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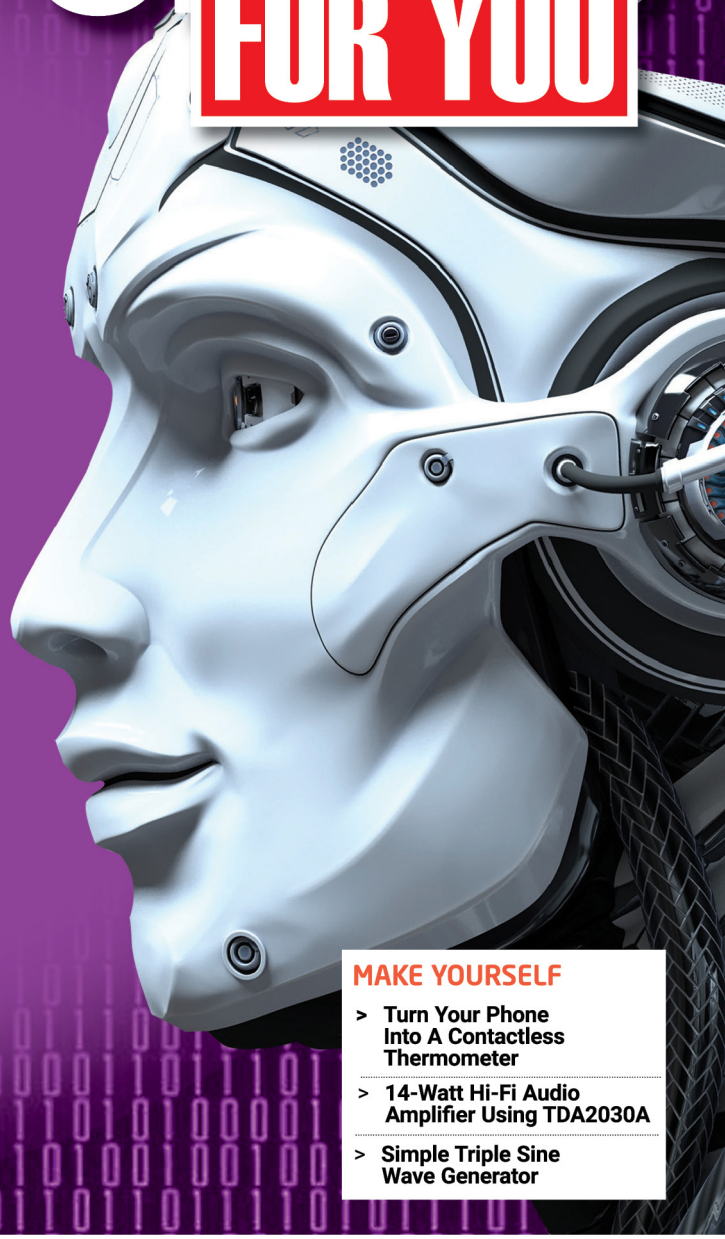
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The above is necessary to ensure reliability of the LED Aviation Obstruction Light. This system design effectively eliminates any active components and circuits inside the aviation light itself, and enhances the solid-state passive reliability of the LEDs (mounted in relatively inaccessible locations at the height of tall structures). This drastically reduces the possibility of component failure - and hence possibility of any maintenance requirement – in the LED Aviation Obstruction Lights themselves (which are mounted at extreme heights in the system).

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- Radio, TV and similar structural towers
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THE BINAY LED OBSTRUCTION LIGHT IS UNDER ACCEPTED PATENT, AND AS SUCH IS A PROPRIETARY PRODUCT

Binay Opto Electronics Pvt. Ltd.

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5 YEARS Warranty 5 Years warranty

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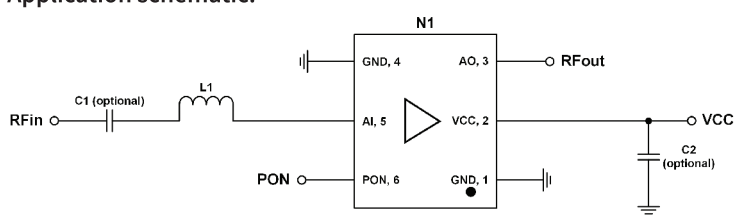
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Application schematic:



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- Robotics Exoskeletons for Healthcare Sector
- How to Make Solar Lamp With Battery Backup

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Q&A

Things You Wanted to Know!



Q1. What is a switch debouncer? How does it work?

Suresh

A1. Mechanical switches are one of the most common components used in electrical and electronics manual control circuits. When you press a mechanical switch, two metal parts come in contact with each other, and the current flows through the contacts. But sometimes the metal parts connect and disconnect several times before the actual stable connection is made. The same thing happens while releasing the switch button. The mechanical switch bounce or contact bounce, sometimes called chatter, is a common problem associated with mechanical switches and relays.

Note that each switch has its own characteristics regarding the bounce. For example, you may have two similar switches, but there is a high chance that each will bounce differently. These problems are very common in digital and microcontroller circuits associated with the mechanical switch. These chattering inputs are electrically cleansed with a switch debouncer circuit to prevent or reduce false triggering or multiple triggering.

One of the simplest solutions is adding a resistor and capacitor (RC) across the switch, as shown in Fig. 1. Here, the RC circuit acts as a filter to smooth out the output glitches. When the switch is open, the voltage across the capacitor remains zero. Initially, the capacitor charges through the resistors (Rp and Rd).

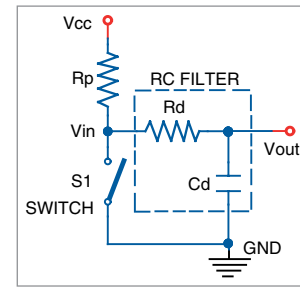


Fig. 1: Debounce circuit

When the switch is closed, the capacitor starts discharging through Rd, and hence the voltage output (Vout) becomes high. In the bouncing condition, the capacitor stops the voltage at the input voltage (Vin) until it reaches Vcc or ground, preventing false triggering.

Q2. Which are long-range wireless modules that can operate in the line-of-sight of up to one kilometre range? Kindly suggest some modules easily available in the market.

Pamarthi Kanakaraja

A2. Long-range wireless sensor modules are used in many applications, including asset tracking systems, community building security, robot wireless control, industrial remote control, telemetering, automatic data acquisition, vehicle keyless entry system, PC wireless networking, toys, and drones among others.

One such sensor is the nRF24L01 module (refer Fig. 2) from Nordic Semiconductor. For application, you may refer to 'Ultra-Low-Power Sensor Hub Using nRF24L01 Modules' DIY article available on *https://www.electronicsforu.com/electronics-projects/ultra-low-power-sensor-hub-using-nrf24l01*.



Fig. 2: nRF24L01 module

Some long-range wireless sensor modules easily available in the Indian market include nRF24L01, Zigbee XBee Pro S2C 802.15.4, HC-12, TS835 FPV 5.8G, and LoRa SX1278 module.

1. nRF24L01 module. Its operating range is up to one kilometre and it uses 2.4GHz global open ISM band.

2. Zigbee XBee Pro S2C 802.15.4 module. Its range for outdoor line-of-sight is up to 3.2km. The operating frequency is 2.4GHz for worldwide deployment.

3. HC-12 wireless serial port communication module. It has a range of up to one kilometre in open space. It works in the frequency range of 433.4-473.0MHz and supports up to a hundred communication channels.

4. TS835 FPV 5.8G 600MW 48CH (2-6S) wireless AV transmitter module. It has a range of 5km to 8km when used with a bigger gain antenna. The operating frequency is 5.8GHz.

5. LoRa SX1278 long-range RF wireless power mental module. It has a range of up to 5km. This module uses SX1278 IC from SEMTECH and works on 433MHz frequency.

There is also a long-range wireless module, the F8L10 series, which can work up to 11km.

Answers compiled by Sani Theo, technical editor. Letters and questions for publication may be addressed to Editor, Electronics For You, D-87/1, Okhla Industrial Area, Phase 1, New Delhi 110020 (e-mail: **editsec@efy.in**) and should include name and address of the sender.

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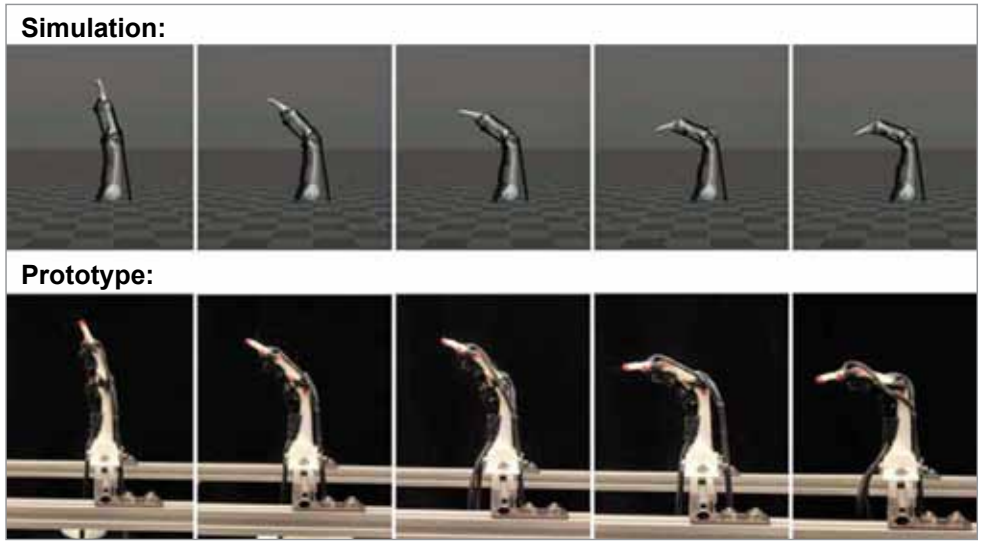
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Biomimetic robotic finger created using 3D printing

Researchers at the University of California, Santa Cruz and Ritsumeikan University, Japan, have designed and fabricated a robotic finger inspired by the human endoskeletal structure. This biomimetic robotic finger, presented at this year's International Conference on Ubiquitous Robots and Ambient Intelligence (URAI), was assembled using a multi-material 3D printer.

"Developing a robotic hand that has hard and soft components, just like the human hand, is a research topic that I wanted to explore for years," Maryam Tebyani, one of the researchers who carried out the study, told *TechXplore*.

The primary objective of the recent work by Tebyani and her colleagues was to create a robotic hand inspired by natural systems. However, the researchers wanted to focus most of their efforts on designing artificial hand rather than in fabricating and assembling it. They thus decided to take advantage of state-of-the-art 3D printing methods, which could simplify and accelerate the overall prototype production process.



Researchers have designed a robotic finger inspired by the human endoskeletal structure (Credit: Tebyani et al)

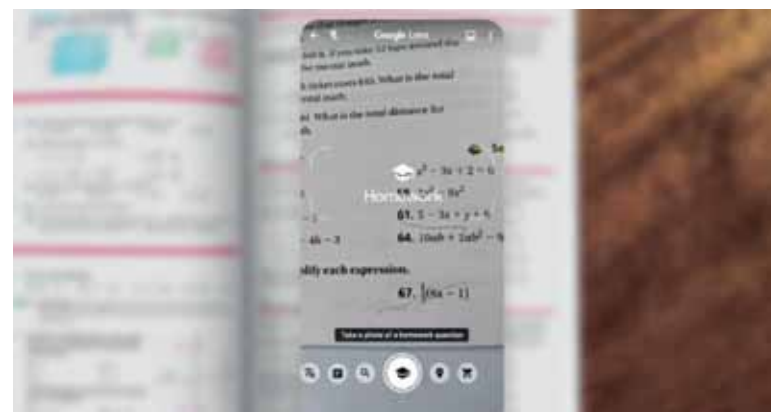
The robotic finger designed by the researchers has bone geometry, ligament structures, artificial muscles, and viscoelastic tendons that resemble those of humans. All of these components were synthesised as a single part using a multi-material 3D printer. The researchers also developed a model of the finger using a popular physics simulation engine called MuJoCo. This allowed them to compare the results achieved by their robotic finger in simulations with those achieved by a printed prototype of the finger in real-world settings.

Google Lens to assist students with homework

Google has announced that the company will soon be rolling out a new educational tool for Lens. Its purpose is to help students (and their home-teaching parents) solve and use math equations.

The Lens tool will be part of a suite of applications provided through Socratic, which Google bought last year. Currently, Socratic supports Math, Science, Literature, Social Studies, and several other subjects. Its purpose is to serve as an online tutor, helping students learn on their own.

To use the Lens tool, a student can take a picture of a formula or equation with their Android or iOS device. And then, the tool will provide quick access to helpful results such as step-by-step guides and detailed explainers that will assist in



Google to roll out a new educational tool for Lens (Credit: Google)

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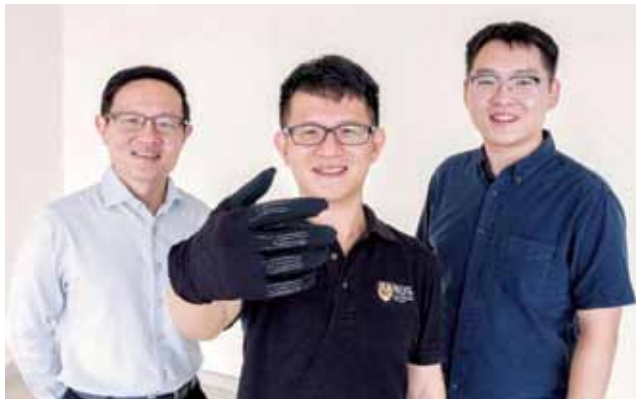
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solving the problem and give a better understanding of the key concepts.

Socratic already has optical character recognition capabilities; thus, repurposing some of its functionality to work directly as a Lens tool should make it easier for students to get help with equations and formulas. The company has not yet announced a release date for Lens tool but hinted that it might be ready for this year's school term.

Smart gaming glove that puts control in your hands

A team of researchers from the National University of Singapore (NUS), led by Professor Lim Chwee Teck, has developed a smart glove called 'InfinityGlove' that allows users to mimic a variety of in-game controls using simple hand gestures.



The smart glove was developed by a team of researchers at NUS (Credit: National University of Singapore)

While the concept of controlling a game using your hands is not new, the main problems have always been weight and flexibility. The InfinityGlove overcomes existing problems by weaving ultra-thin, highly sensitive microfibre sensors into the material of the glove.

These sensors are not only lightweight and accurate but also fulfill the role of wires, thus reducing the need for additional wiring. The prototype weighs about 40 grams and is flexible and comfortable.

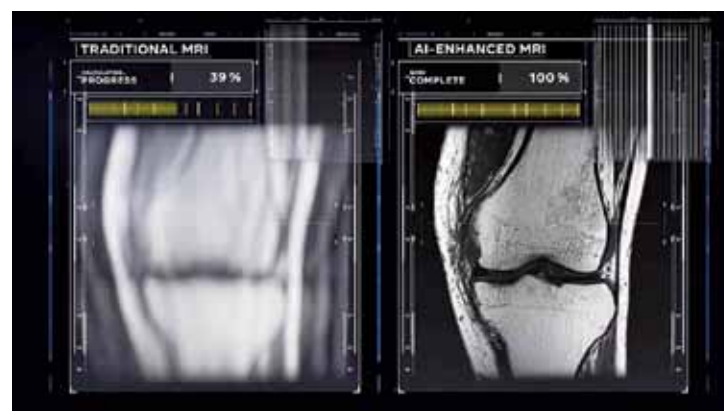
Currently, each InfinityGlove contains a total of five thread-like sensors, one for each finger. This network of sensors can interface with the game software to produce accurate three-dimensional (3D) positions of a moving hand. Various gestures made by the user's hands are then mapped to specific inputs that are found on a regular controller.

To date, the team has mapped a total of eleven inputs and commands that allow users to play games such as Battlefield V. The sensor is made up of a thin and stretchable rubber-like microfibre.

New AI-based technology to speed up MRI scans

Researchers at Facebook and New York University have come up with a new AI-based mechanism to reduce the time taken to capture magnetic resonance images. A faster process is said to make it much easier to use magnetic resonance imaging (MRI). These may also help young children and others who face difficulties staying for a longer period inside the traditional cylindrical tubes for scanning.

The mechanism is part of a collaborative project known as fastMRI between radiologists at the NYU Langone Health and Facebook AI research team, known as FAIR. Researchers successfully figured out a way to train a machine learning model using low-resolution and high-resolution MRI scans. The model then helps predict what the final MRI scans may look like. The result is based on much lesser input data, subsequently making the process much faster.



This new technology makes MRI scans four times faster (Credit: Facebook)

Researchers said that a faster scanning could help expand access to MRIs by helping a higher number of patients from each machine. They are also confident that the breakthrough could help encourage doctors to use more MRIs in place of X-rays and CT scans for some cases.

Tesla's new sensor can detect child left in hot cars

Tesla has asked the Federal Communications Commission (FCC) for approval to market a short-range interactive motion-sensing device that could help prevent children from being left behind in hot cars and boost theft-prevention systems.

Tesla's device would utilise four transmit and three receive antennas driven by a radar front-end unit. Tesla says, "Millimetre-wave radar technology has advantages over other sensing systems like camera-based or in-seat occupant detection systems."

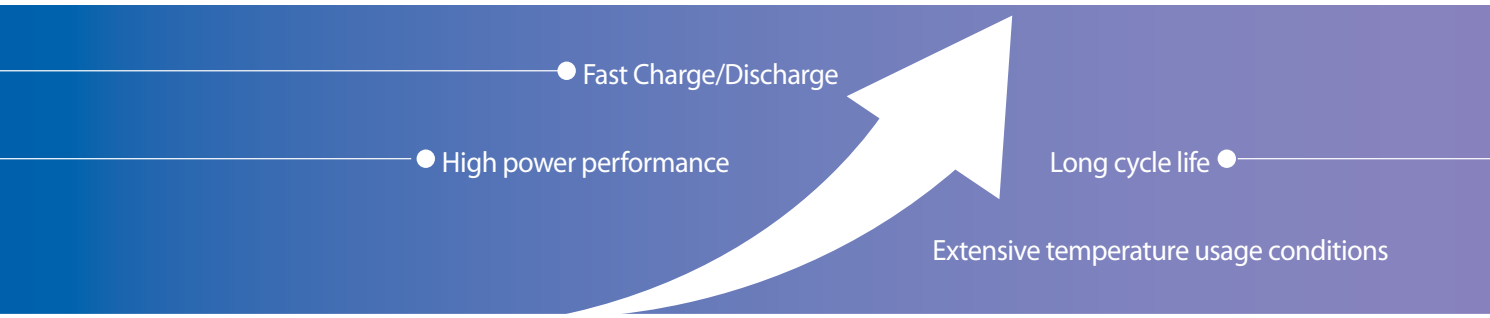
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The radar-based system provides depth perception and can 'see' through soft materials, such as a blanket covering a child in a child restraint.

Tesla adds, "It can differentiate between a child and an object left on the seat, reducing the likelihood of false alarms, and can detect micromovements like breathing patterns and heart rates, neither of which can be captured by cameras or in-seat sensors alone."

Radar imaging can assess body size to optimise airbag deployment in a crash depending on whether an adult or child is seated, which it says would be more effective than existing weight-based and in-seat sensor systems. It would also more accurately determine when to engage seat belt reminders.

Government launches contest to promote homegrown microprocessor companies

The government of India has launched a contest to promote homegrown microprocessor companies in line with its aim of Atmanirbhar Bharat. This comes after indigenously developed microprocessors 'Shakti' and 'Vega' have been rolled out under the Microprocessor Development Programme of the Ministry of Electronics and IT.

Under the Swadeshi Microprocessor Challenge, hundred shortlisted companies will win a grant of total ten million rupees, while 25 finalists will win ten million rupees each. The top ten teams entering the finale will get the seed fund of total 23 million rupees and twelve months of incubation support.

Launching the initiative, Ravi Shankar Prasad, Union Minister of Law & Justice, Communications and Electronics & Information Technology, said that Swadeshi Microprocessor Challenge - Innovate Solutions for Aatmanirbhar Bharat will provide further impetus to the strong ecosystem of startup, innovation, and research in the country. The government has already launched content to promote a homegrown videoconferencing tool along with giving a push to local mobile applications.

This hands-free face shield will let you take calls and listen to music

Indian helmet manufacturer Steelbird has launched a unique hands-free face shield called IGN-1 HF Static Face Shield. Users can connect the face shield to their smartphones with the help of a cable. The face shield has an inbuilt speaker, which can double up as an over the ear headphone, helping you access phone calls and also listen to music.



Steelbird's unique hands-free face shield (Credit: Amazon)

The company mentions that its hands-free shield will help users avoid contact with their smartphone, which is one of the carriers of Covid-19.

The face shield does not need a battery and is compatible with all the mobile phones. The device comes with adjustable ear pads to suit any individual's ear size and position. Further, shield claims to offer high-quality sound and noise cancellation through a single directional microphone. The fact that it is IP5 water resistant makes it adequately waterproof as well.

"With the widespread coronavirus, we thought of coming with a product that gives 360-degree protection to people. So, we innovated IGN-1 HF Static Face Shield, which is a first of its kind revolutionary hands-free face shield. This face shield will not only help you to save yourself from coronavirus infection, but you can also pick or receive a phone call and speak to the caller through the inbuilt battery-less speakers and microphone system. One can also enjoy music through the Face Shield," says Rajeev Kapur, managing director, Steelbird Group.

IIT Roorkee launches online programs on AI and data science

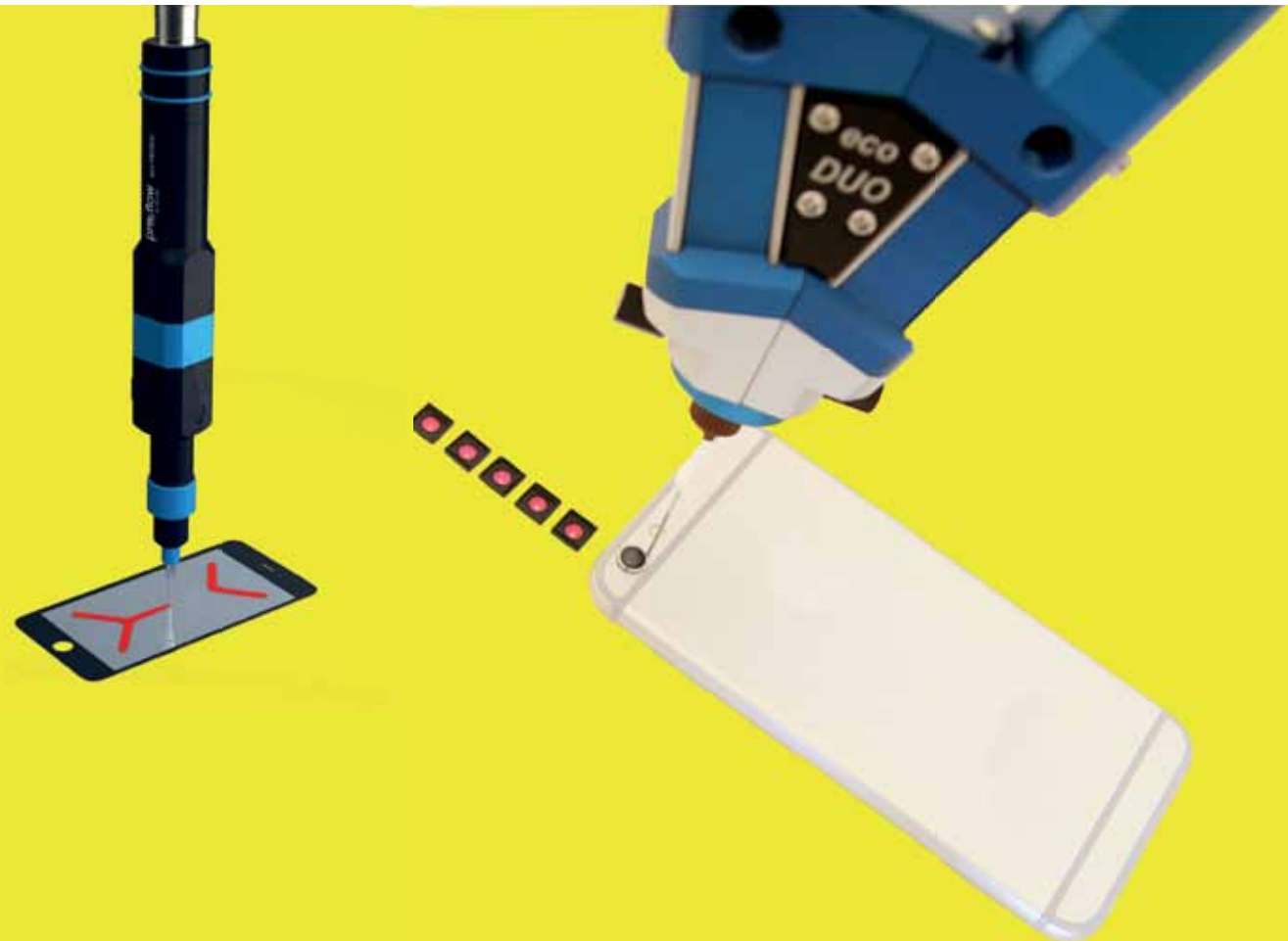
The Indian Institute of Technology, Roorkee has announced a partnership with an online learning platform, Coursera. As a part of this partnership, the two organisations have launched two new certificate programs for learners around the world. While the first program is focused on artificial intelligence (AI) and machine learning (ML), the other one focuses on data science. Both these programs will be available on Coursera in early 2021.

Talking about the programs, the six-month certificate program in AI and ML will consist of video lectures, hands-on learning opportunities, team projects, tutorials, and workshops. This program will also teach classical ML techniques and provide hands-on programming experience with Tensorflow for model building, robust ML production, and powerful experimentation to the learners.

The certificate program in data science, on the other hand, will equip professionals looking to build skills in data science, ML, critical thinking, data collection, data visualisation, and data management. The program will help develop Python and SQL programming skills necessary for a career in data analytics.

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1 Going Into Renewable Energy Era With AI
2 Smart Education To Improve Skillsets Of Students
3 Batteries For Powering Sustainable Development
4 Ai-Driven Cobots In Logistics And Beyond

1 GOING INTO RENEWABLE ENERGY ERA WITH AI

The introduction of artificial intelligence (AI) has helped utilities as well as other energy companies in forecasting renewable energy production and electricity demand. AI also helps in actively delivering infrastructure maintenance and predicting equipment failure. Thus with AI, there has been better integration of large-scale renewable energy systems



Artificial intelligence is playing an important role in renewables industry (Credit: www.windpowerengineering.com

The global energy market is undergoing a huge transformation in the process of making energy clean and reliable for dealing with current world problems like climate change. This is making it difficult for energy companies to manage everything via traditional methods.

Utilities as well as other energy companies are finding ways to bridge the demand and supply gap that has arisen due to the increased use of renewable energy sources. Harnessing technologies like artificial intelligence (AI) offers new solutions to manage the changes and be ready for the next generation of the grid.

As renewable sources like solar and wind are variable in nature, the power supply may not be in sync with consumer needs. There are times when conventional sources still need to be activated as a backup. Users also act as providers when the energy generated is more than their needs, and they send the remainder back to the grid.

There is a massive amount of data available from multiple sources within the utility market. When smart meters were growing, and traditional meters were being replaced in the US, Oracle had reported that this would generate one billion customer data points each day, that is, three thousand times more information than that from the old meters. This number has grown to a much greater extent now. Smart grids, with embedded sensors for sending information to software and monitoring systems, can thus use AI to digitalise energy.

AI can be deployed to forecast renewable energy production as well as weather and short-term, medium-term, or long-term electricity demand. AI algorithms, like those developed by Google's company DeepMind, can handle zettabytes of structured and unstructured data collected from wind or solar panels to identify patterns and make predictions and recommendations based on them. AI can help in actively delivering infrastructure maintenance and predicting equipment failure. AI-driven optimisation is vital to maximise efficiency with real-time monitoring. Predicting what kind of production a solar or wind farm in a specific location might achieve can attract investments.

Fraud or even energy theft is more common than one might think. AI can combat energy piracy by enabling utilities providers to scan individual consumer details, their usage patterns, payment history, and alerting about suspicious discrepancies between billing and usage data.

In conjunction with this, the

technology empowers the consumers through two-way communication with the utility companies. Customer experience is a top business priority for any business. Repetitive type of customer-side tasks like payments, basic inquiries related to billing, complaints, changes in customer details, and the like can be simply solved through virtual agents and chatbots, saving time and money.

In rural areas especially, invoices and other records are still in handwritten form. With capabilities like natural language processing, AI can help in digitising these records. We can even go as far as instructing users on how to install or activate products related to energy management via AI and computer vision if they want to set them up in their homes.

The result is better integration of large-scale renewable energy systems, thereby lowering peak demand, efficient power transmission, reduced operations, and management costs, which are essential to meet economic and environmental needs.

In 2018, SLAC National Accelerator Laboratory at Stanford University came up with a software platform called VADER, which stands for Visualization and Analytics of Distribution Systems with Deep Penetration of Distributed Energy Resources. It can model potential changes in connectivity and behaviour of various resources on the grid using AI for resource optimisation. In India, numerous startups like Avrioenergy, The Solar Labs, and many more are working in this sector.

While the training speed of algorithms has improved due to better computational power, AI presents threats like cyberattacks on an automated power grid. Applying AI in the right way is crucial to successfully deploy it on a large scale. Inadequate quality of training data can lead to false predictions. This causes a lot of time and effort to be spent on data categorisation and integration rather than the task at hand.

But given the potential benefits, as technologies become more advanced, there will be enormous adoption of AI worldwide in the energy sector.

—Ayushee Sharma

2 SMART EDUCATION TO IMPROVE SKILLSETS OF STUDENTS

Smart education is playing an important role in the education sector. It has helped in improving the skillsets of students and made learning more interactive and engaging

A Greek philosopher once said, "The only constant in life is change." The same goes for technology, which has become extremely advanced in the past few years and brought many changes in our daily lives. It has also modernised various sectors, including education and learning. Information and Communication Technology (ICT) has played a key role in changing the dynamics of modern-day education, teaching, and learning.

ICT is deeply integrated into classrooms and coaching centres and has completely changed the traditional methods of teaching. It has also improved the skillsets of students such as global awareness, communication and collaboration, critical thinking and problem solving, social and cross-cultural skills, and self-direction.

These days learning is not only about gaining knowledge but also developing intrapersonal and cognitive skills. As rightly said by experts, the efficacy and success of learning depend not only on the outside environment but also on the suitability of the learning process.

Smart learning is nothing but an amalgamation of technologies. It includes three imperative parameters—learning outcomes, learning behaviour, and mental systems.

The paradigm shift in education. Smart education offers a huge paradigm shift in the way students access education. The rapid changes in technology make it difficult for teachers to understand what the future will be like in the coming years. Smart education solves this quandary with the use of cutting-edge technologies that help both teachers and students to prepare themselves for the road ahead. The unique aspect is that it can be done in both physical and virtual environments.

While speaking about smart education and its benefits in the coming years, we need to understand the importance of technology in education and how it is going to shape the future. The recent market research report from Technavio predicts that the smart classroom market in India will grow at a CAGR of more than twenty per cent in 2020. College, coaching, and school classrooms are now furnished with state-of-the-art tech-based education tools that completely wipe out the traditional methods of education. Electronic items such as projectors and document cameras have made colleges and schools smarter and eco-friendly.

Benefits of smart education. While speaking about various aspects of smart education, we need to look at the various benefits it offers to the education sector. This sector has already adopted tech-based teaching methods with the use of interactive intelligent boards, projectors, smart notebooks, etc. No doubt, these gadgets make teaching sessions much more interactive and engaging. Let's find out some of the top benefits of smart education in the education sector.

Interactive sessions. Students' engagement rate has escalated by 55 per cent globally after the introduction of technology in schools and colleges, as per a report by Gallup. Instead of traditional blackboards, smartboards are now being used in schools to help teachers and college professors give lectures more effectively by utilising various projections. In addition, teachers can explain their chapters more easily with the help of special effects and graphics.

Role of online resources. A smart classroom is furnished with projectors and digital display boards that help teachers to provide practical solutions from the Internet in a trouble-free manner. Students can also look for

various topics on the Internet related to their subjects.

Upgraded learning. With the use of smart technology and electronic gadgets, information can be shared more effectively with the use of photos, maps, graphs, flowcharts, and animated videos. It makes teaching sessions and learning more interactive, easy to understand, and fascinating. Topics can be understood much better through visuals rather than just reading from the blackboard.

Time-saving. This is another major benefit of smart education. In the conventional methods of studies, students need to prepare long hand-written notes, whereas smart education aids students to make presentations online and get feedback from their teachers in much lesser time. The same goes for teachers as well as they do not need to worry about giving verbal or written notes because presentations can be shared directly with all the students.

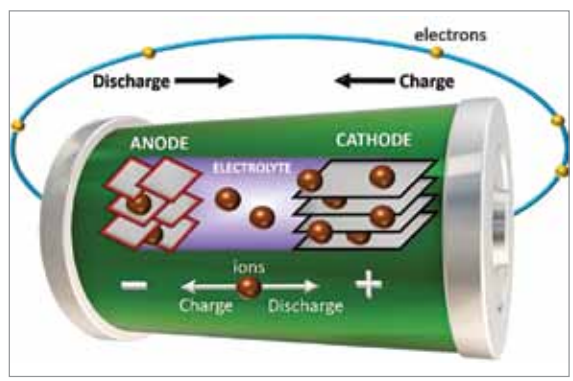
Conclusion. Overall, understanding of technology offers enhanced skills required for a digital future. Teachers, on the other hand, are also required to learn new technologies and methods of executing them in conventional classrooms with the utilisation of ICT. By implementing sophisticated learning techniques, such as online virtual classrooms, virtual learning environments, cloud servers, smartphones, etc, teachers can help students to grasp more out of learning.

—Nijhum Rudra

3 BATTERIES FOR POWERING SUSTAINABLE DEVELOPMENT

Over the years, lithium-ion (li-ion) rechargeable batteries have become immensely popular, but their production process incurs large carbon footprints. Hence, there is an urgent need to find alternatives to these batteries

Batteries are a core technology that power portable electronic devices like smartphones, vehicles, and even provide a backup for the growing renewable energy used in homes, offices and electricity grids by converting chemical energy inside them to electrical energy. In the past few years, lithium-ion (li-ion) rechargeable batteries have become immensely popular due to their high energy density over a wide temperature range and low self-discharge, finding their use even in military and aerospace applications.



Lithium-ion batteries (Credit: www.sigmaaldrich.com)

Just like any other battery, li-ion batteries are made up of a combination of cells, with each cell consisting of anode and cathode that are separated by an electrolyte. The cathode is made up of a lithium compound (such as lithium cobalt), and the anode is typically built from graphite. The electrolyte is usually a lithium salt (lithium hexafluorophosphate) in an organic solvent. During discharge, lithium ions move from cathode through the electrolyte to anode and vice versa during charging. The cells need a protective circuit to limit the peak voltage.

Owing to climate change, we need the development of a sustainable and low-carbon value chain for batteries. The storage of energy heavily relies on heavy metals in batteries. The problem with li-ion batteries is that besides being expensive, extraction of raw materials available in underdeveloped nations is often done in unsafe working conditions, and a huge amount of water gets wasted in the process. Sometimes, it even leads to leakage of toxic chemicals into the water cycle. The production process incurs large carbon footprints, and their disposal is a huge problem. Besides, with China being dominant in li-ion battery manufacturing and battery supply chain, the coronavirus pandemic has led to a series of disruptions in the supply chain.

As the basis for future mobility, there needs to be a defined sustainability criterion for battery design as well as focus on reuse and recycling to boost a circular economy, especially in developing and underdeveloped countries. But the cost of recycling li-ion batteries is higher than manufacturing these from scratch. For moving to a more sustainable future, these issues need to be fixed. There is a dire need for implementation of effective coordination and policies among public, private, and civil society organisations for the deployment of sustainable batteries. In this direction, the Global Battery Alliance was founded in 2017 for global public-private partnerships.

Several researches are also going on to find alternatives to li-ion batteries. For example, sulphur has been considered to have great potential in this field. Lithium-sulphur batteries are economical, more environmentally sustainable to produce, and safer to use. The issue is that the electrodes tend to break down during charging since sulphur is a poor conductor of electricity and heat. Apart from this, these batteries degrade faster over time.

In another instance, researchers at Purdue University have created a technique to turn waste polyethylene terephthalate, a recyclable polymer, into battery components. This paves the way for organic batteries. Biomass-derived electrodes (both carbonised and non-carbonised), electrolytes and separators (membrane between cathode and anode) are a growing topic of

interest for analysis. Biomass-based binders can replace toxic halogenated commercial binders for holding the active material particles inside electrodes and ensure sustainability.

Numerous companies are adopting these technologies, and the situation is gradually changing. Last year, IBM developed a new type of battery that uses raw materials from seawater and is free of cobalt, nickel and other heavy metals, thereby avoiding the trouble of mining and so reducing costs involved in the process. The battery, which is in an early stage of development currently, has a higher power density besides low flammability as compared to lithium-ion versions.

Sodium-ion is another option that has gained significant attention. Even for lithium-sulphur batteries, it has been observed that the addition of molybdenum makes the electrodes conductive and stable. With further research and collaboration, it is possible to expect fully stabilised alternative materials that can be introduced in the market for real, practical, commercial applications in future.

—Ayushee Sharma

4 AI-DRIVEN COBOTS IN LOGISTICS AND BEYOND

With the advancements in technology, traditional robotic systems are now getting replaced by collaborative robots (cobots). Cobots are specifically designed to operate and simultaneously collaborate with human workers safely in the same workspace. These mainly cater to the manufacturing and logistics industries

One of the biggest changes in the Industry 4.0 revolution has been the use of robotics to automate mundane tasks. This was a big change for several organisations that boosted productivity by saving time as well as human labour. Once considered a novelty, robotics is now employed everywhere today, from offices, restaurants to even homes. With greater adoption over the course of time, robotics has evolved to incorporate changes necessary for its smooth functioning alongside humans.

One of the points stressed every now and then is the need to keep humans in the loop. This is why traditional robotic systems are getting replaced by collaborative robots (cobots). This is one of the fastest-growing segments of industrial automation.

