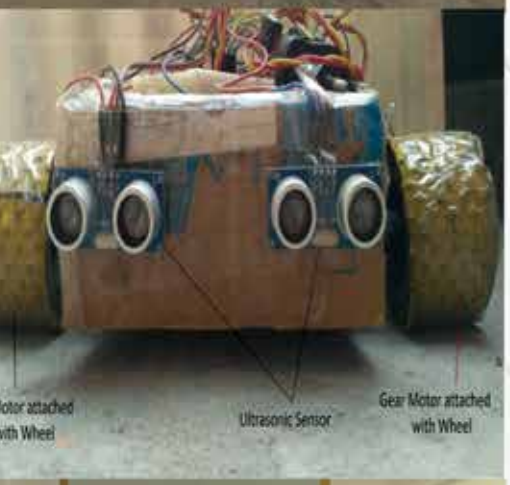

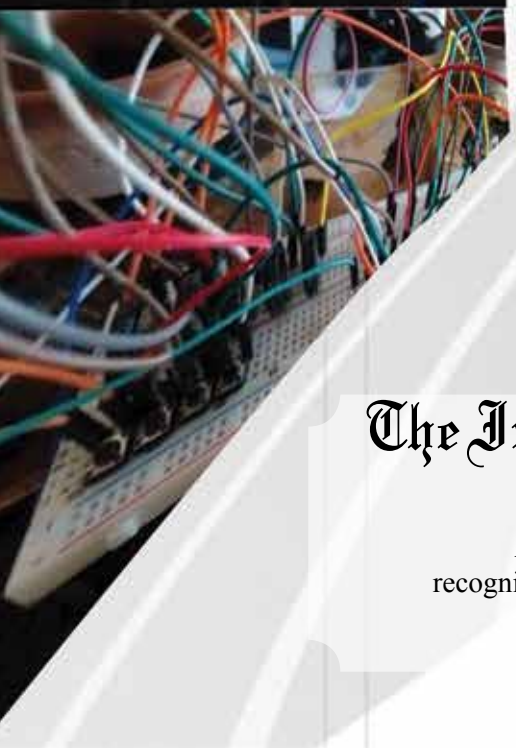

Compendium on R&D Projects

under the IEI Grant-in-Aid-Scheme

Volume 8 September 2019

The Institution of Engineers (India)

8 Gokhale Road, Kolkata 700020

A Scientific and Industrial Research Organisation
recognised by Department of Scientific and Industrial Research
Government of India
ISO 9001:2015 Certified

Message from the *President*

I am pleased to note that the Compendium on R&D Projects under IEI R&D Grant-in-Aid Scheme, Volume 8 is being published. The Institution of Engineers (India) has taken up the role of promoting R&D through funding and active participation in meaningful R&D ventures.

While traditional engineering education will necessarily be required to lay a strong foundation in basic engineering principles and skills, there will be an imperative to constantly upgrade and imbibe new skills, attributes and technology. The Grant-in-Aid scheme was founded with an intent of encouraging students to carry out meaningful R&D projects with societal relevance. The Institution of Engineers (India) recognised as a 'Scientific and Industrial Research Organization' (SIRO) has nurtured and facilitated a host of talent through this scheme which was initiated in 2001.

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

Dr T M Gunaraja
President, IEI

Message from Chairman
Committee for Advancement of Technology and Engineering

It gives me immense pleasure to note that the Eighth Volume of Compendium of R&D Projects under Grant-in-Aid scheme is being published successfully. This Compendium brings out the work carried out in frontier areas of engineering under the guidance and by our Members with the Institution as a facilitator.

It is also encouraging to note that the Compendium also drills down into specific student experience outcomes from research-related activities, most particularly relating to the dissemination of undergraduate research through conferences and journals.

The Compendium on R&D Projects under IEI R&D Grant-in-Aid Scheme, Volume 8 provides an array of fascinating and enterprising projects carried out by our members showcasing their research acumen.

Dr G Ranganath
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. The scheme intends to provide funding to engineering students, for their innovative projects and at the same time hone their practical and technical skills and translate them into tangible career and employment opportunities.

We take pride in informing that our efforts have been duly recognized by the Ministry of Science and Technology, GoI who have once again renewed the recognition of the Institution as a Scientific and Industrial Research Organization (SIRO).

Like every year, it has been a pleasure to bring out the Volume 8 of Compendium of R&D Projects under IEI R&D Grant-in-Aid Scheme, comprising of 57 projects, which provides a glimpse of the versatile range of projects carried out with modest funding from IEI some of which have deep social implication.

Dr Wooday P Krishna
Chairman, RDC, IEI

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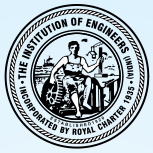

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Serving the Nation and Society since 1920

The Institution of Engineers (India)

Volume 8, September 2019

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Neuromation- Wireless Switching of Electrical Appliances using Neural Oscillations

Student
Ruchit Patel, Rushin Sheth, Alark Jani
pruchit1998@gmail.com

Guide
Dr. Ankit P. Shah, *MIE*
ankitbbit@yahoo.co.in

Institute
B & B Institute of Technology
ISKCON Temple, Near Mota Bazar, Vallabh Vidhyanagar,
District: Anand, State: Gujarat

OBJECTIVES

Neuromation project basically works on BCI (Brain Computer Interface) technology. Human brain is most efficient electrical device. A neural activity inside the brain produces neural oscillations. A system of 10-20 international electrode placement helps in collecting EEG data most effectively. FP1 electrode placement is used for this project. The main objective of this project to make a device which can perform electrical switching of two appliances especially electrical light and ceiling fan based on command given by human brain. The command given by human brain is further synthesized by EEG (Electroencephalography) head bands which send the data to Arduino microcontroller for further arithmetic computations.

ACHIEVEMENTS

This project involves collecting required materials at the initial stage. The procurement of the main component, namely, the EEG headband, took more than a month due to its cost. This was followed by building its circuit and coding. Also EEG data of different people were collected for experiment purposes. This data was used for getting an idea of coding in a particular way. As we started focusing on coding side in arduino, day by day challenges started in malfunctioning of project. It never worked in starting days of neuromation project. Then we started making small goals and tasks, starting from base to top. We continued on programming the arduino. First we solved the raw EEG data by splitting it in different waves like alpha, gamma, beta,etc. Then we programmed arithmetic calculations to separate attention and meditation waves and use attention wave for switching of light and meditation wave for switching of fan. Now the project is working perfectly. We have performed this on two electrical appliances i.e. Fan and Light. Attention wave is used for switching of light and meditation wave is used for fan.

Processing, Characterization and Machinability Properties of Nano Particulate Reinforced Aluminium/ Red Mud (Industrial Waste) Composites

Student
Mayur S
mayursudarshan@gmail.com

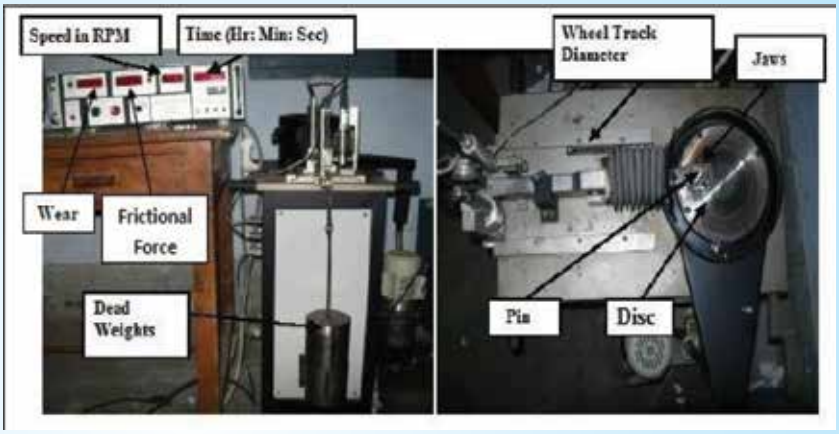
Guide
Dr. Reddappa H. N.
reddyhn.phd@gmail.com

Institute
Bangalore Institute of Technology
K.R.Road, V V Puram, Bangalore
IM0005233

OBJECTIVES

Objectives are as follows:

- Improvement in the thermal shock resistance
- High corrosive resistance
- Reduction due to the thermal elongation
- Improvement in the Young's modulus
- Increase in the yield and the strength at the room temperature, while maintaining the minimum ductility or toughness

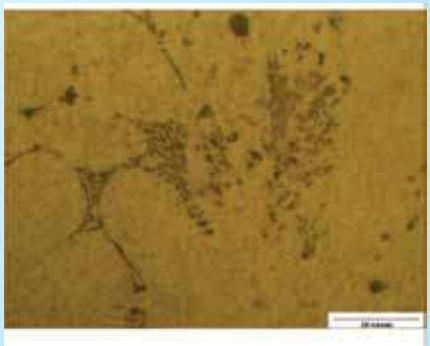


Wear Testing Equipment

ACHIEVEMENTS

Within the purview of the study on Red Mud reinforced aluminium alloy, the following conclusions can be drawn,

- Aluminum based metal matrix composites have been effectively synthesized by stir casting technique and the optical images clearly shows uniform distribution of Red Mud particles.
- Red Mud particulates can be positively used as reinforcing material to light weight metal matrix composites (MMCs). It can replace other higher density and expensive reinforcements. Also, it results in a 'lighter composite material' as compared to composite reinforced with conventional particles such as SiC, Al_2O_3 and ZrO_2 etc. Hence, these composites can be used in light weight aerospace applications.
- The results confirmed that stir cast Aluminum alloy 6061 with uniform distribution of Red Mud particles improves both tensile strength and hardness and wear characteristics of metal matrix composites. The addition of Red Mud particles also reduces the wear loss.
- With heat treatment the tensile strength and the hardness increases.



Microstructure of Al6061+9% Red Mud Composite(1000x)

Sustainable Permeable Concrete Paver Blocks

Student
Himanshu Sanadhya, Shubham Khatik, Shankar lal Dangi
Sanadhya96@gmail.com

Guide
Dr. Manish Varma, *MIE*
hodcivil@gits.ac.in
Yash Agrawal
yash.agrawal@gits.ac.in

Institute
Geetanjali Institute of Technical Studies, Dabok, Udaipur
IM0001327

OBJECTIVES

1. To design sustainable permeable concrete mix for casting paver blocks using suitable material for minimum strength as per Indian Standard (IS) code.
2. To determine the mechanical properties of concrete (Compressive Strength and Flexural Strength) containing granite slurry waste as partial replacement of cement and rubber fibre as additive.
3. To determine the quality of permeable concrete containing rubber fibre and granite slurry waste by non-destructive (UPV) testing.
4. To determine durability properties of concrete (Water Permeability) containing rubber fibre and granite slurry waste.
5. To investigate the ductile behaviour of concrete containing rubber fibre as additive and granite slurry waste by static modulus of elasticity.

ACHIEVEMENTS

In this study the sustainable permeable concrete paver blocks are casted with the use of granite slurry as partial replacement of cement and rubber fibre in additional percentage.

The study was carried out to develop information about the mechanical and durability properties of sustainable permeable concrete paver blocks in two cases which are:

(i) OPC replacement by granite slurry waste

(ii) PPC replacement by granite slurry waste.

In this work, systematic experimental study has been carried out using granite slurry waste to replace cement at various replacement levels. This study has been carried out for w/c 0.33 and specimens have been cast to perform various tests (Compressive Strength Test and Flexural Strength Test), durability properties (Water permeability test), ultrasonic pulse velocity meter test and static modulus of elasticity of concrete.

It has been shown that inclusion of granite slurry modifies the compressive strength and maximum strength has been obtained depending upon replacement level which is 5%.

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

An Automated Ploughing System with Remote Irrigation Monitoring using Internet of Things

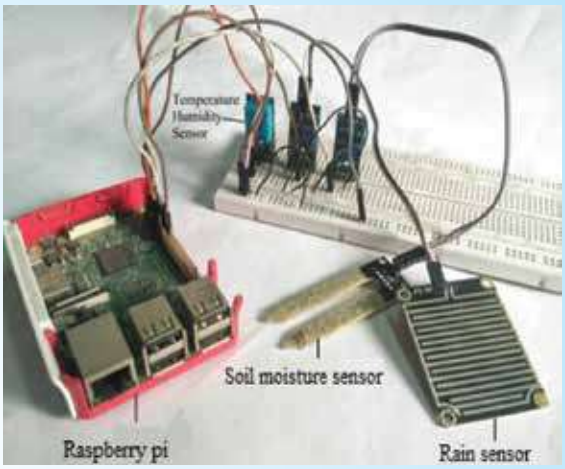
Student
Soumyajit Das, Sonu Gupta, Sahil Kr. Jain
soumyajit.arko@gmail.com
sonug8633@gmail.com
sahiljain390@gmail.com

Guide
Arindrajit Pal, *MIE*
arindrajit@gmail.com

Institute
Academy of Technology
Aedconagar, Adisaptagram
Hooghly, West Bengal
IM0001890

OBJECTIVES

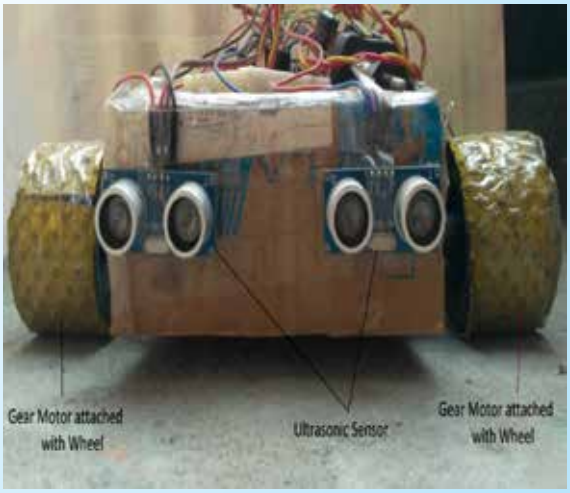
There are two objectives of this project. First one was to develop a model of an automated ploughing machine controlled by wireless devices. This automated ploughing machine will be developed by an artificial intelligent system which can move in the field by remote sensing through IoT. This will improve the farmers' efficiency and they will be able to farm more lands within a short time. Another objective was to develop a remote monitoring irrigation system. One of the crucial parts of agriculture is irrigation. The necessary condition for irrigation includes the knowledge of moisture content of the soil and the climatic conditions. So, the farmers need to monitor the plantation field at regular intervals, which is a very hectic work. So, to reduce the workload of a farmer by giving an opportunity to monitor irrigation through Internet is another part of the project. The main objective was to develop a remote irrigation system through Internet of Things (IoT). This part can be controlled by smart phone of the user. This project can monitor effective usage of water.



Irrigation Monitoring Setup

ACHIEVEMENTS

In the present work, we successfully made a smart irrigation and ploughing module which is controlled by Raspberry Pi and monitored by user using an Android application. Irrigation conditions are ensured by looking up the android application. If the conditions are severe then Irrigation is started by commanding START from Android application, and finished by commanding STOP. The ploughing bot needs to be placed in the field at starting position and it works on user command START/STOP. The bot is given ultrasonic sensor which will read obstacle and choose its path for ploughing. This can be installed in small and large farming areas. The smart irrigation system can help the farmers very much in real scenario. This consumes less energy, reduces animal labour and uses minimum water resource. The farmer needs minimum effort to maintain the irrigation system. This digital system encourages the farmers to accept the modern technologies. This system is very much user friendly and easy to use. This project can be developed in small gardens to large ploughing fields.



Ploughing Bot Setup

Characterization of Ti Alloy Metal Matrix Composite for Aircraft Gas Turbine Engine Blades

Student
Viswanath V G, Venkat Praveen S, Srivathsan R
viswanath.v.g.2014.mech@ritchennai.edu.in

Guide
Dr S K Rajesh Kanna, *MIE*
skrkanna@gmail.com

Institute
Rajalakshmi Institute of Technology, Kuthambakkam (P.O.), Chennai, Tamilnadu
IM0002366

OBJECTIVES

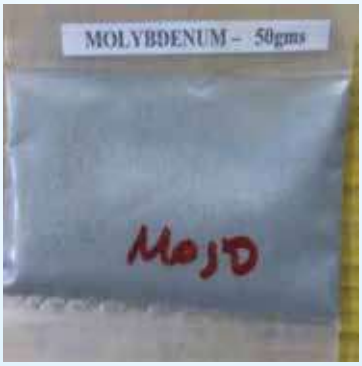
The main objective of this project is to improve the performance of air craft gas turbine engine by identifying and analyzing the suitable material for the blades. The limitations in the existing blades will be eliminated and the material identified in this research to achieve the above mentioned goal is Ti-Al-Sn-Zr-Mo-V alloy. These combinations of the alloys are having the properties like high melting point, high refractiveness, very high strength, high wear resistance and good corrosion resistance. The percentages of these alloys are varied and specimens will be tested for its mechanical behaviour. Based on the test result, the suitable combination of alloy will be identified and can be used in the gas turbine engine blades and thereby the performance of the engine improves. The entire project is divided in to five stages and they are material preparation stage, specimen testing stage, numerical analysis stage, validation stage and design stage. In the initial stage, the various combinations of titanium alloy composite specimens of ASTM standard will be fabricated using powder metallurgy technique. In the second stage, the prepared specimens are tested for its hardness, tensile, compression, wear, corrosion, fatigue, impact, etc. In the third stage, for the selected combination, the finite element analysis will be carried out to validate the experimental results. After validation of the obtained data, best suited combination of alloys for the titanium metal matrix composite will be identified. In the final stage, the gas turbine blades are designed in CATIA V5 and the same have been analyzed in the ANSYS software for its chacterization. The vision of this project is to identify the best combination of titanium alloy to withstand elevated temperature, large centrifugal force and to operate in an aggressive environment.

ACHIEVEMENTS

The produced composites showed significant improvement in hardness, wear and corrosion. These two alloys were made of Ti-6Al-2Sn-4Zr-2Mo alloy and Ti-6Al-2Mo-4Zr-2Sn-xCr alloys. The fabrication was made through powder metallurgy which involves ball milling technique followed by compaction and sintering. The former alloy showed good properties like high melting point, decreased porosity and increased in refractiveness, while the later one showed good corrosion resistance, increased wear resistance and good strength. The manufacturing technique, such as powder metallurgy, produces composites at a temperature less than the melting points of the materials so that the composite produced is highly compact in nature. For the alloy Ti-6Al-2Sn-4Zr-2Mo the manufacturing process was followed by a number of tests to find the achieved characteristics. The hardness of the material is tested on the surface of the metal matrix by using a diamond indenter where metal matrix surface is loaded with a mass of 1kg using the indenter which is positioned at an angle of136^{O} but before loading, the surface is well polished using the mould. The resistance to corrosion was tested through salt spray corrosion test where the cleaned metal matrix is exposed to Sodium Chloride of about 5 percent concentration for 100 hours. Pin on disk wear test was conducted where the titanium metal matrix composite sample of dimension 10mm diameter and 30mm length was wear tested on the pin on disk wear test machine with a disk made up of stainless steel of grade 304 with dimension 55mm diameter and 10mm thickness with 6mm center hole. The tests provided good results for the alloy. The structure of the material was viewed through a Scanning Electron Microscope from which it is clearly understood that the zirconium and molybdenum ions

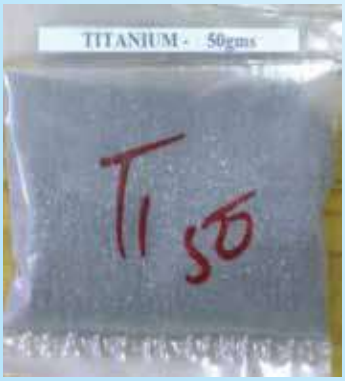
are completely dissolved in titanium alloy. Due this the strength and the refractiveness of the metal matrix composite increased a lot. An analysis was made on the prepared material to find the specimen's deformation and stress distribution. To make this, first the specimen is drawn in the SOLIDWORKS 2009 software and then the drawn model is imported in the ANSYS 15.0 mechanical ADPL using ANSYS WORKBENCH 15.0. For Ti-6Al-2Mo-4Zr-2Sn-xCr alloy, the percentage of chromium was varied from zero to nine percent in four ways. The alloy with 3 percent of chromium showed comparatively good result than the other compositions. On applying any coating to the material, the efficiency and lifetime of the material gets decreased due to the fact that the layer gets eroded through a period of time. By using this titanium alloy, the surface coating of chromium to turbine blades can be eliminated. The hardness of the material is increased due to the addition of very small percentage of chromium into the composite to a certain limit. The high resistance towards corrosion is obtained by subjecting it to high temperature salt solution sprayed environment for hundred hours. The increased hardness is achieved and tested through Micro Vickers hardness test where the material is loaded on the wise and the indenter is loaded to just penetrate the specimen. The ability to resist the wear is tested through Pin on Drum method, where a new specimen is worn in for approximately four revolutions or until its entire end displays wear scars, before beginning the test runs. The result provides a decrease in wear rate though the process. The specimen was viewed through a Scanning Electron Microscope which showed the uniform distribution of chromium when added about in 3 percent compared to other compositions of the alloy. This uniform dispersion clearly contributes to the increase in resistance towards the erosion and corrosion of the material throughout a period of time. Three designs has been analyzed to observe the cooling pattern of the turbine blades. The blades were modeled using CATIA with 6 and 8 holes and the CFD analysis has been performed using numerical flow simulation of FLUENT. It is observed that when the number of holes increased, the pressure decreases.

