"The Market Is Now Shifting To Large-Size TFT Displays In The Automotive Segment"
—Rei Tjoeng, Sharp Devices

"QNu Labs And India Will Be The Go-To Place For Quantum Cybersecurity"
—Sunil Gupta, QNu Labs

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FOR TECHIES

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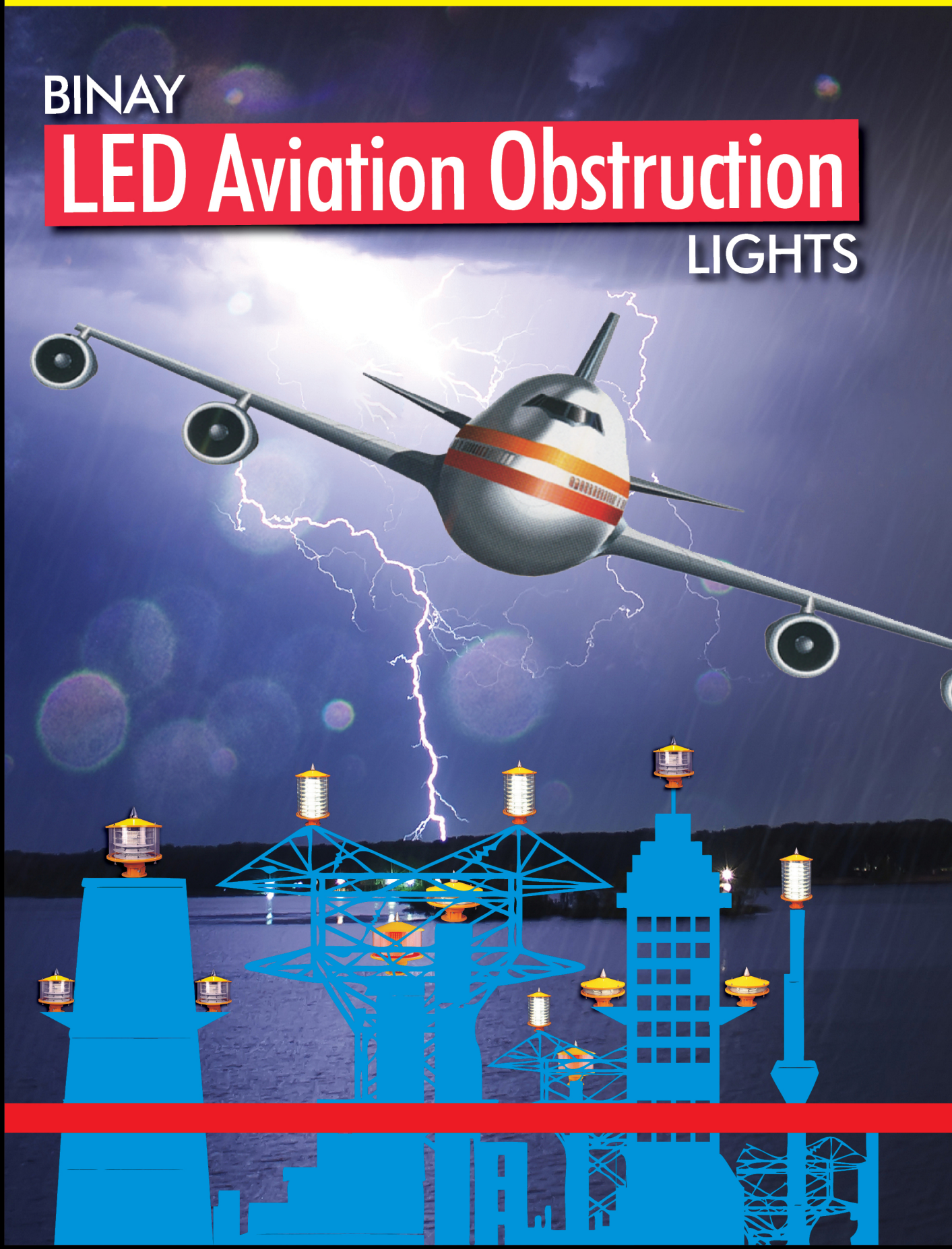
PROVIDING LED POWERED

BINAY

LED Aviation Obstruction LIGHTS



TECHNOLOGIES SINCE 1983

BINAY LED-based HIGH, MEDIUM and LOW Intensity Aviation Obstruction Light Beacons

As per International Civil Aviation Organisation (ICAO) requirements
Available in Low Intensity, Medium Intensity and High Intensity versions (as per International Civil Aviation Organization guidelines), BINAY's patented LED Aviation Lights come with 5-year/3-year warranties

High Intensity
200,000 candela
(Flashing White LEDs)

Medium Intensity
20,000 candela
(Flashing White LEDs)

Medium Intensity
2,000 candela
(Flashing Red OR Fixed Red LEDs)

All BINAY Aviation Lights are based on Non-switching passive type circuitry (NO SMPS)

The circuitry incorporated inside the LED Aviation Obstruction Lights is passive electronic (solid-state) in nature, and does not use internal SMPS driver switching units to control the light unit. Internal LED current control is by non-switching electronic means only. No electrolytic capacitors are used inside the Aviation Obstruction Light unit.

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

The BINAY LED Aviation Obstruction Light offers the following advantages:

- Fit-and-forget maintenance-free operation
- A long life of 100,000 hours (20 years at 12 hours daily burning)
- Pays for itself within a short period of operation in the form of reduced installation, maintenance and servicing costs
- Quick Installation; Reliable operation 365 days per year
- Shock-proof and vibration-resistant
- Over-Designed Intensity to allow for natural LED intensity degradation over its operating lifetime

LED Obstruction Lighting for:

- Industrial chimneys and smokestacks
- Transmission, microwave and cellular towers
- Radio, TV and similar structural towers
- High-rise buildings and structures
- Airports and airfields

THE BINAY LED OBSTRUCTION LIGHT IS UNDER ACCEPTED PATENT, AND AS SUCH IS A PROPRIETARY PRODUCT

Binay Opto Electronics Pvt. Ltd.
(An ISO 9001:2015 Certified Company)
27, Panditia Terrace, Calcutta 700 029, India

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- MVIO on Port C
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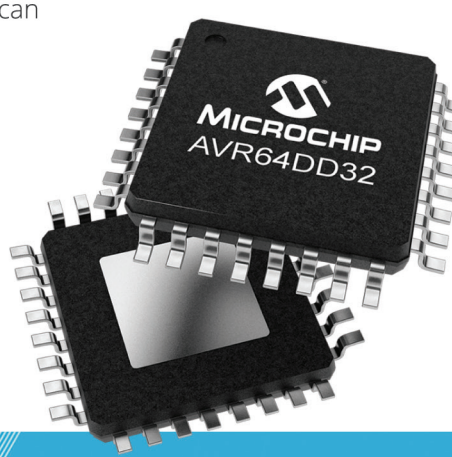

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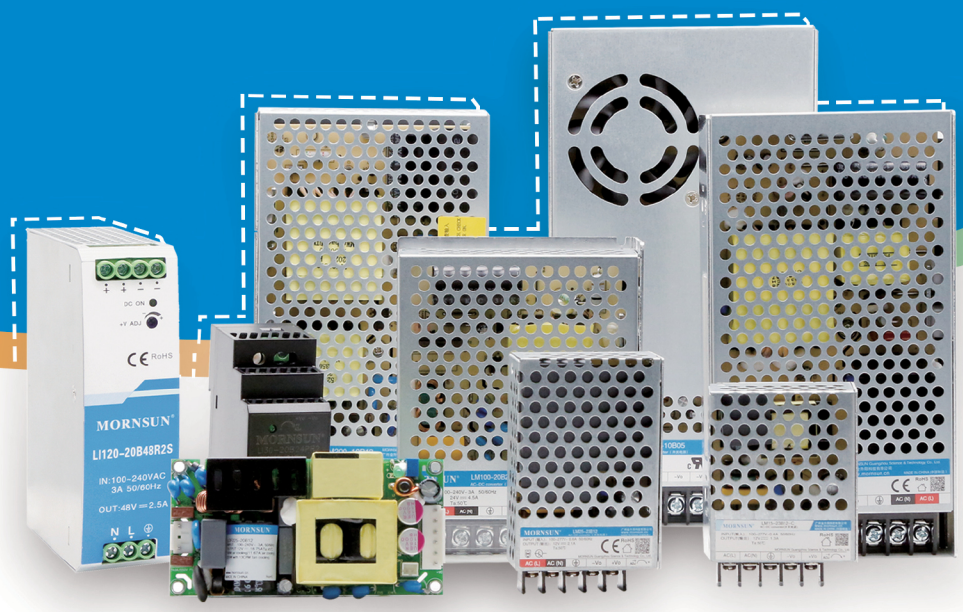

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FROM YOU

YOUR SUGGESTIONS AND THINGS YOU WANTED TO KNOW!

CONTROLLER SOURCE CODE

This refers to Arduino Controlled Controller project. Can you please share the source code? When changing the file name to .ino the Arduino IDE cannot find a sketch and then refuses to open the file.

Christiaan Esterhuyse

EFY. Sorry about that! We provide source code for all EFY projects at *www.efymag.com*. Simply go to Contents→Download Source Code via menu. However, for this project, the said file was missed. It has now been included. Thanks for helping us correct this issue!

• • •

OXYGEN CONCENTRATOR

This refers to the Simple Oxygen Concentrator You Can Assemble At Home (published in EFY October 2021). What software can be used for the pneumatic simulation?

Sawako

EFY. You can do pneumatic simulation using software such as LVSIM, Fluidsim, IRAI AUTOMGEN, etc.

• • •

LIVE DIY TUTORIALS

We hear from a friend that EFY is now doing live tutorials and demos of DIY projects every week. Is that correct?

Dhrjsingh and Zhan

EFY. Yes! It's correct, We are currently doing live DIY tutorials (some in Hindi too) every Friday. You can get details of the next session at *https://live.electronicsforu.com*

• • •

ERRATA

On page 42 of EFY May issue it is mentioned that "Rolling shutter exposes the sensor in a progressive way, as shown in Fig. 8," while Fig. 8 on page 44 shows the photo of a component.

Sachin Goel

EFY. Yes, that's a mistake. It should have been Fig. 6 and not Fig. 8. Thanks for pointing it out!

• • •

SCHEMATICS SOFTWARE

I noticed that the schematics of EFY's DIY projects have changed slightly. Which software is being used to draw them now?

Brundha

EFY. Good observation! We are now using KiCad for drawing the schematics of circuits tested in EFY Lab.

• • •

TECH QUERIES

Do you have a forum where I can ask technical questions from your team, or peers in the industry? Is it your Facebook page?

Sridharan

EFY. Glad you asked. Earlier, we used to promote our Facebook page (EFY's Electronics Design Community) as the go-to page for queries. But, since Facebook has reduced the reach of content posted on such pages, we have now developed the FORUM on *electronicsforu.com*—where our team and other experts can reply to your questions.

• • •

PCB FILES

You provide PCB diagrams of circuits in PDF format. Would it be possible to share them as Gerber files in future?

Tim Low Lan

EFY. Great suggestion! We are working on your suggestion and hope to share some good news soon.

Letters and questions for publication may be addressed to Editor, Electronics For You, D-87/1, Okhla Industrial Area, Phase 1, New Delhi 110020 (e-mail: **onedit@efy.in**)

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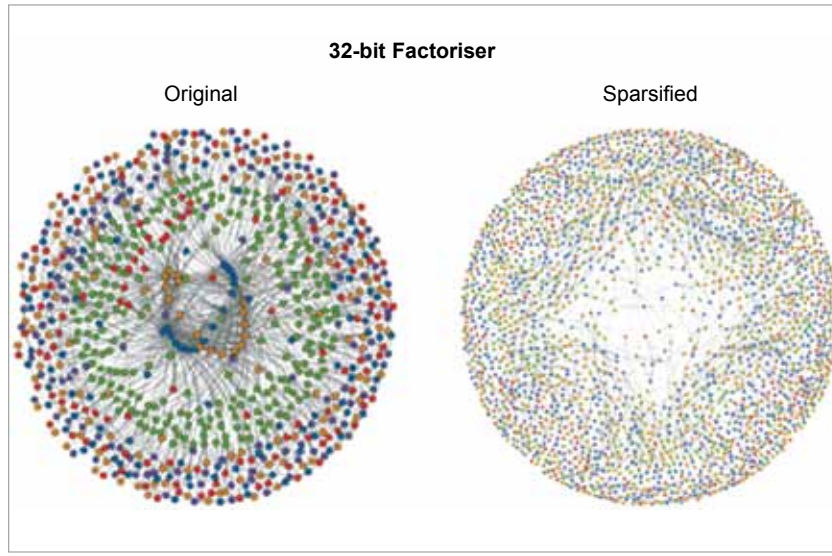
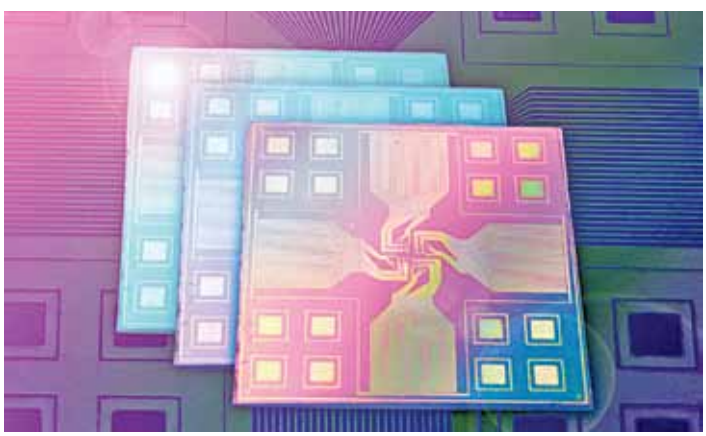
Will the new p-computers replace traditional computers?

It is a well-known fact that traditional computers are unable to compute in an energy-efficient manner. It is a restriction that has prompted a quest for new computing technologies. According to UC Santa Barbara researchers, probabilistic computers, or p-computers, are the answer. They created a one-of-a-kind sparse Ising machine (sIm), a revolutionary computing device that solves optimisation problems while consuming the least amount of energy. The sIm is a collection of probabilistic bits that oscillate between positions and work at normal temperatures. Their prototype was built on an FPGA, and they were able to prove that their design was up to six orders of magnitude quicker than traditional computers.



Hard optimisation problems can be expressed as interacting networks of probabilistic bits. Efficient solution of these problems require making them less dense at the expense of more p-bits (Credit: UC Santa Barbara)

MIT engineers build a LEGO-like AI chip



MIT engineers have created a reconfigurable AI chip that comprises alternating layers of sensing and processing elements that can communicate with each other (Credit: https://news.mit.edu)

With a LEGO-like design for a stackable, customisable artificial intelligence chip, MIT engineers have taken a step toward a modular chip design. Their system transmits data across the device using light rather than physical cables. The chip's layers communicate optically thanks to alternating layers of sensing and processing units, as well as light-emitting diodes (LEDs). As a result, the chip may be changed, with layers that can be swapped out or piled on to add new sensors or processors. Moreover, the chip employs artificial synapses—arrays of memory resistors, or memristors—that can be trained to process and classify signals directly on the chip, without an internet connection!

These synaptic transistors can sense pain

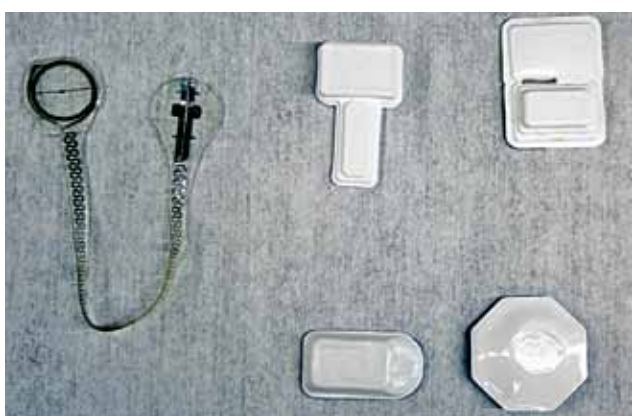
A new type of artificial skin was created by a team of engineers from the University of Glasgow using a novel processing system based on 'synaptic transistors,' which replicates the brain's neural networks in order to learn. The researchers printed a grid of 168 synaptic transistors

The robot hand used for the experiment (Credit: University of Glasgow)

manufactured from zinc-oxide nanowires directly onto the surface of a flexible plastic to create an electronic skin capable of a computationally efficient, synapse-like response. It was then attached to a robot hand. The team trained the skin to respond appropriately to simulated pain using the varied voltages, which then triggered the robot hand to react. It actually learned to move away from the source of discomfort!

A pacemaker that can dissolve in the body after use

Researchers from Northwestern University have unveiled a new, smart pacemaker that is connected to a network of

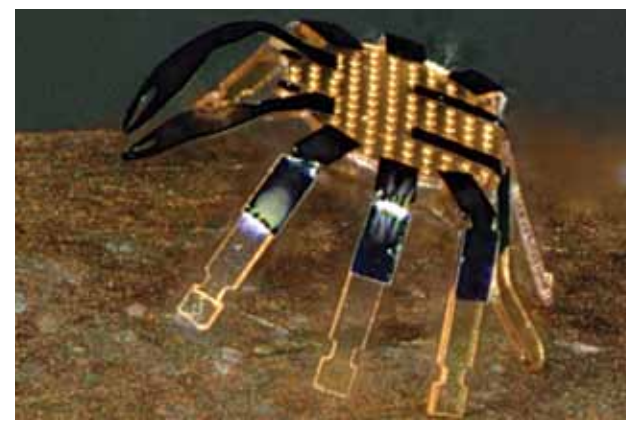


All devices laid out together, with the transient pacemaker on the left (Credit: Northwestern University)

soft, flexible, wireless sensors and control units. The multiple sensors present in the system communicate with one another to keep track of the body's numerous physiological activities, such as body temperature, oxygen level, respiration, muscle tone, physical activity, and the electrical activity of the heart. All of this data is sent to a smartphone or tablet, allowing doctors to keep an eye on their patients from afar. After a time of use, the pacemaker degrades naturally in the body and distributes an anti-inflammatory medication to avoid foreign-body reactions as it dissolves slowly and painlessly.

Engineers develop a tiny remote-controlled robot crab

Northwestern University engineers have unveiled the world's tiniest remote-controlled walking robot—a tiny robotic crab! The researchers believe their device is a



A magnified view of the tiny crab robot, standing on the edge of a coin (Credit: Northwestern University)

significant step toward developing practical robots that can execute remote-controlled operations in small settings. It comprises a shape-memory alloy, which allows it to change shape when heated before returning to its original shape when cooled. The team was able to heat specific portions of the robot using a laser beam, forcing it to walk. Also, because these structures are so tiny, the rate of cooling is very fast. This bot certainly paves the way for more advanced micro-robots in the future.

Bioinspired vision sensors that mimic human vision

Researchers at Hong Kong Polytechnic University (PolyU) and Yonsei University in Seoul have developed vision sensors that mimic and even surpass the ability of the human retina to adjust to different lighting levels. Each of the new vision sensors is made up of arrays of phototransistors.

The bioinspired vision sensors developed by Dr Chai's team can adapt to varying brightness with an effective range of up to 199dB. The human retina can adapt to environments under sunlight to starlight, with a range of about 160dB (Credit: PolyU)

They are designed to look like the rod and cone cells in the human eye, which are responsible for detecting dim and strong light, respectively. As a result, the sensors can identify things in a variety of lighting conditions, as well as flip between and adapt to varied brightness levels—with a range that is even greater than the human eye!

3D printing can now be done in seconds

EPFL researchers have shown a light-based 3D-printing technology that is around 30 times faster than traditional additive manufacturing, producing items in 20 seconds that would ordinarily take more than 10 minutes. Unlike traditional 3D printing, which involves placing blobs of material on a substrate and allowing them to solidify, EPFL's light based technology involves pouring the resin into a container and spinning it. Then, light is shined on the container at different angles, causing the resin to solidify wherever the accumulated energy in the resin exceeds a given level. It's a very precise method and can produce objects at the same resolution as existing 3D-printing techniques.

The team printed this little Yoda figure in about 20 seconds (Credit: EPFL)

World's first SNN developed at IIT Bombay

A team from IIT Bombay has collaborated to create the world's first spiking neuro-synaptic (SNN) core on 45nm SoI (silicon on insulator) technology. The Liquid State Machine, a spoken word recognition system, was used in this development. It is based on the premise that the neural network produces a neuronal reservoir similar to a liquid reservoir. This method was made by including numerous hardware peculiarities in 'ideal' software implementations to demonstrate the hardware implementation's viability. The circuit implementation included a 20-neuron input layer that sent the neural spike signal into a 36-neuron reservoir with 256 synapses connecting neurons in a random recurrent fashion.

(Left to Right) Prof. Maryam Shojaei Baghini, Vivek Saraswat, Prof. Udayan Ganguly, Ajay Singh holding the test board with the neural network chip (Credit: Ankit Bende)

Microprocessors can now be powered by photosynthesis

Researchers from the University of Cambridge's Department of Biochemistry used algae to power an Arm CPU for six months! The scientists created an AA-battery-sized gadget that houses an algae called Synechocystis that naturally harvests energy from the sun through photosynthesis. This biological photovoltaic cell produces power continually, even in low light or at night, because the algae it contains appears to continue processing energy after the sun has set. The device was made of common, sturdy,

The renewable biological photovoltaic cell (Credit: Paolo Bombelli)

affordable, and mainly recyclable materials. The researchers then used an aluminium anode to convert the gathered energy into current, which they then put into a board with an Arm Cortex M0 + CPU.

Copper 'headphones' improve atomic radio receiver

The National Institute of Standards and Technology (NIST) has improved the sensitivity of their atomic radio receiver by putting the small glass cylinder containing cesium atoms inside what appear to be special copper 'headphones.' The structure, which consists of a square overhead loop connecting two square panels, boosts the incoming radio signal (or electric field). This signal is applied to the gaseous atoms in the flask (also known as a vapour cell) between the panels. The structure is actually a split-ring resonator that functions like a metamaterial, due to which the radio receiver can now identify much weaker signals than before.

Copper headphones boost the sensitivity of NIST's atomic radio receiver, which is composed of a gas of cesium atoms prepared in a special state inside the glass container. When an antenna located above the setup sends down a radio signal, the headphones boost the strength of the received signal a hundredfold (Credit: NIST)

A seaglider that tracks ocean acidification

The University of Alaska Fairbanks and its industry partners are the first in the United States to use an unmanned underwater vehicle to monitor carbon dioxide, the primary cause of ocean acidification. The researchers designed a strategy to close the data gaps that exist in the marine environment. They found a means to link a carbon dioxide sensor with a Seaglider that can dive to 1000 metres and carry out weekslong expeditions to distant sections of the ocean in any season, working with worldwide business partners. The most exciting thing is that a power-hungry sensor like the CO_2 sensor was efficiently used on a small glider that was not meant to do stuff like this!

Scientists and their industry partners aboard the research vessel Nanuq recover the carbon dioxide-measuring Seaglider after a test dive in the Gulf of Alaska (Credit: Heather McFarland, International Arctic Research Center)

Researchers develop artificial skin containing heat sensors

Researchers at TU/e have devised a method for producing flexible, thin, and precise sensor electronics that can help robots detect humans. Many industrial operations require close human-robot interactions. This means that the robots need accurate proximity sensors to check if someone gets too close to the robot. To aid this, the researchers created a large flexible sheet filled with heat sensors that can be used to cover a structure, such as a robotic arm. The flexible sensor acts like a sort of 'artificial skin' for the robot. The heat sensors allow the robot to detect the presence of a moveable heat source, such as a person, from a distance of up to 0.4 metres.

Robot arms could become safer in industrial settings by applying an artificial skin containing proximity heat sensors to detect humans in all directions (Credit: Marco Fattori)

Soon 3D FETs will be used as memory devices

Current flash memory technologies require relatively large currents to read or write data. However, mobile cloud-enabled devices and IoT devices require memory that is energy-efficient and small in size. The University of Tokyo's Institute of Industrial Science used a ferroelectric gate insulator and an atomic-layer-deposited oxide semiconductor channel to construct 3D vertically-formed FETs for high-density data storage devices. Furthermore, they discovered that by employing antiferroelectric materials instead of ferroelectric, they were able to erase data with only a small net charge, resulting in more efficient write operations. This research could lead to new data storage memory that is even smaller and more environmentally friendly.

TRULY INNOVATIVE ELECTRONICS

INNOVATION UPDATES

Amongst numerous press releases of new products received by us, these are the ones we found worthy of the title *Truly Innovative Electronics*

Smart RISC-V 3D GPUs

Think Silicon has released a series of RISC-V 3D GPUs called the NEOX. The series includes NEOX G (graphics) and NEOX A (deep learning accelerator). These smart GPUs feature programmable compute shaders running on a real-time operating system and are supported by lightweight graphics and machine learning frameworks. The multi-threaded system can be customised for different applications—such as graphics, machine learning, vision/video processing, and general-purpose compute workloads—through configurable programming libraries using the same hardware blocks.

Think Silicon
https://www.think-silicon.com

ReRAM with dense memory

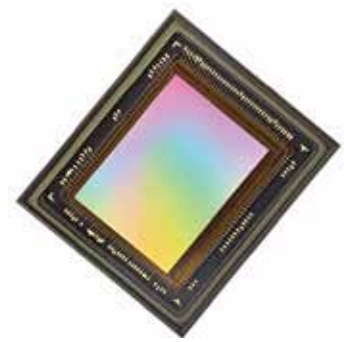
The MB85AS12MT from Fujitsu is a non-volatile IC capable of storing character data equivalent of 90 newspaper

pages. The 12Mbit ReRAM is said to have the largest memory density in ReRAM family. The IC comes in a compact package measuring approximately 2mm × 3mm and offers an outstandingly low level of reading current of 0.15mA. The size and current consumption make it suitable for use in wearable devices like smartwatches and wireless earphones.

Fujitsu Semiconductor Memory Solution
https://www.fujitsu.com/jp/group/fsm/en

Event based vision sensor

The Metavision sensor from Prophesee is an event based vision sensor designed for machine vision applications. The third-generation sensor is claimed to be the first of its kind in an



industry-standard package. Each pixel in the sensor can intelligently activate itself depending on the contrast change (movement) it detects, and each pixel embeds its own intelligence processing enabling it to activate itself independently. This makes the sensor highly power-efficient with just 3nW/event and 26mW at the sensor level. The sensor is capable of detecting images in areas with illumination level as low as 0.08lx. It can be used for ultra-high-speed counting, vibration measurement, kinematic monitoring, etc.

Prophesee
https://www.prophesee.ai

Multi-zone ToF ranging sensor

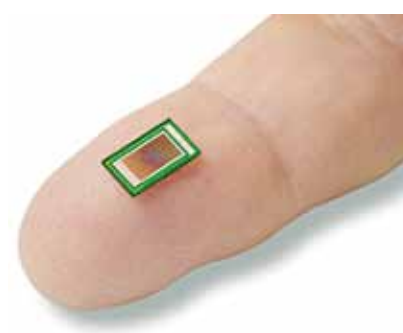
VL53L8 from STM is a second-generation, multi-zone, time-of-flight (ToF), laser-ranging sensor. It can measure absolute distance, irrespective of colour and reflectance of the surface. It works at a fast speed and provides accurate ranging up to 400cm. The VL53L8 is also able to detect multiple

objects within the FoV with depth information for quicker touch-to-focus or mini depth map creation. It consumes 50% lower energy than its predecessor.

STMicroelectronics
https://www.st.com/content/st_com/en.html

Image sensor for mobile applications

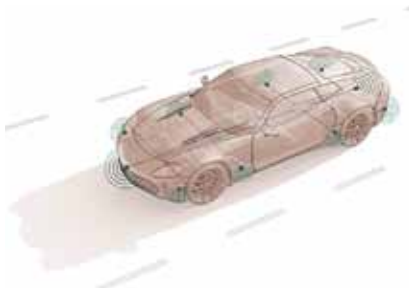
The Topaz series of industrial CMOS sensors from Teledyne include 2MP (1920 × 1080) and 1.5MP (1920 × 800) resolution devices. The sensors are housed in a small 4.45mm wide chip-scale package. The Topaz sensors have an 8.5mm optical format, which is made possible due to the small 2.5µm global shutter pixel that employs in-



pixel CDS (correlated double sampling) and advanced dual light guides to achieve good SNR at low light, with low crosstalk for crisp images. The sensors employ a low-noise, global-shutter pixel technology to offer powerful solutions and enable compact mobile designs for many applications such as smart wearable, IoT, Robotics, etc.
Teledyne
https://imaging.teledyne-e2v.com

Long-range antenna for ADAS

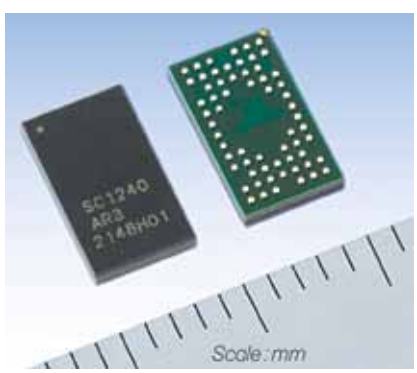
The HUBER + SUHNER 3D waveguide antenna is the first long-range 3D metallised plastic radar antenna designed for advanced driver-assistance systems (ADAS). The antenna offers ultra-low losses for the object



detection whilst meeting automotive standards. It offers improved efficiency, pattern stability, and impedance bandwidth at competitive manufacturing cost.
HUBER SUHNER
https://www.hubersuhner.com/en

Range and angle-calculating sensors

The SC1240 series radio-wave ranging sensors uses the 60GHz band with a built-in signal processing circuit for



detecting the position and movement of a person with maximum accuracy. It is the industry's first sensor with a built-in range-finding and an angle-calculating signal processing circuit. It uses 3D position information without the need for high frequency or advanced signal processing technology. It includes multiple antennas, wireless circuitry, A/D converters, FIFO memory, SPI interface, a high-performance sequencer that flexibly changes the duty cycle and controls power consumption, and a signal processing circuit for high-performance distance measurement and angle calculation.
Socionext
https://socionextus.com

Touch-sensing chip

The AX54A-Force chip adds touch functionality to surfaces, touch button clusters, and other solutions. It features

an integrated force-sensing technology which provides accurate and highly sensitive force-sensing data to the user interface (UI). The AX54A offers a high signal-to-noise ratio (SNR), enabling precise detection with high precision. It can accurately take inputs from 0.1 Newton (10g) to 20 Newton (2000g). It utilises a unique integrated force-sensing technology, which enables the detection of a wide range of forces, thus making it suitable for a wide range of applications.
Touchnetix
https://www.touchnetix.com

TOLL-packaged SiC MOSFET

Onsemi NTBL045N065SC1 is the world's first TOLL-packaged 650V SiC MOSFET. It has a VDSS rating of 650V with a typical RDS(on) of just 33mΩ and a maximum drain current (ID)

of 73A. The transistor can address the rapidly growing need for high-performance switching devices that are suitable for designs with high levels of power density. The module comes in a compact package with a footprint of just 9.90 mm x 11.68 mm and offers 30% savings in the PCB area over a D2PAK package. At a profile of just 2.3mm, it occupies 60% less volume than a D2PAK package.
Onsemi
https://www.onsemi.com

DC-DC controller for LED lights

Infineon's Litix TLD6098-2ES is a dual-channel, DC-DC controller which can drive a full LED headlamp without the requirement of a microcontroller. It can operate the four standard LED front light functions, which include high beam, low beam, daytime running

lights, and turn signal. It can also be used as a voltage supply for controlling the animation in exterior LED lighting. The controller can work with a wide input voltage range of 4.5V to 60V. Each channel of TLD6098-2ES offers both analogue and PWM dimming for precise LED brightness control.
Infineon Technologies
https://www.infineon.com

NEW PRODUCTS

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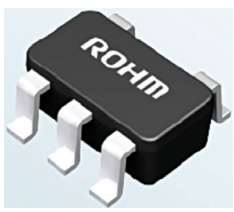
COMPONENTS

LDO regulators

ROHM's BD9xxN1 series of ultra-low dropout (LDO) regulators are capable of providing stable operation at nanoscale



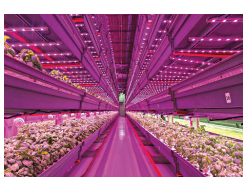
output capacitance. These are specifically developed and optimised for connection to 12V power supplies for a wide range of applications, such as powertrain, body, ADAS, and car infotainment systems. The regulators can handle wide range of output capacitances (as low as 1µF) and come in ultra-compact 0603/0402 size.

ROHM

https://www.rohm.com

Spectral sensor

ams OSRAM AS7343 is a spectral sensor capable of matching the human eye's perception of colour and light intensity. It combines 14-channel spectral analysis of visible and infrared



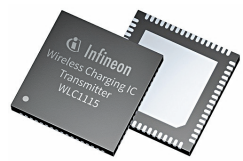
light (IR) with XYZ sensor technology to measure the colour and intensity of light as seen by the human eye. Its automatic ADC reconfiguration also gives a faster multi-channel readout. The compact size of the sensor makes it easy to accommodate space-constrained applications. The AS7343 is suitable for colour analysis in applications which require frequent, accurate measurements, such as in horticulture, smoke detection, etc.

ams OSRAM

https://ams-osram.com

Qi 1.3 wireless charging platform

WLC1115 transmitter controller IC from Infineon is the first addition to the WLC family of controllers for inductive wireless charging. It is a Qi



v1.3.2-certified MP A11 power transmitter reference solution. The IC supports a wide input voltage (from 4.5V to 24V) along with multipath voltage- and current-based ASK demodulation. The charging platform includes a USB-PD/PPS sink, DC/DC controller, gate drivers for DC/DC, a full-bridge inverter, sensing peripherals, and configurable flash memory. The targeted applications include smartphones, smartwatches, speakers, as well as industrial or healthcare accessories.

Infineon Technologies

https://www.infineon.com

BLDC drivers for server fans

A89332 and A89332-1 from Allegro MicroSystems are 3-phase sensorless BLDC gate drivers. These two models

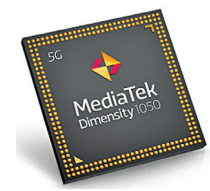
are industry's first code-free solution for server cooling fans. The A89332 has an integrated power loss brake feature while the A89332-1 has an AC-loss feature. These drivers enable compact, high-airflow fan designs to improve thermal efficiency, reducing energy use and data centre costs.

Allegro MicroSystems

https://www.allegromicro.com/en

SoC for good connectivity

Dimensity 1050 system-on-chip (SoC) combines mmWave and sub-6GHz technology to provide good connectivity even in densely populated areas. The chipset is powered by an octa-core CPU, and it integrates an



Arm Cortex-A78 CPU and the Arm Mali-G610 graphics engine. It also supports True Dual 5G SIM (5G SA + 5G SA) and Dual VoNR. The chip is capable of providing superior connectivity to the next generation of 5G smartphones, displays, gaming consoles, etc.

MediaTek

https://www.mediatek.com

Op-amp in DFN8 package

TSV772 is a dual operational amplifier (op-amp) with rail-to-rail inputs and outputs, 20MHz bandwidth, and a unity-gain. It offers a maximum

of 200µV as input-offset voltage and ensures accurate handling of low-amplitude signals. The op-amp is capable of starting from a low input voltage of 2V and can be connected to the same rail as a low-power microcontroller to simplify the design. It offers a slew rate of 13V/µs, 7nV/√Hz input noise density, and 4kV ESD capability (HBM). The component comes in a compact DFN8 package.

ST Microelectronics

https://www.st.com

ESD protection devices

PESD2V8Y1BSF and PESD4V0Y1BCSF are new electrostatic discharge (ESD)

devices from Nexperia. The two protection devices are optimised for use with retimers and redrivers on high-speed data lines.

PESD2V8Y1BSF is capable of protecting USB4 (Thunderbolt) interfaces while PESD4V0Y1BCSF is capable of protecting the HDMI 2.1 interface in addition to the USB4. The RF performance of the TrEOS technology used by the devices remains stable over the full operating voltage range. Apart from USB4 and HDMI 2.1, both can also be used to protect PCIe and DisplayPort interfaces.

Nexperia
https://www.nexperia.com

Compact 40V MOSFET

Diodes Incorporated's DMTH4M-70SPGWQ is a 40V MOSFET that features a low RDS(ON) of 0.54mΩ at a gate drive of 10V, while its gate charge is 117nC. The product helps in achieving high system efficiency in applications such as high-power BLDC motor drives, DC-DC converters and charging systems, while ensuring low power dissipation to achieve high efficiency. It is available in a 64mm² package, which occupies 40% less space than the TO263 (D2PAK) package format.

Diodes Incorporated
https://www.diodes.com

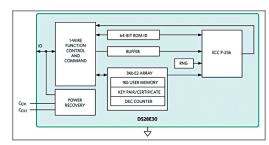
Processor for small-size HMI

Sitara AM62 processor can enable support for small-size human-machine interface (HMI) applications and dual-screen displays. The low-cost solution can enable basic camera based image processing and edge AI function, which includes pattern recognition and image detection. It can also allow gesture recognition in a noisy environment and use wireless connectivity to enable control of machines by tablets or phones.

Texas Instruments
https://www.ti.com

Secure authenticator

Analog Devices DS28E30 is an ECDSA secure authenticator to protect products from counterfeiting. It combines ECDSA along with applications data and secure storage of keys. The cost-effective solution comes in a compact package and requires only a single wire to operate, making it easy to integrate into new or existing products. The secure authenticator can be employed in a wide range of applications, such as asset tracking, battery ID authentication, etc.



Analog Devices
https://www.analog.com/en/index.html

Gas-impregnated PFC capacitor

TDK Corporation's B25674C is an EPCOS gas-impregnated PFC capacitor series that covers a voltage range from 230V to 690V AC. The series can be used at hot-spot temperatures up to 85°C and have a long lifetime of up to 240,000 hours in temperature class -40/D.

The capacitors can handle high inrush currents equivalent to 500 times the rated current.

TDK Corporation
https://www.tdk.com/en/index.html

EQUIPMENT

Precise time scale system

Microchip's fully integrated precise time scale system (PTSS) can act as a backup and enables nations to operate independent time scale back-up to GNSS to protect critical infrastructure. The PTSS is a world-class timing system that is traceable to Universal Coordinated Time (UTC) and does not depend on GNSS. It is a fully integrated system capable of providing timing accuracies comparable to the world's best national laboratories.

Microchip Technologies
https://www.microchip.com

MODULES AND BOARDS

Automotive DC-DC converters

The RPX series of DC/DC converters from RECOM RPX now meets the AEC-Q100 Grade 1 requirement, making it more secure and reliable for automotive applications. The new converters come in a QFN package and include

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'wettable flanks' for automated optical inspection. The series includes RPX-0.5Q and RPX-1.5Q DC/DCs, which have an input range up to 36V, and the output can be trimmed from 0.8V to 30V. The modules require low external components and offer low EMI and fixed frequency operations.

Recom Power
https://recom-power.com

LTE extension boards

The new series of LTE extension boards from Sony includes CXD5602PWBLM1NA and CXD5602PWBLM1E, which are equipped with smart sensing processors for IoT applications. The boards add LTE connectivity to the Spresense main board and carry an on-board antenna and a nanoSIM card holder. They are compliant with NB-IoT*1 communication standards and LTE-M (LTE Cat-M1). The boards are equipped with multiple peripherals and offer a headphone terminal, microSD card slot, and interfaces such as GPIO, I2C, and UART.

Sony Semiconductor Solutions Corporation
https://www.sony-semicon.co.jp/e

The smallest GPS module

The MIA-M10 from U-blox is the world's smallest GPS module which can be employed as a dependable, long-lasting solution for asset tracking. The MIA-M10 is an ultra-low-power global navigation satellite system (GNSS) module, offering a power-efficient solution for size-constrained battery-powered asset tracking devices. The module is capable of receiving four GNSS constellations for maximum coverage and comes in a compact package measuring just 4.5mm × 4.5mm. It offers a power saver mode which can double the battery life by optimally balancing position accuracy and power consumption.

U-blox
https://www.u-blox.com

600V DC relay module

OMRON Corporation's G9KB is a high-voltage DC relay for high-capacity home energy storage system (HESS). It can safely cut off the direct current and improve the safety and efficiency of the HESS. The module employs arc cut-off technology and the new 3D arc simulation technology created by industry-academia collaboration. The relay handles the charging of electricity storage system, switching control and safe cut-off of the direct current that runs during discharging and is suitable up to 600V DC, 50A.

OMRON Corporation
https://www.omron.com/global/en

T&M SOLUTIONS

Portable benchtop MSO

Tektronix benchtop 2 Series mixed signal oscilloscope (MSO) provides an easy-to-use touchscreen display and offers features such as a built-in pattern generator, voltmeter, and frequency counter, to name a few. The module is small enough to be carried in a small backpack and can work for eight hours with the built-in battery. The 2 Series MSO is designed for easy set-up and immediate use.

Tektronix
https://www.tek.com/en

Full-HD touchscreen oscilloscopes

To achieve better signal integrity in real-time, Rohde & Schwarz have introduced new models of oscilloscopes that support bandwidth upgrades right up to 16GHz. These use the com-

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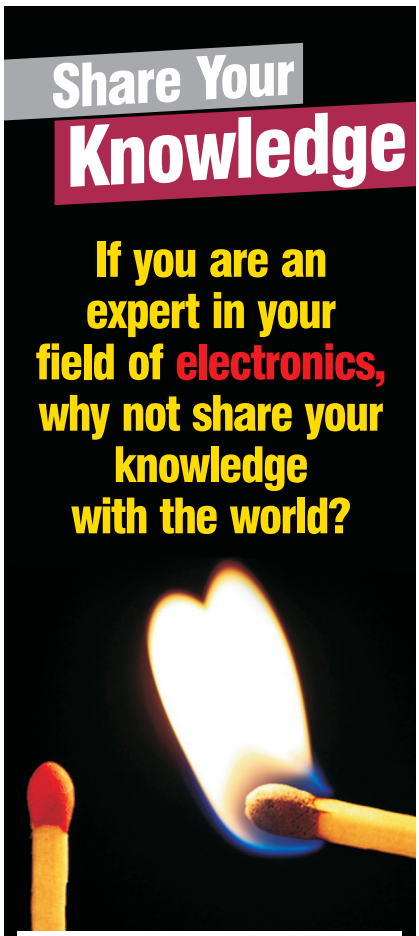

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pany's self-developed acquisition and processing ASIC, which enables a high acquisition rate of up to 750,000 waveforms/s, thus allowing users to easily analyse circuit boards to spot and isolate defects. The oscilloscopes sport a larger full-HD touchscreen display along with an enhanced user interface. Different bandwidth models are available with a sample rate of up to 40 Gsample/s.

Rohde & Schwarz
www.rohde-schwarz.com

Depth measurement camera

DepthVista from e-con Systems measures depth using the time of flight technique. The camera combines Onsemi AR0234 colour global shutter for object identification along with a ToF depth sensor for depth measurement. The module boasts a frame rate of 30fps along with the ability to capture images in low light or even in total darkness. It is capable of performing the depth calculation onboard, thus reducing the computational load on the application side.

e-con Systems
https://www.e-consystems.com

MISCELLANEOUS

BMS system software

The CDD software from Renesas is designed to complement Renesas' Li-Ion BMS IC to enable ASIL D-compliant designs. The software enables faster designing and optimising the performance of next-generation systems. The CDD software includes configuration and integration of required microcontroller abstraction layer (MCAL) modules provided by Renesas for the RH850 MCU. It also provides a low-level solution for collecting battery parameters, such as the cell voltage and temperature measurements, and enables controlling cell balancing functions of the ISL78714. The configurable parameters determine the number of cells in the BMS system and the desired battery cell data collection rate.

Renesas
https://www.renesas.com/in/en

PCIe Gen4x4 for enterprise SSDs

The EPR3760 from Phison Electronics Corp is a customisable PCIe Gen4x4 for enterprise SSDs. The device is powered by the E18DC PCIe Gen4x4 NVMe controller and can enhance the SSD boot drive performance for SSDs employed in workstations and servers. EPR3750 module is backwards compatible in PCIe Gen3 M.2 slots and provides a faster quality of service command execution with enterprise SSD firmware.

Phison Electronics Corp
https://www.phison.com/en

Next-gen wireless connectivity

To enable next-generation connectivity of the 5G module, Quectel Wireless Solutions has integrated the company's RM500Q with the Jetson AGX Orin. The company aims to provide global NVIDIA Jetson platform based devices with an easy, frictionless pathway to high-speed, reliable, and low-latency 5G communications capability. The combined system from NVIDIA and Quectel is a ready-to-use platform which can simplify designing, reduce bill of material, and speed up the development phase. It can also enhance product stability.

Quectel
https://www.quectel.com
NVIDIA
https://www.nvidia.com/en-in

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Manufacturing

"We Will Have A Group Of SUCH SATELLITES MONITORING THE EARTH On Daily Basis"

GalaxEye team with some of their mockups

GalaxEye, an IIT Madras incubated space tech startup, aims to send a constellation of satellites equipped with their proprietary sensor called Drishti into space. Suyash Singh, Co-Founder and CEO of GalaxEye, talks about the startup's journey so far and their plans for the near future. Here are some extracts from his conversation with EFY's Aaryaa Padhyegurjar

Could you please inform about Team Avishkar Hyperloop and how GalaxEye was founded?

We have emerged from the Avishkar Hyperloop team at IIT Madras. When I started my master's in aerospace engineering at IIT Madras in 2017, I got to know about the opportunity at SpaceX, where Elon Musk was organising this competition called 'Hyperloop Contest.'

I got an opportunity to form a team and we worked for a couple of years to build the hyperloop pod, which can go from one place to another inside a vacuum tunnel at a very high speed. So that was the concept, and a lot of students gathered together, and we were able to do well in the competition. In fact, we were the only Asian team to participate, reach the finals, and finish among the top ten.

A few of us from the hyperloop team were excited about space technologies in general. When we were at the SpaceX facility, we met a lot of folks—SpaceX employees as well as Elon Musk. That sparked our interest, and we thought possibly we could innovate in space tech as well.

We are from different backgrounds—aerospace, engineering design, and metallurgy. We came together and figured out a sweet spot: building satellites. Satellites were our interest because they include hardware and output data, which is useful for analytics. And that's how our journey started—by figuring out the purpose of our satellites and how we could differentiate ourselves.

Having a mentor is important in a niche field like space tech. Would you like to talk about your mentors or anyone in particular who has helped you in your journey so far?

We are working on space electronics, and there are multiple categories of electronics involved. If I have to make something work right now, on the table, I can pretty much use any electronics. When it has to work on a drone, or has to have repeatability, I have to use industrial electronics. If it's on an aircraft, I'll have to use military-grade electronics, and then space-grade.

So, it is very important for us to understand the nature of electronics that can be used in space. That's why we have mentors broadly divided into two categories—people who have an aerospace background and people who have an electronics background. Our mentors from the aerospace background tell us about what kind of environment the electronics will be exposed to, and people from electronics tell us how to make the sensors and the satellite function.

> **DRISHTI SENSORS ARE A VERY, VERY KEY TECHNOLOGY AND ALSO THE USP OF GALAXEYE.**

Professor Satya, who is from the Department of Aerospace Engineering at IIT Madras, helps us with the aerospace engineering side. And then there are a few senior advisors whom I can't name as of now, but they are from the electronics side and have been associated with a few reputed government organisations earlier.

Are there any particular open source resources that you had used and would like to mention?

We referred to very little open source material, but there are some good repositories from ISRO and NASA that we found online. For most things, we have to get proprietary information. But there are some very good books written in the past by scientists that we use consistently to build upon our hypotheses and experiment further.

What is the key technology you have implemented? Could you elaborate on Drishti sensors and how your team came up with them?

There is a bigger machine in place—the satellite—which is where the computing also happens. But the Drishti sensors are a very, very key technology and also the USP of GalaxEye. There are multiple sensors today that are used on individual basis. For example, you can use cameras, thermal sensors, radiometers, or radars on a satellite. Drishti sensors are basically a hybrid version of multiple sensors that enable data fusion to give comprehensive data that anyone would want from a satellite. We have filed for a patent for the Drishti sensor.

Initially, we talked to a lot of people to understand their requirements. We figured out the kind of data that was needed; the sensor that we've developed suits those kinds of needs. The sensors themselves are not commercially available; these will be deployed on our satellites only. What we will be making commercially available is the dataset obtained.

Which sectors in the market will the data help?

We're combining multiple datasets together. As I said, data fusion can solve many problems in the industry. It can serve insurance, agriculture, utilities, defense, and many other sectors. Given the comprehensive nature of our dataset, it can serve almost every sector that uses satellite imagery as a data source.

Are there any customer-related challenges that you have identified?

I think it's the volume of the data that will be transferred from

one point to another that's going to be one of the challenging aspects—how the data comes to the station and is then disseminated to the user. We're solving that challenge by building a dashboard where users can come to a website. They'll be able to see a map and they can draw a rectangular cross-section or some sort of polygons. And we will deliver the data for that particular area.

Are there any competitors that you are dealing with? What would you say makes GalaxEye stand out?

There are a few global players who are already there, but we will compete with them by advancing our technology. There are people who are doing satellite imagery using single sensor based imaging. Where we come in is the multi-sensor fusion. That's where we differentiate ourselves.

We've done Avishkar Hyperloop in the past and we have some sort of know-how of how deep tech projects really move ahead. Second, we are lucky to have mentors who have been working in this field. So, it's

> **IT'S THE ENTIRE TEAM OF FOUNDERS, EMPLOYEES, AND MENTORS THAT'S OUR BIGGEST STRENGTH.**

the entire team of founders, employees, and mentors that's our biggest strength.

Apart from that, it's also the differentiation that we bring to the table that's very important for the customers. Generally, when you enter space tech, you don't always think about the customer. You only think about making the technology feasible. But our focus has been to serve the customer from day one. I think our customer-centric approach and our team capacity are our advantages.

What are your future plans?

Our mission is to launch a constellation of satellites working in tandem to provide imagery. We will have a group of such satellites monitoring the earth on daily basis. That's where we will be heading, and that is the ultimate goal. However, the short-term goal is to launch our first satellite, probably by the end of next year. We would definitely have to collaborate with one of the launch providers for this. We are in active talks with a lot of people, but we would prefer to launch through ISRO.

What are the future plans for your startup in terms of hiring and investments?

We have been funded once in the past. Last year, we raised one round of funding. As of now, we actively engage with investors, but funding plans are still not very open. To talk about hiring, in SaaS and many other domains of startups, it's very easy to find people and talent. In our case, we need some hands-on experience—either electronics or very deep knowledge of the fundamentals of electronics or engineering. We are on a constant lookout. We always look out for good talent to join us.

We need people to design components, test components, and then we need people to communicate and make the fabrication happen as well. We're currently working on a small scale, but we are constantly expanding. Anyone and everyone who has an interest in working in space tech and has got good fundamentals of electronics can always reach out to us.

Generally, we look out for people who have some sort of communications experience, someone who has worked on transmit/receive modules, antenna design, sensor design, or the RF side of electronics. We

> **OPTOELECTRONICS, RF, ANTENNA, AND FPGAS—THESE ARE THE FOUR KEYWORDS WE LOOK FOR.**

have observed that people coming fresh out of college are actually more effective than people who are coming from the industry, may be because there was no private satellite industry earlier. Many of our team members are also freshers. So, we generally look for people who can learn fast and unlearn fast, and then implement.

How do you think students interested in space technology at an undergraduate level should proceed?

I think the Indian government and ISRO have been taking steps towards that. There is a student satellite programme of ISRO where they have asked students to submit proposals. Students will actually build CubeSats using ISRO's know-how, and they can put them up on the PSLV rocket and send them into space. At the same time, universities like IIT Madras are coming up with interdisciplinary programmes, where there will be a space based course. So, efforts are being made.

Also, to understand space and other things, it is very important to understand the physics behind it. I think drones are a good way to enter this domain. Students can start by working on quadcopters. They can find such kits on multiple e-commerce websites. So that should be a good start. EFY

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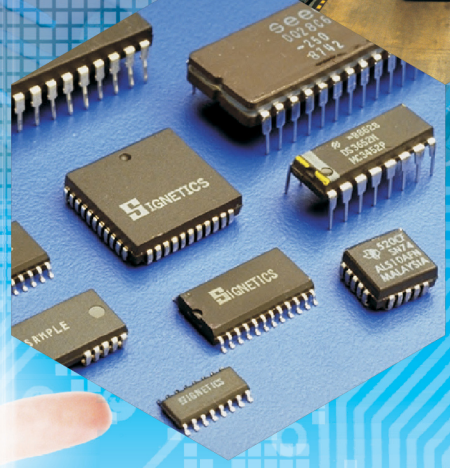

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Future

"QNu LABS And INDIA Will Be The GO-TO PLACE For QUANTUM CYBERSECURITY"

We live in a digital world that's heavily dependent on the internet, and yet, many of our cybersecurity methods are pretty juvenile. QNu Labs, pronounced as Q-New, is India's only quantum-tech cybersecurity company, and it is trying to lead the quantum mission for India. Sunil Gupta, Co-founder & CEO of QNu Labs, explains the need to reimagine cybersecurity in interview with EFY

SUNIL GUPTA
CO-FOUNDER & CEO,
QNu LABS

Why do you feel there is a need to reimagine cybersecurity?

Let me take you back to 2016. About five-and-a-half years ago, there were several things happening in India and also globally. In 2016, demonetisation happened and India decided to go digital—from a cash based economy to a cashless economy. PhonePe, UPI, etc came up. Everybody in the country has started doing things using digital platforms. India is becoming a truly digital economy, except for a few cash based activities. Healthcare, social security, and banking, all happen digitally.

First of all, today's encryption is based upon a complex mathematical problem that can't be broken by current classical computers and supercomputers but hackers will be able to break the encryption using scalable quantum computers. The second thing is that encryption keys today are generated once in a while. They should be generated more frequently and should be random. You will be surprised to find out that large enterprises typically have about 85,000 keys. Most of these keys do

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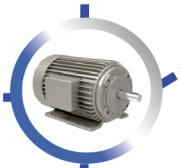
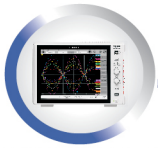


Motor Solutions



MEMORY HiCORDER

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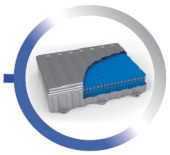

Battery Solutions

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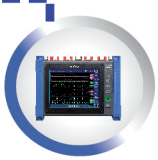

MEMORY HiCORDER

Solutions

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- Performing Layer Short Testing of Motor Windings.
- Measuring Winding Resistance, Measuring Motor Coil Inductance and Measuring Motor Weld Resistance.

Inverter/ Controller

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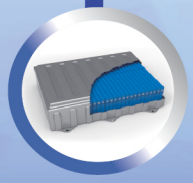
- Calculate Inverter Output Power,
- Evaluating Inverter Efficiency and Loss.



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not change for two to three years! Now imagine if a key is stolen by somebody and the person decrypts the data and steals it.

Whenever a breach happens, people are worried about data loss, but they do not know that they also lose the encryption keys. When people hack into a server, they not only take away the data but also the encryption keys—so that they can steal data in the future as well.

We lock the doors of our houses using keys. We feel that the key is with us and with our family and nobody else has it. Just imagine if anyone has duplicated your key physically. It's the same premise here. The idea is, keys should be changed frequently. There should be no correlation between your past keys and your future keys, and these should be generated in real time. Finally, if enterprises are going to store around 85,000 keys, how are they going to be managed? There should be a proper key management system.

Could you elaborate on some of the common applications or services that we use that are actually a security threat?

In many chat applications, your messages are stored in the company's server. That's how you're able to download your messages again when you buy a new phone. But as long as messages are on the server, it becomes a security issue.

Another one is VPN (virtual private network). When people work remotely, they use VPNs. But a lot of these VPNs are highly secure and have backdoors that are designed to steal confidential data. If you are using a Chinese VPN to connect from your home to your office, the traffic will be routed to Chinese servers—that's a huge security risk.

The data on our phones and laptops is also a good example. A lot of people keep their personal data on their laptops unencrypted. If someone hacks it, it's gone! QNu Labs provides services to combat all three of these issues using quantum technology.

What is hardware based random number generation and how is it different from the software counterpart?

