OPTRONIX 2024

8th International Conference

on

Opto-Electronics and Applied Optics

Conference Proceedings

University of Engineering & Management, New Town, University Area, Plot No. III, B/5, New Town Rd, Action Area III, Newtown, New Town, West Bengal 700160

MESSAGE FROM THE DESK OF CHANCELLOR, UEM KOLKATA

PROF. (DR.) SATYAJIT CHAKRABARTI

University of Engineering & Management, Kolkata, University of IEM group has taken an ambitious program to organize an International Conference on Opto - Electronics and Applied Optics (OPTRONIX 2024) from 25th to 27th July 2024 in the University Campus. In additional to numerous achievements of the University, this is yet another milestone in our academic pursuit. A mix of plenary talks and paper presentations will also be there in the Conference.

I hope three days deliberations and interactions amongst experts and participants will be immensely helpful for the entire fraternity and will emerge many meaningful outcomes. On this occasion I convey my good wishes to the entire team for the relentless endeavor in making the Conference a true success.

MESSAGE FROM THE DESK OF VICE CHANCELLOR, UEM KOLKATA

PROF. (DR.) SAJAL DASGUPTA

It is my great pleasure to know that an International Conference on OPTRONIX 2024 will be organized at the University of Engineering and Management, Kolkata on 25th to 27th July 2024. The Conference aims at bringing the advancement in the field of wireless communication, optical communication, VLSI based communication, Satellite / Space Communications, Visible Light Communications and many more. It lays a special emphasis at educating and informing researchers and industry professionals on the latest development of technology.

The unique nature of the Conference is to bring advancement in the field of communication engineering with its different kinds. This will invite all participants across the globe to attend and share their insights and convey recent development and disseminate the know how in the field of Opto-Electronics and Applied Optics.

I wish this Conference a grand success.

MESSAGE FROM THE DESK OF PRO VICE CHANCELLOR, UEM KOLKATA

PROF. (DR.) SATYAJIT CHAKRABARTI

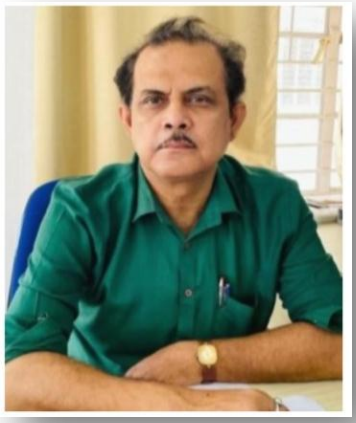
The Concept of Opto-electronics & Optical devices is becoming an enormous issue in modern society. So, special emphasis shall be taken for educating the people in Opto-electronic material and its allied research and also industry professionals at the latest knowledge oftechnology. I am extremely glad as because the Conference theme is of the same. I thank you, the participants, for enriching the Conference by your presence. I hope you will enjoy the content, renew old friendships, make new friends, get new ideas and above all have a good time.

I warmly welcome you to the 8th International Conference on Opto-Electronics and Applied Optics (OPTRONIX 2024) and wish it to be a grand success.

MESSAGE FROM THE DESK OF CONVENER, UEM KOLKATA

PROF. (DR.) ABIR CHATTOPADHYAY

(DEAN RESEARCH)



I welcome all the participants of OPTRONIX 2024. The main goal of organizing this Conference is to share and enhance the knowledge of each and every individual in this optical world. We have given a good opportunity for those who have a thirst in knowing the present technological developments and also share their ideas. Furthermore, this conference will also facilitate the participants to express and share various novel ideas.

The Conference aims to bridge the Research Works in academic and other professional trainings, research presentations and other professional trainings, research presentations and keynote address in current technological trade. It reflects the growing importance of Energy Management for Green Computing. It is the study and practice of using computing resources efficiently by designing.

I thank the Conference Committee for extending their valuable time in organizing the program and to all the authors, reviewers and other contributors.

MESSAGE FROM THE DESK OF DEPUTY DEAN, UEM KOLKATA

PROF. (DR.) RAJASHREE PAUL

I welcome all the participants of OPTRONIX 2024. The main goal of organizing this Conference is to share and enhance the knowledge of each and every individual in this Opto – electronics environment. Furthermore, this Conference will also facilitate the participants to express and share various novel ideas.

I convey my good wishes to the Conference Committee members and their belief in the excellence of OPTRONIX 2024.

