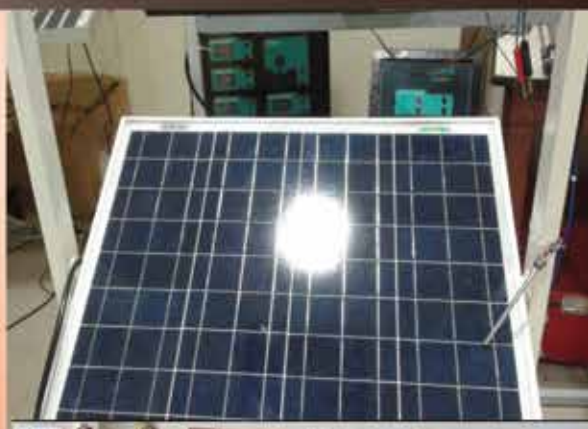
Compendium on R&D Projects

under the IEI Grant-in-Aid-Scheme

Volume 7

September 2018



The Institution of Engineers (India)

8 Gokhale Road, Kolkata 700020

A Scientific and Industrial Research Organisation
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The Institution of Engineers (India)

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The SAIL Awards - for the best paper, broadly pertain to the Iron and Steel Industry, invited and received by the Institution on the subjects announced each year through the Institution publications

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Apart from the above, best papers published in IEI Journals are awarded every year during the Indian Engineering Congress.

Message from the

President

I am glad to note that the Compendium on R&D Projects under IEI R&D Grant-in-Aid Scheme, Volume 7, for the year 2018-19 is being published. Apart from the content, which is truly enriching, it also important to see that students are gaining knowledge about fieldwork, laboratory applications and report writing.

We need to encourage more students to become researchers and agents of change, to think outside the box, and to participate in finding real answers and solutions to real life questions and challenges. It is encouraging to see that some of these research outcomes, under the aegis of IEI, have been published in reputed International Journals.

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

Sisir Kumar Banerjee
President, IEI

Message from Chairman
Committee for Advancement of Technology and Engineering

I have the pleasure to note that the Compendium on R&D Projects-Volume 7 is going to be published shortly. The Institution of Engineers (India) has taken up the role of promoting R&D through funding and active participation in meaningful R&D venture. The initiative launched way back in 2001 has now manifested into a full-fledged program with over thousand beneficiaries across the country. The scheme has provided the students with opportunity to engage in formal and informal learning environments thereby assisting them to develop research acumen. I am pleased to mention that several research work carried out from these R&D funding have been published in IEI-Springer as well as other International Journals which speaks about the success of the program.

The Compendium on R&D Projects is a reflection of IEI funded research carried out in the frontier areas of technology. It is an initiative showcasing efforts put in by the students engaged with research within and/or beyond the formal curriculum with an aim to further their knowledge and understanding. This seventh volume is a bonafied R&D document of our engineering students groomed by The Institution of Engineers (India) Grant-in-Aid scheme.

Deb Kumar Tripathy
Chairman, CATE, IEI

Message from Chairman
Research & Development Committee

The Grant-in-Aid scheme was instituted by The Institution of Engineers (India) way back in 2001 with the objectives of nurturing innovative thinking and fresh talents in technology and engineering and thereby providing a student with the opportunity to develop their technical skills and gain insight into latest researches in the field. Our Grant-in-Aid Scheme allows students to develop professionally and personally. Research experiences give these students an opportunity to gain a deeper knowledge of research techniques and processes, apply classroom learning in real-world contexts, explore academic literature, and form meaningful relationships with faculty members and professional researchers. We take pride in informing that our efforts have been duly recognized by the Ministry of Science and Technology, GoI who have identified the Institution as a Scientific and Industrial Research Organization (SIRO).

Like every year, it has been a pleasure to bring out the Compendium on R&D Projects under IEI R&D Grant-in-Aid Scheme, Volume 7, which provides an array of fascinating and enterprising projects carried out with modest funding from IEI most of which have deep social implications.

K Gopalakrishnan
Chairman, RDC, IEI

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Contents

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

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A Novel Approach to Recycle Sound Energy to Electrical Energy

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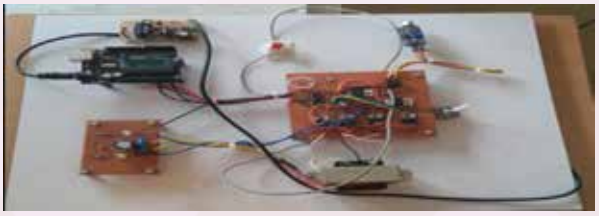
OBJECTIVES

With the necessary demand for utilization of energy resources now a days, there has been a decline in the availability of resources and there have been many methods of recycling of energy sources. In this work we have deviced a new method of conversion of noise energy to electrical energy to meet the energy requirements in Textile Industries. The noise level in spinning department is between 80 dBA, of which the lowest is in blow room and the highest in ring spinning. Noise level in weaving preparatory process is low. Excessive noise level of 94 -99 dBA is in loom shed, and of the shuttle less weaving machines, noise level of water-jet weaving machine is the lowest at 85 dBA, air-jet and rapier weaving machines is 91 dBA, and the projectile weaving machine is 92 dBA. This noise pollution from various sources in textile industry is sensed with various sensors like Piezo Electric crystal, Vibration sensor and Pedal sensor. The sensed output is given to the Microcontroller (Arduino Board). With the help of Microcontroller, the battery will be charged. The energy stored in the battery will be supplied to the Mains/Load by using the inverter circuit. In this way the demand of electrical energy can be mitigated partially at the source itself.



A Novel Approach to Recycle Sound Energy to Electrical Energy

ACHIEVEMENTS

We have designed a board which will convert the sound energy to electrical energy. This circuit board can be utilized in any sound or vibration environment, and the generated Electrical Energy can be used for lightening purpose.

PUBLICATIONS

A Novel Approach to Recycle Sound Energy In Textile Industry To Meet Electrical Demand

2017 International Convention on Dissemination of Innovative Research in Science Engineering Technology & Management Applications

Organized by Malaysia Editorial Board Committee of Journal of Engineering Technological Research (ISSN: 2229-9262) Journal of Engineering Technology & Management Science (ISSN: 2229-9254) in association with Society of Professional Engineers (India) during March 11-12, 2017, Kuala Lumpur, Malaysia.

Design and Development of Stand-Alone Modular Low Cost Toilet Units using Precast Technology for Girl Students in Rural Government Schools- A Swaach Bharath Initiative

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Fully completed-stand alone prefabricated toilet

Semi-finished assembly of precast slabs for toilets

OBJECTIVES

Design, fabrication and installation of stand-alone low cost toilets for girls and women staff in rural schools

a) Conducting user survey to understand the needs of the customer
b) Design conceptualization and finalization
c) Developing engineering specification for the toilet
d) Construction of toilet in modular form
e) Installation of the toilet at the site
f) Developing instruction manual for the maintenance and repair procedure for the toilet

ACHIEVEMENTS

We have designed, fabricated and demonstrated the precast technology suitable for mono structures like toilet. Adoption of this technology has expedited the installation of toilets in remote places which do not have motorable roads for transport of construction materials and/or adequate water available for curing.

The fabrication was optimized with minimum labour due to the usage of simple implements designed as per the need.

The fabrication of all the slabs was done in the premises of the institution followed by the curing which was done in the tanks constructed for this purpose.

A toilet has been created in the college campus for the purpose of demonstration and its utility has been established.

Following this, training was imparted to the local civil construction labours followed by a demonstration through a toilet construction at one of the Government Rural Panchayat Union Middle school.

Precast Technology:

Our toilet structure is constructed by assembling modular slabs that are designed to interlock with each other for stability. These slabs are precast and cured and then taken to the site of assembly. Since toilets have to be added to the existing construction in schools and rural households, the dimensions of the toilet are made to just fit in the already available space. In addition, the leach pits for collecting the human waste are also accommodated within the given space.

Eco-friendly Toilet:

In order to decompose the waste more effectively, quickly and safely, effective microorganisms solution is mixed with water and poured into one of the two leach in use. For lighting the toilet, solar panel of the required size to provide power for the LED lights is used.

Advantages:

1. No need for construction at the site and hence minimal disturbance to the already existing household
2. No use of bricks in the construction
3. Constructed according to M15 standard for concrete
4. Easy to transport as the slabs are modular
5. Designed to be an add-on unit to the existing household and so no need for remodelling the existing structure
6. Structurally stable owing to use of reinforcement
7. Lighting provided with solar panel and LED lights
8. Usage of two leach pits so as to avoid overflowing problems for one year
9. Junction chamber from exit of the toilet also precast with minimum use of construction material
10. Decomposed waste from the leach pits can be used for agricultural purposes

Where these toilets can be used:

Can be deployed in:

1. In rural households where open defecation is still followed
2. In farm houses of the small holding farmers.
3. For usage by non resident users such as tourists and pedestrians.
4. In recently developed people meeting locations where there is no dedicated toilets for womenfolk such as rural marts, women self help group centres, panchayat offices.
5. The proposed low cost toilet technology can be adopted universally with minimum involvement of civil labour and mason at the site.
6. It is suitable for places where assembling has to be done in a short time.
7. It can be universally used in any area irrespective of the water table and soil conditions.

Study of Ageing Behaviour of Copper-added Austenitic Grade Stainless Steel and Modelling the Aging Characteristics

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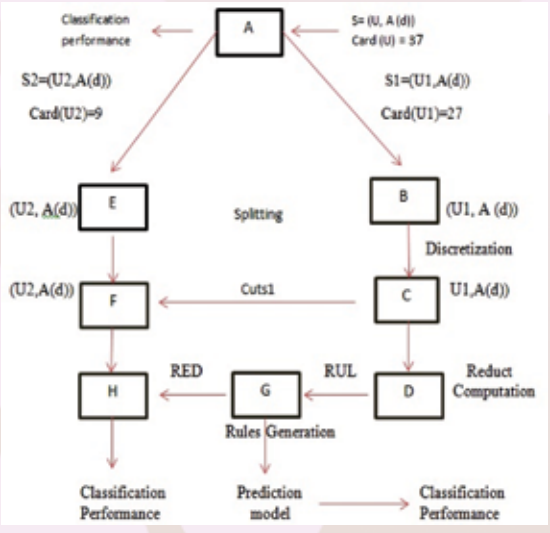
OBJECTIVES

Over the last few years, new type of stainless steel called super 304H stainless steel, containing Cu is being adopted for supercritical applications such as boiler, superheater etc. In this context, the addition of Cu to SUS 304H, aimed at reducing the recycling cost was found to increase the elevated temperature strength of the steels, especially their creep performance in the temperature range of 650–750 °C. It is established that the effect of Cu in enhancing the creep performance of steel accelerates with ageing but its addition also results to embrittlement. A critical assessment of amount of Cu on the overall performance of SUS 304H type austenitic grade stainless steel appears to be a challenging problem.

Flow diagram of the computational strategy and logical approach of the analysis of the data

ACHIEVEMENTS

In this study, the effect of ageing treatment with different combinations of temperature and time on the hardness of SUS 304H + xCu (x=1, 3 and 5 wt.%) austenitic steels was examined. Also the experimental data was analysed with the help of a classification based mathematical model using rough set theory. The model was developed to explore more insight about the ageing behavior of the alloy and to identify the best possible choice of the amount of Cu addition in associated ageing parameters. The modelling scheme has been demonstrated in figure. The alloy with intermediate range of Cu addtion of about 3 wt percent seems to be optimal addition in the alloy for achieving the best hardness. This is possibly due to competition between solute weakening (due to presence of Cu) and precipitation strengthening. While the low wt %Cu alloy shows the least solute weakening, the alloy with highest wt% Cu shows most precipitation strengthening. The rule based model was found to be interesting in view of the generated rules and dependency of the parameters. The dependency of the copper weight percentage, temperature and time were evaluated through rough set analysis. The hardness dependency was found to be most on copper percentage and least on time. The rules had efficiency of approximately 89.3 % for worked data and had 77.87 % for tested data.



Classification model using rough set theory

Design and Development of Biodigester for Effective Food Waste Disposal

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Biogas digester plant setup installed in Men's Hostel of Saveetha Engineering College, Chennai to generate cooking gas from food waste

OBJECTIVES

Biogas digesters are used to produce methane gas from kitchen and agricultural waste through anaerobic digestion technology. Methane is a clean energy, one of the constituent of biogas, which has a great potential to replace the cooking gas. The project involves the design, development and fabrication of three bio-digesters with different concept in internal heating system and gas mixing system to produce more methane gas from food waste.

The objective of this research project are:

- To design and fabricate the bio-digester suitable for a college hostel in educational Institution.
- To introduce three different concepts to produce more methane gas from food waste by considering economic and ergonomic factors.

- To utilize kitchen waste and vegetable waste for maximum biogas production by anaerobic digestion process.
- To reduce the problem of segregating plastic waste, vegetable waste and wet food waste in the campus.
- To install the bio-digester unit in hostel and analysis the methane gas production.

ACHIEVEMENTS

In this work, three biogas digesters A, B, and C were designed and fabricated for same capacity (100 litres) with three different concept in internal heating system and gas mixing system to ensure a constant homogeneous mixture and temperature. They are,

1. Design-A: Conventional Design With Stirrer:- In this design, the food waste was fed into the reactor and it can be decomposed and fermented to produce methane gas. The external rod was used as stirrer.
2. Design-B: Design of Bio-digester with Heater:- In this design, the heater unit was inserted into the reactor. During fermentation some amount of heat was required and was procided by the heater.
3. Design-C: Modern Design of Bio-digester with Filter:- In this design, the produced biogas was sent through the mediums such as lime water and urea for improving calorific value of gas. The calorific value gets increased due to the removal of CO_2 and hydrogen sulphide from the biogas.

The fabricated Biogas digester plant set-up was installed in Men's hostel of Saveetha Engineering College and charged with the food waste consists of cooked waste, uncooked vegetables, bread, tea waste, eggs and cow dung(To initiate the process). The three digesters A, B, and C were charged at the same time and loaded at the same rate. It was observed that the biogas production started on the 3rd day and reached its apex on the 6th day for digester B, production reached its peak on the 4th day in digester A and attained maximum on 7th day, while for digester C, it started on the 7th day and attained maximum on 11th day. Despite all these conditions, digester B performance was found to be very satisfactory, because it produced the highest volume of gas compared to digester A and digester C. It was evident from the results that food wastes could be converted into useful cooking gas (methane gas) and fertilizer with the help of anaerobic digestion process.

PUBLICATION

Muthukumar et al, "Optimization of anaerobic bio-digester process parameters for Biogas Production using Taguchi Method", is accepted for Publication in the International Journal of Applied Mechanics and Materials.

B. Tech Thesis

"Design and Development of Bio-digester for effective Food Waste Disposal"submitted to Anna University Chennai during April 2016.

> 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

ISTAR- Intelligent Solar Tracker with a Compressorless Refrigerator

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Customised Gear Arrangement

Back View of Project

Front View of Project

Project on Display

OBJECTIVES

Solar energy is an indigenous, inexhaustible and clean source of energy that can be tapped in numerous ways to be used to satisfy present energy needs. With about 300 clear sunny days in year, India has a huge potential to reap maximum benefits out of this abundant resource. As per studies, nearly 75% of the energy is lost in the morning and evening hours with fixed mounted solar PV cells, due to the daily east to west transition of sun. Furthermore, about 8.3% of energy is lost with a single axis tracker, since it is incapable of tracking the seasonal movement of the sun. The main objectives of the project are

1. Design and fabrication of an intelligent self-sustainable dual axis solar tracking unit to tap maximum solar energy, thereby improving the efficiency of the solar photovoltaic system. A solar tracker that accounts for both the daily and seasonal motions is known as a dual-axis tracker. The microcontroller-based solar panel tracking system is proposed in this project work. It is azimuth-altitude dual axis tracker (AADAT).
2. To develop an eco-friendly compressor-less refrigerator based on Peltier effect as an application of solar photovoltaic using dual axis solar tracking system.

ACHIEVEMENTS

A prototype dual-axis solar tracking system based on a microcontroller is designed and developed. This auto-tracking system is controlled with two 12V, 17W DC gear box motors. The four light sensors (photodiodes) are used to track the sun and to start the operation. The orientation system calculations are based on astronomical data. The system is designed to control the Altitude angle in the vertical plane as well as the Azimuth angle in the horizontal plane of the photovoltaic panel workspace. The open circuit voltage and power outputs of solar photovoltaic (PV) system were measured for fixed tilt type position and dual-axis solar tracker for different timings of the day. The results show that performance of solar PV with dual axis system is better. The proposed design is capable to enhancing output of solar photovoltaic system by 15-20% by keeping the panel's face perpendicular to the sun. The system is assumed to be valid for any region with small modifications. The output of solar PV system is utilized in developing compressorless refrigerator. It is a thermoelectric refrigerator based on Peltier effect. The thermo-electric refrigeration are advantagious as it is (i) simple, (ii) noiseless, (iii) compact & light weight, (iv) eco- friendly since no refrigerants are used,(v) more reliable than systems with moving parts, and (vi) easy control by varying current.

Every specific application where a thermoelectric cooler module or refrigerator is required is characterized by a set of operation parameters, which dictate the necessity and accurate selection of the optional thermoelectric cooler type among a wide range of single and multi-stage thermoelectric cooler modules.

These parameters are:

ΔT– Operating temperature difference

Qc – Operating cooling capacity

I – Applied or available current

V - Terminal voltage

A prototype thermoelectric refrigerator is developed. The project can used an off-grid portable cooler or warming chamber especially for carrying medicines, foods etc. It can be used as a standalone power system in remote areas.

Blind Assistive Wearable Device

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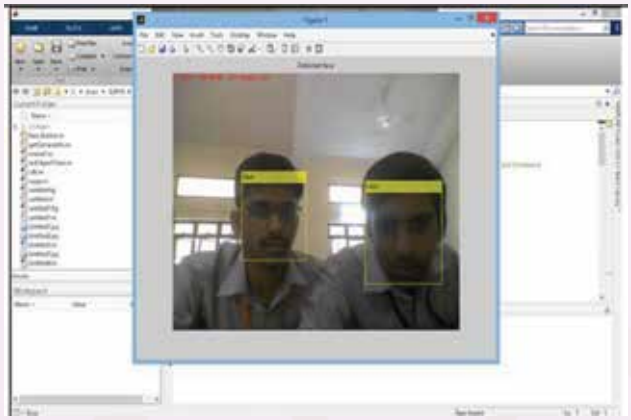

Stages of Project Development

OBJECTIVES

For those millions of us whose vision isn't perfect, there are glasses. But for those hundreds of thousands who are blind, devices that merely assist the eyes just aren't enough. What they need is an alternative technology to assist them for their survival without anyone's help.

Blind Assistive Wearable Device is an embedded device dedicated for blind or visually impaired people. For them, all that information, which exists in the daily life as newspapers, banknotes, schedule of train, books, postal letters, is not easily accessible. Our aim is to build an automatic text reading assistant which combines small-size, protability and low cost. The main aim of this system is to build an automatic text reading assistant using existing hardware associated with innovative algorithms.

Three key technologies which are necessary in this device are text detection, optical character recognition and speech synthesis. This project focuses on providing a virtual guide for the blind to help them analyze and interact with their environment. The device will interact and guide the blind through sound from an earpiece. The project analyses the object in front of the person and gives brief information. For example, the device will analyze the product taken by the blind in market and tell him what the product is and its cost. It will read out news or articles on the paper if it's in person's hand.

ACHIEVEMENTS

For the blind, hearing and touch are the first and second major senses. They will never replace vision but they still gather much information from the environment for daily tasks. That is the reason why assistive devices provide acoustical and tactile feedback to compensate for visual information. In this paper ,we are incorporating different engineering domains such as TTS,OCR,QR Technology, Face Recognition etc to develop an integrated system which is capable of assisting the blind and improving the quality of their life.

Here, we are bringing forth recent advances in technology and various domains together to develop a system which has the potential to become a virtual guide for the blind. QUICK RESPONSE (QR) Code is successfully decoded from arbitrarily captured images and data is successfully processed. OCR program has successfully converted text data in an image to digital text format. Face Recognition program is capable of detecting and recognizing the presence of friends in the blind vicinity. The friends' faces can be stored in database for comparison and recognition. Wi-fi facility and GSM compatibility in the embedded board is capable of accessing data from the internet to guide the blind on demand. The programs to drive the various functions and processes are tailored to a single master program so as to drive the embedded system. An image processing based approach is proposed in this system that enables the blind to analyze the surroundings. The reading difficulty can be solved easily by using this device. This system assists the blind to recognize people in an efficient way. So this system will be a blessing for the blind.

Optimal Design for Non Solenoidal Operation of Starter Motor

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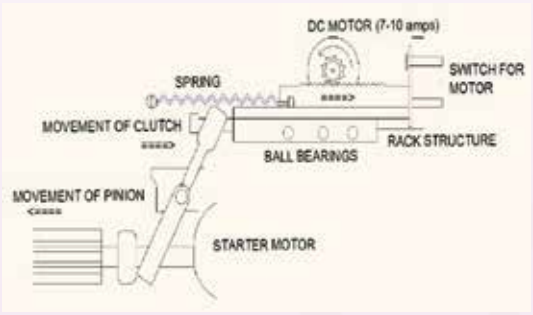


Starter Motor in ON condition

Starter Motor with DC motor (Without solenoid)

OBJECTIVES

A novel design and fabrication of the gear reduction starter motor is proposed. In this proposed configuration, the conventional solenoid of the starter motor is eliminated, resulting in reduction in the starting current required while cranking and the weight of starter motor are reduced by making it more compact. Failed/dead cranking and cost of starter motor are also decreased. The function of the solenoid is replaced by a spring coupled drive system which makes the function of the starter motor an automatic process. In order to prevent accidental cranking, a sensor, which detects the position of the crankshaft is used, whose output is fed back to the control circuit. Thus, the life span of the battery is increased, thereby facilitating the success and growth of the automobile manufacturing organizations in the dynamic industrial environment and operational convenience of the automobile users.

GENERAL

The starter motor is a series-wound direct current electric motor with a solenoid switch (similar to a relay) mounted on it. The following are the common major problems faced in the operation of this motor, in the present day automobiles. The first one is regarding the starting of a car especially when the battery is drained out or during a cold start. In these conditions the battery fails to supply the power required for the starting of the motor. The starter motor may also get stuck with the crank and fail to return back to its original position and as a result it will draw a large current from the battery. The other problems in the present day starter motors are that they are not mechanically sound and the ball bearings and other moving parts of the motor get worn out after few years. The lighting and other ancillary electrical systems in the car also consume the battery power even though the battery is charged from the running engine. Bad ground wire can cause all kinds of electrical problems. This project aims at a viable solution for these problems. Ageing also will render the battery incapable of providing the starting function. But, for the great majority of batteries ageing is progressive, so that performance can be extended by control of slow, deep discharge and management of the state of charge of a healthy battery.

The solenoid present in the starter motor will take a large electric current from the car battery even in the idle condition. When the ignition switch is turned on, a small electric current is sent through the starter solenoid. This causes the starter solenoid to close a pair of heavy contacts, thereby sending a large electric current through the starter motor, which in turn sets the engine in motion.

Most engines need a cranking speed of 200 to 300 rpm to start and so if the starter is weak and can't crank the engine fast enough to build compression, the engine won't start. In some instances, a weak starter may crank the engine fast enough but prevent it from starting because it draws all the power from the battery and does not leave enough for the injectors or ignition system. A good starter will normally draw 60 to 150 A with no-load on it, and up to 200 A or more while cranking the engine. The no load current drawn depends on the rating of the starter, while the cranking ampere required depends on the displacement and compression of the engine.

Starter motor fails to spin or draw current due to open field circuit, open armature coils, defective brushes or a defective solenoid. Starter motor spins but fails to engage the flywheel because of weak and defective starter.

The primary function of the battery in the network is to buffer the output of the alternator by absorbing any high-frequency pulses it may generate and by meeting transients in the current drawn, while the alternator readjusts to meet such a new load. Furthermore, the battery powers the starter motor that cranks the engine to start it. The average, driving cycle therefore consists of the battery providing very high current of more than 600 A, for less than a second to drive the starter motor and start the engine and immediately thereafter powers all electrical loads. The alternator, in a matter of seconds, begins to generate the current drawn by these loads and the battery's discharge current decreases. As the vehicle is driven, the battery lapses to a quiescent state where it discharges only to meet transients in current required. When low-current power from the starting battery is applied to the starter solenoid, usually a key-operated switch is opened and the solenoid opens the contacts to the starter motor.

In order to overcome these issues, a new design of a starter motor configuration without a solenoid has been proposed as illustrated in the following sections.

COMPARISON OF THE EXISTING AND NEWLY DESIGNED SYSTEMS

Starter Motor

The torque generated by the starter motor is amplified through two or three stages of gear reduction so as to be capable of cranking the engine shaft from zero to around 200 RPM. The cranking torque provided by the starter motor is a linear or quadratic function (depending on the stator winding configuration) of the current flowing through the rotor winding of the starter motor.

Design Drawings of the Proposed System

The 2D and 3D models of the proposed design are shown which were obtained using AutoCAD and SolidWorks tools respectively. With the help of these software modules the models of varying measurements are created in order to test their reliability. Inferences are obtained from these models that help in creating hardware models of required dimensions, so as to meet the required demands.

2D Drawings using AutoCAD

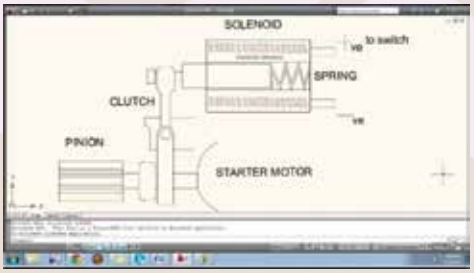


Fig. 1 Existing design in switch OFF state

In the existing system of starter motor assembly, fig. 1. represents the presence of solenoid switch in OFF condition and the contacts of the switch are not closed and the pinion is not engaged with the flywheel.

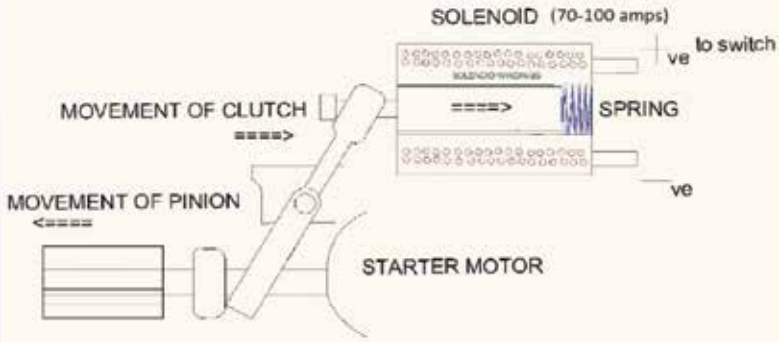


Fig 2 Existing design in switch ON state

Figure 2. shows the presence of solenoid in switch ON condition and the contacts of the switch are closed and the pinion is engaged with the flywheel.

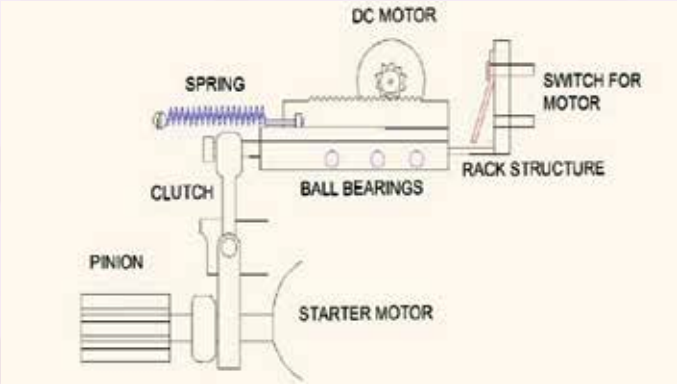


Fig 3 Proposed model of design in switch OFF state

Figures 3 and 4 show the design of proposed model in switch OFF state and ON state respectively. Only in the ON state, the contacts of the switch are closed and the pinion is engaged with the flywheel.

