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CURIN Research and Development News

CURIN
Chitkara University
Research & Innovation
Network

Volume 2022, Issue 4

R&D Activities During October - December 2022

COVER STORY

ICAN 2022 - 3rd Edition of the 'Chitkara University Flagship Engineering Conference' Organized with Technical Sponsorship from IEEE

Highlights

- The International Conference on Management Growth in Emerging Economies Organized by DRC, CBS
- Research Project Worth INR 80 Lacs from DRDO
- Questel IP Excellence Award 2022 for IP Ecosystem at Chitkara University
- 56 Patent Applications Filing and 72 Research Publications in a Quarter

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EXPLORE YOUR POTENTIAL

ICAN 2022 - 3rd Edition of the 'Chitkara University Flagship Engineering Conference' Organized with Technical Sponsorship from IEEE

Participation from 5 countries, 200 delegates attended ICAN 2022

By: Sagar Juneja – Assistant Dean, CURIN and Convener ICAN 2022

Third International Conference on Computing Analytics and Networks (ICAN 2022), which is one of the top engineering conferences of Chitkara University, was held during November 18 and 19, 2022 with technical sponsorship from IEEE. ICAN 2022 witnessed pan India participation as well as participation of authors from 5 different countries and was attended by 200 delegates in the physical and virtual modes combined. It featured 57 paper presentations and 8 invited & expert talks. The conference focused on the diverse applications in computing, analytics, and networks. Broadly, these application areas included Computing for IoT, Quantum Computing and Quantum Artificial Intelligence (AI), AI for Industrial Applications, Energy Systems and Smart Grid, AI for Remote Sensing and Geographic Information System (GIS), Sensor Networks, and UAV for Remote Monitoring of Environment, etc.

The inauguration ceremony of the conference commenced at 10:00 AM Indian Standard Time on November 18, 2022 and it was held at Chitkara University, Rajpura, Punjab, India. It was attended by a close to 75 conference delegates and over 50 students, research scholars, and academicians from Chitkara University. The inauguration ceremony was also streamed live on ZOOM platform. Mr. Sagar Juneja – Assistant Dean, CURIN, Chitkara University and the Convener of ICAN 2022 was the master of the ceremony who welcomed all the delegates and guests in his welcome address. The ceremony started with an inspiring video message by Dr. Madhu Chitkara – Pro-Chancellor, Chitkara University and Chief Patron, ICAN 2022. In her address, she encouraged the researchers to focus on the end applications to make their research more impactful and meaningful. She also highlighted how Chitkara University's focus on applied research for solving real world problems enabled our researchers in developing close to 40 technologies that are nearing commercialization. She also emphasized on the commitment of Chitkara University in conducting high quality conferences for the benefit

of the research community and she thanked IEEE Delhi Section for their continued support to Chitkara University conferences.

This was followed by an inaugural address by Dr. Archana Mantri – Vice Chancellor, Chitkara University, Punjab and General Chair, ICAN 2022. She highlighted the impact that we have been able to create with ICAN over the years and how the research ecosystem at Chitkara University is empowering us in conducting such top-quality conferences. She also made the conference delegates aware about some the latest research initiatives of Chitkara University. The inaugural ceremony featured two keynote talks by Dr. Neeraj Kumar - Professor (CSE), Thapar Institute of Engineering and Technology, Punjab and Dr. Manish Kumar – Assistant Professor (CSE), Punjab Engineering College, Chandigarh. Dr. Neeraj spoke on the topic of Digital Twins for Industrial Automation and the title of Dr. Manish's talk was Data Mining and Analysis of Indian Origin Academicians in Foreign Universities. The inaugural ceremony was concluded with a Vote of thanks that was proposed by Dr. Rajnish Sharma (Pro VC, Academic Affairs, Chitkara University, Punjab and Secretary, IEEE Delhi Section).

In addition to the two keynote talks that were held in the inaugural ceremony, six expert talks were conducted that were delivered by the leading researchers as well as professionals from different parts of the world. Four of these talks were conducted on Day 1 of the conference and two were conducted on Day 2. The details of these expert talks in chronological order are as follows:-

- **Dr. Pao-Ann Hsiung** - Dean, Information Technology Office and Professor, Department of Computer Science & Information Engineering, National Chung Cheng University, Taiwan delivered a talk, entitled Trustworthy AI for Sustainable Smart City Development. In this expert talk he discussed that sustainable smart city development requires not only the information and communication technologies, but also the AI technology that is trustworthy. Trustworthy AI involves not only the AI model robustness and accuracy, but also the fairness, security, and explainability. Through this talk, delegates learned how trustworthy AI can be used to achieve sustainable smartness in a city application, where sustainability is measured in terms of the SDG 11 KPIs as stipulated by the ITU under the United Nations.
- **Mr. Aswini Thota** - Principal Data Scientist, Bose Corporation, USA delivered a talk that was entitled Cold-Start Forecasting: A Deep Learning Approach. In this exciting talk, he discussed advanced models that can help with cold-start (new product introductions) supply chain demand forecasting. He talked about the model architecture, experimentation setup, and attributes that can help organizations to effectively model the new product introductions.
- **Dr. A.K. Sharma** - Principal Scientist, ICAR, NDRI, Karnal, Haryana spoke on the topic of Predicting Sorption Behavior in Edible Bionanocomposite Films with Machine Learning Algorithms. He talked about the biodegradable nanocomposite food packaging material developed using dairy residuals and using machine learning algorithms to predict sorption behavior of this material.
- **Dr. Jagreet Kaur Gill**- Director, Xenonstack Pvt. Ltd., Chandigarh spoke on the topic of User Behavior and Entity Analysis with Log Analytics. She presented a case study for the analysis of user behaviours based on their activities.
- **Dr. Aneek Adhya** - Assistant Professor, G.S Sanyal School of Telecommunication, IIT Kharagpur delivered his expert talk on Day 2 on the topic Use of Machine Learning in Communication Networks: Some Use Cases. He explained that machine learning can solve many complex problems in the communication networks that are becoming increasingly

dynamic and flexible. These problems could not be solved using traditional methods. He discussed some use cases, which are inherently difficult to solve using traditional methods.

- **Dr. Bonny Banerjee** - Associate Professor, Institute for Intelligent Systems, and Department of Electrical & Computer Engineering, The University of Memphis, USA delivered the final invited talk of the conference that was entitled Predictive Coding Agents. He presented a design and development of embodied agent models based on the predictive coding paradigm and how such an agent can learn to physically interact with another agent. The talk was based on the research work his group is carrying out for the last 10 years.

All the eight expert talks of ICAN 2022 were very exciting and insightful. These talks covered diverse applications and yet remained focused on the theme areas of the conference. The budding researchers who are on the path of building their research careers benefitted immensely from these talks as was inferred from the discussions that followed after each of these eight expert talks.

A total of 57 papers were accepted in the conference for presentation and inclusion in the proceedings. The review committee comprising of close to 250 experts reviewed the papers submitted to ICAN 2022. Each one of the 252 papers was reviewed by a minimum of two reviewers using a double blind review process, and based on the recommendations of the reviewers 57 papers were accepted in the conference.

Day 1 of the conference featured 18 paper presentations in a physical mode in two parallel tracks. The track chairs in Track 1 were Dr. A.K. Sharma (ICAR, NDRI, Karnal, Haryana) and Dr. S.N. Panda (Executive Director, Research, Chitkara University, Punjab). The track chairs in Track 2 were Dr. Jagreet Gill (Xenonstack Pvt. Ltd., Chandigarh) and Dr. Jagdish Raheja (Professor, Research, Chitkara University, Punjab).

Day 2 of the conference featured 39 paper presentation in six tracks. Three parallel tracks were held in the morning session and three were held in the afternoon session. The track chairs in each of these six tracks were – Track 3: Dr. Deepak Punetha (VIT, Chennai, Tamil Nadu, India) and Mr. Sagar Juneja (Chitkara University, Punjab, India); Track 4: Dr. T Ananth Kumar (IFET College of Engineering, Villupuram, Tamil Nadu, India) and Dr. Abhishek Kumar (Chitkara University, H.P., India); Track 5: Dr. Piyush Kumar Shukla (Rajiv Gandhi Proudyogiki Vishwavidyalaya, M.P., India) and Dr. Shalli Rani (Chitkara University, Punjab, India); Track 6: Dr. Rajandeep Singh (GNDU, Amritsar, Punjab, India) and Dr. Shivendu Prashar (Chitkara University H.P., India); Track 7: Dr. Surbhi Bhatia (King Faisal University, Saudi Arabia) and Dr. Abhishek Kumar (Chitkara University H.P., India); Track 8: Dr. Shalini Stalin (IIIT Bhopal, M.P., India) and Dr. Shalli Rani (Chitkara University, Punjab, India).

The papers were critically evaluated by the track chairs and based on their evaluations, one paper in each track was declared as the Best Paper. The proceedings of ICAN 2022 have already been published on IEEE Xplore and indexed in Scopus.

Forging Collaborations

CURIN faculty members met researchers/professionals from different organizations to build collaborations

- To explore the opportunities of working on industrial projects related to orthotics, Dr. Anoop Kumar Singh (Professor, CURIN) & Dr. Ankit Sharma (Assistant Professor, CURIN) visited Tynor Orthotics Pvt. Ltd., Mohali, India on November 2. Dr. P J Singh – CEO Tynor Orthotics Pvt. Ltd. explained about different projects in the domain and collaboration opportunities were explored.

  Dr. Anoop Kumar Singh, Dr. Ankit Sharma from CURIN and Dr. Abhineet Saini – Assistant Professor, Mechanical Engineering Department, Chitkara University attended a brainstorming meeting at the Biomedical Instruments & Devices Hub, PGIMER, Chandigarh with Dr. Uttam Saini (Orthopedics, PGIMER) to learn about the bone repair related issues and the role that they can play in solving various problems related to these issues. This meeting was held on November 25, 2022.

- Dr. Ankit Sharma – Assistant Professor, CURIN met with Prof (Dr.) Gursel Alici, Executive Dean, School of Mechanical, Materials, Mechatronics & Biomedical, University of Wollongong, Australia at The Lalit, Connaught Place, New Delhi, India to seek the opportunities of research collaborations. Prof. Gursel Alici is a renowned researcher with more than 13500+ Citations and he is handling several research projects across the globe.

- The use of Augmented Reality (AR) and Virtual Reality (VR) technology can provide valuable situational awareness to front-line soldiers prior to missions. A delegation led by Dr. Pinaki Roy Chowdahry, Additional Director at DRDO-DGRE, visited Chitkara University, Punjab on December 16, 2022 to explore collaboration opportunities in the domains of AR and VR. Dr. P.K. Khosla, Pro-VC, CURIN highlighted the university's strengths in various technological domains. Dr. Archana Mantri, Vice Chancellor, Chitkara University explained to the delegation how the university can collaborate with DRDO-DGRE to develop solutions using immersive technologies. During their visit, Dr. Bhanu Sharma

and Dr. Amanpreet Kaur – Assistant Professors (CURIN) showcased them the Immersive and Interactive Technology Lab (IITL) of CURIN.

- On December 22, a team from CURIN comprising Dr. Sudesh Mittal (Professor), Dr. K.R. Ramkumar (Associate Professor), Dr. Amanpreet Kaur (Assistant Professor) and Ms. Vaneeta Bhardhwaj visited IIT Ropar for a meeting regarding their ongoing DRDO funded project.
- Chitkara University has a MoU with CSIO Chandigarh to work on various research projects. In this context, a three member team led by Dr. Neelesh Kumar from Cognitive and Virtual Rehabilitation Lab, CSIO visited CURIN on December 23 to hold discussions on projects related to immersive technologies with Dr. Bhanu Sharma and Dr. Amanpreet Kaur – Assistant Professors, Immersive and Interactive Technology Lab, CURIN, Chitkara University.

Research@CURIN

Top Research Papers of the Quarter by CURIN (Published during October – December 2022)

Faculty members and research scholars from CURIN publish high-quality research articles in top peer-reviewed journals and conferences. In this section of the newsletter, we select high impact research papers from CURIN and attempt to discuss them in the form of short summaries.

The researcher papers discussed in this issue are the ones that were published during October – December 2022. The complete list of publications by CURIN faculty members and scholars during this period is available in a separate section.

Adult Speech Recognition for a Low-resource Language using Transfer Learning and Spectrogram Augmentation

By: Puneet Bawa – PhD Scholar, CURIN

This article is based on the research paper titled 'Transfer Learning through Perturbation based in-domain Spectrogram Augmentation for Adult Speech Recognition' published by Puneet Bawa from CURIN, Chitkara University, Punjab in Springer journal entitled Neural Computing and Applications.

Transfer learning and spectrogram augmentation are two methods that are discussed in this research paper as potential ways of enhancing the performance of adult speech recognition for low-resource Punjabi language. Spectrogram augmentation is a method that intentionally generates new spectrogram data from the current data in order to increase the performance of speech recognition systems. The variety of training data as well as the resilience of the low-resource system that has been utilized in conjunction with other data augmentation techniques has been improved with the help of this methodology.