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BIOGRAPHY OF THE SPEAKERS

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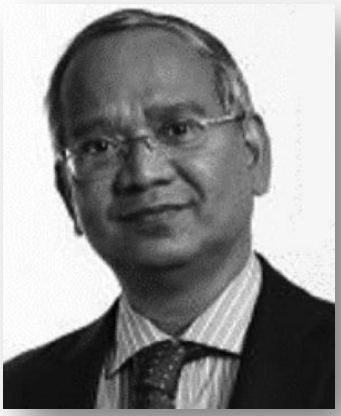
THE CHIEF GUESTS

PROF. (DR.) B.M.AZIZUR RAHMAN

(CITY UNIVERSITY, LONDON)



B. M. A. Rahman (Life Fellow, IEEE) received the B.Sc. Eng. and M.Sc. Eng. (Hons.) degrees in electrical engineering from the Bangladesh University of Engineering and Technology (BUET), Dhaka, Bangladesh, in 1976 and 1979, respectively, and the Ph.D. degree in electronic engineering from University College London, London, U.K., in 1982.
From 1976 to 1979, he was a Lecturer at the Electrical Engineering Department, BUET. In 1988, he joined the Electrical, Electronic and Information Engineering Department, City University, London, as a Lecturer, where he is now a Professor. At City University, he leads the Research Group on Photonics Modeling, specialized in the development and use of the rigorous and full-vectorial numerical approaches, frequency-domain modal solution approach, the beam propagation method, and time-domain approach, primarily based on the numerically efficient finite - element method. His publication topics include Wavelength Shift, Refractive Index, Optical Fiber, Optical Spectrum Analyzer, Rectangular Waveguide, Fiber Bragg Grating, Group Velocity Dispersion, Land Subsidence, Optical Sensors, Polylactic Acid, Shift In Spectra, Single-mode.

PROF. (DR.) JYOSTNA KUMAR MANDAL

(UNIVERSITY OF KALYANI)

Being M.Sc. in Physics from Jadavpur University in 1986, M. Tech. in Computer Science from University of Calcutta, he was awarded Ph. D.(Eng.) in Computer Science & Engineering by Jadavpur University in 2000. Presently he is working as Vice Chancellor, Raiganj University and former Dean, Faculty of Engineering, Technology and Management, Kalyani University, Kalyani, Nadia, West Bengal for two consecutive terms (2008-2012). He started his career as lecturer at NERIST, Arunachal Pradesh in Sept., 1988. He has teaching and research experience of 35 years. His area of research is coding theory, Data and Network Security, Remote Sensing & GIS based Applications, Data Compression, Error correction, Visual Cryptography and steganography. He has produced 29 Ph. D degrees one submitted (2022) and 8 are pursuing. He has supervised 3 M. Phil and more than 80 M. Tech. Dissertations and more than 150 MCA projects. Five sponsored projects are completed as PI. Published more than 450 papers in various international journals and conferences, out of which 185 papers in international journals, 45 papers published in SCI Journals in last five years with highest impact factor 7.980. He is life member of Computer Society of India since 1992, CRSI since 2009, ACM since 2012, IEEE since 2013 and Fellow member of IETE since 2012, Ex-Hon. Executive member of CSI Kolkata Chapter, Ex-Vice Chairman (2015-2016). Ex-Hon. Chairman (2016-2017). He is Ex-Secretary, IETE Kolkata Centre during 2018-2020. Ex-Chairman IETE Kolkata Centre during 2020-2022. He has chaired number of sessions in various International Conferences and delivered more than 1000 expert/invited lectures. Attended number of conferences and delivered 4×5 days expert lectures as guest faculty and organized more than 55 National & International Conferences of ELSEVIER, Springer and IEEE during last Five years. He is reviewer of various International Journals and Conferences, since 1994. He is chief editor of various National/International Journals of AIRCC, editors of various National/International Conferences and proceedings.

PROF. (DR.) AJOY GHATAK

(PROFESSOR, IIT DELHI)

Ajoy Kumar Ghatak is an Indian physicist and author of physics textbooks. Ghatak has written over 170 research papers and more than 20 books. His undergraduate textbook on *Optics* has been translated to Chinese and Persian and his monograph on *Inhomogeneous Optical Waveguides* (co-authored with Professor Sodha) has been translated to Chinese and Russian. In 1995, he was elected Fellow of the Optical Society of America "for distinguished service to optics education and for his contribution to the understanding of propagation characteristics of gradient index media, fibers and integrated optical devices". He received his M.Sc. from Delhi University and Ph.D. from Cornell University.