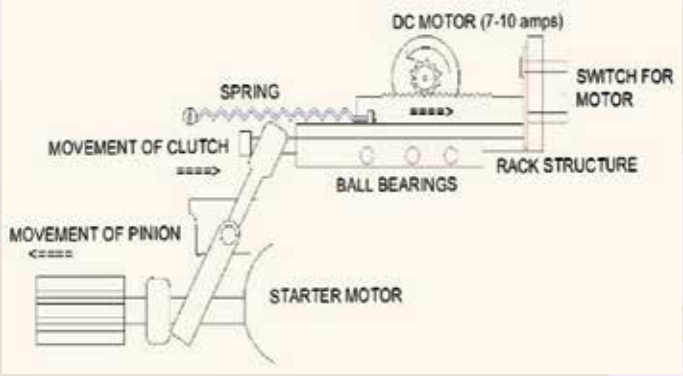


Fig. 4. Proposed model of design in switch ON state

Figures 5, 6 and 7 indicate the dimensions (mm) of the gear used in rack structure, the circular gear and the spring attached to gear structure.

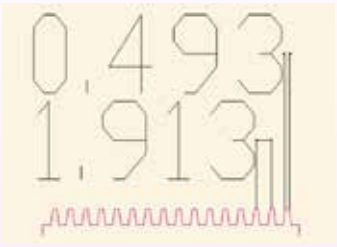


Fig. 5. Gear dimensions used in rack structure

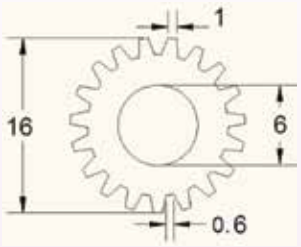


Fig. 6. Gear dimensions used in shaft structure

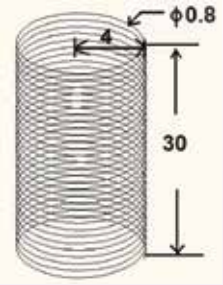
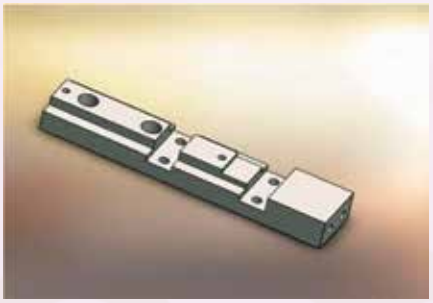
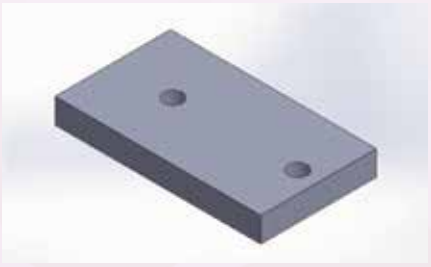


Fig. 7. spring dimensions attached to rack structure

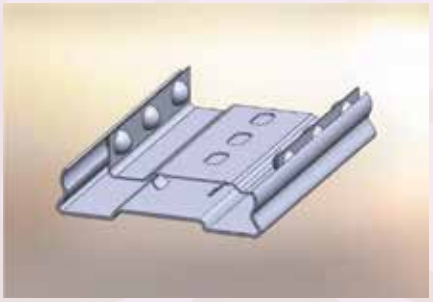
3d Models using Solid Works



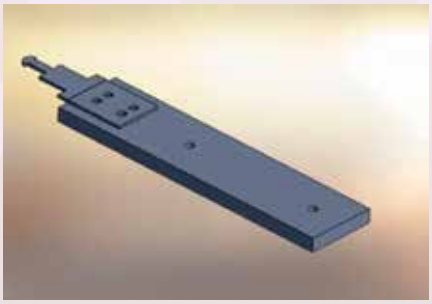
HOLDING RACK STRUCTURE



BASE FOR DESIGN STRUCTURE



BALL BEARING CASE



STRUCTURE FOR MOVEMENT OF PINION

HARDWARE IMPLEMENTATION FOR PROPOSED WORK

The proposed model of the starter motor was fabricated in Alpha engineering, Chennai, which is a company engaged in tool and machining works. The model was then fitted in a TATA petrol engine, replacing the existing GRS-70 gear reduction starter motor. For this new fitting, a slight modification was made and the retuned structural components are as follows:

i) GRS-70 starter motor without solenoid

ii) Rack structure comprising of ball bearing arrangement

iii) 12V industrial DC motor

iv) Spring

v) Gear arrangement

Construction

All the parts of the proposed design are fabricated using mild steel. A thin sheet is moulded and placed over the starter motor and above this sheet the base is welded to seat the structure. Above the base we place another pair of base for screwing purpose over which structure comprising of ball bearing arrangement is seated. The arrangement of rack and pinion structure is mounted over the ball bearing arrangement. The purpose of ball bearing arrangement is to reduce the friction. The rack structure is geared with a DC motor which is placed in a separate stand attached to the base structure. Besides this, we have a switch to close the contacts of the battery and starter motor. The springs are present in the system so as to bring back the pinion to its original position.

Design Dimensions

Figures 9-17 show the top view and side view of various components with dimensions in mm. These were drawn using Solid Works which helped in fabrication of the final hardware.

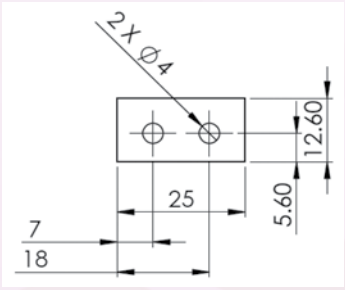


Fig. 9. Top view of the base

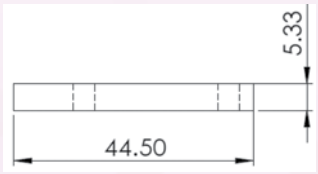


Fig. 10. Side view of the base

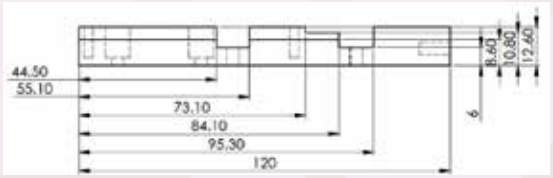


Fig. 11. Side view for screwing structure

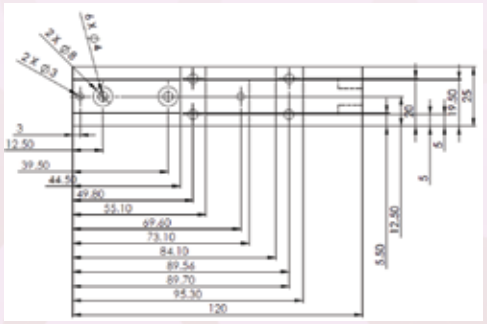


Fig. 12. Top view for screwing structure

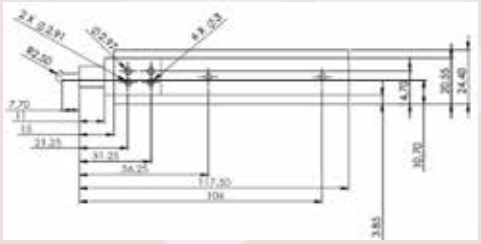


Fig. 13. Top view of Rack base

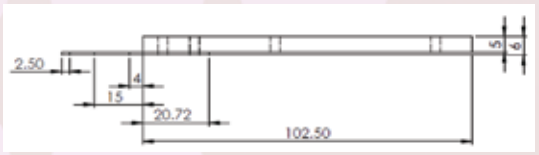


Fig. 14. Side view of Rack base

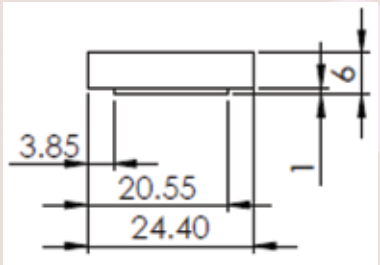


Fig. 15. Back view of Rack structure

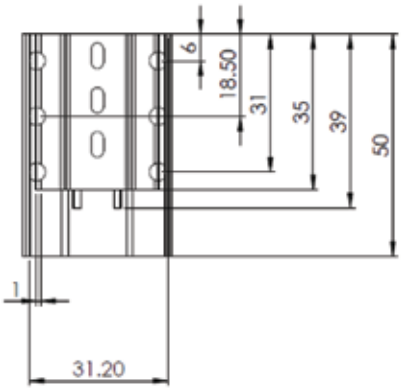


Fig. 16. Top view of the Ball bearing structure

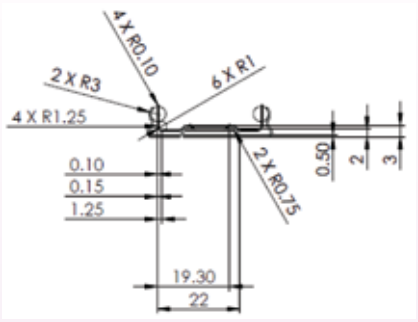


Fig. 17. Side view of the Ball bearing structure

TESTING

The proposed design model was tested in the Light Run Test Rig at LUCAS-TVS, Chennai to determine the difference in current intake by existing design with solenoid switch and our proposed design. The starter motor was mounted with existing solenoid switch as shown in fig.18 and the values of the current were noted in the switching mode with starter motor at OFF condition and free run mode. Then the starter motor with our proposed design was mounted and the respective currents were found. Testing was carried out under limited current conditions in order to control the starter motors torque. Cranking test was not carried out since torque measurement was not needed.

Testing of Existing Model

The Light run test rig has a vise to mount the starter motor. It also has display metres that show the values of source voltage (in volts), starter current (in amps), solenoid current (in amps) and speed (in r.p.m) of the starter motor as shown in fig.19. The starter motor was mounted with existing solenoid switch and the current values were noted at starter motor OFF mode and free run mode.

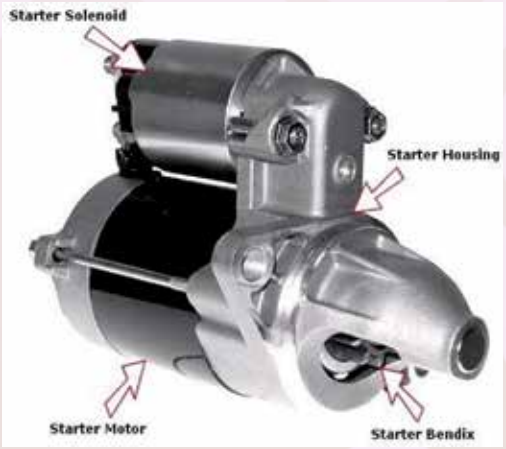


Fig. 18. Existing model of starter motor

Current drawn by the existing solenoid coil = 35.2A
Cranking time < 0.5 seconds

Then a free run test was conducted and the values can be obtained from the set-up seen in fig. 20 and they are as follows:

Voltage = 11.3V

The display values are obtained from the experimental set-up shown in fig.19 and they are as follows:

Voltage = 11.2V

Source Current = 34A

Fig. 19. Testing in switched OFF mode of existing design

Source current (Starter Current and solenoid current) = 51A

Current drawn by the existing solenoid coil = 8.8A

Cranking time < 0.5 seconds

Testing of Proposed Model

The starter motor with our proposed design as shown in fig. 21 was tested and the current values were noted at the starter motor OFF mode and free run mode.

The following are the outputs recorded during testing of the proposed design:

Fig. 20. Testing in free run mode of existing design

Fig. 21. Starter motor with proposed design

Figure 22 shows the light run testing set-up during the switching mode is shown and the outputs recorded are as follows:

Voltage= 10.4V

Source current =7A

Current drawn by proposed design = 7.4A

Cranking time < 0.5 seconds

From the fig. 23. the following are the outputs recorded during the free run testing of the proposed design:

Voltage= 11.4V

Source Current = 46A

Current drawn by the proposed design= 7.4A

Cranking time < 0.5 seconds

Fig. 22. Testing in switching mode of proposed design

Fig. 23. Testing in free run of proposed design

Table 1 gives the quantitative comparison of test results of existing and proposed models.

Sl. NO	Design	Mode	Voltage in volts (V)	Current in ampere (A)
1	Solenoid switch	Starter motor off	11.2	35.2
2	Solenoid switch	Starter motor free run(limited current)	11.3	51(series current) +8.8 (shunt current)
3	Our proposed model	Starter motor off	10.4	7.4
4	Our proposed model	Starter motor free run (limited current)	11.4	7.4

Table 1 : Comparison of Test Results

Table 2 shows the feature comparison between the existing and proposed models

EXISTING GRS-70 STARTER MOTOR	PROPOSED GRS-70 STARTER MOTOR
Operation is purely electrical	Operation is electro-mechanical
Engaging of the pinion onto the flywheel is done by the solenoid	Solenoid is eliminated. Pinion is engaged electro mechanically
Solenoid current is approximately 70- 100 amps.	Starting current of the proposed model is 7-10 amps.
Voltage required for cranking is 12V	Voltage required for cranking is 11V
The starter motor is heavier and complicated	The starter motor is light weight and compact
Series winding in solenoid sometimes fails to move pinion forward due to high inrush of current	Solenoid on the whole is eliminated so no such problems is encountered
Pinion engagement creates noise.	Smooth engagement process.

Table 2 Comparison of existing and proposed models

This proposed starter motor eliminates the flaws found in the existing starter motor with a better performance. Also it was observed that the current is reduced by 52.4 ampere on replacing existing solenoid switch with our designed model at free run with limited current. Hence it was proved that the battery drain will be reduced considerably by using our proposed design apart from benefits increased battery life and associated in the form of customer satisfaction. This corroborates that our project is technically viable and its objectives were successfully obtained.

CONCLUSION

It is shown that solenoid in the starter motor can be eliminated and the functions of the solenoid are performed electro-mechanically in the proposed new system. With this proposal, the operation of the starter motor in automobiles has been made smoother with much less noise and reduced stress on the battery during cranking. This model of starter motor has numerous advantages such as low starting current and voltage, less cranking time, low failures during cranking and also it is cost effective. From consumer point of view, apart from less cost, it also reduces the stress on battery, thereby increasing its life span. Both mechanically and electrically this proposed work proves to be much effective than the existing one. To fully realize the stated advantages, it is proposed to use required spring strength and ensure accurate machining.

Computational Intelligence based Feature Selection for Arsenic Contamination of Drinking Water of West Bengal, Bihar and Bangladesh Region

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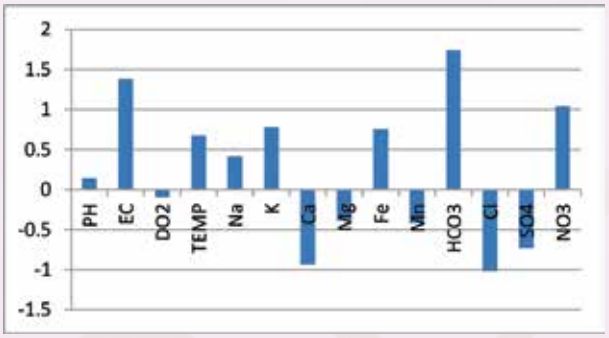
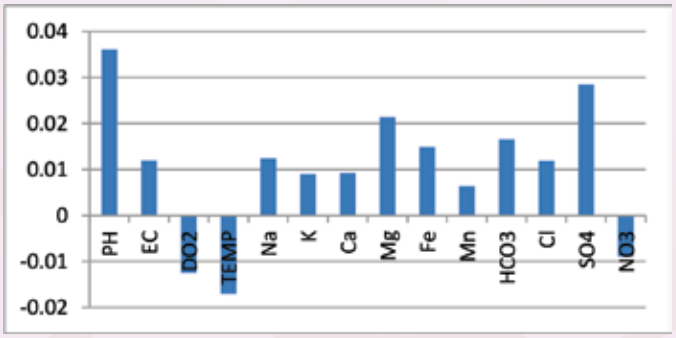


Sensitivity plots drawn on trained ANN model for As



Sensitivity plots drawn on trained SVM model for As

OBJECTIVES

- To identify arsenic contamination of drinking water using artificial neural network, fuzzy logic and other relevant computational intelligence based and statistical techniques, applied on the related water quality parameters.
- develop predictive data driven model using Artificial Neural Network and Support Vector Machine with the selected features behind arsenic contaminations as the independent variables and arsenic content in water as the output.

ACHIEVEMENTS

The achievements of the Project are as follows:

- Several models for predicting the Arsenic content in ground water depending on other related parameters have been developed using Artificial Neural Network as well as Support Vector Machine.
- We have been able to choose a suitable model among various models developed.
- We have been able to find the relative importance of other related parameters with respect to Arsenic content in water samples from the Sensitivity Plot.

Estimation of River Runoff in Haora River Basin with the Help of Multi Criteria Decision Making (MCDM) Environment

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OBJECTIVES

Rainfall is one of the most important factors which describe the climatic condition of a particular place. The parts of Tripura faces moderate to high rainfall throughout the year. There are different river canal found in the state of Tripura and Haora river basin is one of them. As we know, a particular area is responsible for the total run-off taking place within the water shed. The distribution of rainfall or precipitation is not equal throughout the river basin. Therefore, it is essential to divide the total watershed into number of sub-basin which helps to calculate the run-off more accurately. The different rain gauge device needs to be installed in each sub-basin in order to get the amount of rainfall in a particular area. In the present scenario, it has been observed that unequal distribution of rainfall occurs in neighbouring states of Tripura.

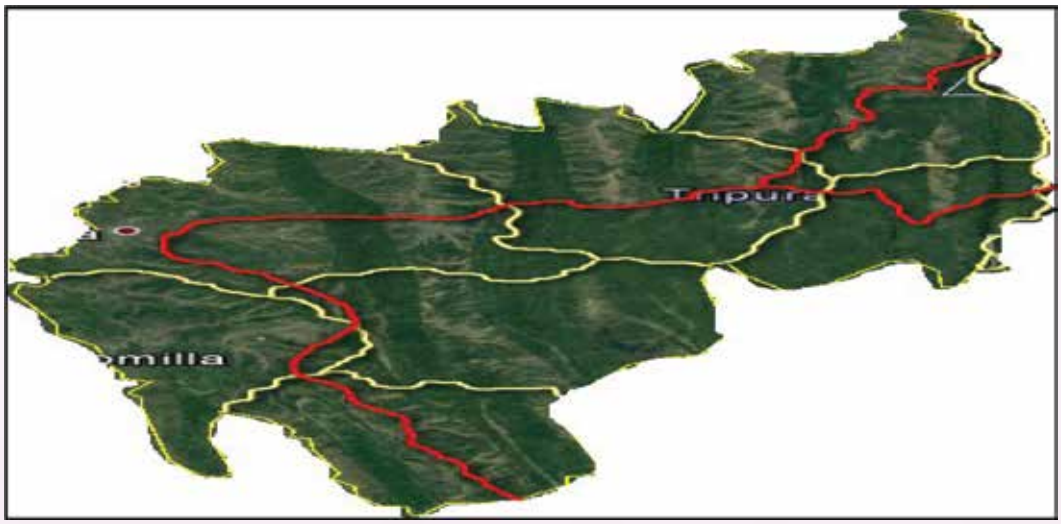
This project mainly focuses on finding out total run-off taking place in Haora river basin. The total run-off in the Haora river basin has been evaluated by adding the amount of rainfall in all sub-basins and also considering other factors responsible for total run-off in water shed management. Moreover, different multi criteria decision making (MCDM) techniques are used to find out most responsible sub-basin contributing in the total run-off. This also can be used to locate the most effective zone affecting the climatic condition of a region in large water shed. MCDM methods also help to locate the zone which is mostly eroded due to the effect of heavy rainfall.

ESTIMATION OF RIVER RUNOFF IN HAORA RIVER BASIN

In this project, Haora river basin has been considered to find out the total run-off with the application of MCDM techniques. The water-shed has been divided into 8 sub-basins. Each sub-basin has a rain gauge to measure amount of precipitation of that area. The other parameters responsible for the total run-off have been considered and their respective data has been collected from the metrological department of Tripura. The total collection of different data predicts total run-off more precisely. MCDM methods like MOORA, VIKOR, COPRAS and TOPSIS is used to predict the highest participation zone in the Haora river basin.

The main objectives of the project are listed below:-

i. Distribution of sub-basin in the Haora water shed using Google earth by observing maximum slope.
ii. Collection of data to find humidity, average rainfall, land use pattern, forest cover, agricultural region and slope.
iii. Development of decision matrix considered in the study to create criteria as parameter responsible for run-off and sub-basins as alternatives.
iv. Application of AHP method to find weight factors for different criteria.
v. Calculation by different MCDM method according to their inherent property.
vi. Calculation of total run-off in the Haora river basin.



Haora river basin

ACHIEVEMENTS

- Accurate method in order to predict the run-off.
- Most eroded zone can be located.
- Reduce the time of calculation for run-off compared to other method.
- Measures to avoid losses and their factors could be identified.

PAPERS PUBLISHED IN JOURNALS / PAPERS PRESENTED IN SEMINARS / M.TECH THESIS / PhD THESIS / PATENT GENERATED FROM THIS PROJECT

- "Analytic Hierarchy Process and Multi-criteria decision-making Approach for Selecting the Most Effective Soil Erosion Zone in Gomati River Basin" Rajesh Chakraborty, Dibyendu Das, Rabindra Nath Barman, Uttam Kumar Mandal, International Journal of Engineering Research and Technology (IJERT), ISBN-2278-0181, Volume-5, Issue-01, 2016.

Haora River in Agartala, Tripura

To Develop an Inbuilt Hydraulic Jack in a Vehicle

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Front jacks

Rear jack hinged mounting

Operation of Rear jack

OBJECTIVES

Objective of the project is

- To make a vehicle with inbuilt hydraulic jack system.
- The hydraulic system will be operated by the Engine itself.
- The hydraulic system will be automatically connected and disconnected by individual switch.
- Independent hydraulic jack for the front and rear wheels.

The proposed automobile hydraulic jack can be easily operated by hand operated leaver provided on the dash board. The jack will be installed on both the sides of chassis according to the weight distributions of the car. The

system operates on hydraulic drive which consists of three main parts-magnetic clutch to drive the hydraulic pump, hydraulic pump and hydraulic cylinder to lift the vehicle. The hydraulic jacks actuate separately for either side of car as per the breakdown condition. This jack will be very useful for all the senior citizens and especially for females (ladies) who find it extremely difficult to operate the jack manually under any breakdown condition. The motive behind using hydraulic system instead of a pneumatic system is to derive more power produced by the system and also simpler its design as compared to a pneumatic system. As the hydraulic oil is incompressible so the lifting capacity is more in comparison with the pneumatic system.

It is believed that 'Necessity is the mother of invention'. Here the necessity lies in reducing the human effort applied during manual operation of the jacks. The manual operation of the jack is a tedious as well as very time consuming work. The jack has been designed keeping in mind the need of the elderly people and ladies which operates on a simple automatic hydraulic system which can be operated from a dashboard mounted control.

ACHIEVEMENTS

An inbuilt hydraulic jack system can be easily attached to all currently manufactured automobile chassis and frames. There is a front suspension hydraulic jack that is mounted to the front side of both the automobile wheels. There is also a rear suspension hydraulic jack that is mounted centrally to the rear suspension of the automobile between its rear wheels.

The system operates on the hydraulic power. This arrangement has many advantages so far as maintenance and servicing of vehicle is concerned. The proposed arrangement is also very useful for heavy loading vehicles and a single person can go on a long drive.

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.

To Develop an Onboard Digital Display to Measure Kilometers Run by Remaining Fuel in Tank

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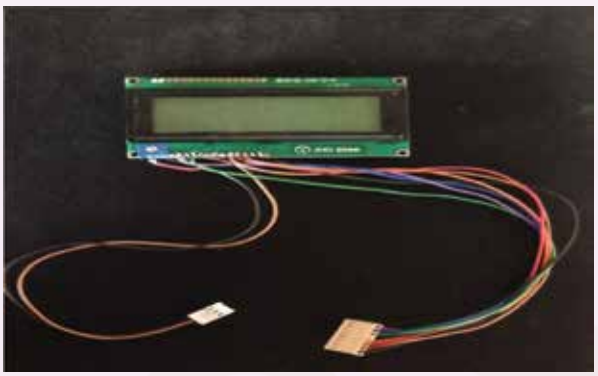

Display

Sensor

Circuit

Micro-controller

OBJECTIVES

In this project we have made a digital fuel measurement device which is able to measure the amount of the fuel in the tank at any time. The concept was to show the fuel level in liters/ml and to show the average/mileage of the vehicle. This idea was initiated by us keeping in mind the increased use of vehicles on roads which further increase the consumption of fuel and to modify the fuel consumption of the luxury segment of cars at per with other vehicles. As the automobile industry is under pressure to ramp-up production across the globe, leading to increased consumption of fuel, it is very much necessary to use the fuel efficiently. The project was undertaken in the same vein, which can show the fuel measurement as well as average mileage of the vehicle exactly so that the driver can have an idea of the fuel in the tank. This also increase the knowledge and idea about the fuel measurement and average which actually guide the driver how much fuel is there in tank as well as how much

Assembly and mounting on frame

is the average of the vehicle and addition to that we also work out that how much the vehicle will move with the remaining amount of fuel in the fuel tank. The main advantage of this project is that our display can show the fuel measurement and average in both petrol and diesel engine and also in 4 stroke and 2 stroke engines.

Legacy of IEI

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

Development of Automatic GSM based ICU Patient Oxygen and Saline Level Monitoring System

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GSM Based ICU Patient Oxygen and Saline Level Monitoring System

Monitoring Saline level using SLOT Sensor

OBJECTIVES

The objective of the proposed system is to monitor the oxygen and saline level of ICU patient by using slot and IR sensors respectively. The proposed system enables the doctor or nurse on duty to monitor the saline and oxygen flow rate from remote sites. The patient need not rely on staff vigilance to ensure that the volume of oxygen in the cylinder does not drop below a critical level. Also an IR sensor is used at the neck of the saline bottle to know the flow rate of the liquid. The output obtained from the sensors is processed to determine the flow rate of oxygen and saline and the same is transmitted through GSM technology to the mobile of monitoring staff for further actions.

ACHIEVEMENTS

The oxygen and saline level of patients are monitored by the IR sensor and SLOT sensor respectively. The IR transmitter and receiver are placed at the floating unit of the oxygen cylinder and the slot sensor is placed below the adjusting unit of the infusion tube. The depletion level in the oxygen cylinder is indicated if an interrupt occurs in between the transmitter and receiver. Similarly, the saline level depletion is indicated when the saline goes below the adjusting level in the infusion tube. If both the oxygen and saline level goes below the threshold level then it alerts the doctor and nurse by sending the message through GSM.

The SLOT sensor is used to determine the saline flow in the infusion tube. IR sensor is used to determine the pressure level of oxygen in the oxygen cylinder. The test bed of the prototype consists of PIC Microcontroller, IR sensor, Slot sensor, amplifier, MAX 232 IC, LCD Display and GSM Modem. When the saline is not present in the infusion tube then the SLOT sensor indicate its low level and alerts the doctor via mobile through the GSM. After displaying the alert message, the GSM module send message to the doctor is or nurse is mobile phone. This system enables the doctor or nurse on duty to monitor the saline flow from remote sites.

Smart Android Home

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Hardware Controller

Main Page of the Android Application

OBJECTIVES

The Smart Android Home is a project focused on the development of a Home Automation System with an Android Device controller, as the name suggests. The main objective of this project was to construct an intermediate hardware controller which would control and monitor each and every appliance in a house individually. Along with this, the project mainly included the design of an android application for sustainable communication and operation of the device. The project also aimed at making an algorithm to continuously evaluate the amount of Energy consumed in BOT units. Elaborating the functions, an android application was to be selectively designed for a particular hardware controller. It would communicate with the hardware using bluetooth. Using this application, the user will be able to graphically monitor and control the whole of the electrical system connected through the hardware from a remote place. User will be able to analyse the water level in the tank reservoir and thereby operate the electrical pump. There will also be an option for completely automatic control in which the selected or all of the appliances will work according to their need sensed by the system. There will also be an option for timed control of the appliances. In this function, user can feed a desired time in minutes to the system after which he she wants a particular device to get turned on or off. One more mentionable feature is the SMS controlled system in which the user can control the appliances from anywhere in the world by sending an SMS to the controlling android device left home. Ultimately, it is worthy to mention that this controller would be very much affordable for the users with flexible controls.

ACHIEVEMENTS

The project on Smart Android Home (SAH) can be stated as a complete success as all the targeted objectives of this project have been achieved. The hardware controller as well as the android app works very efficiently with no lagging in its performance. A prototype of a home electrical power system was designed to test the functionality of the Smart Android Home. A few prominent achievements can be broadly discussed about the project.

