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HOW CHATBOTS
ARE ENABLING
A PARADIGM
SHIFT FOR
ORGANISATIONS

52ND

ANNIVERSARY
ISSUE

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As per International Civil Aviation Organisation (ICAO) requirements

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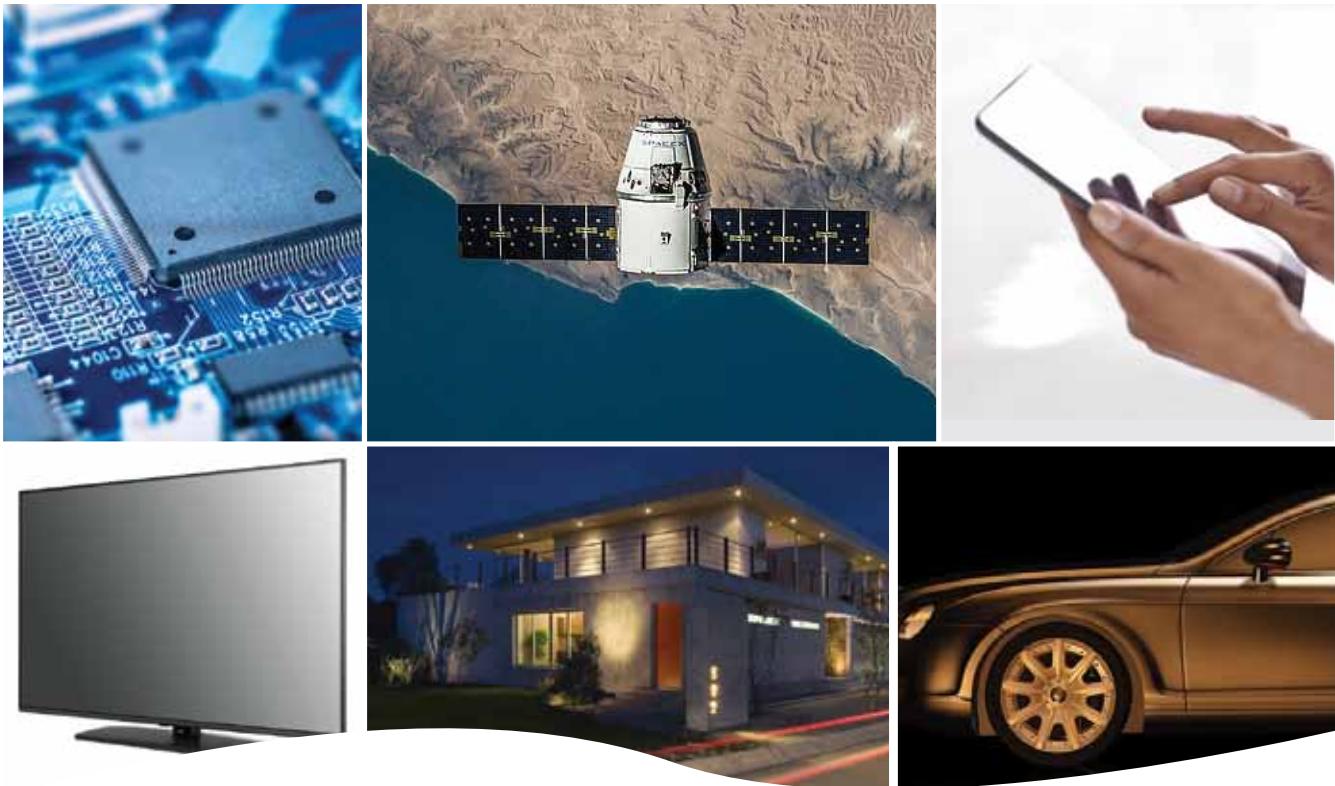
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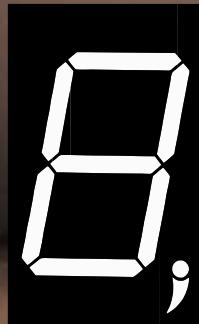
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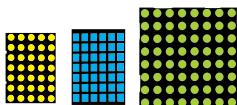
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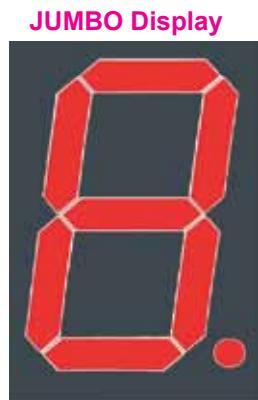
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BACK ISSUES OF EFY MAGAZINE

Where can I get EFY back issues? I need April 2020 to November 2020 issues of EFY magazine.

Dipak Ghosh

EFY. You can buy at <https://ezine.efymag.com/listwholeseller.asp> or buy digital version from <https://ezine.efymag.com/buy/ezinetariff.asp>. April issue was not printed due to lockdown during Covid-19.

• • •

THANK YOU EFY!

Thank you for sending a digital copy of December issue personally to me. Earlier, sometimes I found it difficult to download my own article from the website. It really helps when you send author's copy through mail.

Pamarthi Kanakaraja

• • •

SMART 230V AC BULB HOLDER

I have some doubts concerning 'Smart 230V AC Bulb Holder' DIY article published in December issue. Can we use a triac in place of the relay? Will it be better or worse?

Jijesh

The author T.K. Hareendran replies:
Typical relays and triacs have virtually limitless applications. But this smart bulb holder circuit is designed to drive a relay, and the design math is optimised for that.

For a very high or unknown load, a relay is the most practical option. Relays work in a simple way—these can drive resistive, capacitive, and inductive loads at ease. Relays are

perfectly isolated electromechanical devices and can work with AC and DC current, whereas triacs are semiconductor devices designed to control the distribution level of AC current, but without galvanic isolation.

Besides, a triac has substantial voltage drop at useful current. A small inherent voltage drop is usually not a big issue when considering 230V AC operation, but the power dissipation can be.

• • •

IR CONTACTLESS THERMOMETER

This is regarding the 'Turn Your Phone Into Contactless Thermometer' DIY article published in September 2020 issue, which is also available at <https://www.electronicsforu.com/electronics-projects>.

I want to know more about this project. Please help.

Pooja K.J.

Regarding 'Turn Your Phone Into Contactless Thermometer' project both Kodular and Arduino programming are used. I know Kodular but I want to learn Arduino programming. Please share EFY link or any other link for Arduino programming.

Arvind

EFY. Thanks for the feedback! Please mention your specific doubts and queries to help us clear them. Regarding Arduino programming learning material, you may visit EFY website and check at <https://www.electronicsforu.com/technology-trends/learn-electronics>. You may also check <https://www.tutorialspoint.com/arduino/index.htm>

BREADBOARD POWER SUPPLY

I have a doubt regarding the Breadboard Switch-Mode Power Supply DIY project published in March 2020 issue, which is also available on EFY website at <https://www.electronicsforu.com>. What is the input DC voltage rating and specification?

Ashwani Kumar

EFY. It has a wide voltage input range up to 40V DC and current up to three amperes. You can use any DC voltage input within this range.

• • •

CRYSTAL-LOCKED FM TRANSMITTER

Regarding the Crystal-locked FM Transmitter DIY article published in April 2020, and now also available on your website <https://www.electronicsforu.com>, can you please explain the use of two 24MHZ crystal oscillators in parallel in the circuit?

Ramin

The author Joy Mukherji replies:
The circuit is basically of a variable crystal oscillator (VCO). Two parallel crystals are better than one in a VCO as the frequency can be pulled a little bit more. This results in more deviation and louder audio in this FM transmitter.

• • •

LINE FOLLOWER ROBOT

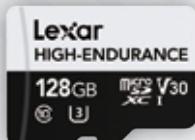
In 'Line Follower Robot Using PID Algorithm' DIY article published in December issue, pin 5 of IC5 should be connected to pin 3 of IC5 and to the rest of the connections as shown in Fig. 3.

Fayaz Hassan, the Author



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Q1. In my counter circuit using TSP1738 IR sensor and CD4026 decade counter, the counting starts automatically even if clock input pin of CD4026 is not connected. When TSOP1738 is connected to clock pin, it does not count properly. What could be the reason?

Kota Sharan Pai

A1. There can be several reasons for this misbehavior of the circuit. First and main reason could be the floating condition at the clock input pin of CD4026 counter. The best solution is to connect a pull-down resistor, say 10-kilo-ohm, at clock input pin. Otherwise, the digital display will automatically start counting or create problem randomly.

Second, if it does not count properly after TSOP1738 is connected to clock pin, it could be due to false triggering of the infrared (IR) sensor. TSOP1738 is sensitive and has inherent false triggering problem if exposed to light. Make sure that your IR sensor is not exposed to any light, and that there is

no electrical sparking near your circuit. You may use a $470\mu F$ electrolytic capacitor across pins 1 and 3 of TSOP1738. You can also cover the sensor in a suitable enclosure with a hole in front to receive IR beam from the transmitter.

The third reason could be frequency mismatch between the transmitter and the receiver. Make sure that the transmitter frequency is tuned to around 38kHz because TSOP1738 is designed to be operated at 38kHz frequency. If the problem persists, try replacing TSOP1738 with a fresh one.

Another reason could be loose connections, either in the receiver or the transmitter circuit.

Q2. The passive keyless entry system in my car was working fine till recently, but now the response time has decreased. When I touch the antenna it recognises the key and unlocks the doors. What could have gone wrong?

Sabih

A2. One of the possible reasons could be a weak battery or lose connections in power supply.

Another could be misalignment of sensitivity settings, or defective proximity sensors in the system. The sensor is used to detect the presence or absence of an object, or driver in this case, using electromagnetic field, light, and sound. There are

many proximity sensors including capacitive, inductive, photovoltaic, ultrasonic, which are meant for specific applications and environments. In most cases, capacitive proximity sensors are used in passive keyless entry systems.

The best solution in such cases is to contact the car dealer, or manufacturer of the device, and get it checked.

Q3. What is LoRa and what is LoRaWAN? Which LoRaWAN modules are easily available in the market?

Pamarthi Kanakaraja

A2. LoRa stands for Long Range. LoRaWAN, also known as LPWAN, stands for Long Range Wide Area Network. LoRaWAN is a protocol designed to connect devices to the Internet for IoT applications. The LoRa physical layer in the network enables the long-range communication link and LoRaWAN defines the communication protocol and system architecture for the network. LoRaWAN is recommended for long-range device communications. Some popular LoRa modules easily available in the market include CMWX1ZZABZ, SX1276RF1JAS, SX1276, RHF0M301, iM980A, and RHF76-052.

Typical LoRaWAN module
(Credit: www.cooking-hacks.com)





Compact, Powerful MCUs

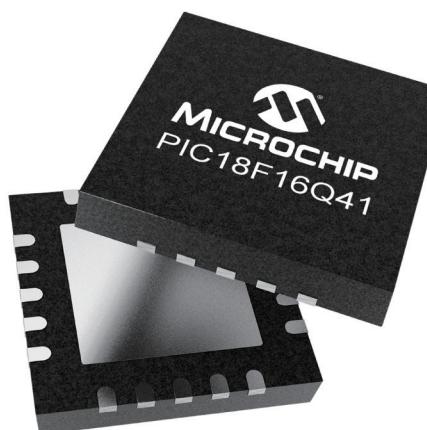
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🔔 Maximising wireless charging efficiency with multiple transmitters



Wireless charging has already found its way in many consumer electronics and medical applications. Maximising efficiency when using multiple transmitters could extend its use to industrial robotics and electric vehicles

Wireless power transfer has proven to be quite useful in electronic devices. Although single-transmitter systems can provide maximum efficiency for wireless transfer of power, achieving the same with multiple transmitter coils is challenging. Scientists at the Incheon National University, South Korea have now devised an effective control strategy that can maximise efficiency in multi-transmitter wireless charging.

To accomplish this, relationships between many variables in the problem were established, such as the connection between the degree of coupling of each transformer to the receiver, its 'perceived' or 'reflected' impedance from the receiver, and the optimal current that should be fed. This allowed the implementation of a novel, maximally efficient, and relatively simpler method for multi-transmitter wireless charging.

🔔 Soft and sensitive robotic finger design to provide accurate grip

One of the main challenges in the design of soft robotic grippers is the integration of traditional sensors onto a robot's fingers. Ideally, a soft gripper should have proprioception—a sense of its own movements and position for safely executing varied tasks. However, traditional sensors are rigid and compromise the mechanical characteristics of the soft parts.

To overcome these limitations, scientists at Ritsumeikan University, Japan have successfully used multi-material 3D printing technology to fabricate soft robotic fingers with a built-in proprioception sensor consisting of vacuum and piezoelectric technology. This design strategy offers numerous advantages and

represents a large step towards developing safer and more capable soft robots.

Get a Grip: 3D Printed Sensitive Fingers for Soft Robots

Hurdles

- Human-like grasping is a top goal in robotics...
- ...but integrating traditional sensors into soft grippers is difficult!
- Undesired mechanical characteristics
- Requires power supply

Introducing...

- 3D-printed soft robotic finger with multifunctional sensor
- Multimaterial 3D printing
- Easy fabrication
- Inflation chamber
- Provides curvature
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- Better interaction between robots and their environment
- Applications in medicine and elderly care

Soft robotic gripper!



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Electrolyte	MnO ₂	Conductive Polymer	Electrolyte	Conductive Polymer	Liquid Electrolyte Conductive Polymer
Max. Voltage	Weak (50V)	Weak (35V)	Excellent (450V)	Weak (50V)	Excellent (100V)
ESR	Normal	Excellent	Weak	Excellent	Excellent
Dissipation		Excellent		Excellent	Excellent
Ripple current		Excellent		Excellent	Excellent
Reliability		Excellent		Excellent	Excellent
Leakage current	Weak	Weak	Excellent	Weak	Excellent
Failure Type	Weak (Short)	Weak (Short)	Excellent (Open)	Weak (Short)	Excellent (Open)

- Electrolyte consists of electrolyte and conductive polymer, and it enabling high voltage and miniaturization compared to solid electric capacitors
- **Application :** Automotive, Communication Home Electric Application LED, Medical, IT (PC, NOTEBOOK)



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Ordinary paper converted into flexible electronic keypad

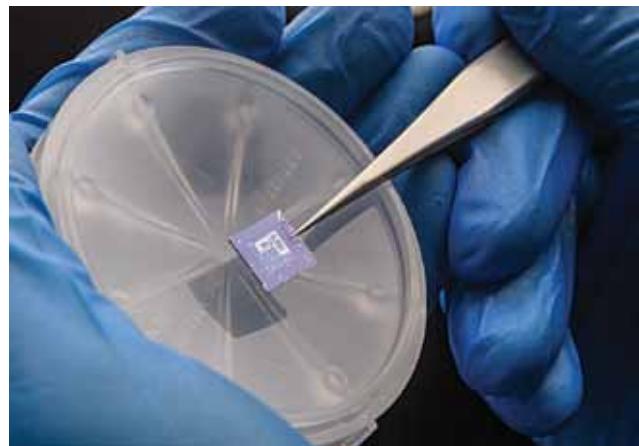
Purdue University engineers have developed an amazing printing technique that renders any paper or cardboard packaging into a keyboard, keypad, or other easy-to-use human-machine interfaces. It was developed using Teflon, a chemical coating that keeps food from sticking to pots and pans, and makes paper waterproof, dustproof, and oilproof.

The electronic circuit was created by including layers that contained tiny nickel particles, which acted as wires for conducting electricity. A tiny Bluetooth chip was added, which allowed the paper to communicate with a computer. In the new keypad, the pressure of a finger-tap acts as a power source by sending electricity along the printed wires. This innovation is suitable for low-power devices such as wearables.

Purdue University engineers have developed a simple printing process that renders any paper or cardboard packaging into a keyboard, keypad, or other easy-to-use human-machine interfaces (Credit: www.purdue.edu)



New transistor design disguises key computer chip from hackers



A hacker can reproduce a circuit on a chip by discovering what key transistors are doing in a circuit. Now Purdue University engineers have demonstrated a way to disguise which transistor is which by building them from material called black phosphorus so that, when a voltage toggles the transistors' type, they appear exactly the same to a hacker.

Current camouflaging techniques require more transistors in order to hide what's going on in the circuit. But hiding the transistor type using black phosphorus—a material as thin as an atom—requires fewer transistors, taking up less space and power in addition to creating a better disguise. This built-in security measure would prevent hackers from getting enough information about the circuit to reverse engineer it.

The four transistors on this chip were built out of a 2D material that disguises them from hackers (Credit: Purdue University photo/John Underwood)

New magnetic spray converts objects into micro robots for biomedical applications

An easy way to make milli-bots is by coating objects with a glue-like magnetic spray known as M-spray. This development was made in a joint research led by a scientist from City University of Hong Kong (CityU). Driven by the magnetic field, the coated objects were able to crawl, walk, or roll on different surfaces.

Composed of polyvinyl alcohol (PVA), gluten, and iron particles, M-spray can adhere to the rough and smooth surfaces of 1D, 2D, or 3D objects firmly. The film it forms on the surface is just about 0.1 to 0.25mm thick, which is

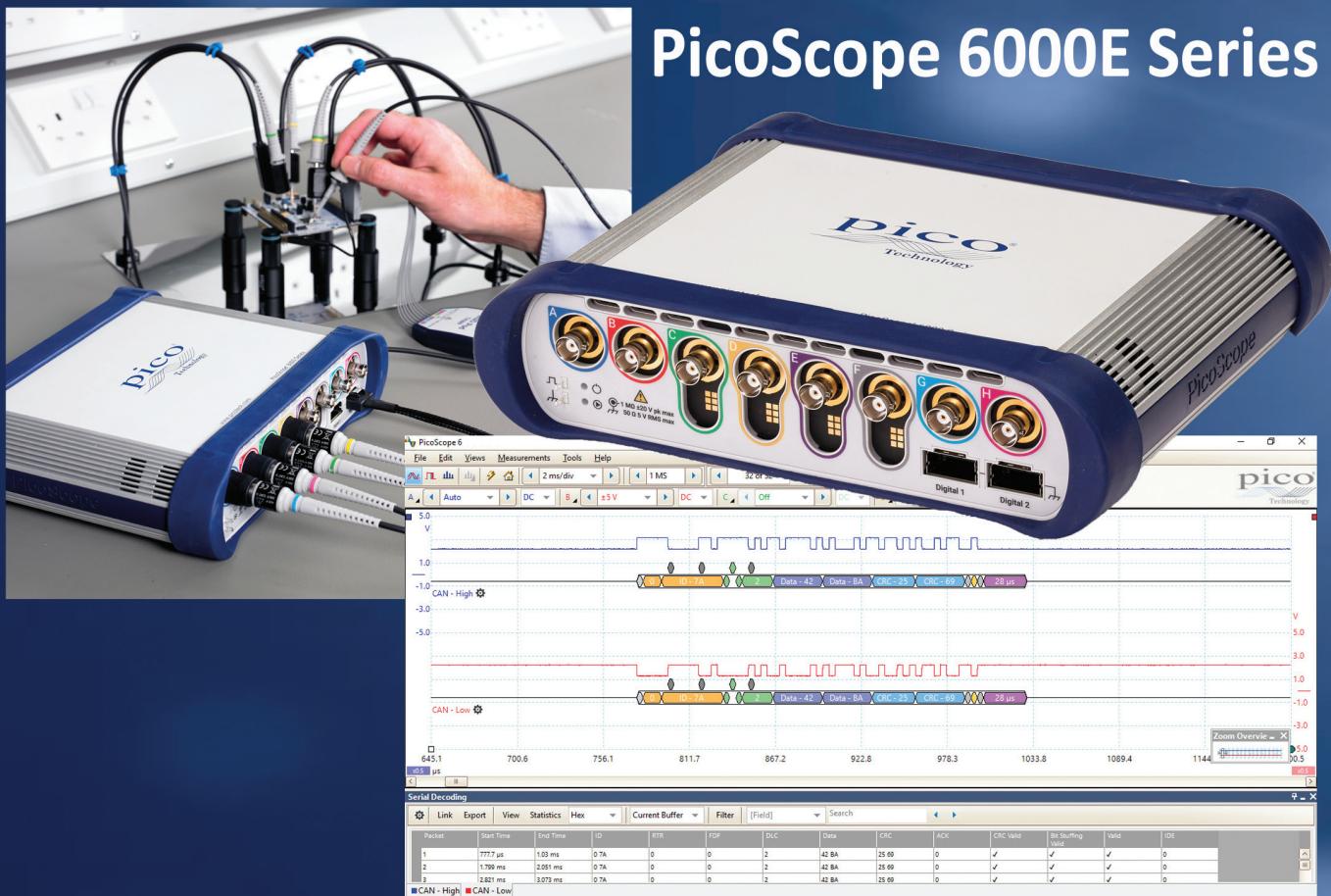


The team successfully converted cotton thread, origami, polydimethylsiloxane (PDMS) film and plastic pipe into soft reptile robot, multi-foot robot, walking robot, and rolling robot, respectively (Credit: City University of Hong Kong)

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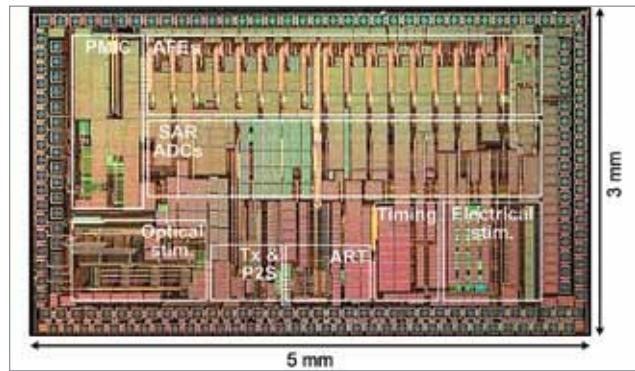
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thin enough to preserve the original size, form, and structure of the objects. After coating the object with M-spray, it was magnetised in single or multiple magnetisation directions, which could control how the object moved in a magnetic field. Then heat was applied to the object until

the coating solidified.

As the magnetic coating is biocompatible and can be disintegrated into powder, when needed, this technology demonstrates the potential for biomedical applications, including catheter navigation and drug delivery.

For neural research, wireless chip shines light on the brain



wireless chip (Credit: <https://news.ncsu.edu>)

Researchers have developed a chip that is powered wirelessly and can be surgically implanted to read neural signals and stimulate the brain with both light and electrical current. The technology has been demonstrated successfully in rats and is designed for use as a research tool for understanding the behaviour of different regions of the brain, particularly in response to various forms of neural stimulation, which can also help pave the way for advances in addressing neurological disorders such as Alzheimer's or Parkinson's disease.