Ghatak joined the Indian Institute of Technology, Delhi in 1966. He retired as an Emeritus Professor of Physics at IIT Delhi in 2007.Ghatak is currently the President of the National Academy of Sciences, India. He also spends his time writing books and doing special guest lectures at universities and colleges in India and internationally. In recent years, he has taken a keen interest in bringing the genius of Albert Einstein to the wider public and was invited to present a TEDx talk, "Inside Einstein's mind" in 2017.

PROF. (DR.) RAJIB CHAKRABORTY

(PROFESSOR, DEPARTMENT OF APPLIED OPTICS & PHOTONICS, UNIVERSITY OF CALCUTTA)

Dr. Rajib Chakraborty received his Doctoral Ph.D. from the Department of E & ECE, IIT Kharagpur on "Effective-Index-based Matrix Method for Integrated Optics and some Experimental Studies " in June 2003 and M.Sc. (Tech.) in Applied Physics (Optics & Optoelectronics) from Calcutta University in the Year of 1995. He received his B.Sc. (Hons) in Physics from Calcutta University in 1992.

He is currently working as Professor in the department of Applied Optics & Photonics, University of Calcutta from 2008. He has served as the Professor & HOD in department of Electronics & Communication Engineering at Techno India, Salt Lake, from Feb 2007 to Sept 2008. Earlier he was working as a Professor and HOD in the department of Electronics & Communication Engineering at Bengal Institute of Technology & Management, Santiniketan from October 2005 to Jan 2007. He has worked as a Research Associate at University of Virginia, USA & Old Dominion University, USA from July 2004 to October 2005 and Visiting Scholar, Virginia Polytechnic Institute & State University, USA from May 2002 to May 2004.

His research expertise includes:

- Clean Room processing of Integrated Optical devices on Lithium Niobate, MEMS &Nanophotonic structures on Silicon and glass
- Periodic poling of Lithium Niobate for acousto-optical memory devices
- Designing of Integrated Optical and Nanophotonic devices.
- Processing of Fiber-Optic based Sensors.
- Micromachining of optical materials and optical fibers using Laser.
- Diamond-like Nanocomposite Surface coating Technology

PROF. (DR.) NIKHIL RANJAN DAS

(PROFESSOR, Department of Radio Physics and Electronics)

Dr. Das obtained his Ph.D. degree, and joined the Department of Radio Physics and Electronics, University of Calcutta, as a full-time Lecturer in 1994, where he is currently a Professor. He is presently the Director, Centre for Research in Nanoscience and Nanotechnology (CRNN), University of Calcutta. He served as the Head of the Department, the Dean, Faculty for Post Graduate Studies in Engineering & Technology, and also earlier as the Director, CRNN, University of Calcutta.

As Dean of the Faculty of Engineering & Technology, of special mention, he took a lead role to successfully launch the 4-year B.Tech course in all Engineering and Technology streams of the University for the first time from 2015. After framing the modalities of the course, he put tremendous effort to arrange new infrastructure for classrooms and laboratories, including resource persons to run the combined first year classes of B.Tech course in the Technology campus. Dr. Das started his research career in the studies on the physical, electronic and optoelectronic properties of submicron structures of semiconductors. His current research interests include semiconductor photonic devices and systems including nanophotonics, with main focus on modeling and design. He spent nearly 3 years in the Department of Electrical and Computer Engineering, McMaster University, Hamilton, Onatrio, Canada as a Post-Doctoral Fellow and later as a Post-Doctoral Research Associate.

Later, he visited Trieste, Italy as a Senior Guest Scientist, and the McMaster University, Canada, the University of Sheffield, UK, and Pohang University of Science & Technology (POSTECH), Korea as a Visiting Professor and Collaborator. He visited Chair "Materials Science and Nanotechnology" of Technical University Dresden, Germany during Aug.-Sep. 2018 with INSA-DFG award. He ran collaborative program such as UKIERI with University of Sheffield (UK), and was the key person from University of Calcutta for Erasmus Mundus ‘LEADERS’ program-a consortium of 13 Asian and 7 European Universities/Institutions. Dr. Das was the Founder/ Chairman of the IEEE Photonics Society (formerly LEOS) Calcutta Chapter (2004). He took initiative on behalf of the IEEE PS Calcutta Chapter to celebrate National Science Day in Science College of the Calcutta University, in which students of various schools (and in some cases, colleges) were invited to attend the day-long program comprising Lectures and Demonstration on various topics on science the participating students learn in schools.