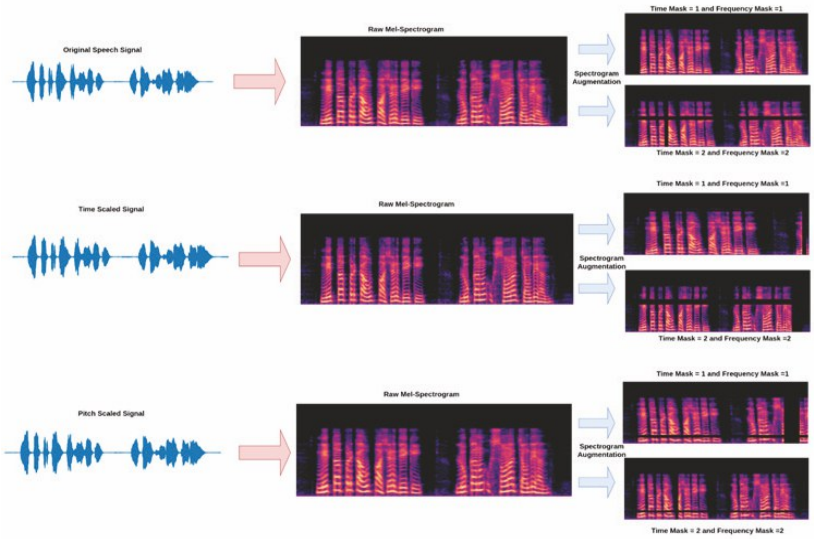


Illustration is borrowed from the published paper

Time scaling is one of the most prevalent data augmentation methods used in speech recognition which includes modifying the duration of the audio stream to assist the system in better managing various speaking rates. In order to provide extra data on the spectrogram that accurately depicts varying speaking rates, spectrogram augmentation has been used with time scaling in a number of recent studies. Another common data augmentation technique is adding noise to the audio signal while simultaneously augmenting the spectrogram. It allows the system to handle the real-world conditions such as background noise and microphone variability in a much better way. Frequency shifting is another augmentation approach, which involves altering the frequency of the audio input. It allows the system to handle a wide variety of dialects and speaking styles with more ease.

In order to provide extra spectrogram data that accurately portrays a variety of distinct speaking styles and accents, spectrogram augmentation has been utilized in combination with frequency shifting. In addition to these approaches,

spectrogram augmentation has also been utilized to produce fresh spectrogram data that reflects different microphone types and different environments. To strengthen the robustness of the speech recognition model, the approach includes introducing minor perturbations to the spectrogram representations of the audio input. However, the augmentations have been kept inside the same speech recognition domain. Therefore, the combination of the aforementioned data augmentation procedures makes it possible for the model to better generalize to speech data that it has not seen before and thus improves its recognition ability. Thereby enabling the acquired information to be translated into various languages with less resources, thus increasing the accuracy of the voice recognition system and decreasing the quantity of data and computer resources that are necessary for computation.

Transfer learning has proven capable of leveraging the large amounts of data used in training the pre-trained models to improve speech recognition performance on a low-resource language, even in situations where only limited amounts of annotated data are available. This is accomplished by fine-tuning pre-trained models on a small amount of in-domain data, which can be done using transfer learning. The performance of speech recognition systems can be significantly improved by utilizing spectrogram augmentation in conjunction with other data augmentation techniques. One of the primary advantages of spectrogram augmentation is that it can be easily implemented in pre-existing speech recognition systems, which is one of the key benefits of spectrogram augmentation. Because of this, it is a solution that is both effective and cost- efficient for boosting the performance of these systems without necessitating substantial modifications to the technology that is being used. In addition, one more advantage of spectrogram augmentation is that it may be used in conjunction with other methods of machine learning, such as deep learning, to further enhance the system's overall performance.

Graphene for Developing Energy Storage Devices

By: Deepam Goyal, Assistant Professor, CURIN

This article is based on the research paper titled 'Graphene: A Path-Breaking Discovery for Energy Storage and Sustainability' published by Dr. Deepam Goyal from CURIN, Chitkara University, Punjab in MDPI journal entitled Materials.

There has been a lot of emphasis on exploring sustainable and renewable forms of energy to meet the ever increasing energy demand. However, there has to be a strong focus on energy conservation as well. To transform the global energy sector a lot of innovative materials have been proposed by the researchers, with Graphene being one such material that has been at the forefront of energy industry as well as academic research since 2010. Due to its fascinating properties of high tensile strength, half-integer quantum Hall effect and excellent electrical/thermal conductivity, Graphene is one of the highly researched materials today. The discoverers of graphene, Prof. Andre Geim and Prof. Kostya Novoselov demonstrated repeatable synthesis of graphene for the first time through exfoliation, and this material came under the class of specialized nanomaterials. Graphene with a zero-band gap, has normally been grouped in the category of semi-metals with nano/microstructure, and is of extensive use in industry and one of the important use is developing and designing energy saving devices.

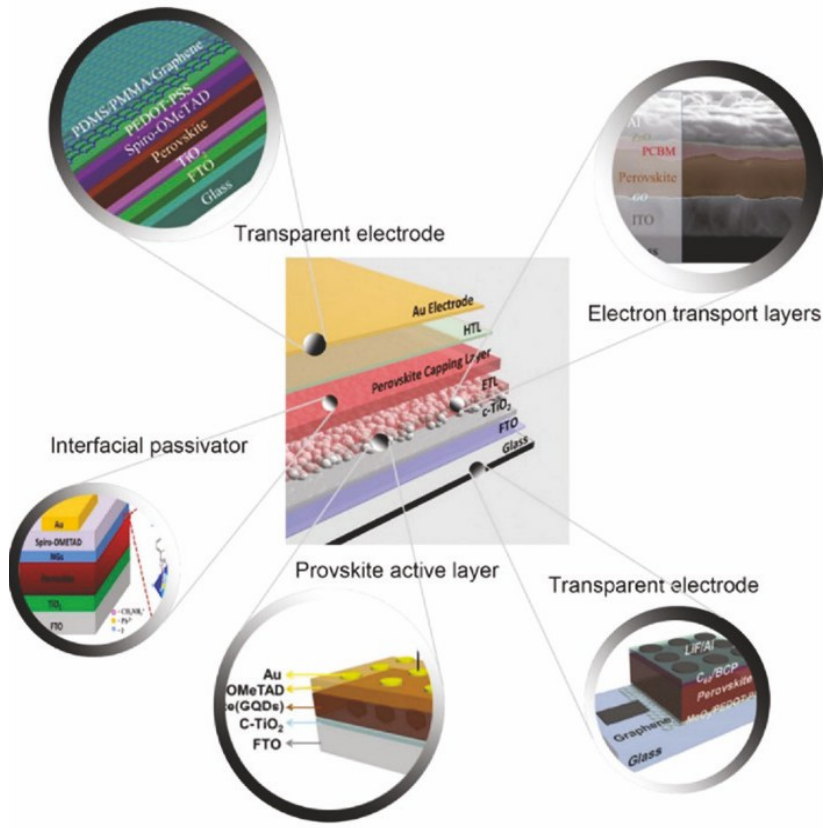


Illustration is borrowed from the published paper

This research article presents an in-depth review on the exploration of deploying diverse derivatives and morphologies of graphene in various energy-saving and environment friendly applications. This study will allow researchers in selecting the appropriate graphene derivative(s) and understanding compatibility with various materials to fabricate high-performance

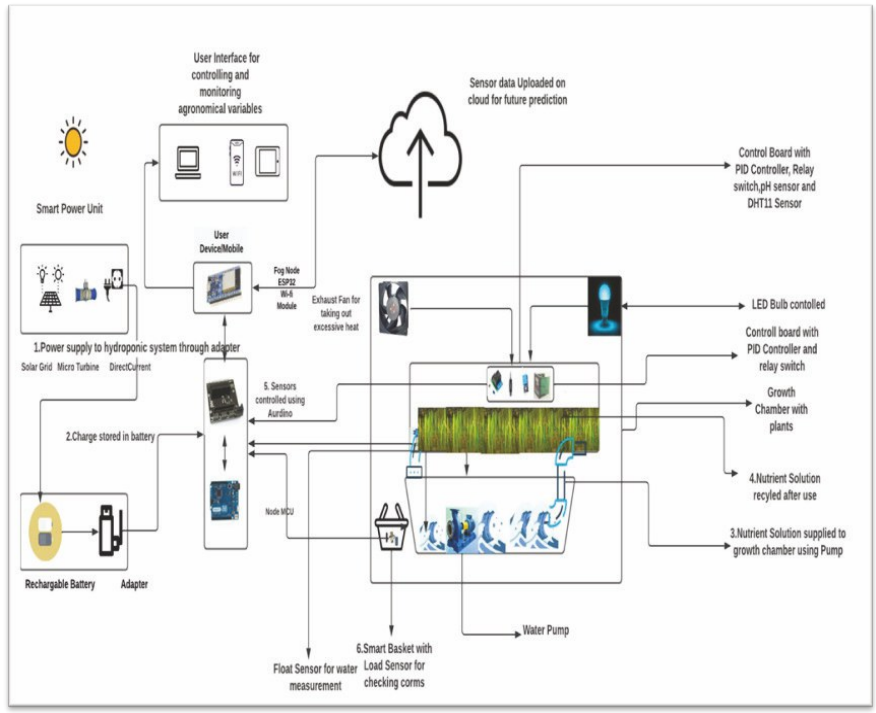
composites for usage in solar cells, fuel cells, super-capacitor applications, rechargeable batteries, automotive sectors, etc. Commercial usage of graphene is possible with economical production of graphene in different forms. Experimental investigations of graphene composite electrodes and membranes need to be carried out in order to check the long-term effects on the performance of batteries and fuel cells. There is a need to explore the use of graphene-based nano lubricants in hydrodynamic lubrication regime. When these key points are addressed, graphene can be effectively utilized as a potential energy-saving material.

Saffron Cultivation in IoT and Sensors based Environment – A Precision and Smart Agriculture Approach

By: Dr. Deepali Gupta, Professor, CURIN

This article is based on the research paper titled 'Monitoring Ambient Parameters in the IoT Precision Agriculture Scenario: An Approach to Sensor Selection and Hydroponic Saffron Cultivation', published by Ms. Kanwal Preet Kour and Dr. Deepali Gupta from CURIN, Chitkara University, Punjab, India in MDPI journal entitled Sensors.

Smart agriculture that can provide a smart artificial environment for the cultivation of crops is going to be of great importance to meet the increasing demand for more food production in the situation where land under cultivation is reducing due to the growing urbanization. IoT and sensors play a crucial role in optimizing the artificial cultivation of crops. In an automated artificial environment, the selection of sensors is important to ensure better quality and yield. However, there are many challenges associated with sensor selection due to a huge competitive market and ample number of vendors available. In this research article, authors have made an attempt to provide a novel approach for sensor selection for saffron cultivation in an IoT-based environment.



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The framework uses solar energy for the cultivation of saffron in a soilless medium by minimizing cost. The hydroponic technique used for water and nutrient uptake is Nutrient Film Technique enabling recycling of water. The components of the framework include dual power supply, plant growth chamber, smart corm weight basket, nutrient tank, interface, and cloud storage for data. Initially, the user selects the power supply mode and the minerals and nutrients in the tank are transported using pump to the growing plants as shown in this figure. Different agronomical variables like temperature, corm size, pH, mineral concentration, and electroconductivity of solution are analysed after short intervals by the deployed sensors. Data is stored on the cloud, which can be shared on real time basis on mobile and laptop interfaces and is used for predictive analysis.

The corms used for cultivation were chosen on the basis of weight (>8 g) to maintain quality standards for growth in hydroponic medium. The corms were treated with 0.2% of Tiabendazole and dried in shade for one day. After this, the corms were sown in the hydroponic system and are being constantly monitored for growth and control of agronomical variables.

Saffron is a crop of great economic importance due to its cost. The work can be expanded further on a large scale for increased saffron quality and yield by considering other important parameters like carbon emission.

U-NET and CNN based Image Processing Technique for Identifying Skin Lesion from Dermoscopy Images

By: Dr. Vatsala Anand – Assistant Professor, CURIN

This article is based on the research paper titled 'Fusion of U-Net and CNN Model for Segmentation and Classification of Skin Lesion from Dermoscopy Images' published by Dr. Vatsala Anand and Dr. Sheifali Gupta from CURIN, Chitkara University, Punjab in Elsevier journal entitled Expert Systems with Applications.

U-Net and CNN models have been integrated to propose a fusion model for segmenting and classifying skin lesions. The figure shows the research methodology for the proposed fusion model. In the first phase of the fusion model, the U-Net model is employed to extract the region of interest (ROI) from the diseased images. In the second phase, a CNN model has been proposed for the multi-class classification of segmented images obtained from the first phase of the fusion model.