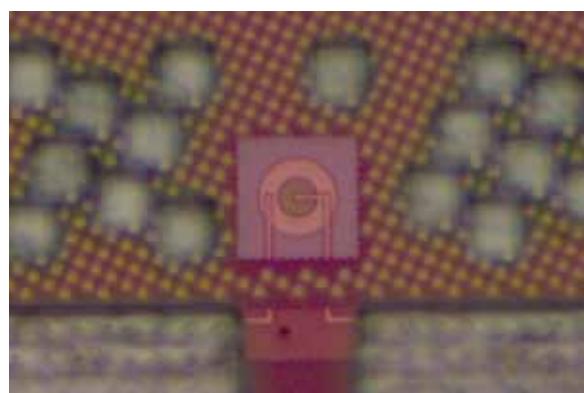
Besides being capable of sending and receiving information wirelessly, the chip can read neural signals in targeted regions of the brain by detecting electrical changes in those regions and stimulate the brain by introducing a small electrical current into the brain tissue.

LED that can be integrated directly into computer chips

LEDs are not just simple inexpensive light sources but are useful for microelectronics too. However, it is tough to make LEDs from silicon. That means LED sensors must be manufactured separately from their device's silicon-based processing chip, often at a hefty price.

But that could one day change thanks to new research from MIT's Research Laboratory of Electronics (RLE). The MIT researchers have fabricated a silicon chip with fully integrated LEDs, bright enough to enable state-of-the-art sensor and communication technologies. The advance could lead to not only streamlined manufacturing but also better performance for nanoscale electronics.

The silicon-based LED has been designed with specially engineered junctions that enhance brightness and efficiency: The LED operates at low voltage, but it still produces enough light to transmit a signal through 5 metres of fibre-optic cable. The ability of the LED to send signals at frequencies up to 250MHz indicates that the technology could potentially be used not only for sensing applications but also for efficient data transmission. Thus, silicon integrated circuits will be able



MIT researchers have developed a bright, efficient silicon LED, pictured, that can be integrated directly onto computer chips. The advance could reduce cost and improve performance of microelectronics that use LEDs for sensing or communication (Credit: <https://news.mit.edu>)

to communicate with one another directly with light instead of electric wires.

Flexible rechargeable battery that's ten times more powerful

A team of researchers from the University of California in San Diego and California-based company ZPower has developed a flexible, rechargeable silver-oxide-zinc battery with five to ten times greater areal energy density of 50 milliamps per square centimetre at room temperature than state of the art.

The battery is also easier to manufacture; while most flexible batteries need to be manufactured in sterile conditions, under vacuum, this one can be screen-printed in normal lab conditions.

The battery can be used in flexible, stretchable elec-

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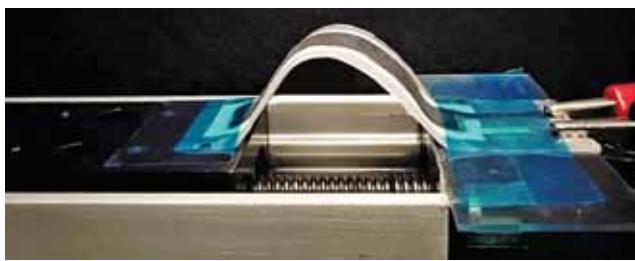
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Flexible rechargeable battery (Credit: <https://ucsdnews.ucsd.edu>)

tronics for wearables as well as soft robotics. Because of its much lower impedance, the new battery has a higher capacity than any of the flexible batteries currently available on the market.

The battery is printed onto a polymer film that is chemically stable, elastic, and has a high melting point (about 200 degrees Celsius). As the 5G and IoT market grows rapidly, this battery that outperforms commercial products in high-current wireless devices will likely be a main contender as the next-generation power source for consumer electronics.

Sensor integrated in plants monitors arsenic levels in soil

Scientists from the Singapore-MIT Alliance for Research and Technology (SMART) have engineered a novel plant nanobionic optical sensor that can detect and monitor, in real time, levels of the highly toxic heavy metal arsenic in the underground environment. This development provides significant advantages over conventional methods used to measure arsenic in the environment. It will be important for both environmental monitoring and agricultural applications to safeguard food safety, as arsenic is a contaminant in many common agricultural products such as rice, vegetables, and tea leaves.

The novel optical nano-sensors exhibit changes in their fluorescence intensity upon detecting arsenic. Embedded in plant tissues, with no detrimental effects on the plant, these sensors provide a non-destructive way to monitor the internal dynamics of arsenic taken up by plants from the soil. This integration of optical nano-sensors within living plants enables the conversion of plants into self-powered detectors of arsenic from their natural environment, marking a significant upgrade from the time- and equipment-intensive arsenic sampling methods of current conventional methods.



MIT arsenic sensor (Credit: <https://news.mit.edu>)

Stretchable micro-supercapacitors to self-power wearable devices



A team of international researchers, led by Huanyu "Larry" Cheng, Dorothy Quiggle Career Development Professor in Penn State's Department of Engineering Science and Mechanics, has developed a self-powered, stretchable system that will be used in wearable health-monitoring and diagnostic devices (Credit: Penn State College of Engineering, <https://news.psu.edu>)

Current versions of batteries and supercapacitors powering wearable and stretchable health-monitoring and diagnostic devices have many shortcomings, including low energy density and limited stretchability. But according to a research team, with members from Penn State, Minjiang University, and Nanjing University, a stretchable system that can harvest energy from human breathing and motion can be used in wearable health-monitoring devices.

Micro-supercapacitors are energy storage devices that have a small footprint, high power density, and the ability to charge and discharge quickly. However, when fabricated for wearable devices, conventional micro-supercapacitors have a sandwich-like stacked geometry that displays poor flexibility, long ion diffusion distances, and a complex integration process. So, an arrangement of micro-supercapacitor cells in a serpentine, island-bridge layout allows the configuration to stretch and bend at the bridges, while reducing deformation of the micro-supercapacitors, providing increased stretchability and adjustable voltage outputs needed to power a wearable device.

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INDIA Is An UNTAPPED MARKET In Terms Of ELECTRONICS REACH And The Potential Is Enormous

Dr Sailesh Chittipeddi

EVP, GM, Renesas' IoT and Infrastructure Business Unit

How has the pandemic changed the game for semicon majors like Renesas? How do they view the acquisition of Arm by Nvidia? To get answers to these questions, Rahul Chopra spoke to Dr Sailesh Chittipeddi, EVP, GM of Renesas' IoT and Infrastructure Business Unit. Here are the extracts of their discussion

Can you share some of the key strategies that have been outlined after Covid-19 and how things have changed?

One of the biggest trends that we see is that there is a big push towards more bandwidth consumption. For example, Netflix or web consumption, Facebook or even text messages—most of these have gone up by over double-digit percentages in a matter of months. That has driven up quite a bit of data centre spend for major players like Google and Amazon.

There has been an increased focus on healthcare and the environment, whether it is for lowering the SpO₂ level or measuring it. There is a correlation between the SpO₂ level and Covid, if your oxygen levels drop alarmingly. So, that has driven interest especially for bio-sensing and ventilator systems.

With the move towards electric vehicles, less polluting activities have taken hold. On the industrial side, certainly smart metering brings more efficient energy consumption. Surveillance and voice user interface have been big and will grow as people are moving away from touch buttons. So, these are some major trends we have seen. Fundamentally, the push is towards data-centric, all the way from front-end to back-end.

Has that resulted in launch of new products also, as in, some products being pushed and others being put on the bench, or has the usual production increased as per greater demand?

A little bit of both. The demand has certainly increased. The need for laptops and personal computing has really gone up dramatically. Even in the USA, there are a lot of regions where school children cannot afford a laptop

or a notebook. So, there has been a big push for Chromebooks, for which districts have been placing big orders.

In terms of investment, we have emphasised a little bit more on things like voice and surveillance and are trying to get some of the products out a little bit quicker. For example, we have pushed our 48V scooter and e-bike solutions a little more aggressively than we would have in the past. Same for the ventilator. So, I would not say that we have slowed down on anything per se, instead we accelerated somewhat to take advantage of some of the six scenarios that we are seeing.

How did Renesas manage to launch products so rapidly during Covid-19, while most brands have been silent? What best practices did you follow to ensure new innovative products kept coming out?

We were trying to make up for the lost time. We were late to launch the Renesas Advanced (RA) Arm-based microcontroller family in 2018. So, we launched that MCU family in October 2019 and followed it up rapidly with a whole set of RA MCU products to significantly expand our portfolio. And then we went out and addressed the gaps that we had in our portfolio early-on in a hurry.

One of my messages to the team has been that customers will always remember how you have served them during challenging times. Because challenging times always allow for the formation of best relationships, whether it's between people, or between organisations. Another message has been that this was the time to out-serve the competitors, whether through new products or a better supply chain.

Coming to Arm being acquired by Nvidia, how is that affecting the Renesas strategy now?

First, I would say there is a finite possibility against the deal occurring as the regulatory authorities may have concerns. But assuming it happens, and based on the discussions we've had with Arm, they have been pretty clear that they are still going to be on an open-licensing model.

We recently announced our first implementation of RISC-V-based solutions, which will begin sampling to customers in the second half of 2021. These MCUs are going to be application-specific solutions through which we will attack motor control and voice markets. Beyond that, we have proprietary 8-, 16-, and 32-bit MCUs as well. We have the RX and RL78 families, which have been around for a long time. So, our customers do not have anything to fear major disruption.

On the other side, there are other GPU providers, such as Imagination Technologies, who do provide cores. So, if we need to pivot, we could on the MPU side. But we don't feel a compelling need to do so at this point of time because Arm as well as Nvidia have been very clear that both will support an open-licensing model. But, obviously, you don't want to be caught working with someone with whom you are competing in another area. That brings a bit of a disadvantage. So, we need to be careful. I must add that we had already taken up some steps to come up with some RISC-V-based products, even before the Nvidia news was announced.

That brings up the question, how do you see the future of RISC-V?

I think people wanted an open-source architecture anyway, primarily because the licensing fees were going





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up. So, there was a natural move towards that direction. And I think that the RISC-V movement, thanks to such a deal, is going to accelerate. The advantage that the Arm ecosystem has and will continue to have for the next several years is really a huge ecosystem of support that has been established around it. No matter what, it will still take time for any organisation to develop that kind of infrastructure support. It will take a while for anybody to replicate it. If Arm is true to its word of being an open-system architecture, then that is no big deal. But it's always good to be careful since we as companies are at the receiving end of things.

Where all are your R&D teams spread? Is there a team in India too?

Earlier there wasn't but now there is an R&D team in India. We are establishing a footprint in Bengaluru primarily for RF and timing devices that have very good capability. And we have leveraged our partnership with a company called Steradian. We have always used India-based design outfits and worked with companies like Tata Elxsi, HCL, Sankalp, and TCS. We have decided to establish a good footprint in India.

Is there a roadmap for India that you would like to share now, or is it under progress?

For RF, we certainly have a very compelling roadmap. A lot of our millimetre wave activities are currently done in India. By millimetre wave I don't mean sub-6GHz, but millimetre wave that is 28GHz and above. We are also working on some of the timing activities in that area and looking at setting up a stronger presence in Bengaluru for that activity. Radar activity also goes on there.

Are e-bikes and surveillance the two key markets or are there other markets also wherein you see some growth?

There are other markets too where we see a growth in. Bio-sensing is one. Due to Covid-19, getting low-cost healthcare to people and air-quality monitoring is going to become much more important. Our team is going after a range of customers in IoT, mobility, medical, consumer, infrastructure, and industrial sectors. It is quite exciting.

My view is that India is an untapped market in terms of electronics reach. And the potential is just enormous. So, in addition to the R&D, for which we have established a footprint, we have plans to work with emerging companies like Ather, besides the established

where we have already established footprint. The reach is going to be quite significant and, if India sets its mind to build the white boxes themselves, I think it will be a massive gamechanger for us. If it starts to do some of the things that are done in Taiwan, including the product design specs, then it will propel us to the next level.

Do you see IoT as a buzzword or a real market opener?

That's a good question. To me, any edge or endpoint device is fundamentally IoT. Are more devices and more sensors getting connected across the globe? Yes, absolutely. Without a doubt, we are marching towards one trillion connected devices in a not too distant future. It doesn't matter to me whether you call it IoT or connected sensors. The trend is already there.

For us to capitalise on that market, it boils down to having all the intellectual property that is needed for it. Companies will not be able to go very broad in this area, and that is the fundamental challenge in IoT. There's no single company that is going to dominate every vertical, because not only we need to have the sensor solution, we also have to be able to interface it to something else in order to get it to operate. If it's a smart home, whether it's a Google Nest thermostat or something else, it needs to interface with another device and the software. So, you have to decide the verticals you are going to go after. Like in India, we are going after smart metering. Motor control is another great vertical that we are pursuing.

Any particular geographies like Europe or the USA that have taken lead in industrial IoT?

For industrial IoT, the areas that are doing well are Japan, Europe, and then the USA. China has an interesting growth story for a variety of reasons, including the fact that they came out of Covid-19 crisis much earlier than a lot of other regions in the world. One of the areas that they do continue to surprise a lot of people is of AI. The dialects in China (certainly not as complex as in India) are vastly different. They have AI companies like iFLYTEK that are really advanced when it comes to voice recognition-based AI technologies. So, China is probably far ahead of India when it comes to industrial IoT, although India is starting to pick up.

Most of the advanced robotics is largely happening in regions such as China, Japan, and the USA. The

traditional base of industrial customers has largely been European, Japanese and the American to some extent. However, China has been increasingly very aggressive in terms of industrial companies that adopt new products quickly. The advantage that they have is that they move extremely fast and don't require the 10/15/20-year lifetime reliability cycles, which the traditional players require. They understand that most of these products would not last more than 7-8 years before you will have to upgrade them to the next version. So, watch that space as there is going to be a big set of disruptions including digitisation, which will get hold of that market over the next 5-10 years and major new players will emerge.

Having seen the entire silicon ecosystem from pretty close, do you think India should go ahead and invest in a semiconductor fab or remain fabless?

India has tried investing in fab earlier as well and this isn't the first time. If we take a look at the history of countries that have been successful in introducing fabs, such as Taiwan who started investing in the late 70s and early 80s, it took thirty years of learning to become what they are now. There is no short-circuiting that process. They have the companies and supplier base, despite being located on a small island, which is a fraction of a vast country like India.

China has repeatedly tried to establish fabs, with far more resources than India, to be successful in the wafer fabrication area. And they are still several decades away from getting there. So, the question is: Do we have the long-term vision to make US\$70-80 billion worth of investment? It is critical to identify the vertical after which you want to go, such as communications and enterprise infrastructure, and then start establishing a company that will build the systems.

If it's for 5G, then there is a perfect opportunity with Open RAN systems to establish a company in India that could set up their own telecom infrastructure. Open RAN is hugely disruptive versus traditional telcos. If you do that, then you will naturally start establishing fabless players and others that will support that ecosystem and set up the entire manufacturing system for it. But, without identifying the vertical to pursue, you won't establish a strong footprint. The semiconductor industry in India will be challenged. Huawei became what it is today because they built the boxes, and that set up Hi Silicon, which led to set up other companies. EFY

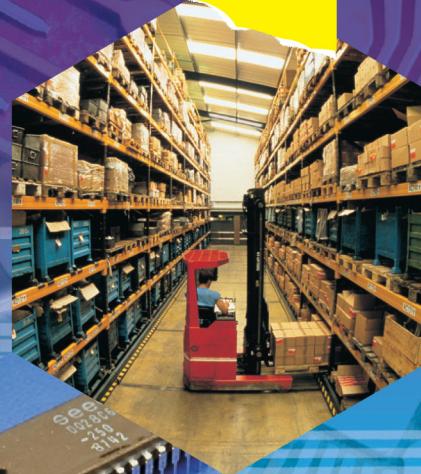
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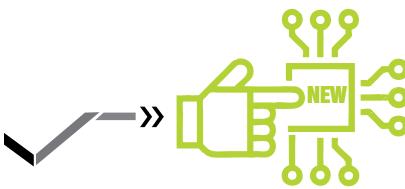
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*Fischer Connectors
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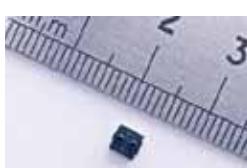
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product and be positioned where measurements matter. It measures a flow rate across a wide measurement range of 0.001 to over 500 standard litres per minute and delivers a fully temperature-compensated and reliable flow signal.

Flusso

www.flussoltd.com

Motion-tracking sensor

The IAM-20680HP is a high-performance automotive monolithic 6-axis motion-tracking sensor platform for automotive, telematics, and navigation system applications. It combines a 3-axis

gyroscope and a 3-axis accelerometer in a thin 3 × 3 × 0.75mm (16-pin LGA) package. Additionally, the IAM-20680HP p r o v i d e s industry-leading sensitivity tolerance and temperature

stability in combination with proven high robustness by supporting 10,000g shock reliability. Other features include programmable digital filters, an embedded temperature sensor, programmable interrupts, I2C and SPI serial interfaces, and voltage operating range of 1.71V to 3.6V.

TDK Corporation

www.tdk.com

MODULES & BOARDS

Graphic TFT displays

The compact TFT displays from Electronic Assembly GmbH have brightness



up to 1000cd/m², allowing clear readability in direct sunlight. Whether in the operating room or an outdoor mea-

uring station, a single glance at these displays is enough to obtain the required information. Thanks to their All Angle Colour Stability (AACS) technology, contrast and colours of these graphic displays remain unchanged even at extreme viewing angles. The displays come with a capacitive multi-touch surface, are compatible with any kind of microcontroller, and have been designed for tough, continuous industrial use.

Electronic Assembly GmbH

www.lcd-module.com

Cellular module

The AVT9152 module fulfills the demanding requirements of cellular connectivity yet consumes low power and has a minimal component size. It incorporates Nordic Semiconductor nRF9160



low-power System-in-Package (SiP) and nRF52840 Bluetooth 5.2/Bluetooth LE advanced multiprotocol System-on-Chip (SoC) to provide engineers and developers with NB-IoT/LTE-M, GPS and Bluetooth Low Energy (Bluetooth LE) wireless connectivity. The nRF52840 Bluetooth 5.2/Bluetooth LE advanced multiprotocol SoC features a 64MHz, 32-bit Arm Cortex M4 processor with floating point unit which, alongside the nRF9160 SiP's Arm Cortex-M33 processor, ensures the module offers a computational power that can support a range of complex and processor-intensive IoT applications.

Avnet
www.avnet.com

Low-light camera module

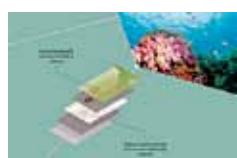
e-con Systems Inc has launched the e-CAM220_CUMI327_MOD full HD MIPI CSI-2 ultra-low light camera module that leverages the powerful Image Signal Processor (ISP) of NVIDIA Jetson edge AI platform. This full HD camera module is based on a 2MP

Sony STARVIS IMX327 CMOS sensor with 2.9µm pixel size. This camera is empowered with ultra-low light sensitivity, higher signal-to-noise (SNR) ratio, and uncompressed full HD streaming at 60fps. This high-sensitivity, low-light camera has the capability of capturing both visible and near-infrared images with very low noise even at extremely low lighting conditions or even with no light. Applications include parking-lot management, smart surveillance, and industrial inspection.

E-con Systems Inc.
www.e-consystems.com

Contactless payment module

This complete, single-source solution in the form of the SECORA Pay with Coil-on-Module (CoM) is easily adaptable to different projects and market requirements. The payment module comes with a



newly developed copper-wire antenna, which is specifically designed for cards made from recycled ocean plastic or wood, thus allowing cost-efficient card manufacturing for mass deployment.

Infineon Technologies AG
www.infineon.com

Computer-on-Modules

congatec has introduced six new Computer-on-Modules with 11th Gen Intel Core processors for the extended temperature range. Built with high-quality components designed to withstand extreme temperatures from -40 degrees Celsius to +85 degrees Celsius, the new

Computer-on-Modules provide all features and services required for reliable operation in the most challenging environments. Typical use cases for the modules can be found in any kind of rugged applications, outdoor edge devices, and in-vehicle installations, which are increasingly leveraging embedded vision and artificial intelligence (AI) functions. Based on the low-power Lake SoCs, the new modules for wide temperature environments offer significantly greater CPU performance and nearly 3x high GPU performance.

congatec
www.congatec.com

T&M SOLUTIONS

5G broadcast transmitter

Using broadcast and/or multicast over 5G allows network operators to deliver premium content to mobile consumers connected to cellular networks, with



consistent high quality of service (QoS) and higher quality of experience (QoE). For venue-casting, ultra-high-quality live video streaming, live commerce, and over-the-air software updates/upgrades, two 5G broadcast-enabled transmitter series, R&STx9 and Tx9evo, have been launched. From an architectural

perspective, 5G broadcast/multicast is a key pillar of the new 5G ecosystem. It comprises a broadcast/multicast Radio Access Network (RAN) and a broadcast/multicast Core Network (CN).

Rohde & Schwarz
www.rohde-schwarz.com

DC electronic load

The new EL30000 series bench DC electronic load tests power sources by presenting various resistances and measuring the response. It ensures devices can output constant energy, as well as handle a



sudden increase or decrease in demand. Multiple ranges allow accurate measurements for small and large devices from zero to 150V. A built-in measurement system eliminates the need for an external digital multimeter, shunts, and associated wiring. Device manufacturers and design engineers use electronic loads to test power devices such as power supplies, batteries, battery modules, solar panels, fuel cells, LED drivers, and power converters.

Keysight Technologies
www.keysight.com

Logic analyser

The PGY-LA-EMBD, an innovative logic analyser for embedded interfaces, can address the complex challenges related



to designing and testing hardware and software. The device provides a 1GS/s timing analysis and is a 100MHz State Analysis capable 10-channel logic analyser with simultaneous I2C, SPI, and UART protocol analysis capability.