Firstly, the smooth control of the manual remote operation of the system is the primary achievement. On opening the SAH android app there comes a button named "Connect To Home". While the SAH hardware is on, if we click on this button the app automatically turns on the bluetooth and connects to the specific hardware for which it is designed. Owing to this, even if any other SAH hardware is in its vicinity it will connect only with its own hardware i.e. the app is hardware specific. After connection is successful, a new button named "Enter Controls" will be enabled which will take the user to the main page as shown in the figure. In this page, user will get a few options out of which s/he needs to go for "CONTROL MANUALLY" which will take him/her to the room selection page. Accordingly, s/he will select the room to be operated and there all the appliances in the room will be shown graphically in a top view map form. An appliance logo will be yellow if it's powered ON, Red if it's OFF and Blue if it's in automated option. To toggle the appliance ON/OFF, user needs to click on it. On long pressing an appliance logo, other options like configuring the timed control, setting the wattage power of the appliance and turning on Automated Mode for it will be displayed. Again, from the main page, user can enter the "TANK CONTROL" page where a graphical and numerical (percentage) representation of a water level in the tank is shown. User can control the pump from this page. There are also separate indicators in the SAH hardware to indicate which appliance is ON and whether there is a timed control triggered for any appliance. This manual control buttons work very efficiently and swiftly.

Additionally, when the system is put to automation mode, the SAH senses the need of an appliance and thereby turns it ON/OFF. For instance if the water level in tank goes below 10%, it will turn ON the pump and will keep it on until it reaches 90%. All the appliances can be made to automation mode by clicking on the "SET HAS TO AUTOMATION" button on the main page.

One more remarkable achievement is the algorithm to evaluate the energy consumed. For every appliance, user has an option to feed its wattage power. This algorithm uses this wattage power and the time for which the appliance was ON to compute the BOT units consumed by it. As a matter of fact, this evaluation won't be very accurate as it will not directly measure the energy consumed but for home usage it can be used for a crude approximation of the electricity bill.

Lastly, a major achievement of this project is the worldwide control of the appliances using SMS control. The user can register one of his mobile number with this SAH application for this feature. If the android device having this app installed is left in the vicinity of the SAH hardware, user can send some specified commands through SMS from the registered number to this device which will be implemented by the SAH. For example, if the android device receives an SMS from the registered user as "SAH ALLOFF", the SAH app will automatically process this SMS, will turn on the bluetooth, connect to the SAH hardware and turn OFF all the connected appliances (as this commands implies to turn off all appliances). A great advantage of this process is that the android device doesn't need to remain connected to the hardware or even have its bluetooth on to process this command. SMS controlled system can be configured from the main page from "SMS CONTROL SETTINGS".

In conclusion, it can be mentioned that all these achievements were verified on the home power system prototype and they showed very precise performance without causing any operational delay or fault.

Low Cost Wireless System for Monitoring and Improving Agricultural Procedures

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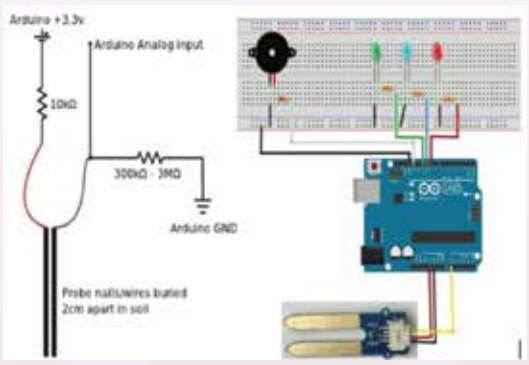
Lab setup with self regular drip irrigation demonstration



Circuit diagram and system interconnection for soil moisture sensor as well sprinkler trigger

OBJECTIVES

In highly populated countries like India there is a large dependence on agriculture for food and living. Innovation and latest technologies have major role in those areas in order to ensure high yield and resource optimisation. Prime objective of this work is to introduce low cost precise agriculture monitoring, maintaining regulated use of pesticides, fertilizer etc. Even for the agri scientist as well the researcher there is no low-cost tools available which can help them to continuously monitor the field conditions so that any outbreak of disease can be monitored as well prevented. An array of sensors coupled into a programmable microcontroller which can be connected to the base station that is a computer or Android mobile phone. These work primarily over the GSM mobile network that will help the farmers, the agri scientist to take decision depending on the weather and other biological reason which may affect the growth and production of any agricultural system. The novelty of the work lies in the form of low maintenance cost, self-controlling, easily availability as local resources, the sensor programming coupling which can utilize the latest IT technologies for sharing the data or knowledge gained.

ACHIEVEMENTS

The main goal of the project is to send sensor readings to mobile phone (android) from arduino board using wireless communication which has been achieved. The module consumes little power as it reads periodically and the combination of sensors i.e. soil pH sensors, moisture sensors and possibly others, like sensors to read leaf wilting, servos to control pumps etc. gives all the required information to the farmer. A reliable bluetooth module can be used to communicate using an android app this platform can also be used in animal husbandry by giving real time information about cattle. The main aim of this project is to propose a wireless sensor system for agriculture, which can show the path to the rural farming community to replace some of the traditional techniques. In this project, the sensor motes have several external sensors namely leaf wetness, soil moisture,

soil pH, atmospheric pressure sensors attached to it. Based on the value of soil moisture sensor, the mote triggers the water sprinkler during the period of water scarcity. Once the field is sprinkled with adequate water, the water sprinkler is switched off. Thereby water can be conserved. Also the value of soil pH sensor is sent to the base station and in turn base station intimates the farmer about the soil pH via SMS using GSM modem. Obtaining the soil pH value in his mobile the farmer selects the necessary fertilizer and crop for his next season. Hereby the amount of fertilizer used can be reduced. In order to overcome the lack of information and technical support and to increase the rice production, development of rice cropping monitoring using WSN is proposed to provide a helping hand to farmers in real-time monitoring, achieving precision agriculture and thus increasing the rice production. Thus automated control of water sprinkling and ultimate supply of information to farmers is done as a result of this project using wireless sensor network.

In this project, we could design real-deployment of WSN based crop monitoring which is designed and implemented to realize modern precision agriculture. End users can tailor the remote operation to a variety of experimental setups, which will allow farmers to reliably collect data from locations previously inaccessible on a micro-measurement scale. Such a system can be easily installed and maintained. This work successfully applies the wireless sensor networks on agro-ecology fields by investigating environmental situations. The complete real-time and historical data logging environment with mobile based visualisation of information is expected to help the agro-ecological specialists to achieve efficient management and utilization of agro-ecological resources.

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

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

Sir M. Visvesvarayya

Novel Design of Automated Wheel Chair for Differently Abled Persons using Wireless Sensor Networks

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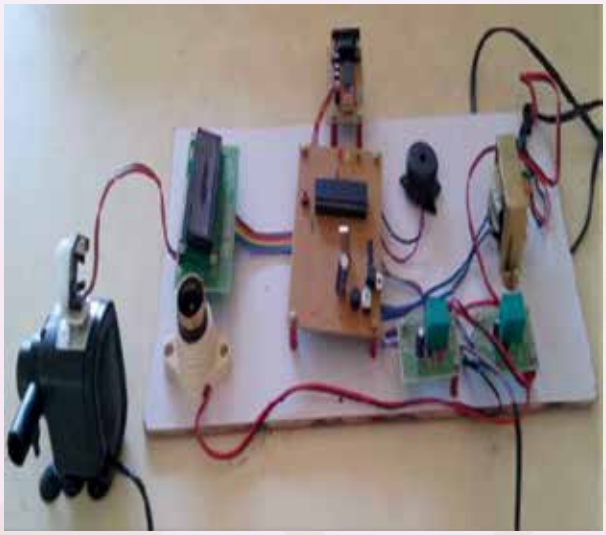
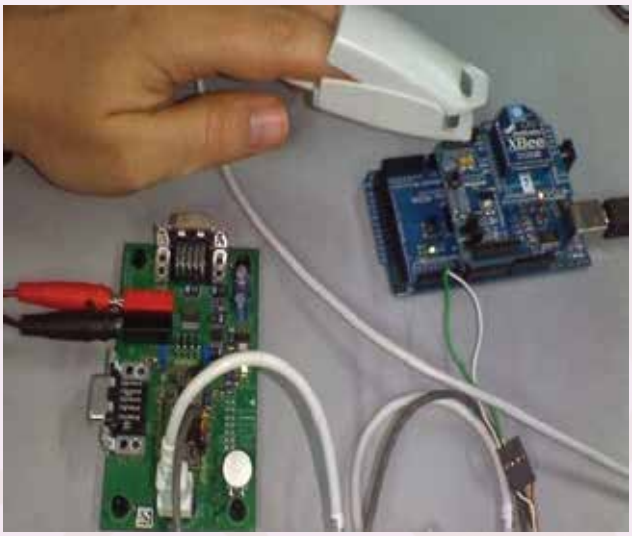


Snapshot of Wheelchair Circuit



Health Monitoring Circuit

OBJECTIVES

Differently abled persons face many challenges in their life. The main aim of the project is to assist differently abled persons in leading a normal life. In this project a fully automatic wheel chair with GPS enabled system is designed to solve the problems faced by differently abled persons. We display their thought using sensor modules and also using net beans. Zigbee technology is involved for monitoring their health conditions. Further, a smart home is designed which provides a fully automatic system for them. By using GSM technology, gas leakage and circuit failures are indicated to them through SMS alarm and we provide security to them by using fingerprint matching circuits. This system is being developed to increase the mobility of differently abled individuals by providing navigation assistance. The ultrasonic sensors are used to improve the localization when we use an automatic control system.

Moisture Level Monitoring

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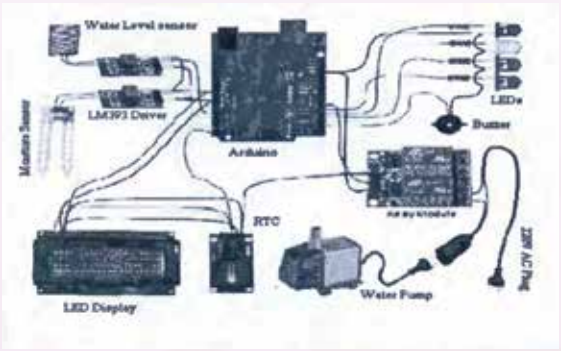
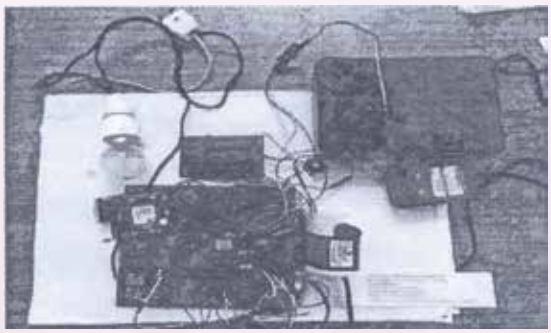


Moisture Level Monitoring



Moisture Level Monitoring

OBJECTIVES

To make better use of our limited freshwater resources, farmers need to have an efficient water delivering system to the plants, and also an efficient watering schedule, so that the plants may get watered with the right amount at the right time. In this context, the objective of the project is to develop a model that makes the agricultural irrigation process easier and burden free for the farmers. With the recent advancement of technology it is important to enhance the ability of conserving the fresh water resources as well as giving a splendid boost to the production of the crops to increase the annual crop production output. Irrigation management is a complex decision making process to determine when and how much water is to be applied to a growing crop to meet specific management objectives. Additionally, if the farmer is far from the agricultural land it is difficult to monitor the power availability. Hence, efficient water management system plays an important role in the irrigated agricultural cropping systems.

Since different crops require different amount of water to be supplied, the designed system focuses on integrating moisture sensor, microcontroller and GSM technology. The project is mainly used to control the switching action of the motor in the field based on the dry and wet conditions of the field using an appropriate moisture sensor data. The moisture sensor used in this project is a variable resistor, whose resistance varies depending on soil moisture and the corresponding information is sent to the controller. Based upon the field conditions, and whenever power supply is available, the motor will be made "ON" and SMS will be sent to farmer. This system has low power consumption, and high sensitivity, which are very useful characteristics of this module.

ACHIEVEMENTS

By using this project farmers can control the moisture content of the soil in the cultivating field. Based on soil moisture, pumping motor will be automatically switch "ON" or "OFF" through relay control. This saves the water and on the other hand the plant can get optimum level of water which increases productivity of the

crop. With implemented technology we have tested and validated numerically and in the field conditions. By using this sensor, we can find whether the soil is wet or dry. If it is dry, pumping motor will pump the water automatically and ON or OFF and status of the motor will be sent to the farmer. The soil moisture content based irrigation system is developed and successfully implemented along with flow sensor. Salient features of the system are: Closed loop automatic irrigation system, temperature and water usage monitoring. User can easily pre-set the levels of the moisture and is regularly updated about current value of all parameters on LCD display. In future, other important soil parameters namely soil pH, soil electrical conductivity can also be incorporated in the system. This project is very useful for the farmers and gardeners who do not have enough time to water their crops/plants. Farmers can optimize their water use, right from their smart-phone. It provides water for plants according to the crop water requirement and operates according to the soil moisture condition of the root zone of plants. Thus it reduces excessive pressure on farmers to pay heavy electricity bill on water utilization and also save energy consumption. Further, automated irrigation system allows farmers to apply the right amount of water at the right time. Use of this system minimizes human attention on irrigation significantly.

Recent advances in soil water sensing make the commercial use of this technology possible to automate irrigation management for vegetable production. However, research indicates that different sensor perform under all conditions with no negative impact on crop yields with reductions in water use range as high as 70% compared to traditional practices.

The project which is to be implemented is an automated irrigation method and has a huge scope for future development. The project can be extended to greenhouses where manual supervision is far and few in between. The principle can be extended to create fully automated gardens and farmlands. Combined with the principle of rain water harvesting, it could lead to huge water savings if applied in the right manner. In agricultural lands with severe shortage of rainfall, this model can be successfully applied to achieve great results with almost all types of soil.

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

Fabrication and Testing of Roselle / Sisal Fiber Reinforced Polyester Composite as a Wood Substitute Material

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Chemical Treatment of Natural Fibers

Composite Plate – Microfibrillated fiber / Polyester matrix

OBJECTIVES

The bast fibers exhibit a superior flexural and tensile strength and modulus of elasticity, but the leaf fibers show superior impact properties. For the current investigation, Roselle, a bast fiber and sisal a leaf fiber are chosen. Roselle/sisal polyester-based hybrid composites exhibited positive hybrid effect

The objectives of the current investigation are as follows :

1. To develop Roselle- Sisal fiber reinforced polyester composites
2. To study the tensile properties of open hole, dry composite specimens.
3. To study the tensile properties of open hole, wet composite specimens.

ACHIEVEMENTS

The composites reinforced with Roselle and Sisal were fabricated. Tensile test was carried out for the neat resin, composite and also open hole tensile test was carried out. Only dry specimens were tested.

The composites containing 10 wt % fiber (15 cm long) exhibited a tensile strength of 38 MPa which is about 100 % more than the neat resin. Tensile tests with open hole and filled hole were carried out .

In the case of open hole tests the strength ranged from 27 MPa to 32 MPa and in the case of filled hole test the strength ranged from 22 – 26 MPa .

In addition, an attempt was made to extract nano cellulose from Sisal fiber. The fibers were steam exploded in an auto clave. The fibers obtained after steam explosion were used to reinforce the polyester. The fibers were characterized using SEM. Dry tensile tests were carried out using 5% micro fibrillated cellulose the results showed that the strength has marginally improved.

Further investigation is to be carried out to understand the behaviour of such materials and to develop a wood substitute.

Design and Development of Disposable Silver Screen Printed Electrode (Ag SPE) for Halogen Detection in Water Bodies

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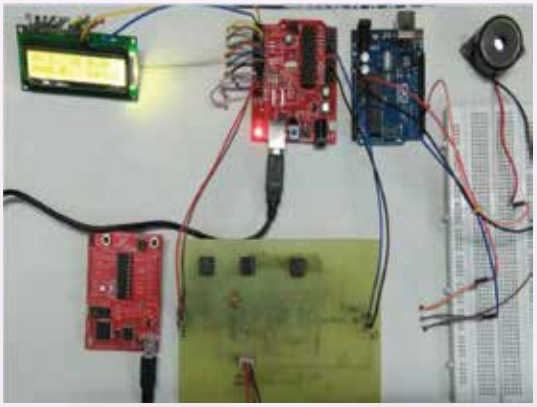

Electronic set up for measuring halogen in water

Correlation study with Agilent Precision Instrument

OBJECTIVES

- Optimum fabrication of disposable screen printed electrode using nanosilver ink
- Design and development of allied electronic circuit with display unit
- To maintain the measurement accuracy by comparing with the standard lab test procedure
- Make it usable in domestic, commercial and industrial environment.

ACHIEVEMENTS

- Presently available techniques like strip methods though indicates the contamination but do not reveal the accurate level of concentration. The other conventional method though accurate but is an expensive one. The developed sensor will quantify the concentration of halogens at a faster rate with accuracy.
- The cost involved for the process is comparatively very less.
- This is portable and user friendly and do not require a skilled person for operation.
- Minimal quantity of sample (in ml) is sufficient to perform the test.

PUBLICATION

"4th International Conference on Nanoscience and Nanotechnology" (ICONN-2017) held at SRM University during August 9-11, 2017.

Smart Cane for Visually Impaired People

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Smart cane with Project Group

Smart cane

OBJECTIVES

The project is intended to help the visually challenged people to walk more confidently. The study hypothesizes a smart walking stick, that alerts visually- impaired people over obstacles, pits and steps in front of them, thereby reducing possibilities of accident. It outlines a better navigational tool which consists of ultrasonic sensor to give information about the obstacles, pits and steps. Ultrasonic sensors are used to calculate the distance of the obstacles around the blind person to guide the user towards the available path. Primary output is in the form of vibration and secondary output is in the form of voice (e.g., turn left, turn right etc) along with a multi language selection feature. It also has a navigation system in which global positioning system is used to get real time coordinates. Geocoding is used to convert address into coordinates. Way-points technique is used to calculate the distance and direction from location A to location B. The result of navigation in terms of distance and direction will be performed by text to speech on processing platform.

ACHIEVEMENTS

The project is intended to help the visually challenged people to walk with more confidence using a smart walking stick. The navigation system with an android app is used to get path from current location to destination. The aplication gives current location when it start running. The speech processing sections identify the destination given by the user, send a specific code to the android App via Bluetooth and the systems navigate the user to desired destination. The voice output is given through a headphone by the Smartphone.

Developing Sub daily IDF Curves for Urban Cities in Kerala Meteorological Subdivision using Multivariate Empirical mode Decomposition and Scaling Theory

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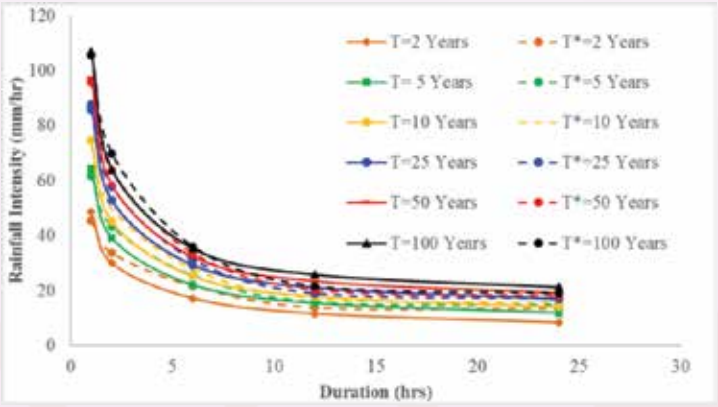
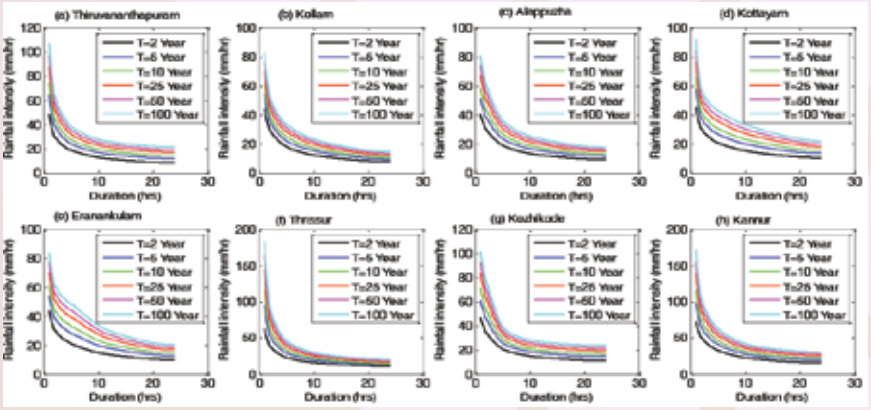


Comparison between IDF curves for Thiruvananthapuram city derived from daily data and monthly data using the MEMD-EV-PWM method. T is the return period for developing IDF curves from daily data and T* is the return period for developing IDF curves from monthly data



Hourly IDF curves for 8 cities in Kerala prepared by MEMD-EV-PWM hybrid method. (a) Thiruvanathapuram; (b) Kollam; (c) Alappuzha; (d) Kottayam; (e) Eranakulam; (f)Thrissur; (g) Kozhikode; (h) Kannur

OBJECTIVES

- To propose an alternative methodology for developing sub-daily IDF curves from coarse resolution data by combining Multivariate Empirical Mode Decomposition with scaling theory.
- To apply the proposed method for developing IDF curves for different cities in Kerala.

ACHIEVEMENTS

- In many of the cities in India, the rainfall data is available only in coarse resolution scale such as daily time steps. For the design of urban drainage systems, the intensity- duration-frequency (IDF) curves are most practical hydrological tools, for which data at finer scale such as hourly/sub-hourly are required. This research proposed a robust alternative method by coupling Multivariate Empirical Mode Decomposition with scaling theory for developing IDF curves of finer resolution data from available coarse resolution data. The method is applied for developing IDF curves for different cities in Kerala, where the rainfall is available only in daily time scale, which is useful for the practitioners in urban infrastructure design. Moreover, this pilot study laid a foundation for major research work such as developing IDF curves for projected rainfall of future and to understand the alterations required for present systems under a changing climate scenario.

PUBLICATION

- International Conference
  - Adarsh S, Jesna Fathima, Muhammed Siddik A, Sruthi V Roy, Rukku Chandran (2017) Derivation of sub-daily IDF curves for urban areas in Kerala using multi-variate empirical mode decomposition and scaling theory. In Proceedings of International conference FEAST2017 NIT Trichy, pp. 37-42.
- International symposium (for students)
  - Jesna Fathima, Rukkuchandran and Sruthi V Roy (2017) presented a paper "Derivation of hourly IDF curves for urban areas in Kerala using multiscale decomposition and scaling theory" in the International Civil Engg Symposium ICES2017 as part of AAKAAR2017at IIT Bombay March 3-4, 2017.

Legacy of IEI

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

Electric Power Generation for Television using Solar based Dish Antenna

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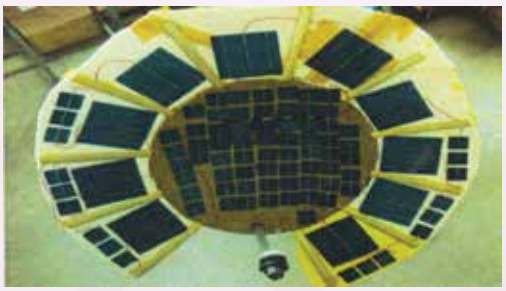
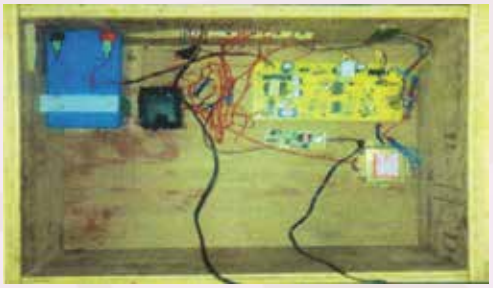
OBJECTIVES

Every household now has a TV set, and many are subscribers to the direct-to-home plan involving a dish antenna and set-top-box. Conventional wisdom says that the dish antenna for a dish TV arrangement collects the beamed signals and focuses the beam on to the feed horn in the device which is mounted in front of the dish and connects to the set-top-box. Different brands of dish TV use dish of different sizes though the picture quality remains about the same. Also, the feed horns used by different brands were more or less of the same size. Since the signal broadcasted TV signal is the same, so it can hypothesized that perhaps the entire dish surface is not needed for a good reception.



Solar Cell With Dish Antenna



Inverter Circuit Design

TV With Set-Up Box Connection

Antenna is an important part of any wireless communication system as it converts the electronic signals into electromagnetic signal. An antenna which is operated at microwave frequencies is known as microwave antenna. There are various types of microwave antenna amongst which the parabolic antenna is the one which is easily installable. Most of the household dish TV has a parabolic antenna for the signal reception.

A parabolic antenna is an antenna that uses a parabolic reflector, a curved surface with the cross-sectional shape of a parabola, to direct the radio waves. The most common form is shaped like a dish and is popularly called a dish antenna or parabolic dish. The main advantage of a parabolic antenna is that it has high directivity. It has many advantages such as highly reliable, having no moving parts and environmentally friendly, when compared to conventional power generators.

ACHIEVEMENTS

This project is mainly used to produce the electrical energy as well as to reduce the power demand. The power utilization cost in the home appliances is minimized.

A method of designing a dish antenna that serves two purposes has been demonstrated in this project. This project was framed around this idea, and it was decided to line this large 'free area' with solar cells and generate electricity. The dish TV setup would then serve its primary function as well as provide an alternate source of

clean energy. The crux of the work is that the whole process is done at the least possible cost and it is affordable for practical implementation. In future it may see all the dish antennas may come plated with solar panels.

The solar cells are no longer an obscure concept. There also now exists the technology to turn this motion into energy and through it one can build a better life. This is the greatest technological breakthrough regarding alternative energy time.

In conclusion, the solar power generation for television is a new step in alternative energy technology. People who claim the effectiveness of the signal from the satellite that there no interference of the signal from the satellite.

The solar power for television offers specific advantages when compared to other existing energy sources. It is the least expensive energy source when compared to traditional electricity generation methods. It does not leave a negative impact on the environment and moreover it the least expensive, clean, and affordable alternative energy source in the world.

FUTURE SCOPE

- In almost all homes, a dish antenna is available. So, a dual function dish antenna can be easily used in homes for lighting, charging and can be used to run low power electrical devices.
- Mobile broadcasting vans also known as outside broadcasting vans are used for remote coverage of an event, using a range of standard broadcasting facilities. As it is under the sun during the day time the concept can be used to its maximum.
- The concept can be used in sailing ships. As the ships communicate to the land system through satellite for transmission and reception, these solar plated antennas can be used for storing energy without hampering its usual work. Also, in defence sectors the purpose can be served.
- The power generated can also be used for decorative lightings and fish tank.

PUBICATION

International Conference

1. N. Balaji, K. Bhanumathi, J. Mujeebar Rahiman and S. Thirumoorthi presented a paper on “Electric Power Generation for Television Using Solar Based Dish Antenna” 2nd International Conference on Advances in Bio Technology, Civil & Mechanical Science (ICABCMS-16)on 17-03-2016 & 18-03-2016 at Selvam College of Technology.

National Conference

2. N. Balaji, K. Bhanumathi, J. Mujeebar Rahiman and S. Thirumoorthi presented a paper on “Electric Power Generation for Television Using Solar Based Dish Antenna” National Level Conference on “Quality through Innovations in Engineering (NLC-QIE)” on 22nd March 2016 at Erode Sengunthar Engineering College.

Project Presentation

3. N. Balaji, K. Bhanumathi, J. Mujeebar Rahiman and S. Thirumoorthi presented a project on “Electric Power Generation for Television Using Solar Based Dish Antenna”,1st IEI HLC Technicians & Students Convention and National Seminar on “Shaping Technical Education to Address Sustainability and Global Competitiveness” on 3rd & 4th March, 2016 at Adhiyamaan College of Engineering.

