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POTENTIA

volume 15

EEE
360^0

YOUNG INNOVATORS
celebrating the entrepreuners of TKM

COVID-19
Rising up from the challenges

Department of Electrical and Electronics Engineering
TKM College of Engineering, Kollam

Our Founder

Janab A. Thangal Kunju Musaliar

Standing live at the forefront of Engineering Education with the vision of excellence in education and research with socio-economic and environmental outlook, ever since its inception in 1958 by the great visionary, philanthropist and social reformer Janab A Thangal Kunju Musaliar, TKM College of Engineering has never failed in instilling colour to the dreams of all those who dwell in. Over the years of existence, the institution has emerged as a kaleidoscope of diversity and vibrancy, transfiguring the way technical education is imparted and practiced.

Through the ever growing number of alumni spanning over the globe, managing variant roles in different domains, the institution is always involved in the process of betterment of this world. Team Potentia pays respect to this campus, our abode, which has offered a better future to the nation, in all its years of excellence and glory.

TKM COLLEGE OF ENGINEERING

Message

Greetings from the Department of Electrical and Electronics Engineering of TKM College of Engineering. Let me begin by congratulating the Editorial Board for the efforts they have taken in bringing forth the latest edition of POTENTIA, the technical magazine published by our department since 2004. The students, faculty and staff have always striven to improve the quality of our magazine year after year. The current edition is undoubtedly a perfect blend of topics from energy, environment, computation, data science and e-mobility. The articles are compiled by the editorial board from the contributions of students from all the batches and the faculty of the department.

This volume of POTENTIA is being released during the COVID era. In these trying times the students and faculty have coordinated the entire academic experience to the best of their abilities by staying home and ensuring everyone's safety. The new mode of online education has completely transformed us into a "user id" and "password". Our existence is now checked by our presence in the online media. This cyber physical interaction has created immense challenges to the our students, especially in their placement opportunities. In spite of being away from each other, our team of editorial board could consolidate sufficient material for this edition of POTENTIA. I feel really excited about this venture and wish all the students a prosperous future.

With Regards,
Dr. Bijuna Kunju K.
Head of the Department

Staff Editor

While the country and the world are combating the pandemic of COVID-19, educational institutions are struggling to find options to deal with this challenging situation. During this crisis, the Department of Electrical and Electronics Engineering has taken a bold initiative to publish its annual in-house technical magazine, Potentia - 15, which provides a platform to instill technological, literary and managerial skill to the students of EEE.

As this pandemic situation demands unity to protect and save our students, faculty, academic staff, communities, societies, nations and humanity as a whole, this situation has challenged education systems towards a paradigm shift of online learning, overnight. The batches of 2020 will be remembered in history as the ones that overcame the pandemic and came out strong towards building the nations and making the world a better place for future generations to thrive.

Our editorial team has quickly adapted to these changes in a short period and was able to maintain the quality of the magazine in its minute aspects, as well. The share of all the contributors with their online efforts are sincerely acknowledged and commended hereby.

It was indeed a privilege for me to be part of this team as Staff Editor. I am thankful to the faculty, staff and students of the Department who have supported and contributed in making this magazine a success.

With Regards,
Prof. Shyba S.
Staff Editor

The Team

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Editorial

"The whole of science is nothing more than a refinement of everyday thinking."

Sir Albert Einstein through these words has rightly laid the foundation beneath all the cutting edge technologies in today's world.Everything from transistors to humanoid robots were just mere illusions years ago,which were given wings to later shape the world we live in today.

POTENTIA '15 is an immensely pleasurable attempt to bring out the top notch technologies in the field of Electrical and Electronics Engineering and to foster the understanding of the fellow readers with regard to the same. In addition,it's also a glimpse of the pride and laurels that the students have earned for the department of Electrical and Electronics Engineering with their ability to stand out in various domains. Besides that, it also encloses the creative ideas turned solutions by the students for maintaining hygiene and good health among the people while battling against the novel Coronavirus.

This edition of POTENTIA also includes a segment called "Young Innovators", dedicated to listing out the ingenius start-ups concieved by our brilliant classmates. We hope to be the first to congratulate them on the success they are sure to achieve in the coming years.

Putting together this magazine amidst the chaos of the pandemic was deemed to be nearly impossible. But as the famous Walt Disney once said,"*It is kind of fun to do the impossible*". Hence we thank all the students and faculty who moved mountains with us while giving us timely support and motivation!
We hope you find reading this magazine to be as pleasurable as it was for us while making it.

Happy Reading!

The Editorial Team

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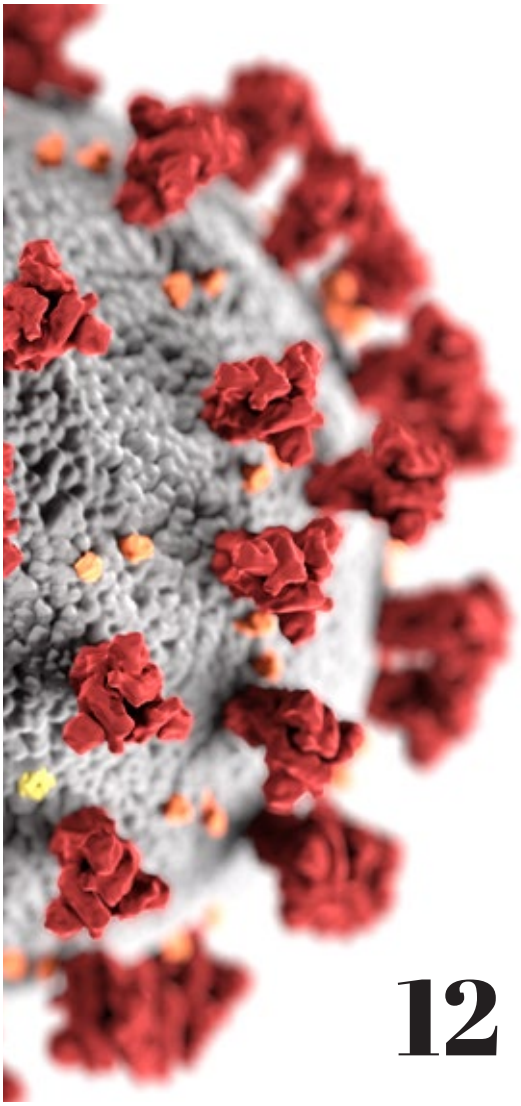
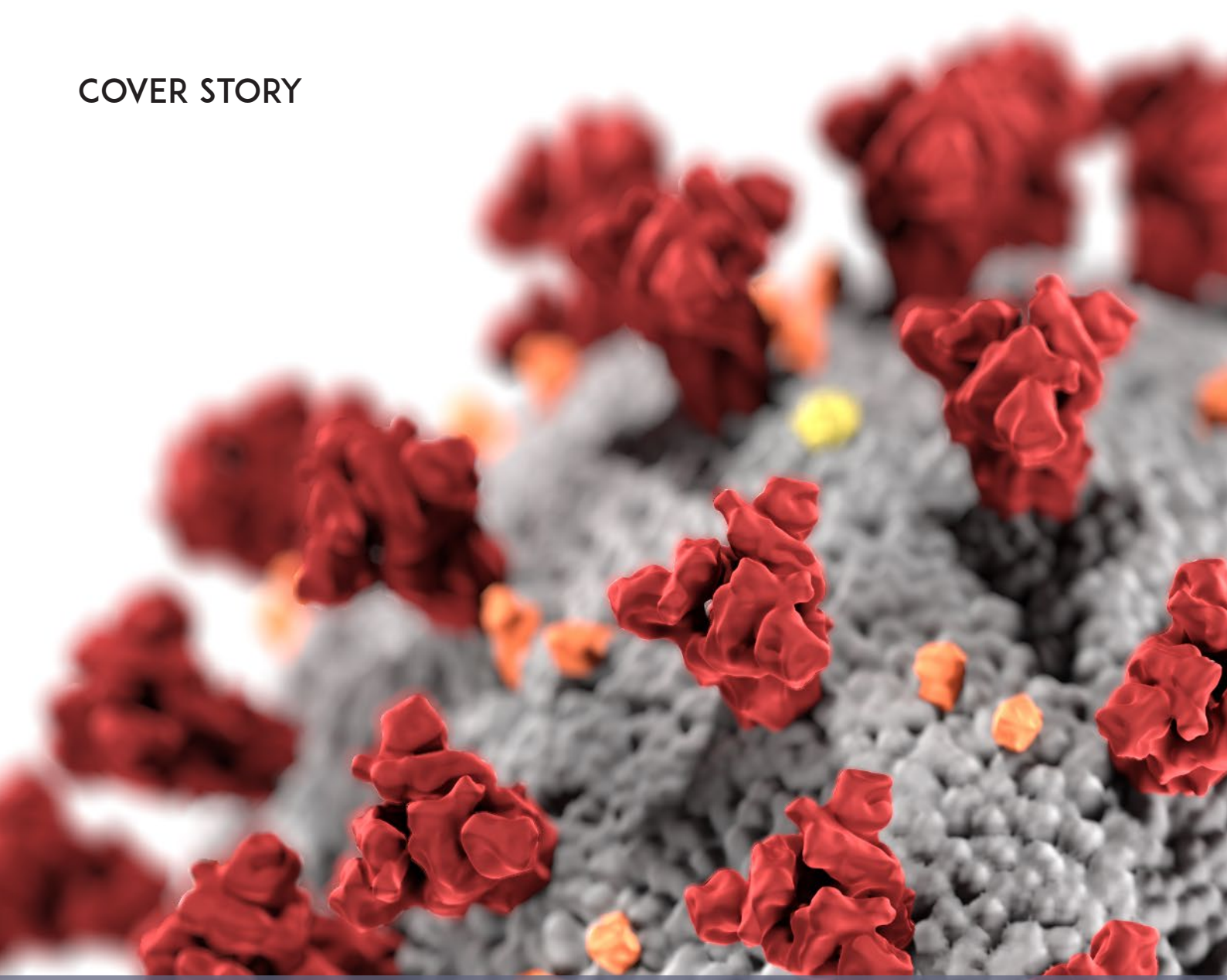


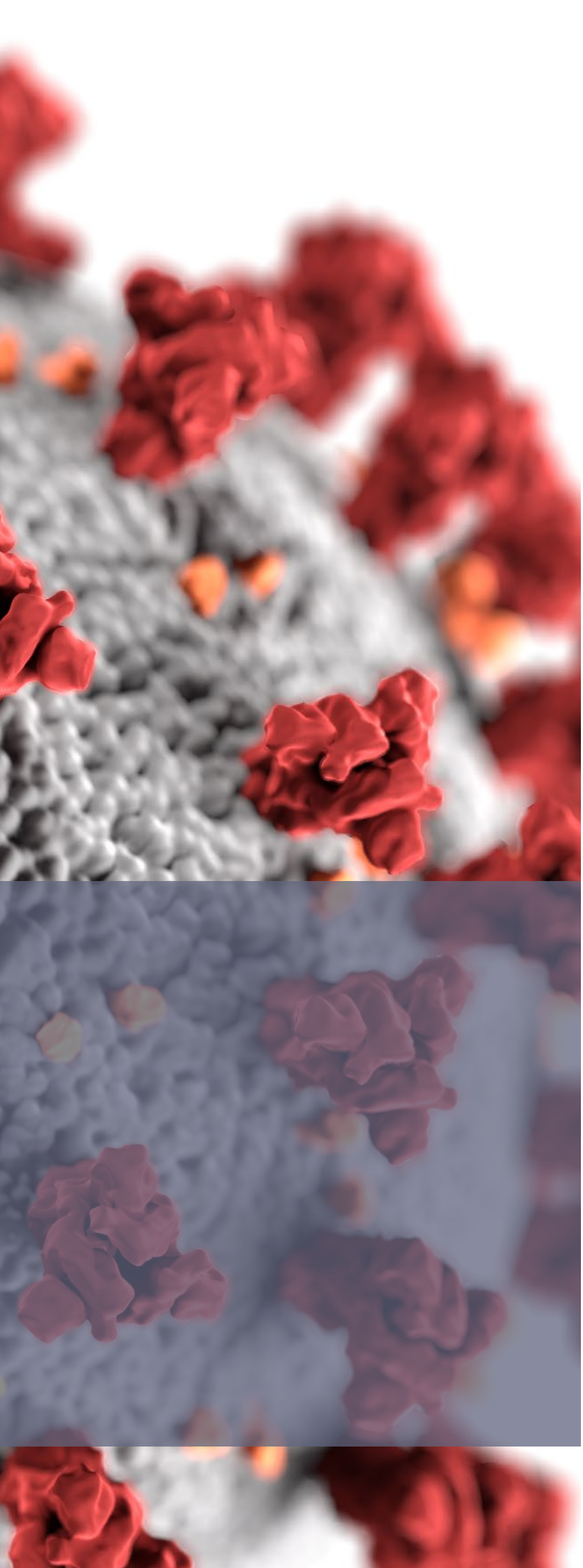
Potentia

volume 15



COVID-19
Rising up from the challenges

BY KRISHNAPRIYA U., 2ND YEAR



Over the past several months, our international community has been challenged by COVID 19 pandemic, a global health crisis that has impacted many peoples all over the world. During this evolving public health situation, our most important priority has been the safety and wellbeing of our humanity. Recent events highlight the essential role of science and technology and the crucial need for knowledge, innovation, and application across academic, public, and private sectors.

The COVID-19 pandemic is defining the global health crisis of our time and the greatest challenge we have faced since World War II. Since its emergence in Asia last year, the virus has spread to every continent except Antarctica. It has been declared a global emergency by the World Health Organization as the outbreak continues to spread. Its outbreak all over the world has disturbed the political, social, economic, religious, and financial structures of the whole world. The pandemic has pushed the global economy into a recession which makes the economy start shrinking and growth stops. Further an early analysis by the International Monetary Fund reveals that the manufacturing output in many countries has gone which reflects a fall in external demand and growing expectations of a fall in domestic demand. It is also observed that the economic recovery from this fatal disease is only possible by 2021 because it has left severe impacts on the global economy and countries to face multiple difficulties to bring it back in a stable condition.

The outbreak of COVID-19 has created a deep impact on the way we perceive our world and our everyday lives. Not only the rate of contagion and patterns of transmission threatens our sense of agency, but the safety measures put in place to control the spread of the virus also require social distancing by refraining from doing what is inherently human, which is to find solace in the company of others. Countries are racing to slow down the spread of the virus by testing and treating patients carrying out contact tracing, limiting travel, quarantining citizens, and canceling large gatherings such as sporting events, schools, etc. When it comes to the human cost of the coronavirus pandemic, it is immeasurable.

Therefore, all countries need to work together with cooperation and coordination to protect the human being as well as the economic, social, and health sector damages.

Health Workers are at the front line of the COVID-19 outbreak response and as such are exposed to hazards that put them at risk of infection. Hazards include pathogen exposure, long working hours, psychological distress, etc. Effective health communication for the adoption of sustainable preventive and effective strategies for helping individuals in dealing with social and physical distancing marked the urgent need for new technologies. It has been interesting to see emerging technology play a major role in response to the pandemic. Technological companies, big and small pivoted to join the fight against the coronavirus and to fast track efforts to help entrepreneurs develop technologies to address the pandemic. University researchers and their students are also playing key roles in the analysis and response. In addition to biomedical technology, Artificial Intelligence and Robotics have become indispensable resources in the fight. Deep Learning models are being used to assess existing and new drugs that might aid in successfully treating COVID-19. Hospitals have deployed AI tools to help and detect COVID-19 on chest scans and use deep learning algorithms to diagnose triage, and monitor CoronaVirus cases from lung images. Technology cannot prevent the onset of pandemics. However, it can help to prevent the spread, educate, warn, and empower those on the ground to be aware of the situation and noticeably lessen the impact. Today with converging technologies like mobile, cloud, analytics, robotics, and AI/ML, it has become possible to test several innovative approaches to the pandemic response. This healthcare crisis is driving new developments in robotics after seeing the successful usage of robots in the battle against COVID-19. Robots can perform repetitive chores such as delivering supplies to medical staff, freeing hospital workers to do more important tasks. Robots are taking on dangerous and careful jobs including handling nasopharyngeal sampling swabs and decontaminating medical equipment and facilities. Robotic vehicles are being developed to support contact-less deliveries and quarantines.

Tracking people with facial recognition and big data

In the case of pandemic management, big data analytics can help in quickly identifying

infected individuals, connect with them, track who they have come in contact with, and so on. Facial recognition technologies along with data can accurately identify people even if they are masked. Such technologies can help in monitoring movement and tracking of people who are quarantined. It can also help in keeping a tab on people and ascertaining whether or not they have been in contact with an infected person. CCTV cameras along with facial recognition technologies can help in identifying infected people who break the rules and step out despite being quarantined.

Positioning technologies

It is known that positioning technologies play a crucial role during the time of crisis and disasters. Government agencies and first responders on the ground require precise positions to accurately assess the situation, pinpoint the riskiest areas, and carry out relief and rehabilitation efforts accordingly. In the case of epidemics and outbreaks too, GNSS comes in quite handy. In China, BeiDou, the country's own GNSS constellation, helped track patients and affected places, thus containing the virus, apart from analysing the pattern of the outbreak. With the help of reliable data and precise mapping and imagery, China could build thousands of new makeshift hospitals across the country

Drones

In some of the severely affected areas, where humans were at risk of catching the virus, drones came to the rescue. Drones were transporting both medical equipment and patient samples, saving time and enhancing the speed of deliveries, while preventing contamination of medical samples. Drones were also flying with QR code placards that could be scanned to register health information. Agricultural drones were spraying disinfectants in the countryside. Drones powered with facial recognition were also being used to broadcast warnings to the citizens to not step out of their homes, and chide them for not wearing face masks. Antwork, a group company of Japanese drone maker Terra Drone, carried medical samples and other essential materials in Xinchang when the city was grappling with the virus

Autonomous vehicles

At a time of severe crunch of healthcare professionals and the risk of people-to-people contact, autonomous vehicles are proving to be of great utility in delivering essential goods like medicines and food items. Apollo, which is Baidu's autonomous vehicle platform, has joined hands with self-driving startup Neolix to deliver supplies and food to a big hospital in Beijing. Baidu Apollo has also made its micro-car kits and autonomous driving Cloud services available for free to

companies fighting the virus. Idriverplus, a Chinese self-driving company that operates electric street cleaning vehicles, is also a part of the mission. The company's flagship vehicles are being used to disinfect hospitals.

Mobile tracking/mass surveillance

In order to effectively fight the virus, created a massive surveillance system by gathering people's smart-phone location data, body temperatures, travel history and other details in a centralized database, in which the data is being analysed using Big Data and Machine Learning.

Thousands of facial recognition-powered CCTV cameras have also been installed at almost every quarantine centre and only those who have been assigned the green colour code are allowed to drive on the roads. Using this data, we can find out the number of people with whom an infected person was in close contact and order them to self-isolate themselves.

Today the greatest risk of worldwide catastrophe is pandemic, an enormously infectious virus that's more devastating and may kill many people. The transparency that we have gained through this current COVID-19 situation, we now understand that we were not geared up for this pandemic situation. The next pandemic is not a matter of "if it happens", but "when it happens", would we be prepared in advance against the pandemic at an individual and collective level. What we actually need is preparedness. Indeed, the technology has advanced more and will continue to advance exponentially, but the human institutions and societies need to accelerate in adapting to it and continue investing in building the technology systems for the preparedness. After the COVID-19 outbreak, it is evident that, from AI to robotics, technological innovations are helping to manage the epidemic and better equip it to fight future public health emergencies in a timely, systematic, and calm manner •

Hybrid Solar Dryer

An elegant solution for the tedious process of cashew nut processing

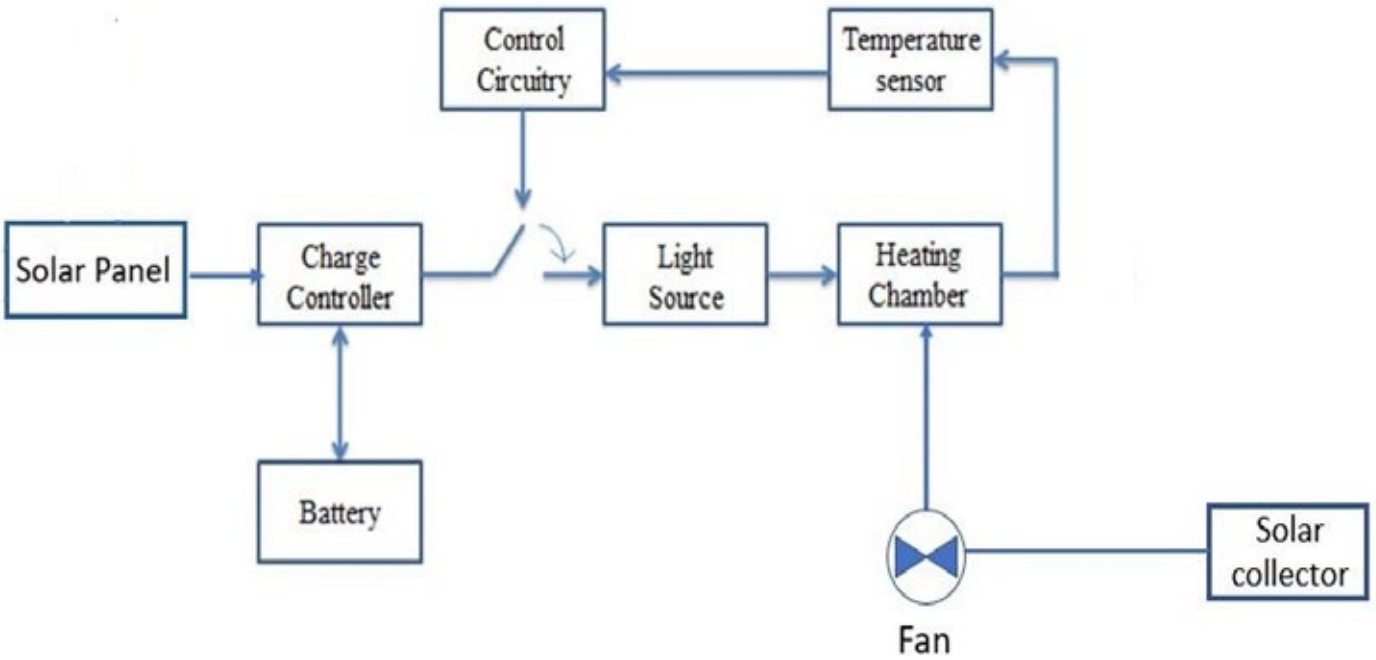
BY ANAKHA GIRI, GAYATHRI S. PILLAI, PRANAV PRAMOD & STEPHEN C. PHILIPOSE

Food dehydration is based on the maximum removal of moisture from food in order to inhibit the growth of bacteria, mould and yeast. Drying provides the possibility of restoring surplus products due to its longer shelf life, for future use. The district of Kollam in Kerala, India is known for its cashew industry.

The cashew industry in India is the livelihood of more than a million employees, a vast majority (more than 90%) of whom are women from the socially and economically backward section of rural and suburban villages. An equal number of people are indirectly employed in the cashew sectors itself. These include farmers, farm labourers, traders, agents, retailers, wholesale sellers and so on.

Within a cashew nut factory, various industrial operations are undertaken for transforming the cashew fruits to the fragrant edible cashew nuts. Traditionally, various processing operations were performed manually by experienced semi-skilled workers. This is still the case in India, which is the world's largest producer of cashew kernels. Since the 1960s, various mechanized pieces of equipment have been developed and are available in several countries. The processes that have been mechanized are roasting, cashew nut shell liquid extraction and shelling. The process of drying stands out as an important processing step, as the quality of the final product vastly depends on it.

Traditionally , in low scale industries the process of drying is carried out manually.
Raw cashew nuts are usually kept in open yard and are dried in the sun for 2/3 days and are rolled over on a regular basis to ensure proper drying. Most existing cashew industries use fossil



Schematic diagram of Hybrid Solar Dryer

fuels in order to generate the heat required for drying. However, both methods have their own disadvantages of being unsustainable and high operational costs ,low profits and time consuming , which have led to the closure of 80% of cashew industries across India. As a result, there is a need for an efficient and sustainable drying mechanism.

Project Overview

The proposed solar dryer is a device that performs the drying of different products with the use of renewable resources, in other words, performs dehumidifying operations without even consuming 1 W of electricity from the utility grid. The system consists of a heating chamber which is irradiated by required light sources. Temperature sensors are enabled in order to control the temperature inside the heating chamber. Thus, the proposed hybrid solar dryer is a clean, sustainable, and industrially relevant idea which can be implemented to bring about a novel method to revive the declining cashew industry.

The proposed hybrid solar dryer makes use of two distinct sources of heat for the drying process, i.e. the infrared (IR) lamp and the heat from the solar collector. The collector is taken as the primary source of the system (except in contingency situations). The desired temperature for the drying process is in the range of 85 ° C - 90 ° C. The solar collector can provide temperatures of up to 60 ° C on an average sunny day. The remaining heat required to achieve the desired drying temperature is provided by the IR lamp, which acts as the secondary source of the system.

The IR lamp is powered using a 300W 12V PV module through a 30A 12V Luminous charge controller. A rechargeable 100AH 12V Agnes Amptek battery is used for storing the excess energy. LM35 Arduino temperature sensor is installed in the drying chamber and an Arduino UNO based control system ensures the desired temperature in the chamber by ON-OFF control of the IR lamp. 85^0 C is selected as the lower control (or IR lamp ON) temperature and 95^0 C is selected as the upper control temperature.

The IR lamp has a life span of 5000h and can provide temperatures of up to 90^0 C in a well-insulated environment. In the event of a contingency, the IR lamp can act as the primary source with the help of the battery backup and still continue to generate the desired drying temperatures

Overall Design

The system consists of a drying chamber which is used to dry the cashews using heat from two sources i.e. a solar panel powered IR lamp and a solar collector. The solar panel and IR lamp are interfaced through a charge controller-based control circuitry.

A battery storage and backup system are also provided to account for the variations in climatic conditions. The developed 3D model of the overall system is as shown in Figure 1.1 and Figure 1.2.

