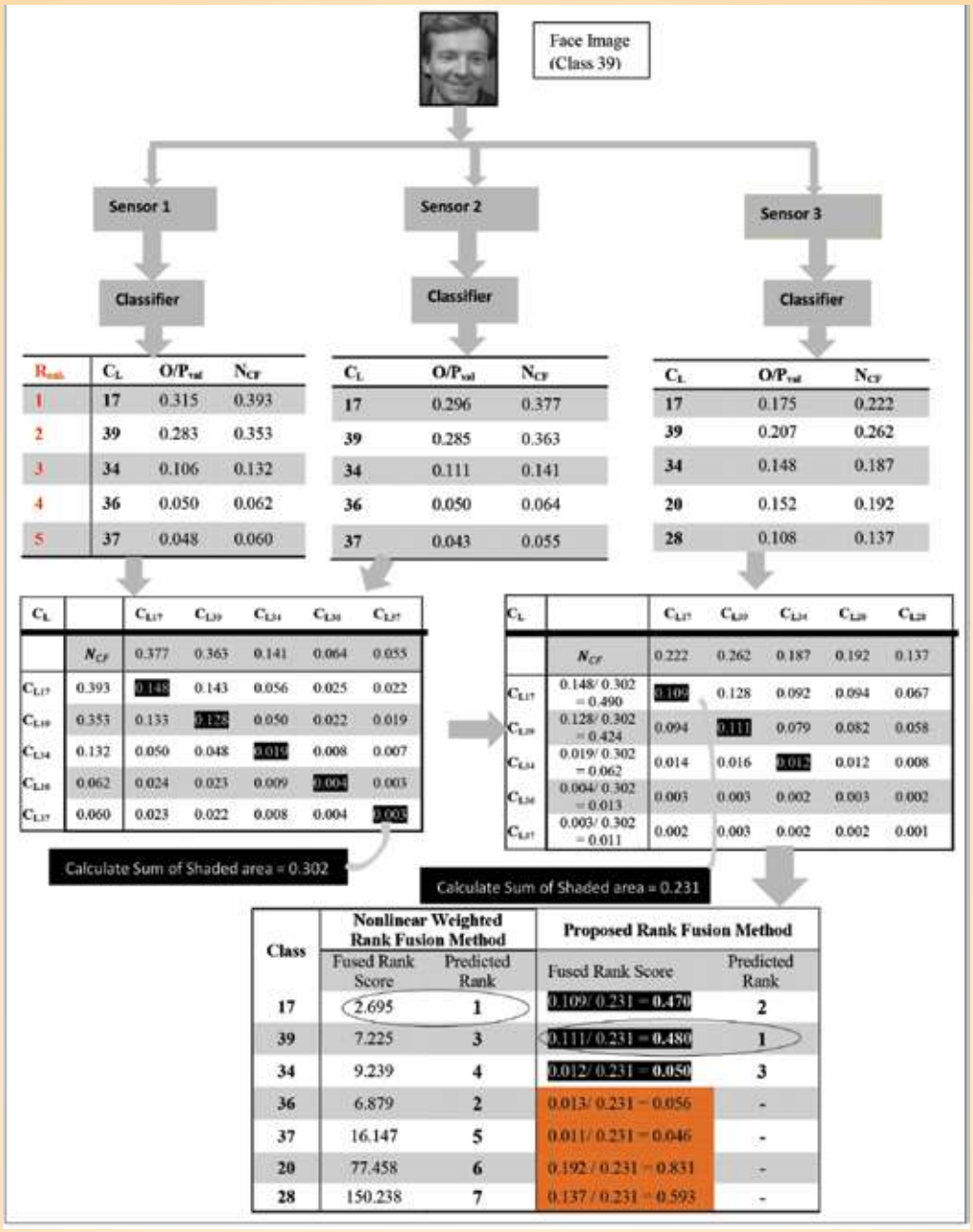

**Schematic diagram of the evidence theory based decision fusion method**

which requires further confirmatory research in this area. Face recognition is akin to a never ending story where the perfection is hard to come by, particularly under uncontrolled conditions or in the context of video surveillance.

## PUBLICATION

**M.Tech Thesis**

Video based face recognition-submitted by Sourav Kumar Dey




| $R_{rank}$ | $C_L$ | $O/P_{val}$ | $N_{CF}$ |
|---|---|---|---|
| 1 | 17 | 0.315 | 0.393 |
| 2 | 39 | 0.283 | 0.353 |
| 3 | 34 | 0.106 | 0.132 |
| 4 | 36 | 0.050 | 0.062 |
| 5 | 37 | 0.048 | 0.060 |

| $C_L$ | $O/P_{val}$ | $N_{CF}$ |
|---|---|---|
| 17 | 0.296 | 0.377 |
| 39 | 0.285 | 0.363 |
| 34 | 0.111 | 0.141 |
| 36 | 0.050 | 0.064 |
| 37 | 0.043 | 0.055 |

| $C_L$ | $O/P_{val}$ | $N_{CF}$ |
|---|---|---|
| 17 | 0.175 | 0.222 |
| 39 | 0.207 | 0.262 |
| 34 | 0.148 | 0.187 |
| 20 | 0.152 | 0.192 |
| 28 | 0.108 | 0.137 |

| $C_L$ | | $C_{L17}$ | $C_{L39}$ | $C_{L34}$ | $C_{L36}$ | $C_{L37}$ |
|---|---|---|---|---|---|---|
| | $N_{CF}$ | 0.377 | 0.363 | 0.141 | 0.064 | 0.055 |
| $C_{L17}$ | 0.393 | 0.148 | 0.143 | 0.056 | 0.025 | 0.022 |
| $C_{L39}$ | 0.353 | 0.133 | 0.128 | 0.050 | 0.022 | 0.019 |
| $C_{L34}$ | 0.132 | 0.050 | 0.048 | 0.019 | 0.008 | 0.007 |
| $C_{L36}$ | 0.062 | 0.024 | 0.023 | 0.009 | 0.004 | 0.003 |
| $C_{L37}$ | 0.060 | 0.023 | 0.022 | 0.008 | 0.004 | 0.003 |

| $C_L$ | | $C_{L17}$ | $C_{L39}$ | $C_{L34}$ | $C_{L36}$ | $C_{L37}$ |
|---|---|---|---|---|---|---|
| | $N_{CF}$ | 0.222 | 0.262 | 0.187 | 0.192 | 0.137 |
| $C_{L17}$ | 0.148/ 0.302 = 0.490 | 0.109 | 0.128 | 0.092 | 0.094 | 0.067 |
| $C_{L39}$ | 0.128/ 0.302 = 0.424 | 0.094 | 0.111 | 0.079 | 0.082 | 0.058 |
| $C_{L34}$ | 0.019/ 0.302 = 0.062 | 0.014 | 0.016 | 0.012 | 0.012 | 0.008 |
| $C_{L36}$ | 0.004/ 0.302 = 0.013 | 0.003 | 0.003 | 0.002 | 0.003 | 0.002 |
| $C_{L37}$ | 0.003/ 0.302 = 0.011 | 0.002 | 0.003 | 0.002 | 0.002 | 0.001 |