In this work, HAM10000 dataset has been used that consists of a total of 10,015 dermoscopy images of skin. This dataset includes seven skin disease classes named Melanoma (MEL), Vascular Lesions (VASC), Benign Keratosis - Lesions (BKL), Dermatofibroma (DF), Melanocytic Nevi (NV), Basal Cell Carcinoma (BCC), and Actinic Keratoses (AKIEC).

In the first phase, U-Net architecture is used for the segmentation of skin disease. The U-Net architecture is modified in terms of feature map size. Initially, the size of input image is 600 * 450 * 3, that is resized to 192 * 256 * 3. The mask is generated from the modified U-Net architecture and the generated mask is multiplied by the resized image to obtain the segmented image. For better classification accuracy, images with segmented ROI are used for classification. After that, these segmented images will be provided as input to the CNN based architecture for classification.

In the second phase of the fusion model, a CNN-based architecture has been proposed to classify the multi-class skin diseases using segmented images obtained from the first phase. The segmented image from the last step is provided as input to the proposed CNN model for better classification accuracy. The problem with images without segmentation is that the image includes all the outside backgrounds, borders of the lesion, and skin texture. Due to this, unwanted features are also extracted from background regions as well. As a solution, the ROI can be segmented from the original image so that only important features from the lesion section can be recovered.

The proposed model is simulated using Adam and Adadelta optimizer with a batch size values of 32 and 20 epochs. The model has outperformed on Adadelta optimizer with an accuracy value of 97.96%. The proposed fusion model can be assisted by dermatologists as a second opinion tool for the diagnosis and treatment of various skin lesions. The proposed approach is validated for the skin. This approach can be generalized by using different biomedical images.

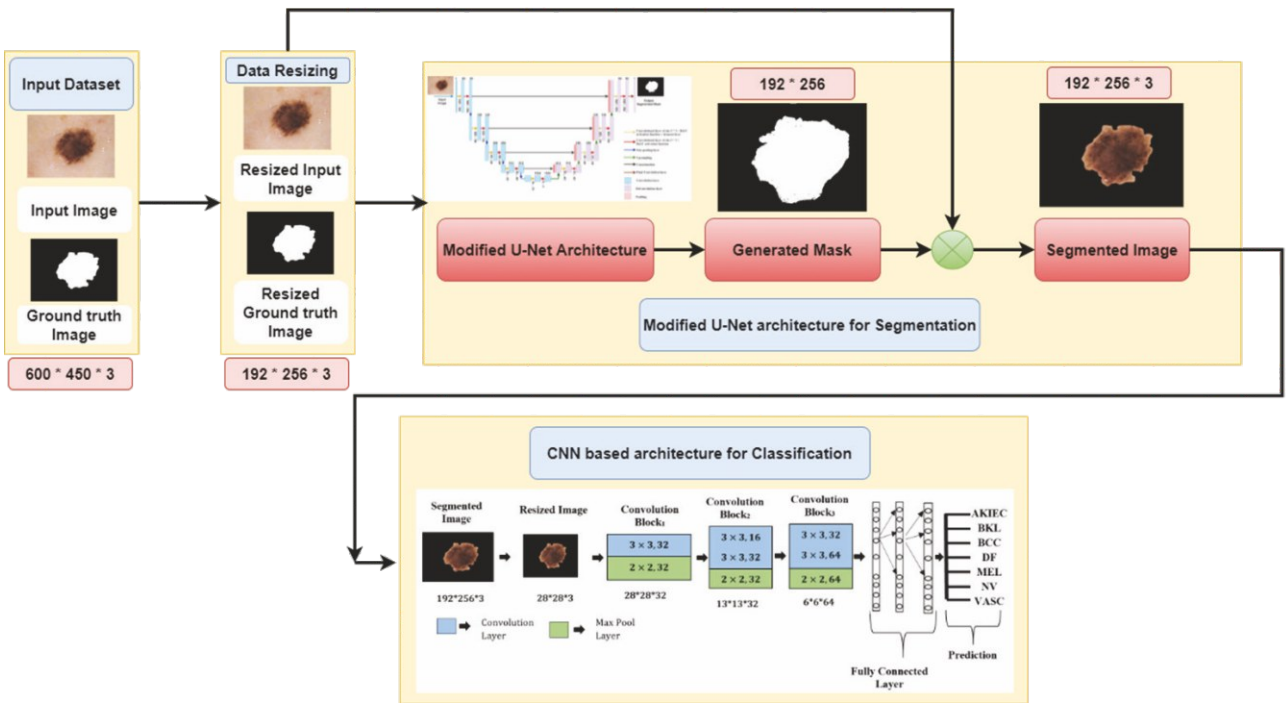


Illustration is borrowed from the published paper

Activities in Schools under the GoI Funded STEM Project

21 Activities (Seminars and Tutorials) Conducted in the 4th Quarter

Chitkara University has the Department of Science and Technology (DST), GoI sponsored project from National Council for Science and Technology Communication (NCSTC) division for Science, Technology, Engineering and Mathematics (STEM) promotions in schools to incline school students toward STEM. Dr. Archana Mantri – VC, Chitkara University, Punjab and Mr. Sagar Juneja – Assistant Dean, CURIN are the PI and Co-PI of this two year project, respectively.

During October – December 2022, we did a lot of activities in different schools under our STEM project. In most of these activities, faculty members from Chitkara University served as resource persons. The details of these activities are presented here.

- On October 10, a seminar at AC National Public Senior Secondary School, Zirakpur was delivered by Dr. Satyam K. Agrawal – Professor, CURIN. His talk was titled "Interesting Concepts of Science" and it was attended by students from classes 8 to 12. In the same school, two more seminars were held on October 11, that were delivered by Dr. Mohit K Kakkar (Assistant Dean, Department of Applied Sciences) and Dr. Arun Upmanyu (Professor, CURIN) from Chitkara University. Their respective topics were, "Applications of Mathematics in Real World" and "What Role do Science and Technology Play in Solving Societal Problems?"

- On October 12, two seminars were held at St. Soldier Paradise Public School, Dhakoli for the students of classes 8 to 12. One of the seminars was delivered by Dr. Reetu Malhotra (Professor, Applied Sciences, Chitkara University) on the topic "Fascinating Concepts of Maths with Examples of Practical Applications" and the second one was delivered by Dr. Pooja Mahajan (Associate Professor, Applied Sciences, Chitkara University) on the topic "Technological Development in the Field of Renewable Energy". The third seminar was delivered in the same school by Dr. Arun Upmanyu (Professor, CURIN) on October 14.



- During October 20 and 21, two tutorial sessions were organized at Adharshila Foundation The International School, Rajpura under our STEM project. The first tutorial was on the topic "Ideation to Prototyping", wherein students learned the concept of building prototypes of their ideas and about the fascinating technology of 3D printing. They witnessed the live 3D printer demo in this session, which was delivered by Mr. Chanpreet Singh – Project Manager, CURIN. The second tutorial that was titled "Advantages of Inculcation of Disruptive Technologies in Science and Mathematics Education" introduced students to technologies like Augmented Reality, Virtual Reality, Metaverse, Blockchain, etc. It was delivered by Dr. Amanpreet Kaur and Dr. Bhanu Sharma - Assistant Professors, CURIN.



- On November 1, Mr. Chanpreet Singh (Project Manager, CURIN) delivered a tutorial on the topic "Prototyping and its Needs" at St. Soldier Paradise Public School, Dhakoli. The students learned about idea generation from the scratch and how to convert those ideas into useful prototypes, especially with 3D printing technology. There were about 40 students from classes 8 to 10 who attended this tutorial and did hands-on activities using the 3D printer.
- On November 3, Dr. Neha Tuli (Assistant Professor, CURIN) and Mr. Shivam Sharma (Project Manager, CURIN) conducted a tutorial at AC National Public Sr. Sec. School, Zirakpur on the topic "Latest

Technological Developments (Augmented Reality, Virtual Reality)". In this tutorial, they gave insights into AR/VR technologies to school students & also demonstrated AR-based science projects.

- On November 4, Dr. Payal Sachdeva, Dr. Akhilesh Kumar (Assistant Professors) & Mr. Girish Chauhan (Lab Instructor), Department of Civil Engineering, Chitkara University visited Angels Valley School, Rajpura and they conducted a tutorial on the topic "Application of Basic Science, Technology and Mathematics in Civil Engineering". In this tutorial, they gave insights into various materials and units of measurement used in civil engineering and their applications. They also demonstrated some equipment used in civil engineering to students as well. There were around 90 students and 5 staff members who actively participated in this session.
- On November 9, Dr. Amanpreet Kaur from Chitkara University visited AC National Public Sen. Sec. School, Zirakpur to conduct a tutorial on the topic "A Road Map to Pioneer Technologies: AR, VR, MR, Metaverse, Block Chain, IoT, Artificial Intelligence". She introduced students to these fascinating technological buzz-words of today.
- On November 10, we invited Ms. Reena Chadha (General Manager, IPCA) who is an expert from industry to conduct one tutorial under our STEM project. This tutorial was conducted at Baby Convent School, Banur and it was titled "Role of School Children in Segregation, Management of Plastic Waste and Entrepreneurship in Solid Waste Management". Around 80 students and 3 staff members actively participated in the session.
- On November 21, two seminars were conducted in Delhi Public School, Rajpura that were attended by students of classes 8, 9, and 11. One each of these seminars were delivered by Dr. Amanpreet Kaur and Dr. Pooja Mahajan. Dr. Amanpreet delivered a talk on the topic "New Realities and their Amalgamation in Science and Mathematics Education" and Dr. Pooja talked about "Emerging Sustainable Technologies". On November 22, Dr. Varsha Singh (Assistant Professor-Centre for Life Sciences, CURIN) delivered a talk that was titled "Fascinating Concepts of Science, Maths, Engineering, and Technology". Around 80 students attended this session. On December 20, Mr. Chanpreet Singh conducted a tutorial on the topic "5 Phases of Design Thinking Process" in the same school, wherein he gave hands-on exposure to the students on 3D printing technology. This session was attended by 60 students.



- On December 5, Mr. Sagar Juneja - Assistant Dean, CURIN and Co-PI of this GoI funded STEM project visited two schools, St. Attri Public Sen. Sec. School, Lalru, Mandi & The Gurukul, Zirakpur for conducting the Teachers' Orientation Session to induct them under this project. Similarly, on December 9, he visited two more schools with the same objective. These schools were The Humming Birds School, Rajpura & Mukat Public School, Rajpura.

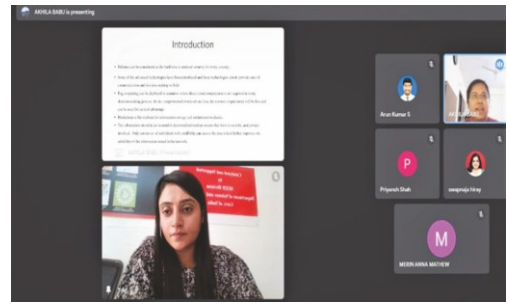



CURIN Faculty Members as Resource Persons

Invited Speakers, Trainers, Session Chairs, etc.

- On October 6, Dr. Rakesh Goyal chaired a paper presentations session titled Engineering Materials and Manufacturing Technology in the International Conference on Advances in Materials and Manufacturing Technology. On November 25, he delivered an expert talk entitled Thermal Spray Technology and Engineering Standards in the Industry at CT University, Ludhiana. His talk was attended by close to 50 faculty members, students and research scholars.

- On October 7, Dr. Bhanu Sharma - Assistant Professor, Immersive and Interactive Technology Lab (IITL), CURIN delivered an expert talk on Emerging Technologies & Innovations at the Government Polytechnic College, Ambala City. More than 80 students explored the innovative technologies like Augmented Reality, Virtual Reality, Mixed Reality, Metaverse, Blockchain, IoT, Cyber Security in this session. On October 8, she delivered an expert talk titled Trailblazing and Imminent Contrivances in Technology to 20+ faculty members of Guru Tegh Bahadur Institute of Technology, New Delhi.