PROF. (DR.) BISHNU PAL

(PROFESSOR & DEAN ACADEMICS, MAHINDRA UNIVERSITY)

Bishnu Pal is Professor Physics and Dean of School of Engineering and Academics at Mahindra University. He had served the then Mahindra University (MU) right from its beginning in July 2014 till June 2017 as Professor of Physics in the School of Natural Sciences, and then for one year he was a Consulting Professor in Physics during 2017-18 at the Times Group's Bennett University in Greater Noida. He rejoined MU in July 2018 as Dean Academics. Prior to these he was a Professor of Physics for over 24 years since 1990 at the Indian Institute of Technology Delhi, during which he served as the Chairperson of the Physics Department (September 2008-December 2011) and Head of the Computer Services Centre (September 2003-August 2006). Bishnu Pal has been deeply involved in Guided Wave Optics and Photonics education since its nascent days in mid-1975s. He had played a key role in establishing and running the highly successful interdisciplinary M.Tech and research program on Optoelectronics & Optical Communication and a teaching cum research Laboratory in fiber Optics @ IIT Delhi in early 1980s.

Prof. Pal has edited several books published by Elsevier/Academic Press, John Wiley, Intech, New Age, and Viva publishers. Select chapters from his books (including ones authored by him) and one of his published research papers in Electronics Letters (IEE) have been reprinted in standard reference books on optical communication. His e-book Frontiers in Guided Wave Optics and Optoelectronics (2010) published by IntechOpen has seen heavy downloads according to the publisher (over 148,100 to date and his own authored chapter over 9800). He has also contributed over 15 chapters. He has extensively contributed to sponsored research and industrial consultancy, especially several international collaborative research projects that involved France, UK, USA, and Russia. His research areas have been Guided Wave Photonics and Optical Communication that broadly encompasses application-specific specialty optical fibers e.g. for dispersion management, large mode area fibers and fibers for DWDM transmission; All-fiber components and devices as branching components for optical communication networks; designs of new generation microstructured optical fibers for super continuum light, metro optical networks, and mid-infrared photonics; optical fiber sensors; guided wave components based on silicon photonics; all-fiber THz generation and transmission, and Anderson type localization of light in disordered optical waveguide lattices.

DR. SUDDHASATWA CHAKRABORTY

(ASSOCIATE PROFESSOR- ELECTRICAL ENGINEERING; IN-CHARGE, ILLUMINATION ENGINEERING LABORATORY, ILLUMINATION ENGINEERING SECTION, ELECTRICAL ENGINEERING DEPARTMENT, JADAVPUR UNIVERSITY)

Dr. Chakraborty passed his Ph.D(Engineering) , Electrical Engineering Department from Jadavpur University, M.E in Illumination Engineering (Electrical Engineering) and topped with Gold Medal from Electrical Engineering Department, Jadavpur University . He Graduated in Electrical Engineering and stood third in the order of merit from University of Kalyani. He is the member of Professional body: **Division Associate- Division -4: International Commission on Illumination (CIE) on behalf of India.**

His work experience includes:

1. **Division Associate- Division -4: International Commission on Illumination (CIE)**
2. **General Secretary, Indian Society of Lighting Engineers (ISLE), Calcutta State Centre**
3. Chairman of the panel (P/4) of Lamps and Related Equipment Committee, Bureau of Indian Standard (BIS) for revising IS 1944: Code of Practice for Lighting of Public Thoroughfare.
4. Member of the Electro-Technical Committee, ETD-23, Bureau of Indian Standard (BIS)
5. Member of the Electro-Technical Committee, ETD-49, Bureau of Indian Standard (BIS)
6. **Visiting Scientist** in Chair of Lighting Technology, Department of Energy & Automation Technology, **Technical University of Berlin (TUB)**, Germany in a collaborative research project entitled "**Contrast threshold with marking light in road lighting.**"

Some of his research interest are EEG Signal analysis to measure the human perception under Road Lighting installation, Human Factors in Lighting, A Novel Approach to Identify The Effect of Lamp Spectrum on Emotion for Theatrical Performance Process biasing in Road Lighting Design, Road Lighting Classification & formulation of New Standards for Road Lighting in Indian Scenario

Present Research Work deals with "Human Factors in Lighting.", "Effect of Road Way surface materials on selecting a light source for Road Lighting design", "Survey

on Road Lighting status in metro cities like Kolkata in India and hence provide a good optimization of Road Lighting solutions. The optimization of Road Lighting by using Optimization Techniques", "Optimization of Different Road Lighting Parameters" "Studies on Road Lighting Control", "Energy Efficient Road Lighting System Design", "Selection of Proper Light Source for Road Lighting", "Development of computer Program for Utilization Curve for Road Lighting Luminaire", "Energy Classification of Road Lighting System in Indian Scenario"