Random number generators need to be truly random, right? Software based random number generators depend on inputs. If you change the input, the output will also change. These pseudo-random numbers are very predictable because software tends to repeat numbers and there are observable patterns. Using these patterns, hackers can figure out what the next random number will be. They are good in terms of their throughput, but they're not good in terms of their randomness.

YOU'LL BE SURPRISED TO KNOW THAT WHEN WE DO INTERNET BANKING, THE SECURITY ALGORITHMS THAT PROTECT INTERNET BANKING ARE ACTUALLY 30 TO 40 YEARS OLD! THOSE ALGORITHMS ARE HIGHLY VULNERABLE AND EXPOSED TO DIFFERENT CYBER ATTACKS.

On the other hand, hardware random number generators are good in terms of their randomness, but not good in terms of their entropy; you need a very high entropy. In our solution Tropos (quantum random number generator), what we have done is, we used the quantum phenomenon.

All the natural phenomena like wind, light, and sound are vector quantities; they have both particle and wave properties. We use a light source, a laser, that generates a light beam. That light beam creates photons. Because photons have a wave nature as well as particulate nature, we put them into a quantum state (superposition state). When this happens, they become inherently random. Even if we generate billions of random numbers, each will be different thanks to the nature of light. Because there is no human intervention, and everything is natural, we're able to do that at high entropy and very high throughput.

Why has QNu Labs chosen India for their Quantum Mission?

India is a digital economy with so many people using digital solutions. Indian philosophy and scriptures have been talking about quantum, and it is the basis of the Indian Vedanta system. This is the reason why—although we have partners all across the world—we believe that India is the right place to build quantum cryptography technology and deploy it.

We are very proud that we have put India on the quantum map of the world. We're probably the second or third largest in the world doing this. We're trying to put India in a core position for this technology. Our whole idea is that everybody in the world would come to us for this type of solution.

We're trying to lead the quantum mission for India. People generally talk about this only in academia and research. But for people to benefit from this, you need to build products and services. We're making quantum cybersecurity a reality and bringing it into the mainstream.

In all Sci-Fi movies, everyone is worried about machines defeating humans. The protagonist has to go back in time and alter something to save the world. That's our premise—we're helping enterprises adopt quantum tech today so that in the future, quantum computers and robots equipped with quantum computing cannot defeat humans. EFY

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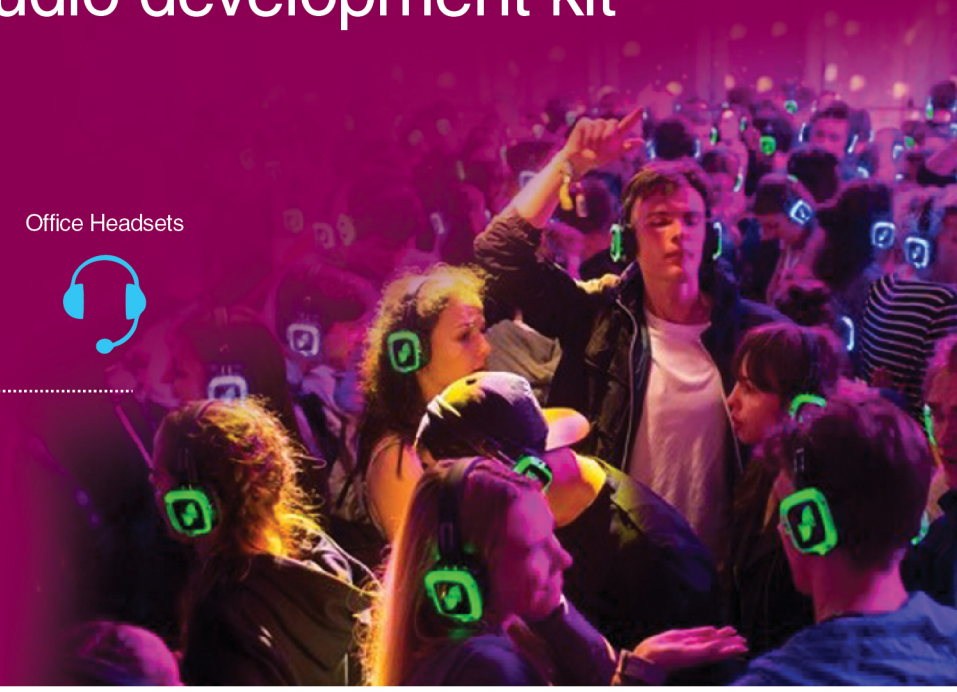

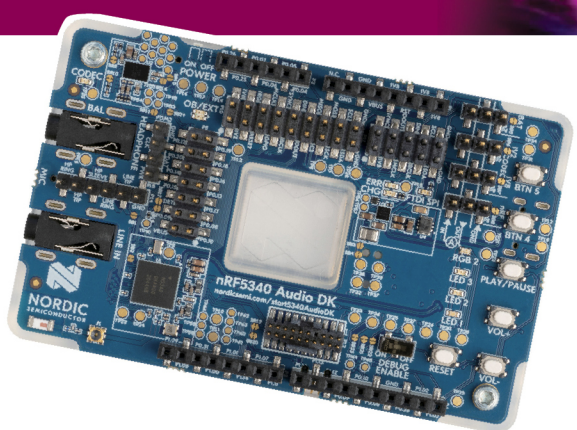

Nordic Semiconductor's recently launched nRF5340 Audio Development Kit (DK) is the ideal platform for Bluetooth "LE Audio" products which comprises of everything needed to start development. The kit is configurable and can function as a USB dongle to send or receive audio data from a PC. It can also function as a Business Headset a broadcast receiver or a True Wireless Stereo (TWS) Earbud. For most use-cases, we recommend using two or more DKs.

Features

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MAKE THE METAVERSE Work For You

The metaverse is in the making—an exciting new universe that melds real and virtual worlds, opening up totally unexplored opportunities. Although it has its origins in gaming, it is going to be a gamechanger in fields ranging from education and fitness to marketing and healthcare. Here is a look at some of the impactful applications of the metaverse

JANANI G. VIKRAM is a freelance writer based in Chennai, who loves to write on emerging technologies and Indian culture. She believes in relishing every moment of life, as happy memories are the best savings for the future

Metaverse—you cannot escape the term—and surprisingly, you cannot define it either because it is evolving so rapidly, bringing more and more technologies and use-cases under its wing each day! Some call the metaverse a parallel universe, but it is not, because it is interleaved with the real one. Some call the metaverse a make-believe world, but in fact, it is not, because real people are doing real business and investing real money in it. So, let us just accept the fact that there is no single holistic definition for metaverse. It is an evolution that we have to understand component by component, and piece together the way we want it to work for us.

Although the term metaverse was coined three decades ago in a sci-fi novel, it gained recognition only recently, with the surge in popularity of massively multiplayer online (MMO) role-playing games like Second Life, Fortnite, Sandbox, Enjin, Decentraland, Minecraft, and Axie Infinity.

MMO games have evolved to a point where the boundaries between their virtual worlds and the real world are blurring. In fact, it is unfair to call them games anymore, because they have transformed into interoperable virtual platforms where millions of people interact with each other, play games or just chill with friends, own and sell properties, create and trade things, and even perform or attend concerts!

Realising the untapped potential of this nascent marketplace, real-world brands like Taco Bell, Pizza Hut, and Adidas have started marketing their goods in virtual worlds, and even opening showrooms there. Companies, hospitals, universities, and other

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organisations have also created virtual places to connect with their stakeholders, for various purposes like training, collaboration, or simply bonding! With covid physically separating people, they are turning to the metaverse to bring them together. So, from being a place for geeks to hangout, the metaverse has now become an advanced 'fusion world' that brings together the best of real and virtual worlds.

Once again, what's metaverse?

Imagine the internet in three dimensions (3D)—you being able to move inside it, like you would in your physical world. That is, probably, where the metaverse is taking us. It makes use of advanced telecom infrastructure, artificial intelligence (AI), and extended reality (XR)—that is, virtual reality (VR), augmented reality (AR), mixed reality (MR), and the likes—to create online platforms that are more immersive, interactive, and interoperable than they are today.

These online platforms or virtual worlds can be accessed through apps on your mobile phone, computer, or other digital devices. You will be represented by your *avatar* in the metaverse. With VR gear, you can immerse yourself completely in the virtual world, but considering its prohibitive cost, many platforms just let users engage through touchscreens. The metaverse also has dynamic digital marketplaces, driven by the forces of demand and supply.

If you want to draw a quick, very basic parallel with the real world, money translates to digital currencies in the metaverse, while assets translate into non-fungible tokens (NFTs). Blockchain technology forms the backbone of these marketplaces, with the tokens and transactions being recorded in it. Real money can be converted to digital currencies through exchanges, and real assets can also be recorded as NFTs in the blockchain. Here is where the blurring of boundaries really happens!

We have been covering all these aspects of the metaverse in detail in the past few issues of *Electronics For You*. Here, we walk through a couple of exciting and impactful use-cases of the metaverse.

Telemedicine: Try it on the twin first

The metaverse can bridge global divides in the availability of reliable medical care. In many remote regions, there are no skilled medical practitioners and people have to travel several kilometres to get proper medical care. Telemedicine helps not only in such situations where care is not available locally, but also in cases where a complex condition requires an expert's intervention—and the expert is somewhere across the world.

The situation has improved remarkably post-Covid, with several medical practitioners getting used to treating simple conditions through phone and video calls. According to a Forbes report, just 43% of healthcare facilities had the ability to provide remote treatment to patients before 2020, but today that figure stands at 95%. In the coming years, the metaverse will add quality to quantity, making these online consultations more immersive and interactive. Virtual reality gives a feeling of being in a real clinic, improving the connect between a patient and a doctor. Agreed, VR gear is not yet within reach of the masses, but a small setup in each village is enough to cater to all the families there. Like internet cafes took the Web to the masses, perhaps virtual clinics will take expert treatment to them.

The metaverse can also help with psychological counselling and caregiving. Take the case of a recuperating patient, who requires daily physiotherapy sessions but is unable to travel to a healthcare facility. The therapist can extend the treatment to the patient remotely, using a metaverse space, VR gear, and haptic feedback suits. One space where doctors are betting big on the metaverse is in helping patients with phobias. In the metaverse, doctors can expose patients to situations and things they fear or are allergic to, under controlled environments. They can monitor how the patients react and help them conquer their mind blocks.

Globally, doctors are experimenting with a concept called digital twinning. Research firm CBInsights defines, "A digital twin is a virtual copy of a physical entity or process, such as a patient, anatomical structure, or hospital environment. It's modelled on data sources including electronic health records (EHRs), disease registries, wearable sensors, and more." In telemedicine, digital twins would help doctors diagnose the problem better and provide a better prognosis. The doctors can trial the course of treatment on a digital twin before administering to the real patient. Powered by cloud data and AI, it also enables doctors to quickly compare the patients with similar cases, to treat them better. It can also potentially explain some grey areas like why certain patients respond better to a treatment than others.

Apart from profiling the patient, digital or virtual twinning technology can also be used to emulate the processes in the healthcare organisation, to make it more efficient. Companies like IBM and Dassault Systèmes are into digital twin tech. According to a report by Accenture, 66% of healthcare executives expect their organisation's investment in intelligent digital twins to increase over the next three years. Research by MarketsAndMarkets indicates that the digital twin market is expected to grow to $35.8 billion by 2025, healthcare and defence being amongst the top adopters.

The metaverse, with blockchain technology as its backbone, can also

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transform the way medical records are maintained. The open and secure nature of the blockchain ensures the safety of an individual's medical records. It does away with fragmentation and redundancy, and makes the record-keeping transparent and efficient. It also prevents lock-in. When you want to consult a specialist from across the world, you do not have to wait for your current physician to give you a copy of your records. You can retain control over your records and give access to a trusted individual at the click of a button! Chronicled, Ever, and Patientory are some of the blockchain based solutions for medical data management. EMRChain and Plenum Data are some of the homegrown solutions.

Product design: Defy the laws of the physical world

The field of product design is in for a mega upgrade in the metaverse era. There are three aspects to this: improvement in the design process, creation of new products for the metaverse, and metaverse integration in traditional physical products.

When you design a product for the metaverse, you can let your imagination run wild, and can create products that can otherwise exist only in dreams! The metaverse does not follow the laws of physics, so you can create drastically different products and experiences. For example, you can create a house on Mars, shoes that make you fly, or a car that hops!

You can also integrate the metaverse into a real, physical object. For example, an immersive lounge chair, which creates a real-time view of a beach or valley of your choice. In CES 2022, LG showcased a concept car or mobile cabin called the Omnipod, a fully autonomous vehicle with an onboard living space that adapts to the passenger's unique needs. It has an expansive tunnel screen called the meta-environment screen, which stretches from the floor to the ceiling, helping to recreate a chosen environment, be it your lounge, workspace, bedroom, or garden! The concept cabin is replete with a virtual assistant called Reah, who also adapts to the chosen environment. For a spot of entertainment, you can connect the Omnipod's tunnel and multimedia screens to get a feeling of virtually entering the movie you are watching! There are exterior cameras, which let you also keep an eye on the road.

Fig. 1: The living space of LG's Omnipod concept car adapts to the user's needs using a meta-environment screen (Courtesy: LG)

The metaverse can also drastically upgrade the very process of designing something. You can collaborate with people across the world to create cross-functional objects. You can first create 3D prototypes and test them in a virtual environment to make sure they work as intended before going to the next stage of development. Even for something as simple as a new series of totes or sneakers, you can first launch the designs as NFTs and gauge the customer response, before physically manufacturing the products. This would reduce the cost of development and risk of failure.

Learning: A long way to go

The pandemic made every student realise that learning through online platforms was not the same as being in school with friends, and they are delighted to be back on campus. However, educationalists still worry about what would happen if another such situation arises where kids are unable to go to school. As a workaround, experts suggest that schools attempt a multi-modal education even on a normal day, so that they can quickly transition to a digital mode when required.

While schools struggled for continuity using e-learning platforms, videos, and chatrooms, in the future the metaverse could be a more effective option. An immersive learning experience with graphics-intensive virtual platforms will empower students to understand concepts better, and to experience how certain things work in the real world. It might be difficult for children to understand how a bank works. What if they could enter a simulated environment and experience it for themselves? The metaverse makes that possible—and it might be a great learning aid even on a normal day.

However, the fact remains that the metaverse is still in a very nascent stage and its constituent technologies are too expensive to have a wide reach. Where it could work wonders is in higher education, upskilling, and corporate training.

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Fig. 2: BMW Group uses augmented reality in prototyping (Courtesy: BMW Group)

Universities such as the University of Nevada at Las Vegas and the University of Miami are experimenting with immersive learning experiences. The University of Miami's XR Initiative spans subjects like architecture, healthcare, climate change and behavioural research. Medical students, for example, can learn how to administer anaesthesia to a virtual patient in a simulated operating room.

Invact Metaversity, founded by former Twitter India head Manish Maheshwari and former Microsoft engineer Tanay Pratap, is a full virtual reality university campus replete with a library, cafeteria, hallways, and a playground. It currently offers a 16-week management course, which students can attend from anywhere using a VR headset. It can bring together students and teachers from around the world. The company claims that students can also enjoy the social nuances of college life in the virtual world.

Upskilling: See you at the top!

According to a PwC report, VR is already known to be effective for teaching hard skills and for job skills simulations, such as a flight simulator to train pilots. However, a survey done by them during the pandemic times showed that VR was, surprisingly, very helpful in soft skills training too! The survey showed that VR can help business leaders upskill their employees faster, even at a time when training budgets may be shrinking and in-person training may be off the table, as people continue to observe social distancing. Learners trained with VR were up to 275% more confident to act on what they learned after training—a 40% improvement over in-person classroom learning and a 35% improvement over eLearning. It showed that employees could also be trained up to four times faster than in a classroom. No wonder then that companies are also turning to the metaverse to train and upskill employees.

Recently, Accenture announced that its 150,000 new hires this fiscal year will use VR headsets to work from the metaverse on their first day. They will meet, collaborate, and learn on the Nth Floor, the company's virtual campus on the metaverse. Accenture believes this immersive experience is 30-40% more productive than traditional ways of learning.

Earlier this year, Mumbai based XR hardware and software company AjnaLens joined hands with Tata Technologies to digitise 150 industrial training institutes (ITIs) in Karnataka. The ITIs will be equipped with AjnaXR stations to provide immersive skill training. The made-in-India, highly-scalable VR training simulator virtually teleports a trainee to an actual jobsite and provides multi-lingual training. AjnaLens has developed extremely lightweight VR glasses—the AjnaX Glasses—which weigh just around 150gm compared to the average 500gm that popular international brands weigh. This makes it possible for trainees to comfortably wear the glasses and train for long durations. This initiative by the Karnataka government aims to upskill more than 9000 students this year. AjnaLens also provides end-to-end enterprise VR solutions, digital twin solutions, and indigenous defence solutions.

Collaboration and productivity: Work smarter

Companies are betting big on the metaverse to help employees collaborate better, unmindful of geographical distances. Microsoft Mesh, Workplace from Meta (earlier Facebook), Gather, Teamflow, and Virbela are some of the key players in this space. Instead of video-calling colleagues and collaborating using ineffective tools like screen-sharing, the metaverse will enable your *avatars* to gather in a virtual meeting room and collaborate. In fact, you can probably do things more smartly than in a physical office, because the virtual space would enable you to pull holographic images out of your hat, to explain things or make changes to a prototype!

The metaverse is especially handy in a factory environment, where technicians are using both hands and cannot simultaneously use the laptop. Imagine a mechanic working on something complex. What if he had a headset like Microsoft's HoloLens to access the sche-

matics and instructions needed to complete the repair? Would he not save so much time? Also imagine, when a mechanic is repairing something and needs an expert's opinion, how would it be if the expert could see the object being repaired through the eyes of the mechanic and explain things in real-time?

How BMW has put all this to work

More than a year ago, BMW Group deployed one of the early examples of the metaverse, when the term was still not so well-known. They deployed an augmented reality (AR) application for vehicle concept and prototype engineering at their pilot plant in Munich. Vehicles and their components are visualised on a platform linked to the BMW Group's product data management system. Specialists can drag and drop CAD files of components from the web based database to the AR goggles, to reproduce the data in 3D and in their original size in a realistic environment. Users can modify the size and position of components with simple hand movements, literally playing around with the design. People at different locations around the world can team up to review designs and concepts together. This helps identify errors much earlier in the process, saving cost and time later. The company said in a press release that the AR application speeded up the process by around 12 months!

Last November, BMW announced the adoption of Nvidia's Omniverse to simulate every aspect of its manufacturing. The idea is for each of its 31 factories to have a fully-functioning, real-time digital twin capable of simulating production and finite scheduling, right down to work order instructions and robotics programming on the shop floor. This will help in improving product quality and output, while reducing manufacturing costs and unplanned downtime. It will enable global teams to collaborate on designing and planning the factory in real time. With the digital twin of an entire factory, BMW engineers can quickly identify where and how each specific model's production sequence can be improved. It also gives BMW the flexibility to reconfigure its factories quickly to accommodate new model launches.

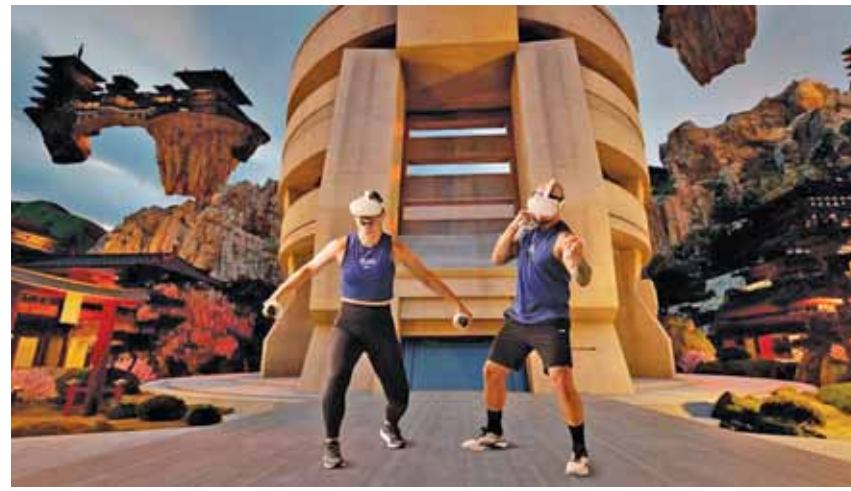

Fig. 3: Popular martial arts workout BodyCombat combines fitness with gaming in the metaverse (Courtesy: Les Mills)

The company has also armed technicians with RealWear HMT-1 headsets, running TeamViewer, in 347 BMW centres across the US to reduce vehicle service times. Using voice commands, technicians can access and view technical documents on a high-resolution micro-display or remotely connect with BMW engineers for expert advice, all the time keeping their hands free to work! HMT-1's camera enables offsite engineers to see exactly what's in front of the local technician, so they can help them troubleshoot the issue in real time. The offsite expert can also markup live video feeds or image stills, which the mechanic can see in the headset's micro-display. According to BMW, vehicle repairs are now being completed 75% faster. And it also serves the purpose of on-the-job training of local technicians!

In a recent podcast, McKinsey senior expert Richard Ward explained, "BMW's new all-electric vehicle production line ran as a simulation for six months, building virtual cars on a one-to-one scale in the metaverse, before they actually did the final layout for the factory. And in the process of those six months, they changed the design about 30% from the original. They have not said publicly how much more efficient it was, but they did say that about 30% of what they thought was the world's best factory on day one of the simulation had to change in the process. These are people who build new factories daily, and they still found that level of learning from the simulation. So, why not practice first in the metaverse, where it's low-cost, you can do things in infinite ways, and you can make the impossible happen? Those types of things really offer people more efficiency and productivity."

Military training: Can't afford to learn on the job!

Governments across the world are experimenting with how the metaverse can be used for military training and strategising.

One of the oft-spoken-about examples is that of flight simulators used to train pilots. And now, real-time information overlay using AR headsets is being used to enable

soldiers and technicians to explore weaponry, machinery, automobiles, and other military equipment. This enables them to learn at their pace. The faster learner gets to take the tests earlier! Strategies can also be formulated better using interactive virtual platforms rather than presentations or charts.

We see start-ups coming up with innovative solutions for the defence sector—and the Indian military forces are quick to recognise, collaborate, and utilise these.

One such homogenous solution is the see-through armour developed by AjnaLens. The AjnaESAS (Enhanced Situational Awareness System) helps overcome a key problem faced by the crew inside a tank. It is very difficult to navigate a tank using the small periscopic view. AjnaESAS uses an AR based head-mounted display and a 360-degree camera to offer the crew a 360-degree horizontal field of view. The camera system also has night vision and 4X zoom capabilities. AjnaESAS uses AI to help navigate the tanks through challenging terrains by eliminating blind spots and providing clear images even when the view is obscured by dust or smoke.

Another of their solutions, AjnaBolt, improves weapon systems with features like thermal sensors for night vision, friend or foe detection (popularly known as IFF—identification, friend or foe), light detection and ranging (lidar), blue force tracking (a GPS-enabled system that gives a real-time picture of the battlefield, which conventional maps cannot give), and so on. Fair-weather weapons can be effectively upgraded to all-weather weapons, providing visual assistance in locating, locking, and engaging targets. When it is combined with a holographic sandboxing system, it helps render a detailed 3D holographic map for planning and preparation. According to the company, "Users can interact and annotate the maps using gesture inputs, enabling them to view the terrain from multiple perspectives and locate tactical advantages in the field. Further, the sandbox facilitates remote networking capabilities, enabling effective coordination between the base and on-field operators."

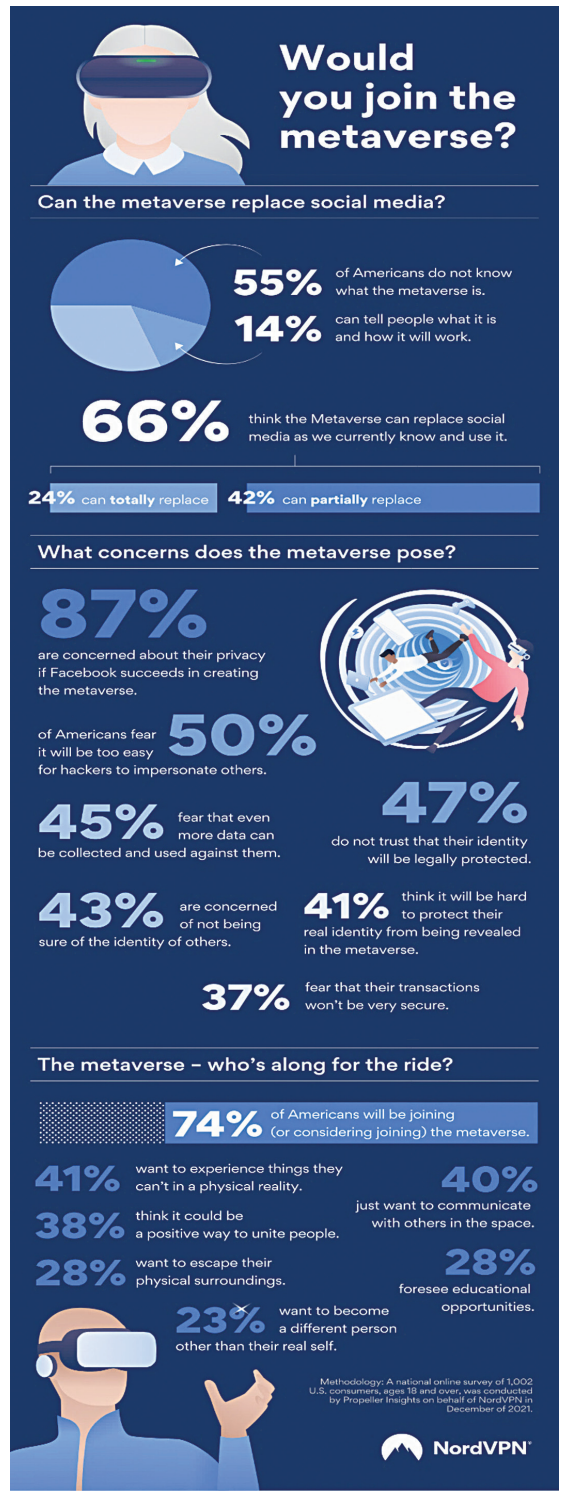

Fig. 4: A survey conducted by Propeller Insights for NordVPN in the US (Courtesy: NordVPN)

Another interesting product is the HoloSuit, manufactured in India by Mysuru based Kaaya Virtualisation Tech. The motion capture suit is embedded with over 40 sensors to capture the wearer's movement from head to toe. The wearer's movements are replayed in the virtual world, and the wearer also feels everything that happens there. For example, the user can operate a machine in the virtual world. The user also gets haptic feedback from the suit. If someone touches, shoves, punches, or shoots the digital twin, the wearer can feel it. It is being deployed by the Indian Army to train soldiers. According to news reports, the company has exported it to the South Korean Army as well, and it is also being used by one of the electricity boards in India to train workers to avoid electrical hazards.

Sports and fitness: Run to win

The metaverse will make sports and fitness much more interesting. We are not talking about immersive views of sports events, or trading of sports NFTs, we are talking about serious training and workout. For those of you who find the gym environment rather dull and boring but are unable to take out enough time to go rough it out in beautiful nature trails, the metaverse could be the perfect escape. Clip on your VR headset and you could be running through your favourite land-

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scape with your friends, as *avatars* though, to keep you company.

Cycle maker Capti has come up with a mind-blowing bike that dynamically switches from an outdoor bike with steering, gliding pedals, virtual shifting and all the works, to a studio cycling bike with fixed handlebars and flywheel! With an immersive 61cm (24-inch) touchscreen, immersive content built on the Epic Games Unreal Engine, 50 maps, 6100 metres (20,000 feet) of elevation and more than 500km of stunning graphics, you get to go on a fresh trail every day. The patent-pending Smart Ride technology auto-configures steering and flywheel to match the workout selected by you, to deliver an immersive experience. With Terrain Adaptive Resistance, the resistance auto adjusts to the grade in the game. When your *avatar* goes uphill, it gets harder, and then easier when riding downhill, just like riding a bike outdoors. You can do a virtual cycling course, heart rate training, or simply play a fun game that keeps you moving. Fitness is gamified—as you cycle more and more, new levels and content are unlocked.

If running is your thing, then try Zippy, a virtual world that lets you run across major marathon cities like Boston, London, Mumbai, and Tokyo, or through scenic environments like jungle trails and beach runs. The virtual environment syncs with the real-world kinematics of the runner using fitness wearables or treadmill sensors. OliveX's ultra-immersive running game Zombies, Run! is just the right option for fiction lovers. The accompanying narration and music set the pace for your run, which is a mission to save the world. For example, you run faster when you are chased by the zombies, and slow down to pick up supplies! Or, if it is serious athletic practice that you are thinking about, Ghost Pacer might be of help. A solution developed by runners, for runners, these AR glasses project a live holographic opponent into your field of view, for you to compete with and train against.

Sports and fitness training by celebrity coaches is also on the rise in the metaverse. BodyCombat is a popular martial arts based group fitness cardio workout that is gaining popularity around the world. They recently teamed up with Odders Labs to transform their workout into a high-octane VR gaming app on the Quest platform. Led by their famous program directors Rachael Newsham and Dan Cohen, the game pits players against martial arts challenges across a variety of levels, spanning intergalactic deserts and neo-city skylines. Players earn points for their effort and technique, with the program directors boosting their morale and providing cues and tips throughout the workout.

Looks like fitness could become fun after all!

Much more to explore

We saw several more applications of the metaverse in the course of our series so far, ranging from art and entertainment to socialising and marketing.

Socialising. When Facebook changed the company name to Meta, the messaging was clear that the metaverse is the future of socialising. People would no longer be connecting over text chats or even voice or video calls. Instead, they will escape to their favourite virtual hangout in some world in the metaverse, and chill by playing their favourite games or just chatting, as if everyone is sitting together in the same room!

Entertainment. The entertainment industry is also making its presence felt in the metaverse, what with Indian artists like Daler Mehndi and south Indian playback singer Karthik performing in the metaverse. When movies start releasing in the metaverse, it will be a totally transformative experience capable of shaking up the whole industry, because sitting in the living room with a VR headset on, a person can experience the same magic as in a large format theatre with surround sound. The homemade popcorn and coffee would also work out cheaper than in a theatre.

Art. The art industry is benefiting greatly by the metaverse. Digital artists are able to sell their work on the metaverse as NFTs, while art galleries are using the blockchain to certify the authenticity of rare and high-value works of art. Sotheby's has even opened a store in the metaverse to showcase and auction rare NFTs. Several art galleries auctioned salvaged digital versions of artworks lost in the Ukrainian war to support the artists.

Marketing. Celebrities, brands, sports associations, almost everyone is using the metaverse to market themselves or their wares. Sports clubs are selling trading cards and historic moments as NFTs. Fashion brands are selling NFTs of upcoming products to create awareness and check the market response. From toilet paper to pizzas, brands are floating themed NFTs to connect with the next generation of consumers who are spending significant time in the metaverse!

To spend or not to spend

All said and done, there is always the dilemma that any company faces—whether to invest in the metaverse or not. Privacy and cost are two of the major concerns discouraging companies hoping to foray into this new world.

Privacy. Experts are worried about privacy and safety in the metaverse. While a digital twin, be it of an organisation or a person, is highly beneficial in many respects, it is also a privacy nightmare, because it is, after all, a twin, and carries with it a wealth of personal information.

A survey of 1000+ adults in the US conducted in December 2021 by Propeller Insights for NordVPN showed that 55% of those surveyed did not really know what the metaverse is. 87% were concerned about how the metaverse could affect their privacy. "They think it might be easy for hackers to impersonate others (50%), users' identities won't be legally protected (47%), and they will be forced to share even more of their private data, which can be later abused (45%)," NordVPN reported.

Then comes the surprise! Despite all these concerns, 74% said they would join or at least consider joining the metaverse for various reasons, such as experiencing things they can't in physical reality (41%), communicating with others (40%), escaping their surroundings (28%), or even wanting to become a different person (23%). No wonder organisations are also keen on expanding into the metaverse—where the users and consumers go, they go!

Accessibility. There is also a valid concern about accessibility. Not everyone can afford expensive VR gear. Does that thin down the user base to discouraging levels? Richard Ward of McKinsey explains that between 2D and 3D lies 2.5D, where three-dimensional gaming technology is leveraged, yet the experience isn't quite truly 3D.

On Ikea's website, for example, you see images of furniture that you can tilt, rotate, or move around by just swiping with your fingers. Using your camera, you can even fit the object into a real environment to see if it matches with your existing décor. That is 2.5D. In fact, most of the so-called metaverses in India are also in this category. People just experience it on a touchscreen.

This 2.5D logic lowers the barriers to entry, and every company can consider making a no-regrets investment in the metaverse. In the McKinsey podcast, Ward says, "I think that's really a no-regrets move that allows people to start taking assets they already have, skill sets they already have, and add a little bit of tech, add a little bit of technical capability, and start moving into this 2.5D metaverse environment in a variety of ways."

"I have conducted 'tours' of the metaverse with maybe a thousand people, and every time I strap on one of these headsets and let people experience what's possible, every single one of them comes away saying they immediately have ideas for how they can bring this into their business. It's one of those things you need to try, instead of reading about it or watching videos about it. For literally just hundreds of dollars, the metaverse awaits," he says.

So, what are we waiting for? EFY

A Guide To A Career In EMBEDDED SYSTEMS

Embedded systems serve as a bridge between the traditional hardware and software. With artificial intelligence (AI), edge computing, and other advancements, the embedded systems are experiencing meteoric growth with many vast and interdisciplinary sub-fields. So, the term Embedded Systems means different to different people in the industry. This article will help gain some important perspectives about this field and understand the nitty-gritty involved

AARYAA PADHYEGURJAR

Venn diagrams and infographics are a great way to describe the interdisciplinary fields of embedded systems. Venn diagrams depict the nature of embedded systems based on the experiences of different designers. It is interesting to note that most of these diagrams are different from each other in certain aspects, but also have striking similarities.

Some examples are given in the figures that follow.

After looking at the diagrams, you will notice that in many cases embedded sys-

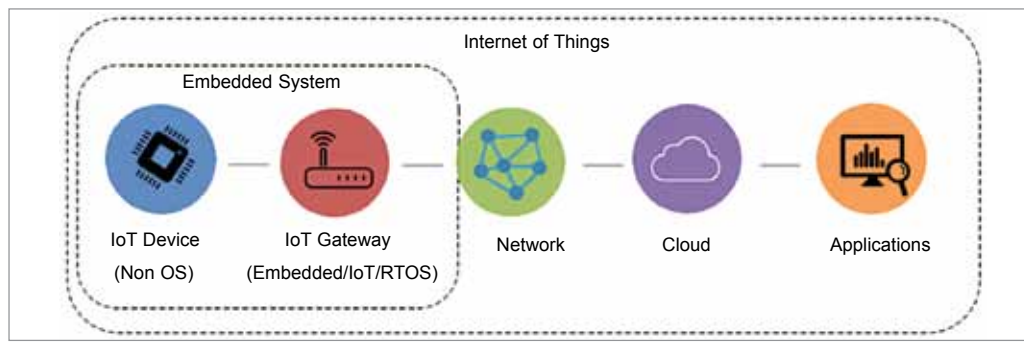

Fig. 1: Embedded system as a subset of IoT (Credit: https://sru.edu.in)

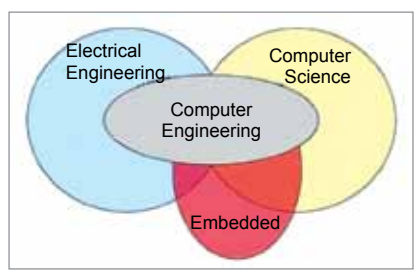

Fig. 2: Embedded evangelist Michael Barr uses this Venn diagram to illustrate the current status of embedded software programming in the computer engineering ecosystem and why there is a lack of good firmware training (Credit: www.eetimes.com)

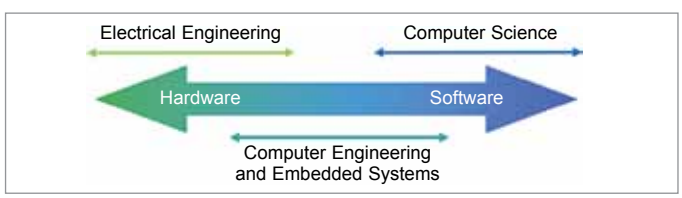

Fig. 3: A description of embedded systems at the TU Delft website (Credit: www.tudelft.nl)

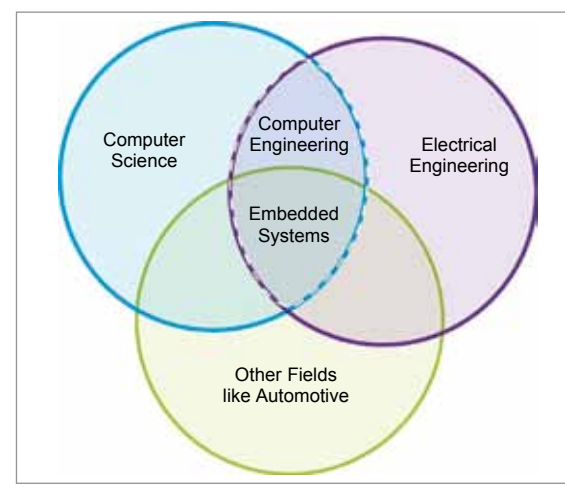

Fig. 4: A Venn diagram that illustrates the three important skills required for embedded systems (Credit: Rosmianto Aji Saputro, https://www.linkedin.com)

DIVERSIFICATIONS THAT MAKE EMBEDDED SYSTEMS INTRIGUING

Project Domain	Some Domain-specific Skills/Requirements	The Why
Mining and marine	Marine environment, Material engineering	The marine environment, particularly saline water and temperature, is tricky for embedded technology. The device will be extensively corroded the instant it is deployed in the sea, if it is not properly sealed.
Controllers (like a traffic light controller for vehicles or trains)	Roadway/ Railway plans, Traffic light standards	In order to develop optimal controllers for transportation systems, one needs to know all rules and regulations that govern such systems.
Handheld devices	Design, Ergonomics	For example, you need to be familiar with text fonts and work closely with a font designer. Also, your PCB needs to fit in the handheld enclosure, so industrial design plays a major role here.
Automotive devices	SAE standards, Mechanical design, Thermal management	You need to design devices that can withstand harsh conditions in a vehicle, like automotive vibrations, higher temperatures, etc. Also, you need to be aware of industry standards and practices, especially regional and customer-specific ones.
IoT and Drones	Device security, Signal conditioning	Any connected equipment, from refrigerators to factory robots, can be hacked if IoT security is lacking. Hackers can take over the object's functioning and steal the user's digital data once they gain control. Hence, security is important.
Robotics	Math, Control systems	Math, mapping, path planning, and control system skills are all essential in robotics.
AI	Computer vision	For applications involving autonomous driving, mobile robots, etc, computer vision plays a major role.
Monitoring systems (like greenhouse monitoring, soil condition monitoring, and inventory management)	Networks, Security, Control systems	Wherever a controlled environment is needed, like in monitoring systems, a clear understanding of control variables is needed. Even here, security plays a major role because a lot of sensitive user data is involved.

tems constitute the overlap between computer science and electrical engineering. So, the question that comes to mind is: What are the disciplines or areas of engineering that one must be familiar with in order to work with embedded systems?

Because embedded systems require programming, we need a background in computer science. We should be able to write reliable and efficient code. And because we shall be interacting with electronic devices like sensors and actuators, we need a sound knowledge of electronics.

That being said, you do not need to be a computer science graduate to do decent embedded systems development work. However, having a basic understanding of computer science may greatly assist you in organising your code into self-contained, reusable modules that are self-explanatory, easy to comprehend, and follow. Your code needs to be good enough for others (or even you) to extract source files that can be reused in other projects.

Many professionals working in the field of embedded systems confirm this thesis. Sundar Balasubramanian, an embedded systems professional with over two decades of experience says, "Knowing programming languages such as C or C++ to be used in embedded systems is enough, especially if you are not working on RTOS. If you're working on RTOS, even then an extremely deep knowledge of CS (computer science) is not needed. In my two decades of experience with five years in embedded systems exhaustively, I feel both knowhow (electronics and computer science) is important for both types of engineers. Domain knowledge comes from work experience anyway."

Hardware designer Petr Dvořák also agrees with this. "I have been weak in computer science and I had decided not so long ago I had to give up programming," he says. To be a great embedded engineer, it is okay if you are not the best programmer in town.

The project-specific field of study

Besides the two main fields that influence embedded systems—computer science and electrical engineering—depending on the device or project you are working on a third field of study often comes into the picture.

For example, if you are working in the domain of robotics, you would require good mathematics skills and a strong knowledge of control systems. Similarly, having knowledge of control systems is very important if you are working on smart systems, like greenhouse monitoring, where you have to create controlled environments for greenhouses. Computer vision and AI are critical for applications like autonomous driving.

Therefore, a certain amount of knowledge outside embedded systems—or probably even outside engineering—is needed.

What would be your third field?

The coolest part about embedded design is that each project offers fresh opportunities for learning. It necessitates the embedded designer's involvement in a variety of fields. There are lots of diversifications (see table) that make it such

an intriguing field.

That being said, here are some technical skills an embedded systems developer needs to have, irrespective of the project domain:

- Computer architecture
- Understanding peripherals, reference manuals, datasheets
- Protocols, networking, and moving data
- Programming languages and structure
- Validation and verification of electronic boards
- PCB designing
- Quality assurance and compliance
- Power and battery management

Different job types

In a broader sense, your expertise and skillset in embedded systems would depend on the type of your job—whether it is firmware or purely hardware, or both. "Good programming logic, if you work in firmware, and an extremely good electronics know-how as per professional need (such as PCB designing, layout, understanding NETLIST), if you work exclusively in hardware, is necessary," says Balasubramanian.

Embedded hardware engineering. Embedded hardware engineers are in charge of all areas of electrical system design, including high-speed digital circuits, power management, PCB layouts, and thermal management. They work with the algorithm and software teams to design and build high-performance computing platforms. Also, testing the hardware is a critical part of embedded hardware development.

Embedded hardware systems are designed, implemented, and tested on a regular basis by hardware test engineers. They employ numerous testing methods and keep track of hardware modifications and hardware-related issues. They regularly test systems to eliminate potential faults and collaborate with cross-functional teams to give system-level support (mechanical, software, hardware, etc).

Embedded firmware engineering. Firmware is a subset of software. It is often a program that controls an embedded system. Hence, firmware engineering includes both hardware and software. It might be part of a standalone product (code that is embedded into very small systems, such as a monitor, a mouse, or a washing machine) or it can run on a system that also runs higher-level software. For example, a laptop will contain a lot of firmware in the form of device drivers, etc.

While working closely with the hardware designers, a firmware engineer will focus mainly on the firmware. Firmware engineers create low-level software that can interact directly with the hardware, such as converting analogue sensor signals to digital data and managing communications protocols. We can say that firmware is a low-level interface to the hardware.

Embedded software engineering. There is a lot of uncertainty and vagueness when it comes to differentiating between an embedded software engineer and a firmware engineer. Many new types of embedded devices have emerged in recent years—devices that are more complex than traditional embedded systems but less complex than personal computers. These utilise file systems on their flash to put programs into memory for execution, and they run larger operating systems like Linux and UNIX.

Embedded software programmers deal with these types of systems as well as old-style firmware on occasion. Routers, smart TVs, and even smartphones and tablets are among the products they work on. Embedded software is basically software that is designed for a specific purpose and has a limited user interface. It will almost never be general-purpose, even if it is highly complicated.

Embedded systems engineering. Embedded systems engineers can create both hardware and firmware, and deal with tradeoffs in order to achieve the highest performance at the lowest cost. On very small devices (of which there are many), we can see them mostly doing hardware and firmware design. Overall, they handle hardware design and then entire hardware-software integration.

Systems architecture is another main aspect that these engineers deal with on a regular basis. The design, development, production, testing, and maintenance of embedded systems are some of their responsibilities. "Simply put, embedded hardware engineers work on the hardware side, and embedded software engineers work on the software/firmware side. Embedded systems engineers work on both," says Rosmianto Aji Saputro, Senior Embedded Engineer at ZebraX.

Non-technical skills

Irrespective of your profession, you can never ignore soft skills. Some soft skills important for embedded system designers are:

- Communication skills
- Marketing
- User research
- Quality assurance
- Time management
- Problem-solving ability
- Ability to learn outside their comfort zone
- Creativity EFY

The author, Aaryaa Padhyegurjar, is an Industry 4.0 enthusiast at EFY with a keen interest in innovation and research.

OPEN RAN: The Future Of Networking

Technology is constantly evolving and at a much faster pace than anyone could have anticipated a few decades ago. Telecommunication industry is no different and, with 4G and its capabilities, it has already proven that. Read on to understand what open radio access network (RAN) brings to the table as the world welcomes 5G

BINITHA MT, SUBHANKAR ADAK, and **KRUTIKA DHANAKSHIRUR, DELL,** and **LAVEESH KOCHER**

It all started with the analogue phones when signals were not digital. 2G introduced digital voice calls along with several facilities, such as text messaging and other data services, although speed was still a major issue. A leap was made with the introduction of 3G as smartphones came into existence with a significant improvement in the speed of the network itself.

As 4G came along, it brought with it a very high speed network with anywhere between 2 to 10MBps (megabytes per second). It allowed multiple devices to connect to a single network. The next big leap being taken is of 5G, with which the speed is going to be even higher. It can vary anywhere between 100 and 200MBps for downloading. It will have the lowest latency rate of about one millisecond, which is far lower than 4G's. It will improve real-time communications tremendously.

What 5G has to offer

There are essentially three aspects that 5G will be assisting with the most:

Enhanced mobile broadband. The applications for augmented reality, where a good internet speed is required with

a low latency, will be a lot more feasible. The uniformity of the connection will be maintained, hence ensuring that your experience is seamless.

Mission-critical services. Self-driving cars require real-time connection with the servers, which can be possible with 5G. A real-time connection also helps in making a better decision and much more access, especially in the robotics sector. In healthcare sector, 5G can make it easier to conduct medical procedures remotely due to its ultra-low latency and strong security.

Internet of Things (IoT) devices. A lot of IoT devices demand good connectivity to function properly and provide users with a hassle-free experience, which can easily be taken care of with 5G. It will improve their overall coverage at a very affordable cost.

How the mobile network works

Mobile devices are kind of IoT devices. All mobile devices are connected to various cell towers that are known as base stations. A group of such towers forms a radio access network and remains connected to the core network.

The core network is responsible for client profiling. It provides access to various services, such as subscriber trunk dialing (STD) calls and data services. Signals from the towers are sent to the core network and the core network is responsible for all the further tasks, such as the execution of the final service. It can be any kind of service, such as an internet connection. The core network, thus, acts as a gateway between the radio access network and the final services (see Fig. 1).

Traditional vs open RAN

Before the introduction of 5G, the base station had mainly two units—the radio unit (RU) or the signal transmitting unit and the baseband unit (BBU) for processing of the signals. RU receives the signals and sends to BBU. Only after that the signals are sent to the core network.

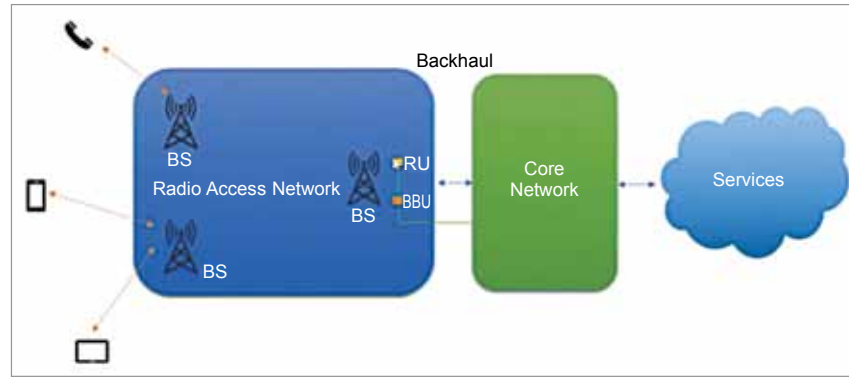

Fig. 1: Mobile network

Earlier on, a single vendor used to provide all the units and the connection between them was also deployed by that vendor only. There used to be a very tightly coupled system, which made it hard to change any component. We use software to run the hardware, but earlier on that software was very tightly integrated inside the hardware, which presented a challenge to change the software as well.

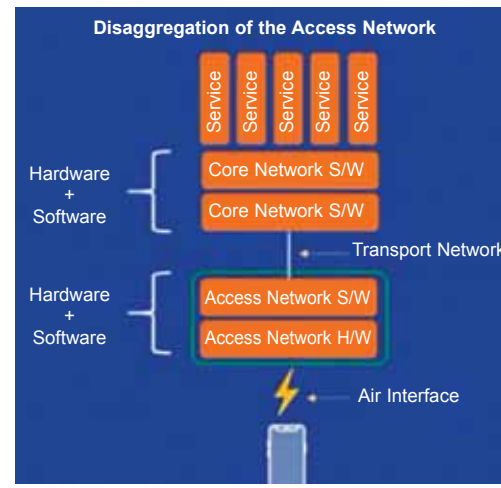

Fig. 2: Typical mobile architecture

So, it was difficult to upgrade the infrastructure besides full dependency on a single vendor. If one wanted to shift to a different vendor, the entire hardware and the software had to be changed, which was never convenient.

Open RAN (O-RAN) makes both hardware and software follow a set of rules so that any vendor can come up with their own solutions. It allows hardware and software from different vendors to work together.

Servers can now independently implement virtualisation due to this desegregation. You do not need a physical server for the mandate. O-RAN even makes cloud solutions possible. It lets one virtualised baseband unit support multiple radios instead of needing a proprietary or a physical unit at every cell site. It is much more flexible and cost-effective at the same time.

Benefits of open O-RAN

Hardware and software disaggregation. The hardware and the software are independent of each other.

Intelligence and automation. It makes open management and orchestration more feasible, since everything is quite open and there are standard rules to do things. It uses external artificial intelligence and machine learning capabilities.

Open internal RAN interfaces. O-RAN lowers layer split, which basically splits the previous single unit to multiple units and mobilises them and makes a multi-vendor solution.

Rapid innovation. It has improved the innovation pace significantly due to the increased competi-

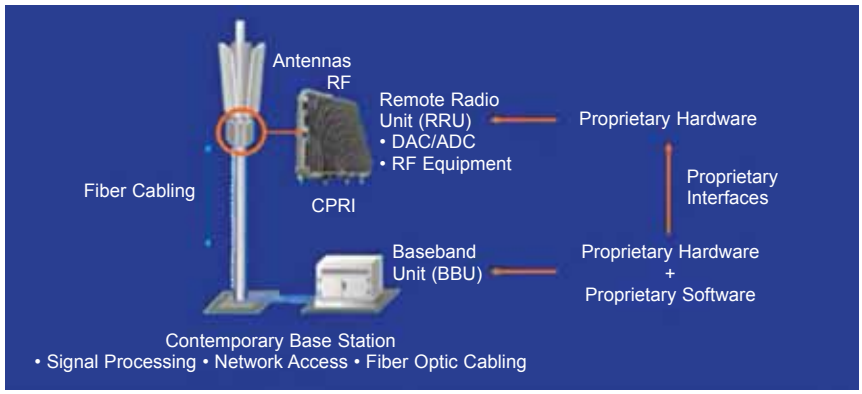

Fig. 3: Traditional RAN

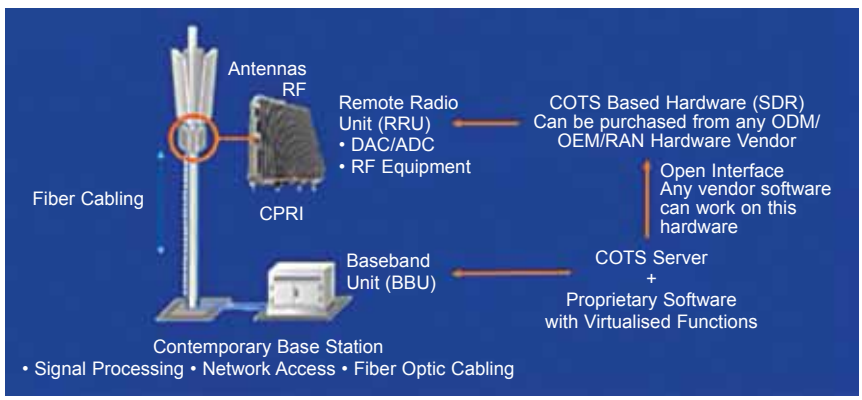

Fig. 4: Open RAN architecture

tion among the vendors themselves. Newer companies are now coming up with their own components which tend to work a lot better.

Architecture of a typical mobile network

As shown in Fig. 2, the core network and the access network are connected by the transport network, which is also known as the backhaul network. Then there is an air interface that connects a user with the service provider's network. There are various other services that run on top of the core network. The core network and the access network contain both the hardware and software that can be seen at the left in Fig. 2.

For proper understanding of the architecture let us understand a few things from previous-generation network architectures first.

All the electronics were in one or more cabinets at the bottom of a mast (tower) when 2G and 3G were in use. The RF cables would run to the antennas on top of the mast. The RF signal continuation in the RF cable was a big problem because of the congestion that used to occur.

As a result, the later phases of 3G entering 4G allowed the industry to take a different approach that worked better. Instead of sending RF signals from the cabinet to the antennas, the RF signals were moved closer to the antennas (as can be seen in Fig. 3). This ensured that there was a very minimal loss of signals. This new piece of electronics is known as remote radio unit (RRU) or remote radio head (RRH). At the bottom we had the base band unit.

Let us move to the cabinet next. A cabinet consists of both the hardware as well as the software. RRU is always a proprietary hardware whereas BBU is a proprietary software along with the interfaces between BBU and RRU.

O-RAN has following components:

Baseband unit (BBU) in telecom systems that transports a baseband frequency, usually from a remote radio unit, to which it may be tied through optical fibre.

Remote radio unit (RRU), which is the distributed and integrated frequency unit that connects to an operator's network with the user equipment like cell phone and mobile devices.

Radio frequency (RF) band, a frequency band that is used for communication transmissions and broadcasting.

Common public radio interface (CPRI), a popular standard for transporting baseband signals to radio units. It is an interface between radio equipment control (REC) and radio equipment (RE).

Understanding the O-RAN architecture

With the O-RAN approach, the RRU is now commercial off-the-shelf (COTS) based hardware that can be purchased from any original design manufacturer (ODM) or original equipment manufacturer (OEM) or RAN hardware vendor. The BBU is proprietary software with virtualised functions running on a COTS server.

It is important to note that the interface between BBU and RRU is an open interface, which is an open functionality that we can see here (see Fig. 4). This would allow any vendor's software to work with any other vendor's hardware and vice versa.

Opportunities and challenges of O-RAN

There are quite a few opportunities offered by O-RAN, some of which are:

Avoid vendor lock-in. With the fully interoperable and desegregated RAN, the service provider should be able to choose from the best in class RAN component manufacturers.

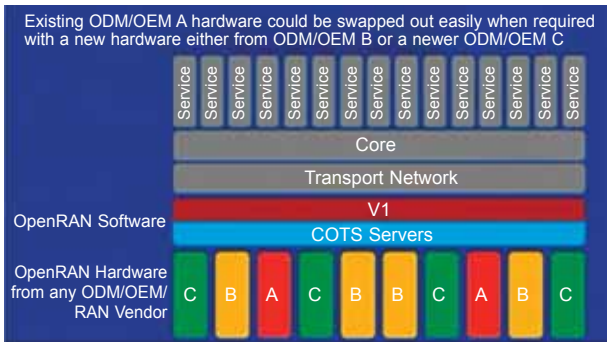

Fig. 5: Open RAN deployment model

This results in a mixture of vendors within the RAN space as opposed to just one or two.

Best of breed. O-RAN brings more flexibility in choosing components from a variety of vendors as per its standards. This fosters an ecosystem of vendors and promotes supply-chain diversification and price competition among vendors.

Reduced cost. O-RAN plays a very crucial role in reducing cost and time to market by enabling rapid innovation, vendor diversification, and higher automation.

Spur innovation. When functionality is 100%, further enhancement to the software can be done proficiently.