Aluminium Powder
30 micron size

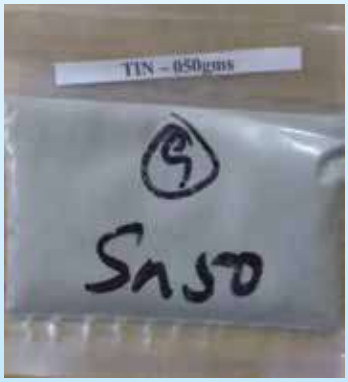


Molybdenum Powder
30 micron size

Zirconium Powder
30 micron size



Titanium Powder
30 micron size

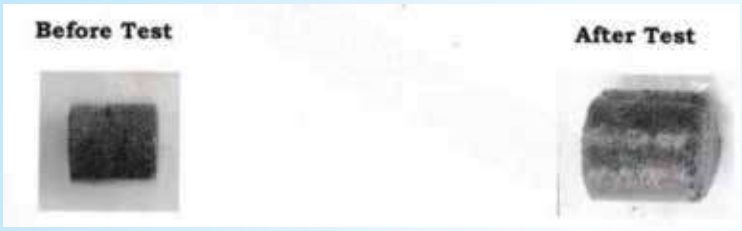


Tin Powder
30 micron size

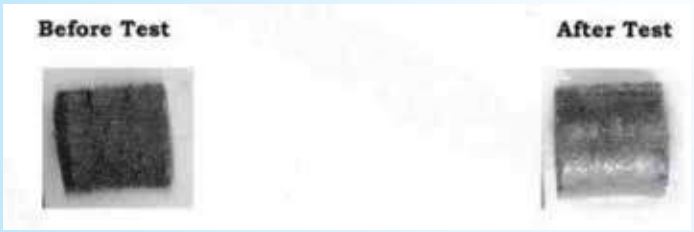
Chromium Powder
30 micron size

specimens of Ti-6Al-2Sn-4Zr-2Mo

specimens of Ti-6Al-2Sn-4Zr-2Mo-xCr

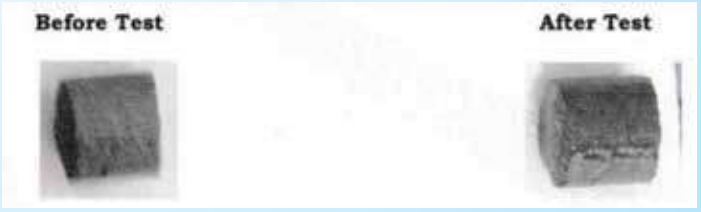


Corrosion result of Ti-6Al-2Sn-4Zr-2Mo

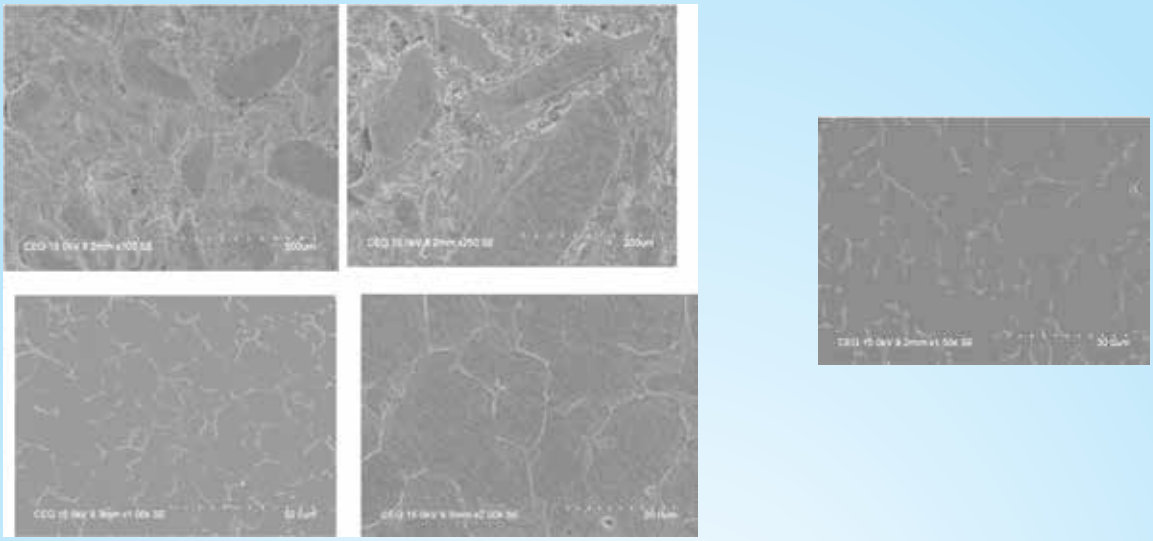


Corrosion result of Ti-6Al-2Sn-4Zr-2Mo-3Cr

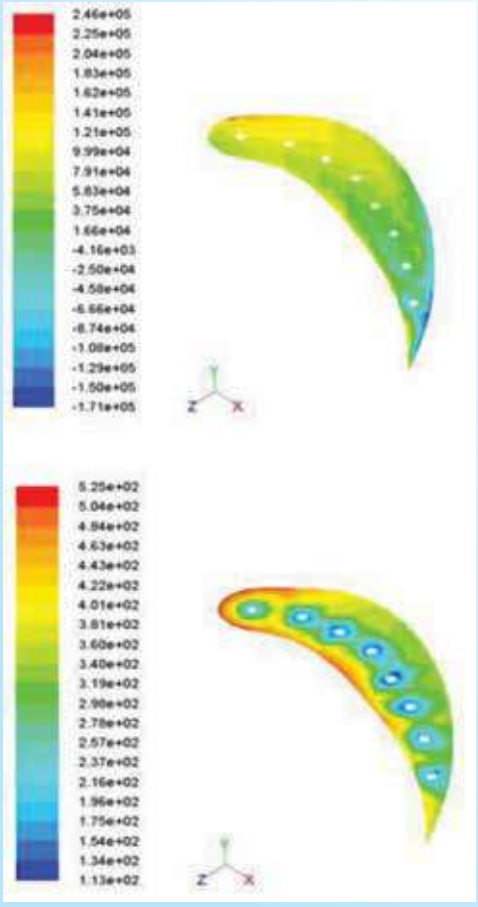
Corrosion result of Ti-6Al-2Sn-4Zr-2Mo-6Cr



Corrosion result of Ti-6Al-2Sn-4Zr-2Mo-9Cr



SEM Images of Ti-6Al-2Sn-4Zr-2Mo-xCr



Variation of static pressure and temperature of 8 holes Titanium composite in Gas Turbine Blade

An Intelligent Helmet for Miners with Air Quality and Destructive Event Detection using Zigbee

Student

A. Abdul Wahith, P. V. Madhu Sharan,
R. Hari Vignesh
abdulwahith360@gmail.com
sharanms0101@gmail.com
rjhari1996@gmail.com

Guide

Dr. C. Natarajan, *FIE*
principal@hindusthan.net
Dr. B. Paulchamy, *MIE*
hit.ece@@hindusthan.net

Institute

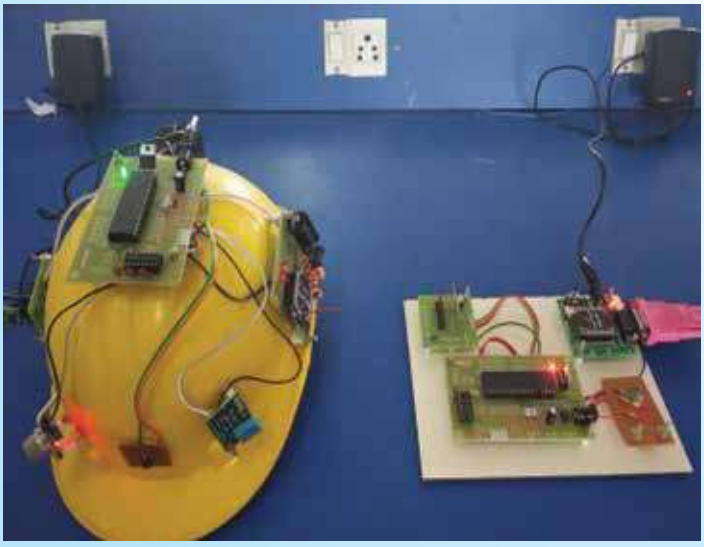
Hindusthan Institute of Technology
Othakkalmandapam, Coimbatore
IM0004253

OBJECTIVES

- The main objective of this project is to develop an intelligent helmet to assist the miners working in the mining industry. Harmful events tend to occur in the mining industry that can lead to severe injury and may prove to be fatal at times.
- LED miner's helmet is the most commonly used helmet because of light weight and low power consumption. However, it does not improve the safety of miners apart from providing illumination.
- Zigbee wireless sensor networks are used to collect sensor data and transmit them. The zigbee based system is cost effective and details are shared with central control unit.
- This project proposes a study of the mining environment and its hazards and how a zigbee is used for transmission from miner to ground control system in case of hazardous events.

ACHIEVEMENTS

- Won first prize at Project Presentation held at Hindusthan Institute of technology on 23.03.2018.
- Won Second prize at Project Expo held at Kathir College of Engineering on 20.03.2018.



Project Module

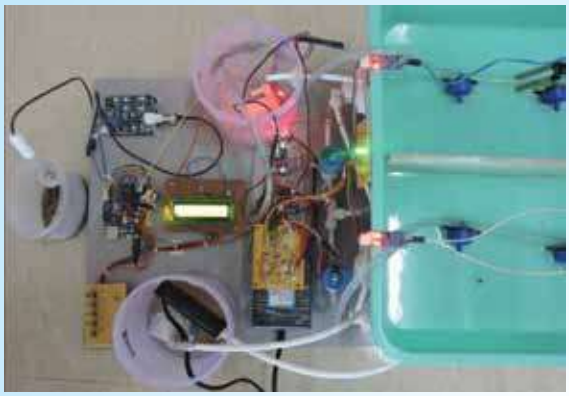
Implementation of the project by the students in the college

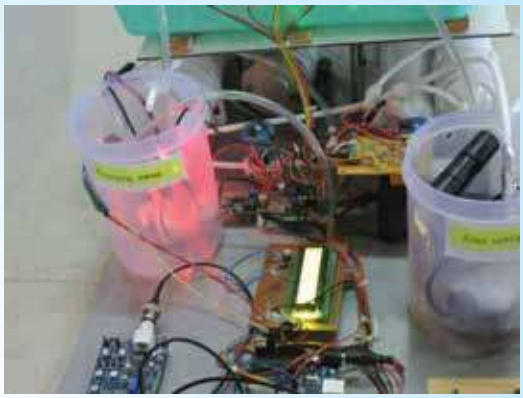
Cost Effective Smart Sewage Water Treatment to Agriculture Fields

Student
S. Deepika, A. Roobaswathiny, E. Sheela
deepikasuresh1691@gmail.com
Email: easyway.1996@gmail.com
sheela1710@yahoo.com

Guide
Dr. P. Raja, *Fellow*

Institute
Sri Manakula Vinayagar Engineering College
Madagadipet, Puducherry
IM0004016





OBJECTIVES

- To provide a helping hand for the famer through automatic field irrigation system.
- To meet up the demand of water scarcity by recycling the polluted water bodies (sewage water).
- To enhance the utilization of the sewage water to enhance the agricultural growth as a compensation for fresh water bodies.
- To help in choosing the required amount as well as quality of the fertilizer for the field.
- To serves both as a black water recycler and as a supportive hand for a farmer.

ACHIEVEMENTS

Runner up in the MINIATURE'17 project contest organized in Sri Manakula Vinayagar Engineering College.

Project has been one the finalist's in Innovators day contest (National level project contest) conducted by Sri Manakula Vinayagar Engineering College.

"If we knew what it was we were doing, it would not be called research, would it?"

Albert Einstein

Study of Mechanical and Wear Behaviour of Mg-B4C-Gr hybrid Composites

Student
Arun Kumar
kumar.arun110897@gmail.com

Guide
Dr. Hillol Joardar, *AMIE*
joardar.2011@gmail.com

Institute
C.V. Raman College of Engineering, Bidyanagar, Mahura
Bhubaneswar, Odisha
IM 0000975

OBJECTIVES

Magnesium-based metal matrix composites (Mg-MMCs) are expected to have extensive applications in aerospace, automotive and medical areas due to the fact that Mg is the light structural metal which results in high specific strength MMCs. The density of magnesium (1.74 g/cm^3) is 35.6% lower when compared to aluminium which makes it ideal for light weight applications. The application of magnesium alloys is limited obviously due to their poor creep resistance at high temperatures, low strength, low modulus and wear resistance. Consequently, some reinforcements are needed to improve the mechanical properties of the base metal. These property enhancements make them a candidate material for replacement of iron and steel in most applications. Boron carbide is an interesting material for many reasons. It has low density (2.51 g/cm^3), excellent chemical resistance and is extremely hard. The addition of boron carbide (B^{4}C) in magnesium matrix increases the interfacial bonding strength, flexural strength, hardness and wear resistance of composite. Also the addition of solid lubricant namely graphite significantly increases the wear resistance of the candidate material. In manufacturing metal matrix composites, the dispersion of the reinforcement particles is a challenge. However, a uniform mixture of metal and non-metal compositions is impossible to obtain by traditional casting methods. Powder metallurgy overcomes the negative effects of liquid state processing methods such as stir casting. Powder metallurgy processing may be used to obtain metallic composite materials containing solid lubricants. In powder metallurgy, the reinforcement is homogeneously dispersed in the matrix for the fabrication of composites.

This work involves

(i) preparation of magnesium based hybrid composite through powder metallurgy method wherein B^{4}C and Gr are used as reinforcements.

(ii) Evaluating the microstructure of sintered hybrid composites.

(iii) Investigating the mechanical properties of composites.

(iv) Study the wear behaviour of the prepared hybrid composites.

ACHIEVEMENTS

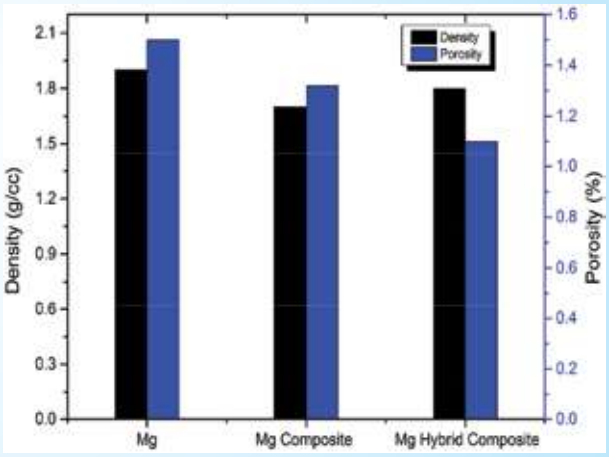
Hybrid Mg–B4C–Gr composite has been successfully developed by powder metallurgy technique. The density, porosity, hardness, ultimate tensile strength, optical microstructure and abrasive wear were evaluated. As compared with pure magnesium, the density of magnesium composite and hybrid composite increased. The porosity of magnesium hybrid composite is less compared to magnesium and its composite. Hardness value of composite is high compared to magnesium and its hybrid composite. The incorporation of B4C reinforcement to magnesium increases the wear resistance of the composite. The developed composite has exhibited higher wear

resistance and higher coefficient of friction when compared with matrix and hybrid composite. The addition of Gr reinforcement in magnesium composite as a hybrid reinforcement further decreased the wear resistance of the composite. The addition of graphite particles provides solid lubrication to the composites and decreases the metal to metal contact and the coefficient of friction, resulting in the reduction of the worn surface temperature. Therefore, the probability of adhesive wear is minimized by the addition of graphite to the matrix material and its composites. However, graphite being a soft material decreases the hardness of composites, and cannot effectively resist the deformation of matrix during sliding.

Die and Punch

Green sample of hybrid composite

Furnace



Variation of density and porosity of samples

"Technology innovation is starting to explode and having open-source material out there really helps this explosion. You get students and researchers involved and you get people coming through and building start ups based on open source products."

Tim Berners-Lee

Development of Pneumatic Extrusion Set-up to produce 3D Homogeneous Scaffold used for Bone Tissue Development

Student
Sudhakar K
ksudhakar12022@gmail.com

Guide
Venkatesh Vakucherla, *AMIE*
venkey355@gmail.com

Institute
Annamacharya Institute of Technology and Sciences
New Boyanapalli, Cuddapah (Dist.,) Andhra Pradesh
IM0002153

OBJECTIVES

Every day thousands of surgical procedures are performed to replace or repair tissue that has been damaged through disease or trauma. The developing field of tissue engineering (TE) aims to regenerate damaged tissues by combining cells from the body with highly porous scaffold biomaterials, which act as templates for tissue regeneration, to guide the growth of new tissue. The scaffold must satisfy two factors in the view of this application, one is mechanical strength and the other is biological activities(cell proliferation, differentiation etc.,). Strength of the scaffold majorly effected by the type of the material, porosity, pore size, pore shape, scaffold external shape. External shape of the scaffold will be changed to its area of usage in the human body, pore size and pore shape can be decided by the maximum load acting on the scaffold, porosity and material will be varied with respective to age and bone strength of the patient. Nowadays, scaffold used in the surgery is not a customized because of which the patients are facing lot of problems which are not possible to cure in their entire life.

Finally, we successfully developed pneumatic extrusion machine to meet this project requirements.

Pneumatic extrusion setup

Developed human scaled nose

ACHIEVEMENTS

In this step we developed patient specific CAD model form CT scan. In this process we used MIMICS software. This CAD model further used to meet different requirements.

Mimics

Materialise Mimics is an image processing software for 3D design and modeling, developed by Materialise NV, a Belgian company specialized in additive manufacturing software and technology for medical, dental and additive manufacturing industries. Materialise Mimics is used to create 3D surface models from stacks of 2D image data. These 3D models can then be used for a variety of engineering applications. Mimics is an acronym for Materialise Interactive Medical Image Control System. It is developed in an ISO environment with CE and FDA 510k premarket clearance. Materialise Mimics is commercially available as part of the Materialise Mimics Innovation Suite, which also contains 3-matic, a design and meshing software for anatomical data.

Process

Materialise Mimics calculates surface 3D models from stacked image data such as Computed Tomography (CT), Micro CT, Magnetic Resonance Imaging (MRI), Confocal Microscopy, X-ray and Ultrasound, through image segmentation. The ROI, selected in the segmentation process is converted to a 3D surface model using an adapted marching cubes algorithm that takes the partial volume effect into account, leading to very accurate 3D models. The 3D files are represented in the STL format. Most common input format is DICOM, but other image formats such as: TIFF, JPEG, BMP and Raw are also supported. Output file formats differ, depending on the subsequent application: common 3D output formats include STL, VRML, PLY and DXF. The 3D files can also be optimized for FEA or CFD and can therefore be exported to Abaqus in INP format, to ANSYS in INP, CDB and MSH format, to Nastran in OUT, NAS and BDF format, and to Comsol in MPHTXT format. To continue with Computer Aided Design, the files can be exported in IGES format or as Point cloud.

After selection of suitable values in the above parameters for the developed of prepared CAD model, G and M codes based source code has to be developed. This G and M code depend on the type of controller and firmware used to run the pneumatic extrusion machine. The machine has developed with RAMPS1.4 (ATmega 2560 processor) with Marlin-1.1 version. Simplify 3D software has been used to develop the G and M code for the selected controller and firmware.

Legacy of IEI

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

A Monotonous Cyborg for an Assessment of Solid Waste Management in Multi Storied Buildings

Student
S.Samuel Berkins
P. Nagarajan, S. Narendran
Samuel.berkins@gmail.com

Guide
Dr. V. Jamuna, *MIE*
jamuna_22@yahoo.com

Institute
Jerusalem College of Engineering
Velachery Main road,
Narayanpuram, Pallikaranai,
Chennai
IM0003982

Smart Bin Floor section

Monotonous Cyborg section

OBJECTIVES

- To design and develop the automated waste bin management for efficient handling of solid waste in multi-storied buildings.
- To minimize the human interference by implementing automated waste bin management using a line follower technique.
- To sort out waste into degradable and non-degradable substance using monotonous cyborg.
- To minimize bad odour produced in multi-storied due to unhandled garbage.
- To minimize the maintenance cost spent for managing the garbage in building and converting the solid waste into green energy.

ACHIEVEMENTS & PUBLICATIONS

Prototype model of the automated solid waste management system with sensors integrated in the smart bin along with monotonous cyborg has been developed. Based on the results obtained from the developed system, paper has been presented in the International Conference on Scientific Research and Innovations "ICSRI 1.0" organized by Chennai Institute of Technology, Chennai. The proposed work was also presented in the National Conference on "Emerging Trends in Science, Engineering & Technology" organized by Jerusalem College Engineering, Chennai.

An Ergonomically Designed Pedestrian Weeder for the Small Scale Growers

Student
Praveen Hanuman Surya Kumar Rajanala
Manikanta Goteti, Venkata Srinivas Kavali
praveenrajanala81@gmail.com
manikantagoteti@gmail.com
srinivas.kvs.360@gmail.com

Guide
Dr. R. B. Choudary, *MIE*
rbchoudary64@yahoo.co.in

Institute
Sasi Institute of Technology & Engineering, Kadakatla, ear Aerdrome, Tadepalligudem, West Godavari, Andhra Pradesh
IM0004164

OBJECTIVES

- To review the state of the art of different weeding tools for mechanical intra-row weed control and to find shortcomings and prospects for further research, development and implementation of mechanical intra-row weed control.
- The aim of the project is to design, construct and test manual weeder suitable for both lowland and upland fields, to provide the best opportunity for the crop to establish itself after planting and to grow vigorously up to the time of harvesting.
- To develop the weeder keeping in view:
  - some arrangement to avoid mud sticking in between the teeth/blades, tyres, wheels
  - wide range of tool sizes to change the width and depth of working
  - safety of the operator
  - ease of operation
  - lightness
  - weather proofness and durability
  - low initial cost

Three tine double wheel weeder

Weeding operation

ACHIEVEMENTS

- A low cost weeder is developed
- Farmer drudgery is reduced
- Adjustable handles (height and width) permit the weeder to meet anthropometric requirements of local people
- The adjustable tool holder permits to change angle of bite as per soil condition
- The weeder is rugged and hence durable
- The flexible frame enables the farmer to use it on 1, 2, 3or 4 wheels as per convenience
- The unit is provided with a multi tool holder and hence the farmer can do more operations with the same equipment.

Recycled bicycle wheels can be used in place of metal (wagon) wheels

Life Saving Gadgets

Student
Sivakumar. S
siva8848@gmail.com

Guide
Dr. Y. Sukhi, *FIE*
ysi.eee@rmkec.ac.in
Dr N. M. Jothi Swaroopan
jothi.eee@rmkec.ac.in

Institute
RMK Engineering College
RSM Nagar, Kavaraipettai,
Gummidipoondi Taluk, Tiruvallur
IM004296

OBJECTIVES

- To develop smart helmet to reduce the Human Death Ratio due to Road Accident in India,
- To reduce risk of death, incase accident takes place,
- To have quick transmission of message to preconfigured contacts to intimate about the victims,
- To provide maximum assistance even in unpopulated area.

ACHIEVEMENTS

The main purpose of smart helmet is to provide safety to the bike riders. The helmet designed provides a provision to detect the victims condition through the predefined mobile messages. This whole circuit can be made into a small module. The helmet consumes very less power. Small helmet has been awarded with India's most promising innovator, CII , Delhi and also Yustart, CII, Startup award.

GPS, Bluetooth and IoT Controller

Life Saving Helmet

Design and Development of RF based Modular Robots with Local and Global Communication

Student
G. Vyshnavi Devi, K.Pramodh Kumar
V. Ramakrishna
vyshnavigonugunta@gmail.com
pramodhkumar930@gmail.com
smilekittu1@gmail.com

Guide
Dr. K. Jagadeesh Babu, *MIE*
jagan_ec@yahoo.com
Dr. B. Kiran Kumar, *MIE*
bandikiran17@gmai.com

Institute
St. Ann's College of Engineering & Technology
Nayunipalli, Vetapalem, Chirala, Andhra Pradesh
IM0001637

OBJECTIVES

The design and construction of modular robots is one of the latest paradigms, where researchers and engineers are working to open the new gateways in robotic technology. The modular robots consists of group of modules that contain sensors or actuators or motors, which are required to communicate continuously to perform a specific task. The main functionality of a modular robot depends on the ability of having good communication between all its interconnected modules.

One of the best solutions to maintain good communication between different modules is the use of RF (Radio Frequency) communication. The benefits of using RF solutions are that they do not require precise module alignment and can provide global and local communication. RF is more versatile and it could be installed in any modular robot without regards to the inter-module orientation and mechanism.

The main challenge in the design of RF based Modular Robots is the establishment of both local and global communication. Based on the operation of the robot, a particular module is required to communicate only with neighbour module, which is known as local communication and similarly in other case the module is required to communicate with all other modules at a time, which is known as global communication. In a modular robot, achieving both local and global communication is a challenging task as various important parameters like distance, power, size and orientation of the module are to be taken into consideration. Hence, in the sanctioned R&D project, a 7 element modular robot, that is capable of establishing both local and global communication, is designed and developed.

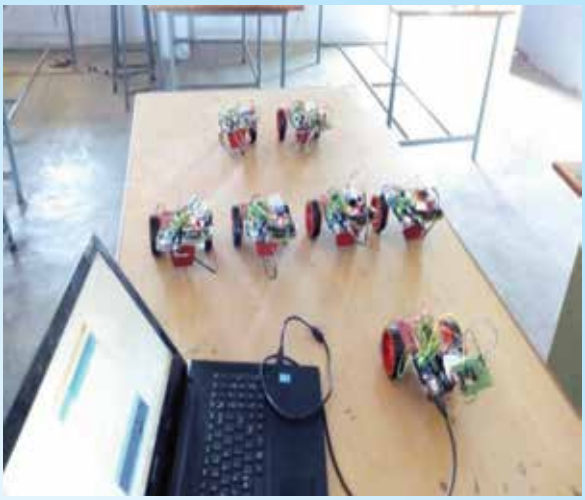
ACHIEVEMENTS

In the proposed research project, seven modules are arranged to achieve local and global communication. Each module has a transceiver, which can transmit and receive signals from the other modules over the allotted radio channel.

Here module (1) is configured as a transmitter, which operates at dual band of frequencies 2.4 GHz and 5 GHz band. These bands are chosen as they are license free in our country. Modules (2), (3), (4) and (5) are selected as receivers and operate at 2.4 GHz frequency band. Modules (6) and (7) are also selected as receivers, but to operate at dual band 2.4 GHz and 5 GHz. The transmitter module (1) is designed such that it can change its operating frequency and power level at specified intervals of time. The procedure for achieving both local and global communication is planned to do in three steps.

Step 1: In step 1, the module (1) communicates in the 2.4 GHz band, thus communicating with module (2), (3), (4) and (5). As shown in Fig.1, the distance from module (1) to (6) and (7) is larger compared to the remaining modules. The power level of module (1) is adjusted so that it can't communicate with modules (6) and (7). This is nothing but local communication

Developed Modular Robot system



Modular Robot System performing local and global Communication

Step 2: In step 2, the power level of antenna in module (1) is raised so that, it communicates with all other modules, thus achieving global communication.

Step 3: In step 3, the operating frequency of the antenna is changed to 5 GHz band, so that module (1) is able to communicate only with module (6) and (7) and not with module (2), (3), (4) and (5) as they are tuned to 2.4 GHz band. This is nothing but establishing local communication between modules (1) to (6) and (7).