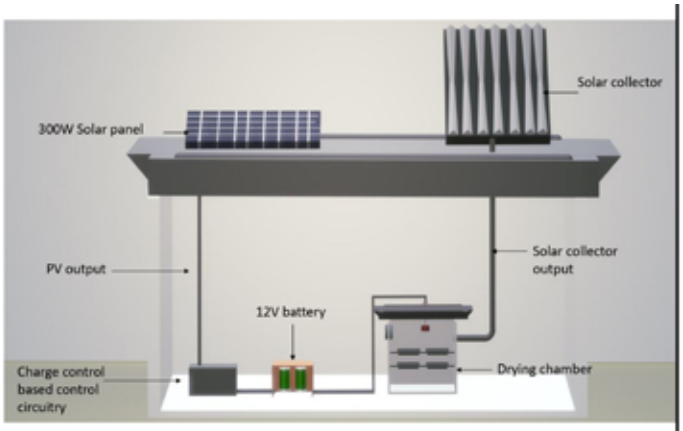


Fig 1.1

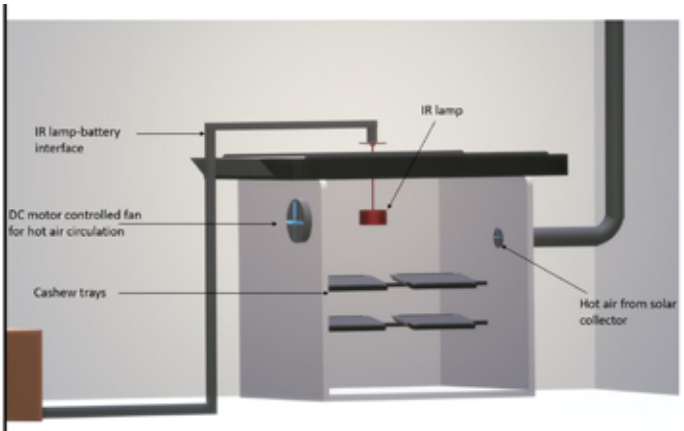


Fig 1.2

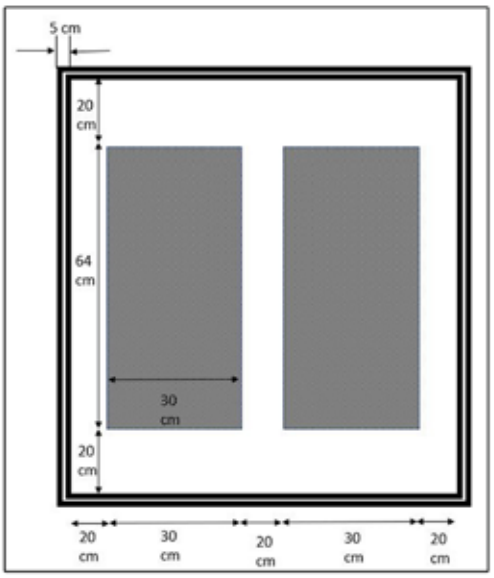


Fig 1.3

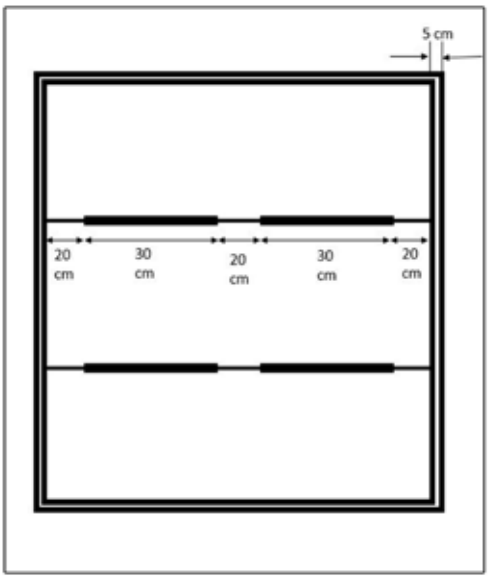


Fig 1.4

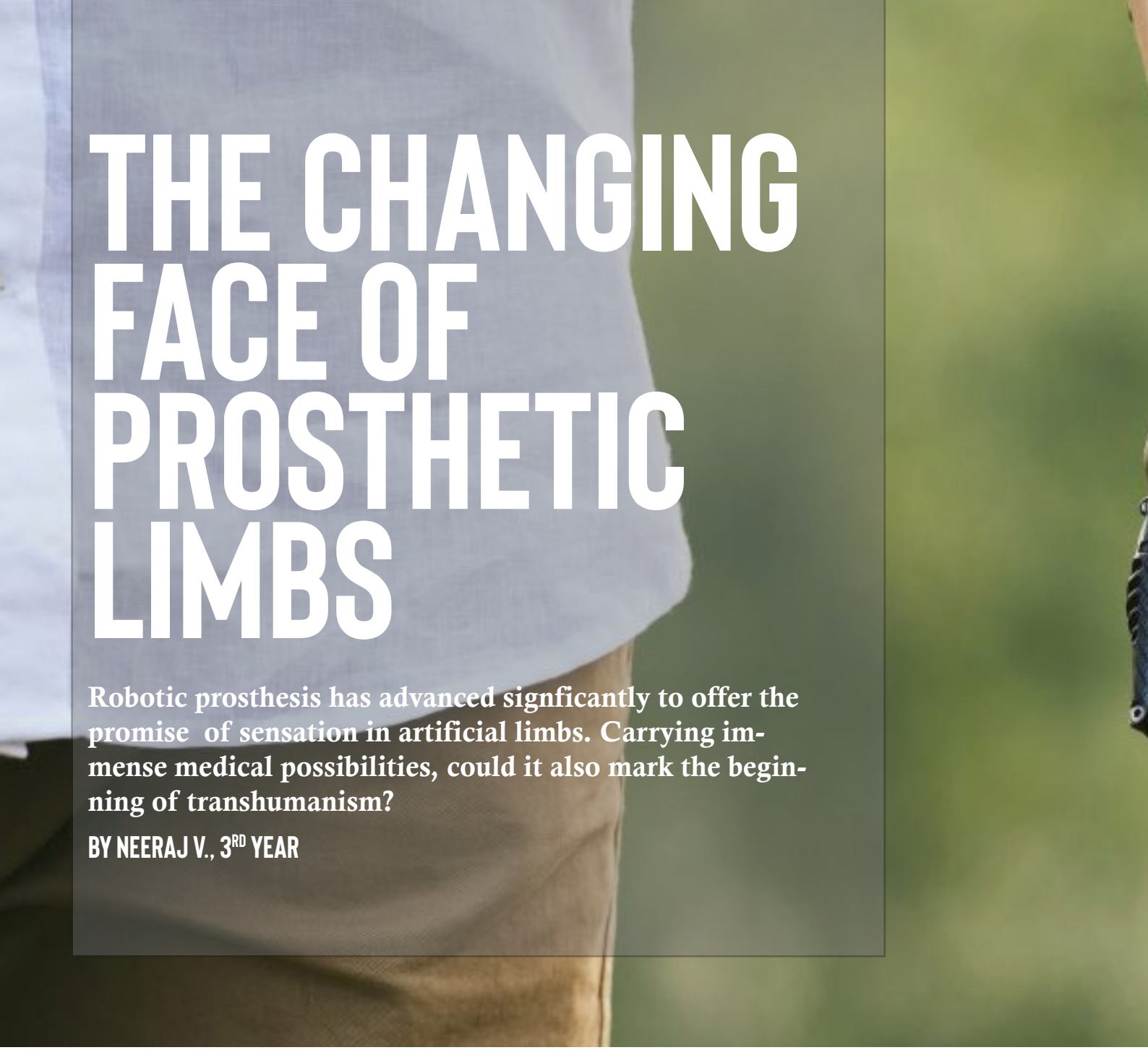
Design of Drying Chamber

The dryer is of double walled design with the inner chamber made up of mild steel and finished with heat resistant aluminum paint. The dryer design is in accordance with the FSSAI standards and regulations. Annular space between walls is filled with glass wool for thermal insulation.

The drying trays are constructed from a double layer of fine wire mesh with a fairly open structure to allow drying air to pass through the food items. The plan and elevation of the drying chamber is as given in Figure 1.3 and Figure 1.4 . An outlet vent will be provided toward the upper end at the back of the cabinet to facilitate and control the convection flow of air through the dryer.

Design of Solar Collector

The collector is made using 7 pieces of steel bars of dimensions 8cm x 4cm x 40cm with drip edge roof flashing. Each of the 7 slats are dual-faceted and each creates their own air channel. This gives a total of 7 closed air channels (and 6 open ones). The slats are painted black to enhance absorption. The metal is then quickly heated by solar radiation, and in turn, this heats the air inside the unit. The hot air is drawn out by using a small solar powered 12Vdc fan (located at the top). The entire collector setup is placed in a wooden box of dimension 60cm x 10cm x 50cm •



THE CHANGING FACE OF PROSTHETIC LIMBS

Robotic prosthesis has advanced signficantly to offer the promise of sensation in artificial limbs. Carrying immense medical possibilities, could it also mark the beginning of transhumanism?

BY NEERAJ V., 3RD YEAR

Technology has been initiating advancements in many fields, let it be art, medicine or science. The rate of advancement accelerates as century progresses. The same can be said for the field of prosthesis. A prosthesis, known as artificial limb or a prosthetic, is an artificial device that replaces a missing body part. This field has been an emotional comfort, giving its users a sense of wholeness while trying to regain what was lost.

The body parts can be lost by amputations due to accidents, a variety of diseases and birth defects.

The field of prosthesis has been present since ancient times. The primitive prosthetics were crude and uncomfortable to wear, giving importance on how it looked more than how it can be used. The earliest prosthetic ever discovered was from Egypt, dated between 950-710 BCE. It was a big toe belonging to a noblewoman, as a big toe was important to the Egyptians in order to wear the traditional Egyptian sandals. The field of prosthesis has then come a long way.

From wooden pegs and metal hooks, to hinged metal prosthetic, to prosthetics that replicate natural motion by improving gait and reducing friction; the field has advanced over the years. But the amputees still had difficulties when they used the prosthetics. In case of hands, holding things and doing tasks involving dexterity was not possible. For legs, climbing stairs and slopes were difficult.

The coming of Bionics

During the 1940s, engineers started researching EMG (electromyography) technology. In this, electrodes situated above the endings of motor neurons near the skin read the myoelectric signals from the

nerves for muscles. This in turn would be amplified and the signals would be sent to run motors and actuators in the respective places.

The first clinically significant myoelectric prosthetic was made in Russia in 1960. It was too bulky and less dexterous though. Later on, materials for manufacture started becoming lighter and durable. Smaller actuators and compact battery packs with longer life made prosthetics more economic and comfortable. Rehabilitation centres started using them as they became a common option for amputees.

Hugh Herr is a renowned figure in the field of bionics and prosthetics. He is a professor at the MIT Media Lab, where he directs the Biomechatronics research group and co-directs the MIT Centre for Extreme Bionics. An amputee himself, he has been bridging the gap between disability and ability with his work. BiOM, a myoelectric bionic leg made by his team has been one of the game changers of prosthetics, being able to augment human walking and running.

Along with synthetic skin that has been modelled after the hard and soft muscle areas near the socket surface for more comfort, smart materials that change their rigidity with voltage given are also used for more
manoeuvrability. Data on how a normal person runs, jumps and walks is prepared in MIT labs, which is

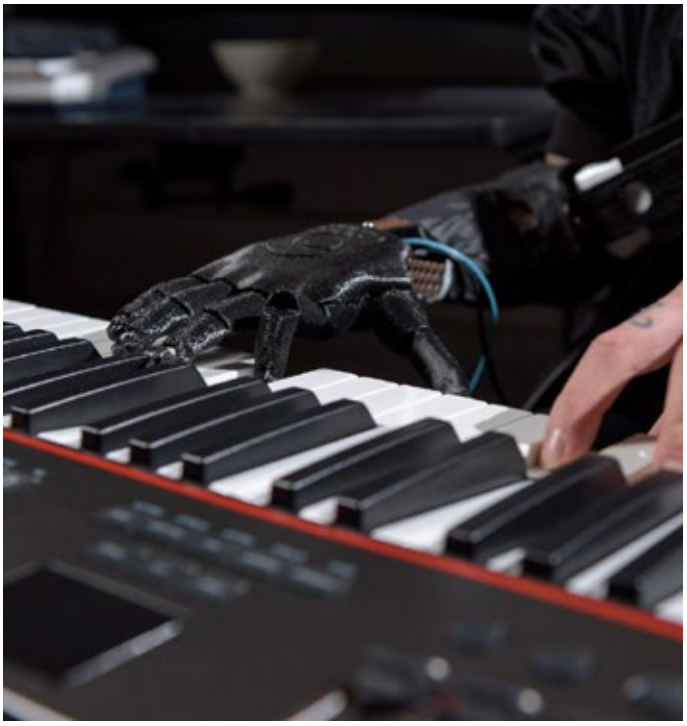
used to teach the machine learning algorithm for the limb. Attenuating shock during heel strike and providing torque as calf muscles do during mid stance are some of the actions performed by BioMS similar to that of a normal leg. The spinal reflexes and their respective reactions have also been studied, so that torque can be adjusted to run or jump as required by the user.

These limbs worked perfectly but still felt incomplete. Visual confirmation was needed as the limb could not be felt. They wanted to take it to the next step with sensory feedback. The earlier method for this was targeted muscle reinnervation which used healthy muscles as reinnervation targets.

Nowadays, Ewing amputation procedure is used to preserve much of the musculature and their relationship through tendons. It creates a neuromuscular interface by linking muscles in pairs in which bi-directional neural communication is possible. The responses from the mechanoreceptors in the limb are sent to these interfaces as neural signals, which are then interpreted by the central nervous system as a sensation of position, speed and torque associated with the movement of the limb. So, not only can a user move like a normal person, he can also feel like a normal person.

Myoelectric prosthetic hands have now become more economical due to cheaper materials and technology like 3D printing. They are now being commercialised and made available to all. Startups like Open Bionics, UNYQ have come up with customer fit 3D printed myoelectric prosthetic arm that is affordable. Customers can modify the design and colour of the arm. They can do almost all work that needs precision and control. More precise activities like playing musical instruments that require individual finger control cannot be performed with these.

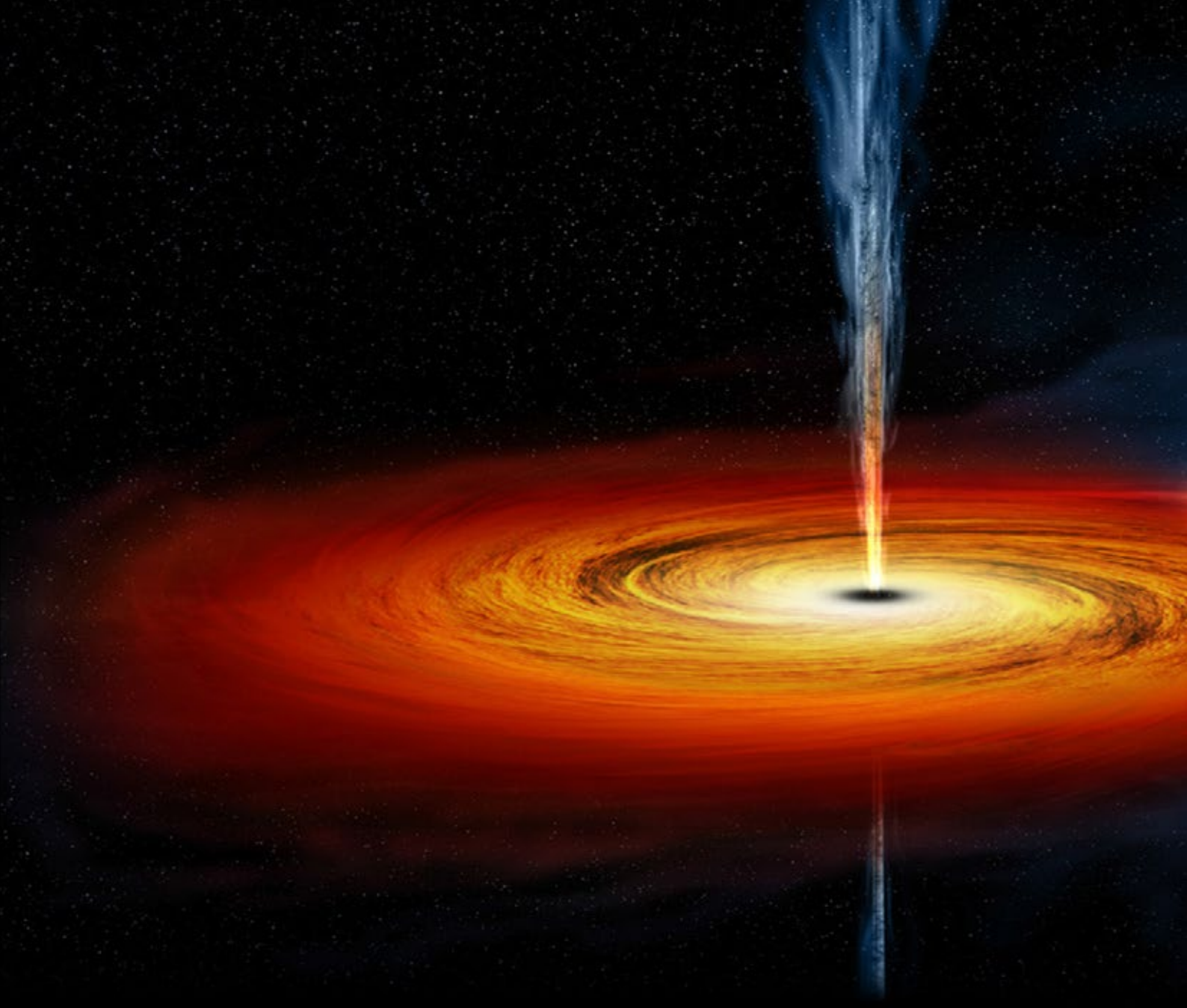
As an answer to this, the Skywalker hand was introduced. Gil Weinberg, a professor in Georgia Tech and the director Georgia Tech Center for Music Technology, and his team developed this arm for finger level control for playing piano. It uses ultrasound imaging instead of EMG as it is more accurate than the neural signals and the speed and trajectory of muscle movements received were clear and distinct. Ultrasound images of muscles are used as data for a machine learning algorithm that learns the pattern and allows fine control. The Skywalker arm, named after the intergalactic hero Luke Skywalker from the movie Star Wars, has shone a new light in the field of prosthetics and is still undergoing research for factors like finer control and low power



consumption.

Technologies like machine learning have made prosthetics evolve into bionic limbs that are able to move at will of the user. Patterns can be studied, broken down and reproduced at will. Times are changing. The machines that join the disabled from abled may one day be used for enhancing humans. The advancement in the field of prosthetics has gone from Jaimie Lannister to Luke Skywalker, quite literally. While many link this to a dystopian future, other questions arise. Will this lead to the age of cybernetic beings? Is transhumanism possible? The quest for the answers still continues •

The world beyond



SO WHAT IS A BLACK HOLE?

Of all the objects in the cosmos, none are as mysterious or powerful as this blankness. In 1960, Princeton Physicist John Wheeler used the term 'black hole' for these objects. This term originates from the name of an infamous prison in India. In the earlier times, people did not believe these objects existed as they defy our understanding of nature. Black Holes are completely invisible objects as light cannot escape them. Yet we are able to investigate about these, by observing the effect they have on their surroundings.

According to Einstein's Theory of General Relativity, space is a bendable four-dimensional fabric called the space time, and gravity is the warping of fabric by massive bodies. The Black Hole could be a puncture in this fabric of space time. Karl Schwarzschild, a German Astronomer studied this theory and was able to map the gravitational field around a star. He was also able to mathematically show that black holes are theoretically possible from Einstein's theory. Years after further discoveries in astronomy, the origin of black holes were found. Scientists found that any star born with a mass ten times the mass of sun or higher ends in a black hole. A star as we know it, is a huge glowing ball of hot gas, mainly hydrogen. Gravity tries to crush the entire mass of a star but the enormous energy released by fusion balances this force thereby keeping stars stable in space. After billions of years, stars run out of hydrogen fuel and finally, gravity wins. The entire star starts to collapse, hits the dense core, bounces back blowing off the outer layers of stars in a massive explosion, the Supernova. At this point, the entire mass

BLACK HOLE

An Enigma for mankind?

Aparna Ajayy, 2nd year

of the star is being concentrated at the stellar core, ergo, the gravity is very strong. The force of gravity pushes the core down until all the mass is compressed into an infinitely small point, a black hole.

Recent findings

In 2015, Gravitational waves were detected by the Laser Interferometer Gravitational- waves Observatory (LIGO) detectors. Based on this, the LIGO scientists estimate that these waves were a result of the collision of two gigantic black holes to form a single one. This observation was also in accordance with General Relativity. "Our observation of gravitational waves accomplishes an ambitious goal set out over five decades ago to directly detect this elusive phenomenon and better understand the universe, and, fittingly, fulfils Einstein's legacy on the 100th Anniversary of his general theory of relativity," says David Reitze, executive director of the LIGO Laboratory.

"I watched in disbelief as the first image I ever made of a black hole was in the process of being reconstructed"
- Dr. Bouman

Later on, in 2019, Astronomers using the Event Horizon Telescope captured an image of the M87 black hole for the very first time. In order to view this far away object, a telescope with size equal to the size of the Earth was required. The Event Horizon Telescope (EHT), an international collaboration was set up. It consisted of eight ground- based radio telescopes which were linked through the precise timing of atomic clocks. Researchers at each place froze the light on to petabytes of data. Every measurement was gotten from combining data of two telescopes. These data were collected and processed to obtain the final picture. Unlike the regular cameras that we use, EHT does not take a picture in pixel space but in frequency space (In space, it is possible to make observations at radio frequencies as these are filtered by the atmosphere from Earth).

The EHT consisted of eight telescopes located as far away from each other as possible (The more distant the telescopes are from each other, the more spatial frequencies we can measure). This helped find finer details in the object. Though EHT had eight telescopes, only five of them were far apart and could see the M87 black hole. Luckily, as Earth rotated, it was possible to find newer sample measurements (As the Earth kept rotating, it was possible to produce elliptical paths in the frequency plane).

With the data measured, an infinite possibility of images could have been developed that were perfectly consistent with the data. In addition to this, due to quickly changing atmosphere above each of the telescopes located at different places, there was an additional time delay. As two telescopes were used to point out a measurement, the same errors were seen in multiple pairs of data and by observing all these commonalities, algorithms were designed to solve the images. Thus an algorithm was developed by Dr. Katie Bouman and her team.

VISION OF THE FUTURE

Seeing a black hole does not just allow us to know they exist but also allow us to test some very basic predictions of the Theory of General Relativity of Einstein. There is obviously going to be an exciting future beyond the first imaging of the black hole as the EHT team has now started planning to double the number of EHT telescopes, creating a "next generation EHT" that is going to open a new window for gravity research. Adding Sagittarius A* to the photo album is also something the team is working on presently. The collaboration has already gotten funding from the U.S National Science Foundation to upgrade their telescope.

ASTEROID REDIRECT MISSION

Mahima L., 1st year

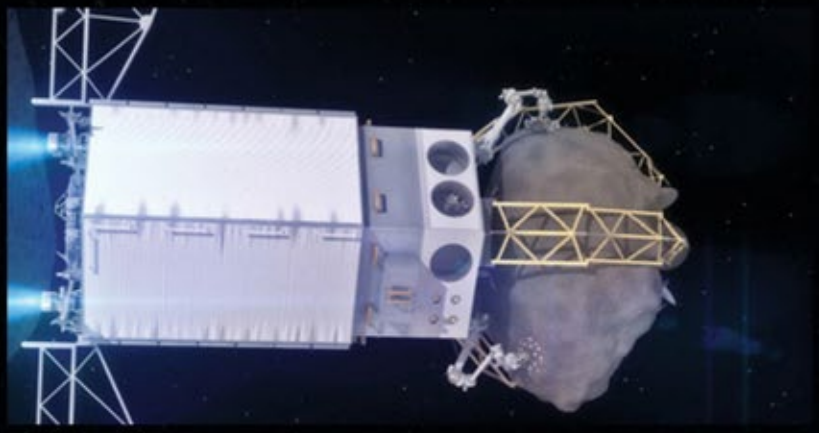
The utilisation of natural resources from asteroids is an idea that is older than the Space Age. The technologies are now available to transform this endeavor from an idea into reality. The Asteroid Redirect Mission (ARM) is a mission concept in the mid-2020s ,which includes the goal of robotically returning a small Near-Earth Asteroid (NEA) or a multi-ton boulder from a large NEA to cislunar space using an advanced Solar Electric Propulsion (SEP) vehicle and currently available technologies.

The idea of capturing and moving a small asteroid was shown to be feasible with technology available in this decade. It offered an important way to advance human exploration beyond low earth orbit. It would be more interesting and beneficial than merely flying astronauts in lunar orbit ,and also more feasible and of lower cost than crewed missions to a near Earth asteroid in its natural orbit.

More importantly, it would advance key transportation technologies needed for future human missions to Mars. Also, it would expand planetary defence, in-situ resource utilization endeavors and further near-Earth asteroid science. ARM would thus represent both an enabling technical step and a programmatic solution to advance human spaceflight.

A more surprising possible benefit of ARM technology is its potential to provide a pathway for protecting astronauts against galactic cosmic ray [GCR] radiation on their long interplanetary voyages to and from Mars. The skills for turning asteroids into habitat radiation shielding could be perfected using the ARM .

METHODOLOGY



The vehicle would land on a large asteroid. Grippers on the end of the robotic arms would grasp and secure a boulder from the surface of the large asteroid. It would dig into the boulder and create a strong grip. An integrated drill would be used to provide final anchoring of the capture mechanism. Once the boulder is secured the legs would push off and provide an initial ascent without the use of thrusters.

The spacecraft would characterise the asteroid and demonstrate at least one planetary defence technique before transporting the boulder to a stable lunar orbit ,where it could be further analysed by future crewed missions.

OBJECTIVES

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The Proving Ground and the Path to Mars

For 40 years astronauts have depended on Earth for resupply and operational support. Many missions aboard spacecraft like the Apollo capsules or space shuttles lasted only days or weeks. Typical stays aboard the International Space Station, in low-Earth orbit, are six months. Crews aboard the space station can return to Earth in a matter of hours in the case of an emergency. These missions are called 'Earth Reliant'.

Testing aboard the space station helps develop ways to break these Earth-reliant bonds, so astronauts can be more autonomous the farther into the solar system they explore. The ARM robotic mission and crewed mission to explore the asteroid will further advance these capabilities in the "Proving Ground" between Earth and Mars, or what is called the **cis lunar space**—the area around the moon.

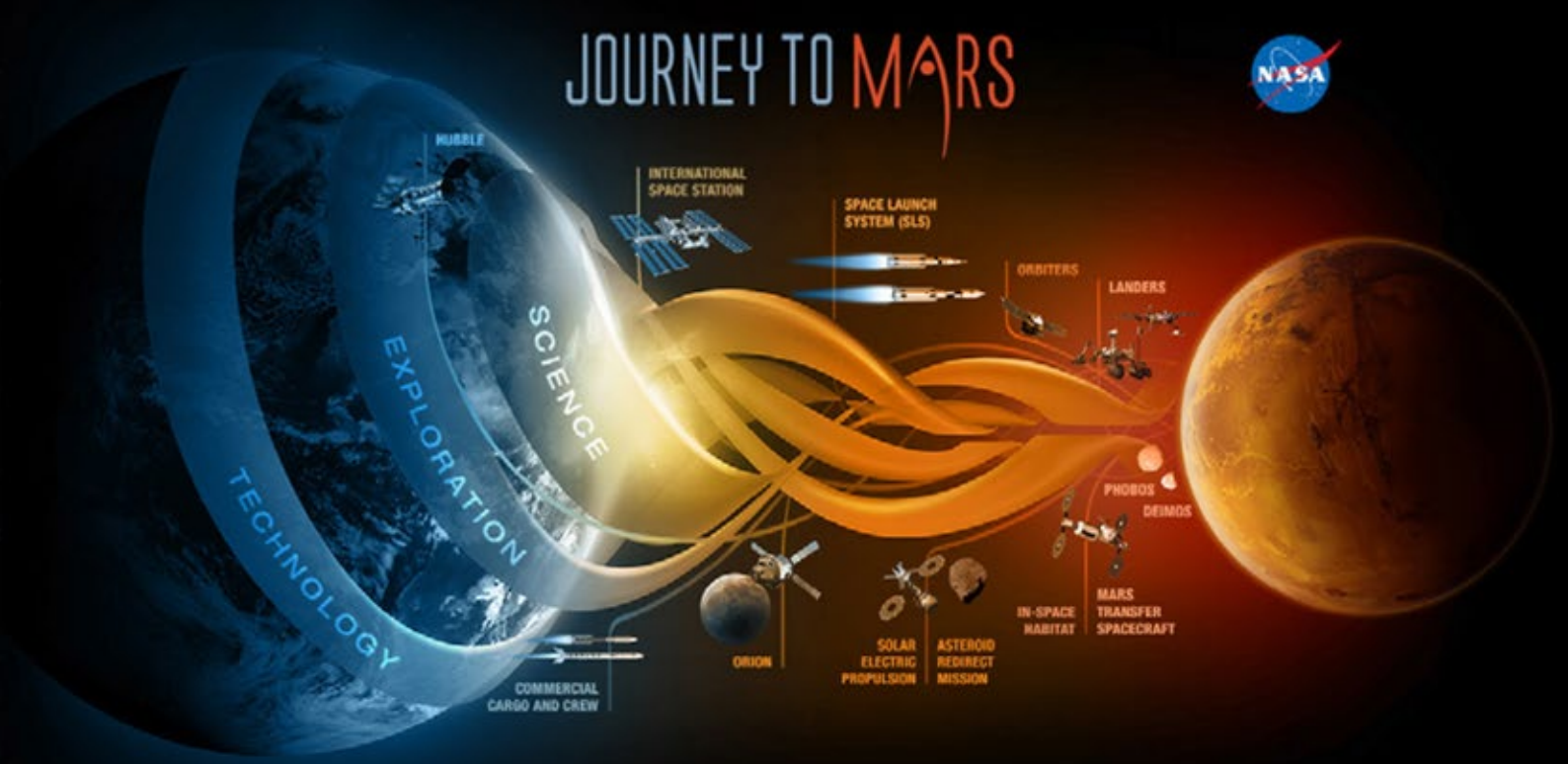
The deep space environment around the moon is different from low-Earth orbit, but very similar to what an **Orion spacecraft** would experience on the trip to and from Mars. For instance, solar and cosmic radiation is more prevalent. A human mission to and from the Mars system could last 500 days or longer, including six to nine months of transit each way. Missions to Mars have to be '**Earth Independent**'.

SAMPLE COLLECTION

Asteroids are the left-over building blocks of the solar system—pristine pieces of the matter that formed our sun's planets and their moons. Astronauts aboard the Orion spacecraft will take samples of the redirected asteroid and bring them back to Earth for scientific evaluation and study. Additionally, the interaction with the asteroid could provide data on the internal structure of the asteroid and answer many long-debated questions about their composition. Some asteroids may contain resources future astronauts could use to extract water and breathable air from, create rocket fuel, or even use for 3-D printing.

DEVELOPING BUILDING BLOCKS FOR EXPLORATION

Overall, the Asteroid Redirect Mission combines the best of NASA's technology and human exploration efforts. ARM is a compelling early use of the Orion spacecraft and SLS rocket that also affordably lays more foundation for future missions to Mars. The mission will lower the costs of exploration by building systems that can be used and upgraded multiple times. Ultimately, the mission allows to move as fast as possible on a human path to Mars, while minimising new developments, building experiences aboard the space station, testing new systems and capabilities in the proving ground of cis-lunar space.



ASTEROIDAL WATER

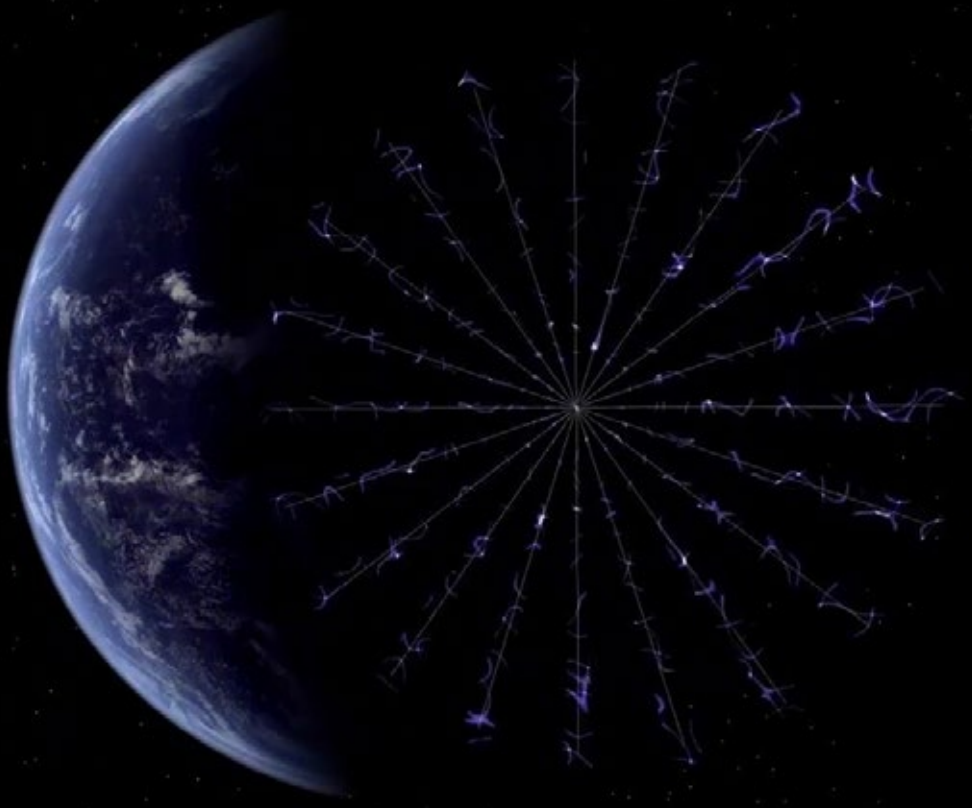
Water is the most valuable and versatile in-space resource to be derived from asteroid materials. It is essential for life support, as a fluid and as an oxygen source, and can be separated into powerful chemical propellants. If ARM returns a carbonaceous chondrite-type asteroid, its water of hydration (up to 20% by mass, loosely bound in the clay mineral matrix of CI chondrites) can be liberated through gentle heating. Temperatures of 250°-300° C, easily provided by solar energy, would release nearly all of the water in a typical carbonaceous chondrite meteorite. Mixed with other volatiles, the water could be preferentially condensed, filtered, and stored. Urine processors aboard the ISS already demonstrate the feasibility of extracting pure water from a contaminated water source under free-fall conditions.