| Class | Nonlinear Weighted Rank Fusion Method | | Proposed Rank Fusion Method | |
|---|---|---|---|---|
| | Fused Rank Score | Predicted Rank | Fused Rank Score | Predicted Rank |
| 17 | 2.695 | 1 | 0.109/ 0.231 = 0.470 | 2 |
| 39 | 7.225 | 3 | 0.111/ 0.231 = 0.480 | 1 |
| 34 | 9.239 | 4 | 0.012/ 0.231 = 0.050 | 3 |
| 36 | 6.879 | 2 | 0.013/ 0.231 = 0.056 | - |
| 37 | 16.147 | 5 | 0.011/ 0.231 = 0.046 | - |
| 20 | 77.458 | 6 | 0.192/ 0.231 = 0.831 | - |
| 28 | 150.238 | 7 | 0.137/ 0.231 = 0.593 | - |

**An example of comparison of rank level fusion methods**

**Papers presented in Conference/Seminars**

S. K. Dey, D. Kundu, S. Chakraborty, A. K. Roy, A. Dey, and M. Ghosh,"Confidence Belief Function Weighted Parallel Rank-level Fusion for Face recognition", Proceeding of the IEMENTech 2019.

**Papers communicated in Journal**

S. K. Dey, A. Dey, and M. Ghosh,"Fuzzy belief factor weighted evidence theory based on decision fusion for face recognition", Neural Computing and Application (Communicated).

# Study, Analysis and Optimization of Workplace Design Parameters to Improve Worker Efficiency through Taguchi's Orthogonal Array Approach

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**Experimental Setup with Customized Chair, Footrest with Standby Mobile**

**Measurements with Small Sized Goniometer**

## OBJECTIVES

- Determine the factor levels that can generate the best performance of the process.
- Overcome the long term health issues including both physical and psychological related issues.
- Enhancing worker efficiency by improving the working environment.

## ACHIEVEMENTS

The industry is changing and will continue to change due to the rapid development in the field of information technology and latest business practices. Operations in banks, schools, offices, IT companies, insurance firms, driving, etc. require an individual to perform the task in sitting posture for long hours. This sedentary nature of working has lead to several occupational disorders.

In this research, the tests were carried-out on volunteers of different age group according to ISO 6385:2016 ergonomic principles of work system design standards. The experimental set-up was designed and fabricated, which included the local customized chair and table, footrest, aquarium, plants, music system and lighting.

The constant rise in the cost of experimentation has compelled researchers to use the Taguchi method to optimize the design parameters of a product or process. L9 orthogonal array was selected for three factors at three levels in this experiment. The statistical measure of performance called Signal-to-Noise (S/N) was used,the ratio between mean(signal) to standard deviation(noise) of the response (Y). Smaller-the-Better quality characteristic given in Equation 1 was chosen for determining optimal factors levels.

$$S/N \text{ ratio } (\eta) = -10 \log_{10} 1/n\sum Y_i^2 \quad (1)$$

## RESULTS

Table 1 shows that custom chair ($B_3$), extended and inclined table ($A_3$) and the use of footrest($C_3$) as the optimum control factor levels.

Table 1: Optimal control factor settings and predicted S/N ratio

| Configuration | Control factor settings | | | Predicted S/N ratio |
|---|---|---|---|---|
| | Table | Chair | Footrest | |
| Optimal levels | Extended & Inclined | Custom made | Inclined | -32.7583 |

Additionally, the use of music, aquarium, plants, and local lighting further enhanced the productivity of the operator. Implementation of the optimized factors at the workplace is expected to completely avoid work related health issues mainly the physiological strain of an individual.

## PUBLICATIONS

1. Technical paper titled "Understanding the End-User Perspective of Workplace Design Requirements" is published in Journal of Saybold Report, ISSN No. 1533-9211
2. Technical paper "Optimization of workplace parameters using Taguchi's orthogonal array approach to enhance the worker productivity" is communicated.

# *Legacy of IEI*


Hon'ble President of India, Shri Ram Nath Kovind and Shri Banwarilal Purohit, Hon'ble Governor of Tamilnadu at the Valedictory Session of the 32nd Indian Engineering Congress, Chennai, December 2017

# Exploring the Potential of Biomass Available in NE India for Biofuel (Synthesis Gas) Production and its further Integration in Fluidized Bed Gasifier

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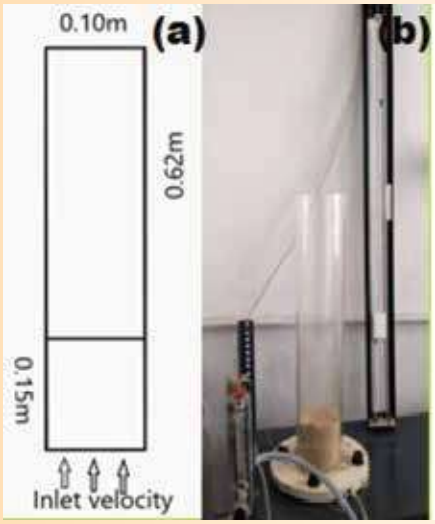
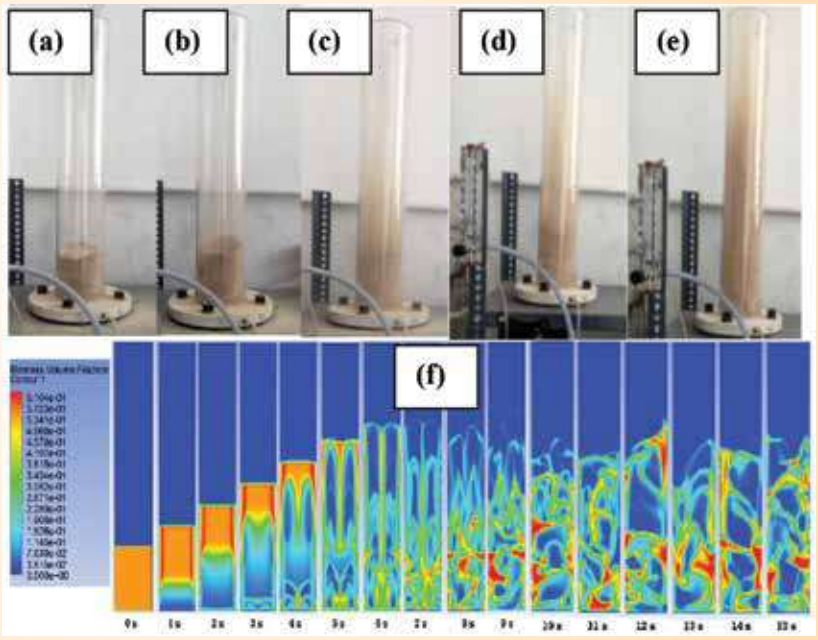



