The TECH Tribune

The biannual newsletter from the office of IPR and IR cell
IIT Kharagpur

Spring 2019

In this issue:

Student Inventors
(2017-2018)

In the new initiative of identifying innovative project works of B.Tech/Dual degree/M.Tech. students (2017-2018 batch), IPR team has selected six project dissertations after novelty evaluation. Following six patents from these projects have been filed in Indian jurisdiction in the year of 2018.

- *Sorting of Red Blood Cells and Spherocytes in Microchannels,* **Manish Ayushman**, M Manikuntala Mukhopadhyay, Sunando Dasgupta*, Department of Chemical Engineering (B.Tech.)
- *Encapsulation of Probiotics at a Low Level of Gum Arabic,* **Divyasree Arepally**, Tridib Kumar Goswami*, Department of Agricultural and Food Engineering. (M.Tech.)
- *Microencapsulation of Oil Blends and Preparation of Shelf Stable Oil Powder,* **Monalisha Pattnaik**, Hari Niwas Mishra*, Mousumi Ghosh, Department of Agricultural and Food Engineering. (M.Tech.)
- *Process Technology for the Development of Cereal Based Carbonated Beverage Mix,* **Anjali Thakur**, Hari Niwas Mishra*, Pooja Pandey, Department of Agricultural and Food Engineering. (M.Tech.)
- *PAMAM Dendrimer Grafted Filter Paper Matrix as a Novel 3d Cell Culture Substrate For Drug Screening Applications*, **Aruja Rustagi**, Tarun Agarwal, Tapas Kumar Maiti*, Department of Biotechnology (M.Tech.)
- *Bio Inspired Marine Rudder with Leading Edge Protuberances,* **K. Shanmukha Srinivas**, Anirban Bhattacharyya*, Department of Ocean Engg and Naval Architecture (M.Tech.)

IPR & IR Cell Congratulates All the Inventors

'Certificate of Student Invention' will be awarded to the Student Inventors

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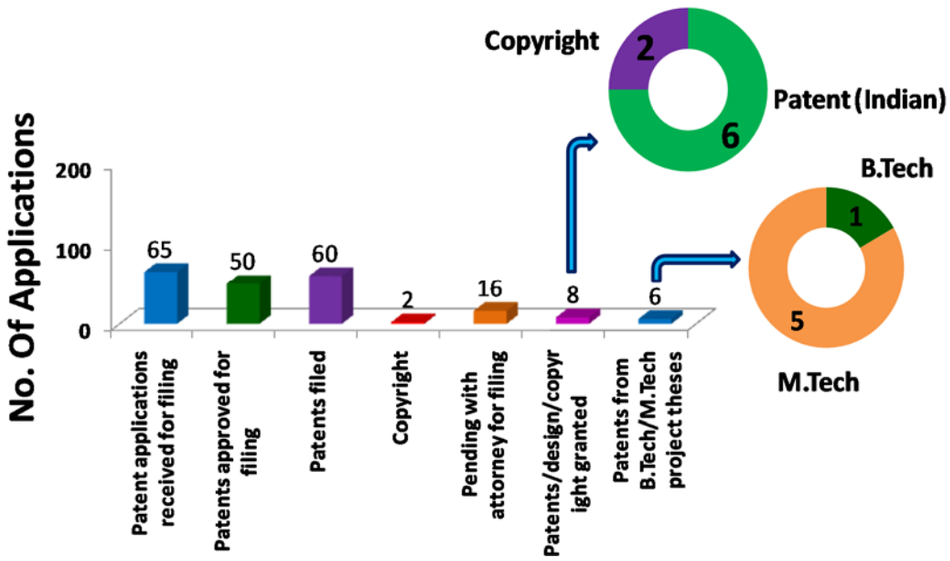
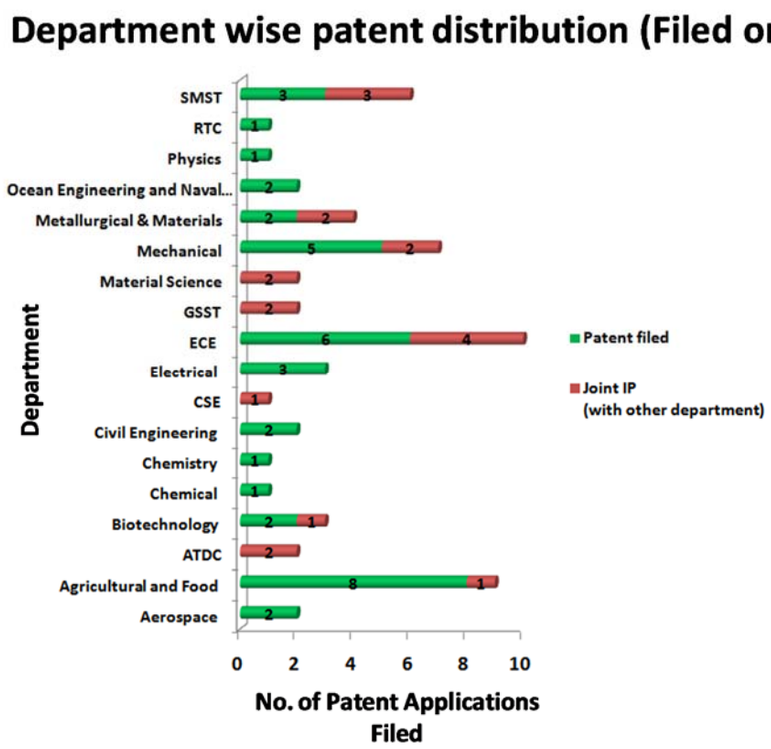
It has become appallingly obvious that our technology has exceeded our humanity. ~Albert Einstein

