Compendium on R&D Projects

under IEI Grant-in-Aid-Scheme

Volume 5

September 2016

The Institution of Engineers (India)

8 Gokhale Road, Kolkata 700020

A Scientific and Industrial Research Organisation
recognised by Department of Scientific and Industrial Research
Government of India
ISO 9001:2008 Certified

The Institution of Engineers (India)

(Established in 1920. Incorporated by Royal Charter in 1935)
8 Gokhale Road, Kolkata 700020
Phone: +91 33 22238311/14/15/16, Fax: +91 33 22238345
Website: www.ieindia.org

The Institution of Engineers (India) or IEI is the largest multidisciplinary professional body that encompasses 15 engineering disciplines and gives engineers a global platform from which to share professional interest. IEI has membership strength of over 0.8 million. IEI functions among professional engineers, academicians and research workers. It provides a vast array of technical, professional and supporting services to the Government, Industries, Academia and the Engineering fraternity, operating from 114 State/Local Centres located across the country.

IEI conducts Section A and B Examinations in different Engineering disciplines, the successful completion of which is recognized as equivalent to Degree in appropriate field of Engineering of recognized Universities of India by the Ministry of Human Resources Development, Govt. of India. Every year as many as 90000 candidates appear for these exams. for details, please see: **www.ieindia.org**

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- Participation in the numerous seminars, symposia, conventions, workshops, lectures, conferences, congresses and other events held at national, regional and local levels.
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IEI R&D Grant-in-Aid

In order to promote Research and Development by students of undergraduate and post-graduate levels and Research Scholars of Engineering Institutes, IEI provides grant to selected projects in every year. For Guidelines and Format of Application please visit: www.ieindia.org

IEI Prizes & Awards

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The Coal India (J G Kumaramangalam Memorial) Award - for the best paper, broadly pertains to the mining industry, invited and received by the Institution on the subject announced each year through the Institution publications.

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

Message from the
President

The Institution of Engineers (India) empowered by the Royal Charter has been trying to fit into the role of a R&D facilitator with the aim 'to encourage inventions and investigate and make known their nature and merits'. The Institution's R&D initiatives have been designed to foster, promote and sustain the spirit of inquisitiveness amongst the engineering student community. R&D is intrinsically linked to the Institution's mandate, vision and future sustainability. It fuels innovation and sharpens our competitive advantage.

The Institution's R&D efforts began in 2001, when the IEI Council formed the Research & Development Committee with the objective of promotion of research and development, promotion of appropriate technology and building up design and research talent keeping with the spirit of Bye Law 98 and SIRO recognition conferred by Ministry of Science & Technology, GoI.

R&D Grant-in-aid program of the Institution, which started in 2001 in a modest way, has now manifested itself into a full-fledged program and its benefits have percolated to student/research community and corporate members across the country. Also, the response to the program has been overwhelming.

This 5th edition of Compendium on R&D Projects is a testament of our continued commitment to research, innovation and support towards building up the innovative capacity of our beneficiaries to drive economic growth, and leverage science and technology to address national challenges.

Mr H C S Berry
President, IEI

Message from Chairman
Committee for Advancement of Technology and Engineering

Being recognized by the Ministry of Science and Technology, Govt. of India as a Scientific and Industrial Research Organization, The Institution of Engineers (India) has taken up the role of promoting R&D through funding and active participation, either in solo or joint mode, with identified organizations.

The initiative was launched way back in 2001 with a modest amount of fund where the role of the Institution was confined to that of a mere funding body. The modest enterprise has now manifested into a full-fledged program which has percolated to the student community across the country. The role of the Institution has also undergone a paradigm shift from that of a technology funding body to that of a technology collaborator and facilitator. The proclaimed beneficiaries of R&D Grant-in-Aid scheme over the last three Financial Years have been over 200. However, we need to consolidate and try and emerge as a 'Category Leader' especially in the area of undergraduate research funding. We are pleased to mention that several research works carried out from these R&D funding have been published in the IEI-Springer Journals which speaks volume about the success of the initiative.

The 'Compendium on R&D Projects' is a reflection of IEI funded research carried out in the frontier areas of technology. The fifth volume is being brought out with the objective of showcasing the talent pool of engineering students that we are proud to nurture and support.

Prof (Dr) N R Bandyopadhyay
Chairman, CATE

Message from Chairman
Research & Development Committee

With dynamically changing technologies and ever increasing thrust on innovation, strong continued support of R&D investments is mandatory to retain the competitive edge at all levels. Engineering fraternity that has realised the importance of research and innovation is driving the economy and changing the lives. Besides high technology domains, the components of urban infrastructure such as clan water, green energy, waste management, autonomous vehicles, smart structures etc., are attracting monumental research inputs. At the core of this research is the basic research performed in academic institutions. Academia is one of the mainstays of India's R&D. It is where more than 60% of the basic research is performed. Academia also produces more than two-thirds of the scientific papers published in the country. There is a dire necessity to support governmental mechanisms with secondary mechanisms to foster R&D among the academia and in that regard IE(I) has taken a concerted step through IEI R&D Grant-in-Aid Scheme.

The highlights of the R&D program of IEI may be attributed as (1) Comprehensive yet user-friendly application process (2) Rapid finalization and intimation to applicants (3) Quick disbursement of one-time grants (4) Dedicated support system to applicants which have culminated in wider acceptability and overwhelming recognition for the scheme (5) Openness to accept proposals from inter-disciplinary and intra-disciplinary efforts and (6) Incentivisation to the institutions is also happening in term of membership benefits.

The 'Compendium on R&D Projects' under IEI Grant-in-Aid Scheme reflects IEI funded research carried out in the frontier areas of technology by students pursuing courses in engineering at UG/PG/PhD level.

Dr U Chandrasekhar
Chairman, R&D Committee

IEI – Springer Journal Series Springer

Journal of The Institution of Engineers (India) – Series A

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ISSN Online: 2250-0553

Journal of The Institution of Engineers (India) – Series D

Online paper submission :
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ISSN Online: 2250-2130

Journal of The Institution of Engineers (India) – Series E

Online paper submission :
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Free e-access of Journal papers for all Corporate Members of IEI

The Institution of Engineers (India) has tied up with M/s. Springer (India) Pvt. Ltd, a reputed publishing house to increase the visibility, greater acceptability, impact factor and improved citation index of the Institution Journals. The tie up added a greater value to the publish research works and results in quantum jump in the circulation of the Journals to a wide spectrum of learned community.

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††† Individual subscription means subscriptions sold throughout the world to Members of The Institution of Engineers (India). The Members of The Institution of Engineers (India) will continue to have free e-access to the Journals via www.ieindia.org

For any query regarding subscription for IEI Journals (Series A to E) and details of payment, please contact :-

Mr Alvin K Masih
Assistant Manager Subscriptions,
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Email: Alvin.Masih@springer.com / indianjournals.service@springer.com

For other details please contact :
The Director (Technical)
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8 Gokhale Road, Kolkata 700 020
Email: technical@ieindia.org/iei.technical@gmail.com

The Institution of Engineers (India)

8 Gokhale Road, Kolkata, West Bengal, India – 700020

(Established in 1920, Incorporated by Royal Charter 1935)

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का अधिकार

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GOVERNMENT OF INDIA
MINISTRY OF SCIENCE AND TECHNOLOGY
Department of Scientific and Industrial Research
Technology Bhavan, New Mehrauli Road,
New Delhi - 110 016

F. No. 11/97/88-TU-V

Date: 1 July, 2016

The Director
The Institution of Engineers (India)
8, Ghokhale Road
Kolkata-700020
West Bengal

Subject: Renewal of Recognition of Scientific and Industrial Research Organisations (SIROs).

Dear Sir/Madam,

    This has reference to your application for renewal of recognition of The Institution of Engineers (India), Kolkata, West Bengal as a Scientific and Industrial Research Organisation (SIRO) by the Department of Scientific and Industrial Research under the Scheme on Recognition of Scientific and Industrial Research Organisations (SIROs), 1988.

2.   This is to inform you that it has been decided to accord renewal of recognition to The Institution of Engineers (India), Kolkata, West Bengal from 01.04.2016 upto 31.03.2019. The recognition is subject to terms and conditions mentioned overleaf.

3.   Receipt of this letter may kindly be acknowledged.

Yours faithfully,

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

The Institution of Engineers (India)

Contents

Bhartiya Intelligence Traffic System (BITS)

Student

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Guide

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OBJECTIVE

Decades of research and development facilitated transportation in several ways such as roads, rails, air and water (by Boats). Major population travels along with roads either by private or public automobiles, which is the best solution for shorter distance. Transportation via roads is easy and cost effective way therefore In India the country which stands as second for largest road networks, millions of people are using public and private automobiles for transportation. Statistics shows that India has 3.8 km road for 1000 people, in addition to this, roads are narrow as well as highways. Therefore accidents, traffic jam, pollution and extra fuel consumption are common issues. Indian roads transportation plays vital role in Indian economy and it contributes 4.7 percent towards India's gross domestic product. According to WHO road safety data, India has highest record of road fatalities with105,000 road-accident caused deaths in 2006.

The Indian traffic and road transportation is under pressure for its improvement and proper traffic management. It needs proper channelization of traffic, following of road safety law and rules. It also demands identification of vehicles for proper control on traffic. Further, there is also necessary to reduce traffic jams and number of accidents on roads. Therefore, we require an efficient and intelligent traffic monitoring system. Hence we presented here an intelligent system for Indian traffic control and management called as "BHARTIYA INTELLIGENCE TRAFFIC SYSTEM (BITS)".

In this project, we have presented a prototype model for Intelligence Traffic system. The main working principle of the project is based on Radio Frequency Identification (RFID) technique. A specific identification Number (or say vehicle Number) will be provided to each vehicle called RFID (transmitter) which can be detected by RF reader unit (receiver) when the vehicle crosses through an illegal path or violates the traffic signal. The reader modules can be operated and controlled by a minicomputer unit which triggers the module according

to the present status of the traffic signal. BITS will not only ensure smooth traffic on roads and consequently reduce jams but also identify the vehicle which violates the traffic signal. Being an automatic system, it will reduce manpower to be employed on roads to maintain traffic.

The main objectives of the project are:-

• To develop a system for detection of the vehicle with owner's details which violates the traffic signals.

• To provide an integrated, efficient and intelligent system for monitoring Indian traffic.

• To reduce accidents, traffic jams, fuel consumption and pollution.

• To reduce the use of manpower for traffic management.

ACHIEVEMENTS

The project if implemented can prove to be very beneficial and less costly as compared to current monitoring system where money is needed to install cameras on every crossing and salary to the number of traffic policemen employed. It has a vast scope in the sense that none of our traffic systems is so systematically organized and controlled and India is a big country. It can start from one area and spread to other. If there is government intervention then every vehicle having a name plate issued will have a unique RFID number and identification. Moreover, details of each person will be made available easily by the government and his identity, bank account and vehicles unique identification will be linked.

Once the system is complete, traffic system will become smooth and intelligent.

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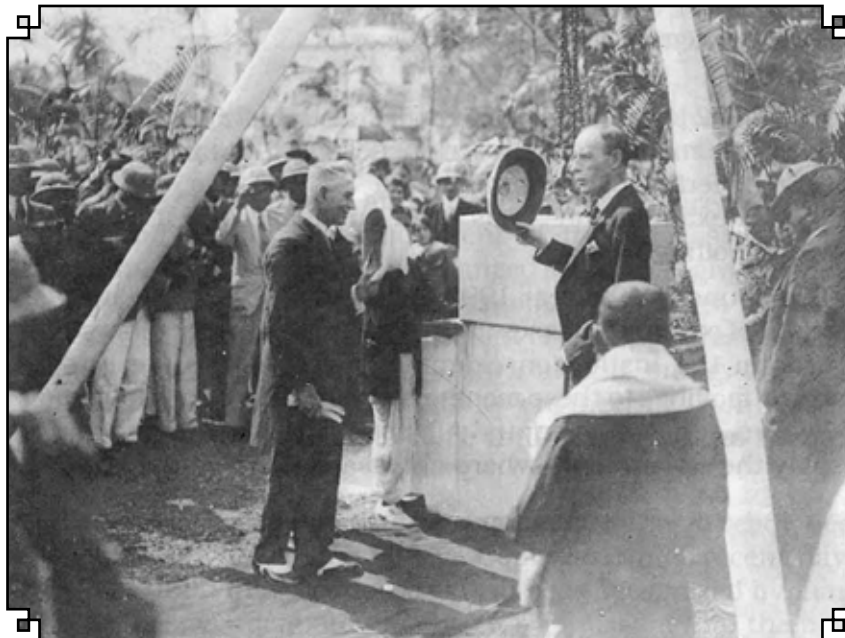
**Lord Irwin, Viceroy and Governor General of India, laying the
Foundation Stone of the First Institution Building in 1930**

Implementation of Voltage Sag Mitigation System to Enhance Equipment Operating Life and Reduce Economic Losses

Student

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Institutional Member, IEI

OBJECTIVE

- To recognize the occurrence of sag and activate the sag compensator.

- To develop a novel voltage sag compensator for powering critical loads in electric distribution system.

- To provide fast response for sag compensation at low cost.

- To design a robust compensator that supplies the missing voltages to maintain rated voltage at the terminal of the critical load.

- To design an efficient compensator that will avoid energy storage components such as bulk capacitors/inductors and two stage power conversion thereby reducing the size, cost and associated losses.

- To design a novel Interphase ac-ac topology by controlling the duty cycle of each ac chopper, thereby compensating the voltage sag.

- To improve voltage sag compensation more than the existing 50% achievement in three phase circuits.

ACHIEVEMENTS

- Voltage sag mitigation.

- Reduction in cost.

- Improvement of equipment immunity.

- Injection of power to compensate lost voltage.

- Provide uninterrupted clear supply.

- Improve quality of power supply.