**Experimental setup of fluidized bed column (a) Geometry, (b) Perspex fluidized bed column**




**Experimental visualization of biomass particles (volume fraction) being fluidized at various velocities of (a) 0.05 m/s (b) 0.10 m/s (c) 0.15 m/s (d) 0.19 m/s (e) 0.55 m/s. (f) Represents the validated CFD simulated image of biomass volume fraction at velocity of 0.55 m/s during 0s to 15s**

## OBJECTIVES

a) Collection of biomass samples which are abundantly available in the region of N.E. India mainly from the states of Tripura and Assam.

b) Pre-treatment of collected raw materials.

c) Characterization of all biomass samples to achieve high yield feedstocks for gasification aspects.

d) Doing hydrodynamic studies using simulation software such as ANSYS which will lead in better scale up of a fluidized based reactor (Gasification/pyrolysis).

## ACHIEVEMENTS

In the first part of the study, various biomass samples were taken into study depending on their availability and they are accordingly characterized to find out the biomass which can be a good feedstock for gasification, pyrolysis etc. For a biomass to qualify as to be a good gasifying or pyrolytic feedstock it should have more hemicellulose and cellulose content and very less lignin amount along with less ash content. One small contradiction between selection of samples with less lignin content along with less ash content can be seen in the case of rice straw where even though the samples were having less lignin content, the ash content was found to be very high and as such its selectivity must depend on the actual aim of the gasifying, pyrolytic experiments as well as material handling capabilities of a gasifier, pyrolyzer etc. Thus it can be suggested that most of the woody biomass samples especially rubber wood and kanak along with muli bamboo and the fibre component of remi can prove to be a considerable better feedstock. However, a detailed experimental study needs to be carried out further inside a gasifying or pyrolytic reactor to have a much elaborated and practical description about the overall usability of a potential biomass which can yield good results depending on the aim and reactor of study.

The second part of the study is concentrated on CFD simulation. As its well known that the performance of gas-solid fluidized bed greatly depends on the hydrodynamic behaviour of the system like inlet velocity. Hydrodynamics are affected by both geometry and unit scale up. The ability to predict homogeneous fluidization is needed to decide which configuration to choose depending on the features of the process to be carried out in the fluidized bed. The current studies reported a good resemblance between the experimental data and the computational data. Moreover, the computational power helped in determining the minimum fluidization velocity as well as the velocity over which the particles may get eleutriated (Out of reactor). Such results will help in the comprehensive designing and scale up of a fluidized bed reactor.

## PUBLICATIONS

1. H. Nath, S. Das, J. Das, A Study on the Potential Biomass Available in Northeast India for Its Applicability in Certain Clean Energy Generation Purposes, J. Inst. Eng. Ser. E. 1 (2020). https://doi.org/10.1007/s40034-020-00166-1 (Springer Nature)

2. S. Debnath, H. Nath, V. Chauhan, CFD modeling of a typical fluidized bed column, Mater. Today Proc. (2020). https://doi.org/10.1016/j.matpr.2020.04.079 (Elsevier)

Engineering is the art of modelling materials we do not wholly understand, into shapes we cannot precisely analyse so as to withstand forces we cannot properly assess, in such a way that the public has no reason to suspect the extent of our ignorance.

Dr A R Dykes

# Enzymatic Conversion of Bio-Diesel Derived Glycerol to Acetins

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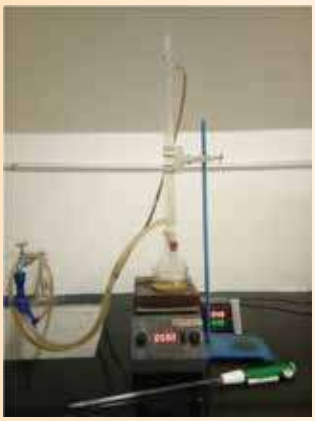

**Experimental Set-up for glycerol conversion to acetins**

**Germinated wheat seeds**

## OBJECTIVES

The work outline and objectives are mentioned below:

- Identification and evaluation of performance of enzyme as a catalyst for the selected reaction.
- Designing the entire study using statistical analytical tools (DOE) and optimization of key process parameters.
- Study the effect of various parameters on the reaction kinetics such as temperature, enzyme concentration, organic solvents, mole ratio of reactions etc.
- Study of stability and reusability of the catalyst for the specified reaction.
- Study of the reaction mechanisms and the development of kinetic models.
- Development of a continuous easy to scale up system that is applicable as a blue print for commercial exploitation.

## ACHIEVEMENTS

1. We, through our experiments, were able to identify enzymes, extract and evaluate the performance of enzymes in glycerol conversion to acetins.
2. As a supporting experimentation, chemical catalysts were also evaluated. Though they showed better conversion rates, enzyme catalysts could catalyze the reactions in an environmental benign way.
3. Three commercial enzyme catalysts and an enzyme catalyst extracted from germinated wheat seeds were employed as catalysts and the findings are published in journals acknowledging IEI.

## PUBLICATIONS

1. Presented a review paper on "Enzymatic synthesis of Value Added Products of Glycerol , a By- Product Derived from Biodiesel Production" at an International conference held at VIT, Vellore in the month of October (Technoscape-16).This paper was also published in an Elsevier Journal "Resource – Efficient Technologies-2017"
2. Published a paper titled "Synthesis of Acetins from Glycerol using Lipase from Wheat Extract" in the Korean Chemical Engineering Research.
3. Presented at findings of our research at the "23rd National Symposium on Catalysis" (CATSYMP-23) held in Bangalore from January 17-19, 2018- organized by the Catalysis Society of India-Bengaluru Chapter.
4. Communicated a paper titled "Kinetic studies on synthesis of acetins using $CeO_2$-$ZrO_2$ metal oxide catalyst" to a Journal and are awaiting their response.