ARM AND RESOURCE UTILISATION

One of the most attractive features of ARM would be the early opportunity to exploit the raw materials in the asteroid target. ARM may return tens to hundreds of tons of pristine asteroidal material to cislunar space, providing access to astronauts, international partners, and commercial mining firms for demonstrations and iteration of resource extraction techniques and application. A potential key benefit of the asteroid retrieval part of ARM is its near-term approach for dealing with the transportation challenge associated with the utilisation of asteroid materials. Demonstrating the ability to affordably deliver several hundred tons of asteroid material to cislunar space, which would be many times the launch mass to LEO, could change the game for in-situ resource utilisation.

CONCLUSION

Water is the most valuable and versatile in-space resource to be derived from asteroid materials. It is essential for life support, as a fluid and as an oxygen source, and can be separated into powerful chemical propellants. If ARM returns a carbonaceous chondrite-type asteroid, its water of hydration (up to 20% by mass, loosely bound in the clay mineral matrix of CI chondrites) can be liberated through gentle heating. Temperatures of 250°-300° C, easily provided by solar energy, would release nearly all of the water in a typical carbonaceous chondrite meteorite. Mixed with other volatiles, the water could be preferentially condensed, filtered, and stored. Urine processors aboard the ISS already demonstrate the feasibility of extracting pure water from a contaminated water source under free-fall conditions.



Electric Sail

The next step in inter-planetary space travel?

By Malavika S., 3RD YEAR

Those shimmering dots that adorn the night sky have always intrigued mankind. Human space exploration has always been a quest tzzzo unravel the mysteries of the cosmos. With many countries dedicating a huge amount in their budgets and many major stakeholders entering the scene, space exploration is more relevant than ever. It is high time that the world look out for cheaper and more efficient methods of propulsion than the conventional chemical propulsion technique. Many new ideas have come out in this respect, which include ion propulsion systems, plasma propulsion systems, even fission and fusion type engines.

Electric sail is a comparatively technologically simpler and efficient method for deep space propulsion. The Electrostatic Sail (E-Sail) is a revolutionary propulsion technology that uses the naturally occurring solar winds to produce thrust without the expense (mass) of propellants, enabling better trip times to the edge of the solar system than those offered by any alternative system. In addition to these benefits (reductions in launch costs and travel times to solar system targets), this system will enable new types of missions that employ non-Keplerian orbits .The concept was established by Finnish inventor Pekka Janhunen at the Kampula Space Centre in 2006.

Solar Wind

Many of us must have dreamt of travelling to the North Pole to get a glance of the beautiful northern lights (Aurora Borealis). What causes this intriguing and spectacular phenomenon is the interaction of Earth's magnetosphere with the solar wind.

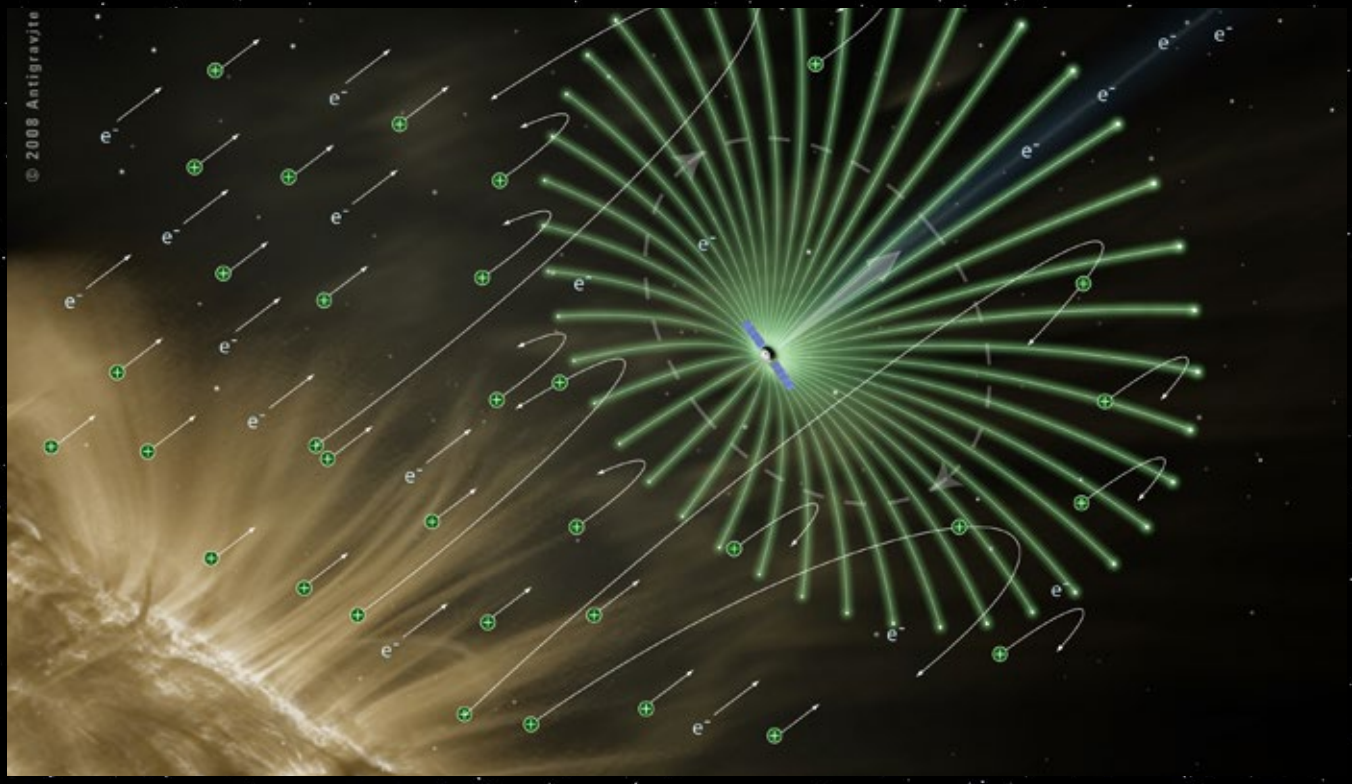
In addition to photons and radiations the sun also releases a stream of charged particles from its upper atmosphere called corona. The plasma consists of both positively and negatively charged particles. By some unknown phenomena these particles gain the escape velocity to move out of the sun's gravitational field. At a distance of more than a few solar radii from the Sun, the solar wind reaches speeds of 250 to 750 kilometres per second and is supersonic. This high speed of solar wind is from thermal and magnetic acceleration. The wind exerts a pressure at 1 AU typically in the range of 1 – 6 nPa , although it can readily vary outside that range. This pressure exerted by the solar wind is utilised in the solar sail technique for in-space propulsion. This technique was used in the Mass Orbiter Mission (Mangalyaan) by ISRO.

Electric Sail

The E-Sail propulsion is created from the interaction of a spacecraft's positively charged multi km length conductors with protons that are present in the hypersonic solar wind. As mentioned earlier electric sail is fuel less propulsion technique. To obtain the thrust required to accelerate the spacecraft so that it attains significant velocity to travel further into space beyond the heliosphere, the space craft deploys conducting wires that are only microns thick and kilometres long. These strands are deployed from the main spacecraft bus, and the spacecraft rotates to keep the strands taut. Once the spacecraft is launched at the near earth orbit, these long tethers are reeled out by slowly rotating the space craft. These tethers increase the area of the spacecraft to like 600 sq. km to create a huge barrier for the solar wind.

The magnitude of the total thrust generated is related to the effective cross-sectional area over which the solar wind is perturbed .The tethers are maintained positively charged by an electron gun powered by the solar panels attached on the aircraft. The protons from solar wind are deflected via natural electrostatic repulsion forces from the Debye sheath (a layer in a plasma which has a greater density of positive ions, and hence an overall excess positive charge) that is formed around a charged wire in space, and this deflection of protons creates thrust or propulsion in the opposite direction. This thrust can impart an acceleration of 1 mm/s2 on a spacecraft of 1000kg, if 100 tethers (each 25 micron thick

and 20 km long) are extended. This acceleration cannot be viewed as insignificant as it is constant, and, over a year spacecraft attains a velocity around 30 km/s, faster than any deep space mission till date. Also the effective area of the spacecraft goes on increasing due to formation of the Debye sheath which facilitates increase in thrust and acceleration. The thrust produced by an E-sail declines at a rate of $r^{-7/6}$ (where r is the solar distance), and the system provides acceleration to distances of 20 AU. In comparison, the thrust of a solar sail propulsion system declines at a rate of r^{-2} and is only capable of accelerating a spacecraft at a maximum radius of ~5 AU. E-Sail velocities are 25% greater than solar sail options, due to the reduced rate of acceleration decline.
The technique can also be put to use in trajectory control and to perform various manoeuvres. To enable manoeuvring and trajectory control, the E-sail thrust can be steered by controlling the voltage of individual tethers and thus changing the plane of the E-sail's rotation. The bias of the wires can be modulated as the vehicle rotates, to provide thrust vectoring over a wide range of angles relative to the incident solar wind.

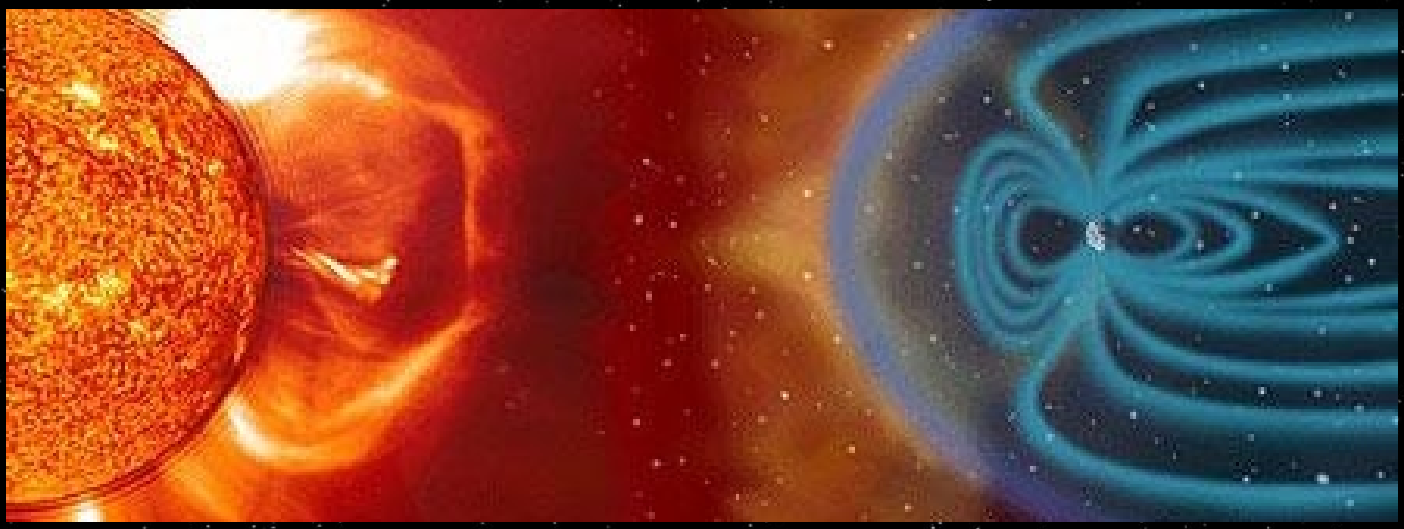


Technical Overview

The important components of the propulsion system are: The wire array that is kept in tension by slow rotation; a wire deployment system; an electron gun to maintain the positive bias on the wires; a programmable high voltage power supply that can individually adjust the voltage on every wire; and a power distribution system. The bias of each wire must be individually controlled to enable thrust vectoring. Critical wire design parameters include material, diameter, total length, count, electrical bias, and configuration.

Current research

The electric sail is an invention made in 2006 at the Kumpula Space Centre in Finland by Pekka Janhunen.The Finns are not the only ones who have taken interest in this concept. In 2014, they received an award from the NASA Innovative Advanced Concepts (NIAC) program to investigate the feasibility



of an electric sail mission they developed called the Heliopause Electrostatic Rapid Transit System (HERTS). The HERTS Phase I study concluded an E-sail mission to the Heliopause could be completed within 15 years, which is much faster than any other existing propulsion system could deliver. In 2015, the NIAC program provided $500k in resources for a two-year Phase II NIAC study with the objective of having the HERTS team investigate some of the key challenges identified in the first study.

More recently in September 2017 a team of Finnish researchers from the Finnish Meteorological Institute announced an idea where they could use an electric sail fleet of 50 satellites to explore the asteroid belt. However this cannot be put to reality soon, as many developmental challenges need to be addressed.

An engineering team was assembled by NASA to assess the technology of the required subsystems in order to develop a plan for future work. The group as a whole identified the systems most in need of development. The subsystems identified as high priority areas of research are:

- A deeper understanding of the physics behind proton interaction and the spacecraft.
- The environment surrounding the elimination of electrons from the system.
- Guidance, navigation and control.
- The mechanical deployment of the wire sail.

Limitations and Challenges

The one major limitation is that the E sail propulsion system cannot provide enough thrust to attain the escape velocity to escape Earth's gravitational field. The system is only useful for interplanetary missions and is not effective within the magnetosphere of a planet where the solar wind is significantly shielded.

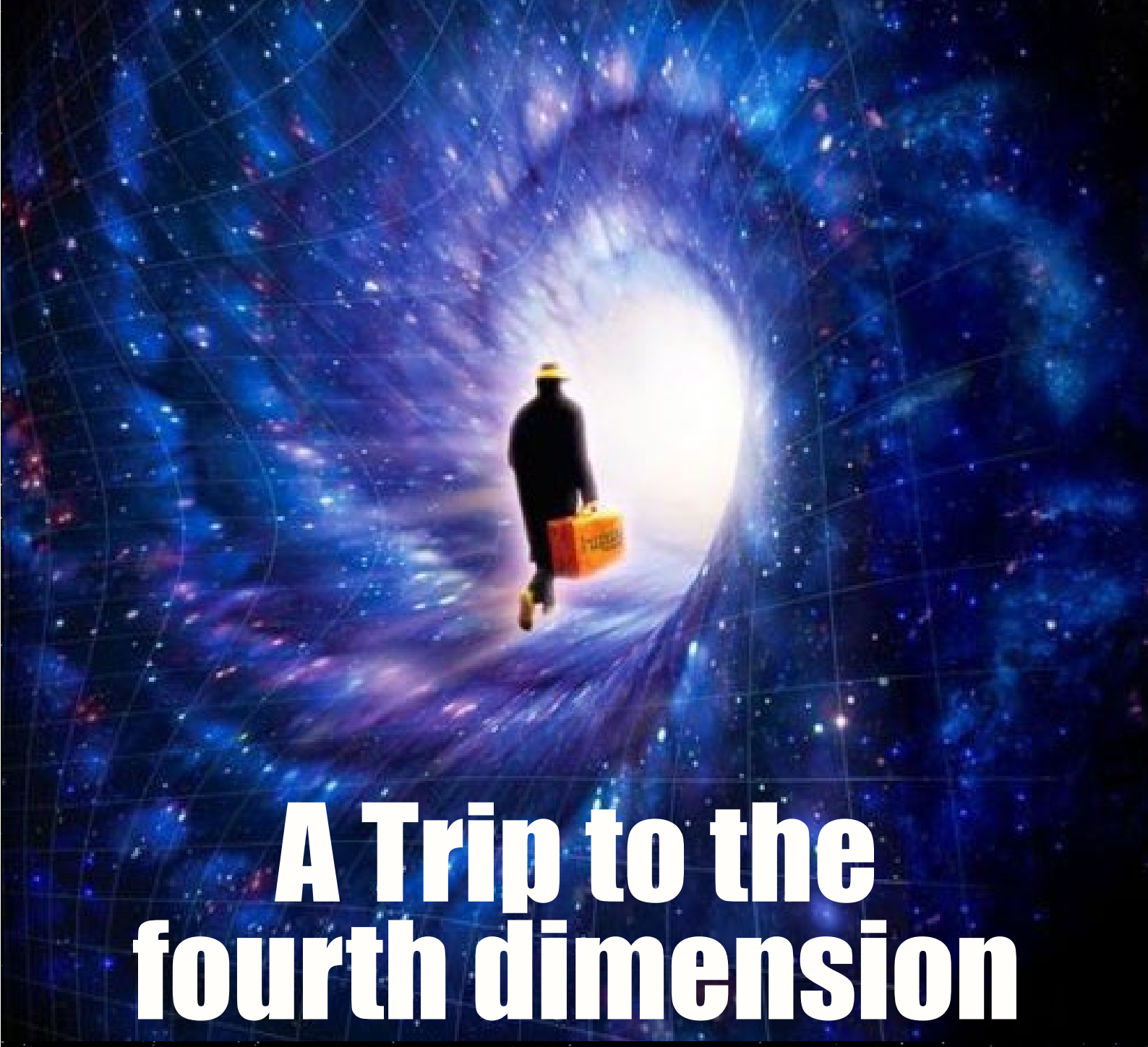
The major developmental challenge is the design for a suitable subsystem for the deployment of the long tethers and keeping them taut.

Space is dense with tiny dust particles that threaten the structural integrity of the E-sail.

Hence protection systems have to be designed and developed to keep the electric sail's structural integrity intact.

The Future

E-sail technology could be available for solar system research within 10 years and, if successful, may revolutionize the way space travel and exploration missions are conceived and executed. The E-sail will enable affordable continuous manned Mars presence, considerably decrease travel times in the solar system, make it possible to tackle space debris, and help facilitate asteroid mining operations. The E-sail thus holds great promise for accessing both scientific and economical treasures of the solar system ●



A Trip to the fourth dimension

By Rahul Raj, 1st year

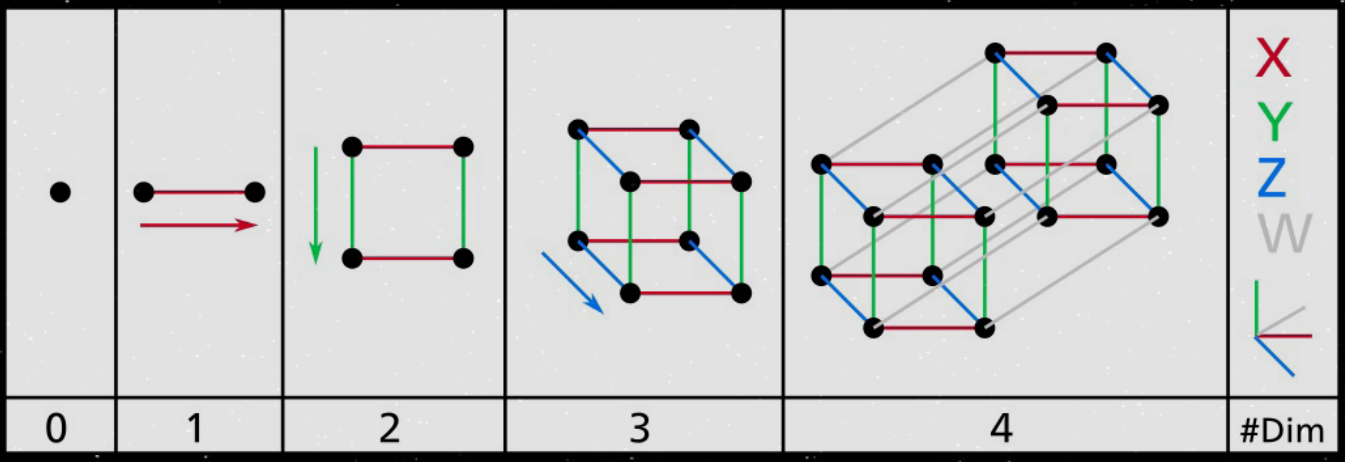
A space just like our three dimensional space, but with one extra dimension. What would it be like? With no effort whatever, one can visualize three dimensional space. What would it be like to live in a three dimensional cube? To be asked to visualize that is like being asked to breathe or blink. It is effortless. There we sit in the cube with its six square walls and eight corners.

So the question is can one visualize what it would be like to live in the four dimensional analog of a cube, a four dimensional cube or a "tesseract" with the same effort? The obvious answer: No

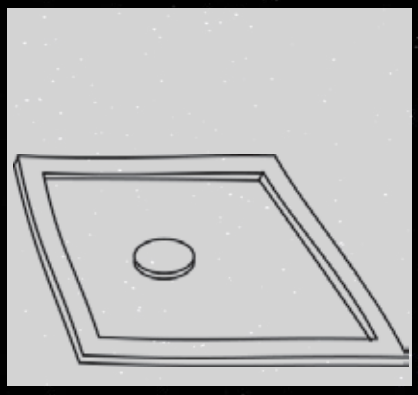
How to visualise 4-D?

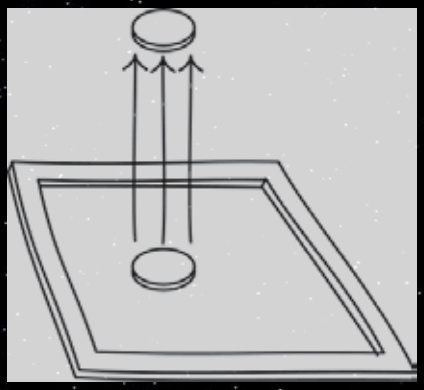
Cubes are just useful tools for understanding four-dimensional space. For example, let's start with a 1-D line segment. By adding a parallel segment and connecting it with two perpendicular segments, all equally sized, we can make a 2-D square. Similarly, if we take two parallel squares and connect them with more perpendicular segments, we get a 3-D cube. In the next iteration, two parallel cubes plus perpendicular connectors creates a 4-D hypercube, or tesseract.

One can get a glimpse of the fourth dimension through an optical illusion called the Necker cube.Consider an ordinary cube with all edges solid drawn in a 2d paper. Now If one stares at the Necker cube long enough, it would appear



to flip back and forth in what mathematician Rudy Rucker calls a "twinkling rearrangement". Eventually, the twinkling may appear as one continuous motion. But, as Rucker points out in his book Geometry, Relativity and the Fourth Dimension, "this motion can only be continuous if it is a rotation in 4-D space." That is because a rotation in three dimensions can't produce a mirror image. So perhaps we can actually produce a 4-D phenomenon in our minds!





How to think in 4-D?

Access to a fourth dimension makes many things possible that would otherwise be quite impossible. To see how this works, we will use the strategy of thinking out a process in a three dimensional space. Then we replicated it in a four-dimensional space.

Consider a coin lying in a frame on a table top. There is no way the coin can be removed from the frame within the confines of the two dimensional surface of the table. Now recall that we have access to a third dimension. The coin is easily removed merely by lifting it into the third dimension, the height above the table. We are then free to move the coin as we please in the higher layer and then lower back to the tabletop outside the frame. The thing to notice about the lifting is that the motion does not move the coin at all in the two horizontal directions of the two-dimensional space. So the motion never brings it near the frame and there is no danger of collision with the frame.Now repeat this analysis for its analog in one higher dimension, a marble trapped within a three dimensional box.

The marble can be removed in exactly the same way by "lifting" it, this time into the fourth dimension. As with the coin in the frame, the key thing to note is that in this lifting motion, the marble's position in the three spatial directions of the box are unchanged. The marble never comes near the walls and there is no danger of colliding with them

Once it is lifted into a new three dimensional space, it can be moved around freely in that space and lowered back into the original three dimensional space, but now outside the box.

What if we were to travel to a four dimensional space?

To make things interesting suppose someone were able to go to a four dimensional space or place, what possible threats would he/she face? Will he/she survive? If he/she does, what are the requisites for him/her to?

The things you will need:

● Polarized lenses: Because light propagates in a direction perpendicular to its electric and magnetic fields, it is hard to predict how it will behave when you add another set of perpendicular coordinates. So sunglasses can't hurt. A retina shaped like a sphere rather than a disc, i.e., a "third eye," would also be useful, according to Scientist Rucker.

● Earplugs: Because sound waves in even dimensions double back on themselves, like ripples in a pond, everything will sound echo-y and drawn out, and you may be constantly bombarded with noise. For example, the start of Beethoven's Fifth Symphony (dum dum dum DAH) would get "mushed out," sounding more like ladidadiladidadidadidididi, says Clifford Pickover, author of Surfing Through Hyperspace.

● Velcro shoes: Just as a looped piece of string lying on a plane will straighten out when you lift one end into the third dimension, a 3-D knot will easily untie in 4-D space. We don't want you to trip on your laces (in several directions at once) when you get there

● A closed loop of string, two wooden rings, and a seashell: As the German astrophysicist Johann Zöllner advised in 1878, you will use these items to confirm that you have in fact reached the fourth dimension. You should be able to tie a knot in the string without cutting the loop, link and unlink the rings, and flip the orientation of the spiral on the seashell.

MONSTER MADNESS: In the 1993 comic book Tales of the Uncanny, Alan Moore (of Watchmen fame) envisioned a 4-D monster that appeared as morphing, disjointed body parts

Now that you've reached the 4th dimension, what should you look out for? **Will one be attacked by a 4-D creature?** We cannot rule out this possibility. Having far more neural connections in their brains, 4-D beings will be super smart. And as Parker informs us, they "would have the ultimate tactical advantage." By way of analogy, let's say that you, a 3-D creature, wanted to torment a 2-D creature. Your victim would be constrained to a flat surface while you could hover above it, out of sight. You could see and access all of its insides. If you reached a hand into its world to grab it, your fingers would appear suddenly as floating, disjointed circles. Similarly, a 4-D attacker could materialize in your 3-D view out of the blue and pluck the money right out of your wallet, or harvest your organs, without laying a finger on your clothes or skin.

So if anyone is looking forward to an adventure in the fourth dimension, don't forget these items and better luck finding a way to the unknown world ●

Look again at that dot. That's here. That's home. That's us. On it, everyone you love, everyone you know, everyone you ever heard of, every human being who ever was, lived out their lives. The aggregate of our joy and suffering, thousands of confident religions, ideologies, and economic doctrines, every hunter and forager, every hero and coward, every creator and destroyer of civilization, every king and peasant, every young couple in love, every mother and father, hopeful child, inventor and explorer, every teacher of morals, every corrupt politician, every "superstar," every "supreme leader," every saint and sinner in the history of our species lived there--on a mote of dust suspended in a sunbeam.

- Carl Sagan

THE POWER DRIFT

ON 5TH APRIL, 2020

How the Power Ministry of India handled one of the biggest drop in power demand in the country's recent history.

BY FATHIMA SHIJAD, 3RD YEAR

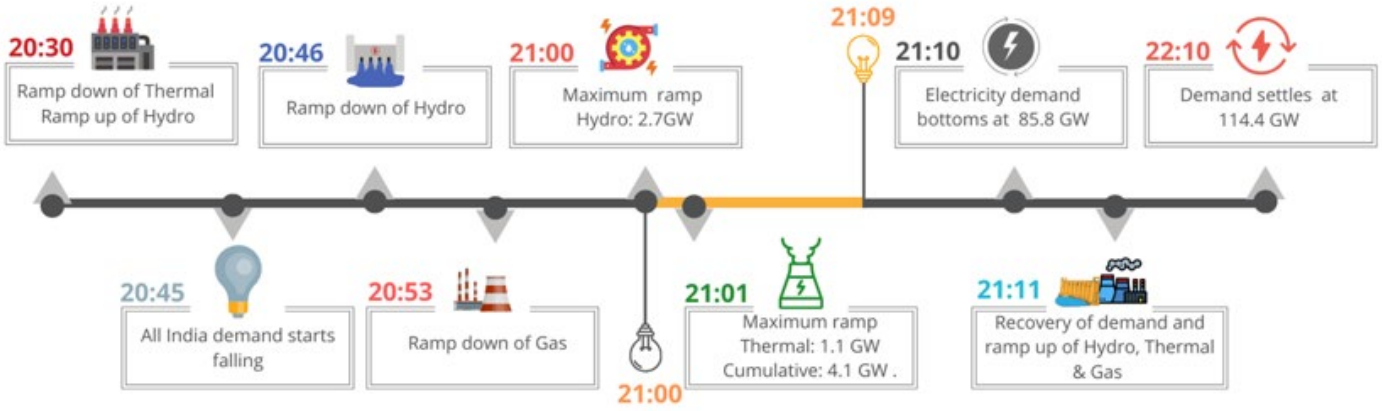
What Happened on that day?

Power ministry flung into action to prepare for the possible scenarios soon after the PM's call for solidarity. They said that switching off the electricity at one time can reduce the electricity demand.