Cobots are specifically designed to operate and simultaneously collaborate with human workers safely in the same workspace. For the cobots to be autonomous, data from sensors attached to them is fed to artificial intelligence (AI) models. This aids in collision avoidance and hence navigation as the exact position and velocity of the operators can be determined in real time. In case there is any failure in the system, the cobot automatically turns off. AI can even predict such conditions by drawing patterns from current and past data for better performance. There is no need for custom programming.

These robots are generally built to be lightweight and are easy to programme and reprogramme without the need for expertise in robotics. The payback period is also short. Most cobot manufacturers claim that the payback period lasts from about three to five months.



AI-driven cobots (Credit: www.themanufacturer.com)

Besides AI, other emerging technologies like augmented reality (AR) can further help in accurate and precise real-time response. The bot that researchers at England-based Nottingham Trent University (NTU) have been working on for spinal surgery treatment uses AR to provide surgeons with live feedback.

The cobots mainly cater to the manufacturing and logistics industries. The reason is that there has always been a high demand for labour in the logistics sector ever since the rise of e-commerce, and amidst the lockdown restrictions during Covid-19 pandemic, this need is constantly growing. At a time when there are health risks involved in gathering a large number of workers at factories, cobots come to the rescue. Due to their affordability and flexibility, even many small and medium-sized companies in India and abroad have deployed them for their business continuity.

Take the example of US-based Locus Robotics, which supplies its cobots to numerous logistics firms globally, such as CEVA Logistics and Geodis. The bots are capable of deploying sensors, carrying items between workstations, and direct human workers to the correct locations in any warehouse. Workers can focus on maximum picking, and the remaining work can be done by these machines.

In India too, cobots have high demand, especially in the automobile sector. Bajaj Auto has been using cobots for years, with more than 150 cobots currently across its assembly lines for purposes like machine tending.

With the world already grappling with unemployment, this poses a problem for many semi-skilled or unskilled workers who get daily wages for these routine tasks. These workers need to be upskilled before being given the newer job requirements that deal with preventive maintenance, validations, and the like.

While these bots have not found their place in homes yet, some companies have started making investments in this sector. In this nascent stage, Café X plans to begin shipping and installations of the beverage making equipment by the year-end, starting with the US. EFY

—Ayushee Sharma

Do We Need To Worry About Radiation Emitting Devices In Common Use?

Digitalisation of resources has made the use of devices like phones and laptops extremely frequent. However, the excess use of such devices can cause harmful effects since these also emit electromagnetic radiations. So, it's important for consumers to take necessary steps to ensure that they are not exposed to radiations round the clock

Ayushee Sharma

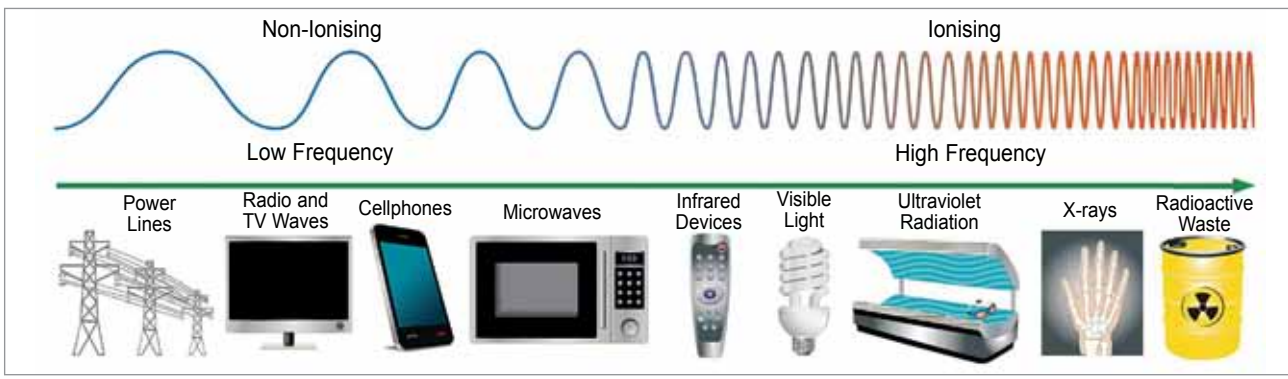
From kids to adults, be it for education or work, digitalisation of resources has made the use of devices like phones and laptops extremely frequent. Even for recreational activities, we have moved to such devices for experiencing everything from the comfort of our homes. In today's world, it is a fact that we are surrounded by technology everywhere to such an extent that we don't even realise it. But with the excess use comes rising concerns.

We would often hear parents telling their kids things like 'don't hold the phone too close' or 'don't keep the laptop on your lap.' The reason is simple—improper and excess use of even the best technologies causes acute and chronic harmful effects, with problems like dry eyes and headaches being the most common. The fear is only aggravated by reports that state electromagnetic radiations like ionising ultraviolet or X-rays can cause DNA damage and have long term risks associated with serious problems like cancer since the gadgets in our daily use also emit electromagnetic radiations.

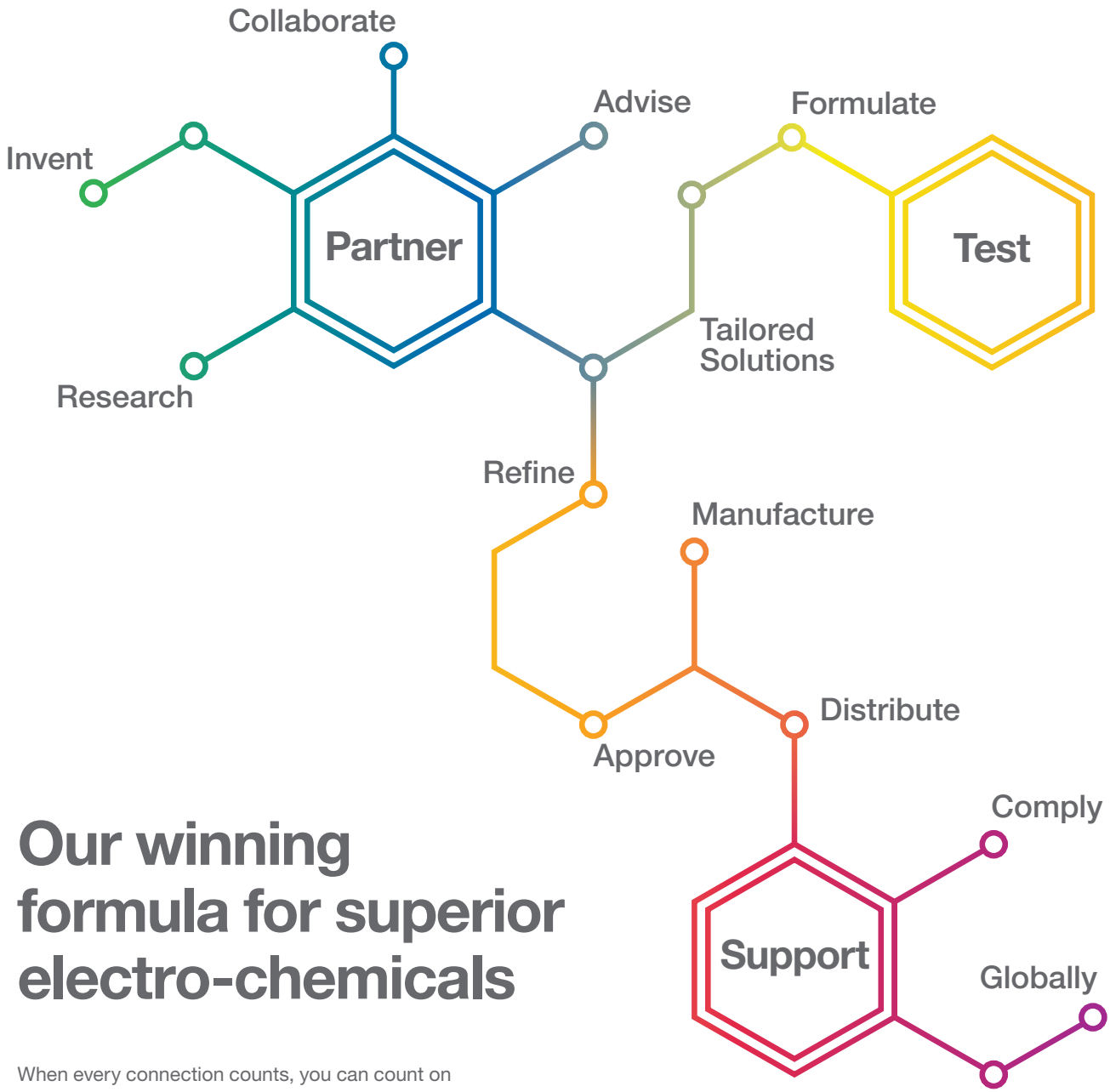
About RF electromagnetic radiation

In the context of commonly used electronic devices, electromagnetic radiation is in the form of radio frequency (RF) energy waves. When alternating electric current travels through the antenna, electromagnetic waves are emitted and received by the antennas inside these devices. Higher the frequency, the faster is the data transfer. Metal parts in the machines amplify RF signals.

Since wireless devices have to detect other tools that they wish to connect to, they increase their emitting power to find them. The permissible upper limit for wireless devices set by the US Federal Communications Commission (FCC) is 1.6 W/kg of RF radiation. Some devices that are commonly used and emit electromagnetic radiations are discussed next.



RF radiation in different devices in order of increasing frequency in the electromagnetic spectrum (Credit: www.niehs.nih.gov)



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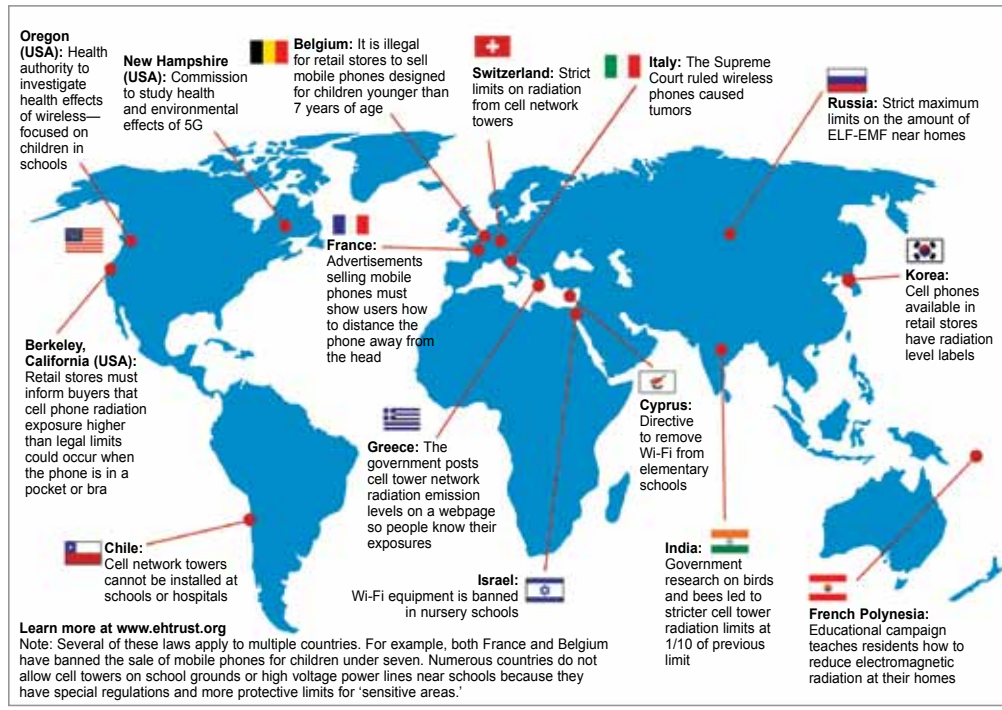
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Cellphones. Our cellphones go with us wherever we go, thereby causing maximum exposure to radiation. The exposure is higher if the mobile being used is older or closer to the body, which is generally the case. On doubling the distance from the source, the radiation gets almost four times weaker. But most of the radiation is the result of using Wi-Fi (2.4GHz or 5GHz) and mobile data (1-2GHz for 4G) to get access to the Internet.

Laptops. Laptops have gained more importance in homes due to their portability over computers. Much like cellphones, radiation from laptops is highest when it is connected to Wi-Fi or Bluetooth for browsing the Internet or sharing files in a close range, respectively. It is recommended that there must be a minimum distance of 20cm between the laptop and the user.



Worldwide policies for wireless devices (Credit: https://ehtrust.org)

Headphones. Headphones are attached to our ears and head when we use them. Wireless headsets emit RF signals to communicate with phones. While wired earphones increase the risks to the brain since the phone is close to the body, the metal in the wire also amplifies the radiation.

Wireless routers. Most homes have Wi-Fi routers installed, which when transmitting data, expose nearby areas to RF signals. However, the amount of radiation absorbed by the human body from a wireless router is quite less as compared to that transmitted from using a cellphone. If the obstructions in the path are of higher thickness, radio waves may be absorbed completely.

Tablets. Tablets are quite popular due to their compact nature and range of functionalities available, especially among kids for purposes like studying, playing games, and practising digital drawings. These devices are connected via Wi-Fi, Bluetooth, or a cellular connection to allow Internet connectivity. However, these emit radiations if the Internet connection is turned on even when the screen is off.

Wearables. Wearables such as smartwatches and fitness trackers are worn on the body and operated via connectivity to other wireless devices like smartphones and laptops. These continuously emit radiation, and hence we are exposed to RF energy 24/7.

Others. Other devices like mouse and keyboards also emit radiations if these utilise wireless connectivity to find the computer they want to work with. Even for wireless microphones, the radiation is high when it is being used to send a large amount of information.

With the growing number of Internet of Things (IoT) connected devices, the sources of RF are bound to grow. This includes smart refrigerators, smart meters, baby monitors, and so on.

What can be done?

Scientists have been studying the effects of long-term exposure to various levels of RF for many years, but it is a tricky assessment. This is because, in such a long time, there are numerous factors that cannot be controlled but may impact the inference. Radiation from RF energy is non-ionising in nature. Due to this, most of them agree that there is no proof of these being carcinogenic in the long run, but it has not been ruled out. So, it has to be made sure that everyone can use the devices safely.

Government agencies set safety guidelines and regulations to limit RF exposure from wireless devices and protect consumers. But there are no international standards, so the permissible exposure limits vary in different nations. The restrictive limits on whole-body exposure mainly lie in the frequency range of 30-300MHz since the entire human body can efficiently absorb RF waves.

EMF meters are used to measure electromagnetic radiations, with more expensive ones having the option of customisation in the high-frequency range.

Users can take some measures to avoid problems in the long run. They can make sure to place their laptop on a table to maintain a safe distance during work, especially when connected to Wi-Fi. By switching off wireless routers when not in use or removing wearables when possible, consumers can ensure that they are not exposed to radiations round the clock.

There are a number of products made of materials like aluminium available in the market for shielding too. For example, some mobile cases can prevent radiation from getting absorbed by the body. EFY

It's not the survival of the fittest...
...It's the survival of the fastest.

LWI Electronics Inc.

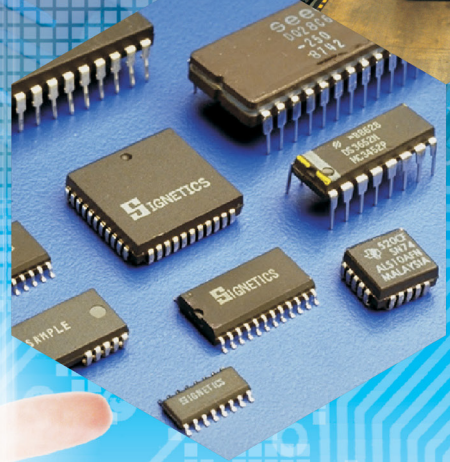
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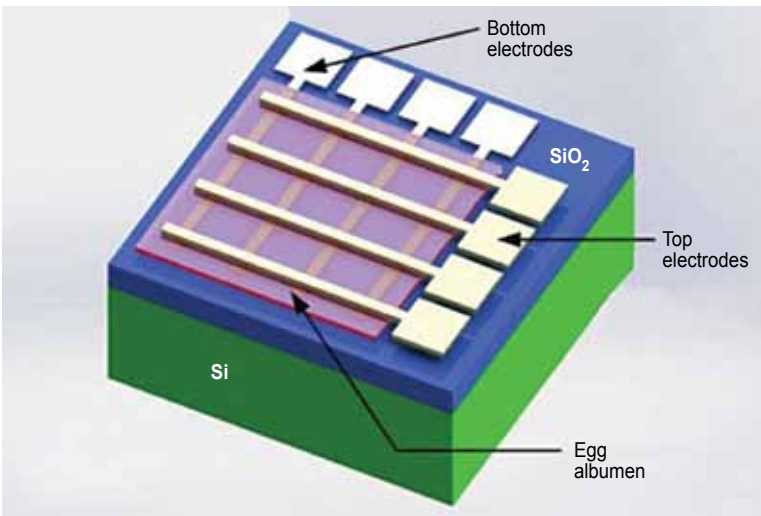
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Egg-Based Electronics To Save The Environment

Organic electronic devices have recently attracted great attention because these offer several advantages such as simple device structure, potentially low cost, and low power consumption. Researchers are currently working on egg white to build organic electronics as it is easy to process, readily accessible, and available at a lower cost



Egg-based memristor (Credit: www.eenewseurope.com)



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Durability is often seen as a hallmark for high-quality electronic systems, but sometimes we need components that don't last for a long period. For example, it would be handy if microelectronic systems that delivered drugs to various parts of the body dissolved after their tasks were over. Similarly, there are many electronic devices like sensors that should simply get dissolved after finishing their job rather than contaminating the environment. The use of electronic devices has grown exponentially, and the United Nations estimates that people throw away about fifty million metric tons of electronics every year.

One way to lessen the problem, some scientists say, is to use biological materials to build devices that are biodegradable and biocompatible. Using biological materials to build electronics would be environment friendly because their ability to biodegrade would lead to less piling up of trash. Moreover, biodegradable materials are non-toxic.

These materials have earned considerable attention in recent years. Biomaterials have the potential to cut the cost of organic electronics and simplify manufacturing processes.

Biomaterials are already used as semiconductors, dielectrics, and substrates in bioorganic field-effect transistors (BiOFETs), but these materials are not always easy to handle and may require many extraction steps. Egg, a well-known dietary and cosmetic supplement, is now advocated as biodegradable, biocompatible, and environment-friendly material towards bioelectronics.

Therefore egg albumen can be a promising alternative to the conventional silicon-based non-volatile memory systems. It may also have potential applications in the imitation of biological memory behaviour, artificial intelligence, and brain-like intelligence because of the good compatibility.

Researchers have recently figured out how to create one such chip out of eggs. They demonstrated that egg albumen-based resistive memory compares favourably to other memories, exhibiting a high on/off resistance ratio as well as good retention and switching endurance even after repeated bending.

Organic electronics

Organic-based optoelectronic and electronic devices have recently attracted great attention because of their potential applications in lighting systems, flat panel displays, backlighting modules, radio frequency identification tags, flexible sensors, and flexible displays.

These organic-based devices offer numerous advantages such as simple device

structure, favourable scalability, potentially low cost, low power consumption, multiple state property, and three-dimensional stacking capability. However, the negative effects of toxic organic materials on the environment and human health pose great concerns for the application of these devices.

To overcome such problems, researchers and scientists have extensively investigated potential non-toxic biomaterials as substitutes over the last two decades. Biomaterials are biodegradable, bioresorbable, biocompatible, and environment friendly. More importantly, complicated chemical synthesis is not required to prepare natural biomaterials.

Previous reports have suggested several promising biomaterials to prepare organic-based electronic and optoelectronic devices with deoxyribonucleic acid that can serve as excellent electron-blocking layers in both green and blue organic light-emitting diodes.

Such materials offer promising uses for non-volatile transistor memory and write-once read-many-times memory applications. Researchers have also attempted to use different natural biomaterials like tobacco mosaic virus, cysteine, ferritin protein, and enzymes to fabricate memory devices with various novel structures. These studies demonstrate that natural biomaterials can effectively simplify the fabrication process and reduce the manufacturing cost of organic memory devices.

A number of protein-based materials have successfully been utilised to fabricate resistive-type memories. For example, the cationic poly (allylamine hydrochloride) (PAH)/ferritin nanoparticle multilayer structure, which is prepared via layer-by-layer assembly, was recently demonstrated as a possible biomemory device with reliable switching property.

The electrochemical property of redox proteins was identified as the principal cause of reversible resistance-switching. The natural silk fibroin protein extracted from the cocoons of Bombyx mori (silkworm) has also been used as an active component of transparent bio-memristors. Gold (Au) nanoparticles embedded in silk fibroin protein have been used to improve the switching property.

However, most of the above-mentioned approaches involve complicated chemical processes, such as extraction or purification, which inevitably increase fabrication costs and method complexity.

To overcome many of such problems with the fabrication of biomaterials, researchers have come with the idea of fabricating and characterising non-volatile resistive switching memory devices by utilising chicken egg albumen obtained directly from fresh eggs without additional purification or extraction.

The proposed devices feature a simpler fabrication process as well as superior switching properties and reliability compared with most previous approaches.

Researchers have used cellulose as a dielectric layer in an inverter circuit and shellac as a dielectric in OFETs. Many other biological materials can be transformed into suitable dielectrics, including aloe, silk, and egg whites. Some other dielectrics with more exotic properties like hydrophobicity are also made from beeswax and carnauba wax.

Researchers are exploring to build OFETs in hard gelatin capsules or on caramelised sugar for biomedical appli-



cations. They are working on conductive, 3D-printable gelatins that could be used to make circuits for sensors that could be swallowed.

Egg-based electronics

Egg white, also known as egg albumen, has very good dielectric properties along with high transparency and high elasticity. It is an ideal material for organic electronics as it is easy to process, readily accessible, and available at a lower cost.

Heat transforms albumen from a soluble liquid to an insoluble solid as its proteins undergo thermal irreversible denaturation, unfolding from linear chains to form networks.

These networks are held together by interactions between amino acids on different protein chains. For example, the thiol functional groups (containing sulpur and hydrogen) of cysteine amino acids in different protein chains form disulfide bonds.

The new research marks that egg albumen can be used to make resistive memories that operate based on changes in resistance rather than electric current as a next-generation alternative to the silicon-based memories that dominate today's electronics. These resistive memories will have potential advantages such as higher speeds, higher densities, and smaller sizes.

Albumen's dielectric constant is higher than that of most polymers used in OFETs, making it a potential insulating material. This is not the first time that egg albumen has been incorporated into electronic devices, but previously also the albumen from chicken and duck eggs has been used in transistors and other devices as the dielectric (insulating) layer.

In a recent study, researchers have found that on mixing egg albumen with hydrogen peroxide, a series of chemical reactions occur that transform the biomaterial into an active film useful to make transparent, flexible resistive memory devices. Scientists have already developed a simple and low-cost fabrication process to make an albumen dielectric layer for OFETs. First, by separating egg white and yolk using a mesh spoon. Then, by creating a thin albumen film by spin-coating it onto a pre-patterned indium tin oxide substrate.

To obtain a smooth and dense dielectric film, the substrate is heated gradually from 80 to 140 degrees Celsius in a vacuum chamber by adding a layer of organic materials and depositing a metal layer through shadow masks.

The dielectric film is one of the main components of resistive memories, and here egg albumen-based film is used, which is normally insulating but can be made conducting by applying voltage. Switching between the states of high and low electrical resistance corresponds to switching between the memory's 'off' and 'on' states, respectively.

The researchers have been able to demonstrate that the resistance of egg albumen material can be made switchable by mixing it with a ten per cent hydrogen peroxide solution. Egg albumen contains more than forty different proteins that are linked together by weak chemical bonds, and deep inside these proteins are large numbers of iron, sodium, and potassium ions.

These ions such as Fe3 + , Na + , and K + are always connected with protein chains in the chicken egg albumen, and so cannot work efficiently when charges are injected. But on treating with ten per cent hydrogen peroxide solution, ions are exposed outside of protein chains. Thus, the resistive switching memory properties of hydrogen peroxide-modified egg albumen film are efficiently improved compared to those of pristine egg albumen. The hydrogen peroxide easily breaks the bonds that are holding proteins together. This denatures proteins and critically exposes the ions.

These ions, which are positively charged, then act as traps that capture negatively charged electrons that are injected when a voltage is applied. When the trap levels are low (few or no electrons), the dielectric material behaves as an insulator, and the memory is in 'off' state. When a negative voltage is applied, it causes the traps to fill with electrons, the material becomes conducting, and the memory switches to 'on' state. In order to reset the memory, a positive voltage is applied, which releases the electrons from the traps and returns the memory to its 'off' state.

Research teams have experimented with different materials to produce dissolvable electronics, including DNA, other types of proteins, and metals, but now the egg-based memristor is developed by researchers. An electronic device made of egg protein albumin has been created by researchers, paving the way for dissolvable sensors that could be used inside the human body.

The device, known as the memristor or memory resistor, is used to regulate the flow of electric current and can also remember charges. It has magnesium and tungsten-based electrodes that are incorporated on a thin film of albumin, a protein found in egg whites.

When used in dry laboratory conditions, the device's performance remained consistent for more than three months, but in water, however, it dissolved almost completely within three days. The ability of this biomaterial to dissolve without trace shows promise for possible medical applications.

Summary

Although great progress and breakthroughs have been made regarding the new material's application and structure design, the mechanism of resistive switching memory is still not completely clear. So, further research has to be continued to investigate the mechanism of resistive switching memory and at the same time, flexible, wearable, and water-dissolution resistive switching memory cells need to be developed using organic-modified egg albumen.

In summary, albumen functions well as a low-cost dielectric material for OFETs. Chicken albumen as a biomaterial can be used as the gate dielectric in OFETs. The albumen does not need further extraction or purification and is easily obtained, processed, and less expensive than other biomaterials for OFET devices. The entire process for preparing albumen dielectric uses properties of natural albumen without synthesis.

Albumen's dielectric constant is higher than that of most polymers used in OFETs, making it a potential insulating material. Albumen dielectrics are also suitable for fabricating flexible OFETs, which are lighter and more durable. Such devices have many more potential applications than those with glass substrates, particularly for portable electronics. Research suggests that albumen dielectrics work well in flexible OFETs and complementary inverters. EFY



Five Mistakes To Avoid When Training Your AI

A sophisticated artificial intelligence (AI) system usually follows a two-stage learning mechanism—training and feedback. However, during the process of AI training, one should be aware of the mistakes they might make in order to achieve better performance and accuracy



Anand Tamboli
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If you want your artificial intelligence (AI) system to perform better, you ought to teach it better; and how do you verify if you have trained it well? By testing it better!

The majority of AI solutions learn in two different stages. The first learning happens while working with controlled data sets and formulated base models. The second learning occurs on the go or periodically with the help of user interactions in the form of feedback.

A sophisticated AI system usually follows a two-stage learning mechanism, whereas a simple AI system may have only one formative stage. The two stages in which AI learns are:

- Training
- Feedback

The training stage is where you form basic machine learning models for the first time and train the system using these models. The accuracy of these models is highly dependent on the training dataset.

On the contrary, when you deploy the AI system, some (or all) data can be fed back to the system for continuous learning, which we term as feedback stage learning. This stage is relatively vulnerable to various ongoing risks.

Mainly because, no matter how accurate you developed your base models in the past,

new data (coming through feedback system) can cause these models to readjust. A lot would also depend on how the machine is learning in each stage.

AVOID THESE FIVE MISTAKES WHEN TRAINING YOUR AI

Meticulous teaching is the fundamental requirement for having an excellent performance consistently. However, there are a few mistakes to which traditional (and contemporary) data analytics or statistical methods are susceptible. Collective calling for such issues is often known as garbage in, garbage out.

1. Not having enough data to train

How much data does one need to train the AI system effectively? Well, it depends!

It's not the answer you would expect when you are at the pointy end of your machine learning stage. Nevertheless, it does depend on the complexity of your problem and the complexity of the algorithm you plan to use. Either way, the best way would be to use empirical investigation and arrive at an optimal number.

You may want to use standard sampling methods in the collection of required data and may wish to use standard sample size calculators as used in standard statistical analysis tools. However, due to the nature of machine learning algorithms, the amount of data is often insufficient. You would most likely need more than what a standard sample size calculation formula tells you.

Having more data may not be a big problem as having less data. You have to make sure that there is enough data to reasonably capture the relationship that might exist within input parameters (features) and between input and output.

You may also use your domain expertise to reasonably assess how much data is enough to exhibit a full cycle of your business problem. It should cover all the possible seasonality and variations.

The model developed with the help of this data will only be as good as the data you have or provide for training, so make sure that it is adequately available. If you feel that the data is not enough, which may be a rare scenario in the current Big Data world, don't rush and wait until you get enough of it.

2. Not cleaning and validating the dataset

Too much data is of no use if it is of poor quality. It could mean one or more of the following three things:

Data has noise. There is too much conflicting and misleading information. Confounding variables or parameters are present, and the essential variables are missing. Cleaning this type of data needs additional data points because the current set is unusable and hence not enough.

It is dirty data. Several values are missing (though parameters are available), or the data has inconsistencies, errors, and a mix of numerical or categorical values in the same column. This type of data needs careful manual cleaning by subject matter experts and may often need re-validation. Depending on resource availability, you may find it easier to obtain additional data instead of cleaning dirty data.

Inadequate or sparse data. It is a scenario where very few data points have actual values, and a significant part of the dataset is full of nulls or zeroes.

The type of issues present within the dataset is often not clear from the dataset itself, which is why I always recommend exploratory analysis and visualisation to be applied at the outset. Doing this first pass not only gives you a level of confidence in data quality but also tells you if there is something amiss.

Based on the visual representation, an interesting question would be—do you see what you expected to see?

If the answer is 'no,' then your data may be of poor quality and needs cleaning.

If the answer is 'yes,' it might be useful in finding some preliminary insights. This validation of the dataset is essential to proceed, and you should never miss it.

3. Not having enough spread in data

Having a large amount of data is not always a good thing unless it can represent all the possible use cases or scenarios. If the data is missing variety, it can lead to problems in future—you increase the chances of losing on low-frequency high-risk scenarios.

For traditional predictive analysis, there is a point of low returns as you obtain more and more data for training. Your data science team can often spot this point empirically.

However, since machine learning is an inductive process, your base model can only cover what it has seen in the data. So, if you miss on edge cases, these will not be supported by your model. It merely means your AI will fail when that scenario occurs. This is the only and the most crucial reason why your training data should have enough spread to represent the real population.

4. Ignoring near-misses and overrides

During initial training, it is hard to identify near-misses and disregarded data points. However, in a continuous learning loop with feedback, it becomes highly essential to pay close attention to near-misses, and human or machine overrides.

When you deploy your AI system for the first time, it has an only base model that governs the performance of an AI. However, as system operation continues, the feedback loop feeds live data, and the system starts to adjust, either live or regularly.

If the model has missed to correctly predict or calculate any output just by a bit and thereby the decision has changed, it would be a near-miss. For example, in case of a loan approval system, if 88.5 per cent score means 'loan approved' and 88.6 per cent results in 'loan declined,' this scenario is a near-miss.

From a technical and pure statistical point of view it is correct. However, from a real-life perspective, a margin of error may play a significant role. If contested by the affected party, such as loan applicants, chances of change in a decision are higher. Therefore these types of data points are of particular interest, and

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you should not ignore them.

The same applies when a human operator is supervising the AI system's output and can decide to override it. You must treat the human operator override as a special-case scenario, and feed it back to the training model. Each of these scenarios either highlights inadequacies in the base model or provides new situations that never existed before. Ignoring overrides can degrade the model performance over time.

5. Conflating correlation and causation

In statistics, we often say, "Correlation does not imply causation." It usually refers to the inability to legitimately deduce a cause and effect relationship between input variables and output. The resulting conclusion still may not be incorrect or false, but the failure to establish this relationship is often an indicator of the lurking problem.

On similar terms, the predictive power of your model does not necessarily imply that you have established an exact cause and effect relationship in your model. Your model may very well be conflating the correlation of input parameters and predicting output based on that.

You may think that "As long as it works, it shouldn't matter." However, the distinction matters since many machine learning algorithms pick upon parameters simply because there is a high correlation. Determining causality based on correlations can be very tricky and can potentially lead to contradictory conclusions. It would be much better to be able to prove that there truly is a causal relationship.

However, these days, developers and data scientists are merely relying on statistical patterns. Many of them fail to recognise that these patterns are only correlations amongst vast amounts of data rather than causative truths or natural laws, which govern the real world.

So, how do you deal with conflation?

Try this—during initial training and model building, soon after you find a correlation, don't conclude too quickly. Take time to find other underlying factors, find the hidden factors, and verify if these are correct and then only conclude.

The basis for trust

As technology is improving day by day, it is placing powerful tools in the hands of people who do not understand how these work. It is creating significant business as well as societal risks.

Developers and data scientists are increasingly getting detached from an understanding of intricacies of the tools they are using and systems they're creating.

The AI system means a black box is becoming a commonly accepted rhetoric, and the only sure-fire way to trust this black box is—training it meticulously and testing it rigorously! EFY

Green IT And Electronics: A Need Of The Hour

Green information technology (IT) aims at designing and manufacturing such communication devices and electronic products that are environment friendly and support energy conservation. This article covers various aspects of green IT, including key components and recent findings, to create a better understanding among people



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In the present digital era, we are surrounded by several electronic devices such as mobile phones, computers, tablets, laptops, and other e-gadgets that form major part of our lives. These devices have revolutionised the way we work, spend our free time, or communicate with each other. This digital transformation has been possible only due to huge contributions by researchers, engineers, and scientists.

However, there is a big question that needs to be answered. Are we really ready for these changes? Do these changes have a negative impact on our life? The major drawback that can be inferred from this digital transformation is huge power consumption and its implication on the environment. This particular drawback and its related effects have given rise to the concept of green computing, green IT or green electronics.

What is green IT?

Green information technology (IT) aims at minimising the negative intervention of IT operations or functionalities with the environment by designing, manufacturing, and using IT, electronics, or communication devices that are environment friendly and support energy conservation. Green IT not only deals with energy-saving or less power consumption but also focuses on e-waste reduction.

In 1992, this concept evolved when the US Environmental Protection Agency launched a voluntary labelling programme that helps organisations save money and reduce greenhouse gas emissions by identifying products that offer superior energy efficiency. Green computing is based on motives like conservation of energy and natural resources, reduction in usage of hazardous materials, recycling of e-waste,

promotion of biodegradability, virtualisation, and usage of energy-efficient products (Fig. 1).

Components of Green IT

There are certain key components that form the base of Green IT. These components are inclusive of technologies like cloud computing, virtualisation, green networking, and re-designing of data centres (Fig. 2).

The major components are described as follows:

Green data centres. The enormous amount of data generated every day needs to be stored and processed in huge data centres. Thousands of computing systems in these data centres are established with gigantic cooling infrastructures because these systems have high power consumption and generate a large amount of heat, thereby consuming enormous amount of energy per day. In fact, according to some sources, if we try to group all these data centres to form a single country, the country formed may stand fifth in the list of countries that consume most energy in the world.

And there is no doubt that these scaring figures are just going to get worse with time in coming years. Hence, it is quite important to devise new technologies that are much greener and based completely on different mechanisms.

It is estimated that there will be nearly ten times increase in data creation by 2025. But until and unless we bring in greener architectures, this would result in a huge generation of greenhouse gases and carbon footprints. The data centres would be considered green only when they fulfil the following paradigms:

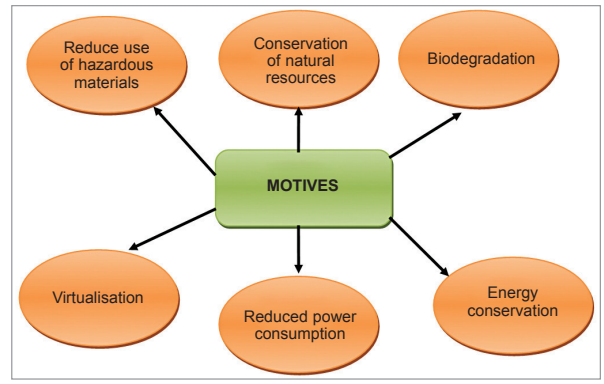


Fig. 1: Motives of green IT

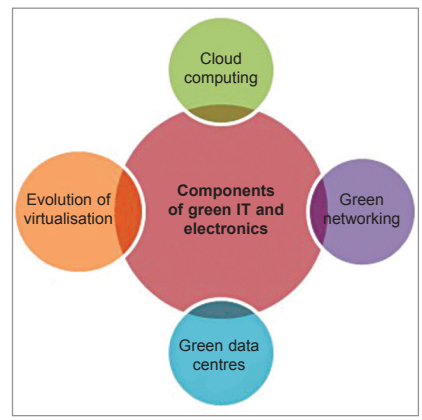


Fig. 2: Components of green IT

- Minimisation of carbon footprints of data centre buildings
- E-waste from these data centres is recycled
- Building material and paints produce less emission on heat generation
- Hybrid and electric vehicles are used at these data centres
- There is use of evaporative cooling, photovoltaic technology, and heat pumps

Innovation in the redesigning of data centres has begun in some countries. Companies like SuperMicro have introduced resource-saving architecture, which minimises e-waste, pollution, power consumption, and much more. Intel has come up with energy-efficient data centres that reduce power consumption.

Green networking. When we use green and energy-efficient devices in order to minimise resource utilisation in the branch of computer networking, it is called green networking. It deals with energy-efficient communication strategies with respect to the environment. For instance, we can utilise energy on the Internet by setting routers to sleep mode in low traffic periods and then utilise the same router for multiple purposes. The green networking can be practiced in the following terms:

- Reducing remote communication/video conferencing
- Making servers more strong and resilient
- Employing system management
- Using greener or energy-efficient products

Cloud computing. Cloud computing is one of the hottest trends in the IT market these days. It delivers on-demand computing services—from applications to storage and processing power—typically over the Internet and on a pay-as-you-go basis.

Evolution in cloud computing in



coming years will lead to the utmost resource utilisation by resource sharing. Instead of buying multiple systems for different operating systems, one can buy just one operating system (OS), set it up online on the cloud, and operate it liberally. This also helps in reducing the amount of e-waste generated.

Virtualisation. Virtualisation has come from its root word virtual, which means 'not real.' The concept of virtualisation puts forth a mirage of resources in front of IT users. The concept of virtualisation in system memory brings in the utilisation of memories and showing them to be much larger than these actually are. The same concept is used in cloud computing and other similar technologies.