- Reducing the number and duration of faults.
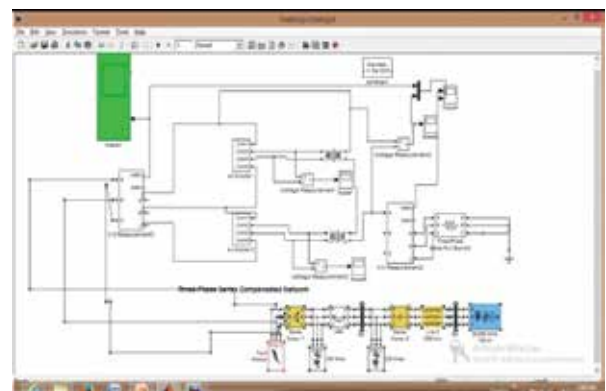
Simulation diagram
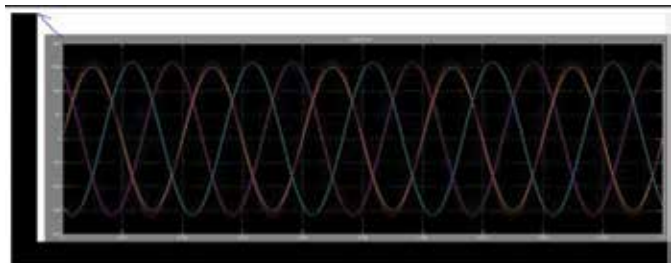
Output for the simulation

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

International Journal

Gayathri,G.S & Manimala,K 2015, "Design of Voltage Sag Mitigation System to Reduce Economic Losses in Industry", International journal of advanced research trends in engineering and technology (IJARTET), Vol II, ISSN 2394-3777(PRINT)

National Journal

GAYATHRI,G.S & MANIMALA,K 2015, "SIMULATION OF DYNAMIC VOLTAGE RESTORER FOR VOLTAGE SAG MITIGATION ", National Journal of Trends in Electrical Engineering , ISSN 2321-4260(PRINT),Volume 5, Issue 2.

Legacy of IEI

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

Design and Development of Rotary Weeder

Student

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OBJECTIVE

The overall goal of this research is to investigate the design and performance of a rotary weeder mechanism intended for intra-row mechanical weeding in vegetable crop production. The specific objectives of this research are to:-

Mini Rotary Weeder

Study weed control efficacy using different machine settings such as working depth, travel speed, rotational speed and number of tines.

Assess the overall mechanical performance of intra-row weeding.

ACHIEVEMENTS

This study has reviewed current systems for non-chemical weed control in order to develop a system for inter and intra-row weed control to reduce the environmental loading of agrochemicals. Weed control is carried out without disturbing the no-till area that surrounds the crop.

Field investigations enable the agronomic evaluation of pre-production prototype on mechanical weed control efficiency. From these investigations, it has been observed that the rotary weeder has the potential to address the issues facing inter and intra-row weed control in widely spaced field vegetables.

A rotary weeder is designed and constructed with 1.5 hp engine power and operated by three wheels.

The following observations have been made :

Main effect plot for field efficiency

- A prototype inter- and intra-row weeding mechanism has been shown to operate successfully at speeds up to 250 rpm at commercial planted vegetables, inter- and intra-row plant spacing, 350 mm. The principles developed in this could be applied to the design of machines for other agricultural row crops.

- This prototype has the capability of changing different blades easily. It has the ability to weed depth up to 8 cm.

- Time depth and forward travel speed have an effect on weed area reduction. There is statistical evidence that time depth and travel speed have an effect on weed area. Deeper working depth and a slow travel speed can achieve good weed control. Therefore, it is very important to consider these two factors to achieve good weed control effect.

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

Venkatachalam, G., Renjith, S.C., Nilay, P.S., Vasan, M. and Annamalai, R., 2016, Investigations on tensile strength of banana fibre reinforced hybrid polymer matrix composites, Engineering Review, Vol. 36 (1) , pp 13-18

Legacy of IEI

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

Renewable Energy based Air Conditioning System for Public Transports in Green Environment

Student

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Institutional Member, IEI

OBJECTIVE

To design and implement an environment friendly air conditioning system for public transports to service the people, by providing cost effective and comfortable travelling.

To utilize renewable energy from the environment (windmill and solar) effectively in order to obtain power for the batteries.

To provide battery biasing for the Peltier Effect devices to provide thermo electric cooling for air conditioning.

Prototype setup with renewable energy source and its output

Hardware snap with renewable energy

ACHIEVEMENTS

- An environment friendly air conditioning system is made for public transports and also in public places, to serve the people.

- Renewable energy from the environment (windmill and solar) is effectively utilized for obtaining power for the batteries, in order to provide cost-effective and comfortable travelling.

- The batteries are used for biasing the Peltier effect devices to provide thermo electric cooling for air conditioning.
- An embedded control is implemented for the integration of renewable energy sources, battery conscious power management, battery swapping etc.

We have found that the proposed system performs better, when performance compared to existing air cooling systems effectively.

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

G.Ganesan@Subramanian, V. Mohan, R. Anandaraj, G. Sundaravadivel, "Renewable Energy based air conditioning system for public transports in green environment", International Society for Green, Sustainable Engineering and Management (ISGSEM), Vol.2; Issue: 23 pg: 49-57, December 2015.

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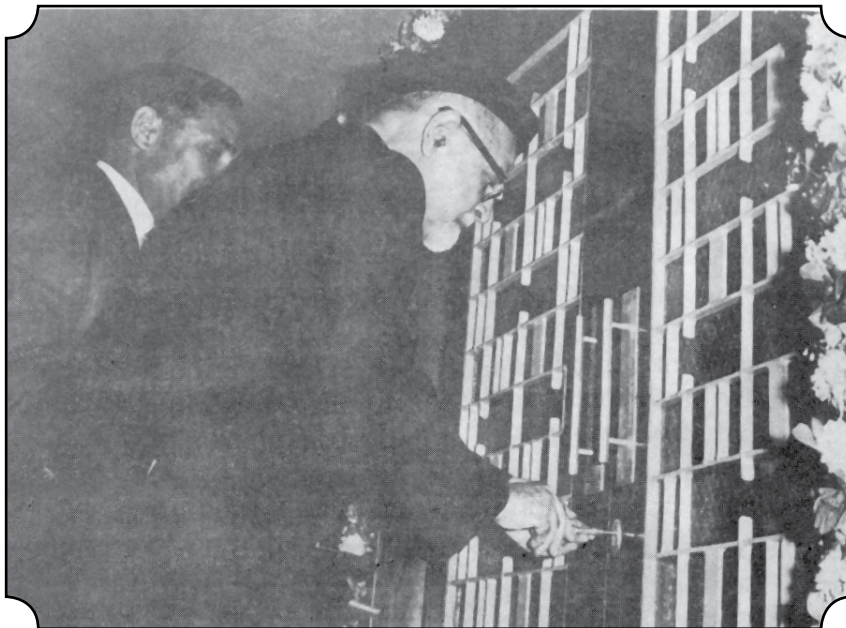
**Dr Zakir Husain, President of India, opening the
Main Door of the New IEI Headquarters Building**

Design and Development Radio Controlled Hybrids ESTOLAS UAV Prototype for Disaster Rescue Mission

Student

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Guide

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OBJECTIVE

The objective of this proposal is to develop Radio Controlled Hybrid ESTOLAS UAV with features like a short, squat design with propeller engines mounted at the rear of a disc-shaped main body that houses a rotor like a helicopter's. Almost entire body of the aircraft is composed of lightweight composite materials. The body of the aircraft is filled with helium to reduce the aircraft's weight further and provide additional lifting power. This would allow it to take off and land at lower speeds on short runways and, if no conventional runways are available, it can use its air-cushioned skirt and wheel-skis to take off and land on any natural surface, such as field.
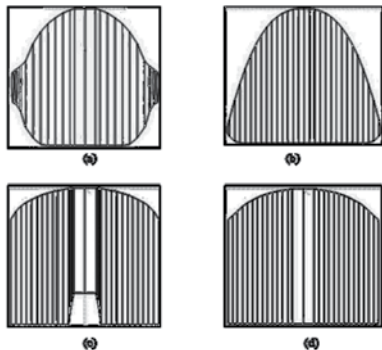
2D Sketches of Conceptual platform shapes
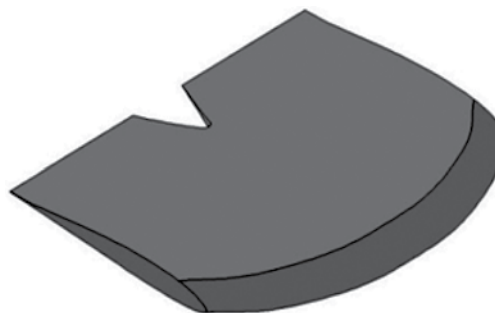
Platform design of Configuration

ACHIEVEMENTS

The perfect wing structure has been designed for this ESTOLAS. The prototype is modelled successfully, which is capable of taking short take-offs and vertical flights and landing on any surface which is achieved due to its design characteristics.

Development of a Watermelon (Citrullus Lanatus) Seed Extractor

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Institute
College of Agriculture
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University of Agricultural
Sciences, GKVK, Bengaluru

OBJECTIVE

i.   To study and review the existing practices of watermelon seed extraction

ii. To study the physical and engineering properties of watermelon

iii. To design and develop watermelon seed extractor

iv. To evaluate the performance of watermelon seed extractor developed and quality of extracted seeds.

Developed watermelon seed extractor

Separated pulp along with seeds and juice after extraction process

ACHIEVEMENTS

Engineering properties such as physical and textural properties of the matured watermelon (*Citrullus lanatus*) fruit and its seeds were measured in order to design, develop and evaluate the watermelon seed extractor. The developed seed extractor consisting of the following systems for (i) watermelon cutting, (ii) watermelon seed extraction, (iii) seed separation and (iv) power transmission. The extractor was evaluated with three types of scrapers, such as, stainless steel, wooden and nylon; two cutting planes viz., transverse and longitudinal planes and three rotational speeds viz., 50, 100 and 150 rpm. The best combination was observed for transverse cutting with nylon scraper at a speed of 100 rpm. The best performance for capacity, extraction efficiency, seed loss, seed damage, germination percentage and vigour index were found to be 1.98 kg of seeds/h, 99.49 %, 0.19 %, 0.26 %, 97.04 % and 3284, respectively. The total cost of developed seed extractor was Rs. 52,371. The cost of operation of the developed extractor was Rs. 57.31/h. The cost for extraction of 1 kg of watermelon seeds by manual method was Rs. 600, whereas Rs. 28.65 by the developed seed extractor. The cost-benefit ratio of developed watermelon seed extractor was 1:1.40.
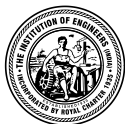
PAPERS PUBLISHED IN JOURNALS / PAPERS PRESENTED IN SEMINARS / M.TECH THESIS / Ph.D THESIS / PATENT GENERATED FROM THIS PROJECT

Thesis submitted to the University of Agricultural Sciences, Bengaluru in partial fulfillment of the requirements for the award of the degree of Master of Technology (Agricultural Engineering) in Processing and Food Engineering.

IEI EXAMINATIONS

Right from inception, the IEI was concerned to fulfil its social objective to provide upgradation and dissemination of engineering education. In its role as a qualifying body the Institution has opened up tremendous possibilities for those who aspire to become engineers but are short of the means or the opportunities to pursue a formal engineering degree course. For such aspirants, the Institution in conformity with the provisions of the Royal Charter, conducts examination bi-annually - the Studentship Examination (suspended since 1998) and the Associate Membership Examination in Sections A and B based on well-structured courses in nine engineering disciplines. The course and curriculum have been modified from time to time. In early nineties a restructured curriculum of courses and syllabi compatible to the changing demands of the period have been introduced from Summer 1993 Examination. In the updated course structure, emphasis has been placed on the basics and common principles of Design, Production Processes and Management Systems as well as on Computer Science, Energy, Environment, etc. The Institution's examinations are held simultaneously at its various Centres all over India as well as at some overseas Centres and there is an ever-increasing demand for enrollment as Technician/Senior Technicians' Members of the Institution to become eligible to sit for the examination.

Strategy to Prevent Implant Infection

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OBJECTIVE

To synthesize a biocompatible polyurethane membrane that can be coated over implant material or catheters and stents, which are susceptible to microbial infection. Polyurethane membrane can serve as drug delivery matrix and prevent biofilm formation by releasing antibiotic in a sustained manner. This polymeric material can be used for fabricating scaffold and we have to observe whether the scaffold induce or hamper in cell proliferation.
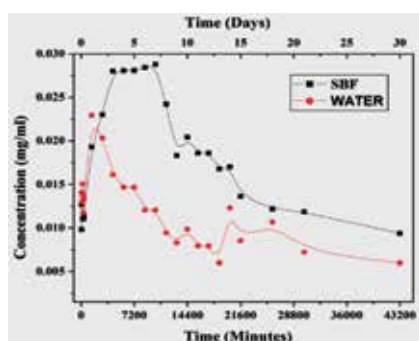
Release of Rifampicin from PUBI
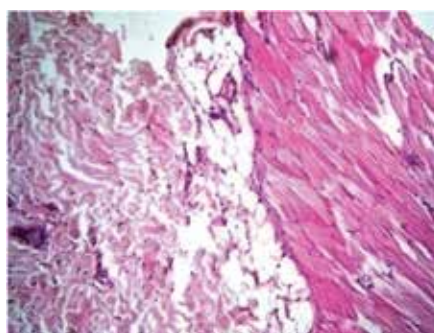
Histological images of in vivo degraded
PU scaffold in Treated tissue

ACHIEVEMENTS

Swelling of PUBI is more in SBF (36–37%) than water (32–34%) and other solvents whereas MDI-PU (32–34%) swells most in water (18%–31%) and least in SBF (5%–7%). FTIR pattern of MDI-PU and PUBI confirmed polyurethane formation. The XRD patterns of both the membranes reveal their amorphous nature and there is no evidence of crystallinity. FESEM images of the MDI-PU shows its micro porous nature and thus explains its swelling property being different from the PUBI. Antimicrobial activity of drug loaded PUBI and MDI-PU was determined by measuring zone of inhibition. Concentration of released drug from both the membranes was higher than the Minimum Inhibitory Concentration (MIC) of the drugs. Both PUBI and MDI-PU showed degradation in all three mediums. Degradation of PUBI was more in hydrolytic medium, whereas MDI-PU showed more degradation in oxidative medium. PUBI was completely degraded in in-vivo condition, whereas MDI-PU showed % degradation. Histopathology of rat skin tissue did not show any abnormality in case of the membranes.