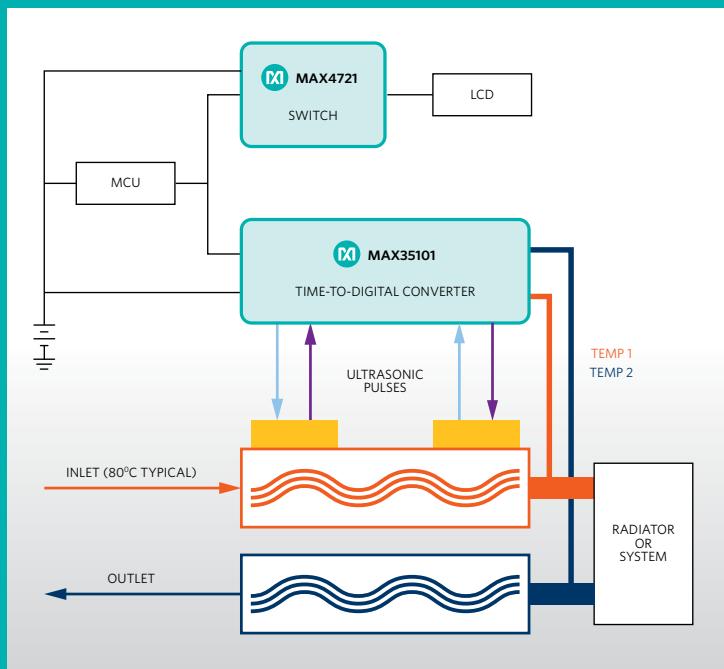
Prodigy Technovations
www.prodigytechno.com

Oscilloscope-to-cloud software

The new TekDrive facilitates large data collaboration directly on an oscilloscope, PC, phone, or tablet. It enables ultimate ease and accuracy in data accessibility and collaboration, and the ability to

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Accurate, cost-effective, ultrasonic flow meters key a transformation in liquid and gas flow measurement.



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- Maximizes Battery Life with Low Device and Overall System Power
- Low 10µA ToF measurement and < 125nA Duty-Cycled Temperature Measurement
- High-Integration Solution Minimizes Parts Count and Reduces BOM Cost
- Built-in Real Time Clock

Applications

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- Ultrasonic Heat Meters
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instantaneously share and recall data directly on an oscilloscope—eliminating the need for cumbersome data-sharing practices.

The software provides ultra-smooth visualisation and analysis capabilities that support any modern browser, including options to view, zoom, pan, measure, decode, and analyse full test and measurement data on any device without the need for any additional software.

Tektronix
www.tek.com

MANUFACTURING SOLUTIONS

Robotic gripper

Designed for low-cost gripping applications, the 2FG7 from OnRobot is easy to use, allowing deployment within minutes to handle demanding payloads—even in tight spaces. The 2FG7 has a

maximum payload of 11kg, an external grip of up to 74mm, and a gripping force of 20-140N for handling heavy, bulky payloads with ease. The gripper is powered by an integrated electric motor, which provides several advantages over pneumatic gripper systems. 2FG7 users can easily make force, speed, and stroke control settings through an intuitive software interface. It is ideal for low-volume and high-mix production that allows fast ROI for applications such as machine tending, material handling, and assembly.

Onrobot
www.onrobot.com



ENTERPRISE-CLASS SOLUTIONS

Cybersecurity solution

The Arcserve X series appliances secured by Sophos come with self-contained solutions with integrated cyber



and data protection for enterprise data volumes. The new appliances uniquely combine deep learning endpoint protection and on-and off-site disaster recovery with over 3PBs of effective capacity in one unit, and linear expansion to increase capacity as needed. Powered by Arcserve UDP software, organisations can protect complex workloads with heterogeneous technologies that can be unboxed and deployed in under 15 minutes. Arcserve X series appliances uncomplicate enterprise infrastructures and offer a higher ROI by eliminating discrete data protection and security strategies.

Arcserve
www.arcserve.com

Smart 3D surveillance system

To provide an enhanced and robust solution for high-security needs, the Leica BLK247 combines LiDAR, video camera,



and thermal imaging technology for security that building owners, operators, security teams, and facilities managers can benefit from through continuous monitoring of buildings and spaces including hospitals, factories, manufacturing plants, and offices. Additionally, the Leica BLK247 provides reliable surveillance for private properties. With the

Leica BLK247, customers can create 3D zones by geofencing areas and applying custom alarm rules. Any number of Leica BLK247 devices can be added to a customer's existing VMS system, providing an enhanced layer of 3D security where previously there was only 2D protection.

Leica Geosystems
www.leica-geosystems.com

Room air disinfection unit

To combat the presence and spread of harmful viruses and bacteria in a closed room or space, the UV light-based Viro-



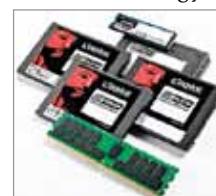
maar UVGI-25C offers an effective solution. Not only does it eliminate airborne pathogens

to create a healthy breathing environment, but also safely applies germicidal UV energy for air disinfection and is a proven technology that can be installed in hospitals, clinics, offices, retail, food outlets, hostels, schools, banks and factories.

Binay Opto Electronics
www.binayled.com

Data centre SSDs

Optimising the business needs of the ever-growing enterprise segment, Kingston Technology has launched five



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Kingston Technology
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Why AI On Edge And What's The Tech Powering It

AI on Edge is not just a buzzword anymore. It holds value for the creators, enablers as well as the end-users. But what are some of the top use-cases, and what tech is available to empower creators for carving out AI on edge? This was discussed by the panel of experts on this subject in October during India Electronics Week. Their thoughts and key points have been compiled and presented below



Vinay Prabhakar Minj

There has been a lot of hype around AI on edge. IoT and AI are not just buzzwords anymore. Consumers, businesses, and enterprises are all looking to adopt digital transformation in their processes and lives. It is important to consider the kind of experiences or values that can be given to the end-user, whether it is B2B or B2C use cases.

At the same time, it is not just enough to know how to build, but also what to build. A lot of techies build things that do not sell. Since these are critical times, there are not enough resources to waste.

The journey till date

Traditionally, AI has been used to identify patterns out of the collected data, saving the data, and making inferences with respect to a business case. It used to demand large computing resources and large datasets, which typically were housed in centralised data centres.

AI did not happen in last ten to fifteen years; it has been happening since the 1950s. But the sheer computing power required to run heavy compute loads became cost-effective about fifteen to

Important Drivers of AI on Edge

- 1. Affordable cost.** The product and the technology has to be suitable at a reasonable price-point, both for general consumers and enterprises
- 2. Strong use-cases.** Relates to devices having intelligence rather than just control features Examples include smart wearables and Alexa
- 3. Mobility.** Ease of carrying around a device such as Alexa Echo Dot, which can be kept in a pocket
- 4. Speed.** Reduced latency and fast response time
- 5. Security of data.** It is the biggest concern. So people prefer storing data on edge rather than on cloud
- 6. Reduced downtime.** More downtime = More financial losses. This can be avoided with the help of preventive maintenance
- 7. Robustness and reliability of a machine**
- 8. Cost of implementing AI** on an edge device (infra-investment) and how effective it is going to be
- 9. Conditions needed to set up and run AI** on edge applications (Does it have to be battery-powered or not?)

Note. Many other drivers/parameters control the adoption of AI on edge. But it generally differs from one use case, or one industry, to another.

twenty years back. It was then that cloud brought inexpensive computing and started giving way to AI and machine learning (ML) workloads to be run on the cloud.

As we all know, IoT technology refers to devices having the ability to talk to the Internet, push data to the cloud, and also have the ability to control or get controlled remotely. AI is a set of frameworks that makes these devices capable of taking their own decisions. Edge computing refers to when the devices can take self-decisions or have local servers through which data can be processed.

“As computing became cheaper, particularly with supercomputers in the form of smartphones and various IoT devices at our expense, the need to bring in that type of intelligence onto the edge became relevant,” as per Venkateswar Melachervu, CTO, Brillium Technologies. He says, “Edge is where data resides and is collected.”

AI on edge is a system that has AI capabilities on the device itself or at some local node. This innovative feature allows devices to make their own decisions based on their previous learnings of different situations and their outcomes.

For instance, devices such as smartphones, smartwatches—even a temperature sensor—can be classified as edge devices. It is to be understood that edge computing is needed not

just for the industry but also for the consumer.

“A lot of data is driven from machines or IoT devices, and that data needs to be computed from the security and privacy point of view. Therefore we need to have a better understanding of the differences between IoT, cloud, and edge computing,” opines Dharmendra Kumar, head of IoT, Arihant.

Since intelligence on edge devices such as smartphones, smartwatches, and connected cars has been there for a long time, Rishi Gargi, founder, Thingify adds another important point, “A boundary needs to be established between what is AI on edge and what other technologies are, and how AI on edge is leveraging AI without having any Internet or making decisions on its own.”

Why go for AI on edge

The power of today’s computing is much more than what was available earlier. Even the latency and longevity of the batteries have improved. All these essentially have helped AI to be pushed for running on the edge, be it IoT devices, within the gateways, or the edge network.

Edge computing generally incorporates a processor and storage, as well as logic to process information. An example is Alexa, which uses natural language processing (NLP) at the edge to respond to queries from a human

being. But AI on edge is more than just computing. “It is not just about processing the data, but also deriving trends and patterns or intelligence by applying machine learning algorithms to give immediate feedback to the user,” thinks Vinay Solanki, head of IoT, Napino.

An example could be of a smart camera that has been installed in a smart city application for monitoring vandalism. While capturing videos or images, it could decide locally without sending any feedback to the cloud and thus become smarter on its own.

Data security is the biggest concern

The real challenge for a customer is regarding data security. People do not want to save their data on the cloud. When running an algorithm in the cloud on a stored data, it should be properly safeguarded, both on the device from where it has been generated and in the network. Cloud can enforce certain other security protocols like firewall, some encryption-decryption logic, or public-private key for the handshake, and make it safer.

“Some users might not be willing to share their data on the cloud. So, this approach can transform the capabilities of such applications to store data on mobile as well as process it. Health-related applications are extremely sensitive, therefore it is important to process the data on the mobile,” believes Amit Kurhekar, head of Data Science, Yodlee.

“It may sound a little oxymoronic because when you have distributed computing resources in the edge network, you are exposed to data attack (for instance DDoS). But usually, AI-edge is considered more secure for your data,” as per Venkateswar Melachervu.

Nikhil Bhaskaran believes that since people do not want all of their private data to go on the cloud, the edge is therefore becoming popular.

The cost concern

Having AI on cloud vs AI on edge is an important question, because on the edge it is the responsibility of the device and the device designer to ensure that it is secured. If some-

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36 A	25 A	200 V – 1000 V	PSB 36MB & PSD 36MT PSB 36MBN & PSD 36MTN	
		1200 V – 2200 V	PSB 36T & PSD 36T PSB 36TN & PSD 36TN	



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PSD	Device Type	
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body hacks into the device, it should be tough for the person to extract the data. But that might result in more cost of the device and more processing power requirement.

"You have to look at the ROI (return on investment) of the application that you are thinking of. One should not apply IoT just anywhere. It should make sense from a use-case perspective. Same goes for AI on edge. If you want to make the edge smarter, then consider whether it is an ROI-friendly decision, because if you need to invest to make every device smarter, then with that there will be added complexity of making the solution secure. One needs to be clear whether any extra investment is going to justify the output or the ROI that will be derived from the solution. It all depends upon what kind of real-time decision you need to make at the edge, or whether sending the feed to the cloud or network is going to be costly, time-consuming, or not secure," advises Vinay Solanki.

Amit Kuhrekar advises having

sufficient whenever you are developing something. Consider the cost of development, cost of hardware, and how many such devices are going to be needed. At the end of the day, you will have to maintain that.

"Always factor in the cost of your solution in the design process itself," opines Nikhil Bhaskaran, founder, Shunya OS.

In terms of cost-effectiveness, it is a matter of business decision for having an aggregated data model in a manufacturing unit. If you have twenty machines, then it is better to deploy sensors at each machine, which may be cost-effective (depending on the business need). The sensors could send data using machine-to-machine communication to a central node device, which is on the edge and has the capability to run ML algorithms or do predictive analytics in conjunction with the backend cloud.

There is cost involved but it is a tradeoff in terms of the outcomes and the ROI that you expect. If there is a proper balance of security, cost, and

form factor, then the edge could be very secure.

According to Venkateswar Melachervu, there is no drastic change in hardware on the edge from what is implemented on the cloud; they are pretty much the same. Edge devices, particularly mobile devices, have to run one or two iterations. This generally causes the battery to drain very fast, which needs to be recharged frequently. This is a constraint in terms of battery life as the device has to run recursively and there is a lot of computational load.

Purpose-built AI on edge

The stack that defines edge could be divided into several parts: Hardware, AI-capable microcontrollers, AI cores (CNNs, BNNs, accelerators, and other neural network binary codes), whether it is open-source or from Google. And then there are software tools that could cross-compile high-level C++ or Java code onto these computing cores, and some reference designs and architectures and custom

services. There are a lot of combinational architectures that Google and Azure are coming out with (both edge and hybrid).

Today, data storage is not a serious problem as gigabytes and terabytes space is available pretty much on every device. The battery life is also gradually improving in terms of longevity. But the biggest challenge would be to have optimised or purpose-built algorithms for edge devices, IoT devices, gateways etc.

This is where innovations are taking place. On the hardware level as an example, Google's AI-edge stack has an edge TPU, called CoralEdge, and an IoT edge software pack that brings in the entire Tensor framework algorithmic pieces as lightweight into mobile devices.

The iPhone 12 has A14 chip that is purpose-built for AI and ML. Called Deep Fusion, it is hybrid and has 8-core neural engines, 6x faster matrix multiplication, one trillion hours per second on CPU, and 40 per cent more power efficiency, making the compute cycle and instruction execution efficient. NVIDIA is also not far behind. Facebook has PyTorch mobile. In terms of difference, each is optimised for battery, storage, and other device needs.

The currently released GPUs are basically vector processing units built into the SoC itself. It is like integrating GPU inside the CPU, and giving a combined solution on the edge, which can do all of those calculations really fast.

Solving the latency issue

For the data, which is being produced at millisecond-level or even second-level, you need some kind of analytics on the edge so that you can prioritise and make immediate decisions, and choose to store aggregated data.

There are two dimensions to latency: propagation delay (the time taken for data to go and come back, which is decided by your IP routes and routing cables) and the time taken to run compute-intensive AI and ML algorithms like CNNs and neural networks. So, if you are running resources in a high-computing data centre with mainframes, then your time would be relatively less

compared to a normal phone, which has a limited MIPS capability.

Companies like NVIDIA, Google, and even Apple have purpose-built AI-chips for running heavy computational loads with respect to AI and ML. Google's TFUs and TPUs run at a much faster rate on par with mainframes and big machines. These tools are coming to the edge today as there is a need and value for businesses and people. It is essential to have hardware with good network and compute speed along with the technical stack such as TensorFlow.

Whenever designing or developing an AI or ML system, you should take into consideration the required response speed along with the expectation of the user. Depending on that, you will have to tweak your algorithms and data flow.

The applications aka use-cases

From the consumer side, there are many applications of doing AI or ML on edge—from voice assistant, face recognition to wearables. From a B2B perspective, it is Industrial IoT (IIoT).

"A French company, which manufactures components for aircraft, uses real-time location solution (RTLS) like RFID or BLE to track different parts. Since new parts keep coming in when old parts are consumed, the company was not able to understand the usage frequency of a particular component in a manufacturing line. Therefore they made gateways, which were deployed in the warehouse and started implementing ML on them. The gateway was power over ethernet (PoE), which has a good processor capability. Through this, they were able to process the information locally and the operator on the floor got quickly informed about the outcome. This was done through multiple ML algorithms on data over a period of one year. This was not done real-time but based on predictions made by the algorithm. Ninety per cent of the time, the predictions came out to be true. If it was done real-time, it would have taken a lot of time to make a decision and give the output to the operator," informs Vinay Solanki.

He further adds that his company, Napino, leverages AI on edge as robots are used for evaluation purposes. An

in-house solution is also being built for social distancing and marking attendance of employees using IoT applications with beacons. This is not yet an AI implementation, but the application is going to have a lot of data on which ML will be implemented to find analytical insights. Another application that was worked upon was a smart shower, which monitored the amount of water consumed while taking a bath. That was achieved using a flow meter plus an IoT gateway to upload the data.

According to Dharmendra Kumar, a major application for AI on edge is industry asset monitoring. Machines need to be controlled and monitored for optimal data consumption and processing. If this happens on AI-edge, then data acquisition will be fast and happen inside edge only rather than data going to the cloud and then giving output. On the consumer side, home automation seems to be big.

Venkateswar Melachervu states a very unique use-case. A year or two ago, he was working on providing a telemedicine platform for pregnant women—right from conception to postpartum. Since a lot of doctor consultations and tests take place over a period of nine months, the idea was to offer these services at convenience with the help of an app. This was a noble step in timely addressing certain critical diseases that can manifest during the pregnancy such as gestational diabetes mellitus, which is characterised by sugar levels becoming high during pregnancy, affecting the health of both the baby and the mother.

Because of the computational intensity and data, it was chosen to run a model in the cloud, get the data and give the results. But with AI-edge coming in, a model can now be created on the edge itself, based on the data of 10,000 to 20,000 pregnant women. With sufficient data, it is possible to derive a linear prediction model to arrive at a risk percentage (between 0 and 1). It can help in predicting early-on gestational diabetes with the help of ML, which can be constantly updated as the results keep coming in.

He also states another use-case. Electricity meter reading is generally

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not done manually now. At times, this leads to inaccurate billing. With a little bit of built-in edge intelligence on a handheld device, a meter reader can go to homes and use that device to generate bills right then and there. This will make it possible to accurately measure the consumption units in a single day without any error, cutting down lots of problems for the consumers as well as the electricity board.

Amit Kuhrekar also shares his earlier experience of working on a problem to identify challenges for the sachet manufacturing process. In this work process, every machine is a high-speed machine. The sachets that we see in strips are initially formed in a mat, which is later cut. While this happens, the operator needs to stop the machine and check whether the sachet is leaking because of bad thermal sealing. There should not be any obstruction in between the seal for it to stay intact. Even if a single sachet is found to be leaking, the whole sachet batch is kept on hold and then everything needs to be tested manually. To identify if there is a sealing issue and predict and stop the machine, thermal cameras were installed. With the help of ML, thousands of images were generated and specific images were identified.

Further opportunities that AI on edge can provide

In the current Covid-19 scenario, startups can focus on providing augmented reality glasses having low latency and fast video processing that are equipped with thermal cameras. So, even if people are moving, their temperature can be scanned, identified, and an alert can be issued.

When people start returning to offices, there can be another application wherein face recognition technology can scan the identity of the incoming people, thereby removing the need to swipe a card.

So, is it worth putting AI on edge? "Yes!" says Dharmendra Kumar. "AI is capable of making a decision depending on the type of scenario and application. For example, for connected cars, AI can take a decision, but it should also come from the driver. For industrial, heavy-

Speakers

Amit Kurhekar,
head of Data
Science, Yodlee



Dharmendra Kumar,
head of IoT,
Arihant

Nikhil Bhaskaran,
founder,
Shunya OS



Rishi Gargi,
founder,
Thingify

Venkateswar
Melachervu,
CTO, Brillium
Technologies



Vinay Solanki,
head of IoT,
Napino

out that everything has a tradeoff. Nonetheless, in terms of being successful on the edge, it is critical to be driven by the utility that users can derive. For that, you could potentially look at the AI-driven CPUs and microcontrollers. Mobile devices these days are pretty much ready in terms of computing resources and storage. TensorFlow Lite provides stacks readily available that can run across platforms like Android and iOS. What you need to look at is whether to optimise on a device itself or do it in an aggregated way in a gateway device within the edge, or do a combination of these two and the cloud at the backend.

When designing the solution, always consider how to move across from one technology to another technology, and from one architecture to another architecture, so that you have enough flexibility and robustness.

Gong the AI on edge way?

Overall, both designers and industry leaders can leverage the huge potential that AI on edge offers. So, while the technology brings faster computing speed and intelligent data processing required for solving the modern-day demands, it is also essential to keep in mind the cost of developing it and the enhanced data security of user data.

"Fall in love with the problem and not the solution. If you fall in love with the problem, then you can always find a solution—whether it is on edge or cloud," advises Amit Kurekar.

"There is a strong case for AI on edge. There are MPUs and bionic chips that are making this possible. At the very base level, the hardware is important for doing AI at the chip level. And since they are cheap, computers are also becoming cheap. At the same time, you have to be careful whether you want to put everything at the cloud level or aggregate it at the edge level. On top of it sits the OS that has been built to run AI. Along with this sits the framework layer, which allows you to run optimally on the edge. The programmer is offered a choice of the framework and to build an AI application. Further, on top, you can use Python or C++," says Nikhil Bhaskaran. **EFY**

vehicle, railways, and ATC applications, AI can be implemented. On the manufacturing side, manufacturers can implement the intelligence in infra on AI-edge."

Agreeing to that Rishi Gargi says, "It is not necessary to always allow devices to make decisions. Sometimes, it could be a hybrid model to suggest to the user the type of action to take. The device can decide if it has well-defined confidence or prompt the user to take a certain decision. It's a reinforcement kind of situation."

Venkateswar Melachervu points

WHAT IF

**WHAT IF WE COULD STOP DISEASES
BEFORE THEY COULDN'T BE STOPPED?**

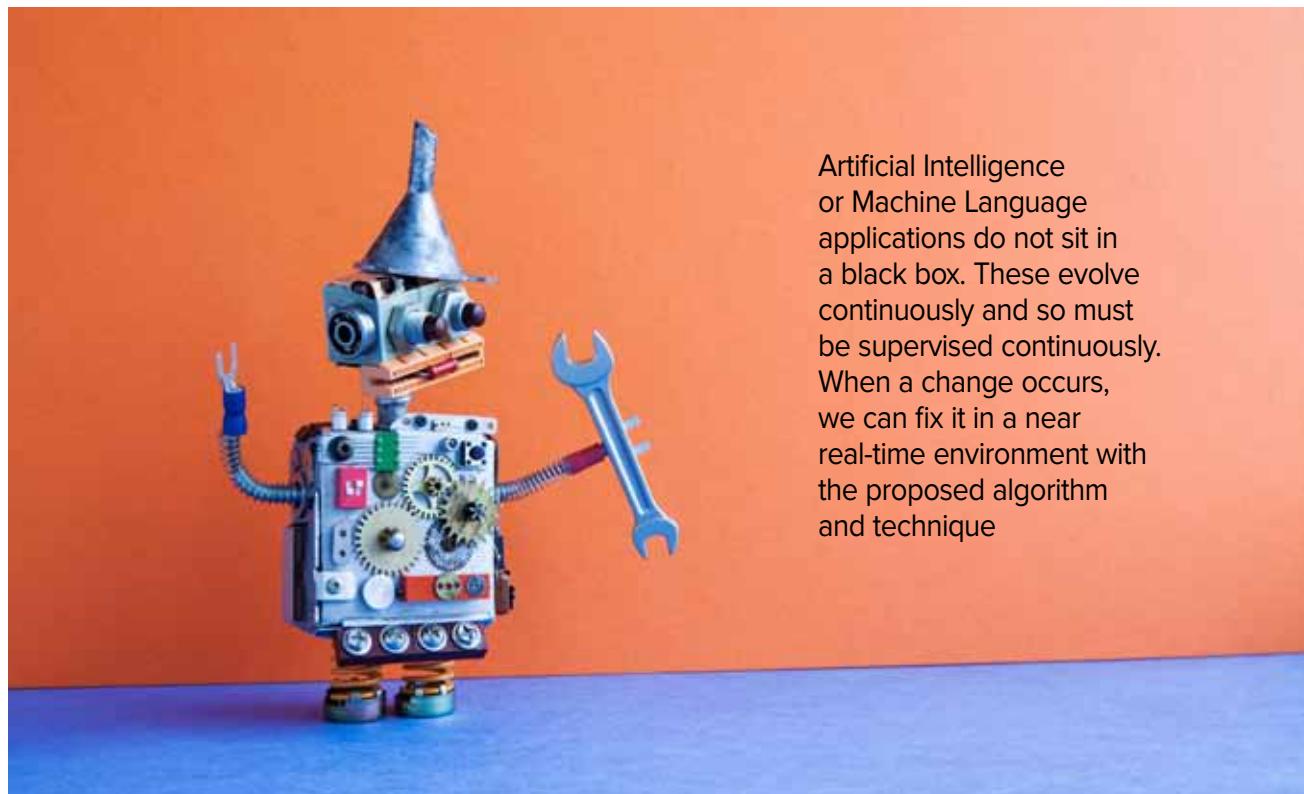
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AI: The Curious Case Of Concept Drift



Artificial Intelligence or Machine Language applications do not sit in a black box. These evolve continuously and so must be supervised continuously. When a change occurs, we can fix it in a near real-time environment with the proposed algorithm and technique

Anand Tamboli

Think about a scenario where you are using an electric motor on your shop-floor. You have installed a few sensors on this motor's outer body, and these sensors are continuously sending the data over the wireless network. Moreover, you also have an elaborate setup on the cloud where your application analyses these parameters and determines your motor's health status.

