INTERNATIONAL

IoT development

The global Internet of Things (IoT) devices market is forecast to surge almost three-fold between 2017 and 2023, exceeding US $45.4 billion in revenue by 2023. Much of this explosive growth will be enabled by LPWAN (Low Power Wide Area Network) technology that possesses unique characteristics – making it particularly attractive for a growing number of deployments across sectors such as utilities, logistics and transportation, agriculture, and smart cities. LPWAN is a wireless communication technology specialised for interconnecting devices together, focusing on power efficiency and long range.

Frost & Sullivan recently collaborated with Murata Manufacturing to develop a White Paper, "Growing Industry Applications of LPWAN Technologies," to further demonstrate the functions and various adoptions of LPWAN technology. A unique 4C (Capacity, Consumption, Cost, Coverage) model was developed to highlight the key characteristics of the technology itself along with real life case studies from around the world.

As part of its research, Frost & Sullivan compared the 4Cs across eight industries and 24 sub-industries to establish a LPWAN Application Suitability Index. Some of the key findings from the index include agriculture as an emerging industry for LPWAN usage, indicating high potential for precision farming while manufacturing and smart city applications being still at nascent stages, mostly using cellular or hybrid technologies. With the diverse range of IoT devices and requirements, there is no one-size-fits-all approach, meaning both licensed and non-licensed LPWAN technologies could carve out their own niche without cannibalising the market share of each other.

"Convergence of LPWAN technologies and LTE (Long-Term Evolution, a 4G mobile communications standard) would be the logical route to address the wide range of IoT use cases. Availability of LPWAN at competitive pricing could outweigh concerns about proprietary technology," noted Tim Chuah, Associate Director, Automation & Electronics team at Frost & Sullivan Asia Pacific. "Partnerships and revenue-sharing business models also need to be explored more extensively in the coming years," Chuah added.

Frost & Sullivan's white paper is intended to serve as a reference point for business leaders and decision makers around the world to guide them towards adopting the latest LPWAN technologies applicable for their relevant industries while lowering costs at the same time. As a key vendor of LPWAN technologies, Murata remains committed to fostering innovation to consistently address the 4Cs (Coverage, Capacity, Cost, Consumption) of LPWAN application suitability for its wide-reaching end-users.

https://www.ruralmarketing.in

Sustainable method to filter salt, metal from water

Scientists have developed a new method to filter out salt and metal ions from water with a technology that could be used in a number of industries. A research team from Monash University, CSIRO, Australia and the University of Texas at Austin, the United States, have discovered that the membranes of metal-organic framework (MOF)—a next generation material—can mimic the filtering function or ion selectivity of organic cell membranes. "Produced water from shale gas fields in Texas is rich in lithium. Advanced separation materials concepts, such as this, could potentially turn this waste stream into a resource recovery opportunity," Benny Freeman, a professor from the University of Texas, said in a statement.

MOFs have the largest internal surface area of any known substance, with sponge like crystals that can be used to capture, store and release chemical compounds. The membranes have the potential to perform the dual functions of removing salts from seawater and separating metal ions in a highly efficient and ultimately cost effective manner.

"We can use our findings to address the challenges of water desalination. Instead of relying on the current costly and energy intensive processes, this research opens up the potential for removing salt ions from water in a far more energy efficient and environmentally sustainable way," Huanting Wang, a professor from Monash University, said in a statement. "Also, this is just the start of the potential for this phenomenon. We'll continue researching how the lithium ion selectivity of these membranes can be further applied."

Wang explained some of the other applications for the new technology. "Lithium ions are abundant in seawater, so this has implications for the mining industry who current use inefficient chemical treatments to extract lithium from rocks and brines," Wang said. "Global demand for lithium required for electronics and batteries is very high. These membranes offer the potential for a very effective way to extract lithium ions from seawater, a plentiful and easily accessible resource."