If all lights are switched off at one time for 9 minutes there is a possibility for grid collapse resulting in blackout in the entire country. To manage the drastic changes in electricity and its impact on the grid, the government drew up an elaborate plan to manage it.

The National Load Dispatch Centre (NLDC), apex body to ensure integrated operation of national power grid, after discussion with regional and all state load dispatch centres issued guidelines for ensuring

CHRONOLOGY OF EVENTS



reliable and secure grid operation. The guidelines were:

• Estimation of demand reduction during the event.
• Generation scheduling frequency control measures.
• Voltage control measures amd general guidelines.

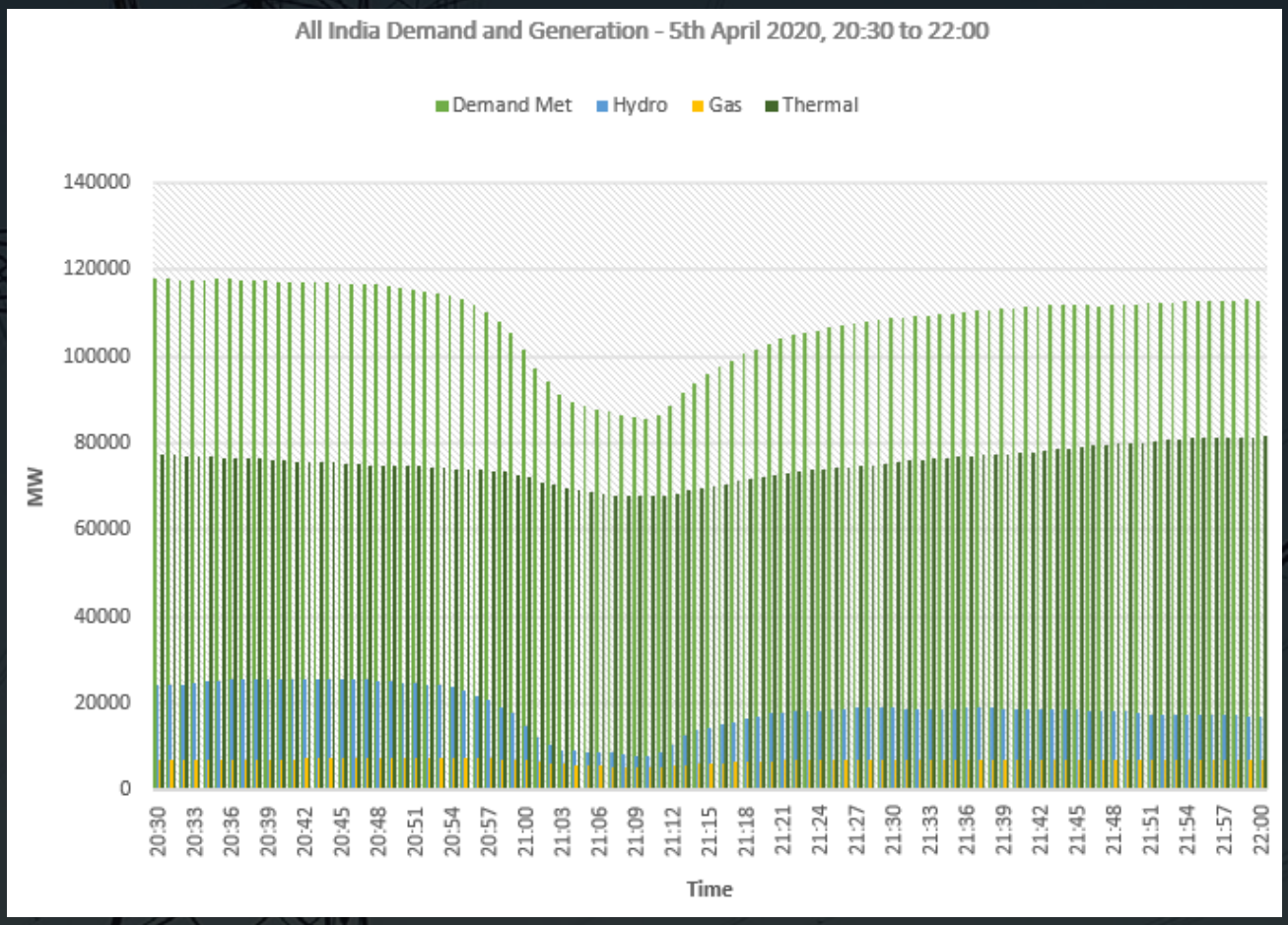
Based on the present data available, they came to some conclusions such as,

» Demand reduction of 12000 - 13000MW can be expected at the All India level and about 500MW in Kerala.
» Hydro generation to be maximized just before the start of the switch off event. Thermal generation to be brought down to technical minimum and cater the base load.
» Pumped storage units to be run in pumping mode by 8:45 PM.
» Wind generation to automatically disconnect from the grid in the event of frequency rising above 50.25Hz.
» Frequency to be maintained around 49.8Hz just before the event.
» Frequency response of all generators to be ensured. Droop settings to be adjusted to (1-2) %.
» All defence mechanisms such as under frequency relay shall be in service.

> **“Let us switch off the lights at home and light a lamp for 9 minutes at 9PM on April 5th**
>
> Narendra Modi
> Prime Minister of India

» High voltage nodes to be identified and voltage control measures taken well ahead of the event.
» Advisory to the public not to switch off any other electrical appliances during the event.
» Ensure black start facilities are in place for faster restoration of grid in the event of a total blackout.

The power ministry was well prepared to face the challenges. Total 118 gas based and hydropower plants with capacity to provide flexibility of 19,392MW were identified. Seven numbers of 765kV substations and nineteen numbers of 400kV of EHT substations were identified where voltage could have risen beyond permissible limits. Elaborate mock exercises were conducted and safety protocols rehearsed prior to the event. On the eve of the scheduled event, coal and gas plants met most of the demand during the evening hours and hydropower was conserved, to be swung later into action. By 8.30PM, hydro generation was peaked to meet the immediate demand. Following a typical late evening demand



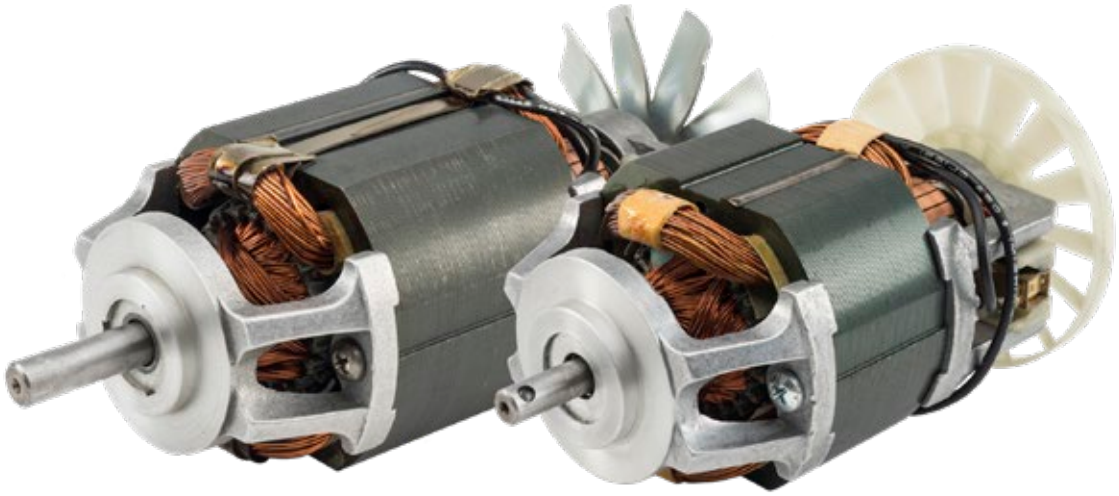
pattern, demand was already on a decline by 8.30 PM and by 8.55 PM demand had fallen by 4.5GW, thereafter falling sharply by another 11.6GW in a span of next 5 minutes. The demand went down to 85.8GW, with a sharp decline of approximately 16GW in a span of 9 minutes. The permissible range of the frequency band is 49.95Hz-50.05Hz as per CERC, during the event frequency increased to 50.25Hz. Electricity demand began to gradually pick up after 9.10 PM and settled around 112GW by 10.00 PM. Hydro generation was back down during the period, while thermal plants were ramped back to meet the electricity demand. During the course of the event, an unprecedented cumulative ramp of 4.1GW was recorded for the power grid.

Our grid operators not only came with flying colours, but also sent a strong and positive message to the renewable energy industry regarding capacity of the grid to integrate renewable power. While effort needs to be directed towards better forecasting and coordination on a day-to-day basis, the resilience of Indian power grid is undeniable •

LOW COST ELECTRONICALLY COMMUTATED BLDC MOTOR

An ergonomic replacement for the universal motor

BY ANANDU AJAYAN, 2ND YEAR

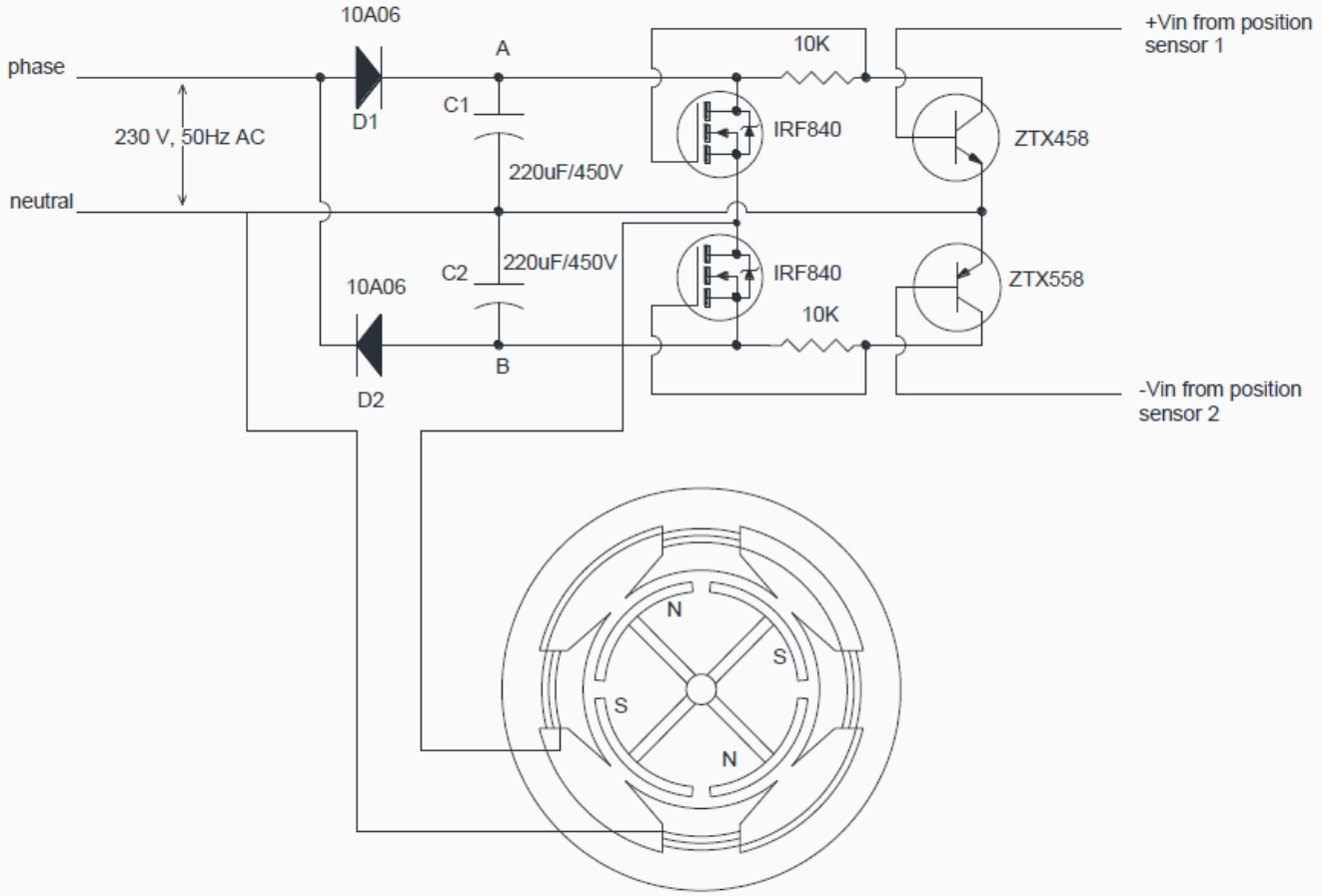


The DC series motor is also known as Universal motor (as it works in both DC and AC). Because of its high starting torque, high running speed, low cost, lightweight and compact design it finds application in a wide number of devices like mixer grinders, vacuum cleaners, drillers, hair dryers etc. But there are some problems associated with universal motors, which are its relatively low efficiency (50% to 70%), frequent requirement of service and maintenance due to wearing out of the carbon brushes and commutators with time and higher noise of operation associated with them due to mechanical commutation.

So there is a need for finding a substitute for universal motors which counters all its disadvantages. An induction motor or a synchronous motor are not ideal substitutes as the speed of these motors are dependent on the frequency of the supply. The synchronous speed of a 50 Hz 2 pole induction or synchronous motor is 3000 rpm (for synchronous motor, rotor speed is equal to synchronous speed and for induction motor, rotor speed is less than synchronous speed), thus making them unsuitable for high speed applications further they also have larger size when compared to an equally rated universal motor.

Brushless DC motor can be used as a good replacement for universal motor, since it has high efficiency (85-90%), good starting torque, high speed, high torque to weight ratio, increased reliability, reduced noise and longer life time. But the problem is its high cost and need for dc power supply.

For example let's take the example of a mixer grinder which uses a 500 watts, 230 V, 50 Hz universal motor if we replace it with an equivalent BLDC motor then there is an extra need for motor drivers and ac to dc converters (with more than 500 W capacity), so its overall cost increases. This article shows how to make some modifications in the conventional design of the BLDC motor so as to make it a low



The circuit diagram of the motor design. Note that the extra 5V DC supply required for powering the diodes are not included in the diagram.

cost substitute for a universal motor.

Design

A conventional BLDC motor has three sets of winding and six MOSFETs in its driver circuit. Instead of three sets of winding if we design it for a single set of winding, then we can drive the motor using an H-bridge. Still it needs four MOSFETs, if we design the circuit as shown in the diagram then we can drive the motor using two MOSFETs. All these modifications are done in order to reduce the overall cost of the motor. The performance of this type of motor may be less than that of a typical BLDC motor, but still it is a good replacement for universal motors.

Here the direct rectification of the mains (230V AC) is carried out using two 10A06 diodes. During positive half cycle the diode D1 is forward biased and capacitor C1 gets charged to +Vmax and during negative half cycle the diode D2 is forward biased and capacitor C2 gets charged to -Vmax, so point A is positive and point B is negative with respect to neutral. In this circuit IRF840 is used for switching. Two BJTs ZTX458 and ZTX558 are used for driving the gate of MOSFETS which is connected to point A and B respectively. Signals from position sensors can be given to the base of the BJTs. The motor has four poles (which is made up of Neodymium magnets) and four stator teeth, winding is done as shown in the diagram. When the MOSFET connected to point A is in ON state and MOSFET connected to point B is in OFF state then the current through the winding flows in one direction, and when the MOSFET connected to point A is in OFF state and MOSFET connected to point B is in ON state then the current through the winding flows in opposite direction. This causes the rotor magnets to be attracted and repelled by the stator and as a result the rotor will rotate. Speed can be controlled by tapping the stator winding.

Universal motor has many disadvantages since it uses mechanical commutation, so we can use a low cost electronically commutated motor as an ergonomic replacement. Through this method we can improve efficiency, lifetime, reduce noise, and maintenance of many electrical appliances like mixer grinders, drillers, vacuum cleaners etc •

AN ADVANCED WATER SPLITTING TECHNOLOGY

BY CHRISTO M.J., 1ST YEAR

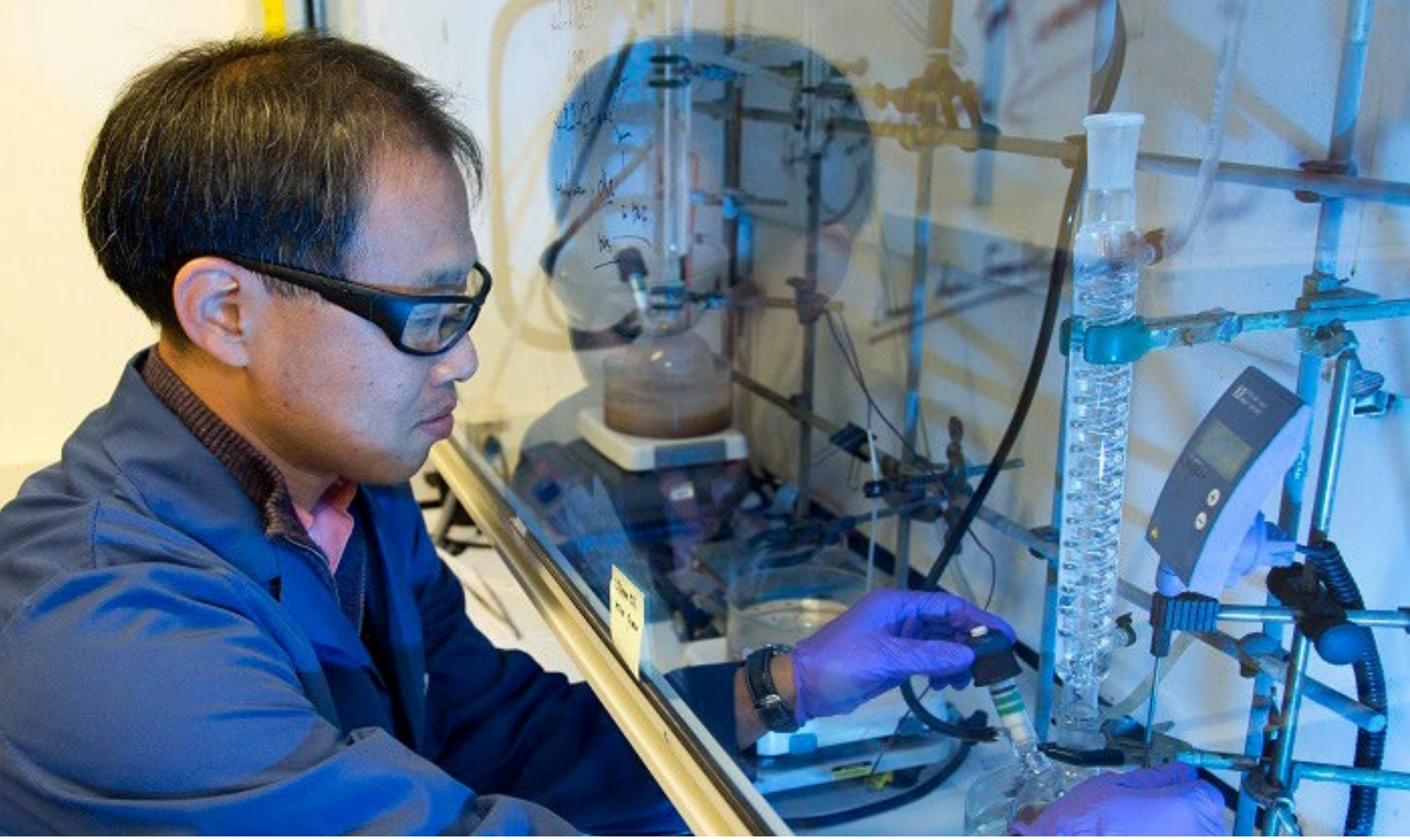
In the quest for clean alternative energy sources, hydrogen is a default. It releases a lot of energy when burned—with an added bonus: The major byproduct of burning hydrogen is pure water. The big obstacle has been to obtain pure hydrogen in sufficient amounts to burn. So scientists are now studying hydrogen evolution reactions, or HERs, a type of water-splitting technology in which electrodes, covered with catalytic materials, are inserted into water and charged with electricity. The interaction of the electricity, the catalysts and the water produce hydrogen gas—a clean fuel—and clean, breathable oxygen.

Currently the most popular system used for water splitting, or water electrolysis, relies on precious metals as catalysts, but a collaborative research team, including scientists from Los Alamos National Laboratory and Washington State University, has developed a system that uses less expensive and more abundant materials. They describe the advance in a paper published in Nature Energy on March 9.

> **"The current water electrolysis system uses a very expensive catalyst. In this system, we use a nickel-iron based catalyst, which is much cheaper, but the performance is comparable"**
>
> *~Yu Seung Kim, a research-scientist at Los Alamos National Laboratory*

Most water splitting today is conducted using a piece of equipment called a proton exchange membrane water electrolyser, which generates hydrogen at a high production rate. It is expensive, works under extreme acidic conditions, requiring precious metal catalysts such as platinum and iridium as well as corrosion-resistant metal plates made of titanium.

The research team worked to solve this problem by splitting water under alkaline,



Dr. Yu Seung Kim, working on fuel cell research at Los Alamos National Laboratory

or basic, conditions with an anion exchange membrane electrolyser. This type of electrolyser does not need a catalyst based on precious metals. In fact, a team led by Yuehe Lin, professor at WSU's School of Mechanical and Materials Engineering, created a catalyst based on nickel and iron, elements that are less expensive and more abundant in the environment.

Lin's team shared their development with Kim at Los Alamos, whose team in turn developed the electrode binder to use with the catalyst. The electrode binder is a hydroxide conducting polymer that binds catalysts and provides a high pH environment for fast electrochemical reactions.

The combination of the Los Alamos-developed electrode binder and WSU's catalyst boosted the hydrogen production rate to nearly ten times the rate of previous anion exchange membrane electrolysers, making it comparable with the more expensive proton exchange membrane electrolyser.

About 10 million metric tons of hydrogen are currently produced in the United States every year, mostly by using natural gas in a process called natural gas reforming, according to the U.S. Department of Energy. Hydrogen produced from a water splitting process that is powered by electricity from renewable energy holds many economic and environmental benefits, Lin said.

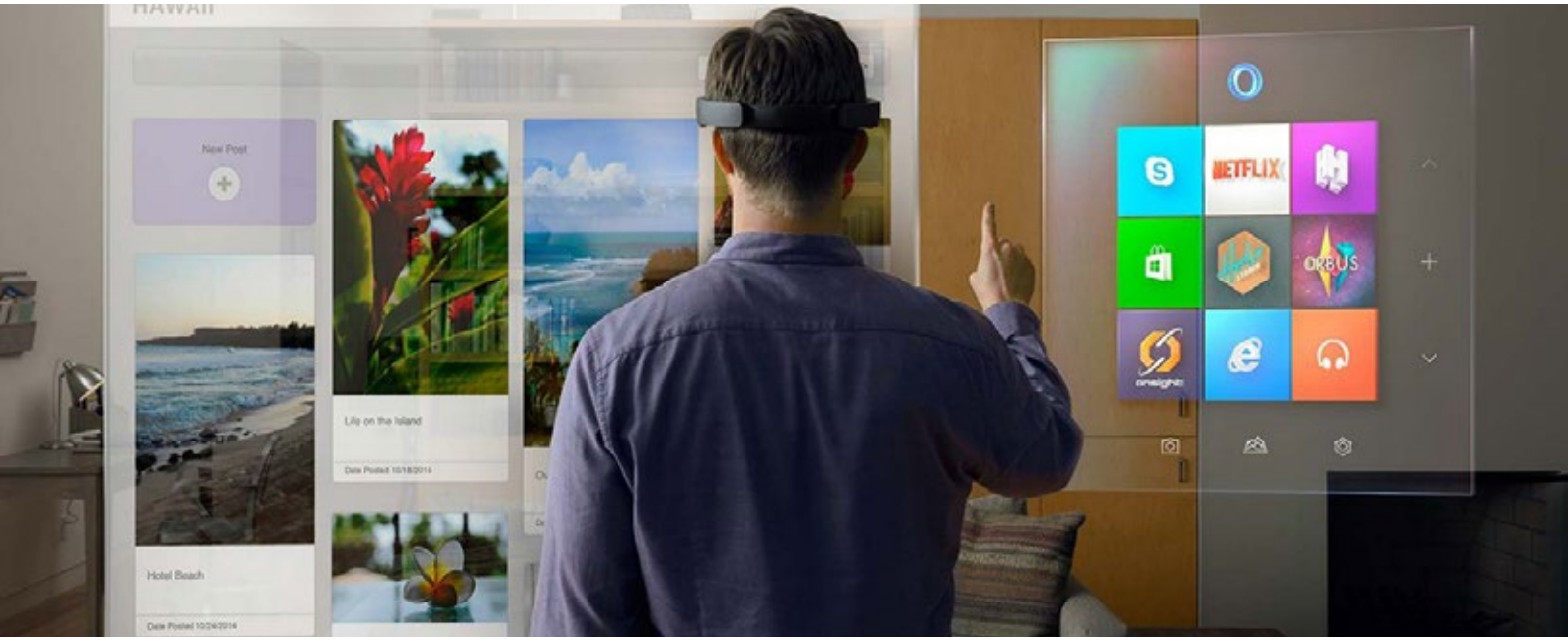
The global hydrogen generation market is expected to reach $199.1 billion by 2023. Potential markets for hydrogen energy include everything right from mass energy conversion and power grid management to fuel cells for cars. It is estimated that there are approximately 600 wind farms in the United States ready for direct connections to water electrolysis systems.

In addition to Los Alamos and WSU, researchers at Pajarito Powder and Sandia National Laboratories also contributed to this work. This research was supported by the HydroGen Advanced Water Splitting Materials Consortium established under the U.S. Department of Energy and Washington state's JCDREAM program.

Continued improvements in efficiency, durability, and cost are still needed for market viability. Ongoing research and development of materials, devices, and systems is making important strides, benefiting from strong synergies with contemporary research efforts in photovoltaics, nanotechnologies, and computational materials •

AUGMENTED REALITY

the present & the future



With the integration of reality and technology gaining momentum, what lies ahead in the direction of the AR technology?

BY RIYA P. ALEX, 2ND YEAR

Augmented reality superimposes computer generated images onto a live environment, helping the user to analyse the real-world situation in more detail. It is the real-time use of information in the form of text, graphics, audio, and other virtual enhancements integrated with real-world objects.

AR is used often with laptops, smartphones, and tablets, where digital images and graphics intersect and interact with the real world to enhance the experience. After capturing the input from the devices, the AR application recognises the target, processes the image, and augments it with pictures, video, and audio to create an illusion that can effectively engage users in a virtual world.

Augmented reality involves designing to add layers of digital elements over real-world views for specific purposes. e.g., using GPS filters/overlays on smart-phone screens to find directions from street views.

AR images can be displayed on a multitude of devices including eye glasses and goggles, headsets and head-up displays like helmet visors etc. Most common way to use AR these days is on smartphones in a variety of apps and games.

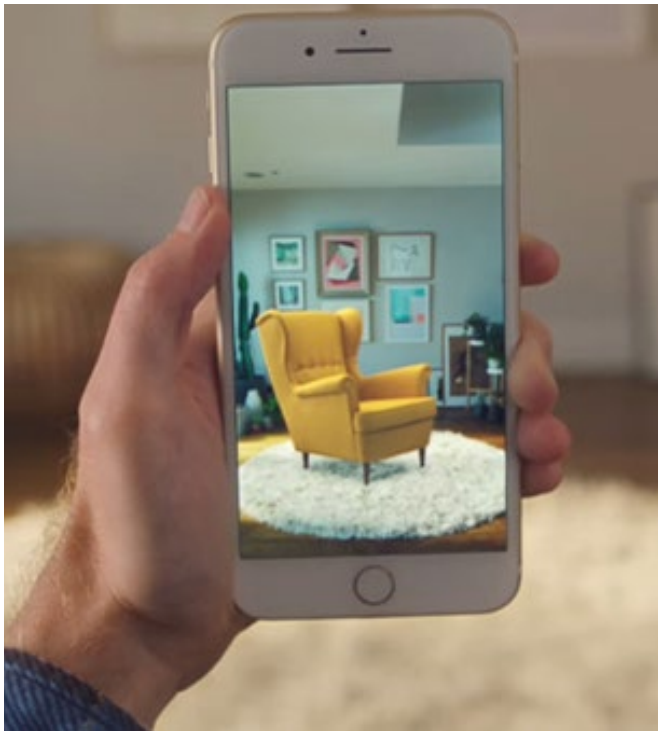
There are two broad types of AR, marker based and marker less. Marker based uses image recognition to identify objects that have been pre-programmed into AR devices or apps. Fiducial markers help AR devices determine the position and orientation of its camera.Marker less is a bit trickier .Not having markers means that nothing has been pre-programmed into the device. It has the recognition algorithm in a device that looks for pattern, colours or other features that might tip it off.

Industries like manufacturing, utilities, telecommunications, retail, healthcare, and logistics are increasingly adopting AR for a variety of uses, including assembly, maintenance and repair, education and training, retail showcasing, and diagnostics.

AR at present

AR is readily available and being used in a myriad of ways including snapchat lenses, and in a variety of shopping apps etc. There is already an Augmented Reality Markup Language (ARML) which is being used to standardise XML grammar for virtual reality. There are several software development Kits (SDK) which also offer simple environments of AR development.

One of the most popular applications of AR is gaming. New AR games provide much better experiences to players, some even promote a more active outgoing way of life . Gaming grounds are being moved from virtual spheres to real life, and players actually perform certain activities. In 2016 Niantic launched the PokemonGo game for mobile devices.



IKEA Place is an AR application that allows users to test IKEA's products in real time through Apple iOS 11's ARKit technology. Dubbed IKEA Place, the iPhone- and iPad-compatible free application features realistically-rendered, true-to-scale 3D products. The app automatically scales products, based on room dimensions, with 98 percent accuracy. The products can be customized, making online shopping more convenient.