## Legacy of IEI


**Shri Tathagata Roy, Hon'ble Governor of Tripura delivering inaugural address during the 30th Indian Engineering Congress at Guwahati in December 2015**

# Development of a New Numerical Busbar Protection Scheme and Laboratory Prototype Implementation

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**Complete hardware setup**

**Busbar protection scheme**

## OBJECTIVES

- To develop a new digital relaying scheme based on instantaneous current values for busbar which provides effective discrimination between in-zone and out-of- zone faults.
- Authenticity of the developed scheme is to be evaluated for varying fault and system parameters such as fault type, fault resistance, fault inception angle, and phase angle.
- To design a new busbar protection scheme which is able to block the tripping of the relay in case of CT saturation. The slope of the percentage differential characteristics should be adaptive to the degree of CT saturation. The developed scheme should be immune to high DC offset value and noises present in saturated CT secondary waveforms.
- To develop a new busbar protection scheme which avoids the problem of delayed fault clearance and unnecessary outages in case of a fault in the blind spot or in between tie breaker and CT.
- Validation of the developed schemes, based on the data acquired from the laboratory prototype.

## ACHIEVEMENTS

An improved differential protection for busbar based on the concept of Generalised Alpha Plane has been presented. The benefits of conventional and the two-restrain alpha plane approach have been combined to develop an improved busbar differential protection scheme. The n-terminal line currents at a busbar has been converted into two-terminal equivalent in a phase-segregated manner. The results obtained from the testing of a large set of fault scenarios show its responsiveness in internal faults and stability against external faults specifically in severe CT saturation scenarios. The results obtained from the hardware setup show encouraging results for on-field implementation. The response time of the proposed scheme is less than 5 ms which is on par with modern state-of-the-art relays.

## PUBLICATIONS


1. S. Jena and B. R. Bhalja, "Numerical busbar differential protection using generalised alpha plane," in IET Generation, Transmission & Distribution, vol. 12, no. 1, pp. 227-234, 2 1 2018, doi:10.1049/iet-gtd.2017.0625.
2. S. Jena and B. R. Bhalja, "A new numeric busbar protection scheme using Bayes point machine," 2017 IEEE PES Asia-Pacific Power and Energy Engineering Conference (APPEEC), Bangalore, 2017, pp. 1-6, doi: 10.1109/APPEEC.2017.8309013.
3. S. Jena, "Improved Schemes for Busbar and Breaker-Failure Protection" PhD Thesis, Submitted to: Department of Electrical Engineering, Indian Institute of Technology Roorkee, Feb, 2020.


## Legacy of IEI


**Shri Keshari Nath Tripathi, Hon'ble Governor of West Bengal delivering inaugural address during the 31st Indian Engineering Congress at Kolkata in December 2016**

# Numerical Investigation of Effect of Elasto-Plastic Behaviour a round the Notches under Cyclic Loading

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**Cold Hole Expansion**

**Working Procedure of Cold Hole Expansion Technique**

## OBJECTIVES

1. To conduct literature and industrial data survey about application of elasto-plastic design consideration.
2. To extend the understanding influence of elasto-plastic analysis of different alloys.
3. To extend and modify of a previously developed model cyclic loading deformation to the case of elasto-plastic deformations.
4. To calibrate the developed model with possible range of experiments for different materials.
5. To correlate the local stress-strain relationships to globally measured engineering stress-strain relationships via Finite Element Modeling.
6. To determine the causes leading to plastic necking and instability in the uniaxial tested specimen.

## ACHIEVEMENTS

In the current research experiments, the method of cold hole expansion and friction stir hole expansion are relatively new methods when compared to other conventional methods of hardening. A meager research work has been carried out in this regard. The efforts to optimize the parameters of cold hole expansions and friction stir hole expansion are very few. There is a lot of scope of cheaper alternatives of making fastener holes more reliable and prevent any failure. The overall objective of this research is to carry out experiments in order to find

out the dependence of properties of materials when the parameters such as feed rate, coolant and taper angle are varied and find the best value of these parameters which provides the optimum results.

## PUBLICATIONS

Title Of Invention: A Smart and Digitalized Knob for A Gas Stove Along with A Device to Check Efficacy and Safety Factors

**International Journal**

- Vishwanath K.C "Corrosion Studies of Al7075/Silicon Carbide Composites in Acid Chloride Medium" to International Journal of Advanced Scientific and Technical Research, (special issue-issue 5 volume 5), ISSN 2249-9954,Available online on http://www.rspublication.com/ijst/index.html
- Vishwanath K.C "Investigation of Effect of Friction Stir Drilling Parameters on Elastoplastic Behaviour of Al Alloy" to International Journal of Mechanical and Production Engineering Research and Development (IJMPERD_Scopus Indexed Jounal id: EC3377CF136468C2), Impact Factor (JCC)-2017: 6.8765, ISSN (P): 2249-6890; ISSN (E): 2249- 8001 Vol. 8, Issue 1, Feb 2018, 1059-1064 © TJPRC Pvt. Ltd.
- Vishwanath K.C "Investigation of Effect of Grain Size on The Mechanical Properties of Al Alloy By Using Friction Stir Hole Expansion" to International Journal Of Engineering Sciences & Research Technology (IJESRT), ISSN: 2277-9655, Impact Factor: 5.164, CODEN: IJESS7, Vol. 7 Iss. 3, March-2018, DOI:10.5281/zenodo.1189018.
- Vishwanath K.C "Investigation of Effect of Mechanical Properties of Different Shaped Notched Around The Specimen under Friction Stir Hole Expansion" to International Journal Of Engineering Sciences & Research Technology (IJESRT), ISSN: 2277-9655, Impact Factor: 5.164, CODEN: IJESS7, Vol. 7 Iss. 8, August-2018 DOI: 10.5281/zenodo.1345627
- Vishwanath K.C, Sreenivasalu Reddy "Characterization of Ballistic and Wear Resistance of Friction Stir Welded AA6061 Aluminium Alloy" AIP Journal (Scopus Indexed)
- Vishwanath K.C , Sreenivasalu Reddy, Satheesha V "Enhancing the thermal efficiency of parabolic trough collector using rotary receiver tube" Renewable energy. Elsevier, ISSN: 0960-1481, Scopus indexed, Web of science,
- Vishwanath K.C "Corrosion studies of Al 7075 alloy using cetirizine drug as drug in Arabian sea water sample" Manuscript Accepted on 13-05-2020, Journal of Marine Science Research and Development
- Vishwanath K C "Effect of copper oxide nano fluid as coolant on thermal performance of spiral heat exchanger" Manuscript Accepted on 17-06-2020, International Journal of Advanced Science and Technology

**International Conference**

- Published a paper titled "Design And Analysis of Simulator Handling System For Star Tracker During Space Craft Level Integrated Mode Testing" to International Multi Conference on Innovations in Engineering and Technology IMCIET- 2014 will be held in Bangalore, August 21st-23rd 2014.
- Published a paper titled "Investigation of Effect Of Friction Stir Drilling Parameters on Elasto Plastic Behaviour of Al Alloy" to International Conference on Emerging Research Trends in Mechanical Engineering, ICERTMCE 2017 will be held in Reva University, Bangalore, 6th& 7th July2017.
- Vishwanath K.C "Influence of Graphene Particles on the Structure and Tensile Properties of Aluminium Surface Composites Fabricated by Friction Stir Processing" to International Conference on Advanced Ceramics and Nanomaterials for Sustainable Development (ACEND-2018), Christ (Deemed to be University), Kengeri Campus, Bangalore, Sept. 19th -21st, 2018.