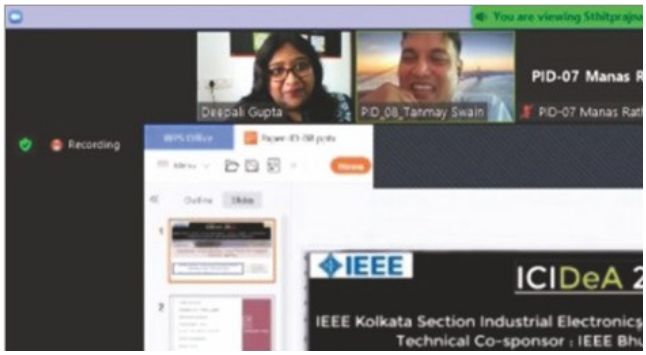


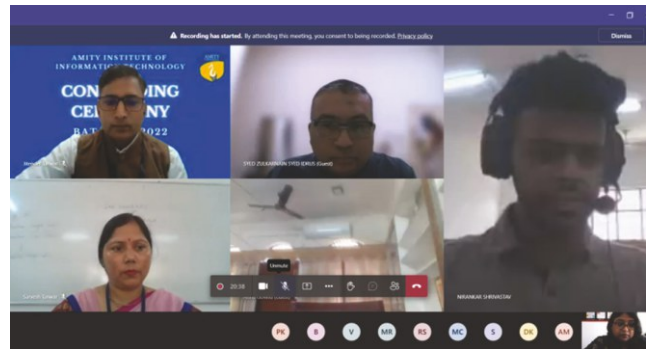
- Dr. Deepali Gupta - Professor, CURIN chaired paper presentation sessions in two conferences namely International Conference on Reliability, Infocom Technologies, and Optimization (ICRITO-2022) organized by Amity University, Noida on October 14 and IEEE International Conference on Industrial Electronics: Developments & Applications (ICIDeA-2022) on October 15, which was organized by the IEEE Kolkata Section Industrial Electronics Society Chapter - Bhubaneswar. In ICIDeA-2022, Dr. Mudita – Assistant Professor, CURIN also chaired one session.

Dr. Mudita received the Best Thesis Award in the IEEE International Conference on Current Developments in Engineering and Technology (CCET) held during December 23-24, 2022 at Sage University, Bhopal, Madhya Pradesh, India for her PhD thesis titled Fault Prediction Recommender Model for IoT Enabled Office. She has received a certificate, trophy, and a cash prize of Rs. 5,000/-

Dr. Deepali participated in the International Conference on Applied Data Science and Smart Systems (ADSSS-2022) organized by Chitkara University during November 4-5, 2022.

Dr. Deepali Gupta, Dr. Mudita, Dr. Ramneet, and Ms. Monica Dutta attended a two-day faculty development program on Adoption of NEP Modules in Academic Curriculum, that was organized by the Department of Computer Science and Engineering on November 30 and December 1. They also attended another FDP on Increase Your Innovation Quotient and Initiate a Start-up Venture during December 22-23 organized by the same department.



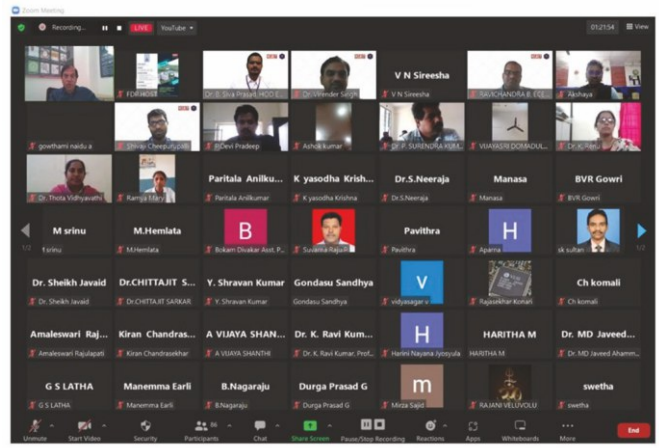


- Sagar Juneja – Assistant Dean, CURIN presented two papers titled 1) Planar Endfire Multibeam Antenna Implementation for Millimeter Wave 5G Applications using a Passive Beam Switching Network and 2) Study of Two Design Variations of an Antipodal Vivaldi Antenna Working at 28 GHz Millimeter Wave Frequency for 5G Applications at the 2nd IEEE Mysore Sub Section International Conference (MysuruCon) held during October 16-17, 2022. For the former paper he received the Best Paper Award.

  He presented two more papers in another conference entitled 2022 IEEE International Conference of Electron Devices Society Kolkata Chapter (EDKCON) held during November 26-27, 2022. The papers were titled 3) Design of a Highly Directive, Wideband and Compact Endfire Antenna Array for 5G Applications and 4) Design of a Passive Beamforming Circuit with -37.5 dB Return Loss and -42 dB Isolation Loss for a Multibeam Antenna in 5G Applications. All four papers were related to his PhD work which is pursuing under the guidance of Dr. Rajnish Sharma – Pro-VC, Academic Affairs, Chitkara University, Punjab and Dr. Rajendra Pratap – Technology Head, Arrow Electronics Inc., Noida.

- India has a 13.76% prevalence of visual impairment among its population. To address this issue, Dr. P.K. Khosla – Pro-VC, CURIN believes that artificial intelligence-powered diagnoses of chronic eye diseases can provide a solution. He emphasized the benefits technology brings to millions of patients, citing the National Telemedicine Service, eSanjeevani, as an example. It has served nearly 80 million patients. This discussion took place during the three-day Faculty Development Program at NS Raju Institute of Technology in Andhra Pradesh that focused on Emerging Trends in Electronics and Computer Engineering. The program was attended by 180 participants, including Dr. N. Prasada Raju, Secretary of NSRIT, Shri N. Kanak Raju, Treasurer of NSRIT, and Dr. J. Raja Murugadoss, Director of NSRIT. Dr. Khosla was invited to deliver the inaugural address on Innovations in Healthcare Technologies on October 27.

  On November 21, Dr. Khosla was invited to deliver a talk at the 10th International Workshop on Soft Computing Applications, Romania. He discussed a plethora of applications of soft computing including facial, speech and handwriting recognition, data mining, robotics, and control systems, etc. He also emphasized

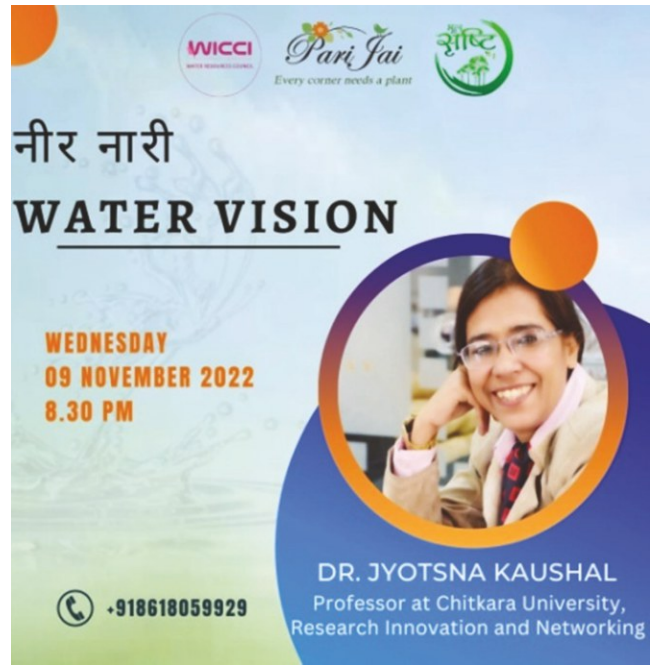


on telemedicine and challenges associated with scaling of telemedicine across the globe.

Dr. P.K. Khosla – Pro-VC, CURIN was invited to deliver a lecture on 5G: Into the New Generation of Global Connectivity at the National Institute of Technology (NIT), Kurukshetra on December 3, 2022. He highlighted how the faster and more reliable 5G network will usher in the new era of mobile connectivity. The advent of 5G technology promises to bring a multitude of new applications with limitless potential. Wearable devices with artificial intelligence and extended reality, seamless media transitions, and voice over IP services will all greatly benefit from this cutting-edge technology. Currently, there is a technological race between the United States and China to become the dominant power in 5G, with China appearing to have the upper hand. India, with its massive subscriber base, is also rapidly catching up.

- Dr. Shalli Rani – Professor, CURIN delivered an expert talk on Enabling Technologies: Internet of Things on November 4 at CT University, Ludhiana. She discussed and shared knowledge on the role of quantum computing, AI, NDN , SDN, etc. in IoT. More than 100 students participated in this session.

  Dr. Shalli chaired a paper presentations session in the 4th International Conference on Information Management & Machine Intelligence held at Poornima Institute of Engineering & Technology, Jaipur, India on December 24, 2022. 12 papers were presented on machine learning, healthcare, EEG signals, WSN, IoT, etc. in her track.



- On November 9, Dr. Jyotsna Kaushal - Professor, CURIN delivered an interactive online session on Neer Nari-Water Vision that was organized with the Women's Indian Chamber of Commerce & Industry (WICCI), Chandigarh unit. She heads the Centre for Water Sciences, CURIN at Chitkara University.

- Dr. Amanpreet Kaur – Assistant Professor, IITL, CURIN delivered one day hands-on workshop on Field Programmable Gate Array (FPGA) to the

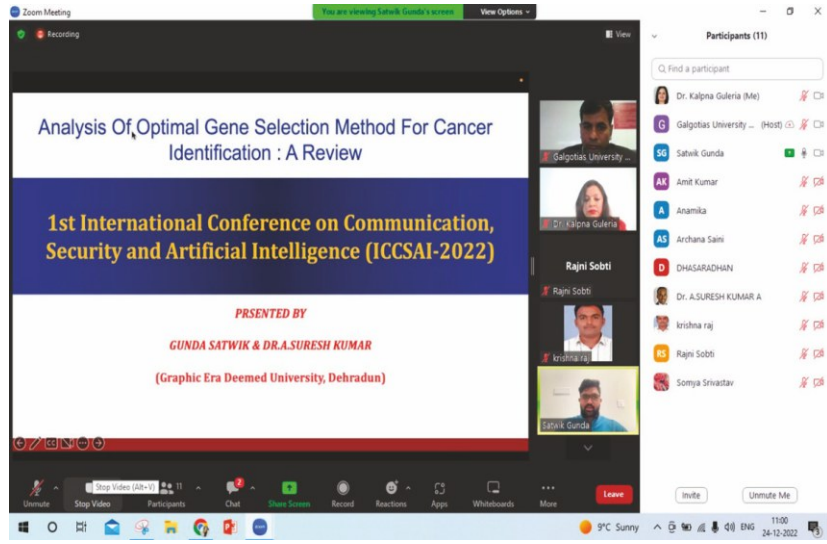
students of Electronics and Communication Engineering on November 11 and Mechatronics students on November 15. She discussed about the different logic families and I/O standards in Vivado: Xilinx tool. She explained the different peripherals on Genesys Kintex 7 FPGA kit & showcased two AR based science projects: ARomatic and ARscination.

- A team from CURIN participated in the CRIKC-CII Exhibition cum Industry Academia Meet held at Panjab University, Chandigarh, Punjab on November 12 and demonstrated two innovative and technology-enhanced projects titled a) Thermal Spray Technology and b) Counterfeit Detector. More than 100 academic institutions and industries participated in this event. The faculty members from CURIN who participated were Dr. P. K. Khosla (Pro-VC), Dr. Anoop Kumar Singh (Professor), Dr. Rakesh Goyal (Associate Professor), Dr. K. R. Ramkumar (Associate Professor), and Dr. Amanpreet Kaur (Assistant Professor).
- Dr. Arun Upmanyu – Professor, CURIN delivered an expert lecture on Basic of Electronics to young minds at Golden Earth Convent School, Mullanpur, Ludhiana, Punjab on November 16.
- A team from IITL, CURIN headed by Dr. Bhanu Sharma and Dr. Amanpreet Kaur – Assistant Professors attended an Industry Academic Alliance Program on AR, VR, and MR on November 16. It was organized by ARK in collaboration with Fusion AR at Crowne Plaza, Mayur Vihar, New Delhi.
- Dr. Kalpna Guleria – Associate Professor, CURIN chaired paper presentations sessions in two conferences namely, IEEE 7th International Conference on Parallel, Distributed and Grid Computing (PDGC) 2022 organized by Jaypee University of Information Technology, Solan on November 26 and 1st International Conference on Communication, Security and Artificial Intelligence (ICCSAI 2022) organized by Galgotias University, Greater Noida on December 24. In the former conference, authors presented papers related to machine and deep learning and their applications in healthcare, vehicular ad-hoc networks, etc. In the latter conference, papers were from machine learning and deep learning for the healthcare sector.

  Dr. K.R. Ramkumar (Associate Professor) & Dr. Amanpreet Kaur (Assistant Professor) also chaired paper presentations session titled Innovative and Disruptive Technologies in ICCSAI 2022.