In 2013 Google beta tested the Google Glass – with internet connection via Bluetooth. Google Glass is a wearable computer featuring a head-mounted display in the form of eyeglasses.

AR in the future

As technology can be further integrated into our lives without being intrusive, it is a certainty that augmented reality provides opportunities to enhance user experiences beyond measure.

In Education, AR technology can be used for making interactive models for learning and training purposes.

In indoor navigation, AR based applications for indoor navigation can provide directions in airports, malls, hospitals, office campuses etc. Real-estate can be benefitted from Augmented Reality via 3D tours of apartments and houses, that can also be manipulated to amend some parts.

For training in different fields, AR technology can be used by creating a mixed reality environment in front of trainees. This can be done using AR Goggles. In Military, AR Heads-Up technology can be used for identifying and analysing targets in a better way. The future will belong to AR when it improves task efficiency or the quantity of the output of an experience for the user. •

THE RACE TO 5G

BY ASKA SANTHOSH, 1ST YEAR

The 5th generation mobile network is a global wireless standard after 1G, 2G, 3G, and 4G networks. 5G enables a different kind of network that is designed to connect virtually with everyone and everything (including machines, objects, and devices).

5G wireless technology is meant to deliver higher multi-Gbps peak data speeds, ultra- low latency, etc with more reliability, massive network capacity and increased availability. Higher performance and improved efficiency brings in new user experiences and connects new industries. 5G is the new driving global growth. This article emphasizes on the salient features, technological design (architecture), advantages, challenges, shortcomings and future scope.

In 2018, telecommunication providers began deploying fifth-generation (5G) networks to meet growing demands for data from consumer and industrial users. 5G networks are expected to enable providers to expand consumer services (e.g., video streaming, virtual reality applications), support the growing number of connected devices (e.g., medical devices, smart homes, Internet of Things), support new industrial uses (e.g., industrial sensors, industrial monitoring systems), perform advanced data analytics, and enable the use of advanced technologies (e.g., smart city applications, autonomous vehicles). 5G is expected to yield significant economic benefits. Market analysts estimate that in the United States, 5G could create up to 3 million new jobs and add $500 billion to the nation's gross domestic product (GDP). Globally, analysts estimate that 5G technologies could generate $12.3 trillion in sales activity across multiple industries and support 22 million jobs by 2035. Experience has shown that companies that are first to market with new products can capture the bulk of the revenues, yielding long-term benefits and significant economic gains for the respective companies. Hence, technology companies around the world are racing to develop

5G products, some countries (i.e., central governments) are also acting in support of 5G deployment. This competition to develop 5G products and capture the global 5G market is often called the “race to 5G.” In the race to 5G, the United States is one of the leaders, followed by China and South Korea. Each country has adopted a different strategy to lead in 5G technology development and deployment.

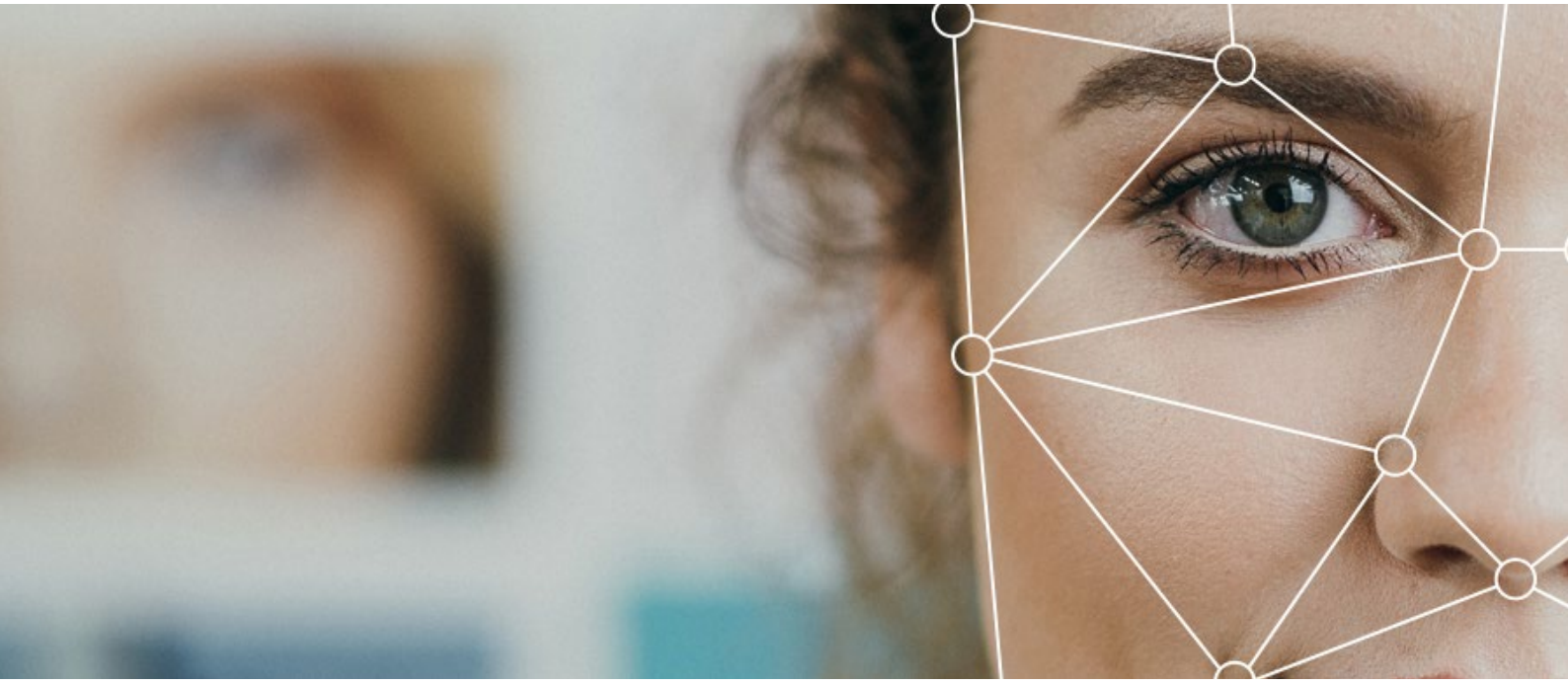
China’s central government is supporting the deployment of 5G infrastructure. China has a national plan to deploy 5G domestically, capture the revenues from its domestic market, improve its industrial systems, and become a leading supplier of telecommunications equipment to the world. In South Korea, the central government is working with telecommunications providers to deploy 5G. South Korea plans to be the first country to deploy 5G nationwide, and to use the technology to improve its industrial systems. In the United States, private industry is leading 5G deployment. U.S. providers, competing against each other, have conducted 5G trials in several cities and were the first in the world to offer 5G services commercially. The U.S. Government has supported 5G deployment, making spectrum available for 5G use and streamlining processes related to the citing of 5G equipment (e.g., small cells).

While each country has taken a different approach to capturing the 5G market, there are factors that drive the timeline for all deployments, including international decisions on standards and spectrum. In the United States, 5G deployment may also be affected by the lengthy spectrum allocation process, resistance from local governments to federal small cell citing rules, and limitations on trade that may affect availability of equipment. The 116th Congress may monitor the progress of 5G deployment in the United States and its position in the race to 5G. Policies that support 5G deployment while also protecting national and local interests could provide significant consumer benefits, help to modernize industries, give U.S. companies an advantage in the global economy, and yield long-term economic gains for the United States.

5th Generation Mobile Network or simply 5G is the forthcoming revolution of mobile technology. The features and its usability are much beyond the expectation of a normal human being. With its ultra-high speed, it is potential enough to change the meaning of a cell phone usability •

The advent of FACIAL RECOGNITION

BY G. NANDAGOPAN, 3ND YEAR



Facial recognition is one of the most interesting applications of the Artificial Intelligence boom that the world has been witnessing. It is a simple idea that has a far-reaching impact on our everyday lives.

A facial recognition system simply means a system capable of identifying or verifying a person from a digital image or from a video frame. The applications of this technology range from law enforcement and security services to social media platforms.

History

The origin of facial recognition technology is traced back to the 1960s in the United States, when Woodrow Wilson Bledsoe, who is often regarded as the Father of Facial Recognition Technology, along with Helen Chan Wolf and Charles Bisson, created a system that could be used to recognise human faces. The coordinates of facial features like eyes, nose, mouth and hairline had to be manually entered into a device called a RAND tablet. These recorded metrics for multiple images formed the database. When a new photograph was entered into the system, it could fetch the image from the database that resembled it the most. Hence it provided a very primitive output as far as accuracy was concerned and also involved a good amount of manual work. This project is supposed to have been done for an unnamed intelligence agency, and so did not receive much publicity.

The 1970s saw more facial markers being introduced to the system. Harmon, Goldstein and Lesk used 21 facial markers, including hair colour and lip thickness. This increased the accuracy of the system, but saw no reduction in manual input needed.

The late 1980s and early 1990s saw the first attempts of automatic facial recognition. The years that followed saw the mainstreaming of facial recognition. Many airports and banks in the U. S. started using the technology for various purposes. A major

milestone occurred in 2010 when social media giant Facebook introduced a feature that automatically identified the face of its users from any photo and tagged them with it.

Recent years have seen government agencies across the globe turning to the use of face-identification systems for surveillance systems.

Methodology

The system is firstly loaded with a database containing a large number of facial images. Every face consists of a number of distinguishable features, such as depth of eye sockets, distance between the eyes, width of nose, and so on. Many systems use around 70 facial features. These features corresponding to each image forms the facial signature of that image. This facial signature forms the key to recognising a face, depending on the application.

If the face is to be stored in the system, the facial signature is saved to the database. In case of identifying the person whose face has been photographed, the system compares the signature with the millions of faces in the database, and fetches the most resembling image, along with the details of the person.

The impact of the external environment may make the process complex. For example, ambient lighting may not be constant. Also, the faces may be aligned to the sides, or the complete face may not be captured. To tackle these issues, there are many complex algorithms being developed, like three-dimensional analysis, skin-texture analysis and thermal scanning.

The efficiency of the system depends on two factors- size of the database and the complexity of algorithms used. A larger database and algorithm which takes into account complex features may lead to increased accuracy of identification.

Applications

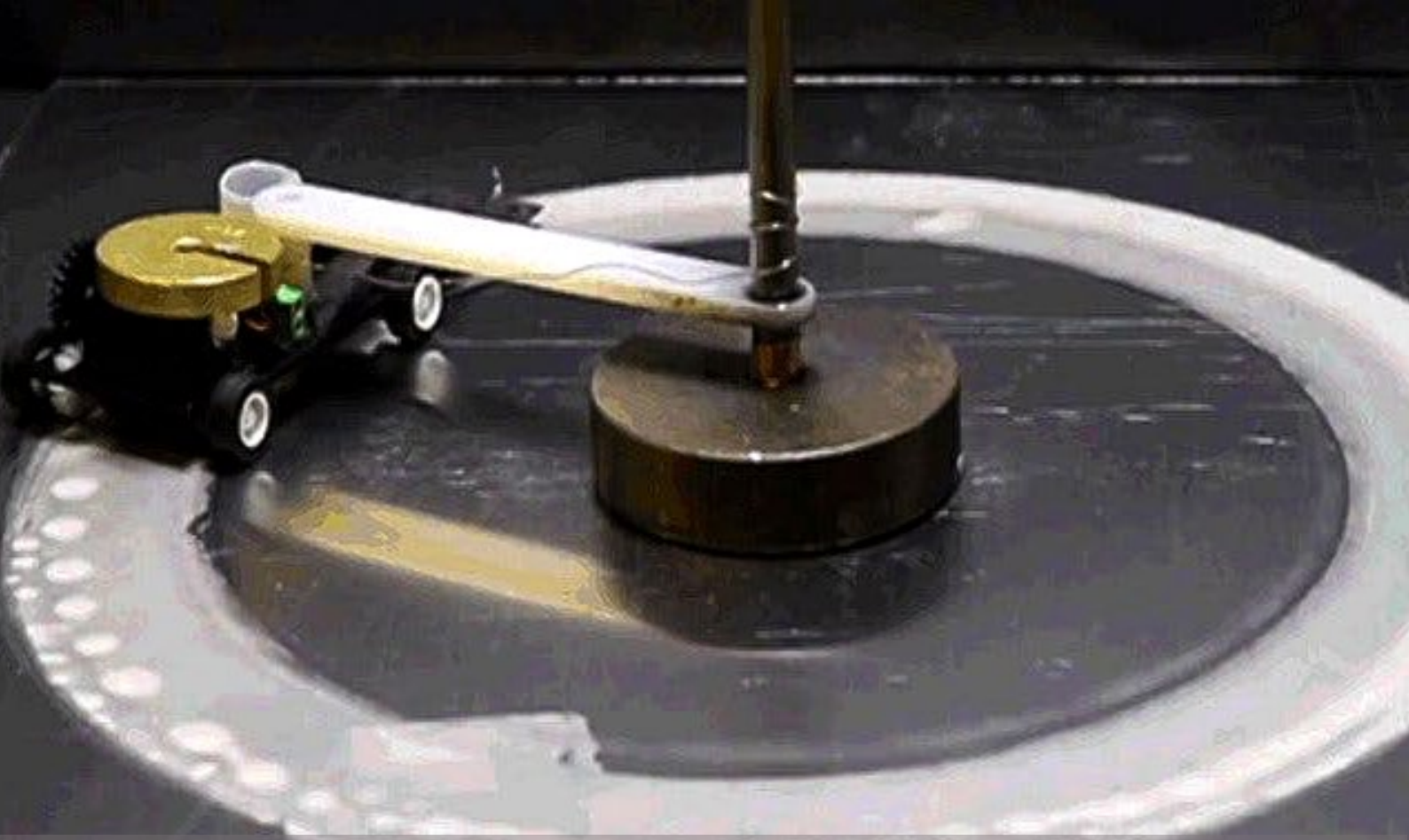
Facial recognition systems have a plethora of applications. Governments around the world have started the mass deployment of face-identification systems at public spaces such as airports, bus stations and busy streets. This helps in dealing with crime and ensuring public safety. Mobile phone makers have unanimously integrated face-lock systems into smartphones. Social media platforms also use this technology to make them more interactive.

Opportunities and Challenges

Facial recognition systems can be used for many applications that could make our lives easier. Educational institutions could use this system to do away with the traditional system of manual recording of students' attendance. Employers can replace the 'punching' or fingerprint scanning that is commonly used for monitoring employees, thereby saving the time spent in punching. On a larger scale, advanced facial recognition systems with a large database can be used by the law-enforcement agencies for detecting suspicious persons in public spaces and thereby averting crimes.

Although Face Recognition has such amazing features, this technology comes with its share of challenges too. Pro-privacy activists have raised an alarm about its use for invading into the privacy of individuals. Authoritarian governments around the globe have started its use for tracking down the dissenters to the regime. China has laid down a vast network of face-identifying cameras across its territory. Also, internet search engines and social media platforms have been accused of mishandling the images of their users.

The future of facial recognition is quite promising. More and more spheres of life will see integration of the technology into them. The technology is projected to grow and generate massive revenue in the coming years. Creating opportunities out of challenges is what that is needed for its responsible usage •



METAL-AIR SCAVENGER
THE PATH TO SELF POWERING ROBOTS

The door opens to a new family of robots which can charge itself by "eating" metal from its own environment

BY JACOB JOHN, 3RD YEAR

With the emergence of Industry 4.0 and development in AI, Machine learning, Automation, the upcoming generation will surely see a rise in the robotic sector. Robots are becoming increasingly useful in search-and-rescue missions, from snake bots that can slither through tight spaces or cracks to reach a person in distress, to drones that can fly inside tight cave shafts to gather information about the tunnel system inside before deploying larger units.

Whilst there are some very impressive innovations in the world of robotics, today's lithium-ion batteries only last for five minutes. At the rate that current lithium-ion batteries are progressing, it could be a long time before they operate for even 15 minutes. The new approach means that robots could recharge by consuming parts of metal surfaces; a small robot would need only the top 100 micrometres of a metal object to do so.

The issue behind powering robots:

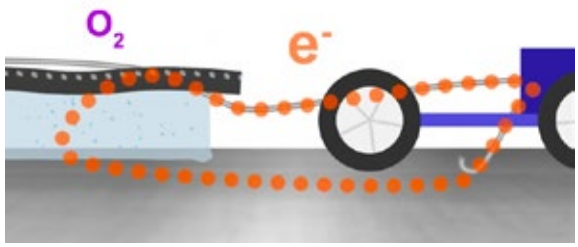
Robots are expected to work tireless hours, yielding perfect, precise results around the clock. But what powers them? They don't need food and water; they need a power source. The selection of a robotic power source should be a decision that is to be made in the early stages of design since it impacts the complete system.

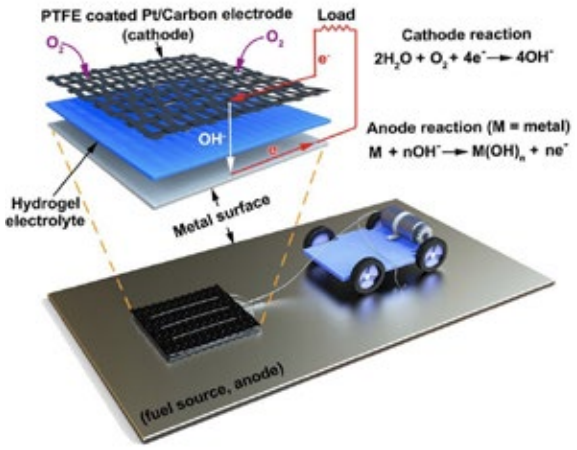
The major disadvantage when it comes to robots is that they are only capable as their battery packs. Once the energy inside the bots is depleted, they will stop whatever they're doing—no matter how important that mission is—and operators must either recharge the battery or load a new one.

This obstacle forms a solid hindrance to the

development of robots in real-world environments. The main sources of electrical power for robots are batteries. The type of battery that is used for a robot varies depending on the safety, life cycle, and weight. Lead acid batteries are common, as are silver cadmium batteries. Rechargeable batteries and primary batteries are both used; batteries that are not rechargeable are generally more powerful.

Other options for robotic power sources are: thermoelectric generators, which convert heat directly into electricity; fuel cells, which are similar to batteries except fuel and oxidants are continuously supplied; supercapacitors, which store high energy as a charge build up on plates; and tethers, which connect the robot to the power supply. The tether option entirely removes the power source from the robot which saves weight and space, but since the robot constantly has to be connected, it can be a nuisance as well.





What is the alternative to powering robots?

When electronics need their own power sources, there are two basic options: batteries and harvesters. Batteries store energy internally, but are therefore heavy and have a limited supply. Harvesters, such as solar panels, collect energy from their environments. This gets around some of the downsides of batteries but introduces new ones, in that they can only operate in certain conditions and can't turn that energy into useful power very quickly.

Food for robots!

Researchers at the University of Pennsylvania have developed a new type of robot that powers itself by "eating" metal from its own environment! New research from the University of Pennsylvania's School of Engineering and Applied Science is bridging the gap between these two fundamental technologies for the first time in the form of a "metal-air scavenger" that gets the best of both worlds.

This metal-air scavenger works like a battery, in that it provides power by repeatedly breaking and forming a series of chemical bonds. But it also works like a harvester, in that power is supplied by energy in its environment: specifically, the chemical bonds in metal and air surrounding the metal-air scavenger.

Constructon

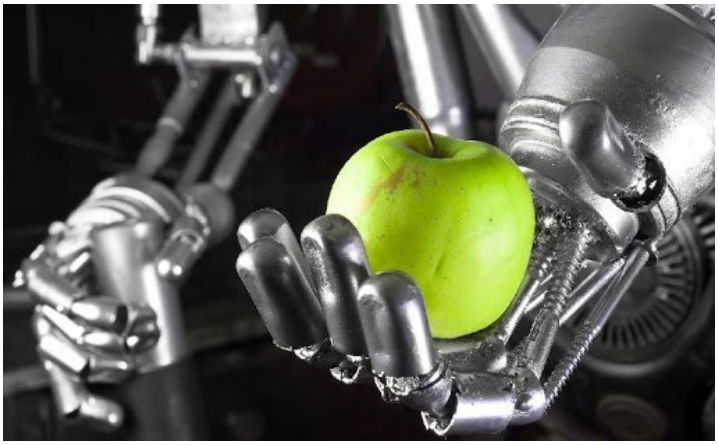
The MAS design would still have the basic layout of a battery, including a cathode, anode, and electrolyte. But the clever part is that the anode isn't built into the device – any metallic surface that the MAS passes over will provide the function.

Like a traditional battery, the researchers' MAS starts with a cathode that's wired to the device it's powering. Underneath the cathode is a slab of hydrogel, a spongy network of polymer chains that conducts electrons between the metal surface and the cathode via the water molecules it carries. With the hydrogel acting as an electrolyte, any metal surface it touches functions as the anode of a battery, allowing electrons to flow to the cathode and power the connected device.

For the purposes of their study, the researchers connected a small motorized vehicle to the MAS. Dragging the hydrogel behind it, the MAS vehicle oxidized metallic surfaces it travelled over, leaving a microscopic layer of rust in its way.

The cathode is made up of carbon, coated in polytetrafluoroethylene (PTFE) and with nanobeads of platinum embedded inside. The electrolyte is a hydrogel containing salty water. When this jelly-like patch is dragged around on top of a metallic surface, it oxidizes the metal below, breaking down chemical bonds to power itself. At the same time, the cathode material is reducing oxygen from the air

above it.
The self-powered vehicle drove around in circles, carrying just a small amount of water to regularly re-wet the hydrogel. Even factoring in the weight of the extra water, the MAS had 13 times the energy density of a lithium-ion battery because the vehicle only has to carry the hydrogel and cathode, and not the metal or oxygen which provide the energy." The oxidation process does affect the surface that the device is driving on of course, leaving a thin layer of rust in its way. But the team says that this only affects the top 100 microns of the surface, so it shouldn't do any significant structural damage. The team says that this system could be put to use powering small internet-of-things devices, such as sensors on shipping containers.



How effective is MAS?
The result is a power source that has 10 times more power density than the best energy harvesters and 13 times more energy density than lithium-ion batteries.

In the long term, this type of energy source could be the basis for a new paradigm in robotics, where machines keep themselves powered by seeking out and "eating" metal, breaking down its chemical bonds for energy like humans do with food.
In the near term, this technology is already powering a pair of spin-off companies. The winners of Penn's annual Y-Prize Competition are planning to use metal-air scavengers to power low-cost lights for off-grid homes in the developing world and long-lasting sensors for shipping containers that could alert to theft, damage or even human trafficking.
The motivation for developing their metal-air scavenger, or MAS, stemmed from the fact that the technologies that make up robots' brains and the technologies that power them are fundamentally mismatched when it comes to miniaturization.

As the size of individual transistors shrink, chips provide more computing power in smaller and lighter packages. But batteries don't benefit the same way when getting smaller; the density of chemical bonds in a material are fixed, so smaller batteries necessarily mean fewer bonds to break. Worse still, adding a bigger battery won't allow a robot to last longer; the added mass takes more energy to move, negating the extra energy provided by the bigger battery. The only way to break this frustrating inverted relationship is to forage for chemical bonds, rather than to pack them along.The researchers also tested the MAS vehicles on zinc and stainless steel. Different metals give the MAS different energy densities, depending on their potential for oxidation.
This oxidation reaction takes place only within 100 microns of the surface, so while the MAS may use up all the readily available bonds with repeated trips, there's little risk of it doing significant structural damage to the metal it's scavenging.
James Pikul, assistant professor in the Department of Mechanical Engineering and Applied Mechanics of PEN University has spoken that as we get robots that are more intelligent and more capable, we no longer have to restrict ourselves to plug them into a wall. They can now find energy sources for themselves, just like humans do. One day, a robot that needs to recharge its batteries will just need to find some aluminium to 'eat' with a MAS, which would give it enough power to make it work until its next meal.
Thanks to this emerging technology, a robot might be able to recharge by consuming part of a metal surface whenever near one •

Electric Mobility

The past, present and the future

BY DR. SHEIKH MOHAMMED S., ASSISTANT PROFESSOR, EEE DEPARTMENT, TKMCE

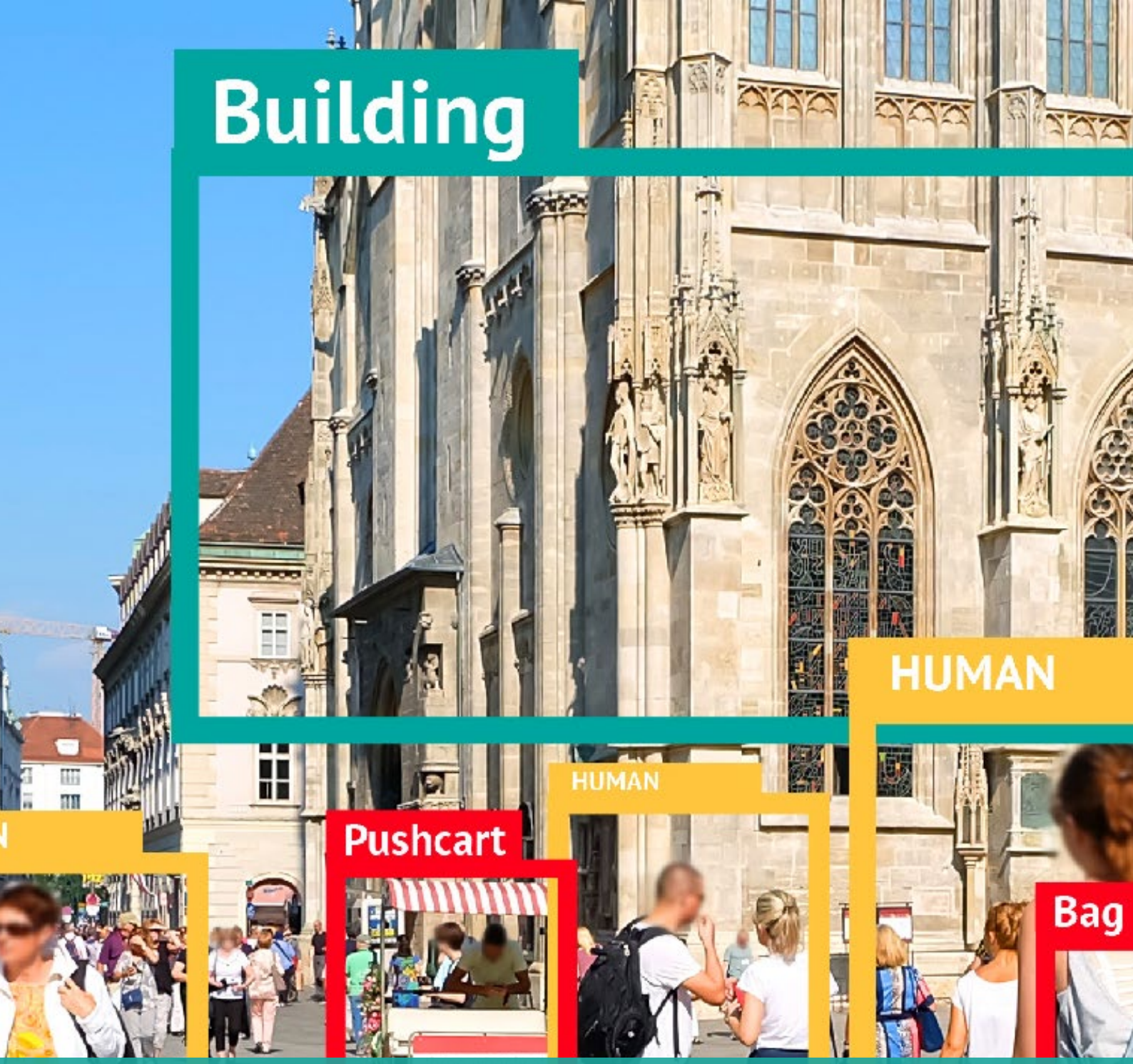
Electric Mobility has become one of the hot topics of discussion in recent times. But, Electric vehicles (EVs) are not new. Electric Mobility is 200 years old technology. The first reasonable and market-friendly electric car was introduced by Gustav Trouve in 1831. In the coming years, EVs competed with other technologies such as “horse-wagons,” steam engines, or the internal combustion engine (ICE) and entered a compelling market share from the beginning. Several companies in the US, England and France made EVs by 1900. EVs launched by Bouquet, Garcin and Schivre (BGS), France in 1900 had set a world record of 290 Km/charge. Believe it or NOT, One-third of the vehicle was an electrically powered vehicle in the US i.e., among 4200 automobiles sold in the US, 38% were EV. However, in the coming years, the strategy has changed. In 1930, the mass production and comparatively cheap price of Henry Ford’s Model T has taken over the EV market, which led to the disappearance of EVs for the first time. From then, the Internal Combustion Engine Vehicles gained supremacy and monopolized the industry over centuries. Approximately after six decades, the success story of the EVs began with the introduction of Toyota Prius, a Hybrid Electric Car in 1997. Today, Toyota has sold more than 6 million HEVs. However, the third wave of the electric car started later. The announcement of Tesla in 2008 was the starting point, and presently, there are worldwide efforts to stabilize Electric

Vehicles. In 2010, GM released the Chevy Volt, making it the first commercially available Plug-in Hybrid (PHEV). The EV market has been evolving steadily and the EV industry had seen unexpected growth in sales in the last 5 years. China and Europe are the dominant markets in EV sale. With 57% sale growth of light passenger EVs such as cars and vans, China market had half of the global EV sales in 2017 compared to the previous year. In Norway, the market share of a plug-in electric car has surpassed to 49.1% in 2018 and close to 2.3 million global EV sales in 2019 was the final tally, up from roughly 2.1 million in 2018. Across-the-board, the 2019 global EV market share was 2.5%, an upgrade from the 2.2% market share of 2018 and the main growth driver was Europe. It is estimated that there will be more than 320 million EVs globally by the year 2040.