A virtual box installed on a computer system can do wonders these days. One can buy resources online from vendors and install a virtual box, irrespective of its compatibility with the system and thereby enjoy all sorts of services. Virtualisation indeed is one of the most important pillars of green computing.

Green computing

To promote green computing concept, the following approaches are employed:

- Minimising energy consumption in an eco-friendly manner
- Safe disposal of e-waste
- Energy-efficient design of electronics and computer products
- Minimising waste during the manufacturing of computer hardware
- Using computers in power-saving modes when away
- Power management
- Re-use of electronics products

Green electronics. As we all know, electronics forms the base of IT. Green electronics is a way of emphasising on disposing of hazardous substances that come from electronic waste or e-waste by using eco-friendly techniques. The e-waste is nothing but the waste generated by electronic products like computers, mobile phones, television sets, cables, wires, batteries, etc. E-waste consists of elements like As, Cd, Pb, and Hg and compounds like plastics, CFCs, PVCs, etc, that are hazardous.

The ewastes are usually disposed of by burning. The whole process is subject to a lot of emissions, which makes the environment poisonous and unfit, inviting unwanted acid rain, global warming, and other environmental concerns.

According to Green Electronics Council (GEC), the modern-world IT contributes a lot to e-waste due to invention and production of IT products made up of toxic substances. The EPEAT, or Electronic Product Environmental Assessment Tool, launched by GEC, ensures that only sustainable IT products are designed, manufactured, and purchased. GEC ensures that both manufacturers and large scale purchasers:

- Understand the problems faced due to e-waste
- Commit to address those challenges, and
- Act wisely to modify the operational and procurement processes with regards to the manufacturing of products by sticking to EPEAT standards

EPEAT is the leading global eco-label of the IT sector. National governments, including the United States and thousands of private and public institutional purchasers around the world, use EPEAT as part of their sustainable procurement decisions.

Green startups

Many companies have come up recently with their focus on environmental protection. Some of these are:

Attero Recycling. Started in 2008 in Noida, Attero Recycling is one of the few companies in the world working on proper e-waste management.

Ather Energy. It is a Bengaluru based EV startup that manufactures its own e-scooters and offers charging infrastructure through the 'Ather Grid.'

Yulu. It is a Bengaluru based startup that aims to prevent traffic congestion and air pollution by manufacturing a number of bicycles and lightweight electric two-wheelers governed by technologies like artificial intelligence (AI), machine learning (ML), and the Internet of Things (IoT).

Ultraviolette. Ultraviolette has recently launched an electric motorcycle powered by modular battery technology, with a self-sustaining advanced and powerful electronic device.

Role of AI and IoT

- A good and efficient amalgamation of hardware and software used to set up AI and IoT systems comparatively reduces the amount of e-waste generation.
- Technologies like these can be exploited to build systems to monitor hardware.
- Using systems like these assist in reducing a lot of carbon footprints.
- AI and IoT systems can be set up with a perspective to reduce air pollution. AI governed systems like these can identify the source of pollution while incinerating e-waste with the help of smart sensors, so that remedial measures can be applied efficiently.

Recent findings and initiatives on green IT and electronics

Many researchers worldwide are investigating various areas in order to find some ways of altering architectures of these IT devices to bring in energy-efficient methods of computation, communication, or data transfer. Analio Fernandez and his fellow researchers at Cambridge University have tried to investigate the same by using nanotechnology and magnetisation. IT revolution has been possible due to the development of miniature integrated circuits (ICs) that are based on millions of transistors, which are, in turn, formed on silicon chips.

These light but powerful devices are reasons for high amounts of processing in any electronic device, but this leads to high power consumption as well. These silicon chips, which form a major part of computers, are nano-metric in size. The bits of information are stored in the form of an electrical charge in capacitors. Computation bits keep moving from memory to processors and again move back to memory after processing.

As we are wasting a lot of energy in continuous energy supply and movement of bits back and forth between memory and processor, current computing architectures need to be more efficient.

Hence, researchers have come up with the idea of using magnetic nanostructures for green computation. Special attention is given to the magnetic nanowires, which are several

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microns long and have a nano-metric diameter. Since these are long enough, bits in large numbers can be stored in the form of packages. These bits can then be moved as packages with a small amount of electrical energy, as these wires are already magnetic and do not need continuous energy supply. Hence, this idea makes computations greener and efficient.

Researchers from Cambridge and collaborators from the US and Spain are investigating three-dimensional nano-fabrication of silicon chips using electron microscopes, which are one of the most versatile tools in nanotechnology. The purpose of this investigation is to bring a radical change by increasing the storage capacity of silicon chips through 3D fabrication. The usual chips are fabricated in a plane, that is, these are two dimensional and hence have less storage capacity.

These researchers from Cambridge have tried to combine electron microscopic processes (electron emissions) with gases in order to use these microscopes as 3D nano printers for the purpose of 3D fabrication. The same group is investigating the properties of nanomagnetic wires for computations, but they are facing a couple of challenges. First, the materials needed must be of good quality for better data flow. Second, 2D nanostructures have limited memory storage capacity. Still, researches and works like these are undoubtedly the stepping stones in the field of green computing and need major attention.

In India, the Ministry of Electronics and Information Technology (MeitY) has sponsored mega facility on nanoelectronics led by IIT Bombay and IISc, called the Centre of Excellence in Nano-electronics (CEN). They work on nanofabrication and development of devices for low power consumption, energy-saving, nano-biosensing, and communication in the domain of healthcare, communication, agriculture, and IT.

More than 37 projects have been completed as of now. A few more projects have been sponsored by DST, DRDO, and other agencies in India on green IT and electronics.

MeitY has also sponsored the Indian Nanoelectronics User Programme (INUP) and Nanoelectronics Network for Research and Applications (NNetRA) to support various activities of green IT and electronics in India.

India has shown quite a positive response towards green IT and electronics. It has already become one of the major concerns for investors, manufacturers, policymakers, and other stakeholders to adopt green IT methodologies and upgrade the existing infrastructure in related companies across India and make it energy-efficient. The achievements of the Indian government, with respect to green IT and computing in India, are as follows:

1. The government of India included green IT in 12th Five-Year Plan with a few guidelines for IT and telecom industries in India such as:

(a) Standardisation for electronic goods and products with energy consumption as a technical standard.

(b) Setting up a centre of excellence in top technological institutes and universities, which is responsible for developing and certifying the prototypes and end products.

(c) Tax incentives to those who adopt greener technologies.

(d) All the carbon footprints released in network-related operations would have to be declared to TRAI.

(e) Service providers were supposed to aim their carbon emission reduction targets for the mobile network at 17.5 per cent by the year 2018-19.

2. Global ICT Standardisation Forum for India was introduced in order to focus on the development of ICT (Information and Communication Technology) and bridge Indian achievements globally.

3. The smart meters deployment initiation by Tata Power Delhi Distribution Limited and BSES substantially reduced revenue loss incurred through AT&C losses.

4. Advanced metering infrastructure, distribution automation, and distributed energy resources, which form an integrated set up of ICT, yield a lot of benefits with respect to power consumption.

5. AI induced ICT tools that add on to green IT applications (like sensors, smart meters, GIS, and SCADA) enable quick identification, prediction, and prevention of expected problems such as air pollution, burst water leaks, non-transparent billing, contamination checks, etc.

Conclusion

It is quite exciting that we can get really close to green computing and electronics with devices in our hands, which are based on greener technologies, processors, and memories designed with smart architectures. Green IT would make these devices less dependent on energy and hence help save energy for the betterment of environmental sustainability.

Moreover, this would not only reduce the amount of e-waste but also help save natural resources like water, which is used as a coolant in data centres. However, there is still a long way to go, and we all need to be conscious about energy and environmental concerns as well. EFY

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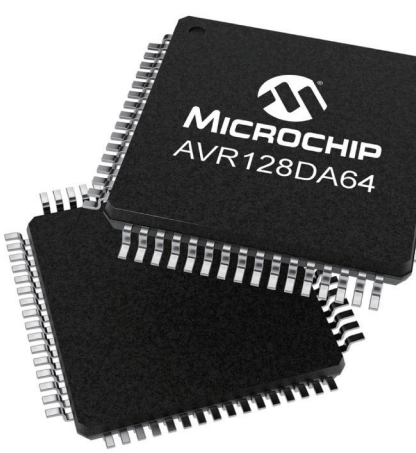


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Digital Transformation: A Must To Be Smart, Smarter, Smartest

While there are different methods to be adopted for a digital-savvy enterprise, how digital transformation can be used to develop a bankable innovation is discussed in this article



Sreenath C. Lakshmanan
is founder and CEO at i4DigitalValue

During this challenging time of post-pandemic, in order to add value to their customers, the electronics industry needs to turn 'smartest' with accelerated digital transformation, which in today's world is a must.

With the Internet of Things (IoT), cloud, artificial intelligence (AI), mobility, 5G, Wi-Fi 6 and Big Data analytics coming together, the end result is that 'smart has to be smarter' and 'smarter has to be smartest' while navigating through change management and achieving success by beating competition during this challenging time.

While there are many processes and technologies available to adopt and leverage, it is important to know which one is suitable to provide commercial value to organisations and customers.

According to a report by IDC, businesses are expected to spend 2.3 trillion dollars a year on digital transformation within the next four years, with worldwide digital transformation technology investment expected to hit at least 7.4 trillion dollars over the next four years.

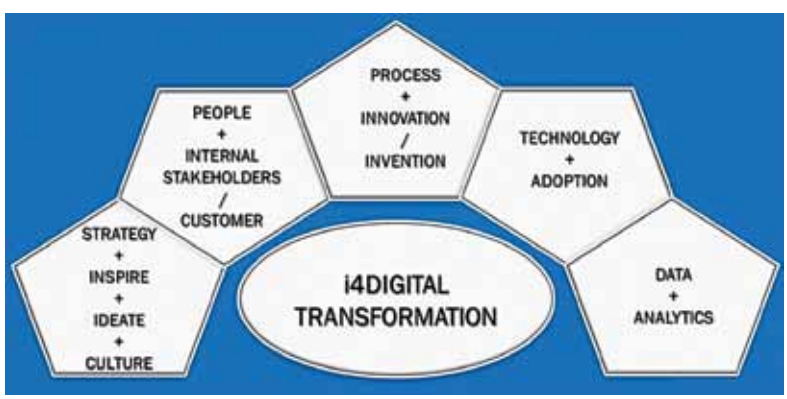


Fig. 1: Simplified diagram on digital transformation. The above model is based on practical experience and has been developed for successful digital transformation journey

Digital transformation avoids disruptions and helps cater to changing market and business needs for enterprises to stay ahead of the competition.

Digital transformation is a process used for integrating digital technology and leveraging various technologies involving cultural change, creating new business opportunities, enhancing customer experience, and increasing operational agility. It is very important to focus on the insights when digital transformation is adopted. In today's era, the entire globe of digital transformation is driving three innovations—IoT, AI, and Big Data analytics.

IoT can be defined as digital transformation technology, or a set of technologies and components, enabling digital transformation. The biggest input IoT provides is tons and tons of data that needs to be managed and is a great fuel for digital transformation.

This article focuses on IoT and digital transformation with a touch of design thinking as this combination is highly successful in developing a bankable innovation.

Digital transformation for IoT.

- IDC forecasts that worldwide spending on IoT is expected to reach one trillion dollars mark in 2022.
- New IDC report mentions that IoT spending in Asia/Pacific (excluding Japan) is expected to reach 398.6 billion dollars by 2023.
- Experts have predicted that people around the globe will have up to 75 billion IoT connected devices by 2025.

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The queries to be answered are.

- With every company launching a new IoT product/service, will they succeed? If they focus only on technology, is it enough because they might struggle?
- Do they require a bankable innovation?
- Do they need to solve an existing problem first as IoT does not escape the basics of good product/service design?



Fig. 2: Inputs on the strategy (types of transformation, strategy objective, strategic culture and emotional quotient)

While there are different methods to be adopted for a digital-savvy enterprise, how digital transformation can be used to develop a bankable innovation is discussed in this article.

While digital transformation is in itself a very big topic, in simple terms, it focuses on strategy, culture, people, process, technology, and data analytics.

1. Strategy to develop a bankable innovation. Strategic goals are the key to success in this digital era for the IoT Industry. It is important to get inspired and believe in the change by ideating. In order to develop a bankable innovation for digital transformation, it's crucial to have senior leadership buy-in, prepare for a cultural change, and get inspired to believe in the innovation that has been developed. It is important to focus on the following strategy for the success of your digital journey:

- What do we want to achieve with this bankable innovation?
- Why do we need to transform?
- How can we transform?
- Do we have clear key performance indicators for innovation?
- Do we need to create a roadmap?
- Do we need to have SOP and review?
- How to make sure that all stakeholders have regular access to the information?

Customers need to adopt the right technology, enabling risk-free digital success with measurable ROI.

Based on multiple discussions, the team decides on the bankable innovation—a usable and valuable commercial opportunity to develop a device that can beat the competition and, at the same time, align to the organisation's needs, customers' needs, and market needs.

2. People to be leveraged for bankable innovation. This section discusses the people who need to:

- Be ready for change to develop a bankable innovation
- Understand the mission and vision of digital transformation
- Use proven industry principles like design thinking.
- Get motivated
- Be ready for behaviour change
- Get inspired to innovate and invent
- Include digital thinking in process
- Empower their team

It is always recommended to have a strong and aligned HR team to lead the people in the area of digital transformation. The HR team itself transforms by using digital technologies like automation. This transformed HR team sets an example for the rest of the organisation.

The team further develops balanced transformation teams as per the devised planning in strategising, developing, scaling, and marketing the bankable innovation. One of the critical areas in this section is brain-

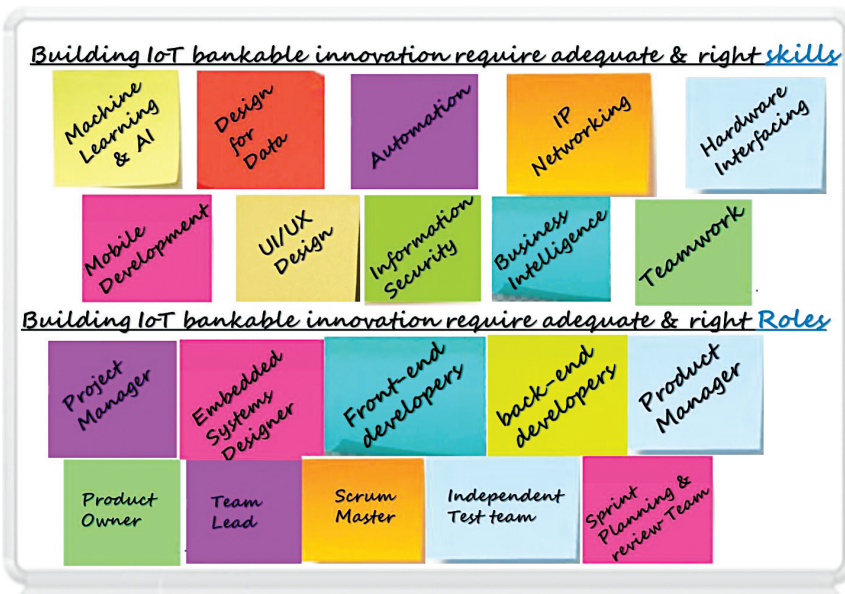


Fig. 3: Inputs on right skills and roles required to develop the bankable innovation

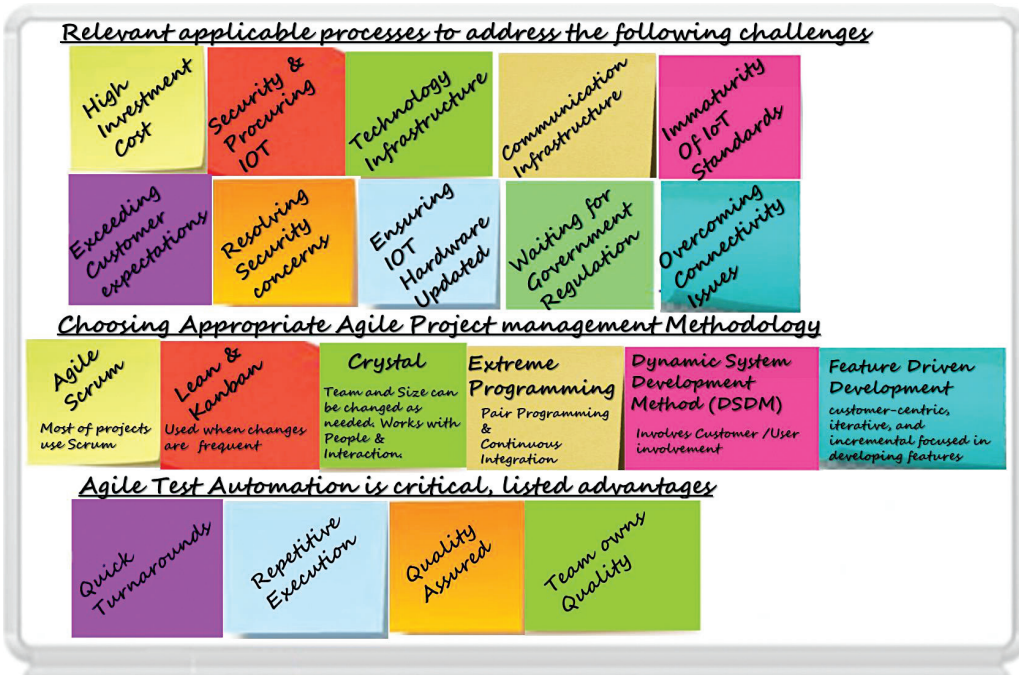


Fig. 4: Inputs on challenges/risks brainstormed to address the relevant process and solutions/mitigation plans to develop the bankable innovation

storming for the right skills and roles to develop the bankable innovation.

3. Process to be adopted for bankable innovation. To enhance productivity and successful digital transformation, it is important to list out processes or techniques that would be more efficient.

A process includes loading and execution of IoT task and checking outcomes upon completion of these tasks. Implementing these processes is the next step where there may be innovation and even invention involved.

To address complex digital transformation, several processes are required to develop a bankable innovation (refer Fig. 4).

While the above figure is only an example, digital transformation covers a huge number of processes, which include business processes (BP), BP optimisation, and BP automation. The process of sensor applications is discussed and defined.

Two examples: Smoke sensors are used in industrial IoT solutions to report even the slightest leakage or a minor occurrence of fire. Multiple sensors can monitor multiple pollution levels in the air or water in a connected city.

We all understand that these sensors/devices communicate with the cloud using the defined connectivity and perform an action by sending alerts, and whenever the critical levels are reached with data analysis over a period of time, exception handling processes are introduced.

4. Technology to be leveraged for bankable innovation. IoT technology stack connects physical and digital worlds, and the primary function is to collect data and process it. The device's software includes operating systems and applications to process the data. Technology should support the IoT reference model that includes:

- Physical layer like devices and controllers
- Integration layer like connectivity, data element analysis, data storage, data processing, reporting, analytics, and control
- Business process layer that manages the business alignment

The combination of AI with IoT is an important focus area to discuss the bankable innovation for automation and control of devices.

It is recommended that artificial intelligence of things (AIoT) should be used because when AI combines with IoT, a powerful bankable innovation can be developed for decision making or problem-solving. But risks need to be considered due to huge data from IoT and security reasons.

Another technology, IoT DaaS (IoT Big Data as a service), is growing nearly three times as fast as non-IoT DaaS. While cloud computing and IoT platforms are growing, edge computing and analytics are yet to be explored for maximum benefits.

5. Data analytics to improve

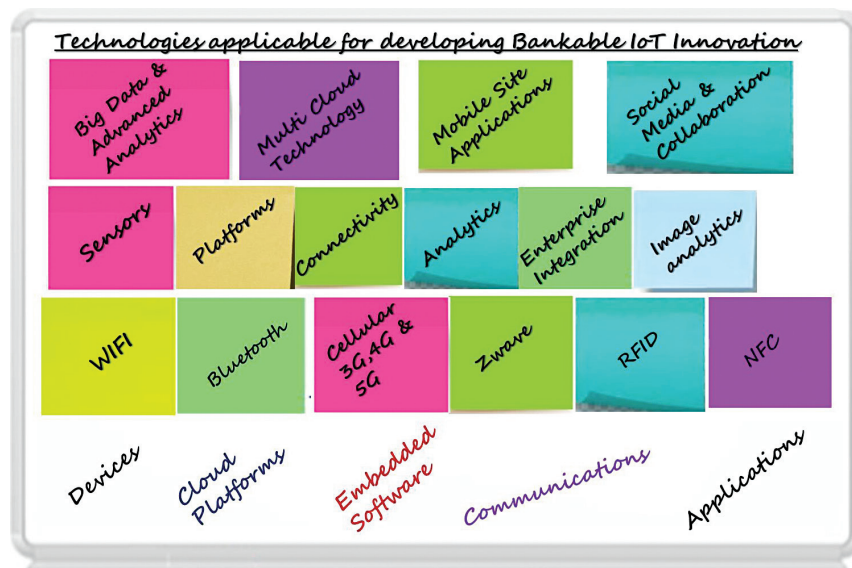


Fig. 5: Technologies used for developing a bankable innovation

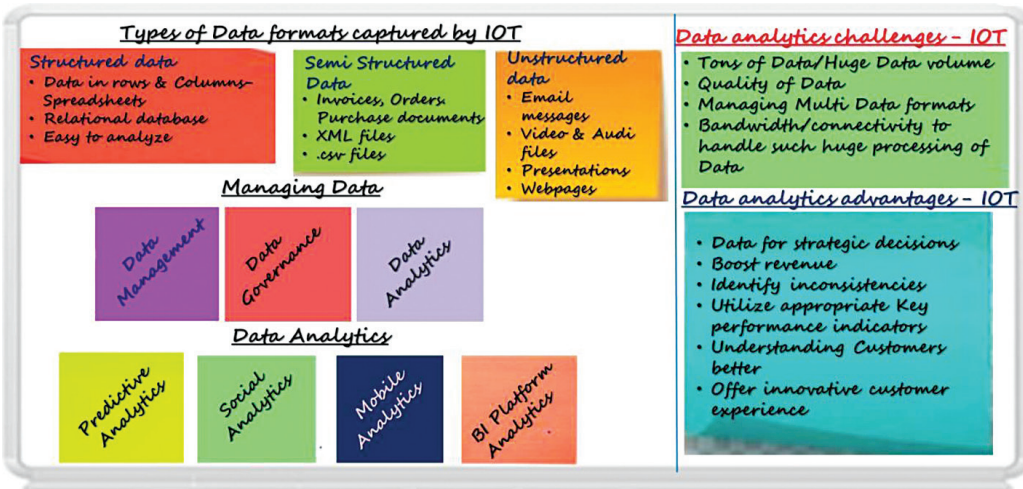


Fig. 6: Data analytics is becoming popular to improve productivity of the business and develop a bankable innovation

productivity and make the right business decision for bankable innovation. We all know that IoT connected devices result in massive data that needs to be managed. Research shows that around 62 per cent organisations are using advanced analytics in new areas, 65 per cent organisations are using data from new sources, and 64 per cent organisations are using new analytics techniques.

Eighty five per cent of the world data today is unstructured, and ninety per cent of the world data was created in the last three years.

The success of any IoT digital transformation depends on how efficient your systems are in capturing, organising, and maintaining analytics with huge terra bytes of data. The combination of AI with ML is being adopted by companies to achieve excellent customer experience with valuable business information to improve business decisions and enhance productivity.

It's important to have an efficient and workable data analytics strategy to ensure that multi-structured, less reliable, merely processed, and real-time data is efficiently managed. It is also important to ensure that there is efficient data security as a recent study says that around 88 per cent of the companies conducting IoT Analytics see data security as an important challenge.

6. How to understand customers using customer journey mapping? In order to solve one of the existing problems in IoT digital transformation, I would like to explain the methodology using the design thinking principle.

Design thinking can be explained as a human-centered collaborative design process with out-of-box solutions to unpack problems and successfully navigate to face disruption and re-envision the enterprises' digital business journey.

There is an approach of brainstorming, brain dumping, brainwriting, brain walking, and recording the findings, as shown in Fig. 2 to Fig. 6.

In order to simplify the article, I have considered a problem statement for the digital transformation IoT use case, which is solved using some of the design thinking techniques.

7. Developing the right skills and

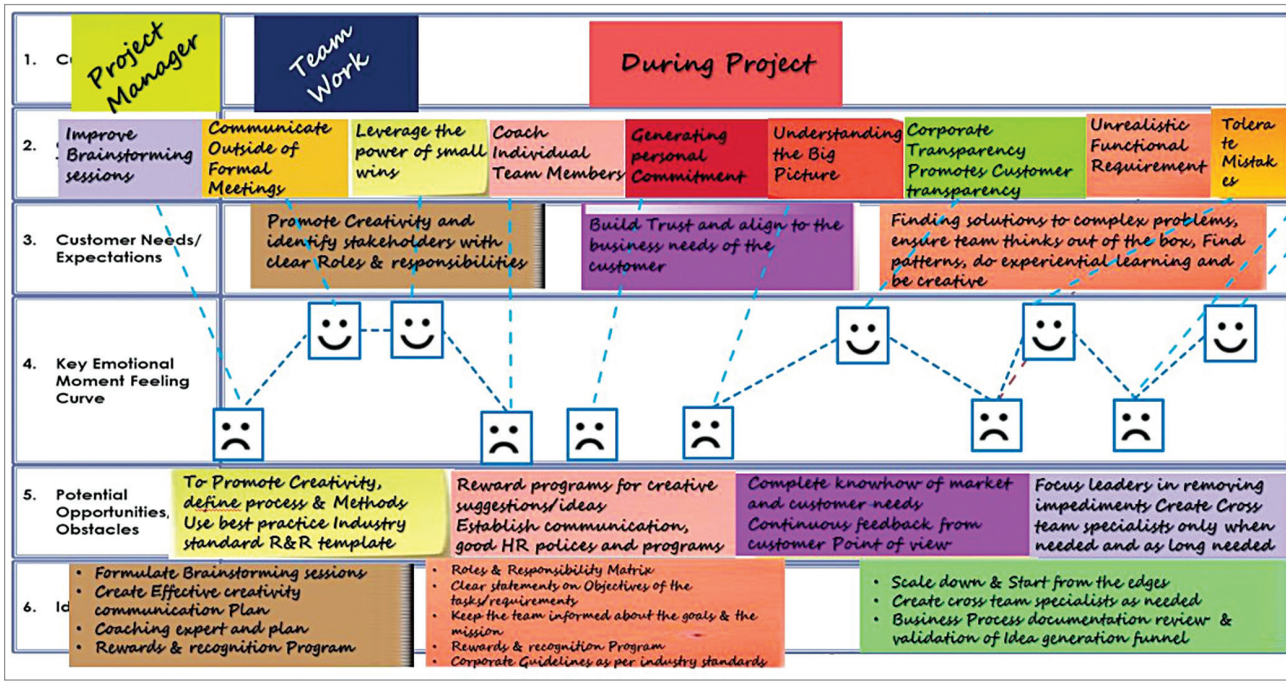


Fig. 7: Customer journey mapping for 'project manager' in developing right skills and successful teamwork for building a bankable IoT innovation

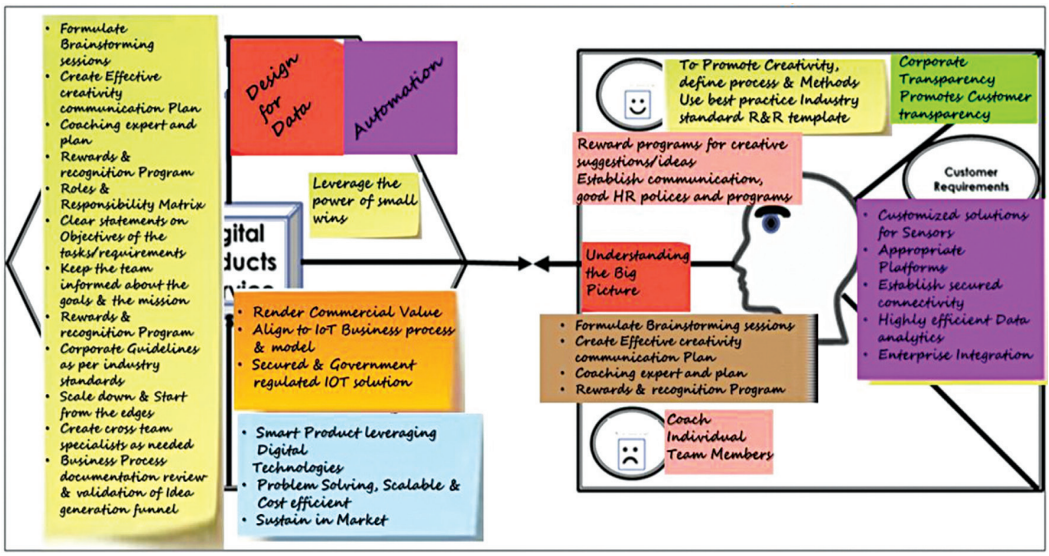


Fig. 8: Final value proposition is developed for the IoT bankable innovation

successful teamwork for building bankable IoT innovation. In order to resolve the above problem, the project manager undergoes the process of:

Problem definition and mapping. Getting deep dive into the problem

Empathy. Getting into the shoes of the customer

Ideate. Brainstorming empathy findings and drawing a customer journey map

Customer journey map is used to visually represent the experience and emotions of customers at every step. We can tell the story of experience by looking into customer touchpoints, needs/expectations, emotional feelings, potential opportunities/obstacles, and finally listing ideas/solutions.

8. Value proposition for bankable innovation. The value developed by the IoT bankable innovation is the result of all the activities of strategy, people, process, technology and data analytics, wherein the problem to be solved is looked through design thinking, empathy, ideating, prototyping and testing with further business/marketing strategy development, product development, and commercialisation after testing in the market.

In conclusion, the above processes can be applied to all the use cases for any new or expandable innovations in IoT space. EFY

Disclaimer. The views and content in this article are the author's personal and based on some references.



How Testing Of Satellites Has Evolved Over The Years

A satellite has to operate in very harsh conditions after launch. Also, building a good satellite requires billions of dollars. Therefore it's crucial to test each satellite properly before it enters space to ensure good performance and safety. This article covers the various types of satellites testing and challenges that may occur during the process



Radio Check-Out Equipment (RF SCOE) (Credit: https://atos.net)



Vinayak Ramachandra Adkoli is BE in industrial production. He has been a lecturer in mechanical department for ten years in three different polytechnics. He is also a freelance writer and cartoonist

Satellites, one of the long-existing inventions, are exhibiting their muscular and exuberant strength in the right way. For years, satellites have been providing services like navigation, communication, remote sensing, surveillance, earth observations, etc. Since satellites face lots of hazards in space during their operation, efficient technological standards are required to design them.

Today, most of the people depend on satellites in one way or the other, from GPS-based vehicles to weather forecasting to many other things in their lives. Currently, there are almost 1,500 active satellites in orbit around Earth.

Building a good satellite is not cheap. Government or private companies spend millions or even billions of dollars a year on satellites, and it would result in a heavy loss if a satellite fails during or following launch. So, tests and measurements play an important role in the case of satellites.

Tests and measurements are required for components of satellites manufactured for sub-systems and final assembly. Evaluating the performance of satellites is essential even on the ground station terminal. Such smart test and measurement solutions ensure good performance and reliable safety and security on every stage during a satellite launch.

Inside the world of satellite testing

Extreme vibrations and high acoustic levels exist during satellite launch. Further, a satellite has to operate in very harsh conditions after launch. It has to function in a vacuum while handling high levels of electromagnetic radiation and fluctuation in temperatures.

Companies like NTS maintain a network of facilities across the US to conduct necessary tests to analyse how a satellite responds to a vacuum of space or extreme changes in temperature.

More tests are required for vibration, solar radiation, dealing with the dust of space, or pyroshock, which might occur during the booster separation stage or satellite separation stage from exploding bolts. Sometimes explosive shock might also occur during the booster separation stage. This can even damage circuits,

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lodge contaminants into satellites, or short circuit electrical components.

Other elements of a satellite that need testing during its construction, design, and payload include:

- Solar panels
- Antennas
- Batteries
- Electrical circuits
- Centre of gravity and mass measurements
- Information transmitting systems from satellite to the ground station
- Fuel cells

Currently, NASA and other private companies are trying to build smaller vehicles that would be capable of repairing satellites. NASA is also working on ideas that would help assemble satellites in space itself.

The satellite's assembly team is the first group to test it. Next, a quality control team conducts a separate series of tests. The team often repeats many of these tests to gather enough data to decide whether or not the satellite is fit to go into orbit.

Testing has to be carried out in a clean room. Scientists and engineers involved in testing can be usually seen wearing a white suit. A clean room or environment is an integral part of satellite testing because one tiny outside contaminant can produce a drastic effect on a satellite.

The two major satellite tests are as follows:

Antenna deployment test. The uplink/downlink commands and telemetry data are established once the satellite antenna is perfectly deployed in space. So, for establishing reliable communication between the ground control station and satellite, this test is essential.

Subsystem testing. It involves activities such as battery voltage and bus voltage testing, primary and secondary battery voltage testing, solar panel voltage testing, actuator and sensor testing, momentum wheel testing, magnetic voltage testing, sun sensor testing, etc.

Testing story of GOES-S

National Ocean and Atmospheric Administration tested its Geostationary Operational Environmental Satellite-S (GOES-S), a weather satellite, in March 2017. As a part of testing, the team had placed GOES-S in a thermal vacuum chamber to determine its ability to operate in the extreme cold conditions of space.



The United Launch Alliance Atlas V rocket stands ready for liftoff with NOAA's GOES-S satellite on Space Launch Complex 41 at Cape Canaveral Air Force Station in Florida (Credit: NASA)

The vacuum chamber tested the satellite across four different cycles that ranged from intense cold to intense heat. Severe temperature fluctuations in the airless chamber gave scientists a chance to check how well the satellite's sensitive instruments perform in these harsh conditions. Scientists had also tested GOES-S thrusters, which helped orient its orbit after its launch vehicle released it.

During testing, a satellite's exact centre of gravity and mass are also measured. This ensures that the satellite is compatible with its launch vehicle. It also helps control the orientation when the satellite is in orbit. This even helps to know how long it will operate in space.

Has the time come for fully automated testing of satellites?

Let's take the example of Electrical Ground Support Equipment (EGSE) satellite testing solution developed by Atos, a French-based MNC. It makes sure that satellites are ready to launch and work perfectly. The Radio Check-Out Equipment (RF SCOE) is the industry-standard solution to test radio frequency subsystems of a satellite with the highest degree of precision. The payload EGSE is highly flexible as it tests the instruments of navigation, earth observation, and telecom satellites. Finally, the power SCOE ensures that the satellite's vital power supply works reliably under all space conditions.

The RF SCOE performs fully automated S, X, Ku, and Ka-band measurements in the Telemetry, Tracking and Command (TT&C) section of the satellite during assembly of spacecraft and space environment testing at the test centre facility. It does the same in the L, S, Ku, Ka, and UHF bands for the mission communication and payload section.

The payload EGSE allows the fully automated execution of calibrations and tests, and it easily integrates with heterogeneous components from different providers and suppliers. Further, all test sequences and procedures are defined in the open source language TCL and can therefore be easily tailored and extended to the best-fit requirements of the satellite owner.

Key parameters seem to be on the rise

Thousands of satellites will be launched over the next decade to provide global Internet coverage, mobile telecommunications, earth observation analytics, and space-based Internet of Things (IoT) for real-time monitoring of assets. Testing the characters of microwave performance of antennas of such satellites is a major part of testing. Measuring group delays with unknown or unstable local oscillators and TVAC drifts are also an important

part of satellite testing.

Modern computer-controlled test equipment also plays a crucial role in modern satellite testing. Detailed knowledge of antennas, microwave, RF, IF, and baseband engineering is essentially required for satellite test engineers. Further, testing techniques of many laboratories are significantly modified by taking into account factors such as rapid spacecraft temperature changes, doppler shift, propagation fluctuations, and signal propagation delay.



ISRO Spacecraft Integration Test Establishment (ISITE), Bengaluru (Credit: www.isro.gov.in)

Small satellites stay at low earth or medium earth orbit and have life expectancies from several weeks to four years or more. The testing of such satellites helps both financially and physically. Space simulation testing is another part of satellite testing. In this, advanced chambers are used to imitate space temperature, pressure, and humidity.

A single satellite can have dozens to hundreds of spot beams. For example, the Inmarsat GEO I-4 satellite has 200 narrow spot beams. Spot beams allow satellites to transmit different data signals using the same frequency. Spot beams greatly increase the complexity of design, test, and calibration of antennas. Smaller spot beams increase antenna size. For addressing the wideband needs of satellite testing, PXA and UXA signal analysers and oscilloscopes can be used.

During testing, the satellite's electromagnetic emission capability needs to be measured. A planar near-field scanner is also required for measuring the performance of antennas used for communication.

Challenges in establishing satellite test centres among different nations for space reforms

ESTEC Test Center in Noordwijk, the Netherlands, is the largest satellite test centre in Europe. STFC RAL Space has been awarded £99 million from the UK government's industrial strategy challenge fund to develop National Satellite Test Facility (NSTF).

At NASA's Goddard Space Flight Centre, a 3.1m × 4.9m robot is busy testing satellites on Earth before it is put to use in space. A six-legged hexapod robot was built by Mikrolar, a New Hampshire-based company.

University of Illinois' premiere space design and testing workspace laboratory supports students, faculty, and other customers to utilise small satellite resources to design, develop, and test satellites. The laboratory is equipped with a clean room, thermal vacuum chamber, vacuum oven, sun simulator, earth orbital magnetic simulator, and range of mechanical and electrical diagnostic equipment. Multiple forms of rapid prototyping design and simulation facilities are also provided.

Satellite Integration and Testing Establishment (SITE) of ISRO was established in 2006. It can integrate and test six satellites of INSAT class at different stages simultaneously. The facility has also carried out vibration and acoustic tests of Mars Orbiter Mission (MOM) spacecraft.