This procedure is repeated for 433 MHz in place of 5GHz and can be applied to any number of modules to achieve both local and global communication. In the proposed work, when a particular module receives signal, LED glows and it can be made to move using motor arrangement.

In implementing the project, the students acquired design and creative skills in addition to acquiring knowledge on various electronic modules and components and also how to interface with them. Also, the students are successful in getting the research work accepted in IEEE International Conference. The knowledge acquired from the current research project helps the students to develop more complex RF based modular robotic structures involving more number of robots in future. The RF based modular robots are highly useful in the applications like space exploration, mining, military etc., where the scenarios are highly unpredictable. The main advantage of these robots is the ability of self-adjustment, which makes them suitable for applications like earthquake disaster management, fire accidents etc.

IEI MEMBERSHIP

The Royal Charter defined the classification of membership and only 5 classes; namely, Honorary Life Member, Honorary Member, Members, Associate Members and Companions were known as Members of the Institution. However, through decades of modifications, changes and demands of the engineering challenges and of the engineering profession the present Bye Laws of the Institution categorized the membership under several classes; they are (a) Honorary Life Fellow (b) Honorary Fellow (c) Fellow (d) Member (e) Associate Member (f) Senior Technician (g) Technician (h) Institutional Member.

Application of Process Industries: Wireless Data Transmitter

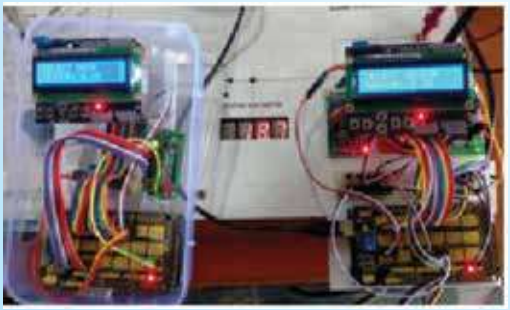
Student
Sourav Rakshit, Kumari Arti Yadav
souravrex3@gmail.com

Guide
Mr. Bikas Mondal, *MIE*
bikas.mondal143@gmail.com
Dr. Rajan Sarkar, *AMIE*

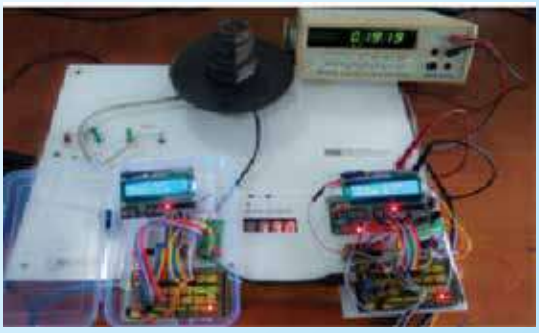
Institute
Asansol Engineering College
Vivekananda Sarani, Kanyapur
Asansol, West Bengal
IM0003478

OBJECTIVES

The proposed project gives one solution for sensor output data transmission in industry where data are collected via RF wireless communication in public frequency band. This solution uses low-cost RF modules and encrypted data transmission for greater data security and minimization of annual maintenance cost. In our current research work, we focused on real-time monitoring system for measuring physical parameters in industry. The developed system mainly focuses on low cost data transmission solution for industry with wireless network capacity, sensor hardware compatibility, low-cost production and efficient data security. The system also has the low-power consumption and has negligible impact on the environment. The tested result from the system report good outcomes which is energy resourceful, has strong communication ability, and presents real-time measurement accuracy. The system designed, gives a lot of option to the users. The cost of this system is very low although this system can control 5 different sensors simultaneously. There is lots of research work done on wireless data transmission, but the proposed system is different because by using our system can monitor 5 different sensors through a single system and also this can be connected to user's smart phone. If user want to see the output data of sensor (1, 2, 3, 4 or 5) by simply pressing the KEY (1, 2, 3, 4 or 5) in his/her phone, user can able to see the output of the corresponding sensors. Besides that, this system uses very simple and commercially available components (like IC's) to execute very complex task. This system works with parallel data, since parallel communication is faster than serial communication. This system gives optimal performance.



Snapshot of proposed system



Working of proposed system

Investigations on Dissimilar Joints Produced by Energy Efficient Friction Stir Welding

Student
Poojan Vora
Poojan.vmc15@sot.pdpu.ac.in

Guide
Dr. Kush Mehta, *AMIE*
Kush.mehta@sot.pdpu.ac.in

Institute
Pandit Deendayal Petroleum University, Pandit Deendayal Petroleum University, Raisan, IM0003672

OBJECTIVES

The main objective of was to investigate dissimilar of aluminum-magnesium joints produced by energy efficient friction stir welding.

Specific objectives based on the main objective are mentioned as under:

1. To develop FSW process for dissimilar Al-Mg joints.
2. Establishment of FSW process parameters for sound dissimilar welding.
3. Set-up the relationship between process parameters and properties of dissimilar Al-Mg FSW.
4. Study of formation of intermetallic compounds.
5. Examination of defects found in dissimilar metal joints.

ACHIEVEMENTS

- Collaborated with Professor Pierpaolo Carlone, University of Salerno, Italy for higher end characterization.
- Achieved all the objectives.

Al – Mg joint produced by FSW

Vertical Milling Machine available at PDPU

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

Development of Low Cost Set-up of Abrasive Jet Machining for Harder Material

Student
Sabuj Kumar Paria, Joy Singh
Maitrayo Brahmachari
me1542@cemk.ac.in

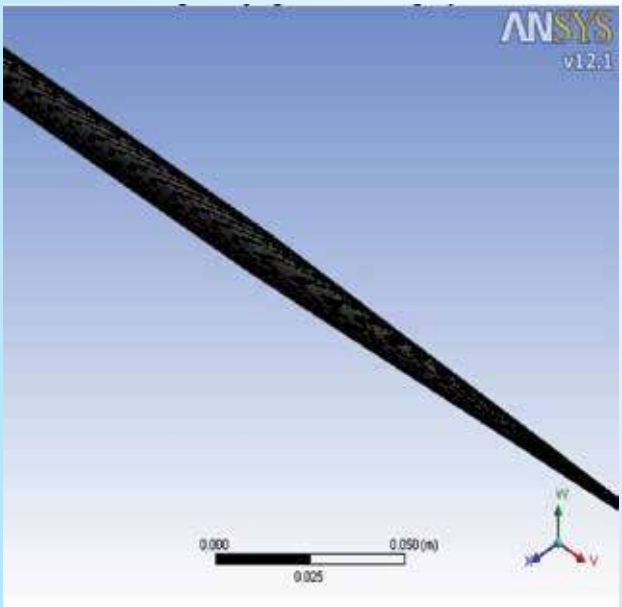
Guide
Dr Dipak Kumar Mandal, *MIE*
dkm@cemk.ac.in
Mr. Deb Kumar Adak, *AMIE*

Institute
College of Engg. & Management,
Kolaghat, P. O: K.T.P.P. Township
Midnapore (E)
IM0002668

OBJECTIVES

The objective of this work is to develop a low cost set-up of AJM for hard and brittle metal along with glass, ceramics, tiles etc. which is otherwise very difficult by conventional machining process. The cost of presently available set-up for machining is very high due to high cost of nozzles for better and continuous performance. Generally, the materials of nozzles are sapphire, stainless steel etc. In this experimental set-up, investigation with abrasive jet system may be carried out to analyse the performance about drilling operation on soda lime glasses and porcelain tiles etc. The material for the nozzle may be cost effective in term of its life by using composite material with carbon nano-fibre, boron nitrides etc. The geometry is the parameter for selecting the nozzle except the material for better performance. The variation of hole-diameter, taper angle, out off roundness with change in pressure and stand-off-distance can be investigated before finalization of the geometry of the nozzle.

Development of such kind of nozzle with appropriate material, shape and size in the working setup will be a great flavour for undergraduate students. This may help to develop a very low cost AJM setup for advance manufacturing laboratory.



Computational domain with mesh

Students with setup

ACHIEVEMENTS

In this present work, a low cost experimental setup is made to study the effect of metal removal rate on the hard and brittle materials on soda lime glass. MRR analyses of soda lime glass under varying abrasive jets are performed. From the experiments, the following conclusion may be drawn :

- If the particle size increased, it will take more time for emptying the abrasive than the small sizes particle if the volume is kept constant,
- If the grain sizes of abrasive particle increase then MRR will increase,
- MRR will increases with the increase in SOD upto a optimum value then decreases with the decrease in SOD,
- For smaller grain size particle, the MRR will decreases with increase in flow rate.

The same experimental set-up can be used on other type of glass like laminated glass, tiles, alumina plate etc. Study on surface roughness in case of policing operation and metal cladding can be done. Taperness and out of roundness can be checked in case of through machined hole. Study on nozzle wear and its operating life can be investigated in this set-up. Optimum nozzle design can be experimentally verified with this set-up. Different types of abrasive particles in terms of material, particle size and shape can be compared about their MRR.

Legacy of IEI

Laying of Foundation Stone of IEI Headquarters Building by Shri Profulla Chandra Sen, Chief Minister of West Bengal in 1963

A Study on IoT Based Intelligent Crowd Surveillance System

Student
Gargee Thakuria, Himangee Talukdar
Parsia Ahmed
gargeethakuria11@gmail.com
himangeetalukdar123@gmail.com
parsiaahmed@gmail.com

Guide
Dr. Amitava Nag, *MIE*
amitava.nag@cit.ac.in

Institute
Central Institute of Technology
Kokrajhar, Kokrajhar, BTAD,
Assam
IM0005446

OBJECTIVES

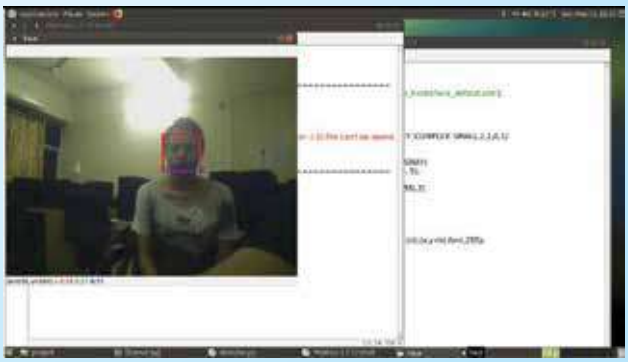
In recent years, Internet of Things (IoT) has gained a lot of attention from both academia and industry due to their potential in surveillance and information gathering. IoT has been widely used in many areas such as agriculture, smart cities, environment monitoring, transport management, safety monitoring, and disaster management. Nowadays, one of the main applications of IoT is surveillance of crowd by providing a way to keep an eye out for any crimes. Raspberry Pi with other IoT devices, such as pi cameras and embedded operating system, can put on an effective crowd surveillance system to identify any suspicious motion in the gathering. The main objectives of the proposed work are

- Design and development of an intelligent IoT based solution to provide a bird's eye view for crowd surveillance
- To provide security and safety of civilians from threats during various festivals
- To anticipate the formation of violent mobs and to prevent it by immediately reporting to the police
- The proposed system can recognize common criminal face from the database.

ACHIEVEMENTS

In the present work, we have successfully implemented a surveillance system for crowd monitoring by providing a way to keep an eye out for any crimes which is controlled by Raspberry Pi. This system can recognize common criminal face from the database and automatically generate an alert message and send it to the police. This system can also anticipate the formation of violent mobs and can prevent it by immediately reporting to the police. Thus this system can provide security and safety of civilians from threats during various festivals.

System Set-up



Face detection

Harmonically Improvised SPWM Based Inverter Drive for Induction Motor used in Irrigation Pumps

Student
Immanuel Davidson S
Ramya R
joshuathomas193@gmail.com

Guide
Dr. P S. Mayurappriyan, *MIE*
mayurappriyan.eee@kcgcollege.com
Mr. K. Vinoth

Institute
KCG College of Technology,
KCG Nagar, Karapakkam
Chennai, Tamil Nadu
IM0003656

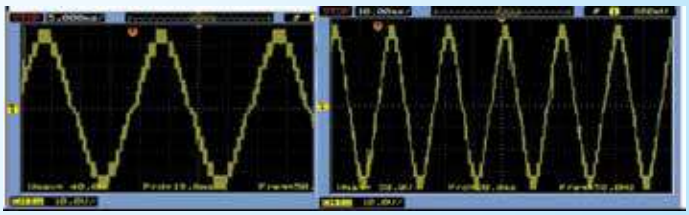
OBJECTIVES

The main objective of this project is to produce quality green power by implementing an asymmetrical fifteen level H-bridge inverter with reduced switches that is controlled by digital multicarrier offset Sine PWM method by FPGA Spartan 6E controller. The input voltage from solar PV array to the inverter is increased with the help of DC-DC boost converter. This proposed multilevel inverter provides an output that exhibits multiple steps at several voltage levels, resulting in high voltage by lower voltage rating devices connected in series. This configuration has very low dv/dt stresses and common-mode voltage variation. The proposed project can feed all industrial and commercial AC loads with low total harmonic distortion, minimum circuit components and it can still be operated at full load with higher efficiency. The proposed project is most suitable for induction motor driven irrigation pumps with improved power quality.

ACHIEVEMENTS

The proposed inverter was designed for harmonics improvement which is well suitable for induction motor drive used in irrigation and pumping applications. The FPGA XILINX SPARTAN 3E controller is programmed for optimized performance of the inverter. The THD level of the proposed system is 1.90 % which satisfies the IEEE Standards.

Prototype Model



Load Voltage Waveforms

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

Sir M. Visvesvarayya

Design and Development of Mist Cooled Condenser for Domestic Refrigerator with Green Refrigerants

Student
S. A. Abdul Rahaman
K. S. Aravindkumar
K. R. Abishek
abdul14mech@gmail.com

Guide
Dr. P. Thangavel, *MIE*
ptvelmech@gmail.com

Institute
Kongu Engineering College
Prundurai, Erode, Tamilnadu
IM0002676

OBJECTIVES

The main objectives of the project are:

1. To develop the mist cooled condenser and assemble with the domestic refrigeration system. Normally air cooled condenser is employed in domestic refrigeration systems. Due to very hot climatic conditions, the condensation effect is reduced. Hence, mist cooled condensation will improve the condensation effect in the refrigeration system.
2. To study and compare the performance analysis of domestic refrigeration system with the air cooled and mist cooled condensation processes.

ACHIEVEMENTS

This project deals with the development of the mist cooled condenser and the performance analysis of domestic refrigeration system with and without mist cooled condenser. The present environment temperature is high due to global warming. Condensation effect of refrigeration system is significantly influenced by the atmospheric temperature and reduced heat transfer rate is achieved at higher atmospheric temperature. When mist cooled air is used as a coolant in the condenser coil, the heat transfer rate is increased. Hence, the condenser outlet temperature is reduced compared to air cooled condensation process in the refrigeration system. Better condensation effect leads to more Refrigeration Effect (RE) in the refrigeration system. Due to increase in RE, the Co-efficient of Performance (COP) is also increased with addition of mist cooled condenser in the refrigeration system. This project is most suitable in very hot climatic conditions. Eco friendly refrigerants can be used to reduce the Global Warming Potential (GWP) and Ozone Depletion Potential (ODP) in the refrigeration system. Potential energy of water storage from the overhead tank is used for developing the mist. Hence, no external energy is needed for the development of mist. The excess water is collected in the reservoir and can be used for various applications like gardening, household purposes, etc. Hence, mist condensation effect is having fruitful outcomes for a domestic refrigeration system.

Mist cooled condenser arrangement in domestic refrigerator with Pressure and Temperature measurement system

Nozzle used for mist formation in the condensing coil

Experimental Investigation on Environmental Friendly Concrete Replacing Fine aggregate by M-Sand and E- Waste

Student

P B Lakshni Narayanan, G. Deepan Raj
M. Vishnu Prasad
narayanjohn340@gmail.com
deepanraj2926@gmail.com
prasathvishnu23496@icloud.com

Guide

Dr. P. Partheeban, *AMIE*
parthi011@yahoo.co.in

Institute

St. Peter's College of Engineering and Technology
Avadi, Tamil Nadu

OBJECTIVES

The present study is conducted to reduce the emission of carbon -dioxide from concrete and to evaluate the performance of Geo-polymer concrete by replacing fine aggregate with M -Sand and E-waste. The waste material from the thermal power station called fly ash is used as the binding material along with change the by-product of iron and steel called GGBFS. Fly ash and GGBS were used in the various combination, as a replacement for cement respectively. Similarly, Manufactured Sand (M -Sand) is also used as the fine aggregate against the normal river sand. Electronic waste (E-waste) is one of the hazardous waste materials which is a non-degradable and creates harmful effects on environment, is also partially replaced with fine aggregate.

Manufacture sand and electronic waste was partially replaced by fine aggregates in 10%, 20%, 30%, 40% and 50%. Mix designs were prepared and specimens are cast. The physical, mechanical and chemical property of fly ash, GGBFS are studied. The characteristic strength of Geo-polymer concrete, replaced with 10%, 20%, 30%, 40% and 50 % of E waste and M-sand as fine aggregates is obtained and a optimum percentage replacement is arrived by studying the physical properties, chemical properties and mechanical properties. The usage of E-waste and M sand in concrete will reduce the environmental pollution and depletion of natural river sand and will help to protect the environment to some extent.

E-Waste Pulverizer

Specimens Cast

Grinding in to 12mm size

Grinding in to >4.75mm

Testing of Specimens

ACHIEVEMENTS

Based on the results obtained in the experimental investigation, the following conclusions are found:

The GGBS and fly ash based geo-polymer concrete gained strength with earlier time period at ambient temperature. The necessity of heat curing of concrete was eliminated by incorporating GGBS and fly ash in a concrete mix. The strength of geo-polymer concrete increased percentage with increase in of GGBS in a mix. Initially, the mix 1 shows better compressive strength. It was observed that the mix 2 gave maximum compressive strength of 35 kN/mm^3. GGBS and fly ash-based geo-polymer concrete has excellent compressive strength and is suitable for structural applications.

There are both environmental and economic benefits of using fly ash and GGBS. The electronic wastes used for producing the binding system in concrete have environmental benefits at this optimal ratio. However, the use of E-waste environmentally benefits, it fails in economic.

The mix 3, mix 4 and mix 5 shows poor performance in its all experimental properties as E-waste steadily reacts with alkaline solution and changes the colour of the concrete and does not allow the cementitious material to bind with one another. This, results in lower strength of the hardened mortar. Hence, it can be concluded that the optimal mix proportion of the eco-friendly concrete which gives the excellent strength in its properties is mix 2 i.e., 80% fly ash, 20% GGBFS and 80% M-sand and 20% E-waste.

Design and Fabrication of Solar Operated Pesticides Spraying Robot

Student
Roshan Rajeshwar Tulaskar
roshantulaskar880@gmail.com

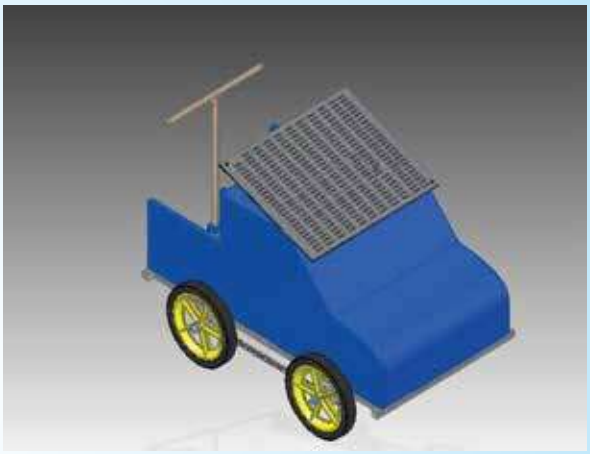
Guide
Dr. Raju K, *FIE*
rajuk@sjec.ac.in

Institute
St Joseph Engineering College
Vamanjoor, Mangaluru
IM0004881

OBJECTIVES

To design and fabricate a solar powered, wireless and eco-friendly pesticide spraying robot for agricultural purpose. The primary aim of this robot is to :

- Reduce human effort
- Eliminate health issues
- Use solar energy
- Be completely automated
- Save time and speed up the process
- Eco-friendly system



Cad model of Robot

ACHIEVEMENTS

In this project, a system has been successfully designed and fabricated which will be very useful in different kinds of fruits and vegetable fields like vineyards, strawberry, cucumber, bell pepper etc. for the purpose of spraying pesticides. Based on testing and working of the system it has been concluded that the system designed will provide the facility for spraying different kinds of pesticides on crops, which otherwise would have been difficult to do manually and poses many health problems. The system can be operated automatically by the use of RFID technology, there by overcoming the problem of scarcity of labour.

This project was an attempt to achieve an environment friendly system. Since, it will make use of solar energy for its operation, the farmers who are economically backward and facing electricity problems like load shedding etc. will stand benefitted. The solar operated pesticide spraying robot will help the farmers of those remote areas of country where fuel is not available easily. They can perform their regular work at the same time they can do pesticide spraying work effectively.

Actual Model of Robot

Autonomous Operated Robot for Water Tank Cleaning

Student
P. Prem Kumar, S. Kathir
prem.premkvp @gmail.com

Guide
Dr. S. Kannan, *FIE*
kannan@ritrjpm.ac.in
Mr. S. Viignesh, *AMIE*

Institute
Ramco Institute of Technology
North Venganallur village,
Rajapalayam, Virudhunagar,
Tamilnadu
IM0003125

OBJECTIVES

It is common in Indian household to store water in tanks which may be ground water, rainwater or from any other source. The water stored in it may have fine particles which will settle at the bottom as well as the sides of the tank and form stains and precipitate when left undisturbed for a while. It needs to be cleaned periodically. If not cleaned periodically, it may form salt deposits in pipes and block the water path. Currently, a manual cleaning process is seen in abundance. In manual cleaning process, a man has to get inside and clean the tank. The problems in this cleaning process include improper light for vision, lack of provisions to get in and out of the tank and risk of damaging the tank in case it is made of plastic or light weight material. The proposed project idea will convert that cumbersome manual labour work to an effortless task. There are many robots available

Assembled Robot

Testing the functionality of the Robot

for cleaning various industrial tanks. Those robots can't be used for cleaning domestic water tanks since they are application specific. Location of the water tank varies with its purpose, a rain water storage tank is usually installed underground and ground water storage tank is installed at the roof-top to use the gravitational pressure. The proposed robot will clean the water tank without much effort. However, a human part is needed to take the robot to the location of tank and to place the robot inside the tank. Once placed inside the tank, the robot cleans the tank autonomously and the user can take out the robot after the completion of the process.

ACHIEVEMENTS

An autonomous water tank cleaning robot is designed and fabricated. An algorithm is developed such that the robot take care of the cleaning task by itself without any human help. This algorithm is converted into computer program and dumed into the microcontroller onboard using IDE. The entire body of the robot is made using non rusting type materials and the body is sealed using water proof adhesive materials to prevent entry of water into the robot. The robot is finally tested by placing in inside a 400 litre plastic tank. Based on its performance, it is found that the robot actually takes less time for cleaning process when compared to manual labour work. The method of operating the robot is also found to be very simple.

PUBLICATION

P. Prem Kumar, S. Kathir, S. Kannan, S. Viignesh, "Autonomous Operated Robot for Water Tank Cleaning", International Research Journal of Engineering and Technology (IRJET), Vol.5, Issue 4, April 2018.

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

Smart Sensor Model for Measuring Soil Moisture and Automated Water Pumping System using IoT

Student
Gourav Bid
Soham Surai
gouravbid25@gmail.com
sohamsurai@gmail.com

Guide
Dr. Debdutta Barman Roy, *MIE*
pal.debdutta@gmail.com

Institute
Calcutta Institute of Engineering and Management, 24/1A, Chandi Ghosh Road, Kolkata
IM0002978

OBJECTIVES

Smart farming represents the application of modern information and communication technologies into agriculture, leading to what can be called a third green revolution. It is very challenging to adopt the global warming into agriculture. Smart agriculture using wireless sensor network leads the answer to this challenge. Farmers are unaware about various technologies that will be beneficial for effective farming. If farmers can make a proper decision in harvesting,it will be helpful for having a better crop. For correct decision making,farmers need to know different factors like condition of soil, weather, proper use of fertilizer,watering the field property etc. By use of sensors it is very easy to collect data about these factors. Using this technology decision making is very easy as it will be done by computer. So the time for the total process will be reduced and smart due to use of particular programs.

ACHIEVEMENTS

SSSM consists of four phases. The phases are categorized according to there functionality.

Phase 1:It is the data collection phase. In this phase data are collected from oil through a sensor device.