It is of no doubt that Electric mobility is a promising technology. It can considerably reduce the environmental pollution, operational cost and maintenance cost when compared to the ICE Vehicles. Vehicle – To – Grid (V2G) technologies allow the power exchange between the EV and the utility grid. Therefore, EV technology has the potential to act as an Energy Storage System (ESS) in the modern smart grid.

But, at the same time, there are new challenges to overcome to adopt EV technology. In the Indian Scenario, one of the major setbacks for EV migration is the lack of public charging infrastructure. Duration of charging is another complication for EVs. It takes 2-8 hours to fully charge the EV batteries. EVs are mobility loads. Hence, connection and disconnections of EVs in the grid are also speculative. This unpredictable integration of a large number of EVs to the power grid will lead to undesirable distortion, voltage instability and other technical, economical and security issues. The cost of vehicles is still high and it is mainly because of the battery. Again, battery replacement cost is also huge in BEVs. In the present scenario, EVs as a vehicle doesn't emit the gases and pollute the environment. However, the energy required for charging the batteries is generated using fossil fuels only.

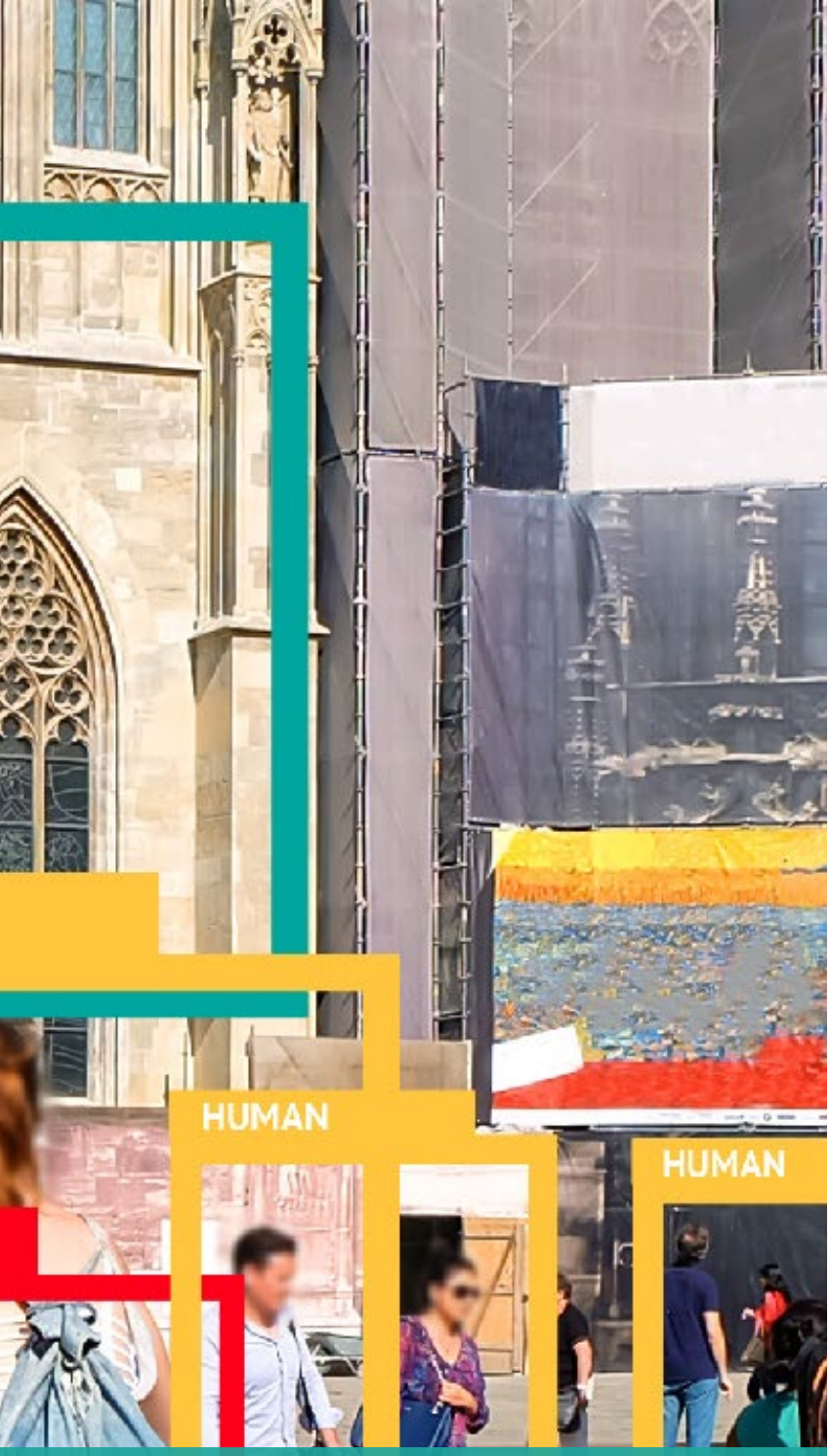
The first and foremost need is the public charging infrastructure, which will certainly ignite the passion to tick EV as the first choice. Of course, initiatives are taken by government agencies and private companies build charging stations across the country. Battery technologies are peaking. Increase in sales of EV and better battery technologies indicates a sign of reduction of the price of EVs in the coming years. Many countries have proven the Stability, Reliability, and Security of the grid system with penetration of EVs by acquiring modern grid technologies that support two-way power and data communications. Finally, Renewable Energy Systems for EV charging station would make EVs absolutely "ZERO EMISSION" •



YOU ONLY LOOK ONCE

A quick look into the state of the art deep learning algorithm YOLO (You Only Look Once) that has stepped up the game in Real-Time Object Detection

BY AVERIL IGNATIOUS, MOHAMED JAMEEL,RIZWAN KAMARUDEEN AND ROHAN R, 4TH YEAR



The problem of real time object detection and classification for giving autonomy to robots has been haunting scientists and engineers for decades. This area of research has attracted a vast majority of scientists due to the wide variety of problems it can solve. With applications in military, medicine, disaster management and surveillance lots of research work is going on.

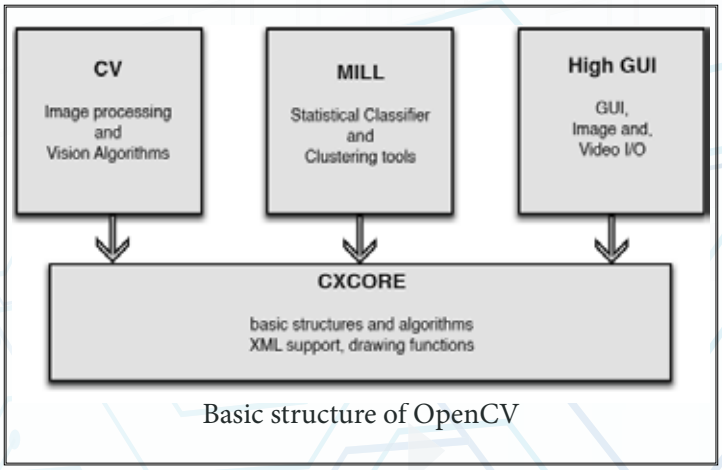
Computer vision is the transforming of data from a still, or video camera into either a representation or a new decision. All such transformations are performed to achieve a particular goal. A computer obtains a grid of numbers from a camera or from the disk, and that's that. Usually, there is no built-in pattern recognition or automatic control of focus and aperture, no cross-associations with years of experience. For the most part, vision systems are still fairly naive. For implementing object detection Raspberry Pi Camera can be used to obtain live video feed which is processed using Python and OpenCV by applying 'You Only Look Once', a deep learning algorithm

Open CV

OpenCV is an open source (see http://opensource.org) computer vision library. OpenCV was designed for computational efficiency and has a high focus on real-time image detection. OpenCV is coded with optimized C and can work with multicore processors. If one desires more automatic optimization using Intel architectures, one can buy Intel's Integrated Performance Primitives (IPP) libraries. These consist of low-level routines in various algorithmic areas which are optimized. OpenCV automati-

cally uses the IPP library, at runtime if that library is installed.

One of OpenCVs goals is to provide a simple-to-use computer vision infrastructure which helps people to build highly sophisticated vision applications fast. The OpenCV library, containing over 500 functions, spans many areas in vision. Since computer vision and machine learning often goes hand-in-hand, OpenCV also has a complete, general-purpose, Machine Learning Library (MLL). This sub library is focused on statistical pattern recognition and clustering. The MLL is very useful for the vision functions that are the basis of OpenCV's usefulness but is general enough to be used for any machine learning problem.



Basic structure of OpenCV

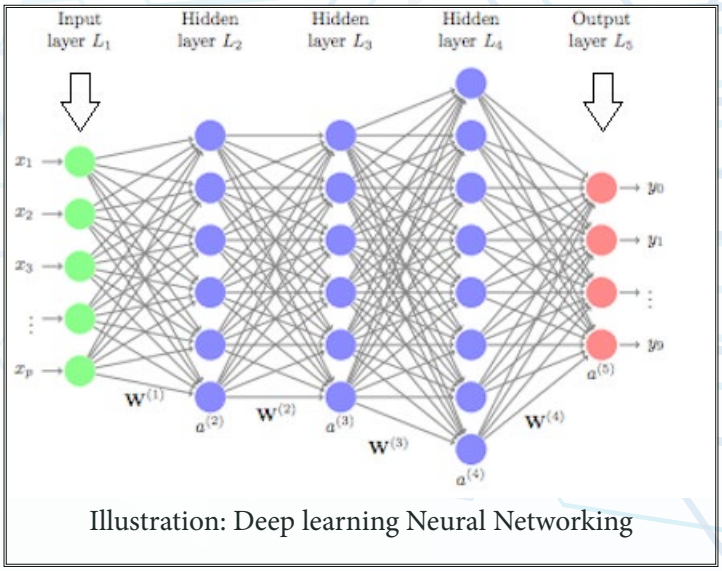


Illustration: Deep learning Neural Networking

Deep Learning

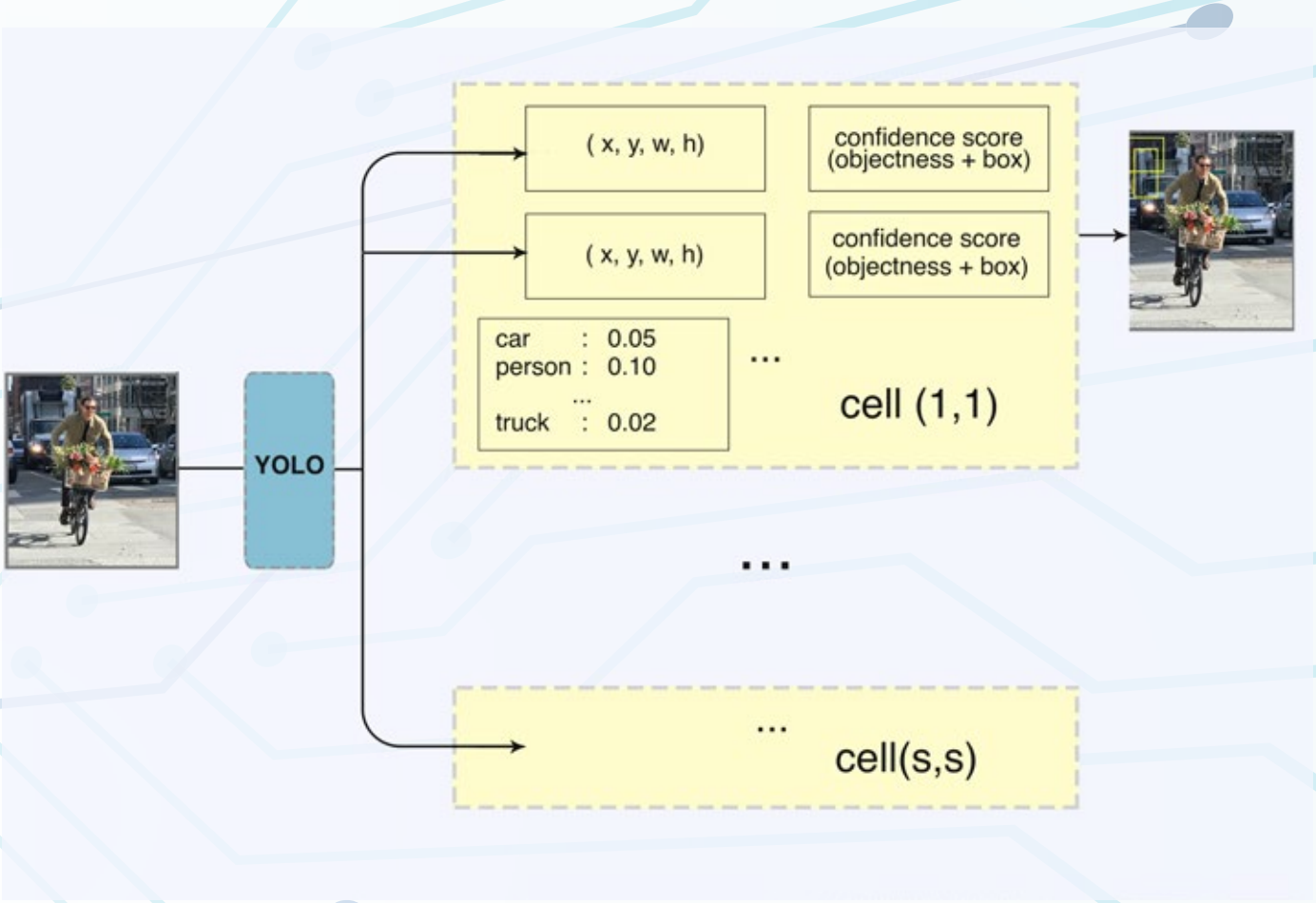
Deep learning is a class of machine learning algorithms that uses multiple layers to progressively extract higher level features from the raw input. For example, in image processing, lower layers may identify edges, while higher layers may identify the concepts relevant to a human such as digits or letters or faces.

In deep learning, each level learns to transform its input data into a slightly more abstract and composite representation. In an image recognition application, the raw input may be a matrix of pixels; the first representational layer may abstract the pixels and encode edges; the second layer may compose and encode arrangements of edges; the third layer may encode a nose and eyes; and the fourth layer may recognize that the image contains a face. Importantly, a deep learning process can learn which features to optimally place in which level on its own.

YOLO

You Only Look Once (YOLO) is a network that uses Deep Learning (DL) algorithms for object detection. YOLO performs object detection by classifying certain objects within the image and determining where they are located on it. For example, if you input an image of a herd of sheep into a YOLO network, it will generate an output of a vector of bounding boxes for each individual sheep and classify it as such.A YOLO network consists of three main parts. First, the algorithm, also known as the predictions vector, second, the network, third, the loss function.

The Algorithm : Once you insert an image into a YOLO algorithm, it splits the images into an SxS grid that it uses to predict whether the specific bounding box contains the object (or parts of it) and then uses this information to predict a class for the object. Before we can go into details and explain how the algorithm functions, we need to understand how the algorithm builds and specifies each bounding box. The YOLO algorithm uses four components and additional value to predict an output:



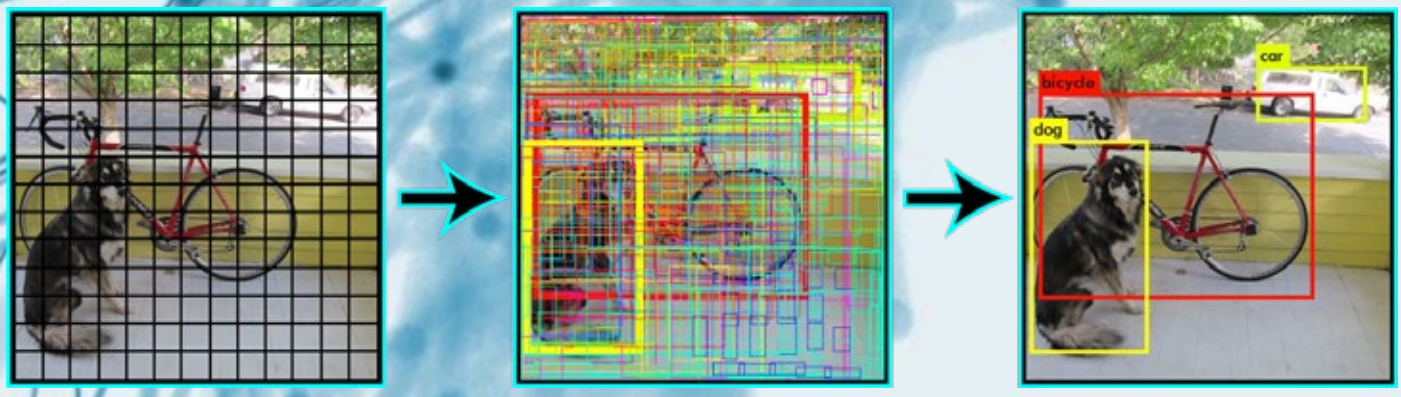
• center of a bounding box (bx by)
• width (bw)
• height (bh)
• class of the object (c)

The final predicted value is confidence (pc). It represents the probability of the existence of an object within the bounding box. The (x,y) coordinates represent the center of the bounding box. Typically, most of the bounding boxes will not contain an object, so we need to use the pc prediction. We can use a process called non-max suppression to remove unnecessary boxes with low probability to contain objects and those who share big areas with other boxes. YOLO divides the input image into an S×S grid. Each grid cell predicts only one object and a fixed number of boundary boxes.

For each grid cell,
• it predicts B boundary boxes and each box has one box confidence score,
• it detects one object only regardless of the number of boxes B,
• it predicts C conditional class probabilities (one per class for the likeliness of the object class).

Each boundary box contains 5 elements: (x, y, w, h) and a box confidence score. The confidence score reflects how likely the box contains an object and how accurate is the boundary box. We normalize the bounding box width w and height h by the image width and height. x and y are offsets to the corresponding cell. Hence, x, y, w and h are all between 0 and 1. Each cell has 20 conditional class probabilities. The conditional class probability is the probability that the detected object belongs to a particular class (one probability per category for each cell). So, YOLO's prediction tensor has dimension of (S, S, B×5 + C) = (7, 7, 2×5 + 20) = (7, 7, 30).

The major concept of YOLO is to build a CNN network to predict a (7, 7, 30) tensor. It uses a CNN network to reduce the spatial dimension to 7×7 with 1024 output channels at each location. YOLO performs a linear regression using two fully connected layers to make 7×7×2 boundary box predictions (the middle picture below). To make a final prediction, we keep those with high box confidence scores (greater than 0.25) as our final predictions.



Network Design : YOLO has 24 convolutional layers followed by 2 fully connected layers (FC). Some convolution layers use 1 × 1 reduction layers alternatively to reduce the depth of the features maps. For the last convolution layer, it outputs a tensor with shape (7, 7, 1024). The tensor is then flattened. Using 2 fully connected layers as a form of linear regression, it outputs 7×7×30 parameters i.e. 2 boundary box predictions per location.

The Loss Function : We only want one of the bounding boxes to be responsible for the object within the image since the YOLO algorithm predicts multiple bounding boxes for each grid cell. To achieve this, we use the loss function to compute the loss for each true positive. To make the loss function more efficient, we need to select the bounding box with the highest Intersection over Union (IoU) with the ground truth. This method improves predictions by making specialized bounding boxes which improves the predictions for some aspect ratios and sizes.

Previous object detection methods like Region-Convolutional Neural Networks (R-CNN), including other variations of it like fast R-CNN, performed object detection tasks in a pipeline of multi-step series. R-CNN focuses on a specific region within the image and trains each individual component separately. This process requires the R-CNN to classify 2000 regions per image, which makes it very time-consuming (47 seconds per individual test image). YOLO is much faster (45 frames per second) and easier to optimize than previous algorithms, as it is based on an algorithm that uses only one neural network to run all components of the task •

SUPERCAPACITORS

An alternative primary power source for EV?

BY SHAMEEM FARIS T, 3RD YEAR

In this era, electric vehicles are widely seen as a successor to ICE vehicles, and most of the automobile industries are trying to electrify their models, and the government is giving much attention for the development of electric vehicles that's because of the low polluting advantages of EV.

Although it's default now, lithium-ion technology may not be the final answer when it comes to powering EVs. Supercapacitors provide solutions to some lasting problems with battery powered electric vehicles and have added benefits for hybrids, too. They could be an answer that the EV world needs now. Although it's default now, lithium-ion technology may not be the final answer when it comes to powering EVs. Supercapacitors provide solutions to some lasting problems with battery powered electric vehicles and have added benefits for hybrids, too. They could be an answer that the EV world needs now.

What is a supercapacitor?

Let's first explain what a supercapacitor is. Sometimes called an ultracapacitor, a supercapacitor is like a battery, which means to store and release electricity. But rather than storing energy in the form of chemicals, supercapacitors store electricity in a static state, making them better at rapidly charging and discharging energy.

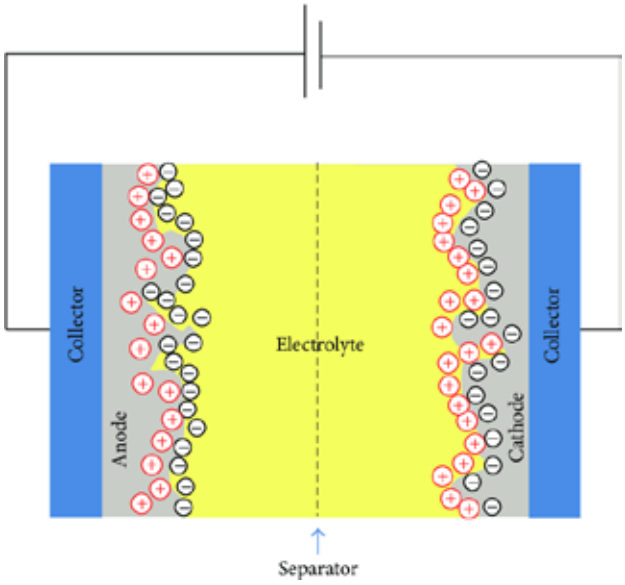
As we know Lithium-ion batteries work by using layers of cells using positive and negative electrodes separated by an electrolyte. They generate a charge as lithium ions move from negative to positive when discharging, and the reverse happens when charging. But in supercapacitors, the stored electricity is in a static state.

In many ways, a supercapacitor is simply a larger capacitor with bigger electrode plates and less distance between them, allowing for a greater charge to be stored in the form of electrical potential energy. A supercapacitor doesn't use a dielectric; instead porous electrode plates are soaked in an electrolyte and separated by a very thin separator material. When a charge is passed through the electrodes, the atoms in them become polar-

ised - giving the electrodes a positive or negative charge. These then attract electrons of the opposite polarity in the electrolyte, and thus create a double electric layer, meaning supercapacitors store a lot more power than their regular capacitor counterparts.

Supercapacitors right now

Supercapacitors already exist in cars with regenerative braking systems. This is due to their greater power density than chemical reaction-based batteries, which allows them to rapidly store and discharge electricity, helps for collecting energy generated under braking then quickly releasing it upon acceleration. There are two main issues with supercapacitors right now, and the most alarming is energy density. Sure, supercapacitors can absorb and deliver a large amount of power, faster than lithium-ion batteries but right now, they aren't able to store as much. It's an issue that makes them less suitable for electric cars as things stand, but doesn't mean they should be ruled out in the future. Don't forget it took a while to extract an acceptable mileage range out of lithium-ion battery systems. Researchers from the University of Surrey have claimed a breakthrough in materials for supercapacitors that could enable them to have the range of petrol cars, but it's early days and you won't see that from current supercapacitors. The second issue with supercapacitors as they stand is discharging, or the amount of time they're able to hold a charge for. Currently, supercapacitors can't hold a charge as long as a lithium-ion battery. If you left a supercapacitor-powered car in the garage for a week, you'd likely find it with no charge when you return. Inevitably, as breakthroughs are made in supercapacitors, we can expect better energy storage and ways to prevent rapid discharging, which could eventually lead to supercapacitors superseding lithium-ion battery systems. But that's looking to be a way off.



So what about now? While supercapacitors may not be seen in EVs for a while, the technology already fits perfectly into hybrid power trains. Supercapacitors are already used to rapidly charge the power supplies in hybrid buses as they go from stop to stop. When hybrid energy is used purely for performance, issues such as range and the ability to hold charge aren't as important – and that's why we're already seeing the technology creep into the hybrid car world.

The Lamborghini Sian combines a supercapacitor-powered 34bhp e-motor in conjunction with a Sant'Agata V12, for sub 3.0sec 0-62mph performance. In the Sian, the use of a supercapacitor is the sole method of electric power storage, but it's possible we could get vehicles that mix supercapacitor and lithium-ion tech, too – harnessing the benefits of both; lithium-ion batteries would still the main source of power, but supercapacitors could augment them for faster energy discharge and recharge during accelerating and braking.

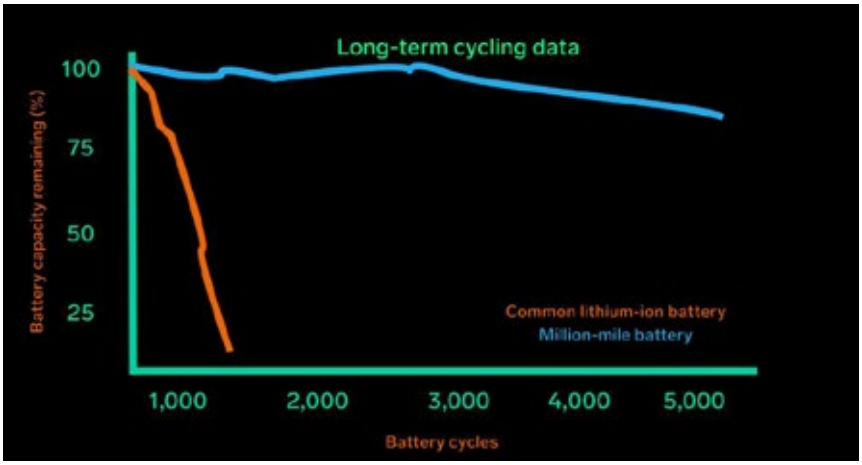
The Future

An EV could run on supercapacitor power around town where there is the infrastructure to support rapid charging, effectively hopping from powerpoint to powerpoint. Then, for longer journeys, the car could switch over to the lithium-ion battery with regenerative braking helping them for more range.
In 2019 TESLA bought Maxwell Technologies, an US based supercapacitor manufacturer. And in future we can expect such an EV from TESLA•

THE MILLION-MILE BATTERY

Reworking the Financial Math & Redefining the EV sector

KEVIN SHALU, 2ND YEAR



You are driving in your favorite car and the necessity of upgrading to a new one despises you. We all wish at times if our favorite chariot lasted more, if it gave us more. The average lifespan of a car is 1,50,000 miles. An average driver drives 15000 miles every year, meaning a car lasts about 10 years. Now, imagine you had a car that could last 400,000 miles. What about 800,000? How about one million miles? Your car could last an entire lifetime. But it sounds pretty much fiction-stuff, right? Well not anymore. That's where the Million-mile battery comes in.

A million-mile battery is just what it sounds like. A battery capable of providing power to the average electric vehicle to run 1 million miles or more. In April 2019, Elon Musk announced Teslas would soon be powered by a battery with a lifespan of more than 1 million miles. In September 2019 a team of battery experts at Dalhousie university with support from Tesla, published a paper that describes a very special kind of battery-a battery that it says "should be able to power an electric vehicle for over 1 million miles." Soon after, Tesla filed a patent for a battery with a similar cell composition to the one in the paper. Many of the Dalhousie researchers, including Jeffery Dahn, Xiaowei ma, and Stephen Glazier, are listed as inventors. The paper presents the results of years of testing, on a new battery cell, or chemistry as you can say. And the team says the results from tests on the battery are "far superior" than other Lithium-ion batteries.

Battery science is an exercise in experimentation. The right tweak in the combination and efficiency of the elements commonly used for batteries could yield big results. In addition to a winning combination, the million-mile battery uses one large crystal instead of many small crystals. This single-crystal nanostructure is less likely to develop cracks when the battery is charging. Cracks cause a decrease in the lifetime and performance of the battery. The life of a battery is determined in discharge cycles.

Using an amount equal to 100% of the battery's charge is one cycle. Where a typical Lithium-ion battery could give you only 1000-2000 discharge cycles, tests showed the million-mile battery had 95% of its life left after 1000 discharge cycles and 90% after 4000 discharge cycles. Even though this is an awesome battery, we are not going to see this version of the battery in a Tesla or probably in any electric commercial cars.

There is one major thing Tesla and other car manufacturers like General Motors who are leading in this revolutionary battery development have to sort out before it can use a battery like this in its cars. This cell chemistry uses a large amount of cobalt. Cobalt, often referred to as "Blood diamond of batteries" is a popular element in battery development and carries inherent challenges. One, cobalt is finite and running out. So it's very expensive. Two, mining cobalt is hazardous and some cobalt mines are infamous for exploitation of children for labor because of its working nature. Tesla and GM are trying to eliminate cobalt from its batteries entirely.

So, that leaves us with another two major questions. If we don't have a viable battery here, what's the significance of batteries in a paper? And how close are we really? The recent data shows us that we are close to obtaining a battery that lasts a million miles and is compatible for use in Teslas, one that is cheaper and probably contains less Cobalt. Tesla uses a formulation called NCA (nickel, cobalt, aluminum) that is already very low-cobalt. Over the last six years, Tesla and Panasonic [which supplies batteries to Tesla] have reduced cobalt dependency by about 60 percent which is already very low. Massive reduction of Cobalt is not a viable option since that will run into engineering problems. General Motors Co is "almost there" on developing an electric vehicle battery that will last one million miles, a top executive said in mid-may 2020. According to GM Executive Vice President Doug Parks the automaker also is working on next-generation batteries even more advanced than the new Ultium battery that it unveiled in March 2020. Even though he did not specify a timeline for introduction of the million-mile battery, he said "multiple teams" at GM are working on such advances as zero-cobalt electrodes, solid state electrolytes and ultra-fast charging.
Battery expert Shirley Meng, a professor at the University of California San Diego, said NMC cells could cost as little as $80/kWh once recycling and recovery of key materials such as cobalt and nickel is factored in. Iron phosphate batteries, which are safer than NMC, could find a second life in stationary grid storage systems, reducing the upfront cost of those batteries for electric vehicle buyers.