IP Profile 2018





List of Granted Patents and Copyrights

1. *Novel diamond like nanocomposite (diamas) material used for biocompatible coating application*, Tarun Kanti Bhattacharyya, Tapas Kumar Maiti, Gobind Singh Bisht, Debasish Mishra, ECE and BT, 294403 (India)
2. *Power transmission system adapted for power saving*, Manoj Kumar Mondal, Industrial Engineering & Management, 298947(India)
3. *Ultra-sensitive simulataneous electrochemical determination of arsenic mercury and copper*, C. Retna Raj, Bikash Kumar Jena, Chemistry, 295648 (India)
4. *Non-Invasive Photo-Acoustic Electronic Apparatus Adaptable To Measure The Concentration Of Body Fluid Components*, Swapna Banerjee, Pralay Mandal, Shib Shankar Das, ECE, 294278 (India)
5. *Enzymatic Transesterification of Jatropa Oil*, Rintu Banerjee, Paramita Mahapatra, Annapurna Kumari), G Vijay Kumar, AgFE, 291288 (India)
6. *A Chemo-Bio Reactor/System for Metal And Sulfate Removal From Waste Water And A Process Thereof*, Jayanta Bhattacharya, Mining, 298964 (India)
7. Margin noise removal, Soumyadeep Dey, Jayanta Mukhopadhyay, Shamik Sural, Partha Bhowmick, Computer Science, Copyright SW-11516/201.
8. Designing purified drinking water distribution at nominal cost, Somnath Ghosal, RDC, Copyright L-76943/2018.

Sorting of red blood cells

Undergraduate student inventor Mr. *Manish Ayushman, Department of Chemical Engineering (Supervisor: Prof. Sunando Das Gupta) speaks on his invention.*

Red Blood Cells (RBCs), under certain pathological conditions, alter their physical properties. This pathology can be deleterious leading to various conditions. 'Hereditary Spherocytosis (HS)' is a genetic condition which arises due to a mutation which leads to generation of 'Spherocytes' from deforming healthy Red Blood Cells. A healthy RBC has a biconcave discoid shape, whereas Spherocytes are spheres. The absence of cell membrane proteins, in conditions such as HS, manifests as differences in the physical properties of the Spherocytes and the healthy RBCs. In our invention, we have attempted to obtain a size based separation of healthy RBCs and diseased Spherocytes by exploiting the subtle differences in their properties. This has been done by altering the geometry along with the aspect ratio of the micro-channels through which these cells are passed and are subjected to altered velocity fields corresponding to the design of the micro-channel. We, therefore, have come up with two optimal designs for the separation.