Hardware-software development. 5G creates new monetisation opportunities.

Telecommunication experts expect their partners to offer 5G on both hardware and software front. Hence, more opportunities can be found in this area as well.

However, there are some challenges faced in the use of O-RAN as well, which cannot be ignored. The two most important challenges to take note of are:

Security. Network security is one of the major challenges as different vendors follow different security protocols.

Openness. Since it is open sourced, it is susceptible to threats.

5G has evolved and is still evolving at a much higher pace. Mobile network operators are benefited tremendously with O-RAN standards. More new features will be introduced to it eventually that will make it even more economical and will improve the hardware and software integration. With this context as a user, you shall be able to make an informed decision for yourself. EFY

This article has been put together from a tech talk session at OSI 2021 by Binitha MT - Dell Technologies, Subhankar Adak - Dell EMC, and Krutika Dhanakshirur - Dell EMC and has been transcribed and curated by EFY's Laveesh Kocher, a tech enthusiast with a knack for open source exploration and research.

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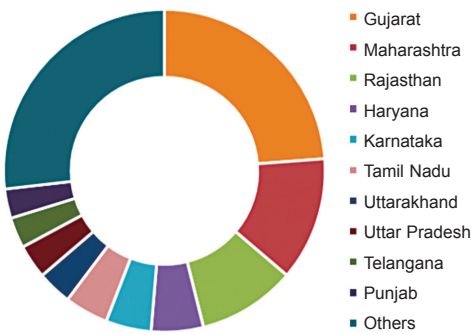
THE DASHBOARD

India Added Over 456MW Rooftop Solar Capacity in Q1

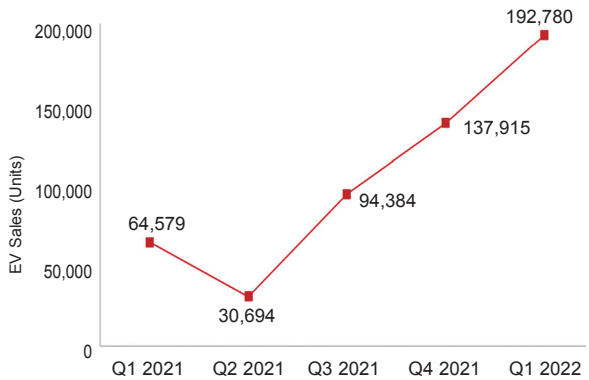
As compared to 341MW registered in the same period last year, a 34% year-over-year growth is seen in total solar installations across India. In Q1 2022, rooftop solar accounted for 15% of the total solar installations. As per a report, the average cost for the same increased by 17%. The top 10 states accounted for nearly 73% of cumulative rooftop solar installations at the end of Q1 2022. Gujarat is the top state for cumulative solar rooftop installations, while Maharashtra and Rajasthan rank second and third.



(Source: Mercom India Research)

EV Sales Increased by 40% in Q1 2022

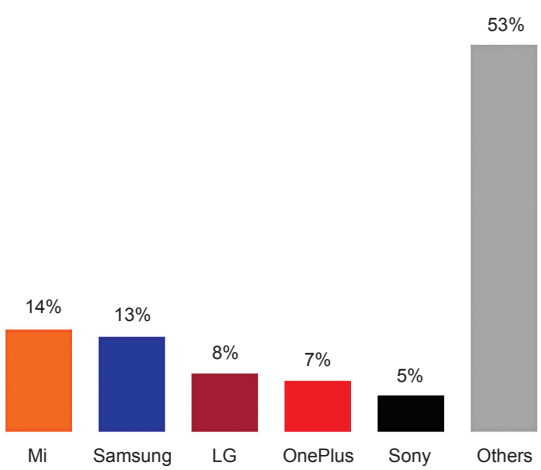
The first quarter of the year saw EV sales register to 192,780 units which is a 40% increase from the previous quarter. This Q-o-Q increase in sales was comparatively small when compared to the sales of 46% from Q3 2021 to Q4 2021. However, these sales have witnessed a steep rise of 199% from the same quarter in 2021, that is, Q1 2021. The highest sales for registered EVs were in the month of March for more than 81,000 units.



(Source: JMK Research)

89% of TVs are Smart in India!

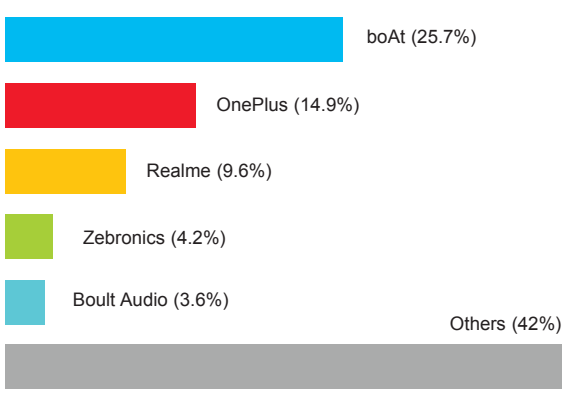
Smart TV share in India's overall TV market grew 33% YoY in Q1 2022 and reached its highest ever at 89%. Xiaomi's 14% market share made it the leading brand while Samsung and LG followed up. In this offline-driven market, the ₹10,000-₹20,000 price band captured over 40% share. The share of TVs with 109cm (43-inch) and above screens is increasing as people are shifting to bigger screens.



(Source: Counterpoint Research)

India Neckband Market Led by boAt, Followed by OnePlus

This market has shown tremendous growth in 2021 as consumers opt in for an alternative audio device. Inspite of the shipments declining to 13% YoY in Q1 2022, they did grow 34% YoY in 2021. The market was led by boAt with a 25.7% share, while OnePlus and realme took the following spots respectively. The price band that captured 70% share was ₹1,000-₹2,000. More than 75% of the total sales were made online.

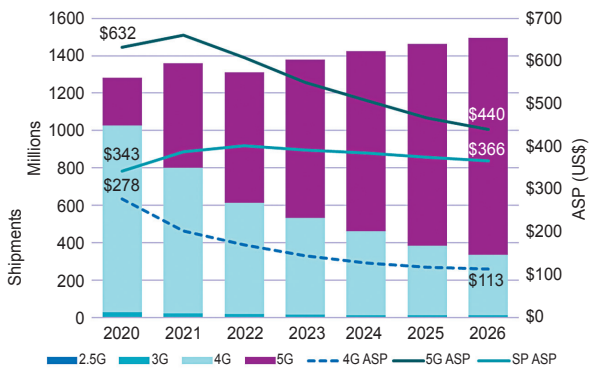


(Source: Counterpoint Research)

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

Global Smartphone Shipments Expected to Decline 3.5% in 2022: Report

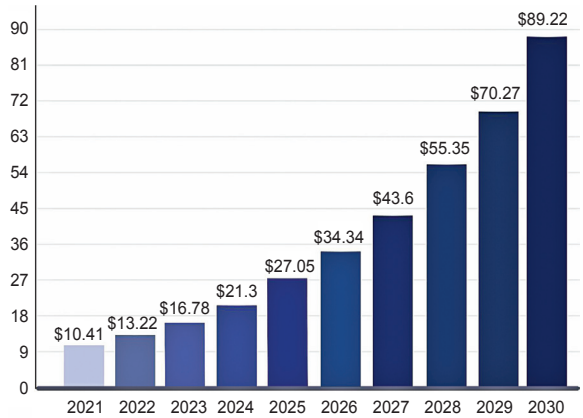
As per IDC's report, shipments of smartphones are expected to decline by 3.5% to 1.31 billion units in 2022. After three consecutive quarters of decline and increasing challenges in both supply and demand, the forecast has been reduced for 2022 from the previous projection of 1.6% growth. Volume expectations for this year were brought down significantly due to increased channel inventory of 5G products in China and the overall reduction in the market forecast. In the long term, 5G is expected to reach a volume share of 78% in 2026 with an ASP of $440.



(Source: www.idc.com)

AI in Hardware Market to Reach US$89 billion by 2030

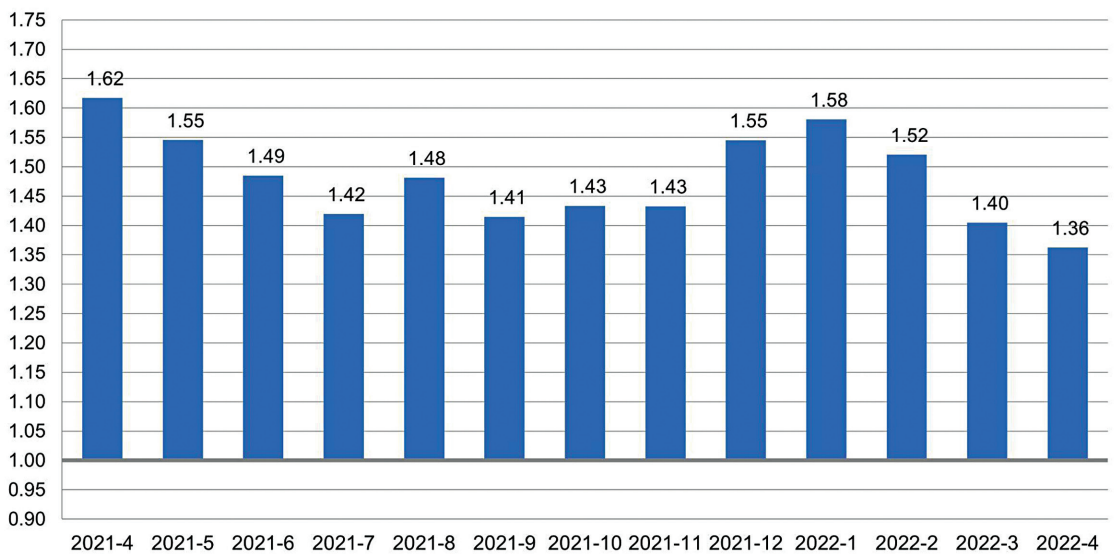
The global artificial intelligence in hardware market size was valued at US$10.41 billion in 2021 and is projected to surpass around US$89.22 billion by 2030 and growing at a compound annual growth rate (CAGR) of 26.96% from 2022 to 2030. Availability of high-speed internet and increase in the number of internet consumers across the globe is driving the growth of the market.



(Source: www.precedenceresearch.com)

North American EMS Industry Up 4.3% in April

The book-to-bill ratio for the North American Electronics Manufacturing Services (EMS) Statistical Program stands at 1.36. The total shipments were up 4.3% as compared to the same month last year. However, in comparison to the preceding month, there was a fall of 10.7%. EMS bookings in April fell 7.2% year-over-year and 2.4% from the previous month.



(Source: www.ipc.org)

OPEN SOURCE BUSINESS MODELS: How Beneficial They Are

The world is moving towards deploying more open source solutions, but are businesses adopting open source in proportion to the way these solutions are being deployed? If yes, are there any proven business models that can help open source companies sustain themselves? Should new companies (startups) venture out in the world of open source?

MUKUL YUDHVEER SINGH

Open source, about a decade back, was referred to as something solely meant for geeks, programmers, and educational institutions. A few years ago, it started gaining recognition as something that is for everyone to leverage upon. Today, even large organisations like Microsoft are openly talking about it, and investing in the same as well.

"A lot has happened and evolved in open source. The top view shows it is free. However, even if it is being made freely available, there are billions of dollars riding on the ecosystem. Not only are there open source companies valued at more than a billion dollars; industry giants including Google and Microsoft are investing millions of dollars in the same," says Mukul Mahajan, MD, Tetra Information Services Pvt Ltd.

Most of these investments, as a matter of fact, focus on hiring manpower for the open source ecosystem. Business models like professional services and cloud hosting are evolving, but the big question is what are the opportunities available to or-

ganisations who aim, or are already working on, in being an open source player, and what are the business models they can pursue for profits?

"I think the key aspect is to have a business model. But here's the thing, the vast majority of people who are investing in open source are not quite investing directly for the sake of it. I don't think there is something directly attracting them to invest in open source," says Hadi Hariri, VP, Developer Advocacy, JetBrains.

He adds, "They are not investing to make a better world using open source but there are key indicators that force us to use open source, which are good until there is a sustainable business model, which unfortunately many do not have."

Cue: Microsoft's here!

We have all heard and also used Microsoft, and the biggest cue that open source is indeed the future can be derived from what the organisation is doing on the respective open source front. But why is Microsoft in open source?

"Satya (Nadella) was very clear when he took over Microsoft, that it has to be more open than it ever was. This actually goes back to our core thinking of wanting to do more for every person and organisation, which cannot be achieved by being closed," says Sanjeev Sharma.

He adds, "If 40 per cent of CIOs have Linux as one of their prime strategies, and 60 per cent of developers want to see the cloud providers in open source, if 90 per cent of enterprises deploy Linux in some shape and form, I think it indicates an absolutely clear market decision."

Sanjeev mentions that he sees tremendous opportunities to build around open source, affirming that Microsoft is committed to stay open in the future. It is worth mentioning here that 50% of Azure's VM cores are Linux, and 60% of images on it are also Linux based. More than half of the ecosystem on Linux, as Sanjeev confirms, is Linux based. SaaS applications and various other applications are leveraging open source.

He goes on to explain, "This also brings opportunity for any new offering that is coming to the market to continue to leverage their core DNA while also getting exposed to the larger market worldwide, giving an opportunity to experience the full might of larger cloud providers. Talking about India, we have more than 30,000 customers in just one segment."

Solving one problem using open source creates room for solving many other problems. For example, a normal customer service app has to touch different platforms, while being compatible with different types of devices. The same might also have to browse through multiple databases. The idea, as per Sanjeev, is to slowly and steadily multiply what is being offered to clients.

"You begin to try by offering one solution to one type of customer base and then you can pivot to a larger market. Today's cloud provides you that opportunity to experiment," he adds.

Another remarkable thing to point out is that Microsoft had acquired GitHub for $7.5 billion in 2018. The company then, in March 2021, had announced a grant of ten million rupees to fund India's open source contributors working on building software using open source tools.

Subsidise and maximise

Taking example of the likes of Microsoft, Amazon, and Google, along with the open source ecosystem they operate in, it is clear that their open source business model is subsidised by the cloud service they provide/sell. Facebook, as per Hariri, is subsidised by data and advertising. Similarly, there are others who subsidise the business of open source by selling tools, and one example of the same is JetBrains.

"I don't think there are any key parameters. You should look at how you are going to sustain your open

Picking the Right Open Source Business Model

"You can always look at it as either half-glass-full or half-glass-empty. We can leverage a little larger ecosystem, by reaching out to companies all over the world, thus leveraging the public clouds," says **Sanjeev Sharma, Director, New ISV Partnerships, Microsoft.**

"Focus more on the pain of the consumer, and then make a business model that can help you survive. Times are changing rapidly. It's good to be on the dynamic side as these changes will help you survive in the long run," says **Samir Doshi, Co-founder & Director at iNextrix Technologies.**

"It's important to keep figuring out things on the way. It's critical to always remain agile and flexible. Everyone should nurture their curiosity and keep testing waters to see what works best for them. The market is optimistic so why shouldn't you be," says **Kabir Chandhoke, COO, SourceFuse Technologies.**

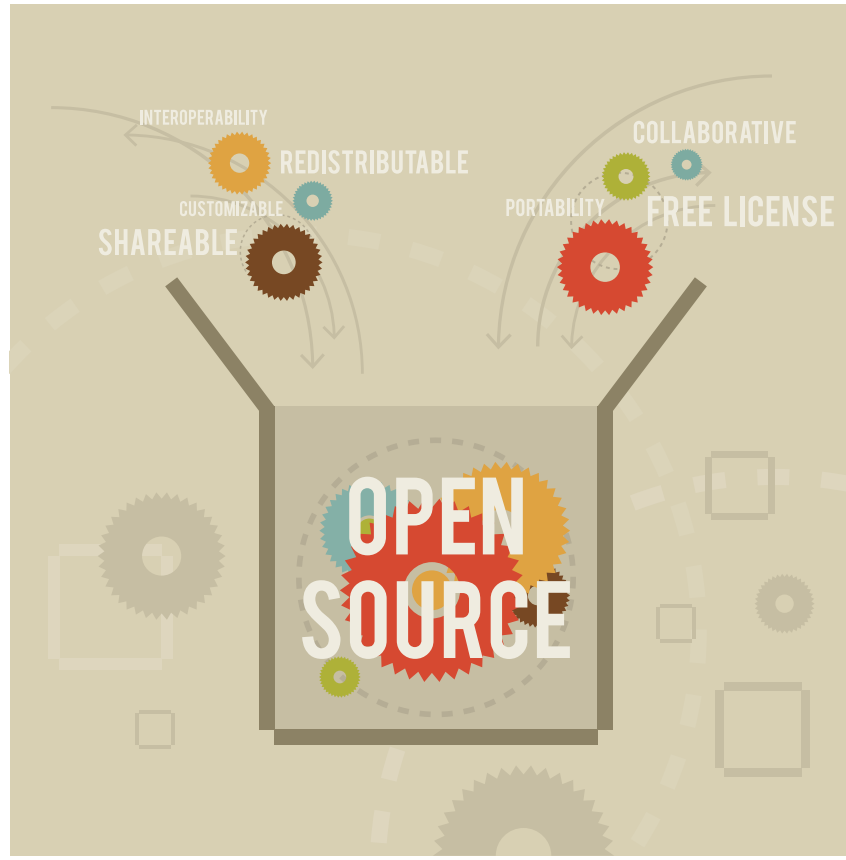
"If you want to leverage open source, you should rethink your decision. Firstly, whether open source will provide any benefits or not. Once your decision is certain, make sure you have a business model around it. If you want to make it successful, make sure you have a license that is not overly permissive," says **Hadi Hariri, VP, Developer Advocacy, JetBrains.**

source contributions. I don't believe that business models based on priority giving succeed. There are only a few success models like that. The best example that can be thought of here is RedHat," explains Hariri.

The model of RedHat, as most of the industry *gurus* will agree, is complicated yet successful enough to require consulting, which is provided by the RedHat team itself as part of the business model. The chances of making the business model sustainable may decrease if the consulting is taken care of by a third party.

Open source, as Mukul points out, might be more of an enabler that helps get traction and build newer business models. What enables open source and new business models to sustain is the demand it gets from all verticals of business.

"When running a business, sometimes you need to subsidise what you are doing for the greater good. Otherwise, you could simply be considered a hobbyist," remarks Kabir Chandhoke.



Market place: Enterprise or community

Enterprise and community are two popular business models that have started to become the talk of the town. The community edition refers to free usage of open source with limited capabilities, whereas the enterprise edition refers to a business model which offers a lot more features available at a cost.

"These two models are becoming very popular. On top of these you can also offer complimentary services such as certification, development services as well as support contracts," says Samir Doshi.

Whether someone refers to an enterprise, community or any other business model around open source, marketplace is one such model that joins all the dots together.

"Marketplace is definitely a brilliant business model as it adds a lot of value to all the open source products. You have brilliant brains coming up with add-ons and applications. It is definitely a good one," adds Samir.

It is critical to understand the relationship between open source and cloud in order to understand business models better. The debate around whether cloud is making open source popular, or vice-versa, is something that the experts still lock horns about.

"If you think about the cloud itself, open source is what actually drove the cloud in the first place. Can you imagine the public clouds we have today and companies paying license fees for their operating systems?" asks Kabir Chandhoke. "We would never have achieved the scale of, say, AWS, had there been license fees for millions and millions of servers rolled out."

He is of the view that open source is the driving factor behind public cloud. This might unearth another business model revolving around offering cloud services to consumers using open source.

"The reverse is also true as the public cloud is responsible for making open source projects popular. Another way public cloud has accelerated the monetisation of open source is through the SaaS route," adds Kabir.

Cloud and open source can enjoy a mutually beneficial relationship as long as the former does not start eating into the latter's business model. This situation arises when an open source product becomes tremendously popular.

"I definitely see evolution taking place in the partnership between cloud and open source. It will be interesting to see how this partnership continues to evolve with opportunities for both the community and the owners being compensated," explains Kabir.

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Elasticsearch, in open source, needs no introduction. It is basically a search engine based on the Lucene library. At a point in time, it was the go to favourite of many, if not the majority of open source developers. The breaking news from the company came in early 2021 as it decided to inform its audience about Elastic License 2.0.

This, as per the company, simply means that the license allows the free right to use, modify, create derivative works, and redistribute. However, there are three limitations:

1. You may not provide the products to others as a managed service

2. You may not circumvent the license key functionality or remove/obscure features protected by license keys

3. You may not remove or obscure any licensing, copyright, or other notices (as published by Elastic.co)

In simple words, this means that neither the Elastic License nor SSPL has been approved by the OSI. Hence, the company is no longer referring to Elasticsearch or Kibana as open source. Elasticsearch is the greatest example proving how fast the world of open source is evolving, and how fast the existing business models are shrinking, while new ones are making their way!

"From the community perspective it was impacted in two ways. The first was that contributors, who worked for the same, were suddenly told that what they worked for was no longer truly open source. The second, keeping big and small players in mind, is the fact that the solutions they are developing now cannot be made public, keeping the announcements made by Elastic in consideration," says Kabir.

Partnership with big players

This decade has been more about collaborations and mergers in the world of technology, and the open source vertical is not an exception. Following this trend, to partner with a big player like Microsoft can be a big opportunity for startups and organisations already operating in the domain of open source.

Sanjeev explains, "If you are a services provider, there are opportunities available with Microsoft as the company has a specialisation in open source Linux and Kubernetes."

In terms of ISV and IP opportunities, the world is witnessing innovation and launch of new solutions. Sanjeev, who gave an example of an assessment engine based on open source notes, "It scaled up very easily. However, the problem was finding customers beyond India. They leveraged the 60+ datacenters that Microsoft has." He also gave an example of a sales nudge solution company, which helps the sales team to analyse deals and close them quickly.

Whether the solutions are for education, health, finance, or any other industry, big players, as per Sanjeev, can not only help scale the offerings across geographies but can also help make these solutions more secure.

"The core of the solutions that Microsoft offers are actually coming via partners. We are only providing them the platform. The solutions are coming through organisations which are based around the world," explains Sanjeev.

The opportunity, as per him, is coming in accordance with the solution provided by the company. More than 60% of the solutions being offered are open source.

Partnering with big names also brings forth a question. Why is the value of open source companies so high? The answer lies in the consumer base that many of these organisations have. It continues with how brilliantly these companies are handling the complex layers of architecture.

"The conflict between Amazon and other companies is also one of the reasons behind the high evaluation. There still exist companies which believe in hosting everything in their own server rather than a cloud," feels Samir.

Then, why do developers work for free?

Samir answers, "Because you are using that tech for yourself. For example, if I am working on a project, I will want to use that for myself as well. I may want to build my UI using React and many such things. Once you start doing that and notice a missing feature, or find a bug, you end up fixing it and that creates an impact for the greater good."

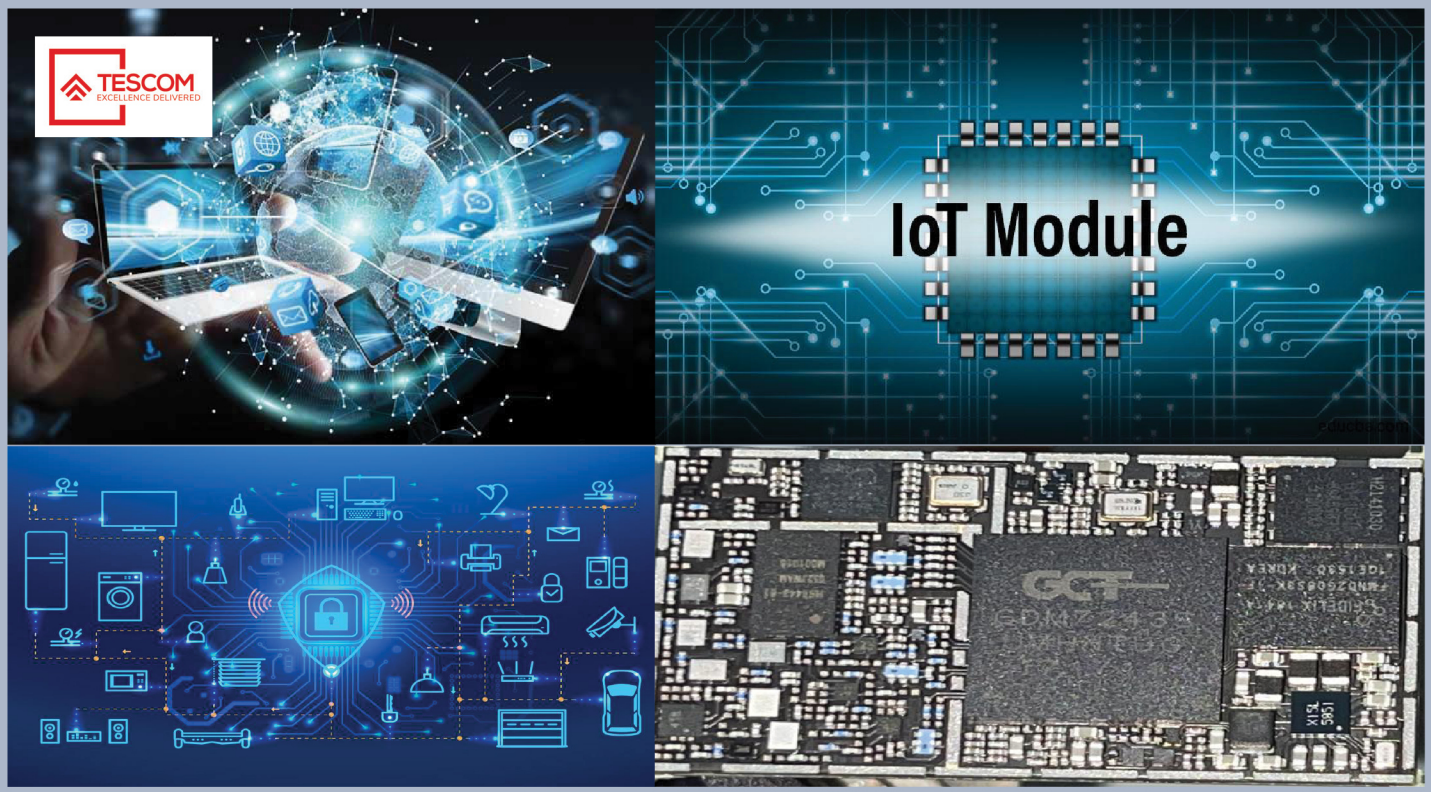
"The same also allows young and experienced developers to polish their skills. It's almost the best CV you can have. It probably serves better than most internships that a developer could have. Where else would you have the opportunity to have your code checked by some of the best and brightest in the world," he adds.

The open source industry is now undergoing a trend wherein the big players (the one's providing cloud services) have also started facilitating open source stacks. Going by the trends, it looks as if every big company will soon join this race, and the same could lead to big changes in the open source Ecosystem.

"I don't think there is space for any major changes. The community will always be there, whether it is from the cloud provider or open source companies. I do not think there would be any threat to communities or business models as such," feels Samir.

Kabir adds, "I think this is the reaction to the recent license changes made in the world of open source." EFY

This article, based on a panel discussion held at OpenSource India 2021, has been compiled by Mukul Yudhveer Singh, Business Editor, Electronics For You, until recently.



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Assessing OPEN SOURCE SOLUTIONS For Deployment

Open source is mainstream now. It has proved its mettle as more and more organisations are adopting OSS. But how can you assess and analyse whether the solution you are interested in is the right fit for your organisation?

MUKUL YUDHVEER SINGH

"Open source is no longer a matter of concern regarding its duration as lot of organisations have already started using it, and (some) are now busy evaluating how soon they can start their journey with it," says Mukul Mahajan, Tetra.

Rightly so, a recent report by Gartner pointed out that by 2025 more than 70% of enterprises would increase their IT spending in open source software (OSS) as compared to what is being spent on it as of now. This shows the increase in the number of organisations that have started to weigh the possibility of using open source solutions. However, it is still a long way to go for the open source solutions.

"The organisations are still not clear about the sustainability of open source solutions. For corporations who adopt open source solutions, despite the solution being free, they always look at the long-term sustainability. So, unless they are sure about it, they are very hesitant

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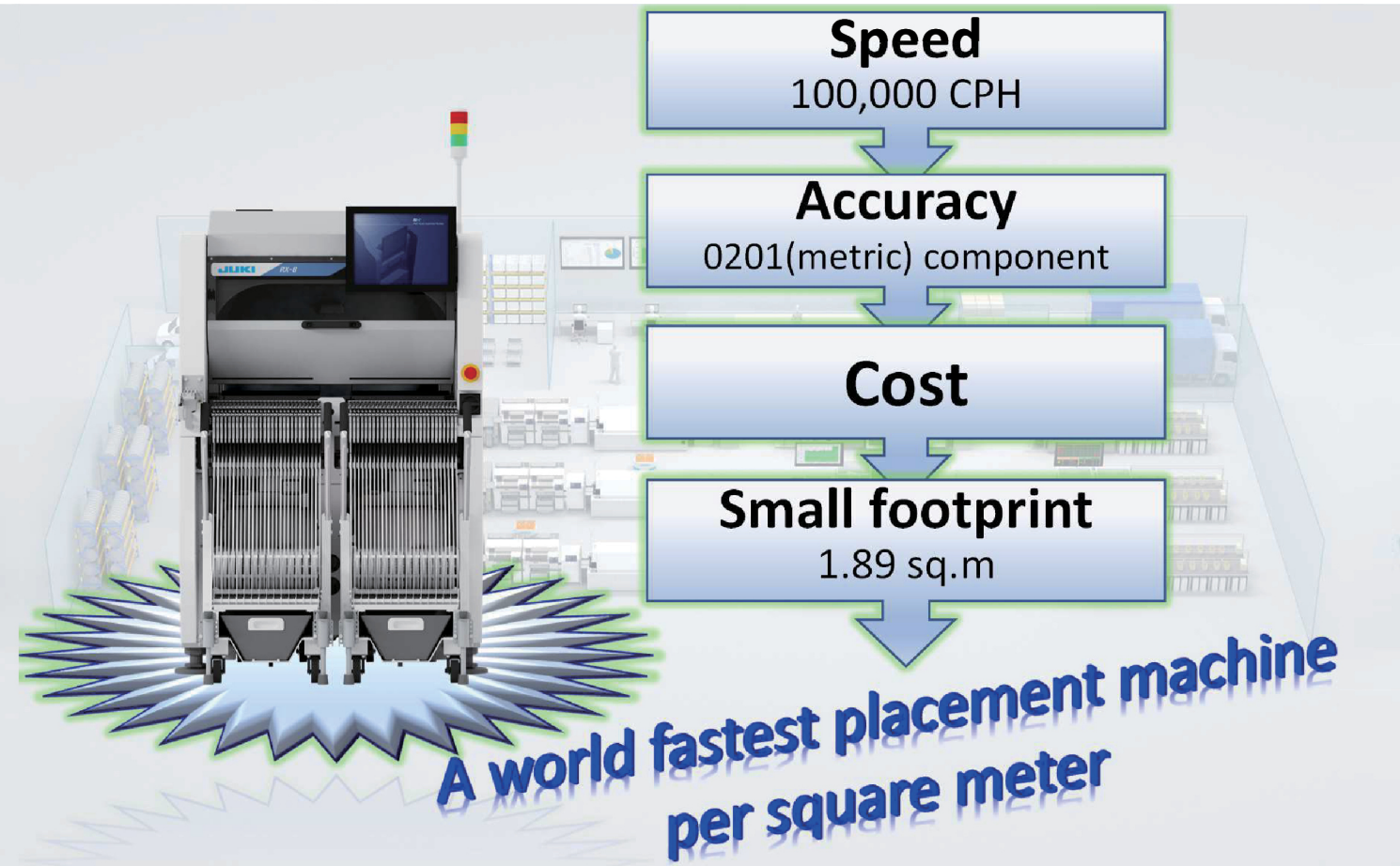

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to adopt it. Moreover, there is no strategy for one solution that fits all approaches. There are multiple strategies, and each strategy has its own advantages and disadvantages," explains Mahajan.

A recent report published by Red Hat notes that 90% of IT leaders surveyed are using enterprise open source today, and they are using it for IT infrastructure modernisation (64%), application development (54%), and digital transformation (53%). The move to remote working, as per the report, forced many organisations to accelerate their digital transformation efforts to maintain innovation and continue to meet customer demands. So it makes sense that it moved up this year to the top three.

Paul Cormier, President and CEO, Red Hat, in the report says, "Open source has solidified itself as an innovation engine for the software industry. The technology trends that you see changing how we work and do business were born in open source—enterprise Linux, cloud computing, edge and the Internet of Things (IoT), containers, artificial intelligence and machine learning, and DevOps. These are the same principles that apply to how you've seen the world come together and make rapid advancements, like the Covid vaccine, in a shorter time frame than ever before. In both cases, enterprise technology and the challenges of a Covid world, the problems are too big for one person, one company, or one organisation to solve."

He adds, "But it's in moments like this where open source truly shows its power. Collaboration, transparency, and the idea that the best idea can come from anywhere are the principles that help organisations not just meet challenges but reach new heights."

Assessing open source adoption

Assessing the adoption rate of open source is not an easy task to accomplish as different industries use open source solutions for different reasons. For instance, a manufacturer might be using open source software for collecting data generated by machines to accomplish better turnover whereas an e-commerce player might be using open source software to enable search on his platform, so on and so forth. The cost of ownership and the risks associated also vary from case to case.

"Open source solutions and their sustainability need to be adopted on case to case basis, keeping unbiased risk assessment in focus," says Mahajan.

The industries and verticals where the open source solutions are being adopted today include infrastructure software, application development, DevOps, databases, analytics, and cloud based operations. There are a lot of open source stacks available for all these verticals. Most of the new databases, as a matter of fact, are open source. There is no vertical left in cloud based solutions where open source cannot play a major role. But the question for organisations looking to deploy open source solutions remains the same. Why should they do so?

The beginning to the answer of this questions lies within the organisations themselves. What are the parameters they have kept in focus while assessing if they should go for open source solutions or not? The parameters that should generally be kept in focus while looking towards open source solutions include, but are not limited to, cost, freedom and flexibility, maturity, and talent retention.

"All these criteria might not be relevant to all the organisations. For some, all of these might be relevant, for others, only a few of these might be relevant," says Mahajan.

What all should be assessed in the cost factor

- Implementation and deployment cost
- Development cost
- Support cost
- Subscription cost
- Training cost

Cost as a criteria

Whether an individual or an organisation is investing in a new building, or a new software, the cost involved plays a critical role. The importance of the cost factor, while deploying an open source solution, increases by leaps and bounds. Cost of an open source solution is not limited to the cost incurred in downloading and installing a solution but also the cost the company will pay for the support services required for that solution.

"Any organisation looking for open source adoption should look at the long term cost of the open source solution. You will need support for the solution down the road. If you do not opt for that support, the only choice you may end up with is to stop using that solution and throwing it away," explains Mahajan.

This could be a point where the senior management could raise questions and ask why this was not given a thought while choosing the solution. The key towards assessing and choosing an open source solution lies in calculating costs for at least five years down the road. The aspects to keep in mind include costs required for installing and maintaining the solution, the costs saved using the solution, and the cost of manpower required for the solution.

One should also keep in mind where further development of the solution will take place in-house, or will the organisation hire a third-party to do so. Further, deploying an open source solution mostly requires paying a support cost to a third party that can support the solution in the long run.

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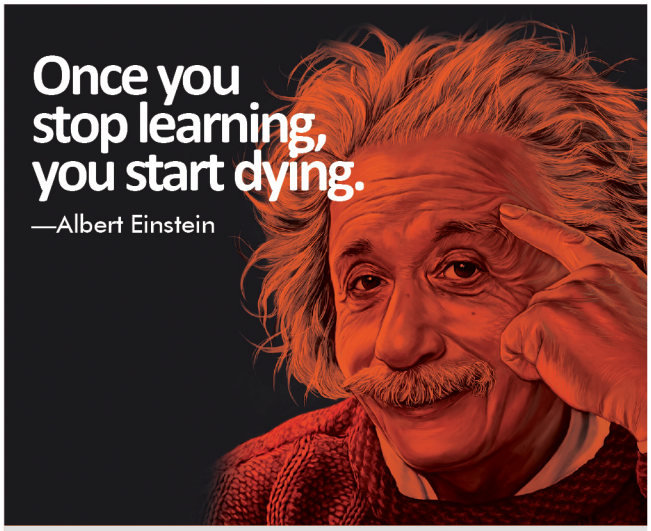

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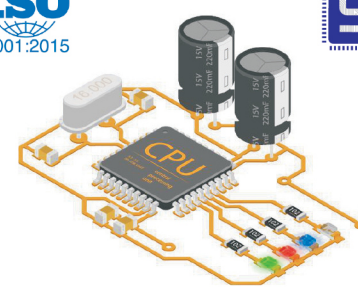

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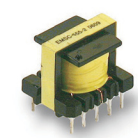

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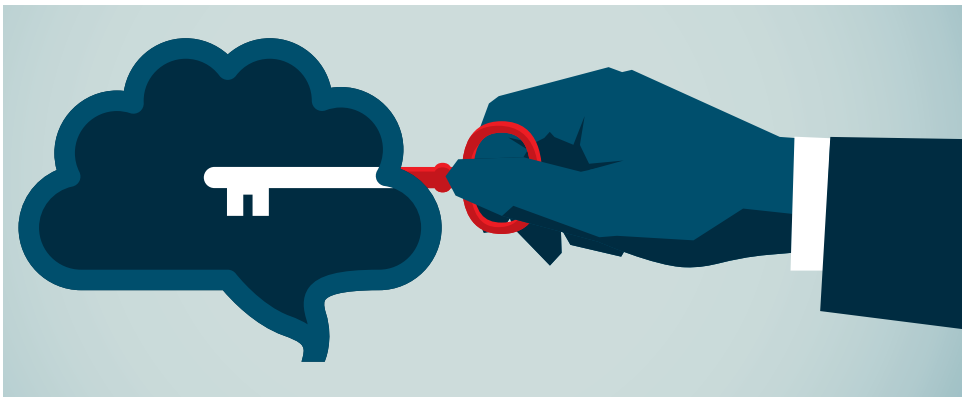


"If the development is being done internally, the organisation will need to make sure that the manpower can be sustained. Then comes in the customisation costs. Many will want to customise the solution as per their needs, and that might cost extra in form of development cost," shares Mahajan.

He adds, "Open source solution providers, such as Zimbra and Red Hat, usually offer open source solutions in subscription models. Red Hat charges 100% as a subscription cost. Keeping that in mind and calculating how much you will be paying in five years as subscription costs can also help organisations in assessing and choosing the right open source solution.

Deploying a new solution always requires the existing manpower to be trained on the same. This training not only costs money but also requires dedicating hours, and sometimes days or weeks, towards training and practicing. Additionally, both the internal and the external teams need to be trained in such a way that they are in sync with each other all the time.

"If you want to deploy Libreoffice instead of MS Office, you will encounter some features that are not usable. You will need to train the users on Libreoffice. It is not essential that open source adoption will lead to lowered costs, or open source cannot be deployed if the costs are higher."

Freedom and flexibility

Freedom and flexibility are among the top reasons that have made open source what it is today. The freedom to choose solutions with the flexibility of customising existing solutions have not only empowered the community developing open source solutions but have also empowered the end users to choose and deploy.

Freedom and flexibility, in the simplest of terms, stands for access to the source code. This access becomes essential for organisations such as the e-commerce portals coming up today because of the changes they are introducing on daily basis. However, this criterion does not hold the same value for all the organisations looking to deploy open source solutions.

"The freedom and flexibility assessment criteria is case-to-case. For instance, the way e-commerce portals are evolving on a day-to-day basis, they cannot work with solutions that are closed source. Such organisations are accessing open source solutions despite the higher costs," explains Mahajan.

The second factor, flexibility, revolves around whether your internal team is flexible and capable enough to support these solutions, or will you be requiring external support (commercial) for the required support. Of course, the internal team, if there, will be required to upskill over time, and the management might also need to make extra efforts to sustain the team.

"You will have to decide whether you want self-support, or you will be needing commercial support. Either you should have the capability to support the solution internally, or you will have to reach out to the vendor, or any other third party for the same," shares Mahajan.

He adds, "Adopting open source solutions requires being able to get suppliers in the long run. This matters a lot when we talk about mature projects. If you are adopting any new solution and there are only a couple of suppliers supporting it, you might find it difficult to find suppliers, if the solution does not grow."

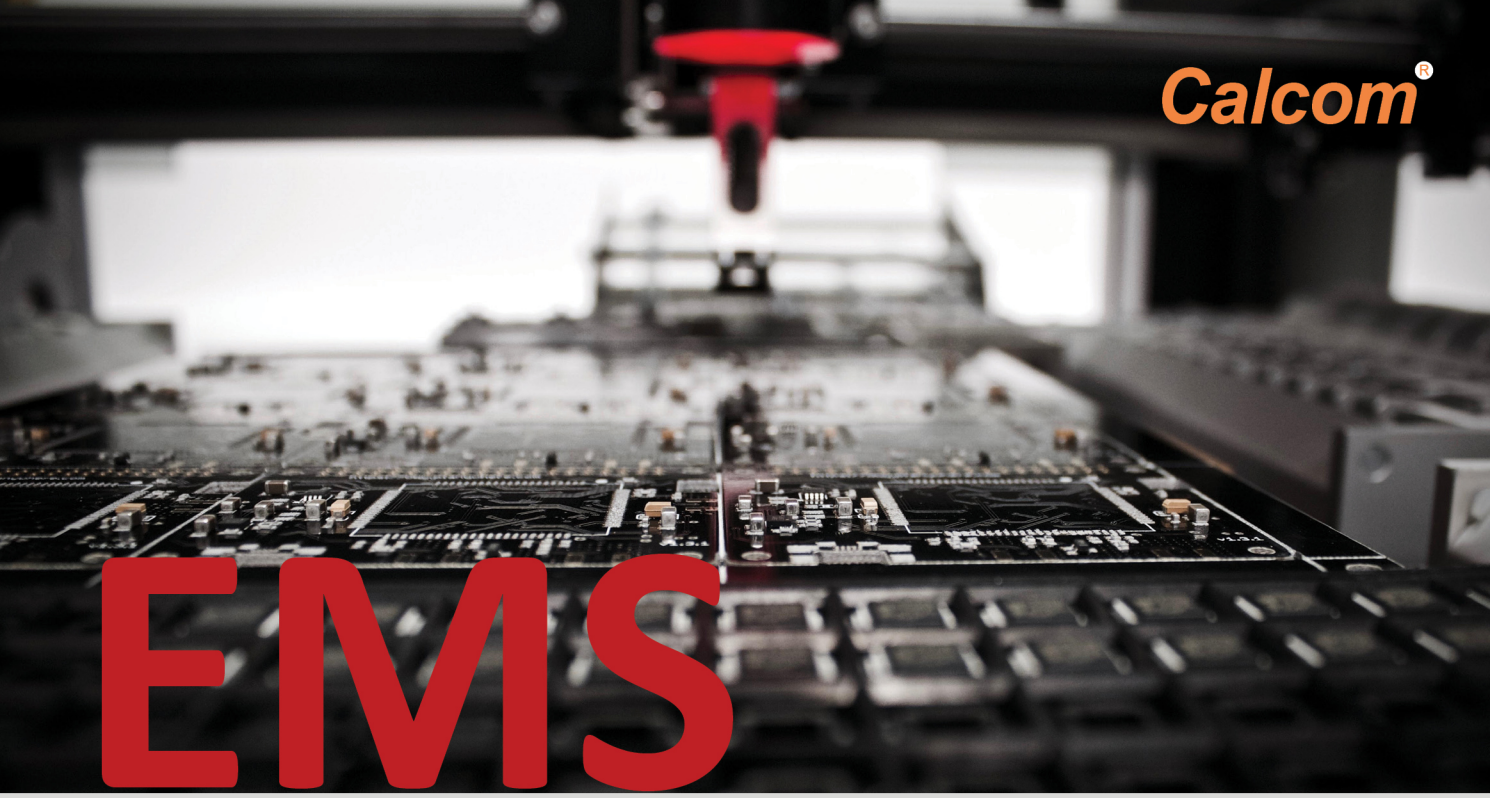
Organisations which have dynamic requirements should carefully assess the freedom and flexibility factor. This is because they might require a lot of customisations, which in turn will require them to work with multiple suppliers at the same time. The frequent changes they need will always need the source code to be present at hand.

Matured solutions only

There are millions of open source solutions available in the market today. A lot of these also make repositories like GitHub on an everyday basis. However, it is not common for all of them to sustain themselves in the long term, in some cases even for short-term. Mahajan is of view that only about 5 to 10% of such solutions reach the mature stage.

What happens if you adopt a solution, and it is not able to mature with time? Choosing solutions that are mature over solutions that have just entered the market can make a big difference in the long-run as support will always be available for the former ones.

"If you are adopting any open source solution, you should always look at the maturity of the solution. Hence the project that you are deploying should be in the mature



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stage and should also be supported by a good number of developers, as well as some key organisations," explains Mahajan.

He adds, "Then comes restrictions of licensing. If the solutions you are deploying are largely restricted by licensing, you might find yourself hanging by a thread. Licensing assessment should be checked in all the cases as organisations will depend a lot on the solution, and this dependency might increase as the time passes. The licensing should not be too restrictive."

Availability of commercial third party support options is something that organisations looking to deploy open source solutions should always assess. There should be more than a handful of vendors who can support the solution that an organisation is deploying. This will not only help in cost negotiations but also in choosing the best support possible.

"Open source also has dual licensing models available where there is vendor lock-in. Organisations must look at what are the things where vendor lock-in is applicable. For example, if an organisation does not take subscription from the vendor, can it still use the solution?" explains Mahajan.

The open source solution that an organisation adopts should have transparency. There have been instances where vendors have used open source just as a base combined with their own codes. Such vendors do not generally allow the organisations to use these codes. The ability to integrate such solutions with other solutions also matters a lot as desired results usually warrant the use of multiple solutions at the same time. It is critical for these solutions to work in harmony with each other.

"If you are deploying ERP, you will have to integrate with CRM, with web, with social media and more. We live in a world of integration, and if the solution you are deploying does not have the capability of getting integrated with other solutions, do not choose it," says Mahajan.

More on the menu

Apart from the check points mentioned above, there is still more that organisations can do to assess risks attached with adopting the open source solution they are interested in. For instance, while a check on the quality of services provided with the solutions is something no organisation will miss, there is a possibility of missing out checking the governance model of the provider creating and enabling that solution. What if there are only three to five people managing the entire governance model, and one fine day they decide to change the model?

"Though the features of such solutions might be good, but lack of a governance model will mean that there is a lack of support. It also means that the solution might not be sustainable in the long term," explains Mahajam.

The attributes of a sustainable open source solution include availability of community support, good documentation around the project, a thriving ecosystem of developers and contributors, transparent licensing model, and an up-to-date security reporting model. What kind of organisations are supporting the solution matters a lot. For instance, solutions being supported by the likes of Facebook will always have high credibility over others.

"Based on the above, open source policy documents should always be made for the organisations. These documents should clearly mention the advantages, the risks, licensing policies, and the total cost of ownership involved. The policy document should also explain the alignment of the solution with business and IT. If it is not aligned with businesspeople, organisations will not adopt it," says Mahajan. EFY

SKILLING IN 5G TECHNOLOGY Holds A Great Promise

India is at the threshold of a big revolution as the highly-anticipated 5G network is finally taking shape in the country. But do we recognise the potential it holds for the electronics industry? And are we getting ready the biggest asset at our disposal—the manpower—at the required speed? Is it possible to take our rightful place in this world without the skilled manpower?

TELECOM SECTOR SKILL COUNCIL and **SIDDHA DHAR**

Telecom Minister Ashwini Vaishnaw successfully tested India's first 5G audio and video call in May this year. "Successfully tested 5G call at IIT Madras. Entire end to end network is designed and developed in India," he tweeted.

As with any new technology, 5G brings with it opportunities and the promise of employment.

The Telecom Sector Skill Council (TSSC) estimates that India will require as many as 22 million skilled manpower by 2025 to reap the full potential of 5G. This is easier said than done.

India is infamous for missing the bus of both the 4G revolution and the electronics manufacturing era in the past. And it can be attributed mostly to one reason—the lack of awareness of the opportunities and the challenges we face. Skilling the youth is a prime example of that.

"The future doesn't lie in the job, it lies in the person doing the job," says Ramesh Kasetty, CEO and Co-founder, Duranc.

A robust telecom sector for a robust electronics industry

The telecom industry no longer sits in the back seat of reforms. The introduction of 5G promises a gleaming future for the industry. This is the result of a long-awaited realisation—a robust electronics and technology industry requires a robust telecom infrastructure.

"The kind of new technologies that are coming, it is not possible to take advantage of that tech without having a robust telecom infrastructure underneath," notes Dr N.S. Kalsi, Chairman, NCVET. Technology is only as good as the hands that use it. The first step to skilling the manpower is

A Case for the Learner's Perspective

Now, while the conversation about the need and means of upskilling goes on, the ground reality is a little different. A predicament skilling centres often find themselves in is having to deal with students who have no desire to upskill. This is at the expense of large sums of time and money spent by the industry on upskilling, and students spending time learning something they do not wish to. A complete lose-lose situation. What can be done?

For starters, putting up more rigid screening tests for potential students is a good way to weed out unsuitable people. Second, Dr Kalsi suggests that keeping the sword of some monetary investment on the student's part can be a good way to make sure that only those who are truly interested are upskilled. It is also important to understand what the people are actually interested in—be it AI/ML, IoT, or Big Data Analytics. Mapping a person for the right skill and competency is very important.

highlighting the opportunities that are available to them to utilise these skills.

The recent policy of the government to introduce semiconductor design manufacturing and the subsequent India Semiconductor Mission have opened doors for the telecom sector to emerge as an economic leader. It is expected that soon every piece of metal will have silicon embedded in it because silicon is what provides a brain to the metal. But that brain will only be able to communicate through connectivity. Hence, telecom provides it with life.

In a similar vein, the recent production-linked incentive (PLI) schemes for electronics manufacturing present further opportunities for skilled manpower to put their talent to use. The introduction of 5G has opened incredible avenues for growth across sectors. And as technologies like IoT, Industry 4.0, and AI/ML keep propping up in conversations, the significance of connectivity and data becomes clearer. But so do the challenges that accompany them.

The country has an impressive herd of skilled manpower for 2G, 3G, and even 4G. However, 5G is a different ballgame. "The infrastructure which is required for 5G is different. It has more additions to it, and hence skilling needs to happen so that the workforce understands what each of these additions has to offer," remarks T.R. Dua, Director General, DIPA.

Talent—the newest competitive edge

India's biggest demographic dividend and asset is the people. Every year, thousands in the workforce migrate to foreign countries in search of employment and better opportunities. Arvind Bali, CEO of TSSC, says, "The responsibility on our shoulders is tremendous as this provides the opportunity to be global skilling leaders."

This is no easy feat, though. The skilling mantra needs to work on a certain paradigm. The centres need to be omnichannel. People need to have the assurance that they will be continuously learning through digital channels and workplaces.

Skilling needs to be aspirational. Given the kind of enthusiasm and drive in the youth today, this is hardly a challenge. The real challenge lies in honing that drive and channelising it in the right direction.

As far as building international cadence goes, Bali provides an interesting insight: "It is no surprise that countries in the Middle East have numerous takers for Indian talent. But what about skilled talent? If we can send these people with a certain level of training, and make them more desirable in terms of skillset, the opportunities for these people increase manifold, and so does our quality of Indian talent across the globe."

But there is a need to recognise skilled manpower on the home turf too. "We need a full spectrum of trained manpower in 5G. Right from the design to implementation and commissioning and finally to operation and maintenance. And then repair and maintenance services," says Dr Kalsi.

It is no surprise that most upskilling and reskilling today happens at the workplace. But as the demand for the technology grows, a stronger foundation needs to be set.

Adding courses on 5G development in the syllabus of engineering college students can help, but a more effective way could be to also provide them with an easy way to opt out by making these courses optional, so that only the ones interested are enrolled. A smaller group also provides space to improve the quality of the course through apprenticeship programmes and partnerships with the industry and fluid practical assignments.

Providing this early on can help make the youth job-ready by the time they come out of the college. Subsequently, creating modules of 60-190 minutes that form the base of the technology can be distributed across the school level to start the process sooner. These modules can also help reskill entry-level employees who have little to no idea about what 5G entails.

Training the trainers

A major roadblock in successfully upskilling the workforce is finding people who are adept enough to impart the necessary skill. Rehman Khan Suri, Professor at DSEU, notes, "The main challenge today is providing training to the faculty which can train the skill in the particular skill-set. With the pace at which technology is changing, academia cannot really match that pace without skilled academicians."

Good faculty development programmes, as such, are not an option anymore. They are necessary to make way for a larger skilled man-

power base. New innovations only come when there is a fresh flow of ideas and a stronger collaboration between the trainers and students is the path for it.

One possible solution to this could be to make it mandatory for master's degree holders and PhD holders to spend at least a year in an educator's role, training not just the students but also helping upskill the rest of the trainers in academic institutions.

The debate around the quality of academia needs to be hotter. This is the only way to help provide quality educators who can help bring about the next technological disruptions through their training.

Industry, government, and academia

The facets of 5G are such that there is every possibility to create a pathbreaking framework where workplaces, educational institutions, and skilling centres can talk to each other. This conversation means that everybody involved needs to pool in their effort. It requires a holistic approach.

For the talent to take lead in not just India but the rest of the world, there needs to be a true public partnership. "A public partnership comes from the perspective of recognition and standardisation," says Ved Mani Tiwari, COO, NSDC.

A common complaint from the industry is that there is a lack of skilled talent, while the workforce complains about the refusal of the industry to make an effort to provide that skilling on the job. A better connection with the industry is the crucial step to putting an end to this chicken and egg situation. As a first step, skilling institutes need to make certifications of such a level that the industry loves to take those certified people.

The whole point of training the trainers also needs to ride on the back of the industry. The industry-academia integration needs to take a stronger and more supportive approach. Providing the institutes with the necessary equipment, which otherwise takes ages to reach them as they pass through multiple levels of authorisations and tenders, can be a helpful step.

As for academia, it needs to have a more open approach toward upskilling the existing workforce in the industry. A big part of why upskilling seems tedious to the workforce is the number of efforts they waste in learning from scratch, something that they might not necessarily require.

Modules and courses have to be framed in a less conservative and more flexible way. For instance, counting a certain number of years of work experience as credits. With these credits, they may skip the initial foundational education and move on to the meat of the curriculum in the second or third year of college. Offering apprenticeship modes (ranging from a few weeks to a few months) can be another way to smoothly upskill/reskill the workforce.

This is how true integration and balance between academia and industry can take place.

A multi-faceted approach

IoT, drones, Industry 4.0—all these new technologies need assistance from the telecom sector to reach their true potential. Although the opportunities are riled up, the challenges to fairly skill/upskill/reskill the workforce need to be overcome to truly achieve the target.

A proper partnership by various stakeholders in the economy is the need of the hour. Skilling needs to be not just multidisciplinary but also multi-ministerial. After all, becoming a global power in the technology manufacturing space is a team effort. It is high time we treat it like one. EFY

This article, based on panel discussions hosted by Telecom Sector Skill Council during the Annual Telecom Report Release, has been transcribed and curated by EFY Business Journalist Siddha Dhar.

Speakers

Arvind Bali, CEO, TSSC

Dr N.S. Kalsi, Chairman, NCVET

Ramesh Kasetty, CEO and Co-founder, Duranc

Rehman Khan Suri, Professor, DSEU

T.R. Dua, Director General, DIPA

Ved Mani Tiwari, COO, NSDC

Opportunities And Challenges For DRONES IN THE MINING SECTOR

The Centre has introduced 'The Drone Rules, 2021' to regulate the use and operation of drones in India. It is safe to say that drones are heralded to bring about major changes in modernising various sectors in the country. A glimpse of it can already be seen with how fast it has transformed agriculture in the country, which has inadvertently resulted in various new agri-tech companies coming up. The mining sector is envisioned to increase the GDP contribution in India from 1.75% to 2.5% in the financial year 2022-23. However, one of the setbacks that the industry faces is its trepidation to adopt newer, faster technologies. Mining companies have realised how drones, as miniaturised flying machines, help the industry not only save time and money but also provide access to the inaccessible, besides having a lasting impact on safety and health regulations in the mining sector

ASSOCHAM and **SIDDHA DHAR**

While the use of drones in mining was at a validation stage till a few years ago, it has now crossed that stage and reached a point where we see an early adoption of drone technology throughout the lifecycle of a mine, starting from the exploration phase to the operations, right till the closure phase. "The tangible value that drones as a technology bring into mining has crossed the early adoption phase. We have reached the stage where we are now seeing a larger, quicker adoption of drones happening in mining," notes Mrinal Pai, COO and Co-founder, Skylark Drones.