ਗੋਲਡਨ ਅਰਥ ਕਾਨਵੈਂਟ ਸਕੂਲ ਪੰਡੋਰੀ (ਮੁਲਾਂਪੁਰ) 'ਚ ਸੈਮੀਨਾਰ ਹੋਇਆ

ਮੁੱਲਾਪੁਰ ਦਾਖਾ,(ਸੰਜੀਵ ਵਰਮਾ) ਗੋਲਡਨ ਅਰਥ ਕਾਨਵੈਂਟ ਸਕੂਲ ਪੰਡੋਰੀ ਮੁਲਾਂਪੁਰ ਵਿਖੇ ਡ: ਅਰੁਣ ਉਪਮਨਿਊ ਦੇ ਪ੍ਰੋਫੈਸਰ ਚਿੱਤਕਾਰਾ ਯੂਨੀਵਰਸਿਟੀ ਰੀਸਰਚ ਐਂਡ ਇਨੋਵੇਸ਼ਨ ਨੈਟਵਰਕ ਨੇ ਸਕੂਲ ਵਿੱਚ ਦਸਵੀਂ, ਗਿਆਰਵੀਂ,ਤੇ ਬਾਰਵੀਂ ਜਮਾਤ ਦੇ ਵਿਦਿਆਰਥੀਆਂ ਦਾ ਇੱਕ ਸੈਮੀਨਾਰ ਲਿਆ। ਉਨ੍ਹਾਂ ਦਾ ਸੁਆਗਤ ਸਕੂਲ ਦੇ ਚੇਅਰਮੈਨ ਸ੍ਰੀ ਬਲਦੇਵ ਕ੍ਰਿਸ਼ਨ ਅਰੋੜਾ ਜੀ, ਪ੍ਰਿੰਸੀਪਲ ਸ੍ਰੀਮਤੀ ਮਨਪ੍ਰੀਤ ਕੌਰ, ਵਾਈਸ ਪ੍ਰਿੰਸੀਪਲ ਬਸ਼ਰਤ ਬਾਸੀਰ,ਤੇ ਸਕੂਲ ਦੇ ਬਣੇ ਹਿੱਡ ਬੁਆਏ, ਹੈੱਡ ਗਰਲ ,ਤੇ ਪ੍ਰੀਫੈਕਟ ਨੇ ਬੁਕੇਅ ਦੇ ਕੇ ਕੀਤਾ। ਇਸ ਸੈਮੀਨਾਰ ਵਿੱਚ ਡ: ਅਰੁਣ ਉਪਮਨਿਊ ਨੇ ਬੱਚਿਆਂ ਨੂੰ ਇਲੈਕਟ੍ਰਾਨਿਕ ਤੇ ਇਲੈਕਟ੍ਰੀਕਲ ਡੀਵਾਈਸ ਦੇ ਅੰਤਰ ਬਾਰੇ ਦੱਸਿਆ। ਇਸ ਵਿੱਚ ਉਨ੍ਹਾਂ ਨੇ ਸੈਮੀਕੰਡਕਟਰ ਤੇ ਉਸਦੀ ਮਹੱਤਤਾ ਬਾਰੇ ਜਾਣੂ ਕਰਵਾਇਆ। ਬੱਚਿਆਂ ਨੇ ਵੀ ਵਧੀਆ ਢੰਗ ਨਾਲ ਬੈਠ ਕੇ ਉਨ੍ਹਾਂ ਦੁਆਰਾ ਦਿੱਤੀ ਜਾਣਕਾਰੀ ਨੂੰ ਸੁਣਿਆ ਤੇ ਸਮਝਿਆ ਇਸ ਮੌਕੇ ਸਕੂਲ ਦੇ ਚੇਅਰਮੈਨ ਸ੍ਰੀ ਬਲਦੇਵ ਕ੍ਰਿਸ਼ਨ ਅਰੋੜਾ ਜੀ, ਵਾਈਸ ਚੇਅਰਮੈਨ ਲੁਭਦਾ, ਪ੍ਰਧਾਨ ਡ ਮਨਿੰਦਰਪਾਲ ਅਰੋੜਾ, ਵਾਇਸ ਪ੍ਰਧਾਨ ਰਾਜੀਵ ਕੁਮਾਰ ਅਰੋੜਾ, ਸਕੂਲ ਦੇ ਪ੍ਰਿੰਸੀਪਲ ਸ੍ਰੀਮਤੀ ਮਨਪ੍ਰੀਤ ਕੌਰ, ਵਾਈਸ ਪ੍ਰਿੰਸੀਪਲ ਬਸ਼ਰਤ ਬਾਸੀਰ ਜੀ ਸ਼ਾਮਲ ਸਨ। ਅੰਤ ਵਿੱਚ ਸਕੂਲ ਦੇ ਚੇਅਰਮੈਨ ਸ੍ਰੀ ਬਲਦੇਵ ਕ੍ਰਿਸ਼ਨ ਅਰੋੜਾ ਜੀ, ਡ: ਮਨਿੰਦਰਪਾਲ ਅਰੋੜਾ, ਪ੍ਰਿੰਸੀਪਲ ਸ੍ਰੀਮਤੀ ਮਨਪ੍ਰੀਤ ਕੌਰ, ਵਾਈਸ ਪ੍ਰਿੰਸੀਪਲ ਬਸ਼ਰਤ ਬਾਸੀਰ ਜੀ ਨੇ ਡ: ਅਰੁਣ ਉਪਮਨਿਊ ਨੂੰ Guest of Honour ਦੇ ਕੇ ਸਨਮਾਨਿਤ ਕੀਤਾ ਗਿਆ ਡ ਅੰਤ ਵਿੱਚ ਇਹ ਸੈਮੀਨਾਰ ਖੁਸ਼ੀ - ਖੁਸ਼ੀ ਸਮਾਪਤ ਹੋਇਆ,ਤੇ ਬੱਚੇ ਇਸ ਸੈਮੀਨਾਰ ਤੋਂ ਸਿੱਖਿਆ ਲੈਣ ਕੇ ਬਹੁਤ ਖੁਸ਼ ਨਜ਼ਰ ਆ ਰਹੇ ਸਨ।



PhD scholars of Dr. Kalpna Guleria presented the research papers in different conferences. Shagun Sharma presented her paper titled Pneumonia Detection from Chest X-ray Images using Transfer Learning in the 10th International Conference on Reliability, Infocom Technologies and Optimization organized by Amity University, Uttar Pradesh on 13-14 October 2022. In the same conference, Meena Rani presented her paper titled Blockchain Technology Novel Prospective for Cloud Security, Swati Goel presented her paper titled Anomaly based Intrusion Detection Model using Supervised Machine Learning Techniques, Amandeep Kaur presented her paper titled A Deep Learning Based Model For Rice Leaf Disease Detection and Seema Gulati presented her paper titled Classification of Migraine Disease using Supervised Machine Learning.

In another conference - ICCSAI 2022, Rajni Sobti presented her paper titled Automatic Speech Recognition (ASR) System: Performance Measures and Corpus Collection Parameters, Swati Goel presented her paper titled Temperature-based Routing Protocols for Wireless Body Area Networks (WBANs): A Comparative Analysis, Archana Saini (ME scholar) presented her paper titled Heart Disease Detection using Predictive Machine Learning and Somya Srivastav (ME Scholar) presented her paper titled Early Detection and Classification of Tumor Disease using Predictive Machine Learning.

- Dr. Manish Sharma - Professor, CURIN presented two research papers in a highly rated IEEE Conference entitled Microwave, Antenna and Propagation Conference - MAPCON 2022 that was held in Bengaluru during 12-15 December, 2022. His research papers were titled – 1) A wideband high directional bow-tie antenna for automatic dependent surveillance – broadcast and 2) A directional flared antenna with slotted ground for ADS-B systems and GPR applications.

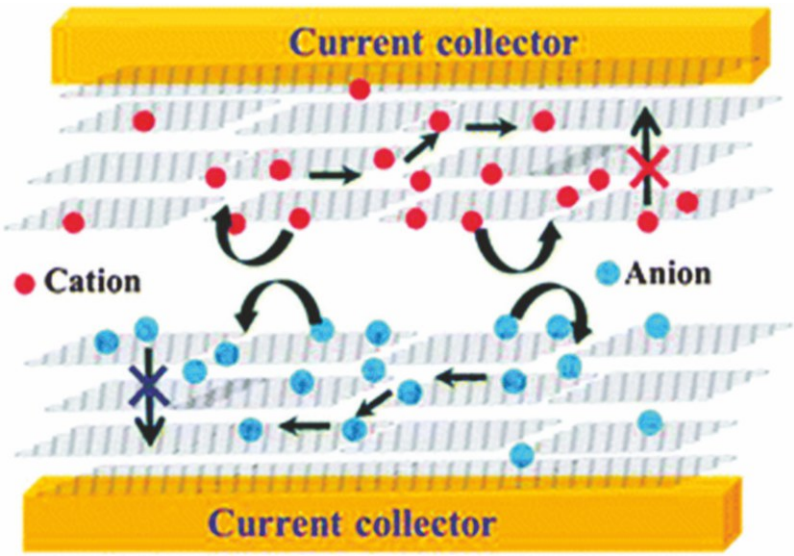
  Dr. Sharma also delivered a talk on Yukti-National Innovation Repository at Shri Atmanand Jain Institute of Management and Technology, Ambala, Haryana on 16th December, 2022.

Notable Achievements of CURIN in Q4, 2022

Research Funding, Awards, Recognition, etc.

Research Funding of INR 80.47 Lacs from DRDO for project titled *Development of High Energy Density Metal Compounds@Graphene Quantum dot Composite for Hybrid Pulse Power Device*

The scientific community at National/ International level has been zeroed-in-on the development of a sustainable electrical energy storage (EES) system for the proper management of electrical energy during its use and also to reduce its consumption. It is worth noting that 61.87% of electrical energy is generated by burning fossil fuel every year that results in global warming. Therefore, effective EES devices are highly desirable for proper utilization and management of the produced electrical energy. In this context, supercapacitors or electrochemical double layer capacitors are the cutting-edge energy storage devices that offer many desirable properties including high capacitance value and high deliverable power density with an extended cycle time. Simultaneously, the unconventional renewable energy resources produce 28.28% of electrical energy every year, which suffers from grid balancing issues and its storage. However, the major shortcomings of hybrid supercapacitors are low energy deliverable capability than battery and high self-discharge rate. These supercapacitors effectively span the gaps between electrolyte capacitors and rechargeable batteries. Furthermore, hybrid capacitors attract many industrial applications because of their fast charging nature (in few seconds/minutes) and robust power deliverable efficiency making them ideal for utilization in portable electronics, electric vehicles, heavy duty machineries, etc. The global electrochemical capacitor market size was valued at $3.27 billion in 2019 and is expected to reach $16.95 billion by 2027, growing at a Compound Annual Growth Rate of 23.3% from 2020 to 2027. These figures show the economic-importance of supercapacitors.



The illustration has been borrowed from one of the published papers of Dr. Partha Khanra

Research team at CURIN, Chitkara University headed by Dr. Partha Khanra – Assistant Professor, CURIN is working on building such an energy storage device and proposed an efficient technique to design & develop an electrode and electrolyte material that will be used in making hybrid supercapacitors. Electrodes will be developed by graphene composite with quantum-dot size metal compounds as electrode materials and advanced non-aqueous ions conducting liquid as electrolytes, which will produce high voltage, high energy density and high-power density with low self-discharge rate. Additionally, the entire system will also help to increase the lifetime of the energy storage devices. To carry out this development, Dr. Partha Khanra has received a research grant of INR 80.47 Lacs from DRDO and the duration of the project is three years.

Questel IP Excellence Award 2022 Won by Chitkara University

Chitkara University, Punjab bagged the Questel IP Excellence Award 2022 for making valuable contributions as an innovation driven organisation by filing significant number of patents, designs and undertaking intellectual property related initiatives. The Office of Patent Facilitation is a vital component of CURIN. Dr. S. N. Panda – Executive Director, Research, CURIN received the award on behalf of Chitkara University in an event held in New Delhi.

Young Scientist Award 2022 by the International Institute of Organized Research

Dr. Rakesh Goyal – Professor, CURIN, Chitkara University, was bestowed with the Pre-Eminent Young Scientist Award 2022 by the International Institute of Organized Research - A Registered MSME with Ministry of MSME, Government of India at the 8th International Conference on Interdisciplinary Research for Sustainable Development (IRSD 2022). He was awarded for his research work in the domain of modifying surfaces of metal equipment and machinery with the help of newly formulated alloy powder coatings. His research outcomes have been applied in industrial boilers by one of the leading boiler manufacturers of Haryana which shows significant improvement in the working life of the boiler tubes. He has more than 75 publications in SCI/ Scopus and UGC journals/conferences to his credit. He has written two books in the field of Surface Engineering.

He has been recognized by Elsevier for reviewing research papers during November –December 2022 for one of the leading journals entitled Applied Surface Science having an impact factor of 7.392.

Won Second Position in an International Hackathon

CURIN made a mark at the international arena when a team from the Center of Excellence of Cyber Security and Artificial Intelligence bagged the second position in the International Quantum Science and Technology Hackathon (QSTH) organized by HackerEarth in collaboration with the Office of the Principal Scientific Advisor (PSA) to the Government of India, Microsoft, IBM, Amazon Web Services, STH, QETCI, Orbit Ventures, T-hub and Apollo Hospitals. This team from CURIN which was led by Dr. K.R. Ramkumar (Associate Professor) comprised Dr. Amanpreet Kaur (Assistant Professor), Ms. Taniya Hasija, Ms. Vaneeta (Phd Scholars) and was mentored by Dr. Sudesh Kumar Mittal (Professor, CURIN). Their project was titled Design and Implementation of a Quantum Safe Cryptography Algorithm using Polynomials to Mitigate Key-Size based Attacks Cell. A total of 128 teams from across the globe comprising of industry as well as academia participants competed in this event.