Solar Smart Cultivation System

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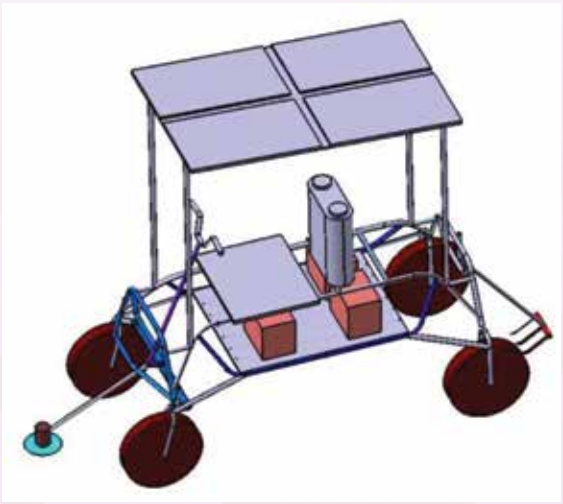
Complete Project View



CAD Model

OBJECTIVES

The main objective of our project is to increase the productivity in cultivation field by using solar energy and decrease the human involvement. It also decrease the effort of man in agricultural fields. Availability of labour has become a big problem nowadays as they are going to towns for earning high wages with less effort compared to farming. This equipment can be used for cultivation of land without involvement of a large number of people.

ACHIEVEMENTS

A farmer can do all the basic works in cultivation fields by using single equipment such as PLOUGHING, SPRAYING and HARVESTING the crop.

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

BiFiCo an Effective Solution for Poultry Farm Odour

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Bifico full setup

Bio column

OBJECTIVES

Poultry farming is a livelihood for a good section of the society these days. However, hygiene in these poultry farms has been a major concern both for the farmer and the consumer. Decomposition of poultry waste, feathers, and dust causes unpleasant odour in the poultry farm. The odour detected from a poultry operation is a complex mixture of gases resulting from the uncontrolled anaerobic decomposition of the poultry excreta. However, feed spoilage can also contribute to the odour. As biological degradation of organic material progresses, odorous compounds are produced in the liquid and solid phases, viz; volatile fatty acids, mercaptans, esters, carbonyls, aldehydes, alcohols, ammonia, and amines. Apart from H_2S and ammonia; n-butyric and n-valeric acid contributes immensely to the pungency. This project aims at the production of a gas biofiltration column capable of removing these 4 components from the gas stream. It is possible to remove H_2S and ammonia gas from the gas stream by using suitable adsorbants. Volatile small chain fatty acids like valeric and butyric acids in its esterified form produce a fruity smell. The characteristics will be used to design of a biofilter column capable of removing/converting these components.

Biofilters are reactors in which waste gases are allowed to pass through a porous packed bed material immobilized with suitable microbial cultures. Biofiltration utilizes a supported media for microbial growth to remove odours from air streams. The objective of this project is to investigate the effectiveness of a biofilter in reducing odour producing components under different operating conditions using a moist enriched woodchip medium. The filter is operated in down-flow mode.

ACHIEVEMENTS

The removal of odour producing components like ammonia, H_2S, butyric and valeric acid was done successfully. It was found that, for 85% removal of odour of humidified poultry farm air it requires almost 2-3 hr.

The adsorption isotherm model for activated charcoal and silica gel was obeyed by the Freundlich equilibrium. The thermodynamic properties of adsorption concluded that the process was spontaneous and favourable. The present study indicates that the locally available coconut shell can be utilized for the production of activated carbon. The value of Freundlich exponent, n is greater than unity, indicating that ammonia ions and H_2S are favourably adsorbed on activated coconut shell charcoal and silica gel.

The strains Saccharomyces cerevisiae and Rhizopusoryzae were able to carry out selective direct acylations of primary and secondary alcohols in organic solvents often found within this species, provided that suited cultural media are employed for their growth. The test for presence of ester wad positive and during the reaction ester will hydrolyse ethanol and the acid produced will neutralise the KOH and turn the indicator to its colourless, acid form.

Legacy of IEI

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

Design and Development of Sliding Mode Controller for BLDC Motor Powered Hybrid Vehicles

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Experiment set up – Compact RIO, drive, I/O module and motor

OBJECTIVES

Brushless DC motor is being used in hybrid electric vehicles due to it being 85–90% more efficient, its ability to respond faster and at higher operating speeds, ability to self-start and simplicity with regard to speed control and reversing and its lesser affinity to failures when compared to brush motors. SMC is being implemented due to its good performance even with non-linear systems, robustness shown by its insensitivity to parameter variations and external disturbances. This project is significant because with the increasing popularity of green vehicles, it is expected that BLDC will dominate the market. The objective of the project is to improve the efficiency of electric hybrid vehicles or even conventional IC engine powered vehicle by proposing an electric power steering system actuated by BLDC motor. A sliding mode control is proposed because of its higher robustness capability against various disturbances and parameter variations.

ACHIEVEMENTS

a) Knowledge in machine theory and advanced control theory

b) Skill in software-hardware interfacing, system integration and problem solving

c) Development of control schemes for BLDC Motors to be used in steer by wire automobiles.

d) Skill in using LabVIEW, MATLAB and FPGA based Real Time Embedded Platform for control applications

Development on High Strength Self-Compacting Concrete

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OBJECTIVES

The problem of the durability of concrete structures has been a major problem posed to engineers. To make durable concrete structures, sufficient compaction is required. Compaction in conventional concrete is caused by vibration, but, vibration causes segregation. In conventional concrete, it is difficult to ensure uniform material quality and good density in heavily reinforced locations. If steel is not properly surrounded by concrete it leads to durability problems. When it comes to heavily reinforced structures, this issue is prominent. In such cases it becomes extremely difficult to compact the concrete which leads to honey combing.

Slump Flow Test

A solution to such a problem is self-compacting concrete. Self-Compacting Concrete (SCC) has a capability to flow in between the most congested reinforcements with its own weight and it requires no compaction. Self-compacting concrete is growing rapidly, especially in the precast market where its advantages are rapidly understood and utilized. High deformability and high segregation resistance is obtained by limiting the amount of coarse aggregate and by increasing the amount of fines.

J-ring Test

High strength concrete can be produced with normal concrete. But these concretes cannot flow freely by themselves and hence require a lot of vibration to compact. High Strength Self-compacting Concrete has been aimed at achieving the fresh properties of SCC and the hardened properties of high strength concrete.

Objectives of the project work:

- The work has been focused in developing SCC mixtures with the strength ranging from 60 to 100 MPa.
- Three different aggregates, such as crushed granite stones, crushed dolerite stones and pebbles (rounded aggregates) which are available in and around Pondicherry are used for the work.
- The flow properties of SCC such as slum flow, J ring test, T50 cm test are conducted to check the flow properties of concrete.

METHODOLOGY

The methodology adopted for the project work was:

1. Identification and procurement of suitable ingredient material required for producing High Strength Self-compacting concrete
2. Identification of suitable concrete mix proportions to produce High strength Self compacting concrete
3. Performing Physical and Mechanical laboratory test on High strength Self compacting concrete.

4. Analysing the result and conclude.

Self-compacting concrete consists of the same components as conventionally vibrated concrete, which are cement, aggregates, and water, with the addition of chemical and mineral admixtures in different proportions. Usually, the chemical admixtures used are high-range water reducers (super plasticizers) and viscosity-modifying agents, which change the rheological properties of concrete. Self-compacting concrete, having enhanced ability to flow, is known to have increased segregation and bleeding potential. To increase the stability of fresh concrete (cohesiveness) requires increased amount of fine materials in the mix. Fines such as fly-ash, silica fumes and quartz powder which are used in the mix are majorly obtained as waste material from industries. Making use of waste material from industries makes it a greener material. Unlike conventional concretes SCC demands a good knowledge on the impact of the constituents on properties of concrete at different stages.

Influence of mineral admixture: Silica fume is the one of the most popular pozzolanas, whose addition to concrete mixtures results in lower porosity, permeability and bleeding because their oxides (SiO_2) react with and consume calcium hydroxides which are produced by the hydration of ordinary Portland cement. Advantage of silica fumes in the mix is that the mortar matrix becomes dense. Because of its extreme fineness and very high amorphous silicon dioxide content, silica fume is a very reactive pozzolanic material. Micro silica is more reactive than fly ash or any other mineral admixtures.

Influence of filler: Addition of filler improves the packing density of concrete by filling the fine spaces between the cement and aggregate wall and makes the concrete dense and homogenous, which increase both fresh and hardened properties of concrete. Quartz powder is crystalline silica with mean size of 10µm. Addition of Quartz powder improves the grading curve and achieves excess paste, giving concrete a very good flow. Quartz particles are inert at room temperature, but, together with $Ca(OH)_2$, they react at high temperature to form C-S-H phases.

Influence of Super-plasticizer: Super-plasticizer is a water reducing agent which does not affect the workability of the concrete. Poly-carboxylate ether (PCE) based super-plasticizer increases the workability and improves the degree of compaction. PCE admixture induce micro structural modifications in the paste which in turn reduce porosity and induce a refinement in pore size, the effect of which is that the paste is less liable to carbonation.

Influence of aggregate: Smaller size aggregate will result in higher compressive strength. The flowability of SCC decreases with the increase in the maximum size of coarse aggregate Therefore, small sized aggregate are preferred. The shape of aggregate influences the properties of concrete i.e. the elongated and flaky aggregate reduces the flow of concrete. The use of rounded aggregates like pebbles in turn increases the flow properties of aggregate. High strength aggregate increases the performance of the concrete in terms of compressive strength.

Mix Proportioning: Mix proportions are aimed to achieve target strength in the range of 60-100 MPa. The mixes are designed using Na Su method. Number trials were conducted by varying the water content and super-plasticizer dosage.

Performed Mix Designs

Mix Design	C (kg/m^3)	SF (15% of C) (kg/m^3)	QP (25% of C) (kg/m^3)	W (l/m^3)	SP (1% of B) (l/m^3)	FA (kg/m^3)	CA (kg/m^3)	W/C	W/B	W/P
SC50-G	500	75	125	180	6	700	690	0.36	0.31	0.25
SC50-D	500	75	125	180	6	700	770	0.36	0.31	0.25
SC50-R	500	75	125	180	6	700	680	0.36	0.31	0.25
SC60-G	600	90	150	190	7	640	630	0.31	0.26	0.21
SC70-G	700	105	175	195	8	550	540	0.28	0.24	0.20
SC50-G-I	500	125	75	180	6	700	690	0.36	0.31	0.25

C-Cement; SF-Silica Fume; QP-Quartz Powder; W-Water; SP-Super Plasticizer; FA-Fine Aggregate; CA-Coarse Aggregate; W/C- Water-Cement ration; W/B- Water-Binder ratio; W/P- Water Powder ratio

B- Binder (Silica Fume + Cement); P- Powder (Cement + Silica Fume + Quartz Powder)

SC50, SC60, SC70 – Self-Compacting Concrete with 500, 600, 700 kg/m^3 cement content respectively

G-Granite; D-Dolerite; R-Rounded Aggregates (Pebbles)

I-Proportions of silica fume and quartz powder has been inverted.

Flow Properties

Mix Design	Slump Flow, mm	T_{50} cm, sec	J – Ring, mm
SC50-G	750	6	5
SC50-D	685	9	7
SC50-R	765	5	4
SC60-G	770	9	4
SC70-G	810	11	4
SC50-G-I	715	8	5

Hardened Properties

Compressive Strength :

Mix Design	7-Days, MPa	28-Days, MPa	60-Days, MPa
SC50-G	68.5	77.8	84.0
SC50-D	72.2	76.3	84.5
SC50-R	55.2	61.2	73.9
SC60-G	59.2	81.0	-
SC70-G	47.8	85.5	-
SC50-G-I	50.7	80.0	-

28-Day Flexural and Split Tensile Strength :

Mix Design	Flexural Strength, MPa	Tensile Strength, MPa
SC50-G	4.76	3.22
SC50-D	6.33	4.32
SC50-R	4.70	3.75

Inference:

1. Increasing the amount of fines such as silica fume, quartz powder and the use of 6 mm aggregate has resulted in homogeneity in the mixture with good flow properties.
2. Use of rounded aggregate shows a relative change in flow property.
3. Dolerite has contributed more towards the hardened properties when compared to granite and rounded aggregates. There is 11% increase in strength when compared to granite.
4. Increasing cement content to 600 and 700 kg/m^3 has shown increase in flow properties and strength.
5. Inverting the proportions of silica fume and quartz powder in mix design has shown similar results.

PUBILCATION

Jeet Daniel Varghese, S. Gowtham, R. Ilavendan, S. Kothandaraman, "Development of High Strength Self Compacting Concrete Using Various Aggregates", ICMSC'17 – International Conference on Modelling Simulation and Control, 1st April, 2017, Coimbatore, India.

Design & Development of a NdFeB Magnet Structure to Produce Large Iso-Gauss Surface for a 2.45 GHz Electron Cyclotron Resonance Plasma Enhanced Nano Film Deposition System

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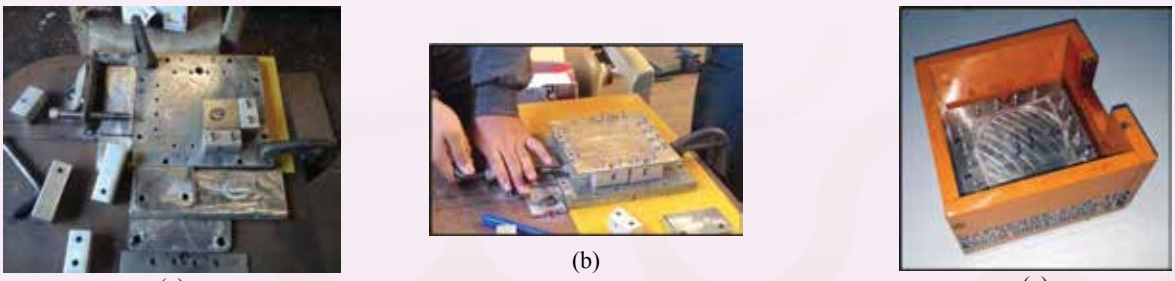
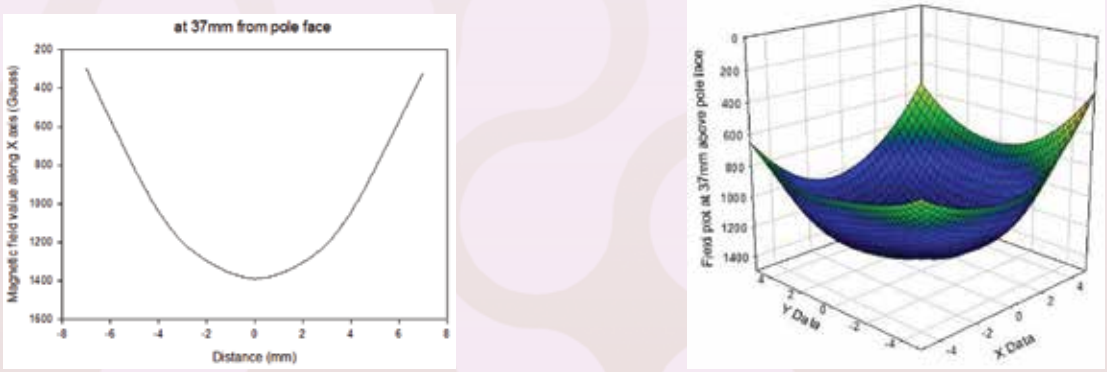


(a) (b) (c)

Fig.1 shows the fabrication steps of the permanent magnet assembly with soft iron return yoke structure



(a) (b)

Fig. 2 The calculated (a) 2-D & (b) 3-D field plots (in Gauss) of magnet assembly at 37mm from the pole face

OBJECTIVES

The basic objective of the proposed project is to design, develop and test of a powerful NdFeB magnet structure to produce large iso-gauss surface for a 2.45 GHz Electron Cyclotron Resonance Plasma Enhanced nano film deposition system. The magnetic structure consists of a powerful dipole magnet symmetrically assembled inside an inverted pot type soft iron return yoke structure. The dipole magnet consists of a set of four numbers of 50mm x 50mm x 25mm rectangular identical NdFeB magnets to create a larger pole area. Each magnet is magnetized along 25 mm direction to retain a residual magnetism of 12 KGauss.

It is really a challenging task to assemble them to form a pole of 100mm x100mm square. A suitable jig has been devised to assemble the permanent magnet under the 15 mm thick pole cap. The magnet assembly along

with the inverted pot like return yoke structure will produce an Electron Cyclotron Resonance large iso-gauss surface of 875 Gauss at a desired distance below the pole face. The resonance of plasma electrons will take place over this iso-gauss surface and high density plasma will be produced efficiently.

The objective is to produce a large (875 Gauss) iso-gauss surface area at a desired distance from the pole face with the help of a permanent magnet assembly and a suitably designed soft iron pole cap and return yoke. The dipole magnet assembly will consist of four identical powerful NdFeB permanent magnet pieces. The magnet pieces will be assembled with the help of a suitably designed nonmagnetic assembly jig. The magnetic field mapping will be carried out with the Hall probe and a final project report will be generated.

ACHIEVEMENTS

The magnetic assembly consisting of four Neodymium Iron Boron (NdFeB) rare earth permanent magnets with 1.2T remanence magnetism assembled inside a 15 mm thick one end open cubical shaped soft iron inverted pot like return yoke structure has been designed and developed. We have used 15 mm thick square shaped pole with hollow cubical return yoke structure as shown in Fig. 1.c. The following works were carried out in the project:

- The mechanical design of the magnet assembly was carried out based on the Magnetic field calculation of the dipole magnetic assembly along with the magnet frame with the help of Superfish-PANDIRA software.
- The four sides of the square iron structure along with the 190mm X 190mm, 15 mm thick square shaped pole were ordered to be machined out from a 20 mm thick soft iron plate.
- 50mm x 50mm x 25mm size four magnet pieces were assembled on the bottom surface of the square iron pole with the help of a suitable jig consisting of a non-magnetic lead screw and magnet adapter. The fixture was used to fix each magnet with the help of a non-magnetic adapter plate, aluminum spacer blocks and bolts as shown in Fig. 1.a & Fig. 1.b. Four walls of the return yoke were assembled to complete the magnet assembly.
- A magnetic field mapping experiment for the complete assembly has been carried out with the help of Gauss meter. The experimental results show good co-relation with the field calculation using PANDIRA software. The experimental result of the field mapping has been presented in Fig. 2.a & Fig. 2.b.
- The gas flow control valves were procured utilizing a part of the grant-in-aid. Both the magnet assemblies along with the gas control valve assembled on the magnet assembly were placed on the thin film deposition chamber and overall testing were carried to observe ECR discharge. The apparatus successfully generated ECR plasma.

PUBLICATION

Dr. G. S. Taki, "A Permanent Magnet Electron Cyclotron Resonance Plasma Enhanced Multi-facility Nano-metric Film Deposition System", Intellectual Property India, Application No. 201731026517, 26th July, 2017.

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

Experimental Investigations on GGBS-RHA based Geopolymer Concrete using Quarry Dust as Fine Aggregate

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Geo-polymer concrete specimens cured at ambient temperature

Compressive strength and Flexure strength testing

OBJECTIVES

(i) Geo polymer concrete has to be produced using GGBS and rice husk ash as source material.

(ii) To study the effect of addition of quarry dust as fine aggregate in geo polymer concrete.

(iii) To study the strength and performance properties of geo polymer concrete at various ages.

METHODOLOGY

- To study strength properties such as compressive strength, split tensile strength and flexural strength of Geo Polymer concrete was determined at various ages.
- Durability properties such as water absorption, acid resistance were conducted on Geo Polymer concrete specimens.
- RHA was replaced with GGBS from (0-20%).
- The effect of addition of quarry dust as fine aggregate in Geo Polymer concrete was studied. Quarry dust was replaced as fine aggregate in various proportions from (0-100%).
- Ground granulated blast furnace slag(GGBS) and rice husk ash (RHA) were used as source material.
- Sodium hydroxide and sodium silicate were used as alkaline solution.
- Alkaline to binder ratio of 0.55 was utilised.

ACHIEVEMENTS

- Mix design for Geo-polymer concrete was designed for M30.
- Ambient curing was adopted.
- Compressive strength of about 98 MPa was achieved at 60 days, when GGBS was activated at ambient curing with the alkaline solution to binder ratio of 0.55.
- At 7 days, GGBS based geo-polymer concrete attained about 90% of its 28 days compressive strength.
- Addition of quarry dust as full replacement for natural river sand has led to development of comparable compressive strength at 28 days.
- Split tensile strength attained a maximum value of 4.61MPa when sand was utilised as fine aggregate with GGBS and with quarry dust strength of about 4.51MPa was achieved.
- Flexural strength of GGBS based concrete obtained maximum value of 5.93MPa with sand and 5.34MPa using quarry dust.
- When exposed to 5% acid concentrations, acetic acid shows lesser deterioration than specimens immersed in sulphuric acid solution.
- GGBS based geo-polymer concrete specimen shows better durability than GGBS-RHA based geo-polymer concrete specimen.
- Replacement of GGBS with RHA less than 10% can be practiced for the production of geo polymer concrete.

PUBLICATION

1) A. Muthadhi, S. Adhi Anbazhagan, G. Bhavani, M. Dhinagar, "Experimental investigations on alkali activated concrete with GGBS and RHA", in the International Conference on Smart Technologies and Green Environment (ICSTaGE 2017) held at Velammal Engineering College, Chennai. pp:39, on 24th March, 2017.

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

Device for Generating Electricity from Speed Breaker

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OBJECTIVES

In this project, the electrical power is being generated in a non-conventional method, from the movement of vehicles on a specially designed setup, which can be placed under the road. Since, we are utilizing the traffic of the road, this method does not require any input electrical or mechanical power as input.

The implementation of the mechanism for this project would give an economical genesis of electricity and also it doesn't waste any form of energy to any other medium. The basic principle is a simple energy conversion from mechanical to electrical by using the vehicle weight (potential energy) & motion (kinetic energy). The number of vehicles on the road is increasing rapidly, so we can convert the total energy of these vehicles into electricity. The application of quick return mechanism helps electric power generation efficiently as compared with other mechanisms. This is the main concept of the project. Compared to the previous works, this mechanism takes less space and converts maximum energy from the vehicle into electricity. With the help of AC-DC converter, generated electricity can be stored into an UPS.

ACHIEVEMENTS

Let us consider,

The mass of any vehicle travelling over the speed breaker = 5000 kg (Approximately)

Height of speed breaker = 15 cm

Torque developed at the generator shaft, T= 128.44 Nm

Power = $2\pi NT/60 = (2\pi*350*128.44)/60 = 4.707$ kw

Output power developed for 1 vehicle passing over the speed breaker:

Power developed for 60 minutes (1 hr) = 282.454 kw

Power developed for 24 hours = 6778.903 kw

This power generated by vehicles is more than sufficient to run twenty street lights the night time.

Manufactured model

SCOPE

This project will be scaled to all over India especially in the states like Tamil Nadu, Andhra Pradesh, etc. where electric power scarcity is a major issue. It can also be a great leap for reducing accidents if applied in large scale for lighting the accident prone areas at night.

Preparation and Evaluation of Phase Change Materials [PCM] by Macro Encapsulation for Thermal Solar Energy Storage

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SiO_2 coated $NaNO_3$ pellets are inside copper tubes

Experimental set up for storing solar energy

OBJECTIVES

The project is formulated with following objectives

- Encapsulate the low cost PCMs for providing a self-supporting structure
- Improve heat transfer rate of PCM
- Retain the PCM composition using silica gel.
- Characteristic evaluation of the encapsulated pellets
- Comparison of results with other PCMs obtained from literature.

ACHIEVEMENTS

The use of a latent heat storage system using phase change materials (PCMs) is an effective way of storing thermal energy. However, PCMs have very low thermal conductivities making them unsuitable for large-scale use without enhancing the effective thermal conductivity. In order to address, the low thermal conductivity of the PCMs, macro encapsulation of PCMs has been adopted as an effective technique. The macro encapsulation not only provides a self-supporting structure of PCM and separates the PCM from thermal fluids but also enhances the heat transfer rate. The current work involves study of various concepts of encapsulation of low cost inorganic PCMs. Sodium nitrate ($NaNO_3$), a low cost PCM, was selected for thermal storage in a temperature range of 300 – 500˚C. Various techniques like coatings using silicates and sand encapsulation are discussed.

Various parameters such as HTF inlet temperature (ºC), flow rate (lit/min) and PCM capsule shape are also optimized for achieving greater efficiency. The coated PCMs are characterized in detail. A solar water heater will be then designed using the macro encapsulated PCM. The storage vessel consists of a number of closed cylindrical pipes filled with the phase change medium.

The scope of the present study is to construct a latent heat storage system that uses a high latent heat phase change material (PCM), macroencapsulation of the PCM helps to overcome the barrier of low thermal conductivity by increasing heat transfer rate, provide the separation of the PCM from other fluids where needed and offer a self-supporting structure for the PCM. The focus of this work is to address the above mentioned challenges and fabricate encapsulated pellets which can withstand a greater number of thermal cycles.

The following conclusions are drawn from the experimental work:

- A press is designed for the production of cylindrical shape pellets of $NaNO_3$.
- Initially paraffin wax is taken as PCM, which is having low melting point.
- The performance of the paraffin wax is observed in TES.
- In the second stage, $NaNO_3$ is taken as PCM, which is having higher melting point.
- Encapsulation of low cost PCMs such as $NaNO_3$ with sand gel for a storage system in a temperature range of 300˚C - 500˚C has been developed.
- The performance of $NaNO_3$ is found to be better than paraffin wax in storing solar energy.
- The efficiency of the system was found to be 55 %.
- The charging and discharging of $NaNO_3$ salt is also studied.

PUBLICATION

Paper submitted in International Conference CHEMCON 2017

Legacy of IEI

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

Design, Fabrication and Testing of a Spherical Parallel Robot for Friction-stir Welding of Polymers

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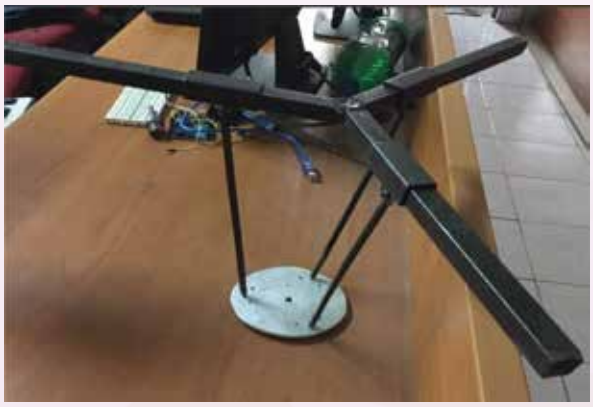

3-PRS mechanism developed

Actuation system employed

OBJECTIVES

To fabricate a low cost spherical parallel robotic mechanism for joining thermoplastic polymers and soft materials

To identify the motion at the mobile platform along with workspace and singular configurations

To design the actuation system for the parallel manipulator with prismatic drives

To develop a microcontroller based electronic circuit for guiding the tool over a specified trajectory automatically.

ACHIEVEMENTS

The parallel mechanism was fabricated with the designed dimensions. Overall configuration was tested for required motions. The stepper motors with lead screw drives act as the actuators. Attempts are made to weld the thermoplastic material by friction stir welding process with carbide steel tool of cylindrical section pin profile. After successful trails, the product can be implemented in plastic industries. The student could successfully submit his project report and achieved PG Degree.

PUBLICATION

Presented a paper entitled 'Design and Kinematic Simulations of 3-PRS spatial Parallel mechanism' in 31st Indian Engineering Congress, Kolkata .

Published in the Technical Volume of 31st Indian Engineering Congress, 15-18 Dec 2016, pp.198-203.

Project has been submitted as a PG Dual degree thesis at Mechanical Engineering, NIT Rourkela

A Novel Printer to Utilize the Used Paper

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Top View of the Reprinter

Side View of the Reprinter

OBJECTIVES

India is a country with immense geographical and environmental diversities. India is home to more than 45,000 spicies of trees, including a variety of endemics. Paper is a material manufactured as thin sheets from the pulp of wood. It was initially invented as a tool for written printed communication. From the wood extracted from the Indian forests only 11% is used directly by the paper industry. The 93% of paper production only depends upon the trees. On the other hand, the recycling of papers is not efficient, Grams per Square Meter (GSM) house hold printing papers cannot be reused for any other purpose. Today, paper is a versatile material with many uses, including writing, printing, packaging, cleaning and a number of industrial and construction purposes. Deforestation is the primary effect of our mindless wastage of paper.