The notable amendment made to the drone policy in 2021 stands as a testament to how the industries across the board have started to recognise the importance of drones as a technology. "I think that's a recognition to what drones technology has been doing across multiple industries and we believe that mining in specific has

a lot of value that can be uncovered using this technology," Pai adds.

Immense opportunities

Drone technology is disrupting the way mining operations, data collection, and insight generation in mining are transformed. "I believe any technology that simplifies the operation of a mine, and makes the life of a geologist mining engineer safe, is here to stay to prosper, and drones are one such technology," says Ajit Sahu, Chief of Exploration and Technology, Vedanta Ltd.

That being said, there is a long way the technology needs to travel, especially in terms of its impact on greenfield exploration. "While the easier ones have been discovered, the less easy ones are yet to be made. I would like to see some breakthrough happening in greenfield exploration use of drones, where the inaccessible become accessible for a geologist and the difficult terrains are traversed," adds Sahu.

It is, therefore, crucial to understand where the mining process lacks behind and what the drone industry can particularly help them tackle.

Common issues faced in mines

Here are some areas where the drones can help:

Blasting. Measuring bench geometry before and after the blasting process is an essential part of any mining exercise. The traditional method of using total stations is slow, cumbersome and puts personnel in mortal danger. (A total station is used to record the absolute location of the tunnel walls, ceilings (backs), and floors as the drifts of an underground mine are driven.) There is no way to verify if drill holes for explosives are positioned as planned. Drones can help by reducing cost and time overruns due to improper management of men, material, and safety surveillance.

Drones aiding in magnetic surveys

The process of mineral discovery and block development in mining is a long and winding process. Surveying is the first phase of the discovery process. This includes geological mapping, physical mapping, and geochemical mapping. All these datasets narrow down the area from there, so that a 10,000-15,000sq km of metallic deposit site can be condensed to 100sq km. As this process continues, the deposit area is further narrowed down to a 1x1sq km of mineral deposit.

This, as per Dr D.S. Jeere, Director of Geology at GSI, is where drones can come in handy. He says, "I find that there is a very big role for drones to play here because what we need in this 1sq km is a 1x4000 scale data graphic mapping."

A high-resolution magnetic survey is another area where drones, especially with their small sensors, can play a major role in the mine development process. But the quality of sensors plays a major role in how the end data comes out.

Sahu says, "We did a drone-aided magnetic survey recently and found that it is good in terms of well-located data. It could be done in a small time period; whatever objectives were set were met. But I also know that the quality of data was not great. It could be because of the sensor. In terms of the survey, one of the problems that we had in our mind was that we may struggle to find well-located data. But that was not the case—it turned out to be good."

Output. Miners have historically made rough assumptions as to the volume of outputs generated, which leads to underreported numbers. Any mistake at the bottom of the funnel leads to resource mismanagement at a macro operational level. A drone can measure critical volumes 2-3 times faster from source to stockpile in near real-time. It can monitor volumes of pits, overburden, dumps, stockpiles, and other critical volumes across the mine 2-3 times faster.

Transport. The design of haul roads and systems using satellite imagery is inefficient as the data is outdated and inaccurate to the extent of several metres. Improperly designed transport routes lead to loss in output production and operating revenues. Drones being highly-accurate, can reduce automated post-processing errors to the minimum. Stockpile volumes can be estimated with an accuracy of 99%.

The challenge of integrating software and hardware

The introduction of drones in mining industry has yielded path-breaking results even in the short amount of time that they have been around. However, as is the case with any nascent technology, there are certain voids that drones are yet to fill. "To my mind, it's not the drones which is the most important thing but how we use the software," remarks Piyush Srivastava, Chief of Natural Resources at Tata Steel.

Drones so far have only aided in the collection and capture of data. Even though drones are capable of carrying both the laser cameras as well as multispectral cameras, operators are yet to learn the integration of software with the data set that they receive from drones to turn them into usable data.

One of the biggest challenges that photogrammetry cloud data collection poses is the trouble of dealing with its sheer size. As per Srivastava, the size of the data for scanning up to five square kilometres of land can reach up to 60GB. Software that the industry currently uses widely is yet to catch up with the demands of such heavy data. "Now to process the data for when there are images from multiple file paths and then you do cognition and then aero-triangulation, the speed is a limiting factor. Sometimes it takes a few days to process the data," notes Srivastava.

One of the possible solutions to deal with this could be the adoption of a hub-and-spoke model, where

everything is centralised within one hub and multiple tall stations can work in tandem in order to be able to process the data.

Transferring this data is another cumbersome task. Most drones come with a chip that is not allowed by secured systems, which makes the data transfer a big hassle. And let's not get started on the condition of 4G connectivity prevalent in the country.

Srivastava suggests opting for a cloud space where they can install and use software like ArcGIS. This helps in centralisation of the data without the need to transfer it from one system to another. Output can be monitored, and the 3D mine models can be viewed in real time. But then again, licensing for such software creates a hurdle, as everyone involved in approving a mine survey is always required to be in possession of it.

Srivastava points out, "There are few people who need to create, but there are many people who need to monitor; the GM of the area might like to see the mine. How does it look? He may like to see the land-use plans, but he may not have the software."

This is where the open source community can come to the rescue, as they create a middleware where the viewership can be done irrespective of whether one has that software or not.

Similarly, integration between the mining software and the point cloud data is also required. This would allow the point cloud data to be used on a software and allow the geologist to update their model from the real-time data, thus enabling a faster upgradation of models.

The other way is to make the model using a UTM bridge network where one can directly import the data into a common framework that is used by everyone. This makes monitoring easier for the regulatory bodies and even for the mining bodies. It also becomes easier to integrate the mining software into the mine planning software, mine training software, and drones photogrammetry software.

Pai adds that emerging technologies like artificial intelligence and machine learning can also help accelerate how well-versed the hardware gets at solving major issues. He says, "While I don't think it completely eliminates the manual processes, because a surveyor on-site knows his mine better than anyone else, since drones capture visual 3-dimensional data, I think there is a tremendous scope of machine learning to automate a bunch of things."

It all starts with skill development

While drone deployment in the mining industry has its share of hardware- and software-related challenges, a major obstacle that precedes them all is the lack of skillset related to drone technology amongst regulators and operators. It is especially prominent among surveyors, according to Srivastava.

Though it requires no qualification and limited knowledge of GIS software, drone operation is a skill that the industry is desperately looking for. Naturally, like it is with any nascent technology, it is much easier to get hold of young surveyors, but they still lack the eye that a veteran surveyor who has been in the field for a much longer period has. Training these surveyors is a win-win for the industry.

In the case of regulators, geo-referencing becomes critically important. Learning the necessary software to analyse the drone data is necessary; an error in approval of land-use plans can have serious results.

Srivastava proposes the use of an open source SaaS model. These technologies cannot be used through local servers and laptops, and everything has to reside in the cloud. On the cloud, the licenses that are required will be different than the desktop licenses, and integration of mining software and the photogrammetry software requires more work to be done.

What the future looks like

Recent developments in the drone industry in India have brought about a huge opportunity for simplifying the mining process. The vision is in place, though the execution is still slow.

Sahu says, "I would like to see drones being used on a daily basis from surveillance to utilisation and monitoring of logistics, where there is enough room. The technology needs to be developed and taken to a level where continuous work is done and another tech can come in to make it robust."

He adds, "I would like to see where discoveries are being made using drones, because i strongly believe that is one area where it can play a vital role, and new mineral discoveries can be made using drones sensibly and wisely." Exploration through drones has definitely picked up the pace, but it is yet to reach the stage where the benefits can outweigh the benefits of other traditional exploration means.

Drone solutions providers need to address the issues quickly. While the golden period of drones use has just begun in the country, this is the perfect time for their use in a sector that is expected to grow at an unprecedented pace. With good research and collaboration, the scope of drone solution providers being able to provide scalable solutions that the mining sector desperately needs increases manifold, thus increasing the possibility of progress in the future. EFY

This article, transcribed and curated by EFY's Siddha Dhar, is based on the panel discussion on 'Drones In Mining' that was hosted recently by ASSOCHAM.

STARTUPS & INNOVATORS

1 Safe Drinking Water For Urban India

2 Security That Helps Organisations Adapt To IoT With Confidence

3 Tenstorrent's Unique Approach To AI Hardware And Software

1 SAFE DRINKING WATER FOR URBAN INDIA

DrinkPrime's water purifiers are trying to solve the problem of providing safe drinking water at reasonable price, without investing in the water purifiers. For this they take help of technology to keep track of water quality and provide the purifiers on a subscription model

Manas and Vijay with DrinkPrime's version 3 of water purifier

In spite of thirty years of the water purification industry, and new technologies being launched, the branded bottled water is believed to be much safer for drinking purposes. Besides, the migrant population finds it a better choice than investing in a water purifier. DrinkPrime addresses the issue of providing safe drinking water without the heavy investment on a good water purifier.

Started by computer science and MBA graduates Manas Ranjan Hota and Vijender Reddy Muthyala, respectively, in 2016, DrinkPrime looks at the root cause of the problem—the source of the water. Ignored for years, the water quality varies from one area to another, based on its source and seasonal changes.

A TDS (total dissolved solids) between 50 and 150ppm is considered good for a drinking water, but it does not give any idea about the amount of minerals present in the water. Hence, it cannot be considered a reliable measure of the water's quality.

DrinkPrime's unique feature is an IoT-enabled customised water purifier that is connected via Bluetooth for a continuous stream of data for a regular tracking of water quality. Its smart sensors can also monitor the amount of water consumed. The details are available on an app.

The various subscription plans available include hardware, installation, service, and capital costs. Technicians check and service the water purifier every four months to ensure it is in top condition to provide the best possible water quality. This helps in keeping track of the purifier's health so that the water consumed remains safe. Consumers are not charged for this service.

There are at present more than 100,000 consumers across Bengaluru, Hyderabad, and Delhi-NCR, with tenants being their major customers. Manas says, "The landlords are being advised to keep the purifier so that the next tenant takes it, making it a win-win situation for both."

DrinkPrime is currently looking for both financial and technical partners, as well as service technicians and customer acquisition executives. Currently, their financiers are Omidyar Network India, Sequoia Surge (₹210 million), Alteria Capital (₹60 million), UC Inclusive Credit (₹50 million), and Western Capital (₹30 million). Their current valuation is ₹2.02 billion.

The three challenges that they currently face concern testing, supply-chain, and innovation. From

the water samples collected from each area, over twenty parameters are checked, including TDS, turbidity, chloride levels, pH levels, minerals, and metals present.

But not everything can be tested online, as some samples need to be kept in a solvent, adding a catalyst to obtain results. "We would be happy to collaborate in a cost-effective way for our supply-chain management. Innovation to increase the life of the water purifier is also something we are dealing with," says Vijender Reddy.

The main vision currently before the founders is to ensure that the vast majority of India's population drinks the right water, starting with the rural areas. As time progresses, they would like to provide water at less than one rupee per litre, or set up community kiosks where people could fill water in rural India.

—Sharon Abhignya Katta

2 SECURITY THAT HELPS ORGANISATIONS ADAPT TO IoT WITH CONFIDENCE

Security systems are extremely advanced in some areas of application, as much as there are vulnerabilities in others. Redinent Innovations, a Bengaluru based startup, aims to change this and establish security tools for CCTV cameras and unmanaged IoT devices, which are often exposed to cyber-attacks

As the number of IoT devices deployed by businesses grows every day, so do the cyber threats to them. As a result, businesses risk losing their privacy, security, and brand value in the market if they fall victim to IoT based cyber-attacks. Hence, Redinent's technology is a much-needed advancement.

The founders of Redinent Innovations, L to R: Cdr K. Arun (Co-Founder, COO), Arko Dhar (Co-Founder, CTO), and Divyanshu Verma (Co-Founder, CEO)

"Redinent Innovations helps organisations protect their CCTV and other IoT devices against cyber-attacks," says Divaynshu Verma, Co-Founder and CEO of Redinent Innovations. "We offer a platform that helps organisations mitigate the risk of cyber-attacks on their IoT infrastructure, especially CCTV cameras."

According to studies, the number of connected IoT devices has already outnumbered the world's population. Unfortunately, the threat to IoT devices is increasing exponentially, since not much security is built into IoT devices. This is a field that is quite challenging since it requires extensive knowledge of protocols, embedded architecture, threat modeling, and near-real-time decision-making.

This is where Redinent's Threat Scanner comes into the picture. Redinent's threat scanning platform is a deep tech innovation that opens a whole new business strategy and opportunity around IoT device security. The technology is heavily influenced by the practices of the defense and security industry and uses some of the best TTPs of cyber defense. "This technology stack inside Redinent acts as a protective backbone to secure the IoT deployments inside enterprise," says Arko Dhar, Co-Founder and CTO of Redinent Innovations.

"Redinent is easy to deploy and is truly cloud scalable, which means that organisations which have multi-location operations can use Redinent Scanner centrally to secure their CCTV and IoT endpoints," says Cdr K. Arun, Co-Founder and COO of Redinent Innovations. "It covers the maximum number of threat scenarios and the widest range of CCTV/IoT brands, apart from evaluating all the brand-agnostic features at the protocol level itself," explains Verma.

The company uses patented threat detection algorithms to discover threats at multiple levels inside endpoint devices and also helps to remediate these threats. With such a solution, organisations will be able to evaluate the vulnerabilities in their IoT/CCTV devices and close them before a cyber-attack can take place.

The solution is already commercially ready. "We are fortunate enough to get very early access to some of the largest brands as our customers and partners. Within a span of five months, we had airports, power plants, SEZs, hospitality and resorts, rail networks, and banks as our clients," says Verma.

Redinent's first customer breakthrough came within two weeks of launch, and they had their first five customers within just 120 days of

launch! The company has also raised capital funding from angel investors and is in talks with investors to raise further funds.

Today, Redinent is looking to increase its product footprint at critical infrastructure institutions across the globe and increase its revenue base significantly. Consequently, the company is hiring top talent resources with expertise in security and IoT-related product development, UX professionals, and automation engineers.

For a company that was founded a little over a year ago—right in the middle of a pandemic—Redinent has come a long, long way. Surely, it is safe to say that Redinent Innovations is building a strong foundation for IoT security in India and abroad.

—Aaryaa Padhyegurjar

3 TENSTORRENT'S UNIQUE APPROACH TO AI HARDWARE AND SOFTWARE

Over the past few years, a lot has been happening in AI—both hardware and software. We have seen new algorithms, new processing techniques, and new AI chips. Tenstorrent Inc., an AI startup headquartered in Canada, aims to build a specialised software and hardware stack that can perform billions of operations per second

Jim Keller, CTO and President, Tenstorrent

AI programs are very different from traditional ones. Because the demand for AI is growing at a meteoric rate, the way AI is processed needs to be changed too. That's what Tenstorrent Inc. aims to do—it is addressing the rapidly growing compute demands for software 2.0. The company wants to bring forth something unique by combining an AI processor and a GPU together in a way no other AI startup is doing.

"Today, the AI revolution is big and we're going to bring something interesting with the combination of GPUs and AI processors," says Jim Keller, CTO and President of Tenstorrent. There's a GPU and an AI program, and they figured out how to write software to connect the two.

They are not emulating an AI program, but instead running the AI program very close to how it's written. And that gives them efficiency and a better pass to write new AI programs and compile them into the hardware.

GraySkull, one of Tenstorrent's primary products, has a PCI Express interface and plugs into a server, like an AMD or an Intel server. What's interesting is the mode of delivery that Tenstorrent offers—customers can customise their purchases.

For example, some customers who already have servers can buy boards from Tenstorrent but use their own GPUs. AI startups working from home can use their cloud services. "We don't want to tell people how to buy it. We want them to tell us what they want," says Keller.

From a business point of view, Tenstorrent wants to focus on AI startups and small researchers. "We wanted to find a hundred small customers and not ten big ones," says Keller. "We've talked to various people—medical imaging people, biotech people—and some of them have very interesting models that are different."

Keller, who has worked at big players like Intel and Tesla, talks about his colleague Ljubisa Bajic (Founder and CEO at Tenstorrent Inc). "Ljubisa Bajic started the company and I had worked with him before at AMD. He was one of the few people I met who had knowledge of four different domains. He understood what the AI algorithms were doing and could translate that to software. And I gave him what's called the angel investment,"

AI is moving really fast right now. Our phones have a CPU, GPU, camera processor, and an AI processor too. And with each generation, it's getting bigger and also more expensive. "You can end up spending $1000 over a weekend running some models," says Keller. But thanks to Tenstorrent, AI processing can soon become more accessible to everyone. Tenstorrent's price plan is to be about five to ten times cheaper than the current market rate.

Also, the company has huge plans for expansion. In April 2022, Tenstorrent opened a new office in Bengaluru. Apart from that, the company has operations in Toronto (headquarters), Austin, Santa Clara, and Belgrade.

Tenstorrent has come a long way since it was founded—from proof-of-concept on an FPGA to a full-fledged AI hardware-software stack that's extremely unique. We can surely expect great things from Tenstorrent in the near future. EFY

—Aaryaa Padhyegurjar

MeitY forms an advisory board to help meet manufacturing targets

With the aim of making India a $300 billion electronics manufacturing hub by 2026, The Ministry of Electronics and Information Technology (MeitY) has formed an advisory board called the Digital India Electronics Mission $300 Billion. To achieve this target, mobile manufacturing has to increase from $30 billion in 2021 to $126 billion by 2026, while IT hardware manufacturing has to go up from $3 billion presently to $25 billion, and so on.

Representational image

MAIT holds discussion with industry to leverage PLI-driven growth

MAIT recently held a discussion that delved into steps required to enable MSMEs to leverage the PLI-driven growth and become the bedrock of the local electronic manufacturing ecosystem of India. The meeting was attended by industry leaders from major global and Indian IT hardware companies including Acer, Dell, Cisco, Flex, HPE, Apple, HPI, Lenovo, Oppo, Prose Technology Private limited (a Rosenberger company), Samsung, and Indian industry players from Netweb, Sahasra (InfoPower), Tube Investments, and Velankanni, among others.

PEOPLE (on the move)

Vikas Puri as Business Head for India operations for Cosmo Ferrites

A seasoned business leader with over 29 years of experience, Vikas Puri will now be responsible for devising strategic solutions to everyday operations and will be expected to strengthen Cosmo Ferrites' presence in the fast-growing ferrites market space. He has served in a number of leadership roles, including Business Head (India) of Varroc Lighting Systems.

Neeraj Bhardwaj and Prasad MN to head ASM India sales and service

ASM Assembly Systems India has appointed Neeraj Bhardwaj (left) and Prasad MN (right), two long-term ASM team members, as Head of Equipment Sales (South Asia) and Head of Equipment Service (South Asia) to further drive the business in South Asian countries.

RattanIndia Enterprises appoints Sarath Chandra as CEO

An alumnus of XLRI, Jamshedpur, Sarath Chandra Gudlavalleti has over 20 years of experience in technology and retail sector with expertise in setting and scaling up businesses. Prior to joining RattanIndia Enterprises, Gudlavalleti worked in organisations like Quikr, Microsoft, Nokia, and Coca-Cola in various leadership roles.

Alvin Tse appointed as head of India business

A British national with a key role in the company's expansion, Xiaomi Global's Alvin Tse has been appointed as the head of its Indian business. He succeeds Manu Jain, who had moved on last year to a global role.

CORPORATE news

Redcliffe and Skye Air tie-up to introduce drones in healthcare

Redcliffe Labs has come up with its first commercial drone flight in the country's healthcare sector. The drone delivered 5kg payload in temperature-controlled boxes from Gyansu, Uttarkashi to Vivek Vihar, Dehradun, which is at 60km aerial distance. The project was a part of Redcliffe and Skye Air tie-up; in the past three months they have done 40 successful trials in North India.

Ananth Technologies starts spacecraft manufacturing unit in Bengaluru

The 15,000sq-m spacecraft manufacturing unit of Ananth Technologies at Karnataka Industrial Areas Development Board Aerospace Park in Bengaluru was recently inaugurated by ISRO Chairman S. Somanath. The unit can conduct assembly, integration, and testing of four large spacecraft simultaneously. Ananth Technologies has contributed towards the manufacture of 89 satellites and 69 launch vehicles built/launched by ISRO.

Tata Motors bags the biggest-ever EV fleet order in India

An order for supply of 10,000 XPRES-T EV units from BluSmart Electric Mobility has been bagged by Tata Motors. The deployment of 10,000 units makes this the biggest ever EV fleet order in India.

Representational image

With deliveries starting soon, these vehicles will be used across the country for commuters, in turn helping minimise the carbon footprint. The company is delighted to continue its association with BluSmart Electric Mobility.

Mitsubishi Electric to produce inverters and factory automation in Pune

Mitsubishi Electric Corporation will be investing ₹2.2 billion to establish a new factory in India, which will manufacture inverters and other factory automation (FA) control systems. The new two-floor, 15,400sq-m factory will be built on 40,000sq-m land near Pune in Maharashtra. It will help expand Mitsubishi Electric's production capabilities to meet local demand, thus contributing to the Make in India initiative promoted by the Indian government.

TVS Motors to raise money for EV business expansion

Automaker TVS Motor Co. Ltd is riding high on its plans to grow its EV business as it engages in advanced talks to raise ₹40-50 billion from private equity firms. It could use the proceeds of the proposed fundraising to create new electric vehicle and battery manufacturing facilities. It is doubling down on electric vehicles as India sharpens its focus on reducing vehicular pollution in cities and cutting dependence on fossil fuels amid surging fuel prices.

Bajaj Auto subsidiary and vendors investing further in EV manufacturing facility

Bajaj Auto's wholly-owned subsidiary Chetak Technology Ltd and its vendor partners will be investing nearly ₹7.5 billion in the electric vehicle (EV) manufacturing plant that is spread across 6.5 acres of land. The plant's 500,000 annual capacity aims to cater to both domestic and export markets and is said to have sold over 14,000 Chetak e-scooters since its launch, and has received more than 16,000 bookings.

eInfochips to open a new design centre in Indore

Recently awarded the Design Services Company of the Year by IESA, eInfochips plans to hire approximately one hundred engineers in the next six months as it opens a new design centre in Indore. The hiring will be focused on embedded systems, hardware design, silicon design, and digital technologies—such as artificial intelligence, cybersecurity, cloud, and blockchain.

SNIPPETS

- $20 billion plus revenue ambition by STMicroelectronics was spoken about in their webcast focussing on sustainable and profitable growth.
- Ola Electric is keeping an eye out for 1000 acres of land to set up its cell and electric car factories. The factories are expected to attract an investment of ₹100 billion; some states have already jumped on the opportunity.
- With eyes set on expansion, EV battery recycling company Attero Recycling is planning to invest $1 billion over five years to build lithium-ion battery recycling plants in Europe, the US, and Indonesia.
- Japanese electric motors company Nidec is looking to spend $78 million in building a new building at its existing plant for motors for home appliances and automobiles. It plans to produce more than one million units per year by 2025.
- Lava International is gearing up to intensify competition in the sub-₹10,000 smartphone segment with focus on new designs and service.
- Auto and railway components maker Jupiter Wagons Ltd is entering the electric mobility market with the launch of Jupiter Electric Mobility (JEM) focusing on commercial EV vehicles.
- The construction of the new $60 million, 14,000sq-m global headquarters in South Burlington, Vermont, by OnLogic has begun. The new facility will be able to fully accommodate their planned growth in Vermont for the next 7-10 years.
- In a bid to cater to the growing demand for electric vehicles in the last-mile delivery segment, Omega Seiki Mobility has formed a strategic partnership with Grip Invest for lease financing to retail investors.
- Digi-Key Electronics has enhanced its myLists tool to now include price quotes to improve ordering efficiency.
- OpenLight has introduced the world's first open silicon photonics platform with integrated lasers. Chip design firms can use it to integrate the technology into their chips.
- The India traditional PC market—which includes desktops, notebooks, and workstations—shipped over 4.3 million units with a YoY growth of 37.7%. While online channels had a share of 13.4% and witnessed YoY growth of 17.5%, offline channels witnessed the bigger spike as they grew by 41.4% YoY.
- Reports project that solar tariffs will climb even further following the recent imposition of a basic customs duty of 40% and 25% on imported solar modules and cells respectively, and the implementation of the Approved List of Models and Manufacturers—a non-tariff barrier covering complying solar modules that excludes modules made outside India.
- The Broadcom Software Group will rebrand and operate as VMware, incorporating Broadcom's existing infrastructure and security software solutions as part of an expanded VMware portfolio.

Adani Defence & Aerospace acquires strategic stake in General Aeronautics

Working closely with farmers and agricultural chemical companies that offer tech-enabled crop protection services and health monitoring, a 50% equity stake has been taken by Adani Defence

Representational image

& Aerospace in General Aeronautics. This helps in providing a platform for startups and MSMEs for rapid growth and scalability of innovative technologies.

ABB acquires controlling stake in Numocity

Increasing its shareholding to a controlling majority of 72%, ABB has acquired a major stake in Numocity. India, South East Asia, and the Middle East are target regions for Numocity, which offers a cloud based digital platform allowing consumers and fleet operators to use a network of fixed chargers or, in simple words, 'pay as you go' basis.

Pact between Ather Energy and Magenta to install EV charging grids

Ather Energy and Magenta have entered into a pact, which gives Ather access to Magenta ChargeGrid's multiple locations across India. It aims to collectively accelerate the pace of expansion of public charging networks and the adoption of EVs in India. Magenta ChargeGrid is currently expanding its charging network to 35-40 cities in India and aiming to set up 11,000 chargers by the end of FY23.

GMES signs MoU to skill CCTV security system technicians

At the launch of CCTV Technician Training and Certification programme 'Surveillance Unmasked,' by GeniusMinds Educational Services (GMES), a memorandum of understanding (MoU) was signed with Electronics Sector Skills Council of India (ESSCI). This multi-city programme is a day event under the terms of the MoU. GMES will provide an 8-hour certificate refresher course for CCTV installers (field technicians), trainers, and industry subject matter experts.

Hero Electric and Zypp Electric expand partnership

To support the growth of the logistics and delivery segment, Hero Electric has expanded its partnership with Zypp Electric. Under the partnership, Hero Electric will be deploying 150,000 electric scooters for Zypp Electric's fleet in the next three years. With a fleet size of 5000 electric scooters, Zypp is currently present in Delhi-NCR and plans to expand to Mumbai, Bengaluru, Hyderabad, and Pune this year.

Tata Motors subsidiary to acquire Ford India's Gujarat plant

A Memorandum of Understanding (MoU) has been signed with the Gujarat government for the potential acquisition of Ford India's Sanand plant by Tata Passenger Electric Mobility Limited (TPEML), a subsidiary of Tata Motors for EVs. TPEML would invest in new machinery and equipment at the plant to make the unit ready to produce its vehicles. The agreement includes a transfer of Ford India's land and buildings, vehicle manufacturing plant, machinery, and transfer of all eligible employees.

ElectricPe partners with Electric One to expand EV charging ecosystem

EV charging platform ElectricPe has partnered with EV store chain Electric One to provide charging infrastructure and encourage EV adoption. Through this alliance, Electric One customers across 82 stores in India will get access to ElectricPe's EV platform. It will also strengthen ElectricPe's network, which has already onboarded 2500 public charging points in Bengaluru, the largest network in the city.

Inventus India now known as Athera Venture Partners

Inventus India, an early stage venture capital firm, has rebranded itself as Athera Venture Partners. It also announced the launch of its fourth fund with a target corpus of ₹9 billion ($120 million). Athera is a Sanskrit word meaning 'path' and direction. This new identity reveals the Indian-ness while having a focus towards investing in the Indian start-up ecosystem.

Mobile calibration van launched by WIKA for door-step service

Launched by WIKA Instruments, the mobile calibration van has been transformed into a value-added service by providing services at the customer doorstep while delivering convenience. Appointments can be booked easily through various channels like toll-free number, email IDs, and WebApp. Apart from being available for calibration, the mobile laboratory gives a report which shows the measurement error.

Vedanta gets board approval to raise funds for chip and display units

Vedanta has a total planned investment outlay of $20 billion for two separate units for chip and display manufacturing. It has received approval to raise up to ₹40.89 billion from its board of directors. The funding will be via debentures on a private placement basis. Vedanta is seeking incentives from the Central government and is also in talks with several Indian state governments on the units' location.

SJVN to invest over ₹10 billion to set up solar projects in UP

Satluj Jal Vidyut Nigam (SJVN) is looking to set up three renewable energy projects in Uttar Pradesh. Two solar projects with a capacity of 75MW each will be set up at villages Parasan and Gurha in district Jalauna and one of 50MW will be set up at village Gujarai in Kanpur Dehat. A total of ₹10.57 billion is being invested in these projects in Uttar Pradesh.

Waaree Energies receives NCLT approval to buy Indosolar

Waaree Energies has received NCLT approval to buy Indosolar Ltd, which will facilitate augmentation of the solar cell manufacturing capacity of Waaree Energies to 5.4GW from the currently planned 4GW. It is expected to start manufacturing operations within six months from acquisition of the Indosolar plant, after assessing the infrastructure and ensuring that relevant equipment complementing the expansion plans are in place.

Spacetech firm Bellatrix secures $8 million in Series A funding round

Bellatrix Aerospace has raised $8 million in a Series A funding round led by BASF Venture Capital GmbH and Inflexor Ventures. The funds will be used for expanding Bellatrix's product portfolio, hiring talent, and developing its infrastructure. The startup competes with the likes of SatSure, Skyroot Aerospace, Agnikul Cosmos, and Dhruva Space. The government has been focusing on boosting spacetech startups in the country. It is also looking at allowing FDI in the spacetech sector.

INTERNATIONAL news

IFA 2022 in large-scale and real-life

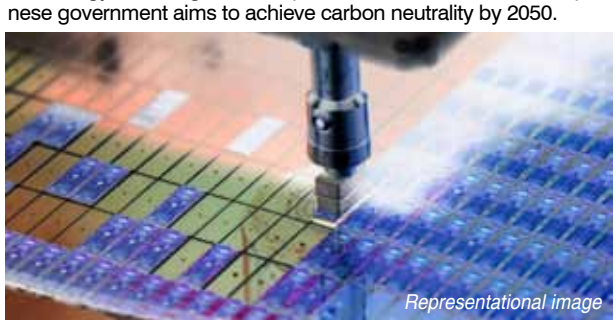
IFA Berlin—the world's most important trade show for consumer electronics and household appliances—is making a large-scale and real-life return this year, from 2-6 September 2022. Two-thirds of IFA's top exhibitors have already confirmed their attendance, with a huge number of exhibitors planning to return at the same scale as in 2019, the last IFA year before the pandemic.

Victor sets up a new power modules facility in the US

Opened at 400 Federal Street, Andover, this mobile manufacturing facility enables scalable, automated, cost-effective manufacturing of power modules in the United States. Celebrating 41 years of its global power electronics industry, Vicor's new facility utilises patented fabrication processes to differentiate Vicor power modules.

20cm SiC wafers being developed by Showa Denko

The New Energy and Industrial Technology Development Organisation (NEDO) has selected Showa Denko's 'Project to Develop SiC Wafers Technology for Next-generation Green Power Semiconductors,' as a candidate for projects to develop 20cm (8-inch) wafers technology for next-generation power semiconductors. The Japanese government aims to achieve carbon neutrality by 2050.



Representational image

Ligado Networks partners with Sony Semiconductor Israel

Partnering with Sony Semiconductor Israel, Ligado Networks has developed advanced connectivity services across North America, enabling provision of chipsets for standalone satellite and terrestrial connections. The two companies have indicated that the initial technology trials would be taking place by the end of the year.

Partnership between Nexperia and KYOCERA for GaN power modules

Gallium nitride (GaN) devices are manufactured at Nexperia using mature mass production techniques, which have proven to meet the highest reliability requirements for devices to achieve AEC-Q101 certification. KYOCERA AVX Components (Salzburg) GmbH, on other hand, supplies advanced electronic components for the automotive industry. The partnership between both the companies is to focus on power components with the aim of jointly developing GaN applications for electric vehicles.

STMicroelectronics and MACOM successfully produce RF GaN-on-Si prototypes

STMicroelectronics and MACOM Technology Solutions Holdings Inc. have announced successful production of radio-frequency Gallium-Nitride-on Silicon (RF GaN-on-Si) prototypes. RF GaN-on-Si offers high potential for 5G and 6G infrastructure. GaN can offer superior RF characteristics and significantly higher output power than LDMOS for these RF PAs. Further, it can be manufactured on either silicon or silicon-carbide (SiC) wafers. The GaN-on-Si technology is expected to offer competitive performance paired with large economies of scale, enabled by its integration into standard semiconductor process flows.

Intel investing in mega R&D lab for innovative data centre tech

Intel has unveiled plans to invest more than $700 million in a 20,000sq-m, R&D mega lab focused on innovative data centre technologies. It also introduced the technology industry's first open intellectual property (open IP) immersion liquid cooling solution and reference design. Construction on the lab will begin this year at the Jones Farm campus in Hillsboro, Oregon, with opening expected in late 2023.

High-voltage fuses with onboard charging protection for EVs from Eaton

Eaton has introduced their EVK series of high-voltage fuses for high-powered electric vehicles. One unique feature is the onboard charging protection. The EV fuses from Eaton meet the requirement of current ratings up to 1000V DC and 600A. They are also able to dissipate the heat appropriately from such areas that are prone to overheating and related damages.

dRISK to build the ultimate test for self-driving cars

dRISK's statistical robustness and auditability has allowed it to win the largest grant from the UK's Centre for Connected and Autonomous Vehicles, enabling dRISK to build the ultimate test for self-driving cars. The global market for AI training data alone is currently valued at $1.5 billion. FWT's investment will accelerate the development and growth of dRISK as a central technology for AV development.

EnSilica on London Stock Exchange's AIM market

Listed on the London Stock Exchange's AIM market, EnSilica has raised £6 million ($7.4 million) through a placing and subscription of 12 million ordinary shares at a price of 50p per share. It will open with a market capitalisation of £37.6 million ($46.6 million).

Rajasthan government releases its electric vehicle policy

The primary objective of Rajasthan government's EV policy is to encourage electric vehicles' adoption in the state. As part of the policy, the Rajasthan government has approved an additional budgetary support of ₹400 million for the SGST pay back to the eligible beneficiaries. A reimbursement of ₹5,000 to 10,000 (via SGST) was announced for electric two-wheelers and ₹10,000 to 20,000 for electric three-wheelers. Moreover, electric vehicles are not taxed under the Motor Vehicle Tax in Rajasthan.

ICEA writes to Central government over indiscriminate ED actions

ICEA has written to the Central government saying that the Enforcement Directorate's (ED's) recent actions against smartphone brands' royalty payments on intellectual property has sent "shivers through the industry." The letter claimed that a case is being built against royalty payments, which is duly acknowledged by the Indian law. This would also have a potential impact on the 'Make in India' programme.

Select The Right ENERGY HARVESTER For Your Next Embedded Project

Stand-alone ambient energy harvesting has become an important issue in the world of Internet of Things and medical implants, where batteries cannot be relied upon for long-time use. Here are some solutions that are emerging. But you need to select the right one for your application

SHARAD BHOWMICK

Advancement in low power electronics has paved the way to make a truly stand-alone ultra-low powered embedded product. This feat is made possible by ambient energy scavenging or, in other words, energy harvesting. Energy harvesting is a method of harnessing and converting the ambient energy into electrical energy for immediate use or to be stored for later usage. In short, energy harvesting makes it possible to realise the goal of a truly stand-alone system.

Selecting the right energy source is important for a design engineer as it dictates the run time, cost of operation, and even the size of the product. Battery needs to be replenished and any sort of non-renewable energy generation from any source like gas or solid fuel requires periodic refuelling, which is not possible for off-grid sensors and devices placed at remote locations. But the ambient environment contains energy which can be harnessed to run the low-power electronics for an extended period without any human intervention. Thus, the need for ambient energy scavenging arises.

Energy harvesters are devices that can convert different forms of ambient energy into electrical energy, thus eliminating the requirement of a battery or extending the battery life of an ultra-low-powered system. It is a combination of transducers and power conditioning circuits. The energy can either be directly used to power a device, or the energy can be stored in a storage device for later use. The block diagram of an rnergy harvester is shown in Fig. 1.

The conversion circuit of an energy harvester usually incorporates a booster which increases the very low extractable voltage into higher voltage output capable of charging a cell or for directly powering a circuit. Some models also incorporate maximum power point tracking (MPPT) algorithms to maintain the optimum current to voltage ratio so that it can capture the maximum amount of energy.

The main task of an

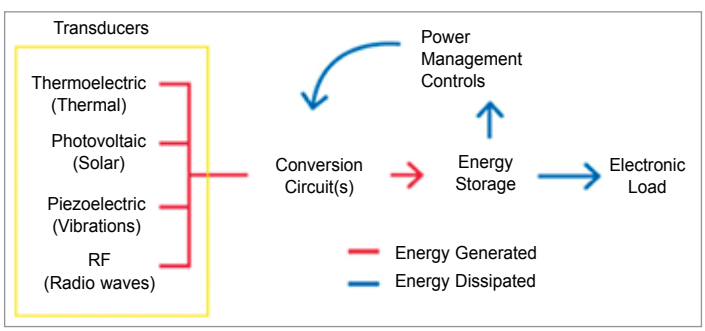


Fig. 1: Energy harvester block diagram

TABLE 1
POWER DENSITIES OF AMBIENT ENERGY SOURCES

Energy source	Power density
Solar	10μW - 25mW
Thermal	20μW - 10mW
RF	0.01μW - 0.1μW
Vibration	4μW - 100μW

energy harvester is to harness the energy and the most important ability of an energy harvester is power conditioning. Power conditioning is essential because the output from a transducer has low voltage and current and might be at wrong frequency. Further, the intermittent output makes transducers unsafe for directly driving a device or charging a battery. The energy harvester IC conditions the input power from the transducer and makes it usable.

Energy can be harnessed from different types of energy sources available in the surrounding environment. And the choice of energy harvesting technology depends on factors such as cost, power consumption, and availability near the device. Solar- and motion-driven are the most common types of energy harvesters while some others use thermal and radio frequency energy harvesting (RFHE).

Table 1 compares the power density of different ambient energy sources.

The different kind of energy harnessing methods—such as solar, thermal, and radio frequency energy harvesting—are briefly described below.

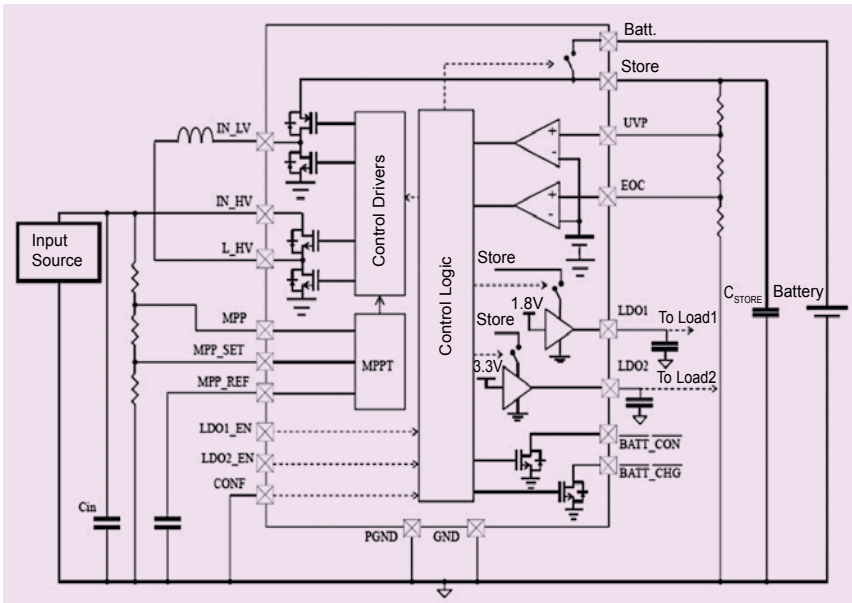


Fig. 2: Application circuit of SPV1050

TABLE 2
COMPARISON OF MAX20361 WITH SPV1050

Model	Manufacturer	Storage type it can charge	Energy can harness	Input voltage (minimum)	Output current	MPPT	Cold start
MAX 20361	Maxim Integrated	Rechargeable batteries, Capacitors	Solar	225mV	30mA	Yes	225mV
SPV 1050	ST Microelectronics	Rechargeable batteries, Capacitors	Thermal and solar	150mV	30-70mA	Yes	500mV (Boost conversion)

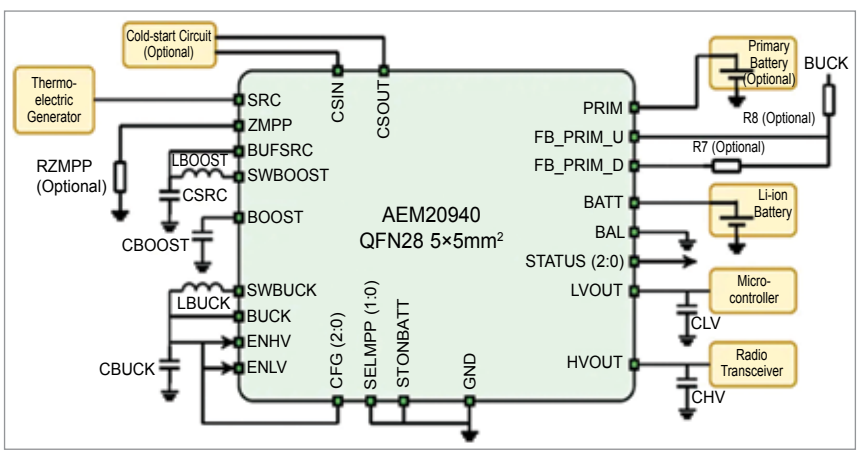


Fig. 3: Application circuit of e-Peas AEM20940

Solar energy harvesting

Solar energy harvesting is the most common type of ambient energy harvesting technique. The solar irradiance from the sun is readily available and the improvement of solar cells makes this a lucrative harvesting method in remote areas. ICs such as MAX20361 from Maxim Integrated and SPV1040 and SPV1050 from STMicroelectronics utilise an external solar panel to harness solar energy into an electrical voltage. These ICs utilise MPPT to harness the maximum amount of energy. They also have either a buck or a buck-boost converter to step-up or step-down the energy to be utilised for charging the battery. This harvesting method is a great choice in remote areas that have lots of sunlight. The application circuit of SPV1050 is shown in Fig. 2.

The main considerations while selecting a solar energy harvester are the type of storage devices it can charge, its input voltage, minimum cold start voltage, etc. Table 2 compares two solar energy harvesters.

TABLE 3
FEATURES OF AEM20940 AND SPV1050

Model	Manufacturer	Storage types it can charge	Energy it can harness	Output voltage range	Output current	MPPT	Cold start
AEM20940	e-peas semiconductor	Rechargeable batteries, Capacitors	Thermal energy	2.2-4.5	80mA (max)	Yes	380mV
SPV1050	ST Microelectronics	Rechargeable batteries, Capacitors	Thermal and solar	2.2-5.3V	30-70mA	Yes	0.5V (Boost conversion)

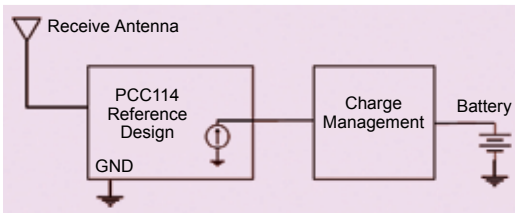


Fig. 4: Reference design of a RF energy harvester

Thermal energy harvesting

Thermal energy harvesting is the process of harnessing heat dissipated by machines or electronic components. Energy harvester ICs, such as e-Peas AEM20940 or STM SPV1050, are capable of thermal energy harvesting. These devices use thermos-electric generators (TEGs) as the transducers to convert ambient heat energy into electrical energy. Thermal energy harvesting finds usage in applications with a high heat loss, such as in power electronics circuits or electro-mechanical systems. A typical application circuit of e-Peas AEM20940 is shown in Fig. 3. Table 3 lists out the features of energy harvesters from STM and e-peas.

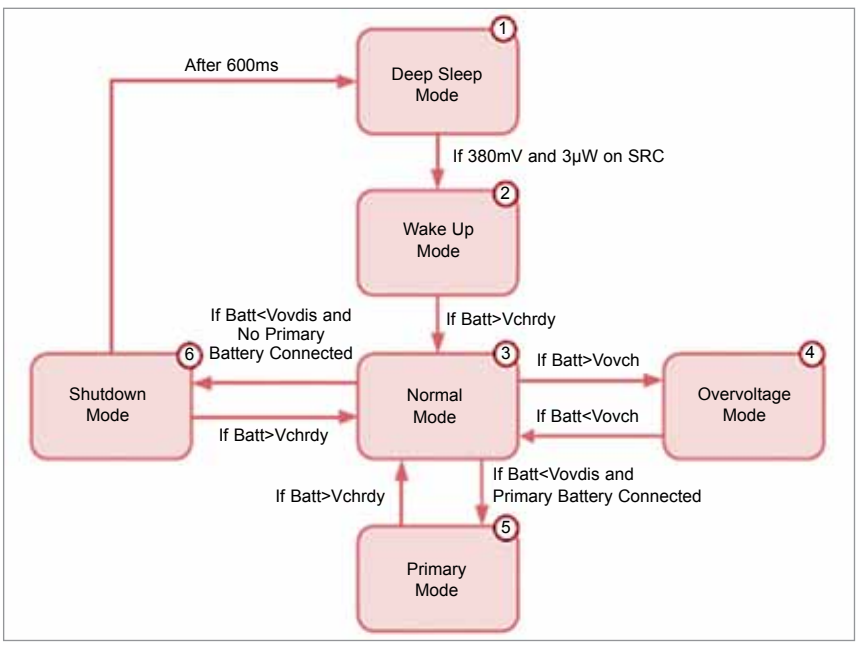


Fig. 5: Modes of AEM40940 from e-peas

TABLE 4
COMPARISON OF e-peas ENERGY HARVESTING ICs

Model	Manufacturer	Storage types	Energy it can harness	Harvesting range	Output voltage range	MPPT
AEM40940	e-peas semiconductor	Li-ion, Capacitor	RF energy harvesting	868-915MHz	50mV-5V	Yes
PCC114	Powercast	Li-ion, Capacitor	RF energy harvesting	10MHz-6GHz	4.3V	Yes
RFD102A	RF Diagnostics	Li-ion, Capacitor	RF energy harvesting	60Hz to 6GHz	4.2V	Yes

Radio frequency energy harvesters

Radio frequency energy harvesting (RFEH) is a technique of harnessing energy from the electromagnetic (EM) waves produced by sources such as phone stations, TV and radio broadcasting stations, Wi-Fi routers, Bluetooth Low Energy (BLE), etc. As shown in Fig. 4, RF harvesting devices have antennas that receive the EM waves and convert them to DC energy, and charge management steps up the DC voltage to be used for power or charging a battery. Fig. 4 shows an RF energy harvester taken from the PCC114 datasheet.

Radio frequency energy harvester (RFEH) devices like PCC114 from Powercast, AEM40940 from e-peas, and RFD102A from RF Diagnostics capture the electromagnetic vibrations of specific frequencies that are available around us to produce electrical energy. The flow diagram shown in Fig. 5 gives an overview of different modes of AEM40940.

RF power has lower energy density than most other sources, but this method is extremely useful for sensor nodes that are present in isolated areas with availability of no other ambient energies like solar, wind, or thermal. RFEH is commonly used for powering smart wearables, IoT devices, RFID tags, etc. Table 4 compares some com-

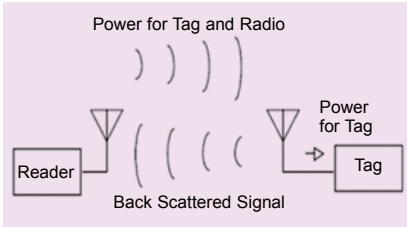


Fig. 6: Working of a passive RFID tag (Source: Link)

mon energy harvesting ICs from e-peas.

Radio frequency identification (RFID)

The passive RFID tags do not have any power source, they harness the energy from the radiated electromagnetic waves from the RFID readers. The coiled antenna within the tag forms a magnetic field and draws power to run the IC. The tag then sends the information over to the reader. The working of an RFID is shown in Fig. 6.

Near Field Communication (NFC)

NFC is like RFID but works at a maximum distance of 10cm and on a frequency of 10.56MHz. It is a secure mode of data sharing and provides peer-to-peer sharing. NFC is used for various purposes, but one of the most common purposes these days is in contactless debit and credit cards for transactions. Its application is shown in the box below.

Where we can use an energy harvester

The IoT industry is growing at a compound annual global rate of 26.9% and the global IoT market size is expected to exceed US$870 billion by 2025. With the adoption of IoT and an increase in data sensing and collection, standalone systems make sense. Some of the applications of energy harvesting are:

- Wearable fitness
- Medical devices
- Industrial IoT sensors
- Asset tracking devices
- Wireless sensor networks
- Smart homes
- Smart agriculture
- Weather forecasting
- Smart cities
- Automobiles

The future of energy harvesting

The advancements in electronics industry pave the way for higher-efficiency components that will increase the adoption of energy harvesting techniques. Till recent years, most of the focus was on transducers which essentially made harnessing possible, but now companies such as Texas Instruments, e-peas, STM, etc are working on improving the energy harvester ICs. Some companies have started integrating ICs with on-chip energy harvesting solutions. Devices such as Atmosic ATM3 series Bluetooth SoC solutions have on-chip RF harvesting.

Contactless payment using NFC

1. A contactless card contains a chip and antenna; the chip contains your secure information while the antenna works to power the chip as well as to transfer the data.
2. The reader emits an electromagnetic (EM) signal.
3. When a card is placed in the vicinity of EM wave, the waves power the chip and a communication between the chip and the reader is initiated.
4. When the reader recognises and verifies the data, a secure communication is formed and encrypted data transfer takes place between the devices.
5. The card reader confirms the payment.

Fig. 7: Contactless payment using NFC (Source: Link)

TABLE 5
COMPARISON OF ENERGY HARVESTING DEVICES

Model	Manufacturer	Energy storage type	Energy it can harness	Output voltage (max)	MPPT
AEM40940	e-peas semiconductor	Rechargeable batteries, Capacitors	RF energy	5V	Yes
AEM40940	Powercast	Rechargeable batteries, Capacitors	RF energy	4.3V	Yes
AEM40940	RF Diagnostics	Rechargeable batteries, Capacitors	RF energy	4.2V	Yes
AEM40940	Maxim Integrated	Rechargeable batteries, Capacitors	Solar	4.7V	Yes
AEM40940	STM	Rechargeable batteries, Capacitors	Thermal and solar	5.3V	Yes
AEM40940	e-peas semiconductor	Rechargeable batteries, Capacitors	Thermal energy	4.5V	Yes

The growth in energy harvesting has accelerated with the start of Industry 4.0. The need for gathering data is growing at a rapid pace, which means more sensors are being installed even at the remotest of locations. Some application areas holding a great promise in the future are mentioned below.

Smart wearable technology. Wearable technology is capable of tracking and monitoring different parameters of our body. This technology is in high demand in wearable applications, such as smart fitness, smart healthcare, smart military, etc. The smart wearable industry is growing at an unprecedented rate and there is a huge demand in consumer-grade wearable devices, such as fitness tracking devices like Fitbit and infotainment devices like Apple watch. The smart wearable has a great scope of using piezo-electric transducers to generate energy and improve the battery life of the device. Mithras, a Switzerland based company, is developing TEGs compatible with wearable technology.

Self-powering medical implants. Bio-medical is another field where a lot of research is going on to harness the energy inside our bodies to extend the lifetime of implants that require electrical energy, such as sensors to monitor body's parameters, pacemakers, and hearing aids, without changing the battery. Kinetic and heat energy can easily be harnessed. A joint mounted device based on generative braking can generate about 34W from the movement of knees and 20W from the ankles. Apart from thermal and kinetic energy harvesting, there are various other energy harvesting options where research is going on; one such method is blood sugar oxidation.

Vibration and kinetic energy harvesting. Any movement by anyone or anything results in vibrations that can be harnessed to generate energy. The movement causes vibrations or low frequencies in the range of 1Hz to 30Hz. Piezoelectric transducers can be installed in sidewalks, bridges, roads, and public areas, such as hospitals, stadiums, etc. Companies like London based Pavegen use electromagnetic induction to generate energy from people walking on the sidewalks. EFY

The author, Sharad Bhowmick, works as a Technology Journalist at EFY. He is passionate about power electronics and energy storage technologies. He wants to help achieve the goal of a carbon neutral world.

India's 1st Independent Survey

For details **www.efy.in/elcina-imrb**

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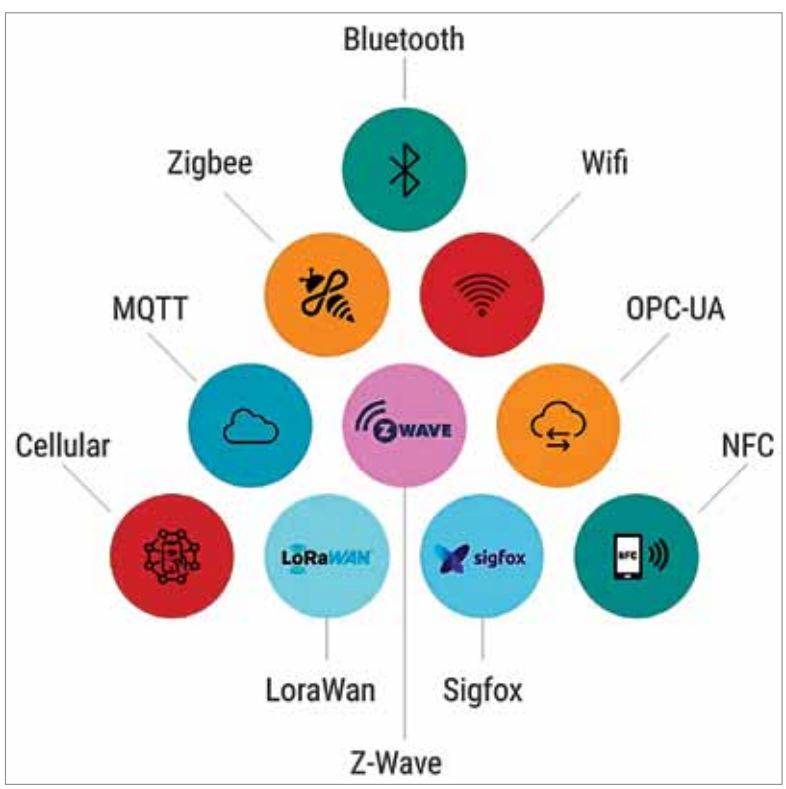
15 THINGS TO REMEMBER While Selecting An IoT Platform

How to compare the IoT platforms available in the market and select the right platform? Let us take a look at some of the platforms available in the market and their features and see the selection guide presented in this article

AARYAA PADHYEGURJAR

Around 2015, there were 260 IoT platforms in the market. In just one year, the number rose to 360! By 2017, there were 450 IoT platforms and today, there are over 600. This exponential growth in the number of IoT platforms proves that IoT has already become mainstream.

But this large number can lead to a lot of confusion when it comes to selecting the right platform for a particular business. There are so many factors that need to be considered and assessed. One needs to keep in mind at least the following 15 things while selecting an IoT platform.



Popular IoT protocols (Credit: Hashstudioz)

1. Vendor/parent company

You need to ensure that the platform you are choosing comes from a reliable and credible vendor—one that has been in the market for a considerable amount of time. You can try checking out other products from the same vendor and see if they have a good life expectancy in the market. You can consider looking at clients and customers of the vendor as well, especially those who have invested in the same platform as you are planning to. Trust is a key factor in the IoT platform market—you are trusting a platform with your data after all.