Of course, this scenario considers the trained pattern of motor vibration and current consumption by the motor during the learning phase. Moreover, so long as nothing changes, this pattern recognition works like a charm. That is what a good

machine learning outcome would look like.

However, the data generated by an electric motor can change over time. It can result in poor analytical results, which otherwise assumes a static relationship between key parameters and motor-health.

The change in data occurs due to various real-life scenarios. These scenarios range from changes in operating load conditions, aging of mechanical components such as ball-bearings, or wear and tear of the foundation on which the motor is installed. Environmental conditions can change, and several other factors may get affected too.

Nonetheless, this occurrence is quite common for several other real-life scenarios

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of machine learning. The data changes over time and affects statically assumed and so programmed relationships. In technical jargon, it is known as 'concept drift.' The word concept refers to an unknown and hidden relationship between the output and its input variables. These inputs are also known as 'hidden context.'

What is the problem here?

For a static use case, concept drift does not pose any problem at all. However, in most use cases, the relationship between input parameters, that is, features and output characteristics, changes with time. If you have assumed this relation to be static during the machine learning model development, it could be an issue in the future.

This problem may be relatively easier to handle if you are maintaining these relationships and formulae on the cloud. You can update the new formulae and relationships, and everything will be back to normal.

However, if your application architecture is edge compute dependent and push learned models to the edge sensors for faster responses, this (new) learning must be transferred regularly. Interestingly, in industrial implementation, edge computing utilisation is highly recommended.

The challenge is how to update these formulae in low-cost sensors? Especially when these sensors do not have large memory, or air firmware (OTA) updates are not feasible. How can you send and update only that basic formula to one sensor device, if needed?

If the solution is designed right, it would have accounted for such drift in the first place and would adapt to the changing scenarios. If that is not the case, either your solution would fail, or the performance will degrade. It may also mean lower accuracy, lower speed, high error margins, and other such issues.

However, remember that it is difficult to identify any scenario in which concept drift may occur, especially when you are training the model for the first time. So, instead of working on pre-deployment detection, your solution should safely assume that the drift will occur and accordingly have a provision to handle it.

Your solution cannot handle drifts; you will have to fix it eventually on an ongoing basis. It is a costly proposition as you keep spending money on constant fixes. The risk of tolerating poor performance for some time exists. This risk increases if the detection of drift is not apparent.

And if you fail to detect the drift for a more extended period, it can be quite risky on several fronts. Thus, the detection of drift is a critical factor. Check if your solution has accounted for concept drift and, if yes, then to what extent. The answer to that check would tell you the level of risk.

Some challenges in handling concept drift

The first and obvious challenge is to detect when it occurs. I recommend two possible methods to handle it:

1. When you finalise a deployment model, record its baseline performance parameters. After deployment, periodically monitor these parameters. If you see any difference, and if it is significant, it could indicate potential concept drift. In that situation, take action to fix it.

2. The other way to handle it is to assume drift will occur. It means you will put a plan in place to periodically update the cloud model and the sensors or edge network. The challenge, in that case, is to handle the edge sensor updates without significant downtime.

The first is easier to manage. However, the second poses a technical problem—so it becomes essential to have an in-built sensor capability that accepts model (formulae) updates without updating complete firmware. And this is where you must use the dynamic evaluation algorithm.

The dynamic evaluation algorithm

The basic algorithm was first introduced in 1954. It was first used in HP's desktop calculators in 1963. Now, almost all the calculators deploy this algorithm.

This algorithm relies on a specific type of representation of the formula, known as Reverse Polish Notation (RPN) or Postfix Notation.

The notation result is always context-free. It means once we con-

vert an equation in Postfix Notation, it becomes easier for a computer to evaluate it. An outside-in evaluation sequence is used to perform this computation.

If you would like to learn more about this algorithm and how it can be implemented at a sensor level, please check <https://www.electronicsforu.com/electronics-projects/hardware-diy/calculator-using-postfix-notation>.

Other scenarios of concept drift

I explained concept drift with an example of an electrical motor. Nonetheless, the problem is not limited to this use case. Many other applications are vulnerable to this phenomenon and resulting problems.

For example, in credit card spend tracking and fraud detection algorithms used by banks consumer spending patterns change all the time.

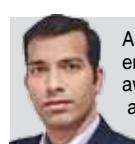
For a security surveillance application used in public places, the visitor pattern can show seasonal or permanent change over time (see what happened with Covid-19). Advertising, retail, marketing, health applications are equally prone.

If your sensor network is monitoring server room temperature and humidity, a new cabinet or rack addition can also affect the pattern of change of these factors.

Summary

It is unrealistic to expect that data distributions stay stable over a long period. The perfect world assumptions in machine learning do not work in most cases due to changes in the data over time, which is a growing problem as these tools and methods increase.

The key to fixing it is acknowledging that AI or ML applications do not sit in a black box. These evolve continuously and must be supervised at all times. When the change occurs, we can regularly fix them in a near real-time environment with the proposed algorithm and technique. **EFY**



Anand Tamboli is a serial entrepreneur, speaker, award-winning published author, and an emerging technology thought leader.



How Techimp's high-voltage monitoring system is built on PicoScope

Techimp is a world leader in electrical asset diagnostics. They recently supplied TenneT, a leading European electricity transmission system operator, with their Power Connection Monitoring System (PCMONS). PicoScope oscilloscopes are an integral part of this system.

System overview

The behavior of transients in high-voltage cables is a matter of concern, especially when overhead lines alternate with cable links. That's why TenneT ordered Techimp's PCMONS for their Randstad 380 kV Noordring Project. The PCMONS is a continuous permanent monitoring system capable of acquiring transients based on amplitude thresholds. The PCMONS acquires all parameters simultaneously each time a transient occurs, with a time stamp accuracy of 100 ns to allow correlation with events acquired from other systems.

The purpose of the system is to collect evidence of the behavior of a combined transmission cable/overhead line and confirmation of the mathematical model in a transient regime, and to obtain a possible indicator of the degradation of the system (residual lifetime) as a result of transients occurring in time.

The PCMONS is installed over a 40 km high-voltage power network in the north of the Netherlands, distributed in eight units covering 13 locations and four substations. It is composed of sensors connected to cabinets hosting amplifiers, acquisition instruments from Pico Technology and the triggering logic. The cabinets are connected via fiber optic to one server for each unit, where the triggering signals are distributed and the data is collected and transmitted to the central unit. This is the central server where data is stored for visualization and analysis using the proprietary human/machine interface (HMI) software, Techimp TiSCADA.

The PCMONS is responsible for acquiring, processing, archiving and presenting information concerning the power connection, and all functions defined are accessible to the user. The system is able to acquire continuous and impulsive voltages and currents, and raw partial discharge (PD) waveforms that are stored in the local servers.

All inputs have an adjustable trigger level above which the recording is started. An event detected on one of the sensors triggers all other measurements inside the same unit. In particular, each input has a dedicated trigger, each trigger level is adjustable between zero and the maximum input level and trigger levels are adjustable from the HMI and remotely. The PCMONS records 1 s of data after the trigger for all inputs with frequencies below 1 MHz, or 20 ms of data for frequencies above 1 MHz.

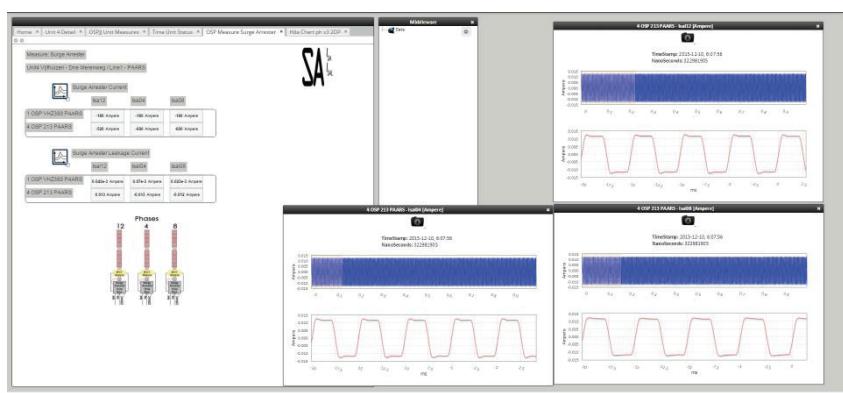


Figure 2: View Events



Figure 1: Indoor cabinet. PicoScope 6000 Series and 4824 devices, the core of the acquisition system, are highlighted, as is Techimp's trigger manager, propagating the trigger signal inside and outside the cabinet.

More details about: Description of parameters to be monitored, Visualization, Waveforms, Events, please browse the link: <https://www.picotech.com/library/application-note/how-techimps-high-voltage-monitoring-system-is-built-on-picoscope> and you can find our local partners for more product information: <https://www.picotech.com/distributors> or send us email: pico.asia-pacific@picotech.com.

Low Noise Power Supply With Four ICs In Parallel

Petre Tzv Petrov

This article presents a low-noise power supply with four 78L15 voltage regulators in parallel, giving about 15V DC output. The modern environment has become noisier, and every power supply is a powerful source of electrical noise, which is highly undesirable for high-quality audio and test equipment.

If you need a power supply of +15V with a tolerance of ± 10 per cent and noise lower than $10\mu\text{VRms}$, then 78L15 voltage regulators can be used. It is because they are low-cost, easily available, have output current of 100mA or more, low output voltage tolerance, small MO package (TO-92), internal current limiting, and thermal protection.

Most 78L15 ICs have an output current of 40mA, but we may need a current of 160-250mA. The use of M series, such as 78M15 regulators with 0.5A, is not suitable because this would require complex filter circuits to minimise noisy output voltages. Also, these regulators are available in TO-220 packages, which are more difficult to mount as compared to TO-92 packages.

One of the solutions to get higher current output is to use 78L15 voltage regulator ICs in parallel. An advantage of this configuration is that if one of the parallel regulators fails, the remaining regulators will provide output voltage and current. But note that 78LXX regulators have large output noise, sometimes more than $100\mu\text{VRms}$ in the range of 10Hz to 100kHz.

Generally, the noise produced by the voltage regulators is random. So, the averaging method—a noise reduction technique—can be applied to reduce the noise and tolerance of the output voltage. Ideally, we should apply this method over an infinite number of voltage sources, but it also

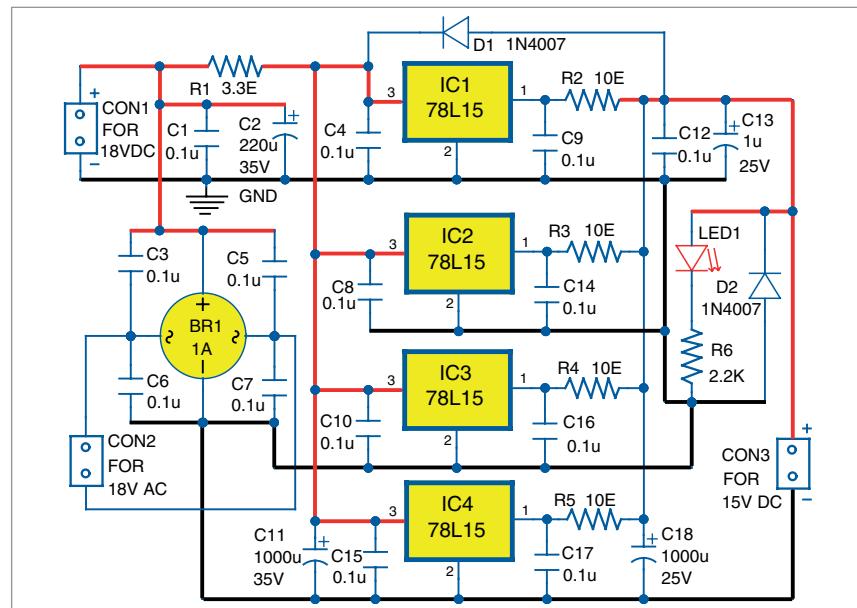


Fig. 1: Circuit diagram of low-noise power supply with four voltage regulators

Different Parameters From The Circuit With Four 78L15 Regulators in Parallel, +18V DC Input Voltage, and R2 Through R5 of 10-ohm Each

Table 1

Parameter	Rload = 100-ohm	Rload = 80-ohm	Rload = 60-ohm
V1	15.02V	15.03V	15.03V
V2	15.08V	15.09V	15.09V
V3	15.06V	15.06V	15.04V
V4	15.03V	15.09V	15.03V
Vout (total)	14.62V	14.55V	14.40V
Iout (total)	146mA	182mA	240mA
Iout (average per regulator)	36.5mA	45mA	60mA
Average voltage over equalisation resistors	0.37V	0.45V	0.60V

works over a small number of voltage regulators. Here we will see a solution based on this method.

Circuit and working

Circuit diagram of the low-noise power supply with four 78L15 voltage regulators in parallel is shown in Fig. 1. It is built around bridge regulator BR1, four 78L15 voltage regulators

(IC1 through IC4), 1N4007 diodes (D1 and D2), LED1, and a few other components.

The circuit uses 18V AC input or 18V DC inputs with RC filters to reduce noise. The RC filters for 18V DC input comprise of resistor R1 and capacitors C1, C2, and C11. The 18V AC input comprises rectifier bridge BR1 and capacitors C1, C2, C3, C5, C6,

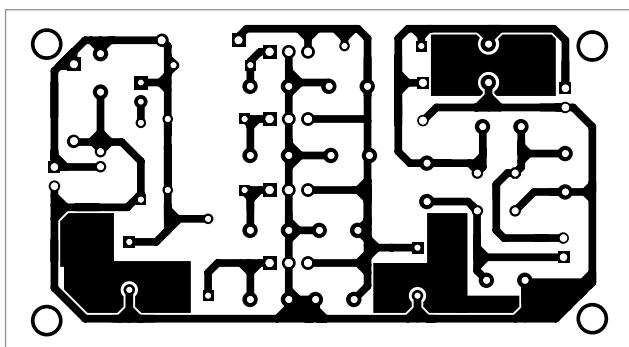


Fig. 2: Actual-size PCB layout for low-noise power supply

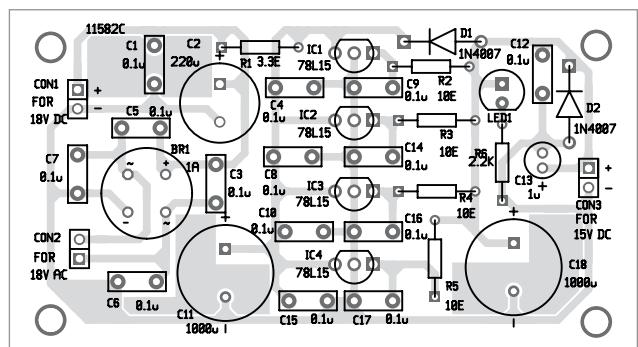


Fig. 3: Components layout of the PCB

C7, and C11. The effectiveness of the noise filtering depends on the internal resistance of the AC voltage source and diodes in the bridge.

The circuit has four 78L15 voltage regulators in parallel. Each of the regulators has an equalisation resistor (R2 through R5) at the output. The values of the equalisation resistors are equal to or greater than 10 ohms. The resistors are much higher in value than the internal output resistance of the regulators.

If required, you may add a capacitor of $0.1\mu F$ to each regulator (refer capacitors C4, C9, C8, C14, C10, C16, C15, and C17 in the circuit). These individual capacitors guarantee stable operation of the voltage regulators and reduce high-frequency noise to some extent.

Selection of equalisation resistors and RC filters. The output voltage of the circuit depends on the load current and equalisation resistors. A higher equalisation resistor will produce better equalisation and better filtering of the noise. But it will also lead to a higher dependency on the output voltage from the load current. That is, larger resistors will improve the filtration of the noise from the regulators but will affect load regulation. In this application, noise reduction is more important. The usual values of these resistors are from 10 to 30 ohms.

The main parameters with 10-ohm

resistors R2 through R5 are given in Table 1.

The cut-off frequency of the output filter built around the equalisation resistors and output capacitors C12, C13, and C18 should preferably be below 20Hz when we use 50Hz/60Hz AC mains input. With resistor $R = 10\text{-ohm}$ and capacitor $C = 1000\mu F$, we have frequency $F(-3\text{dB}) = 15.9\text{Hz}$ along with some harmonic suppression in the 50/60Hz AC mains present in the circuit after rectification.

Construction and testing

An actual-size PCB layout for the low-noise power supply is shown in Fig. 3 and its components layout in Fig. 4. After assembling the circuit on the PCB, connect either 18V DC across CON1 or 18V AC across CON2 as input and take 15V DC output across CON3.

This article presents a low noise power supply with four 78L15 voltage regulators in parallel that produces output of 14.4V at 0.25A. The average output current per regulator is below 75mA, which is below the defined 100mA output current for the 78L15 series. (We have an average current of 62.5mA per the regulator, given a total of $4 \times 62.5\text{mA} = 250\text{mA}$).

The circuit has a current limiting function and short-circuit protection. It does not need any adjustment to work properly.

PARTS LIST

Semiconductors:

- IC1-IC4 - 78L15, 15V regulator (TO-92 package)
- BR1 - Bridge rectifier (1A)
- LED1 - 5mm LED
- D1, D2 - 1N4007 rectifier diode

Resistors (all 1/4-watt, $\pm 5\%$ carbon):

- R1 - 3.3-ohm
- R2-R5 - 10-ohm
- R6 - 2.2-kilo-ohm

Capacitors:

- C1, C3-C10, C12, C14-C17 - $0.1\mu F$ ceramic disk
- C2 - $220\mu F$, 35V electrolytic
- C11 - $1000\mu F$, 35V electrolytic
- C13 - $1\mu F$, 25V electrolytic
- C18 - $1000\mu F$, 25V electrolytic

Miscellaneous:

- CON1-CON3 - 2-pin connector

Preferably, we should use a 78L15 regulator with a tolerance of $\pm 4\%$ or better and equalisation resistors with maximal practical values. Here, we are not concerned about output regulation but are interested in the low-noise output and equal output current distribution between voltage regulators connected in parallel. EFY

Petre Tzv Petrov was a researcher and assistant professor at the Technical University of Sofia, Bulgaria, and an 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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Low-Cost Smart Agriculture System

Jitendra Jangir
and V.K. Shukla

This IoT-based project monitors soil moisture, temperature, and humidity levels near plants and light intensity near the control station. It turns on water solenoid valve when moisture level goes below the threshold level. Its vibration sensor detects movement or any other unwanted activity of animals and rodents near the plantation area.

The project is equally suitable for indoor plants in buildings, greenhouse

farming, and for regular farming. Adafruit IoT platform is used to monitor various sensors' status online.

Block diagram of the low-cost smart agriculture system is shown in Fig. 1. The author's prototype of the project is shown in Fig. 2 while its circuit diagram is shown in Fig. 3.

Circuit and working

The heart of the IoT system is the NodeMCU ESP-32 8266 Wi-Fi module.

It is used to transmit the signals collected from various sensors to the users through a computer network. The sensors include four soil moisture sensors (SS1 through SS4), a light-dependent resistor (LDR), a vibration sensor (VS1), and a temperature and humidity sensor (DHT11).