# Design, Development and Analysis of Hybrid Composite Automobile Body Panels Made up of Conventional and Non Conventional Fibers

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**Hydraulic Press used for Applying Uniform Load (Equipment procured from IEI Grant)**

**Prototype Automobile body panel developed using hybrid composite (Example: Car mirror shell)**

## OBJECTIVES

- Chemical treatment to improve wettability of Jute fabric.
- To fabricate synthetic-bio (E-glass/ Jute) hybrid fiber reinforced epoxy composite.
- To characterize the mechanical properties such as tensile, bending and impact behaviour of developed composite.
- Designing, Developing and Analyzing real version of composites structure for specific automobile body panel application to study the field behaviour.

## ACHIEVEMENTS

In the current research experiments, the mechanical strength, flexural strength, impact resistance, and physical properties of composites showed a major enhancement. The developed composites showed that it is isotropic

in nature and can replace the metal and plastics easily. Moreover, this was not very obvious in the current project when the glass fiber used for composites without special coating. The developed parts are light weight, cost efficient and consists of approximately 30% biodegradable fibres. It is also suitable for mass production and thereby provides economy of scale. Also the raw material is naturally available hence the final product results to be much lesser expensive compared to synthetic products. Components developed mainly find use as secondary load bearing materials in automobile industry. Since, natural fibres are having very good vibration absorbing ability and being low density material weight of the component will be very less as compared to the conventional fibres. This brings down the weight of the vehicle and thereby boosts mileage.

## PUBLICATIONS

**Papers Published in Journals**

1. "Synthesis and Mechanical Characterization of synthetic Bio hybrid FRP composites", ISSN: 2277-3878, Voume-8, International Journal of Recent Technology and Engineering, IJRTE, Issue-IC, May-2019.
2. "Strength Analysis of E-Glass and Jute Fiber Reinforced Composites" International Journal of Mechanical and Production Engineering Research and Development (IJMPERD), ISSN (Online): 2249-8001, ISSN (Print): 2249-6890, Vol - 8, Issue – 2, pp.518-526, Apr-2018
3. "Low Velocity Impact Studies on Synthetic and Bio Fiber Reinforced Polyester Composites" International Journal of Engineering Research and Application[IJERA], ISSN: 2248-9622, Vol. 7, Issue 10, pp.17-20, (Part -I) October 2017

**Paper presented in Seminars/Conferences**

1. "Synthesis and Mechanical Characterization of synthetic Bio hybrid FRP composites" International conference on emerging trends in science and technologies for engineering systems(ICETSE-2019), 17th May 2019, SJCIT, Chickballapur.
2. "Strength Analysis of E-Glass and Jute Fiber Reinforced Composites", International conference on emerging trends in science and technologies for engineering systems, 11th and 12th January 2018, SJCIT, Chickballpur.
3. "Low Velocity Impact Studies on Synthetic and Bio Fiber Reinforced Polyester Composites", International conference on Emerging Research in Civil, Aeronautical and Mechanical Engineering (ERCAM-2017), 25th Nov- 2017, NMIT, Bangalore.

## Legacy of IEI

**Conferment of Honorary Fellowship to Hon'ble Lt Governor of Puducherry, Dr Kiran Bedi**

# Single Image Super-Resolution Tactic for Smartphone Fundoscopy Images using Image Content Specific Self-Deep Learning Model

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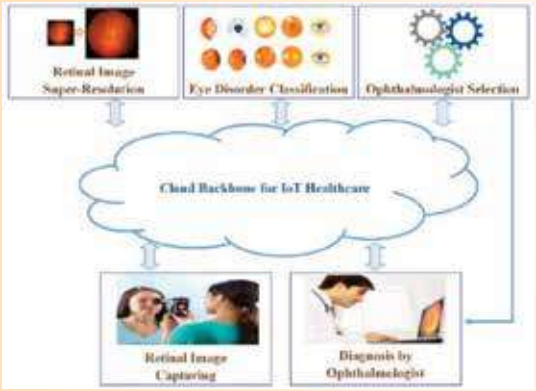
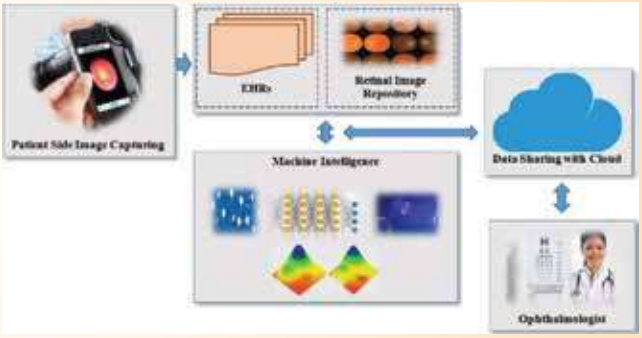



**IoT healthcare architecture with SR**




**Computer Aided Diagnosis of Eye Diseases**

## OBJECTIVES

To develop a single image super-resolution technique using image content specific self-Deep learning model.

To demonstrate that deep learning model is useful in super-resolution problem that can achieve better restoration quality and computationally efficient algorithm.

To find a suitable network structure and its size for faster performance without deteriorating the performance of the algorithm and to perform validation and subjective evaluation of the reconstructed super resolution output images with the help of observer ophthalmologists.

## ACHIEVEMENTS

The resolution of the retinal images from Welch-Allyn iExaminer was improved in terms of PSNR, MSE and RMSE. The learning based super-resolution approaches, that were developed as part of this project, could overcome the existing algorithms.

The deep learning based model provided good learning approximation and helped in the generation of better high resolution images. The results of these SR approaches were evaluated qualitatively by two practicing ophthalmologists and found to be better.

This project model can be adapted in IoT – Healthcare applications.