On the other hand, the use of paper is skyrocketing which is affecting the environmental balance of the country. Often recycled paper is used to produce the low quality papers and cardboards. The best solution to this problem is erasing the printed content on paper. The proposed setup can be used to erase printed content in the paper and also be integrated with the existing printer.

Once the system is implemented, it could reduce the actual paper consumption. This solution proposes a paper reusability system capable of reinstating the quality of printed paper to be fitted with existing printers. A chemical process is adopted for cleaning the printed paper. Once implemented, it shall reduce the paper consumption of an office for saving the valuable natural resources.

ACHIEVEMENTS

The project “Reprinter (A Novel Printer to Utilize the Printed Paper)” is selected as the Best Project under ‘State Level’ category in stream - Electrical and Electronics Engineering conducted by The International Society for Scientific Research and Development (ISSRD), Bangalore.

Solar Panel Life Time Efficiency Improvement

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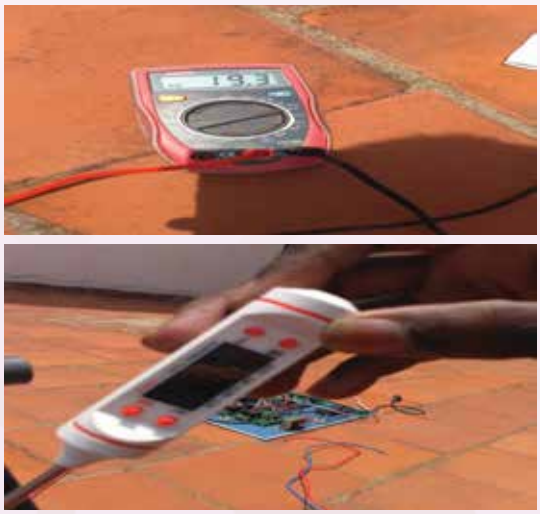
At 12.30 hours panel temperature and panel voltage measurement



After cooling panel temperature and panel voltage

OBJECTIVES

The importance and objective of this project is to identify and solve the problems like low solar panel lifetime, solar power efficiency, performance, cooling system and dust cleaning within solar based system. These issues are raised from insufficient maintenance of solar panels and semiconductor photo voltaic cells. To solve these issues, maintenance of solar panel with less man power, water and power is needed. Reduction of power and water not only improves the solar panel life time, but it also improves the reliability, penalty of heat in high performance real-time based solar systems. Based on above discussions, the objective of the work is summarized as follows:

- To design and implement a 20W solar system with auto cooling to reduce the temperature of solar panel to an acceptable level thereby improving the lifetime of solar panel.

MATERIAL USED

- Amorphous silicon solar cell is considered in this work because it has lower life time compared to other solar cells.

ACHIEVEMENTS

By using modified cooling technique, effect of UV radiation in amorphous solar panel has been reduced. Voltage efficiency of solar PV panel is improved from 3% to 5% with this modified technique along with reduced power and water.

Portable Solar Powered Thermoelectric Refrigerator-cum-Heater

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Solar Refrigerator Body

Complete Portable Solar Refrigerator with
Solar Panel and Charge Controller

OBJECTIVES

1. To design eco-friendly portable refrigerator cum heater powered by solar energy.
2. To design a system that will address the issue of ozone layer depletion by the release of CFC's as the in case of conventional refrigerants.
3. To reduce the global carbon footprints by harnessing renewable source of energy.

ACHIEVEMENTS

1. The developed portable equipment utilizes solar energy for cooling and heating purpose and can be used in remote areas where supply of conventional electricity is not dependable.
2. This system can also be used while traveling in car.
3. The use of this equipment will tend to decrease the total global warming potential of conventional refrigerants and thereby reduce the global carbon footprints.
4. Thermoelectric Module requires less electricity compared to any other cooling or refrigerating system.
5. Compressor has been eliminated from set-up that allows noiseless operation and lowered maintenance cost.

Computerised Water Trait Management System

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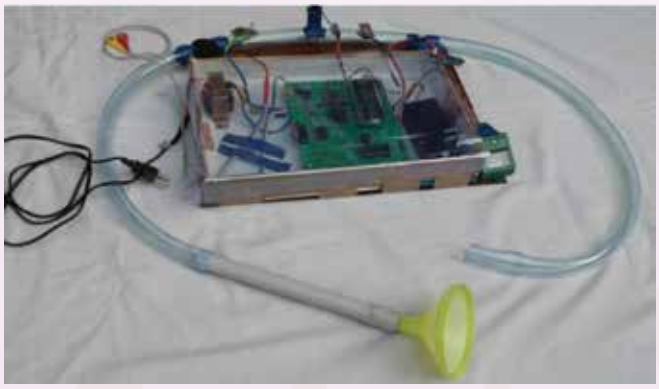

Measurement node with microcontroller and sensors

Application screenshots with readings and suggestions

OBJECTIVES

The water trait monitoring system is an automated system powered by smart sensors to check the parameters of the water at different locations under varying circumstances. Based on the resulting data, the system can suggest the possible ways for the water to be utilized and for what purpose the land from which the water originated can be used. In order to determine these factors, the water in question has to be tested for various physiochemical parameters usually present in water. The physiochemical parameters present in water include pH, conductivity, impurity, temperature, turbidity, flow and GSR. Interaction is done through a mobile application which runs on the Android ecosystem, receiving data through bluetooth. It is an IoT (Internet of Things) application as we receive data from embedded sensors through a wireless medium onto another device. One of the most important resources needed to sustain life is pure water and the quality of the water that we use on a daily basis for most of our needs is highly important. Water is supplied by the taps at residential buildings in urban areas and water sources like wells, ponds in most of the rural areas, but all of them are not safe for consumption. Although, it is the responsibility of the government to ensure that pure water is delivered to it's citizens, the infrastructure which is poorly maintained and also the unmanageable increase in population negates the possibility of a pure water supply system with the current infrastructure. As a result, providing a system which is cheap, reusable and can provide accurate results will go a long way in increasing the purity of water from various supplies and ultimately leading to increase in health quality.

ACHIEVEMENTS

This project requires a clear understanding of working with microcontrollers, interfacing various sensors, data storage and retrieval, application development and understanding the physicochemical properties of water. Furthermore, the knowledge obtained in this project will prove priceless and will open up a wide spectrum of agricultural problems and issues that can be addressed more easily and armed with the knowledge of understanding the needs and requirements of a system similar to the proposed one for other applications; a system that is simple, efficient, quick and easy to use with minimum complexity for an user. Additionally, there is the possibility that other systems like soil testing or air pollution testing can be integrated with the proposed system in the future, providing solutions for multiple problems simultaneously. For example, the idea of a water quality tester can be extended to create a similar system that can test soil quality, or a system to provide optimal soil-and-plant combinations based on parameters like soil, water and availability of crops. Taking the case of providing assistance to farmers, mobile applications for various problems like the lack of information that farmers require can be created, with notifications to farmers on important issues. The knowledge of working with microcontrollers also makes it possible to automate a few of the manual labor tasks that farmers find tedious. The experience acquired working on a project for the students is invaluable, as nothing can replace real-time project development experience. The ability to work with microcontrollers and a different array of sensors, coupled with the mentality and attitude to work consistently on real-time projects will be invaluable to the students. It is safe to say that the project has great scope for the future and the skills and the knowledge that the students acquire working on the project gives a good base on which future additions to the project can be built upon. The proposed system has a wide variety of applications in various fields. The system provides a test for water quality with low error margin. In some areas like waste water management, such systems will be of high importance. The system can be deployed to check the quality of water after processing and removal of waste is done. Similarly, the system can be used to check the quality of drinking water that is to be supplied to the people. Tests on drinking water are currently performed independently; that is, separate tests are done for turbidity, pH, oxidation potential and so on. The use of this system to perform the tests reduces time and provides a single system to replace the multitude of tests required to determine the quality of the water sample, while not compromising on accuracy. Furthermore, the system provides the required information with little complexity, hence the system can be set up across farming areas to provide the water quality testing service to farmers. This is easily doable as the system can be operated with ease, and the information after processing can be easily understood by the user. The research findings from this project can be used to create more affordable and accurate water quality systems that can be usable by a majority of the population. New landowners can test the quality of water on their land and farmers can check the quality of ground water or irrigated water in an affordable way. Thus, there is good scope for the developed equipment and research findings to prove useful in the future.

> 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

Implementation of Novel Spray and Weeding Robot Using Mobile Control for Agriculture Field

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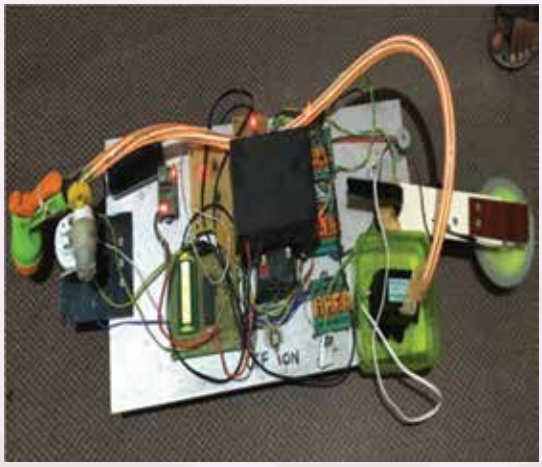

Prototype setup of spray and weed Mechanism using mobile

Testing of Spray mechanism

OBJECTIVES

- To design and implement an environment friendly weeding system for farmers, by providing cost effective and comfort handling.
- The mission of the project is to help and to reduce the manpower in agriculture field.
- To develop the agriculture needs to find new ways to improve efficiency.
- The goal of the Automatic Agricultural Robotics vehicles used for weed detection, agrochemical dispersal, terrain levelling, irrigation, etc.
- To facilitate the farmers to work with increase work and increased ease and increase the productivity.

ACHIEVEMENTS

- The progress in science & technology is a continuous process. New things and new technologies are being invented. The proposed system is to reduce the man power required for agriculture field. It is based on PIC microcontroller [micro chip] which is found to be more compact, user friendly and less complex and can readily be used in order to perform several tedious and repetitive tasks.

- The robotic mechanism will move forward or reverse depend upon mobile key tone (DTMF) operation. Pump will pull the Chemical Compound from tank when we press the spay key. We are using matrix type keypad mobile and each key controls different movement. Unwanted leaf removes with help of weeding mechanism. In this project, the robot is controlled by a mobile phone that makes a call to the mobile phone attached to the robot. In the course of a call, if any button is pressed, a tone corresponding to the button pressed is heard at the other end of the call. This tone is called 'dual-tone multiple-frequency' (DTMF) tone.
- The robot perceives this DTMF tone with the help of the phone stacked in the robot. LCD displayed for corresponding function or operation. Though it is designed keeping in mind about the need for farmers, it can be extended for other purposes such as commercial & research applications. Due to the probability of high technology used this "Implementation of Spray and Weeding Robot using Mobile Control for Agriculture Field" is fully controlled with hardware circuit. This feature in this system will serve as the base for future systems.

PUBLICATION

International Journal

G. Ganesan@Subramanian, V.Mohan, N.Dhanasekar, S.Latha, "Implementation of Novel Spray and Weeding Robot using Mobile for agriculture field", International Journal of Innovative Research in Technology (IJIRT) ISSN: 2349-6002, Page: 27-31; Volume-4 Issue-4, September 2017.

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 December 17, 1994, in presence of HE Governor of West Bengal Shri K V Raghunatha Reddy and Shri Jyoti Basu,Chief Minister of West Bengal

Development and Testing of Green Composites for Roofing Applications

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Tensile Test Specimen – 1

Sample Specimen1 – Coir 85% and Corn Husk 15%

- Overall weight : 400 gms;
- Fiber(Coir) : 85 gms;
- Epoxy resin : 300 gms
- Fiber loading : 100 gms
- Filler(Corn husk) : 15 gms

OBJECTIVES

The objective of the project is to design and fabricate an environment-friendly roofing sheet using natural fibers to minimize the usage of conventional roofing sheets made up of asbestos-PVC and TIN, and finally to compare the mechanical properties of the composite with plastic roofing sheet materials. The project aims to make the use of agricultural residues as alternatives to synthetic fibers.

ACHIEVEMENTS

Natural fibers are emerging as low cost, light-weight and environmentally superior alternatives to synthetic fibers and the specific properties of the natural fiber composites are in some cases better than those of synthetic fibers. This suggests that natural fiber composites have a potential to replace synthetic fiber in many applications. When compared to natural fibers, the artificial fibers possess twice the weight of natural fibers, are costly, cause damage to human beings and require more energy for extraction.

The developed prototype composite with IEI funding is evaluated for their mechanical properties with conventional roofing sheets made up of asbestos, PVC and TIN to understand its suitability. The project makes the use of agricultural residue. Here, the untreated coconut coir and powdered corn husk are taken as reinforcement for the first composite and for second composite coconut coir and palm fruit fiber are taken as reinforcement material. Epoxy resin and PPA Hardener binds these fibers into a single structure.

PUBLICATION

A paper titled “Development and Testing of Green Composites for Roofing Applications” was presented at CDAMIES – 2018 organised by Department of Production Engineering, National Institute of Technology, Tiruchirappalli, 18th & 20th January 2018.

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

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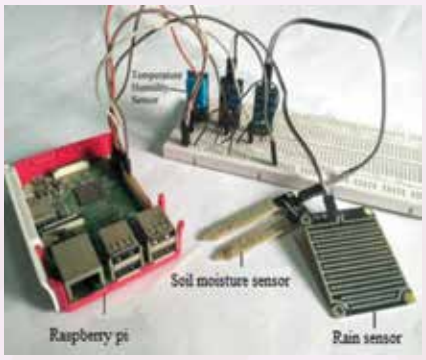
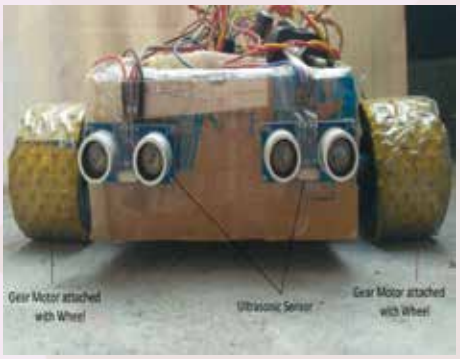
OBJECTIVES

There are two objectives of this project. First one is 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 is to develop a remote monitoring irrigation system. One of the crucial aspects 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. We want to develop a remote irrigation system through Internet of Things (IoT). This part can be controlled by SMART phone of the user. It will greatly improve the water usage.



Irrigation Monitoring Setup



Ploughing Bot Setup

ACHIEVEMENTS

In the present work, a smart irrigation and ploughing module was successfully made 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. Various types of usage of this system can be acceptable for different types of farmers.

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

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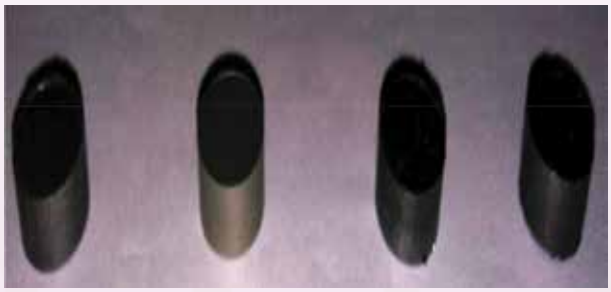
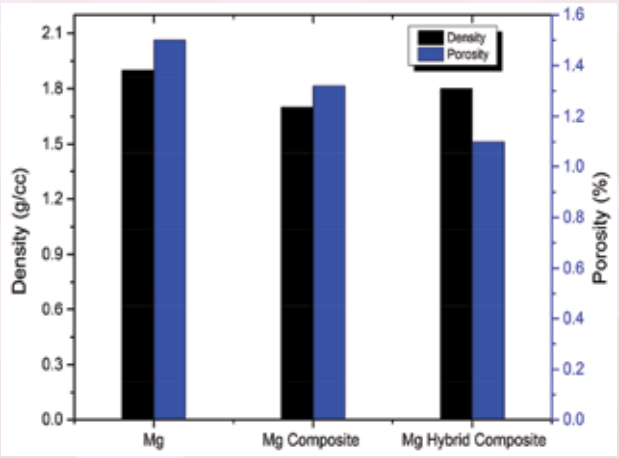
Die and Punch



Green sample of hybrid composite

Furnace



Variation of density and porosity of samples

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 a light structural metal which makes 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_4C) 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 study involves

- Preparation of magnesium based hybrid composite through powder metallurgy method wherein B_4C and Gr are used as reinforcements.
- To evaluate the microstructure of sintered hybrid composites.
- To investigate the mechanical properties of composites.
- To study the wear behaviour of the prepared hybrid composites.

ACHIEVEMENTS

Hybrid Mg–B_4C–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, as mentioned before, graphite is a soft material which decreases the hardness of composites, and cannot effectively resist the deformation of matrix during sliding.

> 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

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

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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 for managing the garbage in building and converting the solid waste into green energy.

ACHIEVEMENTS

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 conference team has recommended the paper as the "Best paper" and has recommended the paper for the possible publication in a reputed journal. The proposed work was also presented in the National Conference on "Emerging Trends in Science, Engineering & Technology" organized by Jerusalem College Engineering, Chennai.

PUBLICATION

V. Jamuna, S.Samuel Berkins, P. Nagarajan and S. Narendran (2018), 'A Monotonous Cyborg for an Assessment of Solid Waste Management in Multi Storied Buildings', International Conference on Scientific Research and Innovations "ICSRI 1.0", Chennai Institute of Technology, Chennai.

An Ergonomically Designed Pedestrian Weeder for the Small Scale Growers

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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 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

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GPS, Bluetooth and IoT Controller

Life Saving Helmet

OBJECTIVES

- To develop smart helmet to reduce the Human Death Ratio due to Road Accident in India.
- To reduce the death rate, if accident takes place,
- To have quick transmission of message to preconfigured contacts to intimate 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.

Application of Process Industries: Wireless Data Transmitter

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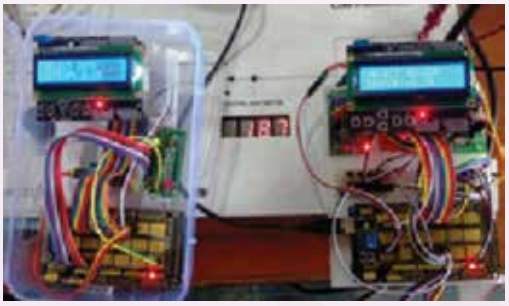
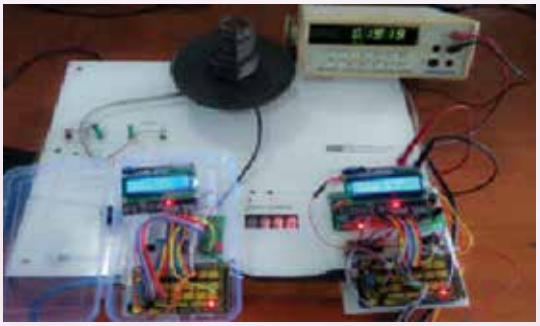


Snapshot of proposed system



Working of proposed system

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 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 this system one can monitor 5 different sensors through a single system and also this system 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.

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

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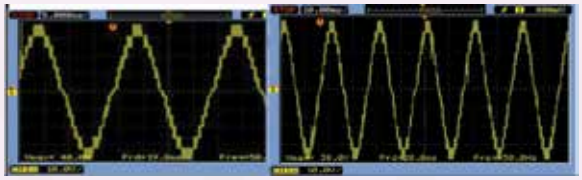
Prototype Model



Load Voltage Waveforms

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 multi-carrier 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.

Design and Fabrication of Solar Operated Pesticide Spraying Robot

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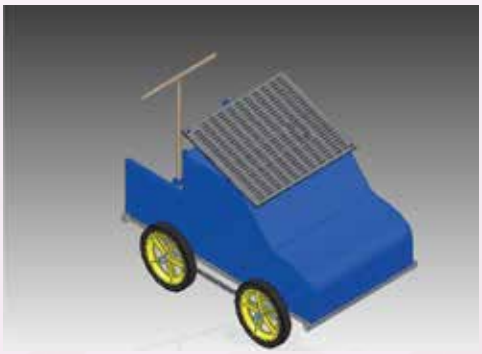
OBJECTIVES

The primary aim of this robot is to

- To design and fabricate a solar powered wireless operated eco-friendly pesticide spraying robot
- Reduce human effort
- Eliminate health issues
- Be completely automated
- Save time and Speed up the process



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.

Actual Model of Robot

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. can be minimized. 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.

PUBLICATION

Submit for publication in Annual Technical Volume of Electronics Engineering Division of IEI for the year 2018 on "Recent Trends in Mechatronics for Sustainable Development in Engineering Applications".

Autonomous Operated Robot for Water Tank Cleaning

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Assembled Robot

Testing the functionality of the Robot

OBJECTIVES

It is common in Indian household to store water in tanks which may be ground water, rainwater or water 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 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 dumbed 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

Dr Sarvepalli Radhakrishnan (sitting 5th from left), President of India, with Council Members of IEI in 1962

Study on Effect of Contaminant Transport on Soil Characteristics

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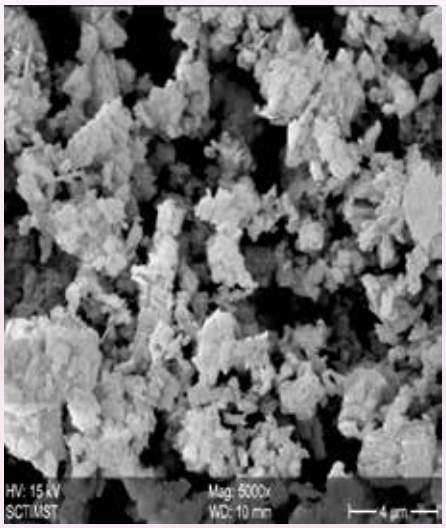
Soil leachate column



SEM images of Lead contaminated Metakaolin clay

OBJECTIVES

- To predict transport or migration characteristics of contaminants or pore fluids with time, on various soils like metakaolin, kaolinite and sand during leaching process.
- To find behaviour of contaminants in soil, in terms of sorption characteristics like adsorption, tortoisity, etc.

  Study of potential mobility of chemicals in soil, contact time between contaminant and soil, to study bonding of contaminant on soil particles, etc is done by performing accelerated soil column leaching tests on various soils.

  Thus yields break through curve, analyse sorption capacity of soils, or mobility curve of contaminants,etc.
- Atomic adsorption spectroscopy is done to analyse the constituents in leachate and contaminated soils, to find elements that are retained at various time intervals at various depth of soil layers and to find elements in leachate or effluent which are collected periodically from soil column leaching tests done. Thus find migration profile of contaminant through soil layers.

- Comparison of above studies on various clayey soils like metakaolin, kaolinite and other geomaterials are to be done to analyse the suitability of these soils as barrier for waste containment system, liner for domestic or industrial landfills and to study long term performance and obtain design thickness of liners based on sorption characteristics of the clay or geomaterials.

ACHIEVEMENTS

The study helps to safeguard against the utilization of locally available clayey soil as liner material, without understanding the sorption characteristics.

This contaminant transport and sorption study helps to prevent the transport of contaminants through liner system and determine its long term performance. Comparison of study on metakaolin, kaolinite, and geomaterials helps to select ideal clay liner used in containment systems. Study also helps to obtain design thickness of landfill liner that can retain peak concentration of different contaminants or pore fluids.

Study also helps to analyse the retention of heavy metals and pesticides in subsoil due to inefficient agricultural practices or waste disposal methods, etc.

PUBLICATION

- 'EFFECT OF LEAD CONTAMINATION ON GEOTECHNICAL PROPERTIES OF SOIL' in National Conference on Geotechnical Application in Transportation Environment Structural Engineering (GATES 2015) at Marian Engineering College, Trivandrum, 25th & 26th FEB, 2015.
- "Effect Of Lead and Iron Contamination On High Plasticity Clay", National Conference on Recent Advances in Civil Engineering (RACE 2015), published by International Journal of Engineering Research and Technology, IJERT (ISSN: 2278-0181), PP 42-46.

Legacy of IEI

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

Design and Development of Biodegradable Tibia Bone Internal Fixation Plate using CT/CAD/Additive Manufacturing

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FDM fabricated AM medical model of tibia bone, biodegradable composite filament and test samples

OBJECTIVES

Additive Manufacturing (AM) is a process of joining materials to create physical models from 3-dimensional (3D) Computer Aided Design (CAD) data. The AM medical models are applicable in the various medical fields such as dental surgery, reconstructive surgery and orthopedic surgery. This research study involves the design and development of human tibia bone from a CT scan and fabrication of AM model with fused deposition modeling (FDM) technique.

The objective of this research project are:

- To take CT scan of human tibia.
- To generate the CAD model of tibia bone from CT scan image by Mimics software.
- To develop Rapid prototyping of tibia bone using FDM process with ABS Material.
- To select matrix and reinforcement material for the bone implant.

- To fabricate the polymer composite filament samples by using Twin screw Extruder.
- To fabricate polymer composite implant samples by using FDM process.
- To fabricate polymer composite samples by Hand Layup method.
- To conduct the mechanical testing for both FDM and Hand Layup method fabricated samples.
- To take SEM analysis for the tested samples.
- To check Bio Compatibility test for FDM fabricated samples.

ACHIEVEMENTS

In this research, anatomy of human tibia bone was modelled using reverse engineering concept. First tibia bone was scanned by CT scan unit and the scanned images in DICOM file format were imported into MIMICS software for reconstruction of 3D CAD model of tibia bone. After obtaining the good quality of 3D CAD model, it was saved as a STL model file. Then this CAD model was processed using pre-processing software and processed CAD model in .CMB file was fed into FDM machine. The model of Tibia bone was build slice by slice by melting of ABS building material in FDM machine.

Also,various biodegradable polymer composite filaments were fabricated through Twin screw extruder and these fabricated filaments were fed as input for the FDM machine for making composite plates. For mechanical testing, ASTM standards specimens were cut from the plates using water jet cutting. Hand layup technique was also used to fabricate composites samples for evaluation purpose. Mechanical testing was conducted for both FDM and Hand Layup samples. Tensile, Flexural and Impact tests were conducted for all the samples. After the mechanical testing, SEM analysis was carried out to observe microscopic view of broken samples and for finding the reasons for fractures.

Then biocompatibility tests such as, In-Vivo swimming motion test, mortality test and muscle pathology study were performed. Using microscope Zebra fish muscle fibres were observed. From the result, selected materials were does not hurt the Zebra fish. In the swimming motion test, sisal fibre implanted fish was very active in the 15 days notice period. Sisal fibre implanted fish was very active and passes the quadrant 12 times/ 20sec. This research allows to obtain patient specific accurate medical models of tibia bone with bio-degradable composite material which helped to solve complex surgeries.

PUBLICATION

International Conference

Muthukumar et al, “Reverse engineering and finite element analysis of a human tibia bone”, proceedings of the 8th International Conference on Advancements in Polymeric Materials- APM 2017 organized by CIPET on February 12-13, 2017 at Indian Institute of Science, Bangalore, India.

M. Tech Thesis Submitted

“Design and Development of biodegradable tibia bone internal fixation plate using CT/CAD/Additive Manufacturing”submitted to Anna University Chennai during June 2016.

Fabrication and Characterization of Super Hydrophobic Surface on Aluminium 6061 Alloy Substrate

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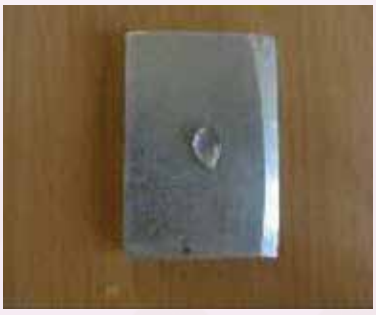
OBJECTIVES

Achieve super hydrophobicity on Al 6061 substrate.

- Etch the aluminium substrate in order to produce the rough surface.
- Coat stearic acid on aluminium substrate by solution immersion method.
- Characterize the super hydrophobic surfaces.
  - Contact Angle (CA) measurement
  - Self-cleaning ability
  - Surface roughness measurement
  - SEM analysis
  - Ice-delaying property



Untreated

Super Hydrophobic

ACHIEVEMENTS

A super hydrophobic aluminium alloy surface is fabricated by treating in the acid bath, boiling water and immersing in STA–ethanol and DMF–H_2O solution. After chemical modification, the wettability of the surface can be changed from super hydrophilic to super hydrophobic with CAs as high as 1580 and a low sliding angles. Meanwhile, both the etching time and STA–ethanol and DMF–H_2O solution play important roles on the super hydrophobicity of the aluminium alloy, while the super hydrophobic aluminium alloy surface with water contact angle of 158^{O}. The present study puts forward a very simple and environment-friendly method for the fabrication of super hydrophobic surfaces over Al sheets. Moreover, it further explores to improve the corrosion resistance of metal materials by enduing metals with the super hydrophobic surfaces. Ice delaying test was conducted and compared with coated and uncoated specimens.