If soil moisture or humidity level near any plant(s) goes below the threshold level (as per the program), the controller in NodeMCU switches

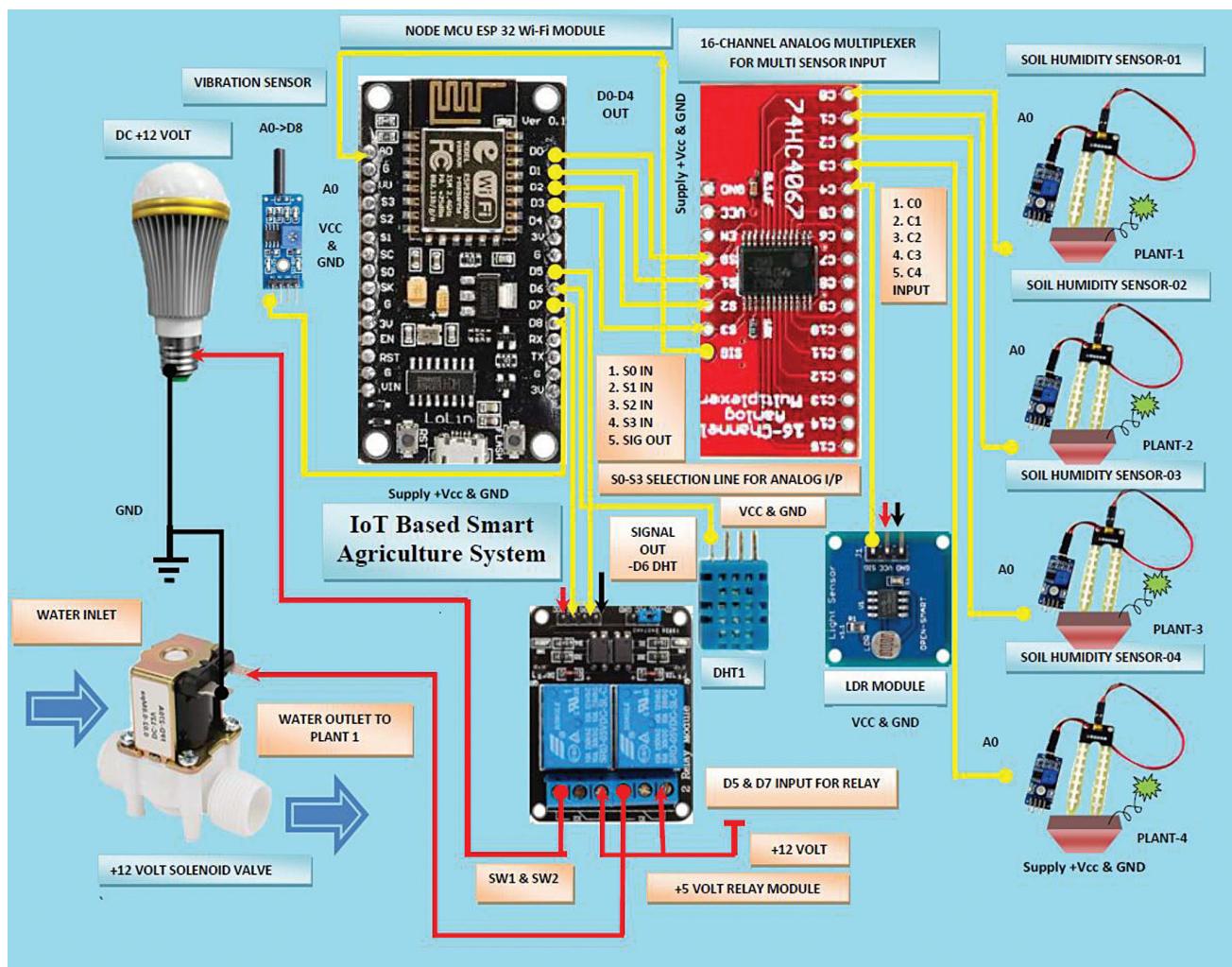


Fig. 1: Block diagram of the smart agriculture system

on the solenoid valve through the relay module (RM1) and water starts flowing.

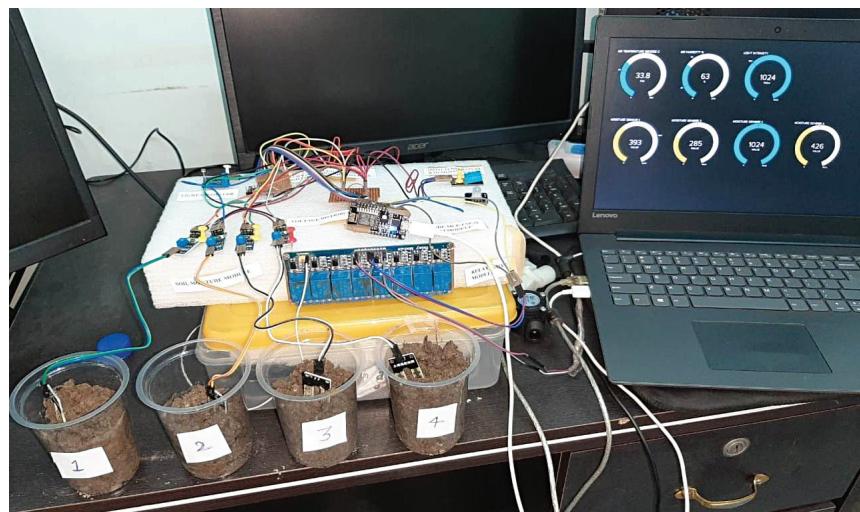


Fig. 2: Author's prototype

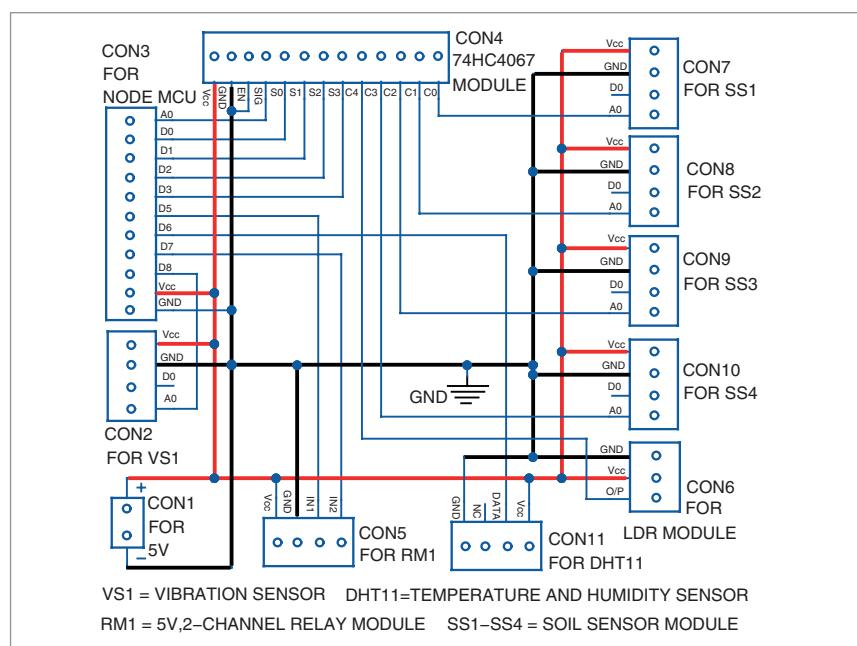


Fig. 3: Circuit diagram of the smart agriculture system

Pin Connections Between 74HC4067 and NodeMCU and Selection Condition of Pins

Table 1

SN pins of 74HC4067 connected to DN pins of NodeMCU				Select Input
D3→S3	D2→S2	D1→S1	D0→S0	SIG/A0
LOW	LOW	LOW	LOW	C0
LOW	LOW	LOW	HIGH	C1
LOW	LOW	HIGH	LOW	C2
LOW	LOW	HIGH	HIGH	C3
LOW	HIGH	LOW	LOW	C4

Where S1 through S3 are selection lines and D0 through D3 are digital pins

The LDR module is used to sense the day and night conditions in the control room. If light intensity in the

room is below the threshold level, especially during night, it turns on the light through relay module RM1.

Sensor DHT11 is connected at D6 pin of NodeMCU to monitor the temperature and humidity levels.

Vibration sensor VS1 is connected to D8 pin of NodeMCU. Any vibration near the plant(s) is registered as unwanted activity, which alerts the user through the glowing of inbuilt LED in NodeMCU board.

NodeMCU has only one analogue input (A0 pin) but we may require as many as six sensors to interface with MCU. This problem can be overcome by using 16x1 analogue/digital high-speed CMOS multiplexer 74HC4067 with NodeMCU-ESP32.

Soil moisture sensors SS1 through SS4 and one LDR sensor module are connected to input pins C0 through C4 of 74HC4067 module. The status of the five analogue inputs from these five sensors is selected using select lines S3, S2, S1, and S0. These select lines control by D3, D2, D1 and D0 pins of NodeMCU. Their connection details are listed in Table 1. The list of sensors connected in the system are shown in Table 2.

After selecting the input from 74HC4067 multiplexer module through the selection lines, a single output from the multiplexer available at pin SIG is connected to analogue input A0 of NodeMCU. The NodeMCU controller processes the input signals and turns on the light or activates the solenoid and connects the signals to the Internet.

The DHT11 sensor's data output is connected to D6 pin of NodeMCU for detection of temperature and humidity.

To control the AC-voltage-operated lights and solenoid valve for water supply to plants, D7 and D5 pins of NodeMCU are connected to input pins IN2 and IN1 of the relay module, respectively.

Software

Arduino IDE is used for programming the NodeMCU board. Connect the NodeMCU to PC/laptop and select proper COM port and board name from Tools menu of the Arduino IDE. The board name used in this project is shown in Fig. 4.

Upload the source code Program_11973.ino to the Arduino board by clicking on the Upload button. Before compiling and uploading the source code, do not forget to include ESP8266WiFi.h, DHT11.h, Adafruit,

and MQTT libraries from Library Manager.

NodeMCU Wi-Fi is connected to Adafruit.io open source cloud service to provide real-time data online. Message queue telemetry transport

(MQTT) is a protocol for device communication that Adafruit.io supports.

Steps to organise the dashboard on Adafruit.io IoT platform:

1. Open <https://io.adafruit.com> website. Create an account with a unique username. Note down this username as it will be used in Arduino code (Program_11973.ino) later.

2. Generate a key and note down this key. This is a long, unique identifier that you use to authenticate any device using your account. You get one key per account, but you can revoke and regenerate your key any time.

3. After creating an account, you need to manage your feeds for publishing on the dashboard as shown in Fig. 5. (Feeds is basically a set of data that you can read or write, as specified in the program, as per your application.)

In this project, we have used four moisture sensors (MS1 through MS4), and a temperature sensor (tmp). So, as an example, if this program used the following in the code, then it would require to create each feed as MS1 through MS4, tmp, LHT, etc to manage on dashboard:

```
Adafruit_MQTT_Publish photocell3
= Adafruit_MQTT_Publish(&mqtt,
AIO_USERNAME "/feeds/MS1");
```

```
Adafruit_MQTT_Publish photocell4
= Adafruit_MQTT_Publish(&mqtt,
AIO_USERNAME "/feeds/MS2");
```

```
Adafruit_MQTT_Publish photocell5
= Adafruit_MQTT_Publish(&mqtt,
AIO_USERNAME "/feeds/MS3");
```

```
Adafruit_MQTT_Publish photocell6
= Adafruit_MQTT_Publish(&mqtt,
AIO_USERNAME "/feeds/MS4");
```

```
Adafruit_MQTT_Publish photocell1
= Adafruit_MQTT_Publish(&mqtt,
AIO_USERNAME "/feeds/tmp");
```

```
Adafruit_MQTT_Publish photocell2
= Adafruit_MQTT_Publish(&mqtt,
AIO_USERNAME "/feeds/hum");
```

```
Adafruit_MQTT_Publish photocell7
= Adafruit_MQTT_Publish(&mqtt,
AIO_USERNAME "/feeds/LHT");
```

You need to add all feeds in Adafruit IO to display live data from sensors on dashboard as shown in Table 3.

More details regarding configuration with Adafruit IoT and Arduino are given in ‘Configurations with Adafruit & Arduino’ document file in the source code folder.

Now open PROGRAM_11973.ino source code, include all your own

List of Sensors Connected in the System

Table 2

Sensor	Pin Name	NodeMCU	74HC4067
Vibration sensor	A0(O/P)	D8(I/P)	-
Soil sensor 1-4	A0(O/P)	-	C0-C3(I/P)
LDR module	O/P	-	C4(I/P)
DHT11	DATA(O/P)	D6(I/P)	-
Relay drive	IN1(I/P) IN2(I/P)	D5(I/P) D7(I/P)	-
16x1 MUX	S0-S3(I/P) SIG(O/P)	D0-D3(O/P) A0(I/P)	-

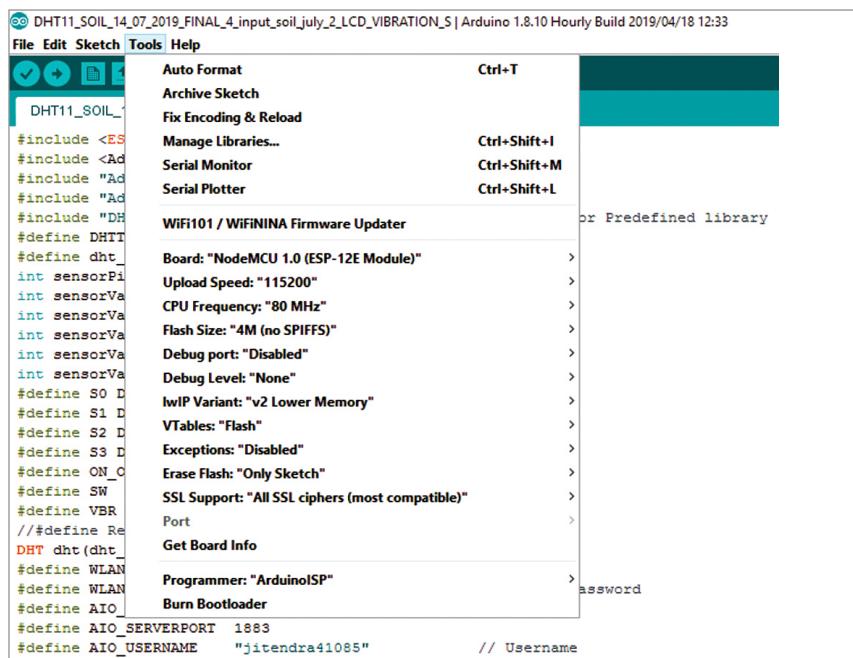


Fig. 4: Selection of board as NodeMCU 1.0 (ESP-12E module)

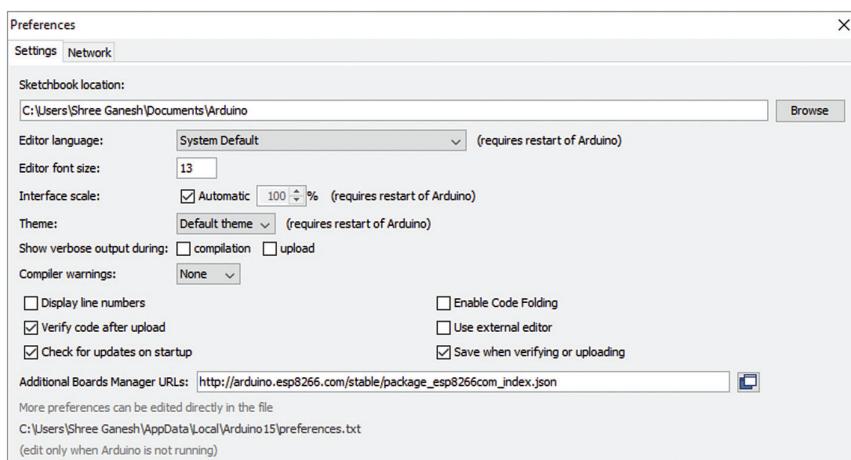
ID	NAME	KEY	LAST VALUE	RECORDED	ACTIONS
606799	test	test	sdfdf	27 days ago	
604996	counter	counter	26	12 days ago	

Fig. 5: Feeds window on Adafruit IoT platform

Feeds on the Adafruit IoT Dashboard

Table 3

FEED	Work/Process/ Activity	Block Title (optional)	Gauge Min. Value	Gauge Max. Value	Gauge Width	Gauge Label	Low Warning Value	High Warning Value	Decimal Places	Test Value
MS1	Soil Sensor 1 Reading	SOIL SENSOR 1	0	1024	25px	Value	350	900	2	45
MS2	Soil Sensor 1 Reading	SOIL SENSOR 2	0	1024	25px	Value	350	900	2	45
MS3	Soil Sensor 1 Reading	SOIL SENSOR 3	0	1024	25px	Value	350	900	2	45
MS4	Soil Sensor 1 Reading	SOIL SENSOR 4	0	1024	25px	Value	350	900	2	45
Tmp	Temp In Degree Celsius	TEMP	10	60	25px	Value	10	40	2	45
Hum	Humidity in %	HUMIDITY	0	100	25px	Value	-	-	2	45
LHT	Light Intensity	LIGHT INTENSITY	0	100	25px	Value	-	-	2	45



PARTS LIST

Board1	- NodeMCU module
SS1-SS4	- Soil moisture sensor module
DHT11	- Temperature and humidity sensor module
VS1	- Vibration sensor module
RM1	- 5V, 2-channel relay module
	- LDR module
	- 74HC4067 module
	- 5V regulated power supply

```
// Your WIFI password CHANGE IT(2)
#define AIO_SERVER "io.adafruit.com" //Adafruit Server
#define AIO_SERVERPORT 1883
#define AIO_USERNAME "jitendra41085" // Adafruit Username
CHANGE IT(3)
```

```
#define WLAN_SSID "Samsungi"
//Your WIFI NAME SSIDCHANGE
IT(1)
```

Next, change the software configuration by adding http://arduino.esp8266.com/stable/package_esp8266com_index.json under File/Preferences in Arduino IDE as shown in Fig. 6. Now you can save the code, compile it again, and upload it to NodeMCU board.

After making all the circuit connections, switch on NodeMCU board and open the Adafruit IoT dashboard. You will see something as per Fig. 7. **EFY**

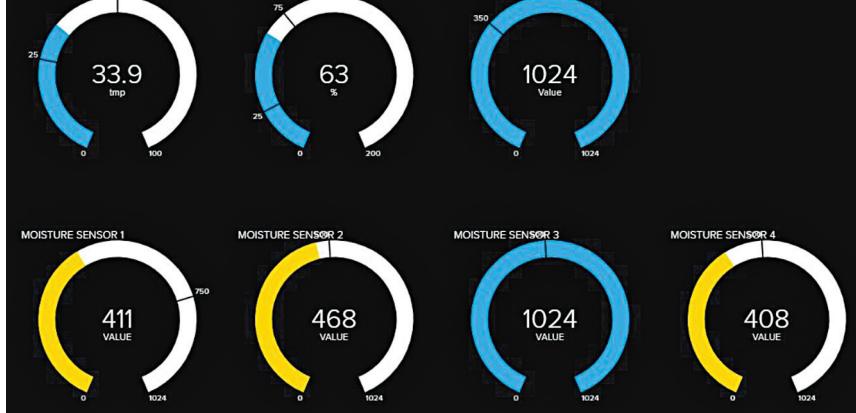


Fig. 7: Adafruit.io dashboard with live data streaming of various sensors outputs

Wi-Fi credentials including SSID, passwords, username, and key as shown below.

```
#define WLAN_SSID "Samsungi"
//Your WIFI NAME SSIDCHANGE
IT(1)

#define WLAN_PASS "abcd123456"
```



Jitendra Jangir is training officer (Electronics) at National Skill Training Institute (W), Patna, Bihar



V.K. Shukla is retired as director at Directorate General of Training, Ministry of Skill Development and Entrepreneurship, government of India

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

LED Emergency Light Cum Power Bank Plus Mini Fan Driver

Gautam Kumar Mandal

This simple circuit can be used as an LED emergency light, a power bank for charging mobile phones, and as on-the-go (OTG) USB DC fan driver.

The power bank with 12Ah can deliver 2A current for charging a mobile phone. There is a provision for adjusting the charging rate through boost converter module. Also, there is a digital voltmeter that monitors Li-ion rechargeable battery pack's voltage as well as the

mobile charging voltage. Inside view of the author's prototype is shown in Fig. 1.

Following components would be required to build the project:

- Four 3,000mAh Li-ion 18650 type batteries (see Fig. 3)
- A 5V, 1A TP4056 micro USB battery charger module with inbuilt LED indicator for charging and automatic overcharge protection system
- A 4V white LED strip with aluminium-sheet base
- An XL6009 DC-DC boost converter module
- Two SPST switches
- One SPDT switch for the digital voltmeter
- A tiny 0.71cm (0.28-inch), 2.5V to 30V DC range mini digital voltmeter
- Switchboard's plastic enclosure with USB female sockets for mobile charging and OTG fan
- Transparent acrylic sheet for the emergency light on the front side
- An OTG mini fan

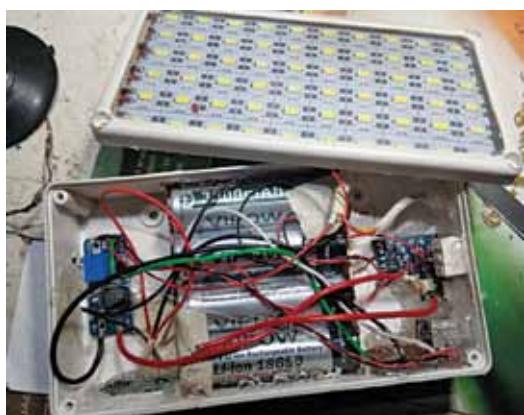


Fig. 1: Author's prototype with inside view

4pcs VIPOW 18650 Battery 3.7V 3000mah



Lithium Ion Button Top

Fig. 3: Li-ion battery pack

Circuit and working

The circuit diagram of the emergency light with power bank and OTG fan driver is shown in Fig. 2. It is built around TP4056 charging module (Board1), DC-DC booster module (Board2), four 18650 type Li-ion batteries (BATT.1), 6 x 10 LED-array, and a few other components.

TP4056 charging module used in the project is shown in Fig. 4 and XL6009 DC-DC booster module in Fig. 5.

Battery bank charger

The battery bank includes four Li-ion 18650 type cells that are connected in parallel. For charging the Li-ion battery bank, a TP4056 charging board (5V, 1A) with an LED indicator and automatic protection is used. Only one charging module is used in this project.

With a good quality smartphone charger input at CON1, it takes around two hours to fully charge the battery bank. When it is fully charged (battery voltage is 4.1 volts), the inbuilt red LED of TP4056 module becomes green. Though maximum voltage

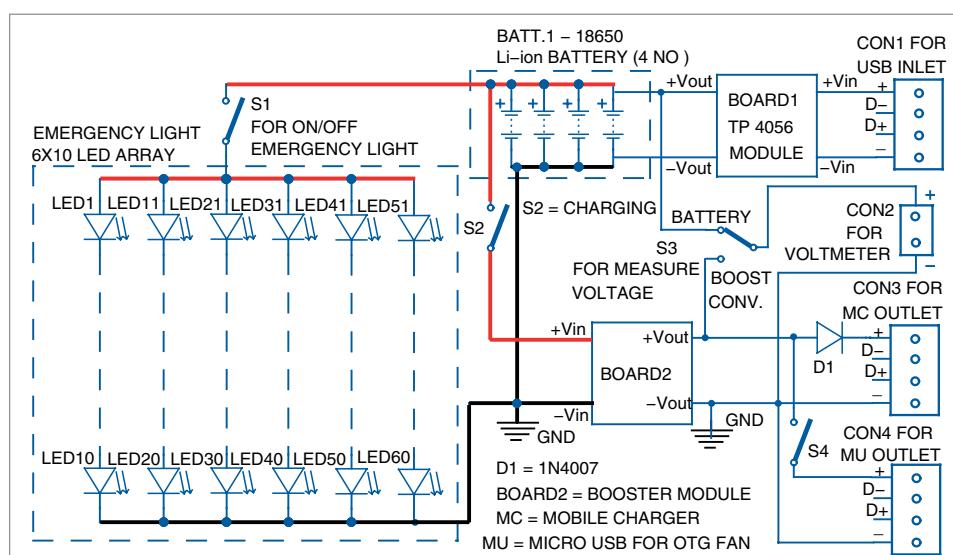


Fig. 2: Circuit diagram of the emergency light with power bank and OTG fan driver

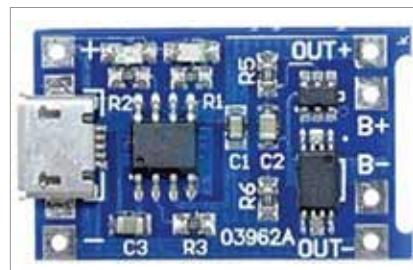


Fig. 4: TP4056 charging module



Fig. 5: DC-DC booster module



Fig. 6: OTG mini fan

of Li-ion battery is 4.2 volts but, for safety reasons, charging stops at 4.1 volts.