Notable Achievements

– Engaged in Collaborative Research in Department of Energy & Automation Technology , Chair of Lighting Technology, Technical University of Berlin, Germany as "Visiting Scientist" since July 2016

– Was invited in CIE Division-4 annual meeting at Technical University of Berlin, 22nd-23rd May 2018, Germany

– Division Associate- Division -4 : International Commission on Illumination (CIE) on behalf of India

– Suddhasatwa Chakraborty was appointed as subject expert for the technical evaluation process of the tenders received and monitoring progress of infrastructure works for the Refurbishment and LEDfication of Flood Lighting at Eden Gardens, Kolkata under the Cricket Association of Bengal (CAB) in 2021.

DR. SUBHASRI CHATTERJEE

(TCS, KOLKATA)

Subhasri Chatterjee is a scientific researcher in the field of Optics & Photonics. She pursued her doctoral and post-doctoral studies from the City, University of London, UK where she worked with different academic and industrial collaborators to develop light-matter interaction-based models with specific interest in biomedical sensing. She has expertise in the fields of optical spectroscopy, physics-based modelling, nano-plasmonics, optical characterization of biomarkers (for pre-cancer detection, sepsis detection, hemodynamic monitoring etc.) and so forth. Currently, she is working as a Senior Scientist at the TCS Innovation lab in Kolkata where she is involved in the design and development of novel sensors for various applications.

DR. VARUN RAGHUNATHAN

(PROFESSOR, IISc Bangalore)

Dr. Varun is currently working as an Associate Professor in the Electrical Communications Engineering (ECE) department at Indian Institute of Science (IISc), Bangalore since June 2022. He did my MS and Ph. D at University of California Los Angles, Electrical Engineering department from 2002-2008 under the guidance of Professor Bahram Jalali in the area of silicon photonics and building active photonic devices in silicon using Raman nonlinear optical processes He completed his BE from Birla Institute of Technology and Science, Pilani in 2002. His areas of interest are in nonlinear optics, integrated micro- and nano-photonic devices and nonlinear optical microscopy. He was an Assistant Professor at IISc from 2016-2022. Before joining IISc, he was working as a research scientist at Agilent Research Labs, Santa Clara, CA, USA from 2012-2016 in the area of biomedical imaging for cancer diagnostics and its clinical translation. I did my postdoctoral training under Professor Eric Potma at University of California Irvine, Chemistry department in the area of nonlinear optical microscopy with the focus on developing novel techniques for resolution and sensitivity improvement.

DR. KAUSIK MAJUMDAR

(PROFESSOR , IISc Bangalore)

Kausik holds a Ph.D. in Electrical Communication Engineering from Indian Institute of Science (2007 – 2011), an M.Tech. in Optoelectronics and Optical Communication from Indian Institute of Technology Delhi (2003-2005) and a B.E. in Electronics and Tele-Communication Engineering from Jadavpur University (1999-2003). Before joining as an Assistant Professor at the Department of Electrical Communication Engineering in Indian Institute of Science in January 2015, Kausik was working as an Emerging Technology Research Scientist at SEMATECH, Albany, USA (2011 – 2014). Earlier, he worked as a Product Engineer at Magma Design Automation, Bangalore, India, (July 2005 – Dec 2006).

Research overview:

Kausik leads the Quantum Electronics Laboratory at the ECE department in IISc. His research group uses a combination of theoretical and experimental techniques to investigate the electrical and optoelectronic properties of low dimensional materials and their nanostructures. The research group is also equally interested in applying these fascinating properties to develop novel devices, encompassing the entire spectrum of device design and simulation, device fabrication using state of the art semiconductor fabrication techniques, and device characterization using various electrical, optical and spectroscopic techniques.

His expertise includes Semiconductor Device Physics, Nanoelectronic and Optoelectronic Devices, Light Matter Interaction at Nanoscale, Quantum Technologies.