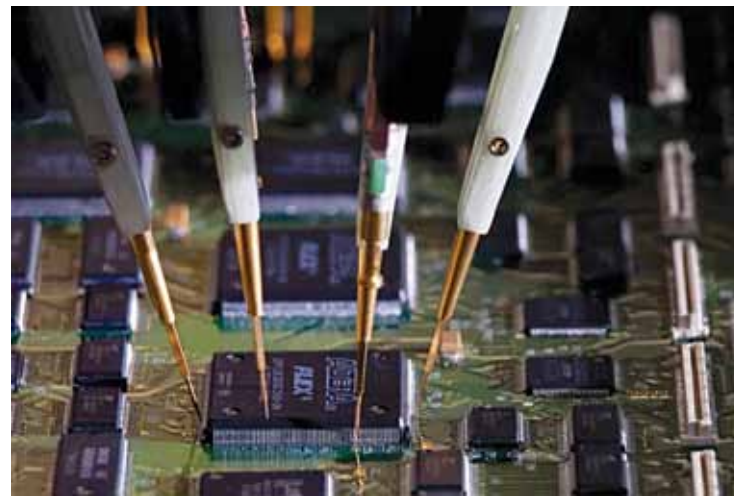
ESTEC Test Center in Noordwijk, the Netherlands, is the largest satellite test centre in Europe (Credit: www.esa.int)

Moving forward

Technological evolution is immensely supporting the satellite testing sector equally. Emerging technologies such as robotics, artificial intelligence, etc, are becoming the fastest drivers of growth and improvements in satellite testing. Opportunities are emerging in the design, manufacturing, and testing of satellites. India has completed a successful decade in satellite testing, and in the coming years, more growth and advancements can be seen in the country's space world. EFY

How To Build An Automated Test Jig To Check PCBs

Printed circuit board testing is an important task for test engineers. However, with increase in complexity of the circuit, it has become difficult to test it. So, nowadays, most of the industries are using a fully automatic test jig that can run the test and make an automated test report



(Credit: https://i1.wp.com/www.onethesis.com)



Sachin Kudari
works as test system designer for a private company

Printed circuit board (PCB) testing is an inevitable task for test engineers. With PCB size becoming smaller and complexity of the circuit increasing, it has become difficult for engineers to perform testing. With a large number of PCBs to test, keeping records manually is not possible. Moreover, sharing all documents is also a difficult task as, generally, testing is not done by original equipment manufacturers (OEMs).

One solution that most of the industries are now using is a simple bed of nails test jig in which a test engineer has to select the switches manually and note down the test point values. But doing things manually can cause errors.

So, the solution to the above problem is to use a fully automatic test jig that can run the test and make an automated test report.

To build an automated test jig use a bed of nails test jig and connect all test points of the device under test (DUT) to the data acquisition board (DAQ). This process will acquire all test points as per the test specified, apply some pass-fail criteria, and finally give a report. DAQ board can be fitted inside the test jig.

The DAQ board runs using an automated software like LabVIEW or Visual Basic. It can be customised as per requirements, or a standard DAQ from the market can be used.

Data for test jig manufacture

The data required for manufacturing test jigs are as follows:

- Gerber files of the device under test
- List of test points and their positions. Normally, through-hole test points are used, but in some cases, SMD points can also be taken
- DAQ board size with connectivity drawings
- Any other PCBs required for testing DUT
- Cables coming in or out of the jig
- Power supply for DUT
- Connectors for the test jig

Automated software

There are other software as well for automating the test, but the most commonly used software programs are LabVIEW and Visual Basic.

LabVIEW. It is a software made by NI, formerly known as National Instruments Corporation. It uses a graphical programming language. With some knowledge, it

can be used for automating tests and generating test reports.

Visual Basic. It is a very old programming language used by engineers. With some knowledge and experience, one can easily automate the tests.

Normally, software architecture has three main steps:

Initialisation. In this, all logic for power-up and configuration are done

Testing. In this, all sequences of the test can be done

Clean up. In this, all shutdown logic can be implemented

Test reports

The test report is the most important part of the test. Reports should be easy to read and transfer to concerned people.

Normally used format is .csv or xls. The advantage is that it is very easy to create, and most software can read it like Excel and Open Office. The disadvantage is that format may change while importing the files. This can be solved by some delimiters, but for large data, it is a very difficult and time-consuming task.

Another format is HTML, which is useful in making a colourful report. Pass and fail tests can be easily marked for the user. Also, HTML files can be viewed on a normal browser, which is a great advantage for some.

PDF is also one of the most popular formats used for test reports. Making reports in PDF may require some plug-ins, which depends upon the test software.

Data storage

Storing the data is the last stage of the test, which is not taken care of by many users. Test data can be stored directly in some folders or a database.

The advantage of storing test data in a database is that it cannot be easily deleted, and only an authorised person can access it. One more advantage of storing the data in a database is that one can analyse the stored test data for debugging.

Cost

Finally, whether to go for automated testing or not depends on the number of DUT to be tested in a day or month. For example, if you have more than thirty DUT to test in a day, it is a good criterion to go for automated tests.

The cost of an automated test jig depends on many factors like the number of test points, the complexity of the test, and the size of DUT. The cost can be divided into mechanical structure, DAQ board design, and software design. Normally, for a board with thirty test points, the cost can go up to ₹ 50,000.

Time and training for users

The time required for testing thirty test points test jigs would not be more than five minutes. However, complex tests require more time.

Extensive training is not required as the user will only monitor the test. In some cases, basic training for DUT and automation software application usage is required.

Conclusion

More and more electronic industries are shifting to automated tests from manual tests. This saves time and resources like multimetres, function generators, and oscilloscopes. Design teams can focus only on the design part. Some EMS vendors also support test jigs. EFY

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Ten Humanoid Robots Likely To Revolutionise The Robotics Industry

Creating a human-like or humanoid robot is difficult because it is quite a complex process. And yet, people continue to develop humanoid robots because these are used in numerous applications such as personal assistance, scientific research, entertainment, hospitals, etc. This article covers ten humanoid robots that would potentially revolutionise the robotics industry

Sani Theo



Fig. 1: Geminoids (www.geminoid.jp)

You might have come across the article "The man who made a copy of himself" in various media publications. As per the article, a Japanese roboticist named Hiroshi Ishiguro is building androids to understand humans—starting with himself. For this project, he has built Geminoid robots that very closely resemble specific human models. The goal is to study various aspects of engineering, cognitive science, and neuroscience to investigate research topics. These could be useful for research on how people interact with artificial intelligence (AI) robots and what differentiates people from the machine.

Creating a human-like or humanoid robot is difficult because it is quite complex, and a lot of research work is required. And yet, people continue to develop humanoid robots because these are used in numerous applications such as personal assistance, scientific research, entertainment, education, automotive manufacturing line, hospitals, and greeting guests and visitors. First-grade sensors and actuators, computing power, programming, etc, are very important in building a humanoid robot, and a small mistake could result in a simple to major glitches. Almost all modern humanoid robots employ some form of artificial intelligence (AI) technology. Therefore high R&D investments and high cost are major factors for the growth of the humanoid robot market.

As per a report by Global Market Insights, humanoid robot global market size is expected to grow at a CAGR of over 35 per cent from 2017 to 2024. The global

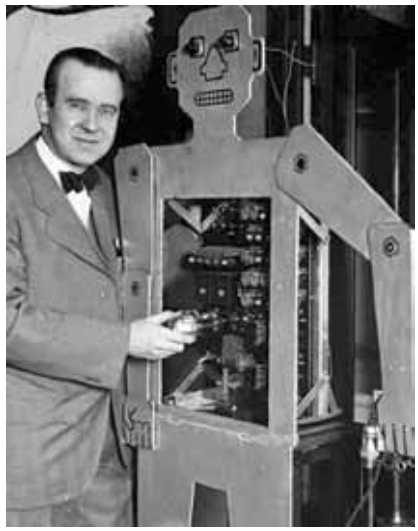


Fig. 2: Herbert Televox humanoid robot (Credit: www.lucarobotics.com)



Fig. 3: Pepper robot (Credit: www.softbankrobotics.com)

shipments are expected to reach one million units by 2024.

In another report by Research Dive, the global humanoid robot market is expected to reach 9,630 million dollars by 2026 at a CAGR of 36.4 per cent, increasing from 803.7 million dollars in 2018. The global market has been dominated by the North America region and is projected to account for 3,052.7 million dollars at the end of 2026.



Fig. 4: Sophia (Credit: en.wikipedia.org)



Fig. 5: AI news anchor (Credit: https://newsroompost.com)

Some of the key players in the humanoid robot market include SoftBank (Japan), ROBOTIS (South Korea), Honda Motor (Japan), UBTECH Robotics (China), Hanson Robotics (Hong Kong), PAL Robotics (Spain), Toyota Motor (Japan), Istituto Italiano di Tecnologia (Italy), Engineered Arts (UK), Robotics Lab (Spain), and National Aeronautics and Space Administration (NASA, US).

This article covers ten humanoid robots that would potentially revolutionise the robotics industry.

1. First humanoid robot

Herbert Televox (Fig. 2) was the first humanoid robot built by Ron Wensley in 1927. The robot could lift the handset to receive a telephone call and control simple processes by operating switches according to the signals it received. While the robot could not speak when it was first created, it later learnt to say two simple sentences. This was the beginning and starting point for the developmental process.

2. First social humanoid robot

Pepper (Fig. 3) is the world's first social humanoid robot that can recognise faces and understand basic human emotions. It was manufactured by SoftBank Robotics and introduced in 2014. Pepper can engage with people through conversations and touchscreen on the chest. The touchscreen on its chest displays messages. It also has a speech recognition feature and can speak in fifteen languages, including English, French, Spanish, German, Italian, Arabic, and Dutch.

3. First humanoid robot citizen

Sophia (Fig. 4) was the first robot to receive citizenship in a country (Saudi Arabia) in 2017. It was developed by Hong Kong-based company Hanson Robotics in 2016. It imitates human gestures and facial expressions, and is able to answer certain questions and make simple conversations on predefined topics. In 2020, Sophia visited the City of Joy, Kolkata, after touring 65 countries. This was Sophia's second visit to India. She first visited India in 2017.

4. First news anchor AI-robot

Qiu Hao, a lifelike image male news anchor (Fig. 5), was developed in 2018 by Xinhua and the Chinese search engine Sogou. It uses machine learning (ML) to simulate the voice, facial movements, and gestures of real-life broadcasters. It can work continuously and tirelessly. This AI technology is not only limited to news presenting but can also be customised to different applications in other industries.

5. First robotic avatar

FEDOR and T-HR3 (Fig. 6) were among the first avatars introduced in



Fig. 6: Robotic avatar (Credit : https://global.toyota)



Fig. 7: Digit delivery robot (Credit: www.agilityrobotics.com)

2017 by Russia and Japan, respectively. FEDOR avatar robot is able to replicate the movements of a remote operator and perform some actions autonomously. It was sent on an experimental mission to the International Space Station in 2019.

T-HR3 is the third generation humanoid robot from Toyota, Japan. It is controlled from a master maneuvering system that allows the entire body of the robot to be operated remotely. The master system may include wearable devices to control movements of the robot and a head-mounted display that allows the operator to see from the robot's perspective. That is, it can mimic the movements of its human operator like a real-world avatar.

In future, these humanoids will be able to perform surgeries while operators (human doctors) will be controlling them from another part of the world. These can also be used by caregivers to work with patients remotely. Avatar robots could change the way people interact and work.

6. First delivery humanoid robot

A two-legged robot called Digit (Fig. 7) from Agility Robotics was announced in February 2019. It is approximately the size and shape of a small adult human. It has advanced feet that allow it to balance on one foot, or carefully navigate through obstacles with both legs. It can navigate environments semi-autonomously with the help of LiDAR and other sensors, enabling it to perceive and map the world for navigation. It can carry boxes up to 18kg in weight in its arms. It can be used in many areas, including logistics, warehouses, telepresence, and industrial inspection.

7. First virtual artificial humans

Neon (Fig. 8), a humanoid artificial intelligence (AI) avatar designed by Samsung's STAR Labs, looks like a human and can respond to questions. It is basically a next-generation AI video chatbot with a human face and personality but not exactly an AI assistant. You can imagine something like Siri or Alexa with a virtual face that could start a conversation. It interacts with humans along with expressions such as a smile or a raised eyebrow. It is still under development but could be the next big thing in the future for use in many fields, including retail, tourism, collaboration, healthcare, among others.

8. First robonaut

A robonaut (Fig. 9) is a humanoid robot for the astronauts. The first-generation robonaut was designed by the Robot Systems Technology Branch at NASA's Johnson Space Center. The core idea behind the robonaut is to have a humanoid machine work alongside astronauts. Many countries are working on their own robonauts



Fig. 8: Neon-virtual humanoid (Credit: www.cnet.com)



Fig. 9: Robonauts (Credit: www.wikipedia.org)



Fig. 10: Dokat Aura—Robotic nurse (Credit: www.msn.com)



Fig. 11: ASIMO—advanced mobile humanoid (Credit: https://en.wikipedia.org)

for space exploration. In India, Vyommitra, a female humanoid robot, is set to launch on an uncrewed spaceflight in December 2020.

9. First humanoid nurse robot

Human-like robots are already being utilised as healthcare workers in elderly homes in countries like Japan. There are many robotic nurses deployed in some hospitals, but humanoid robotic nurses are few.

In 2018, three robot nurses were used to help medical staff in a hospital in Bangkok. Dressed in a nurse's uniform, the robot nurses used to deliver medical documents between departments.

In India, recently, a Coimbatore-based startup has developed an autonomous self-driving humanoid robot named Dokat Aura (Fig. 10). It is the first humanoid robotic nurse developed in India that is used to help in supplying food and medicines to isolation wards, and is being found very useful in hospitals treating Covid-19 patients.

10. Most advanced humanoid robot

ASIMO (Fig. 11) is the most advanced humanoid robot in the world to date. Developed by Honda Motor Company, ASIMO stands for Advanced Step in Innovative Mobility. According to its website, ASIMO is the first humanoid robot in the world that can walk independently and climb stairs. In addition, it can also understand preprogrammed gestures and spoken commands and recognise voices and faces. It has arms and hands to perform activities like turning on light switches, opening doors, and carrying objects. EFY

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How Exoskeletons Help Reclaim Mobility

The introduction of exoskeletons has given hope to people with physical or neurological disorders by enabling them to walk, sit, or stand without any help. Exoskeletons are built to enhance the performance of humans working in fields where excessive human labour is needed. This article covers the role of exoskeletons in the healthcare industry and rising demand among people



Dr Krishna Naga works as a Physics teacher. She has over twenty years of experience in this field. Her hobbies include reading and writing

In the 2014 FIFA World Cup held at Brazil, Juliano Pinto, who is paralysed from the chest down, had performed his first kick in the opening ceremony, which showcased the advances in neuroengineering. The mastermind behind this mind-blowing scientific demonstration was the director and neuroscientist of Duke University Center for Neuroengineering, Dr Miguel Nicolelis, who is also leading the Walk Again project.

The goal of this project is to explore how brain-machine interfaces (BMIs) that incorporate virtual reality (VR) systems use patients' brain activity to control their legs and restore their mobility, strength, and independence.

With the help of BMI, Juliano was able to control the movements of the lower-limb robotic exoskeleton. Such ambulatory exoskeletons are more effective in restoring and improving the motor functions of the user. Dr Nicolelis has eight patients under this Walk Again project. They are not only walking with the help of robotic exoskeleton legs but have now also learned to move forward by themselves.

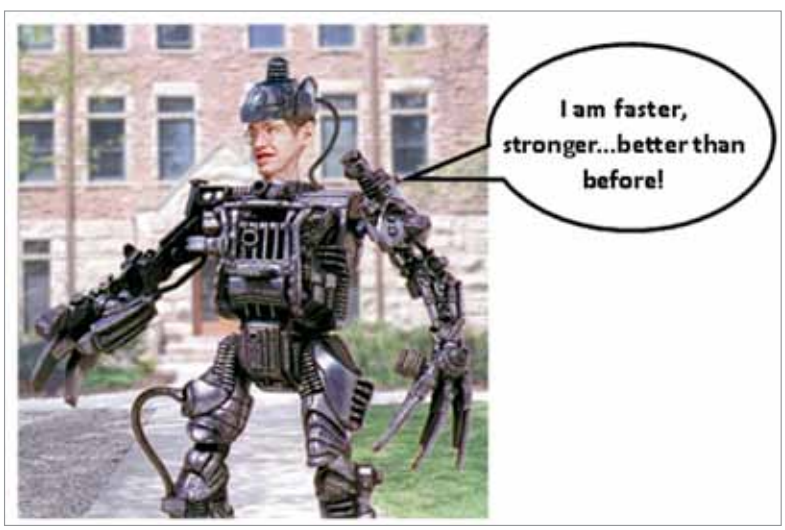


Fig. 1: Award winning physicist Stephen Hawking strolling the Cambridge University in his exoskeleton suit

Exoskeletons

Exoskeletons, as the name indicates, are skeletons existing on the outside of bodies with articulated joints similar to humans, and each joint is powered by one or more servomotors with sensor outputs used as rehabilitation or augmentation medical devices.

These exoskeletons are built to enhance the performance of humans working in fields like defence, logistics, or automotive industry, where excessive human labour is needed. Apart from improving the power and efficiency of individuals, these exoskeleton suits or power gloves support weight and reduce the person's effort, thereby reducing fatigue and stress. Hardiman, a hydraulic and electric heavy bodysuit for military use, was the first exoskeleton built by General Electric in the year 1965. The film industry has also used many exosuits that have made us think critically about their usage in practical life.

Exoskeletons in healthcare

The developments in artificial intelligence (AI), actuators, sensors, computer processors, 3D printers, and li-ion batteries have given a futuristic perspective in building exoskeletons similar to that used in science fiction. Also, newly developed power sources have increased the independence



Fig. 2: 2014 FIFA World Cup: Juliano Pinto, paralysed from his chest down is making his first kick in the opening ceremony with the help of exoskeletons

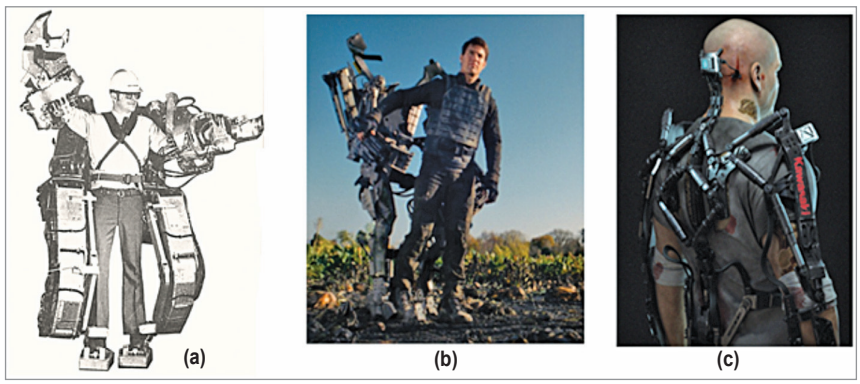


Fig. 3: (a) 'Hardiman'—the first exoskeleton by General Electric, (b) Tom Cruise with his exosuit in 'Edge of Tomorrow,' and (c) Matt Damon with his exoskeleton in 'Elysium'

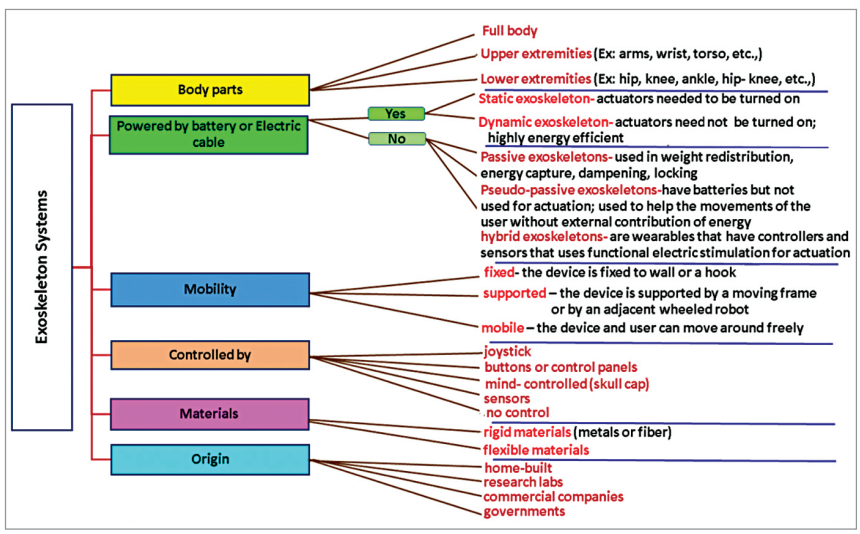


Fig. 4: Classification on exoskeleton systems

of untethered devices. So, the recent past has seen diverse applications of exoskeletons in the healthcare industry due to their exceptional ability to rehabilitate patients with physical or neurological disorders, thus enhancing their performance capability and functionality.

These devices initially entered the medical industry to assist healthcare professionals in lifting and carrying patients. Later, researchers transferred their focus to patients as well. The first working medical exoskeleton was built in 1972 by Mihajlo Pupin Institute in Belgrade, Serbia. Exoskeleton systems in the healthcare industry are classified into different categories, as shown in Fig. 4.

However, in a gait training, the classification is narrowed down into two categories—end-effectors: devices attached at the end of the exoskeleton, and powered exoskeletons: wearable robotics powered by a system of electric motors, pneumatics, levers, hydraulics, or a combination of technologies that allow limb movements. For patients suffering from neurological conditions, particularly leading to gait disorders, exoskeletons are becoming a powerful tool in their rehabilitation process. Thus, the physiotherapy and mobility reforms of the healthcare sector are getting transformed due to exoskeletons.

Need for exoskeletons

Earlier, restoration processes that were used to correct the walking disabilities involved locomotor training in which the mechanical devices used allowed individuals with gait disorders to stand or walk on a bodyweight supported treadmill. The placement of feet could be manual or using a robotic system.

However, such methods had limited success due to the high cost related to ambulation, difficulty in obtaining the required skills and strength, and the incapability to continue the therapy at home. Exoskeletons, especially the powered types, are wearable robots that enhance the strength, endurance, and mobility that increase the independence of the user.

Exoskeletons are highly flexible and can be used for performing a wide range of limb movements like walking, climbing stairs, sitting, and standing up. These, in turn, decrease the number of rehabilitation tools required, the number of therapists required for various tools involved, and hence reduce the cost of the rehabilitation process.

Exoskeletons are also available for patients for their upper limb(s). By using exoskeletons, patients can go through intensive all-day functional therapy during their daily life activities. Also, several researches have proved that exoskeletons facilitate the safety of the user while walking. Other advantages include a reduction in spasticity and pain.

Exoskeletons for gait and balance

Walking is a precious gift given by God, and we often take it for granted. It is a complex task that requires the

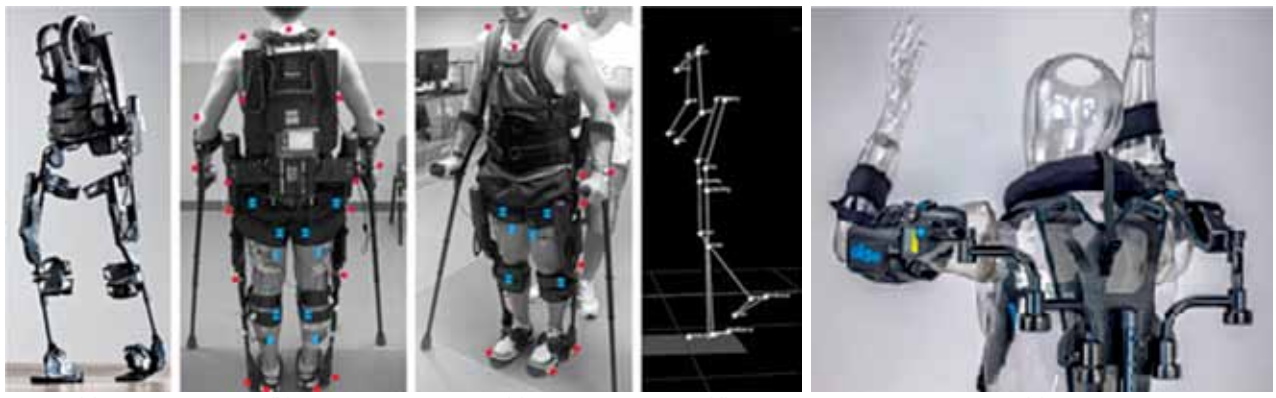


Fig. 5: (a) It is a battery-powered, wearable exoskeleton that enables individuals with severe walking impairments to stand up and walk over ground, (b, c) participants wearing the Ekso. Red dots indicate the positions of the reflective markers for the motion analysis and the blue rectangles indicate the position of the surface electromyographic (EMG) electrodes, (d) markers recorded by the motion analysis system (lateral view in the centre of the motion analysis lab pathway), and (e) exoskeleton for upper limbs [Credit: The Ekso (Ekso Bionics, Richmond, CA, USA)]

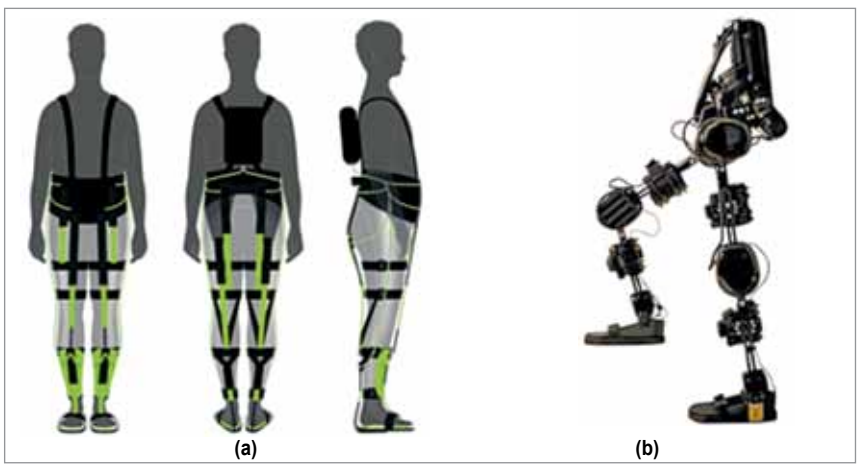


Fig. 6: (a) Exoskeleton for gait (Credit: XoSoft), (b) Exoskeleton for gait rehabilitation (Credit: Zarya)

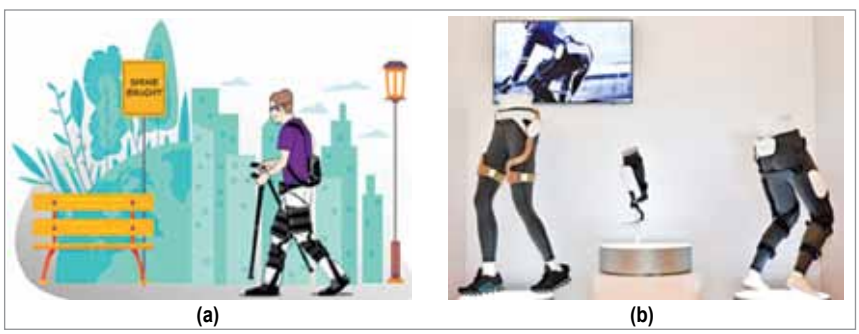


Fig. 7: (a) Managing muscular dystrophy competently (Credit: GenElek), (b) Gait enhancing and motivating system (Credit: Samsung GEMS)

balance and coordination of hundreds of muscles, bones, joints, and a highly complex central nervous system. Gait disorders occur when the walking pattern is affected due to arthritis, inner ear disorder, stroke, foot conditions, neurological condition, and also due to the usage of poor-fitting shoes. Small motors attached in these devices return movements to users' hips and knees. Refer pictures from XoSoft, GenElek and Samsung GEMS (Gait Enhancing and Motivating System).

Exoskeleton for paraplegics and post-stroke patients

A paraplegic person is capable of exercising, walking, and moving easily with the help of exoskeletons. For stroke patients, there is a disrupt in the blood supply in brain, resulting in the death of brain cells. Loss of brain function leads to paralysis of one or more limbs. Ninety per cent of the stroke patients suffer from partial paralysis, leading to abnormal gait.

Exoskeletons for rehabilitation assist the joints to maintain balance while walking. These suits come with specially designed shoes. Users have to pull a cord attached to the shoe insole, and this provides the necessary torque to the ankle, thus correcting the abnormal walking motion.

Exoskeletons for cerebral palsy and spinal muscular atrophy in children

Spinal muscular atrophy in a child occurs when the nerves connecting the body and brain are disrupted, resulting in loss of control over the limbs and torso. Cerebral palsy in children occurs due to abnormal development or damage in the parts of the brain, leading to spinal deformation, delayed growth, and loss of motor muscle control.

Our brain has a specific part that controls our movement. When that part is damaged, the child cannot move his or her muscles normally.

Engineering behind exoskeletons

Design. Exoskeletons consist of rigid frame actuators that control the spherical motion of each hip and joints, microprocessors, software,

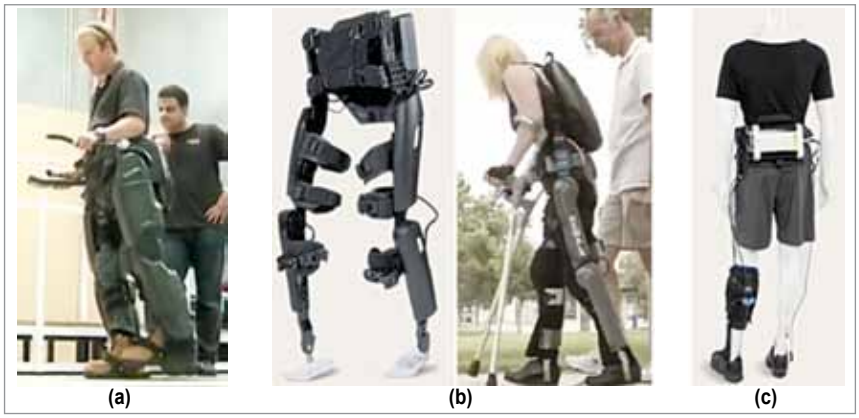


Fig. 8: (a) Fully automated exoskeleton for paraplegics (Credit: Rex Bionics), (b) exoskeleton for spinal cord injury, (c) exoskeleton for stroke (Credit: ReWalk)

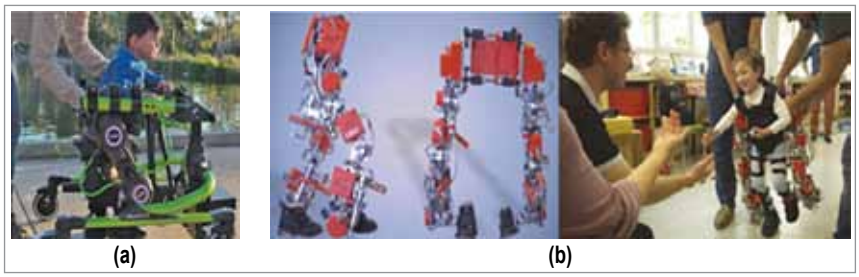


Fig. 9: (a) Exoskeleton for cerebral palsy (Credit: trexo), (b) exoskeleton for spinal muscular atrophy in children (Credit: Marsi Bionics CSIC)

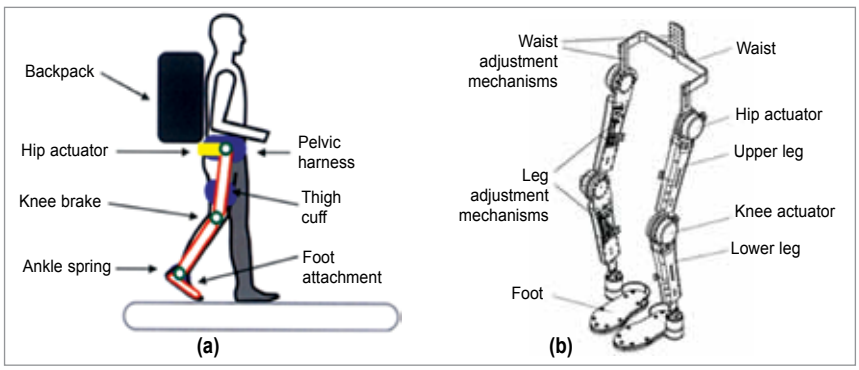


Fig. 10: (a) Main components of the exoskeleton (Credit: James Conor Walsh), (b) design of lower-limb exoskeleton (Credit: intechopen.com)

and sensors. The mechanical design of each exoskeleton varies depending on the patient's level of support. Based on ergonomics, the material used is usually metal, which has to be light and flexible, thus making it easy and natural to wear.

Some exoskeletons are also made of soft materials that can be wrapped around the affected parts like wrist, upper arm, etc. Some exoskeletons require electrical power, and some can be used without any power, giving more degrees of freedom to the wearer. Also, the frames are powered in different ways, that is, mechanically, electrically, or using batteries.

Different companies use different robotic gadgets and different adjustable critical parts as per their customers' needs. The actuators used should also be compact and strong. In addition, these should be capable of meeting the speed and movement requirements for the targeted motion, such as sitting, standing, and walking, to minimise any inconvenience to the wearer.

Actuators can be electric, pneumatic, hydraulic, shaped memory alloy (SMA), or passive. Selecting the joints should be done carefully to achieve a range of degrees of freedom for a range of motion as per the human anatomy.

In case of the upper limb, exoskeleton joints are needed for shoulders, elbow, and wrist. In case of the lower limb, exoskeleton joints are needed for the hip, knee, and ankle. Leading companies increase the range of degrees of freedom of joints and the range of motion so that the user feels comfortable.

However, for patients who have lost their muscular activity in their limbs, the range of degrees of freedom should be restricted to prevent uncontrolled movements. Manufacturers will perform a Clinical Gait Analysis (CGA) to determine the required degrees of freedom and also calculate the required joint movements for the targeted motion. If joints are to be powered, it is done by DC motors.

Control

Controlling the exoskeleton is based on the human-exoskeleton interaction, which is done using interaction signals between the user and the device. But, unfortunately, many paraplegic patients are not able to generate a human-exoskeleton interaction. In such cases, some companies use electromyography (EMG) in determining the user's intentions. But EMG produces noise and also requires extensive signal conditioning.

Pre-defined motion control (PMC) is more suitable because the user can select the intended motion, thereby reducing the computational and hardware complexity.

Feedback

The exoskeleton has a number of input signals based on two features-structural feedback and human feedback. Structural feedback is associated with actual movements and relative position of the mobile parts of the exoskeleton, and human feedback is associated with the biological electrical signals generated by the human nervous system due to the action of exoskeleton on the human body and user's intention to move.

Signals based on structural feedback are obtained from rotation encoders, force sensors torque sen-

sors, etc, while human feedback is obtained from the user who wears the exoskeleton.

The electric signals due to the user's nervous system are registered by using wired electrodes in contact with the user's skin (usually laps, hips, etc), which are retrieved as EMG signals. Movement intention is analysed using electroencephalogram (EEG) signals. Brain-machine interfaces (BMI) are regularly used to recognise human motion intention. Other external interfaces like joystick can also be used to recognise human motion intention.

Conclusion

The technology promises to improve all the limb-functionalities required for carrying out actions for daily living by complementing or fully substituting human functions. Exoskeletons give a new paradigm of control to the wearer that enables him/her to achieve dynamic hand-free walking. For people who have lost their hope, exoskeletons are making their dreams of standing or walking come true by enabling them to participate in a series of exoskeleton-supported activities with confidence and strength.

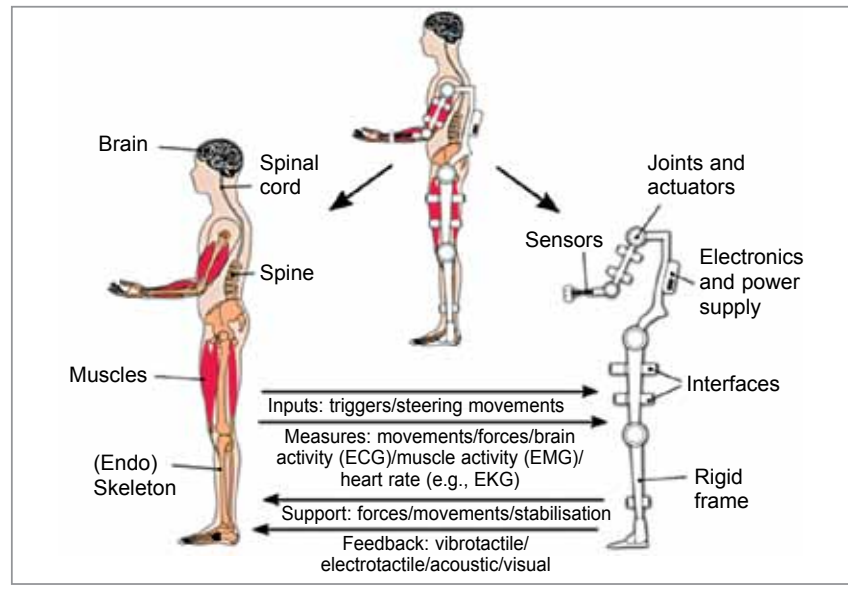


Fig. 11: Multi-layered exoskeleton-user interaction (Credit: eduexo.com/resources)

Several international exoskeleton companies are showing a sharp rise of fiscal sense every year in their profit. India shows a slow growth with very few exoskeleton companies as the initial investment keeps many potential engineers or businessmen out of the market. EFY

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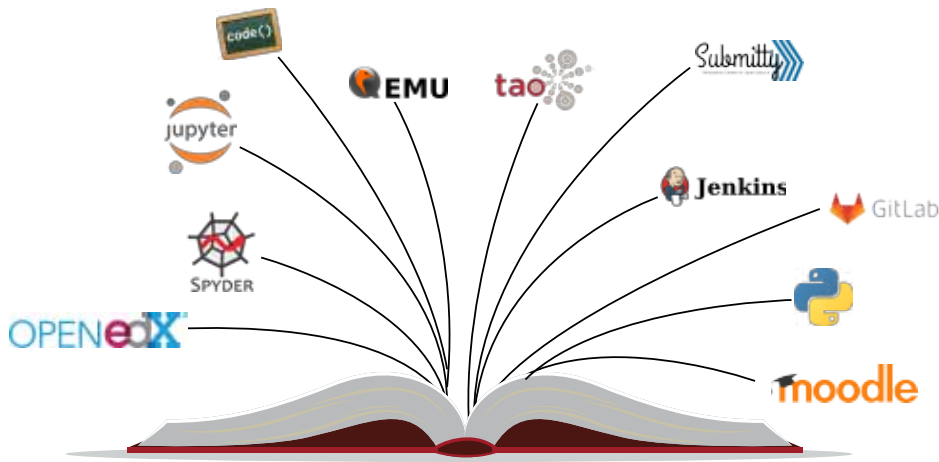
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The Role Of Open Source Software In Engineering Education

Open source software can play a vital role in education, especially when it comes to the engineering domain. As engineering involves complex tools and processes to deliver solutions, OSS ensures lower costs and more robust code built on open standards that can be continually peer-reviewed. This helps in effective teaching and the management of academics



Dr Prithvi Sekhar Pagala and **Rajesh Sola** are educators in the Education and Competency Development (ECoDe) team at KPIT Technologies Ltd. They are passionate about open source and teaching for the automotive segment

The most important open source software for an institution that are in use for educating engineers are:

- Learning management systems (LMS) and tools
- Code collaboration tools
- Submission tracking and assessment frameworks
- Circuit/MCU simulation tools
- Interactive notebooks and IDEs (integrated development environments)

Though we are talking about engineering education here, many of the open source tools and frameworks discussed in this article are equally applicable to other academic and corporate segments.