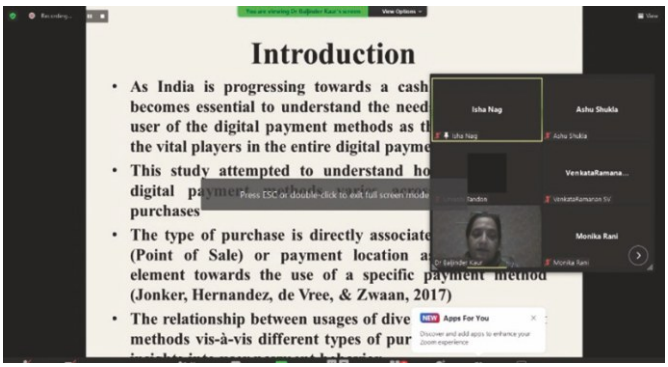
The International Conference on Management Growth in Emerging Economies - ICMEE 2022

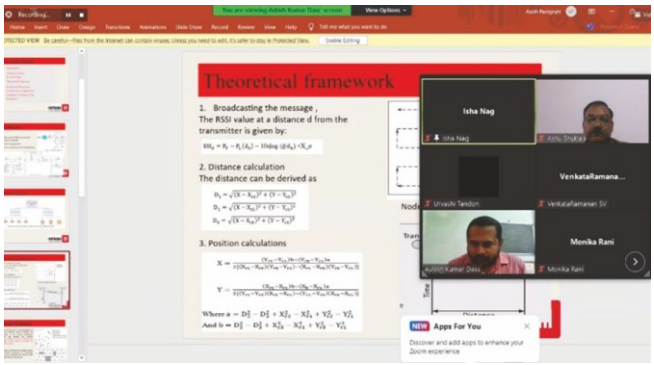
Organized by the Doctoral Research Centre (DRC), Chitkara Business School (CBS)

The International Conference on Management Growth in Emerging Economies - ICMEE-2022, was an initiation by the Doctoral Research Centre (DRC), Chitkara Business School (CBS), Chitkara University with the motive in bringing research scholars, faculty members, students, and practitioners in a common discussion forum to exchange their findings and knowledge for the growth of the management domain specifically focusing on the growth of emerging economies in the domain of marketing, finance, and human resource. It was organized in collaboration with Asia Pacific University, Malaysia.

The conference was held on 26th November 2022 and was attended by more than 200 delegates. The inaugural session began with a welcome address by Dr. Amit Mittal - Pro Vice Chancellor (Research Programs), Chitkara University, Punjab. This was followed by a keynote address by Dr. Meenakshi Banerjee – Vice President, CRMnext.

One distinct feature of ICMEE 2022 was a training workshop on field analysis using VoS-viewer software by Dr. Shashi Kashav from IIM Sirmaur. This session was very helpful for the young researchers to carry out systematic literature review and qualitative analysis. The conference featured paper presentations in three parallel tracks areas wherein 47 researchers presented their papers. In each track, one paper was selected as the best paper and authors of the best papers received due recognition. The conference was convened by Dr. Arun Aggarwal and Dr. Sridhar Manohar – Assistant Professors, DRC, CBS.





Other Activities Organized by DRC, CBS in Q4

Seven-day Faculty Development Program on Research Methodology

During November 14-20, DRC-CBS conducted a faculty development program on Research Methodology that was attended by a close to 50 research scholars and faculty members. It was delivered by Dr. Urvashi Tandon - Associate Professor, DRC, CBS and Dr. Balraj Verma - Assistant Professor, DRC, CBS. They discussed the usage and implication of research process and research design methods, respectively. Participants learned techniques of combining quantitative and qualitative approaches, research designs along with sampling design, balancing out the limitations of each research design method, etc. Through this workshop, participants developed good understanding of the formulation of research problem, formulation of

hypotheses, selecting adequate sample and sampling design, conducting systematic literature review, data collection methods, questionnaire design and report writing.

Invited Talk by an Industry Expert

On November 15, DRC-CBS invited Dr. Charru Sharma - Country Director, Star Scholars Network to deliver an invited talk that was attended by about 60 research scholars and faculty members. She started her talk by discussing the mission of the Star Scholars Network. She focussed on building authentic human-to-human relationships among people in the network, both online and in-person, to build trust and solidarity. She also focussed on new initiatives and activities of the network. She spoke about pioneering open access resources that empower members to leverage the power of the networks to develop their skills, knowledge, and expertise. She further insisted that scholars should engage in continuous learning to understand the trends, resources, and needs of the entire network and their communities.

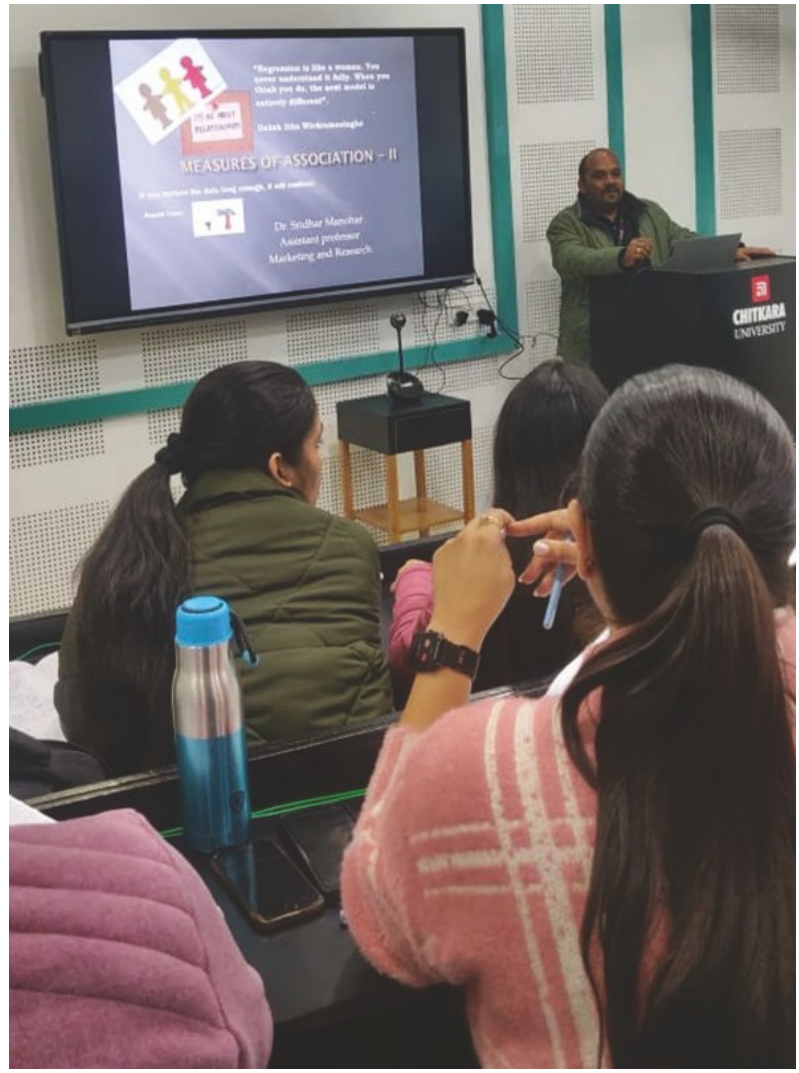
Two-day Faculty Development Program on Factor Analysis

Dr. Arun Aggarwal (Assistant Professor, Doctoral Research Centre, CBS) conducted a two-day FDP on Factor Analysis and Structural Equation Modelling from 14-15 December, 2022. It was attended by more than 40 research scholars. The purpose to conduct this FDP was to give insights into advanced research tools to faculty members and research scholars. It helped the participants in developing an understanding on the applications of the exploratory factor analysis and confirmatory factor analysis, as well as checking the reliability of the data and validity of the questionnaire through convergent and discriminant validity measures.

Two-day Faculty Development Program on Statistical Tools for Data Analysis

In the age of Big Data, research and analytics increasingly plays a fundamental role in business decision making. Research and analytics enhance the quality of business decision making by helping organizations in better understanding their customers as well as competitors. The unprecedented growth and availability of customer data, both structured and unstructured, has engendered many challenges that include data acquisition, management, visualization, and analysis. To equip the research scholars and faculty members with various statistical tools for data analysis, two-day FDP was organized

during December 16-17. It was delivered by Dr. Sridhar Manohar - Assistant Professor, DRC, CBS and it featured various elements including lectures, workshops, discussions, exercises, and case analyses. Additionally, the topics including scale development, identification of latent variables, conjoint analysis, etc. were discussed with relevant examples and case studies.



Invited Talk on How to Write a Research Paper?

Dr. Dinesh Jaisinghani from Bennett University, Greater Noida was invited to conduct a seminar on How to Write a Research Paper? on December 17, which was attended by 45 faculty members and research scholars. The objective was to motivate and guide the participants in research paper writing and to provide a sound conceptual understanding of various research methods, research instruments, tools and techniques for conducting empirical research. Dr. Dinesh discussed the steps that are required to be followed while developing a research idea into a research problem and then transforming it into a systematically arranged research paper. Special emphasis was laid on following an appropriate method of citing references as well determining the quality of the journals using impact factor and h-index.

Invited Talks Delivered by the Faculty Members of DRC, CBS

1. Dr. Sukhpreet Kaur (Assistant Professor) delivered a session on Ethics in Research that was organized by Chitkara School of Health Sciences on October 8. She also presented a paper in the conference titled 5th International Conference on Contemporary Computing and Informatics that was organized by Amity University, Greater Noida on December 15.
2. Dr. Sridhar Manohar (Assistant Professor) conducted a workshop on Integrated Research Design on November 11 that was organized by the Chitkara College of Education.
3. Dr. Balraj Verma (Assistant Professor) delivered a session on Art of Writing a Quality Research Paper in a FDP that was organised by Chitkara College of Sales and Marketing (CCSM), Chitkara University during 19-23 December.

Impactful Researchers from DRC, CBS

- P-Rank, a publication ranking is intended to increase the recognition of scholars with notable publication output. There are many different ways in which notable publication output can be identified. P-Rank comprises nine rankings in which different journals are listed, some of them include ABDC Journal Quality List 2019 Ranking, ERIM Journal List 2016-2021 Ranking, Handelsblatt 2014 Ranking, HCERES 2021 Ranking, Scimago Journal Ranking 2018 Ranking and VHB Jourqual 3 Ranking. Dr. Urvashi Tandon (Associate Professor) and Dr. Arun Aggarwal (Assistant Professor) have been listed in the above mentioned rankings as notable researchers.
- Dr. Balraj Verma (Assistant Professor) received the Best Research Paper Award in the technical session on Computing in Business and Learning in the International Conference on Applied Data Science and Smart Systems (ADSSS-2022) that was held during 4-5 November, 2022. His research paper was titled Exploring Vendor's Critical Attributes to Success in Engineering, Procurement, and Construction companies in India.

The Patent Office has Granted 124 Patents to Chitkara University in Q4, 2022.

56 Patents Filed by CURIN Faculty Members and Scholars in Q4

A total of 196 patents (including industrial designs) have been filed by different departments of Chitkara University during October - December 2022, out of which 56 have been filed by CURIN faculty members and researchers.

The details of these 56 patents, which also include industrial design registrations are given below.