Phase 2: It is the computation phase. In phase 2 computation is done on collected data to measure the percentage of soil moisture.

Phase 3: It is the decision making phase. In this phase decision is taken according to the computated result.

Phase 4: it is the action phase. It is the phase where action is to be taken according to the decision.

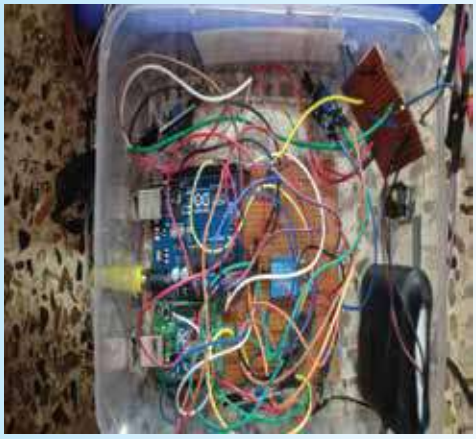
In this soil moisture sensor input part is the YL 69. It measures the resistance of the soil type between two probes. It generally creates a high voltage for high resistance, and low voltage for the low resistance. i.e. low output voltage for the wet soil and high output voltage for the dry soil. Now the soil moisture sensor was

Model presentation at KIIT,Bhubaneswar, 2ND TECHNOVISION'2018

Model presentation at Heritage Institute of technology, Kolkata in TECHNOVATION, 2018

Hardware Used

Display Unit



Server Part of Model

Client Part of the Model

connected with the Arduino UNO at the analog port. The Arduino UNO was connected to the arduino IDE by using USB cable. The sensor collects data as an analog value and sends it to the analog port of the Arduino. The collected analog data was converted to digital signal using ADC (Analog to DIGITAL Converter).

After that IDE input resistance data was converted into percentage value. And then repetitively ten percentage values were taken to do the average for increasing accuracy of the system.

Now the result was ready at the digital output of the Arduino. A L.C.D. was connected to the digital probes to collect the digital data and then show it in proper manner.

This model has been simulated in a small region and it has worked successfully. With this model we have participated in two competitions and successfully implement the model.

- FIRST prize in project competition TECHNOVATION at Heritage Institute of Technology, on 19 September 2018.
- SECOND prize in project competition 2ND TECHNOVISION'2018 AT KIIT, BHUBANESWAR on 5 October 2018.

PUBLICATION

"An IoT Based Smart Agriculture System with Soil Moisture Sensor", CIEM Journal of Innovation and Research, vol:1, pg:39-42, 2018.

A Study on Integration of Global Positioning System (GPS) and Inertial Navigation System (INS) in unmanned Aerial Vehicle

Student
R. Gokul Raj, P. Matheeswaran
J. Koushik
gokulraj.ae14@bitsathy.ac.in

Guide
Prasad G, *AMIE*
prasadjithu@gmail.com
Rajasekar K, *AMIE*
rajasekar.km@gmail.com

Institute
Name: Bannari Amman Institute of Technology, Sathyamangalam
Tamilnadu
IM0004075

OBJECTIVES

1. To construct the Quad copter with autopilot flight control board (APM) and GPS system.
2. To assess the performance. (Power usage, Range, endurance and autopilot system performance).
3. To use autopilot mode with the help of GPS system and enable the drone for image based 3D mapping and surveying.

Hovering of GPS controlled UAV

GPS performance analysis at altitude flying

ACHIEVEMENTS

1. The efficiency of the satellite based GPS system is assessed and suitable remedies are taken to improve the efficiency of the satellite based GPS system.
2. The drone with camera assessed for 3D Mapping and surveying capabilities.
3. The drone performance like range, endurance, stability under different wind conditions and power consumption are analyzed with the help of Ardupilot open source software.

PUBLICATION

1. Prasad G , Vijayaganth V , Sivaraj G ,Rajasekar K ,Ramesh M , Gokulraj R ,Matheeswaran P, " Positioning of UAV using Algorithm for monitoring the forest region", IEEE Xplore Digital Library , pp 1361-1363, JUN 2018.
2. Naveen Kumar K, Prasad G, Rajasekar K, Vadivelu P, Satyanarayana Gollakota. Kavinprabhu S. K, "A Study On The Forest Fire Detection Using Unmanned Aerial Vehicles", International Journal of Mechanical and Production Engineering Research and Development (IJMPERD) , Vol. 8, No. 7, pp 165-171, OCT 2018.
3. Prasad G "Unmanned Aerial Vehicle in Medical Product Transport", International Journal of Intelligent Unmanned Systems, Emerald Publisher,(Accepted on 08-Nov 2018)

Implementation of Rail Track Condition Monitoring and Ubiquitous Knowledge Based on IOT

Student
Pragadeesh Kumar N, Rahul C
Santhana Raman S
praggy@gmail.com
rahulchengalvarayan@gmail.com
gouthamcrazy4@gmail.com

Guide
Dr. C. Chellaswamy, *AMIE*
chella_info@yahoo.co.in

Institute
Rajalakshmi Institute of Technology, Kuthambakkam Post
National Highway
4, Chembarambakkam, Chennai, Tamilnadu
IM0002366

OBJECTIVES

The main objective of the project is to find out the abnormality in railway track, update the abnormal information in the cloud with location information and report it to the control centre.

Other objectives includes:

- Detect the abnormal vibration in the rail track using MEMS accelerometer.
- To track the location of the abnormality using GPS and store the same in the Cloud through Raspberry Pi.
- To analyze the information in the cloud and take corrective actions in short term which will prevent disastrous accidents from happening.
- To use cloud computing technology to store and retrieve the details about the railway track.
- To improve detecting capability of track abnormality the HBO (Honey Bee Algorithm) optimization technique is utilized.

ACHIEVEMENTS

The proposed methodology describes the modeling and employment of a cheap but highly robust, real time railway track monitoring system using Raspberry Pi with over-the-air updating of data using cloud technology for including new uses. The usage of Raspberry Pi to implement the monitoring system owes to its resourcefulness but in an economical pricing. The plasticity of the Raspberry Pi ensures that the data and alert messages can reach whomever we tend to send, be it the developer or the end user. The compact size of the system makes it possible to fit the entire system even in tight places and also in case of any emergencies, any necessary action can be taken in a very short time. In this aspect the MEMS sensor and GPS acts as sensors to detect the irregularities in the track and locate the irregular vibration. The Raspberry Pi 3 board act as a main controller to control and regulate all other components. The data that is collected is then uploaded to the cloud in a MySQL database and can be filtered and sorted according to our preferences in Thing Speak server whenever any data is needed. Four different irregularities in tracks are considered in and around Chennai area and its GPS coordinates are observed. To verify the results of this experiment, a system with the optimal data for reference is mounted separately with the original system. The data is stored for multiple runs on train on the same location with different train speeds.

The experiment is carried out for all the four different irregularities on the railway tracks. For the reference data, before the commencement of the experiment, the system is run on tracks under optimal conditions and the data is captured. The aberrations are made at four different routes to test the working of the IoT-TMS system.

Experimental setup and accelerometer values with corresponding GPS coordinates

GPS coordinates updated in cloud

We have manually set the fault on these locations at 6.2 km, 7 km, 3.8 km, 4 km respectively. Many types of aberrations such as missing bolt, loose bolts, disfigurement with crack, and severe plastic deformation on rail top has been found at different positions. We can see that the signals values received by the accelerometer for visible and invisible damages on the track respectively. The accelerometer readings shows us that the aberrations are present at 6.2 km and 7 km for all the speed settings from the start of the observation and that the signal amplitude for the visible damage is greater than signal amplitude of invisible damage. The accelerometer values changed the below line of "Fault on Track Found" indicates that there is a fault.

The experiment is done and the values are saved for the test run done on 27 June 2018. At any point during the run if the amplitude of the signal rises above the threshold value that is set, the controller concludes that there is an aberration and records the GPS coordinates. The various test-run results for railway track aberrations for the proposed IoT-TMS can be seen on the screen. An aberration is present at the GPS coordinate (13.0224 N and 80.2195 E). By comparing the GPS coordinates with the original location of the aberration, we can see that they are almost matching and a slight variation of 5m is seen from the point of fault. From the figure, it can be seen that there is sudden rise of amplitude in data packet 43 and an aberration is present at the GPS coordinate 13.0822 N and 80.2755 E and this result shows that the predefined place of aberration exactly matches with the GPS coordinate recorded. The results that are recorded for the proposed system that is developed and tested in real time. Based on the data collected from real environment using the MEMS sensors, a threshold can be set for the system.

If this threshold is crossed during the run time of the system, a message is sent to the user with the GPS location by using ThingSpeak. This whole process is made possible using a prototype created with Raspberry Pi. It provides high usability in an affordable package. This system uses Raspberry Pi for data prediction and analyzing the recorded data, the reason being that Raspberry Pi provides error less results to toggle the alert message. This system offers solution to preventing rail accidents and has an advanced approach toward solving it. It can also improve the overall ride quality of the railways by identifying the faults before they even develop.

PUBLICATION

[1] Chellaswamy C, Pragadeesh Kumar N, Rahul C, Santhanaraman "Implementation of Rail Track Condition Monitoring Based on Internet of Things", Journal of The Institution of Engineers (India): Series B, (Submission ID:IEIB-D-18-00331), under review.

Collision Prevention System by Vehicles on Illegally Parked Vehicles and Slow Moving Vehicles in Highways using IoT

Student
Mohammed Fayaz A
moha16224.cs@rmkec.ac.in

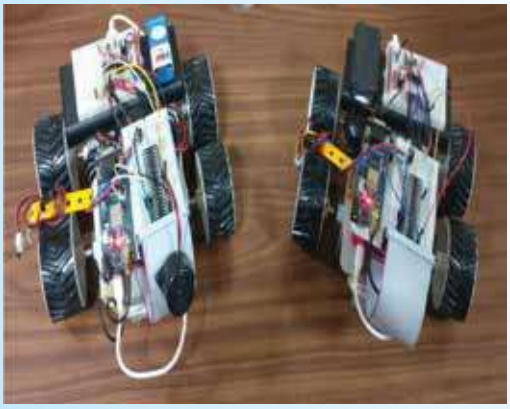
Guide
Dr. Sandra Johnson
sjn.cse@rmkec.ac.in

Institute
R. M. K. Engineering College
RSM Nagar, Kavaraipettai
IM0004296

OBJECTIVES

One of the major causes of accidents on highways is due to illegally parked vehicles and unusually slow moving vehicles. The objective of the proposed project is to develop an intelligent system that will identify illegally parked vehicles and slow moving vehicles in highways and give alert messages to the on-coming vehicles, police patrol and nearest toll.

The objective of the project is to develop a system that will avoid collision due to illegally parked vehicles and slow moving vehicles in highways.



Vehicles with the 'Intelligent Collision avoidance System using IoT' is implemented using Raspberry Pi 3

Students demonstrating the project to the NBA committee members

ACHIEVEMENTS

- Applying for Patents on the methodology used to identify slow moving and illegally parked vehicles in highways.
- Students participated in 'World Youth Federation's Award for the project which most demonstrates an aptitude for Engineering, Dr. Kalam Young Achiever Award 2018.

A Secured Child Care System Using RFID in IoT

Student
Chandradeep Anand, Aman Saraogi
Anjali Goenka
chandradeep.anand@aot.edu.in
aman.saraogi@aot.edu.in
anjali.goenka@aot.edu.in

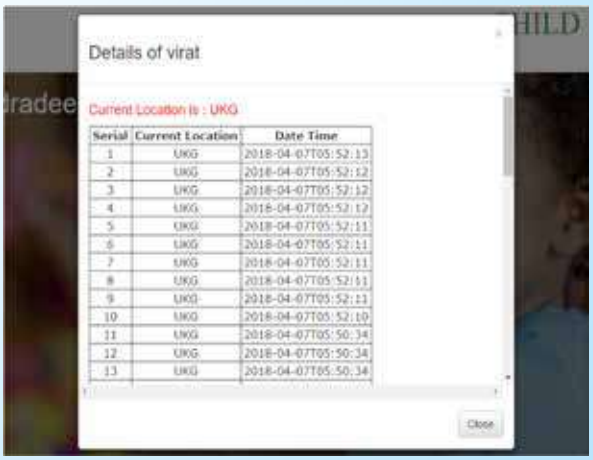
Guide
Prasenjit Das, *MIE*
p.das@aot.edu.in
Anirban Mitra, *MIE*
anirban.mitra@aot.edu.in

Institute
Academy of Technology
G.T road(Adisaptagram),
Aedconagar, Hooghly,West Bengal
IM0001890

OBJECTIVES

Child tracking and protection is a critical issue in our society now. In this project we have tried to develop a child care security system in school premises as an application of IoT where RFID is the backbone. RFID tag are attached with the ID card of child, the information about the students are stored in the tag. The tag can be tracked using the RFID reader which is placed in some specified location and it will send the tag information to the Raspberry Pi attached with it. Rasberry Pi will store the data in a local server as well as in cloud. Every person relevant to child like school authority, teachers and parents can check the status of child anytime from anywhere. The system is capable to handle some undesired situation like if the students are going outside the premises during school hours and if a student is absent from the class for a long time it can generate an alarming message to the concerned person and it can easily find out the location of the missing child. When the school is over if anybody remains inside school that can also be identified with location. A number of applications can be generated according to necessity like attendance collection and monitoring, kidnap of child from school premises etc.

Experimental Setup



Real time location of a UKG student virat

ACHIEVEMENTS

A number of Readers will be placed in some specific location inside the school campus as in main gate, classroom, toilet and corridor etc. The RFID Readers around the campus will track the location of child inside the school. Every child will have an RFID tag attached to its ID card. RFID tags will contain the students'

information in the form of Unique Identity Number (UID) so that every time a child is within the range of a reader, its location will be fetched along with the information stored in the tag. We have implemented it using Rasberry Pi 3 model B and use Mifare Reader and Tag.

When the tag are coming within the range of any reader the reader will fetch the tag information. The position of reader indicates the location. The Pi sends the collected data in cloud in the form of student information along with location, date and time. We perform local filtering of data in Pi since a huge amount of data is collected in pi per unit time. Since the data are fetched continuously so number of data from a particular reader for a particular tag a huge data will be collected where difference between two data is only in time(seconds). Any authorized user, say parent of a child, can login into the system to view his/her childs location in real time but will never never access to the information of other childs. A school staff and principal can see the details of all the students. If any undesired situation like if any child in stay more than a threshold time within the toilet and emergency message is generated. If any student is outside the classroom where he/she is supposed to be there it can be reported to the concerned person Since the reading range of the reader MFRC522 is very short about 5cm, we have created a model to test the behaviour of the proposed system. We have purchase cloud domain www.childcareaot.com from 2GB hosting. We design the data base to store the collected data , the collected data will be automatically store into the cloud for further processing. We have use python based program for data collection and uploading. We do not have a scope to implement ECC based authentication protocol. The tag itself have a communication protocol by which it is communicate and transfer the data to the reader.

PUBLICATION

IEEE 8th IACC 2018 organized by Bennet University. 'An Efficient Method for Text Encryption Using Elliptic Curve Cryptography'.

Paper Id: 171

Legacy of IEI

Prime Minister Mrs Indira Gandhi cutting the Golden Jubilee Cake

Artificial Intelligence Based Personal Assistant for Seminar Halls using Raspberry PI

Student
Venkata Rajeshmurala
Sai Vamsi Krishna Pendyala
Pavan Kumar Singavarapu
m.vrk@outlook.com

Guide
Dr B Venkateswara Rao, *MIE*
bvrao.eee@gmail.com
drbvrao@vrsiddhartha.ac.in

Institute
V R Siddhartha Engineering College (Autonomous), Kanuru
Vijayawada, Andhra Pradesh
IM0005330

OBJECTIVES

Now a day to organize a seminar at least 1 or 2 technicians are required for to turn ON/OFF/adjust the equipment in the hall and to change the slides. But sometimes they are not available or busy with their works, which results in momentary disruptions in seminars and loss of electrical energy. To overcome all these complexities, a digital assistant is needed. The main aim of this project is to develop an economically effective and performance wise efficient digital assistant for Seminar Halls (D.A.S.H) using Raspberry Pi for seminar halls based on the concepts of Natural Language Processing and Artificial Intelligence. It can control electrical equipment like lights, fans and projector, and also controls the presentation slides by voice commands or input from a touch screen or an infrared remote. This device makes conduction of seminars easy.

Raspberry Pi is a credit-card-sized single microcontroller computer. In this Python is used as the main programming language. It is easy to develop and suitable for real world applications. The chip specifically provides HDMI and there is no VGA support. Arduino can successfully work with Raspberry Pi computers. So in this project we use the Arduino and Raspberry Pi for seminar hall control. Artificial Intelligence provides us the framework to go real-time decision and automation for Internet of Things (IoT).The work deals with discussion about different intelligent seminar hall automation systems. Application developed using the Android platform controlled and monitored from a seminar hall. The sensors and actuators/relays are directly interfaced to the main controller. Proposed design offers the control of energy management systems such as lightings,

Personal Assistant to Control Fan and Light Using Raspberry Pi with Voice

Personal Assistant to Control Fan, Light, AC and PPT using Raspberry Pi with LCD Touch Screen

heating, air conditioning and changing of slides in power point presentation with voice.

The main objectives of the project are:-

1. To develop a low cost, reliable and scalable AI based control device to save energy.
2. To reduce the man power and maintenance cost in seminar halls.
3. To control power point presentation either by voice or through infrared remote.

ACHIEVEMENTS

1. Developed a low cost, reliable and scalable AI based control system that can replaces computers, laptops and security systems.
2. It reduces the man power and maintenance cost in seminar halls.
3. The developed device saves energy by adapting automation.
4. It creates a friendly interface to the users.
5. It controls power point presentation either by voice or through infrared remote.
6. Successful in controlling the ppt, fans, lights and AC.
7. Able to indicate the each and every operation in LED screen.
8. App has been developed which provides the graphical user interface.

PUBLICATINON

- M V Rajesh, B VenkateswaraRao, P SaiVamsi Krishna and S Pavan Kumar, "Raspberry PI based Digital Assistant for Seminar Halls (D.A.S.H)", International Conference on New Trends in Engineering & Technology (ICNTET)-2018, Conducted by GRT Institute of Engineering and Technology, Chennai, during 7-8 September 2018.

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

Division Based Automatic Irrigation System for Smart Agriculture using Internet of Things (IoT)

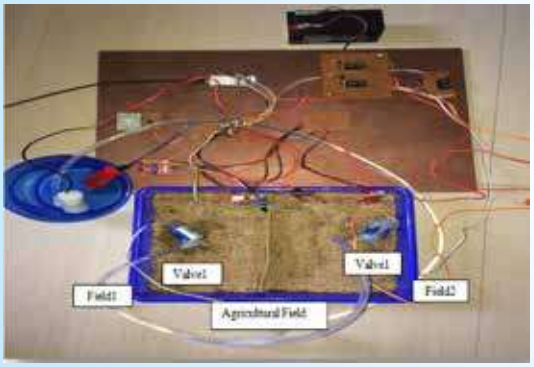
Student
S. Gomathy, L. Kalyanee, A. Nivetha
gomathy199803@gmail.com

Guide
Ms. L. Sugasini, *AMIE*
sugasini2588@gmail.com

Institute
Jerusalem College of Engineering
Velachery Main Road
Narayanapuram, Pallikaranai,
Chennai, Tamilnadu
IM0003982

OBJECTIVES

- To design a smart agriculture system capable of providing sufficient information about an irrigation system in an automated manner using the controllable parameters of soil.
- To implement the system that can identify water and moisture level to provide ease of irrigation and to transmit this information to the GSM module.
- To measure and regulate important factors in precision agriculture and to secure the field from animals and unauthorized individuals.



Automatic irrigation system

Sensor output section

ACHIEVEMENTS

Students have presented the paper titled "DIVISION BASED AUTOMATIC IRRIGATION SYSTEM FOR SMART AGRICULTURE USING INTERNET OF THINGS (IoT)" in the National Conference on Emerging Trends in Science, Engineering & Technology in Jerusalem College of Engineering, Chennai. Based on the results obtained from the developed system, paper has been presented in the National Level NSS Day event "GRITXEMPLERS 2018" and won THIRD PRIZE (Cash Award) in the event IDEA PRESENTATION conducted by NSS, Sri Sairam Engineering College, Chennai.

PUBLICATION

L. Sugasini, S. Gomathy, L. Kalyanee and A. Nivetha have communicated the paper titled 'Division Based Automatic Irrigation System For Smart Agriculture Using Internet of Things (IoT)', for the possible publication in the International Journal and to the Conference on Emerging Trends in Science, Engineering & Technology (ICETSET-2019).

Fading of LF & HF Signal and Associated Dynamics of the Atmosphere

Student
Arup Kumar Chandra
arupchandra1201@gmail.com

Guide
Dr. Kousik Roy, *MIE*
kousikroy002@gmail.com

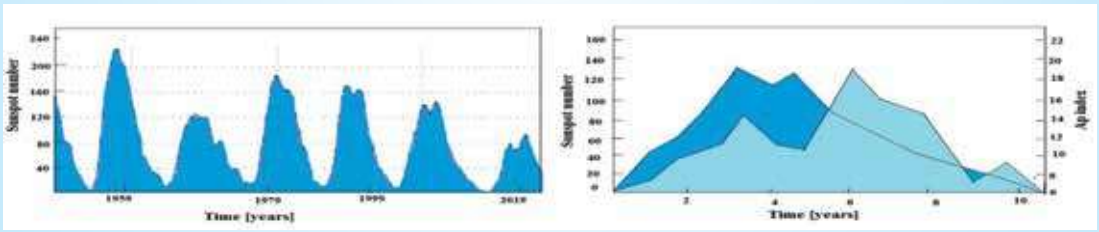
Institute
Asansol Engineering College
Vivekananda Sarani, Kanyapur,
Asansol, West Bengal
IM0003478

OBJECTIVES

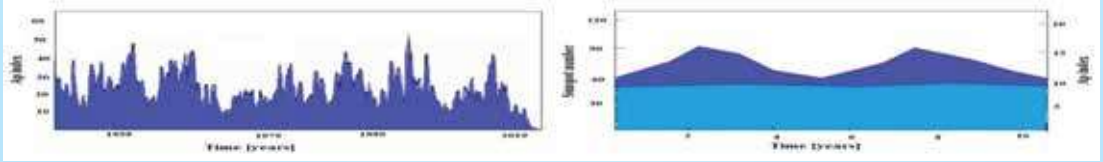
i) The purpose of the project is to centre the deviations of the intensity of radio signal at the moment of sunrise and sunset in addition to the outcome in the noise level by the supposed cosmic ray deposit creation after sunrise.

ii) Long-period fading in sferics throughout rigorous meteorological disorders and connected solar geophysical phenomena are also to be examined in brief.

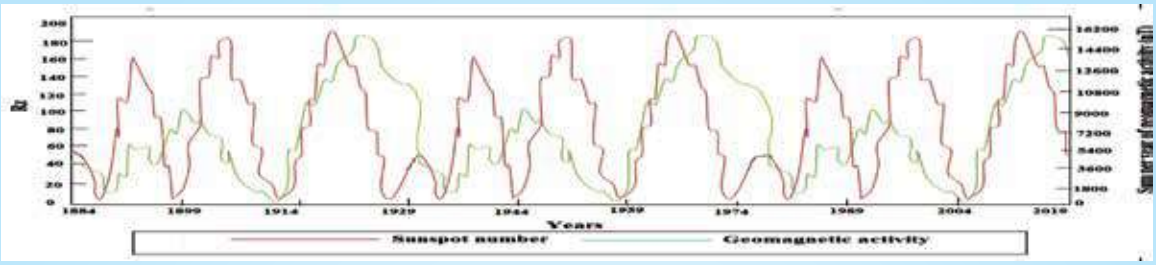
iii) A globular clouds produces initially in NW part of West Bengal during the pre monsoon month (March-May), when resembling towards Kolkata transformed to a entire fledge cumulonimbus clouds, thus in the path of journey in the direction of our examining station Asansol creates energetic sferics movement and finally degenerate along SE path. Subsequent these desire to study the fading of LF & HF signal and linked dynamics of the atmospheric turbulences close to Asansol and its border.