Learning management systems (LMS) and tools

Open edX. This is a digital MOOC (massive open online course) framework created by MIT and Harvard, with all the necessary functionalities to deliver and manage content. It has had at least one major release per year ever since its launch in 2013, and has been used by more than 35+ million people. The LMS is based on the Django application framework with Python for the back-end, while Mako, JavaScript and CSS are primarily used for the front-end. MongoDB and MySQL have been used for the database. Multiple interfaces are enabled for external application through LTI (learning tool interoperability) and the edX Xblocks API. The course creation is done in OLXML and is interoperable with easy export and import. The data analytics engine gathers the events and makes insights available with the help of Hadoop and the REST API. Multiple educational institutions and corporates are leveraging the edx.org platform today, or creating their own customised versions, based on their learning needs.

URL: https://open.edx.org

Moodle. This is one of the oldest frameworks built for a virtual learning environment; its initial release was in 2002. The objective of Moodle is to create online courses for different modes of learning, combined with self-paced learning. Today, it has more than 90 million users and major releases occur twice a year. It is based on PHP, JavaScript and CSS.

It is highly extensible due to its modular nature and the plugins. It supports activities, resources, enrolment, authentication and other components of a typical LMS through plugins. There have been many changes in Moodle over the past 17 years. The latest version is Moodle 3.8.

URL: https://moodle.org

Code collaboration tools

GitLab. Git is a popular source code management (SCM) protocol that supports distributed version control systems (VCS). Most open source projects are currently on Git hosting services like GitHub and others. To leverage the advantages of SCM, we can also host internal Git repos. GitLab is a good option for this with its complete continuous integration (CI) and continuous deployment/delivery (CD) tool chain. The community edition is free and easy to install in any on-premise server or available cloud service. When delivering educational content, GitLab can offer examples with wikis, along with lab manuals documented with version tracking (branches). It can also create groups for collaborative team work and submissions. CI/CD workflows can be integrated for build checks, issue trackers, to check code quality parameters and to present different dashboards.

URL: https://docs.gitlab.com

Jenkins. This is a leading automation server with a rich set of plugins for engineering programming languages like C, C++, Java and Python. For the purpose of education content delivery, CI/CD pipelines can be set up to perform particular tasks, which include platform-specific builds, various code quality checks like static analysis, heap error detection, code complexity and standard compliance. xUnit frameworks can be integrated to perform unit and integration testing, and coverage. Also, rich dashboards and trending charts are supported to visualise the changes, based on the build.

URL: https://jenkins.io

Submission tracking and assessment engines

Submitty. This is an open source programming assignment-submission system developed for programming courses in engineering institutes. Submitted code can be evaluated manually as per predefined rubrics or automatically against test metrics. It comes with a rich set of plugins for various checks on programming assignments like compilation, execution, coding style, static analysis, and memory leak detection for automated assessments. Scores can be configured for each of the desired parameters. We can check the functionality of the code with the help of the available xUnit framework. The evaluation can also be configured as a combined score in dual mode, i.e., some parameters get checked automatically and some manually. This framework helps the engineering faculty to set up formal assessments and programming challenges.

URL: https://submitty.org

Codeboard.io. This is a Web based IDE for teaching programming modules. Examples can be created for sharing with students, or one can create blank/partial code and encourage students to submit the completed solutions. Examples in popular languages like C, C++ (up to C++14 std), Java and Python (with support for unit testing in the latter two) can be created. Codeboard.io can be hosted internally through Docker images. It can integrate with popular LMSs in engineering education through LTI plugins.

URL: https://codeboard.io

TAO Testing. TAO is a next-generation open source assessment framework, with support for single sign-on and LTI. It can easily integrate assessments with popular LMSs. It is Question and Test Interoperability (QTI) compliant and has a great degree of interoperability with other LMS solutions. It offers a strong role based access matrix to define privileges for various roles like admin, test author, invigilator, student, etc, for hosting and managing the assessments, which can be objective questions using multiple-choice or 'mix and match' questions.

URL: https://www.taotesting.com

MCU simulation tools

Qemu. This is an open source emulator with support for various architecture families. It allows full system emulation with GUI and network support. The GNU MCU Eclipse project comes with a customised version of Qemu, which can emulate additional MCU targets like the STM32 family with Eclipse plugins for a complete development cycle. From mid-2019 onwards, these custom Qemu binaries have been part of the xPack project. Do refer to a previous article in OSFY for more details on the GNU MCU Eclipse project (*https://opensourceforu.com/2017/12/developing-arm-targets-using-gnu-mcu-eclipse*).

URL: https://xpack.github.io/qemu-arm

mbed Simulator. ARM mbed OS is a free, open source embedded operating system designed for various ARM Cortex-M based targets. It comes with a rich set of drivers for various sensors, I/O devices, connectivity with a powerful networking stack, RTOS APIs and security. Recently, a Web based simulator has been introduced. It can run various examples with sensor interfacing and networking through mbed APIs.

URL: https://labs.mbed.com/simulator

Interactive notebooks and IDEs

Jupyter Notebook. This is an open source Web application, formally known as IPython. It allows users to create and share documents with live code, equations, graph plotting and documentation. Though Jupyter is designed primarily for Python, it supports various kernels for C, C++, Java, JavaScript and other languages. Xeus-cling is a Jupyter kernel for C++, based on the Cling interpreter. For engineering education, it provides an interactive way to learn complex algorithms and fundamentals in different programming languages through Notebooks.

URLs: https://github.com/jupyter/jupyter/wiki/Jupyter-kernels; https://xeus-cling.readthedocs.io/en/latest

PythonTutor. This helps in overcoming a fundamental barrier to learn programming by running code line by line, by code tracing, and the visualisation of the stack and heap. The Web service allows visualisation of code snippets that can be embedded into other services through Iframe. It supports other programming languages apart from Python, like Java, C, C++, JavaScript and Ruby. More than five million people have used the service to visualise over 100 million pieces of code, often as a supplement to textbooks, lectures and online tutorials.

URL: http://pythontutor.com EFY

This article is a reprint from February 2020 issue of Open Source For You magazine

"AN FPGA Is A Reconfigurable INTEGRATED CIRCUIT Used To Implement COMPLEX LOGIC FUNCTIONS"



Apurva Peri
senior engineer, product marketing, FPGA Business Unit, Microchip Technology Inc.

The ability of FPGAs (field-programmable gate arrays) to be reprogrammed to achieve the desired application or functionality after manufacturing makes them ideal for today's constantly evolving applications that impose strict restrictions on power and latency while requiring high compute capabilities. Apurva Peri, senior engineer, product marketing, FPGA Business Unit, Microchip Technology Inc., shares tips for FPGA designers and beginners in an interaction with Ayushee Sharma

Q. How can one decide whether to choose FPGA or processor for an application?

A. While processors are relatively easy to use and program, these only offer sequential programming and have speed constraints.

FPGAs can be perceived as complex devices but offer high-speed parallel computation environments, which are a growing necessity in all modern-day applications. We can now even combine a processor core with an FPGA to optimise performance and speed for current application designs like edge computing, smart vision, Internet of Things (IoT), etc.

Q. Can you give some tips for FPGA designers to avoid common mistakes?

A. Designers have to understand the FPGA architecture, including the logic element, memory blocks, and I/O capabilities. Consider any special features such as DSP blocks, SERDES blocks, and embedded processors that are required for the application. Consider what the FPGA interfaces with to ensure that the FPGA has proper I/O for the application.

Use a good coding style when writing VHDL or Verilog description of the design. Designing with an HDL language is not the same as writing software. Good coding techniques are necessary in order to get the best possible performance.

Understand timing constraints and how to apply them. This will lead to a better implementation through synthesis and layout and make it easier to identify any timing violations. Also, pay attention to the timing verification step to identify any timing violations before programming the part. Finally, consider any debug features that are available in the FPGA.

Q. What is the architectural difference between FPGA and CPLD?

A. A complex programmable logic device (CPLD) is typically an EEPROM-based programmable logic device with a simple architecture and a small gate count. It is ideal for simple designs that do not demand flexibility and extensive computational ability. It offers the advantage of operating as soon as powered up owing to its EEPROM-based structure, but design modifications on CPLDs can be tedious.

An FPGA is a reconfigurable integrated circuit used to implement complex logic functions supporting multiple system implementations and revisions. It can implement anything as simple as a gate or as complex as a multicore processing system. Most FPGAs in the market are made from volatile RAM, which means that additional memory is required to commence operation after power-on. Microchip's FPGAs are, however, made from a non-volatile flash-based instant-on technology that enables them to deliver thirty to fifty per cent lower power than competing FPGAs.

Q. What are some of the FPGA design tools for beginners?

A. Most of the content is offered by leading FPGA manufacturers, FPGA distribution houses, and other third parties. Academic platforms like MIT OpenCourseWare, Coursera and Udemy also offer professional design courses around FPGAs. For professional embedded designers without FPGA experience looking to work on FPGAs, we have introduced the Hello FPGA kit. It is a low-cost, compact, versatile hardware that serves as an easy tool to familiarise designers with FPGAs.

Q. Which is the best choice - Flash-based, SRAM-based, or anti-fuse based FPGA?

A. The choice is dependent on the specific needs of the application design and acceptable compromises. Flash-based FPGAs do afford additional benefits of low power, immunity to radiation, and inherent security features making them an ideal choice for a wider range of applications, including those with stringent requirements like in aerospace and defence.

Q. How vulnerable are FPGAs to security threats?

A. Security starts during silicon manufacturing and continues through system deployment and operations. In FPGAs, SRAM-based FPGAs lack the key capabilities required to create a trusted and secure hardware platform for a secure embedded system, making them vulnerable to cloning, copying, and reverse engineering.

Q. In which application areas is FPGA technology going to bloom in the coming years?

A. FPGAs have surfaced as the platform of choice for numerous applications owing to their lower latency, configurability, and power efficiency. Some examples are imaging, artificial intelligence (AI)/machine learning (ML), IoT, industrial automation, automotive, aerospace and defence, wireline access networks, and cellular infrastructure. EFY

IoT Is All About DATA And How It Is Being Used Effectively For RUNNING A BUSINESS



Karen Ravindranath
director, WebNMS

The Internet of Things (IoT) is all about data and how it is being used effectively for running a business. Data from various operations can yield valuable insights that can drive new business models and customer-driven products and help business owners make critical financial and investment decisions. In an interaction with Nijhum Rudra, Karen Ravindranath, director, WebNMS, explains how IoT is turning infrastructure into hubs of innovation and the role of fleet telematics and IoT in supply chain efficiency

Q. IoT has gained huge traction over the past few years and is going to be a game-changer in shaping the future of technology. According to you, what are the various technologies that will shape the excellent future of IoT and how?

A. IoT, machine learning (ML), and artificial intelligence (AI) are the key technologies that will influence the future of businesses. IT systems helped businesses go digital and changed the way processes were handled in organisations. As the next wave of technology is embracing IoT, it will help organisations become more inclusive. By 'inclusive' we mean integrating assets, processes, people, and all the critical aspects of the business on a unified digital platform to help run smooth business operations based on real-time data and insights. IoT can not only build a digital forte for the business but can also be a reservoir of valuable information for running an informed business and venturing into new business arenas. Future technology is going to be proactive rather than reactive, and IoT will be a major factor enabling this transformation.

Q. How IoT is turning infrastructure into hubs of innovation?

A. IoT is all about data and how it is being used effectively for running a business. Data from various operations can yield valuable insights that can drive new business models and customer-driven products. The insights accumulated over a period can help business owners make critical financial and investment decisions as well as expand their business operations. IoT data can be effectively used for running businesses and government institutions while creating new and innovative streams of income.

Large city infrastructures managed by city corporations like railway stations, parks, hospitals, etc, can turn into valuable data reservoirs with IoT. IoT can also help create revenue streams by converting regular lighting poles to smart poles that can display advertising, act as temporary charging poles, or even run context-driven promotions for nearby businesses. IoT can also boost and regulate traffic for major traffic-ridden metro cities like Bengaluru, Mumbai, and Delhi through smart and proactive parking systems.

Q. What is the role of fleet telematics in supply chain efficiency? Is it going to benefit IoT and connected vehicles?

A. The adoption and use of IoT fleet management applications in the supply chain and logistics industry are on the rise, especially in developed countries such as the USA. However, the larger part of the supply chain in India is still unorganised with lesser use of technology. As companies are moving towards more transparent and tech-driven operations, the supply chain is an area where digitisation has to be adopted to create a tangible increase in efficiency and cost optimisation.

Fleet telematics can offer the basics of track and trace of vehicles on the move, but IoT can build intelligence into the process. IoT can integrate all processes, from loading to monitoring parameters in transit and final delivery. IoT tracks the estimated time of arrival (ETA), unloading/waiting at the destination, driving behaviour, vehicle and cargo safety, end-to-end process automation and workforce management.

IoT, with ML and AI, is helping companies optimise space, route, and operations' planning. Adopting IoT helps track assets on the move and ensures compliance to standards such as AIS140, hours of service, etc. This, in turn, ensures safety and enables the company to have a clear record for compliance needs. The IoT data also helps management teams to analyse vendor performance and make informed annual contract decisions based on insights for factors such as quality, efficiency, etc.

Q. Are you doing anything to focus on industrial IoT solutions? What are the steps required to strengthen it?

A. Companies now offer rich and highly developer-friendly IoT platforms to build industrial IoT solutions for manufacturing units as well as help operations teams use IoT applications to maintain factory premises proactively. The platform and solution cater to a wide array of industries that include the manufacturing sector, oil and gas, as well as medium and large scale organisations that need centralised and proactive monitoring and management.

WebNMS' industrial IoT capabilities empower industries to seamlessly converge physical and digital aspects of their business on a unified platform that can collect data, monitor and manage assets, perform remote automation and provide data analytics for day-to-day activities as well as strategic operations. The company's partner ecosystem enables it to seamlessly connect with PLCs, CNC machines, and other equipment on the shop floor, thereby enabling retrofitting IoT to existing infrastructure. The platform and solutions are aimed at helping manufacturers proactively monitor assets and processes, perform predictive maintenance, iron out process bottlenecks, and ensure the quality of production, all remotely and seamlessly. EFY

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Turn Your Phone Into A **Contactless Thermometer**

Ashwini Kumar Sinha

Due to the outbreak of Covid-19 pandemic, it has become important to check the body temperature of people without any contact with them to prevent spreading of the disease. There are many contactless thermometers available in the market, but here is a simple solution that will add a thermal screening feature to your smartphone. That is, it will turn your phone into a contactless thermometer using an MLX90614 infrared (IR) sensor module.

Components Required

Component	Quantity	Description
Arduino Micro/Nano/Mini	1	For programming
MLX90614	1	IR temperature sensor
Bluetooth HC-05	1	Bluetooth module
Wires	—	For connections
Battery	1	9V PP3

You can make a smart Bluetooth based contactless thermometer by connecting the sensor with Bluetooth and getting the body temperature readings on an app. You can get the sensor data over the phone using a USB cable if you don't wish to use Bluetooth.

This project basically has only two units: transmitter (IR thermometer sensor circuit) and receiver (mobile phone).

For making the Bluetooth based contactless IR thermometer, we need the components listed in the table above.

```
Final

#include <Wire.h>
#include <Adafruit_MLX90614.h>

Adafruit_MLX90614 mlx = Adafruit_MLX90614();
////////////////////
#include <U8g2lib.h>
U8G2_SSD1306_128X64_NONAME_F_HW_I2C u8g2(U8G2_R0, /* reset=*/ U8X8_PIN_NONE);

////////////////
void setup()
{
   ////////////////
  u8g2.begin();
  ////////////////
  Serial.begin(9600);
   mlx.begin(); }
void loop()
{
u8g2.clearBuffer();


  mlx.begin();

    u8g2.setFontDirection(2);
    u8g2.setFont(u8g2_font_pxplusibmvga9_tf);
    u8g2.setCursor(111, 50);
    u8g2.print("AmT=");

avrdude done.  Thank you.
```

Fig. 1: Arduino code with sensor library

```
Final


  mlx.begin();

    u8g2.setFontDirection(2);
    u8g2.setFont(u8g2_font_pxplusibmvga9_tf);
    u8g2.setCursor(111, 50);
    u8g2.print("AmT=");
    u8g2.print(mlx.readAmbientTempC());
    u8g2.print(char(176));
    u8g2.print("C");

////////////////////////////////////

Serial.print("Ambient=");
Serial.print(mlx.readAmbientTempC());
Serial.print("----Object Temperatur=");
Serial.print(mlx.readObjectTempC());// Serial.println("*C");
Serial.println("  ");

//////////////////////////////


    u8g2.setCursor(110, 10);
    u8g2.setFont(u8g2_font_helvB24_tf);
    u8g2.print(mlx.readObjectTempC());
    u8g2.print(char(176));

avrdude done.  Thank you.
```

Fig. 2: Serial.println( ) function

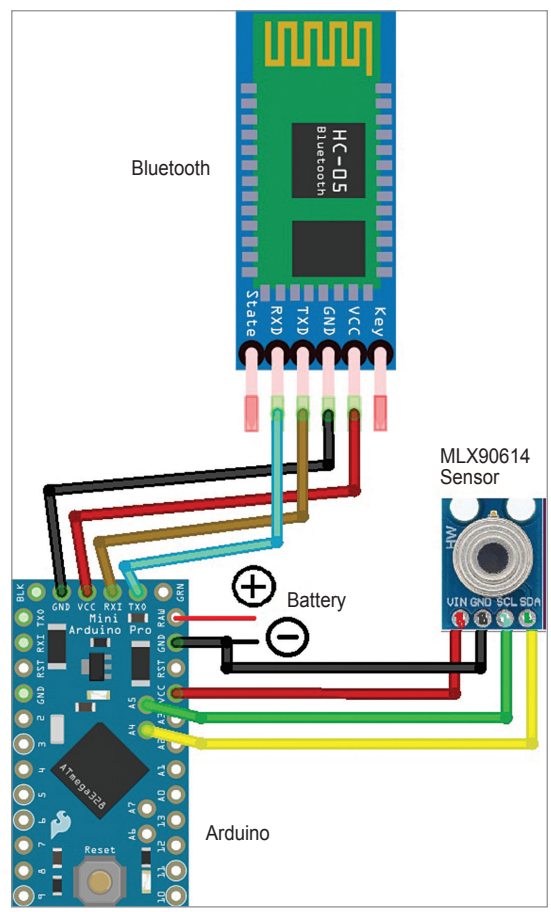


Fig. 3: Connections diagram (transmitter)

Coding

To write the Arduino code, install MLX90614 library in the Arduino IDE by selecting Adafruit MLX90614 Library from Sketch→Include Library→Manage Libraries option, and then add it in the code, as shown in Fig. 1. Next, create a setup function and set the baud rate for the Bluetooth module. Here, the default baud rate of Bluetooth is 9600. Create a loop function that runs again and again. Check

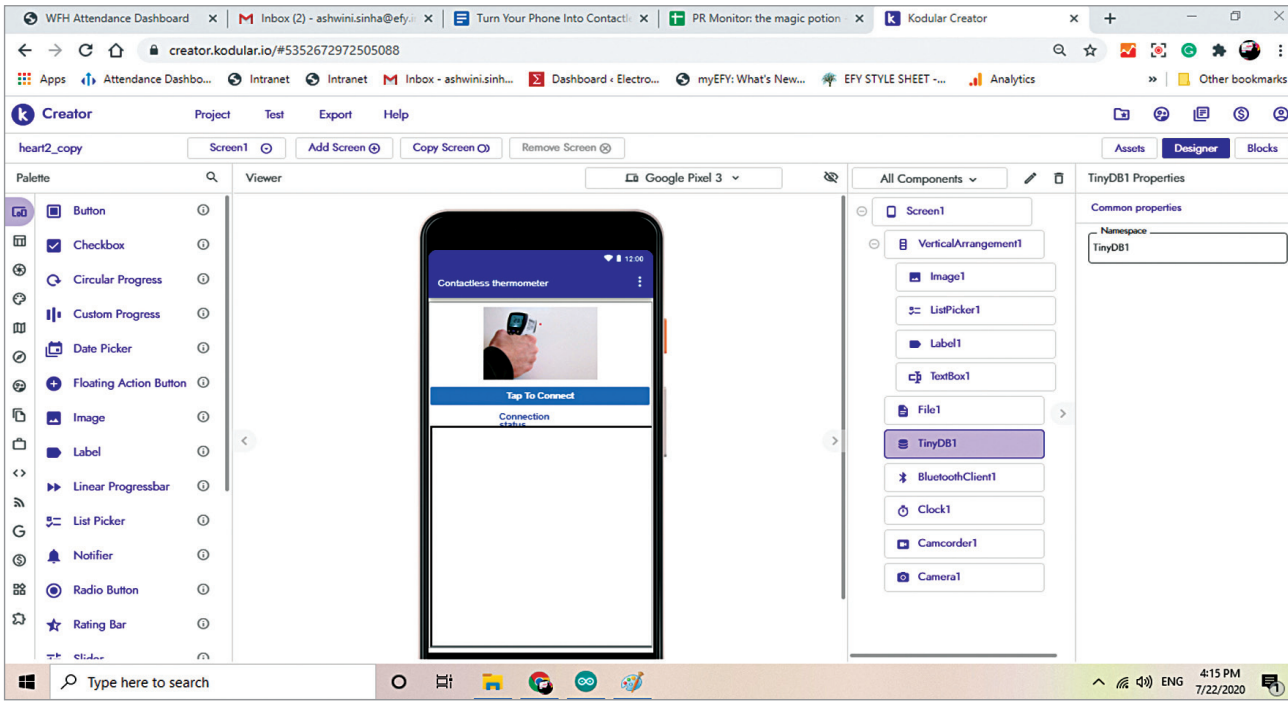


Fig. 4: App layout in Kodular platform

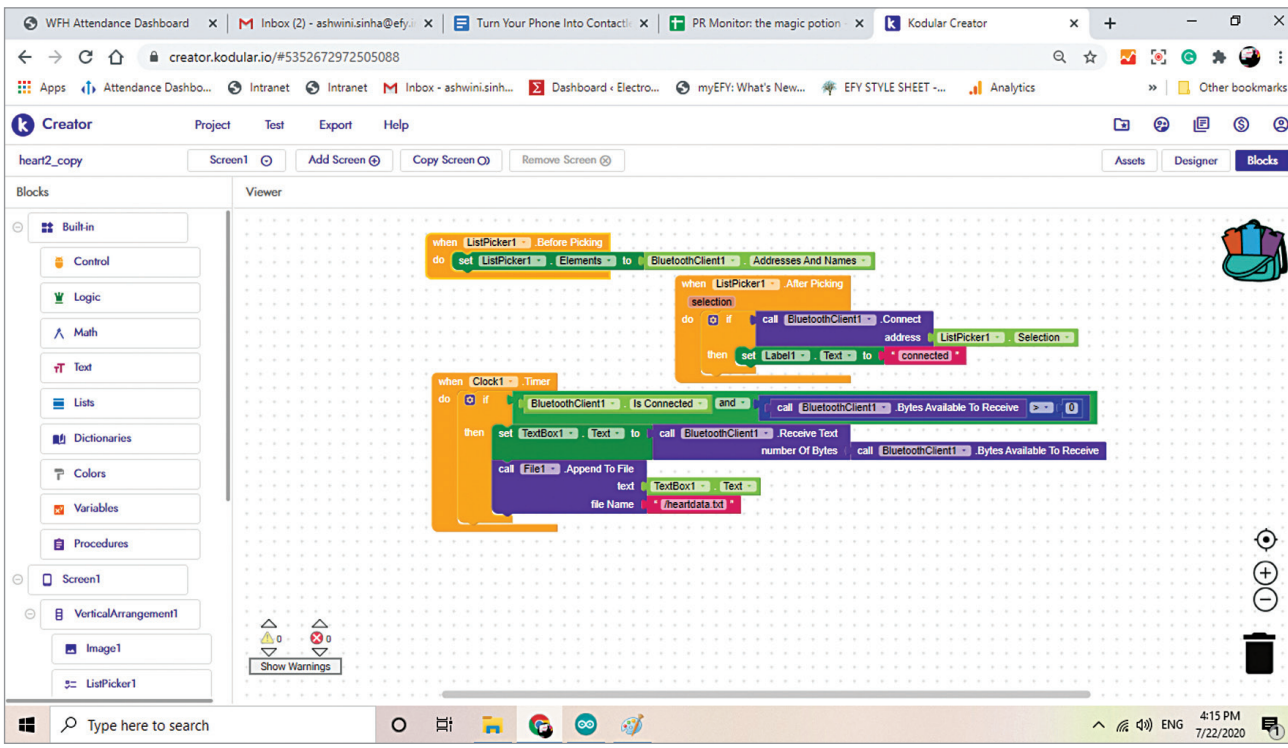


Fig. 5: Coding in Blocks section

the sensor readings and pass them to the serial.println() function (refer Fig. 2) so that when you connect the Bluetooth to the serial pin of Arduino, it transfers those readings to the Bluetooth module. You can also add an OLED display, but it is optional.

Connections

Next, make the connections as shown in Fig. 3. Make sure you connect power supply using a 9V PP3 battery. Positive wire of battery should connect to RAW pin and negative wire should connect to GND pin of Arduino Pro Mini. After this, make an app for Bluetooth communications through which you will get live readings on your phone.

Android app development

To make an app, you can use app crea-

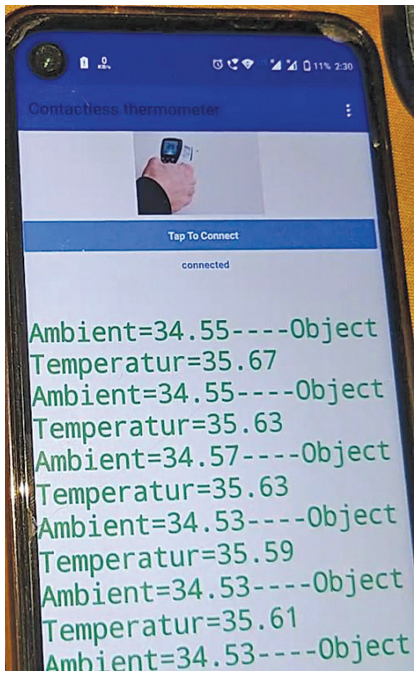


Fig. 6: Temperature readings on mobile phone

tors such as MIT App Inventor, Kodular, Android studio, Eclipse, and others. For this project, Kodular has been used to create the app.

First, open Kudular on *https://www.kodular.io/* website using a valid email ID. Then, create a new app by clicking the 'Create project' option. Name the project as per your choice. Here, the project name is 'Contactless IR thermometer.' Next, make the app layout and add the following components to the layout:

- Bluetooth client
- File
- Listpicker
- Clock
- Image

There are three sections in the Kodular platform: Assets, Designer, and Blocks. The app layout in the Designer section is shown in Fig. 4. Open the Blocks section and start the coding by joining various blocks, as shown in Fig. 5. Next, export the project as IRThermo.apk file and install it on your Android phone.



Fig. 7: Connecting OTG with mobile

Testing

After making the connections and installation of the app on your phone, enclose the hardware along with a 9V battery in a suitable plastic box with MLX90614 sensor fitted on the front panel. But first, you need to upload the Arduino code (IRThermo.ino) to the Arduino board.

Turn on the Bluetooth on your phone, open the app, and click on the 'Tap to Connect' button. Select HC-05 to connect it. After a successful connection, you can see the temperature readings on the app, as shown in Fig. 6.

Keep the IR temperature sensor near your forehead (about 5cm) and check the readings, which should be between 35°C and 37°C. The app can also save the temperature readings in a text file. You can check them in the file manager.

USB based contactless IR thermometer

You can also make the project by omitting the Bluetooth HC-05 module. With the same code in the Arduino board, connect the circuit with the phone using a USB cable and an OTG (on-the-go) connector, as shown in Fig. 7.

You need to install a serial monitor app such as Serial USB Terminal (by Kai Morich) on your phone. After connecting the circuit with the mobile phone, you can see the object and surrounding temperatures on the phone. EFY

EFY Note
The source code of this project is available for free download at *source.efymag.com*

Ashwini Kumar Sinha is an electronics hobbyist and tech journalist at EFYi

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14-Watt Hi-Fi Audio Amplifier Using TDA2030A

Raj K. Gorkhali

Here is a simple mono audio amplifier using a single 5-pin IC TDA2030A. This IC is inexpensive and easily available in the market. The author's prototype, which gives 14W output, is shown in Fig. 1.

The circuit diagram of the audio amplifier is shown in Fig. 2. It comprises TDA2030A audio amplifier (IC1), two 1N4007 rectifier diodes (D1 and D2), four resistors (R1 through R4), nine capacitors (C1 through C9), 15-watt speaker (LS1), bridge rectifier (BR1) and a few other components.

For the power supply, the amplifier uses 230V AC primary to 12V-0-12V, 2A secondary transformer (X1). Two electrolytic capacitors C1 and C2 are used as filters for DC output voltage. The amplifier requires a dual ± 12V power supply, which can be obtained across transformer X1 and bridge rectifier BR1. The +12V supply is connected to pin 5 and -12V to pin 3 of IC1.

Pin 1 of TDA 2030A is connected to the audio input terminal through electrolytic capacitor C3 (1µF/25V). Loudspeaker LS1 is connected to output pin 4 of IC1.



Fig. 1: Author's prototype

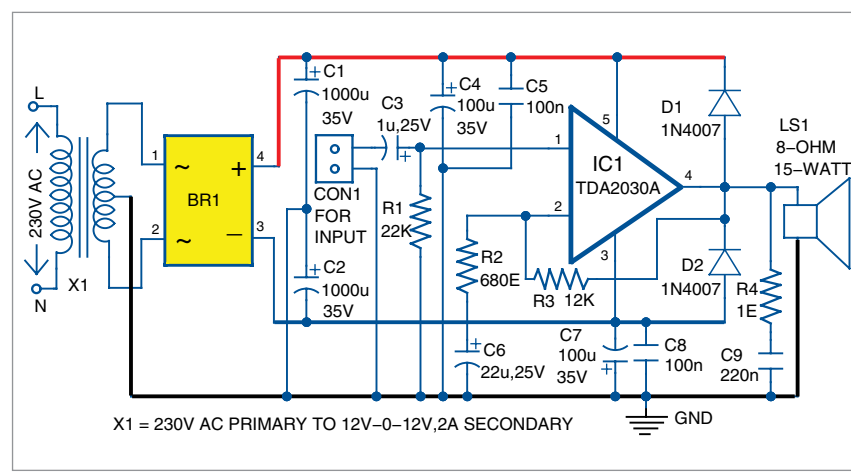


Fig. 2: Circuit diagram of the audio amplifier using TDA2030A

PARTS LIST

Semiconductors:

IC1	- TDA2030A audio amplifier
D1, D2	- 1N4007 rectifier diode
BR1	- 2A bridge rectifier

Resistors (all 1/4-watt, ±5% carbon):

R1	- 22-kilo-ohm
R2	- 680-ohm
R3	- 12-kilo-ohm
R4	- 1-ohm

Capacitors:

C1, C2	- 1000µF, 35V electrolytic
C3	- 1µF, 25V electrolytic
C4, C7	- 100µF, 35V electrolytic
C5, C8	- 100nF ceramic disk
C6	- 22µF, 25V electrolytic
C9	- 100nF ceramic disk

Miscellaneous:

CON1	- 2-pin male Berg connector
LS1	- 8-ohm, 15-watt speaker
X1	- 230V AC primary to 12V-0-12V, 2A secondary transformer
	- 2-pin terminal connector
	- Heatsink for IC1

Construction and testing

An actual-size PCB layout for the audio amplifier circuit is shown in Fig. 3, and its components layout in Fig. 4. After assembling the circuit on PCB, connect audio input from computer/

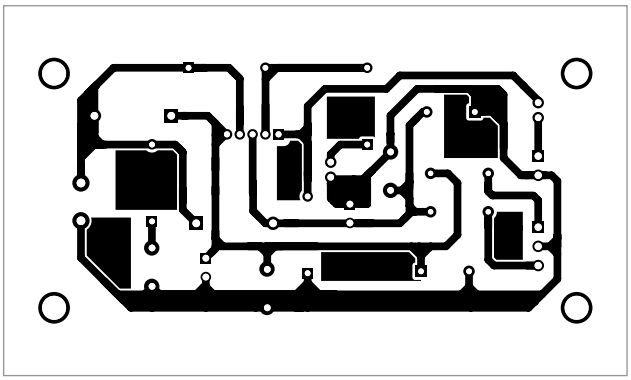


Fig. 3: Actual-size PCB layout of the amplifier

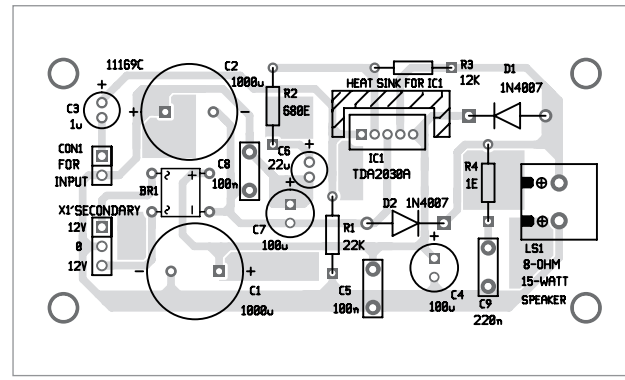


Fig. 4: Components layout of the PCB

laptop/mobile phone across CON1 and the 8-ohm, 15-watt speaker across LS1. Connect the transformer's secondary output (12V-0-12V) to the PCB and its primary to 230V AC mains.

You can also construct your amplifier on veroboard (5cm × 7cm). Mount IC1 in the middle of veroboard. Use a 2-pin connector on the left side and a 3-pin connector on the right side of the veroboard. The 2-pin connector is used for audio input, and the 3-pin connector is for dual power supply. Solder all the remaining components like resistors, capacitors, diodes, etc, using a low wattage soldering iron. You will need a suitable heat sink for IC1.

After connecting the dual power supply (12V-0-12V) to the circuit, you can test the circuit. For that, take a metal screwdriver and gently touch on the input terminal. You will hear a humming sound from the speaker, which means your amplifier is working. Note that the output power of amplifier will depend on the power supply.

Connect audio input at CON1 from any audio source such as MP3 player, laptop, or mobile phone. EFY

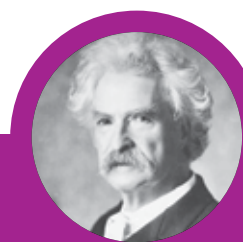


Raj K. Gorkhali is a regular contributor to EFY and an electronics hobbyist

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Overcurrent **Fault Detector**

T.K. Hareendran

The overcurrent fault detector presented here is a general-purpose current-consumption sensor circuit that raises an alert when the flow of current through the system exceeds a certain limit. This simple circuit is based on ACS712 Hall Effect-based linear current sensor chip. The author's prototype is shown in Fig. 1.

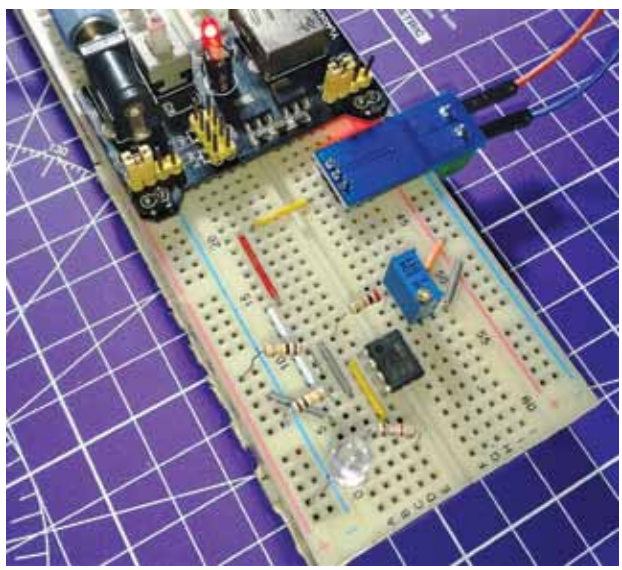


Fig. 1: Author's prototype wired on breadboard

Circuit and working

The circuit diagram of the overcurrent fault detector is shown in Fig. 1. It is built around ACS712 current sensor module, op-amp LM393 (IC1), diode 1N4007 (D1), pnp transistor BC557 (T1), 5V single-changeover relay (RL1) and a few other components.

A 5A version of the ACS712 current sensor is used here. The output sensitivity of the sensor designed for 5V single-supply operation is 185mV/A, and its quiescent output voltage (output of the sensor when the primary current is zero) nominally remains at Vcc/2.

The rest of the circuit is a common comparator built around one part of the popular LM393 (IC1). Analogue output of the ACS712 module is connected to inverting input (pin 2) of IC1, while non-inverting input (pin 3) of IC1 is connected to an adjustable potential divider (VR1, R2, and R3). A pull-up resistor (R4) and an overcurrent fault indicator (LED2) are connected at the output (pin 1) of IC1. This open-collector output pin 1 goes to a low (L) level when there is an overcurrent fault condition.