In 1 mg/ml of MDI based polyurethane, the cell viability percentage was the highest and lowering the concentration up to 0.8mg/ml it showed acceptable percentage of cell viability, but at 0.5mg/ml suddenly viability decreases.

Samples	O.D. at 540 nm				Viability, %	Inhibition, %	SD
	n_1	n_2	n_3	average			
1% DMF control	0.5425	0.5572	0.550	0.5499	100	0	0.010
MDI based PU(1mg/ml)	0.6747	0.703	0.689	0.6889	102	-2	0.020
MDI based PU (0.8mg/ml)	0.6366	0.5975	0.617	0.61703	90	10	0.028
MDI based PU (0.5mg/ml)	0.3787	0.4374	0.408	0.40803	71	29	0.042
1% DMSO control	0.6882	0.6636	0.676	0.6759	100	0	0.017

The scaffold of 2cm X 2cm was again inserted in the female mouse model approximately of 5 months age in subcutaneous layer of skin in lower abdomen region at dorsal side in order to investigate the histocompatibility of the material. After 21 days, area was surgically opened but no scaffold was found nearby indicating it was degraded totally in due time. However histological tissues extirpated, processed as described earlier and examined. No significant change was observed upon implantation in treated tissue. Neither any accumulation of macrophages nor tumor, lesion was found at the site of implantation. Thus it can be henceforth considered for therapeutic applications.
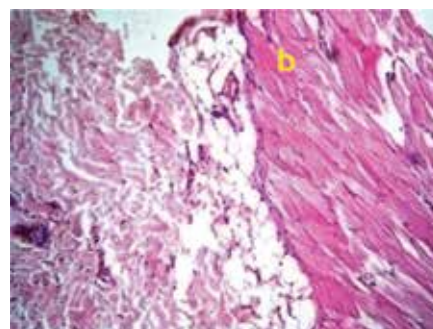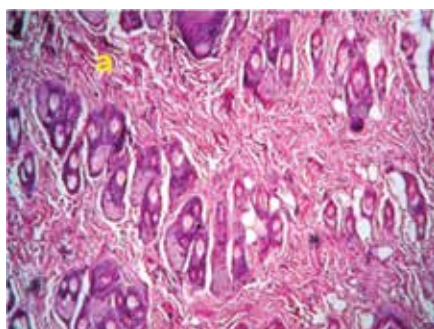
Histological images of in vivo degraded PU scaffold in a. Control and b. Treated tissue

It can be summarized from the work that MDI and HDI based polyurethane membrane was synthesized successfully. Beside that a porous scaffold was also fabricated. The FTIR data represents formation of characteristic polyurethane bond and the XRD pattern confirms its amorphous nature in case of both the membranes. The capability of the drug loaded membranes in inhibition of bacterial growth makes them successful drug loading matrix to inhibit microbial infection. Cytotoxicity assay of the polyurethane also shows its biocompatible nature. Also, in-vivo study establishes that the membranes possess no threat to animal body. So these membranes can be easily used as an antibiotic loading coating for medical implant to reduce biofilm formation and subsequent microbial growth.

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

Neha Arora, Asif Ali, Sohini Sen, Nandan Kumar Jana & Piyali Basak (2014)

Synthesis and characterization of polyether urethane coatings for preventing implant infection, Composite Interfaces, 21:1, 51-58.

Design and Development of Photovoltaic Power System with Different Technologies using Remote Monitoring System

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OBJECTIVE

Objective of the present work is to introduce new Photovoltaic (PV) technologies, install and integrate into the existing system and performance evaluation for Indian coastal conditions i.e., Visakhapatnam. The power generated by the new PV system is used to run the equivalent electrical appliances.

Off grid photovoltaic power system

Solar panel installation on roof

ACHIEVEMENTS

Photovoltaic power generation is evolving as one of the most renewable energy sources because of its many advantages. Photovoltaic power systems convert sunlight directly into electricity. A residential PV power system enables a home owner to generate some or all of their daily electrical energy demand on their own roof, exchanging daytime excess power for future energy needs (i.e. night time usage). The outcome of the project is introduced as new PV technologies, installed and integrated into the existing system i.e., Vignan's Institute of Information Technology examination cell and performance evaluation is done for Indian coastal conditions i.e., Visakhapatnam. The power generated by the new PV system is 1 KV from the solar energy is sufficient to run the equivalent electrical appliances and also capable of utilizing the solar power by exam cell.

Fabrication and Manufacturing of Water Purifier: A Simple and Economic Way of Treatment

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OBJECTIVE

The main objective of the proposed work is to provide water purifier at minimal cost with quality water. Another objective of this project is to enforce an advanced technique in the apparatus for purification of water which can maintain a healthy balance of natural minerals.
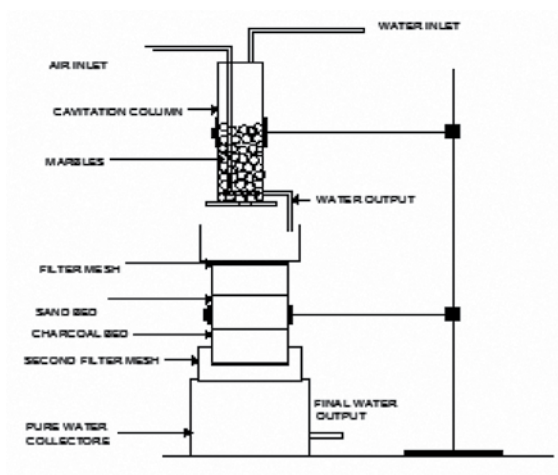
Schematic representation of water purifier set up

ACHIEVEMENTS

The present work has shown that the air marble cavitation phenomenon can be effectively removed hardness, total solids and turbidity from the water by using sand and membrane filtration. Initial parameters like pH and dissolved oxygen are also minimized up to desired range. By reducing the hardness and turbidity of the water, it is clearly established in the present study that the use of air marble cavitation in this process will be a good option for water with higher value of hardness, turbidity, and dissolved oxygen.

Experimental Studies of Corrosion Inhibitors on Concrete

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OBJECTIVE

The corrosion is one of the major issues in concrete. To delay the corrosion in concrete, the corrosion inhibitors are widely used now. The main objective of this study is to delay the corrosion rate and to reduce the porosity of concrete by adding corrosion inhibitors. In this present investigation, the effect of two corrosion inhibitors, such as, Sodium Nitrite & Potassium Dichromate, on conventional concrete is to be studied. This work involves the comparative studies of mechanical properties like strength and durability properties through water absorption test and acid resistance test on concrete without and with inhibitor. The grade of concrete used for this project work is M 30 for conventional concrete. The same grade is going to be used for making concrete by adding chemical admixtures of Sodium Nitrite (0.5%), Potassium Dichromate (0.5%) as corrosion inhibitor. The mechanical and durability properties of concrete will be studied and the results will be compared against the conventional concrete with 0.5% of corrosion inhibitor. The effect of inhibitor will be compared with conventional concrete by testing the specimens. The specimens used for this study are 100 mm cubes and 100 × 200 mm cylinders. The SEM analysis has been conducted to identify the ranges of pores in concrete.
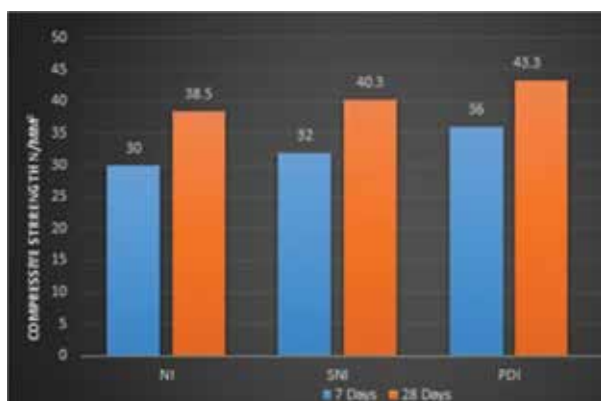
Compressive Strength Test Results
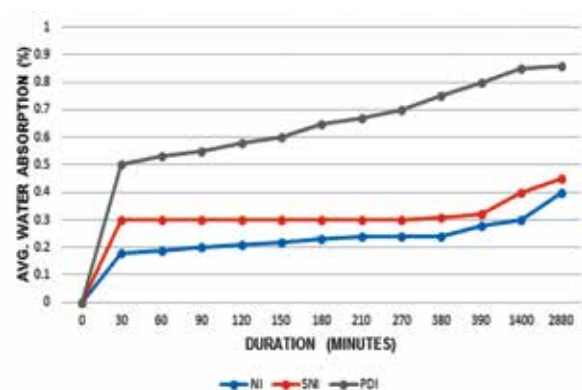
Water Absorption Test on Concrete

ACHIEVEMENTS

The present project work deals with the corrosion inhibiting admixtures effectively and successfully which was aimed to delay the corrosion in concrete. By means of conduct experimental investigations on the mechanical and durability properties, the following achievements were attributed when inhibitor is used as admixtures in fresh concrete.

- It was found that the both corrosion inhibitors added about 0.5% by mass of cement in concrete but made no effects / defects in workability of concrete. The result of workability of inhibitor concrete to the no inhibitor concrete provided a better result in the slump cone test.

- The results of the compressive strength test indicated that the addition of Sodium Nitrite and Potassium Dichromate inhibitors increased the compressive strength of concrete compared to the conventional concrete.

- From the strength test results obtained from compressive strength test, 0.5% of PDI increase the strength while 0.5% of SNI decrease the strength compare to the NI concrete.

- The decreasing and increasing of strength, when inhibitor is added implies that the inhibitor plays a major role in strength of concrete.

- It was observed from the durability studies, in the water absorption test, the addition of inhibitor helps in better performance which means that the addition of inhibitor reduces the amount of pores.

- The porosity of concrete gets reduced while inhibitor is added in concrete. When compared between both the inhibitors, Potassium Dichromate shows better results.

- Both the inhibitor show better result in Acid Resistance test when compare to the conventional concrete. Particularly the PDI concrete shows a better performance in the durability properties.

- 0.5% of PDI shows less pores than 0.5% of SNI in the SEM analysis results which mean that the PDI shows a better performance in the rate of corrosion.

- The penetration of chloride, sulphate in concrete can be avoided in the highly polluted area and sea shore areas when the inhibitors were used.

- From the various test results during the project, it can be inferred that the rate of corrosion in concrete can be reduced by adding corrosion inhibitors. It can be utilized in highly polluted areas and sea shore areas where rate of corrosion is very high for the concrete structures due to the salt contents present. Because of the action of inhibitors, the pores in concrete can be arrested and the rate of corrosion can be delayed to some extent.

The outcome of the project is beneficial for the Construction Industries, people residing in sea shore and highly polluted areas.

> 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**

Investigations for Mechanical Properties of Nylon 6-SiC-Al$_2$O$_3$ based Feed Stock Filament for Fused Deposition Modelling (FDM)

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OBJECTIVE

- To develop feed stock filament for Fused Deposition Modelling (FDM) with Al$_2$O$_3$ reinforcement as Single Particle Size (SPS), Double Particle Size (DPS), Triple Particle Size (TPS) in Nylon 6 matrix.

- To investigate the effect of particle size ie, SPS, DPS, TPS on mechanical properties of developed feed stock filament material.

- Optimization of process parameters for feed stock filament of FDM, namely :

- Tensile Strength

- Dimensional Accuracy

- Young's Modulus

- Yield strength

- Percentage elongation

- To develop feed stock filament with hybrid reinforcement (SiC and Al$_2$O$_3$) in Nylon matrix.

- To investigate the effect of hybrid solute on properties of developed feed stock filament material (like: tensile strength, percentage elongation, Young's modulus etc.).

FDM setup used in experimentation
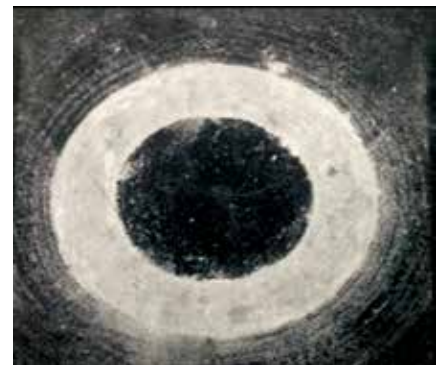
Wear Track of ABS pins

ACHIEVEMENTS

Alternate feed stock filaments with Al$_2$O$_3$ reinforcements as SPS, DPS and TPS in Nylon 6 matrix have been successfully developed. The MFI of feed stock filaments prepared with SPS, DPS and TPS were made comparable to the ABS filament used conventionally in FDM. The mechanical properties (like: Percentage elongation, Young's Modulus, Tensile strength, Yield strength) have been optimized to increase the application domain of FDM. The empirical relations for mechanical properties have been successfully developed and counter verified. Finally, it is concluded that in-house prepared FDM feed stock filament with tailor made properties can be successfully used (based upon industrial applications). Further, in this project, effect of SPS, DPS, and TPS of Al$_2$O$_3$ (as reinforcement) in Nylon-6 matrix on wear properties of functional prototypes has been studied. The outcomes for the present work show feasibility of development of FDM wire from alternative

material. As ABS wire is having limited wear properties so alternative material with SPS, DPS, and TPS of Al_2O_3 (as reinforcement) in Nylon-6 matrix can be used to have tailor made properties. In this case a wire from alternative material has been successfully developed and pins were successfully prepared. The prototype/pins of composite material have been developed with high resistance to wear. The wear track obtained in this study shows that material is highly wear resistant. The wear model was developed and cross checked for its accuracy.