Reverse osmosis membranes are currently responsible for more than half of the world's desalination capacity and the last stage of most water treatment processes. However, these membranes can be improved by a factor of two to three in energy consumption and do not operate on the principles of dehydration of ions or selective ion transport in biological channels.

https://www.rdmag.com

ASIA-PACIFIC

AUSTRALIA

Graphene filter makes water drinkable

Last week, we reported on a breakthrough from researchers in Australia and the US that could make it possible to desalinize sea water inexpensively. The process involves a new class of materials called metal-organic frameworks that may also be able to extract minerals like lithium and gold from the oceans that surround us. One of the parties to that international research is the Commonwealth Scientific and Industrial Research Organization, Australia's premier research organization. CSIRO has also announced a new form of graphene it says can filter polluted water and make it drinkable in one step.

According to a report by *Engadget,* CSIRO calls its new product Graphair. It is a combination of graphene film and nanometer-size channels that allow water to pass but block pollutants. "All that's needed is heat, our graphene, a membrane filter and a small water pump. We're hoping to commence field trials in a developing world community next year," says Dr. Dong Han Seo, who heads the research. His team is now looking for commercial partners to help scale up the technology. It is also working on other applications for Graphair, such as desalinizing seawater and removing industrial effluents from waste water.

Part of the exciting news about Graphair is that is manufactured from renewable soybean oil, which makes it quick and easy to produce in a process that is environmentally friendly. Most water filters are degraded by oil byproducts, which have to be removed before filtration can begin, but Graphair can remove those pollutants without clogging up and can do it faster than any other method.

https://cleantechnica.com

CHINA

Technology revolutionizes agriculture

Zhang Pan used to think of agriculture as farmers wearing straw hats, carrying reaping hooks while laboring on the land despite strong winds or scorching heat. However, when he was accepted into a graduate program two years ago he realized that the natural environment can be controlled to prevent plants from harmful weather and improve productivity.

In the lab at Northwest Agriculture and Forestry University, where Zhang studies, a piece of equipment emits a purple light onto several lettuce plants sitting in water. The temperature, humidity and light intensity are monitored by a control terminal. Zhang and three other students from the university jointly developed the technology. "The equipment can control the root temperature of the crops and supplement sunlight at any time based on their needs," he said. "It is one of the techniques of protected cultivation."

Protected cultivation involves a series of techniques modifying the natural environment of plants to improve their quality and yield. Tests showed that the yield, levels of Vitamin C and amino acids in eggplants grown with help of Zhang's equipment saw an increase of 30%, 20% and 30% respectively, compared with those grown in open fields.

http://www.chinadaily.com.cn

INDIA

Solar study lamps for rural students

The Indian Institute of Technology-Bombay (IIT B) have initiated 'Solar Urja Lamp' (SoUL) that aims to provide solar study lamps to the rural students through skill transfer to local communities. Through this project, the institute is lighting up homes with renewable energy and providing rural women with the chance to become entrepreneurs.

According to an IIT-B professor Chetan Singh Solanki (who is part of the project), there are two types of solar lamps – module one and module two. Module one consists of a lamp that provides LED light and a solar panel that is placed outside under the sun. Module two solar lamp also consists of a mobile charging pin. The battery life of these lamps is 10 to 12 hours when on low mode and 5 to 6 hours when on high mode. Under this intervention, one million children in Maharashtra, Madhya Pradesh, Odisha and Rajasthan have been given the solar lamps. Last year, the ministry of new and renewable energy sanctioned the project after which around 70 lakh solar study lamps will be provided in Assam, Bihar, Jharkhand, Odisha and Uttar Pradesh.

Solanki who is from the Department of Energy Science and Engineering of IIT B and initiated the project in the year 2013 said it was done keeping in mind the eradication of kerosene lamps in villages especially among school children.

"We fail to realise but kerosene lamps emit carbon dioxide fumes which are inhaled by the children causing damage to their body. Also, as these lamps are inflammable there are high chances of mishaps like fire causing burn injuries or even death. Hence, the idea of using renewable energy (solar) is safe and this will build a solar eco system," said Harshad Supal, member of the technical team of SoUL project. Through this project, they want to promote education among the students but in an environmental friendly manner.