The first micro-channel design is a channel with repeated units of square expansions. It involves introduction of repeated units of square expansions on the main channel. The zones of sudden expansions were introduced to aid in the separation owing to inertial effects and drag force effects arising from sudden changes in velocity profile of the flow in the channel. Based on our results, we concluded that the designs with 9-11 repeated square expansions units would give the best results. The second design is the Serpentine shaped channel. It involves a channel with repeated units of horizontally rotated 'S shaped' sections placed one after the other, thus giving it a serpentine morphology. Each of the curves in the design is a semi-circle whose radius is the same for all the curves in a particular design. However, the radius was varied across designs to fit the desired number of repeats within a fixed main channel length. Based on our results, we concluded that micro-channel designs with 5-7 repeated units would give the best results.

This was followed by testing of the effect of applied external electric field on the trajectories of RBCs. The lack of information on the electrical properties of spherocytes prevented us from computationally studying the effects of electric field on their trajectories. The results obtained showed that the preferential segregation of the healthy RBCs into the two outlet arms of the 'micro-channel with square expansions' was more pronounced in the case with the applied electric field, than in the case when there was none. This implied that the electric field does bring about a significant alteration in the path of the RBCs.

Novel aspect of this invention

The prevailing state of art for separation of healthy Red Blood Cells and Spherocytes, and for diagnosis of diseases like Hereditary Spherocytosis, etc. relies on separation by means of Fluorescence-activated Cell Sorting (FACS). The flow cytometer, which is the equipment required for FACS, is an expensive device to purchase and maintain, significantly larger in size than our invention and requires trained personnel for handling. Our designs provide an advantage over current cell sorting setups owing to its better handling and potentially lower prices of manufacture and operation. Since this is a micro-fluidic device, a scale-up would be much more feasible, which could facilitate handling of significantly larger quantities of samples simultaneously. This could thus be extended to primary healthcare centers and government hospitals in rural and sub-urban areas of India which do not have sophisticated facilities to handle expensive equipment like Flow Cytometers for sorting of cells, making diagnoses of such diseases feasible all over. This is a first attempt where sorting of discocytic RBCs from the spherocytes inside micro-channels has been explored. This has not been attempted in the previous studies, owing to its complexity due to the marginal differences in the physical properties of the two different cell types. The future work pertaining to this invention would involve experimentally modelling the microchannel designs and testing for both size-based and shape-based separation efficiencies of the healthy RBCs and Spherocytes. It would also involve experimental studies determining the effect of applied external electric field on the separation of spherocytes and whether it would improve the overall separation of healthy RBCs and spherocytes, over the designs with no applied electric field.

What was your experience during the process of filling the patents and what role did the IPR office play during the process of filing patent?

The process was essentially very smooth. I wrote the thesis of my B. Tech Project and one fine day during summers, my supervising professor asked me to submit my thesis so that he could submit it for "IP potential". Back then, I had no idea what that meant. He clarified to me that he wanted my work to be considered for a patent. I sent him the thesis sometime around July and so the process started in August. The IPR office directly contacted us and we were given around four to five big forms to fill, which took quite a lot of time to fill as they were quite extensive. All the required documents were also sent to the legal firm in Kolkata who were supposed to file it. They did a priority filing of sorts and it was filed within a month. Before filing, the firm contacted us to go through the complete draft. I visited the IPR office several times to clear my doubts since none of us has filed a patent earlier. They were very cooperative and the process was executed very smoothly.