2. Scalability

A scalable system is a stable system. Over time, businesses grow, expand and sometimes even pivot. Your IoT platform must be scalable enough and should accommodate all these changes—especially the large influx of data as a company matures in the market. To make your selection process easier, check how the IoT platform has grown from the time it was launched. Did it compete with the changing technologies? Has it adopted newer protocols?

3. Protocol support

Does your IoT platform support the data protocols, device protocols, or communication protocols that your development team is accustomed to? For example, if you, a decision-maker, select a platform that does not support general data formats, your developers will have to spend time to get used to the format that the platform does support. Hence, select a

TABLE 1
IoT PLATFORMS FOCUSED ON CONNECTIVITY

Details	Cisco IoT Control Center	EMnify	Vodafone IoT
Type	SaaS solution	SaaS solution	SaaS solution
Account Types	2 - Essential (Simple IoT) and Advantage (Complex IoT). Pricing, features, and services differ in each type.	EMnify has a single plan type but has two types of coverage options -- Basic and Extended	N/A
API Support	Available	Available	Available
Visualisation	The Control Centre is an environment for real-time evaluation, testing, and deployment	Dashboard	Dashboard, Web interface
Services	Data (GPRS, LTE, NB-IoT, 5G NSA, 5G SA), SMS, Voice	Data (2G, 3G, 4G, LTE-M, NB-IoT), SMS, USSD	LTE, LPWA Technologies, 4G, 5G, NB-IoT, SMS, Voice
Pricing	Multiple pricing plans are available - monthly fixed pool, monthly flexible pool, prepaid and monthly individual. Pricing depends on the account type	Pricing varies based on the number of active SIMS and device consumption. They have a pay-as-you-go option as well as an inclusive volume option	Outcome-based pricing depending on your solution.
Additional Features	Multiple add-on packages that enterprises can subscribe to as their needs evolve	Automated integration into cloud (AWS, Azure, Google Cloud)	Vodafone Business App-Invent: This is an Application-as-a-Service solution that helps companies create IoT apps quickly and cost-effectively.
Getting Started	Cisco provides a Starter Kit, making it easier to launch your connected device services	The company provides a free trial as well as a Factory Test Mode for pre-deployment connectivity testing.	N/A (Contact Vodafone IoT to obtain onboarding details)
Website	https://www.cisco.com/c/en/us/solutions/internet-of-things/iot-control-center.html	https://www.emnify.com/	https://www.vodafone.com/business/iot/managed-iot-connectivity/iot-platform

platform that caters to your development needs, and not vice versa.

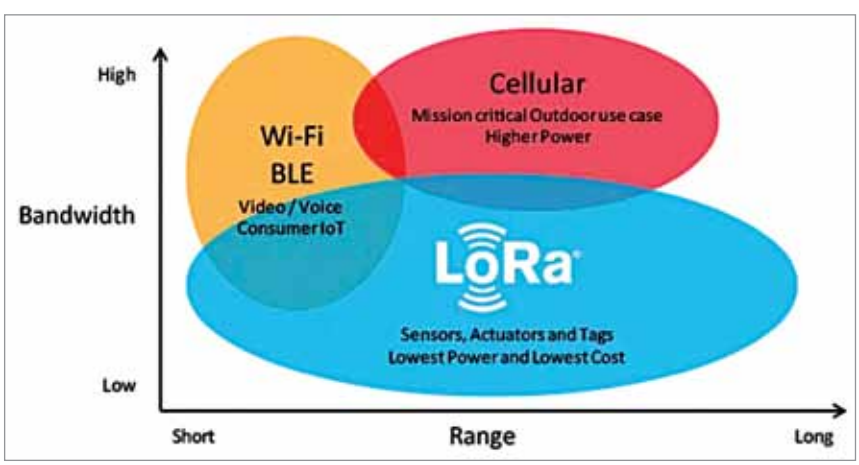
4. Customer support

Another important parameter to consider is whether your platform comes with the necessary support for your application. Also, if you do not have cloud engineers in your team, you can consider a vendor that provides in-person support in setting up your platform. Certain platforms cater to only software and cloud needs. In such a scenario, if your application is more hardware-centric, you will end up doing a lot of work yourself.

5. User-friendliness

A complex platform that is not easy to use involves a learning curve even for IoT professionals. But it does not make sense to spend time learning the platform instead of working on the solution itself. As a decision-maker, you need to consider the user-friendliness of the platform—whether the platform offers dashboards, graphs, and reports.

Young IoT platforms may not have user-friendly user interface (UI) as the developers are more concerned with connectivity, data security, and other issues. Before selecting, you can try using the trial version of the platforms you shortlisted, just to check if these are flexible and user-friendly.



Bandwidth vs range of connection protocols (Credit: The Things Network)

6. Developer-friendliness

Does the platform connect easily with your existing systems, including the IoT hardware? Does it provide a good test and development environment? Does it use open source technologies that your developers might already be aware of? Perhaps the most critical feature of any IoT platform is how easy it is for developers to use.

You need to ensure that the platform supports integrations like RTOS and SDKs in various programming languages, and API support. Many platforms provide custom APIs

TABLE 2
IoT PLATFORMS FOCUSED ON DEVICE MANAGEMENT AND AI

Details	C3 AI	Particle IoT Platform	Kaa IoT Platform
Type	SaaS solution	PaaS solution	PaaS solution
Integrations	Its architecture is scalable with cloud services like AWS Cloud	It can integrate with GCP, Azure IoT Hub, IFTTT, QuestDB	REST API, WebSockets, Data Analytics, Business tools like SAP, Salesforce
API Support	REST APIs, Customisable API integration	REST API	REST API
Features	• Data Query & Analysis • Data Integration • Data Abstraction • Machine Learning • Application Management • Application Logic • Application Deployment • Operations Workflow Management	• Edge-to-Cloud Stack • IoT Device Management • Data Pipeline • IoT Hardware and Tracking	• Handle millions of devices • Ease of use • Third-party integration • Data security • Multicloud architecture
Noteworthy Characteristics	Users can select from a set of pre-built applications. The C3.ai platform also provides a development environment for building custom IoT applications	Particle supports Over-The-Air (OTA) firmware updates. Also, the program structure for Particle is built with Arduino compatibility.	It is a completely open source solution
Interface	Web based, Desktop	Web IDE, Desktop IDE(Dev) and a CLI (Command Line Interface)	N/A
Visualisation	Reports, dashboards, visualisations, and actionable insights	Dashboard, Google Maps	Built-in Dashboard or third-party tools like Grafana. Users can stream data from IoT devices to any data analytics system via the pre-integrated Kafka channel.
Pricing	Depends on features selected, Quote-based	Three pricing levels: Enterprise, Starter, Tracking	Multiple plans are available, depending on hosting and number of devices
Website	https://c3.ai/c3-ai-suite/	https://www.particle.io/what-is-particle/	https://www.kaaiot.com/

during the implementation phase, which makes it easy for developers to get started.

7. Disaster recovery and downtime

In any application, it is only natural for technical problems to occur. What matters is how the parent company deals with such problems, and how long its recovery takes. While selecting an IoT platform for your application, you need to make sure that the platform provides the necessary infrastructure to handle such occurrences without any data loss. Check if the company provides a backup solution for your data, either locally or on cloud.

8. Updates and upgrades

Although it is mainstream, IoT can still be called a relatively new technology. Your needs might change, your company might grow. So, does your IoT platform support such updates in your company's infrastructure? Does it support the newer versions of IoT protocols? Does it provide facilities to update your firmware over-the-air? If yes, are these facilities in your budget? These are important questions that you need to ask before taking any decision and selecting an IoT platform.

9. Device management

IoT device management is significantly crucial because all your devices need to be secure and connected for your system to function properly. Ideally, the IoT platform should enable you to register a device easily, provide means to delete or update it, provide its status updates, and notify you if it gets disconnected from the system or malfunctions. All of this needs to be done in real time.

Moreover, the platform should enable you to remotely control your devices over the internet. It should support a wide variety of devices and should have a good mechanism to sort them into types. It should also have low latency even if the number of devices increases and should easily allow bidirectional communication between devices and the cloud.

10. Data handling

The data that you receive from your IoT hardware needs to be properly stored and analysed. This becomes challenging as more and more devices are introduced into the system and the volume of data increases. While selecting a platform, try to find out how your vendor handles data from your system. Keep in mind that, at times, the pricing model heavily depends on the data. Also, make sure to be well informed about data ownership rights and regulations.

11. Security features

While selecting an IoT platform, one must choose a platform with good security solutions. You should also check if the vendor has the latest security certifications and compli-

TABLE 3
THE BIG 5

Details	AWS IoT	Microsoft Azure IoT	Google Cloud IoT	IBM Watson IoT	Oracle IoT
Security	Link Encryption (TLS), Authentication (Sig V4, X.509)	Link Encryption (SSL/TSL)	SSL/TLS	Link Encryption (TLS), Authentication (IBM cloud SSO), Identity Management (LDAP)	REST API
Data analytics	Real-Time analytics (Rule engine, Kinesis, AWS Lambda)	Real-Time analytics	Real-Time analytics (Cloud IoT Core)	Real-Time analytics (IBM IoT Real-Time insights)	Real-Time analytics
Data format	JSON	JSON	JSON	JSON, CSV	CSV. REST API
Application Environment	Java, C, NodeJs, Javascript, Python, SDK for Arduino, iOS, Android	.Net, UWP, Java, C, NodeJS. Ruby, Android, iOS	Go, Java, Python, .NET, NodeJS	C, Python, Java, NodeJS	Java, iOS, Javascript, C, Android
Protocols	MQTT, HTTP1.1	MQTT, HTTP, AMQP	MQTT	MQTT, HTTPS	MQTT. HTTP
Visualisation	AWS IoT dashboard	Web Dashboard	Google data studio (Dashboard)	Web Dashboard	Web Dashboard
Edge Computing Options	AWS Greengrass	IoT Edge	Google Edge TPU	IBM Edge Application Manager	Oracle Roving Edge
Pricing	AWS allows you to pay for the services you use. You can calculate your pricing using the AWS Pricing Calculator.	A free version, basic version, and a standard version are available. Pricing varies for each.	Cloud IoT Core is priced according to the data volume used in a calendar month.	Three plans are available, depending on the service selected: Connection, Analytics, or Blockchain.	Oracle offers uniform pricing across all global regions and also provides a cost estimator similar to AWS.
Website	https://aws.amazon.com/iot-core/?nc=sn&loc=0	https://azure.microsoft.com/en-in/services/iot-hub	https://cloud.google.com/solutions/iot	https://internetofthings.ibmcloud.com	https://www.oracle.com/in/internet-of-things

ances, like SoC 2 Type II, which is a report that captures how a company safeguards customer data. It would also be wise to check the encryption protocols that are being used along with a thorough inspection of how the vendor's privacy laws might affect your company in the future.

12. Edge support

IoT is moving towards edge computing, AI, and ML. Hence, the support for such features is important, even if your solution does not employ them at this point in time. There are many platforms in the market that are dedicated to analytics and edge intelligence, but even if your selected platform is not one of them, it is a good sign if they still accommodate new topologies and utilise edge intelligence.

13. Bandwidth and range

High bandwidth means low latency. For fast movement of data and good connectivity, the system should consume extremely little power, have a huge range, and should be able to transmit a large volume of data. Hence, bandwidth management for IoT devices should not be overlooked. At the same time, the system should have a good enough range to accommodate your hardware—there will always be a tradeoff.

14. Time-to-market and platform migration

To reduce time-to-market, some IoT platform providers offer quick-start packages for new customers, and some offer drag-and-drop functionality to generate simple applications. Overall, the IoT platform you select must allow you to go to market in your projected timeline. Furthermore, in the unlikely event that you need to change your platform after going to market, the transition needs to be smooth, and your initial platform needs to permit this migration in a hassle-free manner.

15. Pricing model

This is one of the most important considerations. Most IoT platforms provide multiple pricing options depending on features, similar to how Gmail provides services to enterprises. But some might try to sneak in some additional costs that you might overlook while selecting! Some IoT platforms might charge according to the number of reads and writes; so it becomes costlier as your company grows! Also, you can try to check if the company is flexible enough to accommodate your needs and modify the pricing accordingly.

Comparison of some IoT platforms

Let us take a look at a few IoT platforms and compare their features and pricing as given in Table 1 to 3.

Once all relevant platforms are analysed according to the fifteen points mentioned above, you will be able to decide which one suits your application the best. EFY

The author, Aaryaa Padhyegurjar, is an Industry 4.0 enthusiast at EFY with a keen interest in innovation and research.

Systems

"The MARKET Is Now SHIFTING To Large-Size TFT DISPLAYS In The AUTOMOTIVE SEGMENT"

The adoption of LCD technology in vehicular displays has happened quite quickly and smart displays have by now pretty much replaced the mechanical dashboards of yesteryears in cars. In an interview with our team, Rei Tjoeng from Sharp Devices revealed some interesting information regarding automotive-grade LCDs, the recent trends, and specific characteristics that make some LCD displays different from the others available in the market

REI TJOENG
SHARP DEVICES

How is the modernisation of 2- and 4-wheelers affecting the demand for LCD displays?

Adoption of TFT in 2-wheeler cluster applications has increased in a big way. The global automotive industry is widely believed to be on the cusp of tremendous change in terms of manufacturing, sales, and the overall business model, owing to the rapid advances in new-age technologies such as autonomous driving, augmented reality, and big data.

Visualisation technologies are the most vital components of in-vehicle interactions, with overall automotive navigation and connectivity characterising the cars of this generation.

Advanced driver-assistance systems (ADAS)—such as parking assistance, forward collision, lane-departure warnings, and blind-spot monitoring—are frequently hailed as the technologies that will usher us into an age of autonomous transportation, but drivers are still either untrusting or too trusting of these features. This has led to an evolution of sorts in the in-car user experience interfaces, and more so with the way automotive display makers are developing new products.

The future for ergonomic conformal displays, display-based dash, central console, in-door wing mirrors, and transparent displays that offer unobtrusive visual information during journeys is bright. Head-up displays are fast gaining popularity as an ideal interface for dissemi-

nating crucial information such as navigation messages, vehicle speed, and warnings.

Are there any broad categories of LCD displays that are witnessing demand?

Yes, reflective LCDs, which use ambient light to reflect in order to read. In 2W cluster applications, where TFT is exposed to direct sunlight, readability is a major issue. Sharp Reflective LCD is a solution as visibility is crystal clear without any glare and is available in colour too. Equipped with a backlight, it can be used at night also.

Normal TFT has to pump more power through the backlight, which results in more power consumption and backlight life also gets affected to a large extent. This reflective LCD consumes very little power and could be the best fit-in product for the EV segment.

One of the first fears that come to one's mind when we see a large tablet-like display in cars is of its breaking. But what is the actual risk of these screens breaking?

The market is now shifting to large-size TFT displays in the automotive segment. These displays are automotive-grade LCDs and are tested for shock, vibration, high and low temperature, etc. For more protection and safety, glass bonding is done over TFT. Glass bonding with a cover glass on the LCD protects it from shock, as the hardened adhesive behind the glass acts as a shock

Selection Parameters For LCD Screens For Automotive Applications

Wanting to select the right LCD screen for an automotive design? Here's a list of parameters you need to consider:

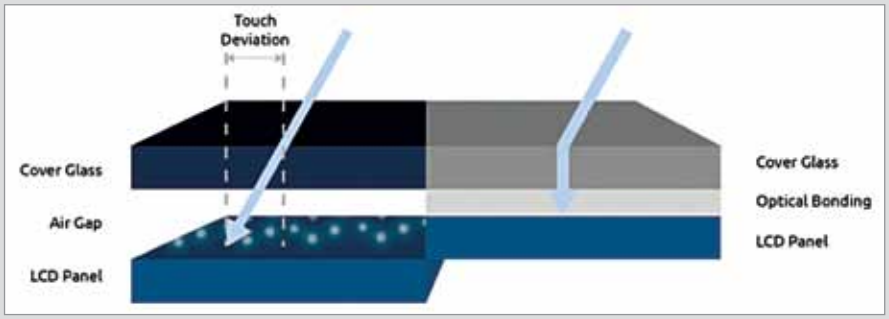
Free form display prototype (Credit: Sharp Devices)

High brightness and anti-glare. More brightness and higher contrast make the display clear even during bright sunlight conditions. Manufacturers have enormously brought down surface reflectivity with anti-reflective coatings, making the display easier to pursue during high-sunlight glare conditions. Progressive Super View Technology of Sharp, for example, gives an extremely crisp image under sunlight without pumping more power from the backlight, which helps in maintaining the life and quality of the product.

Screen size and resolution. Auto displays range from 3.8cm to more than 30cm. There's a trend toward bigger display sizes (up to 61cm), with the reception of solid-state and advanced digital clusters. Thus, HD resolution is moving from wide VGA (800 × 480) to 720p and 1080p.

Form factor. In the automotive sector, the most common aspect ratio for display sizes between 17.8cm and 31.4cm are 16:9, 5:3, 16:9, and 16:6. From hatchback, sedan to SUV, the height varies a lot and, therefore, aspect ratio plays a vital role for display selection. Recent innovations like Free Form help automotive designers to break free from the rectangle to any size or any form factor of the display. The device may be shaped to fulfil a large range of user needs due to the incorporation of IGZO technology and proprietary circuit design methods.

Conventional displays are rectangular because they require a minimal width for the bezel so as to accommodate the drive circuit, called the gate driver, around the perimeter of the screen's display area. With the morpheme display (using IGZO technology), the gate driver's function is dispersed throughout the pixels on the display area. This enables the bezel to be shrunk considerably, and it gives the liberty to style the LCD to match whatever shape the display area of the screen has to be.



Optical bonding with cover glass (Credit: Newline Interactive)

Interface. Low-voltage differential signalling (LVDS) could be a popular choice for giant LCDs and peripherals in need of high bandwidth, like high-definition graphics and fast frame rates. It is most ordinarily utilised in automotive TFT applications. It's an excellent solution due to its high speed of data transmission while using low voltage.

Two wires carry the signal, with one wire carrying the precise inverse of its companion. The electrical field generated by one wire is neatly concealed by the opposite, creating much less interference to nearby wireless systems. At the receiver end, a circuit reads the difference (hence call Differential) in voltage between the wires. Therefore, this does not generate any noise or gets its signals scrambled by external noise. The interface consists of four, six, or eight pairs of wires, plus a pair carrying the clock and a few ground wires.

Wide viewing angle. Centre-stack displays should be visible to both driver and the passengers, including those on the rear seats. LCD display modules are designed to provide the best contrast and readability in one of the four directions, known as the Viewing Angle or Optimal Viewing Direction. These four directions are laid out in the shape of a clock. The top view is at 12:00pm and the bottom view is at 6:00pm.

Touch and glass bonding. Optical bonding is the method involving overlaying touchscreens, glass, or plastic cover lenses, adding EMI filters and other display upgrades to an LCD. A layer of glue is incorporated between the cover layer and display to fill the air gap abandoned in a regular edge or gasket bonding. Optical bonding helps in enhancing clarity, viewability, reducing reflections, and making TFT more rugged, which are critical factors in automotive applications.

Wide temperature range. Temperature range can typically span from -40°C to 85°C. Such a high-temperature range is required because in summer ambient temperature adds up with the operational temperature of TFT, where normally in desert areas ambient temperature rises to 55°C in summer.

Colour depth. Higher-resolution displays might have to upgrade from 18-bit red, green, blue (RGB) to 24-bit RGB to attain a wider colour gamut.

Refresh rate and response time. Keeping away from slacks is basic for warning indicators and navigation functions like maps and traffic updates.

Power consumption. Low power consumption enables better fuel consumption and allows components to be placed in hot spots.

Lifetime and production support. Displays must support design and production cycles of a minimum of five years, extendable up to ten years because of vehicle warranties.

absorber. Shakes and shocks are less likely to damage the display and glass, making this an important benefit for transportation applications. In the unlikely event that the glass is damaged, shards of broken glass will remain stuck to the optical adhesive.

Reflection or glaring sunlight sometimes makes it difficult to read the displays. Any innovation introduced recently, or underway, that may solve this issue?

Reflective LCD and Progressive Super View are the two technologies which are effective under high ambient light. In progressive super view technology, internal and external reflection is cut down, which results in a clear view without glare. And the beauty of this technology is that it happens without pumping more power from the backlight. This helps in more lifetime of the backlight and less power consumption.

Reflective LCD is another technology that uses ambient light to reflect in order to read, hence there is more clarity under sunlight and very less power is needed. It is more beneficial for EV applications.

How do LCDs combat the continuous temperature changes throughout the day, especially in automobiles?

Automotive-grade LCDs have strict requirements. The LCD must remain working during the extreme environment, for example, Indian summertime. For example, our LCDs are tested for storage temperature of

-40 to 95°C and operating temperature of -30 to 85°C.

From a design engineer's perspective, what are the top factors—besides the obvious ones like price, size, brand, after-support, etc—that should be borne in mind while selecting the right LCD panel?

There are a few LCD specs the design engineers need to consider at high priority when they select the LCD. The first specification will be the screen size and aspect ratio. The aspect ratio is the ratio between the length and width of the LCD. Some common ratios are 4:3, 5:4, 16:9, and so on. Of course, sometimes marketing people will also consider these specs as they will affect the whole outlook and design of the product.

Then the engineer may need to consider the LCD's resolution and interface, whether they are matching with the motherboard. If the product is a semi-outdoor or outdoor application, then the engineer needs to also check the LCD's brightness and operating temperature range, because these are very important specs if the product is located in the sunshine.

Design engineers can also refer to the box item titled 'Selection Parameters for LCD Screens for Automotive Applications' (see previous two pages).

What are the common myths or missing info related to designing LCD screens for automotive solutions?

The smartphone has become very popular in recent years and it is influencing the engineers' design. We saw some EV companies use the smartphone LCD as the cluster or GPS display for their first-generation products. The smartphone LCD is nice but, unfortunately, it is not designed for automotive applications, especially not for 2-wheeler outdoor usage. When the 2-wheeler is under the sunshine, the driver can barely see anything from the smartphone LCD. And, also, the smartphone LCD's lifetime becomes much shorter under the automotive application scenario.

A head-up display (HUD) is any transparent display that presents data (Credit: GoMechanic)

How do you support customers, design engineers, and R&D teams during their initial stages of identifying the right LCD for their design?

Sharp Singapore has been in this region for many years. We understand our customers. First, our team will get the customer's requirements from both the marketing and engineering sides. We will check the customer's motherboard's graphics capability, display interface, and other necessary technical details. We will propose the best suitable LCDs to the customer and explain the reason. We will explain what we observe from the market trend and help the customer to know the best options.

LCD samples and demo kits are available for the engineers to see the actual performance. There is also technical support available to help the design engineers to evaluate the LCD and design-in the LCD.

Do you have some form of sampling programme for them to receive samples during their prototyping stages? Do you have development or evaluation kits for your LCD displays?

Sharp Singapore understands that samples and evaluation kits are important in the project's early stage. Evaluation kits are available for the engineer to evaluate the LCD performance during the proof of concept stage. Then we will provide sample LCDs for the customer's prototype builds.

What is your support structure for design engineers in India?

We have salespersons stationed in India at New Delhi and Bangalore. They are working closely with the customers' design engineers. There are technical support persons in Singapore and Japan. Our Indian team can support the customer onsite and bridge as technical person effectively between India and Singapore.

Are we correct to assume that you supply the displays through major distributors or through your India office?

We have many distributors in India who can support the customer's needs. Major OEMs are supported directly through our headquarters in Singapore. EFY

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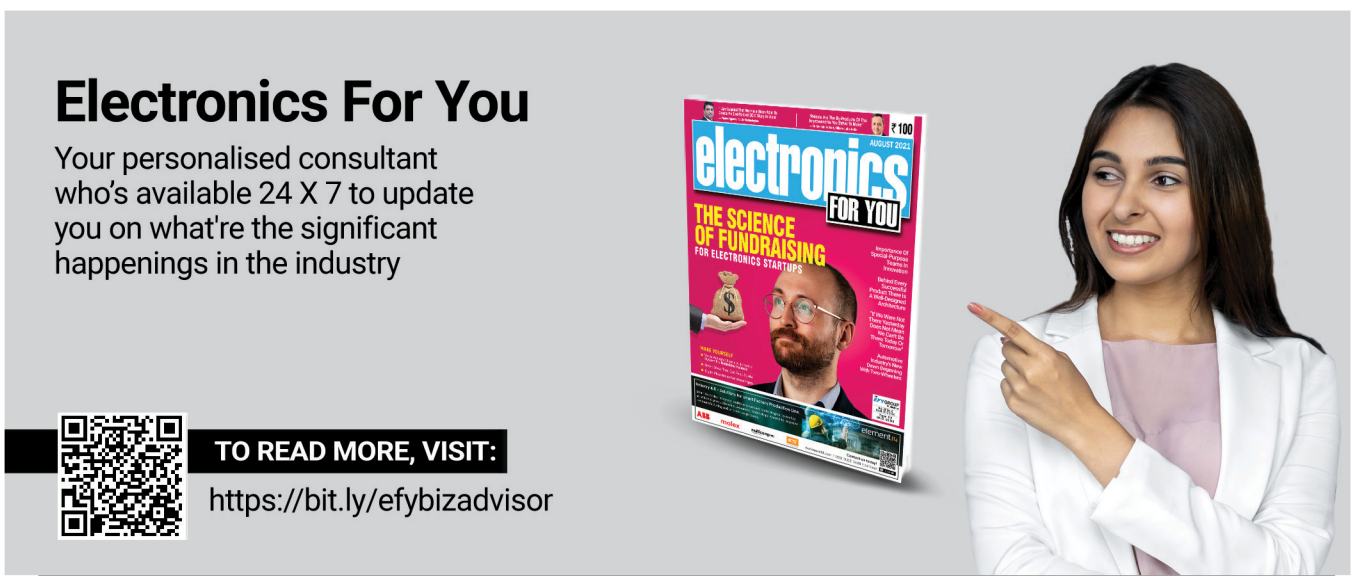
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EFY TESTED Anand Bhatt

SECURITY ALARM For Two-Wheelers

S.C. DWIVEDI

This simple security alarm circuit can help you secure your bike or scooter. It raises an alarm if someone tries to drive away your two-wheeler. You just need to connect the circuit to the vehicle's wheel (preferably front wheel) through a thin flexible wire that can break easily.

Connect the bike's wheel to the circuit with the wire in such a way that when someone tries to steal the bike, the wire would break. When that happens, the speaker in the circuit would generate a machine-gun sound, or some other alarming sound, and alert everyone around.

The prototype assembled on a breadboard for testing in EFY Lab is shown in Fig. 1. Circuit diagram of the security alarm is shown in Fig. 2.

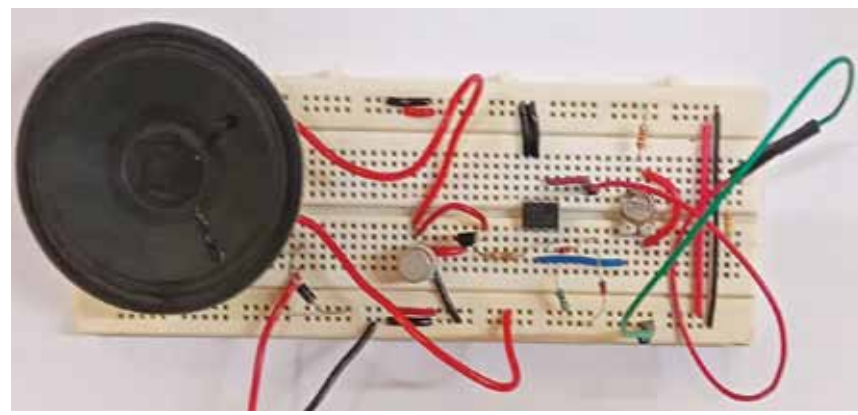


Fig. 1: Prototype tested on breadboard

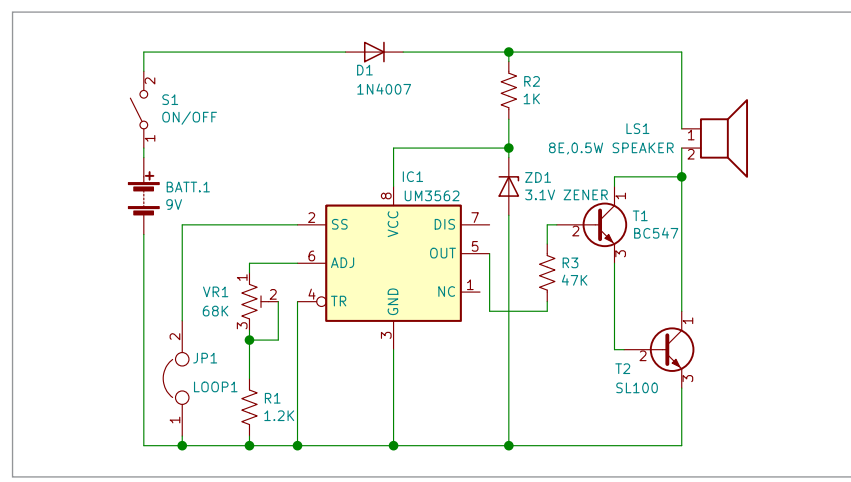


Fig. 2: The circuit diagram

Circuit and working

The alarm circuit is built around machine-gun sound generator IC UM3562 (IC1), transistors BC547 (T1) and SL100 (T2), a 3.1V Zener diode (ZD1), rectifier diode 1N4007 (D1), and a loudspeaker (LS1).

Sound generator IC UM3562, the heart of the circuit, is a low-power CMOS LSI (large-scale integration) chip in an 8-pin DIP package. It includes a voltage-controlled oscillator (VCO), timer generator, tristate selector switch, envelop control, and mixer.

Normally pin 2 of UM3562, along with trigger pin 4, is used as a tri-state selector switch that helps generate three types of sound. When pin 2 is low, a special kind of pulsating sound is generated. When it is connected to 3V, it generates a rifle's firing sound. When this pin is in floating condition (unconnected), it generates the machine-gun sound.

In this design, pin 2 is kept in low state by making trigger pin 4's state low. When the wire connecting the circuit to vehicle's wheel breaks, machine-gun sound is generated. The machine-gun's shooting rate (sound) can be adjusted through preset VR1.

IC UM3562 works on 2.4 to 3.6V, so normally it uses a 3V battery for operation. In this circuit, 9V battery voltage is reduced to the required level by R2 and ZD1. The 9V battery helps in producing a louder alarm sound from loudspeaker LS1.

Output of the UM3562 at pin 5 is in audio range. The two transistors T1 and T2 used as a Darlington pair amplify the sound.

Working of the circuit is simple.

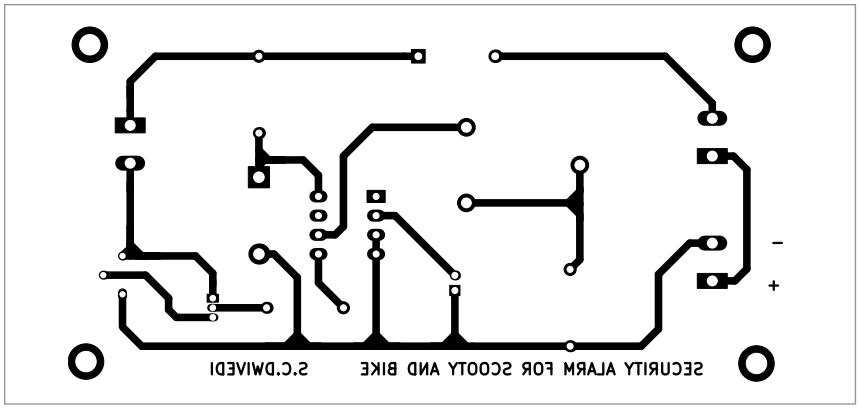


Fig. 3: Actual-size, single-side PCB design for the circuit

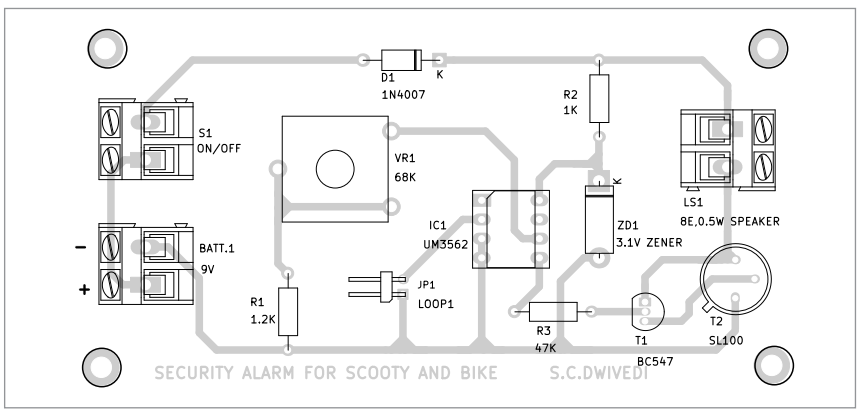


Fig. 4: Component layout of the PCB

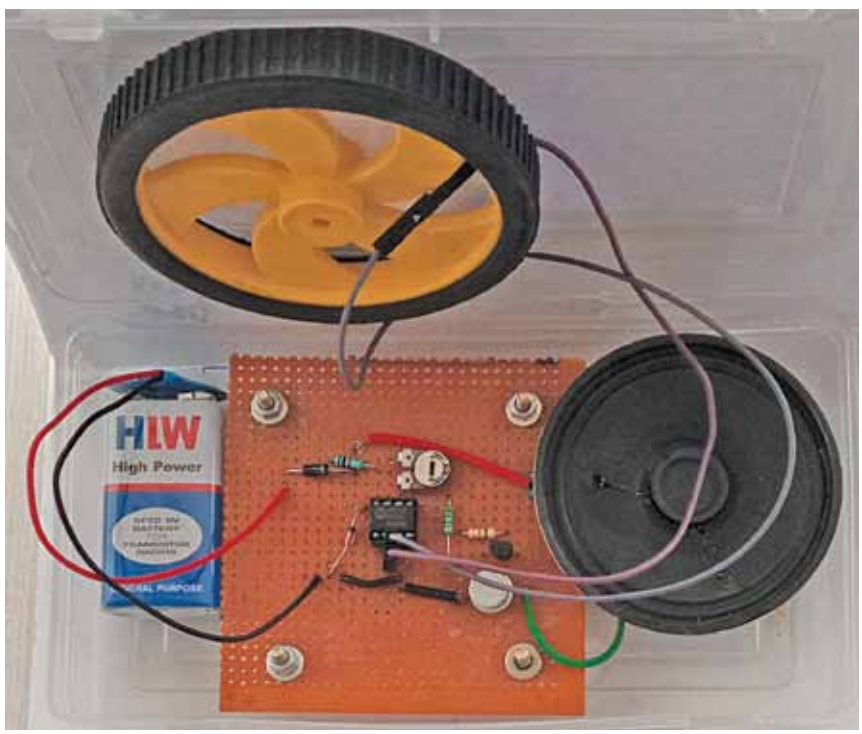


Fig. 5: Author's prototype in a box

PARTS LIST

Semiconductors:

IC1	- UM3562 machine-gun sound generator
T1	- BC547 NPN transistor
T2	- SL100 NPN transistor
D1	- 1N4007 rectifier diode
ZD1	- 3.1V Zener diode

Resistors (all 1/4-watt, ±5% carbon), unless stated otherwise:

R1	- 1.2-kilo-ohm
R2	- 1-kilo-ohm
R3	- 47-kilo-ohm
VR1	- 68-kilo-ohm preset

Miscellaneous:

S1	- On/off switch
LS1	- 8-ohm, 0.5-watt speaker
BATT.1	- 9V battery
	- Thin flexible wire

After connecting the circuit to bike's wheel, switch on S1 to enable the circuit. This readies the circuit to protect the bike. When someone tries to drive away the bike and breaks the wire, loudspeaker LS1 sounds an alert to let you know someone is trying to steal your bike.

Construction and testing

An actual-size, single-side PCB for the bike alarm is shown in Fig. 3 and its component layout in Fig. 4. After assembling the circuit on PCB, enclose it in a suitable box. Connect the flexible wire tightly to the bike's wheel such that it would break if someone turns the bike's handle to drive it away.

After connecting battery to the circuit, switch on S1 and hide the assembled unit somewhere in the bike (say, under the spare tyre). Fix the thin flexible wire in such a way that it will definitely break when someone turns the vehicle's handle to move it. The author's prototype wired on a general-purpose PCB and fitted in a plastic box is shown in Fig. 5. EFY

BONUS. You can watch the VIDEO of the tutorial of this DIY project at: *https://www.electronicsforu.com/videos-slideshows/live-diy-security-alarm-scooty-bike*

S.C. Dwivedi is an electronics enthusiast and circuit designer at EFY

EFY TESTED Ashwini K. Sinha

OBJECT DETECTION And CLASSIFICATION Using Edge Impulse On Raspberry Pi

AKANKSHA GUPTA AND SAGAR RAJ

If machines could recognise objects the way human beings do, it would be quite interesting. Object detection is a trending topic nowadays. So let us make an object detection camera that can do live classification of objects and people, and every activity is displayed live on web using an IP address.

We will use Edge Impulse to train an ML model and integrate it with a computing machine (Raspberry Pi) and acquire live video and images through camera interfacing. The project will be able to work with the internet and without the intranet. Using the internet, we can use the project for activities like:

- Live door monitoring to alert when an unknown person enters
- In industry to do object classification and separation using robotic arms
- Counting of fruits on a tree or in a separator

There are various versions and flavours of OS available for Raspberry Pi but we need to prepare the SD card with the latest OS. To load the OS on SD card, follow the steps mentioned below:

1. Download Raspberry Pi Desktop Imager on a PC.
2. Launch the Raspberry Pi Imager
3. Choose OS as Raspberry Pi OS (32-bit)
4. Choose SD card
5. Select Write
6. Insert SD card into Raspberry Pi
7. Connect Raspberry Pi to power, keyboard, mouse, and monitor
8. If OS is properly installed, you will see "Welcome to Raspberry Pi Desktop" message.

Now, with the OS ready, connect the USB camera or Raspberry Pi camera. If Raspberry Pi camera is used (connected with a ribbon

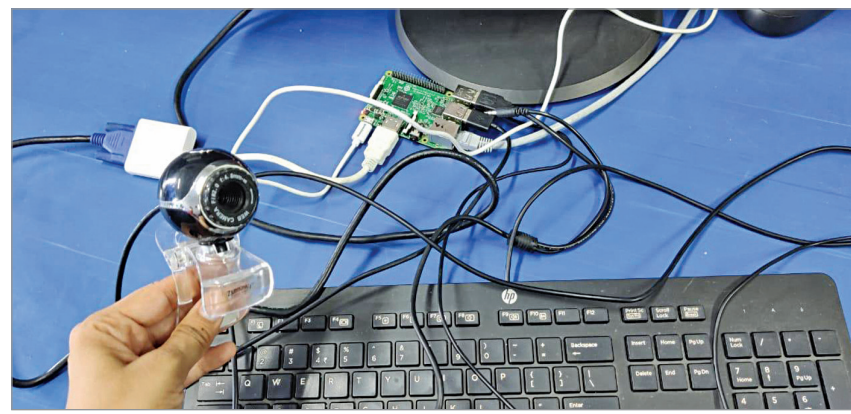


Fig. 1: Author's prototype

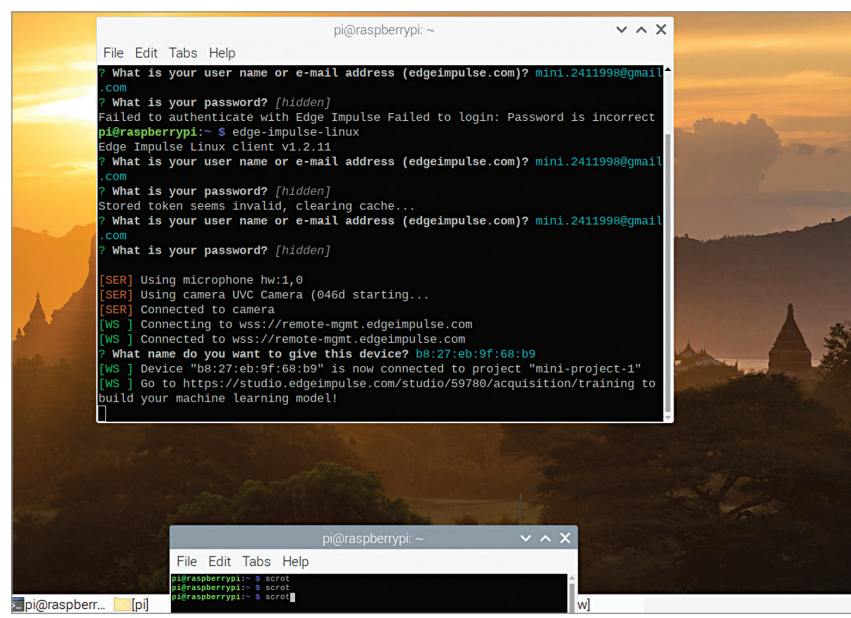


Fig. 2: Running Edge Impulse engine

BILL OF MATERIAL

1. Raspberry Pi 3 B-1
2. USB camera/Raspberry Pi camera-1
3. Keyboard-1
4. Monitor-1
5. Mouse-1
7. SD Adaptor (32GB)
8. HDMI to VGA cable
9. 5V power adaptor with USB Type-C connector
10. SD card reader

cable), first enable the camera interface in Raspberry Pi config setting. Then install Edge Impulse on Raspberry Pi by running the following commands on terminal:

- *curl -sL https://deb.nodesource.com/setup_12.x | sudo bash -*
- *sudo apt install -y gcc g++ make build-essential nodejs sox gstreamer1.0-tools gstreamer1.0-plugins-good gstreamer1.0-plugins-base gstreamer1.0-plugins-base-apps*
- *sudo npm install edge-impulse-linux -g --unsafe-perm*

After setting up Edge Impulse, create and train the ML model. So, open the Edge Impulse website and then enter your name and email id and sign up. Create a new project in Edge Impule, open Linux terminal and run the command *edge-impulse-linux*

When you select the project, your device will try to connect with Edge Impulse. If the connection is proper, the device detection of the Edge Impulse Raspberry Pi cam will be shown, and you will get a link. Open the link in a web browser and get the data acquisition interface to take a photo or any other data for ML mode. Photos can be taken of objects like a bottle or cup, and any other item (including human beings) for the ML model.

For data acquisition, take at least 100 photos of the different objects that you want to classify and use for training and testing the ML model. To rebalance the data, the ratio of splitting should be 70:30.

Go to dashboard, where the Labeling Method should be bounding boxes (object detection). Label all the objects and see this in Labeling Queue. Then go to Impulse Design, where the image width and image height should be 320*320. You may change the object detection pro-

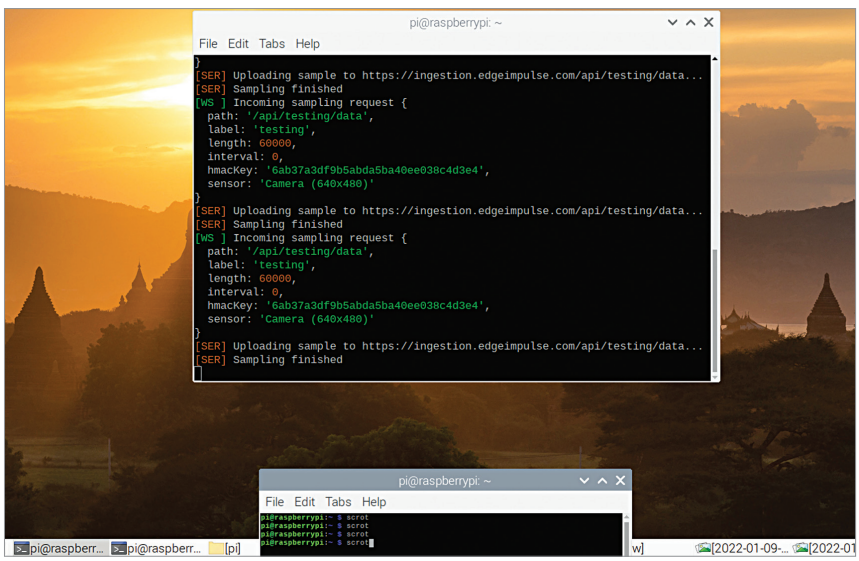


Fig. 3: The terminal

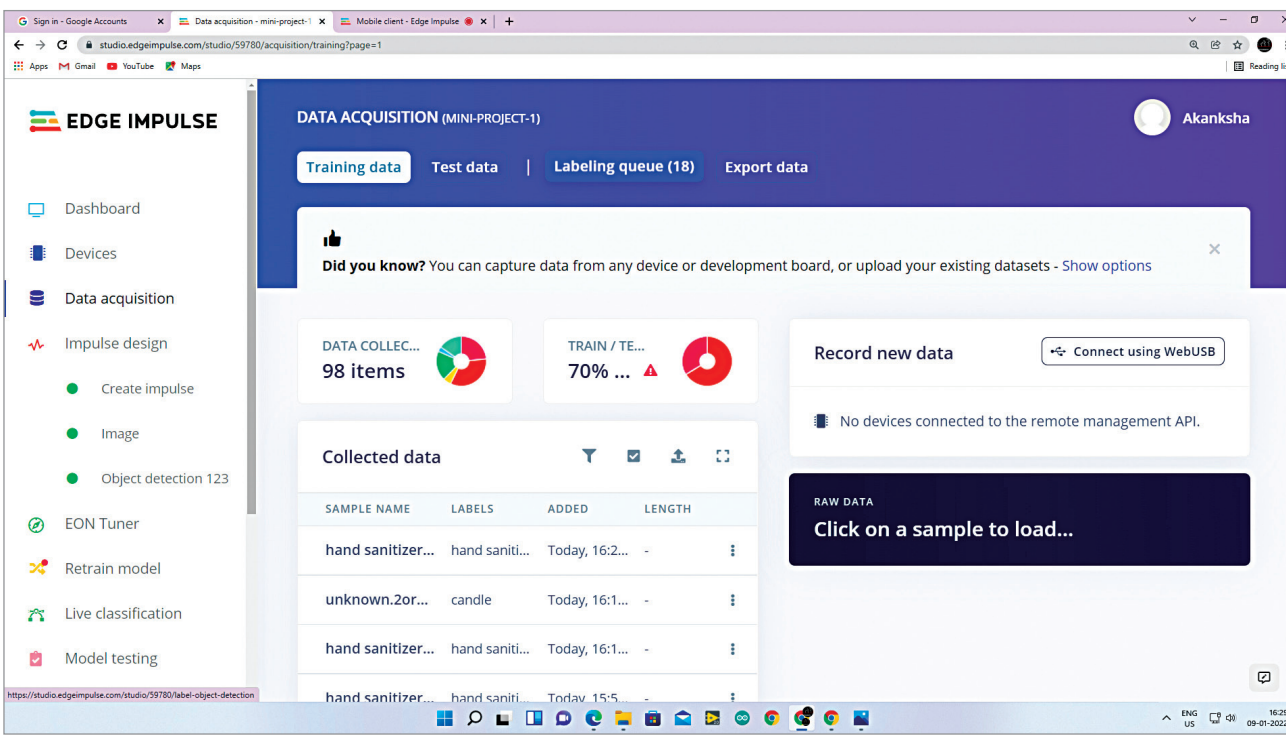


Fig. 4: Data acquisition

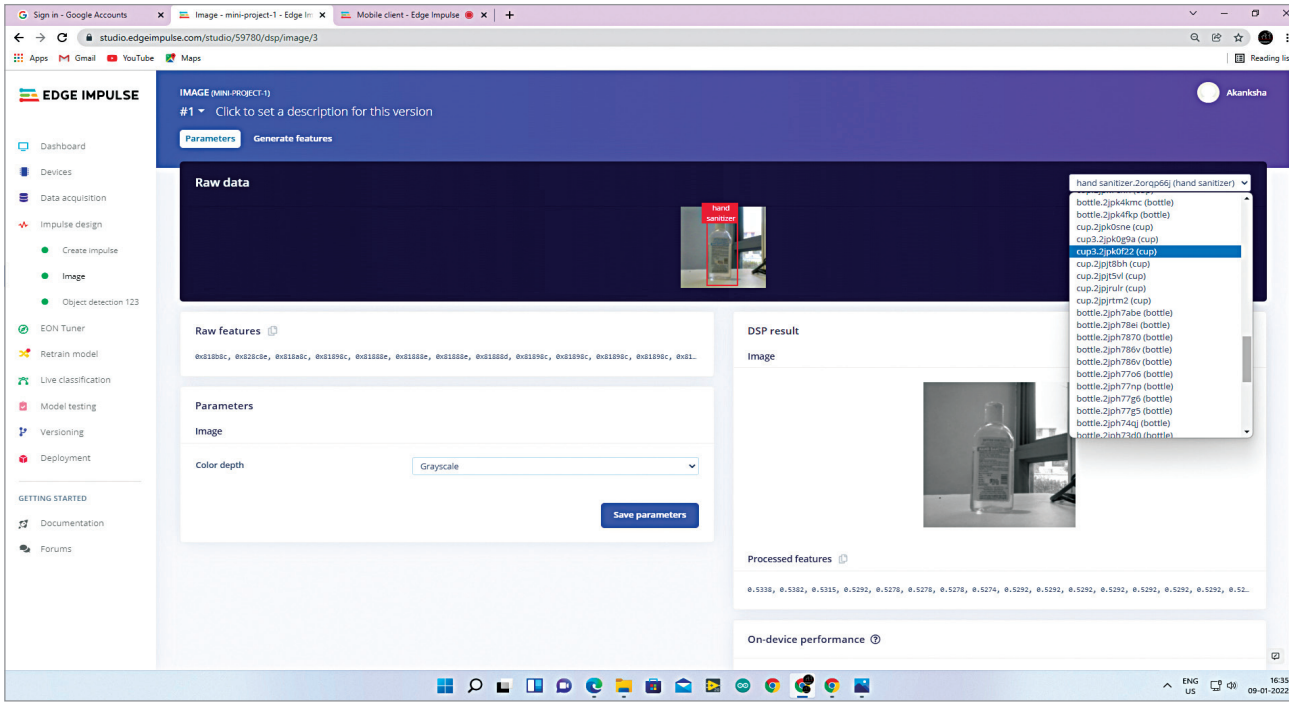


Fig. 5: Generating feature

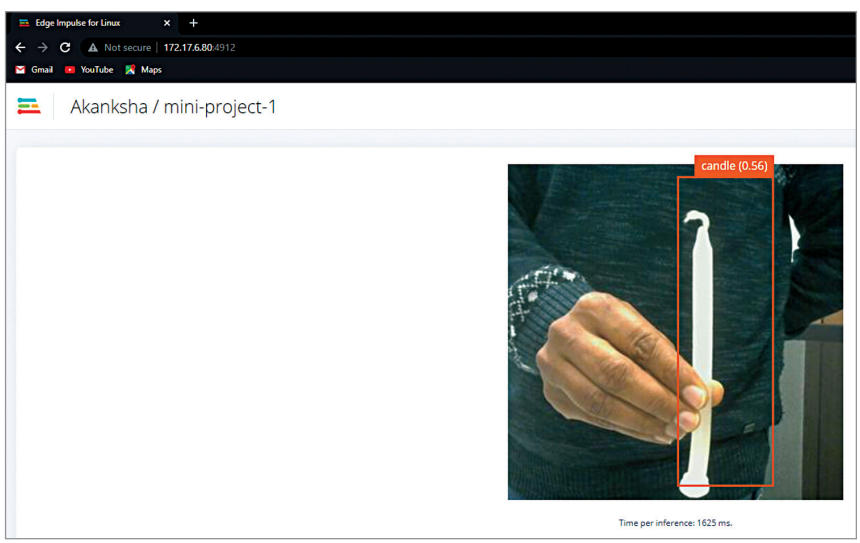


Fig. 6: ML model showing live classification

ject's name and then click on Save Impulse.

In the Image section, configure the processing block and select raw data on top of the screen. Now save the parameters either in RGB or Grayscale.

Due to different dimensions of the images, dimension reduction takes place.

In the Object Detection section, the number of training cycles and learning rate can be set. In the author's prototype the number of training cycles was set at 25 and the learning rate at 0.015.

You can now start training the model. After training the model you can get a precision score. For validating your model, go to Model Testing and select Classify All. Then go to live classification.

Put an object in front of the camera and the video of object can be seen in Live Classification section of Edge Impulse without any label of the classified and detected object, such as the bottle, cup, or a person. If you want to see it with IP address, run the command *edge-impulse-linux-runner*

This command builds and downloads the model in Raspberry Pi and gives an IP address to see live classification. When you open this IP address in browser you can see the output *http://192.168.1.19:4912* EFY

Akanksha Gupta is M.Tech in Electronics and Communication from NIT Jalandhar. She is a Research Scholar in the Electrical department of IIT Patna. She is interested in designing real-time embedded systems and biomedical signal processing

Sagar Raj is Founder and Director at Shoolin Labs, Jaipur (Rajasthan). He is Founder and Director at Lifegraph Biomedical Instrumentation, Buxar, and IoT Trainer at Lifegraph Academy, Incubation Centre, IIT Patna

EFY TESTED S.C. Dwivedi

AN LED GLOBE THAT BLINKS
When ISS Passes Overhead

ARPAN MONDAL

If you are a space enthusiast and like to look at the stars, chances are you are already familiar with the ISS. The ISS, or International Space Station, revolves around the earth six times each day. If you are interested in the ISS, like the author who is an aerospace engineering student, you will love this project.

This easy-to-make device is a small hemispherical lamp that gives a mild glow when connected to a power supply. But when the ISS passes over its location, the lamp starts blinking for about 30 seconds to a few minutes. The author's prototype is shown in Fig. 1.