Faculty and students of IIT-B, along with the supply of these lamps will be training the women of villages to let them understand the solar technology. Apart from the lamps, IIT-B aims to introduce other solar products like home lighting, water pumps, solar cooking to build a solar eco system.

http://www.asianage.com

Solar technology for rural applications

Indian Institute of Technology Madras (IIT Madras) and Verizon Data Services India in collaboration with Southern Power Distribution Company of Telangana Limited (TSSPDCL) and Rural Electrification Corporation will now provide power using solar technology to 300 households across four hamlets in rural Telangana. IIT Madras developed this Solar Technology, which was technology transferred to and commercialized by Cygni Energy Private limited, an IIT Madras-incubated firm, which also carried out the installations. Verizon provided financial assistance of Rs. 75 lakh under Corporate Social Responsibility (CSR) for this project.

Ramunigundla Thanda, Kesya Thanda, Jogi Thanda and Mantriya Thanda are four rural hamlets of Devarakonda Mandal in Nalgonda district, Telangana. Predominantly dependent upon paddy and cotton farming for livelihoods, the hamlets are about 100kms from Hyderabad, located on Nagarjunsagar Road near Mallepalli.

The Inverterless System, comprising a 125Wp Solar Panel, a 1kWh battery, an Inverterless controller unit and DC loads operating on a 48V DC internal distribution line, were installed in all houses. It powers a DC fan, a DC tube light, two DC bulbs, a DC mobile charger, a DC power socket and a remote controller to operate

the fan and tube light. Installations were completed by June, 2017 and everything has been working flawlessly. The performance and health of all the installed systems are being monitored remotely, with data being collected via mobile phones and synchronized to a central server.

The project was implemented under Prof. Ashok Jhunjhunwala, Principal Advisor, Ministries of Power and New and Renewable Energy, Government of India, and Professor (On Sabbatical), IIT Madras. He said, "Today, millions of homes in India either do not have grid connectivity, or suffer from power outages for large fraction of the day. This is a very serious challenge as majority of these homes fall under low-income category and cannot afford power even with some subsidy. Solar DC Inverterless technology deployed in the 300 homes of Devarakonda, Telangana tackles this problem and shows how, with a small 125W solar panel on the home rooftops, the dynamics of electricity in India could be transformed."

https://tech.economictimes.indiatimes.com

Garden waste into fuel pellets

A new study by researchers from Indian Institute of Technology Bombay, Mumbai has, for the first time, demonstrated an efficient way to convert garden waste into fuel pellets that could be used for cooking. Many urban households, and a few rural ones, sport a garden in the backyard, often populated with flowering and vegetable plants and some trees. The gardens also are a hotspot for a host of biodiversity, like butterflies, birds, reptiles and rodents, often attracted to the greenery that grows there. Garden owners are also fond of keeping their gardens clean, often trimming the overgrowth and cleaning off fallen leaves, twigs and other biomass. The garden waste that is generated after cleaning is usually burnt or disposed off. What if all that waste needn't be wasted but can instead be put to good use, by converting it into fuel for cooking?

Scientists from IITB have been exploring ways to do exactly this. In their new study, the scientists have developed a method to convert the garden waste biomass into fuel pellets that could be burnt for usable energy. The fuel pellets that are formed could be used in stoves as an efficient substitute to firewood and other fuels.

Various parameters, like moisture content, milling size and die size, of the pellets that were formed were further probed for optimal performance using regression models- a statistical tool. Their study showed that an increase in the moisture content of the biomass affected the durability of the final product. It also revealed a biomass moisture content of around 6% and a die size of 15mm were ideal for the pellets formed to perform efficiently. The pellets were also probed under a Scanning Electron Microscope to study the effect of moisture on the final product, which showed the pellet particles sticking closely together when the moisture content in the biomass was considerably low.