Along with this an alternative feed stock filament with hybrid reinforcements as SiC and Al_2O_3 in Nylon 6 matrix have been successfully developed. The value for wear and MFI has been established. A Nylon-6 based feed stock filament was successfully developed with hybrid reinforcement of SiC and Al_2O_3. The wire as feed stock filament of FDM with the tailor made wear properties can be easily predicted by the proposed empirical model.

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

Paper Title	Authors	Journal Details
Modelling the wear properties of Nylon-6-SiC- Al_2O_3 based FDM feed stock filament	Rupinder Singh, Narinder Singh	Transactions of the Indian Institute of Metals An International Journal of Minerals, Metals and Material Engineering (Springer Publications)
Effect of hybrid reinforcement of SiC and Al_2O_3 in Nylon-6 matrix on mechanical properties of feed stock filament for FDM	Rupinder Singh, Narinder Singh	Journal of The Intuition of Engineers (India), Series C (Springer Publication)
Modelling the wear properties of single particle size, double particle size and triple particle size Al_2O_3 in Nylon-6 matrix based feed stock filament for FDM	Rupinder Singh, Piyush Bedi	Journal of Manufacturing Processes (Elsevier Publication)
Effect of single particle size, double particle size and triple particle size Al_2O_3 in Nylon-6 matrix on mechanical properties of feed stock filament for FDM	Rupinder Singh, Piyush Bedi	Journal of Manufacturing Processes (Elsevier Publication)

M.Tech Thesis

1. Experimental investigations for mechanical properties of Nylon6-SiC-Al2O3 based feed stock filament for FDM (P.T.U.: GNDEC Ludhiana)Candidate: Mr. Narinder Singh

2. Effect of Single particle size, double particle size and triple particle size Al2O3 in Nylon 6 matrix on mechanical properties of feed stock filament for FDM.

   (P.T.U.: GNDEC Ludhiana)Candidate: Mr. Piyush Bedi

Mix Design for Pavement Overlays for Sustainable Development

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OBJECTIVE

❖ Determination of optimum dosage of admixture for control concrete.

❖ Determination of optimum dosage of admixture for fly ash concrete.

❖ Proportioning and mix design of control concrete for M_{60} grade as per IS 10262-2009.

❖ Proportioning and mix design of fly ash concrete for M_{60} grade as per IS 10262-2009.

❖ Proportioning and mix design of crusher dust control concrete for M_{60} grade as per IS 10262-2009.

❖ To determine various properties of control concrete, crusher dust control concrete fly ash concrete and fly ash crusher dust concrete for M_{60} grade like compressive strength, flexural strength, split tensile strength, modules of elasticity, etc at different percentages of fly ash and stone crusher dust.

Experimental Appar's Used in the Present Study

Casting of Control Concrete Cube

- ❖ Thus an effective utilization of fly ash and stone crusher dust is made and maintenance, disposal and environmental pollution caused by these are checked.

- ❖ Estimation of reduced CO_2 emission due to reduction in cement utilization by HVFAC.

- ❖ As per KYOTO POROTOCOL, the saved CO_2 emission can be traded, thus getting monetary benefits and also contributing towards development of greener planet.

- ❖ Clean Development Mechanism [CDM] is emphasized for sustainable development of the country.

- ❖ Utilization of fly ash, stone crusher dust, carbon trading in all leads to the sustainable development of the country.

ACHIEVEMENTS

- ❖ The road sector in the country is likely to use cement concrete in a big way in coming years. This approach and laboratory studies have given good performance using addition of fly ash and replacement of crushed stone dust.

- ❖ Crusher dust control concrete is designed by replacing sand in the control mix by crusher dust at different percentages. The percentage of crusher dust at which compressive strength of cube is maximum is considered as optimum percentage of dose of crusher dust. The value is 30%, behind which compressive strength decreases.

- ❖ From this study, it is concluded that the concrete with 60% addition of fly ash and 30% crusher dust at 56 days curing with 1.2% super plasticizer, the maximum compressive strength of 64.67 MPa.

- ❖ The maximum flexural strength of 5.70 MPa is obtained for the concrete with 60% fly ash and 30% crusher dust at 56 days curing with 1.2% super plasticizer.

- ❖ Optimized fly ash and crushed stone dust are used in the control concrete. Obtained fly ash crusher dust concrete is the one used for sustainable development.

- ❖ From this study, the carbon credit will be calculated. For Indian scenario 77.76 million tones of CO_2 can be saved from the emission of cement production. When converted in rupees, it will fetch Rs 22,500 crores and 493.43 kilo tones of CO_2 saved emission from no vehicular transportation. The grand total will be 22,673.36 crores.

- ❖ Calculating the carbon credit with respect to the present population of India, i.e., 140 crores, the savings per head comes around Rs. 161 per capita/year.

Calculation of Carbon Credits

- ❖ India's cement production for the year 2012-13 was 324 million tonnes (Indian Brand Equity Foundation: The cement industry of India is expected to add 30-40 mt per annum of capacity in 2013. The industry has a current capacity of 324 MTPA and operates at 75-80 percent utilization).

- ❖ On implementation of our project, 30% of the cement produced will be saved, which means approx 77.76 million tonnes reduction of CO_2 emission by cement industries in India.

- ❖ Now let us calculate the number of vehicles required to transport this "saved cement" and probable CO_2 emission from these vehicles.

  - ● As per obtained data, a truck of 10 wheels (3 axles) carries 19 tons of cement.

  - ● For 77.76 Million Tons of cement, number of trucks required is 3.710×10^6.

  - ● From the data obtained by Environmental Protection Agency (EPA) USA, 1 liter combustion of

diesel by trucks emit's 2.66 kg of CO_2.

- Considering a truck travels about 100 km for transporting cement with a fuel efficiency of 2km/liter.
- Therefore 3.710×10^6 numbers of trucks consumes 185.5×10^6 liters and emit 493.43×10^3 tonnes of CO_2.

❖ **Carbon credit calculation**

- On an average in the International Market, a ton of CO_2 fetches around \$40 - \$50. Let us take it as \$50/ton of CO_2.
- For 77.76 million tones of CO_2 saved emission from cement production,

  $77.76 \times 10^6 \times 50 = \$ 3.888 \times 10^9$

  Rs. 22,550 Crores.

- For 493.43 kilo tones of CO_2 saved emission from no vehicular transportation,

  $493.43 \times 10^3 \times 50 = \$ 24.6715 \times 10^6$

  Rs. 123.36 Crores

- Grand total

  Rs. 22,550 crores + Rs. 123.36 crores= Rs. 22,673.36 crores

❖ India with present population of 140 crores, savings per head is approx Rs. 161 per capita/year

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 (i) Donor Member.

Application of Zigbee Technology in Automatic Track Surveillance and Fire Detection

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OBJECTIVE

Railways are one of the largest transports in the world, especially in India, which daily transports nearly 200000 people in the country. Due to frequent train scheduling, it is very difficult to maintain the track by workers and it takes a lot of time. With the advent of computer technology and sensors, it is easy to maintain track with less time and more accuracy. It also enhances the security of people travelling, which in turn increases the income to the railways. The main reasons for the accidents of train's are train derailment at curves cracks and slopes collisions between running train and standing train, missignaling due to fog or mist and fire accidents. No fruitful steps have been taken so far in these areas. This project deals with two of the efficient methods to avoid fire accidents and derailment of train due to presence of cracks in track. The unmanned automatic track surveying system is used in this project to reduce the manpower and maintenance cost. Crack detection is done by using sensors, which transmits the message to the train/station near to the fault track in order to alert the train drivers/controlling the signal posts. The next cause of accidents is due to fire which can be overcome by placing fire sensors at locations accidents if they exceeds particular limit. The system has been implemented and demonstrated by using MEMS sensor and ZigBee with the help of microcontroller to minimize the accidents due to human errors.

Track Survelliance

Fire Detection

ACHIEVEMENTS

A track surveillance is done with the help of LED-LDR sensors and MEMS sensors. It reduces maintenance time, cost, man power and human errors. This prototype detects cracks easily by using LED-LDR sensor and immediately sends the information to the maintenance workers and to the nearest station or train which is scheduled to come on the faulty track. Track alignment is verified using MEMS sensors, which sends the position/angle of track. By using these sensors and ZigBee we can easily detect and pass the information faster and effectively. Thus, we can minimize accidents due to derailment of train by that we can save human life and improve the railway protection system which automatically works. Fire accidents are the other major train accidents and by using Fire sensors we can send the information to the driver and thus reduce the damage caused by fire.

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

R&D under IEI Grant-in-aid Scheme

Optimization and Performance Benchmarking of Image Processing Techniques on Android Platform

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OBJECTIVE

The objective of this project is to implement image processing techniques on Android along with measurement and comparison of performance of those processes. The main aim of the project are stated below-

- To identify and analyze the various loading and processing tasks used frequently.

- To design an app that could run those tasks on any android device and measure resources used in the process.

- To mark out the boundary value cases where these tasks take too much time or memory.

- To compare contemporary corresponding techniques that carry out the tasks using less memory and time.
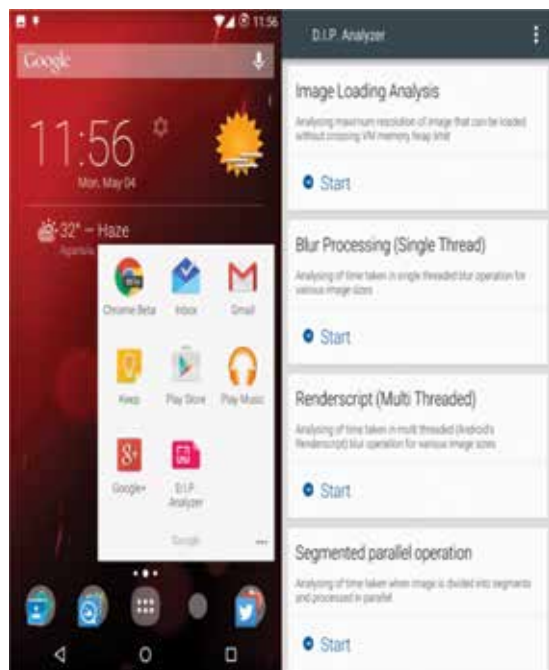
User Interface (Main Screen)
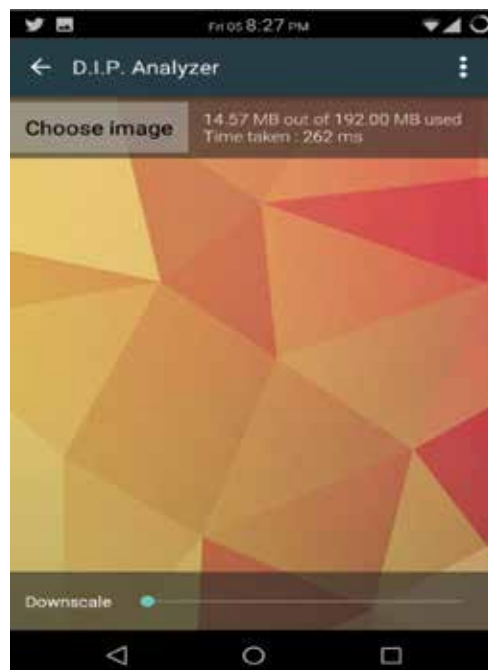
User Interface (Operation Screen)

ACHIEVEMENTS

This project helps developers to apply data mainly image data for quick estimation of time and space requirement. The image data will show common bottlenecks in image processing operations and developers can circumvent   them to better optimize their apps. Users could take advantage of faster image processing operations on Android platform. The image data will show common bottlenecks during its processing and Android application developers or users can use our methodologies to optimize their apps. Achievements are stated as follows-

The first part of the proposed work dealt with "Image Loading" operation, which is fundamental and it is used in the subsequent parts.

Second part of the proposed work measures performance of image operation (blurring) in plain simple single thread technique, which gives slow performance.

Third part of the proposed work uses Android native technique called "RenderScript" to measure performance of same operation. It gives extremely fast processing, but RenderScript requires graphics drivers and in-built system level support.

Fourth part of the project measures the same operation using proposed technique of cutting down the image into segments and processing them in parallel. Although it couldn't attain faster processing than RenderScript, but it achieved similar speed. This is a good outcome since proposed technique is free from the drawbacks of RenderScript. This technique can be dynamically modified and applied to various image processing operation, without requiring graphics driver support. This is one major advantage over RenderScript.

Legacy of IEI

Prime Minister Mrs Indira Gandhi cutting the Golden Jubilee Cake

Self Assistive Voice Controlled and Eyes Motion Tracking Technology for Disabled People

Student

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OBJECTIVE

This system describes the design of an innovative self-assistive technology that is used to facilitate the control of a wheelchair by using advanced voice commands and movements of eyes of the disabled people. The performance of this microcontroller based and voice integrated design is evaluated in terms of accuracy and velocity in various environments. Apart from this, the principle of eyes motion tracking technology is based on Infrared emitter and phototransistor which is attached on assistive technology for the disabled persons without any third person's assistance.

The complete project model

Spectacles used for eyes tracking

ACHIEVEMENTS

- The proposed system will provide an alternative to the physically challenged people with quadriplegics who is permanently unable to move their limbs (but who is able to speak and hear) and elderly people to control the motion of the wheelchair using their voice and eyes to lead an independent, confident and enjoyable life.

- The use of this new technology in conjunction with a mechanical system is in order to simplify everyday life. It would spark interest in an ever growing modern society. The aim of this study is to implement an interesting application using small and advanced vocabulary word recognition and eyes motion tracking system.