All you need to make this project is a node microcontroller (nodeMCU), a 5mm LED, a bit of wire, thick cardboard to make

Fig. 1: Author's prototype

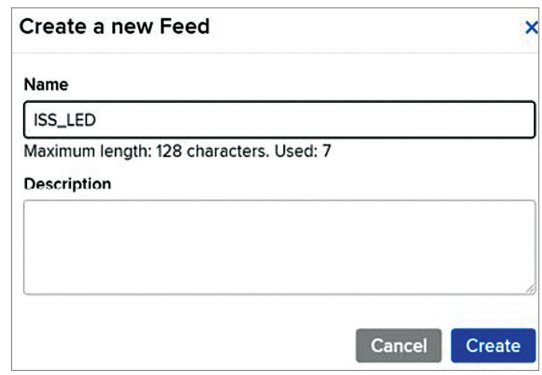


Fig. 3: Step 2 to create a feed on Adafruit

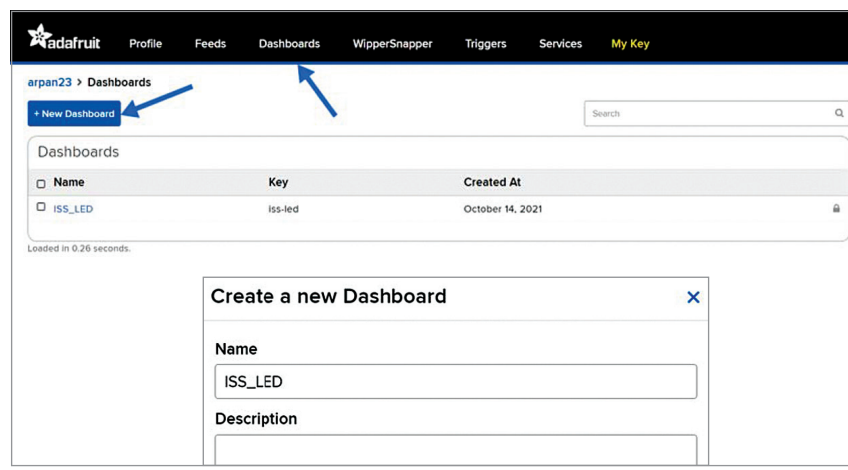


Fig. 4: Creating a dashboard

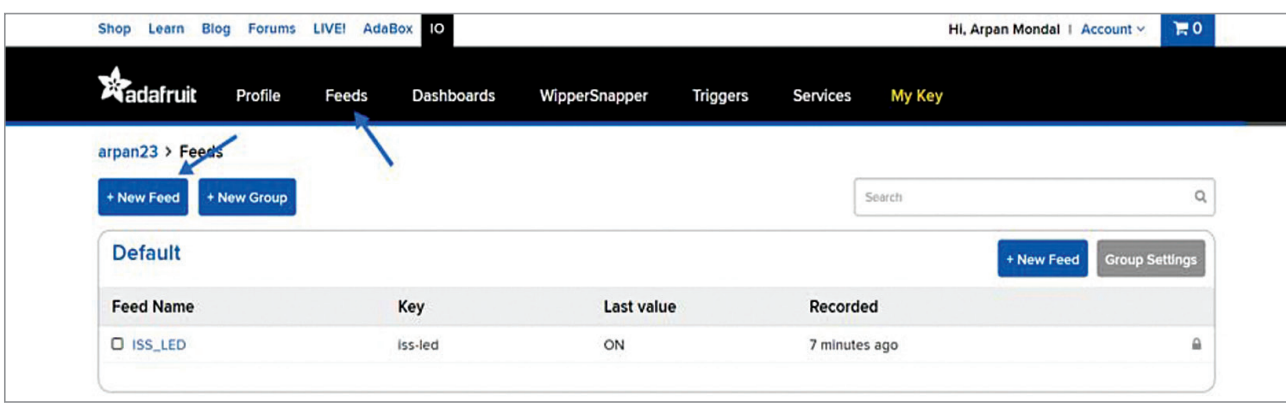


Fig. 2: Step 1 to create a feed on Adafruit

Fig. 5: Creating a new block

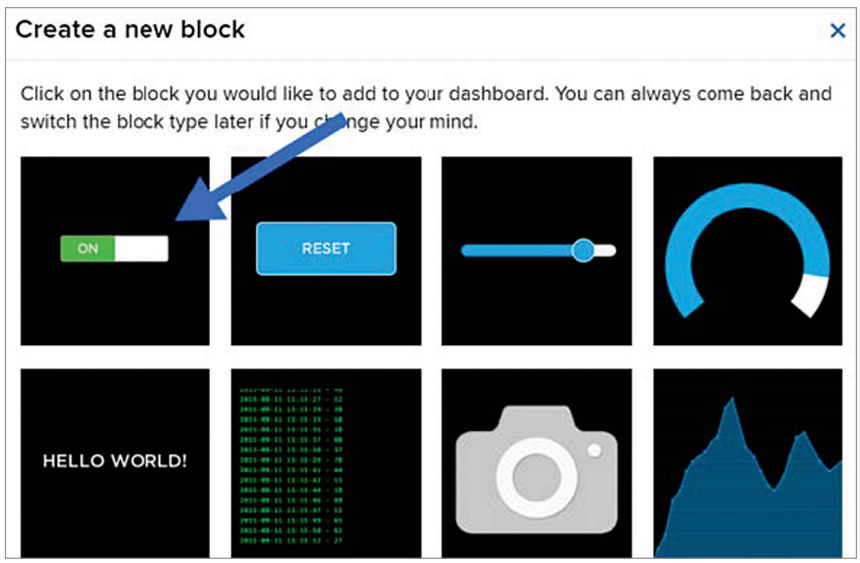


Fig. 6: Selecting toggle switch as your block

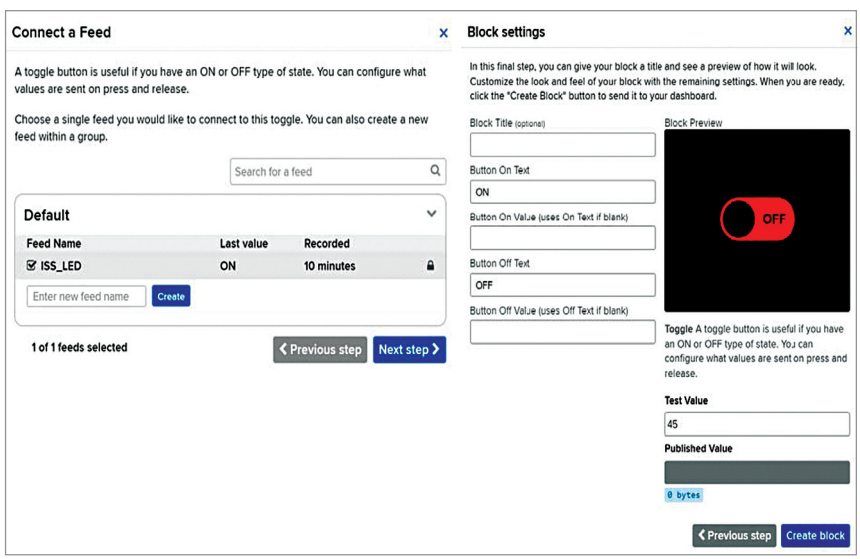


Fig. 7: Configuring the toggle switch

the stand, and the globe to work as a lamp.

For testing this project, you need Adafruit IO and IFTTT platforms. Adafruit IO is a cloud service designed for the users to display, respond, and interact with their data safely and securely in the cloud. IFTTT derives its name from the programming conditional statement "if this, then that" and is a software platform that connects apps, devices, and services from different developers to trigger one or more automations involving them.

To make the project, first set up Adafruit IO and then install the IFTTT app, which is easily available for free on internet. To set up Adafruit, open the website io.adafruit.com, create an account, and login. Then follow the steps mentioned below:

1. Click on Feeds in the top bar and select New Feed, as shown in Fig. 2.

Give a name to your feed. You may use the same name that has been used for the project (see Fig. 3), which is ISS_LED, as this will make the programming easier.

2. Click on Dashboards in the top bar and select New Dashboard, as shown in Fig. 4. Give it the same name as your feed, that is, ISS_LED.

3. Click on the dashboard you created and select the gear icon on the right (see Fig. 5). Then select 'Create a new block' and click on the toggle switch (see ON in Fig. 6).

4. Select your feed name (ISS_LED in this case) in the popup window and click on Next Step. In the next window, don't change anything, just click Create Block.

5. Once your block has been created, click on My Key in the top bar (see Fig. 2) and note down your Username and Active Key, which is unique to your project. Do not share these with anyone as they may mess up your project (see Fig. 8).

Now that the Adafruit set up has been completed, you can set up IFTTT after downloading the IFTTT app (or you can just use the desktop site). To set up IFTTT, follow the steps below:

1. Click on Create (bottom left in Fig. 9) and select If This box. Search Space in the search bar and click on it. Click on 'ISS passes over a specific location' box and select your location.

Now click on Then That block and search for Adafruit on the search bar. Click on 'Send data to Adafruit IO' (see Fig. 10), select the feed name (ISS_LED), and type ON in the 'Data to save' field.

After configuration of Adafruit and IFTTT has been done, all that is left is to upload the code. To recap, we have created a toggle switch on Adafruit that can control your NodeMCU via Wi-Fi. And we have created an applet on IFTTT that toggles the Adafruit switch every time the ISS passes over the selected location.

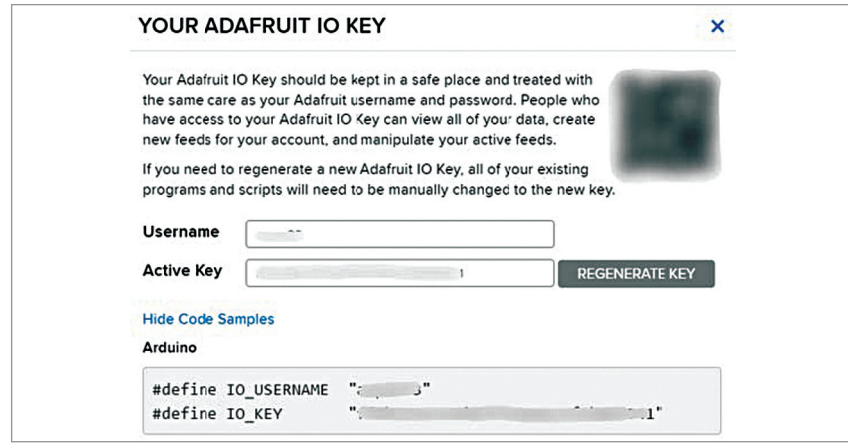


Fig. 8: Entering your Adafruit active key

The code

The heart of the ISS globe is the NodeMCU, which needs to be coded to work the way we want it to. Make sure you have the NodeMCU and Adafruit mqtt libraries installed on your Arduino IDE. The source code ISS_LED_SAMPLE.ino shown in Fig. 11 needs to be changed a bit for it to work.

Make following changes in the sample code:

- Replace SSID with your Wi-Fi (or mobile hotspot) name.
- Replace PASSWORD with your Wi-Fi (or mobile hotspot) password.
- Replace Adafruit ID with your Adafruit username.
- Replace AIO KEY with the active key you had noted after creating the Adafruit toggle switch.

If you named your Adafruit feed as ISS_LED you are done with editing of the code. But if you have used a different name, replace ISS_LED everywhere in the code with the name you have used.

This code keeps the LED turned off by default. When the ISS arrives, the LED starts blinking. In case you want the LED to remain on by default, you can replace *digitalWrite(led,LOW)*; with *digitalWrite(led,HIGH)*; in the first line of the void loop() function.

Now you can go ahead and upload the code to your NodeMCU. Please note, during testing, EFY Lab

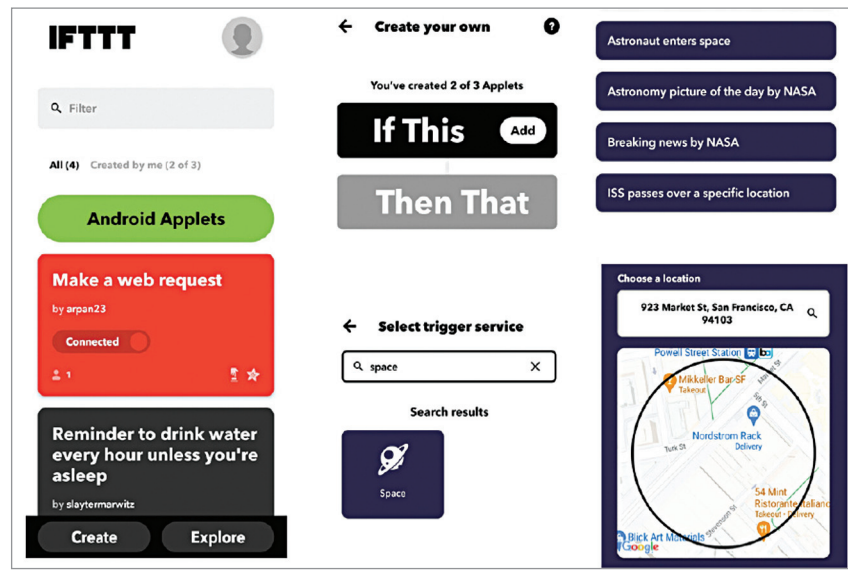


Fig. 9: Configuring If This block on IFTTT

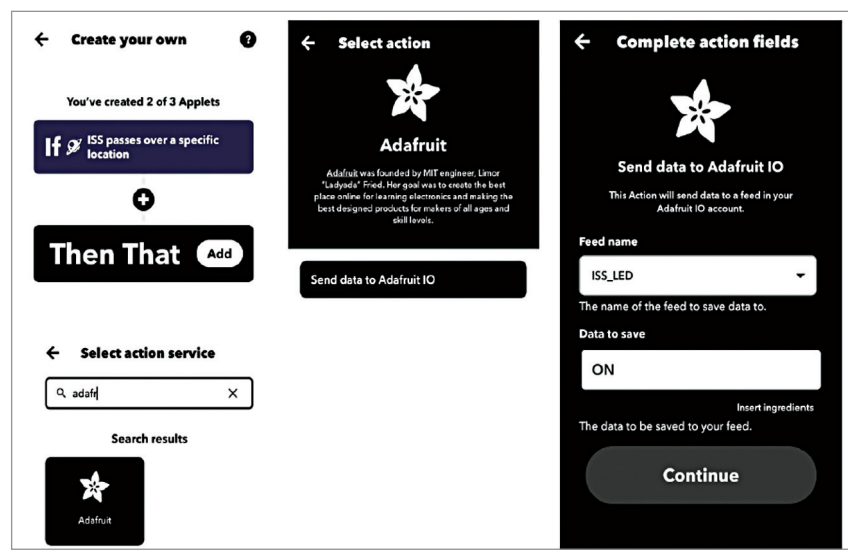


Fig. 10: Configuring the Then That block on IFTTT

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

```
ISS_LED_SAMPLE | Arduino 1.8.9
File Edit Sketch Tools Help
ISS_LED_SAMPLE
#include <ESP8266WiFi.h>
#include "Adafruit_MQTT.h"
#include "Adafruit_MQTT_Client.h"

#define WIFI_SSID ".....SSID....."//Your wifi name
#define WIFI_PASS ".....PASSWORD....."//your wifi passw
#define MQTT_SERV "io.adafruit.com"
#define MQTT_PORT 1883
#define MQTT_NAME ".....Adafruit ID....." //Your adafru
#define MQTT_PASS ".....AIO KEY....." //Your adaf

int led = D7;
```

Fig. 11: The sample code that needs to be modified

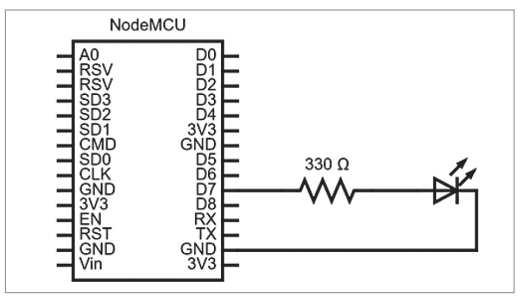


Fig. 12: NodeMCU connections

USERNAME was efytech2 and #define IO_KEY was aio_sXlY05Iri6o3ueuWYL-LY5KnZIcAa, which were included in the source code ISS_LED_SAMPLE.ino before uploading. For location of the ISS, the website *https://www.astroviewer.net/iss/en/* was used.

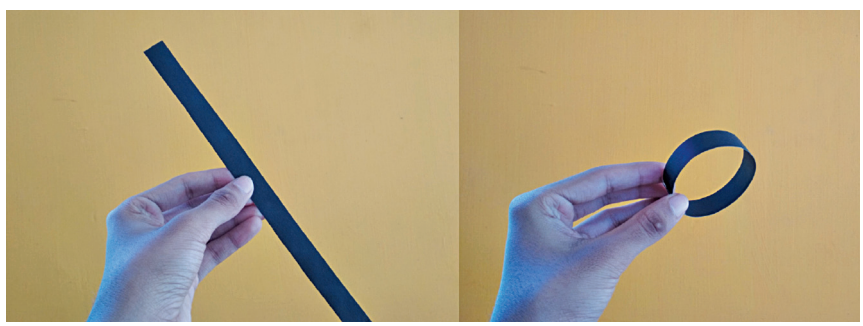


Fig. 13: Making cardboard base of the lamp

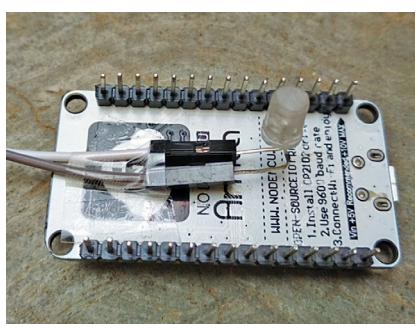


Fig. 14: NodeMCU and LED placed at the bottom

Fig. 15: Diffuser placed on top of the base

The circuit

In this last step of getting the project working, connect the LED to D7 pin of your NodeMCU. The 330-ohm resistor in series (as shown in Fig. 12) is used to limit the current through the LED.

To make the base of the lamp, you may cut a strip of black cardboard and roll it into a cylinder. The height of the cylinder (width of the strip) should be a bit more than the height of the NodeMCU when it is resting on its pins. The dia of the cylinder should be the same as that of diffuser's base.

Cut another piece of cardboard in circular shape with its diameter equal to the diameter of the cardboard cylinder and stick the cylinder to it with adhesive. Place the NodeMCU and the LED inside this cardboard base and place the diffuser on top (refer Fig. 13 through Fig. 15).

Your very own ISS overhead indicator is now ready. Every time the ISS passes over your location, the lamp will let you know.

The ISS crosses a location once or twice most days (sometimes at dead of night when it may not get noticed). There are some days when it does not show up at all, but that's rare.

It feels good to know there are people working up there in ISS and it is exciting when they are just overhead. When ISS arrives after sunset, you can even run out and have a look at it moving in the sky and may be wave a hello! EFY

Arpan Mondal is pursuing aerospace engineering and is an innovative projects creator. He also likes playing guitar and sketching

EFY TESTED Ashwini K. Sinha

MagSafe Enabled WIRELESS POWER BANK

ASHWINI KUMAR SINHA

MagSafe, a magnetic technology embedded into the internal engineering of iPhone 12 model, was originally created as a safety feature for MacBook charging cords. It creates a new ecosystem of accessories for easy attachment and faster wireless charging. The cost of a wireless

BILL OF MATERIAL

Component name	Quantity	Description
Inductor coil	1	For wireless power
5V stepup charging BMS	3	5V stepup charging module
Wireless power TX module	1	Power transmitter
3.3V rechargeable battery	2	2000mAh or 1000mAh
3D printed case	1	Powerbank case

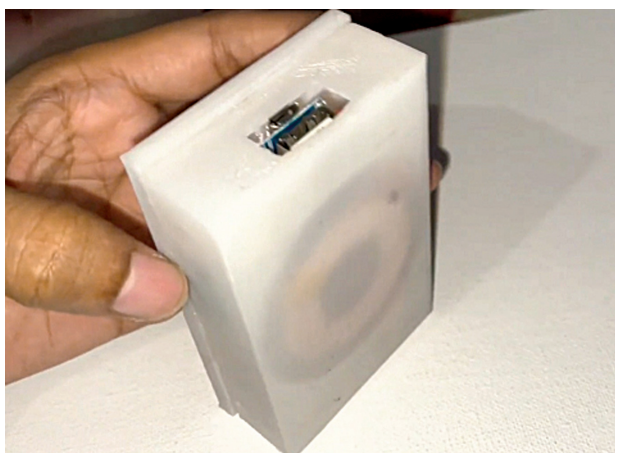


Fig. 1: MagSafe enabled wireless power bank

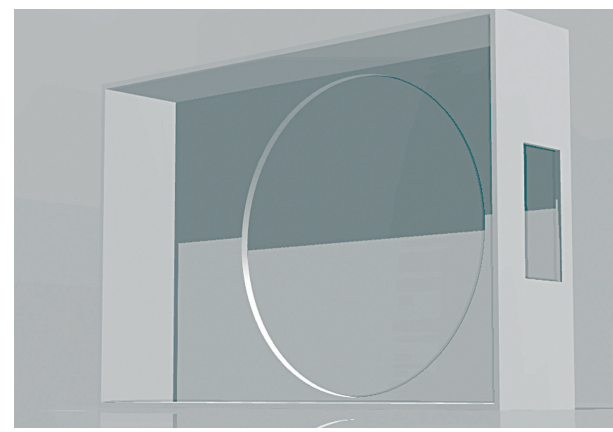


Fig. 3: Case design

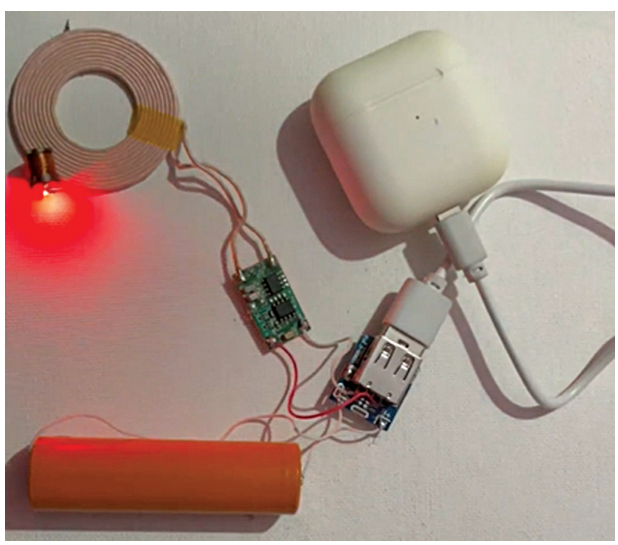


Fig. 2: Components used

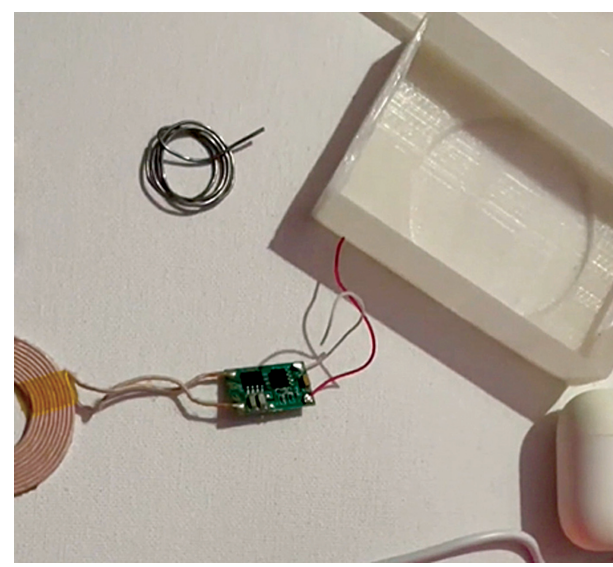


Fig. 4: 3D printed power bank case

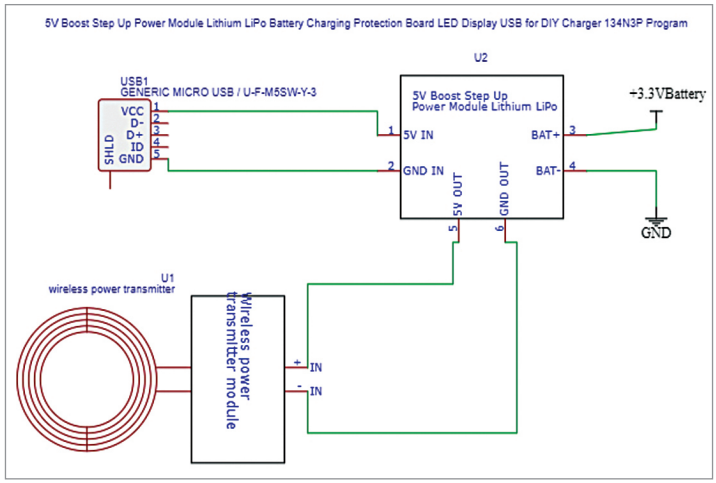


Fig. 5: Wireless power bank circuit

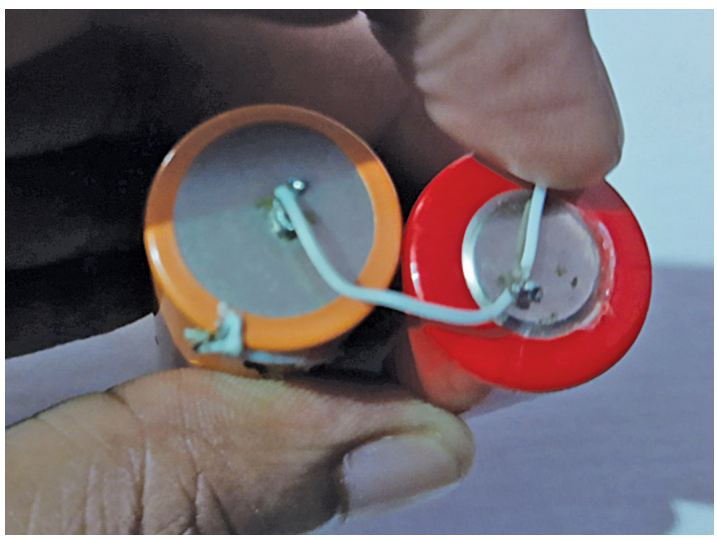


Fig. 6: Connecting the batteries in parallel

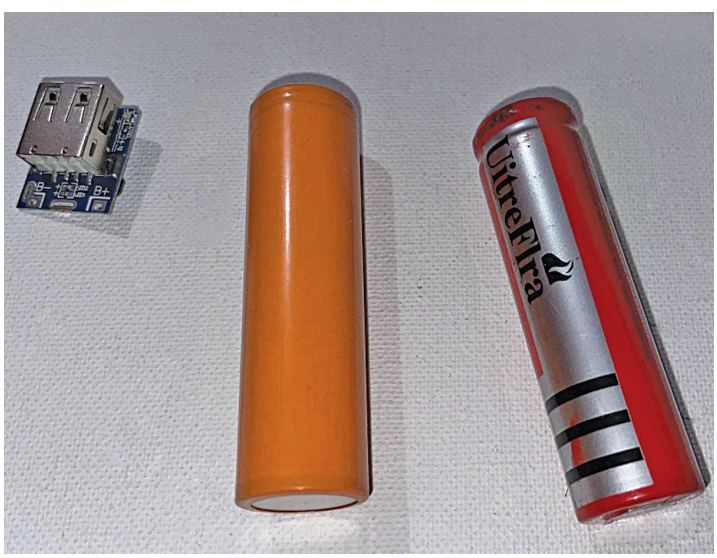


Fig. 7: The module and battery cells

power bank with MagSafe ranges from ₹5000 to ₹7000. Apart from being expensive, it is difficult to procure from the market.

This DIY project is of a wireless power bank with MagSafe, which can not only charge iPhones but also other compatible devices (including IoT devices). It offers the benefit of having a wireless powering system, MagSafe technology, and a USB charging system that is compatible with many devices.

Designing

The size of the battery is important for designing a proper case. Both the battery and the

Fig. 8: Battery terminal soldered

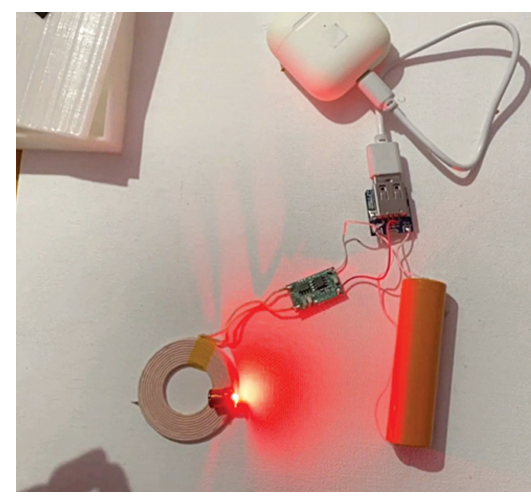


Fig. 9: Wireless transmitter charging module connected to the charger module

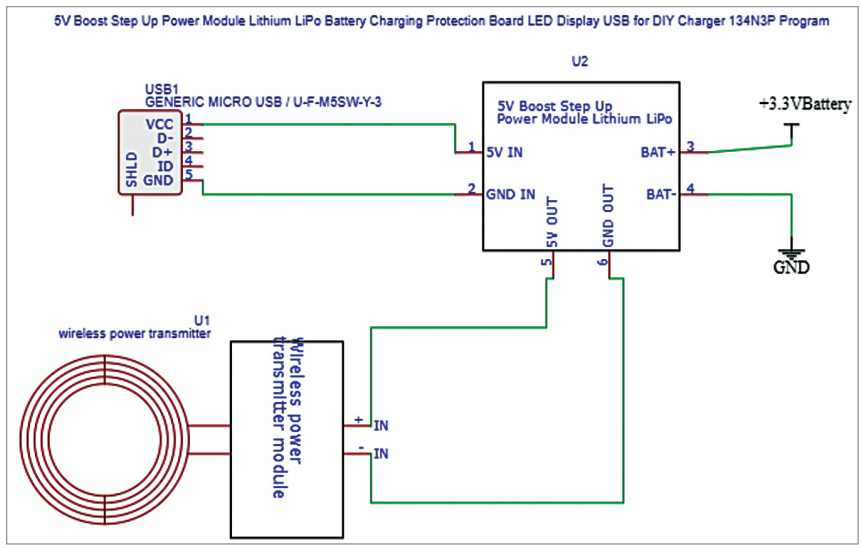


Fig. 10: The circuit diagram

charging module have to fit inside the case, which has to be cut to make provision for input power charging (USB) and output power. A cavity is also made on one wall of the case for the coil and MagSafe magnet to be placed, as shown in Fig. 3.

For the circuit, we can either use a 5V step-up battery management IC or a module. A TP4056 one-ampere battery charging module was used in the author's prototype. The module's output is connected to a wireless transmitter, as shown in Fig. 5.

Connections

The battery terminals are soldered

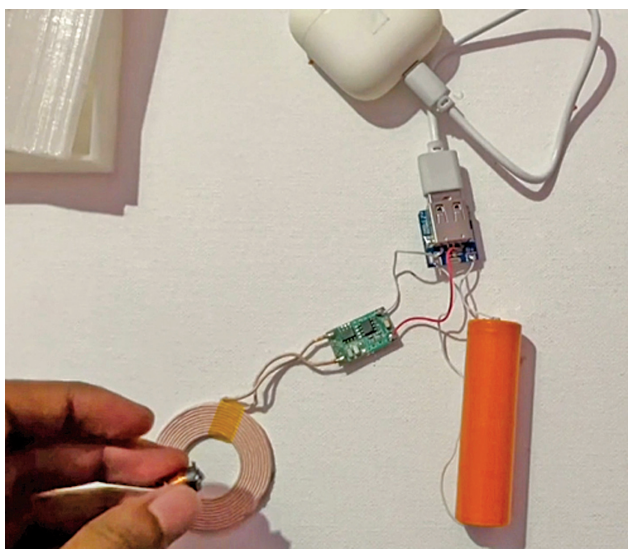


Fig. 11: Fixing the coil and magnet

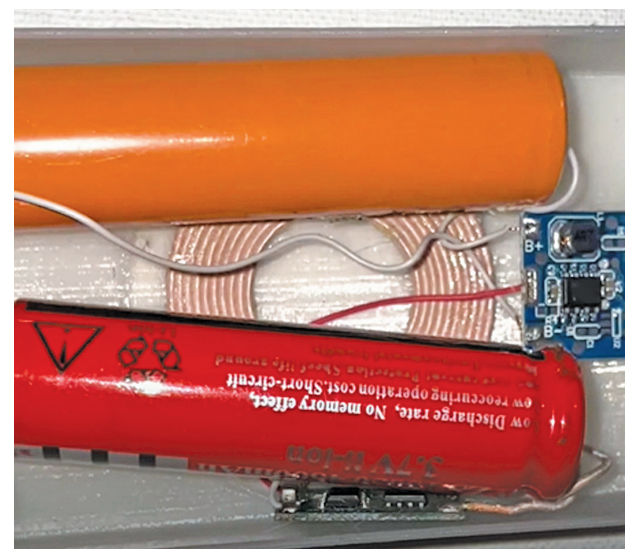


Fig. 13: An inside view

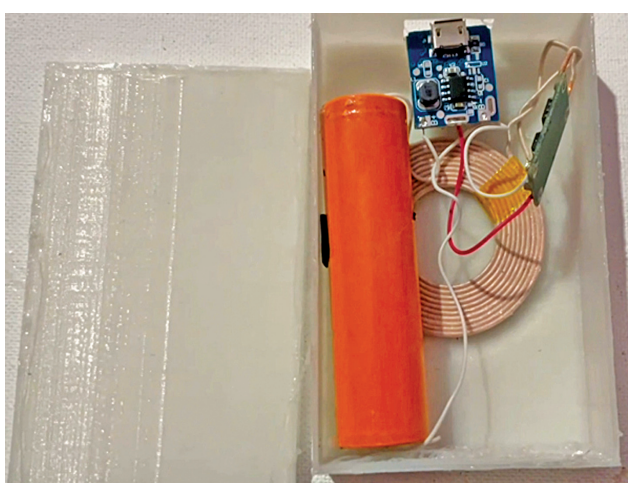


Fig. 12: Fixing the coil and circuit along with battery

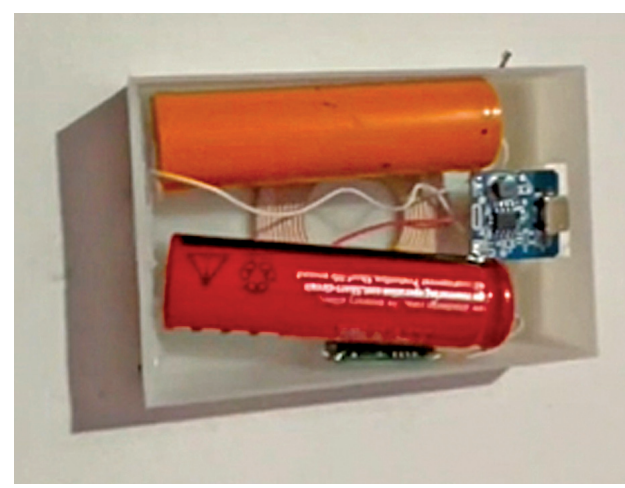


Fig. 14: Author's prototype without the top cpver

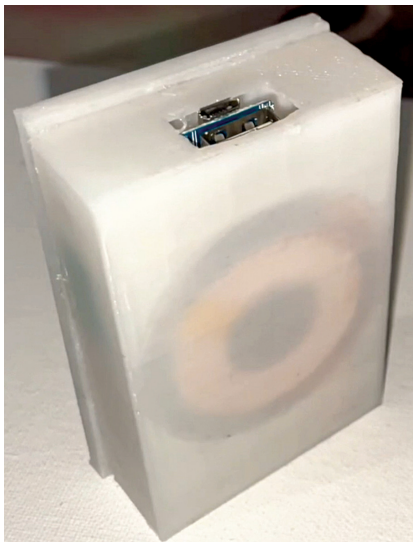


Fig. 15: The author's prototype

Fig. 16: Testing power bank and charging AirPods

Fig. 17: Testing power bank's wireless charging system by powering LED wirelessly

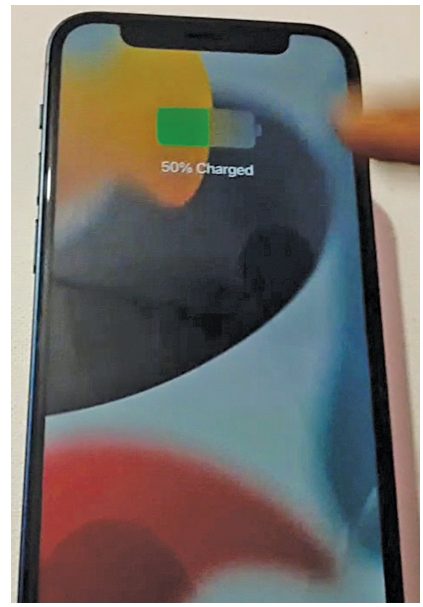


Fig. 18: A phone being charged

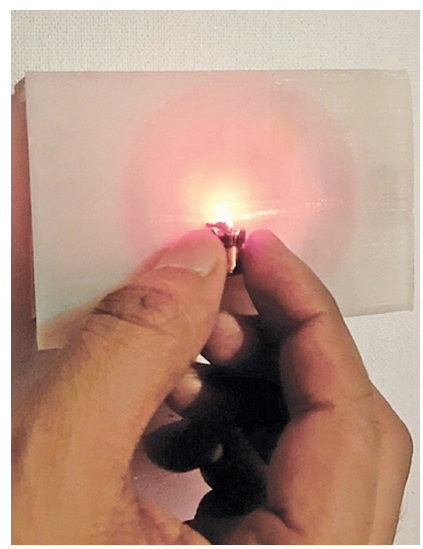


Fig. 19: LED glowing to indicate power transfer

either with the wires directly or a battery pack connector strip. In case of multiple batteries being used, make sure to connect the batteries in parallel (see Fig. 6). Next, connect the battery step-up charging module as shown in the circuit diagram. The wireless charging coil should now be soldered with the input of the wireless power transmitter module and its output with the charging module output pins (see Fig. 7 through Fig. 10).

The coil may now be fixed in the cavity with a magnet for MagSafe. Above this fix the battery along with the BMS module in USB cavity of the 3D-printed case. Finally, fix the top cover (see Fig. 11 through Fig. 14). For MagSafe, fix the circular magnet in cavity with glue.

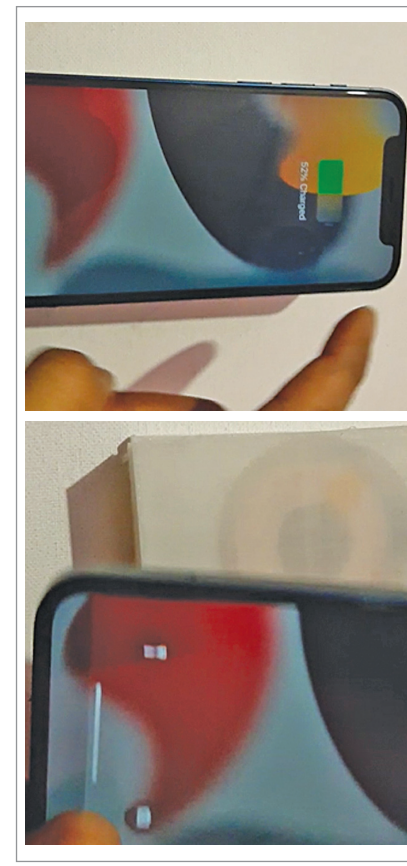


Fig. 20: Phone charging

Testing

To test the circuit, plug in any device to the USB and notice it charging. (In the pictures an Airpod case is shown plugged in.) Next, bring any wireless device (a wireless LED is shown in the pictures) and see the LED glowing, as shown in Fig. 19, as the power bank emits power in the form of electromagnetic waves. A phone can be charged by placing it on the device, as shown in Fig. 20. EFY

Ashwini Kumar Sinha is a technology enthusiast at EFY

EFY TESTED Sharad Bhowmick

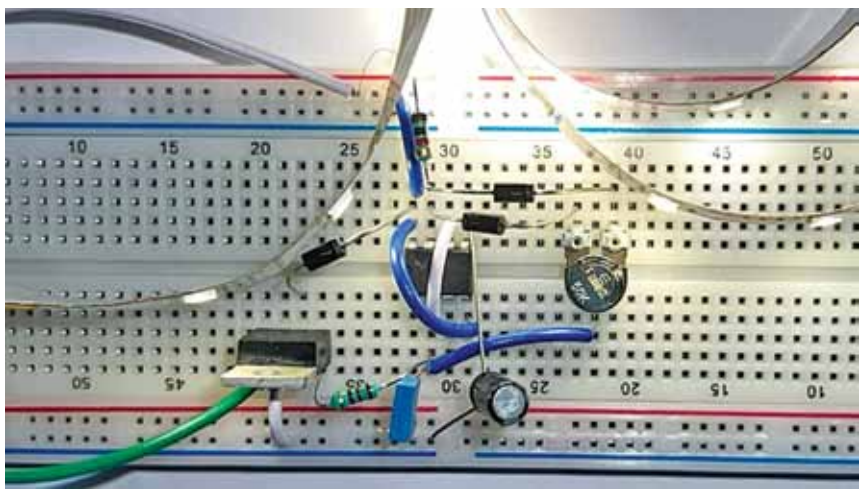
LEDs' LIGHT INTENSITY CONTROLLER
Based On PWM Technique

SHARAD BHOWMICK

This article describes how a simple circuit can be designed to control the intensity of a string of LEDs. The circuit is based on a common 555 timer IC that employs pulse width modulation (PWM) technique to control the voltage. The 555 IC is driven in an astable mode. The same circuit can be used to control the speed of a DC motor as well.

The most important component in this project is the 555 timer IC along with the MOSFET that works as a switch. The circuit works like a power electronics buck converter, which can be used to step down the DC voltage.

Components required for the project are listed in the table below.



The circuit on a breadboard

BILL OF MATERIAL

- 555 Timer IC
- IRFZ44N
- 1k Resistor
- 200-ohm Resistor
- 100nF Capacitor
- 1nF Capacitor
- 3×IN4001 Diode
- 100k Potentiometer

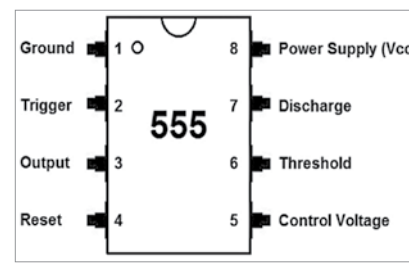


Fig. 2: Pin diagram of 555 timer

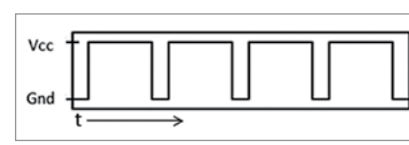


Fig. 3: Example of a PWM signal

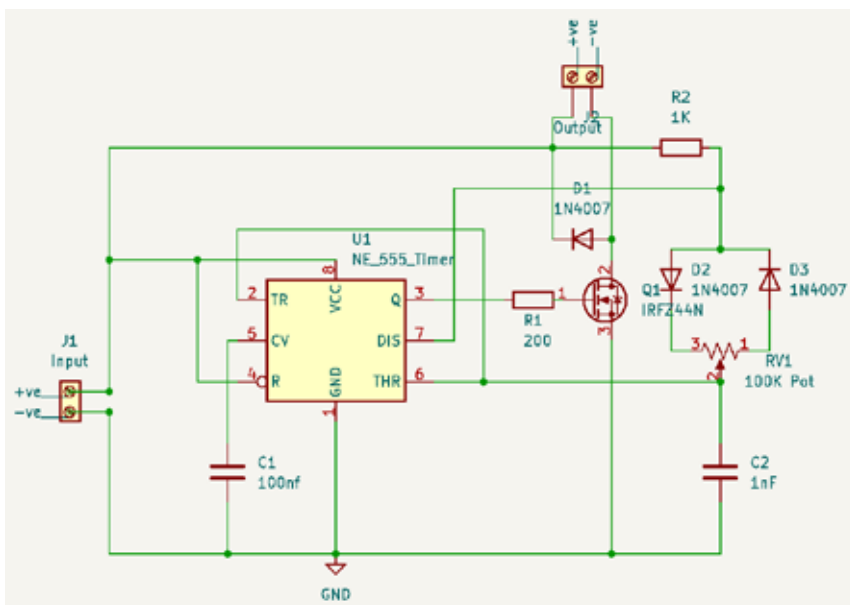


Fig. 1: Circuit diagram

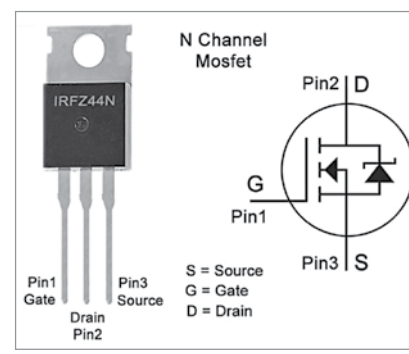


Fig. 4: Pin configuration of IRFZ44N

Designing a PWM LED controller using 555 timer is absolutely straightforward and requires only a few components. From the diagram shown in Fig. 1 it is clear that the whole circuit is built around the 555 IC as the PWM generator. Hence, we can control the switching frequency and therefore the brightness of the LEDs with the help of passive and active components connected to it.

The 555 timer is a commonly used 8-pin integrated circuit (IC) that is used for a variety of applications, including pulse generator, oscillator, and timer. The operating voltage of the IC may vary from 4.5V to 16V. Fig. 2 shows different pins of the 555 IC.

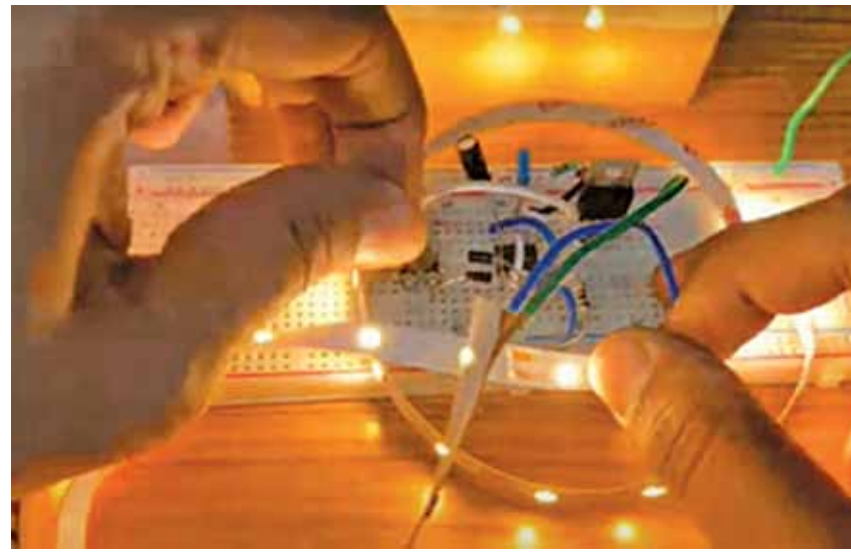


Fig. 5: Author's prototype showing maximum illumination of LED strip

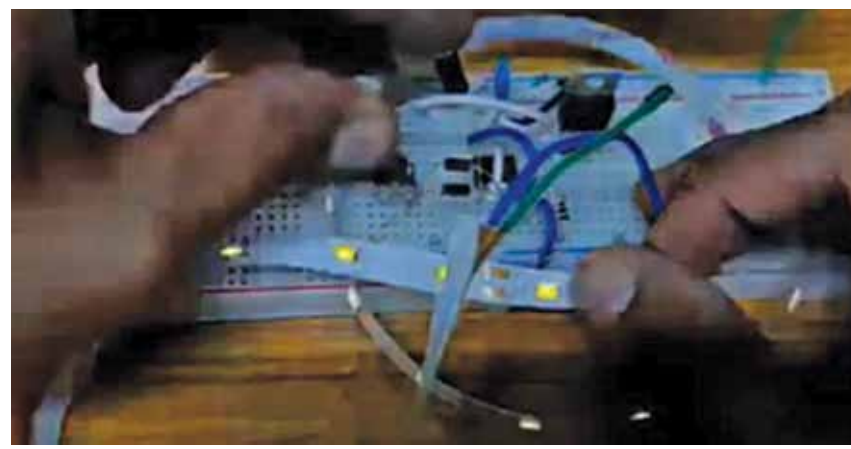


Fig. 6: Brightness of LED strip reduced using potentiometer

PWM control using 555 IC

Before delving further into the circuit, let us understand the technique of PWM, which is also known as pulse duration modulation. It is a method of controlling the average power delivery by pulsating the DC current. In this circuit, the average power is controlled (reduced) by effectively chopping it up into discrete parts by connecting and disconnecting the power source in fast succession.

To achieve a PWM signal, the 555 timer is driven in an astable multivibrator mode. As the name suggests, the 555 timer has no stable state in this mode, but rather two quasi-stable states that change from high to low and low to high. In simpler words, in this mode the 555 timer turns on and off at a very high speed, which can be considered as 0 and 1 in the binary context, thus producing a square wave signal, as shown in Fig. 3.

Connecting the 555 IC

• Pin 1 is the ground pin and is connected to the -ve rail.

• Pin 8 is the VCC pin and is connected to the +ve rail.

• Pin 2 and pin 6 are the trigger pin and threshold pin, respectively, which are connected with the ground through a 1nF capacitor timing capacitor.

• Pin 3 is the output pin, which emits the PWM signal and is connected to the gate of the MOSFET.

• Pin 4 is the reset pin, which can be used to reset the operation. But we are not using it, so connecting it permanently to the +ve rail.

• Pin 5 is the control voltage pin, which is connected to the ground with a 100nF capacitor. It keeps the output stable and provides immunity against electrical noises.

• Pin 7 is the discharge pin, which is connected to the +ve input with a 1k resistor and is also connected to the inverted diode setup and helps change the duty cycle.

IRFZ44N for high-speed switching

The 555 timer IC is capable of outputting a small amount of current as an output, which can be directly used only for a handful of LEDs. But in order to drive a long LED string, or control the speed of a motor, the current is not enough. To overcome this problem a MOSFET is used in the circuit whose gate is connected to the output of IC 555. The N-channel MOSFET used provides a negative switching control to the circuit.

For our circuit we are using N-channel MOSFET IRFZ44N as a

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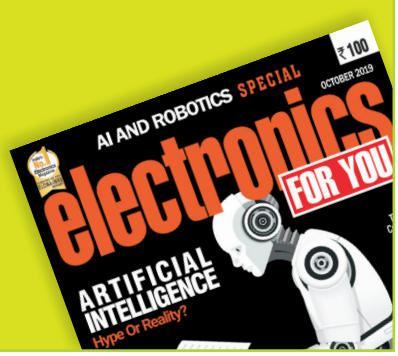

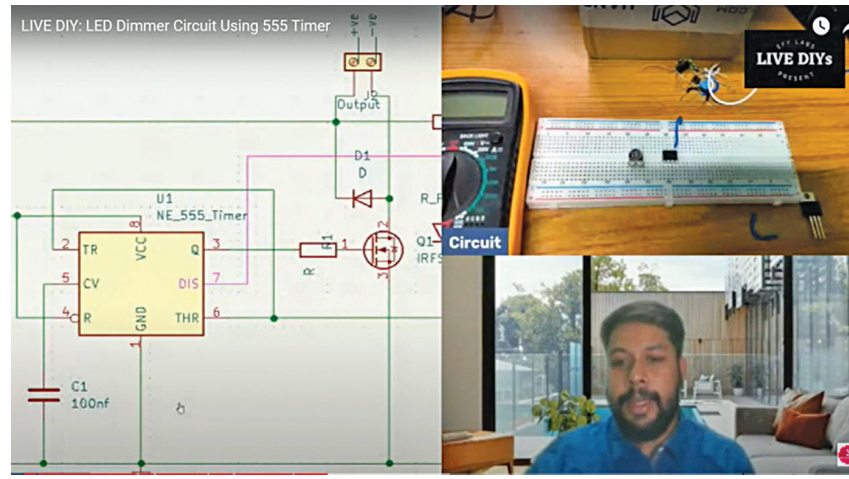

Fig. 7: Screenshot from recorded video of the project's demonstration

switch, which can be excited by the output of 555 timer and is suitable for the voltage requirement of our load. It has following specifications:

VDSS = 55V
RDS(on) = 17.5mΩ
ID = 49A

Controlling intensity of LED

As mentioned earlier, passive components in the resistor and capacitor (RC) network can be used to control the duty cycle and therefore the brightness of the LED.

Duty cycle (D) = PW/T

Here, D = Duty cycle, PW = Pulse Width (pulse active time), and T = Total period of the signal

Duty cycle represents the ratio of time when the load is connected to the power compared to the time load is not connected to the power. The higher duty cycle means that the load is connected to the power source for a longer duration compared to a lower duty cycle.

This technique can be used to control the intensity of LEDs or the speed of a motor, When the duty cycle is high, the LED glows brighter or the speed of the motor will be greater. To reduce the intensity of the LEDs, or to reduce the RPM of the motor, the duty cycle needs to be reduced.

Intensity of LEDs = (On time/total time) × max illumination

Speed = (On time/total time) × max speed

Testing

To check whether the circuit works properly or not, you may use a 12V battery pack (like the author) as input. Since we are using an N-channel MOSFET and providing a negative switching control, the positive terminal of the load is always connected while the negative terminal is connected to the drain of the MOSFET, which is driven by the 555 timer IC. Fig. 5 shows the LED strip glowing at the maximum brightness.

To reduce the LEDs' intensity, turn the knob of the potentiometer anticlockwise, which reduces the brightness of LEDs, as shown in Fig. 6.

The same setup may be tested with a 12V DC motor. We should be able to control the speed of the motor. A live demonstration of this circuit may be seen by watching the video at *https://urlcc.cc/dimmer* EFY

BONUS. You can watch the VIDEO of the tutorial of this DIY project at: *https://www.electronicsforu.com/videos-slideshows/live-diy-led-dimmer-circuit-using-555-timer*

The author, Sharad Bhowmick, works as a Technology Journalist at EFY. He is passionate about power electronics and energy storage technologies. He wants to help achieve the goal of a carbon neutral world.