S. No.	Title	Inventors	Application Number
1	A blockchain based system and method for managing liquid medical oxygen supply chain	Ishu Sharma, Jagdeep Sharma	202211062370
2	A device for recharging a battery	Neeraj Anand, Manjeet Singh, Lakshya Gupta, Hiral Patel, Gourav Singh, Shivam Sharma	202211074659
3	A device for relieving muscle pain	Taniya, Amanpreet Kaur, K R Ramkumar, Sudesh Mittal	202211061258
4	A non-toxic herbal hair dye composition and a method of preparation thereof	K R Ramkumar, Sugasini K R, T V Aswini	202211062626
5	A system for converting wind energy into electrical energy	Narinder Pal Singh, Akshiv Nagta, Bhanu Sharma, Shivam Sharma, Neha Tuli, Archana Mantri	202211057645
6	A system for detecting a spinal curvature disorder	Anuj Kumar Jain, Rahul Bhandari, Amit Vajpayee, Sunita Singhvi, Kamal Deep Garg, Vinay Kukreja, Raj Gaurang Tiwari, Mukund Pratap Singh, Nitin Jain	202211057643
7	A system to prevent misbalance during operation of a two-wheeler vehicle and a method thereof	Kalpna Guleria, Meena Rani, Surya Narayan Panda, Swati Goel, Amandeep Kaur, Shilpi Garg	202211071378
8	Apparatus and method for microwave torrefaction of biomass	Varinder Singh, Nitin Kumar Saluja, Gurjinder Singh, Debarshi Ghosh	202211070435
9	Chair with multiple body parts massage system	Bhanu Sharma	202211061264
10	Device to detect blink rate	Sachitanand Singh, Krishna Kumar Gupta, Jai Prabhat Ranjan, Sheifali Gupta, Rupesh Gupta	202211057642
11	Edible oil quality monitoring system	Prateek Srivastava, Jasminder K Sandhu, Deepam Goyal, S K Mittal, Shailendra Partap Singh, Ashiwani Kumar	202211069733
12	Electrostatically double side doped passivated emitter and rear contact module for solar cell	Savita Kashyap, Rahul Pandey, Jaya Madan	202211060072
13	Measuring tape with integrated scriber tool	Naveen Kumar, Rajesh Kumar Kaushal, Mohit Kumar, Shilpi Singhal, Mansi	202211074658
14	Monitoring and management system for a salon	Ishu Sharma, Rahul Sharma, Saket Mishra	202211068408

S. No.	Title	Inventors	Application Number
15	Multi-functional pen with marker	Satwik Kanhere, Samarth Jain, Sanjeev Verma, Saksham Walia, Saurav Gupta, Sukhmanpreet Singh Jaswal	202211067405
16	Multifunctional wheelchair for mobility-impaired person	Surya Narayan Panda, Sanjeev Verma, Sreenivasa. S, Usha Desai, Sonu Goel, Ashutosh Panda, Mohit Kumar, Sudarson Jena	202211059676
17	Nail growth monitoring device	Sanjeev Verma, Surya Narayan Panda, Naveen Kumar, Rajesh Kumar Kaushal, S. Sreenivasa, Mansi, Mayank Verma	202211057279
18	Onion waste extract- derived antiurolithic composition	Varinder Singh, Manjinder Singh, Deepinder Singh	202211061801
19	Ornament selection system for ears	Syna, Vinay Kukreja	202211062369
20	Pen cap with a drone	Bhanu Sharma, Archana Mantri, Jatin Kumar Gulati, Harbani Sharma, Deepika	202211065868
21	Pharmaceutical mixture for oral drug delivery	Varsha Singh	202211065180
22	Portable device for ptosis evaluation	Krishna Kumar Gupta, Sachitanand Singh, Jai Prabhat Ranjan, Sheifali Gupta, Rupesh Gupta	202211062901
23	Portable device to meet toilet needs of kids	Mohit Kumar, Surya Narayan Panda, Sreenivasa.S, Usha Desai,Sonu Goel, Sanjeev Verma	202211059675
24	Resonator based system for the estimation of adulteration	Nitika Dhingra, Debarshi Ghosh, Nitin Saluja, Chanpreet Singh	202211058126
25	Smart baby car seat	Amandeep Kaur, Ramkumar Kr, Amanpreet Singh	202211065179
26	Smart travel bag	Arun Upmanyu, Deepam Goyal, Prateek Srivastava	202211066252
27	System and method for automatic generation of reminders based on GPS location	Harjeet Singh, Shivani Sood, Mohit Kapoor, Partha Khanra	202211059674
28	System and method for cash logistics management using blockchain	Ishu Sharma, Kirandeep Kaur, Jagdeep Sharma, Tushar Malik, Arsnoor Kaur	202211062627
29	System and method for detection of kidney disease	Gurjinder Kaur, Meenu Garg, Sheifali Gupta	202211058131
30	System and method for determining the depression score of the subjects	Nitin Kumar Saluja, Mukul Goyal, Nayan Gupta, Debarshi Ghosh, Varinder Singh, Gurjinder Singh, Ananya Bansal	202211065434
31	System and method for recognizing plant diseases	Preeti Sharma, Devender Setia, Anikait Jasrotia, Varinder Singh	202211063834
32	System and method for remote patient monitoring and drug delivery	Surya Narayan, Sanjeev Verma, Sachin Ahuja, Ashutosh Panda, Naveen Kumar, Prabin Kumar Panigrahi, Sreenivasa S.	202211057004
33	System and method to assist a vehicle in lane maintenance	Shalli Rani, Himanshi Babbar	202211062625
34	System and method to disseminate data from a vehicle	Meenu Khurana	202211059087

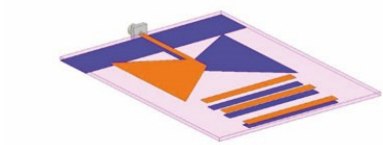
S. No.	Title	Inventors	Application Number
35	System for charging virtual reality based device	Shivam Sharma, Neha Tuli, Sanchit Vashisht, Archana Mantri	202211065869
36	System for detection and prevention of accidents	Varun Aryan Chhabra, Balwinder Singh, Puneeta Dadhich, Shalli Rani	202211071206
37	System for hydroponic cultivation of saffron	Kanwal Preet Kour, Deepali Gupta, Kamali Gupta	202211070124
38	IoT-based system for sorting and collecting garbage in bins	Vatsala Anand, Sheifali Gupta, Rupesh Gupta	202211061629
39	System for metal cladding using microwave energy	Varinder Singh, Nitin Kumar Saluja, Gurjinder Singh, Debarshi Ghosh	202211070925
40	System to escape from a building in an emergency by collapsible staircase	Surya Narayan Panda, Sanjeev Verma, Ashutosh Panda, Vinod Kumar, Vinay Kumar Gupta, Mansi, Sudarson Jena	202211060998
41	System to safeguard a CCTV camera	Meenu Garg, Hitesh Gupta, Sheifali Gupta, Rubina Dutta, Isha Gupta, Gurjinder Kaur	202211057282

INDUSTRIAL DESIGN REGISTRATIONS

42. Antenna for automatic dependent surveillance broadcast

By: *Manish Sharma*

Application No. 372230-001



43. Augmented reality based music composer

By: *Narinder Pal Singh, Bhanu Sharma, Sanchit Vashisht, Archana Mantri*

Application No. 372648-001

44. Bottle with medicine slots

By: *Prateek Srivastava, Mohit Kumar, Deepam Goyal, Ashvni Kumar*

Application No. 373700-001

45. Car keys with locking mechanism

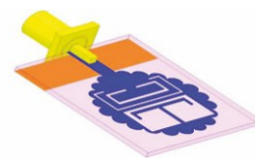
By: *Amanpreet Kaur, Dhruv Kholi, Devang Khurana, Barinder Singh*

Application No. 372225-001

46. Balanced bullock cart

By: *Manish Sharma, Naveen Kumar, Rajesh Kumar Kaushal*

Application No. 373050-001



47. Futuristic chair

By: *Deepanshu Goyal, Jaya Madan, Rahul Pandey*

Application No. 372848-001

48. Portable geyser

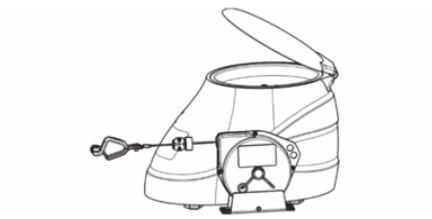
By: *Amanpreet Kaur, Ramandeep Singh*

Application No. 372847-001

49. Self-powered centrifuge

By: Navita Gupta, Varun Jain, Nitin Kumar Saluja, Varinder Singh

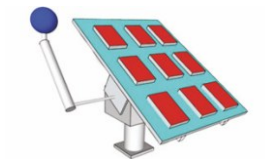
Application No. 374358-001



50. Smart dual axis solar tracker

By: *Himanshu Jindal, Amanpreet Kaur*

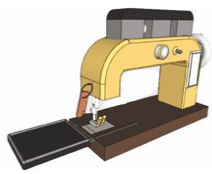
Application No. 372226-001



51. Stitching cum embroidery machine with automatic coloring provision of threads

By: *Amanpreet Kaur, Himanshu Jindal, Raj Kumar*

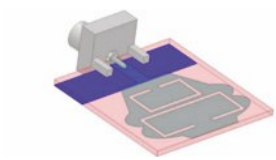
Application No. 372846-001



52. Super-wideband dual filter antenna

By: Manish Sharma, Rajesh Kumar Kaushal, Naveen Kumar

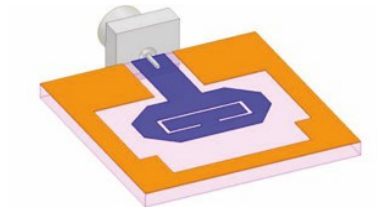
Application No. 372229-001



53. UWB antenna with an accurate WLAN notch band

By*: Rajeev Kumar, Gurpreet Kumar, Renu Popli, Manish Sharma, Isha Kansal, Maninder Singh*

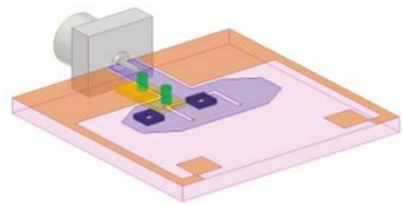
Application No. 373053-001



54. UWB antenna with dual rectangular notch band characteristics incorporating u-slot, SRRS, and EBGS

By*: Renu Popli, Gurpreet Kumar, Rajeev Kumar, Manish Sharma*

Application No. 372845-001



55. Wiper

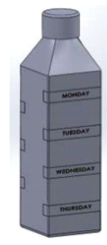
By: *Bhanu Sharma, Archana Mantri, Shweta Lamba*

Application No. 375192-001

56. Bottle with medicine slots

By: *Parteek Srivastava, Mohit Kumar, Deepam Goyal, Ashvni Kumar*

Application No. 373701-001



Water Treatment and Water Disinfection

Centre for Water Sciences (CWS), CURIN, Chitkara University

By: Dr. Jyotsna Kaushal, Professor, CURIN

To provide a quality water to the common people is one of the biggest challenges especially in the developing countries. There are lot of anthropogenic activities which pollute the surface as well as groundwater. Therefore, treatment of wastewater at low cost is the utmost need of the developing countries to achieve the Sustainable Development Goal 6 : Clean Water & Sanitation.

The Centre for Water Sciences (CWS), CURIN, Chitkara University is contributing on social and research aspects of water purification. CWS is headed by Dr. Jyotsna Kaushal, Professor (Research), CURIN, Chitkara University. Under her guidance a team of researcher scholars are working on different areas of water treatment. Four research scholars have completed their PhD and seven students are currently pursuing from the same group under her guidance. The CWS has published 60+ papers in reputed SCI and Scopus indexed journals and has also filed 14 patents. Research interests of the CWS include use of waste materials for the synthesis of bio-char and its derivatives, and their application in removal of contaminants such as fluoride, dyes, heavy metals from wastewater. A low-cost earthen potable system has been developed by a team at CWS in which agro-waste material is incorporated along with mud to purify the water for drinking purpose. To remove fluoride from drinking water, above unit is embedded with funnel cum candle system. The team is also working on Bioremediation and Phytoremediation techniques for water purification.

CWS give emphasis to water testing and analysis and provides awareness to general public about the essential features of water testing. It seeks to have top-notch testing and analysis of water in addition to research in order to meet the testing demands of the society. CWS regularly hosts events on water-related topics for students, and faculty members of the university as well as for general public from villages and towns near to the university and for several external organizations as well.

CWS is equipped with sophisticated instruments like AAS for testing of heavy elements (Cd, Cr, Pb, etc), Flame photometer for testing of light elements (Na, K, Ca, etc.), Ion meter for fluoride determination, pH meter, Conductivity meter, COD/BOD chambers, etc. for testing and analysis of water in the lab.

Activities to Promote Industry-Academia Collaborations

Under GoI sponsored TEC and NewGen IEDC

Chitkara University has the Department of Science and Technology (DST), GoI sponsored Technology Enabling Centre (TEC) whose primary objective is to promote industry-academia collaborations in the region for joint development of technologies and for technology commercialization.

To sensitize and involve a large number of industries of the region in TEC, two major activities were conducted in the fourth quarter of 2022.

On October 7, Chitkara University TEC did an event with the Patiala Chamber of Industries (PCI) that was attended by close to 50 industries associated with the PCI. The event was held at the PCI Hall, Industrial Area, Focal Point, Patiala. In this event, Mr. Sagar Juneja – Assistant Dean, CURIN and Coordinator, Chitkara University TEC delivered a presentation to give an insight about TEC to the participating industries. He discussed the objectives of TEC and the various activities we have been doing in the centre. It was objectively highlighted how it is mutually beneficial for industry and academia to collaborate under TEC initiative of GoI. An overview of more than 10 industry-academia joint projects was given to the participating industries, all of which were supported by Chitkara University Technology Enabling Centre. The representatives of industries were encouraged to share their technical problem statements wherein academia can partner with them for developing solutions.