- Here a manual wheel chair is modified into an electrical wheel chair which is controlled by using voice command and eyes motion. This proposed system is easy to operate by the user and will be helpful for the disabled people to a great extent.

- With the help of voice command methodology, the user can also control several home appliances. For this one has to connect some home appliances with microcontroller and also have to program it according to the user's command.

- It can also be used for security purpose.

Legacy of IEI
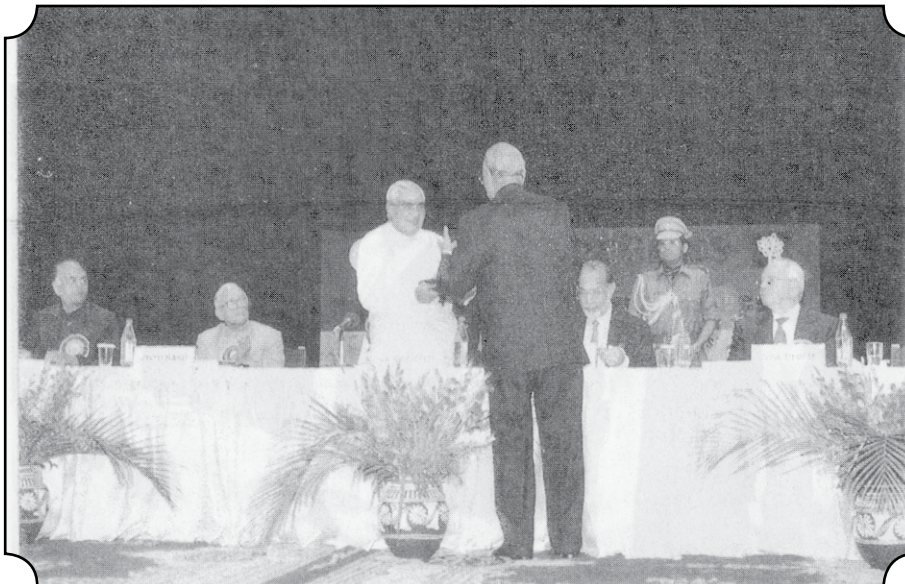
Shri Atal Bihari Vajpayee, Hon'ble Prime Minister; HE Governor of West Bengal, Shri Viren J Shah; Shri Jyoti Basu, Chief Minister of West Bengal; Shri K C Pant, Deputy Chairman, Planning Commission of India on the occasion of World Congress on Sustainable Development organised by IEI, during January 20-23, 2000

Design and Development of an Affordable and Reliable Solar Mobile Charger with Optional Battery Backup

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OBJECTIVE

Portable electronic devices are an exponentially growing market. Besides the constant design effort to increase their autonomy, there is also an important need for electronic chargers for these systems. In most applications, the charging energy is drawn from conventional AC adapters with power plugs. An emerging trend, however, is to charge batteries using green energy sources, one being solar energy. The cell phone has become a ubiquitous personal electronic device in people's daily lives. However, the power supply problem of the cell phone has not yet been solved satisfactorily. A battery takes the largest space and is the heaviest component within the cell phone. Despite the size and weight, the battery still cannot meet the ever increasing power demand due to the rapidly increasing functionalities of the cell phone. It is highly desirable to reduce the dependency of the cell phone on the battery by harvesting "green power" from the environment. The solar power is among the best option due to its wide availability.

Although the initial purchase of solar chargers is considered to be substantial, the efficiency that it provides on the long run makes it a worthwhile and cheap purchase after all. Solar panels and solar mobile chargers as alternative energy source is great not only for campers, bikers, and people who are passionate of the outdoors, but are the best energy supplier for urbanites who want to contribute to preserving nature without having to leave the concrete. Their compact size will make them ideal to carry around as well. People now can charge their small devices while walking around the city. This project aims to tackle this problem by designing a suitable circuit for an affordable and effective solar charger without and with battery backup.

Solar Charger without Backup

Solar Charger with Backup

ACHIEVEMENTS

- The solar charger circuit ensures an efficient and reliable operation and is most affordable.
- The cost of the circuit can further be reduced by mass production.
- The use of this circuit can reduce the electricity bills and can also reduce the pollution due to the energy source of the mobile battery.
- The device can find use in any household.
- It is especially helpful for people in rural areas as the power shortage is more.
- The device can be used for communication in military operations.

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

1. M. Krishna Harsha ,V. Sandeep Raju and G. V. Nagesh Kumar, "Design and Development of an Affordable and Reliable Solar Mobile Charger with Optional Battery Backup", National Conference on Contemporary Control, ConCon-2014 , conducted by Andhra University, 20-21 November, 2014.

2. B. Tech Project Report: "Design and Development of an Affordable and Reliable Solar Mobile Charger with Optional Battery Backup".

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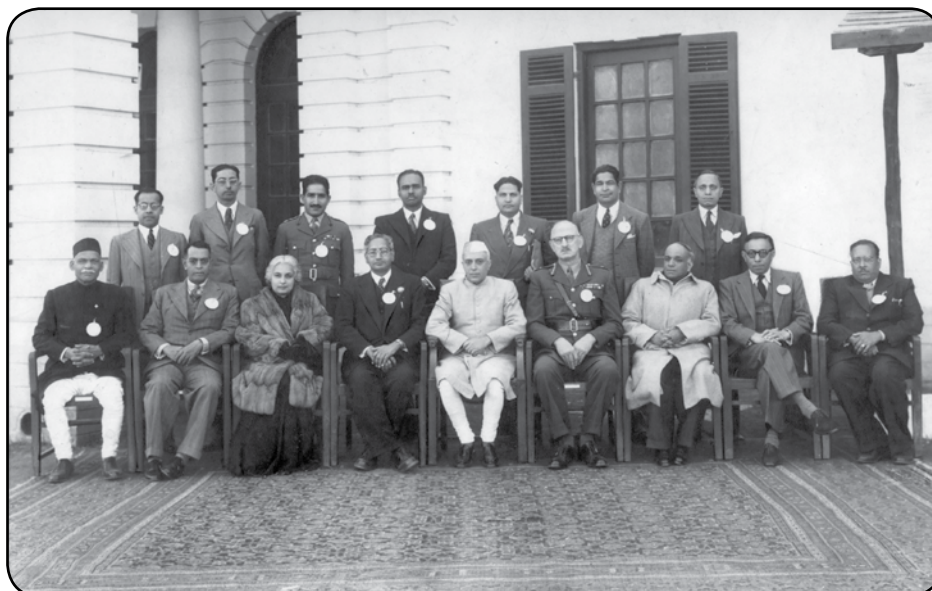
**Pandit Jawaharlal Nehru, First Prime Minister of India, during the
Annual Meeting of Central India Centre of IEI in 1950**

Wearable Healthcare Watch to Detect and Indicate Cardio Vascular Attack and to Provide Emergency Response System

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OBJECTIVE

The objective of this project is to design a embedded system to help the people who had frequent cardiovascular attacks to inform the hospital by short messaging service. This will help to increase the chance of survival. This project focuses on the design and implementation of an intelligent wearable device for ECG continuous acquisition and transmission with SMS based control and status updates. The designed device is an important component of a complete prototype for remote ECG continuous monitoring of patients with diverse cardiac diseases.
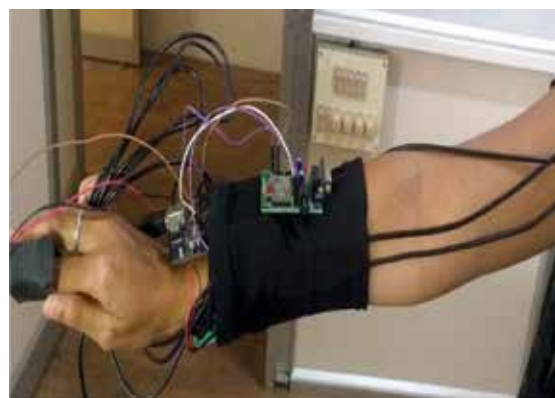
ACHIEVEMENTS

This project is intended to help to save the patient who had heart attack. It involves a wired system which runs through the body. The ECG and pulse sensors are used to detect the ECG waves and the pulses that are obtained from the watch which is on the wrist of the person. The waves of the ECG are compared with the triangular waves & if any abnormalities are detected an alarm is triggered. If the alarm is turned off then the monitoring continues else it sends an SOS messages to all the preset numbers via the GSM module, sharing the location that is obtained from the GPS module and thus providing immediate response to the user.

Development of Low Cost Unmanned Aerial Vehicle for Inspecting Crop Damage

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Quad-Copter after fabrication and assembly

Image processing Analysis

OBJECTIVE

The objectives are to build an unmanned aerial vehicle(UAV), to provide provisions for inspection of crops and to identify the crops that are infected, using image processing.

ACHIEVEMENTS

A comprehensive quad-copter capable of crop inspection was built.

The quad-copter built is an economical one. Components can be purchased at a relatively low cost to accomplish the making of the product and the objectives for doing so.

This quad is ideally suited for small fields due to its size and capacity and due to its high strength to weight ratio, it is preferable by the farmers to be able to easily transport it and extract maximum advantage out of it.

In case of failure or inability to operate in the middle of the field, its downfall amidst crops will effect only minimum damage since its weight is low. Unlike other complicated platforms like RC planes, quads are relatively easier to learn and fly and hence, control.

Design and Fabrication of Male Type Solar Powered UAV

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OBJECTIVE

To design UAV based on payload, wing area and how fast it can handle consumer's stunt requirements.

UAV designed in this project is to meet the following requirements:

- Slow runner
- Only day/time operations (9am to 4pm)
- No stunts
- Can be used in surveillance
- UAV total weight not more than 1000 grams

Solar Panel Fitted MALE Type UAV

**Brushless Motor & Electronic Speed
Controller for Solar Powered UAV**

ACHIEVEMENTS

The achievement of a solar powered aircraft capable of continuous flight was still a dream some years ago, but this great challenge has become feasible today. In fact, significant progresses have been realized recently in the domains of flexible solar cells, light weight batteries. Electric propulsion concept is quite simple; UAV equipped with solar cells covering its wing, it retrieves energy from the sun in order to supply power to the propulsion system and the control electronics and charge the battery with the energy in ground. A major interdisciplinary effort is necessary to optimize and integrate concepts and technologies to a fully functional system. As a matter of fact, the major issue is the combination and sizing of the different parts in order to maximize a certain criterion, for example the endurance, one parameter being the embedded payload. Solar panel alone doesn't give enough power to the propulsion system, but electric current from solar panel can get extra flying time about 15 minutes to 30 minutes.

It has been found that the endurance of UAV increases from 7 minutes to 8.6 minutes and range of UAV increases from 5km to 7 km. This may be the first Mini UAV model that has been constructed with a wing span of 1 meter equipped with solar panel of weight 700 grams and 200 grams of payload. This model can be used for 24 hours surveillance in borders, monitoring warfield, emergency check on highway for accidents.

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

A Prototype of Irrigation in Highland Areas using Hydram Irrigation Plan

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OBJECTIVE

The main objective of Hydram Irrigation Plan is to use only low head hydropower for pumping water to a destination higher in elevation than the source. It requires no outside source of power other than kinetic energy of flowing water. The concept of this project will help to irrigate in remote hilly areas so that the people of those areas can utilize this continuous water supply to increase their agricultural productivity and also for drinking purpose.

This project will give them a huge positive impact in their livelihood without affecting their environment and their eco-system at low cost.

Setup of the Hydram Ram Pump Model

Hydram Ram Pump

ACHIEVEMENTS

We achieved the goal of pumping water from low elevated surface to high elevated surface without using any external power source like motor pumps, electric source, etc. but by using the kinetic energy and potential energy of water itself.

Antenna Tracking System for Airbone Vehicles using UHF Range

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OBJECTIVE

The purpose of this project is to design and develop an Antenna Tracking System for airborne vehicles in UHF communication range. It will reduce human involvement and help to track the exact position of a system [automatically] under consideration. It could be an unmanned air vehicle to an unmanned ground vehicle or even a satellite.

Antenna Tracking System for airborne vehicles uses an Arduino UNO revision 3 board. Arduino is a single-board microcontroller, intended to make the application of interactive objects or environments more accessible.

With the development in the field of technology, we are witnessing an increase in the production of number of vehicles, aircrafts etc. also due to various other reasons we humans always are in a hurry to reach somewhere or someplace, due to which we are witnessing an increase in the traffic jams. At the same time the amount of theft of valuables like gold ornaments, vehicles, cash etc, in public places in broad daylight have also increased significantlly. In the defense sector also we are losing our best pilots, soldiers due to mishaps.

Our Antenna Tracking System for airborne vehicles and land vehicles in UHF range can reduce all the above mentioned problems. It can be used for surveillance of cities and coastal areas which may help in reducing terrorist activities by informing the authorities in advance.

Working Model of Project Prototype

ACHIEVEMENTS

The main functionality of this project is to track airborne vehicles in the vicinity of the radar using ultra high frequency (UHF). The hardware consists of an open-source hardware board designed around an 8-bit Atmel AVR microcontroller, or a 32-bit Atmel ARM. Current models feature a USB interface, 6 analog input pins, as well as 14 digital I/O pins which allow the user to attach various extension boards. The project of ours can be implemented in various fields like traffic control, spy drones, security functions details etc.

The circuit uses a servo which is a small device that incorporates a two wire DC motor, a gear train, a potentiometer, an integrated circuit, and an output shaft. Of the three wires that stick out from the motor casing, one is for power, one is for ground, and one is a control input line. The output line of the servo is connected to the input of the Arduino UNO R3. L298N H-Bridge is connected to the Arduino board and through stepper motor. A 433 MHz receiver is connected to an antenna.

The system is in the ready state initially. As soon as an airborne system is located in its range of operation, the system starts to receive its GPS coordinates. On receiving the GPS coordinates, the azimuth and elevation are decoded. The software module updates the hardware module in accordance with the decoded values. The antenna, which is controlled by the hardware module, follows the airborne system and collects data from it. The process repeats till a reset is pressed to stop.