KEYNOTE SPEECHES

Enabling the Future: Integrating Photonics and AI for Advanced Sensing Applications

Subhasri Chatterjee

TCS, Kolkata

ABSTRACT

Recent developments in scientific research have focused on the transformative synergy between photonics and artificial intelligence towards innovative and sensing technologies. By amalgamating photonics and AI algorithms, novel applications in healthcare, environmental monitoring, and autonomous systems emerge. This convergence enhances sensing capabilities, enabling real-time data analysis, improved accuracy, and enhanced decision-making. The talk discusses key advancements, challenges, and future prospects, emphasizing the potential for societal impact and technological innovation.

Silicon Photonics: A Versatile Platform for Guided Wave Sensors and Passive Components

Babita Kumari,[1] R. K. Varshney,[1] and *Bishnu Pal*[2,*]
[1]Physics Department IIT Delhi
[2]École Centrale School of Engineering
Mahindra University Hyderabad
[*]Formerly with IIT Delhi; email: bishnu.pal@mahindrauniversity.edu.in

ABSTRACT

Silicon photonics in recent years has emerged as a versatile CMOS technology platform, which allows low foot-prints, low cost, and low power consumption for integrating nano-scale optical waveguide-based network branching components and sensors with micro-electronics components in a shared silicon platform. It holds numerous promises by combining best of both the silicon and the photonics technologies. Silicon photonics is a promising technology for large data centers as it can provide low-cost, high volume efficient network branching components and low power consumption. Silicon is an abundant and relatively inexpensive material and hence silicon-based sensors and components should be cheap to produce in mass volumes through the matured CMOS technology. Its high refractive index contrast enables strong light confinement and very small bend radius ~ 2 μm, an attractive feature for densely populated opto-electronic integrated circuits (OEICs). Silicon is transparent in the wavelength regime of 1.1 ~ 7 μm. Several compact optical components and devices such as, modulator, hybrid-laser, detector, coupler, resonator, switch, filter etc. have already been reported. Silicon waveguide (WG)-based sensors have been realized for biomedical and environment sensing. Sensitivity of such WG sensors relies on the accessibility of the evanescent field fraction in the sensing region, which in turn amounts to magnitude of power confinement parameter (Γ) in the low index cladding region of a WG. Among variousWG geometries, slot WG yields maximum value of Γ in recent times, we have studied several slot geometries as gas sensors in their molecular fingerprint near IR-wavelength regime. Due to large r.i. contrast, Si-based devices/components exhibit strong polarization dependence, which is often a challenge in their practical utilization. To mitigate this challenge, we have designed polarization splitters (PS) and polarization rotators (PR)/converters (PC) to realize polarization-independent operation in Si photonics integrated circuits by designing suitable architectures for integration in silicon photonics OEICs. In this talk, depending on time availability, we will dwell on some of the above – mentioned Si photonics-based sensors and components.

Nanophotonics in Sensing and Imaging

Nikhil Ranjan Das
Institute of Radio Physics and Electronics
University of Calcutta

ABSTRACT

Photonics is emerging as the technology of future, and is expected to replace the existing semiconductor electronics in many areas. Nanophotonics brings in extra advantageous features that were hard to achieve using conventional photonics. In this talk, various scopes and applications will be discussed indicating the role of nanophotonics. Nanophotonics using semiconductor quantum structures, photonic crystals and plasmonics will be mentioned after discussing their principles of working. A special focus will be given on how nanophotonics is useful in sensing and imaging applications.

On-chip single photon emission and detection using layered materials

Kausik Majumdar
Associate Professor
Department of Electrical Communication Engineering
Indian Institute of Science
Bangalore 560 012, India

ABSTRACT

Van der Waals heterojunctions allow us to manipulate electrons at the atomic scale. In this talk, I shall discuss the promise of such heterojunctions towards on-chip quantum device applications. Specifically, I shall discuss about two recent developments from our lab, namely, (a) a high emission-rate (> 10 MHz) single photon source with good single photon purity, and (b) a room-temperature single photon detector @1550 nm with efficiency >20%.

Building intelligent indoor optical wireless communication systems

Varun Raghunathan
Associate Professor
Electrical Communication Engineering (ECE)
Indian Institute of Science (IISc)
Bangalore, Karnataka 560012
India

ABSTRACT

Indoor optical wireless communication is seen as a promising access technology for next generation heterogenous wireless communication for 6G and beyond. With the increase in carrier frequency from RF/ microwave to optical range, the instantaneous bandwidth available grows significantly with beams having narrow beam spread and more directivity. Such kind of narrow pencil beam communication links benefit a lot by incorporating suitable intelligence in the form of sensing and steering to cater to multiple mobile users. In this talk I will discuss the two important ingredients which add intelligence to the optical wireless link viz. beam steering and user position sensing. I will show examples of how such functionalities are incorporated in an optical link to support mobility of users while maintaining high data throughput. Such sub-systems become key enablers for realizing optical reconfigurable intelligent surfaces (o-RIS) with enhanced functionality.