Finally, it was also highlighted how academia look up to MSME industries to commercialize their research and technologies. An overview of some of the technologies that have been developed by academia was given to seek commercialization support from industry. The session was very well received by the industry participants. Thanks are due to Mr. Jatinder Singh Sandhu (President, PCI) and the entire leadership team of PCI for this opportunity. Some of the faculty members and representatives from CURIN, Chitkara University also attended this event and interacted with the industries. These members were Dr. Rajesh Kaushal, Dr. Naveen Sharma, and Dr. Rakesh Goyal – Associate Professors, CURIN, Mr. Chanpreet Singh (Project Manager, CURIN), and Mr. Parul Chawla (Assistant Manager, TEC, CURIN).

A similar session was held on October 29 and it was conducted for the member industries of Sangrur District Industrial Chamber (SDIC) and was held at SDIC Bhawan, Focal Point, Sangrur. In this session also, Mr. Sagar Juneja gave insights about the TEC initiatives and how it is mutually beneficial for both industry and academia to collaborate for solving technological

problems. Around 35 Industrialists from Sangrur Cluster (Sangrur, Sunam, Dhuri, Malerkotla, Bhawanigarh) attended the session. Thanks are due to Mr. Gora Lal (Chairman, SDIC), and Mr. Aman Zakhami (President, SDIC) for this opportunity.

Chitkara University has the DST sponsored New Generation Innovation and Entrepreneurship Development Cell (NewGen IEDC) to support innovative projects at the university with prototype-development funding with an objective of converting those projects into start-ups or commercialized technologies.

- During November 23-24, an awareness drive was conducted in the university to motivate students to avail prototype funding from NewGen IEDC for their projects. NewGen IEDC also conducts an annual hackathon titled as Idea-Thon to invite project ideas from students. These project ideas are given mentoring support to bring them to a level where they can be pitched for seeking funding support. Some of these ideas after successful pitching and evaluation by the jury are awarded funding support from NewGen IEDC for development of prototypes . The objective of this awareness drive was also to promote Idea-Thon 2.0 among students. The drive was led by Mr. Chanpreet Singh – Project Manager, CURIN.
- On December 15, CSI Student Chapter, Department of Computer Applications, Chitkara University invited Mr. Sagar Juneja for an expert session. He delivered a talk on the topic “Funding Opportunities for the Development of Innovative Ideas & Products”. He discussed about NewGen IEDC funding available for students' projects in the university. He also highlighted why students should work on projects that are intended for solving real world problems and the importance of building good quality project prototypes. He also explained why students must avail pre-incubation support for building their projects. Around 110 students and 4 faculty members from the Department of Computer Applications attended the session.
- A similar invited talk was delivered by Mr. Sagar for the students and faculty members of Department of Applied

Activities to Promote Entrepreneurship and Start-ups

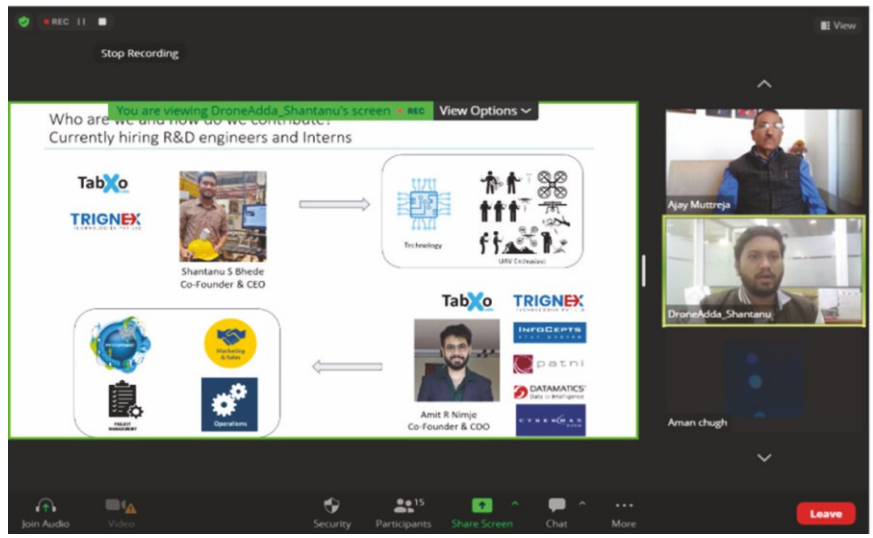
By Chitkara Innovation Incubator Foundation (CIIF)

Chitkara Innovation Incubator Foundation (CIIF) is a registered company under section-8 of the Company Act. It recognized as a Chitkara University-Technology Business Incubator funded by DST, Govt. of India which aims to provide a platform to the budding startups, innovators & entrepreneurs of the region. In Q4, 2022, CIIF conducted the below mentioned activities.

- On 10th November 2022, CIIF organized a boot camp on Tech Future Hackathon. Ms. Prabal Kaur Deol (Incubation Executive FITT, IIT, Delhi) was the speaker of the session and she motivated around 130 students to submit their startup ideas based on Machine learning and Artificial Intelligence as start-ups to receive government & investors funding. Also, Dr. Adarsh Aggarwal, Vice President, CIIF shared about the funding that winners of the hackathon will receive from MeitY, Govt. of India.

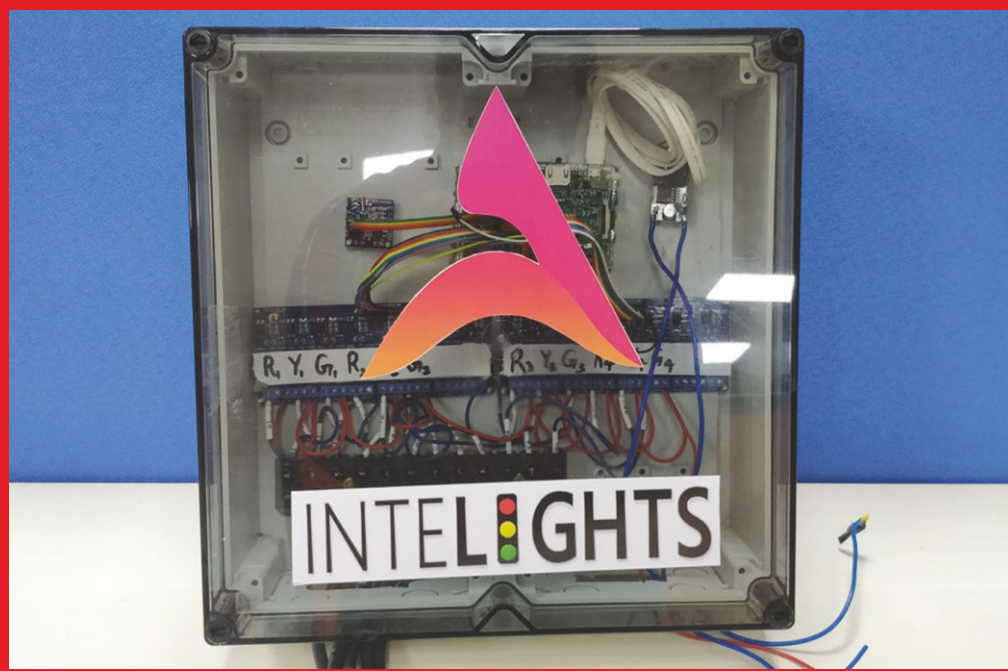
- On 24th November 2022, CIIF organized a "Milestones Setting cum Mentoring Meet for Start-ups". The main agenda of the meeting was to review the milestones presented by two start-ups namely 80 Wash LLP and 6DOF Solutions Pvt. Ltd. who got selected for MeitY TIDE 2.0 scale up investment and to provide mentoring to the emerging start-ups of CIIF. Mr. Bhavish Sood, General Partner, Modulor Capital and Mr. Siddharth Angrish, Co-Founder & CEO, Jiyyo were the reviewers and mentors of this meet. The reviewers suggested the founders of 6DOF Solutions Pvt. Ltd. to reach out to the schools/parents in the Tricity region & 80 Wash LLP to showcase the product to major electronic brands such as LG, Samsung, IFB and others for possible collaboration. They also provided one to one mentoring to other start-ups namely Vecrep Technologiees Pvt. Ltd., Emprex Energies Pvt. Ltd., Code shod ventures Pvt. Ltd. and Anshaj Smart Waste Management Pvt. Ltd.

- On 15th December, 7th Meeting of the Incubator Seed Management Committee of the CIIF was conducted with an objective to select the potential start-ups for providing seed funding under Start-up India Seed Fund Scheme. The committee comprised Dr. Archana Mantri (CEO, CIIF), Dr. Adarsh Aggarwal (Head Incubation, CIIF), Mr. Deepinder Dhillon (Joint Director, DIT, Govt. of Punjab), Dr. Aman Chugh (Founder, Aman Chugh Ventures Pvt Ltd), Mr. Piyush Garg (Vice President, CEED, Chitkara University), Mr. Harpreet Bhatia (Founder - Languafina Global Services LLP), Mr Himesh Sharma (CEO- Skill Labs Resource Services Pvt. Ltd.), Mr. Anuj Mittal (Ex-CoFounder-Healthians.com), Mr. Vince Kohli (Startup Judge, MIT), Dr. HK Mittal (Chairman, SISF). They reviewed the pitches of the start-ups namely Sabera Healthcare Private Limited, Zerodrag Technologies Private Limited, Bakz4ever (OPC) Private Limited, Sneakwear Private Limited, and Miviinno Consultancy Private Limited.



Commercialization of a Patent

A patent licensing agreement dated 18th November 2022 has been signed by and between Chitkara Innovation Incubator Foundation (CIIF) and M/s. Anukai Solutions Pvt. Ltd. (Anukai) for the Patent titled 'System for Controlling Traffic at an Intersection' having an Application Number 201911045568, which was filed on November 08, 2019. The Patent has been granted on June 21, 2021 having Patent No. 369721. Hon'ble Vice Chancellor Dr. Archana Mantri has signed the agreement for & on behalf of CIIF. As an outcome of the patent licensing agreement, Anukai has an exclusive license of the patent, which shall initially be for a period of seven years. Anukai is a start-up company which is working towards solving the problem of traffic congestion via smart computer vision and AI-based algorithms. The licensing agreement was felicitated by Mr. Sanjay Bhatnagar – Head, Tech-Commercialization, Chitkara University, Punjab.



List of Publications

72 publications by CURIN in Q4

CURIN faculty members and scholars have published research papers/book chapters in SCI and Scopus indexed journals, conferences, and books. This alphabetically sorted list contains those publications that have been indexed in Scopus during October- December 2022.

[1] A. Bansal, R. Goel, S. Sharma, K. Verma, M. Bhushan, and A. Kumar, "An insight on latest technologies of cyber security," *Lecture Notes in Networks and Systems*, vol. 491, pp. 555–563, 2023.

[2] A. K. Al-Mousoi, M. K. A. Mohammed, S. Q. Salih, R. Pandey, J. Madan, D. Dastan, E. Akman, A. R. A. Alsewari, and Z. M. Yaseen, "Comparative study of the correlation between diffusion length of charge carriers and the performance of CsSnGeI3 perovskite solar cells," *Energy and Fuels*, vol. 36, no. 23, pp. 14403–14410, 2022.

[3] A. K. Al-Mousoi, M. K. A. Mohammed, R. Pandey, J. Madan, D. Dastan, G. Ravi, P. Sakthivele, and G. A. babu, "Simulation and analysis of lead-free perovskite solar cells incorporating cerium oxide as electron transporting layer," *RSC Advances*, vol. 12, no. 50, pp. 32365–32373, 2022.

[4] A. K. Sharma, D. Goyal, B. S. Pabla, K. K. Saxena, C. Prakash, and D. Buddhi, "Optimization of friction stir welding parameters for micro alloying of AA6082 alloy," *International Journal on Interactive Design and Manufacturing*, pp. 1–11, 2022.

[5] A. Kumar, M. Kumar, S. Gothwal, and P. Srivastava, "Analysis of the sliding wear (experimental and modeling validation), thermal, thermo-mechanical, and fracture performance of AA7075-Chromium alloy composites," *Journal of Bio- and Tribo-Corrosion*, vol. 8, no. 4, pp. 1–21, 2022.

[6] A. Rana, A. Taneja, and N. Saluja, "Beyond 5G enabled internet-of-things for next generation smart systems: A use case scenario," *AIP Conference Proceedings*, vol. 2451, no. 1, p. 020046, 2022.

[7] A. Saini, V. P. Pandey, A. Singh, and P. Kumar, "Dosimetric comparison of photon beams using CIRS Thorax Phantom to evaluate monaco radiotherapy treatment planning System," *ECS Transactions*, vol. 107, no. 1, pp. 5729–5735, 2022.

[8] A. Saini, V. P. Pandey, A. Singh, and P. Kumar, "Evaluating impact of medium variation on dose calculated through planning system in a low cost in-house phantom," *Biomedical Physics & Engineering Express*, vol. 8, no. 2, p. 025022, 2022.

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