The advances in battery technology, the strategy of expanding the ways in which EV batteries can be used and the manufacturing automation on a huge scale all aim at the same target: Reworking the financial math that until now has made buying an electric car more expensive for most consumers than sticking with carbon-emitting internal combustion vehicles ■

ELECTRIC PAINT

Ahammed Ameen C. K., 3rd year

Have you ever thought of drawing your own circuits? Wouldn't it be wonderful to draw your own circuits in almost any surface and do the things you always wish you could do?

Well, we have a solution for that. We don't have to rely on high tech machines to etch out your circuit designs anymore. Now we can use electric paints which will allow you to easily draw your circuits on any type of surface and you can use your artist abilities to create amazing patterns and design your circuits.

And that's not it, you can also design your own capacitive sensors which can help in lots of amazing new innovations in the realm of new gen-technologies.

What are conductive inks?

Conductive inks are paints that are electrically conductive, meaning they conduct electricity. It consists of a conductive pigment, for example, silver, copper, nickel, or various forms of carbon, either suspended as particles or dissolved in a solution. Many different formulations exist, each developed for specific applications with particular material properties.

Although most people use the terms conductive ink and conductive paint interchangeably, there is a technical distinction between the two terminologies and a few different definitions. It's generally accepted that paint is a material that is sprayed or brushed onto a surface and ink is a material which is printed onto a surface. Additionally, a paint typically describes a material which sits on the surface of a substrate, whereas an ink will penetrate the surface like ink on paper. As is probably now clear, the distinction between inks and paints isn't always clear, but in general, when working within printed electronics, most materials are referred to as inks, due to the use of printing in manufacturing.

There are many companies that manufacture such paints for the consumer market using conductive carbon, graphite, copper or silver as the conductive material. It is worth familiarising oneself with the pros and cons of different conductors before choosing a conductive paint to use. Copper and silver paints can require solvents to remain in suspension ,thus can be toxic, require curing, ventilation or both. Metal based paints also have particles which can fall out of solution or oxidise, so it may have a shorter lifespan once applied. Finally, conductive inks made of metals tend to have a much higher price tag making them expensive to use in large-scale applications. Silver conductive paint can be used for paper circuits, but due to the material's rare nature, silver conductive ink is expensive compared to graphite-based paint, and subject to the market fluctuations around the price of silver itself. Compared to metal conductors like silver, nickel or copper, graphite has a higher electrical resistivity, but it is much easier to source, and thus can be used in large quantities at a low cost. There are many different paint products and formats developed for different use-cases and applications. These include small bottles, syringes, pens, jars, or even spray cans. There are even online videos for creating 'DIY conductive paint' at home.

A common application for conductive paint that most people will be familiar with is windshield defrosters. However, there are many common-use cases for these technologies,

including use in photovoltaics (solar cells), RFID tags, medical devices including diabetes test strips, in-mold electronics, wearable electronics, 3D antennas, flexible hybrid electronics, electronic circuits, touch screens, and many more. We see an even larger future in the built environment. Conductive inks and paints will find their next set of successful applications within smart buildings and automotive.

So, What is an Electric Paint?

Electric Paint is a water-based electrically conductive paint which was developed as an easy-to-use alternative to industrial conductive inks. The material is non-toxic, water soluble, electrically conductive, and can be used to create small printed circuits and capacitive sensors.

Electric Paint uses a combination of carbon black and graphite in a water-soluble solution to make a conductive water-based paint. It takes advantage of materials and binders used in the food industry to create a carbon ink formula that is solvent free and safe. Carbon is one of the elements, like oxygen or hydrogen, which in turn can take different forms, like diamond or graphite, charcoal or carbon black. Electric Paint uses two forms of carbon, carbon black and graphite to create the maximum conductivity along with the desired physical characteristics like flexibility and a viscosity appropriate for home use. The combination of carbon black and graphite make Electric Paint a "carbon paint" in industry speak, and they also give it its deep, black colour.

Electric Paint air-dries at room temperature so it doesn't require any curing. It can be applied onto most non-conductive materials with a brush, roller, sprayer, stencil or by screen printing. As the paint dries, the water in it evaporates leaving behind conductive particles on the surface. Electric Paint can be applied to a wide range of substrates such as paper, cardboard, wood, plasterboard, textiles, plastic, glass and most non-hydrophobic surfaces (any surface that doesn't repel water), including non-hydro-phobic plastics. When applied in a thin layer, by screen printing onto paper or textiles, Electric Paint is flexible and allows for a degree of bend. Since, it is water-soluble, Electric Paint isn't water-proof and can smudge. This can be controlled by sealing Electric Paint using an acrylic varnish, spray or a water-proof coating. Once sealed, Electric Paint can be covered with another acrylic paint to conceal it completely, or to add colour. Sealing the paint doesn't affect its conductivity, as the paint remains intact underneath the sealing coat.

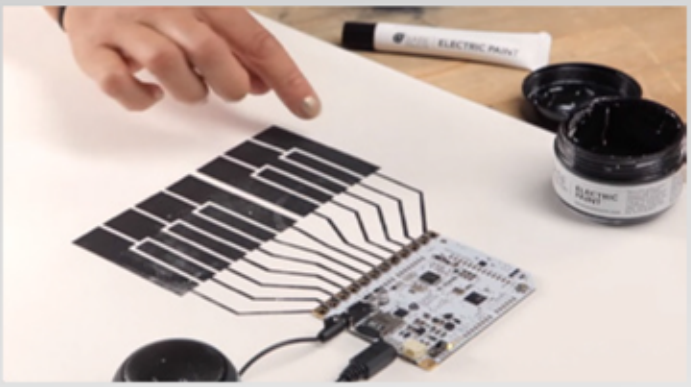
The conductivity of a surface coated with Electric Paint depends on how the paint has been applied and the thickness of the coat. At a thickness of 50 microns, Electric Paint has a sheet resistance of 55 Ohm/square. As a general rule, carbon-based inks like Electric Paint have a higher resistance compared to silver paint or copper based inks. As a water soluble paint, Electric Paint can be thinned by adding water in order to change the viscosity of the material. However, this can affect the conductivity of the paint.

How Can we use Electric Paint?

Electric Paint can be used for most of the same applications as other conductive materials. It can be painted to create circuits, or as a conductive coating for shielding, as seen with EMI shielding in guitars. Since the paint dries at room temperature and because of its viscosity, Electric Paint can also behave like glue and thus be used as a conductive adhesive for cold soldering non-permanent connections, so two electrical components can be attached without requiring a soldering iron. Electric Paint can also be applied to textiles, expanding the possibilities for integrating electronics into wearables. However, the primary use-case for Electric Paint is in the development of printed capacitive sensors

What is capacitive sensing and how does it relate to Electric Paint?

Capacitive sensing is a sensing technology that works through the generation of an electric field. This field can detect nearby objects by sensing any disruptions. Although you may not have heard the term, chances are you use this technology on a daily basis as capacitive sensing is the technology used on smartphone screens to detect touch. Capacitive sensing can also be used to detect proximity, making it easy to detect something without directly touching it. This is particularly useful for use-cases where gestures, movement or hygiene are important. When printed over a surface, and connected to the right hardware and software, Electric Paint can be used to create discrete, flexible, and large-scale capacitive sensors.



CONCLUSION

The printed sensors allow you to create bespoke interfaces, detect unwelcome guests or gather anonymous data about users, even monitor water leaks, transforming the built environment and are currently developing sensors for smart buildings, automotive and smart homes. Whether as an interface in your dashboard, tracking a person's movement in a room or detecting liquid leakage, we have just begun exploring the many possibilities that exist to harness the power of conductive inks and paints in the creation of smart surfaces, and we can't wait to see where it takes us.

TRANSMISSION LINE INSPECTION ROBOT

A comprehensive look into the present day automated line inspection technology

BY DONA THOMAS T, 3RD YEAR

The proper maintenance of high voltage transmission lines is of vital importance, since any simple problem may result in the interruption of electricity with many negative impacts. Preventive maintenance is the best way to avoid problems with infrastructure, by detecting them in an early stage and responding accordingly with action plans for repairs or improvement.

The inspection of high voltage transmission lines is a very risky operation, as workers have to move on the lines several tens of meters above ground, in very demanding and stressful conditions. Helicopters are used as a way to improve safety and speed of inspection operation. Even though video shot from the cameras placed on the helicopters provides general information regarding the conditions of the lines, and the vegetation around the towers and lines, this method cannot provide details of the lines regarding scratches or minor faults or corrosion, these are early signs of problems that should be repaired before the lines are seriously damaged.

New approaches to automate line inspection processes take advantage of global positioning system technology, sophisticated cameras and related data recording equipment, aerial access to the remote areas and robotics. The monitored information is transmitted using wireless communication. A mobile robot that can crawl along the overhead wires to perform part of power line inspection tasks can be developed based on the said approach with a camera being fixed to the robot. The robot captures pictures of the transmission line at regular intervals of time and distance and transmits them to the control unit.

Problems of detereoration in transmission line

Transmission lines are exposed to a variety of problems such as corrosion and wind induced vibrations, which cause different problems and limit the lifespan of the lines. Damage to the transmission line can be categorized into two main groups:

i) Damage to Insulators: The insulators are affected by weathering, cyclic mechanical and

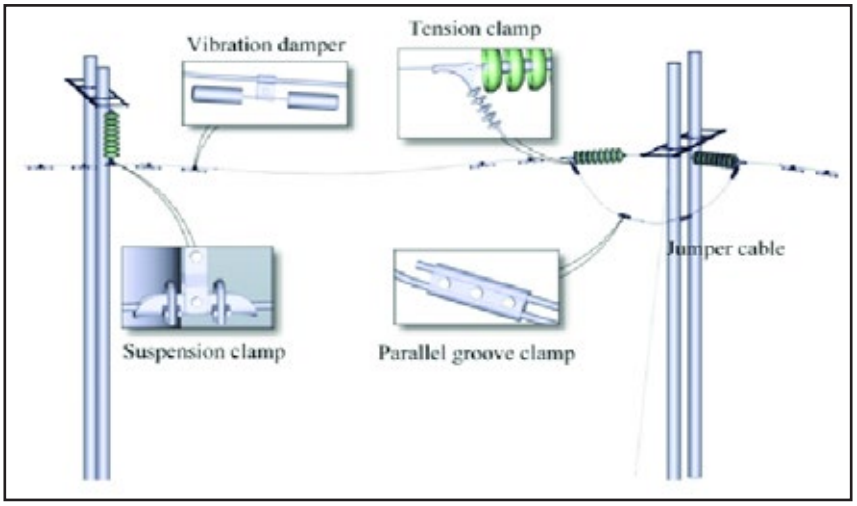
thermal loading, electro thermal causes, flexure and torsion, ionic motion and corrosion. Temperature difference between hot sunny days and freezing cold nights as well as the heat generated by fault current arcs cause thermal cycling, which produces micro cracks and allows water to penetrate into material. The amount of imposed stress depends on relative expansibility of dielectric, metal fittings and the cement used to fix the metal fittings of the line to the conductor. Cement growth, which is mainly caused by delayed hydration of periclase as well as sulphate related expansion, generates radial cracks in the porcelain insulators' shells and makes them faulty.

ii) Damage to the conductors: The steel reinforced aluminium conductors are one of the most popular conductor types. The most important phenomena that degrades such conductors is corrosion of aluminium strands. Pollutants and moisture in the form of aqueous solutions containing chloride ions, ingress into the interface between the steel and the aluminium strands and attack galvanizing protection of the steel. Corrosion of the galvanizing coat exposes steel and aluminium to each other and leads to galvanic corrosion between iron and aluminium. In addition to corrosion, wind induced vibrations can cause severe mechanical damage to the conductors due to generation of cyclic mechanical load. The wind flow creates vortices downstream when it passes the line.

Symptoms of transmission line damage

Damage to the line can be detected through investigation of their symptoms. Most of the line problems produce unusual partial discharges. Whenever the electric field intensity on the line surface exceeds the breakdown strength of air, electrons in the air around the conductor ionize the gas molecules and par
tial discharges, namely corona effects, occur. High

frequency partial discharges produce radio noise in ultra-high frequency range, as well as audible noise in ultrasonic range. In addition to the noise, it sends a current to the line which can be used to detect the fault. Abnormal temperature is also a symptom which can be used to identify defects on transmission lines.



Requirements of Inspection robot

The robot must be designed such that it is capable of being mounted on the transmission line to work on the 'Walk-Stop-Detect' principle. It must travel on the transmission line and inspect the physical parameters of the transmission line components closely and check for the symptoms of line deterioration as said before. It then transmits the collected data to the operator sitting in a centralized location, in a safe place. Once the images/ datas are received, they have to be compared. At first they are processed so that the unwanted noises are being removed. The datas are authenticated , recognized and are compared. In case if any defects are found then the buzzer indicates with an alarm and the LCD display notifies a message saying defect is found and the process is going on.

The robot must be capable of crossing all the minor obstacles like spacers, dampers and also the major hindrances like towers and jumpers etc. It is to be designed to operate in live conditions, inspect physical conditions, tackle obstacles and parallelly transmit the data collected from the field to the operator in remote condition.

According to the inspection task requirements for 110 kV power transmission lines, the inspection robot needs to move along the power transmission line, navigate the obstacles and carry visible light camera and infrared camera to complete inspection tasks.

The environment of the inspection of the 110 kV power transmission lines is very complicated, where there are straight towers, strain towers, conductors, vibration damper and other electric power equipment. The general schematic of 110 kV transmission line is presented in figure.

There are many obstacles on conductors such as vibration damper, suspension clamps, strain clamps and jumper. Strain towers in transmission grids are common as they are used to change in direction because of terrain or avoidance of privately owned land. A jumper is a short length of conductor that does not sustain mechanical tension, making an electrical connection between two separate sections of a line. Jumpers at the strain towers are the most complex obstacles on the line to traverse; they are flexible cables that are not as stiff as main spans and have complex spatial curves. At the end of the jumper, its slopes are approximately vertical, and their layout varies considerably from tower to tower. In order to accomplish the inspection task, the robot must have the ability to navigate the obstacle around the straight line tower and the strain tower.

The robot should have the ability to move on the jumper since its span is very long. Because of the flexibility and un-tensioning, the posture of the jumper cable will change when the robot moves on it. The robot mechanism must be of high stability and simplicity and have navigation capability. When gripping the jumper, the robot must not damage the conductor. Because the inspection tasks are carried out on energized lines, reducing the electromagnetic effect on the performance of the robot is a very important requirement. The size of the robot should be minimized so that a safe insulation distance from ground and other circuits are maintained.

Advantages

• This robot can form an important solution for all

the companies that are involved in Transmission Business.
• It improves the quality of transmission line inspection because of the advanced technologies involved.
• Faster operation compared to manual inspection.
• Minimizes line disconnection time thus improving reliability.
• Most importantly, it will minimize/eliminate risk involved in the Transmission line inspection

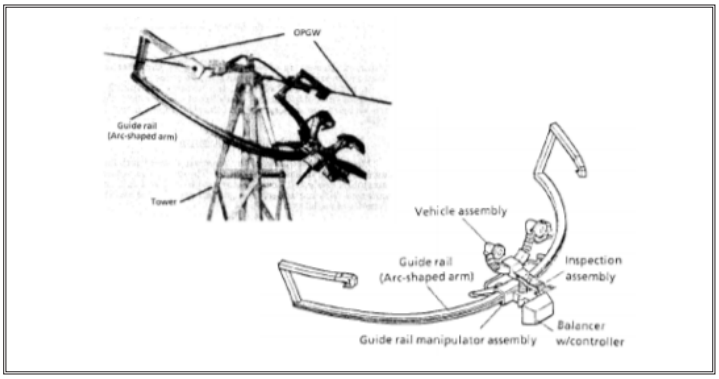


Fig 1.3

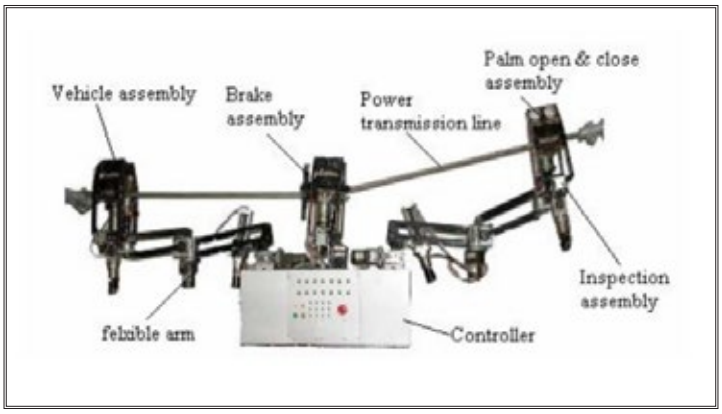


Fig 1.4

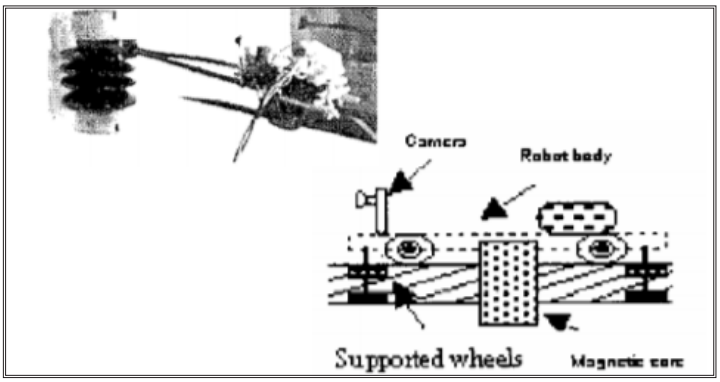


Fig 1.5

Three major studies
•Japan, 1990: The Tokyo Electric Power Co and Toshiba Corporation developed a mobile robot that can navigate power transmission lines unattended by human operators. The robot is designed to navigate the overhead ground wires. The most prominent feature of the robot is the 3m foldable guide rail that it uses to negotiate transmission towers, seen in Fig 1.3
•China, 2005: This robot is very complex; it has a full 16 degree of freedom (DOF). A Chinese research grant provides the funding for the project team developing this robot system, and many articles have been published about it. Most articles related to this project deal with the control of the robot. With 16 DOF and the power of modern microcontrollers, making this robot do what it is supposed to do is quite a challenging task. The robot has passed the tests, clearing towers on transmission lines. Like the 1990 Japanese robot this robot operates on an overhead ground wire. *Shown in Fig 1.4*
•Thailand 2001: This robot is very different from the two previously discussed systems. This is a small construction, built on the concept of gathering power from the magnetic field around the transmission line and using that power to propel a robot along the wire. As shown in the illustration below, the robot is little more than an iron core around the wire with a motor and wheels to propel it and a minimum of other components including camera. *Shown in Fig 1.5*

Conclusion
The inspection robot can roll on the transmission lines autonomously and navigate counterweights, clamps and other obstacles in remote control and local autonomy mode. For the better operation of line inspection robot, it needs to master five key technologies:
• Climb on Energised Line
• Pass obstacles
• Inspect Equipments
• Autonomous opera tion
• Gather power from line
Line inspection robots decreased the time interval of line disconnection and increased the safety of the maintenance procedure. This mobile robot can be used as a basis for future developments, generating a more complete system for energy transmission line services •

GROWTH OF SOLAR POWER IN INDIA

Evaluating the country's steps towards sustainability

BY CAROLINE MARIA JOHN, 4TH YEAR

India has made a tremendous progress in the solar power sector in the last 2 decades as is evident from the fact that India rose from a country with a 2MW solar power plant in Amritsar in 2009 to the country with the largest solar power plants in the world in 2020.This growth in the solar sector was well planned and quick with various government as well as the private sector agencies showing great interest in solar based projects as well as investing generously to effectively in implementing them . India has a total installed capacity of around 35,122 MW as of June, 2020 and the country has the lowest cost per MW of installing solar power plants globally.

However, the latest development that brought India to the forefront of the Solar power harnessing countries in Asia is the commissioning of a 750MW Rewa Solar power plant in Madhya Pradesh. What makes this solar power plant different from the others in India is that it is the first solar project in the country to break the grid parity barrier. This means that it is

able to generate power at Levelized Cost of Electricity (LCOE) which is less than or equal to the price of power from the electricity grid. Rewa Ultra Mega Solar Limited which is the implementing agency of the plant is a joint venture between the solar energy Corporation of India and the Madhya Pradesh Urja Vikas Nigam Limited. Rewa Solar Power Plant is also the first in India to receive funding from the Clean Technology Fund (CTF) from the World Bank. This funding was available at a rate of .25% for a 40-year period and this was a major contributing factor behind the low tariff achieved in the Rewa Project. The plant consists of three solar power generating units, each of 250MW capacity which are located on a 500 hector unit of land which is inside a 1500 hector solar park. This plant is expected to reduce the country's emission of carbon dioxide by 15 lakh tonnes annually.

It is important to note that India is also the home to the world's largest solar park which is the Bhadla Solar Park. It has a total capacity of about 2245MW and is located at the Bhadla village in the Jodhpur district of Rajasthan. This plant was developed in several phases and the final phase was commissioned in early 2020. It is spread over a total area of 14000 acres.

Before the commissioning of the final phase at Bhadla, Pavagada Solar Power Plant at Karnataka was the largest solar power plant in the world with a total installed capacity of 2050 MW.

Thus it is clear that the solar power generation in India has made tremendous progress in a very short time and at this rate we could hope that India would soon develop into the largest solar harnessing country in the world.•

The Electrical and Electronics Engineering Association 2019-20 was officially inaugurated by Mr. Varghese Cherian, Head of Technology services, UST Global, Trivandrum at an auspicious ceremony organized at the Jubilee hall on the 1st of November 2019. The function was presided by Prof. Dr. Bijuna Kunju K, the Head of the Department of Electrical and Electronics engineering in the presence of Prof. Dr. T.A Shahul Hameed, Principal of TKM College of Engineering, Mr. Renjith Ramakrishnan Nair, Senior Project Manager, Enlighten Technologies, Prof. Dr. Imthias Ahmad TP and Mr. Sreeson S S, the newly elected Association Secretary.

Prof. Shyba S, Faculty advisor of the EEE department welcomed the distinguished guests and the attendees and also wished her best for the coming endeavors of the association. The inauguration of the Association was gracefully marked by the lighting of the lamp and our chief guest, Mr. Varghese Cheriyan declared the Electrical and Electronics Engineering Association inaugrated and gave

Electrical and Electronics Engineering Department Association Annual Report 2020

his blessings and wishes to the department.

Prof. Dr. T.A Shahul Hameed, Principal, TKMCE launched the website of IPECS-2020, The International Conference on Power, Energy, Control, Signals and Systems. Mr. Renjith Ramakrishnan Nair released the 14th edition of the Potentia magazine. Prof. Dr. Imthias Ahmad TP felicitated the programme. The students were awarded with their deserved prizes and momentos by the honorary guests. Sreeson S S, EEE Association Secretary, concluded the auspicious ceremony with a note of gratitude.

The inaugural ceremony of the association was then followed by an interactive session by Mr. Renjith Ramakrishnan Nair, whose thoughts gained wide attention among the students. The event was then graced and made vibrant and colourful by a wide variety of cultural programs in the auditorium.

Technical Workshops

Engineers are built on theory and run on experience. Workshops are the best means to provide a growing engineer with all the experience he wants for about the contemporary technology. The Electrical and Electronics Engineering Association in collaboration with various organizations conducted a handfull of workshops that benefitted the students.

MEP and C-coding workshop

EEE association in collaboration with TEQIP and CGPU arranged a two day program solely for the final year students of EEE department on Oct 12-13, 2019. The program consisted of two separate workshops - MEP and Coding.

• **MEP** - Mechanical Electrical Plumbing Training program was arranged with the intention of providing the participants the exposure to the practical side of electrical engineering in building constructions and system designs.

The sessions were handled by faculties from Capitol group. A Total of 25 students participated.

In accordance with the current trend in the field of engineering, MEP companies have gained a lot of popularity such that these companies are now being considered as an integral element in any construction field. Hence it is highly necessary that undergraduate students must realize the true heart and soul of various activities being done in an MEP company as it appeals as a prosperous career option for EEE Students. The students actively participated the session and benefited the following :

1. Students were trained in autocad for design of electric wiring in high rise build-

ings providing them an opportunity to see how system design theories taught in class were being used in practical life for system realization. Further they were familiarized with the popular software AUTOCAD with proved quite fruitful

2. Estimation of electrical installations were introduced, which was really beneficial from the point of view of an engineer.

The two day session proved quite useful in the sense that it not only introduced students to the world of MEP companies but also motivated them to get indulged in this side of engineering which is not covered in the curriculum.

• **C-Coding Workshop** - Coding skills are now a prerequisite to crack any job interview or test. Coding was a weak side for most electrical students as it was not completely covered in our curriculum. With this idea, a coding workshop on C was arranged with the collaboration of CGPU unit of TKMCE.

A two day workshop was conducted, faculties from established institutes in kerala managed the classes. A total of 40 students attended the session. The students were trained in the basics of C programming and were given proper insights to various tricks to crack complex programming questions frequently asked in job interviews and tests. The sessions went down very well and the results of this workshop was pretty evident from the spike in the placement count in the EEE department afterwards.

Android App Developement Workshop

A two day workshop on Android App Development was conducted exclusively for the first year students . The workshop was handled by Harkrishnan S of fourth year, EEE. The program was conducted on 1st and 2nd February,2020 at Microprocessor Lab, EEE dept. A total of 40 students participated. The students could peep into the task of an android developer. All the participants tried their hands on creating the apps in smartphones and tabs. The session was very interactive.

HESTIA '20- EDISLA

"What makes a work beautiful is the amount of commitment one puts into it "

Hestia is not simply a tech fest which comprises of a number of events with handsome rewards, it's a collaboration among various departments, among various years, teachers and students who put their mind and body into transforming a simple win or lose event into a magical one that leaves a scar, a happy scar in the heart of all that never heals even in the long run and still continues to burn deep down one's memory lane urging one to re live those moments again.

As a part of Hestia'20, EEE department hosted EDISLA. It was an event that was superlative and of high spirit. It was a combined effort of three stalls - Psycho room, expo stall and the game stall.The game stall comprised of a room full of jovial and stimulating games. The games were of technical

nature built using the simple principles of electrical engineering. It was run by the students with great integrity and harmony and was constantly filled with screeches of victory and 'that was tough and tricky' quotes with laughter. Each game had a fixed entry fee and attractive cash prize. The games were quite intriguing for many visitors and overall, the game stall stood out among other stalls in EDISLA.

Expo stall had 12 bracing projects namely, BLDC motor, IoT switch, voice IoT, level detector, Li-Fi, walking stick, Door knock, CNC, bike, Robotic hands, solar tracker and 5V relay. It was all a combined effort and diligent work of all 4 years with such great agreement, morale and team spirit.

Psycho room named for its very spooky and eerie appearance had technical projects and other visual effects.

To sum it all up, EDISLA was a staggering and superlative one. Most of us had spent majority of our time arranging, coordinating, working out, helping, implementing, innovating, inventing and leading. It was at this point of time where all the students got together without any superior inferior issues and decreasing the gap between acquaintances. All of the participants had one hell of an experience with a lot of memories and knowledge gained for a lifetime.

"Persistence is very important. You should not give up unless you are forced to give up."

~ Elon Musk

Young Innovators

VECTOR

VECTOR SPREADING TECH is a technical start-up that aims at improving the life of common people through implementing technology. Technology has gone far beyond our expectations and it is growing exponentially. The revolutionary outbreak of EV in the automobile industry serves as an example. The company provides products and services from multidisciplinary levels of technology by following latest trends. VECTOR as a startup currently incubated under IEDC, TKMCE.

The team comprises of M S Ali, Muhammad Salmun S, Amal Udayakumar and Mohammed Sajith A. All of whom are 2nd year students of EEE dept.

Following are some of their many accomplishments:

• Launched their own motor driver into the market

Motor drivers based on l293d and l298n have a wide range of applications in beginner level DIY projects. Due to high demand these motor drivers were overpriced for many students. So, by integrating simple innovative ideas VECTOR successfully developed these motor drivers and made it available for students at an affordable price.

• Developed a new variant of proximity sensors

IR sensors have been in use for a long time. IR sensor modules of variant types are available and using common microcontrollers like Arduino and Rpi with these sensors are cumbersome. Taking this into account VECTOR developed an IR proximity sensor that incorporates PASSIVE infrared sensor and other IR leds that can be used as a substitute for thermal camera modules for very simple applications.

• Automatic hand sanitizer

During the hard times of Covid-19, it's our duty to do what we can to ensure the safety and well-being of ourselves and the community. Hence VECTOR tried to achieve the same through manufacturing a low-cost automatic hand sanitizer dispenser. The product was

launched by Kollam District Collector.

• Design and manufacture custom circuits to multi-layer PCBs

VECTOR with respect to the customers varying demands, design and manufacture custom PCBs. They have already designed the IOT Node circuit, Buck boost Circuit and even DC to AC converters

.• Designed and manufactured a BSPD for XLR8 FST

BSPD is a circuit that has to be included into the vehicle according to regulation. It compares the brake pressure and the throttle valve position to identify a faulty condition, where the throttle is stuck open and the driver is braking hard. VECTOR developed this circuit for XLR8 FST which ensured the driver's safety during their race.

•Designed a safety monitoring system for Team Jäger

VECTOR developed an integrated display for the team Jäger that helped to view the details of the car real-time for the driver. They also implemented the BSPD circuit in the car.