Your message to the young inventors/ students to bring out novel technologies

The first thing is you need to do is try and get into research. I would totally discard the various myths associated with research, like it involves studying the entire day. It's just you working on your interest. If you come up with an idea, it might be that your department is not the right place to work on that idea, but there is definitely someone in this institute who would be willing to listen to your idea and offer you with the necessary help. So try and find that professor and make sure that you work hard enough to make your work worth publishing or worth filing a patent for. It won't just benefit you financially, but would also impact the entire population in a positive way. The feeling is satisfactory since you would be doing new and intellectually challenging work every day.

What are your future plans and are there any other patentable work on which you are working currently?

We are working towards developing the technology for rapid diagnosis of thalassemia. This work is based on drying blood and observing patterns.

Patent: Basics

Prof. Tapas Kumar Bandyopadhyay

A patent is considered as limited period exclusive right that is provided by State (country) to the patentee for his patentable invention in a particular jurisdiction/s (country/ies) where his patent is registered. It is also treated as negative right as patentee (whose name is registered as owner) can prevent 3rd party to use his patented product or process without his permission in that jurisdiction/s (where it is registered) during the term of patent. The term of patent is 20 years from the date of filing of patent application on that jurisdiction. There is no term world patent. Patent right is limited period, exclusive, and territorial right e.g. your Indian Patent is valid in India only. In India, Patent application can be filed by (a) any person claiming to be the true and first inventor of the invention, (b) by any person being the assignee of the person claiming to be the true and first inventor in respect of the right to make such an application, (c) by the legal representative of any deceased person who immediately before his death was entitled to make such an application. True and First inventor means the natural person/s who has/have contributed substantially to complete the invention. Invention means new product and or process having an inventive step (technical advancement and or economic significance that is not obvious to the person skilled in the art), and capable of industrial application (capacity to be used in industry). Now, substantial contribution can be interpreted as contribution without which the invention has not been completed. But, financial contribution does not qualify to be considering as inventor. On the other hand, intellectual contribution may be judged from laboratory note book or record. However, an employee of a firm may assign right to the firm for making application and in such case firm can apply for patent but proof of right as per section 7 (2) of The Indian Patent (Amendment) Act 2005 is required. Hence, patent system provides reward and incentive to the inventor following *quid pro quo* mechanism. The same can be traced/discovered from history of patent system.

The Patent system promotes science and technology. The technological advancement has been taking place over the time to provide solutions to existing problem e.g. 3G to 5G in communication technology. If we look back to trace the origin of present day CFL bulb/lamp, we have to traverse back as long as Edison's tungsten filament bulb. The existence of patent system is found in even 600 BC. The earliest form of patent existed in the 500 BC in Sybaris, Greece. It was granted in the form of exclusive right for one year. The exclusive rights were provided to creators of unique culinary dishes. The existence of patent system is also reported during Roman Empire. Early practice of reward for limited period by means of exclusivity was there in European countries also.

IPR Workshop – August, 2018

IPR workshop on Innovation, Invention and Creativity with a theme of Roadmap for Patent Creation was organized in two phases on 25th August and 8th September 2018. In the first workshop a total of **82** students/researchers have participated and the second workshop had a total of **72** students/researchers. The Technology Transfer Group students managed both the workshops. The workshop started at 9.30 AM and ended at 1.15 PM. Prof. M. Padmavati, Dean, RGSOIPL welcomed the participants and Prof. C. R. Raj, IPC IPR & IR briefly introduced the Institute patent filing procedures and patent portal. TTG students presented their role in the IPR activities in the campus and explained the patent abstract submission in the patent portal.

Prof. Gouri Ashok Gargate, RGSOIPL delivered the lecture on '*Roadmap for Patent Creation*' and taught the fundamentals of patent creation and patent filing in two sessions. The workshop was interactive and the participants put forward several queries and the speaker and other IPR team members clarified the queries and doubts. The video of this workshop is now available with this link https://youtu.be/QEjhGda9IBk

Upcoming IPR Special Lecture: 26th February 2019
IPR workshop: 1st Week of March 2019

TeamKART

TeamKART is an automobile research project under the Mechanical Engineering Department and SRIC, IIT Kharagpur. It is a team of undergraduate students from all years of study who design, fabricate and test formula-style single-seat race cars. These cars represent IIT Kharagpur in various international level formula student competitions. TTG members had a conversation with TeamKart…

What are some of the new modifications/technologies that TeamKART is working on implementing in its next model?