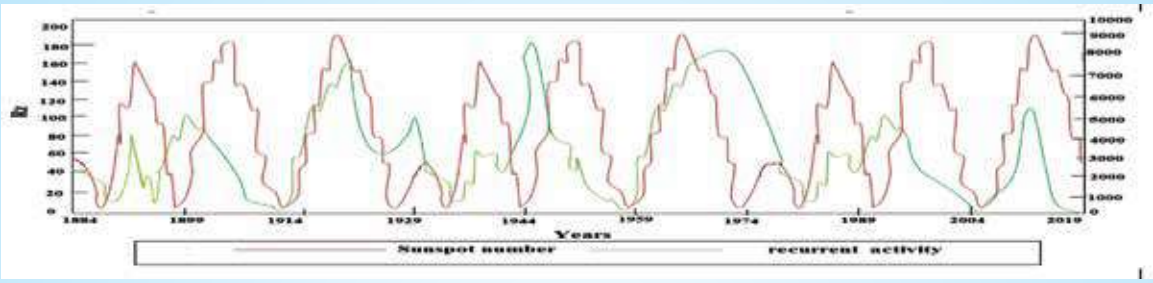
Variation of Sunspot number with respect to time and variation of sunspot number and Ap index with respect to time



Variation of Ap index with respect to time and variation of Sunspot number and Ap index with respect to time



Variation of Sunspot number and Geomagnetic Activity with respect to time



Variation of Sunspot number and Recurrent Activity with respect to time

ACHIEVEMENTS

i) We have studied the variations of sunspot number with respect to time and also variation of AP index with respect to time.

ii) We have studied the variations of sunspot number and Geomagnetic activity with respect to time.

iii) We have studied the variations of sunspot number and Recurrent activity with respect to time.

Legacy of IEI

Dr Shankar Dayal Sharma, Hon'ble President of India, lighting the lamp to mark the inauguration of the Platinum Jubilee of IEI on 17 December 1994, in presence of HE Governor of West Bengal Shri K V Raghunatha Reddy and Shri Jyoti Basu,Chief Minister of West Bengal

A New Approach of Solar Powered Electronic Voting Machine with Authentication System and for Blind People

Student
S. Agathiyan, V. Sathish
R. Naveen Prasath
agathiyaneee98@gmail.com

Guide
Prof. G. Ganesan @ Subramanian, *MIE*
ganesan@egspec.org
Dr. M.Chinnadurai, *MIE*
mchinna81@gmail.com

Institute
E. G. S. Pillay Engineering College, Nagapattinam
Old Nagore Road, Thethi Village, Nagapattinam
IM-0003435

OBJECTIVES

- To introduce and to design an Electronic Voting Machine that uses punch card and password protection.
- To utilize the renewable energy instead of grid power so that the power source in the circuit can reduce the dependency on the grid system.
- To reduce the manpower requirement for voting purposes like polling officers and vote counters.
- To provide an eco friendly machine as it uses solar power and being digital in nature does not require paper.
- To reduce the delay in publishing the result. As it runs on solar power it can be used in remote locations where there is no access to electricity.
- To minimize the errors, as there is no human factor is involved in vote collection and counting, there will be almost no scope for fraudulent activity.
- To maintain records safely and complete with confidentially.

ACHIEVEMENTS

Electronic voting machines are used for voting purpose. But in some foreign countries, E-Voting Systems have gained very much success by reducing the use of ballots and by using internet. The main reason why E-voting systems have gained such success in these countries is just because of convenience in this voting system as compared to other traditional voting system. Here we discuss about social sites e-voting, News channel or Newspapers, Electronic voting, Electronic vote counting and Reality shows e-voting systems. It reduces our time and cost also. We also discuss about some next generation hi-tech e-voting systems which can be used

Electronic voting machine module with solar panel

Immense image of electronic machine

to improve traditional voting systems. In this system we have used thumb impression for voter identification or authentication. Every person has an individual unique thumb impression and it helps with accuracy. In a constituency the thumb impression of the database is created for all the voters through this the illegal and repetition of votes is checked. And also aid for blind people using Mini Embedded MP3 Sound Module while vote, the people can hear the name of the political parties and the SMS method used to send your vote to the voters the GSM method.

In elections government needs these type of secured system's which is generally used for the public and visionly challenged people. The use of components for this particular devices are very less and can be operated for a long tenure. The finger impression and authenticated security help to enhance the device by protecting it from unauthorized persons. The economic and reduced electricity tariffs are other benefits as this project uses renewable energy (i.e.) solar. This gives the independent extraction of power flow the grid and also eco-friendly. Thus the solar operated EVM with authenticated system for visionly challenged people helps for the environment as well as to the society.

PUBLICATION

S. Agathiyan, G. Ganesan @ Subramanian, S. Latha and J. Menaka, "A new approach of solar powered electronic voting machine with authentication system and for blind people", International Journal of Advance & Innovative Research, Vol.6; Issue:1 (XIV); Page: 36-40; ISSN: 2394-7780; Jan-Mar 2019. (UGC approved Journal).

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 20-23 January 2000

Wireless Public Addressing System Using nRF24L01+

Student
Harieshkumar S S
harieshkumar37@gmail.com

Guide
Selvakumar S, *MIE*
suruliselvakumar@gmail.com

Institute
K. L. N. College Of Engineering
Pottapalayam, Sivaganga District
Tamilnadu
IM0000865

OBJECTIVES

In this project ISM band of 2.4 GHz is used, which is user free frequency. It is cheaper and power efficient than Wi-Fi .Separate receivers are connected and transmitter can select the receivers. In this project latest wireless technology with nRF24L01+ is used.

PA system Transmitter with microphone

PA system Receiver with speaker

ACHIEVEMENTS

The Wireless Public Addressing System Using nRFL01+ is designed and tested for one transmitter and three receiver nodes. This work is to be implemented for the selective or common addressing of students either in class rooms or laboratories.

> The ideal engineer is a composite ... He is not a scientist, he is not a mathematician, he is not a sociologist or a writer; but he may use the knowledge and techniques of any or all of these disciplines in solving engineering problems.
>
> N. W. Dougherty

High Gain Non-Isolated Step-Up DC-DC Converter Based CSI Fed BLDC Drive for Air-Vehicle Environment Control System (ECS)

Student

Arunkumar L
Balajivishwanath R
Elanchezian T
elanchezian.don@gmail.com

Guide

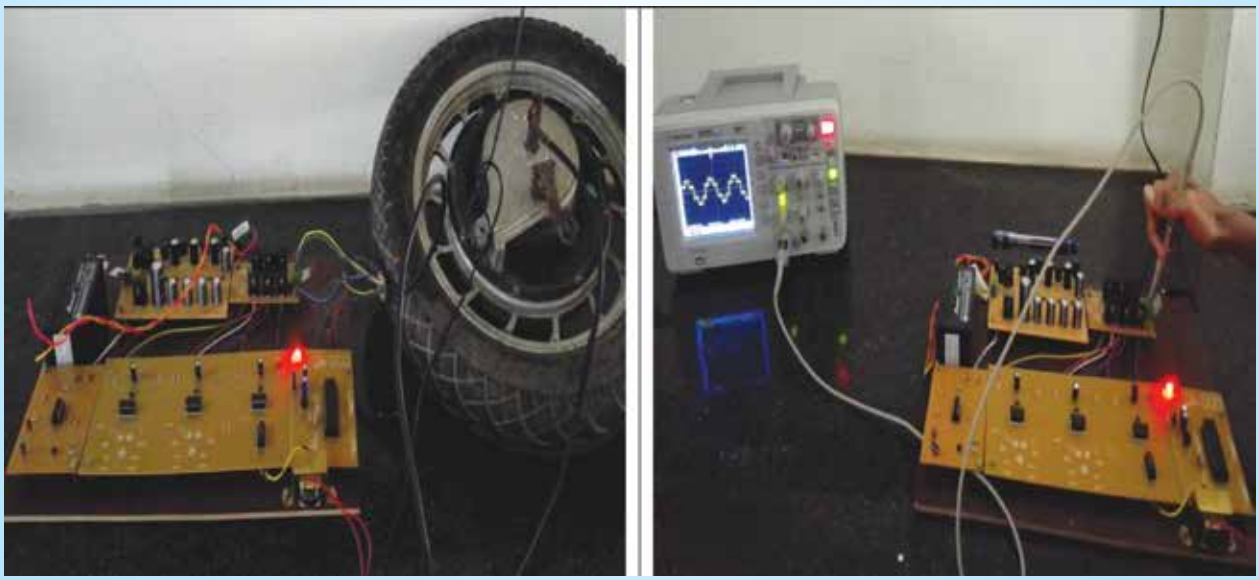
Dr. P. DeivaSundari, *MIE*
deivasundari.eee@kcgcollege.com
Mr. S. Gowtham, *AMIE*
gowtham12591@gmail.com

Institute

KCG College of Technology
Rajiv Gandhi Salai, Karapakkam,
Chennai
IM0003656

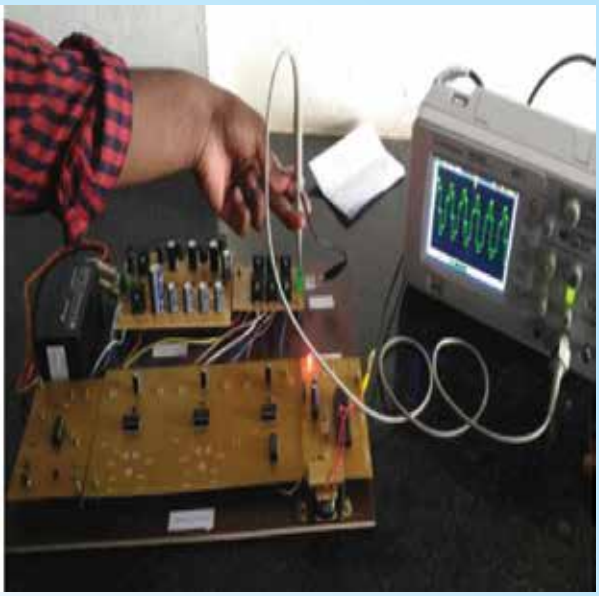
OBJECTIVES

Environment Control System (ECS) is used for air-conditioning and pressurization of the vehicle. Fan Air Modulating Valve (FAMV), a part of ECS, is used for controlling the air supply in the vehicle. This FAMV is powered by Brushless DC (BLDC) motor. BLDC are highly preferred for land and air-vehicles because of its less maintenance, longer life, lower weight and reliability. The control of BLDC motor is highly dependent on the solid state switches. Normally for vehicles the motors are powered by batteries, so step-up DC to DC converters are very important in driving the motor. A normal boost converter can increase the voltage level with certain limitations. Using interleaving technique the current ripple at the input can be reduced and with suitable voltage magnitude compensators (VMC) the voltage gain can be increased at different levels. The coupled inductor improves the power handling capability of the entire system. Traditional BLDC drives use Voltage Source Inverter (VSI) that utilize hard switching, thereby generating switching losses and entail the use of large heat sinks. VSI needs a huge DC link capacitor that is inherently unreliable and is one of the most expensive components of drive. Hence, a Current Source Inverter (CSI) is used to replace the hard switching by soft switching; thereby eliminating the heat sinks as well as the large DC link capacitor. So in this project we used a high gain non- isolated DC-DC converter which comprises of VMC and CI which will certainly improve the performance of the overall system at low cost and reduce maintenance.



Hardware Prototype

Output of the proposed system in multimeter



Output waveform of the proposed prototype system

ACHIEVEMENTS

A 12V battery is used for providing the supply. The value of inductor connected with the source is designed such that it reduces the stress across the switch by making the power electronic switches to experience turn on and off at zero voltage and current. The interleaved boost converter is designed to increase the voltage level of the from 12V to 24V and also to reduce the ripple content in the input current. With 24V as input to the voltage magnitude compensator the voltage level is increased from 24V to 192V with the help of Voltage Magnitude Compensators (VMC) in simulation but in hardware we were able to achieve more than 230V as the rms value. This rms value is given as an input to three phase inverter. The output of the inverter is then connected to the BLDC motor which is rated at 500W and 3000rpm. BLDC motors provide the required speed and voltage for Fan Air Modulating Valve. Hall sensors were used to measure the position of the rotor. It helped in controlling motor with the help of solid state switches. A current controller is used for maintaining the voltage supply to the motor by taking speed as its reference. The three phase inverter is controlled with the firing pulses generated from current controller.

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

FPGA based Control of BLDC Motor for Electric Two Wheeler

Student
Nandha Kumar S, Preetha A
kumarnantha1997@gmail.com

Guide
Dr. N. Booma
booma_nagarajan@yahoo.com

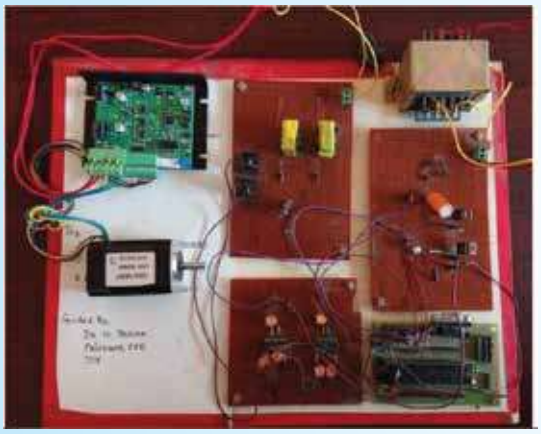
Institute
Jerusalem college of Engineering
Pallikaranai, Velachery Main Road
Chennai, TamilNadu
IM0003982

OBJECTIVES

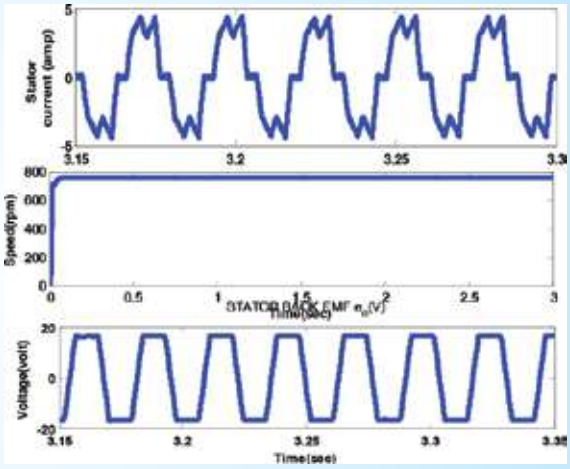
To design and simulate DC-DC converter fed BLDC motor drives

To design a control logic and controller for BLDC motor used in electric two wheeler.

To implement the BLDC motor drive for electric two wheeler applications.



Snapshot of the developed prototype



Motor current ,speed and voltage

ACHIEVEMENTS

The design and simulation of different DC-DC converters and three phase inverter fed BLDC motor drive Simulation of the system has been done and the results are analysed using MATLAB software. The design of the controller is also done to control the motor. Hardware implementation in the prototype model of the BLDC drive is also accomplished. The simulation and hardware results are in good agreement.

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

Design and Development of Nano Structured (Bio) Sensors for Smart Agriculture

Student
Akash M, Aravind R, Ganesh P
akashjack1212@gmail.com
aravindchellam676@gmail.com
pganesh3107@gmail.com

Guide
Vasantha Prasath N, *MIE*
vasanthanil@gmail.com

Institute
GRT Institute of Engineering and Technology, Chennai – Tirupathi National Highway, Tiruttani, Tiruvallur, Tamilnadu

Sensor Assembly without Samples (Soil)

Sensor Assembly with Samples (Paddy Soil)

OBJECTIVES

In this project, the nanostructured (bio) sensors have been developed to support smart agriculture. Smart agriculture involves multifarious approaches based on more energy-efficient and environmentally friendly cross-cutting technologies, including:

i) nanoformulation delivery systems to improve dispersion and wettability of nutrients/pesticides,

ii) Sensors for fertilizer /pesticide residue analysis of soil and crop, and

iii) Remote sensing, yield mapping, and positioning systems for crop growth/disease control.

ACHIEVEMENTS

In this project, we developed TiO_2 Nanotubes (50 nm) with different combinations like 100 % TiO_2, PAN- TiO_2 and PVA – TiO_2 to detect atrazine in soil and ZnO Nanocomposites with different combinations like 10% ZnO, 20% ZnO and 30% ZnO to detect Trichoderma.

> 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*

Design, Fabrication and Testing of a Hand Operated Cocoa Pod Breaker

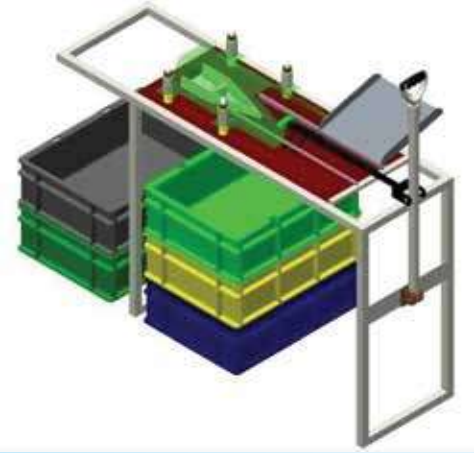
Student
Uday Ramu Pujari
Yeswanth Surya Teja Putta
Venkata Mahesh S
udayram7598@gmail.com
yaswanth.putta14@gmail.com
venkatamahesh55@gmail.com

Guide
Dr. R. B. Choudary, *MIE*
research@sasi.ac.in

Institute
Sasi Institute of Technology & Engineering, Tadepalligudem
Near Aerodrome, Kadakatla,
Tadepalligudem, West Godavari,
Andhra Pradesh
IM0004164

OBJECTIVES

An ergonomically designed cocoa pod breaker is developed. Unlike the conventional method where the worker has to be in squatting posture, the proposed model allows the worker to operate in standing posture. This eliminates posture related musculoskeletal problems. The farmers of small holdings can now perform depodding on their own thereby reducing labour charges.



CAD Model of hand operated cocoa pod breaker

Working prototype of cocoa pod breaker

ACHIEVEMENTS

An ergonomically designed cocoa pod breaker is developed. Unlike the conventional method, where the worker has to be in squatting posture, the proposed model allows the worker to operate in standing posture. This eliminates posture related musculoskeletal problems. The farmers of small holdings can now perform depodding on their own thereby reducing labour charges.

Study the Characteristics of Ionic Polymer Metal Composite (IPMC) as EMG Sensor

Student
Satwik Halder, Saheli Banerjee
Ankana Sadhu
satwikhalder.rcciit@gmail.com

Guide
Dr. Srijan Bhattacharya, *MIE*
srijaneie@gmail.com

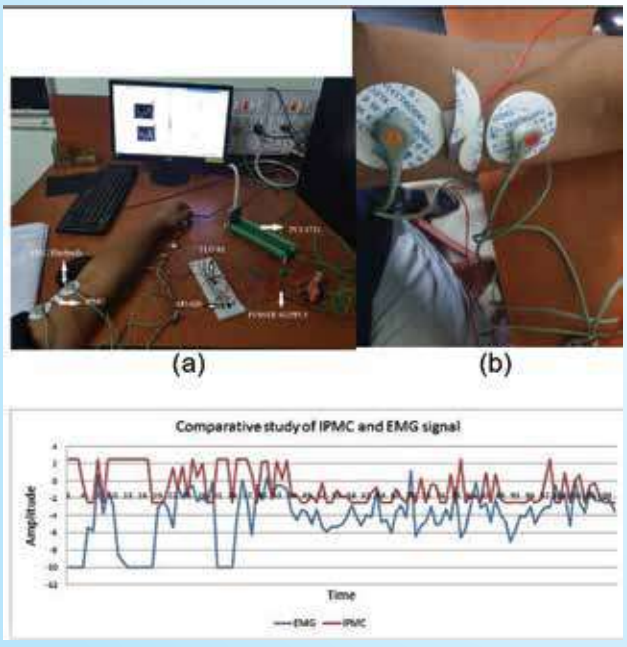
Institute
RCC Institute of Information Technology, Canal South Road, Beliaghata, Kolkata, West Bengal
IM0002854

OBJECTIVES

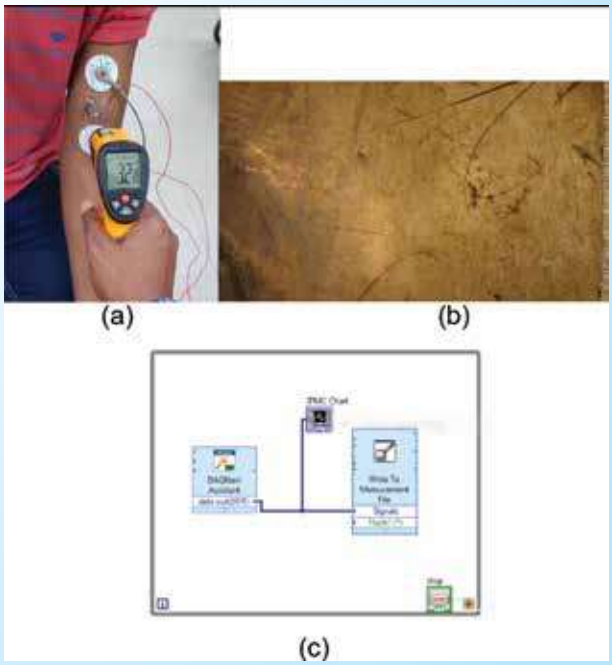
To study the characteristics of the IPMC strip as Electromyographic (EMG) Sensor.

ACHIEVEMENTS

The characteristics obtained from IPMC were found to be analogous to that obtained from EMG electrode. Thus, it can be inferred from the above observation that IPMC, here, behaves as a sensor thus detecting the electrochemical signal produced during muscle movement. The different magnitude of voltage generated due to varying amount of applied pressure is detected by the IPMC strip. Since here it behaves as a pressure sensor, the magnitude and pattern of the characteristics can be further studied individually for different objects.



(a) Experimental Setup (b) IPMC placed in arm (c) Comparative study of IPMC and EMG signal



(a)Temperature increased during muscle activity (b) IPMC surface after actuation (c) Lab view used for data logging

Compact Compression Open Mould Setup for Composite Product Development

Student
P. Jayagovindaraju
jayagovindraju@gmail.com

Guide
Dr. Sasikumar, *FIE*
director_research@selvamtech.edu.in

Institute
Selvam College of Technology
Salem Road (NH-7)
Pappinaichenpatti Post, Namakkal,
Tamilnadu
IM0004911

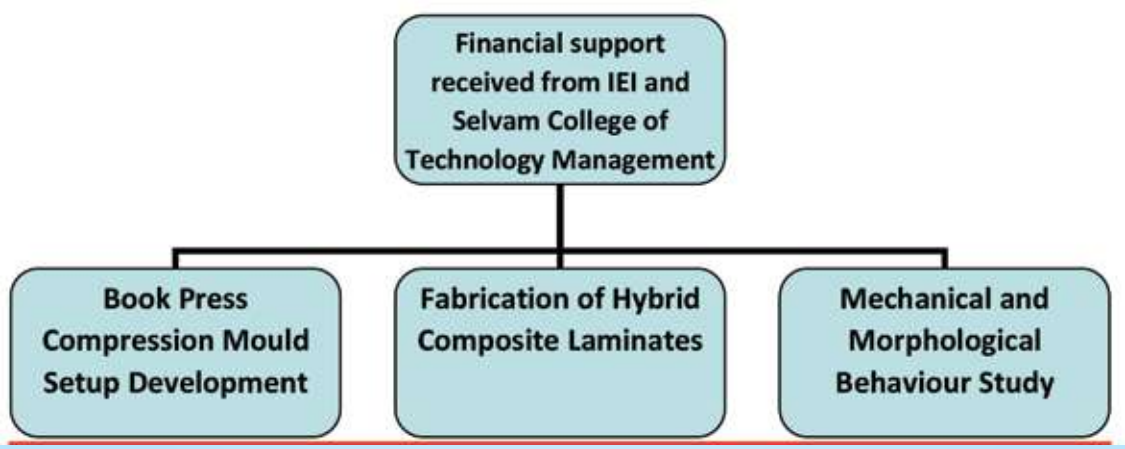
OBJECTIVES

The main objective of the proposed project is to fabricate specialized Open mould compression machine to prepare unique hybrid composite products. There are numerous methods for fabricating composite components such as Resin infusion processes, Vacuum-assisted resin transfer moulding (VARTM), Resin film infusion (RFI), Book press moulding, Injection moulding, Automated fibre placement (AFP), Automated tape laying (ATL) and Centrifugal casting. Even though, these methods are used to prepare advanced composites to meet specific design or manufacturing challenges. In most of the engineering fields still uses traditional hand layup method due to high fabrication cost involved in setting up the advanced processing equipments setup.