If commercialized, the technology could be used as a suitable substitute for cooking gas and other fuels in low income households. "We deduced from the combustion test that garden waste pellets may be conveniently used in a residential cookstove" claim the researchers about their new technology

https://researchmatters.in

Eco-friendly cement

A research collaboration between India and Switzerland on a new cement material that can reduce carbon dioxide emissions in the manufacturing process is set to take off into implementation. The construction sector is a major contributor to global carbon dioxide emissions. Though this is known, it appears difficult to reduce the scale of construction, especially as it is a route to establishing more equitable conditions in developing countries like India. One way of mitigating the emissions factor is the use of Limestone Calcined Clay Cement or the LC3 technology.

Traditional processes that manufacture cement from clinker-limestone or clinker-calcined clay combinations are well known. LC3 effects a synergy between these processes. The combination of the new method and the material properties effectively reduces carbon dioxide emissions by 30% as compared to the traditional way of manufacturing cement. Research on this evolved over ten years in Karen Scrivener's lab at the Swiss Federal Institute of Technology (EPFL) at Lausanne, in Switzerland. Partners in this research are IIT Delhi, IIT Madras and TARA (Technology and Action for Rural Development).

In manufacturing portland cement, limestone and materials like clay are heated together in huge kilns to high temperatures (approximately 1,450 degrees C), so that they fuse without melting to give clinker. "This is the most CO_2-intensive part of the whole process. The carbon dioxide comes both from the burning of the fuel needed to create that temperature and due to the breakdown of limestone into calcium oxide and carbon dioxide. The latter part accounts for 60% of the CO2 emissions in manufacture of cement," says Prof. Scrivener. The best thing to do would be to substitute CO2-intensive clinker with a different material.

In India, fly ash – a waste produced in the burning of coal for producing energy – is used in the manufacture of blended cement. However this is used in a lower proportions and only where available; therefore, for effectively reducing emissions, more clinker is to be substituted with calcined clay and limestone. This reduces emissions by 30% with respect to portland cement.

To take this product from the lab to commercial use requires that the cement be certified by reputed research and testing centres, and for this purpose, Prof. Scrivener's team has collaborated with Indian and Cuban agencies. The results of the Indian tests were published in *The Indian Concete Journal,* special issue on cements. Nearly ten tonnes each of four blends of LC3 (50% clinker, 30%calcined clay, 15%crushed limestone and 5% gypsum) were produced in India. To obtain a variation, clays and limestones of two different qualities were used. The LC3 obtained was used to manufacture solid and hollow concrete blocks, door and window frames, low duty paving blocks and roofing tiles, and to make roads.

"Good results were obtained from the blends despite the sub-optimal conditions of production of the cement, demonstrating the viability and robustness of the technology," Shashank Bishnoi of IIT Delhi and other authors write in the paper. The authors compared the strength of the various LC3 samples with Ordinary Portland Cement (OPC, a popular type of cement) and Portland Pozzolanic Cement (PPC, a variation of OPC in which locally available fly ash was added). They found that the strength of the LC3 made with low quality clay was comparable to the OPC and the samples of LC3 containing superior quality clay was higher than the OPC.

http://www.thehindu.com

EUROPE

UK

Solar water purification

Researchers at the University of Edinburgh have designed a water purification system that harnesses the sun's energy to decontaminate polluted water. According to "India-Situation-and-Prospects" of UNICEF, millions of people in India die every year from diseases like diarrhea and pneumonia related to contaminated water, including 600,000 children.

Sewage often pollutes the water supply in India's countryside, where 70% of the population resides. The Indian government has focused primarily on treating the water in rivers and streams, but Neil Robertson, professor of chemistry, and his team at the University of Edinburgh took a different approach. "The use of solar photocatalysis to destroy pollutants has been worked on before," Robertson told Seeker. "In our work however, we have made improvements to the material most-typically used by improving the amount of visible light absorbed and improving the efficiency of the photocatalytic process."