PUBICATION

Presented a paper titled “Fabrication of super hydrophobic Aluminium alloy 6061 surface by simple etching method” in the National Conference organized by Mechanical Engineering Department of Dr. Sivanthi Aditanar College of Engineering on 01-04-2015.

Design and Development of Solar Energy Aided PEM Electrolyser for Hydrogen Production

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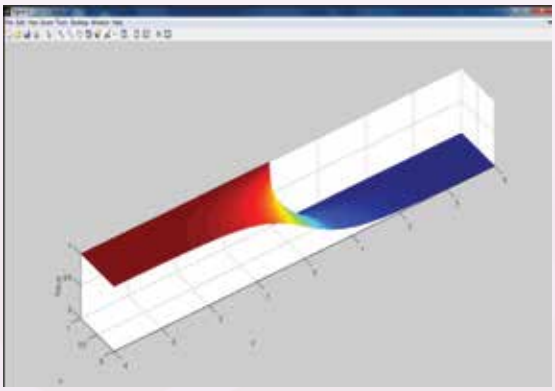
Final Experimental Setup for Optimize Direct Coupling of Solar PV with PEM Electrolyser



Simulation of Temperature Distribution in the Interior of Gas Diffusion Membrane

OBJECTIVES

- To investigate the performance of an integrated concentrating solar photo voltaic for hydrogen gas production on the avenues of improving energy efficiency by using modified PEM electrolyser.

ACHIEVEMENTS

- Platinum- Iridium 1:1 by wt. cathode side coated 5x5cm MEA leads to cost reduction with same performance compared to current best cathode side iridium coated catalyst.
- Matlab-simulink model based on electrochemical equations was developed for hydrogen gas production rate 0.4829 Nm^3/hour and oxygen gas production rate 0.2415 Nm^3/hour and is validated by using experimental data taken from published research journal paper.
- System performances analysis having been studied from characteristics output graph for ohmic loss (V) and current density(A/cm^2) for different thickness of nafion Membrane and minimum thickness membrane reduce ohmic loss. Ohmic Loss (V) is a function of Electrolyte Cell Area is concluded from characteristic curve plot for ohmic loss and Electrolyte cell area. Thus ohmic loss variation depends on electrolyte cell area. Simulation of Temperature Distribution in the Interior of Membrane Electrode Assembly was studied both from the theoretical model and experimental data based on research published journal paper.

Investigation on Abrasive Wear Properties of Plasma Sprayed Tungsten Carbide (WC) with 12% Cobalt (Co) Coating to Assess the Suitability for the Application as Hydro Turbine Blades

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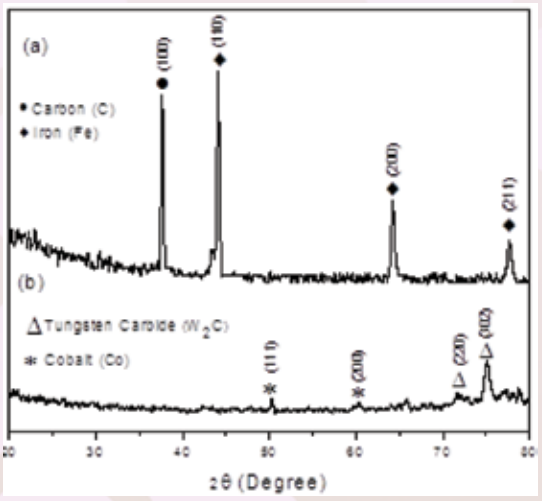
OBJECTIVES

- The objective of the cited project is to modify the surface of engineering materials to facilitate the production of superior products in terms of reduced wear, increased corrosion resistance, better biocompatibility and improved mechanical properties.
- To improve the abrasive wear resistance by coating the tungsten carbide with cobalt using plasma spraying technique.
- To study the characteristics under dry abrasive wear conditions for plasma sprayed tungsten carbide with cobalt (WC-Co) coating in comparison to regular heat treatment process.
- To investigate the wear behaviour before and after the plasma sprayed coating of the material will be carried out.
- To investigate the mechanical properties of the coating through conducting the tests like X-Ray diffraction, wear test, hardness test, corrosion test and peel test.

Plasma spray torch arrangement



XRD result for (a) mild steel and (b) WC-12%Co coated steel in mild steel for iron (Fe) – JCPDS: 06-0696 and Carbon (c) – JCPDS: 80-0004 In coated steel for Tungsten Carbide (W2C) – JCPDS: 79-0743 and Cobalt (Co) – JCPDS: 15-0806

ACHIEVEMENTS

Surface modification of engineering materials allows the production of far superior products in terms of reduced wear, increased corrosion resistance, better biocompatibility and improved optical and altered mechanical properties. To improve the abrasive wear resistance, the tungsten carbide with cobalt coating was produced using plasma spraying technique. The characteristics under dry abrasive wear conditions are studied for plasma sprayed tungsten carbide with cobalt (WC-Co) coating in comparison to regular heat treatment process. Investigations on the wear behaviour before and after the plasma sprayed coating were carried out. In general tungsten carbide with cobalt coating shows superior wear resistance compared to conventional heat treatment process. The surface of the treated coating was examined by scanning electron microscopy analysis (SEM), wear test, hardness test and X-Ray diffraction test (XRD). The XRD result for substrate shows that

the amount of iron (Fe) is high than the other materials present in it. Carbon (C) shows the higher amount of percentage than other metals and less percentage than iron (Fe). X-Ray Diffraction pattern for coated material includes some W2C peaks indicating that W2C are higher than the other material and some Co peaks indicating less amount of cobalt present in the coated material. The particle size for WC-Co is in micron level, so that the peaks in the coated material are less than compared with the mild steel. So XRD result for coated steel shows the present of WC-Co in the mild steel. The detailed review of the past research revealed the existence of a research gap in addressing the effects of decarburization in thermal spray process applied for coating the candidate material over the substrate. The research work conducted with this background with an aim of improving the surface properties of the resultant coating through the introduction of carburization yielded a scope to bridge the research gap. In this work, coating of WC-12%Co on ASTM A36 steel through plasma spray process was undertaken for the study of wear properties. Hardness of the resultant coating (435 BHN) was observed as less than that of carburized steel substrate (461 BHN). It was also confirmed that hardness of the resultant coating, done on the carburized steel, increased (BHN 600) remarkably. Similarly, resistance on wear also improved for the coating given on the carburized steel (35µm under 1kg load) against the coating given noncarburized steel (45µm under 1kg load). The corrosion test results indicated that resistance for corrosion increased significantly for the coating after carburization. The chemical composition test indicated the increase in carbon content in the steel substrate after carburization. The XRD result confirmed that the material coated on steel substrate was WC-Co. The potentiodynamic polarization corrosion test was carried out with the three-electrode electrochemical workstation setup which consists of reference electrode (AgCl), a working electrode (WC-12% Co coated specimen) and an auxiliary platinum electrode to obtain the linear sweep volumetric tafel curves. Anodic and cathodic polarization curves showed a tendency towards passivation with high critical current density of about 3.70E-8 A cm−2 (coated) 6.33E-6A cm−2 (Carburised) and 9.88E-6A cm−2 (uncoated) specimens. The drop in current density occurred for the carburized and coated specimens due to the application of a protective layer of WC-12% Co coating. The results indicate a corrosion rate of 0.00043 mm/year for carburized and coated specimens which is negligible and 0.073565 mm/year for carburized specimens. The test also indicated the experience of the bare steel substrate with maximum corrosion rate of 0.11392 mm/year. The SEM study revealed that the WC-Co was coated properly on the substrate with homogeneous distribution. Extension of the research work with candidate substrates as well as coating for the specific application with the introduction of carburization process will yield certain research outcomes in the field of coating, edging for reducing the material.

The outcome of the project will be would be very much useful to the following industrial sectors

- Hydel Power plants (Turbine blades)
- Steam valve Industries (Valve seats)
- Aerospace Industries
- Defence applications

PUBLICATION

1. " A review on Wear behaviours of WC-Co coating by thermal spray process" P. Karuppuswamy, S.D. Arunkumar, "International Journal of Applied Engineering Research", ISSN 0973-4562 Vol. 10 No.19 (2015).
2. "A review on performance of Ni Cr alloy for turbine blade applications", P. Karuppuswamy, R.N.Kirupakaran, C.Bhagyanathan, "International Journal of Applied Engineering Research", ISSN 0973-4562 Vol. 11 No.3 (2016).

Bio Engineered Concrete-A Sustainable Solution for Cracks

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OBJECTIVES

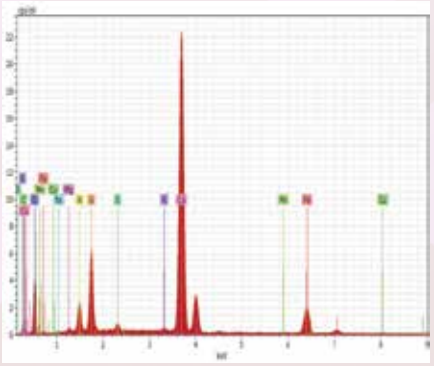
To study the flexural behaviour of beam

- Load – deflection curve
- Ductility index
- Energy absorption capacity
- Energy ductility
- Stiffness
- Ultimate load carrying capacity
- Crack pattern

Acid attacked cube

To study the durability properties of bacterial concrete

To produce eco-friendly and maintenance free concrete



Acid attacked cube

ACHIEVEMENTS

- The application of bacteria in concrete improves the compressive, tensile and flexural strength of concrete by 13.2%, 31.4% and 26.04% respectively.
- Maximum strength is obtained at the concentration of 105 bacterial cells per milliliter of water.
- The bacterial concrete beam carries more load under two point loading compared to controlled concrete beam.
- The load carrying capacity of bacterial concrete beam is increased by 9.5% compared to controlled concrete beam.
- The ductility ratio, stiffness and energy absorption capacity of bacterial beam is higher than the control concrete beam.
- The increase in concentration of bacteria in concrete shows higher resistance to acid and sulphate attack.
- The results of SEM analysis reveals the presence of calcite crystals which helps in higher self healing of bacterial concrete.
- From the results and observation it was concluded that the bacterial concrete will find wider application in future.

PUBLICATION

M. Ummu Thahira , Dr. V. S Tamilarasan , "EXPERIMENTAL STUDY ON STRENGTH OF BACTERIAL CONCRETE" International Journal of Applied Engineering Research, ISSN 0973-4562 Vol. 10 No.57 (2015)

Investigations on Mechanical and Tribological Behaviour of Palmyra Shell Ash Reinforced Aluminium Alloy (AlSi10Mg) Matrix Composites for Automotive Applications

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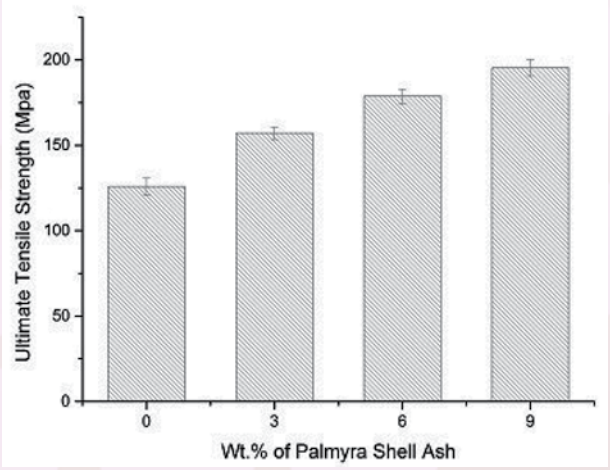
Palmyra Shell Ash Preparation



Variation of ultimate tensile strength over different PSA wt%

OBJECTIVES

High strength, light weight, ease of fabrication, excellent castability and good wear resistance find aluminium alloy composites suitable for commercial applications. In this work, one such silica rich ash particle (Palmyra shell ash) was reinforced with aluminium alloy (AlSi10Mg) composites and its mechanical and tribological properties were studied. The aluminium alloy was reinforced with 3, 6 & 9 wt. % of Palmyra shell ash particles, its dry sliding wear behaviour were studied using Pin-On-Disc machine under different loading conditions. The result shows that the dry sliding wear resistance of Al-Palmyra shell ash composites was almost similar to that of fly ash and rice husk ash reinforced Al-alloy composites and these composites exhibit better wear resistance compared to unreinforced alloy. The Palmyra shell ash particle weight fraction significantly affects the wear and friction properties of the composites. The microscopic examination (SEM) of the worn surface reveals, at

various loads Palmyra shell ash particles act as a load bearing constituents. Further the wear resistance of the reinforced Palmyra shell ash of size range (1-50µm) were superior than that of unreinforced alloy. Mechanical properties (hardness and tensile strength) were also studied and observed that the reinforced Al-alloy showed significant increase in mechanical properties.

PUBLICATION

In this work, a detailed study on fabrication, mechanical and tribological properties of composite fabricated by dispersing Palmyra shell ash particles into aluminium alloy using stir casting were done using the following methodology:

- Palmyra shell ash is prepared from its shell.
- Percentage of silica content is measured using EDX.
- Through stir casting, the PSA (Palmyra shell ash) is reinforced with AlSi10Mg alloy.
- 3, 6, 9 12 wt% of specimens are prepared.
- The Brinell hardness test was performed as per ASTM-E10 standard at a room temperature of ~25°C
- The tensile strength was measured in accordance with ASTM-E08 standard.
- Wear tests were conducted using Pin-on-Disc Tribometer.

Final achievements from the work are:

- Particle weight fraction exhibits direct relationship with the wear rate. Incorporation of 3, 6 and 9 weight percentage of Palmyra shell ash into AlSi10Mg alloy results in decrease in wear rate at low loads (10, 20 & 30N) due to strong interfacial bond between the matrix and reinforcement.
- Nine percentage weight fraction of Palmyra shell ash showed less wear rate of all as compared to the unreinforced alloy. Sliding distance shows direct relationship with wear. Increase in sliding distance results in microthermal softening of the matrix and composite due to rise in temperature where bonding efficiency decrease with increased wear rate.
- Significant increase in hardness (from~76 to 116 HBN) and tensile strength (from~125 to ~195MPa) was observed when the weight fraction of the composite increased from 0 to 9% of Palmyra shell ash which restricts the deformation of the material thereby increasing the hardness and tensile strength.
- Abrasion, adhesion and oxidation were found to operate under the test conditions of normal loads.

PUBLICATION

Shankar, S. and Elango, S., 2016. Dry sliding wear behaviour of Palmyra shell ash reinforced aluminium matrix (AlSi10Mg) composites. Tribology Transactions, (Accepted for Publication). SCI Indexed Impact Factor:1.418. DOI : 10.1080/10402004.2016.1178362

"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

An Efficient Parallel Turbo Decoder Architecture for Wireless Network Applications

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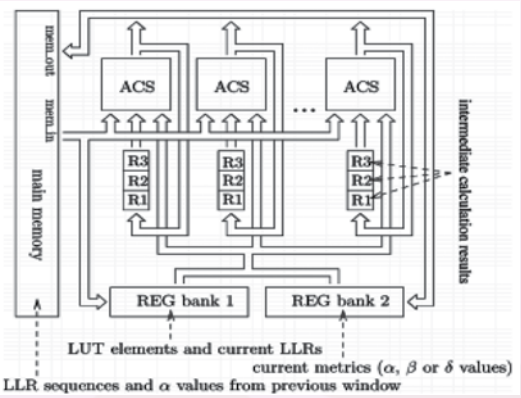
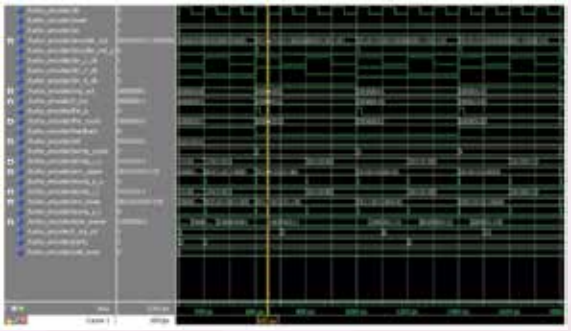
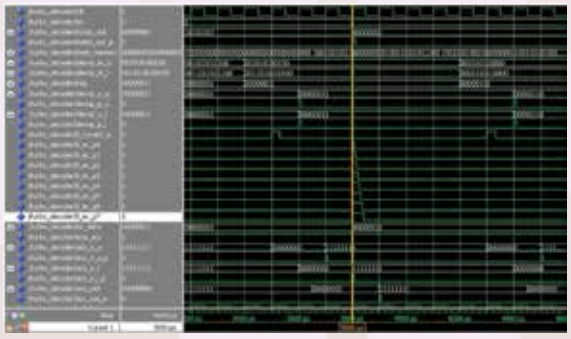


Energy-efficient LUT-Log-BCJR architecture



Output waveform of the Turbo-encoder



Output waveform of the Turbo-decoder

OBJECTIVES

- To design high data rate and high throughput parallel turbo decoder architecture for wireless sensor network.
- To increase the speed of turbo decoder and to reduce the number of decoding iterations by using parallel processing.
- To adopt look-up table based log BCJR (LUT log BCJR) technique to reduce the hardware complexity and increase the throughput.

- To develop the Hardware Description Language programming for proposed parallel turbo decoder using Xilinx 14.5 software tool. The proposed work will be simulated, tested and verified by using Model sim 6.3g-p1.

ACHIEVEMENTS

The proposed work is implemented using clock gating technique in order to reduce the power consumption. The previous turbo decoder architectures uses optimal-log based algorithm which has the complexity about 75% and hence leads to time and energy consumption due to sequential operations. The proposed architecture uses the fundamental Add Compare Select (ACS) operation. Due to the parallel processing operation of ACS blocks the proposed architecture tends to have low processing steps, so that low transmission energy and less complexity about 71%. The proposed work implementation has a throughput of 1.03 Mb/s, memory requirement of 128 Kbps, power consumption of about 0.016(mV) and requires 0.010(A) of current. Compared to the optimal-log based algorithm in the proposed lookup table based architecture the complexity is reduced by 4% and by implementing the clock-gating technique the power consumption is reduced by 38%.

PUBLICATION

1. Anitha. V and Dr. T. Menakadevi, "VLSI Architecture of a Clock-gating Turbo Encoder for Wireless Sensor Network Applications" IJISET - International Journal of Innovative Science, Engineering & Technology, Vol. 2 Issue 12, December 2015, Pg.No 577-585, ISSN 2348 – 7968.
2. Anitha. V and Dr. T. Menakadevi "VLSI Implementation of a Parallel Turbo-Decoder for Wireless Communication" in IJIRSET - International Journal of Innovative Research in Science, Engineering & Technology, Volume 5, Special Issue 2, March 2016, Pg.No 104-108, ISSN (Online) : 2319 – 8753, ISSN (Print) : 2347 – 6710.
3. Anitha. V and Dr. T. Menakadevi "An Efficient VLSI Architecture of a Clock-gating Turbo Decoder for Wireless Sensor Network Applications" IJOER - International Journal of Engineering Research & Science, Volume 2, issue 3,March 2016, Pg.No 25-40, ISSN: [2395-6992].
4. Anitha. V and Dr. T. Menakadevi "VLSI Architecture of a Clock-gating Turbo Encoder for Wireless Sensor Network Applications" a two day national level conference NCFCSPS – National Conference on Resent Trends in Frontiers in Communication and Signal Processing Systems, held on 11th& 12th of March, 2016.
5. Anitha. V and Dr. T. Menakadevi "An Efficient VLSI Architecture of a Clock-gating Turbo Decoder for Wireless Sensor Network Application" a two day national level conference ICVE 2K16 – Emerging trends in Information, Communication, VLSI design and Embedded system, held on 16th & 17th of March, 2016.

Innovation distinguishes between a leader and a follower

Steve Jobs

Experimental Study on Structural Behaviour of RC Columns using Slag from JSW Steel Industry as Coarse Aggregate

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Casting of specimens to study primary properties of concrete

Experimental test set up for column with EOF steel slag as aggregate

OBJECTIVES

Steel slag is a molten by-product of metallurgical operations in steel making process. Usually there are two methods for steel slag production: Basic Oxygen Steel (BOS) and Electric Arc Furnace (EAF) which are used widely. National Slag Association (NSA accessed, 2008) recommended the use of steel slag as an ideal aggregate in hot mix asphalt (HMA) surface mixture, for manufacture of Portland cement, as a shoulder material, for soil stabilization and in agriculture. So there is an increasing demand for GGBS, BOS Slag and EAF Slag. The new efficient steel making method is Energy Optimized Furnace (EOF) and the utilization of EOF Slag is not well explored. In Tamilnadu, 12000-13000 tons of EOF Slag is produced per month and 2,00,000 m^3 - 3,00,000 m^3 EOF slag is produced annually. Piling up the steel slag for long period is a burden for environment and land usage which creates the scope for effective usage of steel slag.

Aggregates have a significant influence on both rheological and mechanical properties of mortars and concrete. They give body to the concrete, reduce shrinkage and effect economy. Since aggregates occupy 70-80 percent of the volume of concrete, their specific gravity, particle size distribution, shape and surface texture influence markedly the properties of mortars and concrete in the fresh state. On the other hand, the mineralogical composition, toughness, elastic modulus and degree of alteration of aggregates are generally found to affect the properties of concrete in the hardened state. Reuse of industrial solid waste as a partial replacement of aggregate in construction activities not only saves landfill space but also reduces the demand for extraction of natural raw materials.

This study aims to assess the physico-chemical and mineralogical characterization of EOF Steel slag and conventional coarse aggregate as per standards and to examine the constraints related to the bulk utilization. In this study, coarse aggregate is partially replaced by steel slag in concrete for M20, M30 and M40 grade concretes at different replacement proportions like 10%, 20%, 30% up to 100%. Strength parameters like compressive, split tensile, modulus of rupture are ascertained and compared for finding the optimum replacement level of steel slag.

The effect of replacement of fine aggregate is not fully studied in structural members. So an experimental investigation will be done to study the strength and behaviour of reinforced concrete columns for failure load, flexural stiffness, ductility and energy absorption capacity. JSW Steel Ltd., Salem Works (JSWS) which is located nearby Salem, have huge quantity of EOF slag. This study will solve the solid waste management problem and also will be cost effective and eco friendly.

ACHIEVEMENTS

The characteristic of steel slag is almost same with that of natural coarse aggregate. The experimental study concluded that the replacement of coarse aggregate, the strength improvements was notably observed at 100% replacement level of EOF steel slag. The full substitution of EOF steel slag aggregate with normal crushed coarse aggregate improved the flexure and split tensile strength at all replacement from 10% to 100%. The workability of concrete decreased with 100% replacement of normal coarse aggregate with EOF steel slag aggregate. Workability of the concrete is reduced when the percentage of steel slag replacement is increased. But up to 100% replacement, the slump value satisfies the recommendations of IS 456:2000. It could be concluded that full replacement of EOF steel slag, instead of normal coarse aggregate enhance concrete density.

From the compressive strength test it is arrived that for M20, M30 and M40 grade, the steel slag replaced concrete has higher compressive strength than the conventional concrete. From the results, it can be concluded that for M20 and M30 grade, the steel slag replaced R.C. column has higher ultimate load than the conventional R.C. column.

It is also inferred that the ultimate load of steel slag aggregate R.C. column for M20 and M30 grade is 14.06%, 9.34% higher than that of conventional R.C. column respectively. For M40 grade steel slag replaced R.C. column has lesser value than conventional R.C. concrete and it is 5.6% less when compared with the ultimate load. For M20, M30 & M40 grade, the ultimate load of R.C. column obtained from the experimental results is higher than the design load. For higher ultimate load the corresponding deflection was also higher for M20, M30 and M40 grade of R.C. column. When the ultimate load is higher the corresponding deflection was also higher. The stiffness does not show much variation for M20 0% and M20 100% whereas in M30 0% and M30 100% the stiffness is more or less same upto a load of 60kN. Beyond that, stiffness increases up to certain load and then the stiffness remains same. For M40 0% and M40 100% stiffness varies from 60kN to 990kN. Beyond that, stiffness remains almost similar for both the R.C. column.

Hence, it could be recommended that EOF steel slag aggregate could be effectively utilized as coarse aggregate in all concrete applications either partial or full replacement of normal coarse aggregate. It is concluded that

there are lot of scope to utilize EOF steel slag as partial replacement for coarse aggregate. In-depth research is needed to investigate on durability properties. The outcome of this project is going be beneficial to both steel industry and construction industry.

PUBLICATION

Papers published in journals

1. M.Arivoli and R.Malathy "Study on Particle Packing Characteristics of Steel Slag Aggregate" in International Journal of Applied Engineering Research (IJA M)Apr, 2016.
2. .Arivoli and R.Malathy "Validation of Fuzzy System by Slump and Compressive Strength of Steel Slag Aggregate Concrete" Journal of Structural Engineering and Management, Vol.3, issue.2, 2016.
3. Arivoli. M, Malathy. R, "Study On Mechanical Properties Of Concrete Replacing EOF Steel Slag As Coarse Aggregate" Journal of Advances in chemistry, Volume 13, Number 5, p 6172-6177.

Papers presented in Conferences

1. M.Arivoli and R.Malathy "Optimization of Packing Density of M30 Concrete with Steel Slag as Coarse Aggregate using Fuzzy System" International conference on Sustainable Materials, Design and Applications (ICSMDA 2016), Kongu Engineering College, March 2016
2. M.Arivoli and R.Malathy "Study on Strength properties of concrete replacing EOF steel slag as coarse aggregate" National conference on Innovations and Sustainable in Civil Engineering and Technology, ES Engineering College, March 2016.
3. M.Arivoli and R.Malathy "Experimental Investigation on Mechanical properties of concrete replacing EOF steel slag as coarse aggregate" National conference on Innovations in Concrete and Construction, Sona College of Technology, 30th March 2016.
4. M.Arivoli and R.Malathy "Study on Particle Packing Characteristics of Steel Slag Aggregate" 2nd International Conference on Advanced Engineering and Technology for Sustainable Development (ICAETSD 2016), Karpagam College of Engineering, Feb 2016,p-137-141.
5. M.Arivoli and R.Malathy "Validation of Fuzzy System by Slump and Compressive Strength of Steel Slag Aggregate Concrete" 2nd National Conference on Innovations in Concrete and Construction (ICON 2016), Sona College of Technology, March 2016
6. Arivoli. M, Malathy. R, "Study on elastic properties of concrete with EOF steel slag as coarse aggregate" 2nd International conference on sustainable practices in civil engineering, KPR institute of Engineering and technology, April 2017.
7. Arivoli. M, Malathy. R, "Study on particle shape characteristics of steel slag aggregate using digital image processing and its effect on mechanical properties of concrete" 3rd National conference on innovations in concrete and construction, Sona College of technology, April 2017.

M.Tech Thesis

1. Study On Strength Properties Of Concrete With Partial Replacement Of Coarse Aggregate By Eof Steel Slag
2. Study On Performance Enhancement Of Steel Slag Aggregate Concrete Using Particle Packing Theory
3. Study on particle shape characteristics of steel slag aggregate using digital image processing and its effect on mechanical and structural behaviour of concrete.