Notification for R&D Grant-in-aid

The Institution of Engineers (India) invites applications, as per the format available on our link *http://www.ieindia.org*, for grant-in-aid in support of industry-oriented R&D projects for the session 2015-2016 for supporting students (B Tech/M Tech/Research Scholars) working under the guidance of faculty members who should be Corporate Member of IEI. The filled-up application may be emailed to *research@ieindia.org* and one printed copy of the same may be sent via post to the following address:

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

Applications received in format other than given in the above link will not be accepted. Application should be forwarded through the Guide, Head of the Department and Head of the Institution. Please note that preference will be given to projects received from Institutions who are members of The Institution of Engineers (India), projects dealing with industry-oriented/ applied research with matching grant from industry. In case of project proposal from UG students it is desirable that he/she be a member of the Students' Chapter of the IEI, if available in his/her institution. In case of proposals from PG and PhD scholars, the applicants should be members of IEI. The grant is not intended for the faculty members who have access to other avenues for research funding. Proposals received will be scrutinized and the recipients of R&D Grant will be informed accordingly.

Secretary & Director General   Chairman, R&D Committee
The Institution of Engineers (India)   The Institution of Engineers (India)

Magnetic Wheel Shaft

[Built a successful non polluting magnetic vehicle using high Gauss power permanent magnet with low maintenance cost and fuel consumption.]

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OBJECTIVE

Requirement in development for any engine to operate with fewer sources is increasing day by day. For the ever expected break-through, the alteration that has been proposed is Magnetic attraction force, as an alternate fuel to drive the shafts. As the petroleum products are in demand and producing lots of pollution to the atmosphere, the research is focused to make an alternate fuel also to reduce fuel consumption by making modification in shafts system of an automobile. Here we have designed a system, which makes a shaft to rotate automatically using magnetic force of suitable Gauss power and right incident angle of force direction. This system needs a lower energy from the engine in case of higher loads comparatively with the existing internal combustion engine.

**N52 Block Magnet with
Stainless Steel Cover**

Magnetic Wheel Shaft Setup

ACHIEVEMENTS

Magnetic wheel shaft is purely based on magnetic attraction operation. This system needs a lower energy from the engine in case of higher loads comparatively with the existing internal combustion engine. Sometimes by using magnetic wheel shaft, we rotate the wheel easily instead of engines. The main advantage of the magnetic wheel shaft :-

1. Free from pollution
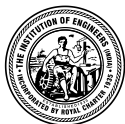
2. small amount of noise created when compare to normal engine vehicles

3. maintenance costs are very low when compare to normal engine vehicles

4. easy to operate

5. life time of magnetic wheel shaft is more than normal engine.

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

Advance in Aerospace Science and Application (volume 4, Number 1,2014) ISN2277-322 page.no.65-72.

Fillip to R&D: Initiatives of IEI

The R&D funding in India has so far been at the behest of government and industrial ventures. Most of these avenues are meant for professionals with profound R&D exposure. Consequently, many promising R&D ventures in our country have been aborted in absence of a supportive and inclusive financial system that provides the necessary risk capital to spur such innovations and enterprises.

Taking into cognizance the plight of such ventures, The Institution of Engineers (India) has retrofitted itself into the role of promotion of R&D through funding and active R&D either in solo or joint mode with identified organizations. The initiative was launched way back in 2001 with a modest amount of fund where the role of the Institution was confined to that of a mere funding body. The modest enterprise has now manifested into a full-fledged program which has percolated to the student community around the country. The role of the Institution has also undergone a paradigm shift from that of a technology funding body to that of a technology collaborator and facilitator. The proclaimed beneficiaries of R&D Grant-in-Aid scheme over the last three FYs have been over 200. However, we are trying to consolidate our efforts and emerge as a 'category leader' especially in the area of undergraduate funding.

Our funding has enabled student community across the country to come-up with some meaningful projects which is reflected partly through our compendium. It has resulted in works which has been accepted and published in highly indexed Journals and several occasions patent has also been filed.

The most recent venture has been the fellowship scheme for students pursuing PG & PhD courses in Engineering for the FY 2016-17 aimed at supporting purposeful post graduate and doctoral level initiatives. Initially the scheme has been extended to around 259 institutions comprising of (1) Institutes of National Importance (2) NAAC-'A' Rated Engineering Colleges/ Universities and (3) CSIR-Labs.

Our constant endeavour has earned us and also helped us in retaining the status of a Scientific & Industrial Research Organization [SIRO], recognition from Department of Science & Technology, GoI.

RFID Based Passport Details Identification

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OBJECTIVE

This model is innovative because of its hardware and software design to deals with passport authority management. The motto of the project is to simplify the job of the security people and to have flawless passport verification system. In this project the details of the person would be fed into the RFID cards (passports in RFID form) then the RFID reader reads the details of the RFID passport and sends the data wirelessly with the help of RF transceiver. On the other side the other RF receiver receives the details and sends to the microcontroller. Here, the controllers compare with the data already available in the memory. If it matches than the person is allowed, otherwise he would be termed as a criminal by giving an alarm and/or buzzing signal.

Security is a growing issue in international travel for both travelers and governments. Some countries however, are beginning to require passport verification to help and improve the security efforts for travel abroad. It's an important issue with the potential for criminals and terrorists to travel between countries with fake or forged documentation. The more effort those countries, universities and other organizations put into verifying the identity of foreign nationals, the better the chance of keeping criminals and terrorists from entering a country and causing problems. As technology improves, it becomes easier to verify the citizenship documentation of individuals. Very often, one of the main reasons that people travel between countries is for educational purposes. Some universities require passport verification for immigrant student before they are allowed to enroll and attend. This is done to help ensure the safety of fellow, students, staff and university visitors. There is risk involved in allowing illegal immigrants to attend colleges and university since there would be no way to definitively determine their true identities. Without verification, it would be easy for international criminals or terrorists to infiltrate the educational system. In the past, terrorists have used information learned in colleges, aviation schools, etc. in order to carry out terrorist attacks.

Working Model of Project Prototype

ACHIEVEMENTS

The main functionality of this project is to access the passport details of a passport holder through RFID technology. For this purpose, the authorized person has to be issued a RFID card. This card contains an integrated circuit that is used for storing and processing the information through modulating and demodulating of the radio frequency signal that is being transmitted. Thus, the data stored in this card is referred as the passport details of the person.

Earlier works have been reported to aimed at identifying the passport details of a person but they are time consuming and are unable to provide the desired level of security. We propose a project which can provide full security as per the requirement in less time. Through our project Passport verification and checking is a very simple and less time consuming. This proposed system simplifies the process by giving the authorized person an RFID tag containing all the passport details like name, passport number and nationality etc. Once, the person places the card in front of the RFID card reader, it reads the data and verifies it with that data present in the system and if it matches then it displays the details of the passport holder.

Here we use microcontroller from 8051 family and for display purpose a 16 X2 LCD is used. The status also can be retrieved from this system by pressing the status button interfaced to a microcontroller. This project accesses the details of a passport holder by using Radio frequency identification technology. In this system, an RFID card contains an integrated circuit that stores unique data and information of the passport holder. This system also uses a microcontroller, an RFID reader, power supply, a status button and an LCD. Because the passport verification and checking are a time consuming processes, the proposed methodology is expected to reduce the time using RFID technology.

When a passport holder with an RFID tag moves the tag over the RFID reader it reads and verifies the data and displays the message on the LCD confirming the status as authorized. On pressing of the status button, the RFID reader retrieves the data after comparing the stored data in the integrated circuit with the data in the microcontroller and displays the output like name, passport number and nationality etc.

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

Synthesis of Mixed Metal Oxides by High Energy Ball Milling for their Application as Photocatalyst for Waste-Water Treatment

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OBJECTIVE

An efficient way for the synthesis of hybrid metal oxide systems by simple high energy ball milling (HEBM) technique for the degradation of hazardous dyes, which causes major threat to our environment is being reported here. The effect of suitable binary or ternary addition of metal oxides with an aim to improve the structural, electronic and catalytic properties has also been explored. For this reason, Si was chosen to harvest the NIR region of incident light. An attempt was made to study the catalytic activity of mixed metal oxides based hybrid systems constituted by varying combinations of semiconductors for better light harvesting properties leading to enhanced catalytic effect than the single phase systems like pure TiO_2, ZnO, Fe_2O_3 or CuO. The combination of two or three different semiconductors with proper band alignment will also help in better catalysis by instantaneous separation of charges through band bending and thereby inhibiting the photo-generated carrier recombination. Our main objective was to find an efficient way of synthesis for large scale production along with better light harvesting capability of the catalysts for the degradation of hazardous dyes.

SEM and XRD pattern of the 10 hour milled ZnO/CuO/Si heterogeneous system

Time dependent Uv-Vis absorption spectra and photocatalytic degradation kinetics of Indigo Carmine dye using ZnO/CuO/Si heterogeneous system

ACHIEVEMENTS

High energy ball milling technique was used for the synthesis of binary and ternary hybrid systems for large scale production of the catalysts, which also have the better light harvesting capability over a broad region, viz. UV-Vis-NIR. We have synthesized a ternary system comprising of ZnO (UV), CuO (Vis) and Si (NIR) for the degradation of hazardous dyes by high energy ball milling. Large scale production of the catalyst is needed for the treatment of waste-water at industrial level, which is easily achievable by HEBM. The proposed ZnO/CuO/Si based heterogeneous catalytic system may serve as a promising photocatalyst towards the degradation of organic dyes like Indigo Carmine and Rose Bengal due to the enhanced and broadband exploitation of solar spectrum. But, experimental results show that the proposed ZnO/CuO/Si based heterogeneous system can degrade Indigo Carmine drastically than Rose Bengal. This might be due to the anionic nature of Indigo Carmine. As the degradation mechanism showed by the ZnO-CuO-Si system is majorly "oxidative", the anionic centres help in this process in Indigo Carmine. This in turn, may help in selective degradation of the anionic dyes by the ZnO-CuO-Si systems, if designed properly.

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

A manuscript entitled "An efficient approach towards the photodegradation of Indigo Carmine: Introduction of ZnO/CuO/Si ternary system as photocatalyst" is under preparation for publication in the "Journal of The Institution of Engineers (India) : Series D".

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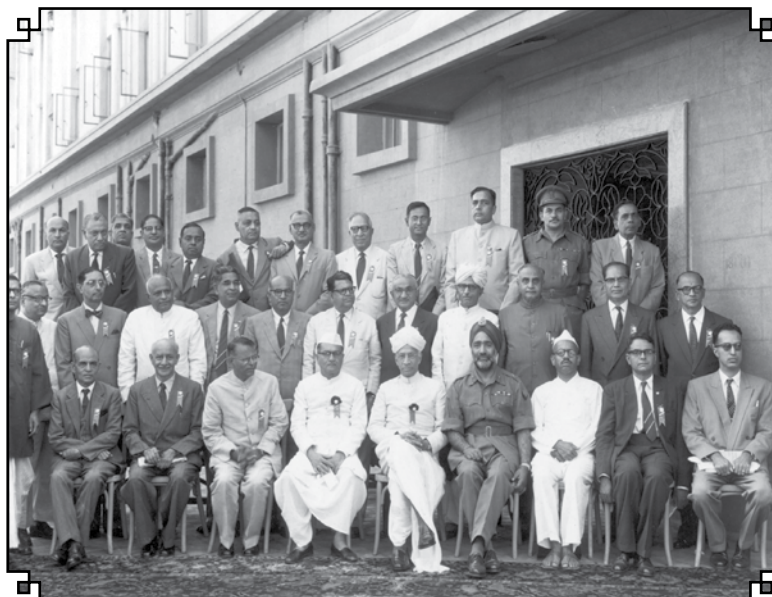
Dr Sarvepalli Radhakrishnan (sitting 5th from left), President of India, with Council Members of IEI in 1962

Solar Powered Water Purifier Cum Water Cooler

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OBJECTIVE

Water is the vital source of existence of life on earth. Drinking pure water has changed from luxury to necessity for the past few years. In general the people living in urban areas have access to good drinking water by having water purifier and at times can afford for packaged drinking water. But for rural areas it is difficult to get safe drinking water.

The objective of the project was to provide hygienic, filtered and cool water in rural areas of the state of Rajasthan state with the help of abundant solar energy.

Side View of Water Purifier & Cooler

Front View of Water Purifier & Cooler

ACHIEVEMENTS

The project 'Solar Power Water Purifier Cum Water Cooler' is based on the principle of conversion of solar energy into electrical energy. It contains a solar panel, which absorbs the energy of the sun rays and converts it into electrical energy. This electrical energy is used to power the water purifier (RO+ UV + TDS) which has its two outlet pipes, one for pure water and other for waste water. Here, in this project, the waste water is utilized to cool the pure water by an arrangement of cooling coil which functions similar to radiator in automobile. For more effectiveness a cooling fan, driven by the PV cell energy, is also used. Further, a battery and inverter assembly is also used to power this assembly in bad weather conditions. A solar charge controller is also provided to prevent the battery from overcharging and increase its life.

Solar Based Crack Detection & Alert System for Dam Protection

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Institutional Member, IEI

OBJECTIVE

The main objective of our project is to determine the major cracking produced by the environmental changes and also due to the flooding and man made errors. So generating alarm through the help of different circuits and then displaying the output on the screen. In this way we will determine the cracks and finally protect the dams and alert all the concerns to take necessary action on time. By protecting the dams we aim to control disaster like flood and save the life of people.