• Selected from the KSUM Boot Camp

The start-up India Kerala Yatra was launched by Hon'ble Chief Minister Shri. Pinarayi Vijayan on 1st November and went on till 27th November, 2018. As part of the Yatra, 8 Boot camps and 14 Van stops were planned in 14 different districts of Kerala. One of the 8 boot camps was in TKMCE. VECTOR was able to pitch their start-up idea and were among the few to be selected for their grand finale. After the finale VECTOR was incubated under KSUM •

Slepnir: E-Cycle

"Slepnir" are the first-generation ultra-light-weight urban micro-mobility e-cycles which has been developed at TKM College of Engineering. Slepnir was developed by the now non-existent start-up venture called AIR Innovations. Slepnir is the sixth iteration of electric-cycles built by AIR innovation and was a particular fiscal and engineering challenge for the team. It paints a more realistic real-world project scenario for all engineers and would-be tech-entrepreneurs due to the number of decisions that are required to be made to make financial and technical sense. Like any successful project or endeavor, the main driving force is the team. The core team consisted of Nikhil MS (E6), Devendu M(E6) and Asif Mohammed A (E4).

The Challenge

The idea was to develop a light-weight electric cycle which had sufficient speed and torque to fit into the urban scenario. But it came with its own set of challenges. The Government had a number of regulations which had to be followed in order to be classified as a micro-mobility cycle and not as an electric vehicle. If violated, the cycles would be treated like a normal vehicle and would require two-wheeler license and registration. Moreover, the government has put a limit on the maximum power rating of the motor at 250 W.

The legalities had to be dealt with technical workarounds. The team started with the normal DC brushed motors of 250 W rating with a built-in metal gear reduction to receive a moderate rpm. These lacked torque and even the range of operation was limited. The torque went down drastically and made scraping noise due to the carbon brushes being worn down by the mechanical commutator. They also tried using lead-acid batteries which meant heavier vehicles and moderate range per charge. The legalities had to be dealt with technical workarounds. The team started with the normal DC brushed motors of 250 W rating with a built-in metal gear reduction to receive a moderate rpm. These lacked torque and even the range of operation was limited. The torque went down drastically and made scraping noise due to the carbon brushes being worn down by the mechanical commutator. They also tried using lead-acid batteries which meant heavier vehicles and moderate range per charge.

However, this made financial sense as these kinds of electric cycles meant higher margins. Here the team had to make a choice

whether to continue with their current path or pivot and develop their-own motor controller and gear-reduction ratios. Pivoting meant higher R&D costs and increased development time and money.

The Pivot

The team decided to pivot in order to improve their product, but they continued to make the previous versions to bankroll their R&D, they thus sold 6 such e-cycles with a return of 12%. Their R&D decided to start with the motor, they wanted to switch to a more suitable alternative, which was the Brushless DC Motor. BLDC motors are silent and employ electronic commutation as opposed to the mechanical commutation of the normal dc motors. As they were developing this idea, they received an order which was particularly challenging. They were asked to make an e-cycle which was able to go at above std e-cycle speeds and able to tackle inclines while carrying a rider of 90kgs excluding any sort of luggage. This presented them with a challenge as a BLDC motor of 250W would not be able to carry out the task on its own. The team decided to go with a planetary gear-system within an aluminium sealed case to increase torque while they used a custom controller with higher clock-speed to achieve higher rpm at the end of the operation range to achieve this. This became their standard till they decided to package it in a hub configuration to achieve a smaller form-factor. They also decided to switch to Lithium-based batteries with a custom Battery Management System to increase the delivery of the battery pack to allow one to have higher range per charge while maintaining weight to power ratio relatively small.

From an entrepreneurial aspect, the pivot was a complicated situation as this meant they were financially under pressure to support the R&D as well as maintain the supply to the demand of the current and potential clients. The custom designs were outsourced for fabrication and this taxed the fiscal situation as they were not able to support the development of the next iteration. IEDC TKMCE helped out by loaning out the required sum with which the team finished the development of the current generation of E-cycles.

The Present and The Future

After the finishing of the development, they were ready to debut the latest iteration which weighed 12kg and was able to haul a rider up to 120 kgs. The tests proved that the device had a range of 60 km per charge and was powered using a mere 2 rupees worth of electricity which meant it made more economic sense as month worth usages did not cost more than 1 Litre of petrol. The system was independent of the host cycle which means it can be fitted to the needs of the customer. The next generation is equipped with IoT technology to interconnect cycles to a single server to enable OTA update systems which can improve the user experience with having to come to service the cycle. The cycle is accompanied by an app which can track the cycles and geofence the cycles to a certain locality. The cycle is being designed to be launched into the market. This new design would leverage economies of scale to bring down costs•

Revolt

Revolt innovating life is a tech startup initiated by students of EEE Department of TKMCE, whose main area of service is in Mobile App Development. The company is based in Kerala, India with its first-class team of mobile app developers and mobile app designers. The company develops highly polished apps from start-ups to enterprise solutions for clients with a 360degree methodology in digital marketing.

Revolt is packed with the best team which enables clients to express their likes and dislikes and to make the final product according to the clients taste. The core team comprises Arjun Sunil, 1st year, Muhammed Basil, 2nd year and Mohammed Amal, 2nd year. All of whom are EEE students.

Products so far:

•Edupro Learning App: Edupro Learning App aims in delivering the best quality education for students of all stratas in our nation and to revolutionize the way millions learn! Edupro is planning to launch 12 competitive exam courses within 2023.

As a first step they have launched the UPSC CSE exams contents. Edupro Learning App offers one the required UPSC coaching at a reasonable fee so that each and every aspirant gets the right opportunity to study.

Edupro offers aspirants content for 7 subjects - History, Geography, Economics, Sociology, Current Affairs, Politics and also provides the aspirants free test series. Civil service aspirants can attend these weekly tests without any fees. Edupro Learning App enables every aspirant to analyse their knowledge after studying each topic. Edupro Learning App has a section 'Top News' which enables the aspirants to read English newspapers. Edupro Learning App also provides a section called 'Questions' which showcases a wide gallery of previous year questions so that the aspirants can work out on these and increase their probability of winning. Edupro Learning App allows aspirants to share their notes or any other educational content which helps to expand its collection of notes.

•Edupro Plus: It is a wing of edupro learning app. edupro plus will be a 'premium personalised exclusive' app designed for NEET, JEE & KEAM aspirants. Edupro plus will contain an endless number of mock tests and the premium version contains exclusive personalised weekend mock tests. Edupro plus also offers a platform for private and other institutions and organisations to create their customised quizzes at a reasonable price.

Scan here for more details

EEE Buzz

EEE BUZZ – TKMCE is an android app developed for the benefits of EEE Students of TKMCE. The app mainly constitutes various features that are meant for benefiting students in both academics and aiding them in their daily routine as a EEE student of TKMCE.
EEE BUZZ was initially developed by Harikrishnan S (E8) on 29-7-2018, after proper scrutiny Dr. Bijuna Kunju ,HOD EEE , TKMCE approved the app which was later updated with minor changes and published on google playstore on 13–09 -18 in collaboration with IEI (Electrical) SB TKMCE . The app was officially released to students on 14-09-2018 by Dr Kumaravel, Assistant professor,NITC.
The co-developers include: Sreeson S S (E8) ,Jovin Johns (E8),Nikhil MS (E6) and Sarin Santhosh (E6).
Further on the app was updated a number of times, currently the app is available in playstore, till date the app has registered a download count of 4233 with 135+ 5 star ratings. Simple and interactive UI of the app made it unique in all respects, currently this app has gone down well for EEE students of TKMCE, which is very much evident from the positive reviews that the app has received so far both from students as well as faculties.
The main features of the app include : syllabus of all EEE subjects with a unique and simple UI design based display, PDFs of standard textbooks and e-books of all semesters, PDFs of lecture notes of professors at TKMCE, students are able to download the same if they want, dynamic drive incorporated , notes are uploaded by both faculties and selected students every week , direct links to useful websites like KTU portals etc, SGPA and CGPA calculator based on KTU scheme , notification services to inform important events , contact details of entire faculty of EEE department.TKMCE, and many more.

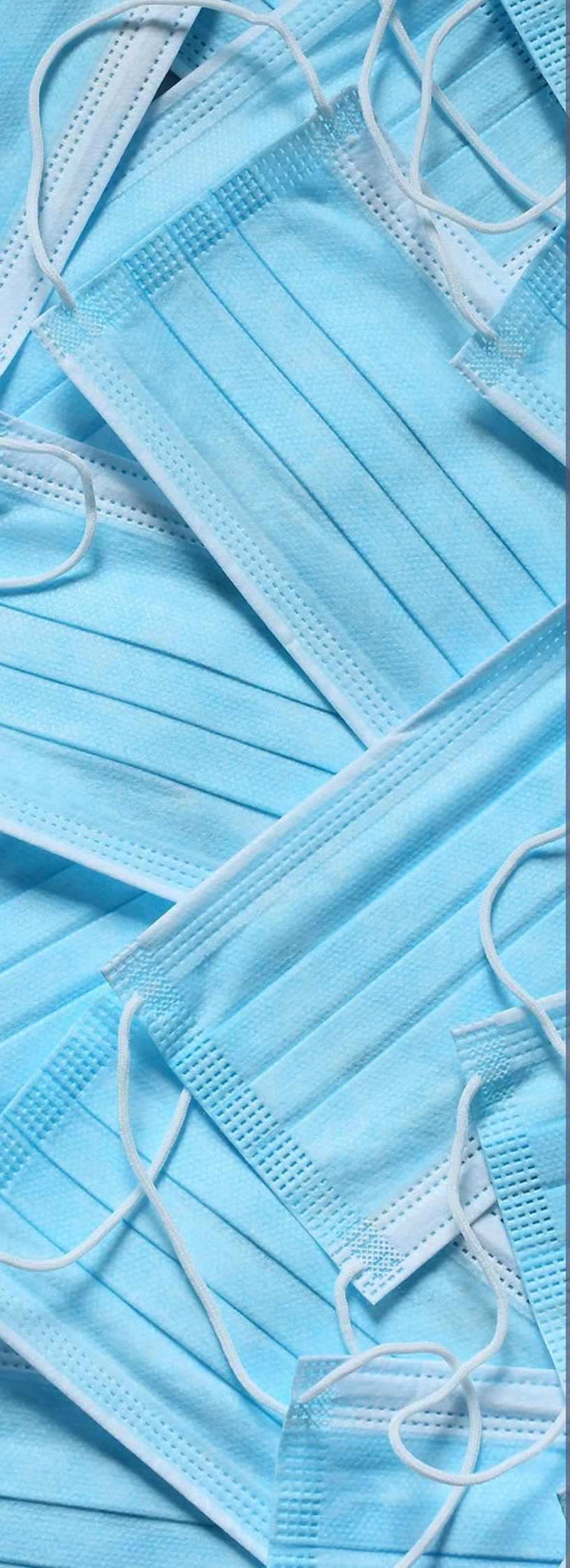
Scan here for more details

REX

"REX" is the first-generation electric bike with a light weight, better looking (scrambler type) outfit designed by Jayesh Krishnan of 2nd year EEE. It is designed mainly for single person transport with an engaging drive and that too with more storage capacity and a higher weight loading capacity of up to 160 kg (almost 352 lbs). This e bike prototype is designed to provide a bulky appearance of a motorcycle and an almost similar performance, so as to attract youth to buy the same, the final market product is yet to be developed. This project was designed and done by Jayesh krishnan of 2nd year EEE.

This bike is designed to be lightweight (approx.47 kg) and can cloak a max speed of 37 km/h at 70 kg load and a range of 50 km at a single charge. The cost economy is ₹4 / charge (assumption based on present state electricity charge) and the charging time is 3- 4 hours (cannot provide fast charging which affects battery's reliability or overall cost).

The present standard bike can be fitted with a larger battery as the bike provides a greater storage capacity. It can also be fitted with modern security systems (GPS...) and also plans to add a separate power-pack for other electrical fittings (inc. Light, horn, dc-dc converters, indicators...) which can provide 3-4 kms extra range.



Today we live in a timeline defined by the Coronavirus. All our day to day activities are now in the control of this virus that has shook the world entirely on a global scale. The devastating effects it has rendered are quite unfathomable but still it is the duty of any socially committed engineer to come up with innovative solutions to tackle the outburst of this pandemic and to make our lives more comfortable.

"To equip the students for higher learning and to nurture the capacity to develop innovative solutions for technological challenges faced by the society and industry"

The above cited is one among the missions of EEE dept. of TKMCE. Inspired by this, the following are some of the various projects the students of the EEE department have come forward with in response to the COVID -19 pandemic. By doing so they have brought pride to the entire college and have inspired many to work in this direction to make a better tomorrow.

eee covid19 response

Automizer

Automizer is another automatic sanitizer dispenser developed by Anandu Ajayan (E4) is user friendly, simple, low cost, rechargeable, table top automatic sanitizer dispenser.
Automatic sanitizer dispenser body is divided into two compartments. Lower compartment is used for storing sanitizer, it consists of a 3-6V submersible DC pump for pumping the sanitizer, check valve for preventing the return of the sanitizer, s all flexible PVC tube for connecting the pump with nozzle. Upper part is used for placing electronic circuits, batteries etc. When a hand is placed near the nozzle IR rays from the IR LED fall on the hand and reflect back and are received by the IR receiver, thereby the presence of hand is detected. The circuit is designed in such a way that, when presence of hand is detected it will drive the pump for a small interval of time (that interval can be controlled using an amount control knob) thereby sanitizer will come out from the nozzle and stop. The battery can be recharged through a female micro USB port provided on the upper compartment using a mobile charger. For ON and OFF an SPDT switch is provided at the top. A transparent slot is provided in the lower compartment for knowing the sanitizer level.

Automatic sanitizer dispenser circuit part consists of a sensor, timer, battery and pump driver circuit. IR sensor circuit is made using LM393 IC in the comparator circuit configuration. Monostable multivibrator (using NE555P IC) is used as the timer. For giving negative edge triggers to pin2 of 555 IC, output of the comparator is connected to an RC differentiator. When IR rays fall on photodiodes, output of the comparator goes from HIGH to LOW, as a result a negative edge trigger is obtained in the comparator output. When a negative edge trigger is given to a monostable multivibrator, its output goes from LOW to HIGH for some interval of time, which can be varied by changing the resistance of the 100k potentiometer. Output of this 555 timer is connected to the base of a TIP122 power transistor which is used for driving the pump. Today this work by Anandu is being used at the college as dispensers.

Automatic Hand Sanitizer

IEDC TKMCE in association with VECTOR successfully designed and launched a Portable Automatic Hand Sanitizer. A state of the art product efficiently designed by MS ALI(E4) and MOHAMMED SALMUN (E4) under the guidance of Prof. Shafi M.N (Electronics and Communications Department), this sanitizer has various distinguishing features that makes it stand out from many of the other products available in market.

Features:

Portable design, 18hr continuous backup, easily rechargeable with a normal mobile charger, container capacity of 1L, designed for Wall-mounting and table tops and adjustable dispensing.

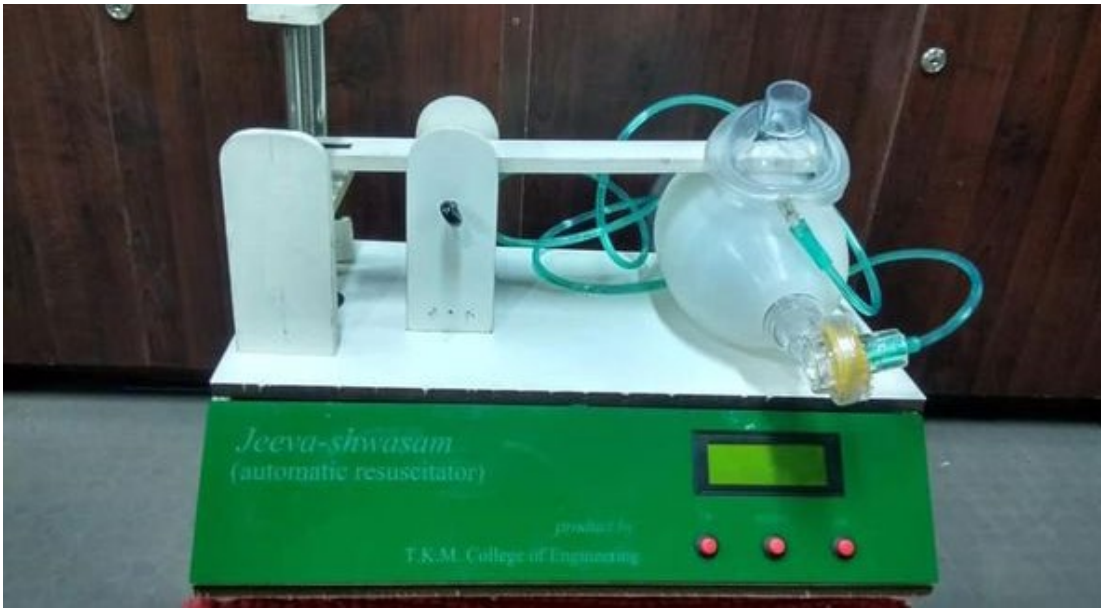
The automatic sanitizer was handed over to the honourable district collector, Sri Abdul Nassar IAS at the Kollam collectorate. It was also successfully deployed to KSRTC.

QuarmTKM

As the number of Covid First Line Treatment Centers an Isolation Centers rise, Harikirishnan S of fourth year along with his team have developed an app for isolation centres in kollam district. This app is currently in use for allocating patients into hostels of TKM, which are being used as quarantine centres. It provides details of people admitted in different centres, location and facilities available there along with the number of vacant slots. This app also displays the food supply status and provisions for updating the status. The app is available in Playstore and protected with passwords for ensuring security.

Jeeva Shwasam

'Jeeva Shwasam' is a low cost substitute for the normal ventilator. This initiative taken up by the faculty and students of the college aims to meet the rising demand for basic hospital amenities. The team was led by Assistant Prof. Shafi M N and Assistant Prof. Karthik S Prakash along with Tradesman Shibu Kumar PB and Students M S Ali (E4) and Muhammed Salmun S (E4).



The prototype is a low-cost portable mechanical ventilator that can be used in mass casualty cases until a proper state of the art ventilator is available. The device will help in supplying breathable air into and out of the lungs with prescribed parameters, to deliver breaths to a patient who is physically unable to breathe, or breathing insufficiently. The device delivers breaths by compressing a conventional bag-valve mask (BVM) , thus eliminating the need for a human operator for the BVM. It is achieved using a stepper motor and pivot arrangement. While a 'bag valve mask' is currently hand-powered and, therefore, not suitable for continuous use as a ventilator, the system developed by this team provides control over these parameters and makes them viable for longer durations.

The main features of the low-cost, low-power portable ventilator are:
• Adjustable tidal volume, flow, breathe per minute (BPM and Inspiratory Expiratory ratio (IE).
• All parameters can be set via digital interface
• An LCD screen will display the status and can even be seen on a mobile phone.
• Alarms to indicate various system failures.

INTERNATIONAL CONFERENCE ON POWER, ENERGY, CONTROL, SIGNALS AND SYSTEMS

The International Conference on Power, Energy, Control, Signals and Systems (IPECS 2020), a three-day virtual conference organised by the Department of Electrical and Electronics Engineering, TKM College of Engineering, Kollam was held from 24th to 26th of June 2020. The event was sponsored by TEQIP II, supported by Kerala Minerals and Metals Limited, Chavara, Kollam and Institution of Engineers (India), Kollam Chapter. The conference was conducted virtually through the Google Meet Platform.

The 3-day grandeur saw its flag-off on 24th of June 2020 when the conference was inaugurated by Dr. Saifur Rahman, Director, Virginia Tech Advanced Research Institute, USA, the President of IEEE Power and Energy Society 2018, 2019 and candidate for IEEE President 2021 at 04:30 PM through Google Meet Platform. The inaugural function concluded at 05:15 PM.

Following the inaugural function, the event was set onto motion by a webinar on 'Challenges of remote delivery and ensuring program quality in pandemic' from 06:30 PM to 08:00 PM by Dr. Mohammed H Rashid, Professor Emeritus, Department of Electrical and Computer Engineering, University of West Florida. It was a pre-recorded video session through Google Meet, elucidating numerous cases of social benefits linked to new knowledge and technology in pandemic.

Paper presentation sessions on Power Electronics, Power Systems, Control Systems, Computing and Signals and webinar sessions were arranged as part of the Conference. The session witnessed the generation and sharing of great ideas and heated discussions backed with remarkable experts in various field from in and off campus.

On the second day, 25th of June, the conference was started with the first paper presentation sessions on Power Electronics, Power Systems and Control Systems (PE 1, PS 1 & CS1) concurrently from 09:00 AM to 10:30 AM.

The paper presentation session was followed by a webinar on 'Design and Multidisciplinary optimisation of E-motor for Electric Vehicles' from 10:30 AM to 11:30

AM by Mr. Sandeep Ramagiri, Senior Application Engineer, Altair India. It was an informative session that provided enormous knowledge on various aspects of online learning and remote delivery, the recent advancements and related technology. We have received an excellent feedback for the event.

Following, the second session of paper presentation PE 2, PS 2 and SS 1 was conducted from 01:30 PM to 03:30 PM.

On the third day, 26th of June, started with paper presentation session PE 3, CC 1, SS 2 from 09:00 AM to 10:30 AM. It was followed by a webinar on 'Data Analytics' from 10:30 AM to 12:00 PM by Dr. Manoj Thulasidas, Associate Professor, School of information systems, Singapore Management University. It was a nice session expounding the benefits, relevance and applications of data analytics.

Afternoon session began with the paper presentation on PE 4, CS 2 and SS 3 from 01:30 PM to 03:00 PM

The conference concluded with a valedictory function, where many people came up with great compliments. Due to the combined effort of organisers, coordinators, other staff members and students, the event was a great success.

EEE 360°

Awards and Recognition

Head of Department gets honoured

Dr. Bijuna Kunju K, HoD was adjudged as the outstanding Women in Engineering (WIE) volunteer of Kerala IEEE section for the year 2019.

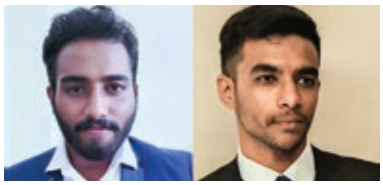
Students recieve patent for final year project

The final year project group consisting of Gayathri S Pillai, Pranav Pramod, Anakha Giri, and Stephen C Philipose, under the guidance of Dr. Sheik Mohammed S, obtained a patent publication for their project, “Hybrid Solar Dryer for Cashew Drying”. The project is intended to bring about a time saving, cost efficient and environment friendly model for drying cashew nuts. The hybrid solar dryer makes use of two distinct sources of heat for the drying process, i.e. an infrared (IR) lamp and the heat from a solar collector.
(Detailed article on pg. 17)

Technical paper by final year students gets selected for IECON 2020 to be held at Singapore

The paper ‘Detection and Classification of Transmission Line Faults based on Recurrent Neural Networks’ submitted by 4th year Serene Benson, Asif Ali A, Aparnna A., Ahamed Dilshad, under the guidance of Dr. Sabeena Beevi K, was accepted for IECON 2020 organised by the IEEE IES and Nanyang Technological University, Singapore, to be held at Singapore.

Technical paper by final year students gets selected for IEEE R10 HTC, to be held in Indonesia



Fourth year students Nirmal A. Kumar and Yazin Haris Thangal ‘s paper ‘IoT Enabled Navigation System for the blind’ was selected for presentation and publication at IEEE R10 Humanitarian Technology Conference held on November 12-14, 2019, at Depok City, Indonesia.

Students' start-up shines at Entrepreneurial Conclave hosted by Kerala Govt.

Nikhil M S, Devendu M, Asif Mohammed, S Arjun Vignesh and Akhil A Mentored by Dr. Muhammed Shanir P P from EEE Dept of TKMCE won Second prize for 'Entrepreneurship and Development of E-cycles' at Entrepreneurial Conclave hosted by the Govt. of Kerala at Thiruvananthapuram by presenting their start-up **'UMo (Urban Mobility)'**.

Students bag prizes at IEEE's Future Energy Design Contest

Team consisting of Nirmal A Kumar, Allan Sabu Joseph, 4th year students, Jithin J, 3rd year student and Navaneeth M, 2nd year student has won the third prize at Future Energy Design Contest Conducted by IEEE at All Kerala level by presenting 'Design of Electric Vehicle Charger for an EV for range up to 300km'.

Technical paper by final year student gets selected for ICMSS'19

Team consisting of Harikrishnan S (4th year EEE, left) and Sikhin V C (3rd year ECE) presented their paper 'Human Detection System for Rescue Operations' at ICMSS '19 held at TKMCE on 27 September, 2019. Their work was published online by AIP publisher on April, 2020.

Third year students bag prizes at IEEE Innovation Challenge

Team consisting of Nikhil M S, Jithin J, Abdussalam Yoonus and Fathima Shijad, 3rd year students has won Third prize in 'Innovation challenge conducted by IEEE' by presenting '4-way ventilator splitter concept'

Third year student shortlisted for national level innovation challenge

Adwaitha Pradeep, 3rd year student got selected for the finals of 'And Woman Innovator' contest to be held in Delhi

Team ‘Star Trek’ qualifies for the national level Space App Challenge by NASA

Team consisting of Harikrishnan S, 4th year student, Adwaitha Pradeep, Maheswari Nandial and Jithin J, 3rd year students has won First prize in ‘Space App India Hackathon’, Kollam – Pathanamthitta zone, conducted on 31st January,2020 at TKMCE.

Final year student excels at regional quiz competition

Rasal V, fourth year student was part of Quiz team which became 1st runners-up in Numero Yono Regional Quiz Competition, conducted by Yono SBI.

Retirement from service

Mr. Nishad Sait E (Trade Instructor - Senior Grade, Electrical) retired from service on 31st March 2020. His vibrancy in machines lab was a great boost to students making the lab hours more dynamic.

EEE on Wheels

Team Jäger 2.0

Team Jäger 2.0, led by Mohammed Jameel in final year, bagged the AIR-2 in Aesthetics at National Electric Kart Championship held at NID (Bhopal), 1st in Kerala and 3rd in South India. The team consisted of 30+ students of which 16 students were from the EEE Department.

Team Vegha

Team Vegha bagged 3rd place in best technical presentation of Vehicle at national level and 1st place in Kerala at ational Electric Two-Wheeler Design competition, which was hosted by SAE. The team consisted of 10 students of which 5 were final year students from EEE department.

Team DEXRAY

As a part of National Level E-Bike Challenge conducted by Hero Electric, Team DEXRAY led by Final Year Electrical Students represented our college. Team DEXRAY was reached in top 10 and qualified for phase 2. The team comprised of 20 students of which 4 students from EEE department. Nirmal A Kumar, Yazin Haris Thangal and Allan Sabu Joseph, 4th year students and Navaneeth M, 2nd year student were part of Team DEXRAY from EEE department.

Team XLR8

XLR8-Racing team is the first team from Kerala history to participate in the final endurance run of SAE-NIS Efficycle 2020 competition. They bagged 21st position in all India and 1st position in Kerala. The team consist of 13 members including Tinto Raj and Reenu Marian Aby from final year EEE department.

EEE on Tracks

Football

Naseeb M of 4th year (left) and Aditya Joe Thomas of 3rd year (right) were part of the College Football team which became KTU B-Zone champions, KTU Interzone runners-up and Kollam League A-Division champions.
Naseeb M was selected for KTU Football team.

Basketball

Fasil Jabbar Punnakkal of the final year was captain of College Men's Basketball team which became KTU B-zone champions, All Kerala Inter-Collegiate Basketball tournament champions and the 39th Ashoka Memorial Basketball tournament champions. He was awarded Best Player of the Tournament in All Kerala Inter-Collegiate Basketball tournament

Athletics

Jain G Jacob, 4th year student was awarded the Individual Champion of 60th Annual Athletic Meet by securing 1st place in 10,000 meter, and 5000 meter and a 3rd place in 1500 meter.

Badminton

Aparna Ajayy (left), 2nd year student was part of the College Women's Badminton team that became the KTU B-Zone champions and KTU Intezone 2nd runners-up. Rohit P R (right), 2nd year student of was part of the College Men's Badminton team which became the KTU B-Zone champions.

Chess

Stephen C Philipose of 4th year and Deepu Raj of 1st year were part of the College Men's Chess team which became the KTU B-Zone champions.

Cricket

Sagar S D, 4th year student, was part of the College Cricket team which became KTU B-Zone champions.

Handball

Asif C Jafer, 4th year student, was part of the College Handball team which became KTU B-Zone champions.

Kabbadi

J Sanjeev, 4th year student, was part of the College Kabaddi team which became KTU B-Zone runners-up.

Tennis

Mammen Varghese Puthukkeril, 4th year student was part of the College Men's Tennis team which became KTU B-Zone champions and KTU Interzone runners-up

Our Toppers

2019-20

first semester



1. Anjali Menon K.R. (10)
2. Balabhaskar S.S. (9.76)
3. Bharat P.S. (9.76)

third semester



1. Nazila N. (9.71)
2. Swathi P.V. (9.67)
3. Joshna J. (9.67)

fifth semester



1. Jacob John (9.57)
2. Pooja Rejikumar (9.48)
3. Nandini J. Nair (9.46)

seventh semester



1. Hari Mohan S. (9.11)
2. Caroline Maria John (8.89)
3. Harikrishnan S. (8.84)

Gallery

Staff

B. Tech 2016-20


B. Tech 2017-21


B. Tech 2018-22

B. Tech 2019-23 (A)

B. Tech 2019-23 (B)


M. Tech 2018-20


M. Tech 2019-21

POTENTIA 15

Department of Electrical and Electronics Engineering

Thangal Kunju Musaliar College of Engineering