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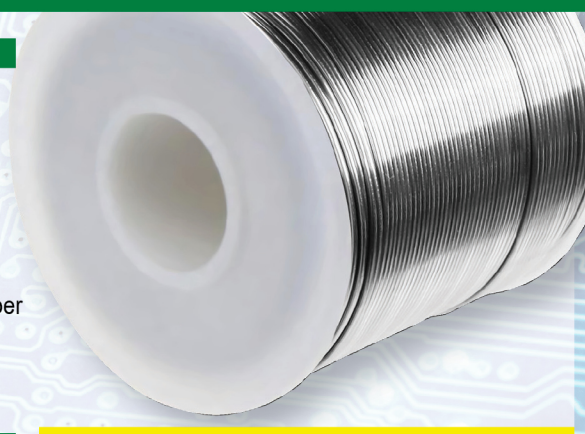

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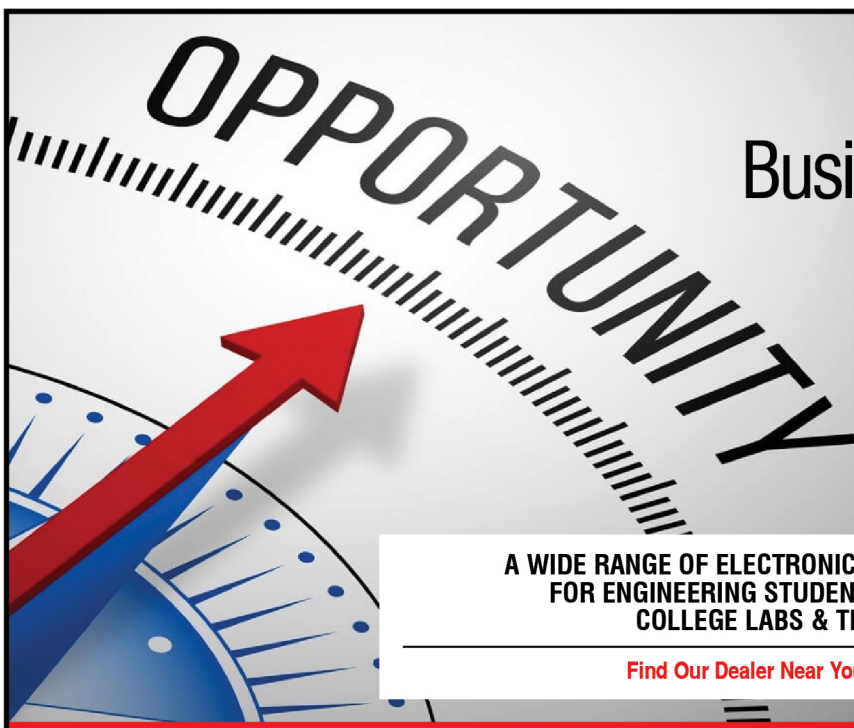

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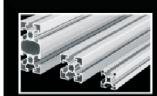
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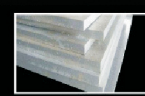
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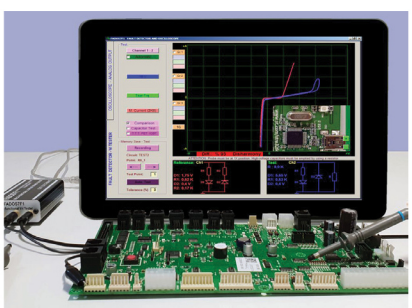

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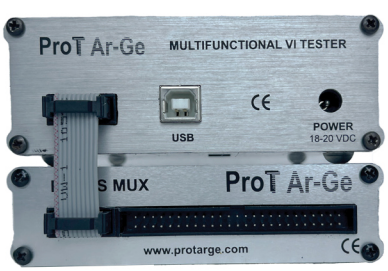

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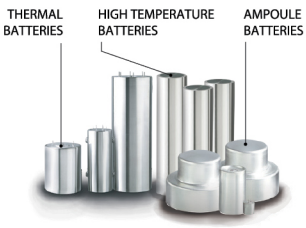

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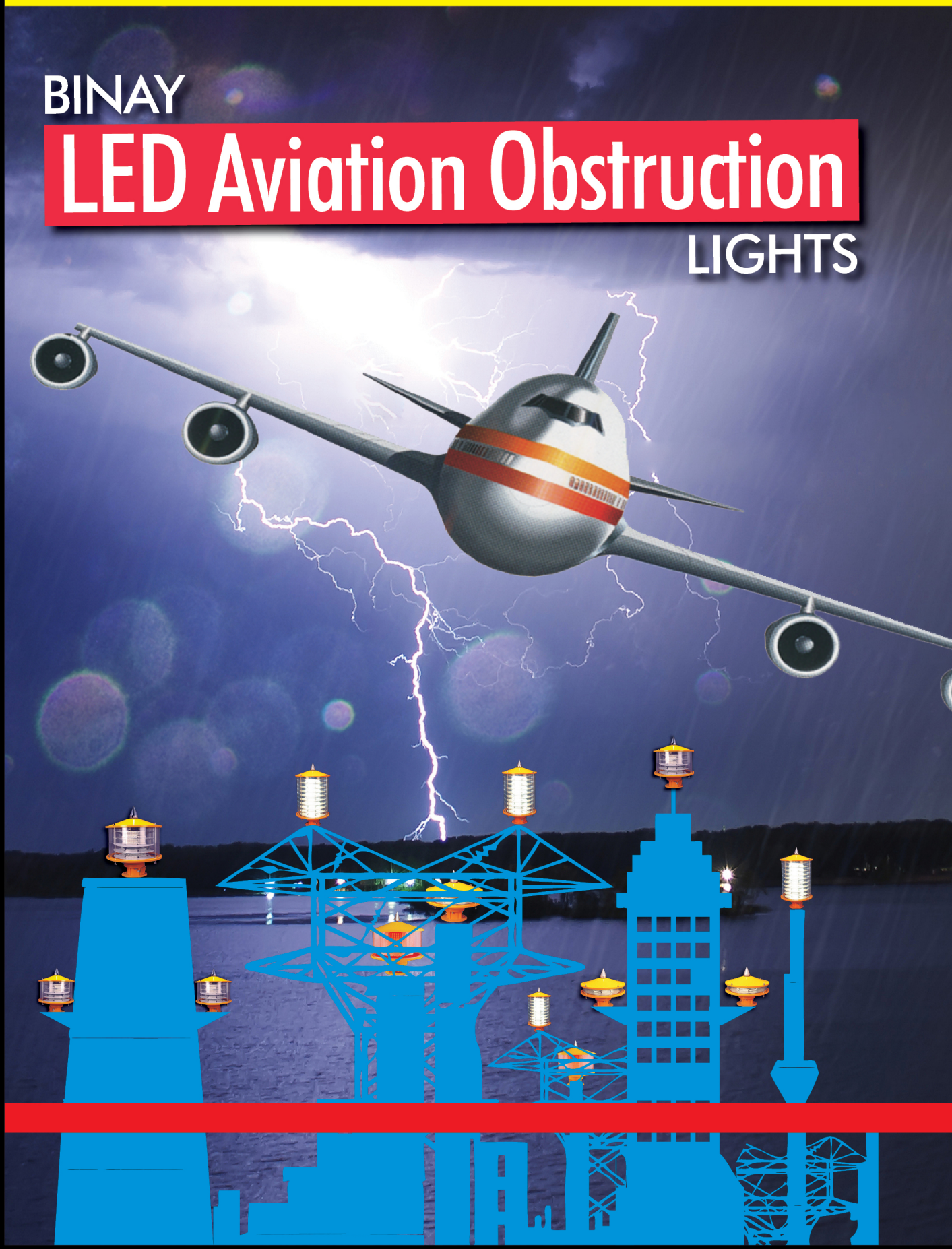

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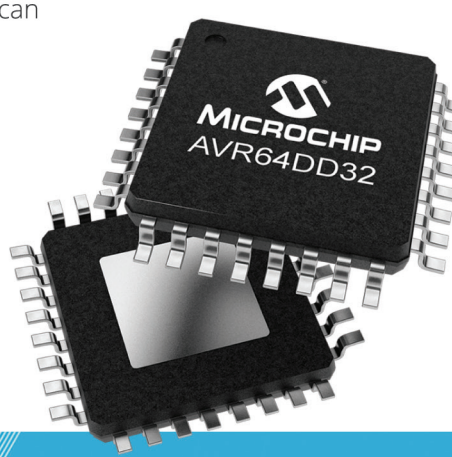

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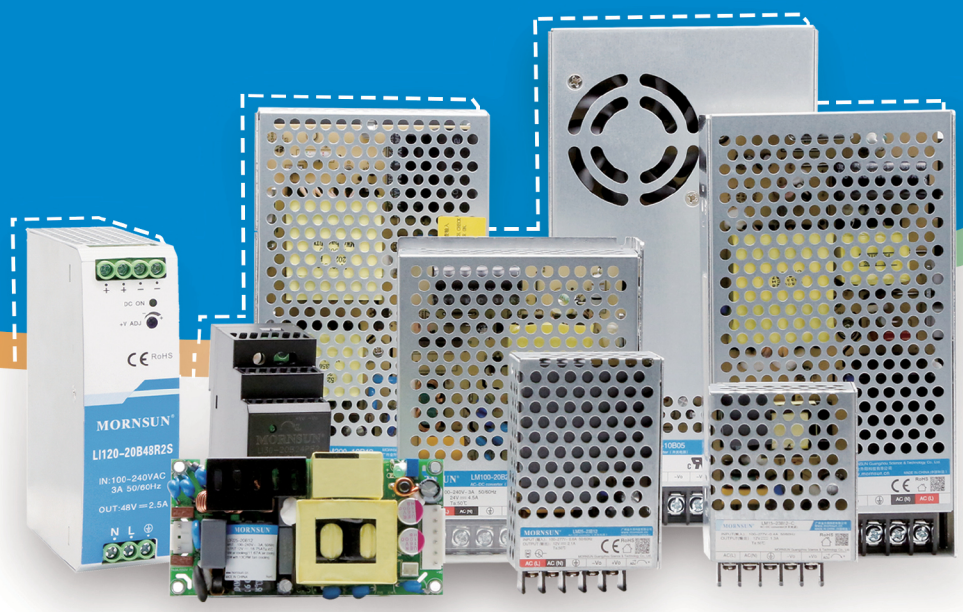

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FROM YOU

YOUR SUGGESTIONS AND THINGS YOU WANTED TO KNOW!

CONTROLLER SOURCE CODE

This refers to Arduino Controlled Controller project. Can you please share the source code? When changing the file name to .ino the Arduino IDE cannot find a sketch and then refuses to open the file.

Christiaan Esterhuyse

EFY. Sorry about that! We provide source code for all EFY projects at *www.efymag.com*. Simply go to Contents→Download Source Code via menu. However, for this project, the said file was missed. It has now been included. Thanks for helping us correct this issue!

• • •

OXYGEN CONCENTRATOR

This refers to the Simple Oxygen Concentrator You Can Assemble At Home (published in EFY October 2021). What software can be used for the pneumatic simulation?

Sawako

EFY. You can do pneumatic simulation using software such as LVSIM, Fluidsim, IRAI AUTOMGEN, etc.

• • •

LIVE DIY TUTORIALS

We hear from a friend that EFY is now doing live tutorials and demos of DIY projects every week. Is that correct?

Dhrjsingh and Zhan

EFY. Yes! It's correct, We are currently doing live DIY tutorials (some in Hindi too) every Friday. You can get details of the next session at *https://live.electronicsforu.com*

• • •

ERRATA

On page 42 of EFY May issue it is mentioned that "Rolling shutter exposes the sensor in a progressive way, as shown in Fig. 8," while Fig. 8 on page 44 shows the photo of a component.

Sachin Goel

EFY. Yes, that's a mistake. It should have been Fig. 6 and not Fig. 8. Thanks for pointing it out!

• • •

SCHEMATICS SOFTWARE

I noticed that the schematics of EFY's DIY projects have changed slightly. Which software is being used to draw them now?

Brundha

EFY. Good observation! We are now using KiCad for drawing the schematics of circuits tested in EFY Lab.

• • •

TECH QUERIES

Do you have a forum where I can ask technical questions from your team, or peers in the industry? Is it your Facebook page?

Sridharan

EFY. Glad you asked. Earlier, we used to promote our Facebook page (EFY's Electronics Design Community) as the go-to page for queries. But, since Facebook has reduced the reach of content posted on such pages, we have now developed the FORUM on *electronicsforu.com*—where our team and other experts can reply to your questions.

• • •

PCB FILES

You provide PCB diagrams of circuits in PDF format. Would it be possible to share them as Gerber files in future?

Tim Low Lan

EFY. Great suggestion! We are working on your suggestion and hope to share some good news soon.

Letters and questions for publication may be addressed to Editor, Electronics For You, D-87/1, Okhla Industrial Area, Phase 1, New Delhi 110020 (e-mail: **onedit@efy.in**)

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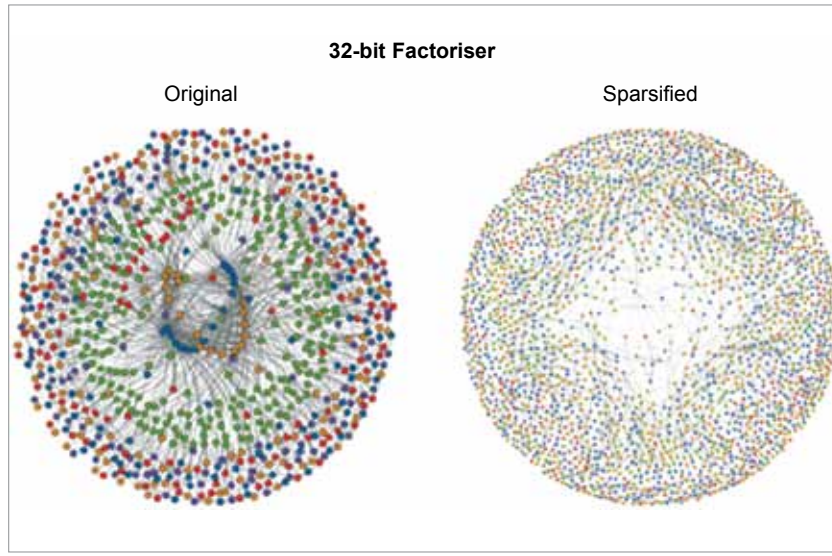
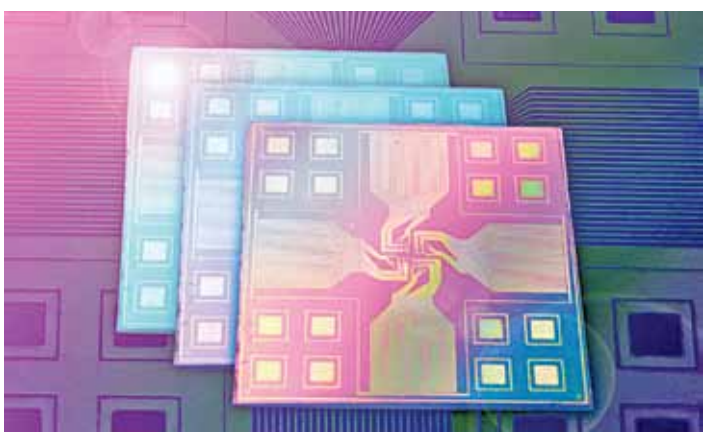
Will the new p-computers replace traditional computers?

It is a well-known fact that traditional computers are unable to compute in an energy-efficient manner. It is a restriction that has prompted a quest for new computing technologies. According to UC Santa Barbara researchers, probabilistic computers, or p-computers, are the answer. They created a one-of-a-kind sparse Ising machine (sIm), a revolutionary computing device that solves optimisation problems while consuming the least amount of energy. The sIm is a collection of probabilistic bits that oscillate between positions and work at normal temperatures. Their prototype was built on an FPGA, and they were able to prove that their design was up to six orders of magnitude quicker than traditional computers.



Hard optimisation problems can be expressed as interacting networks of probabilistic bits. Efficient solution of these problems require making them less dense at the expense of more p-bits (Credit: UC Santa Barbara)

MIT engineers build a LEGO-like AI chip



MIT engineers have created a reconfigurable AI chip that comprises alternating layers of sensing and processing elements that can communicate with each other (Credit: https://news.mit.edu)

With a LEGO-like design for a stackable, customisable artificial intelligence chip, MIT engineers have taken a step toward a modular chip design. Their system transmits data across the device using light rather than physical cables. The chip's layers communicate optically thanks to alternating layers of sensing and processing units, as well as light-emitting diodes (LEDs). As a result, the chip may be changed, with layers that can be swapped out or piled on to add new sensors or processors. Moreover, the chip employs artificial synapses—arrays of memory resistors, or memristors—that can be trained to process and classify signals directly on the chip, without an internet connection!

These synaptic transistors can sense pain

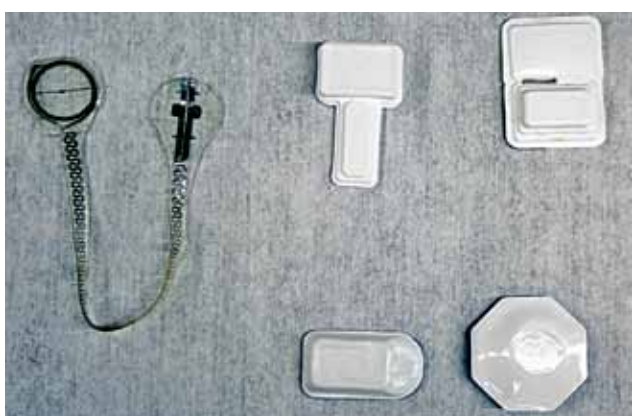
A new type of artificial skin was created by a team of engineers from the University of Glasgow using a novel processing system based on 'synaptic transistors,' which replicates the brain's neural networks in order to learn. The researchers printed a grid of 168 synaptic transistors

The robot hand used for the experiment (Credit: University of Glasgow)

manufactured from zinc-oxide nanowires directly onto the surface of a flexible plastic to create an electronic skin capable of a computationally efficient, synapse-like response. It was then attached to a robot hand. The team trained the skin to respond appropriately to simulated pain using the varied voltages, which then triggered the robot hand to react. It actually learned to move away from the source of discomfort!

A pacemaker that can dissolve in the body after use

Researchers from Northwestern University have unveiled a new, smart pacemaker that is connected to a network of

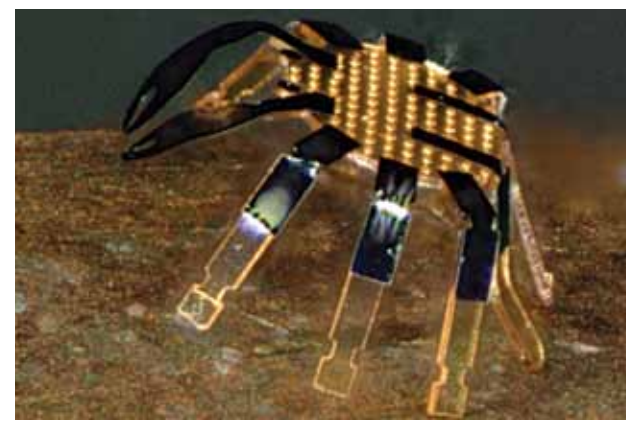


All devices laid out together, with the transient pacemaker on the left (Credit: Northwestern University)

soft, flexible, wireless sensors and control units. The multiple sensors present in the system communicate with one another to keep track of the body's numerous physiological activities, such as body temperature, oxygen level, respiration, muscle tone, physical activity, and the electrical activity of the heart. All of this data is sent to a smartphone or tablet, allowing doctors to keep an eye on their patients from afar. After a time of use, the pacemaker degrades naturally in the body and distributes an anti-inflammatory medication to avoid foreign-body reactions as it dissolves slowly and painlessly.

Engineers develop a tiny remote-controlled robot crab

Northwestern University engineers have unveiled the world's tiniest remote-controlled walking robot—a tiny robotic crab! The researchers believe their device is a



A magnified view of the tiny crab robot, standing on the edge of a coin (Credit: Northwestern University)

significant step toward developing practical robots that can execute remote-controlled operations in small settings. It comprises a shape-memory alloy, which allows it to change shape when heated before returning to its original shape when cooled. The team was able to heat specific portions of the robot using a laser beam, forcing it to walk. Also, because these structures are so tiny, the rate of cooling is very fast. This bot certainly paves the way for more advanced micro-robots in the future.

Bioinspired vision sensors that mimic human vision

Researchers at Hong Kong Polytechnic University (PolyU) and Yonsei University in Seoul have developed vision sensors that mimic and even surpass the ability of the human retina to adjust to different lighting levels. Each of the new vision sensors is made up of arrays of phototransistors.

The bioinspired vision sensors developed by Dr Chai's team can adapt to varying brightness with an effective range of up to 199dB. The human retina can adapt to environments under sunlight to starlight, with a range of about 160dB (Credit: PolyU)

They are designed to look like the rod and cone cells in the human eye, which are responsible for detecting dim and strong light, respectively. As a result, the sensors can identify things in a variety of lighting conditions, as well as flip between and adapt to varied brightness levels—with a range that is even greater than the human eye!

3D printing can now be done in seconds

EPFL researchers have shown a light-based 3D-printing technology that is around 30 times faster than traditional additive manufacturing, producing items in 20 seconds that would ordinarily take more than 10 minutes. Unlike traditional 3D printing, which involves placing blobs of material on a substrate and allowing them to solidify, EPFL's light based technology involves pouring the resin into a container and spinning it. Then, light is shined on the container at different angles, causing the resin to solidify wherever the accumulated energy in the resin exceeds a given level. It's a very precise method and can produce objects at the same resolution as existing 3D-printing techniques.

The team printed this little Yoda figure in about 20 seconds (Credit: EPFL)

World's first SNN developed at IIT Bombay

A team from IIT Bombay has collaborated to create the world's first spiking neuro-synaptic (SNN) core on 45nm SoI (silicon on insulator) technology. The Liquid State Machine, a spoken word recognition system, was used in this development. It is based on the premise that the neural network produces a neuronal reservoir similar to a liquid reservoir. This method was made by including numerous hardware peculiarities in 'ideal' software implementations to demonstrate the hardware implementation's viability. The circuit implementation included a 20-neuron input layer that sent the neural spike signal into a 36-neuron reservoir with 256 synapses connecting neurons in a random recurrent fashion.

(Left to Right) Prof. Maryam Shojaei Baghini, Vivek Saraswat, Prof. Udayan Ganguly, Ajay Singh holding the test board with the neural network chip (Credit: Ankit Bende)

Microprocessors can now be powered by photosynthesis

Researchers from the University of Cambridge's Department of Biochemistry used algae to power an Arm CPU for six months! The scientists created an AA-battery-sized gadget that houses an algae called Synechocystis that naturally harvests energy from the sun through photosynthesis. This biological photovoltaic cell produces power continually, even in low light or at night, because the algae it contains appears to continue processing energy after the sun has set. The device was made of common, sturdy,

The renewable biological photovoltaic cell (Credit: Paolo Bombelli)

affordable, and mainly recyclable materials. The researchers then used an aluminium anode to convert the gathered energy into current, which they then put into a board with an Arm Cortex M0 + CPU.

Copper 'headphones' improve atomic radio receiver

The National Institute of Standards and Technology (NIST) has improved the sensitivity of their atomic radio receiver by putting the small glass cylinder containing cesium atoms inside what appear to be special copper 'headphones.' The structure, which consists of a square overhead loop connecting two square panels, boosts the incoming radio signal (or electric field). This signal is applied to the gaseous atoms in the flask (also known as a vapour cell) between the panels. The structure is actually a split-ring resonator that functions like a metamaterial, due to which the radio receiver can now identify much weaker signals than before.

Copper headphones boost the sensitivity of NIST's atomic radio receiver, which is composed of a gas of cesium atoms prepared in a special state inside the glass container. When an antenna located above the setup sends down a radio signal, the headphones boost the strength of the received signal a hundredfold (Credit: NIST)

A seaglider that tracks ocean acidification

The University of Alaska Fairbanks and its industry partners are the first in the United States to use an unmanned underwater vehicle to monitor carbon dioxide, the primary cause of ocean acidification. The researchers designed a strategy to close the data gaps that exist in the marine environment. They found a means to link a carbon dioxide sensor with a Seaglider that can dive to 1000 metres and carry out weekslong expeditions to distant sections of the ocean in any season, working with worldwide business partners. The most exciting thing is that a power-hungry sensor like the CO_2 sensor was efficiently used on a small glider that was not meant to do stuff like this!

Scientists and their industry partners aboard the research vessel Nanuq recover the carbon dioxide-measuring Seaglider after a test dive in the Gulf of Alaska (Credit: Heather McFarland, International Arctic Research Center)

Researchers develop artificial skin containing heat sensors

Researchers at TU/e have devised a method for producing flexible, thin, and precise sensor electronics that can help robots detect humans. Many industrial operations require close human-robot interactions. This means that the robots need accurate proximity sensors to check if someone gets too close to the robot. To aid this, the researchers created a large flexible sheet filled with heat sensors that can be used to cover a structure, such as a robotic arm. The flexible sensor acts like a sort of 'artificial skin' for the robot. The heat sensors allow the robot to detect the presence of a moveable heat source, such as a person, from a distance of up to 0.4 metres.

Robot arms could become safer in industrial settings by applying an artificial skin containing proximity heat sensors to detect humans in all directions (Credit: Marco Fattori)

Soon 3D FETs will be used as memory devices

Current flash memory technologies require relatively large currents to read or write data. However, mobile cloud-enabled devices and IoT devices require memory that is energy-efficient and small in size. The University of Tokyo's Institute of Industrial Science used a ferroelectric gate insulator and an atomic-layer-deposited oxide semiconductor channel to construct 3D vertically-formed FETs for high-density data storage devices. Furthermore, they discovered that by employing antiferroelectric materials instead of ferroelectric, they were able to erase data with only a small net charge, resulting in more efficient write operations. This research could lead to new data storage memory that is even smaller and more environmentally friendly.

TRULY INNOVATIVE ELECTRONICS

INNOVATION UPDATES

Amongst numerous press releases of new products received by us, these are the ones we found worthy of the title *Truly Innovative Electronics*

Smart RISC-V 3D GPUs

Think Silicon has released a series of RISC-V 3D GPUs called the NEOX. The series includes NEOX G (graphics) and NEOX A (deep learning accelerator). These smart GPUs feature programmable compute shaders running on a real-time operating system and are supported by lightweight graphics and machine learning frameworks. The multi-threaded system can be customised for different applications—such as graphics, machine learning, vision/video processing, and general-purpose compute workloads—through configurable programming libraries using the same hardware blocks.

Think Silicon
https://www.think-silicon.com

ReRAM with dense memory

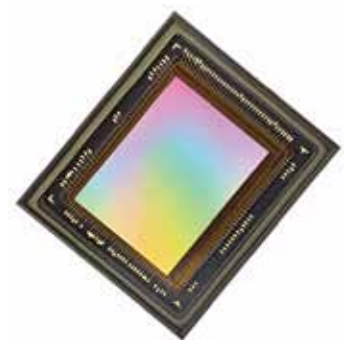
The MB85AS12MT from Fujitsu is a non-volatile IC capable of storing character data equivalent of 90 newspaper

pages. The 12Mbit ReRAM is said to have the largest memory density in ReRAM family. The IC comes in a compact package measuring approximately 2mm × 3mm and offers an outstandingly low level of reading current of 0.15mA. The size and current consumption make it suitable for use in wearable devices like smartwatches and wireless earphones.

Fujitsu Semiconductor Memory Solution
https://www.fujitsu.com/jp/group/fsm/en

Event based vision sensor

The Metavision sensor from Prophesee is an event based vision sensor designed for machine vision applications. The third-generation sensor is claimed to be the first of its kind in an



industry-standard package. Each pixel in the sensor can intelligently activate itself depending on the contrast change (movement) it detects, and each pixel embeds its own intelligence processing enabling it to activate itself independently. This makes the sensor highly power-efficient with just 3nW/event and 26mW at the sensor level. The sensor is capable of detecting images in areas with illumination level as low as 0.08lx. It can be used for ultra-high-speed counting, vibration measurement, kinematic monitoring, etc.

Prophesee
https://www.prophesee.ai

Multi-zone ToF ranging sensor

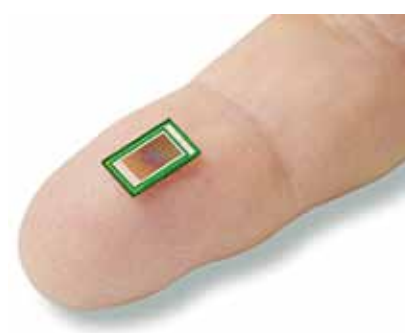
VL53L8 from STM is a second-generation, multi-zone, time-of-flight (ToF), laser-ranging sensor. It can measure absolute distance, irrespective of colour and reflectance of the surface. It works at a fast speed and provides accurate ranging up to 400cm. The VL53L8 is also able to detect multiple

objects within the FoV with depth information for quicker touch-to-focus or mini depth map creation. It consumes 50% lower energy than its predecessor.

STMicroelectronics
https://www.st.com/content/st_com/en.html

Image sensor for mobile applications

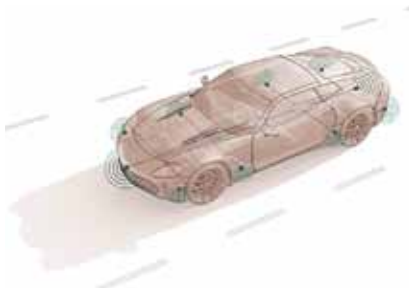
The Topaz series of industrial CMOS sensors from Teledyne include 2MP (1920 × 1080) and 1.5MP (1920 × 800) resolution devices. The sensors are housed in a small 4.45mm wide chip-scale package. The Topaz sensors have an 8.5mm optical format, which is made possible due to the small 2.5µm global shutter pixel that employs in-



pixel CDS (correlated double sampling) and advanced dual light guides to achieve good SNR at low light, with low crosstalk for crisp images. The sensors employ a low-noise, global-shutter pixel technology to offer powerful solutions and enable compact mobile designs for many applications such as smart wearable, IoT, Robotics, etc.
Teledyne
https://imaging.teledyne-e2v.com

Long-range antenna for ADAS

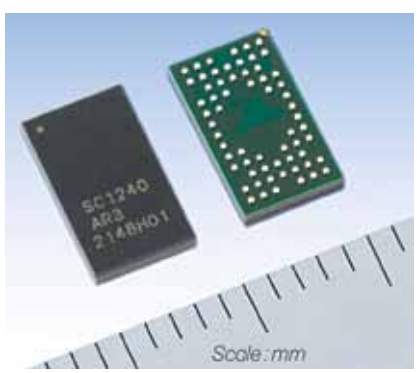
The HUBER + SUHNER 3D waveguide antenna is the first long-range 3D metallised plastic radar antenna designed for advanced driver-assistance systems (ADAS). The antenna offers ultra-low losses for the object



detection whilst meeting automotive standards. It offers improved efficiency, pattern stability, and impedance bandwidth at competitive manufacturing cost.
HUBER SUHNER
https://www.hubersuhner.com/en

Range and angle-calculating sensors

The SC1240 series radio-wave ranging sensors uses the 60GHz band with a built-in signal processing circuit for



detecting the position and movement of a person with maximum accuracy. It is the industry's first sensor with a built-in range-finding and an angle-calculating signal processing circuit. It uses 3D position information without the need for high frequency or advanced signal processing technology. It includes multiple antennas, wireless circuitry, A/D converters, FIFO memory, SPI interface, a high-performance sequencer that flexibly changes the duty cycle and controls power consumption, and a signal processing circuit for high-performance distance measurement and angle calculation.
Socionext
https://socionextus.com

Touch-sensing chip

The AX54A-Force chip adds touch functionality to surfaces, touch button clusters, and other solutions. It features

an integrated force-sensing technology which provides accurate and highly sensitive force-sensing data to the user interface (UI). The AX54A offers a high signal-to-noise ratio (SNR), enabling precise detection with high precision. It can accurately take inputs from 0.1 Newton (10g) to 20 Newton (2000g). It utilises a unique integrated force-sensing technology, which enables the detection of a wide range of forces, thus making it suitable for a wide range of applications.
Touchnetix
https://www.touchnetix.com

TOLL-packaged SiC MOSFET

Onsemi NTBL045N065SC1 is the world's first TOLL-packaged 650V SiC MOSFET. It has a VDSS rating of 650V with a typical RDS(on) of just 33mΩ and a maximum drain current (ID)

of 73A. The transistor can address the rapidly growing need for high-performance switching devices that are suitable for designs with high levels of power density. The module comes in a compact package with a footprint of just 9.90 mm x 11.68 mm and offers 30% savings in the PCB area over a D2PAK package. At a profile of just 2.3mm, it occupies 60% less volume than a D2PAK package.
Onsemi
https://www.onsemi.com

DC-DC controller for LED lights

Infineon's Litix TLD6098-2ES is a dual-channel, DC-DC controller which can drive a full LED headlamp without the requirement of a microcontroller. It can operate the four standard LED front light functions, which include high beam, low beam, daytime running

lights, and turn signal. It can also be used as a voltage supply for controlling the animation in exterior LED lighting. The controller can work with a wide input voltage range of 4.5V to 60V. Each channel of TLD6098-2ES offers both analogue and PWM dimming for precise LED brightness control.
Infineon Technologies
https://www.infineon.com

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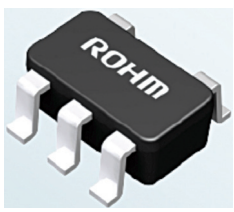
COMPONENTS

LDO regulators

ROHM's BD9xxN1 series of ultra-low dropout (LDO) regulators are capable of providing stable operation at nanoscale



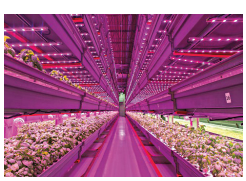
output capacitance. These are specifically developed and optimised for connection to 12V power supplies for a wide range of applications, such as powertrain, body, ADAS, and car infotainment systems. The regulators can handle wide range of output capacitances (as low as 1µF) and come in ultra-compact 0603/0402 size.

ROHM

https://www.rohm.com

Spectral sensor

ams OSRAM AS7343 is a spectral sensor capable of matching the human eye's perception of colour and light intensity. It combines 14-channel spectral analysis of visible and infrared



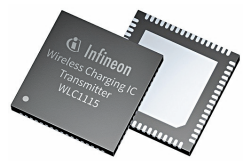
light (IR) with XYZ sensor technology to measure the colour and intensity of light as seen by the human eye. Its automatic ADC reconfiguration also gives a faster multi-channel readout. The compact size of the sensor makes it easy to accommodate space-constrained applications. The AS7343 is suitable for colour analysis in applications which require frequent, accurate measurements, such as in horticulture, smoke detection, etc.

ams OSRAM

https://ams-osram.com

Qi 1.3 wireless charging platform

WLC1115 transmitter controller IC from Infineon is the first addition to the WLC family of controllers for inductive wireless charging. It is a Qi



v1.3.2-certified MP A11 power transmitter reference solution. The IC supports a wide input voltage (from 4.5V to 24V) along with multipath voltage- and current-based ASK demodulation. The charging platform includes a USB-PD/PPS sink, DC/DC controller, gate drivers for DC/DC, a full-bridge inverter, sensing peripherals, and configurable flash memory. The targeted applications include smartphones, smartwatches, speakers, as well as industrial or healthcare accessories.

Infineon Technologies

https://www.infineon.com

BLDC drivers for server fans

A89332 and A89332-1 from Allegro MicroSystems are 3-phase sensorless BLDC gate drivers. These two models

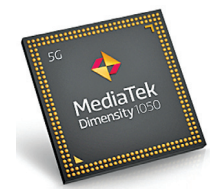
are industry's first code-free solution for server cooling fans. The A89332 has an integrated power loss brake feature while the A89332-1 has an AC-loss feature. These drivers enable compact, high-airflow fan designs to improve thermal efficiency, reducing energy use and data centre costs.

Allegro MicroSystems

https://www.allegromicro.com/en

SoC for good connectivity

Dimensity 1050 system-on-chip (SoC) combines mmWave and sub-6GHz technology to provide good connectivity even in densely populated areas. The chipset is powered by an octa-core CPU, and it integrates an



Arm Cortex-A78 CPU and the Arm Mali-G610 graphics engine. It also supports True Dual 5G SIM (5G SA + 5G SA) and Dual VoNR. The chip is capable of providing superior connectivity to the next generation of 5G smartphones, displays, gaming consoles, etc.

MediaTek

https://www.mediatek.com

Op-amp in DFN8 package

TSV772 is a dual operational amplifier (op-amp) with rail-to-rail inputs and outputs, 20MHz bandwidth, and a unity-gain. It offers a maximum

of 200µV as input-offset voltage and ensures accurate handling of low-amplitude signals. The op-amp is capable of starting from a low input voltage of 2V and can be connected to the same rail as a low-power microcontroller to simplify the design. It offers a slew rate of 13V/µs, 7nV/√Hz input noise density, and 4kV ESD capability (HBM). The component comes in a compact DFN8 package.

ST Microelectronics

https://www.st.com

ESD protection devices

PESD2V8Y1BSF and PESD4V0Y1BCSF are new electrostatic discharge (ESD)

devices from Nexperia. The two protection devices are optimised for use with retimers and redrivers on high-speed data lines.

PESD2V8Y1BSF is capable of protecting USB4 (Thunderbolt) interfaces while PESD4V0Y1BCSF is capable of protecting the HDMI 2.1 interface in addition to the USB4. The RF performance of the TrEOS technology used by the devices remains stable over the full operating voltage range. Apart from USB4 and HDMI 2.1, both can also be used to protect PCIe and DisplayPort interfaces.

Nexperia
https://www.nexperia.com

Compact 40V MOSFET

Diodes Incorporated's DMTH4M-70SPGWQ is a 40V MOSFET that features a low RDS(ON) of 0.54mΩ at a gate drive of 10V, while its gate charge is 117nC. The product helps in achieving high system efficiency in applications such as high-power BLDC motor drives, DC-DC converters and charging systems, while ensuring low power dissipation to achieve high efficiency. It is available in a 64mm² package, which occupies 40% less space than the TO263 (D2PAK) package format.

Diodes Incorporated
https://www.diodes.com

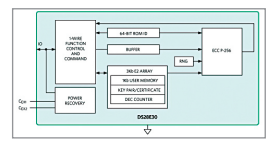
Processor for small-size HMI

Sitara AM62 processor can enable support for small-size human-machine interface (HMI) applications and dual-screen displays. The low-cost solution can enable basic camera based image processing and edge AI function, which includes pattern recognition and image detection. It can also allow gesture recognition in a noisy environment and use wireless connectivity to enable control of machines by tablets or phones.

Texas Instruments
https://www.ti.com

Secure authenticator

Analog Devices DS28E30 is an ECDSA secure authenticator to protect products from counterfeiting. It combines ECDSA along with applications data and secure storage of keys. The cost-effective solution comes in a compact package and requires only a single wire to operate, making it easy to integrate into new or existing products. The secure authenticator can be employed in a wide range of applications, such as asset tracking, battery ID authentication, etc.



Analog Devices
https://www.analog.com/en/index.html

Gas-impregnated PFC capacitor

TDK Corporation's B25674C is an EPCOS gas-impregnated PFC capacitor series that covers a voltage range from 230V to 690V AC. The series can be used at hot-spot temperatures up to 85°C and have a long lifetime of up to 240,000 hours in temperature class -40/D.

The capacitors can handle high inrush currents equivalent to 500 times the rated current.

TDK Corporation
https://www.tdk.com/en/index.html

EQUIPMENT

Precise time scale system

Microchip's fully integrated precise time scale system (PTSS) can act as a backup and enables nations to operate independent time scale back-up to GNSS to protect critical infrastructure. The PTSS is a world-class timing system that is traceable to Universal Coordinated Time (UTC) and does not depend on GNSS. It is a fully integrated system capable of providing timing accuracies comparable to the world's best national laboratories.

Microchip Technologies
https://www.microchip.com

MODULES AND BOARDS

Automotive DC-DC converters

The RPX series of DC/DC converters from RECOM RPX now meets the AEC-Q100 Grade 1 requirement, making it more secure and reliable for automotive applications. The new converters come in a QFN package and include

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'wettable flanks' for automated optical inspection. The series includes RPX-0.5Q and RPX-1.5Q DC/DCs, which have an input range up to 36V, and the output can be trimmed from 0.8V to 30V. The modules require low external components and offer low EMI and fixed frequency operations.

Recom Power
https://recom-power.com

LTE extension boards

The new series of LTE extension boards from Sony includes CXD5602PWBLM1NA and CXD5602PWBLM1E, which are equipped with smart sensing processors for IoT applications. The boards add LTE connectivity to the Spresense main board and carry an on-board antenna and a nanoSIM card holder. They are compliant with NB-IoT*1 communication standards and LTE-M (LTE Cat-M1). The boards are equipped with multiple peripherals and offer a headphone terminal, microSD card slot, and interfaces such as GPIO, I2C, and UART.

Sony Semiconductor Solutions Corporation
https://www.sony-semicon.co.jp/e

The smallest GPS module

The MIA-M10 from U-blox is the world's smallest GPS module which can be employed as a dependable, long-lasting solution for asset tracking. The MIA-M10 is an ultra-low-power global navigation satellite system (GNSS) module, offering a power-efficient solution for size-constrained battery-powered asset tracking devices. The module is capable of receiving four GNSS constellations for maximum coverage and comes in a compact package measuring just 4.5mm × 4.5mm. It offers a power saver mode which can double the battery life by optimally balancing position accuracy and power consumption.

U-blox
https://www.u-blox.com

600V DC relay module

OMRON Corporation's G9KB is a high-voltage DC relay for high-capacity home energy storage system (HESS). It can safely cut off the direct current and improve the safety and efficiency of the HESS. The module employs arc cut-off technology and the new 3D arc simulation technology created by industry-academia collaboration. The relay handles the charging of electricity storage system, switching control and safe cut-off of the direct current that runs during discharging and is suitable up to 600V DC, 50A.

OMRON Corporation
https://www.omron.com/global/en

T&M SOLUTIONS

Portable benchtop MSO

Tektronix benchtop 2 Series mixed signal oscilloscope (MSO) provides an easy-to-use touchscreen display and offers features such as a built-in pattern generator, voltmeter, and frequency counter, to name a few. The module is small enough to be carried in a small backpack and can work for eight hours with the built-in battery. The 2 Series MSO is designed for easy set-up and immediate use.

Tektronix
https://www.tek.com/en

Full-HD touchscreen oscilloscopes

To achieve better signal integrity in real-time, Rohde & Schwarz have introduced new models of oscilloscopes that support bandwidth upgrades right up to 16GHz. These use the com-

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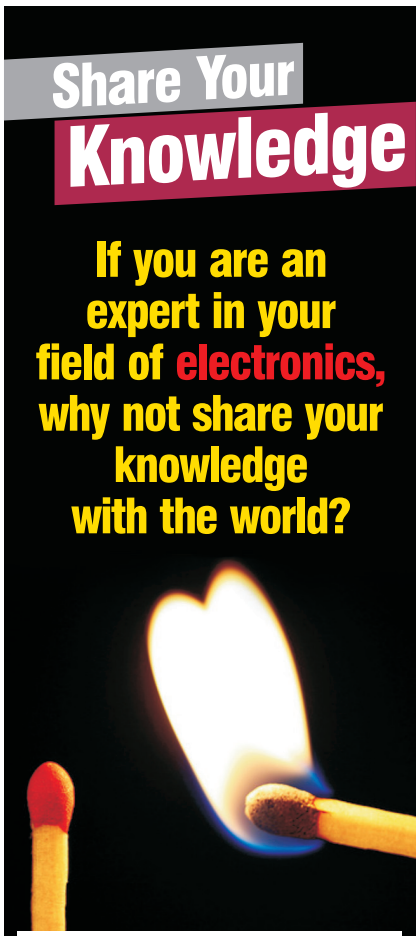

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pany's self-developed acquisition and processing ASIC, which enables a high acquisition rate of up to 750,000 waveforms/s, thus allowing users to easily analyse circuit boards to spot and isolate defects. The oscilloscopes sport a larger full-HD touchscreen display along with an enhanced user interface. Different bandwidth models are available with a sample rate of up to 40 Gsample/s.

Rohde & Schwarz
www.rohde-schwarz.com

Depth measurement camera

DepthVista from e-con Systems measures depth using the time of flight technique. The camera combines Onsemi AR0234 colour global shutter for object identification along with a ToF depth sensor for depth measurement. The module boasts a frame rate of 30fps along with the ability to capture images in low light or even in total darkness. It is capable of performing the depth calculation onboard, thus reducing the computational load on the application side.

e-con Systems
https://www.e-consystems.com

MISCELLANEOUS

BMS system software

The CDD software from Renesas is designed to complement Renesas' Li-Ion BMS IC to enable ASIL D-compliant designs. The software enables faster designing and optimising the performance of next-generation systems. The CDD software includes configuration and integration of required microcontroller abstraction layer (MCAL) modules provided by Renesas for the RH850 MCU. It also provides a low-level solution for collecting battery parameters, such as the cell voltage and temperature measurements, and enables controlling cell balancing functions of the ISL78714. The configurable parameters determine the number of cells in the BMS system and the desired battery cell data collection rate.

Renesas
https://www.renesas.com/in/en

PCIe Gen4x4 for enterprise SSDs

The EPR3760 from Phison Electronics Corp is a customisable PCIe Gen4x4 for enterprise SSDs. The device is powered by the E18DC PCIe Gen4x4 NVMe controller and can enhance the SSD boot drive performance for SSDs employed in workstations and servers. EPR3750 module is backwards compatible in PCIe Gen3 M.2 slots and provides a faster quality of service command execution with enterprise SSD firmware.

Phison Electronics Corp
https://www.phison.com/en

Next-gen wireless connectivity

To enable next-generation connectivity of the 5G module, Quectel Wireless Solutions has integrated the company's RM500Q with the Jetson AGX Orin. The company aims to provide global NVIDIA Jetson platform based devices with an easy, frictionless pathway to high-speed, reliable, and low-latency 5G communications capability. The combined system from NVIDIA and Quectel is a ready-to-use platform which can simplify designing, reduce bill of material, and speed up the development phase. It can also enhance product stability.

Quectel
https://www.quectel.com
NVIDIA
https://www.nvidia.com/en-in

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A Guide To A Career In EMBEDDED SYSTEMS

Embedded systems serve as a bridge between the traditional hardware and software. With artificial intelligence (AI), edge computing, and other advancements, the embedded systems are experiencing meteoric growth with many vast and interdisciplinary sub-fields. So, the term Embedded Systems means different to different people in the industry. This article will help gain some important perspectives about this field and understand the nitty-gritty involved

AARYAA PADHYEGURJAR

Venn diagrams and infographics are a great way to describe the interdisciplinary fields of embedded systems. Venn diagrams depict the nature of embedded systems based on the experiences of different designers. It is interesting to note that most of these diagrams are different from each other in certain aspects, but also have striking similarities.

Some examples are given in the figures that follow.

After looking at the diagrams, you will notice that in many cases embedded sys-

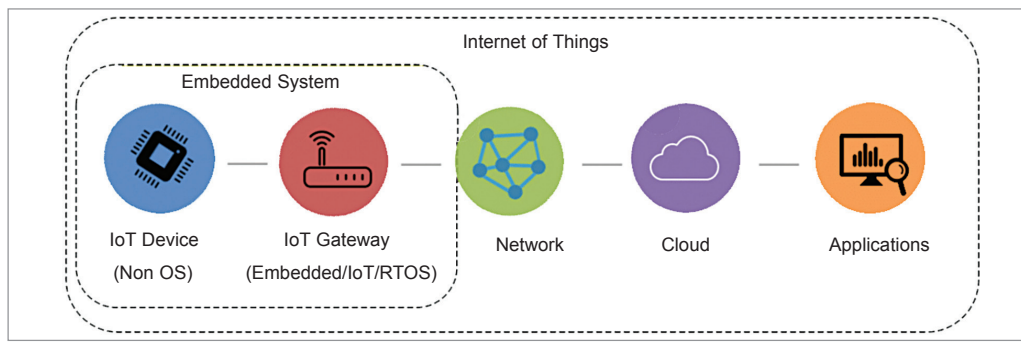

Fig. 1: Embedded system as a subset of IoT (Credit: https://sru.edu.in)

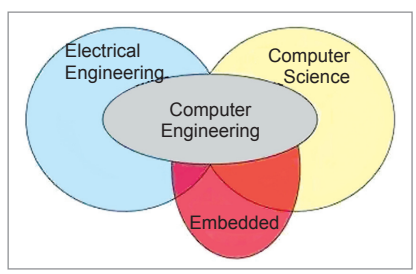

Fig. 2: Embedded evangelist Michael Barr uses this Venn diagram to illustrate the current status of embedded software programming in the computer engineering ecosystem and why there is a lack of good firmware training (Credit: www.eetimes.com)

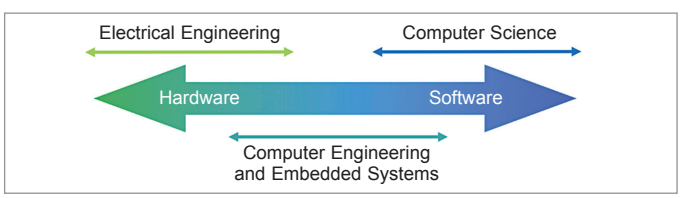

Fig. 3: A description of embedded systems at the TU Delft website (Credit: www.tudelft.nl)

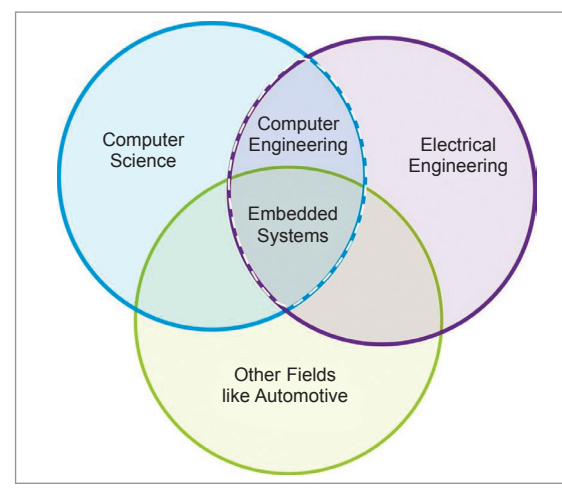

Fig. 4: A Venn diagram that illustrates the three important skills required for embedded systems (Credit: Rosmianto Aji Saputro, https://www.linkedin.com)

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DIVERSIFICATIONS THAT MAKE EMBEDDED SYSTEMS INTRIGUING

Project Domain	Some Domain-specific Skills/Requirements	The Why
Mining and marine	Marine environment, Material engineering	The marine environment, particularly saline water and temperature, is tricky for embedded technology. The device will be extensively corroded the instant it is deployed in the sea, if it is not properly sealed.
Controllers (like a traffic light controller for vehicles or trains)	Roadway/ Railway plans, Traffic light standards	In order to develop optimal controllers for transportation systems, one needs to know all rules and regulations that govern such systems.
Handheld devices	Design, Ergonomics	For example, you need to be familiar with text fonts and work closely with a font designer. Also, your PCB needs to fit in the handheld enclosure, so industrial design plays a major role here.
Automotive devices	SAE standards, Mechanical design, Thermal management	You need to design devices that can withstand harsh conditions in a vehicle, like automotive vibrations, higher temperatures, etc. Also, you need to be aware of industry standards and practices, especially regional and customer-specific ones.
IoT and Drones	Device security, Signal conditioning	Any connected equipment, from refrigerators to factory robots, can be hacked if IoT security is lacking. Hackers can take over the object's functioning and steal the user's digital data once they gain control. Hence, security is important.
Robotics	Math, Control systems	Math, mapping, path planning, and control system skills are all essential in robotics.
AI	Computer vision	For applications involving autonomous driving, mobile robots, etc, computer vision plays a major role.
Monitoring systems (like greenhouse monitoring, soil condition monitoring, and inventory management)	Networks, Security, Control systems	Wherever a controlled environment is needed, like in monitoring systems, a clear understanding of control variables is needed. Even here, security plays a major role because a lot of sensitive user data is involved.

tems constitute the overlap between computer science and electrical engineering. So, the question that comes to mind is: What are the disciplines or areas of engineering that one must be familiar with in order to work with embedded systems?

Because embedded systems require programming, we need a background in computer science. We should be able to write reliable and efficient code. And because we shall be interacting with electronic devices like sensors and actuators, we need a sound knowledge of electronics.

That being said, you do not need to be a computer science graduate to do decent embedded systems development work. However, having a basic understanding of computer science may greatly assist you in organising your code into self-contained, reusable modules that are self-explanatory, easy to comprehend, and follow. Your code needs to be good enough for others (or even you) to extract source files that can be reused in other projects.

Many professionals working in the field of embedded systems confirm this thesis. Sundar Balasubramanian, an embedded systems professional with over two decades of experience says, "Knowing programming languages such as C or C++ to be used in embedded systems is enough, especially if you are not working on RTOS. If you're working on RTOS, even then an extremely deep knowledge of CS (computer science) is not needed. In my two decades of experience with five years in embedded systems exhaustively, I feel both knowhow (electronics and computer science) is important for both types of engineers. Domain knowledge comes from work experience anyway."

Hardware designer Petr Dvořák also agrees with this. "I have been weak in computer science and I had decided not so long ago I had to give up programming," he says. To be a great embedded engineer, it is okay if you are not the best programmer in town.

The project-specific field of study

Besides the two main fields that influence embedded systems—computer science and electrical engineering—depending on the device or project you are working on a third field of study often comes into the picture.

For example, if you are working in the domain of robotics, you would require good mathematics skills and a strong knowledge of control systems. Similarly, having knowledge of control systems is very important if you are working on smart systems, like greenhouse monitoring, where you have to create controlled environments for greenhouses. Computer vision and AI are critical for applications like autonomous driving.

Therefore, a certain amount of knowledge outside embedded systems—or probably even outside engineering—is needed.

What would be your third field?

The coolest part about embedded design is that each project offers fresh opportunities for learning. It necessitates the embedded designer's involvement in a variety of fields. There are lots of diversifications (see table) that make it such

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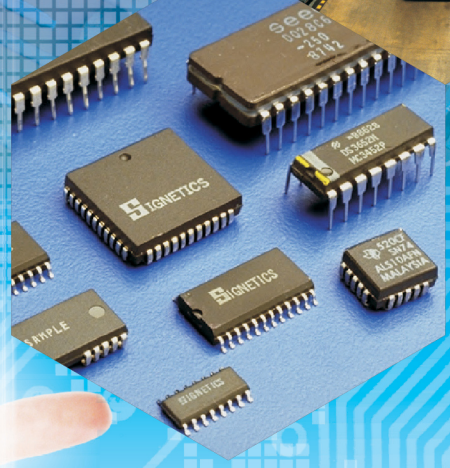

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an intriguing field.

That being said, here are some technical skills an embedded systems developer needs to have, irrespective of the project domain:

- Computer architecture
- Understanding peripherals, reference manuals, datasheets
- Protocols, networking, and moving data
- Programming languages and structure
- Validation and verification of electronic boards
- PCB designing
- Quality assurance and compliance
- Power and battery management

Different job types

In a broader sense, your expertise and skillset in embedded systems would depend on the type of your job—whether it is firmware or purely hardware, or both. "Good programming logic, if you work in firmware, and an extremely good electronics know-how as per professional need (such as PCB designing, layout, understanding NETLIST), if you work exclusively in hardware, is necessary," says Balasubramanian.

Embedded hardware engineering. Embedded hardware engineers are in charge of all areas of electrical system design, including high-speed digital circuits, power management, PCB layouts, and thermal management. They work with the algorithm and software teams to design and build high-performance computing platforms. Also, testing the hardware is a critical part of embedded hardware development.

Embedded hardware systems are designed, implemented, and tested on a regular basis by hardware test engineers. They employ numerous testing methods and keep track of hardware modifications and hardware-related issues. They regularly test systems to eliminate potential faults and collaborate with cross-functional teams to give system-level support (mechanical, software, hardware, etc).

Embedded firmware engineering. Firmware is a subset of software. It is often a program that controls an embedded system. Hence, firmware engineering includes both hardware and software. It might be part of a standalone product (code that is embedded into very small systems, such as a monitor, a mouse, or a washing machine) or it can run on a system that also runs higher-level software. For example, a laptop will contain a lot of firmware in the form of device drivers, etc.

While working closely with the hardware designers, a firmware engineer will focus mainly on the firmware. Firmware engineers create low-level software that can interact directly with the hardware, such as converting analogue sensor signals to digital data and managing communications protocols. We can say that firmware is a low-level interface to the hardware.

Embedded software engineering. There is a lot of uncertainty and vagueness when it comes to differentiating between an embedded software engineer and a firmware engineer. Many new types of embedded devices have emerged in recent years—devices that are more complex than traditional embedded systems but less complex than personal computers. These utilise file systems on their flash to put programs into memory for execution, and they run larger operating systems like Linux and UNIX.

Embedded software programmers deal with these types of systems as well as old-style firmware on occasion. Routers, smart TVs, and even smartphones and tablets are among the products they work on. Embedded software is basically software that is designed for a specific purpose and has a limited user interface. It will almost never be general-purpose, even if it is highly complicated.

Embedded systems engineering. Embedded systems engineers can create both hardware and firmware, and deal with tradeoffs in order to achieve the highest performance at the lowest cost. On very small devices (of which there are many), we can see them mostly doing hardware and firmware design. Overall, they handle hardware design and then entire hardware-software integration.

Systems architecture is another main aspect that these engineers deal with on a regular basis. The design, development, production, testing, and maintenance of embedded systems are some of their responsibilities. "Simply put, embedded hardware engineers work on the hardware side, and embedded software engineers work on the software/firmware side. Embedded systems engineers work on both," says Rosmianto Aji Saputro, Senior Embedded Engineer at ZebraX.

Non-technical skills

Irrespective of your profession, you can never ignore soft skills. Some soft skills important for embedded system designers are:

- Communication skills
- Marketing
- User research
- Quality assurance
- Time management
- Problem-solving ability
- Ability to learn outside their comfort zone
- Creativity EFY

The author, Aaryaa Padhyegurjar, is an Industry 4.0 enthusiast at EFY with a keen interest in innovation and research.

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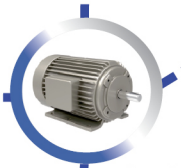
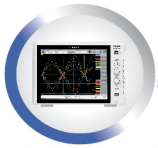
IMPULSE WINDING TESTER

RESISTANCE METER



Motor Solutions



MEMORY HiCORDER

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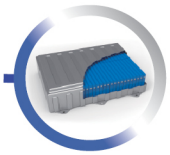

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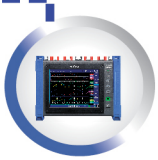

MEMORY HiCORDER

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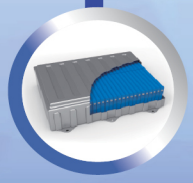
- Evaluating Motor Efficiency and Loss.
- Measuring Motor Torque Vibrations and Measuring Resolver Rotation Angles
- Performing Layer Short Testing of Motor Windings.
- Measuring Winding Resistance, Measuring Motor Coil Inductance and Measuring Motor Weld Resistance.

Inverter/ Controller

- Inverter Motor ECU Measurement and Calibration
- Calculate Inverter Output Power,
- Evaluating Inverter Efficiency and Loss.



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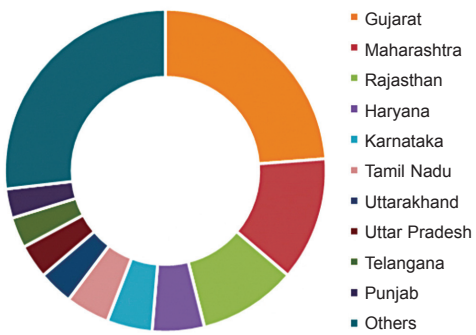
THE DASHBOARD

India Added Over 456MW Rooftop Solar Capacity in Q1

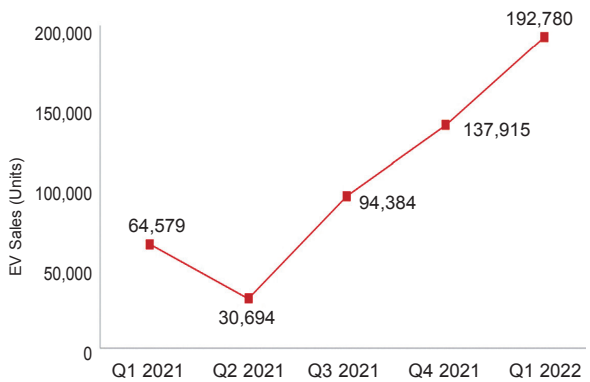
As compared to 341MW registered in the same period last year, a 34% year-over-year growth is seen in total solar installations across India. In Q1 2022, rooftop solar accounted for 15% of the total solar installations. As per a report, the average cost for the same increased by 17%. The top 10 states accounted for nearly 73% of cumulative rooftop solar installations at the end of Q1 2022. Gujarat is the top state for cumulative solar rooftop installations, while Maharashtra and Rajasthan rank second and third.