**PUBLICATIONS**


1. Jebaveerasingh Jebadurai, and J. Dinesh Peter. "Super-resolution of retinal images using multi-kernel SVR for IoT healthcare applications." ELSEVIER Future Generation Computer Systems 83 (2018):338–346. IF: 4.639. SCIE.
2. Jebaveerasingh Jebadurai and J. Dinesh Peter. "DeepCS: Deep Convolutional Neural Network and SVM Based Single Image Super-Resolution". In: Melbourne A. et al. (eds) Data Driven Treatment Response Assessment and Preterm, Perinatal, and Paediatric Image Analysis. PIPPI 2018, DATRA 2018. Lecture Notes in Computer Science, vol 11076, September 2018, Pages: 3-13, ISBN: 978-3-030-00806-2, Springer, Cham. SCOPUS Indexed.
3. J. Dinesh Peter and Jebaveerasingh Jebadurai. "I3: Intelligent Image Interpolation for Super-Resolution of Retinal Images in Automatic Eye Disorder Diagnosis System." CSI Communications, 42(3), June 2018, Pages: 24-26. ISSN: 0970-647X.


## Legacy of IEI


Hon'ble Governor of Tamil Nadu, Shri Banwarilal Purohit and Hon'ble Minister for Tamil Official Language and Tamil Culture, Government of Tamilnadu, Shri K Pandiarajan at Inauguration of Centenary Celebrations of IEI was held at Chennai 13 September 2019.

# Development of Poly Lactic Acid, Hydroxyapatite and Chitosan based Three Dimensional Scaffolds/ Functional Prototypes by using Additive Manufacturing for Biomedical Applications

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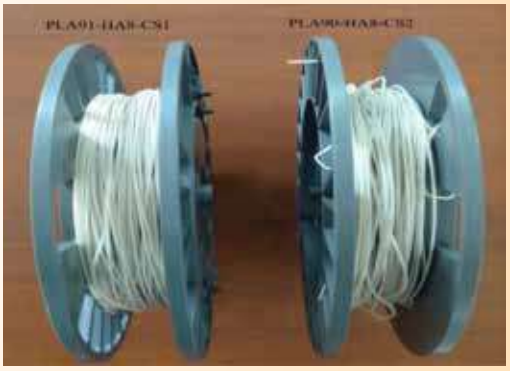
**3D view of twin screw extrusion**



**Fabricated feedstock filament of composition (PLA91-HA8-CS1 & PLA90-HA8-CS2)**

## OBJECTIVES

1. To develop the biocompatible feed stock filament of Poly lactic acid (PLA) with reinforcement of hydroxyapatite (HAp) and chitosan (CS) by using twin-screw extruder (TSE) for fused deposition modelling (FDM).
2. To perform the thermal, rheological and mechanical analysis for determining the best composition/ proportion of materials for preparation of scaffolds/ functional prototypes via FDM for bio medical applications.
3. To perform the in-vivo and in-vitro analysis for ascertaining the biocompatibility and compressive strength related issues (in order to co-relate/ match degradation rate of functional prototypes with regeneration rate of bone/tissue).

## ACHIEVEMENTS

In this research work multifactor optimization for development of biocompatible and biodegradable composite material based feed stock filament of fused deposition modelling (FDM) has been reported. The poly lactic acid (PLA) has been selected as a polymer matrix with hydroxyapatite (HAp) and chitosan (CS) as filler for potential use in medical applications. The feedstock filament of PLA-HAp-CS has been used directly on FDM open source 3D printer (without change in any hardware or software of system). The optimization results are supported by mechanical tensile testing; thermal analysis and scanning electron microscope (SEM) based photomicrographs. Finally the feasibility of fabrication of functional prototypes for medical applications by using in house prepared feedstock filament on the FDM has been ascertained. Following are some of the major observations:

- In this study, PLA, HAp and CS based composite material has been used for fabrication of biocompatible and biodegradable feedstock filament (in first stage). The results of melt flow index suggested four different compositions/proportions of PLA-HAp-CS for fabrication of feed stock filament which were further shortlisted based upon mechanical properties. It has been observed that peak strength of PLA91-HA8-CS1 and PLA90-HA8-CS2 are very close to each other. But based on thermal analysis, it was concluded that feed stock filament PLA91-HA8-CS1 was better according to thermal stability and barrier resistance from cell growth point of view.
- Based upon SEM analysis it has been concluded that for both compositions/ proportions (i.e. PLA91-HA8-CS1 & PLA90-HA8-CS2) of feedstock filament open porous structure is formed. Hence, it can be gainfully employed for cell growth. But based upon rendered 3D images and Ra value, PLA91-HA8-CS1 is a better option.
- Finally, based upon Taguchi analysis and regression model for PLA91-HA8-CS1 based feed stock filament, temperature at 190°C, RPM 140 and dead weight 12kg are the recommended optimized settings on TSE. The functional prototypes developed at proposed settings will certainly have better scaffolding which will provides attractive surfaces for new bone cells.

In second stage as an extension of work reported on HAp and CS reinforced PLA based biocompatible feedstock filament for 3DP of functional prototypes joining of orthopaedic scaffolds (OS) has been performed with rapid tooling (RT) by using friction stir welding (FSW) process. Finally, the mechanical properties (such as tensile strength and hardness) of the OS joints were studied with support of the photo-micrographs and thermal images. Following observations have been made for joining of PLA-HAp-CS based thermoplastic composite:

- For joining of OS of PLA-HAp-CS, FSW has been gainfully employed. Since, the temperature while joining is around 70°C (at optimized settings), there will not be any deformation of side by tissues and other structure elements of scaffolds/ implants. Along with this FSW for patient can be done on line on the operation table itself, which makes it a more convenient and time saving process.
- The best setting for joining of micro cracks in OS of PLA-HAp-CS are: rotational speed of 1000 rpm, with length of consumable tool as 4 mm and staring time as 40 sec. The photomicrographs, hardness values and thermal images captured during joining process also support the tensile data.
- This work may be extended on other biocompatible thermoplastic materials like PEEK, PEKK etc. and more RT with assistance of RP can be printed in shorter time duration to address the clinical needs.

## PUBLICATIONS

Journal publications:

❖ JP Singh, Nishant Ranjan, IPS Ahuja, Rupinder Singh, Multifactor optimization for development of biocompatible and biodegradable feed stock filament of fused deposition modelling, Journal of the

Institution of Engineers (India): Series E, Vol. 100, Issue 2, 2019, DOI: 10.1007/s40034-019-00149-x, pp 205-216.

- Nishant Ranjan, Rupinder Singh, IPS Ahuja, Investigations for in-house prepared biocompatible feed stock filament of FDM: A process capability study, Journal of Mechanical Engineering, Transaction of the Mechanical Engineering Division, The Institution of Engineers, Bangladesh., Vol. ME 48, 2018, pp 18-23.
- Nishant Ranjan, Rupinder Singh, IPS Ahuja, Jatenderpal Singh, A Framework for Development of Biocompatible Feedstock Filament of Polymers by Reinforcement of Fillers for FDM, International Journal of Material Science and Engineering, Vol. 8, No.2, 2017, pp 185-189.
- Nishant Ranjan, Rupinder Singh, IPS Ahuja, Mechanical, rheological and thermal investigations of biocompatible feedstock filament comprising of PVC, PP and HAp, NASA Part A (Springer Publication), In-Press.