Dams are constructed for the purpose of power generation, water supply and irrigation. The failure of the dams will increase the risk of life and property and cause great loss of life and people. Basically our project is based on detecting the cracks and levees of the dams made up of concrete/raw materials. By using the Arduino controller and some part of image processing, we determine the cracks and/or any other leakage. It is constructed for the purpose of detecting major cracks and to alert the concerned authorities so that major losses can be averted. By detecting the cracks, which is sensed by Arduino controller using set up of sensors and print the status will show on LCD screen. Basically proposed dam protection was based on the social and environmental point of view but it can also detect the problem related to manmade disaster. If we take a look at the past scenario then we will find that the dams for storage and diversion works have been built in India since pre-historic times providing useful services. More than 5000 large dams have been built in India since independence (1947) and the protection of DAM is a major issue. The total storage potential of the reservoirs is around 225 BCM while the requirement is about 400 BCM. It is estimated that another 1500-2000 large dams will be required to achieve the ultimate storage potential to utilize it for socio-economic development of the country, including food security and flood control. In recent years, dam safety has drawn increasing attention from policy makers, practicing engineers as well as the public. This is because floods resulting from dam failure can lead to devastating disasters with tremendous loss of life and property, especially in densely populated areas. Hence, a robust understanding of the characteristics of dam failures is needed.

ACHIEVEMENTS

We have implemented and established the proposed model successfully by using microcontroller 89S52 and Arduino UNO R3 and concept of Image processing. The planned system is an embedded system which is able to closely monitor the parameters of a dam dike on a regular basis. It provides full automation over the dam dike parameters with closed loop designs. Authorities are indicated for changes in actuator state thereby giving an option for manual override. It has low power & compact design hence is easily portable. Also it provide a user-friendly interface panel hence will have a greater acceptance by the technologically unskilled workers.

In this system the setup provides us the information about to ensure robustness of operation and also the design has been carefully modified to permit rugged operation. Another disadvantage that can be attributed to the conventional commercially available testing equipment is that they are heavy which poses a practical limitation. However, this important disadvantage has been rectified in our project as the design is simple and sensible making the device easily portable.

Reliable data interpretation and real-time event notification are crucial to the receiver system design. In this part, the receiver microcontroller board processes all incoming data and illuminates corresponding light emitting diodes (LEDs) on the information display board to report current water level/crack status and transmitter status. The flood warning module is activated when the system detects persistent high water level. Also, the receiver system automatically resets the display module as soon as water level recedes below the sensor line. Hence, this project provides the concept of dam failure prevention system. It can be used to prevent the dam leakage by using sensitive shunt wires network. This network detects the cracks when any one or more wire breaks due to crack in dam wall or due to pressure of water by cracked wall. Hence, the crack of the dam can be easily detected and the alert signal is wirelessly transmitted from dam location to control room immediately. LED network in the control room will directly indicate the location of the crack in the dam.

Hence, this project can be used at local, national, and international level dams. It works on the phenomenon of basic electronic circuitry. Some basic principles of communication engineering and digital electronics are used here.

Legacy of IEI

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

Solar Based Sewage Blockage Detection System

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OBJECTIVE

In India one of the major problems faced by transportation system is over flooding of roads in rainy season. This causes many problems in transportation via roads because of the presence of water all over the place and hence vehicles find it difficult to travel. This happens because when water start flowing from the road surface it is collected in tunnels during their flow path, and when it is encountered by a blockage it start flowing in reverse direction and will finally result in water blocking of the roads as it will not be able to find its way through the tunnel. Our main target here should be able to remove this blockage for the flow of water. This proposal is going to deal with this most frequently faced problem and hopefully be able to solve it.

As the name suggest this proposal will be able to detect blockage in sewage pipes in their initial state and remove them before hand so that it does not cause total sewage blockage resulting in over flooding of roads in rainy season. The main objective of this project is to construct a device with capability of primarily detecting blockage in sewage pipes which are caused by various solid impurities and secondly give information about it. For this information providing part we can either construct an arrangement which can directly provide information about blockage.

ACHIEVEMENTS

We have implemented and established the proposed model successfully by using microcontroller 89S52, Arduino UNO R3 and display system. The planned system is an embedded system which is able to closely monitor and control the parameters of a sewer line chamber on a regular basis, round the clock, for collecting accumulation of clogs as well as increasing the water level in the chamber that might speed up the message system to the concerned authorities to take the further necessary action.

In this system the setup provides us the information about blockage and also the area or section in which it has occurred. With this we will be able to know that in which area the blockage has occurred. On getting this information we can send a team to that recorded area and able to provide before time servicing. This will lead to reduction in our problem of blockage of pipe lines in rainy season as we will be able to detect the problem before it reach its final stage where the sewage pipes gets fully blocked as road side water is not able to get its way through pipes. And hence we can have onetime maintenance of roads too.

The complete blockage detection system used over here will defiantly have power supply requirement for its operation. For ties purpose we can use solar cell panels. The setup can be connected on the street light. During day time it will collect the energy and will be stored it battery which in turn can be used by the sensor.

In this project the main work of detection of blockage in done by the sensor which has a specific work of detecting liquid flow and bubbles in liquid. It can also be configured for any other type of liquid. This sensor is named as LG01-2000 (Liquid Flow Switch and Bubble Detector). This sensor will be placed at the joining section of the pipelines where the chance of formation of blockage is maximum. Such an arrangement will be present at a distance of two to three joining. As the sensor will detect blockage it will send the signal to comparator circuit. Comparator circuit will compare the signal value from its reference value. If output signal value exceeds this reference value then it will send an output signal to controller circuit. Controller circuit will send signal to RF transmitter and it will send it to RF receiver.

The data recorded by RF receiver will glow the respective LED which will indicate the area of blockage. For data reception part we have to setup a data base which will record all the information generated by sensor. Here we will have information about serial number of the sensor and the area or section which it is covering. So that we can get to know the exact position of the blockage and labour can be send.

Legacy of IEI

Shri Jyoti Basu, Chief Minister of West Bengal addressing the gathering during Diamond Jubilee Celebration of IEI in 1980

Investigation on Solid State Welding of Hybrid Al6061/10%SIC/10%Al$_2$O$_3$ Metal Matrix Composite

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OBJECTIVE

The aluminium alloys are the most widely used in applications like engine valves, drive shafts, turbocharger, axles, drill bits and machine tools. Joining aluminium alloys by fusion welding processes produce unexpected phase propagation and a series of negative metallurgical changes such as grain boundary corrosion and a wider HAZ. Friction welding (FW) is a solid state joining process which produces coalescence of materials by the heat obtained from mechanically-induced sliding motion between the rubbing surfaces. This process usually involves the rotation of one part against another to generate frictional heat at the junction. The variations in process parameters like speed, upset pressure and frictional pressure affect the mechanical properties of joints. The objectives of the research includes :

- Providing an informative report on the solid state joining of Al6061/10%SiC/10%Al$_2$O$_3$ composite.

- Studying the microstructure of the fractured surface through FESEM images to identify the impact of the reinforcements on the bond properties.

- Obtaining an optimal parameter design using grey based desirability method.

- To offer the required guidelines and database for welding Al6061/10%SiC/10% Al$_2$O$_3$ composites using continuous drive friction welding process.

Cast Al/SiC/Al$_2$O$_3$ Composite Rods

Sample Friction Welded Joints

ACHIEVEMENTS

These results disclose the solid state joining of Al/SiC/Al$_2$O$_3$ composite rods using continuous drive friction welding process. Taguchi's L9 orthogonal array is used for experimentation. The grey based desirability (GBD) approach is used to predict the optimal friction welding parameters for sound joints. The following conclusions are drawn.

- The uncertainty handling ability of grey is combined with the easy computational approach and ranking capability of desirability analysis to predict the optimal friction welding parameters, through the methodology of grey based desirability.

- The ANOVA results has revealed significantly higher contribution of parameters like frictional pressure (42%) and upset pressure (49%) compared to the other inputs.

- The optimal combination predicted by the GBD approach (frictional pressure- 70 MPa, upset pressure- 130 MPa, burn off length- 2 mm, rotational speed- 2000 rpm) has improved the observed quality characteristics of the joint significantly. This approves the usage of GBD approach in other manufacturing processes as well.

- The temperature values are observed away from the weld interface, during the cooling cycle and modelled by using the Design Expert software. The model developed is observed to be fit and significant with the required amount of precision. The upset pressure and frictional pressure play an important role in increasing the temperature near the weld interface.

The research findings and the generated mathematical model will offer the required guidelines to perform the solid state welding on Al/SiC/Al$_2$O$_3$ composites used in drive shafts for light load vehicles, piston rods and valve trains. Further, the results will contribute in widening the industrial applications of MMCs.

Legacy of IEI

Dr Triguna Charan Sen, former President of IEI and former Education Minister, Govt. of India, delivering the Presidential Address at 43rd Annual General Meeting of IEI

InGaAs/GaAsSb Heterojunction TFET for the Realization of Energy Efficient Complementary Logic

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OBJECTIVE

Power dissipation is a fundamental problem faced by nano electronic industry today. Scaling down the supply voltage can reduce the energy needed for switching, but the transistors used in today's integrated circuits, that is the FET's, face scaling limitations. This is because of the large subthreshold slope characteristics of the transistors used. The MOSFETs used today have a sub threshold slope greater than 60mV/decade that is at least 60 mV of gate voltage is required to increase the drain current by one order of magnitude at room temperature. But tunnelling devices has got the advantage of steep switching slope that is they can attain sub 60mV switching slope at room temperature. Tunnel FETs avoid limitation of large switching slope and attain high switching speed as they operate by the principle of quantum-mechanical band-to-band tunnelling, rather than thermal injection over the barrier, and thus inject charge carriers into the device channel. Tunnel FETs
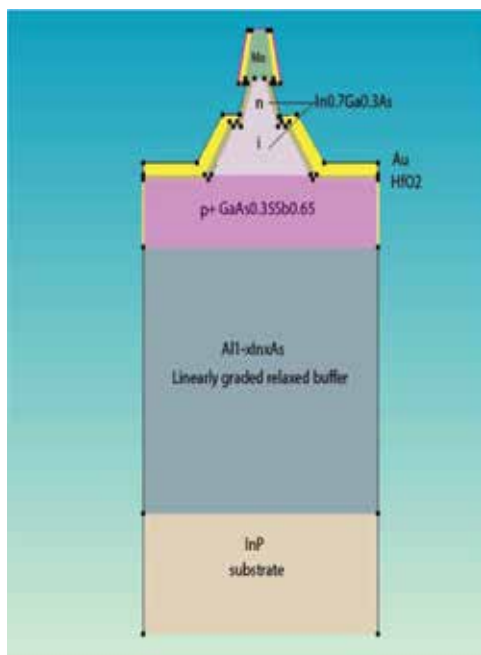
High Staggered InGaAs/GaAsSb 2D Vertical TFET System
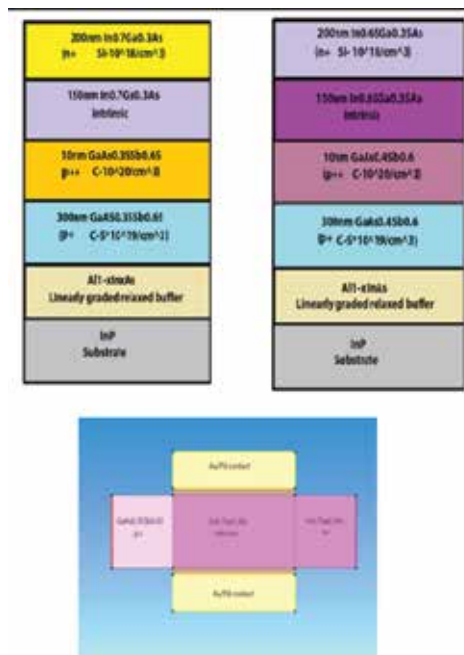
Layer Structures of the n-channel and p Channel Systems with Doping Profiles and a Simple Double Gated TFET

based on semiconducting films which are ultrathin or cylindrical systems that is nanowire systems can attain 100 times power reduction over CMOS transistors. So integrating high performance tunnel FETs with CMOS technology can result in the development of low-power integrated circuits.

TFETs can achieve a sub-60 mV/decade switching slope at room temperature and thus enable supply voltage scaling III–V-semiconductor-based heterojunction. TFETs are of interest as they allow a high on–off current ratio (ION/IOFF) and high ION through reduction in the tunneling barrier height. Further, performance can be improved by incorporating barrier engineering in heterojunction TFET for simultaneously optimizing the ION/ IOFF ratio and average sub threshold slope. So the objective is to model a TFET that can efficiently replace the MOSFET which overcomes the low ON current limitation of the TFETs without compromising the steep sub threshold slope and achieve lower power dissipation at room temperature so that supply voltage scaling can be effectively done and the Moore's law can be kept on the go.

ACHIEVEMENTS

TFETs as such are known as steep switching devices. They provide steep SS and very low OFF currents and this low OFF current characteristics makes TFET ideal for low power and low stand by power logic applications. The only limitation of TFET is the low ON current limitation. Here the ON current performance of the TFET is boosted up using the TFET performance boosters. The challenge is raising the ON current without degrading the OFF current and SS of less than 45 mV per decade over more than four decades of drain current. This requires the summed up combination of the many technology boosters specific to complementary hetero structure TFETs .Till date the structures developed has gained high ON current but at the cost of reduction in the steepness of the sub threshold slope. Here in this work attained is the record ON current among the hetero system TFET without making any compromises in the OFF current or the sub threshold slope.

This high staggered heterojunction TFET is a combination of material engineering, junction engineering and barrier engineering applied together to a TFET in order to overcome the low ON current limitation of the TFET without compromising the OFF current and the sub threshold slope. Barrier engineered $In_{0.7}Ga_{0.3}As$ homojunction control, $GaAs_{0.4}Sb_{0.6}/In_{0.65}Ga_{0.35}As$ moderate-stagger, and $GaAs_{0.35}Sb_{0.65}/ In_{0.7}Ga_{0.3}As$ high stagger heterojunction TFETs have been modelled and dependence of ION on effective tunneling barrier height Ebeff has been systematically studied . From the analysis high staggered heterojunction TFET yields high ON current without degrading the OFF current and the subthreshold slope performance. The analysis proves that a sub 60mV switching device can be developed using this particular material combinations and incorporating barrier engineering with record ON and OFF currents.