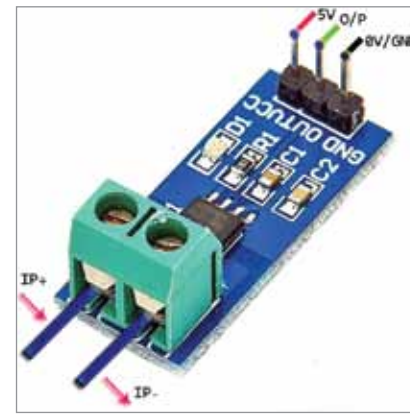


Fig. 3: ACS712 module

The ACS712 current sensor is available in surface mount SOIC8 package, which is often hard for some makers to handle and solder. Luckily, you can buy an expensive and compact pre-wired ACS712 module (Fig. 3) from most online component vendors. Since LM393 has an open-collector output, you can safely interface this circuit with a 5V or 3.3V microcontroller board through the CON3 connector. So, make arrangements in the circuit board to remove/add the optional output components (R4-R5-LED2) when required.

If you want to implement an add-on circuit, the easiest way is by using a simple electromagnetic relay driver circuit built around transistor T1, diode D1, and relay RL1. It can turn on appliances

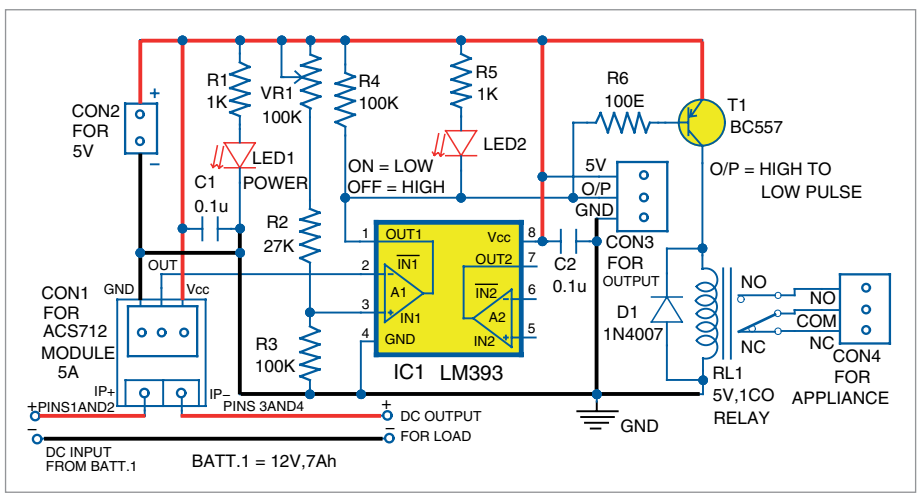


Fig. 2: Circuit diagram of the overcurrent fault detector

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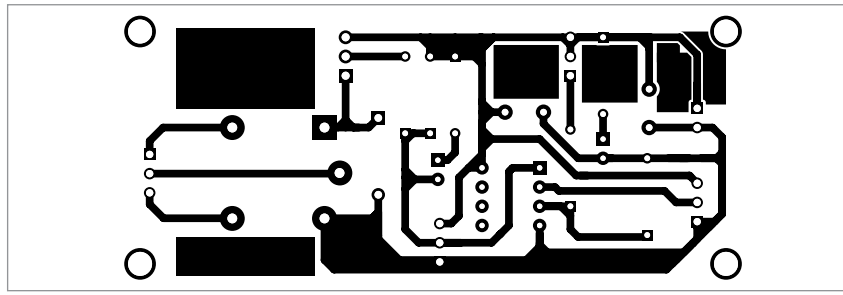


Fig. 4: Actual-size PCB layout of overcurrent fault detector

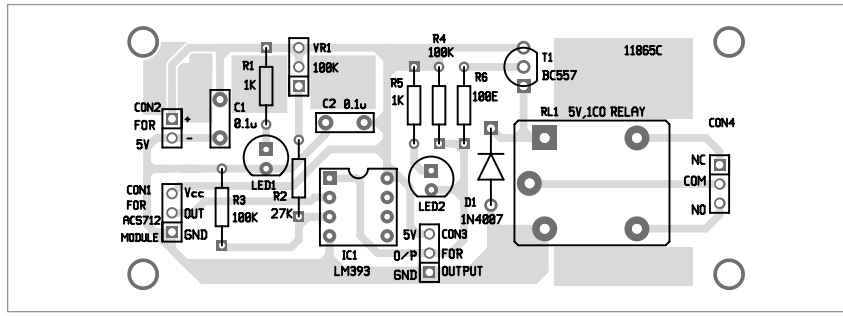


Fig. 5: Components layout of the PCB

like annunciator (or connect/disconnect any electrical device) connected across CON4 once the current reaches a particular level.

Construction and calibration

An actual-size PCB layout for the overcurrent fault detector is shown in Fig. 4 and its components layout in Fig. 5. After assembling the circuit on PCB, connect a 5V across CON2. Connect a 12V battery at IP+ and load at IP- of the ACS712 sensor module.

The trip-point can easily be configured through the potmeter (VR1). The trip-point in the author's prototype is set at 3A.

To set up for a particular application, you can alter the values of VR1 and R2. Assume that you need an overcurrent fault detection just above 2A. At the current of 2A, the ACS712 module roughly gives an output of 2.87V, and the same voltage should be at its inverting input pin. Therefore you should tune VR1 to set the appropriate voltage at the non-inverting input of IC1 so that it provides an overcurrent fault alert signal (logic-low) when the current level goes beyond 2A.

Note. The calibration process demands both theoretical and empirical skills. ACS712 current sensor used here can handle current up to 5A. It can convert input current into an analogue output voltage of about 2.5V plus 185mV/A. One drawback of the ACS712 sensor is that it tends to be quite unstable at lower currents. It is hypersensitive to external magnetic fields, so keep the working circuit away from strong magnetic fields. EFY

PARTS LIST

Semiconductors:
IC1 - LM393 operational amplifier
D1 - 1N4007 rectifier diode
T1 - BC557 pnp transistor
LED1, LED2 - 5mm LED

Resistors (all 1/4-watt, ±5% carbon):
R1, R5 - 1-kilo-ohm
R2 - 27-kilo-ohm
R3, R4 - 100-kilo-ohm
R6 - 100-ohm
VR1 - 100-kilo-ohm potmeter

Capacitors:
C1, C2 - 0.1µF ceramic disk

Miscellaneous:
CON1, CON3, CON4 - 3 pin terminal connector
CON2 - 2 pin terminal connector
RL1 - 5V, single-changeover relay
- ACS712 module (5A)
- 8-pin IC base
- 5V regulated power supply



T.K. Hareendran is an electronics designer, hardware beta tester, technical author, and product reviewer

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Simple Triple **Sine Wave Generator**

Petre Tzv Petrov

This generator produces audible signals to test microphones and codecs used in audio amplifier equipment. This simple triple sine wave generator can also be used for testing other audio systems, including VoIP (Voice over Internet Protocol) equipment.

The equipment for transmitting speech signals is usually designed to transmit audio signals in the range of around 300Hz to 3400Hz. Testing of such equipment is usually carried out using three frequencies—300Hz, 1000Hz, and 3400Hz. During the tests, we normally use separate and mixed frequencies.

Circuit and working

Circuit diagram of the simple triple sine wave generator is shown in Fig. 1. It is built around three dual audio operational amplifiers NE5532 (IC1 through IC3), a dual power supply, and a few other components.

You can use an operational amplifier like NE5532A, RC4560, or any similar or better one capable of driving loads of up to 600-ohm.

The circuit has three sine wave generators with Wien bridges and three operational amplifiers (IC1 through IC3). The frequencies of the oscillators are shown in the table above.

It is better to use resistors R4 through R9 and capacitors C1 through C6 with tolerance of ±2 per cent or better. We can calculate the frequency of oscillations by using the formula for the standard Wien bridge oscillator.

Pins 1 and 7 of IC1 are outputs of

The Frequencies of the Simple Triple Sine Wave Generator

Resistors	Capacitors	Frequency (approximate)
R4 = R5 = 5.1k	C1 = C2 = 100nF	312Hz
R6 = R7 = 4.7k	C3 = C4 = 33nF	1026Hz
R8 = R9 = 4.7k	C5 = C6 = 10nF	3400Hz

PARTS LIST

Semiconductors:
IC1-IC3 - NE5532 operational amplifier

Resistors (all 1/4-watt, ±5% carbon):
R1-R3 - 68-ohm
R4, R5 - 5.1-kilo-ohm
R6-R9, R14, R19 - 4.7-kilo-ohm
R10-R13, R16, R18 - 10-kilo-ohm
R15 - 30-kilo-ohm
R17, R20-R23 - 100-ohm
VR1-VR3 - 510-ohm potmeter
VR4-VR6 - 1-kilo-ohm potmeter

Capacitors:
C1, C2, C7, C8, C11-C14 - 100nF ceramic disk
C3, C4 - 33nF ceramic disk
C5, C6 - 10nF ceramic disk
C9-C10 - 100µF, 40V electrolytic

Miscellaneous:
CON1-CON2 - 2-pin connector
CON3 - 3-pin connector
- 8-pin base (3 number)
- Jumper wires

(All these are available from kitsnspares.com)

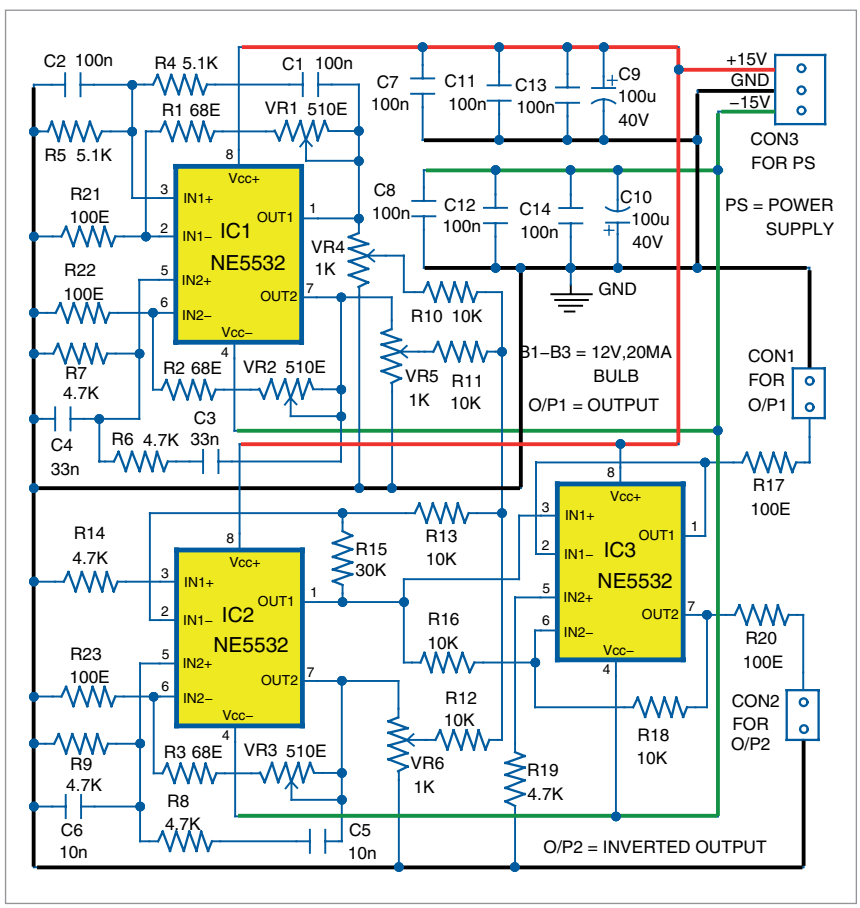


Fig. 1: Circuit diagram of triple sine wave generator

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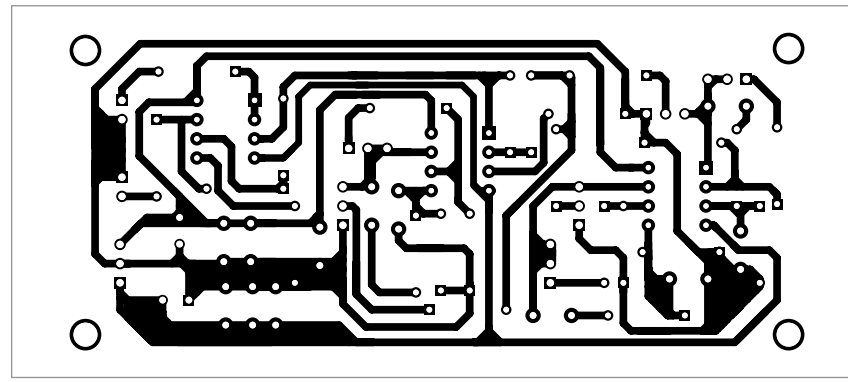


Fig. 2: Actual-size PCB layout for triple sine wave generator

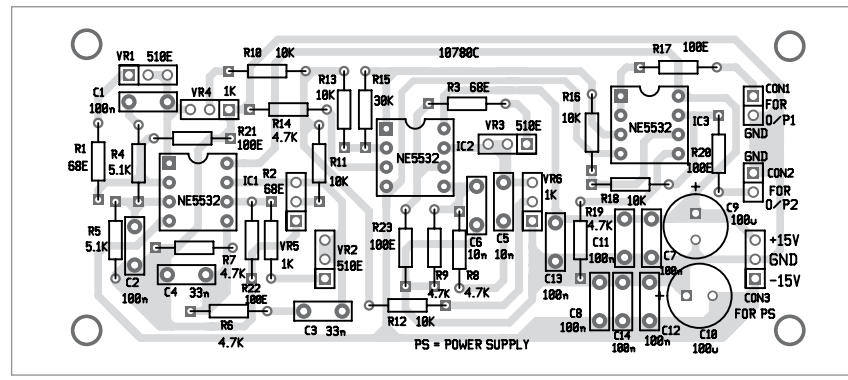


Fig. 3: Components layout of the PCB

the first and second oscillators, respectively, while the output of the third oscillator is obtained from pin 7 of IC2.

All the three signals produced by these three oscillators are mixed at IC2. Pin 1 through pin 3 of IC2 and associated components operate as a signal mixer.

The amplitudes of input signals at pin 2 of IC2 are adjusted with potentiometers VR4, VR5, and VR6.

The triple sine wave generator has two outputs. The forward output is buffered by first op-amp formed by pin 1 through pin 3 of IC3, and the inverted output is buffered with second op-amp formed by pin 5 through pin 7 of IC3. Sine wave output (O/P1) is available across CON1, and its inverted output (O/P2) is available across CON2.

The triple sine wave generator is operational in ±5V to ±15V range, but it is better to use it with power supply in the range of ±7V to ±15V only.

Construction and testing

An actual-size PCB layout for the triple sine wave generator is shown in Fig. 2 and its components layout in Fig. 3. Assemble the circuit on the PCB. Connect ±15V dual power supply across CON3, and your circuit is ready to use.

The given circuit can produce three sine-wave signals (312Hz, 1026Hz, and 3400Hz) simultaneously, as listed in the table. These outputs are available at CON1 and the inverted outputs at CON2 connector.

The circuit needs a simple adjustment of the amplitude for each oscillator. The potentiometers VR1, VR2, and VR3 are used to adjust the output amplitude of the oscillators around IC1 and IC2. We can replace these potentiometers with appropriate fixed resistors. EFY



Petre Tzv Petrov was a researcher and assistant professor at the technical University of Sofia, Bulgaria, and expert lecturer in OFPPT (Casablanca), Kingdom of Morocco. Now, he is working as an electronics engineer in the private sector in Bulgaria

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Simulink Model For **Real-Time Logging Of Process Data** In MATLAB Workspace

Shibendu Mahata

In this project, temperature data is logged in real time in MATLAB workspace by building a model using Arduino IO Library in Simulink. Process parameter measurement carried out for experimental research and analytical testing generally needs to be saved in real time in order to conduct further analysis.

This is particularly relevant in the domain of instrumentation engineering where parameters such as temperature, pressure, flow rate, pH, viscosity, etc, are measured and then saved on the computer in order to analyse the dynamics of the process, or for fault diagnosis. This project is based on Arduino Uno and temperature sensor LM35 IC. The authors' prototype is shown in Fig. 1.

Hardware and construction

The components used in this project are:

Arduino Uno. Arduino Uno is an AVR ATmega328P microcontroller (MCU) based development board with six analogue input pins and 14 digital I/O pins. The MCU features 32kB ISP flash memory, 2kB RAM, and 1kB EEPROM. The board provides the capability of serial communication via UART, SPI, and I2C. It can operate at a clock frequency of 16MHz. In this project, the analogue pin A0 of Arduino is used to read the output voltage (from pin no. 2) of LM35.

LM35. This is a precision IC temperature sensor. Its output voltage is linearly proportional to the temperature (in degree Celsius). LM35 exhibits typical accuracies of ±1/4°C at room temperature and ±3/4°C over a full temperature range from –55°C to +150°C. This sensor provides a sensitivity of 10mV/°C. In this project, the Vout pin (pin no. 2) of LM35 IC is connected to analogue input pin A0 of Arduino. Pin numbers 1 and 3 of LM35 are connected to +5V and GND of the Arduino Uno board, respectively.

The connection diagram of the interfacing temperature sensor with the Arduino board is shown in Fig. 2.

Software

The application program is developed in MATLAB R2014a with the Simulink toolbox. In order to build a Simulink model, 'Arduino IO Library' is needed, which can be obtained by installing 'Legacy MATLAB and Simulink Support for Arduino package' as explained below:

- Download Legacy MATLAB and Simulink Support for Arduino package from the MathWorks website. Extract ArduinoIO compressed folder
- From this folder, copy the pde folder and paste it in C:\ Program Files (or Program files x86)\ Arduino\Examples (path may be different depending on the installation directory of the IDE)
- After pasting the pde folder in the correct location, open Arduino IDE. If you have pasted the folder in the correct location, you would find pde in File→ Examples→pde
- Open adios code from File→ Examples→pde
- Connect the Arduino Uno board to your PC. From the device manager, note the COM port at which the Arduino Uno board is installed
- From Tools menu in Arduino IDE, select the board as Arduino

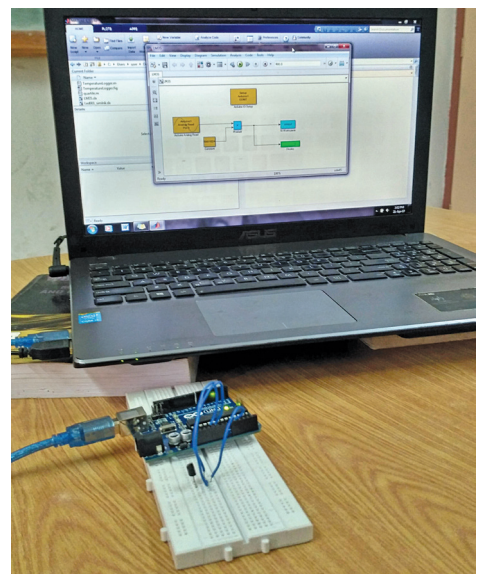


Fig. 1: Authors' prototype wired on breadboard

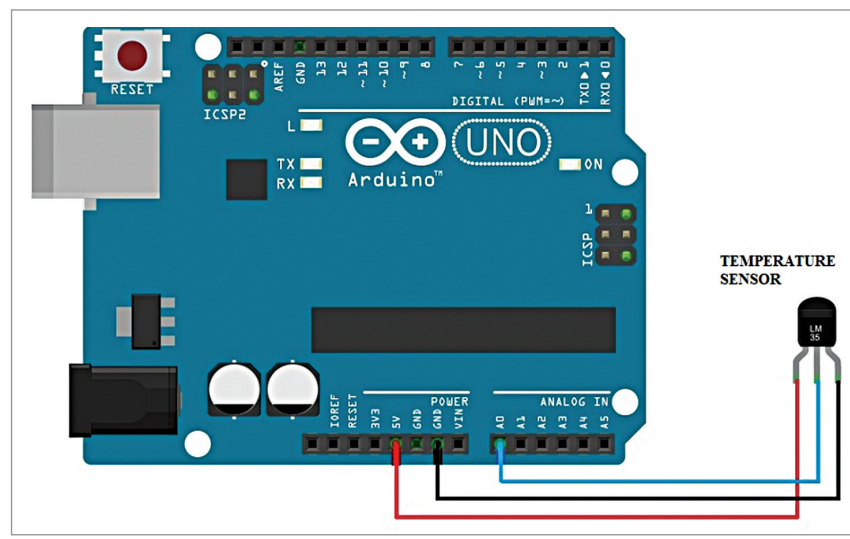
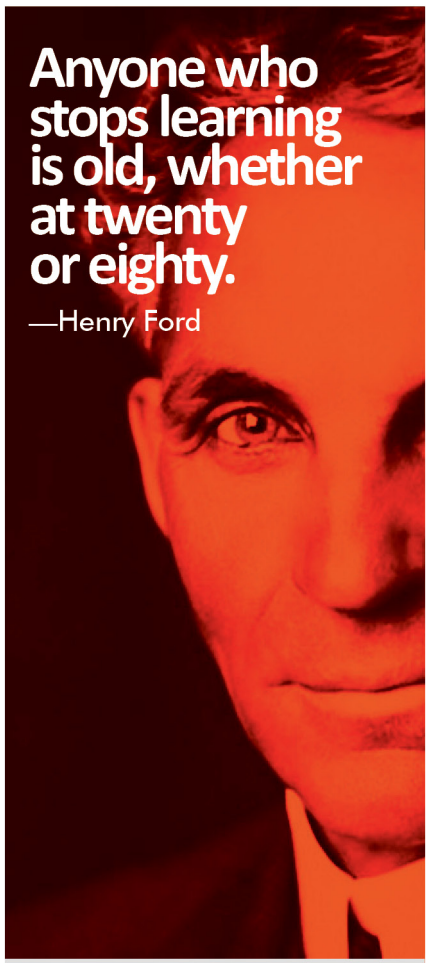


Fig. 2: Connection diagram

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—Henry Ford



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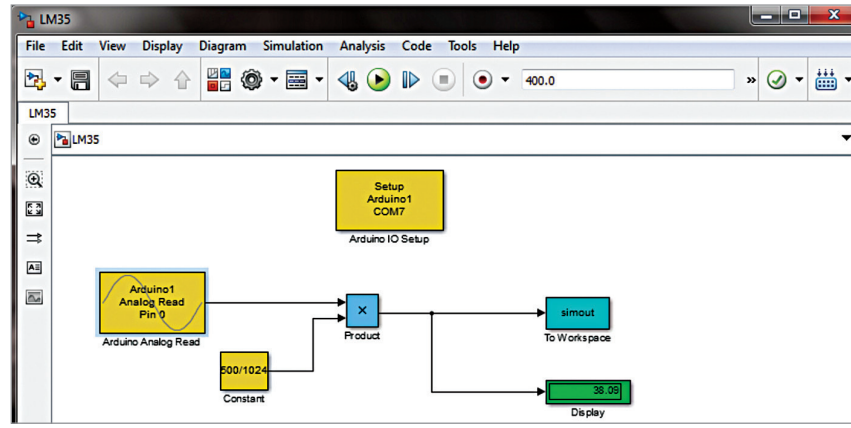


Fig. 3: Screenshot of the Simulink model

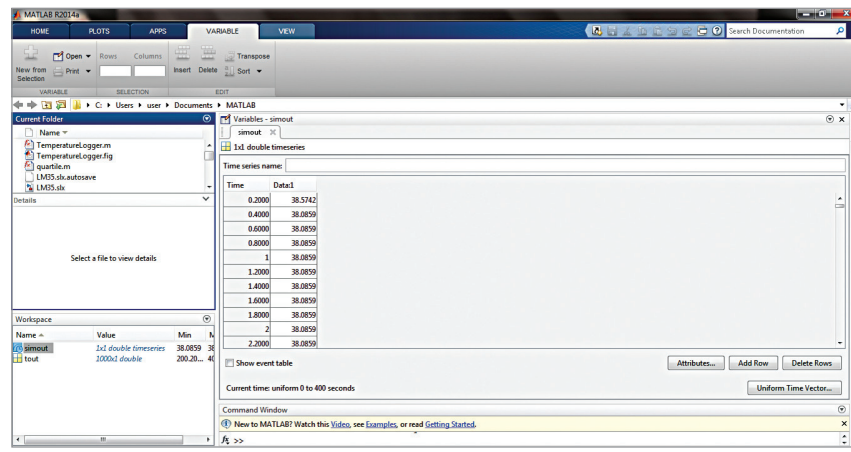


Fig. 4: Screenshot of the temperature data stored in MATLAB workspace

Uno and select COM Port number noted earlier

- Upload adios code to the Arduino Uno board by pressing the upload button in IDE
- Copy the entire contents of the extracted ArduinoIO folder to a folder in My Documents (For Windows PC). This step may be different if you are using the latest version of MATLAB
- Open Simulink LM35.slx source code file from MATLAB. The screenshot of the designed Simulink model is shown in Fig. 3
- Double click on the block 'Arduino IO Setup' and change the serial (COM) port number (set as 'COM7' here) with the corresponding port number in your PC where the Arduino has been installed
- If you want to connect LM35 to some other analogue pin of Arduino, double click on 'Arduino Analogue Read' block and set the corresponding pin
- Set 'Simulation Stop Time' as per your requirement
- Click on 'Run' button in Simulink
- The corresponding value of temperature can be seen on the 'Display' block in the model window. Additionally, the temperature data is also logged in MATLAB workspace variable 'simout'. When the simulation terminates, the temperature data can be read by double-clicking on 'simout' in the workspace window of MATLAB. The screenshot of the temperature (in degC) data saved in MATLAB workspace is shown in Fig. 4 EFY

EFY Note
The source code of this project is available for free download at *source.efymag.com*



Shibendu Mahata is MTech (gold medallist) in instrumentation and electronics engineering from Jadavpur University. He has made several contributions in the domain of signal processing in reputed international journals and conferences

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Sound Based Computer Automation Using Python

Vijaykumar Sajjanar

This project is used to control computer such applications as slideshow, music, or video with a finger snap or a clap. It aims at understanding the automation of computer functions through microphone without using microcontroller boards.

The project uses Python and its package 'sounddevice' to access sound intensity on a microphone inbuilt in a laptop or connected externally. Python package 'pyautogui' is used to automate keystrokes. You may also need to install the PortAudio package by running 'conda install portaudio' on Command Prompt with administrator privileges or by opening Environments through Anaconda Navigator.

A test script is included to test the sensitivity of different microphones and sound ambience. This script plots the intensity of sounds and noises encountered to determine the threshold level of a person's snap/clap. When a finger snap or a clap is detected, a single keystroke is automated.

Operating systems for laptops invariably include/support a voice assistant such as Cortana (MS Windows), Siri (Mac OS), and Mycroft (Linux). Voice assistants automate tasks but are slow and not customisable. This project overcomes all these limitations to automate any task imaginable by a developer.

How it works?

The computer application running in the background can be controlled by automating keystrokes. Fig. 1 gives a brief overview of the procedure. Microphone records sound using Python script. The sound intensity is analysed and keystrokes are mimicked to control applications such as presentation (slideshow), music, or video. For example, music is muted or unmuted by mimicking multimedia 'mute' key on the keyboard. The keystrokes can be changed as per requirements.

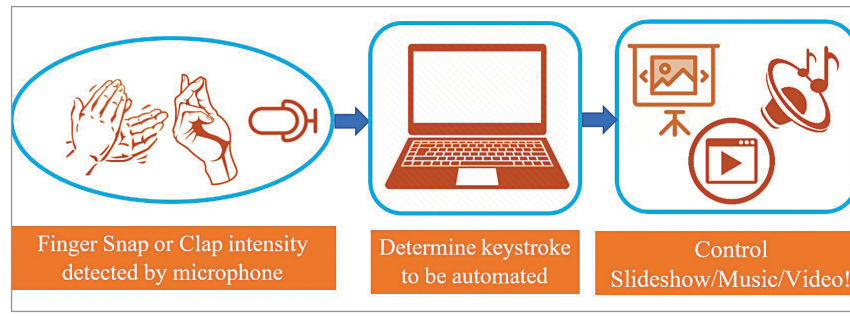


Fig. 1: Block diagram of the project

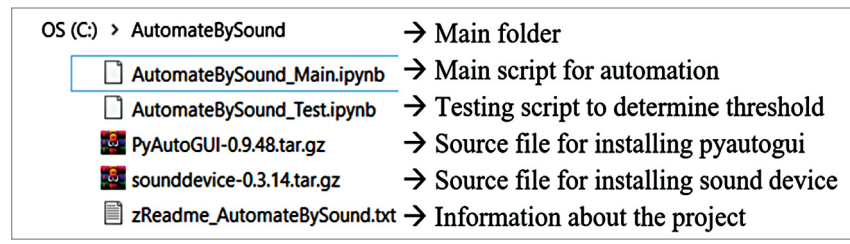


Fig. 2: Working environment

```
C:\>cd\

C:\>cd AutomateBySound

C:\AutomateBySound>pip install PyAutoGUI-0.9.48.tar.gz

C:\AutomateBySound>pip install sounddevice-0.3.14.tar.gz
```

Fig. 3: Installing packages using pip command

Creating a work environment

Use Anaconda Distribution on Windows Operating System. Anaconda is preinstalled with Jupyter Notebook, Python 3.xx, and many other Python packages. The AutomateBySound zipped folder consists of five files, as shown in Fig. 2. For simplicity, keep the unzipped AutomateBySound folder in C drive (location C:\AutomateBySound >).

Software installation and running the project

Step 1. First, install Python 3.7 Distribution from www.anaconda.com. With this, Anaconda PowerShell Prompt, Jupyter NoteBook, and other Python packages will also get installed. Then, open Command Prompt. (For running in Windows 7, you would need to run PowerShell from Start Menu on the desktop to open Command Prompt.) Install

Python packages offline from the AutomateBySound folder with commands, as shown in Fig. 3.

The advantage of using offline source files for package installation is that Python script runs every time without being affected by package version changes or updates or deprecation. Alternatively, for online installation, 'pip install sounddevice' and 'pip install pyautogui' commands will also work. After installation, 'successfully installed' or 'requirement already satisfied' message appears on the screen. You may also need to install the PortAudio package by running 'conda install portaudio' on Command Prompt with administrator privileges or by opening Environments through Anaconda Navigator.

Step 2. This step can be skipped assuming a safe threshold value of 0.1 for a finger snap, which is default scripted in AutomateBySound_Main.ipynb. To change the threshold value, follow the steps below:

(a) Open AutomateBySound_Test.ipynb script in Jupyter Notebook.

(b) Run the script. Provide ten snaps/claps at a gap of five seconds in front of the microphone connected to your PC/laptop. You will see ten graphs plotted on the screen with ten maximum intensity values being displayed. The threshold can be determined by observing the graphs. Fig. 4 shows a sample graph. For the sample graph shown, the threshold is 0.2.

Step 3. Next, open AutomateBySound_Main.ipynb in Jupyter Notebook. Edit the value of variable 'data' in the script with the threshold as determined in Step 2. Run the AutomateBySound_Main.ipynb script. It will prompt you for inputs, as shown in Fig. 5. Time duration of five seconds is provided by the program so that the target application (presentation/music/video) can be started by user.

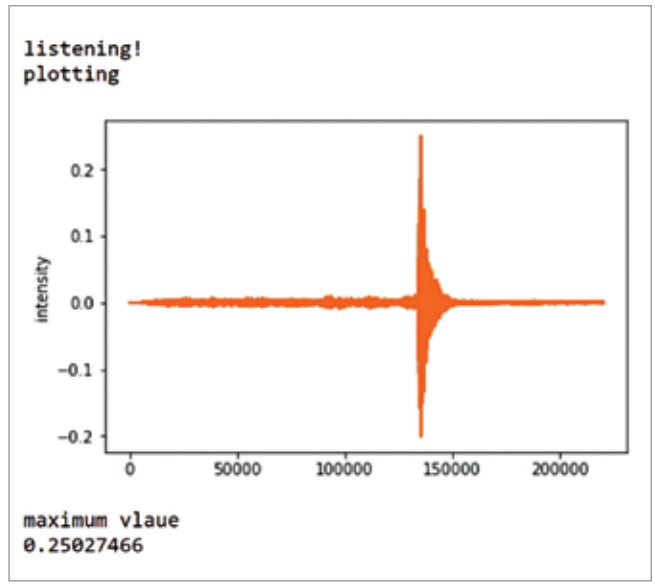


Fig. 4: Sample graph

```
Welcome, What would you like to automate today?
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
Press Number Followed by Enter
SlideShow-1, Music-2, Video-3
1
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
For how many minutes the automation should run?
60
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
Your SlideShow will be Automated in 5 seconds.
It will run for 60 minutes
You can change slide by snap/clap. Good luck!
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
```

Fig. 5: Prompt for gathering information and automating slideshow

Step 4. Next, you need to run the application (presentation file or audio file or video file.) In the example shown in Fig. 5, '1' is selected to start a slideshow presentation that would run for sixty minutes. With a finger snap or clap, the slide will change to the next slide every five seconds by itself. Similarly, you can enter '2' and run a music file; it will mute the audio. For a video application, you need to enter '3' for it to pause and play video. (Note you need to first click on the first slide of the presentation file, and the audio/video file should not be in stop mode before the start of automation.)

The main script can be downloaded as a Python file(.py) and run directly by double-clicking on it. The script can be distributed as a Windows application(.exe) to other computer systems that don't have a Python tool by using the 'pyinstaller' package.

Challenges and future scope

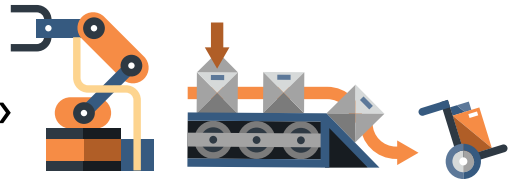
Sound detection and analysis are tough because sound/voice varies from person to person, and sound is always affected by noise. Different microphones provide varied responses in terms of sound intensity and frequency.

This project runs on a single snap/clap. Suitable scripting can incorporate multiple snaps/claps. Python is a versatile language; hence, small modifications in this project can automate many tasks such as opening applications, sending automated emails, opening websites, Web scraping, mouse clicks on-screen positions, hibernating laptop, etc. The same project can be extended very easily to build applications that include microcontroller boards (Arduino, NodeMCU, ESP, Raspberry Pi, etc) and sensors to control computer functions or external actuators (LED, motor, buzzer, speaker, etc). A Fourier transform can be included to automate laptop functions based on the frequency of sound. EFY

EFY Note
The source code of this project is available for free download at *source.efymag.com*



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UP government announces new electronics manufacturing policy to attract investors

According to a report, the Uttar Pradesh government has released a new electronics manufacturing policy to become a global electronics hub. This will help in attracting international investors looking to shift their base in India in the post-Covid-19 scenario.

An official spokesman reveals that the policy aims at inviting investments of 400 billion rupees in five years and creating 0.4 million direct jobs.

Noida, Greater Noida, and Yamuna Expressway regions have been manifested as the upcoming mobile manufacturing hubs in the state, which have attracted foreign direct investments from many countries. The state accounts for more than sixty per cent of all the mobile phones manufactured in India.

The incentives proposed in the policy shall be applicable to all units setting up their bases anywhere in Uttar Pradesh. Further, to address the regional imbalance, double the rate of land subsidy has been provided to investors for setting up manufacturing units in Bundelkhand and Purvanchal regions.

To promote MSME units in electronics manufacturing, the state government will encourage the development of rental facilities on the 'Plug and Play' model through public-private partnership (PPP) mode.

Government allows registration, sale of EVs without pre-fitted battery

The Ministry of Road Transport and Highways has issued a notification allowing the sale of electric two- and three-wheelers without a pre-fitted battery. This has been done to reduce the upfront cost of electric vehicles (EVs).

The ministry says that batteries account for almost half the cost of an EV, making them vastly more expensive than a combustion engine vehicle of similar performance. It adds that if the cost of batteries is delinked from that of the vehicle, electric two- and three-wheelers could cost less than fossil-fuel-powered vehicles.

Then the batteries can be sold by the manufacturer or an energy service provider. An energy service provider can then rent charged batteries to EV owners, akin to the refuelling of conventional vehicles.

As per Livemint, in a letter to the transport secretaries of all states and union territories, the ministry says that vehicles without batteries can be sold and registered after getting an approval certificate issued by a test agency.

Compound semiconductor market to reach $212.95 billion by 2027

The global semiconductor market is estimated to reach 212.95 billion dollars by 2027 as per a report by Allied Market Research. It adds that the value stood at 89.94 billion dollars in 2019, and it will grow at a CAGR of 11.1 per

ON THE move

Ketan Patel appointed MD of HP Greater India

Ketan Patel has been appointed as the managing director of HP Greater India. He will be responsible for the company's business in India, Bangladesh, and Sri Lanka. He joined HP in 2005 and has held various leadership positions across HP's personal systems, print, and graphics solutions businesses.

He has also worked as the head of the personal systems category for Greater Asia. From 2013 to 2017, he was the senior director of personal systems at HP India. Before joining HP, Patel was associated with Wipro Infotech, Wipro Peripherals, and TVS Electronics in India.

Dinesh Kumar Batra takes charge as BEL director

Dinesh Kumar Batra has assumed charge as director (Finance) of Navratna Defence PSU Bharat Electronics Limited (BEL). In a career spanning over three and a half decades, he has served the company in various capacities in Ghaziabad, Delhi, Pune, and Bengaluru.

Prior to his elevation as director, he headed internal audit at BEL's corporate office, regional office-Delhi, and Pune unit as general manager.

To make India 'Aatmanirbhar' in electronic artillery fuses and other ammunitions, he got 200 acres of land allotted by Maharashtra government at Nagpur to set up an explosive integration complex.

TEMA appoints BK Syngal as chairman of 6G Council

TEMA has appointed BK Syngal, founder chairman of VSNL, as chairman of TEMA 6G Council. BK Syngal is a pioneer in the Indian telecommunication sector and has been referred to as the 'Father of Internet & Data Services in India.'

His five-decade career includes senior executive positions in public sector telecom companies in India, including chairman and managing director of VSNL, India's leading provider of telecommunication services, chairman of Reliance Telecom, and vice-chairman of BPL Communications.