The power bank's output can be used to drive an emergency light, charge a mobile phone, or drive a mini OTG DC fan (refer Fig. 6). For emergency light, six 4-volt strips, with ten LEDs on each strip, are used in parallel. Switch S1 is used to switch the emergency light on/off.

XL6009 booster module

When the power bank's output is connected to a load such as an emergency light, its battery voltage slowly starts dropping. To maintain a constant voltage level for charging a mobile phone or driving a mini fan, an XL6009 DC-DC step-up converter module is used (via switch S2). It is basically an adjustable power booster module that raises the power bank's output (low battery voltage) from 4.1 volts to 5 volts.

Using XL6009's inbuilt trimmer,

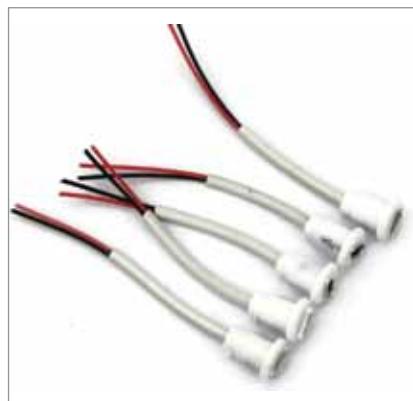


Fig. 7: Female USB sockets



Fig. 8: Author's finished prototype from outside

its output voltage can be increased to 5.5 volts for quick charging of a smartphone. But this voltage needs to be limited to 5.5 volts and should not be increased beyond this level for safety of the connected device. Recommended set point of output voltage is 5V.

The output is available through a standard female USB socket for charging mobile phones using a USB cable. This mobile charging output is available at CON3 in the circuit.

Another micro USB female socket is used at CON4 for driving the OTG mini fan. Switch S4 is used to switch off OTG fan. Typical female USB sockets available in the market are shown in Fig. 7.

A mini digital voltmeter is used to show the battery bank's voltage and boost converter's output voltage to

PARTS LIST

Semiconductors:

- Board1 - TP4056 micro USB 5V, 1A 18650 Li-ion battery charging board with LED indicator
- Board2 - DC-DC boost converter module XL6009
- D1 - 1N4007 rectifier diode
- Miscellaneous:**
- CON1, CON4 - Micro USB for TP4056 module and OTG fan
- CON2 - 2-pin connector
- CON3 - USB type A female socket for mobile charging
- S1, S2, S4 - On/off toggle switch
- S3 - Single-pole double-throw (SPDT) switch
- 3,000mAh Li-ion 18650 rechargeable battery pack (4 nos.)
- 4V white LED strip with aluminium sheet
- OTG mini fan
- 0.71cm (0.28-inch), 2.5V to 30V range digital voltmeter

monitor the power bank's condition and mobile phone's charging state. A single-pole, double-throw (SPDT) switch (S3) is used to select between the power bank output and mobile charging output voltages.

Construction

A $17.78 \times 10.16 \times 3.81\text{cm}$ ($7 \times 4 \times 1.5\text{-inch}$) size plastic box can be used for housing the entire circuitry. It can accommodate all the components including Li-ion battery bank and LED lights.

The slots for switches and USB sockets can be provided on the enclosure as shown in Fig. 8. You may use a small knife or a poker to make holes in the plastic box for the sockets and switches and fix them using hot glue and double-sided tape.

A transparent acrylic sheet can be used on the front side for covering the LEDs of emergency light. Since aluminium sheet is present at the back of each LED strip, no separate heat-sink is required.

The author's finished prototype for the emergency light is shown in Fig. 8. **EFY**

Gautam Kumar Mandal is deputy general manager in Durgapur Steel Plant (SAIL). He did his M. Tech from NIT, Durgapur and B.E. from BE College, Shibpur (now IIEST-Shibpur). He is an electronics hobbyist and a regular reader and contributor to EFY



THE DASHBOARD



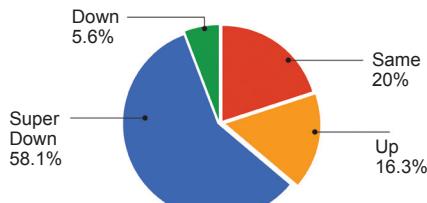
16% Grow, 20% Un-affected Despite All Odds

How's business? How's it compared to last year on a year-on-year (YoY) basis?

Result:

16.3% Up, 20% Same, 5.6% Down, Rest Super Down

While 64% said business was down or super-down (or worse), 20% said it was the same and 16.3% said it had grown on a YoY basis



Credit: EFY Research Cell

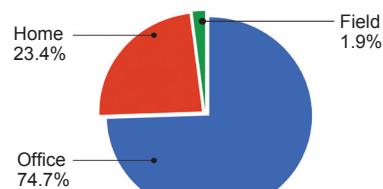
Sales from Home, Office or in the Field

Where is your sales happening from?

Result:

74.7% from Office, 23.4% from Home, Rest from Field

Majority (74.7%) have their sales team working from office. Very few (1.4%) have their sales team on the field. And, a considerable amount (24.7%) is still happening from home



Credit: EFY Research Cell

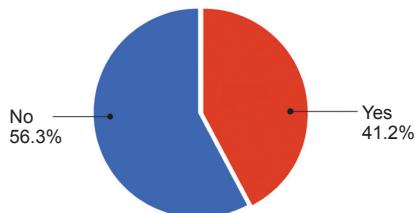
Any Change in Product-Mix

Any new product launched? Any product closed?

Result:

41.2% Changed Product Mix, 56.3% No Change, Rest Unsure

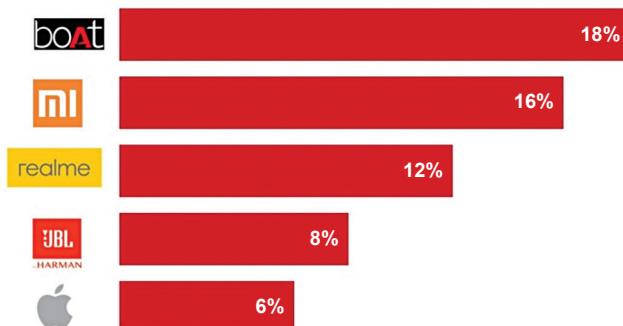
Quite a significant percentage (41.2%) have either launched new product categories or reduced some products. Rest had no change or were still awaiting clarity from the top



Credit: EFY Research Cell

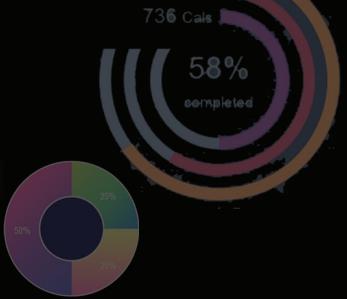
TWS Market Grows 7 Times

India's Truly Wireless Speakers (TWS) market growth soared 723% YoY in Q3-2020, defying the impact of economic slowdown, reaching its highest ever growth in shipments for a single quarter. An Indian brand (boAt) tops the list!



Courtesy: Counterpoint Research

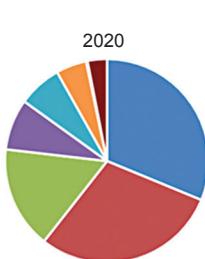
At-a-glance view of key industry trends that can shape the future of your business...



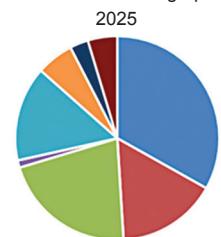
Graphene: A Growth Market (2020 - 2030)

IDTechEx forecasts that the market for graphene materials will reach \$700 million by 2031. Here's how the revenue and volume of graphene will be attributed to different verticals

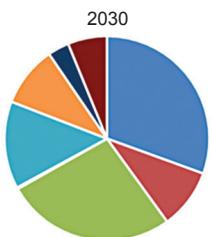
- Energy storage
- Thermal management
- Composites
- Research
- Functional coatings, inks, and adhesives
- Sensors
- Concrete and Asphalt
- Others



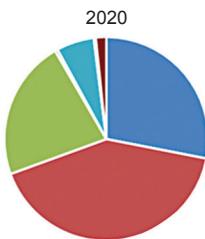
Revenue attributed to graphene



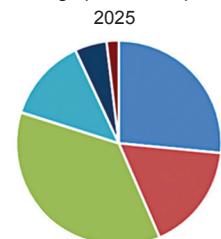
Revenue attributed to graphene



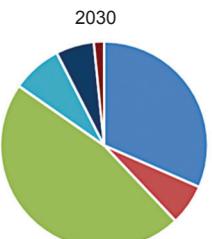
Revenue attributed to graphene



Volume of graphene nanoplatelets



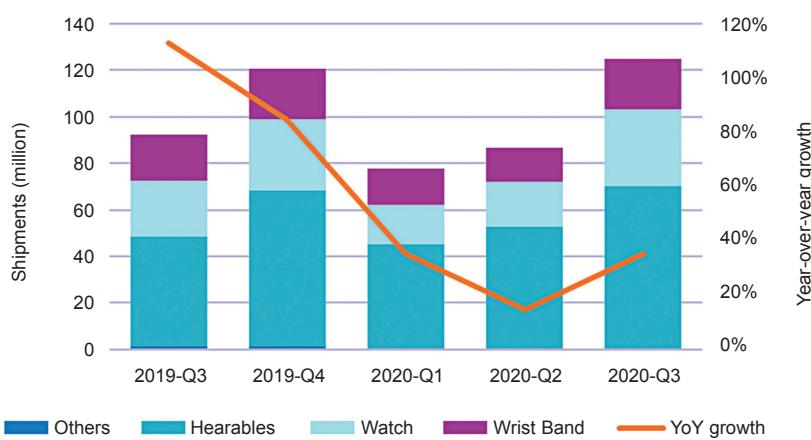
Volume of graphene nanoplatelets



Source: www.idtechex.com

Q3-2020: Wearables Up 35.1% Globally

The global wearables market grew 35.1% (YoY) during the third quarter of 2020 (3Q20) with total shipments reaching 125 million units as per International Data Corporation (IDC). The surge was driven by seasonality, new product launches, and the global pandemic



Source: www.idc.com



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How Chatbots Are Enabling A Paradigm Shift For Organisations

When a human resource is unable to handle the continuous demand for customer service well, organisations switch to AI-powered chatbots. AI chatbots are now being used in various fields to improve customer service and thus the revenue

Dr Krishna Naga

"We are now witnessing a new shift in computing: the move from a mobile-first to an AI-first world."

—Sundar Pichai, CEO of Google

The advances in technology have increased exponentially, which has brought a revolution in the user interface by extracting maximum value from artificial intelligence (AI) to enhance the productivity of businesses and boost their revenue. In recent years, the intense innovations in machine learning and other fundamental technologies like natural language processing have led to an astonishingly widespread use of chatbots or conversational agents that facilitate the human-to-bot interaction, which is the biggest dominating mobile trend of this time.

Chatbots, derived from 'chat robots,' are text- or voice-based algorithms powered by AI that are capable of checking

the customers' needs and providing possible suggestions. These are now gaining more popularity on Facebook Messenger, Twitter, LinkedIn, Skype, Slack, Kik, and other messaging platforms.

The human-to-bot interaction lets the users have normal conversation in dialogue form, entering their purposes directly into the machines to buy things, to book their place in the salon, to make hotel reservation, to get online health advise, or to even get directions. The chatbot appears as if the machine language has been humanised and is making the computers or mobile phones to adopt the human world. But, in fact, the human language is being mechanised to bring us into the machine world!

Chatbots, virtual assistants and live chat software

Chatbots and virtual assistants (VA) are both smart applications of AI and they both are conversational interfaces. Chatbots are automated software that is company-oriented, programmed with a learned set of knowledge and reacts to users' questions by providing a pre-defined answer. Whereas VAs like Cortana or Siri are digital assistants, similar to human assistants, that deal with an individual user, like organising and reminding business appointments, handling to-do lists, setting up alarms, and assisting in other daily routines.

Chatbots, being information acquisition tools, facilitate customers' communication with any business venture. An organisation can build its customised chatbot for virtual conversation with its customers using



Fig. 1: Chatbots in e-commerce business

a technology called Natural Language Processing (NLP). The NLP algorithm is making the chatbot smarter.

VA uses high-level automation software, based on advanced NLP, which enables it to understand natural language voice commands and interact with the individual user, offering human-like assistance in a highly effective way. VA follows the dynamic conversational flow technique, which means it can interact with human beings continuously, even if the communication is not continuous, and can

remember the fundamental perspective of the conversation. Instead, a chatbot fails to retain the conversation because it lacks in dialogue management, which makes the customer start all over again. However, this flaw has been overcome in Google's Meena chatbot by using powerful encoders and decoders.

So, organisations need to focus on appropriate areas where the AI applications, VAs, and chatbots can be implemented correctly to leverage their business. This article points out some sectors where the organisations' re-

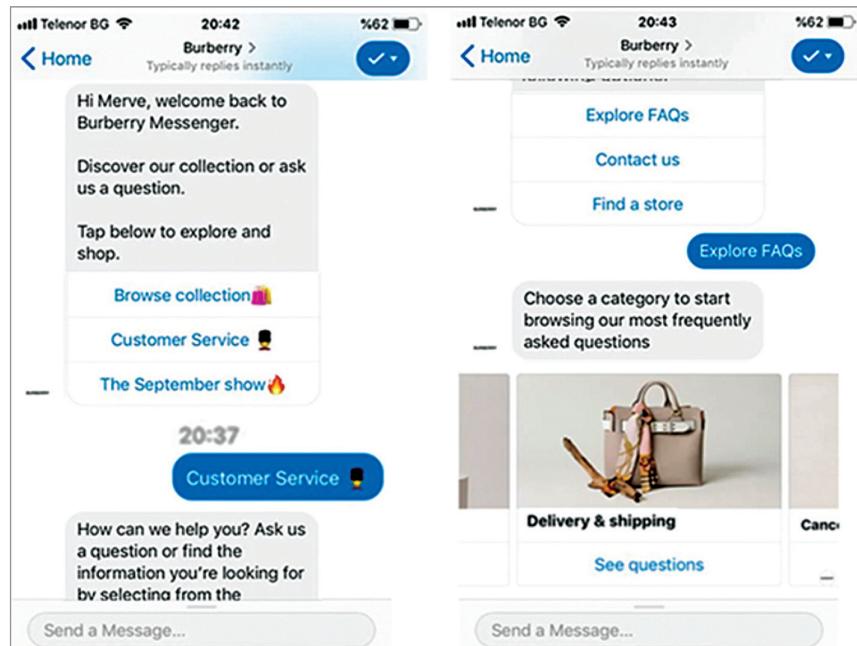


Fig. 2: Burberry chatbot (Credit: MERVE POSTALCIOGLU)

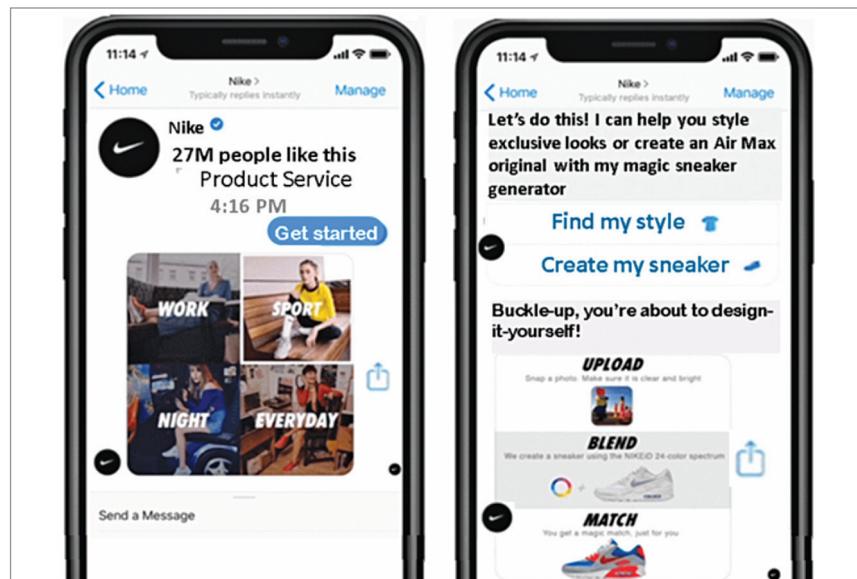


Fig. 3: Nike chatbot (Credit: Nike)

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Coronavirus Self-Checker

Hi, I'm Clara. I'm here to guide you through the Coronavirus Self-Checker.

If you are experiencing a life-threatening emergency, please call 911 immediately.

This system does not replace the judgment of healthcare professionals or the performance of any clinical assessment.

To provide information on the right level of care, we are going to ask you a series of questions.

During the assessment, you can refresh the page if you need to start again

Ready? Let's get started.

Where are you located?

United States

Outside the US

CDC Just now

Fig. 4: CDC corona virus chatbot (Credit: CDC website)

venue and customer retention rates have increased due to the usage of chatbots.

Chatbots in e-commerce business

AI in online shopping has transformed the e-commerce industry by using chatbots to provide 24/7 support to their online customers; thus making the customers feel that they are in direct contact with the brand regardless of the time. As chatbots use NLP, they can construe the voice-based communications. So, the requirements of the customers are perceived profoundly, hence increasing their confidence in the company.

Chatbots can identify the thoughts and views of the customers from their searches and questions and can provide instant answers, facilitating good customer service. Also, they can remember the preferences of the customers so that any offers from the organisation get communicated personally to each customer.

Burberry chatbot (UK/US). Burberry, one of the luxury fashion brands, uses a 'see-now-buy-now' chatbot that can be accessed by scanning a QR code or through the company's Facebook Messenger page. This bot provides customer service support by answering frequently asked questions

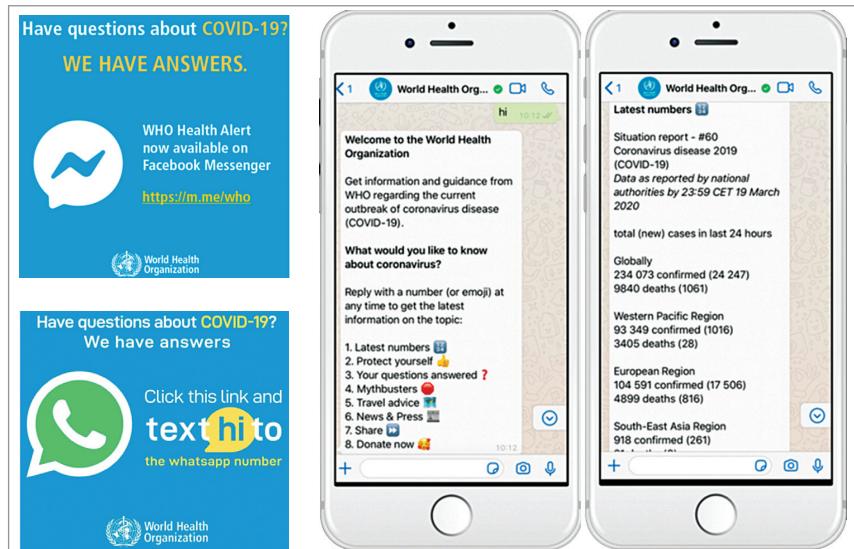


Fig. 5: WHO's Health Alert chatbot (Credit: World Health Organization)

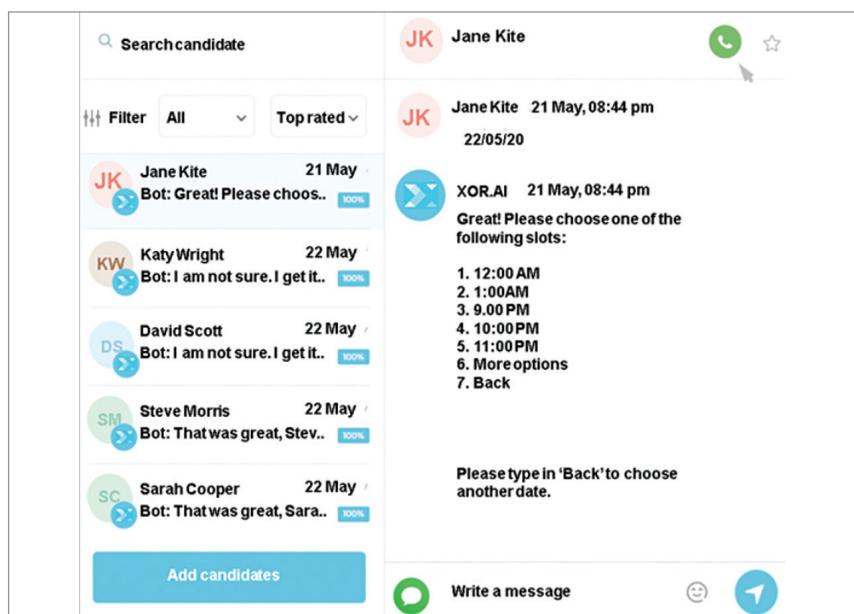


Fig. 6: XOR chatbot for recruiting (Credit: XOR.ai)

through categorised options, hence enabling a better 'conversational commerce' by allowing access to a large user database for better communication with their target audience.

When Burberry launched its chatbot in 2016, it was only allowing its customers to have a look at their collections and shop some selected pieces. But now, the company's chatbot can send push notifications to all the customers who communicate with it, can help the customers get in touch with the Burberry Consultant directly, can locate a particular store, or book a Uber ride to their Makers' House.

Also, the see-now-buy-now bot allows Burberry customers to design their trench coats—the brand's classic outerwear—thus giving a personalised shopping experience to them. Shopping percentage rises when brands offer such personalised experiences, which takes marketing to a new level and targets more customers.

Nike chatbot. Nike's chatbot, developed by Snaps.io, allows users to browse Nike footwear and clothing selections. Nike By You (previously NikeID) service encourages individuals to design their shoes either by uploading their design pictures, or by blending options, or using

'magic match.' As the chatbot is language agnostic, it is capable of catering to international audience.