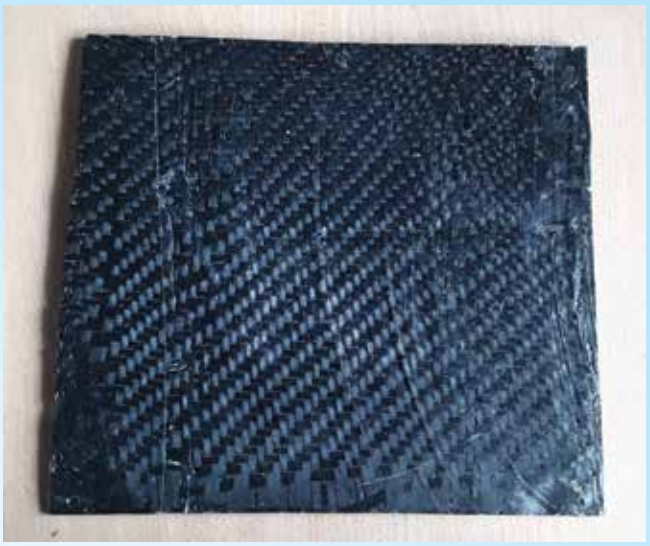
Hand layup is one of the most basic fabrication method of thermoset composites. It is an open mould method suitable for making a wide variety of composites products from very small to large. Our proposed setup provides a low cost platform for open molding or mutated hand layup process which typically consists of provision where the layer of composite fibre fabric is spreaded with Epoxy resin (Resin hardener mixture 3:1) by hand to form a laminate stack. The gel coated laminates were compressed by varying load depends upon the size and thickness of the laminate.

Several curing methods are available. The most basic is to allow cure at room temperature. Cure can be accelerated, however, by applying heat, typically with an oven, and pressure, by means of a vacuum. After curing process the composite laminate or product put up with various testing processes to study its mechanical behaviour. The book press molding machine mainly simplifies the fibre laminate production process and suitable for preparing small fibre reinforced composites.

ACHIEVEMENTS



Compact book press compression mould setup



Fabricated hybrid fiber laminate

PUBLICATION

M.S. Santhosh, T. Thangavel, R. Sasikumar, M. Vignesh, M. Vishnu, M. Vinu, V.T. Vinvath Ragav. "Mechanical Behaviour of Aluminium Powder Modified Carbon/Basalt Reinforced Vinyl Ester Composites, IOSR Journal of Polymer and Textile Engineering (IOSR-JPTE), Volume 6, Issue 1, PP 52-58, 2019.

Legacy of IEI

Shri Pranab Mukhejee, President of India, in the inaugural programme of the 28th Indian Engineering Congress at Chennai in 2013

Design and Fabrication of Low Cost Die Set Up Assembly for Superplastic Forming of Light Alloys

Student

Aluru Vamsi Krishna
Poreddy Rakesh Reddy
Tungenwar Prashanth
vamsi.aluru98@gmail.com
rakeshpr365@gmail.com
prasant.tungenwar@gmail.com

Guide

Dr J Kandasamy, *MIE*
professorkandan@gmail.com

Institute

MaturiVenkataSubba Rao
Engineering College
Nadergul Village, BalapurMandal,
Hyderabad, Telangana.
IM0005136

OBJECTIVES

To fabricate a low cost experimental set up for superplastic forming of light alloys

To perform finite element analysis to generate a pressure-time curve for maintaining a constant strain rate throughout the superplastic forming process of Sn-Pb alloy sheet into a cylindrical die.

To observe the thickness variation of the sheet due to the generated pressure-time curve in finite element simulation for different L/D ratios viz., 0.25, 0.5,0.75 and 1

To check the agreement of the thickness variation of the sheet obtained from the finite-element model with the experimental investigations.

Low cost Experimental Die Set Up Assembly for Superplastic forming of Light Alloys

ACHIEVEMENTS

In this project, a low cost experimental set up is fabricated for superplastic forming of light alloys. A cylindrical die with three inserts and a self-locking air tight seal lid is manufactured. Experiments are conducted on Tin-Lead (Sn-Pb) alloy sheet in the cylindrical die by varying the depth of form. The argon gas is supplied onto the sheet to pressurize the sheet into the die cavity with constant strain rate. The sheet is deformed to take the shape of die under gas pressure. A finite element analysis software package is used to simulate the deformation of the sheet. Observation is made to evaluate the effect of process pressure on the thinning of the sheet metal during forming. The results from the FEA package are compared with those obtained from the experimental results.

Experimental Set Up and the Components formed

1. A low-cost experimental setup for superplastic forming of light alloys is fabricated successfully.
2. The new set up facilitates the understanding of forming behaviour of light alloys in gas forming.
3. The sheet thinning is found to be vary exponentially with increase in L/D ratio of the die in finite element simulation and observed to be in close agreement with experimental investigations.
4. The thickness distribution in the manufactured component is due to stick friction between the die and sheet leading to resistance in grain boundary sliding, and thus regular stretching of the surface.

Implementation of Waiter Robot using Arduino

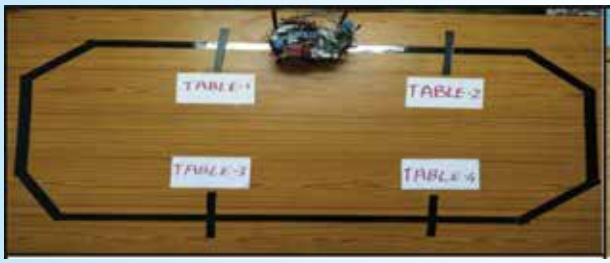
Student
G. Raja Vimal
rajavimalseelan98@gmail.com

Guide
Dr. K. Manimala, *FIE*
smonimala@gmail.com

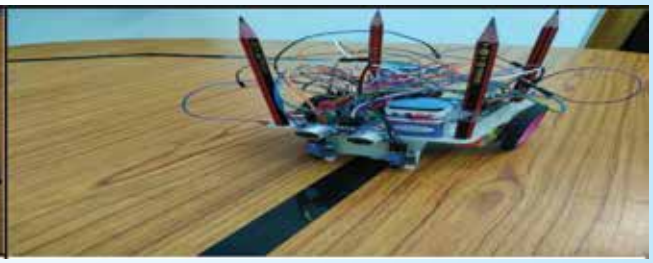
Institute
Dr. Sivanthi Aditanar College of Engineering, Ranimaharajapuram
Tiruchendur, Tuticorin
IM0000851

OBJECTIVES

- To design a cost effective embedded controller based robot.
- To design an intelligent robot that works effectively.
- To design a robot suitable for hotels, homes etc.
- To reduce manpower.
- To increase the accuracy of work by reducing human errors.



Working Model



Building the robot

ACHIEVEMENTS

The waiter robot is based on line following technique using IR sensor and it follows the path from kitchen to the customer's table. If any obstacle comes in between the path, ultrasonic sensor will detect the obstacle and stopped the robot. It would be able to serve food items, move and navigate on its own along the marked path for serving the customers in hotels. The robot has been designed using Arduino processor to control the movements for providing efficient and clean and hygienic service in hotels.

PUBLICATION

National conference on Power Electronics and Power Systems PEPS '2K18' at Dr.Sivanthi Aditanar College of Engineering on 15.02.'19

Experimental Analysis, Evaluation and Optimization of Friction Welding Parameters on EN 353 Alloy

Student
A. Rakesh, W. Robinson
C. Naveen
rakesh.angaraj@gmail.com

Guide
Dr. N. Baskar, *MIE*
baskarnaresh@yahoo.com
Mr. S. Karthikeyan, *AMIE*

Institute
Saranathan College of Engineering
Venkateswara Nagar, Panjappur,
Tiruchirappalli
IM-0002447

OBJECTIVES

Welding is a hazardous undertaking and precautions are required to avoid burns, electric shock, vision damage, inhalation of poisonous gases and fumes, and exposure to intense ultraviolet radiation. Solid-state welding processes provide an excellent alternative to fusion welding. Rotary friction welding is a solid state joining process, where the required heat is generated by friction between the joining specimens.

The main intention of this experimental investigation is to increase the productivity, improve the quality of the welded joints to a higher level, to reduce the production cost and to fulfill the customer expectations in industries. Welding the similar specimen of EN 353 alloy steel based on the various input process parameters like heating pressure, heating time, upset pressure, upset time, rotational speed and chemical composition of the test specimen using friction welding process. The welding is carried out in the friction welding machine and the tests are conducted to get the output responses like axial shortening, hardness and temperature in the traditional machines and the results are tabulated to find the better optimal values.

The obtained results are then optimized using Taguchi Design of Experiments (DoE) to set the optimal input process parameters as well as gives better result for this experimental work.

The following objectives are considered in this investigation.

- To increase the productivity by reducing the welding time, welding cost, to improve the quality of the joints and to fulfill customer expectations in metal joining process.
- Based on literature survey, the input process parameters like heating pressure, heating time, upset pressure, upset time, rotational speed and chemical composition of the test specimen are considered in this experiment.
- To maximize output responses like axial shortening, hardness, temperature and to improve the quality of the welded joints.

KUKA - Friction welding machine

Specimen before welding

Specimen after welding

- To optimize the friction welding parameters using Design of Experiment (DoE) approach optimized results will be validated and recommended to welding industries.

ACHIEVEMENTS

According to the literature review, an experimental investigation was carried out to improve the quality of the welded specimen and to reduce time and cost. The input process parameters considered for the experimental investigations were weight, heating pressure, heating time, upset pressure, upset time, rotational speed and temperature. The output responses selected were axial shortening, hardness, and temperature produced during welding. The literature assessment on the friction welding process was crucial to study the effect of process parameters on the welding strength and quality of the welded specimen. In this experimental research work, EN 353 alloy steel was used for friction welding process. Combination of similar metal was tried in this experimental work. The main scope of this project is explained briefly.

- Based on literature survey, L27 orthogonal array was selected for the experimental investigation.
- Friction welding about 27 welding joints were made based on different input process parameters and the results were tabulated for the investigation.
- To investigate the effect of mechanical properties like axial shortening, hardness, temperature and to analyze the results from the experimental investigation to validate the experimental outputs.
- Application of Design of Experiment (DoE) was used to develop a mathematical relationship between the welding process parameters and the output variables.
- These investigational studies helps in the applications of EN 353 alloy steel in the field of Automobile for manufacturing camshaft, gears, gudgeon pin, shafts, pinions and other parts.
- In this research work, welding, testing, optimizing and analyzing the results on EN 353 was done successfully using the friction welding machine and other testing machines. The research findings help in the identification of optimal input process parameters for EN 353 alloy steel and its applications.

Friction welding process was carried out in KUKA continuous drive friction welding machine in WRI, Trichy on EN 353 alloy material based on the selected input process parameters. Before joining the material, weight, length and hardness of the specimen, was noted and the specimens were machined properly to the required dimension using the lathe machine. The joining surfaces were cleaned properly to remove unwanted dust. During the friction welding process, the heat produced between the interface was measured using the temperature gun. The obtained values were tabulated to calculate the optimal process parameters of the welded joints. The joints were then measured for its axial shortening using digital vernier caliper, hardness in the joint using Rockwell Hardness machine and temperature using the temperature gun. The axial shortening, hardness tests were carried out using the mechanical equipments available in our college.

- Taguchi design of experiment was effectively used in this investigation.
- Heating time plays a major role in the friction welded joints.
- The optimal level of axial shortening for this experimental work was heating pressure of 25 bar, heating time of 7 sec, upset pressure of 35 bar and upset time of 5sec.
- The effective optimal parameter for the experimental investigation of the temperature was 25 bar of heating pressure, heating time of 7 sec, 29 bar of upset pressure and 3 sec of upset time.
- The optimal level of hardness for the investigation was 12 bar of heating pressure, 3 sec of heating time, 29 bar of upset pressure and 3 sec.

Based on the experimental work, axial shortening, hardness and temperature were considered for the output responses. During the friction welding process the quality and strength of the welded joint based on

the input process parameters were improved. This experimental work was very precious for the researchers to develop the ability of the friction welding on EN 353 specimen which was essential for the modern development in the engineering industry.

PUBLICATION

- Best paper award – Paper presentation in National level Conference on "Cutting Edge technologies in Electrical, Communication and Soft Computing techniques" (NCCEECS'19) organized by Saranathan College of Engineering, Trichy on 14 March 2019.
- Paper presentation in International Conference on "Recent Trends in Nanomaterials for Energy, Environmental and Engineering" (ICONEEEA-2K19) organized by K.Ramakrishnan College of Technology, Trichy during 14-15 March 2019.

Legacy of IEI

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

Microbial Fuel Cell Based Large Scale Sustainable Energy with Waste Management

Student
Rishabh Mrinal
Nair Anirudh Murali
mrinalrishabh.2143@gmail.com

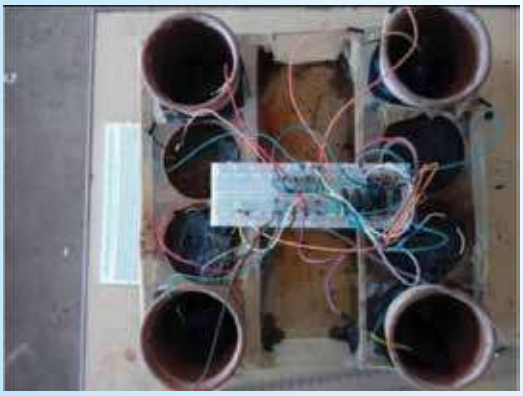
Guide
Dr. J. Divyanavamani, *MIE*
divyanavamani.j@ktr.srmuniv.ac.in

Institute
SRMIST
SRM Nagar, Potheri,
Kancheepuram Dist.
IM0000452

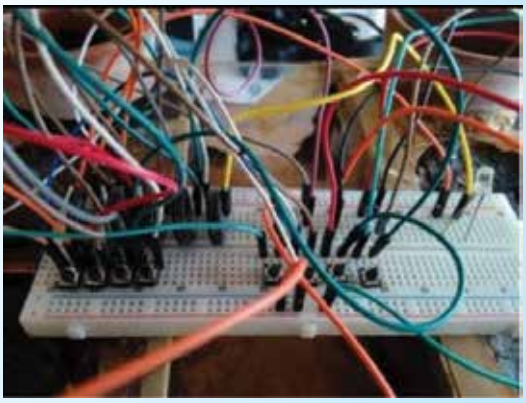
OBJECTIVES

This project was selected to utilize the concept of microbial fuel cell for the place where wastewater is directly dumped into the river creating a polluting environment affecting both soil and water,leaving the area as a wasteland. This project uses the concept of microbial fuel cell to generate electricity from this wasteland making it a valuable resourceful place in terms of power production. Objectives can be stated as

- To use ceramic and soil based MFC in that area as one system
- To make cost effective System
- To develop harnessing circuit so that power can be tapped efficiently



Array of Microbial Fuel cells



Capacitive circuit

ACHIEVEMENTS

The project has achieved in building a economically feasible MFC, along with the construction a new electrical harvesting circuit. It also aims at processing liquid waste, as part of the procedure involved in generating electrical power. The project offers new application scheme for MFC technology that have not been attended yet.

IoT based Adaptive Distance Protection Scheme for PMU Deployed Smart Grid with Hybrid Wind-Solar DGs

Student

Praveen Kumar R, Raghavi R
Varsha V
pravinkumar14021998@gmail.com
raghavi031097@gmail.com
varshavenkat797@gmail.com

Guide

Dr. S G Bharathi Dasan, *MIE*
bharathi@svce.ac.in

Institute

Sri Venkateswara College of Engineering, Penallur, Sriperumbudur TK, Tamilnadu
IM0001114

OBJECTIVES

The objective of this project is to integrate the Renewable Energy Systems in a 9 bus power system system with Adaptive Distance Protection Scheme deploying PMU and to test this environment in emulated prototype using IOT.

Among different sources of alternate energy, wind and solar are two prominent and promising alternatives to meet the future electricity needs for mankind. Generally, these sources are integrated at the distribution utilities to supply the local distribution customers. If the power generated by these sources is bulk, then they are either integrated at the distribution/transmission level or may be operated in an island mode if feasible. The integration

of these renewables in the power network will change the fault level and network topologies. Existing protection schemes may fail to operate because of their pre-set condition. For a large number of integrated renewable, it is manually not feasible to set the reach of each distance relay for different renewable infeeds. The proposed algorithm thus succeeds in achieving the desired distance relay operation in the presence of renewable energy sources like hybrid wind-solar DGs. The impact of infeed is eliminated by effectively utilizing the technologies like IoT, Phasor Measurement Units (PMU), etc that are readily available in smart grids.

ACHIEVEMENTS

1. Simulink/Matlab model of the Hybrid Wind-Solar DGs is developed and various outputs parameters are analyzed.
2. Simulation of the protection scheme with Hybrid Wind-PV DGs using MATLAB simulink in a smart grid environment is performed.
3. Hardware prototype developed such that output of Phasor Measurement Units of two buses (distance relay Incorporated) can be stored and retrieved from cloud though IOT based communication network.
4. In this hardware implementation Raspberry Pi 3 processor and raspbian software is used to test the emulated prototype.
5. Adaptive Distance Protection Scheme is simulated for Hybrid Wind-PV DGs and results are verified through hard ware prototype.
6. The results obtained from both simulation and hardware setup are satisfactory.

PUBLICATION

Presented at National Conference on Advances in Electrical and Electronics Engineering (NCAEEE – 2019), 29th March.

Legacy of IEI

Pandit Jawaharlal Nehru, First Prime Minister of India, during the Annual Meeting of Central India Centre of IEI in 1950

Pool Boiling Analysis of Water Over a Horizontal Copper Tube Heater

Student
U. Poongundran
kani.poongundran@gmail.com

Guide
Dr. M. Mohamed Sitheeq, *FIE*
msitheeq@gmail.com

Institute
Mohamed Sathak A J Col. Of Engg
Egatur, Sirusei IT Park, Chennai

OBJECTIVES

The purpose of this study is to analyse the pool boiling phenomenon of water over a horizontal copper tube heater of 28mm diameter. The experiment has been carried out to observe the bubble growth and bubble departure characteristics for the heat flux range of 1000-42,000 W/m^2. The entire process was recorded by a digital camera at different time intervals. The images have been converted into AUTO CAD drawings to measure the bubble dimensions. The measured parameters have been used to determine the initial layer thickness,macro layer thickness and critical heat flux and validated with models proposed in the literatures.

Experimental setup

ACHIEVEMENTS

We obtained the values of Initial layer thickness, Macro layer thickness and CHF by calculation. Also we observed that the value of CHF increases as the base fluid temperature increases. The maximum value and its range for our experiment is summarised as follows:

- Initial macro layer thickness increases as the base fluid temperature increases.
- The values of macro layer thickness and initial layer thickness gradually increases and drops at certain point and then gradually increases till the nucleation site.
- The contact angle has 5% error in the experimental data.
- The bubble departure diameter has 10% error in the experimental data.
- The critical heat flux has 8% error in the experimental data.
- The initial layer thickness has 10% error in the experimental data.
- The experimental value of the CHF, initial layer thickness and macrolayer thickness of water was found to have a good agreement with Rajvanshi models.

Photo: bubble formation after 22:42 mins at Tw = 94^{O}C and q=32035.67W/m^2

PUBLICATION

Paper presented in National Conference on Advances in Mechanical engineering, NME2015, Anna University, Tirunelveli Region.

IoT based Power Management and Condition Monitoring in Microgrid

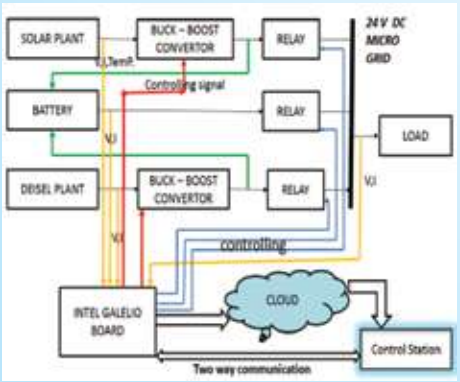
Student
Mr. N. Sivan Kumar
sivankumar93@gmail.com

Guide
Dr. V. Agnes Idhay Selvi
agnesvelusamy@gmail.com
Mr. M. Karuppasamypandiyan
pandi1081@gmail.com

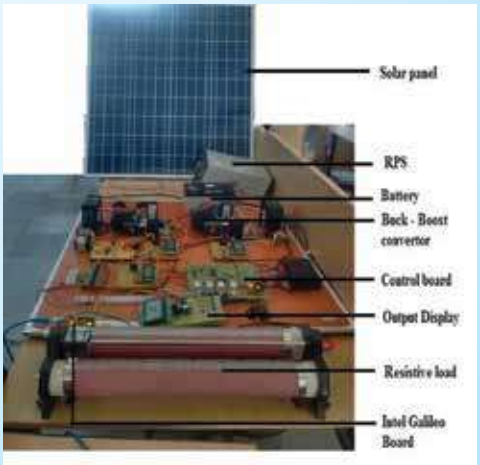
Institute
Kalasalingam Academy of Research and Education
Anand Nagar, Krishnankoil
IM0004135

OBJECTIVES

India has huge potential to generate power from renewable sources, but still most of the regions are denied to use renewable sources due to its poor reliability. This problem can be resolved by micro grid, integrating several renewable sources, as a main source for that particular region. A smart condition monitoring system and power management is essential to maintain the system reliability. Condition monitoring is the process that collects the various electrical parameters and analyse the performance of the system or its components such that remedial action may be planned in a smart manner. In this planned work, an Internet of Things (IoT) based condition monitoring system is developed for standalone micro grid. This standalone micro grid consists of solar, hybrid generator and battery. In this work, an IoT based Web Architecture was developed with intelligent controller to take optimal decisions for efficient power management of micro grid. A dedicated web page for remotely accessing the data was also developed for continuous access of production and usage of power, condition of loads, and availability of battery power, voltage and load power factor. The status of the system can be monitored online through this smart network. The fuzzy logic controller is developed to perform the control action on micro grid. This controller facilitates the management of distribution of loads by properly scheduling loads and source management by optimally utilizing the sources. The control actions are based on the total power both from generating units and battery storage, the load requirement and the battery status. The designed controller will facilitate as a communication channel between the sources and load to avoid the deep discharging of battery at heavy load condition and prevents the overcharging of battery at light load condition.



Block Diagram of Proposed System



Prototype of Microgrid setup for Power Management and Condition monitoring

ACHIEVEMENTS

A simulation of DC micro grid of 24V, has been built using a solar PV array, battery and diesel generator. Storage of the battery is obtained by utilising suitable converter which is connected at the output of the the renewable energy sources which produces 24 V. Maximum energy is tapped from PV panels by integrating MPPT algorithm. Diesel generator is operated based on the amount of renewable energy sources and the load demand. Contractors will be initiated to switch off diesel generator if the availability of energy is in excess. Standalone DC microgrid is balanced by proper design of fuzzy controller. The power management is simulated using MATLAB/Simulink. The status of the microgrid parameters is displayed and remotely monitored. The major achievements of the projects are:

- An Fuzzy based intelligent controller has been developed for energy management in microgrid.
- An Internet of Things (IoT) based condition monitoring system for standalone micro grid is developed.
- An IoT based Web Architecture with intelligent controller to take optimal decisions for efficient power management of micro grid is developed.

Website for monitoring Microgrid Parameters
Web page URL: http://iotakpds.do.am

- A dedicated web page for remotely accessing the data for monitoring the micro grid parameter. The status of the system is monitored online through this smart network. (Web page URL: http://iotakpds.do.am)

PUBLICATION

M.TECH Thesis:

- N.Sivan Kumar, "IoT Based Power Management and Condition monitoring in Microgrid", M.Tech thesis, May 2018, Kalasalingam Academy of research Education.

National Conference:

- Sivankumar N , Agnes Idhaya Selvi V , Karuppasamypandiyan M , "Power Management in Micro Grid Using Fuzzy Logic Control", Fifth National Conference Power and Energy Systems-NPES'18 organized by Department of EEE, KARE, March 2018

International Conference:

- Sivankumar N , Agnes Idhaya Selvi V, Dr.A.Ram Kumar, Karuppasamypandiyan M , "Condition Monitoring in Standalone Microgrid", International Conference on Power and Energy system, Jan,2018, pp.345-358, Vellamal college of engineering, Madurai,Tamil nadu.