Calendar of Forthcoming Electronics Fairs/Exhibitions/Seminars/Events

Event, Date and Venue	Topics	Contact address for details
Renewable Energy India E-Expo September 2-3, 2020	Asia's most influential event on renewable energy that provides knowledge-based conference sessions in a virtual environment	Renewable Energy India E-Expo Website: www.reieexpo.maximumvirtual.com
IFA Berlin September 3-5, 2020 Exhibition Grounds Berlin Expo Center City, Messedamm 22, Berlin, Germany	Main meeting place for key retailers, buyers, and experts from the industry and the media	IFA Berlin Website: https://b2b.ifa-berlin.com
SEMICON Taiwan September 23-25, 2020 Taipei Nangang Exhibition Center, Hall 1 (TaiNEX 1)	The industry's first comprehensive physical-virtual event to gather industry leaders and visionaries for the latest developments, market trends and innovations in smart technologies	SEMICON Taiwan Website: www.semiexpo.expotec.tech/visitor/index
GITEX Technology Week September 27-October 1, 2020 Dubai World Trade Centre	World-class technology event. Technology leaders, enterprises and startups from around the world come together to show the future of every business and every industry	GITEX Website: www.gitex.com
OSI Days October 8-9, 2020 Nimhans Convention Centre, Bengaluru	Mega technology show with multiple events including expositions, conference and seminars	EFY Enterprises Pvt Ltd Website: www.opensourceindia.in
Engineering Design Show October 14-15, 2020 The Ricoh Arena, Coventry	UK's only event entirely dedicated to engineering, electronics and embedded design	Engineering Design Show Website: www.engineeringdesignshows.co.uk
3rd Automotive World October 21-23, 2020 Portmesse Nagoya, Japan	Exhibition and conference for advanced automotive technologies including electronics, smart factory and robotics	Reed Exhibitions Japan Ltd Website: www.automotiveworld-nagoya.jp
Light + LED Expo India 2020 December 3-5, 2020 Pragati Maidan, New Delhi	Will have Future Zone for innovative products, Solar Zone, and Launch Zone for new products	Messe Frankfurt Trade Fairs India Private Limited Website: www.in.messefrankfurt.com Email: deepak.bohara@india.messefrankfurt.com
Renewable Energy India 2020 December 10-12, 2020 India Expo Centre, Greater Noida	Technology leaders, policy-makers, influencers and decision-makers from around the world come together to discuss current challenges and technological advancements	Renewable Energy India 2020 Website: www.renewableenergyindiaexpo.com
CES 2021 January 6-9, 2021 Las Vegas, Nevada	Global consumer electronics show	Consumer Technology Association Website: www.ces.tech
NEPCON JAPAN January 20-22, 2021 Tokyo International Exhibition Center, Tokyo	Asia's leading electronics tech show about R&D and manufacturing, including packaging, with seven concurrent specialised shows	Reed Exhibitions Japan Ltd Website: www.nepconjapan.jp/en
India Electronics Week February 3-5, 2021 Karnataka Trade Promotion Organisation, Bengaluru	Mega electronics and technology show with multiple co-located events including expositions, conference and seminars	EFY Enterprises Pvt Ltd Website: www.indiaelectronicsweek.com
Smart Nation Expo & Forum March 23-25, 2021 MITEC, Kuala Lumpur	The biggest international exhibition on smart cities, 5G services, smart technologies, applications and solutions	Smart Nation Website: www.smartnationexpo.org/ve

Since this information is subject to change, especially due to coronavirus breakout, all those interested are advised to ascertain the details from the organisers before making any commitment.

cent from 2020 to 2027.

The report adds that an increase in demand for the epitaxial wafer in LED technology and the growing adoption of compound semiconductors compared to silicon-based technology are driving the growth of the global compound semiconductor market.

It adds that high cost associated with compound semiconductor components and materials is anticipated to restrain the market growth. It also says that a rise in usage in smart technologies is expected to provide new growth opportunities during the forecast period.

As per the report, "Major compound semiconductor manufacturers across the globe have halted their production activities due to disrupted supply of raw materials such as gallium and arsenide due to restrictions on mobility amid lockdown."

Defence production to reach ₹ 1,750 billion by 2025

Ministry of Defence (MoD) has formulated a draft Defence Production and Export Promotion Policy 2020 (DPEPP 2020). It aims to make India among the leading countries of the world in the defence sector, including aerospace and naval shipbuilding sectors.

The document says, "The present 'Defence Production & Export Promotion Policy (DPEPP) 2020' is positioned as Ministry of Defence's overarching guiding document to provide a focused, structured and significant thrust to defence production capabilities of the country for self-reliance and exports."

The policy has the goal of achieving a turnover of 1,750 billion rupees, including the export of 350 billion rupees in aerospace and defence goods and services by 2025. It aims to develop a dynamic, robust, and competitive defence industry, including aerospace and naval shipbuilding industry, to cater to the needs of armed forces with quality products.

The share of domestic procurement in overall defence procurement is about sixty per cent. To enhance procurement from the domestic industry, it is incumbent that procurement is doubled from the current 700 billion rupees to 1,400 billion rupees by 2025.

Delhi government announces new EV policy to curb air pollution

The Delhi state government has announced a new EV policy, which was introduced in December 2019. As per chief minister Arvind Kejriwal, the policy aims at reducing air pollution in the capital city. It has seen a

Edition Motors to invest ₹ 50 billion in Uttar Pradesh

South Korean EV giant Edition Motors has expressed its interest in investing almost fifty billion rupees to set up its production facility in Uttar Pradesh. It has proposed to invest five to seven billion rupees in the first phase, ten to fifteen billion rupees in the second phase, and twenty to thirty billion rupees in the third phase for its EV plant in UP.

A delegation of South Korean electric vehicle manufacturer, Edison Motors, met Uttar Pradesh chief minister Yogi Adityanath at his official residence in Lucknow. They talked about their desire to set up an electric vehicle plant in the state. They also said that this would create fresh employment opportunities for 5,000 people.

Okaya Power Group teams up with Prakriti E-Mobility for EV charging stations

Okaya Power has announced a strategic partnership with Prakriti E-Mobility Private Limited for providing charging stations to the fleet operations of Prakriti E-Mobility. Okaya said that its lithium-ion batteries and EV chargers with intelligent BMS have all the safety features to protect the battery and the vehicle.

Nimish Trivedi, co-founder and CEO, Prakriti E-Mobility Private Limited says, "The partnership with Okaya Power is very important to us, as it will help mitigate a major concern hindering the adoption of EVs in the country—the absence of adequate charging infrastructure. We are confident that this partnership will not only help us provide a robust charging infrastructure but also provide a much-needed impetus to the overall EV ecosystem in India."

Samsung might shift smartphone production in India

Samsung may shift a major part of its smartphone production to India from Vietnam and other countries with the South Korean electronics major finalising plans to produce devices worth over forty billion dollars in the country.

"Samsung is likely to diversify its production lines for making smartphones to India under the PLI (Production Linked Incentive) scheme, and this will have an impact on its existing capabilities across various countries like Vietnam," a person familiar with the matter informed *The Economic Times*. Vietnam is the world's second-largest exporter of smartphones after China.

Indian startup ION Energy signs big deal with esVolta

esVolta has selected ION Energy to improve the operational efficiency of its utility-scale battery energy storage projects, in one of the largest such deals in the world. Under the partnership, ION Energy's battery analytics platform, Edison Analytics, will be deployed across esVolta's entire portfolio of battery energy storage projects in North America, totalling to 581MWh of energy storage.

Unlike generic platforms, Edison, as per the company, is designed to improve the operational efficiency of battery energy storage systems (BESS) by reducing battery degradation and maximising energy trading revenues. esVolta has decided to deploy Edison Analytics across its entire portfolio of energy storage systems across ten locations in North America.

25 per cent reduction already over the past five years.

The Delhi EV policy aims to register 500,000 EVs in the city by 2024. It will be driven by a bunch of incentives offered by the state government through its newly incorporated State EV Fund and State Electric Vehicle Board, which will be chaired by transport minister Kailash Gahlot.

The Delhi chief minister says that the Delhi EV policy is one of the better policies among all those announced around the world, targeted to curb air pollution. It aims to give a boost to the economy of Delhi after getting a major setback due to coronavirus. He adds that it will give a strong impetus to the economy of the city.

The policy will also see the establishment of a dedicated EV cell to implement the policy at the ground level. The policy has been rolled out for the next three years and it will be reviewed from time to time.

Government puts imports restrictions on colour televisions

India has imposed restrictions on the import of colour television sets, bringing back curbs it had lifted almost two decades ago, in a measure to encourage domestic production. Imports of TVs in certain categories will now require a licence from the government.

"Import policy of colour television sets is amended from 'free' to 'restricted'," the Directorate General of Foreign Trade (DGFT) says in a notification, adding that it would separately issue the procedure for the grant of licence.

The curbs are applicable to TV sets included in the 'other colour' category that covers LCD TVs among the goods. There is no restriction on monochrome TVs. The total imports under the restricted category in fiscal 2020 were 781 million dollars. Of these, Vietnam and China accounted for 428.37 million dollars and 292.48 million dollars, respectively.

At present, around 35 per cent of TV sets sold in the country are imported. TVs are some of the non-essential goods whose imports India wants to cut down to boost domestic manufacturing. Sports goods, toys, and plastic goods are some other categories that are likely to face import restrictions.

The chairman of homegrown contract manufacturer Dixon Technologies, Sunil Vachani, says the move would further boost the Make in India initiative for TV sets and go a long way for self-reliance.

BEL equips government schools in Yadgir district with smart class facilities

Navratna Defence PSU Bharat Electronics Limited (BEL) has, as part of its CSR initiatives, empowered around 13,000 children studying in 122 government high schools of Yadgir district, Karnataka, by equipping these schools with solar-powered smart class facilities. The total cost of the project is 38.4 million rupees.

The solar-powered smart class facility offers visually attractive content that helps students to assimilate information more effectively. It facilitates teachers to explain difficult concepts easily, improves teaching effectiveness, and enhances the academic performance of students.

The smart class facilities provided by BEL to the government schools include a 127cm (50-inch) LED TV, CPU with accessories, green board, and LED lights, all of which are powered by a standalone solar PV power system with battery.

A cabinet has also been provided to store all the equipment. The digital educational content covers subjects such as English, Mathematics, Science, and Social Science for students of 8th, 9th and 10th classes.

Apart from the smart class facility, BEL is also installing handwash facility in hundred government primary schools in Yadgir.

Startup Zone

1 Bringing Automation To The Kitchen With Robotics

2 Using Plastic To Substitute Conventional Fuels

3 Waterless Solar Panels Cleaning Robots

4 A Connected Sports Bike Redefining The Indian EV Ecosystem

1 BRINGING AUTOMATION TO THE KITCHEN WITH ROBOTICS



Globally, more than enough food is produced to feed the entire human population, but world hunger is still an appalling problem in the modern world. One of the main reasons behind this is the wastage of food after harvest due to causes like improper packaging of meals or inadequate food storage systems. Overproduction of food is done to compensate for the wastage. But this requires more water and land, which leads to an excessive carbon footprint. In addition to this, a growing number of people are switching to healthier lifestyles.

These are some of the reasons that pushed Simon Watt and Barney Wragg along with Brent Hoberman to establish UK-based startup Karakuri two years ago. The company develops and installs intelligent robotic automation systems for restaurants, commercial kitchens, and the like. By adding machine learning (ML), optics, and sensors, the system is capable of producing personalised fresh meals with a focus on nutrition, calories, and quantities.

By tracking the required quantities, the data can be used by ML models to predict future requirements, which aids in streamlining the food supply chain and reduces food wastage. With automation, staff can also focus on more creative roles instead of regular, repetitive, and time-consuming manual tasks. The purpose is not to replace human workers but to help them in food preparation. This boosts productivity and increases customer satisfaction, including those with food allergies, which benefits businesses.

Their first off-the-shelf food preparation robot, DK-One (2100mm × 2400mm; 1,125kg), allows users to adjust their meals so as to fit their requirements based on the mass and temperature of individual ingredients. Typical output is one meal every ten seconds, assuming an average of 5.6 ingredients per box. With an average power consumption of 1500W and an IP44 IP rating, a maximum of 48 ingredients, including wet, dry, soft, or hard, can be dispensed per installation.

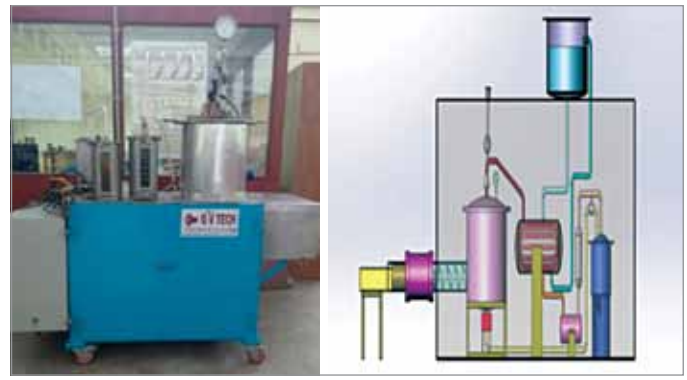
The economical alternative to DK-One is Marley (1700mm × 1750mm; 250kg), which is capable of providing customisation on a small scale. Not more than twelve ingredients can be dispensed into a biodegradable cup for each installation, with a typical meal output of one serving per thirty seconds. The average power consumption is only 400W.

In 2019, the startup raised £7million seed funding from Ocado Group, Firstminute Capital, Hoxton Ventures, and Taylor Brothers. The products can cater to a wide range of applications, including hospitals, ice cream parlours, cinemas, airports and transport hubs, stadiums and sports events, canteens and cafeterias, among others.

Due to the massive impact of Covid-19 on the hospitality industry, businesses have a huge focus on contactless delivery and maintaining proper hygiene. Consumers are hesitant to order food even in places where lockdown restrictions have been lifted. In such a situation, technology like robotics can aid in reviving the post-pandemic economy. Using food preparation robots like that from the startup is likely to become a preferred option due to the lower risk of contamination. Also, customers can interact with a restaurant's menu via an app so that social distancing measures are followed.

—Ayushee Sharma

2 USING PLASTIC TO SUBSTITUTE CONVENTIONAL FUELS



When the use of plastic began in the last century, it was seen as a way to protect and preserve goods. Its insulating property, durability, and ability to take different shapes made it quite popular for daily use. But now the world is facing the repercussions of its boom. According to a recent United Nations Environment Programme report, around 400 million tonnes of single-use plastic waste is produced annually all over the world. It is certain that recycling plastic waste is creating more jobs, yet currently, only about nine per cent of the plastic is recycled worldwide. Despite efforts to ban single-use plastic, we can't turn a blind eye to the numerous proofs of its hazards to the environment. The waste is littering our cities and oceans, choking our animals to death, and harming our health.

Located in Chennai, an IIT-M incubated clean tech startup Samudhyoga Waste Chakra has come up with a way to put even non-recyclable plastic waste to good use. The company specialises in the manufacturing of decentralised plastic pyrolysis machines. These machines are capable of turning plastic waste into low-density fuel oil that fulfills commercial standards in a sustainable and economically viable manner. The units have solar panels for alternative power supply for further reducing pollution.

In pyrolysis, long chains of molecules in plastic polymers that contain units of carbon and other atoms are broken down into smaller units in the absence of air. The resulting products from this thermochemical treatment are carbon black, gases, and fuel oil. The temperature needs to be greater than 350 degrees Celsius, and the process takes between sixty and ninety minutes to complete. Although plastics of any size can be accepted for processing, a minimum of 1kg weight is necessary. Plastics that can be converted to oil include low-density polyethylene (LDPE), high-density polyethylene (HDPE), polyvinyl chloride (PVC) ranging from one to five per cent, polypropylene, and polyethylene terephthalate (PET) ranging from ten to twenty per cent.

Usually, plastic waste management systems incur large logistics costs and have huge space requirements. In addition, consistent unavailability of raw material can make optimation of such systems difficult. These machines are small, mobile, user-friendly, and can work whenever required. Decentralised approach minimises the additional burden of waste collection, segregation, and disposal, which makes these units suitable for residential and industrial needs in urban, semi-urban as well as rural areas. On winning the Zero Carbon Challenge 2018, the startup had received a funding of 1.5 million rupees for the initial setup.

The fuel oil generated can replace pollution-causing conventional diesel fuel used to power furnaces, industrial boilers, diesel engines, generators, and even agricultural pumps. The company aims to improve the yield of fuel via suitable catalysts. The ultimate goal is to reduce landfilling and carbon emission through sustainable waste management of solid wastes and wastewater. Large-scale adoption of such systems can help in meeting the targets of Swachh Bharat Abhiyan and efficiently addressing our country's waste disposal problems.

—Ayushee Sharma

3 WATERLESS SOLAR PANELS CLEANING ROBOTS

Solar panels are known to sustain themselves for a long time without requiring much maintenance and effort. However, this is only applicable to areas receiving adequate rainfall throughout the year. Due to their inclined installation, rainfall washes most of the dirt, bird droppings, and dust settlement. But in dusty regions, or where the panels have stood for a long time, cleaning by rainfall is no longer enough.

In addition, manual cleaning is a risky and tedious job. Any exposed cable or a loose connection can lead to severe shock hazards. This is when professional cleaning services become a necessity to maintain the desired performance and keep accidents at bay.

To overcome these hurdles, startup Aegeus Technologies has come up with intelligent waterless solar panel cleaning robots, namely Unicorn and Shreem, with an aim to protect the

environment and save precious water resources. Waterless solar panel cleaning is a new technology, which uses a dry cleaning technique to enhance the capability of solar energy harnessing system.



Unicorn is a smart robot with machine learning (ML) capabilities. It senses dust levels and cleans accordingly. It can also differentiate dust from bird droppings or panel breakage. It features a rotary brush coupled with blower and auxiliary brushes to clean the panels. Unicorn can be set to operate at a fixed time of the day and week by using 'time' mode, or it can be operated based on the dust level when set in 'auto' mode. The fully automated system is ideally suited for both rooftops and ground mount farms, irrespective of the size and geography.

It sends a communication to the central monitoring station or designated mobile phone over GPRS when manual intervention is required. This intelligent robot can easily clean 400-800 panels per hour, depending upon the level of dust.

Shreem is exclusively designed for rooftop solar projects. It consists of two sets of soft microfibre cloth brushes (axial and radial). Controlled airflow ensures dust is blown away from the panels efficiently. The radial brush also ensures it blows away any leftover dust from edges.

The robot weighs approximately 5kg, which makes it light and portable. It can clean around 200 panels an hour and comes with a backpack so that it can be carried from one location to the other. In its basic version, the Shreem robot is Bluetooth enabled and can be operated using a mobile app. In case of large farms, it can be operated using an RF remote-operated controller.

Both robots use unique airwash technology to ensure there is no need for water or any harmful chemicals. The docking station monitors relevant weather parameters like rain, wind speed, etc. If the parameters are unsafe for the operation of robots, these continue to be in the docking station. The robots are powered by Li-ion batteries.

The docking station is equipped with a solar panel to charge the robot batteries when docked. There is no need for an external power supply or any cabling. The use of such technologies extends the life span of the panels, providing a payback of six to eighteen months, offering greater throughput, and increased efficiency.

Founded in 2017, the company is led by Suraj Vernekar, an engineer turned into an avid entrepreneur. "By 2025, an estimated 1.8 billion people will live in areas plagued by water scarcity, with two-thirds of the world's population living in water-stressed regions," says Suraj.

Aegeus is the only Indian startup that has received a patent for the innovative and unique airwash system. These waterless solar panel cleaning systems have received a nod from NCPRE-IIT Mumbai. The company strives to develop products that help clients to consume fewer resources.

The startup is also working on the Internet of Things (IoT) products like distribution transformer monitoring solution to monitor transformers, ensure continuity of power supply, and protect valuable assets of the utilities.

—Pallavi Singh

4 A CONNECTED SPORTS BIKE REDEFINING THE INDIAN EV ECOSYSTEM

With awareness regarding the benefits of electric mobility in maintaining a clean and green environment, it has gained drastic importance in India over the last few years. Now with the goal of self-reliance for reviving the country's economy, fostering Made in India technologies and replacing conventional fuel become far more crucial.

So a Bengaluru-based startup established by Niraj Rajmohan and Narayan Subramaniam in 2015, Ultraviolette Automotive unveiled F77, a high-performance premium electric sports bike last year with an aim to boost the electric vehicle (EV) sector and bust the myths around it.

The company spent the initial years in building a business model and testing prototypes of motorcycles, chargers, and modular batteries through self-funded capital, starting with the first prototype completion in June 2016. It won the excellent design award at the International Bike Festival 2016 in Taipei for developing a hybrid cycle. In 2017, automobile company TVS bought 15 per cent stake in the startup, which grew to about 25 per cent later on.

The two-wheeler having a lightweight steel-aluminium frame uses a sealed motor and electronic modules. It has only hand controls and there is no clutch. The range varies according to the load, driving pattern, road conditions, ambient conditions such as temperature, and so on. Previous data from riders and vehicles over a period of time is fed into machine learning models, and range estimates

are provided on the dashboard. The data collected from different sensors is also useful in diagnosing and predicting problems before their occurrence. With a top speed of 147kmph, immediate torque of 90Nm all-electric powertrain, and acceleration of 0-60kmph in 2.9 seconds, a range of about 150 km using three modular lithium-ion battery packs on a single charge can be achieved.



The smart e-bike uses modular battery technology to regulate heat dissipation issues, thereby improving the lifecycle of the battery. The EV has IP67 rated battery that can be charged at home with normal 230V AC mains. A regular 5A socket is suitable for the standard charger that takes three hours to charge to eighty per cent capacity while the fast charger works with a 15A socket and completes eighty per cent charging in fifty minutes. Using CCS Type-2 connector with a qualified DC-fast charger completes fast-charging within ninety minutes.

It comes with connected features like ride telematics, multiple ride modes (eco, sports, and insane), preventive maintenance, remote diagnostics, regenerative braking, and over-the-air (OTA) updates on a mobile application. FindMy-Bike feature allows users to locate the bike via LTE connectivity and GPS positioning and lock it down in real time, if required. According to the company, the vehicle has been tested for the toughest and most extreme terrain and climatic conditions in India and is capable of travelling through 30cm of water while passing through waterlogged areas.

The motorcycle is available in three variants—F77 Lightning, F77 Shadow, and F77 Laser—in a price range of ₹ 300,000 to ₹ 325,000 (on-road). The company is also working on setting up a nationwide smart network of charging points, beginning with Bengaluru. EFY

—Ayushee Sharma



The Benefits Of Robotics Outweigh The Challenges

Robotics is playing a huge role in the growth of businesses worldwide. It not only contributes to the smooth running of the business but also eases scalability. This growing technology also reduces the cost of operations. This article covers the growth of robotics in India and globally along with its advantages in various sectors



Progression of robots (Credit: https://miro.medium.com)

Nijhum Rudra

A robot is nothing but a programmable machine that interacts with the world physically and has the potential of performing intricate sets of tasks autonomously or semi-autonomously. For the past several years, the demand for robotics has increased among various industrial and hospitality sectors. The robotics sector has improved a lot due to falling sensor prices, open-source development, rapid prototyping, and convergence of different technologies.

The colossal demand for mobile computing has also proved to be a huge boon for the growth of robots and cobots, which ultimately leads to price reduction, swift advances, and the development of sensor technologies.

The popularity of IoT devices is a key factor for the popularity and growth of robotics. According to various experts, by the end of 2025, there will be approximately a hundred billion IoT connected devices that will help generate revenue of ten trillion dollars.

The most imperative factor for the development of robotics is the falling prices of sensors that collect and send data related to torque, pressure, and position. Earlier, for self-guiding robots, the prices of infrared and LiDAR sensors used to be very high. However, their

prices have now reduced by almost ninety per cent due to the aggressive launch of self-driving cars by Google's Waymo and others. Also, 3D cameras that used to be very expensive are now within the reach of every company.

One of the leading international business research firms, Freedonia Group, has speculated that the worldwide escalation for robots will be around eleven per cent each year in the coming three years. The huge improvement in technology during the past ten years has helped enhance the growth of robotics.

Currently, robots are mainly used in material handling, assembling, and welding applications in industries. According to a survey by McKinsey & Company published last year, the industrial robotics market experienced record unit sales of 381,000 in 2017, and currently has an installed base of about 2.1 million units worldwide. The market for industrial robots has been growing at a record rate of around nineteen per cent per annum since 2012, and is expected to continue like this until 2021.

Highlighting the development, growth, and usefulness of robotics, Balaji Viswanathan, founder and CEO of Invento Robotics, says, "In large auto warehouses, robots now run the major portion of the operation that doesn't need much light, thus reducing the cost of operation. Right now, our virtual assistant enabled chatbots are also a kind of robot that solves our various queries online."

Usefulness and growth of robotics in global business

Previously, the interaction between a man and machine was very limited and monotonous. But now, with the introduction of new robots, interactions have become very interesting. Nowadays, these robots interact and assist in various physical activities, and also have the ability to save our lives.

Various organisations around the world have now realised the importance of robots and taken important steps to start using these in their various applications. For example, MIT has unveiled a soft robotic fish known as SoFi that can help save the vast ocean. NASA is all set to send a huge bunch of robots to Mars.

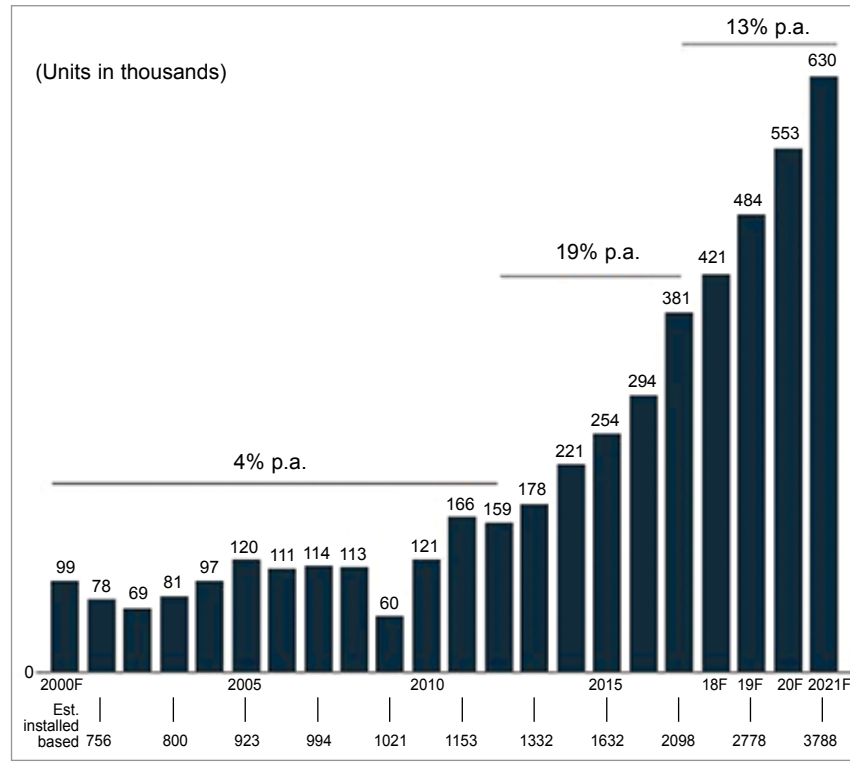


Fig. 1: Annual shipments of industrial robots worldwide

Not only this, robotics is also playing a huge role in the giant automobile industry. For instance, in a BMW facility in Chennai, robotic arms pick up material, thus helping in the smooth operation of the assembly line. While such mechanical jobs done by a human involve a lot of effort, robots make these jobs extremely easy and trouble-free. Most importantly, robots make the assembly and manufacture more consistent and efficient.

According to a study by Research Dive, the global collaborative robot (cobot) market will surpass 8,840.5 million dollars by 2026, at a CAGR of 41.2 per cent. Various industries are increasingly adopting cobots due to such advantages as increased productivity, effective employee utilisation, and improved workplace safety.

Phanindra Karody, head, Bengaluru plant, Continental Automotive India, says, "Cobots are designed to share the workspace with humans and take over duties that can result in being burdening, hazardous, or unergonomic such as assembling and carrying heavy components. Employing cobots to take over such mundane work results in minimal or no error while keeping the downtime in check. On the other hand, workers can focus on tasks requiring close attention and maintaining precision at production, quality, and testing. Thus, promoting productivity, quality, efficiency, and sustainability (in terms of cost-saving, resource-saving, and safety) on the shop floor."

The robotics firm Addverb exclusively stated to EFY that robots and cobots (collaborative robots) have emerged as a preferred choice by businesses to acclimatise their manufacturing with these changing times. With the onset of Covid-19 pandemic, robotics and increasing automation have become a strategic priority for global businesses.

If implemented correctly, robotics can not only contribute to the smooth running of the businesses but also enable scalability. The technology can ensure consistency so that the same level of quality is achieved from company-wide operations. Flexibility, agility, and productivity are three key drivers that are primarily accelerating the adoption of cobots. With the change in the supply chain paradigm and the quest to provide customers with the best product in the shortest

Experts' views

"Historically, one of the biggest barriers to automation and robotic adoption has been cost and time constraints associated with the production setup. Traditionally, setup is done by a team of robotics experts adept in programming languages and advanced engineering. The rise in collaborative applications has made robots easily deployable without the need for companies to have large and complex engineering departments. These offer a fast, easy, and affordable alternative to bulky traditional industrial robots. Intelligent robotic tooling comes with in-built features that are easily programmable, enabling faster set-up. These solutions are making automation more inclusive, enabling collaborative applications to meet modern automation needs."

—Niels Ole Sinkbæk Sørensen, country manager, South Asia, Southeast Asia & Oceania, OnRobot

"The disadvantage is that mobile professional service robotics works on batteries, and power often restricts their functioning accomplishments. Also, running on-the-go machine learning algorithms using traditional chips such as GPUs that utilise hundreds or even thousands of watts leads to a battery capacity limitation. Last but not the least, maintaining strong and reliable connectivity in professional robotics for their constant mobility is often difficult. And using 4G networks connectivity or inexpensive Wi-Fi systems in robotics do not guarantee their quality of service. We can make use of advances in edge AI chips, which can improve the robotics performance and power consumption as these chips are designed to draw much lesser power than GPU chips. Advanced 5G technology in solving connectivity problems gives a reliability rate of 99.99 per cent. Also, network slicing technology allocates network performance to different tasks based on their priority with enhanced reliability. 5G delivers sub-millisecond latencies, which allow much faster reaction times."

—Sangeet Kumar, CEO and founder, Addverb

"I would say that the benefits outweigh the challenges. The industry—tier 1 and 2, OEMs and suppliers, large and small—realise the fact that this is not yet another passing tech fad. Everyone is working towards technological transformation. That said, this change is effort and capital intense. The scale, pace, and levels of automation are different across organisations. To top it all, there is the pressure to ensure that your workforce is skilled and fully equipped to manage the change. There are other aspects too to consider, for example, making sense of the data we generate and convert it into usable information. Another example is cybersecurity."

—Phanindra Karody, head, Bangalore Plant, Continental Automotive India

possible time, the businesses have been quick to adopt robots and cobots on the shop floor.

Karody further adds, "These collaborative robots help in relieving staff from the repetitive and mundane tasks and eliminate the inaccuracies caused due to fatigue and manual errors. Businesses can look for the sweet spot by carefully automating the menial and physically taxing tasks and delegating the more adroit and skilful tasks to humans. This sweet spot can ensure highly scalable and accurate operations. With the improvement in technology and IT infrastructure, the application of robots and cobots can see a disruptive improvement and lead to far wider adoption by businesses."

A report in the International Federation of Robotics (IFR) suggests that a substantial share of this cobot adoption will be driven by more intelligent components such as smart grippers, plug & play interfaces, and programming by demonstrations. Programming by demonstration allows direct programming methods through digital sensors and smart software. For instance, workers can now program a robot by taking the robot arm and hand guiding it through the movements.

Niels Ole Sinkbæk Sørensen, country manager, South Asia, Southeast Asia & Oceania, OnRobot, says, "Robots offer numerous benefits, including making the production process shorter, increasing productivity, reducing the defect rate and supporting employees, making them more efficient and valuable. Automation is crucial, especially for SMEs who have smaller cash reserves and a more limited customer base, making them vulnerable to disruptions. These companies have new options in automation as collaborative applications offer a fast, easy, and affordable alternative to bulky traditional industrial robots. Collaborative robots (cobots)—robots that work safely alongside workers—account for three percent of global robot sales, and this share is expected to rise to 34 per cent of a 25 billion dollars market by 2025."

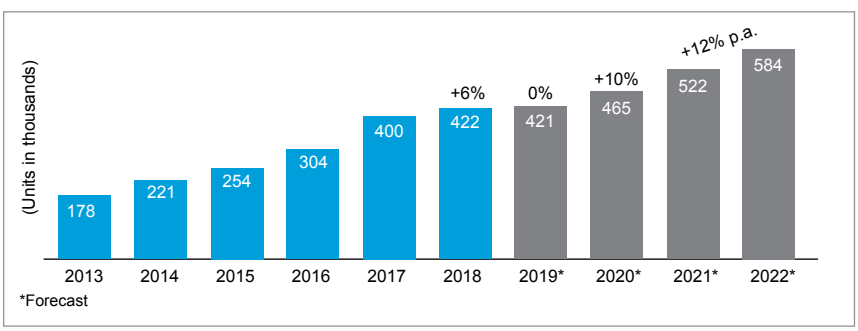


Fig. 2: Annual installations of industrial robots 2013-2018 and 2019-2022* (Source: World Robotics 2019)*

Growth of robotics market in India and globally

According to IFR, Asia is said to be the largest market for robotics. Back in 2018, robotics installations in South Korea and China chiefly reduced, while the market for Japan augmented massively. Overall, the market in Asia grew by one per cent. Both Europe and the US reached the peak of robotics installations six years in a row.

The new World Robotics report shows an annual global sales value of 16.5 billion dollars in 2018—a new record. 422,000 units were shipped globally in 2018—an increase of six per cent compared to the previous year. IFR predicts an average growth of twelve percent per year from 2020 to 2022. Allied Market Research forecasts that the industrial robotics market size is expected to reach 70,715 million dollars by 2023, at a CAGR of 9.4 per cent from 2017 to 2023. Statista, on the other hand, claims that the global market for robots is expected to grow at a CAGR of around 26 per cent to reach 210 billion dollars by 2025. It is predicted that this market will hit the hundred billion dollars mark in 2020.

Talking about the Indian market,

it is now one of the fastest-growing economies in the world. Sales of industrial robots in India reached a new record of 4,771 new units installed in 2018—an increase of 39 per cent compared to the previous year (2017: 3,412 units). India now ranks eleventh worldwide in terms of annual installations, claims IFR. The Indian industrial robotics market was evaluated at 4,564 units in 2018 and is estimated to grow at 13.3 per cent CAGR in the coming three to four years.

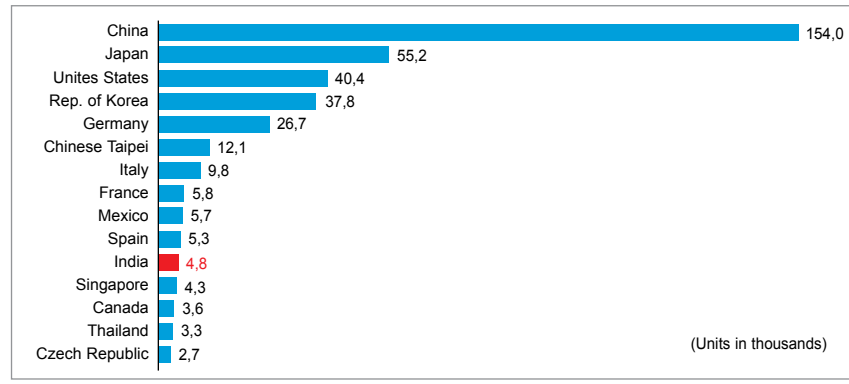


Fig. 3: Annual installations of industrial robots—15 largest markets 2018 (Source: World Robotics 2019)

Challenges of robotics in manufacturing

Robotics has considerably reduced several pains of the manufacturing process, including reduction in the cost of operations. But there are various obstacles faced by manufacturers while installing robotics in their units. These are as follows:

Training and skillset. When new robots are installed in the units, a new form of training and skills are required for the employees. They have to be trained on how to operate in this new environment. Also, companies have to look for a few other employees who have the necessary qualifications in handling robotics

Safety measurements. There is a saying that every development comes at some cost, and the same is the case with robotics. The industrial robots come with several safety hazards to the units, and strict regulations have to be maintained. Manufacturers have to look for and take all the necessary precautions before installing robots.

Budget. For the industrial robots, a huge upfront cost is associated, though their prices are now decreasing. The volume of production and sales level will have to remain stable during the speculated ROI timeline to compensate for the initial investment.

Apart from manufacturers, robot makers themselves face several tough challenges. These challenges are hindering the practicality of professional services of robotics in businesses. EFY



New Products

COMPONENTS

Automotive speech synthesis IC

LAPIS Semiconductor has introduced the ML2253x series of automotive speech synthesis ICs that have been optimised for audible notifications and sound effects in the advanced driver assistance system (ADAS) and acoustic vehicle alerting system (AVAS). The new product series not only improves quality by detecting audio defects using a playback anomaly function but also facilitates system configuration while simplifying software design for the main MCU.



The ML2253x series also includes a playback sound anomaly function that can send error signals to the main MCU. This makes it possible to detect playback anomalies such as skipping, thereby further improving the quality of automotive audio output systems.

Compared with a conventional compression algorithm, HQ-ADPCM enables to achieve high fidelity sound without distortion. Additionally, flash rewrite function from the main MCU enables rewriting of voice data even after shipment.

LAPIS Semiconductor
www.lapis-semi.com/en/

Imaging chip

RFISee, an Israel-based developer of imaging radars for the automotive industry, has launched phased array 4D imaging radar on a chip. RFISee's all-weather radar can detect cars from 500m and pedestrians from 200m, with an angular resolution greater than one degree. The phased array antenna technology is used in cutting edge military systems, including F-35 fighter jets and in air defence systems.

The company's 4D imaging radar uses a powerfully focused beam based on proprietary phased array radar technology. The focused beam created by dozens of transmitters rapidly scans the field of view. The receivers ensure a much-improved radar image, a better signal to noise ratio and a wide detection range (nearly 6x compared to existing radars) of obstacles such as cars and pedestrians.



The radar's features prevent accidents that go undetected by other existing radar systems.

RFISee
www.rfisee.com

MEMS speaker

xMEMS Labs, a developer of speaker technology for personal audio devices, has introduced Montara, a MEMS speaker that can deliver high-fidelity, full-bandwidth sound and low total harmonic distortion (THD) for sealed in-ear personal audio devices, including true wireless stereo (TWS) earbuds.