**Chapter publications:** Chapter on 'Biocompatible thermoplastic composite blended with HAp and CS for 3d printing', in book on 'Encyclopedia of Renewable and Sustainable Materials', 2018, Elsevier Inc.; doi:10.1016/B978-0-12-803581-8.11237-8, pp. 1-10 (Co-author: Nishant Ranjan, IPS Ahuja)

**Ph.D Thesis:** Development of poly lactic acid, hydroxyapatite and chitosan based functional prototypes by additive manufacturing, Candidate: Mr. Nishant Ranjan, Status: On-going (2017-20).

## Legacy of IEI

**Conferment of Honorary Fellowship to Hon'ble Governor of Assam, Prof Jagdish Mukhi**

# Synthesis and Characterisation of Biodegradable Composites as an Alternative Materials in High Tunnel Agricultural Applications

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**Green house /poly house agricultural High tunnel application cover with 10 X 6 feet**

## OBJECTIVES

1 To determine the mechanical properties such as tensile, compressive, flexural an impact strength.

2 To determine the morphological properties for tensile test fractured samples.

3 To study the functional groups of biodegradable polymers and also found its crystallization/amorphous by conducting X-Ray Diffraction (XRD) and Fourier transform infrared spectroscopy (FTIR) test respectively.

4 To determine the rheological properties for prepared polymer and their co-polymer blends.

## ACHIEVEMENTS

1. Developed a composite material which is bio-degradable and has better strength using both PLA and ABS by utilizing advanced melt blend technique called semi compression molding.
2. The advanced fabrication technique was used to avoid the manufacturing defects which are observed in conventional manufacturing techniques.
3. ABS is considered as ductile material, but it does not have a degradable nature. To overcome the drawback, PLA is added to make it bio degradable by sacrificing strength of composite.
4. The developed composites were tested for its mechanical properties such as tensile, compressive, flexural and impact strengths and attained better properties because of using the advanced manufacturing technique.
5. The highest tensile strength was observed by improvement factor of 9.90 and 11.90 % at the Binary blend PLA30/ABS70 and ternary blend PLA45/ABS45 /TCS10 respectively.
6. Morphological properties showed good particle distribution when high ultimate tensile strength was attained, with improved bonding between ABS and PLA. No sign of manufacturing defects were observed from the study.
7. Rheological properties showed that the ternary blends (PLA/ABS/TCS) is pseudo plastic in nature. Hence, Newtonian- index greater than the unity the developed composites can be used for high tunnel agricultural applications.