The next model of TeamKART, the K4, will be launched soon. The major modifications are a dynamometer tuned engine, for reliable and optimum performance; and a much more compact chassis than the previous model, for lowering the polar moment of inertia, for better handling of the car. It also incorporates various new technologies: an electronic gear shifter, for quicker shifting at just the

push of a button; a lithium ion battery, for higher energy density; anti roll bars, to reduce body roll; and an underbody diffuser, to generate downforce for better acceleration.

What are the basic challenges that a prototype needs to overcome in order to be considered a successful model?

The first objective for the car is that it should satisfy the various constraints as required by the competition rulebook, to ensure the safety of the driver. The basic challenge then, is to achieve the best possible performance within these constraints. The performance of the car is measured by its acceleration, braking and cornering capabilities. The ergonomics of the car is also evaluated. All these factors are considered in the design of the car. The final challenge is to fabricate a car which actually agrees with the design parameters, all in a constrained timeline.

What are some of the recent competitions of which TeamKART has been a part of?

TeamKART participated in Formula Bharat 2017, with its car K3. It was a national level competition with around 70 participating teams. The team successfully cleared the technical scrutiny and the tilt test and performed appreciably in the design event. The major achievement of the team was being ranked 2nd in the event for its Business Plan Presentation. TeamKART will soon be participating in Formula Bharat 2019, which will be held in Kari Motor Speedway, Coimbatore, in the month of January with its car K4. The car has been fabricated and is currently in its testing phase. This involves running the car daily, validating the working of various parts, checking the response of the car, and making modifications as per the feedback. The team is also working on the business, cost and design presentations for the event.

Autonomous Ground Vehicles

Team AGV is a multi-disciplinary research group aimed at building a self-driving car suitable for Indian road conditions. The project involves several aspects - Computer Vision, Deep Learning and Reinforcement Learning. The self-driving car has to perform challenging tasks like lane changing, intersection decision, parallel parking in the real-world environment, which require fault proof real time motion planning algorithms. The car has to "perceive", i.e. see and process useful information about its dynamic surroundings which requires a fast and reliable perception pipeline that can perform object detection, tracking, distance estimation. Team AGV has designed and implemented various vision based algorithms using monocular, stereoscopic and depth cameras for tasks like Pedestrian Detection, Dynamic Obstacle Tracking, Lane Detection and Road Segmentation. Recently the new in-house parabolic curve fitting based Lane detection algorithm enabled the glorious performance of the robot 'EKLAVYA-6' in the 26th Intelligent Ground Vehicle.

Faculty Inventor speaks…

Prof. MM Ghangrekar, *Department of Civil Engineering made remarkable contributions in the field of wastewater treatment. He speaks to TTG members on his innovation…*

You have received an award from the Ministry of Drinking Water and Sanitation for your project on smart microbial fuel cell and bioelectric toilet technology, which treats human waste and wastewater in use and also recovers electricity simultaneously. Can you tell us something about this project and the award?

This project is intended to offer onsite treatment to the sewage generated and to convert it into reusable quality treated water, (which can be reused for flushing, horticulture purposes, gardening etc.) and to be able to generate electricity. So it's facilitating the sewage treatment and also generating electricity and treated water with reusable quality standards. In India, under the Swachh Bharat mission the government is installing toilets for benefit of the people not having access to proper sanitation, but this toilet doesn't work efficiently unless there is assured water supply, which

is a must to maintain the hygiene of the toilet. Our invention helps in recycling the water and hence, the water will always be available for flushing and cleaning the toilets. This invention is particularly important for the places which are not connected to the electrical grids, women belonging to those places, are reluctant to use a toilet in the night. We can overcome this drawback through the indigenous electricity generated, that can be used for illuminating the toilet premises.