The bot interacts with the users through a multiple-choice format on topics extending from products, users' preferences, style or size, shipping, etc. The collected information is used as input and the bot begins its search based on the users' requirements and redirects the users to Nike's site for purchasing the products, thus saving the customers' effort and time.

Chatbots in the medical industry

The whole world has seen a sharp and tenacious decline in the economy due

to the Covid-19 pandemic. The virus has also impacted most of our daily routine and has turned events to virtual versions. The novel pandemic has made the medical industry also go through ups and downs throughout the catastrophe. So, this industry has now taken the centre-stage position among all the sectors. Establishments like the Centers for Disease Control & Prevention (CDC) and World Health Organization (WHO) have shown the potential of chatbots in saving lives. These organisations are using chatbots to share information, to recommend actions and procedures that support our health, and to offer emotional support.

CDC's Clara chatbot. CDC was

using a chatbot named 'Clara' that was built on Microsoft's Healthcare Bot powered by tech giant Azure's cloud architecture. This chatbot is available any time of the day to give up-to-date information. It can hear and respond in natural language and it can simultaneously speak to millions of people in their local languages and dialects.

During the peak of Covid-19 outbreak, doctors, nurses, and administrators were overwhelmed with the number of cases they had to attend. Clara could differentiate individuals with high-risk and low-risk factors and thus helped healthcare professionals to focus first on patients who needed critical care.

WHO's Health Alert chatbot. WHO has launched a chatbot on Facebook Messenger and WhatsApp, called WHO Health Alert, which provides instant and accurate information about Covid-19. The chatbot was developed in collaboration with Sprinklr and in partnership with Praekelt.Org using Turn machine learning technology.

This chatbot can be accessed in Arabic, English, French, Hindi, Italian, Spanish, and Portuguese languages for correct information about coronavirus and what people can do to protect themselves and others.

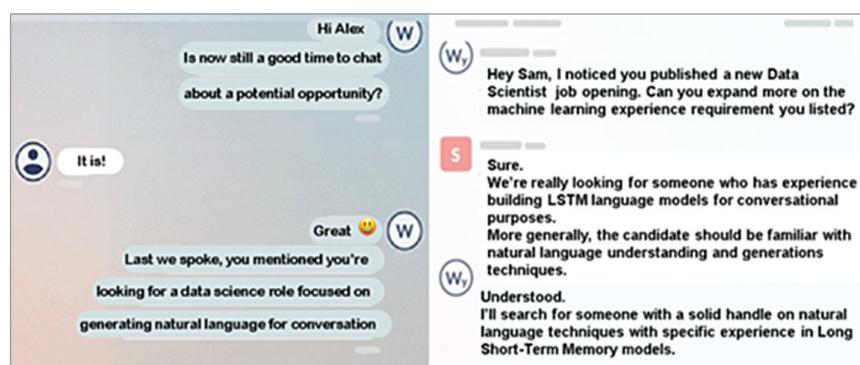


Fig. 7: Wade and Wendy chatbots (Credit: welcome.ai)

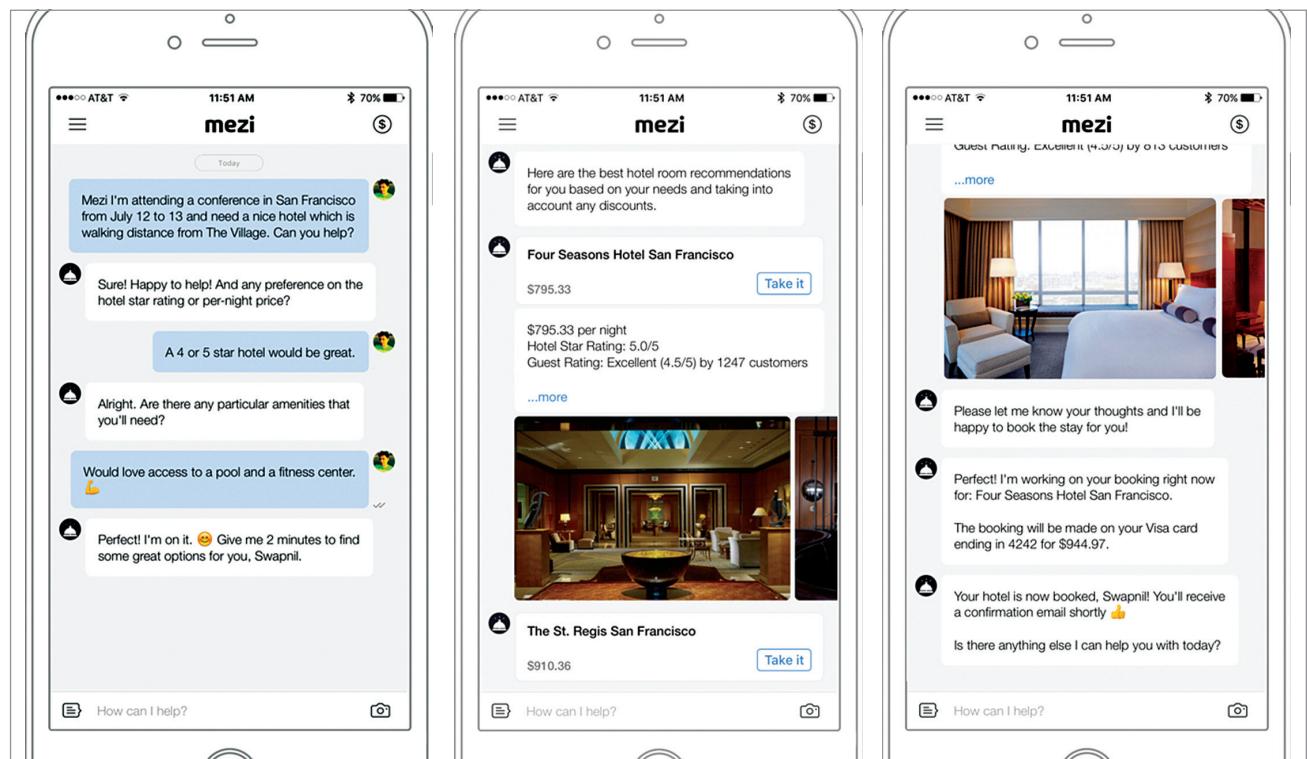


Fig. 8: Mezi for travel agencies (Credit: Mezi)

Chatbots for human resource

AI has transformed the landscape of human resource management. Chatbots have set foot in the workplace in the form of HR chatbots that automate most of the tasks in the HR departments like recruiting, managing payroll, managing training skills or professional development, and furnishing any other new prospects to boost employee experience. This advanced automation reduces human participation and expenses.

Each workplace is now adopting new conversational interfaces to interact with employees to have personalised but frictionless interactions. Organisations prefer chatbots because these are capable of engaging across multiple channels like a website, a mobile app, Microsoft Teams, Slack, or any other messaging app.

XOR chatbot for recruiting. XOR AI can speak 103 languages to attract applicants from all around the world! It is an easy-to-use chatbot that requires no coding skills and can be integrated with most of the applicant tracking systems and HR technology platforms within a day and maximum up to two weeks.

XOR chatbots select resumes that match the job requirements, call the selected candidates, and arrange for interviews. This process is completed within minutes whereas the same procedure requires three to four weeks for the HR department. XOR is finding application in companies like ALDI, CISCO, Heineken, and IKEA.

Wade and Wendy chatbots. Wade and Wendy are two different chatbots for recruitment that use advanced AI technology for conversational intelligence. Chatbot Wade guides the job seekers by helping them find a job they aspire for and describing them the job criteria; Wendy ensures that it screens the applicants based on the given job criteria.

Wendy makes the hiring process more humane by keeping each applicant engaged as the recruitment is chat-driven with role-specific conversations. It helps the HR throughout the hiring process by acquiring and synthesizing the information and finally making its recommendation about the best fit for the specified job role.

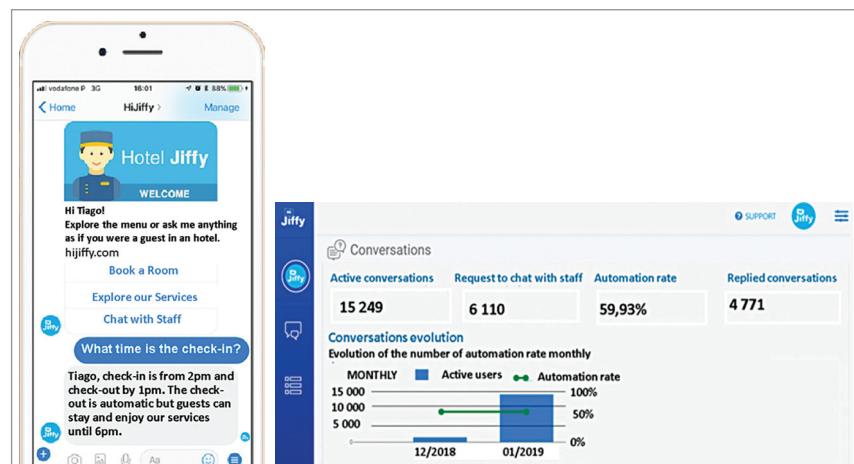


Fig. 9: HiJiffy for hotels (Credit: HiJiffy)

Wendy's conversation with the applicants is not identical because its response is based on what the applicants say. Wendy is capable of diving deeper into the applicants' responses and can ask follow-up questions to get a better understanding of the candidate's skills, depth of experience, and familiarity with certain processes or tools.

Chatbots in tourism and hospitality

The atavistic wish to voyage all around the world is inherent in every individual. According to Google, 82 per cent of travellers use the Internet for planning their travel and making online bookings. The rise and shine of chatbots has made a positive impact in customer interactions in the tourism sector, hotels, and other hospitality-related businesses. Leading companies like Skyscanner, Expedia, and Booking.com have already transformed digitally by using chatbots to retain their sales momentum.

Mezi for travel agencies. AI-powered Mezi is a free chatbot that assists travellers in making their travel plans simple, fast, and easy. It is integrated into Facebook Messenger, Slack, and Skype and can answer more complex questions than any other travel AI as it is equipped with a large dataset of itineraries, room inventory, and pricing details.

For the given dates and destinations, Mezi can provide the best flight and accommodation options and can also make recommendations like the best time to visit a particular place. Mezi is powerful in picking up the

hints of the traveller's needs from their own words and can reply to them instantly with all possible suggestions and recommendations. Besides working for travellers, Mezi offers business subscriptions for travel agencies and travel management companies.

HiJiffy for hotels. Chatbots are also being used by hotels to handle customer lexicon by centralising, automating, and measuring all customer care activities. Customers can contact chatbot HiJiffy through any messaging channel; it can recognize and respond to the customers instantly, creating a fast-track revenue stream for the hotels. More than 500 hoteliers and property owners running their businesses in 30 countries use HiJiffy.

Conclusion

When a human resource is unable to handle the continuous demand for customer service well, organisations switch to AI-powered chatbots. AI chatbots are now being used in various fields to improve customer service and thus the revenue. Chatbots are useful not only for the cutting-edge tech companies but also for any start-up companies striving to scale up fast. You can also consider them to increase your sales by using this innovative way to engage your customers, enhance your company's vision, and look up to a better future! EFY



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



LED Lights: Can India Make For The World?



LED Lights is one of the fastest growing businesses in the world. While India is considered the second biggest consumer of these lights, can it also become the biggest in manufacturing these?

Mukul Yudhveer Singh

The Indian LED lighting market, as per a report by IMARC, reached a value of US\$2.87 billion in 2019. The global lighting market size, on the other hand, stood at US\$115.44 billion in 2018 and is projected to reach US\$161.58 billion by 2026. China, India's neighbour, is one of the top exporters of LED lights. India, on the other hand, is a big importer of LED lights and a variety of components that go into these lights.

Based on these facts and figures, and the government of India's focus on promoting manufacture of electronics within the country, EFY interacted with Parag Bhatnagar, SVP, Havells; Raja Mukherjee, BU head, Panasonic Life, and Arun Kumar, business leader, Signify. This interaction was chaired by Arpit Chhabra, CEO, IoTfy

with the aim to find answer to one question: Can India lead in LED manufacturing space?

"The adaptability of LED lights in India is perhaps the best on the globe. We are poised to grow 15 per cent YoY in terms of further adoption. The demand for LED lights is projected to grow at a rate of 23 to 24 per cent per year till 2023-24. India, with its base of around 100 manufacturers, will be able to meet this need but there are challenges on the capability front," says Mukherjee.

A look at the current capabilities in India

Mukherjee explains that the advent of LED lightning would now require subject matter experts. The availability of such experts in India is an issue at present. Setting up the ecosystem for enabling growth of LED lights in

Can India Do It? Some Hard Facts

- India currently produces approximately 80 million LED lights (in organised and unorganised sectors) per month. That is around 960 million LED lights in a year!
- Most of these LED lights are assembled within the country
- Several companies are still manufacturing conventional lights (approximately 400 million per year)
- An ecosystem for manufacturing components required in LED lights does not exist in the country
- Smart lightning is one of the biggest opportunities India can focus upon
- Exporting to countries in the African continent can be a big opportunity
- Rural markets, within the country, are the next big opportunity
- Investments in R&D, design and component manufacturing are need of the hour
- Government will have to play a bigger role in the form of levying duties and taxes on imports to promote India-based manufacturing of components and finished goods

the IT vertical is another big challenge.

India, when it comes to assembling these, falls at the top of the value chain. However, to call India a manufacturer, the country will have to graduate in terms of a lot of things ranging from ICs, modules, and every other component that goes into manufacture of LED lights.

“Data estimates are that around 50 million LED bulbs are produced in India every month in the organised sector, and production of around 20 million LED lamps takes place in the unorganised sector. But the opportunity ahead can be assessed from the fact that about 400 to 500 million conventional lamps are still being produced in India,” says Kumar.

He further explains that, while we may be sufficient in producing as per present requirement and forecast for the near future, India still needs to build capability to produce components for which it depends on other countries. He points out towards thermal and optics components as two examples where the country needs to build its capability in particular.

“Three aspects which the LED industry should focus on right now are R&D, design studios, and components side. While the first two are industry extensive, the third one is where the government will have to step in to make India a hub of LED lights manufacturing,” says Bhatnagar.

Parag, giving example of recent PLI scheme for manufacturing mobile phones, explains that something of similar nature is needed for India’s LED lightning industry. Offering incentives, as per him, to the players falling in the LED lights ecosystem can

make a huge difference in the industry. It is to be noted here that the PLI scheme for mobile phones offers four to six per cent incentive for mobile phone makers calculated on the basis of incremental sales per year.

How to produce LED lights for the world

Mukherjee advocates that both the public sector as well as private players will have to play equal roles to make India a hub of LED lights manufacturing. The LED lights market in India, pointed out by Arpit Chhabra, CEO, IoTfy, is fragmented and price insensitive. The first step towards making India a global hub of manufacturing LED lights should be in the direction of disciplining the market.

“We will have to start with consumer awareness campaigns focusing on educating the consumer about the bad effects of using not-up-to-the-mark LED lights. These campaigns need not boil down to the price factor every single time. Not just buying the product, the consumer needs to

understand the overall cost associated with owning a bad and a good LED product,” he explains.

The next step, as Parag explains, should be introducing standards in LED lights that are compliant with the standards that are acceptable on the global level. It is to be noted here that the new BEE standards for LED lights are set to come in effect from January 2021.

Building a robust components ecosystem in India should be the first focus as per Arun. It is the components that decide the quality of LED lights manufactured, and it is the quality of products which defines whether these would be accepted and entertained on a global level or not.

“It’s great to see that India-based players can assemble millions of LED lights in the country. But if we are to become a global hub of manufacturing LED lights, we will have to be very strict in terms of the quality of components that we use. The best way to do the same will be to develop a robust ecosystem of component supplies in the country itself,” opines Kumar.

The governments will also have to ensure that manufacturers follow all the BIS and BEE norms stringently. There have been products in the market which have promised something and offered something else. Arun explains that such products, once exposed, do not just create a negative image of the brand but also for the whole country.

Cheap imports of LED lights by the unorganised sector, as per the leaders from the lightning industry, are hurting India’s economy already. These also carry the danger of creating a negative

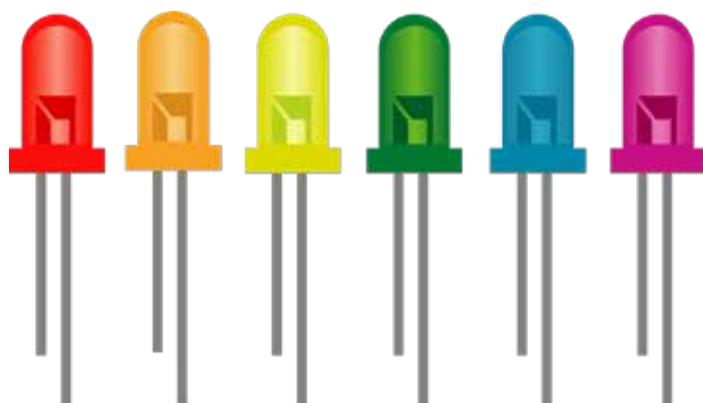


image of the country in terms of its capability to manufacture LED lights for the world. There are many unorganised players who import unsafe LED light components just because they are cheap. The threat to one's safety is also a concern because of the same.

It is to be noted here that India imported lamps and lightning fittings amounting to a value of over US\$436 million in FY 2020. India, as per Energy Efficiency Services Limited, is the second largest LED lights market by value.

As a matter of fact, the government of India has recently introduced mandatory testing of LED lights imported from outside India. The customs department of the country has been given a free hand to randomly pick up samples of LED lights and get them tested at labs accredited by the authorities.

Interestingly, China is among the world's largest exporters of LED lights and raw materials required for making LED lights. During 2014-15, India imported LED lighting products under HS code 9405 worth US\$ 222.3 million. China was the largest supplier with a share of 84.76 per cent, followed by Republic of Korea with 5.43 per cent and Hong Kong with 2.4 per cent.

Dumping ground to global manufacturing hub

The two questions that need to be answered in order to make India a hub of LED lights manufacture revolve around dumping of components and finished products in India by foreign players and our dependence on imports. Raja explains that if we keep focusing on importing certain components required for manufacturing LED lights, we might not be able to focus on developing an ecosystem for manufacturing these components in the country.

"If we keep importing components into India, we might not feel it to be important for developing these within the country. The government also needs to start by putting up certain entry barriers in forms of duties and legislations to make sure that production of components required for LED lights is promoted," says Bhatnager.

The volumes of LED lights that are being assembled in India might not be



perfect for setting up the component ecosystem here. Arun explains that if India starts getting export orders for LED lights, and the conventional lamps still being produced in India are replaced with LED lights, the volumes will become good enough for component makers to set shop in the country.

"If volume comes, people will definitely invest in manufacturing components for LED lights. Once the volume comes India can easily become the export zone of LED lights," feels Kumar.

The availability of cheaper products, as pointed out by Parag, is a challenge that every business faces. Parag explains, the best way to address this challenge is by adding value for the end-consumer. Investing in R&D and design, as per him, is the best way to move towards the direction of making India an export hub for LED lights.

"The modern consumer, whether from India or from abroad, is a very smart consumer. If you can add value to a product, the modern consumer will value it. I am very happy to say that a lot of manufacturers in India have started focusing and investing on R&D and design to make the quality better," says Bhatnager.

Betting upon smart LED lights

While there are a lot of interesting verticals coming up in the LED lights arena, the one that India can possibly lead in is the smart LED lightning. The trend is not only picking up pace in

India, it is also picking up pace in a lot of developed countries. The market for mood lightning, voice-activated lightning, automatic lightning, use of smart LED bulbs in vehicles, and LiFi have started to show promising growth.

India, as per Kumar, should focus on this vertical given the excellent work IoT developers in the country have shown. India's capability to design IoT solutions around LED lights comparatively economically than a lot of other countries is a big strength. He explains that betting big on this vertical can help the country appear on the globe as the hotspot of manufacturing smart LED lights.

The next big opportunity in terms of LED lights will come from rural India and small towns in the country. Parag explains that these areas have not yet witnessed the advantages in terms of cost savings that LED lights offer.

Further, there are many countries in the world which can be a great market for LED lights manufactured in India. The neighbouring continent of Africa is a big example of how big the opportunity is on the global level. India already exports tons of generic medicine, mobile handsets, and automobiles to the many nations in Africa; LED lights can be an addition to the list.

Mukherjee explains that facade lightning is also a big opportunity. The government is trying to capitalise on night tourism, and facade lightning has a huge role to play in the same, according to him. **EFY**

“Instead Of Replacing Current Leaders In Terms Of SEMICONDUCTORS, We Should TRY AND FIND SOLUTIONS To Newer Problems”

Krishnan Srinivasan

managing director, Lam Research India



Krishnan Srinivasan, managing director at Lam Research India, in an exclusive interaction with Mukul Yudhveer Singh spoke about whether India should invest in a semiconductor fab or not. Here is what he had to say

Does India require a semiconductor fab?

Not just India, I think every major economy should have access to a spectrum of technologies. The question should not be whether or not we should have a fab, but how soon can we have a semiconductor fab? Should it be set up by private players, or should the government play a role, or should it be a mix of both, are the right questions to ask!

The government's Chandigarh fab is a proof that capabilities exist in India. After the capability comes the question of economic benefit. Unless the answer to this question is clear, private players may not be interested in investing in a semiconductor fab. The good news is that a lot of multinational companies have started coming to India to get their electronic products assembled here.

I think it is just a matter of time before India moves up the value chain in terms of electronics manufacturing. The journey may be from designing circuit boards to their assembly, to manufacturing them, and so on, but it is just a matter of time. Once we have done that it will become attractive for a lot of big players to set shop in India.

By when should India have a semiconductor fab?

We missed that boat about forty years ago. A truth that not many know is, that amongst the Asian nations, India had the fab development going on earliest. Even countries like Japan were having the same level of discussions around fabs in the 1980s, just like us in India.

I wish we move fast now because everything in the ecosystem outside semiconductor fab already exists in India. The biggest proof of the same is that every big chip manufacturing company of the world has a technical office in India. Then there are a good number of startups designing chips in India that have the potential to go global. To top it all, we have a large base to consume it all here in the country. If we just take the example of smartphones, there are hundreds of millions of consumers waiting to upgrade their smartphones.

Then we have a huge consumption of consumer electronics. The defense, aerospace, and space sectors also use a lot of semiconductors. Most importantly, the level of human talent available in the country is excellent. The number of Indians working in the semiconductor industry can astonish anyone. Indians are associated with top semiconductor companies as CFOs, CTOs, and many other managerial and technological roles.