Implementation of Variable Slice Thickness on FDM Machine (JULIA V2 by Fractal Works)

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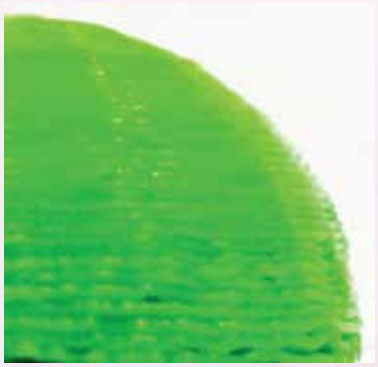
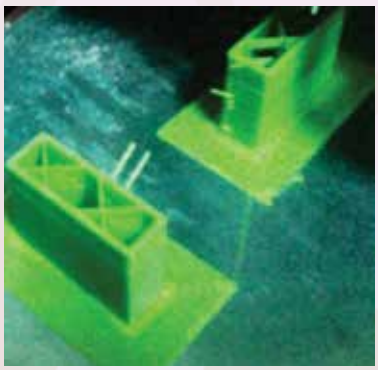
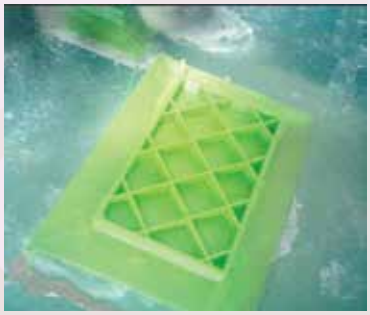


Hemisphere built - variable slicing, side view

Hemisphere built - variable slicing, top view



Machine capability testing – smallest length along X & Y directions



Machine capability testing – smallest length along Z direction

CAD model of the specimen

Specimen printed with ABS – variable slicing

OBJECTIVES

a. To find limitations of machine and various materials in context of adaptive slicing,

b. Find the parameters affecting quality of the layup process and their analysis of interactions between them. Find the optimal control parameters.

c. Develop an algorithm for slicing.

d. Implementing slicing procedure on FDM machine,

e. Testing and validation.

ACHIEVEMENTS

Fused Deposition Modeling (FDM) is one of the additive manufacturing process which uses the plastic wire as a material. The wire is fused and deposited layer by layer to build up a complete part. Generally, commercially available machines uses the uniform slicing through out build, that's why variant slicing was considered for implementation on commercial scale.

According to the work plan, the project is carried out and the objectives of the projects were fulfilled according to the work plan. The first objective was to find out the limitations of machine in various context of adaptive slicing. Experiments were carried out to find out the dimensional errors in the deposition.

The parameters affecting the quality was found out during this experiments. The parameters were grouped into hardware, software and material property. The bed temperature, nozzle temperature, distance between nozzle, material melting temperature, extruder rate, nozzle size etc. are the parameters. G code is first manually modified for testing the machineability to accept the change, and successfully carried out during the experiments

The next step was to find out the best algorithm of slicing for implementation on FDM machine. Through literature survey one of the algorithm was selected. The algorithm was mathematically described and was programed into the slice engine (CURA –an open source software) using the Python language. However, the number of trials were made to implement the algorithm into the desired form. Controlling and changing the extrusion of wire according to the change in layer height was the challenging task that was done using the change in program accordingly.

For the testing of the change in the layer height, according to curvature requirement one specimen was designed, the test specimen is successfully printed with the implemented algorithm into the CURA.

"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

Development of Radial Swaging Tool for Cold Working of Inner Surface of Cylinder

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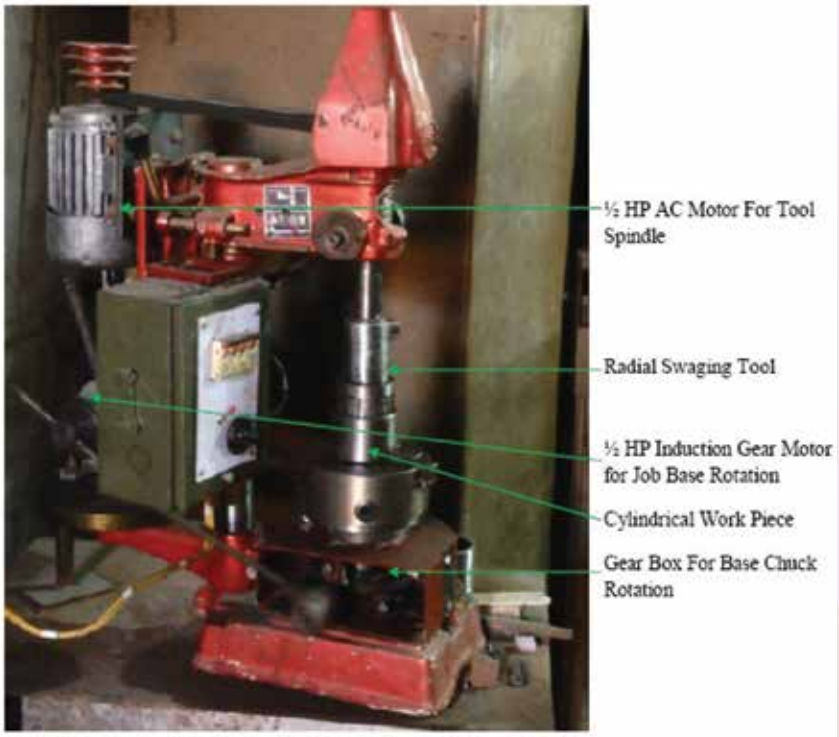
OBJECTIVES

The main objectives which are achieved with this tool are:

1. To make the internal cylindrical surface smooth i.e., to reduce Ra value.
2. To improve the anti rust properties of internal cylindrical surface.
3. To increase the hardness of internal cylindrical surface thereby improving its wear resistance.
4. To provide the plateau finish in internal cylindrical surfaces for providing best sealing & lubricating surface.



Title of the photo: Swaging Tool Fitted in a Radial Drilling Machine

ACHIEVEMENTS

A tool is made which does hammering of internal cylindrical walls with repeated rapid blows of hammers. In this tool we have a cam attached to the spindle. When spindle rotates the cam expels the hammers outward to strike with cylinder wall. The hammers are pulled back by springs. In this way cylinder walls are cold worked with the help of a hammering tool. Peaks are hammered by peening effect.

The striking surface of hammers (4 Nos.) is exactly like the inside surface contour of cylinder inside walls so that hammering is uniform all along the cylinder circumference. Also the job (cylinder) is given very slow and intermittent rotation so that there is no generation of Out of Roundness. In this way cylinder inside wall is repeatedly hit by hammers resulting in a more wear resistant and smooth surface.

Design and Implementation of Novel PV Z-Source Inverter Topology used for Water Pumping

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OBJECTIVES

1. Study and simulation of Photovoltaic system
2. Study and simulation of Conventional ZSI.
3. Study of different PWM techniques for ZSI.
4. Hardware implementation of proposed topology.
5. Integration of Photovoltaic system with this topology and comparison with Conventional PVZSI.

PV as the input source

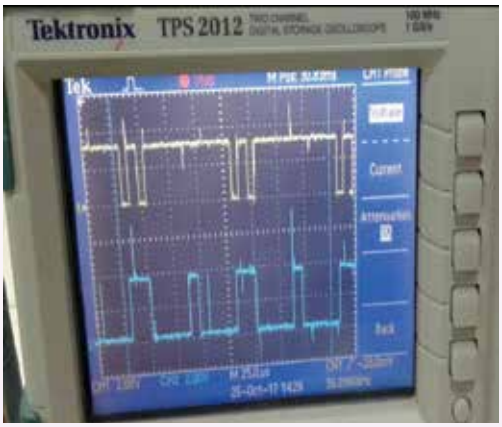
Z-source Inverter connected to 500Ω and 25 mH resistive, inductive load

Increasing power demand drives the power analysts towards renewable sources like Photo Voltaic (PV). Inverters play a vital role while converting constant DC power to variable AC power to meet the load demand. Impedance Source Inverter or Z-Source Inverter (ZSI) has wide range of applications nowadays because of its unique boosting technique in the field of fuel cells, electric vehicles, motor drives, UPS, renewable energy sources, active filters etc. This project work presents an analytical study and its implementation in MATLAB/ Simulink software as well hardware with sine triangle PWM techniques for proposed new topology PV-ZSI. It has been observed that the output voltage of the proposed inverter is higher than the conventional VSI inverter. As the proposed inverter is lesser in size and output voltage is greater so it is more efficient than conventional VSI. There is no requirement of boost to boost converter to boost up the voltage.

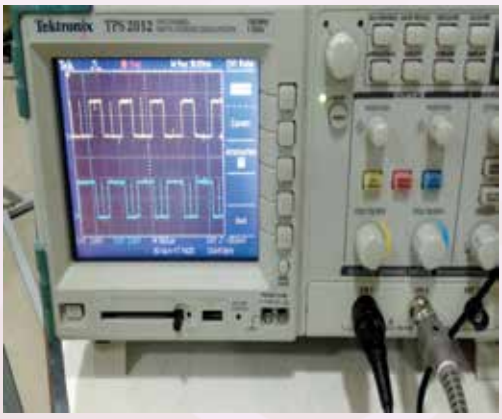
ACHIEVEMENTS

- PV system based ZSI, provides more boosting factor and lesser size compared to conventional ZSI. This topology has wide range of applications nowadays in the following fields. Interfacing of PV three phase ZSI with Grid can be used for rural electrification. Use of PV three phase ZSI in Active filtering, motor drive application, distributed generation, electric vehicle applications, fuel cell.
- The two main stand-alone PV applications are: Battery Charging and Solar water pumping.
- In many remote and rural areas, hand pumps or diesel driven pumps are used for water supply. Diesel pumps consume fossil fuel, affect the environment, need more maintenance, and are less reliable.

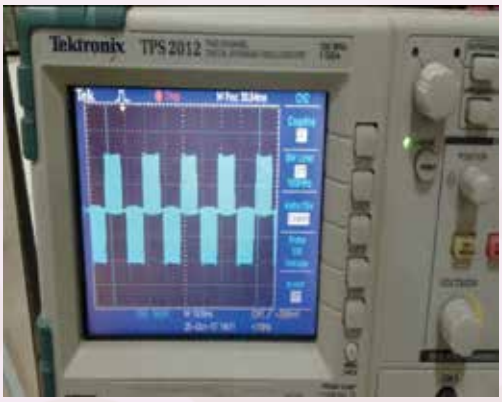
70V is the input voltage received from the PV panel



PWM pulses of inverter (T1 and T2) with maximum shoot through

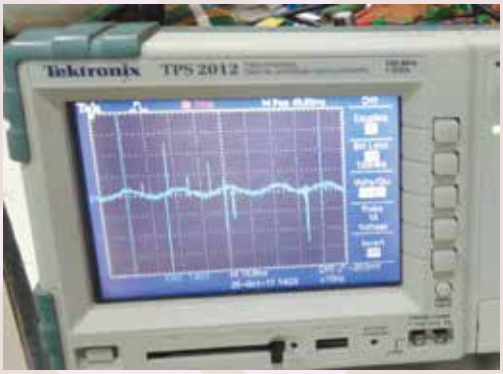


PWM pulses of inverter (T1 and T2) with minimum shoot through



Output voltage of the Inverter with minimum shoot through (110V)

Output voltage of the Inverter with maximum shoot through (170V)



Output current of the Inverter

Output current of the Inverter (0.12A)

PV input voltage given to Inverter is70V
Z-source Inverter connected to 500Ω and 25 mH resistive, inductive load. In place of RL load, we can use motor load which can be used for water pumping.
Output voltage of the Inverter with minimum shoot through is 110V.
Output voltage of the Inverter with maximum shoot through is170V.
Output current of the Inverter as well as across load is 0.12A.

- Photovoltaic (PV)-powered water pumps have received considerable attention because of major developments in the field of solar-cell materials and power electronic systems technology.
- Solar water pumping systems usually have DC or AC pumps. To feed the AC motors, a suitable interface is required for the power conditioning.
- The PV inverters for the stand-alone applications are very expensive. To reduce the cost and to increase the efficiency, PV system based ZSI topology can be used.
- This topology has wide range of application in irrigation, agricultural purposes also.

Legacy of IEI

Prime Minister Mrs Indira Gandhi cutting the Golden Jubilee Cake

A Precision 2.45 GHz Microwave Driven Electron Cyclotron Resonance Plasma Enhanced Thin Film Deposition System

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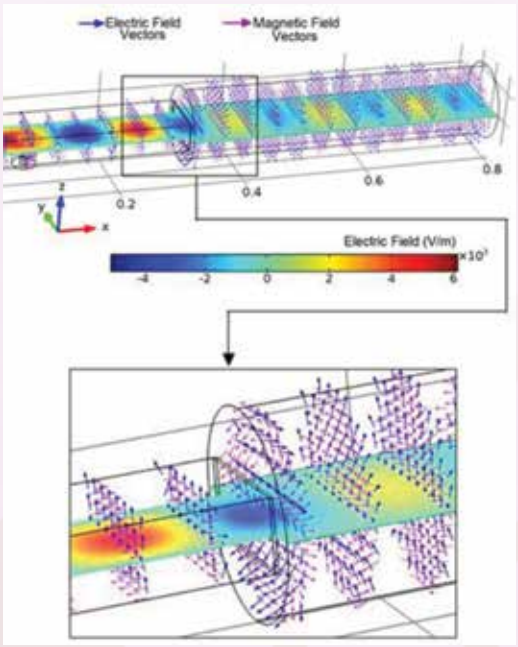
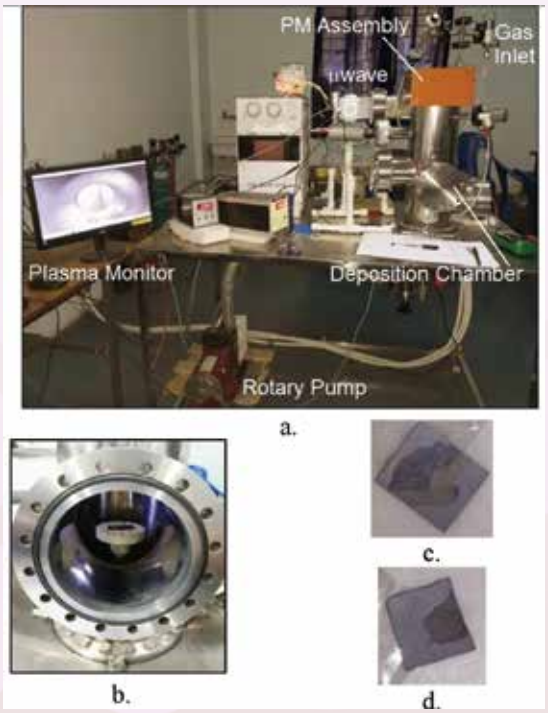


Simulated result of EM Field Distribution inside the deposition reactor



a. 2.45 GHz ECR-PE Nano-film Deposition System b. Substrate loading inside deposition reactor
c. & d. Graphene transferred on Si-wafer 5mm X 5mm

OBJECTIVES

The basic objective of the proposed project is to design, develop and test a 2.45 GHz low cost microwave driven Electron Cyclotron Resonance Plasma Enhanced (ECR PE) thin film deposition system. The equipment will be used for the synthesis of nanometer thin films of various materials, enabling us to develop, in future, the state-of-the-art bio-sensors, Photo-catalysts and high-κ dielectric films. In this instrument, electrons gain energy from microwave power under cyclotron resonance condition and the energetic electrons collide with the injected gas/precursor molecules to produce high density plasma containing energetic radicals. Owing to enormous stored energy in ECR plasma, the energetic fragmented radicals impinge on the substrate and create very high quality thin films at low temperature. The deposition rate can be controlled by controlling the plasma parameters. Neither external high temperature is needed for precursor cracking; nor does any substrate damage occur due to high operating temperature.

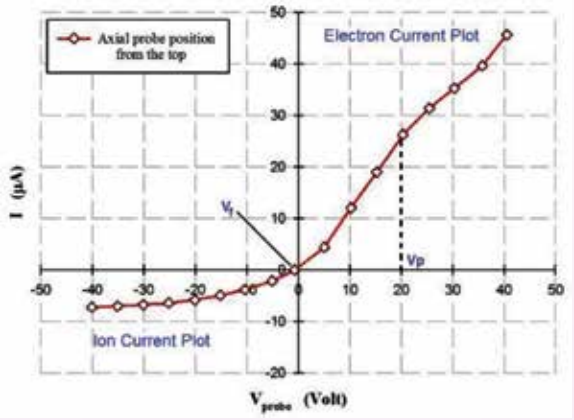


Figure (a) : Langmuir Probe Characteristics - electron and ion current (I) vs. probe potential (Vprobe) Vp : Plasma Potential Vf : Floating Potential

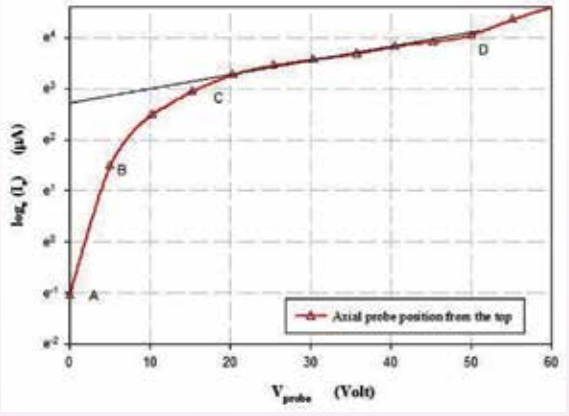


Figure (b) : Langmuir Probe Characteristics (Logarithmic Plot) AB: bulk electron current BC: knee current CD: electron saturation current

The main components of the proposed nano dimensional film deposition system are:

1. A 2.45 GHz magnetron based precisely variable power microwave source and its injection hardware including protection devices
2. Deposition cum plasma chamber containing precursor/gas flow arrangement, Vacuum window for microwave injection and substrate/sample holder
3. Vacuum system with measuring gauges to obtain purity and desired plasma condition
4. Magnet assembly using permanent magnets to create static resonance magnetic field without using electrical power
5. Mounting stand for the entire setup
6. Deposition of thin films of metallic or non-metallic materials.

ACHIEVEMENTS

A 2.45 GHz microwave driven Electron Cyclotron Resonance Plasma Enhanced (ECR PE-CVD) thin film deposition system has been indigenously designed and developed in Institute of Engineering & Management, Kolkata. In this setup, an enormous energy stored into the confined magnetized plasma has been utilized to heat up the precursor molecules and dissociate into its fragments for desired deposition of the film. The high density magnetically confined plasma is generated over a horizontal iso-gauss surface of 875 Gauss. The deposition system consists of permanent magnet assembly, Microwave power source and its injection line hardware, a multiport cylindrical non-magnetic stainless steel deposition reactor chamber and a high vacuum system.

- A100 ltr/min double stage rotary vane pump along with vacuum gauge controller is used for evacuation of ~12ltrs reactor chamber and ~5 $X10^{-3}$ mbar pressure is obtained inside the chamber with a pump down time of 10 minutes.

- A 2.45 GHz low cost microwave magnetron along with its control circuit has been used here to deliver power to the multiport cylindrical deposition reactor through a microwave injection line. The injection line hardware consists of WR 340 rectangular waveguide, E-plane bend and a vacuum window. The components have been designed and developed indigenously. Adequate forced air cooling has been provided for long time continuous operation of the magnetron. The power injection into the plasma has been studied precisely with the help of COMSOL Multiphysics software.
- The iso-gauss surface over which the Electron Cyclotron Resonance takes place, is created with the help of four powerful NdFeB rare earth permanent magnets with 1.2T remanant magnetism. The magnetic blocks are nested at the center of the cubical inverted pot like return yoke structure. An undergraduate student's project funded by The Institution of Engineers (India), includes the design, field calculation and development of the rare-earth permanent magnetic assembly mentioned above. This magnet assembly is essentially needed to produce the iso-gauss Electron Cyclotron Resonance zone for ECR PE Deposition system. A square shaped inverted pot like soft iron return yoke structure enables us to produce the desired field configuration avoiding less fringing field outside the yoke structure.

  A strong permanent magnet structure of 100mm X 100mm X 25mm is composed of four 50mm X 50mm X 25mm bar magnets possessing 1.2T remanant magnetism. Assembling of such magnets is a challenging task. A special jig of non-magnetic SS along with aluminum spacers were used for successfully assembling the magnets on a 15mm thick 190mm X 190mm square shaped soft iron plate.

  The return yoke structure consists of four 160mm X 100mm X15mm soft iron walls fitted on the iron base plate which together form a pot like return yoke structure of the magnet.

  The magnetic field calculation of this total magnetic assembly has been carried out utilizing LANL SuperFish code and the field mapping was done utilizing Hall probe.

  Thus a uniform iso-gauss surface has been achieved for the resonance of 2.45 GHz microwave power driven ECR plasma inside the chamber which is essential for nano film deposition.
- A multi-port, 150 mm diameter, 500 mm long cylindrical shaped non-magnetic SS-304 Plasma chamber has been designed and developed. Fig. 2a. and Fig. 2b. shows the developed ECR Plasma Enhanced Nano film deposition system. A rectangular shaped port identical to WR340 wave guide aperture is used through which the microwave is injected into the reactor chamber. This chamber consists of three 100mm diameter circular ports, mutually 90° apart at different heights. The ports are used for substrate handling, high vacuum pumping. A 40mm diameter circular port is used for viewing purpose during operation. A specially designed port extended outside the permanent magnet assembly is used for plasma gases and precursors. Gases are injected through precisely controlled needle valve. The plasma diagnostic connections are taken through an eight pin glass-metal vacuum feed through. Substrate biasing and heating are also provided by the vacuum feed through.

  A 160CF bottom flange provides the connections for rough vacuum pumping by a double stage rotary vane pump and vacuum measuring gauges etc. A stainless steel right angle valve isolates the system from vacuum pump.

  A sample manipulator shaft is inserted through a Wilson type vacuum seal. As per our design, a 75 mm diameter substrate holder sits over a 75 mm diameter SS base plate attached to the drive shaft. A 8 mm thick hollow cylindrical shaped alumina disc is used between the base and substrate holder to isolate the substrate holder from the rest of the chamber. Substrate heating, temperature measuring and the biasing arrangement facility is provided to the substrate holder.

- A stable ECR discharge inside the chamber at different vacuum pressure has been achieved. The property of the ECR plasma has been studied with the help of Langmuir probe at various axial distances. Electron and Ion Current characteristics are shown in Fig. 1a. & 1b. at operating pressure ~5.8 X 10^{-2} mbar at an axial distance ~60mm from top of the reactor chamber. Plasma Potential (Vp), Floating Potential (Vf), Plasma Density (ne) and Bulk Electron Temperature (Te) has been calculated from the characteristics curve.

Plasma Potential (Vp)	~20 Volt
Floating Potential (Vf)	~(-1) Volt
Plasma Density (ne)	~9.6 X 10^{8} cm^{-3}
Bulk Electron Temperature (Te)	~1.43 X 10^{4} K

- An 80µm thick commercially available copper foil has been exposed under Hydrogen plasma for etching and achieved a clean glossy surface. After surface cleaning, it is exposed to Methane plasma for Graphene synthesis. The routine synthesis and characterization of the graphene film has been carried out for device fabrication work.

PUBLICATION

1. Dr. G. S. Taki, "A Permanent Magnet Electron Cyclotron Resonance Plasma Enhanced Multi-Facility Nano-Metric Film Deposition System", Patent Application No. 201731026517 A, 26th July, 2017
2. Soumik Kumar Kundu; Samit Karmakar; Shamik Mukherjee; Shubham Majee; Suman Kundu; G. S. Taki, "Design study of a portable permanent magnet ECR plasma source for thin film deposition", 2017 1st International Conference on Electronics, Materials Engineering and Nano-Technology (IEMENTech), 28-29 April 2017.
3. Samit Karmakar; Shamik Mukherjee; Soumik Kumar Kundu; Deepantee Jha; G. S. Taki, "Conceptual design of a double antenna fed ECR plasma enhanced nano-film deposition system", 2017 1st International Conference on Electronics, Materials Engineering and Nano-Technology (IEMENTech), 28-29 April, 2017
4. Soumik Kumar Kundu, Samit Karmakar, Mili Sarkar, G. S. Taki, "Study on 2.45 GHz Microwave Propagation in an ECR Plasma Enhanced Film Deposition System" – 31st Indian Engineering Congress, The Institution of Engineers (India) Kolkata, 2016.

Legacy of IEI

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

Performance Analysis of Switched Reluctance Motor Drive for Electric Vehicle Application with DSP

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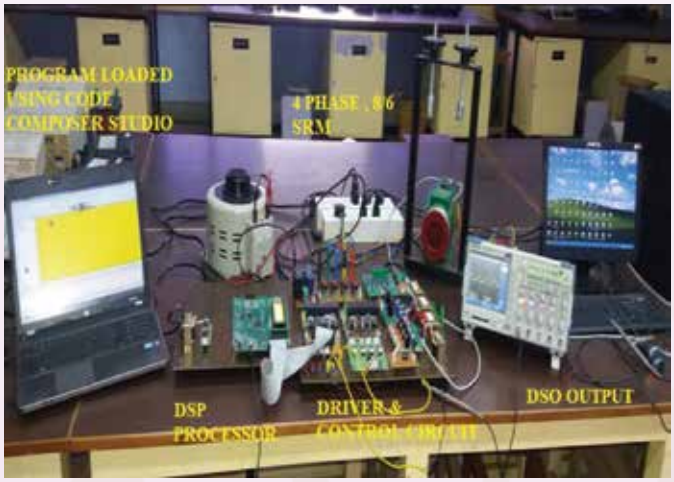
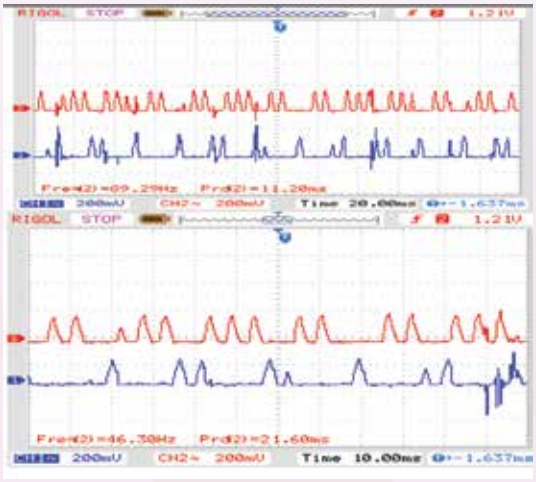


Hardware setup



Current sensor outputs

OBJECTIVES

The objective of this project is to analyze the performance of drive such as control acceleration/deceleration, reversible driving, and regenerative braking characteristics of Switch Reluctance Motor (SRM) for electric vehicles.

The most promising solutions to develop the electric vehicles (EVs) have been speeding up in recent years because of energy crisis and environmental pollution. The electric motor drives have advantages such as high efficiency, high power density, high controllability, wide-speed operating range, and maintenance free operation. For electric vehicle drive applications the switched reluctance motor (SRM) is important alternative for it is clean, efficient and environmentally friendly because it is simple and robust structure. In this project the dynamic performance of the SRM for electric vehicle is forecasted by simulating with MATLAB /simulink software. To test the feasibility the hardware work is carried out using AC-DC converter, IGBT module for asymmetric bridge converter for four-phase SRM, 0.5hp. 4 phase, 8/6 poles, 300V and 4000rpm switched reluctance motor and DSP TMS320F28335 processor. The opto-couplers provided for position measurements at six discrete points per electrical cycle of the SRM. The performance of SRM drive is tested with load and without load conditions and found suitable for electric vehicle applications.

ACHIEVEMENTS

1. In this project the Simulink/MATLAB model of the SRM drive is developed and various outputs parameters of the drive are analyzed. Using PI and PID controllers the SRM drives is operated on starting,

running and breaking conditions at various speeds and to obtain their stability under sudden application of load.

2. Hardware setup is designed, developed and implemented. The results are tested at various load conditions.
3. In this hardware implementation DSP processor and code composer software is used to control the SRM.
4. Simulation and experimental results are compared to verify the feasibility of project.
5. The performance of drive for electric vehicle such as control acceleration/deceleration, forward driving and reverse driving is analyzed.
6. The results obtained from both simulation and experimental work are satisfactory.

PUBLICATION

1. J.Jeffy Felcia Sharon and Nalin Kant Mohanty "Simulation of Switched Reluctance Motor Drive for Electric Vehicle Application" International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering Vol. 6, Special Issue 2, March 2017 pp 312-317.

Legacy of IEI

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

Automated Robotic Weed Eradication System using Embedded Technique

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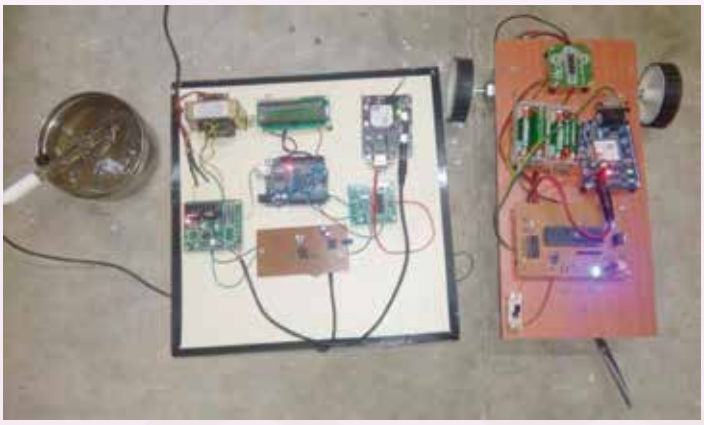


Analysis of sample of sand using pH analyser

pH Sensor

pH sensor is use to measure the "pH value of weeds" and using the pH value of weed, weed is identified and eradicated.