Journal Publication:

- Sivankumar N,Agnes Idhaya Selvi V, Karuppasamypandiyan M,Sheela A"IoT Based Power Management and Condition Monitoring in Microgrid", Lectures Notes in Electrical Engineering, Springer. (Accepted for Publication) (SCOPUS INDEXED)

Production of Fuel Grade Products from Waste Plastic through Pyrolysis

Student
Bhatt Ritul Shailesh
ritulbhatt.29@gmail.com

Guide
Hemant Kumar Balsora, *AMIE*
hbalsorabhu@gmail.com
Kartik S, *MIE*
kartik521@gmail.com

Institute
Shroff S R Rotary Institute of Chemical Technology, Ankleshwar, Gujarat
IM0004210

OBJECTIVES

1. To study the decomposition kinetics of single and mixed plastics by thermo gravimetric analysis (TGA).
2. To apply the kinetic models for decomposition data for determination of kinetic parameters.
3. To study the thermal pyrolysis of single and mixed plastic feed (In designed, fabricated pyrolysis unit).

Pyrolysis unit designed and fabricated

Plastic Pyrolysis products

ACHIEVEMENTS

This work was initiated with an aim to fabricate a pyrolysis unit on which parametric studies can be carried out for evaluating the effect on yield of oil obtained from pyrolysis. The newly designed set up is capable to perform pyrolysis of plastics and biomass feedstock's. The fabricated set up can be subsequently utilized with an aim to carry out pyrolysis of waste generated from various point sources into fuel and other value added products. The investigator, Mr. Ritul Bhatt has successfully completed his research work as assigned by university. Investigator and guides are grateful to IEI for providing such grant for promoting and motivating research scholar in pursuing their higher education.

PUBLICATION

M.E. thesis"Studies on the Thermal Decomposition of Mixed Plastic".

Design and Implementation of PV MPPT Controller with DC-DC Converter used for Lighting in Remote Villages

Student
Ipsheeta Sahoo
ipsheeta.sahoo@gmail.com

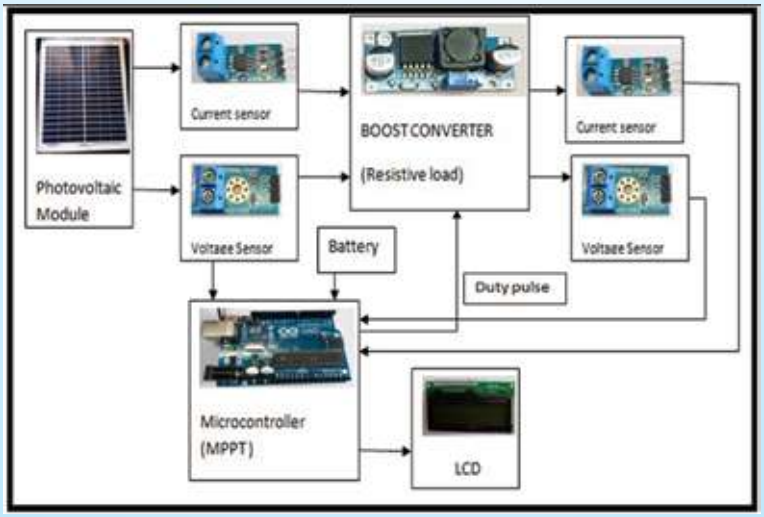
Guide
Dr. Bhagabat Panda, *MIE*
Dr. Babita Panda, *MIE*
pandababita18@gmail.com

Institute
KIIT deemed to be University
Patia, Bhubaneswar
Odisha
IM0001300

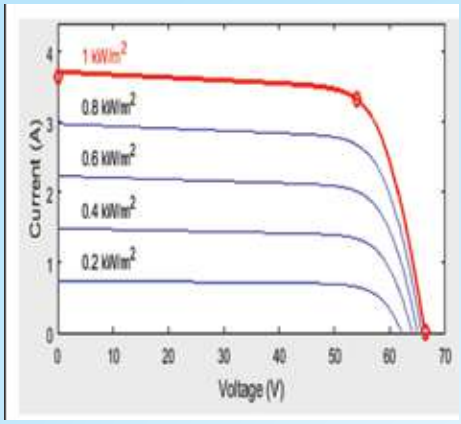
OBJECTIVES

1. Study and simulation of Photovoltaic system
2. Study and hardware implementation of MPPT controller
3. Study and simulation of DC- DC converter.
4. Study and simulation of DSPIC controller.
5. hardware implementation of proposed topology.

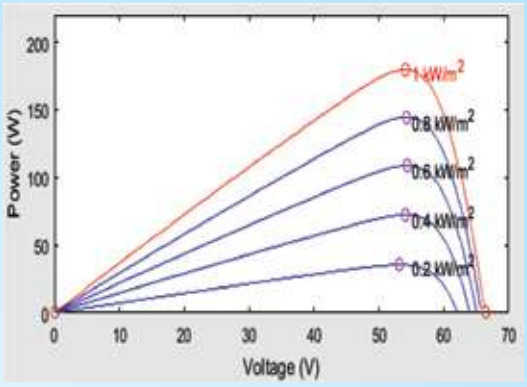
Increasing power demand drives the power analysts towards renewable sources like Photo Voltaic (PV).In order to commercialize and utilize the solar energy, power electronics interface is required. So,the conversion system should be efficient and can boost the input voltage as the Photovoltaic cell voltage is small. Maximum power point tracking (MPPT) is used in photovoltaic (PV) systems to maximize the PV array output power, irrespective of the temperature and irradiation conditions and the load electrical characteristics. DC-DC boost converter transfers maximum power from the solar PV system to the load and it acts as an interface between the load and the system. This topology has wide range of applications nowadays in various fields.



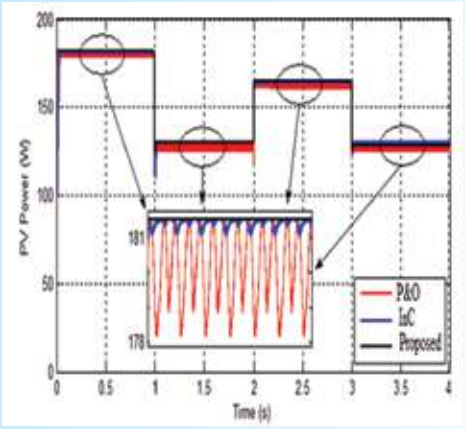
Block diagram representation of PV module connected with Boost converter



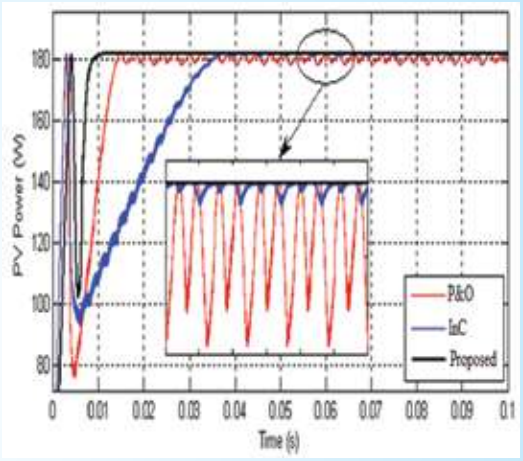
I-V curve of single PV module at various irradiance



P-V curve of single PV module at various irradiance



Comparison of PV output power for proposed, P&O and InC method



Dynamic response of PV output power using proposed, P&O and InC method

ACHIEVEMENTS

- This topology has wide range of application in irrigation and agricultural purposes also.
- Another extension of this project would be to directly power the microcontroller and other circuits from the solar panel instead of from a power supply.
- To incorporate a power supply into the system that draws energy from the solar panel or an energy storage element that is in turn charged by the solar panel. This extension would allow the system to be deployed to remote locations.
- Solar water pumping systems usually have DC or AC pumps. Yet another more useful system would be one that could directly power a DC or AC load. An additional DC-DC converter would be needed to supply a regulated DC signal.

PUBLICATION

- "Design And Implementation of PV MPPT Controller with DC-DC Converter" is submitted to Arabian Journal for Science and Engineering (AJSE).
- M.Tech Thesis named "Design and Implementation of PV MPPT Controller with DC-DC Converter" is submitted to KIIT University.

Automated Machine for Bio-Degradable Natural Fiber Extraction and Conditioning

Student
G. Soumya Sireesha
sirimech.eng@gmail.com

Guide
Dr. (Ms) Bhimana Madhavi, *FIE*
madhavimatlapudi72@gmail.com

Institute
Maturi Venkata Subba Rao
Engineering College
Nadergul, Balapur Mandal,
R. R. Dist., Hyderabad, Telangana
IM0005136

OBJECTIVES

Calotropis is a wildly growing shrub and its use as a source of excellent cellulose fibers is reported to have enormous economical implications. This fiber has enough potential for replacing or supplementing other fibrous raw materials as reinforcing agent.

The renewable aspect added with cheap availability makes Calotropis Procera (CP) economically and environmentally viable alternative sources of natural fibers that can replace some of the existing applications based on Fiber Glass (FG) in regard to applications in composites and form a key alternative, as standalone or a blend in many other new applications.

The issue with CP based natural fibers has been the traditional manual methods used for extraction that take extended periods of time for soaking, peeling that is laborious, slow and hence uneconomical from a commercial perspective.

Among other plant fibers, Calotropis is a fast growing plant with high potential yield per hectare. The plant has valuable fibers in the bast of stem accounted for about 75% cellulose, 4.0% lignin and 2.0% ash. Studies on Calotropis bast fibers and extraction methods have been minimal and there is limited information available on the effect of extraction methods.

Fabricated model of plant fiber extraction machine

Natural fiber extracted from the machine

Extraction of abundantly available Calotropis procera and other plant stems possessing rich natural fibers is a serious problem to be addressed by engineers. The aim of this project is to extract plant fibers at faster rate using automated machine. The objectives of the current research work are

1. Design and Fabrication of a device / equipment for extraction of the bio-degradable natural fibers based on Calotropis procera or any stem based plant rich in natural fibers.
2. To characterize the extracted fibers in terms of physical and mechanical properties suitable for composite preparation as per ASTM Standards.
3. To identify the suitable applications of Calotropis fibers based on the properties derived through characterization.

ACHIEVEMENTS

Natural fibers such as Calotropis procera, jute, Sisal offer such benefits as reductions in weight cost and CO_2 and the added benefit that these fiber sources are green or ecofriendly.

Studies on characteristics of Calotropis bast fibers are reported that are extracted manually. In traditional methods of extraction, the dried stems were retted for a period of 5 days and then the fibers were separated by hand. In another method the stems were debarked manually and then the fiber was extracted from using several alkali solvents.

Calotropis bast fibers conventionally are being extracted manually and the present invention aims at extracting the same with the machine designed that is scalable and cost effective.

In view of numerous advantages, natural fibers from Calotropis have been of great interest as it has many interesting applications in the industry. In order to exploit this renewable resource as natural fibers, the design and construction of a fiber extracting machine is undertaken; this works on the principle of mechanical forces.

Achievements of the current research:

1. Calotropis stems are slightly toxic in nature and is not safe to extract fibers through manual mode. However, the fibers of the plant are highly useful for certain engineering applications. Hence automating the extraction of theses fibers through plant fiber extraction machine is good achievement.
2. Mechanization of fiber extraction process as drastically reduced the time consumed for producing the fibers.
3. Preparation of laminate with thermos plastic polymers is an indication of product developments using natural fibers.
4. Synthetic fiber like E glass is non decomposable material whereas the natural fiber is a bio-degradable material and hence can be replaced in engineering application where low strength capable structure are utilized.
5. Natural fiber composites have been embraced by car manufacturers and suppliers for door panels, package trays and dash boards.

PUBLICATION

Patent copyright is filed related to the research work and the application for patent numbered 201741040315 dated 12-11-2017.

The current research work is submitted to patent office to obtain full patent.

A paper will be sent to IEI – Springer Journal after obtaining the patent.

A Novel Wireless Smart Shoe System for Gait Analysis in Older Adult

Student
AATHIRA N. A.
aathirana93@gmail.com

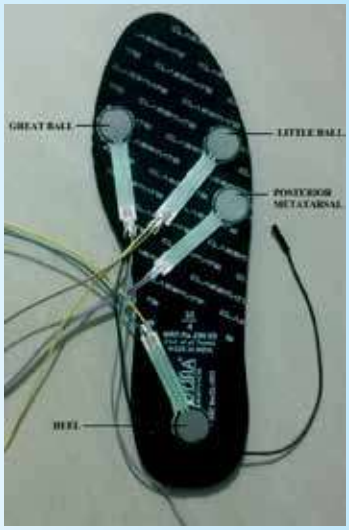
Guide
ASHITHA P. R., *AMIE*
ashitha.p.r@vidyaacademy.ac.in

Institute
Vidya Academy of Science and Technology, Thalakkottukara
Thrissur, Kerala
IM0001408

OBJECTIVES

The general objective of the project is to Develop a multisensory system that investigates walking patterns to predict a cautious gait in older adults. It can be further divided into following objectives:

- Develop a smart shoe-based gait detection system to measure the pressure distribution of foot for analysis of human locomotion patterns.
- Develop a Wi-Fi based network for the communication between the smart phone and smart shoe.
- Propose a signal classification technique to identify any abnormality in users' gait patterns.
- Design a system that monitors the status of older adults in real time and sends the information to a caregiver or loved one.

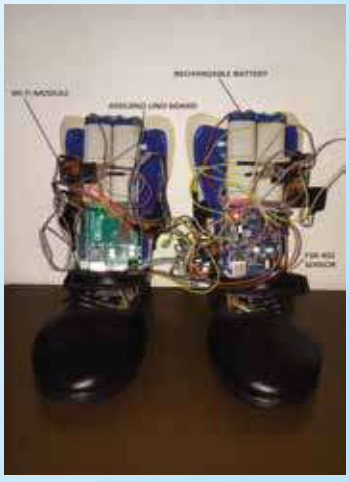


Sensors attachment to the shoe with anatomical locations

ACHIEVEMENTS

A wireless system is developed to analyze gait using smart shoe-worn sensors through a real-time detection of abnormality in users' gait patterns. The shoes are able to measure the pressure distributions of foot and send such information to a smart phone through a wireless network. Four piezo-resistive pressure sensors were placed in different locations on the insole of the shoe which continuously measured the pressure values. The measured values were then transmitted to the smart phone for further processing through a wireless network. The application developed in the smart phone analyze the data based on the specified algorithms and classifies it into normal walking, stiff leg discrepancy, or leg length discrepancy.

The developed system could analyze the gait of an older adult by measuring the foot pressure distribution and able to recognize and also provide alert mechanisms to the older adult whenever a cautious gait happens. It also provide alert message regarding the abnormal walking condition of older one to the caregivers and doctors. The developed system is cost effective, portable and able to collect the real time data for classification purpose. It can also be used in outer environment other than a lab set up.



Hardware setup of the proposed system

PUBLICATION

Aathira N. A. and Ashitha P. R. (2018) A Novel Wireless Smart Shoe System for Gait Analysis in Older Adults, International Journal of Engineering Sciences & Research Technology (IJESRT), 29-32.

Experimental Investigation on Solar Hybrid Heatrier System

Student
Aravind Kannan S
aravindkannan1997@gmail.com

Guide
Sridharan M, *AMIE*
sridhudhiya@gmail.com

Institute
Saranathan College of Engineering
Venkateswara Nagar,
Trichy-Madurai Main Road (NH 45 B),
Panjappur, Thiruchirappalli
IM-0002447

OBJECTIVES

To design a solar heatrier system: Primary objective of this work is to design a solar heatrier system, a hybrid device which combines working principle of stand-alone solar water heater and solar dryer is termed as solar heatrier system. It occupies a less space in comparison with stand-alone dryer and water heater. Design of such heatrier system includes both heating and drying parameters.

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 with mass flow rates of 0.5 kg/min.

To enhance heat transfer rate naturally by geometrical modifications: Increasing rate of heat transfer between heat transfer fluid and hot surface is directly proportional to increase in performance of heatrier system. In order to improve rate of heat transfer Mohammad omidi, *et.al* suggested geometrical modifications and usage of core materials with high thermal conductivity.

To formulate ANN Model: In order to predict performance of solar heartier system, the study proposed a artificial neural network (ANN) model which is capable of predicting performance more accurately.

Schematic view of experimental setup with as a dryer unit

Schematic view of experimental setup with as a heatrier unit

To formulate GRNN Model: In order to predict performance of solar heartier system, this study proposed a generalized regression neural network (GRNN) model which is capable of predicting performance more accurately than ANN.

ACHIEVEMENTS

- A real time solar hybrid heartier kit for UG and PG students
- Competitive heat transfer rate in comparison with stand-alone systems
- Area occupied is half that of area occupied by stand-alone systems
- Cost of this solar hybrid heartier kit is 60% of the stand-alone systems
- First ANN and GRNN model for predicting solar dryer performance is developed.

PUBLICATION

1. A research article titled "Application of Generalized Neural Network (GRNN) for the Performance Prediction in Natural Convection Solar Dryer", to Journal of The Institution of Engineers (India): Series C, The submission Id is: IEIC-D-19-00194.
2. A research article titled "Verification and Validation of Natural Convection Solar Dryer Performance Using Internet of Things", to Journal of Verification, Validation and Uncertainty Quantification, the submission Id is: VVUQ-19-1018.

Legacy of IEI

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

Analysis of Heavy Metal Concentration in Soil using Remote Sensing Data

Student
P. Anusha
anushakutty69@gmail.com

Guide
Dr. G. Wiselin Jiji, *FIE*
jijivevin@yahoo.co.in

Institute
Dr. Sivanthi Aditanar College of Engineering, Tiruchendur, Thoothukudi District, Tamilnadu.
IM0000851

OBJECTIVES

- To identify the heavy metal concentration in soil using spectral mixture analysis.
- To analyse the percentage of heavy metal concentration in soil.
- Based on concentration, we will classify soil into highly polluted / moderately polluted / not polluted.

ACHIEVEMENTS

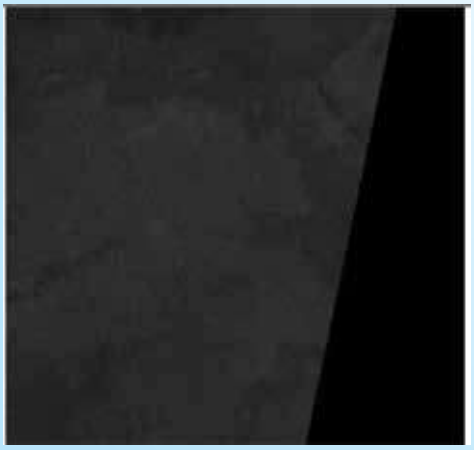
a. We have carried out soil and water pollution analysis of Tiruppur district – promising results obtained.

b. Communicated research outcomes in Journals.

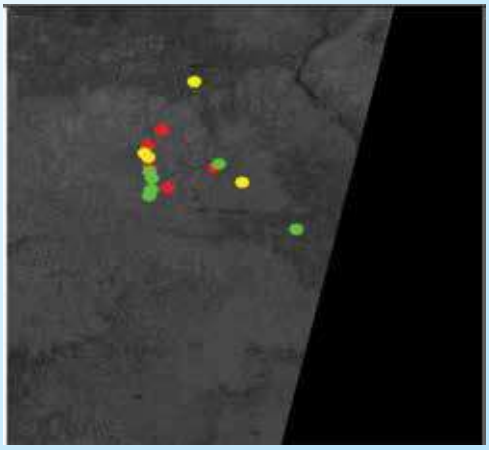
c. Research articles are published in reputed journals and conferences.

PUBLICATION

1. "Exploration of Heavy metal concentration in soil using Regression Analysis" in SSRG International Journal of Civil Engineering(SSRG-IJCE)- Special Issue ICTER Mar 2019.
2. "Analysis of Soil pollution in Tiruppur District using Image Processing" in International Conference on Networks, Image and Security(ICNIS-2019), NICHE.
3. "Exploration of Heavy metal concentration in soil using Regression Analysis" in International Conference on Trending Technologies in Engineering Research (ICTER-2019), Mangayarkarasi college of Engineering, Madurai.



Input image of Tiruppur district taken from LANDSAT 8 (Band 4 - Red)



Heavy metal Concentration Levels (Red-Highly polluted, Yellow-Moderately polluted, Green-Not polluted)

Effect of Additives on Germanium Chemical Mechanical Planarization Slurries

Student
Apeksha Gupta
apekshagupta2014@gmail.com

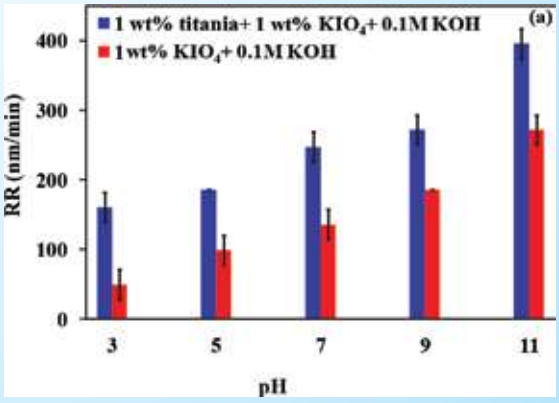
Guide
Dr. R. Manivannan, *AMIE*
rmani.che@nitrr.ac.in

Institute
National Institute of Technology Raipur
G. E. Road, Raipur, Chhattisgarh
IM0005373

OBJECTIVES

The main objective of this work is to identify a suitable additive and to formulate slurry for chemical mechanical planarization (CMP) of germanium (Ge). The slurry should provide a reasonable removal rate for Ge. Additives will also be chosen based on its potentiality to form complexes with germanium or by oxidizing the Ge surface. Abrasive in the slurry will be varied for the polishing experiments. Oxidizing agent is chosen in such a way that it can oxidize the Ge surface. Oxidizing agents such as hydrogen peroxide or persulfate can be used for study. In addition, surfactant may be added to improve the quality of Ge surface. Germanium surface after CMP should have better surface quality. Hence, surfactants such as sodium dodecyl sulfate, cetyl trimethyl ammonium bromide, Triton-X etc., may be added to the slurry formulation. CMP removal rates strongly depend on the pH of the slurry. To optimize the slurry composition polishing experiments will be performed by varying the pH of the slurry. Dissolution rate study will also be performed to understand the chemical kinetics. To study the effect of operating parameters such as concentration of abrasive, slurry pH, surfactant and oxidizing agent will be varied in the slurry for the polishing experiments. In addition to the polishing experiments, the germanium surface will be characterized by scanning electron microscopy (SEM). Abrasive particle morphology will be captured using transmission electron microscopy (TEM). A suitable mechanism will be proposed based on the above studies for Ge removal rate.