It is being presented as a pilot project with a capacity of 1500L volume which can treat nearly 200L of sewage generated per day. During the treatment, it is able to generate about 200 milliamperes of current, which is stored in 4 super capacitors, charged in parallel. The charge is then released in series which helps boost their voltage. The desired current can then be withdrawn for the illuminating toilet premises. Coming to the wastewater treatment performance, more than 95% biochemical oxygen demand is removed. It also facilitates the removal of pathogens, quantified as faecal coliform number, is being reduced to be zero or a single digit value which makes the water suitable enough to reuse for flushing. Though it is still not potable, it is safe for horticulture, or for cleaning purposes and any accidental contact won't be of risk to a human being.

One research scholar of the team received the *Gandhian Young Technological Innovation Award* last year for this project. We have received 2 awards in that category, in the same year, one for the membrane that we developed and the other for precision. This plant is in operation for 15 months now and it has been giving consistent performance. We also won a podium at an event held to commemorate the three years of completion of the Swachh Bharat Mission. Interestingly, we were the only academic institution within a pool of several industrial competitors, and we were successfully able to secure the third prize.

Can you explain the novel aspect of the invention or what makes it different?

What makes it different is the low cost. One of our primary concerns was to make the technology economically viable. Internationally available polymer membranes are extremely costly with prices ranging from $900 to $1,500 per square meters. For a cheaper alternative, we have developed ceramic membranes in our lab. The clay used in it has cation-exchange capacity. It is spiked by adding the cation-exchange gel. Special ceramic separators are used which helps in efficient transfer of protons from anode to cathode side in order to complete chemical reaction, so this is our invention, low cost ceramic which is quite cheaper, each membrane cost 10 rupees per square feet compared with cost of the $900- $15,000 per square meter that reduces the overall cost of the fabrication of the device drastically. Another innovative aspect is the design that we made. Internationally researchers have struggled to get efficiency of less than 1% (in terms of coulombic capacity) whereas we are able to demonstrate 4-6 percent coulombic efficiency in 1500L large reactors. We also assured the wastewater treatment capability by enriching the electrogenic culture without adding any toxic chemicals for the separation of pathogen by adding the selected plant extracts. Extracts are added intermediately in our MFC which gives us the enrichment of the bacterial culture in anodic chamber that helps in getting higher electrical performance

What was your experience during the process of filing the patents patent of this invention?

We always got the necessary support and guidance during the process and our doubts were addressed quite efficiently.

Can you tell us your experience in using the institute Patent portal?

Institute Patent Portal is very user-friendly. As most of the usage of the portal during the process is being done by our research scholars, there feedback was very positive and they didn't face any issues while using the portal

Are you planning to commercialize this technology? What are the industries that can benefit from this technology?

Urban and village local bodies and municipalities, being the providers of sanitation infrastructure, are the major stakeholders of this technology. We are making efforts to commercialize this technology. We have installed one plant in Netra Campus, Noida. We have also been approached by the Indian Oil Corporation Limited, who wants to construct several of these toilets. We have received a large quantum of requests and queries including one from African countries under the United Nations programme. However, I think it's best to take one step at a time, and right now, we are planning to work with IOCL.

Can you tell us the challenges that you and your students have faced while developing this new technology?

Any engineering problem brings with itself a number of obvious challenges. Thankfully, we were trained enough to handle these. Also the sanitary section of our institute helped us overcome a lot of challenges from time to time.

What are your suggestions for the IPR office for the purpose of protecting this technology?

Since the technology is novel, it should be protected. I have come to know that people are already commercially exploiting the ceramic membranes and a few plants have been established in other countries that are using our invention. We filed the provisional patent four years back and I do not have further expertise so as to tackle this. The geometrical shape and structure is different but the material is the same. Our patent offers protection within the Indian jurisdiction, but I do not have the idea as to how we should tackle the commercial exploitation internationally.

What are your future plans and is there any other patentable work on which you are currently working?