OBJECTIVES

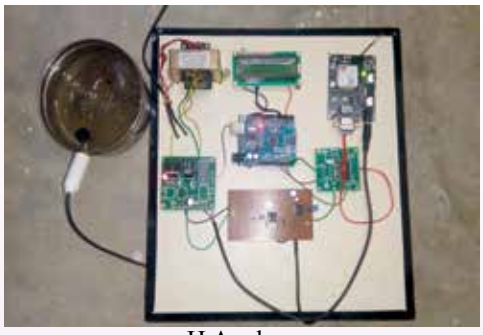
Now-a-days the eradication of weeds using pesticides is really the only practical way for farmers to keep weeds under control, because farmers can use tractors to cover large areas in a short amount of time. But all of those are deadly (to weeds) chemicals and then we don't want to kill the plants (because we want to eat them). The most organic and eco-friendly way of eradication of weeds is the oldest method: physically removing them. "Physical removal" can mean pulling weeds out completely, but that takes more amount of time. A better solution is to just crash it way down into the ground, which is faster, easier, and a robot can do excellently.

The main goal of the proposed system is the removal of weeds and crops in agricultural fields using embedded techniques. The proposed method is designed to identify the weeds from crops using the similar spectral signatures of crops and the irregular distribution of weeds in the agricultural field. The proposed strategy is aimed to implement using Electrochemical sensors, arduino device and weeding tool. Electrochemical sensors are used to measure/sense pH level of weed and plant and using this pH value, the weeds are determined. The stamping tool is 1 centimeter wide, and it drives weeds about 3 cm into the soil. It's

Soil	Moist Level	PH Level
Black Gram	9.5	6
Green Gram	9	5.8
Sorghum	9	6.5
Sunflower	10	5.2

pH Meter strips

Hardware Setup



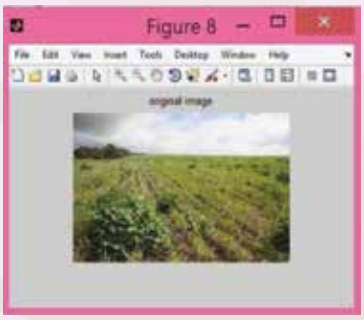
pH Analyser

pH Measurement

Weeding tool

Automated Weed Eradication System

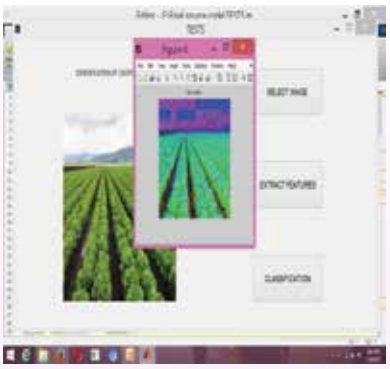
GUI Design



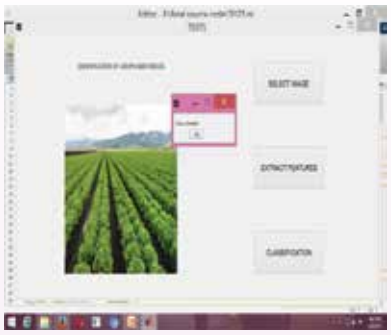
Original Image of Weeds with Crops

Removal of Noise

Original Crop Image

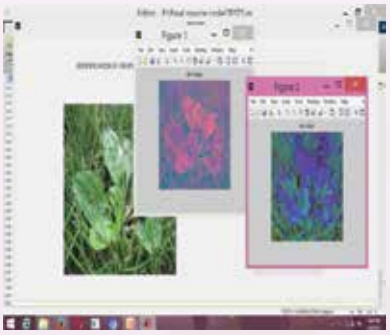


HSV Image



Classification of Crops

Original weed Image



Lab and HSV Image

Identification of Weeds

designed to detect (using pH value) and destroy small weeds that have just sprouted, although for larger weeds, it can hammer them multiple times in a row with a cycle time of under 100 ms. From these techniques, it is planned to eradicate the weeds and increase the productivity of crops.

PUBLICATION

Paper titled on Automatic weed eradication system using embedded system is presented on International Conference on "Advanced Computing & Communication Systems" at Sri Eshwar College of Engineering, Coimbatore, Tamilnadu, India.

Research is creating new knowledge

Neil Armstrong

Experimental Investigation of Scalable Underwater Missile Launching System

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Electromagnetic launcher setup solid propellant property test

Projectile motion in the rails (captured and processed with image processing tools) scaled underwater launcher setup

OBJECTIVES

Overall objective of the proposed research is to find out the alternate energy source in contrast with the usage of high pressure air to push the missile clear out of the water.

The specific objectives are:

- To create the electromagnetic force by the power of capacitor bank and analyses the effect of Lorentz force.

- ❖ To create the electromagnetic force by the power of capacitor bank and evaluate the Lorentz force.
- ❖ To increase the propulsive efficiency of the launcher.
- ❖ To make the launching process more reliable and flexible.

- To make the solid propellant motor and evaluate the specific impulse of the propellant.
- To combine the electronic ignition and altitude data recording system with the missile.

PUBLICATION

Presented the research work "An Experiment on solid Propellant Combinations, Evaluations of the Solid Propellants", International Conference (International Conference on Mathematical sciences and Engineering Applications (ICMSEA-2016 on December 23-25) at Baba Institute of Technology and Sciences, Visakhapatnam.

K. M. Parammasivam, J. Sarathkumar Sebastin, "Experiment on the Solid Propellant Combinations: Evaluation of Solid Propellants", Open Journal of Technology & Engineering Disciplines (OJTED), Vol 4, December 2016.

Legacy of IEI

Shri V P Singh, Chief Minister of Uttar Pradesh inaugurating
60th Annual General Meeting & Diamond Jubilee Celebration
of Uttar Pradesh State Centre of the Institution in 1981

Effect of CO_2 Adsorption and Durability Properties of Concrete Modified with Zeolite

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CO_2 adsorption test set up using CO_2 gas

CO_2 adsorption test using dry ice

OBJECTIVES

The objective of the study is as follows:

To design a mix of M30 grade concrete with zeolite as partial replacement of cement

To compare the CO_2 adsorption property of concrete modified with zeolite and conventional concrete

To compare the strength properties of concrete modified with zeolite and conventional concrete

To compare the durability characteristics of concrete modified with zeolite and conventional concrete.

ACHIEVEMENTS

- Concrete modified with zeolite had decreased compressive strength when compared to that of conventional concrete.
- Concrete with 15% of cement replacement with zeolite, showed an 8.11% increase in split tensile strength than that of conventional concrete.
- Water absorption and sorptivity test results showed an increasing trend with increase in zeolite content.
- Durability characteristics showed positive results for concrete with zeolite as partial replacement of cement.
- CO_2 adsorption of concrete after final setting (24 hour initial air curing) increasedwith zeolite content. A maximum of 10.27% CO_2 adsorption was obtained for 25% zeolite replacement level.
- CO_2 adsorption of hardened concrete increased with zeolite content. A maximum of 7.52% CO_2 adsorption was obtained for 25% zeolite replacement level.

- Compressive strength of conventional concrete and concrete modified with zeolite were increased after CO_2 adsorption.

From the analysis, it is clear that zeolite can be used as a cementitious material in concrete as a partial replacement of cement.

It is observed from this experimental investigation, CO_2 adsorption in concrete increased due to the presence of zeolite which will improve the durability and strength properties of plane concrete. As such this may be a good application in pavements, chimneys, exterior walls etc. where plane concrete is used.

PUBLICATION

Krishna Lekha R T, Lathi Karthi and Alester Joseph Vanreyk, "Effect of zeolite powder on mechanical properties of concrete", International journal of developmental research, 7, 2017.

Krishna Lekha R T - M Tech Thesis - Effect of CO_2 adsorption and durability properties of concrete modified with zeolite.

Krishna Lekha R T, Lathi Karthi and Alester Joseph Vanreyk, "Experimental investigation on CO_2 adsorption properties of concrete with zeolite as partial replacement of cement" (Paper sent to Journal of The Institution of Engineers India – Series A).

Legacy of IEI

Mr E S L Narasimhan, Hon'ble Governor of Andhra Pradesh and Telangana Inaugurated the 29th Indian Engineering Congress at Hyderabad in December 2014

Managing E-Waste Through Pyrolysis

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Pyrolysis unit designed and fabricated

Fuel oil produced using the designed set up from e waste

OBJECTIVES

1. To fabricate an experimental setup to demonstrate the successful separation of products from waste printed circuit boards of electronic waste.
2. Characterization of products obtained from pyrolysis.
3. Application of fuel oil and gas from pyrolysis to generate energy.

ACHIEVEMENTS

The work was initiated from an idea to make a customized pyrolyser which can work as fluidized as well as for fixed bed. It is having both conditions of fixed and fluidized bed pyrolyser. The work demonstrated here is a first attempt in India for electronic plastic waste recycling. So far this waste was land used as filling and had no use. Now it is successfully converted into fuel oil of 12000 J/gm. The work will be continued to refine the fuel oil for different applications.

ACKNOWLEDGEMENT

The work was accomplished with the Grant-in-Aid scheme of IEI. This setup was in sketch from a long time however funding was a problem and was done with this scheme. Investigator and guides are grateful to IEI for providing such grant.

PUBLICATION

(1) Vaibhav Pandere, Alok Gautam, Shina Gautam, Fuel oil production from waste electrical and electronic equipment, CHEMCON 2017, HIT Haldia, 27-30 December 2017.

(2) M.Tech. thesis on Fuel Oil Production From Waste Electrical and Electronic Equipment.

Cascaded H-bridge Multilevel Inverter for Industrial Applications

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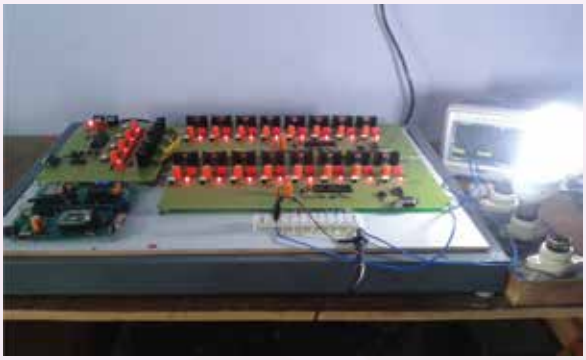

Cascaded H Bridge Multilevel Inverter Hardware setup (without solar panel)

Cascaded H Bridge Multilevel Inverter Hardware setup (with solar panel)

OBJECTIVES

The aim of the project is to design a Cascaded H-bridge Multi-Level Inverter for Grid connected Photovoltaic system to improve the Power Quality so as to meet industrial requirements with cost effectiveness. The design will use entirely enhanced PWM techniques and intelligent controlling mechanism to achieve the ultimate best performance than the existing ones.

ACHIEVEMENTS

In this project, a real time implementation of Cascaded H-bridge eleven level inverter using various high switching frequency pulse width modulation techniques for grid connected DC power source has been carried out. The high switching frequency PWM technique such as Sinusoidal PWM (SPWM) is employed for eliminating or minimizing the THD exhibited in the output voltage and current waveform. The performance of Cascaded H-bridge eleven level inverter using various controllers such as PI controller, PID controller and fuzzy logic controller are reported. Harmonics in source current distorts waveform and quality of power supply. Further, these harmonics reduces the source power factor and produce abnormal heating in the system. To eliminate this harmonics in source current, LC filter is used in this research work. Furthermore, this Cascaded multilevel configuration is able to improve the quality of the output voltages and currents, thus resulting in better total harmonic distortion than in conventional converters.

In order to improve the performance of the conventional PI and PID controllers using SPWM, the tuning of PI and PID controllers using Ziegler-Nichols tuning technique is also carried out. The optimum values of proportional, integral and derivative gains are fixed. Hence as the new contribution, control of Cascaded H-bridge eleven level inverter is optimized by considering both tuning of PID parameters. Then, fuzzy logic

control using SPWM is developed in this work to obtain desired output voltage and minimize the harmonics of the chosen inverter. A rule based fuzzy logic controller is used to track the reference voltage for any load condition and produces low harmonic distortion and improved step response compared to conventional PI and PID controllers also, it is found that pv arrays with MPPT works well under rapidly changing environmental conditions. This can always ensure that the maximum active power can be injected into the grid. Moreover, the output voltage of the inverter has eleven levels which make the shape almost sinusoidal with improved power factor and increased power quality. A MATLAB/SIMULINK platform is used and an experimental verification setup was constructed and developed to implement in an ARM processor LPC 2148 and the observations validated the proposed idea. The FFT analysis of the simulated and experimental output voltage and current waveform confirms the effectiveness of the proposed technique. The THDs of terminal voltage across the load terminals and current are measured to verify the improvement. By implementing PI,PID and Fuzzy Controllers for cascaded H-Bridge multilevel inverter topology using sinusoidal PWM, grid current harmonics is reduced below 5% which satisfies the IEEE constraints. This implementation is suitable for industrial applications.

PUBLICATION

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M. S. Sivagama Sundari and Dr. P. Melba Mary, "Cascaded H-Bridge five level Inverter for grid connected PV System using PID Controller", Journal of Semiconductor Technology and Science, Vol.16, No.4, August 2016.

M. S. Sivagama Sundari and Dr. P. Melba Mary, "Real Time Implementation of PI and PID Controlled Cascaded H-Bridge Eleven Level Inverter using SPWM" Informacije MIDEM – Journal of Microelectronics, Electronic Components and Materials, Vol.46, No.2, pp 65-73, 2016.

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

Separation of Organic Compounds from Wastewater using Vacuum Assisted Pervaporation in a Pilot Plant

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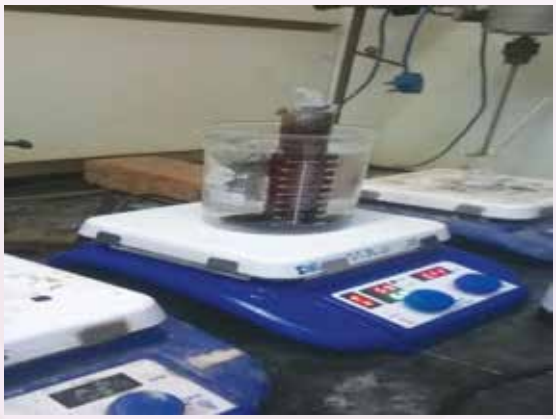
Experimental setup for pervaporation



Cross-linking set up of membrane

OBJECTIVES

The PV performances of composite cross-linked membranes will be studied with respect to the contents of various cross linkers, feed temperature and feed water concentration for the HAc/water binary solutions. Membrane characterization is essential in order to evaluate the quality of the synthesized membrane. All the resultant composite membranes as prepared by the previous method will be analyzed by contact angle, FTIR, AFM and SEM analyzer. In order to measure the swelling degree of resultant composite membrane each sample of membranes are immersed in the solution of the different concentration of acetic acid at room temperature in a closed glass flask. After being taken out from the solution, the swollen membranes are wiped rapidly with tissue paper and to be weighed immediately. The weight of each sample is to be monitored periodically until a constant weight is achieved. Swelling degree of membrane is calculated. Pervaporation experiments are performed using the laboratory set-up. The permeation cell consisted of two detachable stainless steel parts which were provided with inlet and outlet openings for the flow of feed solution and an outlet opening for the withdrawal of permeated product. The dimension of the test cell: 240 × 180 × 25 mm. Stainless steel net is embedded in one part of the cell to support the membrane. The two parts of cell were sealed tightly using teflon rings. The acetic acid dehydration will be carried out by using different water permselective membranes. The effective area of the membrane in the pervaporation cell is 110 cm^2. The liquid feed-mixture is circulated in contact with the membrane using a peristaltic pump from a feed tank, equipped with an overhead condenser to prevent any loss of feed due to evaporation. The constant temperature of feed (45, 55, 65°C) is maintained by using a thermostat bath and controlled on the inlet and outlet of cell. The diffusion behaviour and mechanism of solute/solvent transport through polymeric membranes in pervaporation is studied.

ACHIEVEMENTS

Effect of temperature on molar flux, selectivity and intrinsic membrane permeability was investigated with a commercial PVA-PES composite membrane crosslinked with glutaraldehyde during the pervaporation of water-acetic acid binary mixture over a wide concentration range. The degree of swelling increased almost linearly with increasing acetic acid concentration in the feed mixture ultimately resulting in an increase of the total flux. With increase in feed temperature degree of swelling decreased marginally. At 25°C the maximum degree of swelling was found out to be 46.3%, which reduced to 39.5% at 65°C. The rate of increase of molar flux of water with temperature was found to be substantially higher than the rate of increase of acetic acid molar flux. At 70°C the molar flux of water was found out to be 0.3342 m^3(STP)/m^2h, whereas the acetic acid flux was 0.0526 m^3(STP)/m2h, almost about seven fold lower. However the separation factor decreased with increasing temperature. At 50°C the separation factor was estimated to be 2.3, which decreased to 1.52 and 1.35 at 80°C and 90°C, respectively. The apparent activation energy value of water permeation (Epw) was significantly lower than that of acetic acid permeation (EpHAc), indicating a higher separation efficiency of the membrane. The membrane used in the present study could tolerate highly concentrated corrosive acetic acid, thus may be useful for dehydration of other organics. However, further efforts for flux enhancement are needed in the future. A commercial PVA-PES composite membrane crosslinked with glutaraldehyde was used in the pervaporation of water-acetic acid binary mixture over a wide concentration range of 10-90%. The degree of swelling increased almost linearly with increasing water concentration in the feed mixture ultimately resulting in an increase of the total flux. There was disproportionality between the flux and selectivity for all liquid feed mixture compositions and operating temperatures. With an increase in acetic acid feed concentration, the selectivity and enrichment factor increased while the flux decreased due to less swelling effect induced by water molecules. The highest water flux and selectivity were recorded to be 1.875 kg/m^2h and 8.59 at 10% and 90% acetic acid concentration respectively. Pervaporative separation index was found to decrease with increasing acetic acid concentration in feed. The rate of decrease of selectivity was much higher than the rate of increase of flux with feed concentration. Diffusion coefficient for water and acid through the membranes were also evaluated. The membrane used in the present study could tolerate highly concentrated corrosive acetic acid, thus may be useful for dehydration of other organics.

- Rutvi Patel and Haresh K Dave, "Study and Evaluation of Various Performance Parameters for the Separation of Acetic acid and Water Mixture by Pervaporation Technique in National Conference on New Trends and Development in Chemical Science and Technology jointly organized by ISTAR, Vallabh Vidyanagar and SVNIT, Surat on 31st January, 2015.
- Haresh K Dave and Kaushik Nath, "Pervaporative Dehydration of Acetic acid-Water using PVA-PES Composite Membrane in International Conference on Membrane Based Separation (MEMSEP 2015) organized by MSU, Baroda during 21-23rd February, 2015.
- Haresh K Dave, Anam Khan and Kaushik Nath, "Pervaporative dehydration of dilute acetic acid using a novel polyvinyl alcohol-graphene oxide (PVA-GO) composite membrane in a pilot plant', organized by IIT Guwahati during 27-30th December 2015.
- Haresh K Dave and Kaushik Nath, "Graphene oxide incorporated novel polyvinyl alcohol membrane for pervaporative recovery of acetic acid from vinegar wastewater", Journal of Water Process Engineering (Elsevier) 14 (2016) 124-134.
- Haresh K Dave and Kaushik Nath, "Effect of temperature on pervaporation dehydration of water-acetic acid binary mixture", Journal of Scientific and Industrial Research, CSIR-National Institute of Science communication and Information Resources, Volume 76, Issue 1, pp 217-222, 201

Defluoridation by Biosorption Technique for Safe Drinking Water

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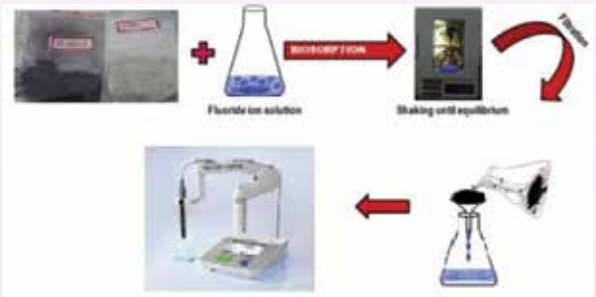
Illumination chamber for the batch cultivation of algal cultures



Schematic diagram of a batch experiment

OBJECTIVES

- To collect different algal species (Spirulina Platensis, chlorella vulgaris, chlorella protothecoides) and cultivate them in batch cultures in a light chamber using different media and further in a photobioreactor.
- To determine the sorption potential of microbes for fluoride removal by performing batch studies.
- To study the influence of varying the experimental conditions for fluoride removal, such as the initial fluoride concentration, pH, contact time, the dosage of adsorbent, and the temperature. The effects of operating parameters are to be optimized using response surface methodology (RSM).
- To elucidate sorption mechanism by employing instrumental techniques, viz., Fourier transform infra red spectroscopy (FT-IR), scanning electron microscopy (SEM).
- To determine adsorption mechanism by two-parameter isotherm models such as Langmuir and Freundlich. The applicable kinetic models of fluoride adsorption onto the adsorbent will also be studied along with the thermodynamic parameters.
- To study the performance of biosorbents in continuous mode (column operation).
- To evaluate the viability of the biosorbents for real field application using water samples collected from the Pavagada region.
- To study the regeneration and recovery of the spent adsorbent as it increases the economic viability of the process.

ACHIEVEMENTS

- Biosorption has proved to be an efficient substitute to the already existing fluoride removal technologies.
- The present study highlights the biosorption capabilities of different non-living algal in their original forms.
- The biosorption mechanism and the optimum physical conditions required for fluoride ion biosorption from aqueous solutions by different algal biosorbents, namely, Chlorella vulgaris, Chlorella protothecoides, and Spirulina platensis in native and immobilized forms were determined.
- The surface characterization of the biosorbents by FTIR and SEM analysis were determined.
- Statistical optimization of process parameters required during the sorption process was determined.
- Analysis and validation of equilibrium data in terms of adsorption kinetics and isotherms were also performed.
- Column studies were conducted to assess the practical applicability of the sorption process.
- The fluoride-contaminated ground water collected from Pavagada region, Tumkur, Karnataka were used to evaluate the viability of the biosorbents for real-field application. The performance of C. vulgaris-immobilized calcium alginate beads in packed beds for fluoride biosorption was satisfactory.
- The optimum conditions for biosorption were determined as: flow rate of feed to column = 5 mL/min, initial fluoride concentration = 10 ppm, and bed height of biosorbent = 60 mm.
- C. vulgaris-immobilized calcium alginate beads were regenerated using 0.1 M HCl and three sorption/desorption cycles were conducted. After three cycles, the beads disintegrated and the percentage fluoride removal decreased from 4.6 to 3.3.
- The FT-IR spectral analysis and SEM images of the beads before and after fluoride biosorption confirmed that the non-living cells of C. vulgaris are a suitable biosorbent for fluoride removal.
- The immobilized C. vulgaris cells were found to be efficient in treating ground water samples of Pavagada taluk, Tumkur district, Karnataka using packed beds.

PUBLICATION

- Hiremath, P.G., Théodore, T. 2017. Modelling of fluoride sorption from aqueous solution using green algae impregnated with zirconium by response surface methodology, Adsorption Science & Technology, 35(1-2):194-217, DOI: 10.1177/0263617416674014.

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- Hiremath, P.G., Théodore, T. 2015. Optimisation of fluoride biosorption by calcium-doped Chlorella protothecoides. Sixth National Level Annual Research Symposium of Chemical Engineering Research Scholars (ChEmference 2015), IIT Hyderabad, Hyderabad, India, 05-06 December 2015.

Design, Development and Optimisation of a Moisture Management Simulator to Quantify Moisture Transfer in Active Sportswear under Various Deformations using Thermal Image Processing

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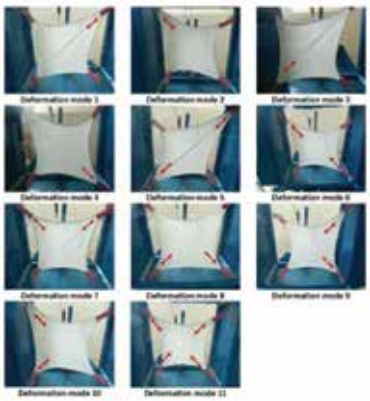
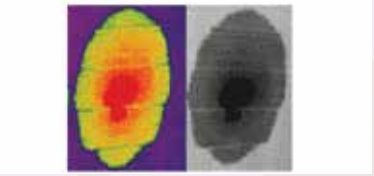
Moisture management simulator instrument



Different deformation modes in Moisture management simulator instrument



Thermal and grey image of the liquid spread

Deformation modes, thermal and grey image of the liquid spread

OBJECTIVES

Comfort with clothing for sports persons is very essential and considered as primary need than aesthetic properties as it is worn next to skin to players to make them highly competitive and to excel in their sports. The Moisture transport properties of fabrics have been widely acknowledged as the key contributors creating discomfort during wear. The un-evaporated and drenched moisture stays behind on skin causes increased fatigue level experience which in turn lowers the competence of the player. During exercise or active sports activity, moisture on the skin is comparatively excess and highly correlated to moisture and thermal discomfort and it will lead to increased friction with skin, dampness, stickiness, itching, extra added weight, improper stretch ability of the fabric etc. which affects the vigorous movements of the sports person while playing.

The moisture transport in sports garment during real application will occur along with different movement and deformations and also influenced by micro climate prevailing in between the body and the garment which includes temperature, wind velocity and humidity. The available standard test methods can be employed to evaluate a wicking test in static state.

The main aim is to design and develop a new testing instrument Moisture Management Simulator capable of measuring the trend of moisture transportation in the fabric as similar to real situation in all the aspects say, climate condition, deformations, sweat flow and arrangement of fabric.

The main objectives are:

- To evaluate the wicking and drying trend of the sports garments when subject is under movements.
- To investigate the effects of temperature, humidity, wind velocity and sweat flow rate in wicking and drying of the fabric under different deformations
- To recommend fabrics for the sports garments based on the findings of the developed instrument

ACHIEVEMENTS

In most of the standard test methods and research findings, wicking test are carried out when the fabric is in static state. The results from these test method, would not provide sufficient information for designing active sportswear. Sportswear will undergo different deformations during each and every action of sports. This issue can be overcome by this developed instrument moisture management simulator by testing the liquid transport characteristics of fabric during various deformations.

The influence of micro climate on the liquid transportation of fabric can be measured with this instrument. It has the provision to maintain required temperature, humidity and wind velocity to simulate the microclimate of the garment.

A thermal camera was used at front to acquire exact measure of liquid spread on any type of fabric without assistance of any colored solution. The thermal camera assist in capturing the images of liquid spread on dark colored fabrics, multi-color printed fabrics, lustrous brocade fabrics, napped fabrics or multi layered fabrics.

Two cameras, one at front and one at back are fixed in this instrument. This is provided to find out the rate of liquid transfer from the inner surface of the fabric (contact with skin) to outer surface (exposed to outer environment). This liquid transfer from inner side to outer side will assist in faster evaporation to attain good moisture management character of fabrics.

Hence, the results obtained from this moisture management simulator instrument will be holistic details about the fabric which will help the sportswear manufacturers to identify and decide best suitable fabrics for various kinds of sports activities.

PUBLICATION

A manuscript titled “A Multi Directional Wicking Instrument to Measure Wicking Characteristics of Fabrics under Dynamic Movements” has been submitted to Journal of The Institution of Engineers (India): Series E.

> Research is what I’m doing when I don’t know what I’m doing
>
> Wernher von Braun

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

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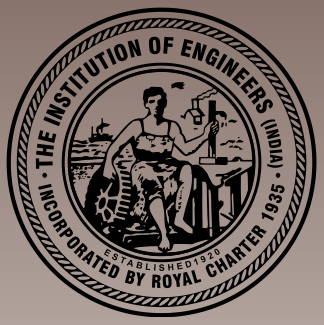

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