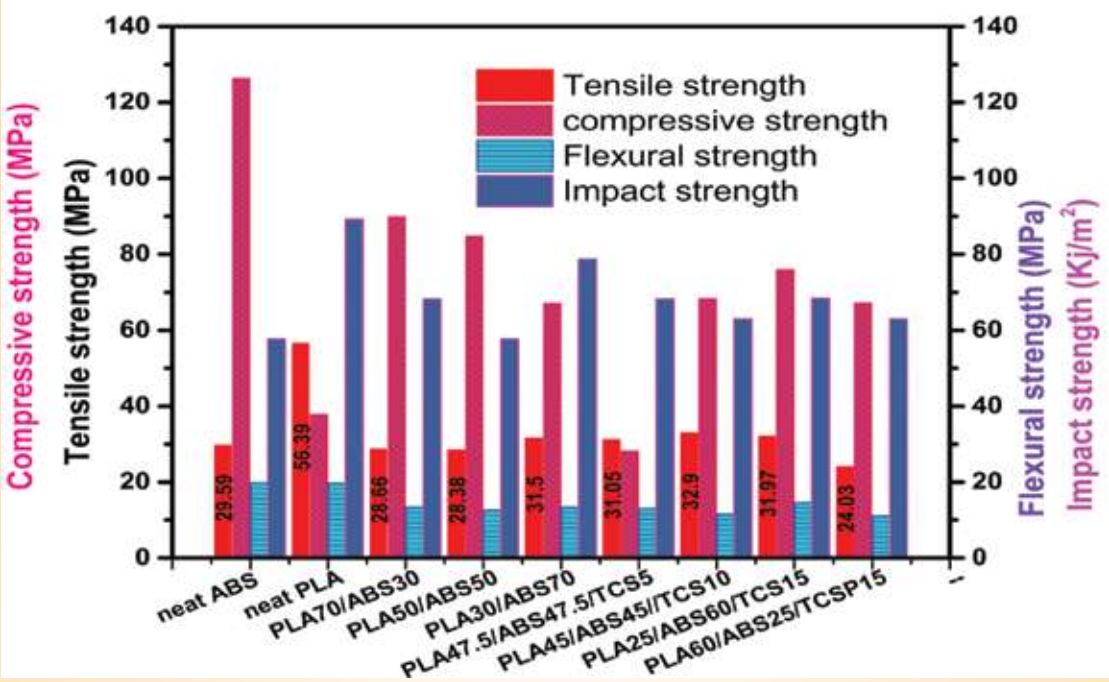
## PUBLICATIONS

**I .Papers published in national and International journals:**

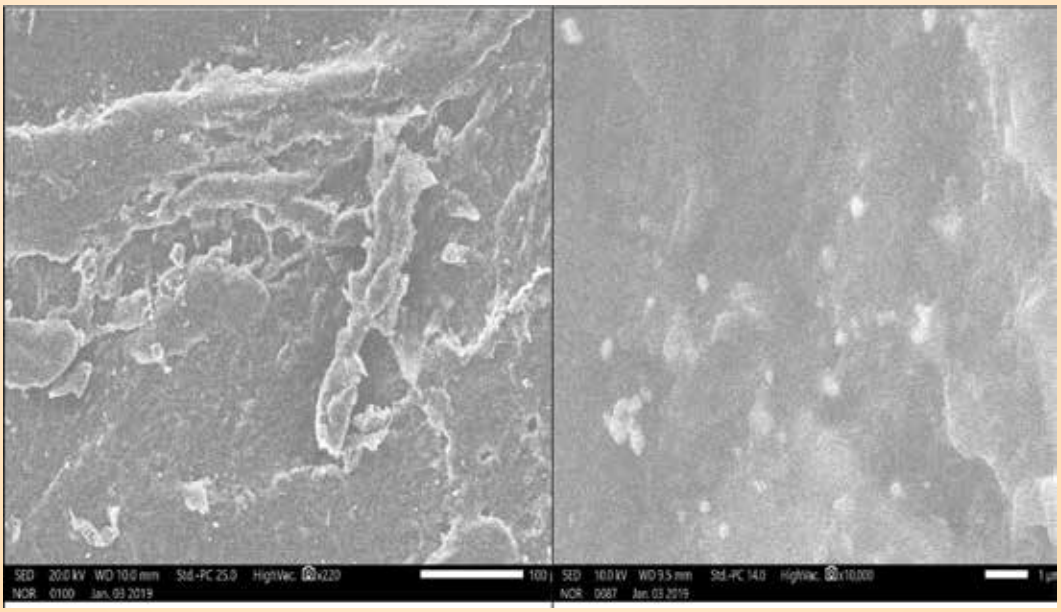
1. B Ramanjaneyulu Dr. N Venkatachalapathi., Dr.Smt. G.Prasanthi.,"Preparation, Rhelogical and Mechanical Properties of Poly LacticAcid and Acrylo Nitrile Butadiene Styrene Polymers Blend"., National Conference On Emerging Trends In Information, Management And Engineering Sciences (NC'e-TIMES #1.0- 2018 ) , 14-15 March2018, ISSN: 2395-1303.AITS(Autonomous), RAJAMPET (KADAPA), ANDHRA PRADESH.(Review article )peer reviewed journal
2. B Ramanjaneyulu., Dr. N VenkatachalapathiDr.Smt. G.Prasanthi.,"Mechanical Properties And Morphology of Poly (Lactic Acid) (PLA) With Different Flexible Copolymers "., International Journal of Mechanical Engineering and Technology (IJMET) , Volume 10, Issue 01, January 2019, pp. 745–754, Article ID:IJMET_10_01_076 3.AITS(Autonomous),Rajampet (KADAPA), Andhra Pradesh.(Research Article) ( Scopus )
3. B Ramanjaneyulu Dr. N Venkatachalapathi., Dr Smt G Prasanthi.,"Tensile and Micro Structural Properties Analysis of Biodegradable Polymer Blends International Journal of Recent Technology and Engineering Volume - 8 Issue-2, July 2019,. AITS(Autonomous),RAJAMPET (KADAPA), ANDHRA PRADESH. (Research Article)(Scopus )
4. B Ramanjaneyulu, Dr. N Venkatachalapathi, Dr Smt G Prasanthi., "Testing and characterization of binary and ternary blends with poly (lactic acid), acrylonitrile-butadiene-styrene and tapioca cassava starch powder" ,material today proceedings ., 2019 Nov 15 (online )https://doi.org/10.1016/j.matpr.2019.09.092. (Scopus )

**II. Papers presented in (Seminars/conference )**

1. International conference on Materials and Manufacturing Methods, (5-7 jul,2019) NIT, Trichy, Tamila Nadu Testing and characterization of binary and ternary blends with poly (lactic acid), acrylonitrile-butadiene-styrene and tapioca cassava starch powder".




**Various mechanical properties comparisons plot**



**(a) Binary blend at PLA30/ABS70 (wt. %)**

**(b) Ternary blend at PLA45/ABS45/ TCS10 (wt. %)**

**Scanning Electron Micrographs (SEM) of tensile fractured surface of the blends**

# The Institution of Engineers (India)

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## IEI R&D Grant-in-Aid Scheme

### INSTRUCTIONS TO AVOID REJECTION OF PROJECT PROPOSALS DURING INITIAL SCRUTINY

#### (I) MUST FURNISH THE FOLLOWING GENERAL INFORMATION PRECISELY

1. The project title should have clarity and must be relevant to the proposal.
2. Attach supporting documents for NBA / NAAC Accreditation or valid NIRF Rank for the Institutions.
3. Applications from Institutional Members [IMs] will be preferred.
4. Do not include names of more than two guides for a single project proposal .
5. Both the guides should be Corporate Members (AMIE/MIE/FIE- for UG Project Proposals and MIE/FIE- for PG & PhD Project Proposals). In case they are not, they must send the membership form with requisite fees along with project proposal.
6. Guide(s) should be from the same Institution as that of the Applicant(s).
7. A guide will not be allowed to carry out more than one project simultaneously.
8. Maximum number of students/applicants that can apply for a single UG Project Proposal must be limited to five. In case of PG & PhD only one student per project is allowed.
9. UG Applicants should be Student Members (SMIEs) of the Institution, whereas, PG & PhD students must be Corporate Member. In case they are not, they must send the membership form with requisite fees along with project proposal.
10. The 'Completion Date of Study' (Item D) should not be earlier than 'Project Completion Date' (Item H) or should not exceed the maximum duration prescribed for each category.
11. Inclusion of different category of applicants (UG/PG/PhD) in a single project proposal is not permitted.
12. Only full time students pursuing a course in engineering at UG/PG/PhD is eligible for funding. Faculty Members or those who are pursuing part-time course in engineering will not be considered as students.
13. PG applicant must enclose 'Enrolment Certificate' whereas PhD applicant must enclose 'Enrolment Certificate' as well as 'Registration Certificate' along with project proposal.
14. Project proposal will be considered for scrutiny only when the soft copy sent via email is followed with a hard copy of the proposal which must be signed and sealed by all concerned in required places.

#### (II) MUST ESTABLISH NOVELTY & FINANCIAL FEASIBILITY OF THE PROPOSAL

1. 'Review of R&D in the proposed area' (Item G) should be well documented and must establish novelty/uniqueness of the proposal.
2. Under item 'G', a list of 'References' should be provided for the earlier works carried out in the area.
3. The Applicant's Institute must extend its infrastructural facilities or provide partial funding for carrying out the project.
4. Proposals receiving Industry Support in cash/kind will be given preference.
5. It is expected that the proposal must provide complete information about items being procured. Procurement under non-permissible heads will not be considered for funding. In order to avail maximum grant 'Details of Financial Requirements' [Item-O] must be filled up with reference to upper ceiling of funding available under various Heads.

#### (III) INFORMATION SHEET & PAYEE DETAILS MUST BE COMPREHENSIVE

1. The 'Information Sheet' must be completely filled along with Membership Numbers for Guides, Students & Institute. Contact Numbers and E-mail of Guide(s) and Students must be furnished.
2. Payee Details should include all requisite details along with the GST number of the Institution.
3. Project proposal should be accompanied by hard copy of cancelled cheque. The cancelled cheque should be from the same account against which payee details have been provided and should bear the name of signatory authority.
4. Request of transfer of grant to account other than Principal/Director/Registrar/Dean (R&D) will be not entertained.


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