We are quite a motivated group, trying to do leading edge research and I am really thankful to my students and Research Scholars who always put in a lot of hard work. I feel really proud to say that with consistent efforts since the last 15 years, we are now among the top five publishers in bioelectrochemistry domain all over the world. We are looking forward to create more patentable work in the ceramic separator area under projects funded by DST, DPT or from joint Indian-European collaborations.

Apart from that we are also working on a project to crystallize carbon dioxide from biogas, (which typically contains about 30% carbon dioxide) using bioelectrochemical processes to synthesis value

added chemicals. We have obtained some encouraging results so far and we are looking forward to further optimize our performance.

Do you have any message for young inventors and students?

First and foremost, students need to keep themselves updated. In technology, the word novel bears a lot of weightage. To create something novel requires constant efforts, one needs to update themselves with state of the art literature. They need to develop the maturity to identify loopholes and simultaneously put in hard work, with reasonable intellectual efforts. The area is a gray area, and I would say that there is a lot of scope to develop. If one feels that one has a particular area of expertise, he/she can join hands with friends or colleagues for a joint contribution. The synergy of a group will help to take the work further, identifying and mending weak areas on its path. Simultaneously consistency is very important. Initial failures are always very normal. They help you to understand the loopholes and to answer the question as to why something didn't work in the first place, positive spirit and energy is the key.

In the News

IIT Kharagpur, Oxford develop technology for water treatment

THE ECONOMIC TIMES -22 MAY,2018

Researchers at Indian Institute of Technology-Kharagpur and University of Oxford have developed a low-cost technology to treat water contaminated with arsenic. In this new method, water is chemically treated by activating naturally available laterite that acts as an adsorbent to filter arsenic. The department of science & technology as well as the West Bengal public health engineering department and West Bengal arsenic task force have already accepted the technology. The collaborative research with University of Oxford includes efficient design of large-scale filters based on strong foundation of modelling from first principles. The Oxford team worked on the mathematical modelling techniques to predict the extent of arsenic contamination through the filtration bed and performance of the adsorption medium.

IIT Kharagpur develops tech to filter fake news about disasters

THE ECONOMIC TIMES- NOV 20,2018 The Indian Institute of Technology Kharagpur has come up with a solution that uses artificial intelligence to extract critical information from social media platforms that is difficult to obtain manually. This information can be used to determine the authenticity of posts and also pass on data to aid rescue and relief operations.The institute started with pilots on Twitter and WhatsApp during the 2015 Nepal earthquake and the 2016 Chennai floods. The project was jointly funded by IIT Kharagpur's Institute Scheme for Innovative Research and Development grant, Microsoft Research India and ITRA, Media Labs Asia and Department of Electronics and Information Technology. The institute along with its collaborators at Qatar Computing Research Institute (QCRI) has submitted a proposal to Microsoft Research India. "If the proposal gets accepted, we will collaborate with Microsoft Research and QCRI to develop the systems for aiding post-disaster relief operations," said Ghosh. The next stage for the institute is to develop web-based systems for aiding post-disaster relief operations.

Technology Transfer Group

TTG is a group of students, a body which comes under the aegis of SRIC, IIT Kharagpur that works on promoting, protecting the research, sowing the seeds of research culture in the campus and parallely also acting as the "Industry-Academic" link.

This 10 year old group was made by our Director, Prof. Partha Pratim Chakraborty, when he was dean of SRIC. Activities of these enthusiasts starts almost from the ground level including help for the researchers to choose domains from patent potential areas, law resources for the patent creation and finally to the creation of patent. The year 2018 witnessed implementation of one of the schemes of Technology Transfer Group, UG Portal. The portal is made to ease out the process of finding ongoing Projects among student community and connecting the students with the concerned faculty for further research related work.

Technology Transfer Group is headed by The Dean of SRIC, Dr. Pallab Dasgupta, and functions under the guidance of Prof. C.R. Raj. The Group acknowledges them heartily for their constant support and motivation.

Cartoon Corner: IP Filing