Robertson's solar-powered system takes high-energy particles from the sun and induces them within a photolytic material, creating a chemical reaction. Oxygen molecules are activated to break down bacteria and other organic matter in the water. The materials don't need a power source, so the technology is easy to set up off the grid. It only needs to be hooked up to containers of contaminated water and pointed toward the sun.

"Our aim is for a very simple technology with very low cost, applicable to the domestic environment," Robertson said. "It could be rolled out across the same rural domestic context across India." Although this technology is an innovative advancement in the field, it's not yet a catch-all solution to India's overall water contamination problem. "While interesting and promising, I'm not convinced that this approach deals with the full chain of water quality issues that are relevant for large swaths of rural India," Pavani Ram, associate professor of epidemiology and environmental health at SUNY Buffalo, told Seeker. "This approach might lead to water disinfection but doesn't seem like it would prevent recontamination of the water," Ram continued. "[This] can happen if water is stored in wide-mouthed containers or otherwise comes into contact with unwashed hands or other sources of contamination."

Ram points out that water in some parts of India, particularly the northeast, can also be contaminated with particles other than microbes, for example: "arsenic, [dangerous levels of] fluoride, and other chemical contaminants, which can be very damaging to human health," she said. "We can no longer afford to look only at the microbial quality of water." Robertson and his team recently partnered with the Indian Institute of Science Education and Research. They're working towards scaling up this technology and hope it will be useful in some of the many other countries where accessing clean water is still a daily struggle.

https://www.seeker.com

Algae-powered solar cell for rural communities

Cambridge team separates charge generation and power delivery in algae solar cells, enabling energy storage function. While most research into photovoltaic technology focuses on mineral-based mechanisms, from crystalline silicon to the promising perovskite materials, there are other possibilities. One of these exploits the most successful type of solar energy generation, photosynthesis, which has been powering the planet's plants for aeons.

Biological solar cells generally use single-celled plants — algae — to harvest solar energy. The Cambridge team, comprising chemists, biochemists and physicists, now claims to have overcome one of the biggest obstacles to developing this technology: the conflicting demands of generating electrons and converting them into useful electric current.

Previous biophotovoltaics (BPVs) have co-located these two functions in the same chamber; algae absorb sunlight, generate electrons, some of which are secreted outside the algae's cell walls, and immediately inject these electrons into an electrical circuit. But this is not an efficient method, explained Kadi Liis Saar, of the Department of Chemistry. "The charging unit needs to be exposed to sunlight to allow efficient charging, whereas the power delivery part does not require exposure to light but should be effective at converting the electrons to current with minimal losses."

The team designed a system where the two functions are separated into distinct chambers, using microfluidic technology in the power delivery chamber. "Separating out charging and power delivery meant we were able to enhance the performance of the power delivery unit through miniaturisation," explained Professor Tuomas Knowles from the Department of Chemistry, also affiliated to the university's Cavendish Laboratory. "At miniature scales, fluids behave very differently, enabling us to design cells that are more efficient, with lower internal resistance and decreased electrical losses."

In a paper in *Nature Energy*, the researchers explain how the power conversion chamber uses laminar flow to separate fluid streams containing positive and negative charges, allowing it to work without membranes. Moreover, the algae used were genetically modified to minimise the amount of charge generated that could not be converted to current. Together, these in-

novations allowed the cells to generate power density of 0.5W/m^2, five times that of previous designs.