ABSTRACT OF ACCEPTED PAPERS

AN INTEGRATED AI DOCTOR ASSISTANT BOT WITH FACIAL EMOTION RECOGNITION AND SMART MEDICATION DISPENSING FOR ENHANCED PATIENT CARE

Souptik Roy[1], Sneha Roy[1],Kheya Bharadwaj[1],Nivedita Saha[1],Soumyajit Ghosh[1], Maumita Das[1],Shreya Nag[1]

[1]Department of Electronics and Communication Engineering, Institute of Engineering and Management, Newtown Campus, University of Engineering and Management, University Area, Action, Area III, B/5, Newtown, Kolkata, India.

Abstract. The healthcare sector consistently faces challenges due to the shortage of adequately trained medical personnel for individualized patient care. This study presents a multifunctional biomedical assistant bot to address the persistent shortage of healthcare personnel. The proposed system combines obstacle-avoiding mobility, emotion recognition through facial expression analysis, and smart medicine dispensing. By catering to patients' physical and emotional needs while assisting healthcare providers, this bot aims to enhance patient care quality, improve resource allocation, and facilitate comprehensive health monitoring in clinical settings.

Keywords: Artificial intelligence, convolution, neural network, emotion recognition, healthcare automation, patient monitoring.

TEMPERATURE DEPENDENT FAN SPEED CONTROLLER UTILISING INFRARED SENSING

Jeet Naskar[1], Sayan Ghosh[1], Pretty Ghosh[1], Rupayan Saha[1], Shreya Nag[1]

[1]Department of Electronics and Communication Engineering, Institute of Engineering and Management, Newtown Campus, University of Engineering and Management, University Area, Action, Area III, B/5, Newtown, Kolkata, India.

Abstract. This study introduces a novel approach todevelop a low budget and easy to use temperature based fan speed controller for induction fans. An infrared based temperature sensor(MLX90614ES) has been used to monitor the temperature of the room and an ATMega8A microcontroller has been used to monitor and processes the temperature data to generate a corresponding PWM signal. This PWM signal is feed into a Triac (BTA12) to control fan speed by limiting power. A Zero Cross Detection (ZCD) method has been used to provide flexibility. An Optocoupler based driver has been used to drive the Triac and also used to isolate high voltage side from low voltage side. A LCD display has been used to display real time temperature value.

Keywords: —*IR temperature sensing, PWM signal, Triac, Zero Cross Detection, Optocoupler.*

IR REMOTE CONTROLLED 16-CHANNEL SWITCH PANEL FOR HOME AUTOMATION

Jeet Naskar[1], *Arnab Kumar Das*[1], *Srijita Sarkar*[1], *Shreya Nag*[1], *Mandar Chakrabarti*[1]

[1]Department of Electronics and Communication Engineering, Institute of Engineering and Management, Newtown Campus, University of Engineering and Management, University Area, Action, Area III, B/5, Newtown, Kolkata, India.

Abstract. This study introduced a unique approach to developing a low-budget and easy-to-use wireless switch panel for home automation. A TV remote has been employed to control the switch panel. A 16-channel, 5- volt relay module has been used as a controllable switch. A HX1838 capacitive IR sensor has been used to detect the upcoming IR infrared data, and an AVR-based ATMega8A microcontroller has been used to decode and process the sensor's data and also to control the relay module. An LED panel has been incorporated to indicate the state of the attached load. The whole setup has been powered by an on-board mobile charger. The proposed circuit seems to produce a relatively faster output response.

Keywords: *IR data transfer, capacitive IR sensor, home automation, AVR.*

SMART AGRICULTURE SYSTEM

Mohammad Maaz[1], *Harsh Agarwal*[1], *Devraj Chauhan*[1], *Pratip Bera*[1], *Kaifuddin Sanpui*[1], *Ujjwal Raj*[1], *Maumita Das*[1], *Sudipta Ghosh*[1]

[1]Department of Electronics and Communication Engineering, University of Engineering and Management, University Area, Action, Area III, B/5, Newtown, Kolkata, India.

Abstract - This research paper presents a smart agriculture system that optimizes irrigation using soil moisture sensors, relay-controlled water pumps, and rainfall detectors controlled via a Raspberry Pi. The system automates water application based on soil moisture levels and adapts to rainfall, promoting efficient water use and sustainable farming practices.