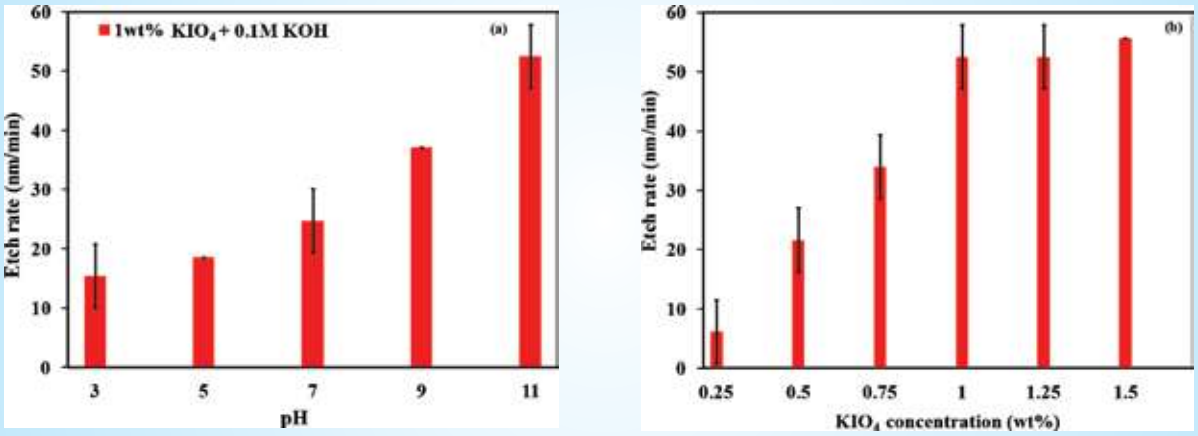
Germanium Ingot, 99.999% purity, 1 in. diameter and 0.5 in. Tall



Effect of pH on Ge RR with and without 1 wt% titania

ACHIEVEMENTS

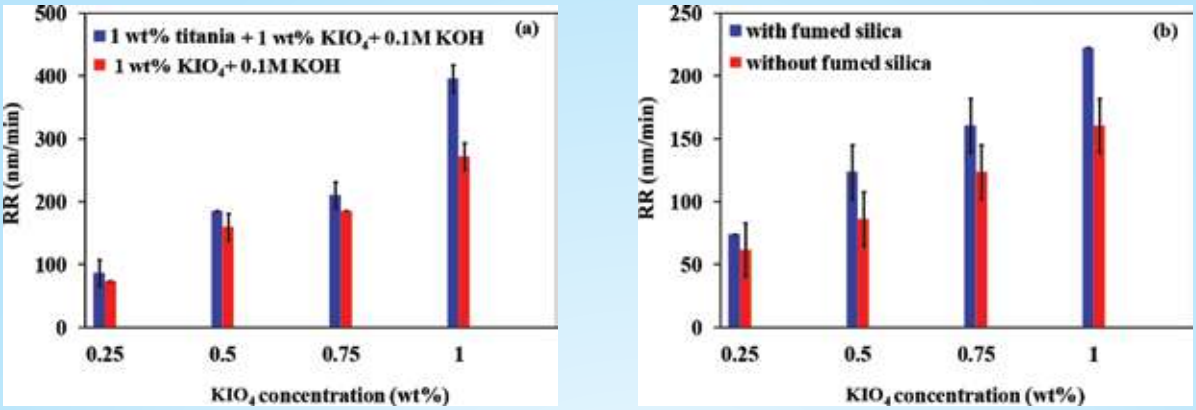
99.999% pure germanium ingot of dimension 1" x 0.5" was purchased. A comprehensive literature survey about the slurry formulation for germanium chemical mechanical planarization was performed. Based on the literature survey, promising chemicals were identified and procured. Static etch rate (ER) of germanium using additive potassium periodate was conducted by immersing the disc in particular solution by varying pH. According to literature, potassium periodate has very low solubility of 0.42 g/100 ml of water at 20˚C, which can be enhanced with the addition of KOH in the solution. Based on initial screening experiments and reactive chemistry with Ge, etchant solution of 1 wt% KIO_4 was selected to perform dissolution study. To increase the solubility of KIO_4 in deionized water 0.1M KOH was added in the etchant solution. Static etch rate of Ge was performed by varying pH and concentration of solution. It can be clearly seen that the etch rate greatly depends on pH of etchant solution (1wt% KIO_4 + 0.1M KOH). With increasing pH the ER showed an increasing trend. Ge ER was found to increases from ~15 nm/min to ~52 nm/min when the pH of etchant solution was increased from 3 to 11, shown in Fig.1a. Effect of ER by varying concentration is shown in Fig.1b. Saturation of Ge ER beyond 1 wt% of KIO_4 concentration may be attributed to the limitation of Ge surface available for oxidation. KIO_4 concentration of 1 wt% with 0.1M KOH was selected for further study, as there was no significant increase in Ge ER beyond 1 wt% KIO_4 concentration.



Effect of ;(1a) pH (1b) KIO_4 concentration on etch rate of germanium

Polishing experiments was performed to select the process conditions. Ge was polished using two different abrasives, anatase titania and fumed silica in the presence and absence of potassium periodate and removal rate (RR) of germanium was investigated. The solubility of KIO_4 is enhanced by addition of 0.1M KOH in the solution. Ge RR was found to be zero when polished with 1 wt% anatase titania or 3 wt% fumed silica over the pH. It can be seen that the Ge RR increases with KIO_4 concentration, Fig. 2a and Fig. 2b. The increase in Ge RR with KIO_4 concentration is due to the increase in oxidation of germanium. As the concentration of KIO_4 increases, Ge surface oxidizes rapidly to form GeO_2 and subsequently resulted in the formation of soluble species. Ge RR was found to be higher in presence of 1 wt% titania with 1 wt % KIO_4 + 0.1M KOH solution, ~86 nm/min. to ~395 nm/min with increasing concentration (Fig 2a). Whereas in the presence of 3 wt% fumed silica, Ge RR was found to increase from ~74 nm/min to ~222 nm/min with KIO_4 concentration increasing from 0.25 wt% to 1 wt% respectively (Fig.2b). The increase in the RR with the addition of abrasive could be due to the synergetic effect of chemical etching and free abrasive polishing.

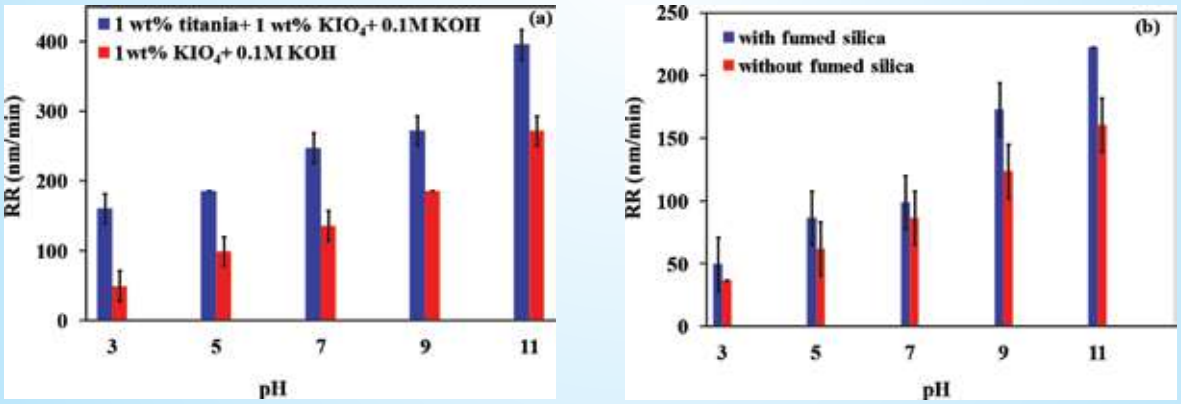
Polishing experiments were conducted at different pH. The effect of pH on Ge RR is shown in Fig.3a and 3b. It can be seen that as the pH increases from 3 to 11, the Ge RR also increases from ~160 nm/min to ~395 nm/



Effect of KIO_4 concentration on Ge RR with and without; 2 (a) 1 wt% titania (b) 3 wt% fumed silica at pH

min for the Ge coupons polished using 1 wt% titania + 1 wt% KIO_4 + 0.1 M KOH solution Whereas, in the presence of 3 wt% fumed silica with 1 wt% KIO_4 + 0.1 M KOH slurry, Ge removal rate was found to be ~49 nm/min at pH 3 and ~222 nm/min at pH 11, shown in Fig 3b.

The dependency of Ge RR on KIO_4 concentration, pH of the slurry, turntable speed and down pressure was also studied. There was a noticeable increase in the Ge MRR over Ge ER for the same KIO_4 concentration and at same pH. This is due to the synergetic effect of chemical etching and free abrasive polishing. The higher removal in alkaline region can be attributed to the availability of - 4 IO and - 3 IO ions with increasing pH, subsequently Ge oxidized to form germanium dioxide (GeO_2) followed by formation of easily soluble Ge species. With increase in platen rotational speed and pressure, material removal exhibited non-linear trend and follows non-Prestonian behaviour.



Effect of pH on Ge RR with and without; 3 (a) 1 wt% titania (b) 3 wt% fumed silica

PUBLICATION

A. Gupta, S. N. Victoria and R. Manivannan, "Chemo-Mechanical Planarization of Germanium Using Potassium Periodate based Titania Slurries," ICPT 2017; International Conference on Planarization/CMP Technology, Leuven, Belgium, 2017, pp. 1-6. (ISBN No. 978-3-8007-4462-6).

A. Gupta, S. N. Victoria and R. Manivannan, "Chemo-Mechanical Planarization of Germanium using Potassium Periodate based Slurries" (Communicated).

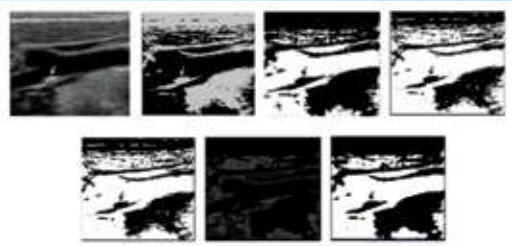
Identification of Ultrasound Carotid Artery Abnormalities using Computational

Student
S. Latha
latha.su@ktr.srmuniv.ac.in

Guide
Dr. S. Dhanalakshmi, *MIE*
dhanalakshmi.s@ktr.srmuniv.ac.in

Institute
SRM Institute of Science and Technology, Katankulathur, Kancheepuram District
IM0000452

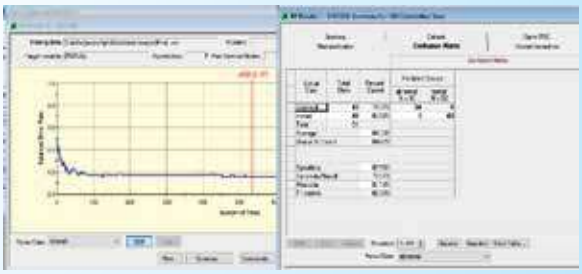
OBJECTIVES



Segmented carotid artery ultrasound image

Atherosclerosis, solidifying of veins because of hypertension, progressive intimal accumulation of lipid, protein, and elevated cholesterol, causes stroke, heart attack, stenosis and other deadly conditions. Ischemic stroke is the most common type in which blood vessels in the brain become blocked, as a result of rupture of atherosclerotic plaques formed in the carotid arteries, especially at the bifurcation and the entrance to the internal carotid artery which feeds the cerebral circulation. Ischemic strokes caused by artery stenosis, account for approximately 75% of all strokes. Today, 42 % of people die because of heart attack and 9% because of stroke.

Carotid Intima-Media Thickness (IMT) is an estimation of the thickness of the two deepest layers of the blood vessel divider and gives the separation between the lumen-intima and the media-adventitia layers. Ultrasound images of carotid arteries acquired from patients with erratic degrees of carotid disease are to be examined and computational models will be erected to predict the mechanical stresses within carotid arteries with or without atherosclerosis. In this work, A fully automated system to identify the presence of plaque using ultrasound carotid artery images with fast spontaneous denoising, segmentation and classification is proposed.



Classification result with 89.58% accuracy

- Pre-processing of carotid artery ultrasound to remove the speckle noise.
- Segmentation, Normalization in the denoised image followed by feature extraction, Optimization techniques in a fully automated manner.
- For classification based on the parametric values as symptomatic or asymptomatic, random forest approach is proposed. Slow convergence rate, local minima and intensive human intervention are solved in this algorithm.

ACHIEVEMENTS

- The carotid artery ultrasound images were collected from a scan center and with the help of radiologist, the database was created. The image's speckle noise were removed by a novel approach called Significant Cluster Identification for Maximum Edge Preservation.
- The denoised images were segmented by affinity propagation and DBSCAN algorithm.
- Significant features of the segmented images were extracted and the data set for machine learning was prepared.
- The dataset gave an accuracy of 89.58%.
- Thus the carotid artery ultrasound image classification as symptomatic or asymptomatic is achieved.

Design and Control of Power Conversion System for Electric Vehicles

Student
Bindu R
rbinducrit@gmail.com

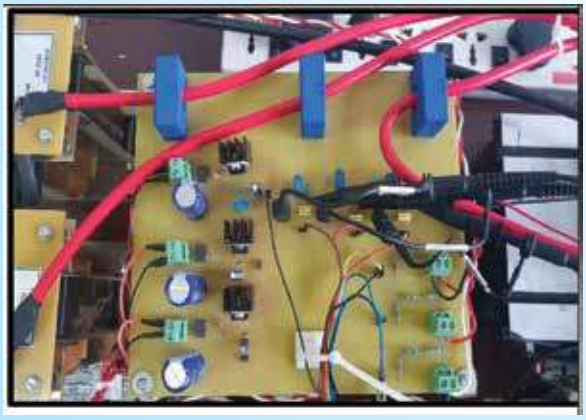
Guide
Dr Sushil Thale, *FIE*
sushil.thale@fcrit.ac.in

Institute
Fr C Rodrigues Institute of Technology
Sector 9A, Vashi, Navi Mumbai,
Maharashtra
IM0003648

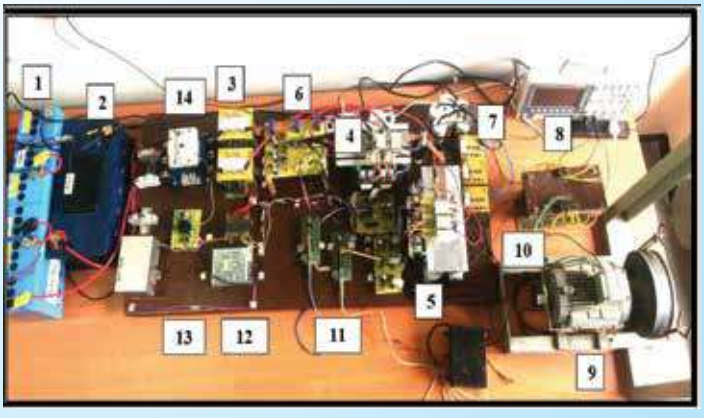
OBJECTIVES

Some of the possible solutions to reduce air pollution and global warming are improving energy efficiency of the system, shifting to renewable energy sources like wind, solar, hydro and using clean electric vehicles. Transport sector contributes around one fourth of the world CO_2 emissions. An alternative for harmful emission fuel is the implementation of electric vehicle (EV) technology which uses electric power stored in a battery to run electric motors which drives the propulsion system. The objectives of the project are stated below:

- To select and size the hybrid energy storage system for an electric vehicle application.
- To design and implement the power conversion system for electric vehicle application which includes a DC-DC bidirectional converter and an inverter to control the power flow.
- To implement appropriate control strategy, for power flow through the DC-DC converter as per the power sharing strategy decided, using a digital signal processor.
- To implement suitable control strategy to the pulse width modulated (PWM) inverter fed induction motor
- To design an LC filter for the inverter output fed to the induction motor.
- To make regenerative braking more effective.
- To improve the performance of the system.



The Sensing Circuit in the System



Power Conversion System of Electric Vehicle

1. Battery, 2. Ultracapacitor, 3. High frequency inductor, 4. Converter, 5. Inverter, 6. Sensing circuit, 7. LC filter, 8. Transformer, 9. Induction motor, 10. Rotary encoder, 11. Digital signal processor, 12. Auxiliary supply, 13. Protection circuit.

ACHIEVEMENTS

- A prototype of the electric vehicle system consisting of the hybrid energy storage system (HESS), DC-DC converter, DC link capacitor, three phase inverter and the low voltage three phase induction motor with the loading arrangement is developed.
- Li-Ion battery having high energy density and ultracapacitor having high power density are selected with appropriate ratings.
- The DC-DC converter designed has bidirectional feature which controls the power flow in forward and reverse directions corresponding to the motoring and regenerative braking of the propulsion unit.
- The converter also controls the power sharing among battery and ultracapacitor so that the battery shares the average load and the ultracapacitor takes in the transient power due to acceleration and deceleration. This helps in improving the cycle life of battery.
- Design and development of the three phase pulse width modulated (PWM) inverter which controls the three phase induction motor. Closed loop V/f control is implemented for the speed control of induction motor.
- An LC filter is designed to reduce the high frequency harmonics so as to improve the life of induction motor.
- The control scheme is implemented using Texas Instruments digital signal processor TMS320F28069.

PUBLICATION

- "Sizing of Hybrid Energy Storage System and Propulsion Unit for Electric Vehicle," IEEE Transportation Electrification Conference (ITEC 2017), Pune, Dec. 13-15, 2017.
- "Design and Control of Power Conversion System for Electric Vehicle Application," IEEE Biennial International Conference on Technological Advancements in Power & Energy (Tap Energy 2017), Kollam, Dec. 21-23, 2017.
- "Electric Vehicle Power Conditioner with Battery-Ultracapacitor Hybrid Energy Storage System," IEEE India Council International Conference (INDICON 2018), Coimbatore, Dec. 16-18, 2018.
- "Power Management Strategy for an Electric Vehicle Driven by Hybrid Energy Storage," Under Review in IETE Journal of Research.

"Engineering is not merely knowing and being knowledgeable, like a walking encyclopedia; engineering is not merely analysis; engineering is not merely the possession of the capacity to get elegant solutions to non-existent engineering problems; engineering is practicing the art of the organized forcing of technological change... Engineers operate at the interface between science and society..."

Dean Gordon Brown

Investigation of Biodynamic Responses Among Indian Tractor Operators Exposed to Whole Body Vibration

Student
Amandeep Singh
ip.nitj@gmail.com

Guide
Dr. Lakhwinder Pal Singh, *MIE*
singhl@nitj.ac.in
Dr. Harwinder Singh, *FIE*
harwin75@redi fmail.com

Institute
Dr. B. R. Ambedkar National Institute of Technology Jalandhar, Grand Trunk Road, Bye pass, Jalandhar, Punjab
IM0005209

OBJECTIVES

To investigate whole body vibration (WBV) exposure of tractor operators engaged in various field operations.

2. To measure and analyze Seat Effective Amplitude Transmissibility (SEAT) under varying tractor operations.

3. To recommend suitable effective interventions or design improvements to limit vibration exposure among tractor operators.

Implements used for Experimentation

ACHIEVEMENTS

The present study has been conducted in real field off road and on road operations to evaluate the biodynamic response in terms of seat effective amplitude transmissibility. The attempt of investigating effect of various ride parameters like forward speed, pulling force, tilling depth, front harrow pin angle, rear harrow pin distance, trolley load and water quantity in tanker has been successful as per Indian applications. It has been found that the vibration exposure is dominant along vertical axis among all the operations. The vibration exposure was found to exceeding recommended exposure limits as per ISO 2631-1 (1997). The existing tractor seat showed poor vibration isolation capacity as per seat effective amplitude transmissibility. Regression models have been developed to predict the SEAT percentage response with varying ride levels. The ride parameters are optimized using desirability approach. Thereby, the study has provided optimum ride levels with respect to selected operations in order improve the ride comfort.

Instruments Used for Experimentation

PUBLICATION

1.Evaluation and analysis of occupational ride comfort in rotary soil tillage operation. Measurement, Elsevier, Vol. 131, pp. 19-27.

2.Whole body vibration exposure during rotary soi l tillage operation: the relative importance of tractor speed, pulling force and tilling depth. International Journal of Automotive and Mechanical Engineering, UMP Publisher [Manuscript ID: IJAME-78].

3.Investigation into the compressive stress on lumbar spine due to whole body vibration exposure in rotary tillage operation. International Journal of Automotive and Mechanical Engineering, UMP Publisher [Manuscript ID: IJAME-96].

Influence of Organic Matter on the Strength and Compressibility Characteristics of Clay

Student
Annie Joy
annjoy87@gmail.com

Guide
Dr. Benny Mathews Abraham
bennymabraham@gmail.com

Institute
TocH Institute of Science & Technology, Arakkunnam P.O
IM0001556

OBJECTIVES

Organic soils are extremely compressible and are known to be problematic for geotechnical works. It has an adverse effect on the settlement of foundations. It can also lead to instability problems such as development of slip failure, local sinking, and massive primary and long-term settlement. As a result of the above, the construction of foundations, embankments, excavations, and other ground works often becomes very difficult in presence of soils with organic matter.

Geotechnical properties of organic soils depend on various factors like organic content, type of organic matter, degree of decomposition of the organic matter and void ratio.

Even though there have been studies on the index properties and engineering of soils containing organic matter, there appears to be a very significant void in some of the areas that need to be addressed.

Determination of organic content in soil samples using BS code/IS code method.

Determination of organic content in soil samples using ASTM method

The main objectives of the present work are:

- To adopt an appropriate method for the determination of organic matter in soil
- To evaluate secondary compression in soils containing organic matter.
- To establish a relationship between shear strength and organic matter in clays.

ACHIEVEMENTS

During the course of the project work, we could compare the different methods available for determining organic matter in soils and find the best and reliable one.

A Software to Generate Nanoparticle Phase Diagram

Student
H. R. Aniruddha Ram
aniruddharam007@gmail.com

Guide
Dr. Gopalakrishna K, *FIE*
gk@ciirc.jyothyit.ac.in

Institute
CIIRC, Jyothy Institute of Technology
Tataguni, Off Kanakapura Road
Bengaluru, Karnataka
IM0005616

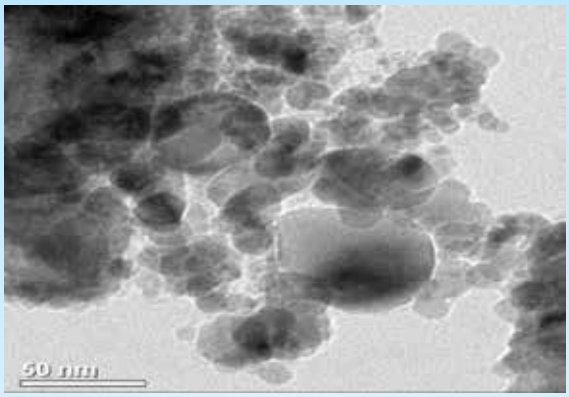
OBJECTIVES

- The primary objective of the proposed project is to predict binary phase diagrams for nanoparticles with varying particle size. The phase diagrams play a vital role in predicting the melting point of alloys, phase determination, microstructure, intermediate phases, alloy properties with varying temperature-composition and heat treatment design. Phase diagrams are also essential to understand the behaviour of the alloys and its stability at various temperatures and different compositions. Since the melting point of the nanoparticles vary with particle size, the solidus and liquidus temperatures will also change resulting in a distinct phase diagram. Further, the phase diagram for nanoparticles change as a function of particle size. Hence determination of phase diagrams is very crucial for nanoparticles.
- The secondary objective is to build a software that can generate phase diagrams for nanoparticles of different particle sizes. Many softwares like Thermo-calc, CHEMIX, COMPUTHERM, etc., are very powerful in plotting phase diagrams, but lack in predicting phase diagrams for nanoparticles. Hence, there is an opportunity for building a software that can predict phase diagrams for nanoparticles with varying particle size.
- One of the major aims of the proposed project is to experimentally verify the predicted phase diagrams for one or two binary isomorphous systems. Experimental verifications are essential and the results will be matched with the theoretical predictions to assure that they are in good agreement.
- Synthesis and characterization of nanoalloys using high-energy planetary ball mill. The nanoparticles will be blended in a ball mill and will be characterized for its melting point, solidus and liquidus temperatures, solubility and morphology.
- The other goals include the fundamental understanding of phase stability and phase transformations in different binary systems.

ACHIEVEMENTS

- Successful development of nanophase diagram generator.
- Preparation of Cu-Ni nanoalloys of various compositions through ball-milling.
- Characterization of Cu-Ni alloys using various techniques like XRD, FE-SEM, TEM and DSC.
- Prediction of phase diagrams for nanoalloys using various models.
- Comparison between experimental results and theoretical predictions to fit the best model.

Copper and Nickel alloys form binary isomorphous system with a symmetric lens shaped curve formed by solidus and liquidus. This shape and size of the solidus and liquidus curves are altered by the particle size. This effect is greatly enhanced if the particle size is less than 100 nm. In the present work, phase diagram is predicted for nanoparticles considering Copper and Nickel and is compared with the experimental results.



TEM image of Cu nanoparticle

Copper and Nickel nanoparticles were procured and were characterized for the particle morphology and size using TEM. The nanoparticles were also subjected to DSC analysis to find the melting point. The nanoparticles were blended in a high energy ball-mill for various compositions. The blending was carried out for different time intervals and was characterized using XRD until there was effective alloying. The blended nanoparticles after effective alloying were subjected to DSC analysis to experimentally determine the solidus and liquidus points for various compositions. Phase diagram was determined experimentally and was compared with the theoretical prediction. Various theories have been used to predict the phase diagram for nanoparticles. It was found that the predicted phase diagram for nanoparticles is in good agreement with the experimental results. Copper and Nickel nanoparticles were characterized using TEM and DSC. It was found that the average size of the Copper nanoparticles were 25 nm and average size of Nickel nanoparticles were 26nm. The melting points of Copper and Nickel nanoparticles were found to be 944° C and 1083° C respectively using DSC analysis. Three different theoretical models were analyzed to find the melting point of the nanoparticle and was compared with the experimental results. It was found that Thermodynamic model was relatively closer and hence the same model was used to predict the phase diagram. The phase diagram was predicted using Thermodynamic model and was compared with the experimental results and it was observed that they agree with each other.

Legacy of IEI

Dr Zakir Hussain, President of India with the Council Members in 1969

The Institution of Engineers (India)

8 Gokhale Road, Kolkata 700 020

Phone : +91 (033) 2223-8311/14/15/16, 40106299

Fax : +91 (033) 2223-8345

Website : http://www.ieindia.org

e-mail : research@ieindia.org

iei.technical@gmail.com