This is still well below power densities of inorganic photovoltaics, the researchers admit. "While conventional silicon-based solar cells are more efficient than algae-powered cells in the fraction of the sun's energy they turn to electrical energy, there are attractive possibilities with other types of materials," said Professor Christopher Howe from the Department of Biochemistry. "In particular, because algae grow and divide naturally, systems based on them may require less energy investment and can be produced in a decentralised fashion." This might be particularly useful in rural Africa and South Asia, where established grids may not exist and cells could be made in local communities without the need for the hjgh-tech factories required by inorganic PV technology.

https://www.theengineer.co.uk

NORTH AMERICA

CANADA

Chemical-free water purification for rural communities

The University of British Columbia (UBC) engineers have found a way to help remote communities gain access to drinking water by creating an affordable water-purification system that doesn't use chemicals. The system uses membrane tubes to filter non-potable water into drinkable water, a technique West Vancouver, Abbotsford, and several other B.C. communities already use. But those conventional membrane filters for water use chemicals to keep the membranes from getting clogged up, and UBC professor Pierre Berube has found a way to use gravity to rinse the membranes periodically, erasing the need for chemical cleaners. It also drops the operational cost of turning grey water into drinking water "to essentially nothing."

"Often in smaller communities, there is capital available to build the water system but it's difficult to get operating capital," said Berube, a civil engineer. Berube's water-purification system is essentially self-cleaning, with the only mechanism being a valve that opens and closes, mimicking the effects of turning the system on its head every once in a while to let gravity do its work. Water and air bubbles rush up over the membranes when the valve switches, much like a when a pop bottle is turned upside down, he explained. That movement is enough to dislodge most of clogged debris.

The lack of chemicals also has the added benefit of allowing microbiology communities to grow on the membranes, surviving on the contaminants stuck on the outside of the tubes. "Those micro organisms will slowly eat away at those retained contaminants. They munch away on [them]," said Berube. His team is currently using a test system installed in West Vancouver to put the finishing touches on the design. The water, although 100% safe to drink, is not going to residents, Berube said.

http://www.metronews.ca

USA

Mapping technique for fighting poverty

An Indian-origin scientist in the United States has developed a novel technique that combines cellphone records with satellite data to create timely and incredibly detailed poverty maps, which may be useful in areas of war and conflict, as well as remote regions. For years, policymakers have relied upon surveys and census data to track and respond to extreme poverty.

While effective, assembling this information is costly and time-consuming, and it often lacks detail that aid organisations and governments need in order to best deploy their resources.

"Despite much progress in recent decades, there are still more than one billion people worldwide lacking food, shelter and other basic human necessities," said Neeti Pokhriyal, the study's co-lead author, and a PhD candidate at the University at Buffalo in the US. "This study details a newer mapping technique for poverty using different data sources than traditionally used," Pokhriyal told PTI. She jointly led the study along with Damien Jacques, from Universite Catholique de Louvain, Belgium.

Some organisations define extreme poverty as a severe lack of food, health care, education and other basic needs. Others relate it to income; for example, the World Bank says people living on less than US$ 1.25 per day (2005 prices) are extremely impoverished, researchers said.

The latest study published in the journal *PNAS* focused on Senegal, a sub-Saharan country with a high poverty rate. The first data set were 11 billion calls and texts from more than nine million Senegalese mobile phone users. All information was anonymous and it captured how, when, where and with whom people communicate with. The second data set came from satellite imagery, geographic information systems and weather stations. It offers insight into food security, economic activity and accessibility to services and other indicators of poverty, researchers said. This can be gleaned from the presence of electricity, paved roads, agriculture and other signs of development.

The two datasets were combined using a machine learning- based framework. Using the framework, the researchers created maps detailing the poverty levels of 552 communities in Senegal.

Pokhriyal, who began work on the project in 2015, said the goal is not to replace census and surveys but to supplement these sources of information in between cycles. "The study does not try to replace census. Instead, provides a way to produce inter-censal or interim statistics on poverty, that can be generated in between cycles of census," she said. The approach could also prove useful in areas of war and conflict, as well as remote regions. The framework also can help predict certain dimensions of poverty such as deprivations in education, standard of living and health, said Pokhriyal. Unlike surveys or censuses, which can take years and cost millions of dollars, these maps can be generated quickly and cost-efficiently. And they can be updated as often as the data sources are updated. Their diagnostic nature can help assist policymakers in designing better interventions to fight poverty.

http://www.tribuneindia.com