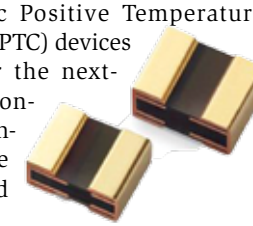
Montara is an IP-57 rated micro-speaker, enabling water and dust-resistant earbuds without special protective mesh or coverings. Consumers can benefit from enhanced audio fidelity with raised levels of clarity, extremely low latency, waterproof earbuds, and longer listening times.

Montara replaces the previous highly-variable voice-coil speaker technology with a high-precision, high-consistency, monolithic semiconductor process, thus reducing package height and eliminating driver matching and calibration due to inherent variability in membrane assembly.

xMEMS Labs
www.xmems.com

PPTC devices

Littelfuse has launched a new series of Polymeric Positive Temperature Coefficient (PPTC) devices designed for the next-generation consumer electronics to become smaller and more reliable.



The new series provides robust overcurrent and overvoltage protection on the signal lines for both li-ion battery pack ICs and fuel gauge. These PPTC devices are for high voltage (13V DC) applications and ideal for designing increasingly small mobile and wearable product designs such as smartphones, notebooks, etc.

The zeptoSMDC series PPTC devices are available in small 0201 surface-mount sizes in tape and reel format.

Littlefuse
www.littlefuse.com

Power amplifier

Qorvo has introduced a GaN power amplifier (PA) that delivers a fifty per cent increase in power for improved range, performance, and multi-target tracking in S-band (2-4GHz) phased array radars.



With 150 watts of power for the 2.9 to 3.5GHz frequency range, the QPA3070 achieves 58 per cent power added efficiency (PAE) and 28dB power gain with the help of ultra-reliable and highly efficient gallium nitride (GaN)

on silicon carbide (GaN-on-SiC) process technology, which offers superior efficiency, power density and affordability.

The device enables engineers to design higher power radar solutions with significant size, weight, power, and cost (SWAP-C) improvements and bring them to market faster.

Qorvo
www.qorvo.com

DC-DC controllers for vehicles

Renesas Electronics Corporation has announced a pair of new 42V dual synchronous controllers with low 6µA quiescent current and integrated 2A source/3A sink MOSFET drivers that provide primary power stage solutions for Renesas R-Car H3 and R-Car M3 SoCs.

The ISL78264 dual sync buck controller manages DC-DC conversion by stepping down the 12V battery system to 5V and 3.3V to power the vehicle's electronic control unit (ECU), in-vehicle infotainment (IVI) and digital cockpit systems with 50W to 200W power levels.



The ISL78263 dual sync boost and buck controller provides DC-DC conversion to support power levels of 25W to 100W while providing a pre-boost when the battery voltage (VBAT) dips to as low as 2.1V during a cranking transient or a start/stop event.

Renesas
www.renesas.com

Railway DC-DC converters

TRACO POWER introduces TEP 40UIR and TEP 60UIR, two series of high-performance railway DC-DC converters with ultra-wide 12:1 input voltage range.



The ultra-wide input allows the converter to act as an all-in-one solution for covering different voltage ranges in the same application, thereby resolving the issue of having multiple different converters installed.

An internal circuit present in these modules helps to extend the hold-up time with ease while eliminating the need for expensive high voltage capacitors to cover the full input range. With only a 25V capacitor (independent of the input voltage), the whole input range can be covered, reducing cost, size, and inrush current.

All models are approved for railway applications according to EN 50155 and EN 61373. These are also qualified according to EN 45545-2 (for fire behaviour).

TRACO POWER
www.tracopower.com

TEST & MEASUREMENT

Oscilloscope

Tektronix has announced the expansion of its TBS1000 series with the launch of the new TBS1000C digital storage oscilloscope. It has a 17.7cm (7-inch) WVGA colour display with up to 1 GS/s sample rate and bandwidths from 50MHz to 200MHz. It also includes Tektronix's HelpEverywhere system, which provides useful tips and hints.

The TBS1000C digital storage oscilloscope has been designed for quick hands-on learning and easy operation.



Besides a WVGA colour display, a network of ten vertical divisions and fifteen horizontal divisions enables users to see more signals per screen.

The series has dedicated front panel controls to provide easy access to important settings and new large menus with clearly labelled on-screen information for easily finding the required data.

Tektronix
in.tek.com

Vector signal generator

Rohde & Schwarz has released a new multi-standard and fully configurable platform, R&S SMCV100B vector signal generator for automotive, broadcast, navigation, and wireless applications, ranging from the lab to production. The R&S SMCV100B can cover the 5G NR extended FR1 frequency range of up to 7.125GHz, making it ideal for mobile communications applications.



In the automotive industry, the R&S SMCV100B is suited for end-of-line testing of car radios or GNSS navigation equipment. Broadcast standards can be combined with mobile communications, wireless, and navigation standards. For Go/NoGo tests, the generator can offer GPS, GLONASS, Galileo, and BeiDou signals of a single navigation satellite.

Rohde & Schwarz
www.rhode-schwarz.com

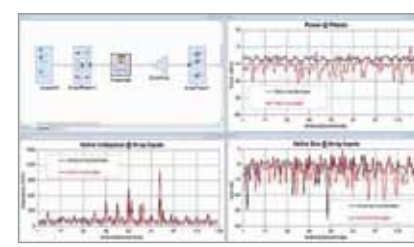
SOFTWARE

PathWave Design software

Keysight Technologies has announced the release of PathWave Design 2021. The latest version is an open, scalable, and predictable 5G and mmWave software solution.

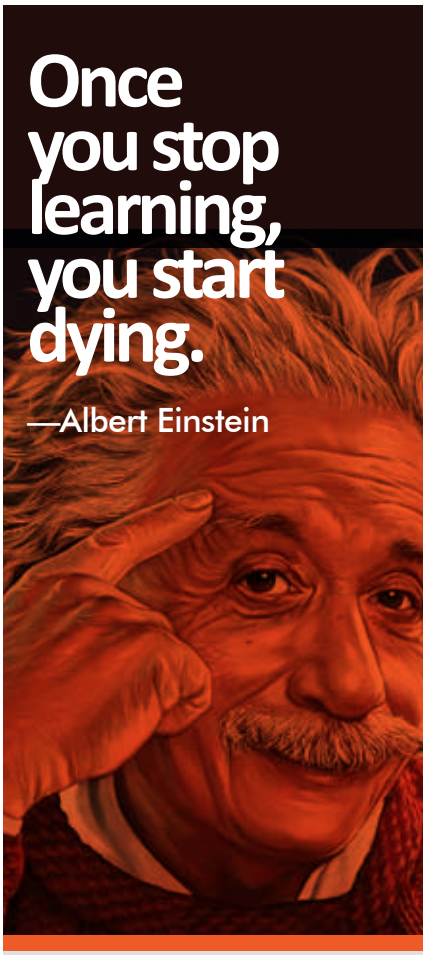
Through this release, design and validation engineers will be able to accelerate the delivery of chip, board, and system products by integrating device, circuit, and system design with improved performance and accuracy.

Keysight's PathWave Design software suite includes PathWave Advanced Design System (ADS), PathWave RFIC Design (GoldenGate), PathWave System



Design (SystemVue), and PathWave EM Design (EMPro), which deliver the key capabilities needed to address 5G challenges such as radio frequency/microwave (RF/MW) simulation and verification, electronic system-level (ESL) simulation and device modelling.

Keysight Technologies
www.keysight.com



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Automotive software

In order to quicken the prototyping of new automotive solutions, STMicroelectronics has introduced a new automotive development platform—the AutoDevKit. It provides huge flexibility in design for empowering designers to address new challenges during the development phase of a new electronic module for an automotive application, thus allowing rapid prototyping for a faster time-to-market.

The foundation of the AutoDevKit comprises a wide variety of hardware and software support, making the entire solution follow a 'Lego-like' approach where a variety of building blocks can be assembled in an application.

The flexibility to reuse existing hardware as well as applications developed with AutoDevKit allows removal of some building blocks (that had been used in previously released applications) and replace them with new ones.

STMicroelectronics
www.st.com

Optical sensor

Maxim Integrated has introduced MAXM86146, a dual-photodetector optical sensor solution. The sensor module includes built-in algorithms for heart rate and oxygen saturation (SpO_2) monitoring as well as advanced activity classification. Its small size and ease of design allow innovative biosensing features in less space and support the rapid development of accurate and continuous health-monitoring devices.



The MAXM86146 offers wearable product designers the ability to achieve a 45 per cent thinner optical design versus a discrete approach. Additionally, the module comes with biosensing algorithms that are verified by strict medical standards for measuring vital signs.

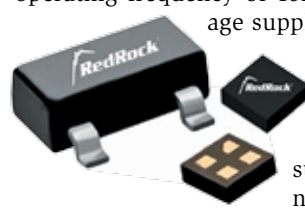
Maxim Integrated
www.maximintegrated.com

SENSORS

Digital magnetic sensor

Coto Technology, a provider of relays for switching and magnetic sensing solutions, has introduced the new RedRock RR122-1A22-511/512 wafer-based TMR (Tunneling Magnetoresistance) digital omnipolar sensors.

The RR122-1A22 series features an operating frequency of 10Hz, a voltage supply range of +1.7V to +5.5V, and an extremely strong magnetic sensitivity. With a low current drain (75nA) for an active magnetic sensor, the series is suited for performing 'wake up' or 'turn on' function for battery operated and power-sensitive applications.



The operating temperature range is from -40 degrees Celsius to +85 degrees Celsius. An upgraded version providing high temperatures of up to +125 degrees Celsius is also available.

Coto Technology
www.cotorelay.com

MISCELLANEOUS

Power Supply

RECOM has introduced a highly compact 230W innovative baseplate-cooled power supply for medical, household, industrial, and ITE applications.

The new, compact RACM230-G series power supplies from RECOM support up to 160W continuous output power and 230W for several seconds for loads with peak demands, without fan cooling. With forced air, depending on the model, line input, and ambient temperature, 230W is available continuously.



Outputs available are 12V, 24V, 36V, 48V, and 54V nominal with conversion efficiency up to 92 per cent and an operating temperature range of -40 degrees Celsius to +80 degrees Celsius.

RECOM, www.recom-power.com

Industrial Robotics Standards For Safety And Efficiency

Eric Esson is national sales manager at Dynatect Manufacturing, Inc.

There have been significant changes in industrial safety standards for robotics. Safety managers, plant managers, and others need to keep pace with the latest codes and regulations. According to the US Occupational Safety and Health Administration (OSHA), 'machine guarding' that pertains to machines' general requirements and general industry (29 CFR 1910.212) consistently falls in the top ten most frequently cited OSHA standards violated in any given year. Thanks to the Robotic Industries Association (RIA) R15.06-2013 standard, proper risk assessments are no longer just a best practice; they are mandatory.

RIA 15.06-2013 harmonises international and US standards. The RIA 15.06-2013 was written to be compliant with international standards already in place in Europe. This standard requires better hazard identification related not only to robotic motion, but also to the task being performed. Additionally, it requires validation and verification of the safety systems employed and requires designs that incorporate protective measures for the robot cell and the operator.

Some of the biggest changes in the RIA 15.06 industrial robot standard include safety-rated motion and allowing advanced programmable safety devices to be used. What this means is that the software will now be allowed for 'safety-rated' control of various aspects of the robot's function, limiting the area in which the robot operates and the speed of robot motion.

The basics of machine guarding risk assessment. The first step for facility/safety professionals is to identify and understand all applicable codes and regulations for their facility and operation. Next, they should examine the prevailing machine guarding choices for those applications to validate their safety system and its components. Risk may even vary between similar operations, depending upon employee exposure and other factors.

Determining risk. When performing a proper risk assessment, point-of-operation guarding is the most involved aspect. It is easy to place perimeter guarding around the entire process. However, in most situations a machine operator needs to interact with the process by loading or unloading materials (such as metals to be welded) and 'running' the machine. Many details must be considered when it comes to this area, including the layout or design of the process and the limits of the system.

Once the severity of the potential hazard has been determined, the frequency or duration of exposure and the possibility of eliminating or limiting exposure can help safety managers choose the proper machine guarding device. Also, using the distance formula identified in OSHA guidelines can help in this selection.

Limiting hazard exposure. Light curtains, laser scanners, and other presence-sensing devices are a commonly used and widely accepted method of machine guarding in manufacturing facilities from Tier 1 automotive to small machine shops and fabrication facilities. With presence-sensing, the automated process ceases once the safety device's infrared beam is tripped. In many instances, these devices provide acceptable safety. However, these are not always the best choice in all applications, especially after a risk assessment is performed. Coupled with safety interlocks (up to PLe per EN ISO 13849-1 when integrated properly), fast-acting automated barrier doors or roll-up curtains offer an increased level of protection for point-of-operation guarding.

From EN 954-1 to ISO 13849-1 and EN 62061. One of the biggest regulatory paradigm shifts occurred with this move. ISO 13849-1 provides a clearly defined set of rules to follow when designing the safety system as applied to industrial machine control systems. Officially defined as "safety of machinery, safety-related parts of control systems, general principles for design," this regulatory shift was made necessary by increasingly complex manufacturing processes using robotic and automated technology.

The ISO 13849-1 standard applies common sense and forces facility managers to validate their safety systems, whereas EN 954-1 only required facilities to apply safety devices (controls) properly, specifying non-programmable, out-of-date technology.

EN ISO 13849-1 is ultimately making a much safer manufacturing environment because it accounts for the regulatory gaps in the older standards. For regulations such as RIA 15.06 and EN ISO 13849-1, it is important to keep up with the latest and greatest safety technologies available to match the right product to the right process.

Creating a smaller manufacturing cell. Due to the nature of a properly interlocked automated barrier door, certain aspects of OSHA's safety distance formula become moot because there is no depth penetration factor. The safeguard can be placed much closer to the hazardous area, which reduces the manufacturing cell's footprint. This space savings is a huge benefit in most facilities. The smaller safety zone may also help increase productivity and create a better ergonomic situation for the machine operator by limiting required motion. EFY

Credit: https://blog.isa.org/new-industrial-standards-robotic-safety

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+ **Browser:** Mozilla Firefox (*www.mozilla.org*)
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+ **Media player:** PotPlayer (*potplayer.daum.net*)

Ayushee Sharma

Software For ROBOTICS

Roboguide

Visit: *https://www.fanucamerica.com*
Full version: Paid

Roboguide family of software packages allows users to create, program, and simulate a robotic workcell in 3D without the need for the Internet. For applications that require material handling, HandlingPRO comes with features like CAD to path programming and machine modelling. Others include PaintPRO for simplifying the painting process, PalletPRO for mainly developing workcell layouts, and WeldPRO for simulating the robotic arc welding process. This reduces the time and cost incurred in creating a physical prototype, besides avoiding the risks involved due to design problems after actual installation.

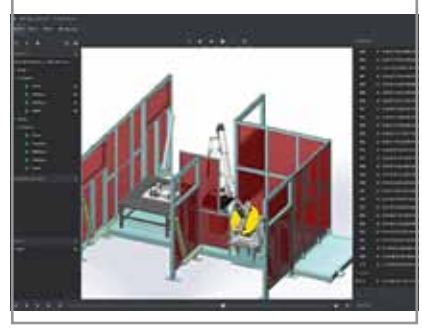


Workcell with simulation of robotic path playback

Robotmaster

Visit: *https://www.robotmaster.com/en*
Full version: Paid

Robotmaster offers a task-based robot programming platform for part manufacturing. This includes welding, cutting, drilling, fastening, and so on. The standalone tool is easy and intuitive, even if the users lack robotics or CAD/CAM expertise. All errors are visualised and mapped in a single screen and colour-coded by type. Click-and-drag interactive simulation/editing environment makes analysis simple and reduces time. Other features include offline programming, automated robot motion optimisation, accurate robot trajectories without the use of teaching points, terminology and control setting custom to the application, and the like.



Virtual Robotics Toolkit

Visit: *https://www.virtualrobotics-toolkit.com*
Full version: Paid

Virtual Robotics Toolkit by Cogmation Robotics is an educational software that allows users to design and program their digital robots. The development environment is made for use with Lego Mindstorms NXT and EV3 robots. Students can expand their knowledge and share their projects in the form of files without the need for additional resources. Testing for various environments and troubleshooting can be done without the requirement of physical space. Simulation lessons are also available for all skill levels.



CoderZ Learn

Visit: *https://gocoderz.com;* **Full version:** Paid; free trial

CoderZ Learn is a STEM education platform to teach students between 6th and 12th grade about programming of virtual 3D robots. The codes can be tested with real-time simulation. There is no need for prior experience or additional hardware and software. The online environment is designed in a fun and engaging way so that students can learn from anywhere in the world. Working on it also helps in understanding other STEM concepts like navigation, mechanics, and sensors.



IRBCAM

Visit: *https://www.irbcam.com;* **Full version:** Paid

IRBCAM is a 3D simulation software for robot machining, used mainly in industries. It has an intuitive and user-friendly 3D interface that enables conversion of NC-code (DIN G-codes or APT-CLS format) to high-quality executable robot motion code. It is compatible with various CAD/CAM software like SurfCAM, Creo, PowerMill, ProEngineer, among others. Users can select any robot from a built-in library of over 250 commercially available robots. The software can also be used for standalone offline programming and verification.



MOBILE APPS
For Robotics



Scan the QR codes to download the apps based on the operating system of your device

RoboDK

Updated: June 2020
OS: Android and iOS
Download: Full version (paid)

RoboDK app allows users to view and edit projects related to 3D simulation and programming of industrial robots on-the-go. The user-friendly graphical user interface (GUI) enables easy creation of programs for robot manufacturing without the need for prior programming experience. Drag-and-drop functionality allows setting up of tools from the library and environment for the projects quickly. Other features include fast collision detection, multiple robot simulation, optional integration external axes, APIs for several programming languages, and so on. A free trial of the professional version is available for thirty days.

Android *iOS*

Lego Boost

Updated: July 2020
OS: Android and iOS
Download: Full version (free)

Lego Boost app is a tool that allows users to operate their Lego creations made using the creative toolbox (17101). Each set includes a motorised hub, colour and distance sensor, additional motor, and the like. Building instructions are provided for multifunctional models available with the toolbox. There are more than sixty fun activities with step-by-step challenges as well as fun videos to help users progress and increase their coding skills. Any number of models can be built, programmed, and customised with Creative Canvas. For Android, version 5.3 or above is required, while for iOS, 10.3 or newer version is necessary to use the app.

Android *iOS*

Robotics Engineering

Updated: April 2020
OS: Android
Download: Full version (free)

Android

Robotics Engineering App helps users in understanding the basics of robotics like modelling, planning, and control through a step-by-step process. Not only for beginner students, the app is also useful for professionals in fields like robotics and automated systems, electrical, electronics and mechanical engineering, among others. Ways and examples are provided for electronics, mechanics, and programming skills with a focus on geometrical models of robot mechanisms. Up-to-date accomplishments, challenges, social and ethical implications of robotics are covered too.

Industrial Robotics 3D

Updated: March 2020
OS: Android
Download: Full version (paid)

Android

Industrial Robotics 3D is an app that provides industrial robotics training to its users for handling even a six-axis bot. This covers robot trajectory control, handling process, welding process, painting process, glue process, deburring process, and obstacle avoidance. Besides the basics of robotics, a demo for 3D robot cells with CNC is also available. Draw mode enables users to export their drawings by email using a joystick, so no programming is needed. The latest version also includes the milling process, among other minor improvements.

Cyber Talk

Updated: August 2019
OS: Android and iOS
Download: Full version (free)

Android *iOS*

Cyber Talk by Clementoni S.p.A. allows users to learn the principles of block-based coding via tutorials while having fun with the robot by recording, editing and sending voice messages back and forth as well as control it in real time. Using augmented reality, the app can read all the available QR codes corresponding to various commands and recreate the sequence digitally before it is received by the bot. Other features include voice modulator for messages, gyro mode for movement control, a training mode for understanding commands, and so on. The communication between the app and robot is made possible through Bluetooth Low Energy (BLE).

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Laptop

With ultra-slim display



Dell has launched a new laptop in India, XPS 17. It features a 43.2cm (17-inch) full-HD + InfinityEdge anti-glare display with a 16:10 aspect ratio and peak brightness of 500 nits. Under the hood, it features a thermal design equipped with GORE thermal insulation for increased fan airflow.

It comes with a built-in lid sensor that allows the laptop to automatically power on when the lid is opened. It also features Windows Hello facial recognition for easy logins.

It features the latest 10th gen Intel Core i7 processor and i7 UHD processor with up to Nvidia GeForce GTX graphics. The laptop runs on Windows 10 Pro and features 64GB RAM.

Smartwatch

With AMOLED display

Samsung has launched its Galaxy Watch 3 in India. Galaxy Watch 3 41mm comes in mystic bronze and mystic silver colours, while Galaxy Watch 3 45mm is available in mystic silver and mystic black colour options.

The larger variant of the smartwatch features a 3.5cm (1.4-inch) circular display. The smaller version has a 3.1cm (1.2-inch) display. Both the variants feature AMOLED display with Corning Gorilla Glass protection. Samsung Galaxy Watch 3 comes with a rotating bezel as well.

The watch also features an atmospheric pressure sensor, GPS antenna, light sensor, touchscreen, and speakers. It also features a pressure vent and heart rate sensor on the back.



Mouse

With 4000DPI precision sensor

Logitech has launched a new mouse called MX Master 3. It has a new MagSpeed scroll wheel. It uses electromagnets for silently scrolling through long web pages within seconds. There's also Logitech MX signature Darkfield 4000DPI precision sensor that can even track on glass surfaces. Its rechargeable battery is claimed to last up to seventy days on a single charge. A three-minute quick charge is said to deliver a full day's use.

The mouse has front/back buttons on the left side, along with gesture buttons and a thumbwheel. The buttons can be customised. There is a mode shift button as well. The mouse can be charged using a Type-C port, which is placed at the front and works with Bluetooth connectivity. It is compatible with Windows 7, 8, 10, or later, macOS 10.13 or later, and Linux. It can also run with iPadOS 13.1 and later versions.



Media streamer

With a built-in Chromecast

Flipkart has launched a media streamer in India as part of its strategic relationship with Nokia. The device supports streaming content at a full HD resolution (1920 × 1080 pixels), and it runs on Google's Android TV 9 Pie operating system.

The device comes with 1GB RAM and 8GB storage. It is powered by a quad-core processor paired with Mali-450 GPU. The device also comes with a built-in Chromecast and support for Dolby Audio.

The device comes with access to Google Play Store, using which customers can download and access a vast number of Android apps, including streaming apps like Amazon Prime Video, Disney + Hotstar, and more. Apart from Netflix and Zee5, it comes pre-installed with core Google apps such as YouTube and Google Play Movies.



Price ₹ 3,499

Earbuds

With LED indicator

JBL has launched Tune225 TWS earbuds in black, blue, grey, and white colour variants. These have a 12mm dynamic driver and frequency response from 20Hz to 20kHz.

In addition to 105dB SPL sensitivity, the earbuds also have 32 ohms impedance. Some other specifications and features include Bluetooth v5.0, 22mAh headset battery, and 410mAh battery case.



Price ₹ 10,499

As per the company, the earbuds run for up to five hours on a single charge, along with an additional 25 hours from the charging case. It can also charge from zero per cent to full in less than two hours. In addition, fifteen minutes of charging is said to deliver up to one hour of music playback. There's a Type-C port to charge the case.

There's a charging LED indicator on the case as well as on each earbud. It has a stem with microphones so one can attend calls and give voice commands to a virtual assistant.

Feature phone

With heart rate sensor

Lava International Limited has launched a new feature phone, Lava Pulse. The speciality of the feature phone is that it comes with a heart rate and blood pressure sensor.

It is said to be the first feature phone in the world to come with these features. The company claims Pulse's sensor readings have accuracy similar to present electronic heart rate and digital blood pressure measuring devices.

The feature phone is available in rose gold colour option. It features a 6.09cm (2.4-inch) display. The phone comes with a polycarbonate body. It has a primary camera with video recording support. The phone is powered by a 1,800mAh battery. It comes with up to 32GB expandable storage support and 32MB RAM.

Price ₹ 1,599



The prices, features and specifications are based on information provided to us, or as available on various websites and portals. EFY cannot vouch for their accuracy.

HOW WEARABLE TECH CAN HELP IN COMBATING COVID-19



Potshangbam July

The Covid-19 pandemic has hit the global economy, businesses, and normal life hard. The number of Covid-19 cases is increasing with each passing day worldwide. Even then, there are a few countries who have been hailed as a role model in handling the pandemic effectively. However, this intelligent virus is very tricky in nature and can spread again in a more unexpected manner.

There can be no room for complacency, and no country can afford to let down its guard until a vaccine is available. For instance, take the case of New Zealand. Just after the World Health Organization (WHO) praised the country for its exemplary handling of the crisis, the virus broke out again after 102 Covid-free days. In these challenging times, technologies have proved to be one of the most effective tools that are aiding significantly in the fight against the outbreak of the deadly virus.

In the healthcare space, there is a shift towards using new and evolving technologies to tackle the pandemic. Wearable tech has emerged as a reliable means of battling against the virus in the healthcare sector. Wearable devices are playing a critical role by easing the burden on hospitals and clinics during this unprecedented health crisis.

These act as a monitoring mechanism capable of detecting early Covid-19 symptoms before the onset of disease. The data collected from the smart wearable tells whether the user has Covid-19 symptoms or not. Researchers say wearables can provide data on heart rate, body temperature, heart, sleep patterns, and other indicators that can be used as diagnostic tools. As per reports, researchers are increasingly

looking at tech wearables and other such devices as a possible early warning system for the deadly virus.

Here are some of the promising wearable devices that can help in tackling Covid-19:

Fitbit. The device can detect people who are infected with Covid-19 even before the symptoms appear. The technology is capable of monitoring active and resting heart rate,



change in heart rate, respiratory rate, etc. This gives a chance to identify and warn the person before the spread of the virus unknowingly. Users can use 'Today' screen to access stats such as steps taken, distance covered, calories burned, and floors climbed. It also includes other features such as fitness tracking, up to five days of battery life, and 4.22cm (1.66-inch) LCD display.

GOQii. This smartwatch claims to assist in diagnosing and monitoring Covid-19 symptoms, early detection, and effective management of coronavirus. The device is equipped with an integrated pulse oximeter



that measures the rate of oxygen in your blood. The device comes handy as it gives real-time updates of variation in blood oxygen levels. Besides, it can track blood pressure and body temperature, and wearers can immediately get a sense of change in their vitals. The device also features a touch OLED display with a battery life of up to seven days and a 360-degree motion sensor.

Oura ring. The smart ring can track symptoms of Covid-19 days before any actual signs show up. Most of the cases are asymptomatic but end up spreading rapidly in a stealthy way. Oura ring can be used as an effective tool to curb further spread of the deadly virus. The ring gives insights about body temperature, heart rate, respiration condition, sleeping pattern, etc. If any symptom of coronavirus is detected while track-



ing, it gives a chance of early treatment. It is packed with technologies such as infrared photoplethysmography sensors (PPG) for heart rate and respiration, negative temperature coefficient (NTC) sensor for body temperature, and 3D accelerometer for movement.

Apple Watch. Apple Watch comes with various sensors that allow users to monitor their health conditions and detect early signs of the virus. The users get an early warning so that they can take the necessary precautions. Apple Watch features an S5 processor, ECG sensors, always-on display, LTE and non-LTE options, etc. To combat the current Covid-19 crisis,



Apple announced watchOS 7, a new software update to its Apple Watch operating system. watchOS 7 brings a number of notable health, fitness, and style features to the Apple Watch. The new handwashing detection feature automatically detects when a user is washing his/her hands. Using its motion sensors, microphone, and on-device machine learning, it will start the 20-second timer automatically. It will also remind users to wash their hands when they return home. watchOS 7 includes a new sleep tracking feature, providing sleep analysis in an easy-to-read chart. The Apple Watch uses the accelerometer to detect subtle movements associated with breathing, so it knows if the user is asleep or awake.

MediBioSense's wearable sensors. UK-based startup MediBioSense



develops medically approved wearable sensors that conduct real-time monitoring of a wide range of vital signs in conditions such as diabetes, hypertension, and coronary heart disease. Patients with such chronic diseases are at a higher risk of developing complications if infected with the virus. The technology effectively monitors heart rate, respiration rate, ECG, skin temperature, and oxygen levels of users. It allows the collected data to be viewed by healthcare workers remotely anywhere in the world. It provides remote monitoring solutions, which are advantageous in times such as the Covid-19 pandemic.

Jawbone UP. Jawbone UP is one of the most popular fitness bands



with some unique features. The band is capable of studying the user's sleep cycles, movements, workouts, resting and passive heart rates, etc. It is paired with an app that displays the user's activities and details from the UP24 or UP band. It is compatible with most Android and iOS smartphones and can be easily synced to your phone via Bluetooth. It also has the option of sharing your accomplishments with friends by teaming up in the UP24 app. EFY

MID-RANGE AI-ENABLED VOICE ASSISTANT SMART SPEAKERS

Nijhum Rudra

In the past few years, technology has not only improved but has also become smarter and made things easier and trouble-free in our lives. In the field of technology, smartphones are considered to be one of the biggest innovations. However, with the advancements in technology, we have started witnessing the evolution of other new products. One such innovation is smart speakers. These are not only wireless and Bluetooth-enabled but now also feature AI-enabled voice assistants and sophisticated design to enhance customer experience.

Popular voice assistants such as Siri, Google Assistant, Cortana, and Alexa have become our trusted digital helpers. With just a command, these play music of our choice, set time according to our preference, and also help children with their homework. As the AI-enabled voice assistant ecosystem is expanding, a huge variety of smart speakers are now available in a wide range of prices.

Before focusing on the latest AI-enabled smart speakers available, let us first check out the essential features that one must look for while buying a smart speaker.

Sound quality. This is the most important criterion for any speaker, be it a smart speaker or a normal music speaker. If you are planning to buy a smart speaker only for giving commands and listening to the news, you can opt for a budget smart speaker. But if you also want a good sound quality with high bass, you should opt for premium smart speakers. Their sound quality and reaction to commands are better as compared to a budget smart speaker.

Trouble-free use. This involves accessibility, set-up, and how the speaker reacts to your commands under various environments. Speakers with a low budget and low review scores respond much later even in quiet rooms, and sometimes you may even need to repeat your command several times. A good smart speaker can respond to your command even in a bigger room. But, as of now, even a premium smart speaker cannot respond well in a noisy environment.

Services and command. A good smart speaker with sophisticated technology and AI can hold better conversation after you ask your first question. For example, if you ask to show a nearby continental restaurant, the reply can be followed by the question when it will open. This feature is not available in a low-cost smart speaker. In terms of services, a few smart speakers can be connected to Spotify, Netflix, ABC news, Amazon Prime, and many more. You can command directly from your speaker or connect to Bluetooth.

Now, let's find out some of the top smart speakers available in the Indian market with latest technologies.

Invoxia Triby. Crafted by Invoxia, Triby is one of the first 'Alexa-enabled' devices built with AVS, which means that you can do almost everything with Alexa on Triby that you can do with Alexa on Echo. It is a new connected family-friendly kitchen device that magnetically sticks to the fridge and can play music, make calls, display messages, and is voice-activated. You can address Alexa through Triby using the wake word 'Alexa.'



For instance, simply say 'Alexa, play Adele' and Triby can play Adele from Prime Music. In addition, it can make calls over VoIP or with a paired smartphone from 4.5 metres away.

Price: ₹ 14,500

Amazon Echo (3rd Gen). Launched by Amazon, this speaker features Dolby for 360 degrees audio with crisp vocals and dynamic bass response. With built-in voice assistant Alexa, this speaker responds to commands for music, news, trivia, scores, weather, alarms, kids rhymes, and stories. Users can access songs in



various regional languages such as Hindi, English, Telugu, Tamil, Punjabi, Marathi, Bengali, Bhojpuri, Kannada, and more. With your voice, you can control your smart lights, AC, geyser, or water pump.

Price: ₹ 8,249

Apple HomePod. Coupled with Apple music and voice assistant Siri, this unique speaker offers high-quality audio. It is an 18cm tall speaker that is furnished with custom Apple-engineered audio technology and state-of-the-art software. Its high-excursion woofer offers a high-quality bass.



A six-microphone array along with an internal bass-EQ microphone analyses and compensates for the effect of the room on the bass response, providing rich and consistent sound. After HomePod recognises the wake word 'Hey Siri,' whatever you say is encrypted and sent anonymously to Apple servers without being tied to your Apple ID. It is powered by an A8 chipset for enhanced performance.

Price: ₹ 19,900

Google Nest Hub Max. It has a smart display, initially unveiled under Home Hub by Google. It features a 25.4cm (10-inch) HD screen with stereo speakers. The device can be



used for checking the weather, traffic, news, recipes, jokes, games, riddles, and more. It features a wide-angle camera coupled with 127 degrees field-of-view that can be used for video calls via Google's Duo service. It is backed by nifty video processing smarts, allowing the display to automatically focus and zoom in on an individual while he/she is moving in the room. It is a combo of smart speaker and smart display coupled with Google photos

Price: ₹ 7,999

Google Home Mini. Right from finding your phone to keeping your family entertained, Google Home Mini is here to offer all the help you need. This powerful little helper will answer all your questions as it is equipped with features such as Google Search, Maps, and much more. You can even control your other smart devices at home with your voice. It can also play music from popular streaming platforms. Apart from this, it works with up to six users with personalised settings.



Price: Starts at ₹ 2,299 (Flipkart exclusive only)

Marshall Uxbridge Voice. Launched this year, Uxbridge Voice is engineered to create a thunderous sound from its compact frame. Just ask Alexa to play music from the most popular streaming services, and you're all set to experience your favourite music on just one command.

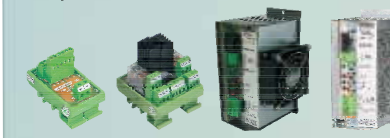


You can connect with Wi-Fi, Airplay 2, SpotifyConnect, or Bluetooth. You can get answers, manage everyday tasks, and easily control smart devices around your home just by using your voice. Alexa can help you listen to your favourite song, turn up the volume, find a dinner recipe, or check your commute to work. You can even dim the lights, ask for the latest news, or check what's on TV, all with a single voice command. You can use the rocker buttons on your speaker's top panel to adjust your sound according to the room you're in.

Price: ₹ 14,967 + tax EFY

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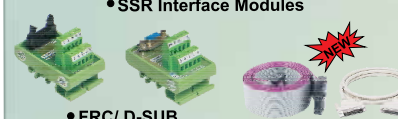
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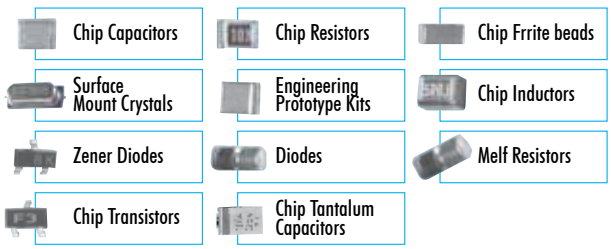
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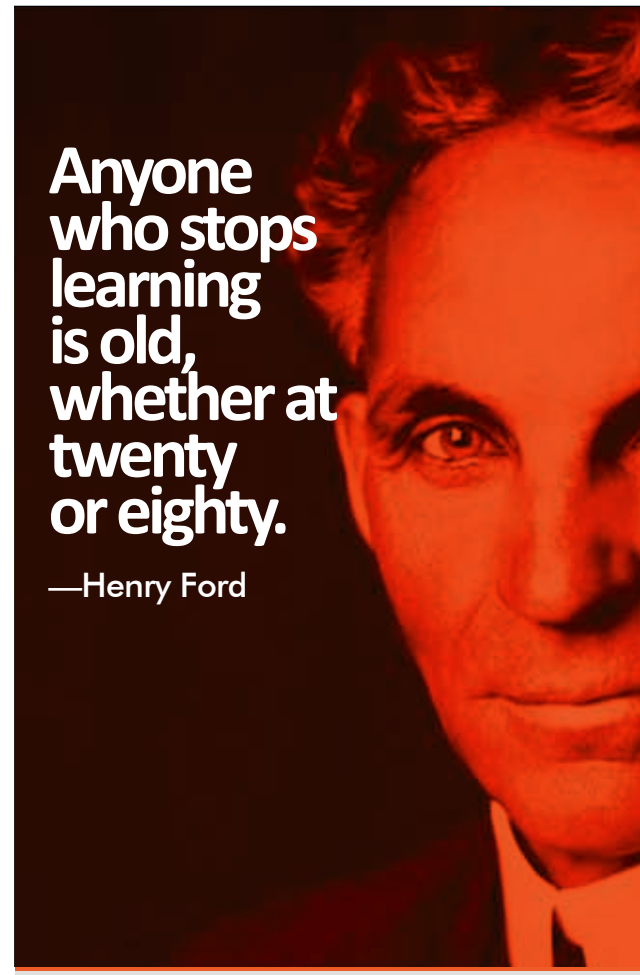
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August	Education and Skill Development	AI in Education Industry	Technologies in Education and Skill Development	Cutting-Edge Gadgets Making Schools and Classrooms Smarter	Electronics in Education and Skill Development
September	AI, Robotics and Cobots	AI in Humanoid Robots	Exoskeletons for Healthcare	Top AI-Powered Speakers Under ₹ 15k	Industrial Automation Through Robots and Cobots
October	Renewable Energy	AI in Fighting Global Climate Change	Electricity from Snow, Plastic and Any Other Raw Materials (Other Than Water and Solar)	Top Solar and Wind Power Panels	Transition from Conventional to Renewable Sources of Energy
November	Bots and Conversational Apps	AI in Customer Service Industry	Robotic Process Automation	Top Free Bots and Conversational Apps	Chatbots Prospects in Businesses
December	Blockchain	AI and Blockchain - A Perfect Match	Blockchain for Travel and Tourism	Top Antivirus Software for Malware	Database Management with Blockchain

In addition, there will be regular series every month on subjects such as:

- Smart World
- Test & Measurement
- Design/R&D
- Artificial Intelligence
- Do-It-Yourself
- Market Survey
- Startup Zone
- Interviews
- eStyle
- New Products
- Tech News
- Industry News

Plus, subjects such as the following will be covered more or less in each issue:

- Automation
- Healthcare
- The Internet of Things (IoT)
- Wireless/5G

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