Despite all the strong pointers, why does India keep missing the bus for setting up a semiconductor fab?

I think what is lacking is an honest effort to bring all the advantages together. We need to work on all the factors and bring in a solution that appeals to possible stakeholders in an economically viable manner. Whether it is land availability, power availability, access to ports, or availability of high quality chemicals and reliable labour, all these need to be coordinated in such a way that players find it a good deal to make semiconductors in India.

LAM Research is a USA headquartered company that manufacturers equipment needed for semiconductor manufacturing. They have been manufacturing equipment used for making chips since forty years. Their biggest clients include Samsung and Intel among others. Their India office focuses on hardware design, software, and materials procurement.

Today, it is easy to go to Taiwan and get semiconductors manufactured from a design, and a lot of startups are already designing semiconductors here. The investment required to set up a modern fab is so huge that private players might not be ready to invest. So, the government might have to intervene, encourage, and offer as much help as possible.

Why should India have a fab at all?

India has a significant presence in every technology and vertical except electronics, be it medical, software, or some others - you name it and India is among the leaders. However, when it comes to electronics, we have not been able to make our presence count. If you look at China and carefully assess what the country did, you will find that they took calculated moves following a very large electronics import bill and worked on making themselves self-sufficient in terms of electronics.

Twelve years ago, the Indian Semiconductor Association published a report pointing out that the import bill for electronics was very soon going to

exceed the export bill of electronics in India. At some point we might land up with a \$100 billion trade deficit in terms of electronics.

Being dependent on outside for something that is as strategic as semiconductors is not a good idea. An economy that is as aspirational and as big as India's should have access to a spectrum of leading technologies. We should focus on semiconductors not only because we want to be self-reliant in terms of semiconductors, but also because it could give us access to a spectrum of technologies.

With political stability as one of the biggest advantages of India, do you think the country can become the hub of semiconductor manufacture?

Asia's demand is already being met by the suppliers to a large extent; the likes of Taiwan, Japan, Korea, and China are meeting semiconductor demands quite successfully. We might not be able to get very far by trying to replace the existing suppliers of semiconductors. What we could do probably better in India is to generate

a whole new range of applications for semiconductors. India has a unique set of problems where millions are transitioning from a farm-based economy to an urban-based economy. The problems during this transition are going to be both a challenge and an opportunity. Technology will play a big role in charting out solutions for these problems.

The best part is that, once these solutions are available, the same will find applications in a lot of other parts of the world. I see the continent of Africa and Latin America as two of the biggest examples. Some examples of the solutions could be concerning agriculture, weather forecast, and communication. Instead of replacing current leaders in terms of semiconductors, we should try and find solutions to newer problems, and then proliferate the same to the rest of the world.

What kind of semiconductor fab do you think India should look at under the present circumstances?

That is a difficult question to

answer. Instead of looking at what technology a country should start with in terms of a semiconductor fab, it should look at what applications it wants to focus on. In my 25-year journey with Lam, I have gone from 250Nm technology to 5Nm technology.

What we at Lam have recently discovered is the repurposing of older technologies for newer applications. For example, if you are building an IoT device that generally does not require cutting-edge technology, or a water sensor for assessing the quality of water in a lake or a pond, it would not require 5Nm technology. These can be developed using 90Nm or 65Nm technology.

It is the application that should drive selection of the technology, and hence the kind of investment required. The expense in setting up a 5Nm fab is humongous. Instead of debating whether to go for 12Nm or 5Nm technology, we should look at the applications we want to build. **EFY**

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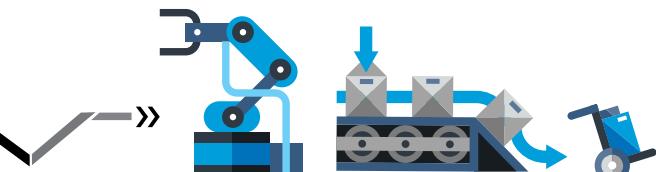
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Electronics industry can soon add trillion dollars to India's economy

Telecom and IT minister Ravi Shankar Prasad, during the Assocham Foundation Week, said that India's electronics manufacturing sector has the potential to contribute a trillion dollars to Prime Minister's vision of making India a five trillion dollars economy by 2025. The minister explained that India was not going to stop with mobile phone manufacture.

"My future plan is very straight and simple. I am not going to stop with mobile phones. By 2025, we will manufacture one billion mobile phones, 50 million TVs, and 50 million hardware including laptops and tablets," the minister announced.

He pointed towards the Modified Special Incentives Package (M-SIPS)

scheme introduced in 2016. The government of India has disbursed over ten billion rupees in incentives under it, according to him. Exports worth 470 billion rupees have been achieved by manufacturing firms since then. India has around 250 mobile manufacturing units at the moment. This number was two units in 2014.

Government floats EOI for setting up semiconductor FABs

The Indian government has invited proposals from entities to set up electronic chip manufacturing units in the country and even acquire any company making semiconductors

overseas. The expression of interest (EOI) floated by the Ministry of Electronics and Information Technology (MeitY) says that the government of India is keen to incentivise and attract

investment in setting up semiconductor FABs in India.

"The Ministry of Electronics and Information Technology (MeitY) invites Expression of Interest (EoI)

ON THE move



Ampere Electric appoints Srinivasan as CTO and head of manufacturing

Thiruppathy Srinivasan has joined Ampere, a wholly-owned electric mobility subsidiary of Greaves Cotton Ltd, as chief technology officer (CTO) and head of manufacturing. Before this, he was with Ather Energy. His expertise lies in technology and organisational strategy, product development, and manufacturing operations to enable efficiency in businesses.

Hassane El-Khoury joins ON Semiconductor as CEO

Hassane El-Khoury has joined ON Semiconductor Corporation as the company's president, chief executive officer, and member of its board of directors. He served as president, chief executive officer, and member of the board of directors at Cypress Semiconductor until its sale to Infineon in April 2020.

Best Power Equipments appoints Satyabrata Sahoo as VP, Sales & Marketing

Best Power Equipments has appointed Satyabrata Sahoo as vice president - sales and marketing for international market. Having worked for more than 20 years along with a deep understanding of global markets like Singapore, Philippines, UAE, and South

East Asian countries, he plans to create footprints and have a wider reach of BPE and their products in these regions.

Vicor appoints David Krakauer as VP of corporate marketing

Vicor Corporation has announced the appointment of David Krakauer as vice president of corporate marketing and channel strategy to oversee corporate branding, promotion, and communications, as well as channel marketing and sales enablement. Before joining Vicor, Krakauer was responsible for corporate marketing and customer experience at Analog Devices where he also held prior roles managing successful product lines.

Ola appoints Jose Pinheiro to head global manufacturing and operations

Ola has appointed former General Motors executive Jose Pinheiro as head of global manufacturing and operations for its electric vehicles business to spearhead the building of world-class manufacturing facilities. Ola will start with the world's largest scooter factory and then expand to build multiple such facilities across India.

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CORPORATE NEWS snippets

Bharti Global and OneWeb Launch 36 communication satellites

Bharti Global and the UK government-led OneWeb have launched 36 communication satellites. The duo aims to offer high-speed internet from its constellation of satellites in India by mid-2022. This was OneWeb's third launch in 2020. It has brought the total in-orbit constellation to 110 satellites, part of OneWeb's 648 LEO fleet designed to deliver high-speed, low-latency global connectivity.

Ola to set up EV manufacturing plant in Tamil Nadu

Ola has signed an MoU with the Tamil Nadu government for an investment of 24 billion rupees in setting up its first EV manufacturing factory in the state. Upon completion, the factory will create almost 10,000 jobs and initially have an annual capacity of two million units. The factory will produce Ola's upcoming range of two-wheeler products, starting with Ola's electric scooter.

Honeywell makes investment in Bengaluru-based Trinity Mobility

Honeywell has announced a strategic investment in Trinity Mobility Private Limited, a Bengaluru software company and provider of the leading Internet of Things (IoT) smart cities platform and software applications. This strategic investment will allow it to expand its smart cities capabilities by providing access to Trinity's smart city solutions. This strategic investment, which is structured to provide Honeywell with a path to full ownership of Trinity, will allow Honeywell to more fully partner with cities that are expanding their smart city deployments or integrating new systems.

Intel sells power management chip business to MediaTek

Taiwan-based chip manufacturer MediaTek has acquired Intel's power management chip business, Empirion. The deal, estimated to be worth \$85 million, was done through MediaTek's subsidiary Richtek. Famous for chips used in smartphones, MediaTek might be eyeing an expansion of its integrated power solutions used in FPGA, CPU, SoC, and ASIC.

Samsung planning to develop 3nm silicon semiconductor chips

Samsung is gearing up for semiconductor wars with a humongous \$116 billion budget. The company has allocated this budget to be used in the next two years specifically for the development of 3nm silicon semiconductor chips. It is worth mentioning here that the only 5nm chip available in the world right now, capable of powering an entire laptop, comes from the house of Apple's ARM.

HMD Global planning to make India its sourcing hub

HMD Global, the maker of Nokia mobile handsets, will be making India its prominent sourcing hub for global markets. It is presently working on building capabilities for smartphone manufacturing. HMD had recently raised \$250 million from investors like Nokia Technologies, Google, and Qualcomm.

STMicro optimises ToF sensors for complex imaging applications

STMicroelectronics has optimised FlightSense, a powerful and accurate time-of-flight (ToF) sensor. The company's perspective

and future goals were recently shared by Jerry Chang, technical marketing manager, Imaging Division, Greater China & South Asia, and Vincent Lin, technical marketing manager, Imaging Division, Greater China & South Asia. FlightSense is based on a laser emitter that transmits light or photons, which bounce back after colliding with the target and are taken in by the receiver. It gives exact distance, irrespective of colour, size, or reflectance of the object.

Tata Sons seeks funding for phone and components manufacturing

Tata Sons is looking to secure \$750 million to \$1 billion in external commercial borrowings and mobilise the remaining sum through internal accruals to set up a mobile phone and component manufacturing plant in Tamil Nadu to make iPhone parts. Tamil Nadu government had recently announced the Tamil Nadu Electronics Hardware Manufacturing Policy 2020. It aims to increase electronics industry output to \$100 billion by 2025 with the state contributing 25 per cent of India's total electronic exports by that year.

Lion Electric to go public through SPAC deal

Lion Electric Co. is going public through a merger with blank-check company Northern Genesis Acquisition Corp. It aims to ramp up production capacity to tap growing demand for electric vehicles. It expects to receive about \$500 million of net cash proceeds from the deal to expand its US manufacturing capacity, develop advanced battery systems, and construct a battery-system assembly factory.

Okaya bags contract from EESL for EV charging stations

Okaya Power Group firm Okaya has bagged a World Bank-funded contract from state-run Energy Efficiency Services Limited (EESL) for the deployment of 1,020 EV charging stations with CCS, CHAdeMO, and Bharat specification protocol across India. In September, it announced its partnership with BluSmart Electric Mobility startup for transportation solutions using electric vehicles. Okaya will be providing electric vehicle charging stations infrastructure for BluSmart's fleet operations as well.

Coal India to invest in solar projects

Coal India will invest 56.5 billion rupees (\$763 million) by March 2024 to build 14 solar projects to power its mining operations and cut costs. It will spend nearly two-thirds to construct rooftop and ground-mounted solar power projects with a capacity of 3,000 megawatts (MW) with cash. A joint venture with lignite miner NLC India would finance the rest of the company's solar expansion. Coal India has also signed an agreement with Solar Energy Corporation of India for 1,000MW solar projects.

L&T Technology selected for Alexa integration in devices

L&T Technology Services Limited (LTTS) has been selected as a consulting and professional services provider to support Alexa Voice Service (AVS) integration in various connected devices. Alexa, the Amazon cloud-based voice service, is available on devices from both Amazon and third-party manufacturers and powers connected devices. "We are delighted to see LTTS use their expertise in the consumer and industrial market, product development, device testing and certification, and innovation to transform their clients' customer experience," said Eric King, general manager, Amazon Alexa Europe.

from companies/consortia desirous of setting up/expansion of existing semiconductor wafer/device fabrication (FAB) facilities in India or acquisition of semiconductor FABs outside India," reads a note issued by MeitY.

The government had approved two semiconductor units in 2013 with an investment of around 630 billion rupees. But these could not be set up due to lack of electronics manufacturing ecosystem in the country and policy-linked market support.

India's EV market to be worth \$206 billion by 2030

India's electric vehicle market could be worth nearly \$206 billion (about 14,420 billion rupees at current rate) in the coming decade, if India were to achieve its 2030 electric vehicle (EV) ambitions as per an independent study released recently by the CEEWCentre for Energy Finance (CEEW-CEF). It estimates a cumulative investment of over \$180 billion (approx. 12,500 billion rupees) in vehicle production and charging infrastructure until 2030 to meet India's EV ambition.

It adds that even if 50 per cent of the battery manufacturing capacity were indigenous, investments would amount to as much as \$6.1 billion (about 429 billion rupees) by FY30, says the study. The cumulative investments required would exceed \$12.3 billion (about 859 billion rupees) in case of 100 per cent indigenisation of battery manufacturing.

Consumer electronics and electric vehicles driving demand for graphene

The global graphene battery market size was valued at \$48.8 million in 2019. It, as per Valuates Reports, is projected to reach \$398.6 million by 2027. The forecast represents CAGR of 31.2 per cent during the period. Indo-Pacific region has been the second-largest revenue contributor in the graphene battery market and is expected to see considerable growth during this period.

The global demand for graphene batteries is driven by a rise in electric vehicles in the automotive sector and portable electronics such as cell

phones, laptops, tablets, and portable speakers. Thus, the growing adoption of graphene in the automotive sector is expected to increase the graphene battery market size. The rapid growth of the Indo Pacific region is due to increased CO₂ emission regulations and a growing understanding of non-conventional energy resources.

Construction drone market to reach \$11.96 billion by 2027

The global construction drone industry garnered \$4.8 billion in 2019. The same, as per Allied Market Research, is projected to reach \$11.96 billion by 2027. This represents a CAGR of 15.4 percent from 2020 to 2027. The land surveying segment of drones has been forecast to continue its dominance throughout this period.

Indo-Pacific, followed by North America, accounted for the highest market share in 2019, contributing to more than two-fifths of the global construction drone market, and will maintain its highest contribution in terms of revenue throughout the fore-

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cast period. The region is expected to witness the largest CAGR of 17.8 percent during the forecast period. This is due to the rise in urbanisation and surge in construction activities in countries including China and India. The report also explored other regions including Europe.

Lithium-ion battery separators look like a big business opportunity

The global lithium-ion battery separator market size is projected to reach \$15,390 million by 2026, from \$8,084.2 million in 2020. This represents a CAGR of 11.3 per cent during 2021-26. Major factors driving the growth of lithium-ion battery separator market size are increasing adoption of lithium-ion batteries, government regulations that support the adoption of lithium-ion batteries, and declining lithium-ion battery price. The Indo Pacific is expected to be the fastest-growing market for battery separators in the forecast period.

Uttar Pradesh the largest electric two-wheeler market in India

The sales volume of the Indian electric two-wheeler industry is expected to massively increase from 152,000 units in 2019 to 1,080,500 units in 2025. This represents a 57.9 per cent CAGR between 2020 and 2025. Presently, Uttar Pradesh is the largest electric scooter and motorcycle market in



Representational image

India in terms of sales volume. In the coming years, Karnataka is expected to witness the fastest growth in the demand for such automobiles.

The reasons for both these industry findings are the rising adoption of electric two-wheelers in the major Tier-I, II, and III cities of the states, developments in the EV value chain, and government support. Additionally, major automakers are expanding their presence in Uttar Pradesh, considering the high growth potential of the industry here.

Electronics industry wants separate incentive for PCB assemblies

The electronics manufacturing industry has asked the government to roll out a separate incentive scheme

for printed circuit board assemblies (PCBAs). It presents a \$109 billion export opportunity for India in the next five years.

Pankaj Mohindroo, chairman of the India Cellular and Electronics Association, told reporters in a virtual conference that the industry is seeking a separate production-linked incentive (PLI) scheme for PCBAs. He added that RoDTEP (Remission of Duties or Taxes on Export Products) should get instituted on PCBs, and that is already in progress and the ball is in the government's court now.

As per the joint report released by ICEA and consulting firm EY, if support of six per cent on exports of PCBAs can be provided, by 2025-26, the cumulative PCBA export for India can be about \$109 billion. If no support is offered, the export is estimated to dwindle to \$4 billion.

EU countries joining hands for semiconductor push

Germany, France, Spain, and ten other EU countries have joined forces to invest in processors and semiconductor technologies, which are key to internet-connected devices and data processing, in an effort to catch up with the United States and Asia. Europe's share of the 440-billion-euro (\$533 billion) global semiconductor market is around ten per cent, which makes the EU rely on chips made abroad. Security concerns have added to worries about relying on foreign chips used in cars, medical equipment, mobile phones, and networks, and for environmental monitoring.



Representational image

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Emergency LED Bulb



Product
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Application
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Application
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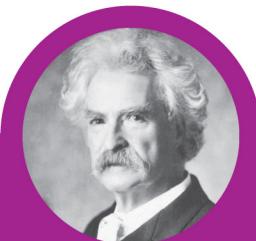
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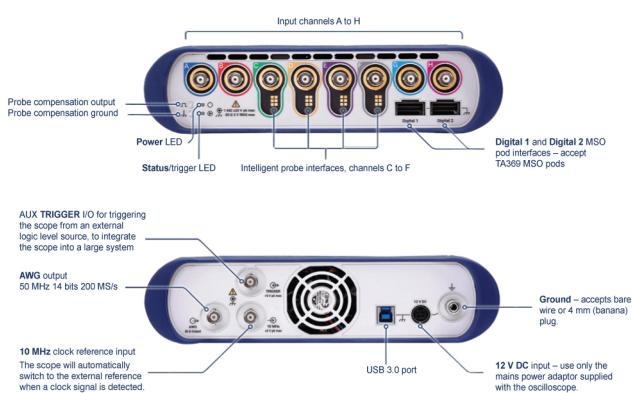
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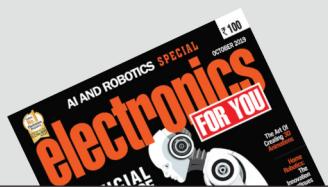
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- AUTOMATION & BATTERY CHARGER
- LED DRIVER
- ADAPTER
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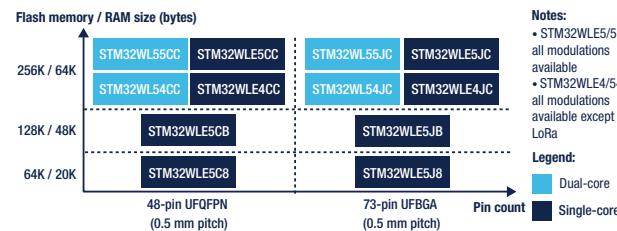
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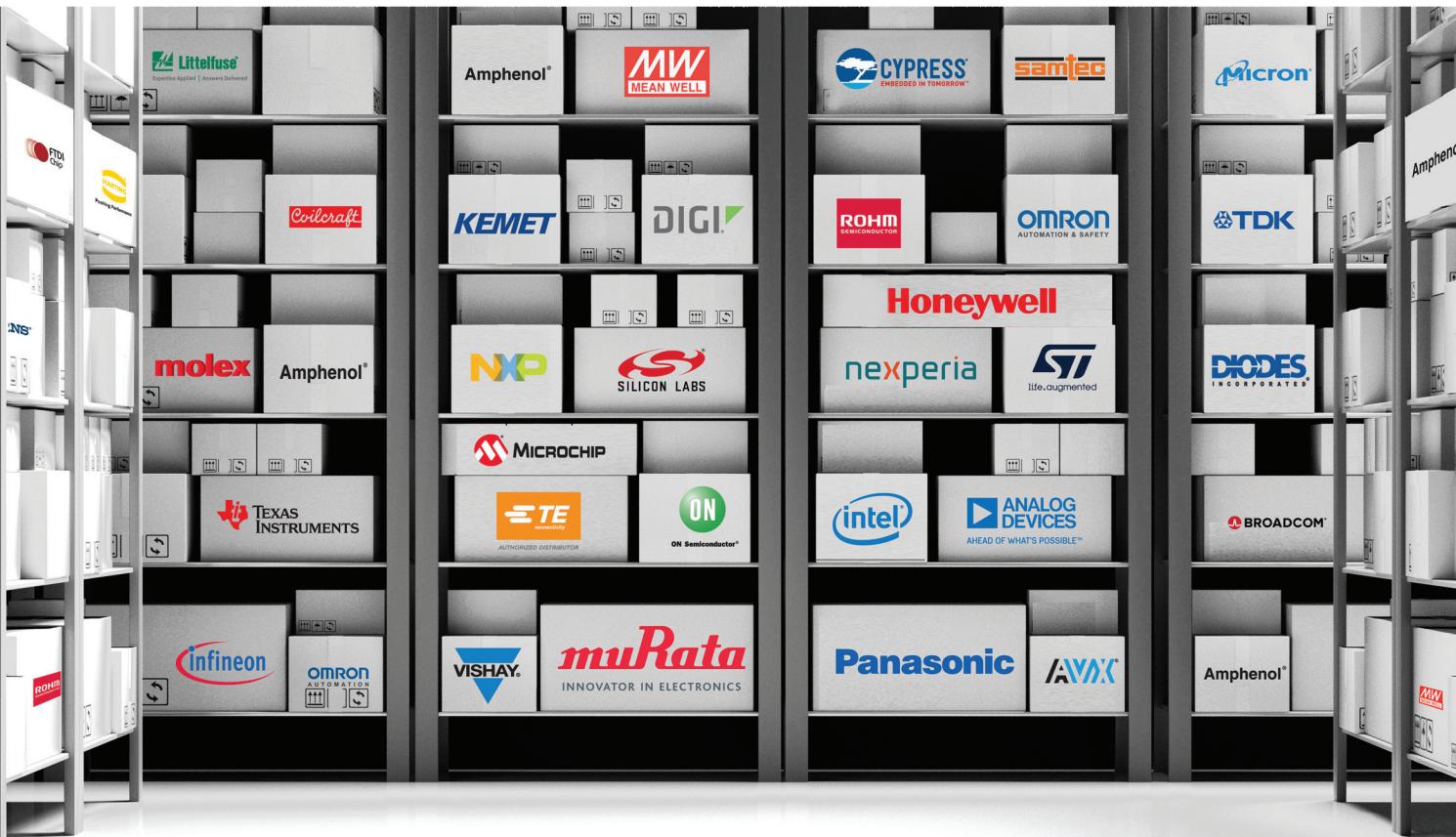
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