Keywords—*Smart Agriculture, Embedded Systems, IOT, Sustainable farming, Irrigation Optimization, Raspberry Pi*

COMPARATIVE STUDY OF DUAL AXIS SUN TRACKERS FOR BETTER SOLAR PANEL EFFICIENCY

Jeet Naskar[1], Sayed Rahaman[1], Rohit Dey[1], Shreya Nag[1], Maumita das[1]

[1]Department of Electronics and Communication Engineering, University of Engineering and Management, University Area, Action, Area III, B/5, Newtown, Kolkata, India.

Abstract - This study introduces an easy and automatic way to increase the energy efficiency of solar panels. In this project, a dual-axis detachable sun training system has been developed to track the sun continually. In our proposed model, four LDR sensors have been used to continuously detect the position of the sun by comparing light intensity on different sides of the LDR's. As per the LDR signal, two servomotors have been integrated to move the solar panel, and an AVR-based microcontroller, ATMega8A, has been used as a processing unit for the LDRs and also to drive the servos accordingly. A heavy-duty plastic frame has been developed to hold all the components together, including the solar panel.

Keywords: *Solar panels, Sun tracking, LDR, Servo, AVR.*

DESIGN AND IMPLEMENTATION OF A SMART SAFETY BAG FOR WOMEN'S PROTECTION: A COMPREHENSIVE STUDY

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Abstract. Ensuring women's safety remains a critical societal concern, prompting the development of innovative safety devices tailored to their needs. This abstract explores various technological advancements aimed at enhancing women's safety in diverse settings. From compact personal alarms to discreet wearable gadgets equipped with GPS tracking, these devices provide immediate alerts and location data in distress situations. Moreover, smart applications integrate emergency contact notifications and real-time monitoring features, fostering a network of support for users. The evolution of such devices reflects a proactive approach to addressing safety concerns, empowering women to navigate public spaces with greater confidence and security. Challenges such as affordability, accessibility, and user acceptance underscore ongoing research and development efforts in this field. As technology continues to advance, the integration of artificial intelligence and machine learning promises further enhancements in predicting and preventing potential threats. Ultimately, the efficacy of these devices hinges on comprehensive user education and community engagement to foster a culture of safety and support for women worldwide.

Keywords: *Global Positioning System (GPS), General Packet Radio service (GPRS), Universal Asynchronous Receiver /Transmitter (UART)*

COMPARATIVE STUDY OF FRACTIONAL ORDER SERIES AND PARALLEL CASCADE CONTROL

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Abstract. This study presents a methodical design and comparison of the fractional-order parallel cascade controller (FOPCC) and fractional-order series cascade controller (FOSCC). There are two fractional order controllers in the planned both in FOPCC and FOSCC. For the primary loop and the secondary loop, separate fractional order controllers are used. In this study, we used fractional order PIDs to create a novel parallel cascade model and series cascade control model. To control realistic models with better output response, a novel parallel cascade control mechanism is required. The innovative structure offers improved solutions for first and second order systems in FOPCC with time delay. Fractional order differential equations can be used to express the fractional order controller. The theoretical foundation for deriving the controllers and analyzing the equations is provided by a number of fractional calculus laws. Using Smith Predictor in primary and secondary loops improves simulation results. Robustness, stability factors, and performance criteria through time response characteristics analysis have all undergone thorough evaluations. The ability to deliver a stable reaction to any process disruption is superior to the traditional series cascade controller compare to parallel cascade control. Examples are given to show how the recommended parallel cascade structure may be employed and how it performs better than the conventional series cascade control.

Keywords: *Parallel Cascade Controller; Frictional Order cascade control; Smith predictor, Series Cascade Controller.*

IoT BASED AGRICULTURAL SYSTEM FOR SMART FARMING

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Abstract. In the proposed model of Smart Agriculture/farming, five different smart features are created combining IoT technology, microntroller boards, electronic components, Bluetooth and WiFi modules which include smart irrigation, to manage proper watering of crops to increase crop quality. IoT based smart fire sensor are implemented to protect crops from fire damage, animal repellent to prevent animals and insects from eating away and damaging crops. Motorized Sunroof is used for shielding the crops from extreme solar radiation. Artificial Basking provides light to the crops in the absence of sunlight due to cloudy sky as light is important for photosynthesis.

Keyword: *IoT, sensors, Bluetooth, WiFi, motorized,artificial basking, smart agriculture*