Both n channel and p channel systems are modelled using the same material system and hence the complementary logic can be implemented and hence used in switching applications. Both n and p type systems using this particular ternary compound based high staggered heterojunction yields record ON current that is ON current higher than that of MOSFET with a much reduced sub threshold slope and much lower OFF current. On comparison with the existing technologies of binary and ternary compound based heterojunction systems it is clear that the proposed system not only gives the highest ON current but also provides the highest switching ratio ION/IOFF and also the steepest switching slope.

$GaAs_{0.35}Sb_{0.65}/In_{0.7}Ga_{0.3}As$ high stagger heterojunction TFET is mathematically modeled and barrier engineering is done using MATLAB and simulation is done using TCAD. ION enhancements over the existing technologies is studied along with the subthreshold slope characteristics and the ION/IOFF enhancements .The system proposed provides an ON current higher than the ON current of MOSFET that 145µA/µm, a high ION /IOFF of 107 at VDS=0.5V and all these are achieved without compromising for the steep sub threshold slope. The modeled heterojunction has a sub threshold slope of 34.48mV/decade at room temperature and thus allows for supply voltage scaling. The p-channel TFET also gives a similar ON current higher than that of MOSFETs thus here too the low ON current limitation of the tunneling device is overcome and ON/OFF

characteristics is 106 and hence can be used to effectively create the complementary logic and hence used in switching applications attaining high switching speed with low power dissipation. Thus energy efficient high speed integrated circuits can be developed by incorporating the proposed InGaAs/GaAsSb based high staggered heterojunction TFET.

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

❖ Arathy Varghese, Ajith Ravindran and Praveen C S. Article: InGaAs/GaAsSb Heterojunction TFET. IJCA Proceedings on International Conference on Emerging Trends in Technology and Applied Sciences ICETTAS 2015(3):21-25, September 2015. [ISBN: 973-93-80888-58-8].

❖ Arathy Varghese, Ajith Ravindran, Shajimon K John "Arsenide-Antimonide heterojunction TFET with MOSFET like ON-Current and steep subthreshold slope", in Proceedings of 3rd Conference on Solid State Circuits, August 2015, pg. 157-162.

❖ InGaAs/GaAsSb Heterojunction TFET for the realization of energy efficient complementary logic (M.Tech Thesis (2015), Arathy Varghese, Saintgits College of Engineering)

Legacy of IEI

Shri B Patnaik, Chairman, Planning Board, Orissa State and former Chief Minister of Orissa addressing the 5th Annual General Meeting at the Orissa Centre of the Institution

Characterization of Graphene Polymer Composite

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OBJECTIVE

Nanotechnology is used in numerous fields, wherever the application varies from engineering to cosmetics. The main advantage of this technology is the size that creates place in all fields. Nanotechnology is precisely defined as characterization, production and application of devices and systems at nanometer scale, manipulating their shape and dimensions in a controlled way. These nano scale products and materials exhibit at least one novel or superior property due to their nano scale size.

Graphene Epoxy Composite specimens are prepared with five different percentage ratios of graphene i.e. (0%, 1.5%, 3%, 4.5% and 6 %.). Specimens were prepared by Ex-situ process & as per ASTM standards for Tensile (D638), Compression (D695 – 85) and Wear (G99) test specimens. The total amount of matrix (Epoxy) used for Tensile, Compression and Wear test specimens is 150 grams, which is constant for every percentage variation in graphene and tests are conducted.

Graphene Polyester Composite specimens are prepared with five different percentage ratios of graphene i.e. (0%, 1.5%, 3%, 4.5% and 6 %.). Specimens were prepared by Ex-situ process & as per ASTM standards for Tensile (D638), Compression (D695 – 85) and Wear (G99) test specimens. The total amount of matrix (Polyester) used for Tensile, Compression and Wear test specimens is 130 grams, which is constant for every percentage variation in grapheme and tests are conducted.

Epoxy Graphene composite end specimens

Machined specimens for test

ACHIEVEMENTS

❖ Tensile strength is maximum in Epoxy Graphene Composite when compared to Polyester Graphene Composite.

❖ Wear tests were conducted in the Pin On Disc (POD) machine for a load of 10 kg initially for Epoxy Graphene Composite the results are good. When the tests are conducted for Polyester Graphene Composite the maximum load taken by it is 5 kg.

❖ To have a good comparison between the two Epoxy and Polyester the load is finalized to 5 kg at a speed of 500 rpm which is constant for all the percentages of Graphene specimens.

❖ Hence, from above results it can be concluded that Epoxy Graphene Composite is having good wear resistance when compare to Polyester Composite.

❖ Graphene Composites is an area interest for scientist to discover and to utilize its property for many applications like defence, medical, aerospace and civil applications etc.

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

"Characterization of Graphene Polymer Composite" published in International Research Journal of Engineering and Technology (IRJET) Volume 2, Issue 4 July 2015.

Legacy of IEI

The President, Major Genral Harkirat Singh (7th from the left), with members of Council and Flood Control Committee of the Institution of Engineers (India) on the Occasion of their visit to the Panchet and Kadakvasla Dams in the Wake of the Disastrous Floods in Pune City

Design & Implementation of Solar Powered Remote Environment Monitoring System for Industry and Landfill Sites

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OBJECTIVE

The primary causes for the increased global warming are the green house gases which are emitted from the Industries and Landfill (Waste Disposal) sites. So the proper monitoring of these sites is the prime concern of the proposed system. Because the long term exposure to these harmful gases causes severe heart and brain related diseases to the living beings. With proper monitoring of these sites especially the landfill sites the awareness about the concentration of harmful greenhouse gases emitted into the environment can be created to the peoples who are living around the landfill sites.

The main objective of the proposed system is to develop a cost effective and efficient solar powered environmental monitoring system specially for the small area of landfill sites, which is capable to measure the temperature in the surroundings of the landfill site, concentration levels of the greenhouse gases like Carbon Monoxide (CO), Carbon Dioxide (CO_2), Methane (CH_4) and the presence of the toxic liquid like Leachate.

The prime objectives of undertaking this project are :

● To compare the measured toxic levels against the safety levels.

Solar Powered Remote Environment Monitoring System

Project Module with ARM7

- To store the measured toxic levels in a internet enabled personal computer (PC) so that the data can be accessed by the respective authorities and the public.

- To send the information around the selected sites automatically to the respective authorities when the toxic levels exceeds the limits and the public are allowed to access the system by "SMS" on demand service to know the concentration levels of the toxic gases around selected landfill site.

ACHIEVEMENTS

- The remote environment monitoring system was developed successfully with integration of sensors to IoT Platform and online SMS system is used to send alert SMS to pollution control board authorities and also to peoples who are living near industries and landfill sites to avoid catastrophe.

- The Project was exhibited at Reputed Engineering Colleges.

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

The research work of this project is presented at 2nd International Conference, ICECIT-2015, and published in LNEE by Springer, eBook ISBN -978-981-10-1540-3, Hardcover ISBN -978-981-10-1538-0 & Series ISSN -1876-1100, December 2015.

Legacy of IEI

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

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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OBJECTIVE

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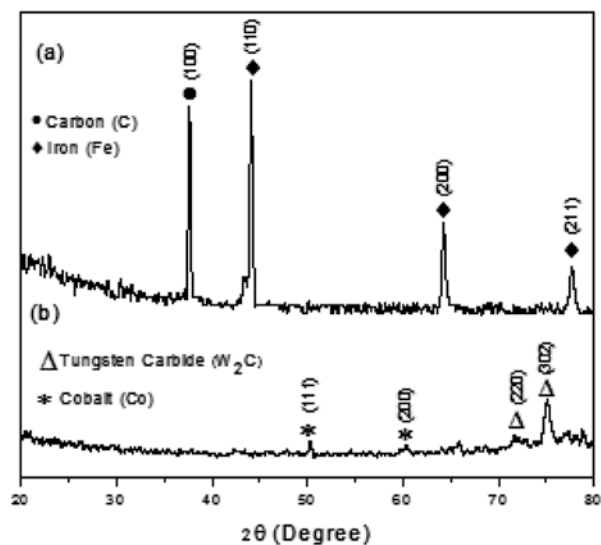
XRD result for (a) mild steel and (b) WC-12%Co coated steel in mild steel for iron (Fe) – JCPDS: 06-0696 and Carbon (c) – JCPDS: 80-0004 In coated steel for Tungsten Carbide (W2C) – JCPDS: 79-0743 and Cobalt (Co) – JCPDS: 15-0806

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 higher 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 under 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 research 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 was increased (BHN 600) remarkably. Similarly, resistance on wear was 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 was 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 as detailed in table III 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

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

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).

3. "The Effect of Carburization of ASTM A36 Steel Substrate In Improving Wear Properties Of Plasma Sprayed Wc-12%Co Coating", P. Karuppuswamy, C. Bhagyanathan, S. D.ArunKumar, Surface Review and Letters, World Scientific Publ Co Pte Ltd ISSN: 0218-625x 1793-6667 (Under review).

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

Development of Paper Recycling Plant at MITS Gwalior

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OBJECTIVE

- To determine the amount of paper printed for use of the institution.

- To determine the amount of paper wasted in the institution.

- To determine the maximum possible use of paper.

- To make self-sustainable plant.

- To find out the amount of recycling that can be done in the institution and how best to implement better recycling procedures.

- To minimize energy use in all aspects.

- To utilize the recycled paper in various forms like file covers, envelope, visiting card etc.

- To train the students to utilize the plant.

- To automate the plant and increase the production capacity too.

- Established the plant at all institute level, school in Gwalior.

- The developed equipment can be used in schools, institutes, domestic level and small scale industries.

- For first year students a recycling workshop introduce in lab.

Paper Recycling Plant at MITS Gwalior

Cutting & Rolling

ACHIEVEMENTS

The cost of materials was analyzed; 250 gram waste paper is 2.5 rupee, 10 liter water is 1 rupee approx., 50 gram glue is 0.5 rupee, 50 gram bleaching powder is 1 rupee, color is 5 rupee and 0.25 power supply is 2 rupee

The costs of 6 numbers of sheets of size 17"x25" are 12 rupee; one sheet is made in 2 rupee (approximate).

The maximum value of GSM is 364, because it is big sheet having sheet weight 58g and area is 0.23 m^2.

The minimum value of GSM is 107, because it is small sheet having sheet weight 22g and area is 0.2 m^2.

We optimize the design of machines for making the File cover (17'X25') that size is not used by others for making recycled handmade sheet. File covers is used in large amount in any academic institutions.

We optimize the cost of machines; Rs 40,000 is the manufacturing cost of the machines. Other Plants have machines cost in Lakh rupees.

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

• International conference, IAET- 2014

• 2 - M.Tech. Thesis (Sunil Dohare and Richa Agrawal)

Legacy of IEI

**Mr Tathagata Roy, FIE & Hon'ble Governor of Tripura (2nd from left)
inaugurated the 30th Indian Engineering Congress at Guwahati**

Compendium on R&D Projects under Grant-in-Aid Scheme Vol. 4, September 2015

Sl. No.	Title
1.	Autonomous Navigation of Unmanned Aerial Vehicle (Quad-X) by Tracking (using GPS)
2.	Development of Weather Ballon for Environment Studies
3.	Design and Engineering of A Small Satellite – CANSAT
4.	Wireless Bomb Detector and Diffuser Spying Robot
5.	Recycling Polythene Waste through Semi Automated Extrusion
6.	Development of Unmanned Aquatic Vehicle for Applications in Surveillance and Tracking
7.	Conversion of Waste Plastics to Petrol and Diesel
8.	Development of Photo Elastic Stress Analysis Module through Stereo Lithography
9.	Automatic Load Control with Respect to Power Generation using Smart Meter
10.	Design and Development of Trolley for Medical Applications
11.	Development of Student Satellite Technology for Aerial Surveillance
12.	FDTD Simulations for Plasmonic Nanoantenna
13.	Smart Phone Based Application for the Simultaneous localisation and Mapping of an Unknown Environment
14.	Analysis and Development of PICO Satellite Structure
15.	Development of Hybrid Power Generation Model using Solar, Wind and Rain Water
16.	Design and Implementation of Reduced Switch Cascaded Multilevel Inverter
17.	Fluidized Bed Catalytic Reactor for the Degradation of Pharmaceutical Active Compounds (PAH) using Batch Reactor
18.	Electrically Mediated In-vitro Transdermal Drug Delivery by Means of Drug Loaded Nanocomposite Polymeric Membranes
19.	Design of an Adaptive Coal Mine Rescue Robot using Wireless Sensor Networks
20.	Hanging Power Plant
21.	Investigation on Electrical and Physical Properties of Transformer Oil and Natural Ester Oil using Nanocomposites
22.	Forecasting Air Quality Impacts of Episodic Condition at Traffic Intersections in A Mixed Urban Environment
23.	Design and Development of an Intelligent Structural Health Monitoring System for A Simply Supported Bridge using Wireless Sensor Network
24.	Characterization Of Doped Iron-alumina Nanostructured Metal Matrix Composites (MMC) Synthesized using Powder Metallurgy (P/M) Technique
25.	Development of Solar Drier for Agricultural Application
26.	Surface Roughness Evaluation of Turned Surface Roughness using Computer Vision System
27.	Autonomous Ground Vehicle for Remote Area and Border Surveillance
28.	Implementation of 1-ϕ PWM Rectifier using DSP
29.	Development of Mathematical Models for Blending of High-Ash Non-coking Coal Towards Total Quality Assurance
30.	Use of Bamboo as Reinforcement in Lintels
31.	Uniq Eco Blended Fuel
32.	Guiding Visually Challenged with Inbuilt RFID Walk Stick
33.	Briquette Burner – An Alternative for Cooking Stove
34.	Enhancement of Non-equilibrium Solubility of Binary Immiscible Systems by Ternary Addition
35.	Low Cost Highly Accurate 3d Surround Scanner