(Source: Mercom India Research)

EV Sales Increased by 40% in Q1 2022

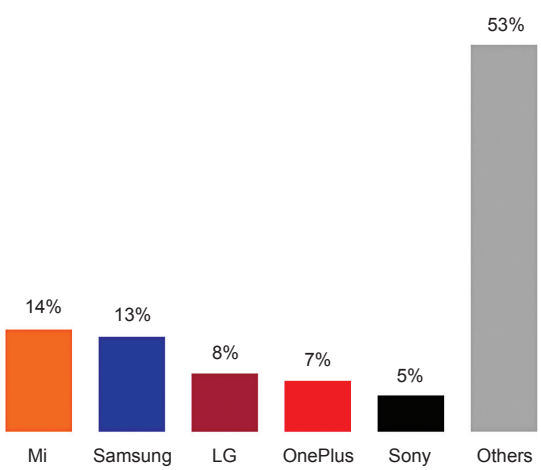
The first quarter of the year saw EV sales register to 192,780 units which is a 40% increase from the previous quarter. This Q-o-Q increase in sales was comparatively small when compared to the sales of 46% from Q3 2021 to Q4 2021. However, these sales have witnessed a steep rise of 199% from the same quarter in 2021, that is, Q1 2021. The highest sales for registered EVs were in the month of March for more than 81,000 units.



(Source: JMK Research)

89% of TVs are Smart in India!

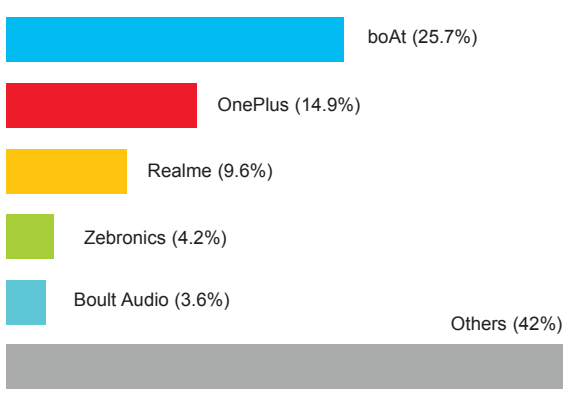
Smart TV share in India's overall TV market grew 33% YoY in Q1 2022 and reached its highest ever at 89%. Xiaomi's 14% market share made it the leading brand while Samsung and LG followed up. In this offline-driven market, the ₹10,000-₹20,000 price band captured over 40% share. The share of TVs with 109cm (43-inch) and above screens is increasing as people are shifting to bigger screens.



(Source: Counterpoint Research)

India Neckband Market Led by boAt, Followed by OnePlus

This market has shown tremendous growth in 2021 as consumers opt in for an alternative audio device. Inspite of the shipments declining to 13% YoY in Q1 2022, they did grow 34% YoY in 2021. The market was led by boAt with a 25.7% share, while OnePlus and realme took the following spots respectively. The price band that captured 70% share was ₹1,000-₹2,000. More than 75% of the total sales were made online.

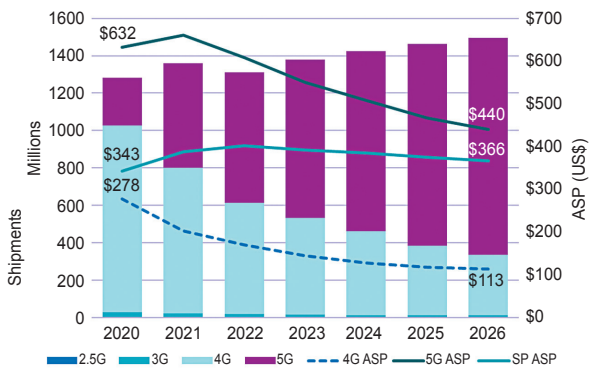


(Source: Counterpoint Research)

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

Global Smartphone Shipments Expected to Decline 3.5% in 2022: Report

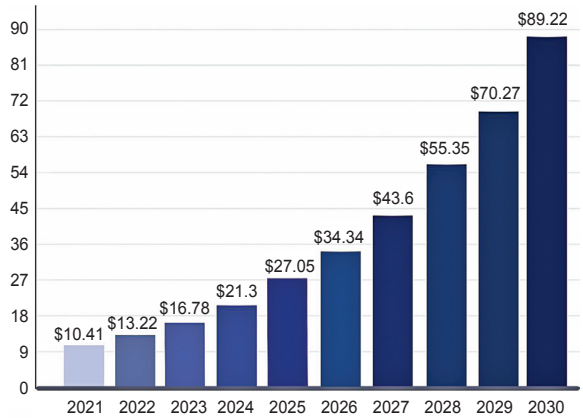
As per IDC's report, shipments of smartphones are expected to decline by 3.5% to 1.31 billion units in 2022. After three consecutive quarters of decline and increasing challenges in both supply and demand, the forecast has been reduced for 2022 from the previous projection of 1.6% growth. Volume expectations for this year were brought down significantly due to increased channel inventory of 5G products in China and the overall reduction in the market forecast. In the long term, 5G is expected to reach a volume share of 78% in 2026 with an ASP of $440.



(Source: www.idc.com)

AI in Hardware Market to Reach US$89 billion by 2030

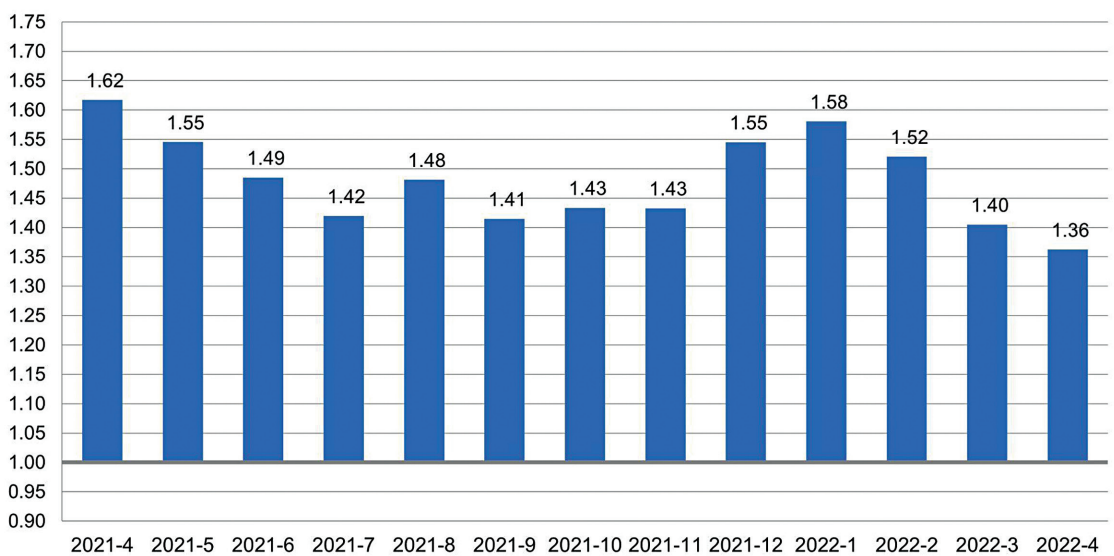
The global artificial intelligence in hardware market size was valued at US$10.41 billion in 2021 and is projected to surpass around US$89.22 billion by 2030 and growing at a compound annual growth rate (CAGR) of 26.96% from 2022 to 2030. Availability of high-speed internet and increase in the number of internet consumers across the globe is driving the growth of the market.



(Source: www.precedenceresearch.com)

North American EMS Industry Up 4.3% in April

The book-to-bill ratio for the North American Electronics Manufacturing Services (EMS) Statistical Program stands at 1.36. The total shipments were up 4.3% as compared to the same month last year. However, in comparison to the preceding month, there was a fall of 10.7%. EMS bookings in April fell 7.2% year-over-year and 2.4% from the previous month.



(Source: www.ipc.org)

OPEN SOURCE BUSINESS MODELS: How Beneficial They Are

The world is moving towards deploying more open source solutions, but are businesses adopting open source in proportion to the way these solutions are being deployed? If yes, are there any proven business models that can help open source companies sustain themselves? Should new companies (startups) venture out in the world of open source?

MUKUL YUDHVEER SINGH

Open source, about a decade back, was referred to as something solely meant for geeks, programmers, and educational institutions. A few years ago, it started gaining recognition as something that is for everyone to leverage upon. Today, even large organisations like Microsoft are openly talking about it, and investing in the same as well.

"A lot has happened and evolved in open source. The top view shows it is free. However, even if it is being made freely available, there are billions of dollars riding on the ecosystem. Not only are there open source companies valued at more than a billion dollars; industry giants including Google and Microsoft are investing millions of dollars in the same," says Mukul Mahajan, MD, Tetra Information Services Pvt Ltd.

Most of these investments, as a matter of fact, focus on hiring manpower for the open source ecosystem. Business models like professional services and cloud hosting are evolving, but the big question is what are the opportunities available to or-

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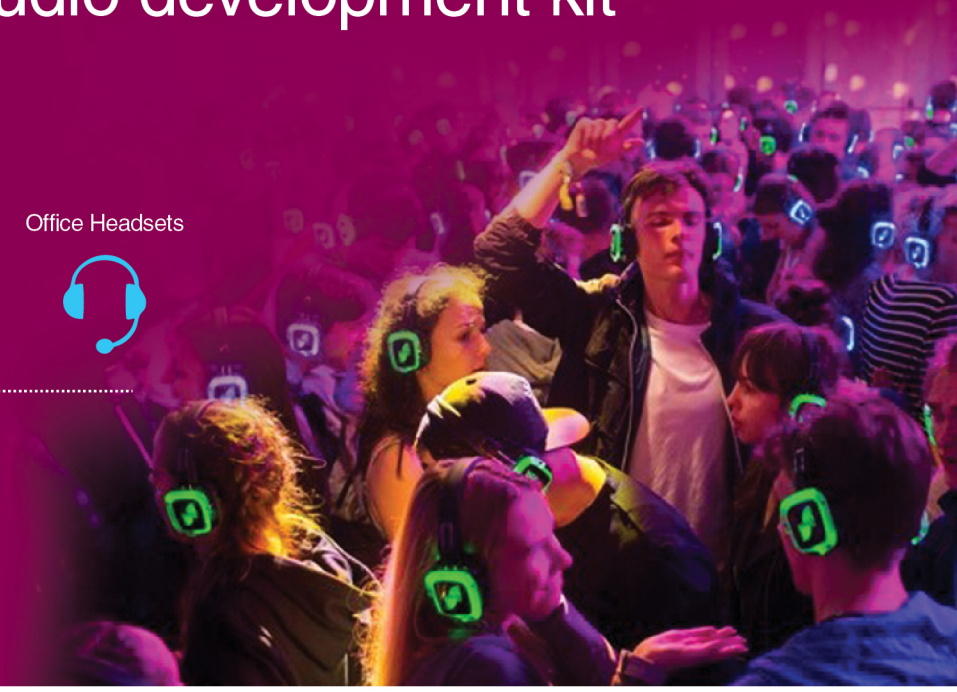

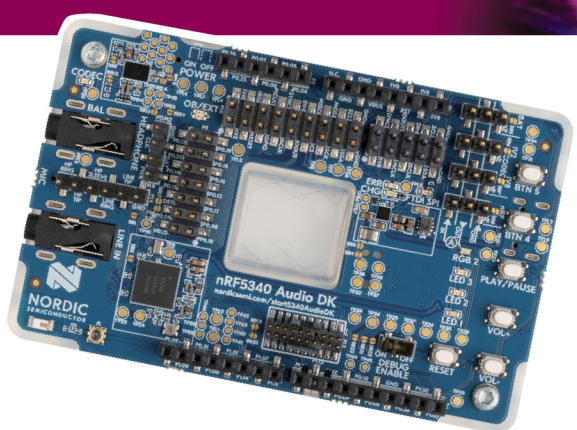

Nordic Semiconductor's recently launched nRF5340 Audio Development Kit (DK) is the ideal platform for Bluetooth "LE Audio" products which comprises of everything needed to start development. The kit is configurable and can function as a USB dongle to send or receive audio data from a PC. It can also function as a Business Headset a broadcast receiver or a True Wireless Stereo (TWS) Earbud. For most use-cases, we recommend using two or more DKs.

Features

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SCAN ME

ganisations who aim, or are already working on, in being an open source player, and what are the business models they can pursue for profits?

"I think the key aspect is to have a business model. But here's the thing, the vast majority of people who are investing in open source are not quite investing directly for the sake of it. I don't think there is something directly attracting them to invest in open source," says Hadi Hariri, VP, Developer Advocacy, JetBrains.

He adds, "They are not investing to make a better world using open source but there are key indicators that force us to use open source, which are good until there is a sustainable business model, which unfortunately many do not have."

Picking the Right Open Source Business Model

"You can always look at it as either half-glass-full or half-glass-empty. We can leverage a little larger ecosystem, by reaching out to companies all over the world, thus leveraging the public clouds," says **Sanjeev Sharma, Director, New ISV Partnerships, Microsoft.**

"Focus more on the pain of the consumer, and then make a business model that can help you survive. Times are changing rapidly. It's good to be on the dynamic side as these changes will help you survive in the long run," says **Samir Doshi, Co-founder & Director at iNextrix Technologies.**

"It's important to keep figuring out things on the way. It's critical to always remain agile and flexible. Everyone should nurture their curiosity and keep testing waters to see what works best for them. The market is optimistic so why shouldn't you be," says **Kabir Chandhoke, COO, SourceFuse Technologies.**

"If you want to leverage open source, you should rethink your decision. Firstly, whether open source will provide any benefits or not. Once your decision is certain, make sure you have a business model around it. If you want to make it successful, make sure you have a license that is not overly permissive," says **Hadi Hariri, VP, Developer Advocacy, JetBrains.**

Cue: Microsoft's here!

We have all heard and also used Microsoft, and the biggest cue that open source is indeed the future can be derived from what the organisation is doing on the respective open source front. But why is Microsoft in open source?

"Satya (Nadella) was very clear when he took over Microsoft, that it has to be more open than it ever was. This actually goes back to our core thinking of wanting to do more for every person and organisation, which cannot be achieved by being closed," says Sanjeev Sharma.

He adds, "If 40 per cent of CIOs have Linux as one of their prime strategies, and 60 per cent of developers want to see the cloud providers in open source, if 90 per cent of enterprises deploy Linux in some shape and form, I think it indicates an absolutely clear market decision."

Sanjeev mentions that he sees tremendous opportunities to build around open source, affirming that Microsoft is committed to stay open in the future. It is worth mentioning here that 50% of Azure's VM cores are Linux, and 60% of images on it are also Linux based. More than half of the ecosystem on Linux, as Sanjeev confirms, is Linux based. SaaS applications and various other applications are leveraging open source.

He goes on to explain, "This also brings opportunity for any new offering that is coming to the market to continue to leverage their core DNA while also getting exposed to the larger market worldwide, giving an opportunity to experience the full might of larger cloud providers. Talking about India, we have more than 30,000 customers in just one segment."

Solving one problem using open source creates room for solving many other problems. For example, a normal customer service app has to touch different platforms, while being compatible with different types of devices. The same might also have to browse through multiple databases. The idea, as per Sanjeev, is to slowly and steadily multiply what is being offered to clients.

"You begin to try by offering one solution to one type of customer base and then you can pivot to a larger market. Today's cloud provides you that opportunity to experiment," he adds.

Another remarkable thing to point out is that Microsoft had acquired GitHub for $7.5 billion in 2018. The company then, in March 2021, had announced a grant of ten million rupees to fund India's open source contributors working on building software using open source tools.

Subsidise and maximise

Taking example of the likes of Microsoft, Amazon, and Google, along with the open source ecosystem they operate in, it is clear that their open source business model is subsidised by the cloud service they provide/sell. Facebook, as per Hariri, is subsidised by data and advertising. Similarly, there are others who subsidise the business of open source by selling tools, and one example of the same is JetBrains.

"I don't think there are any key parameters. You should look at how you are going to sustain your open

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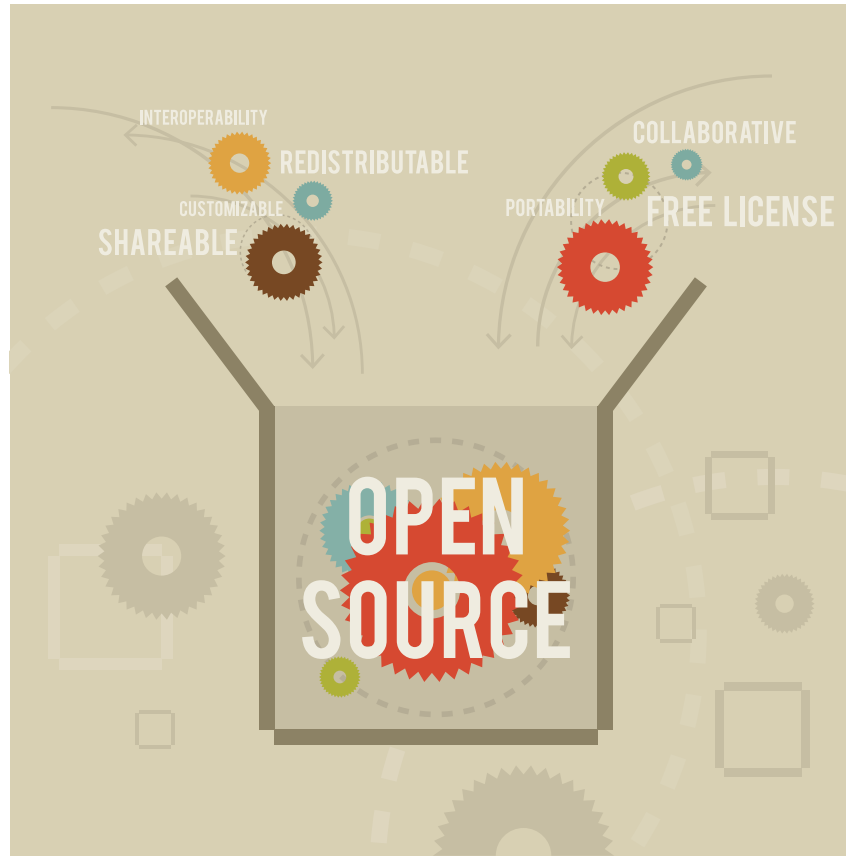
source contributions. I don't believe that business models based on priority giving succeed. There are only a few success models like that. The best example that can be thought of here is RedHat," explains Hariri.

The model of RedHat, as most of the industry *gurus* will agree, is complicated yet successful enough to require consulting, which is provided by the RedHat team itself as part of the business model. The chances of making the business model sustainable may decrease if the consulting is taken care of by a third party.

Open source, as Mukul points out, might be more of an enabler that helps get traction and build newer business models. What enables open source and new business models to sustain is the demand it gets from all verticals of business.

"When running a business, sometimes you need to subsidise what you are doing for the greater good. Otherwise, you could simply be considered a hobbyist," remarks Kabir Chandhoke.



Market place: Enterprise or community

Enterprise and community are two popular business models that have started to become the talk of the town. The community edition refers to free usage of open source with limited capabilities, whereas the enterprise edition refers to a business model which offers a lot more features available at a cost.

"These two models are becoming very popular. On top of these you can also offer complimentary services such as certification, development services as well as support contracts," says Samir Doshi.

Whether someone refers to an enterprise, community or any other business model around open source, marketplace is one such model that joins all the dots together.

"Marketplace is definitely a brilliant business model as it adds a lot of value to all the open source products. You have brilliant brains coming up with add-ons and applications. It is definitely a good one," adds Samir.

It is critical to understand the relationship between open source and cloud in order to understand business models better. The debate around whether cloud is making open source popular, or vice-versa, is something that the experts still lock horns about.

"If you think about the cloud itself, open source is what actually drove the cloud in the first place. Can you imagine the public clouds we have today and companies paying license fees for their operating systems?" asks Kabir Chandhoke. "We would never have achieved the scale of, say, AWS, had there been license fees for millions and millions of servers rolled out."

He is of the view that open source is the driving factor behind public cloud. This might unearth another business model revolving around offering cloud services to consumers using open source.

"The reverse is also true as the public cloud is responsible for making open source projects popular. Another way public cloud has accelerated the monetisation of open source is through the SaaS route," adds Kabir.

Cloud and open source can enjoy a mutually beneficial relationship as long as the former does not start eating into the latter's business model. This situation arises when an open source product becomes tremendously popular.

"I definitely see evolution taking place in the partnership between cloud and open source. It will be interesting to see how this partnership continues to evolve with opportunities for both the community and the owners being compensated," explains Kabir.

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Elasticsearch, in open source, needs no introduction. It is basically a search engine based on the Lucene library. At a point in time, it was the go to favourite of many, if not the majority of open source developers. The breaking news from the company came in early 2021 as it decided to inform its audience about Elastic License 2.0.

This, as per the company, simply means that the license allows the free right to use, modify, create derivative works, and redistribute. However, there are three limitations:

1. You may not provide the products to others as a managed service

2. You may not circumvent the license key functionality or remove/obscure features protected by license keys

3. You may not remove or obscure any licensing, copyright, or other notices (as published by Elastic.co)

In simple words, this means that neither the Elastic License nor SSPL has been approved by the OSI. Hence, the company is no longer referring to Elasticsearch or Kibana as open source. Elasticsearch is the greatest example proving how fast the world of open source is evolving, and how fast the existing business models are shrinking, while new ones are making their way!

"From the community perspective it was impacted in two ways. The first was that contributors, who worked for the same, were suddenly told that what they worked for was no longer truly open source. The second, keeping big and small players in mind, is the fact that the solutions they are developing now cannot be made public, keeping the announcements made by Elastic in consideration," says Kabir.

Partnership with big players

This decade has been more about collaborations and mergers in the world of technology, and the open source vertical is not an exception. Following this trend, to partner with a big player like Microsoft can be a big opportunity for startups and organisations already operating in the domain of open source.

Sanjeev explains, "If you are a services provider, there are opportunities available with Microsoft as the company has a specialisation in open source Linux and Kubernetes."

In terms of ISV and IP opportunities, the world is witnessing innovation and launch of new solutions. Sanjeev, who gave an example of an assessment engine based on open source notes, "It scaled up very easily. However, the problem was finding customers beyond India. They leveraged the 60+ datacenters that Microsoft has." He also gave an example of a sales nudge solution company, which helps the sales team to analyse deals and close them quickly.

Whether the solutions are for education, health, finance, or any other industry, big players, as per Sanjeev, can not only help scale the offerings across geographies but can also help make these solutions more secure.

"The core of the solutions that Microsoft offers are actually coming via partners. We are only providing them the platform. The solutions are coming through organisations which are based around the world," explains Sanjeev.

The opportunity, as per him, is coming in accordance with the solution provided by the company. More than 60% of the solutions being offered are open source.

Partnering with big names also brings forth a question. Why is the value of open source companies so high? The answer lies in the consumer base that many of these organisations have. It continues with how brilliantly these companies are handling the complex layers of architecture.

"The conflict between Amazon and other companies is also one of the reasons behind the high evaluation. There still exist companies which believe in hosting everything in their own server rather than a cloud," feels Samir.

Then, why do developers work for free?

Samir answers, "Because you are using that tech for yourself. For example, if I am working on a project, I will want to use that for myself as well. I may want to build my UI using React and many such things. Once you start doing that and notice a missing feature, or find a bug, you end up fixing it and that creates an impact for the greater good."

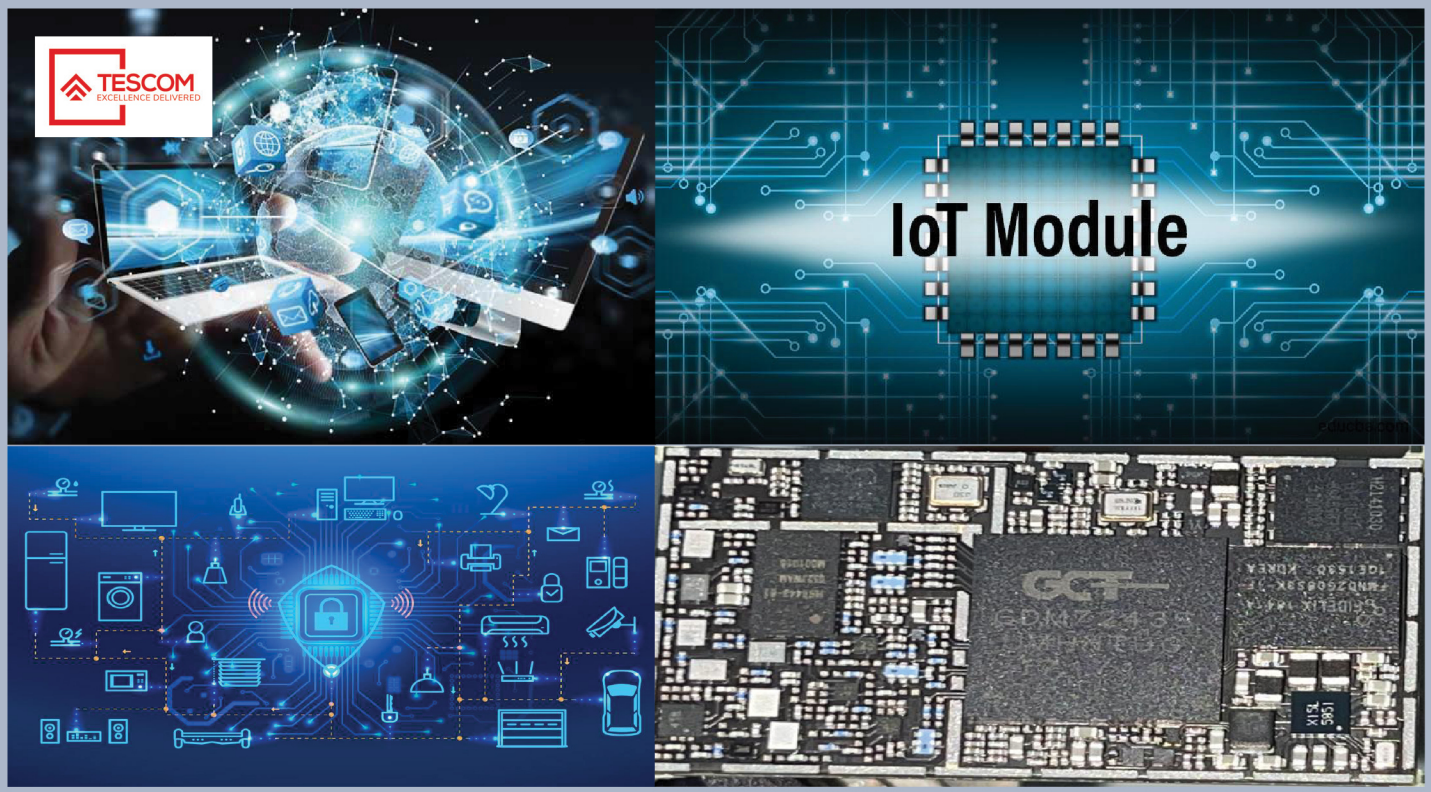
"The same also allows young and experienced developers to polish their skills. It's almost the best CV you can have. It probably serves better than most internships that a developer could have. Where else would you have the opportunity to have your code checked by some of the best and brightest in the world," he adds.

The open source industry is now undergoing a trend wherein the big players (the one's providing cloud services) have also started facilitating open source stacks. Going by the trends, it looks as if every big company will soon join this race, and the same could lead to big changes in the open source Ecosystem.

"I don't think there is space for any major changes. The community will always be there, whether it is from the cloud provider or open source companies. I do not think there would be any threat to communities or business models as such," feels Samir.

Kabir adds, "I think this is the reaction to the recent license changes made in the world of open source." EFY

This article, based on a panel discussion held at OpenSource India 2021, has been compiled by Mukul Yudhveer Singh, Business Editor, Electronics For You, until recently.



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Assessing OPEN SOURCE SOLUTIONS For Deployment

Open source is mainstream now. It has proved its mettle as more and more organisations are adopting OSS. But how can you assess and analyse whether the solution you are interested in is the right fit for your organisation?

MUKUL YUDHVEER SINGH

"Open source is no longer a matter of concern regarding its duration as lot of organisations have already started using it, and (some) are now busy evaluating how soon they can start their journey with it," says Mukul Mahajan, Tetra.

Rightly so, a recent report by Gartner pointed out that by 2025 more than 70% of enterprises would increase their IT spending in open source software (OSS) as compared to what is being spent on it as of now. This shows the increase in the number of organisations that have started to weigh the possibility of using open source solutions. However, it is still a long way to go for the open source solutions.

"The organisations are still not clear about the sustainability of open source solutions. For corporations who adopt open source solutions, despite the solution being free, they always look at the long-term sustainability. So, unless they are sure about it, they are very hesitant

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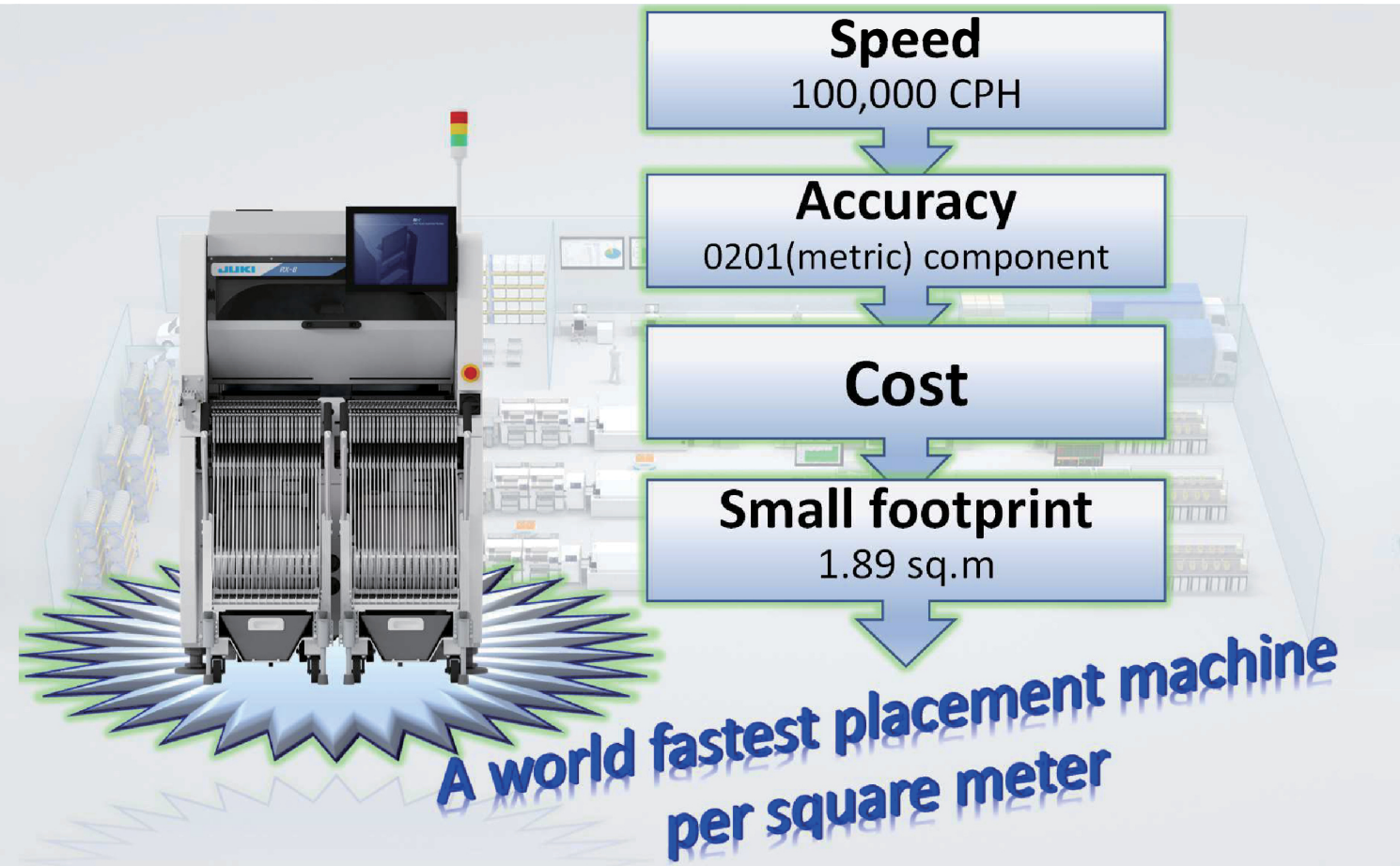

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to adopt it. Moreover, there is no strategy for one solution that fits all approaches. There are multiple strategies, and each strategy has its own advantages and disadvantages," explains Mahajan.

A recent report published by Red Hat notes that 90% of IT leaders surveyed are using enterprise open source today, and they are using it for IT infrastructure modernisation (64%), application development (54%), and digital transformation (53%). The move to remote working, as per the report, forced many organisations to accelerate their digital transformation efforts to maintain innovation and continue to meet customer demands. So it makes sense that it moved up this year to the top three.

Paul Cormier, President and CEO, Red Hat, in the report says, "Open source has solidified itself as an innovation engine for the software industry. The technology trends that you see changing how we work and do business were born in open source—enterprise Linux, cloud computing, edge and the Internet of Things (IoT), containers, artificial intelligence and machine learning, and DevOps. These are the same principles that apply to how you've seen the world come together and make rapid advancements, like the Covid vaccine, in a shorter time frame than ever before. In both cases, enterprise technology and the challenges of a Covid world, the problems are too big for one person, one company, or one organisation to solve."

He adds, "But it's in moments like this where open source truly shows its power. Collaboration, transparency, and the idea that the best idea can come from anywhere are the principles that help organisations not just meet challenges but reach new heights."

Assessing open source adoption

Assessing the adoption rate of open source is not an easy task to accomplish as different industries use open source solutions for different reasons. For instance, a manufacturer might be using open source software for collecting data generated by machines to accomplish better turnover whereas an e-commerce player might be using open source software to enable search on his platform, so on and so forth. The cost of ownership and the risks associated also vary from case to case.

"Open source solutions and their sustainability need to be adopted on case to case basis, keeping unbiased risk assessment in focus," says Mahajan.

The industries and verticals where the open source solutions are being adopted today include infrastructure software, application development, DevOps, databases, analytics, and cloud based operations. There are a lot of open source stacks available for all these verticals. Most of the new databases, as a matter of fact, are open source. There is no vertical left in cloud based solutions where open source cannot play a major role. But the question for organisations looking to deploy open source solutions remains the same. Why should they do so?

The beginning to the answer of this questions lies within the organisations themselves. What are the parameters they have kept in focus while assessing if they should go for open source solutions or not? The parameters that should generally be kept in focus while looking towards open source solutions include, but are not limited to, cost, freedom and flexibility, maturity, and talent retention.

"All these criteria might not be relevant to all the organisations. For some, all of these might be relevant, for others, only a few of these might be relevant," says Mahajan.

What all should be assessed in the cost factor

- Implementation and deployment cost
- Development cost
- Support cost
- Subscription cost
- Training cost

Cost as a criteria

Whether an individual or an organisation is investing in a new building, or a new software, the cost involved plays a critical role. The importance of the cost factor, while deploying an open source solution, increases by leaps and bounds. Cost of an open source solution is not limited to the cost incurred in downloading and installing a solution but also the cost the company will pay for the support services required for that solution.

"Any organisation looking for open source adoption should look at the long term cost of the open source solution. You will need support for the solution down the road. If you do not opt for that support, the only choice you may end up with is to stop using that solution and throwing it away," explains Mahajan.

This could be a point where the senior management could raise questions and ask why this was not given a thought while choosing the solution. The key towards assessing and choosing an open source solution lies in calculating costs for at least five years down the road. The aspects to keep in mind include costs required for installing and maintaining the solution, the costs saved using the solution, and the cost of manpower required for the solution.

One should also keep in mind where further development of the solution will take place in-house, or will the organisation hire a third-party to do so. Further, deploying an open source solution mostly requires paying a support cost to a third party that can support the solution in the long run.

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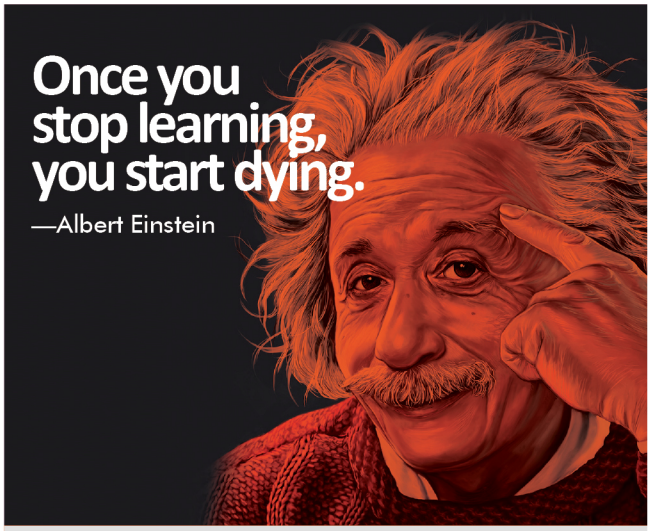

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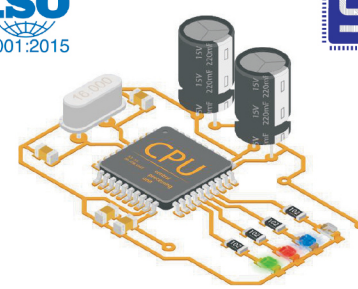

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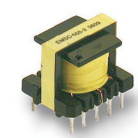

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"If the development is being done internally, the organisation will need to make sure that the manpower can be sustained. Then comes in the customisation costs. Many will want to customise the solution as per their needs, and that might cost extra in form of development cost," shares Mahajan.

He adds, "Open source solution providers, such as Zimbra and Red Hat, usually offer open source solutions in subscription models. Red Hat charges 100% as a subscription cost. Keeping that in mind and calculating how much you will be paying in five years as subscription costs can also help organisations in assessing and choosing the right open source solution.

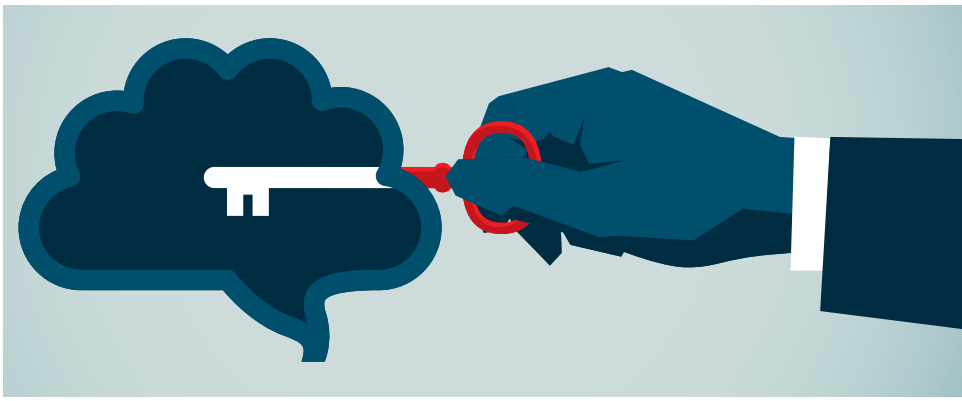
Deploying a new solution always requires the existing manpower to be trained on the same. This training not only costs money but also requires dedicating hours, and sometimes days or weeks, towards training and practicing. Additionally, both the internal and the external teams need to be trained in such a way that they are in sync with each other all the time.

"If you want to deploy Libreoffice instead of MS Office, you will encounter some features that are not usable. You will need to train the users on Libreoffice. It is not essential that open source adoption will lead to lowered costs, or open source cannot be deployed if the costs are higher."

Freedom and flexibility

Freedom and flexibility are among the top reasons that have made open source what it is today. The freedom to choose solutions with the flexibility of customising existing solutions have not only empowered the community developing open source solutions but have also empowered the end users to choose and deploy.

Freedom and flexibility, in the simplest of terms, stands for access



to the source code. This access becomes essential for organisations such as the e-commerce portals coming up today because of the changes they are introducing on daily basis. However, this criterion does not hold the same value for all the organisations looking to deploy open source solutions.

"The freedom and flexibility assessment criteria is case-to-case. For instance, the way e-commerce portals are evolving on a day-to-day basis, they cannot work with solutions that are closed source. Such organisations are accessing open source solutions despite the higher costs," explains Mahajan.

The second factor, flexibility, revolves around whether your internal team is flexible and capable enough to support these solutions, or will you be requiring external support (commercial) for the required support. Of course, the internal team, if there, will be required to upskill over time, and the management might also need to make extra efforts to sustain the team.

"You will have to decide whether you want self-support, or you will be needing commercial support. Either you should have the capability to support the solution internally, or you will have to reach out to the vendor, or any other third party for the same," shares Mahajan.

He adds, "Adopting open source solutions requires being able to get suppliers in the long run. This matters a lot when we talk about mature projects. If you are adopting any new solution and there are only a couple of suppliers supporting it, you might find it difficult to find suppliers, if the solution does not grow."

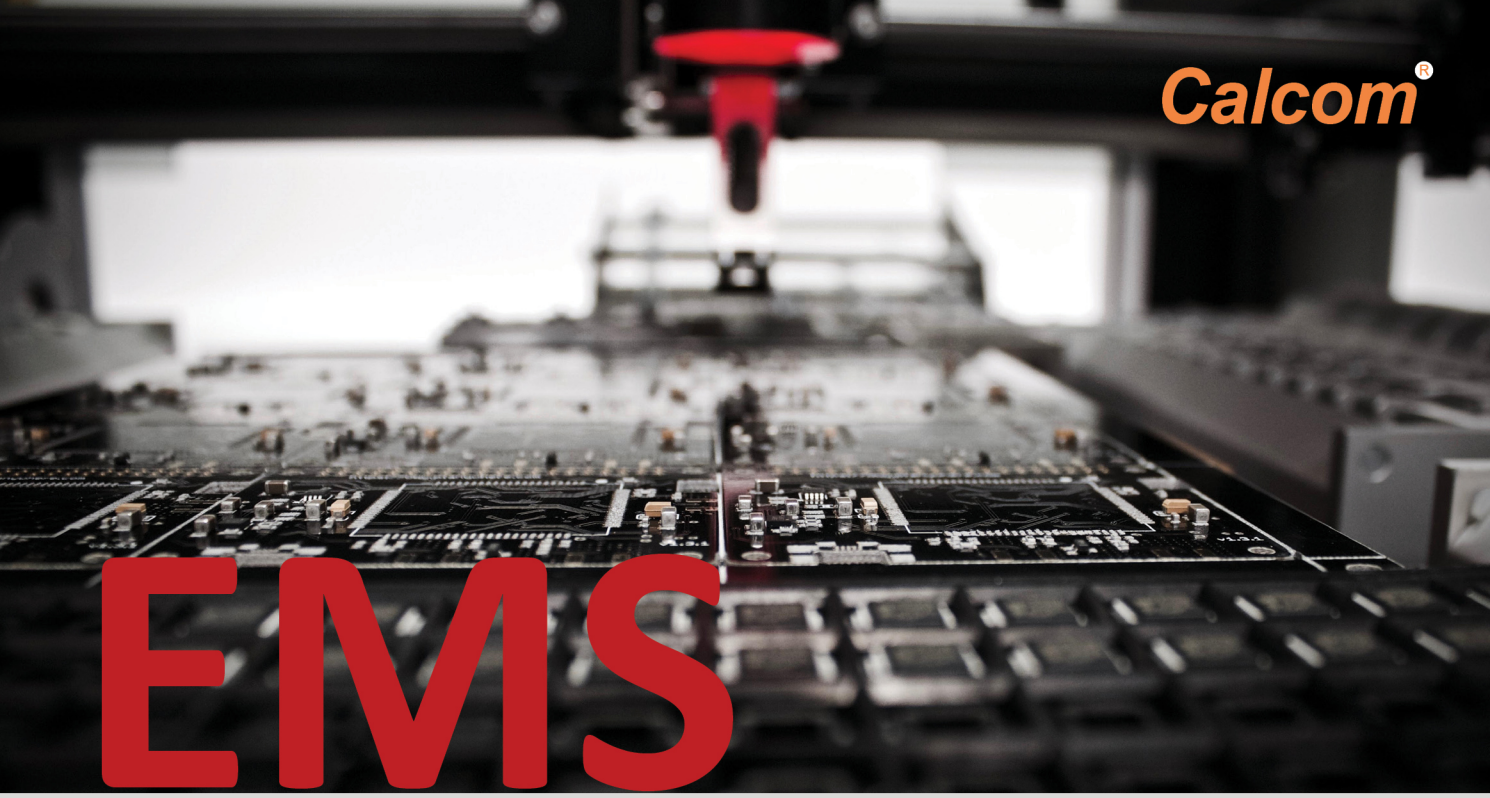
Organisations which have dynamic requirements should carefully assess the freedom and flexibility factor. This is because they might require a lot of customisations, which in turn will require them to work with multiple suppliers at the same time. The frequent changes they need will always need the source code to be present at hand.

Matured solutions only

There are millions of open source solutions available in the market today. A lot of these also make repositories like GitHub on an everyday basis. However, it is not common for all of them to sustain themselves in the long term, in some cases even for short-term. Mahajan is of view that only about 5 to 10% of such solutions reach the mature stage.

What happens if you adopt a solution, and it is not able to mature with time? Choosing solutions that are mature over solutions that have just entered the market can make a big difference in the long-run as support will always be available for the former ones.

"If you are adopting any open source solution, you should always look at the maturity of the solution. Hence the project that you are deploying should be in the mature



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stage and should also be supported by a good number of developers, as well as some key organisations," explains Mahajan.

He adds, "Then comes restrictions of licensing. If the solutions you are deploying are largely restricted by licensing, you might find yourself hanging by a thread. Licensing assessment should be checked in all the cases as organisations will depend a lot on the solution, and this dependency might increase as the time passes. The licensing should not be too restrictive."

Availability of commercial third party support options is something that organisations looking to deploy open source solutions should always assess. There should be more than a handful of vendors who can support the solution that an organisation is deploying. This will not only help in cost negotiations but also in choosing the best support possible.

"Open source also has dual licensing models available where there is vendor lock-in. Organisations must look at what are the things where vendor lock-in is applicable. For example, if an organisation does not take subscription from the vendor, can it still use the solution?" explains Mahajan.

The open source solution that an organisation adopts should have transparency. There have been instances where vendors have used open source just as a base combined with their own codes. Such vendors do not generally allow the organisations to use these codes. The ability to integrate such solutions with other solutions also matters a lot as desired results usually warrant the use of multiple solutions at the same time. It is critical for these solutions to work in harmony with each other.

"If you are deploying ERP, you will have to integrate with CRM, with web, with social media and more. We live in a world of integration, and if the solution you are deploying does not have the capability of getting integrated with other solutions, do not choose it," says Mahajan.

More on the menu

Apart from the check points mentioned above, there is still more that organisations can do to assess risks attached with adopting the open source solution they are interested in. For instance, while a check on the quality of services provided with the solutions is something no organisation will miss, there is a possibility of missing out checking the governance model of the provider creating and enabling that solution. What if there are only three to five people managing the entire governance model, and one fine day they decide to change the model?

"Though the features of such solutions might be good, but lack of a governance model will mean that there is a lack of support. It also means that the solution might not be sustainable in the long term," explains Mahajam.

The attributes of a sustainable open source solution include availability of community support, good documentation around the project, a thriving ecosystem of developers and contributors, transparent licensing model, and an up-to-date security reporting model. What kind of organisations are supporting the solution matters a lot. For instance, solutions being supported by the likes of Facebook will always have high credibility over others.

"Based on the above, open source policy documents should always be made for the organisations. These documents should clearly mention the advantages, the risks, licensing policies, and the total cost of ownership involved. The policy document should also explain the alignment of the solution with business and IT. If it is not aligned with businesspeople, organisations will not adopt it," says Mahajan. EFY

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SKILLING IN 5G TECHNOLOGY Holds A Great Promise

India is at the threshold of a big revolution as the highly-anticipated 5G network is finally taking shape in the country. But do we recognise the potential it holds for the electronics industry? And are we getting ready the biggest asset at our disposal—the manpower—at the required speed? Is it possible to take our rightful place in this world without the skilled manpower?

TELECOM SECTOR SKILL COUNCIL and **SIDDHA DHAR**

Telecom Minister Ashwini Vaishnaw successfully tested India's first 5G audio and video call in May this year. "Successfully tested 5G call at IIT Madras. Entire end to end network is designed and developed in India," he tweeted.

As with any new technology, 5G brings with it opportunities and the promise of employment.

The Telecom Sector Skill Council (TSSC) estimates that India will require as many as 22 million skilled manpower by 2025 to reap the full potential of 5G. This is easier said than done.

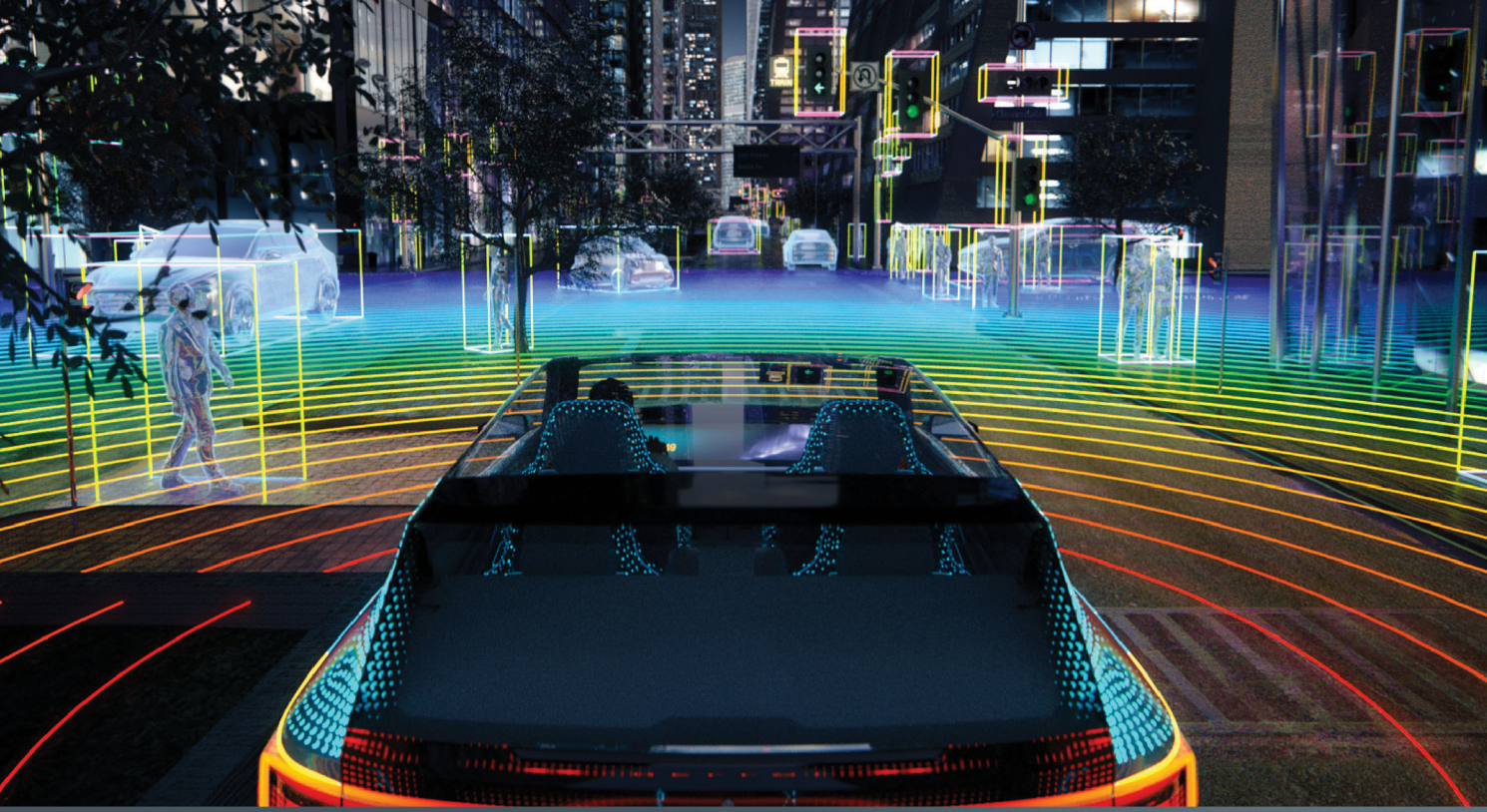
India is infamous for missing the bus of both the 4G revolution and the electronics manufacturing era in the past. And it can be attributed mostly to one reason—the lack of awareness of the opportunities and the challenges we face. Skilling the youth is a prime example of that.

"The future doesn't lie in the job, it lies in the person doing the job," says Ramesh Kasetty, CEO and Co-founder, Duranc.

A robust telecom sector for a robust electronics industry

The telecom industry no longer sits in the back seat of reforms. The introduction of 5G promises a gleaming future for the industry. This is the result of a long-awaited realisation—a robust electronics and technology industry requires a robust telecom infrastructure.

"The kind of new technologies that are coming, it is not possible to take advantage of that tech without having a robust telecom infrastructure underneath," notes Dr N.S. Kalsi, Chairman, NCVET. Technology is only as good as the hands that use it. The first step to skilling the manpower is



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A Case for the Learner's Perspective

Now, while the conversation about the need and means of upskilling goes on, the ground reality is a little different. A predicament skilling centres often find themselves in is having to deal with students who have no desire to upskill. This is at the expense of large sums of time and money spent by the industry on upskilling, and students spending time learning something they do not wish to. A complete lose-lose situation. What can be done?

For starters, putting up more rigid screening tests for potential students is a good way to weed out unsuitable people. Second, Dr Kalsi suggests that keeping the sword of some monetary investment on the student's part can be a good way to make sure that only those who are truly interested are upskilled. It is also important to understand what the people are actually interested in—be it AI/ML, IoT, or Big Data Analytics. Mapping a person for the right skill and competency is very important.

highlighting the opportunities that are available to them to utilise these skills.

The recent policy of the government to introduce semiconductor design manufacturing and the subsequent India Semiconductor Mission have opened doors for the telecom sector to emerge as an economic leader. It is expected that soon every piece of metal will have silicon embedded in it because silicon is what provides a brain to the metal. But that brain will only be able to communicate through connectivity. Hence, telecom provides it with life.

In a similar vein, the recent production-linked incentive (PLI) schemes for electronics manufacturing present further opportunities for skilled manpower to put their talent to use. The introduction of 5G has opened incredible avenues for growth across sectors. And as technologies like IoT, Industry 4.0, and AI/ML keep propping up in conversations, the significance of connectivity and data becomes clearer. But so do the challenges that accompany them.

The country has an impressive herd of skilled manpower for 2G, 3G, and even 4G. However, 5G is a different ballgame. "The infrastructure which is required for 5G is different. It has more additions to it, and hence skilling needs to happen so that the workforce understands what each of these additions has to offer," remarks T.R. Dua, Director General, DIPA.

Talent—the newest competitive edge

India's biggest demographic dividend and asset is the people. Every year, thousands in the workforce migrate to foreign countries in search of employment and better opportunities. Arvind Bali, CEO of TSSC, says, "The responsibility on our shoulders is tremendous as this provides the opportunity to be global skilling leaders."

This is no easy feat, though. The skilling mantra needs to work on a certain paradigm. The centres need to be omnichannel. People need to have the assurance that they will be continuously learning through digital channels and workplaces.

Skilling needs to be aspirational. Given the kind of enthusiasm and drive in the youth today, this is hardly a challenge. The real challenge lies in honing that drive and channelising it in the right direction.

As far as building international cadence goes, Bali provides an interesting insight: "It is no surprise that countries in the Middle East have numerous takers for Indian talent. But what about skilled talent? If we can send these people with a certain level of training, and make them more desirable in terms of skillset, the opportunities for these people increase manifold, and so does our quality of Indian talent across the globe."

But there is a need to recognise skilled manpower on the home turf too. "We need a full spectrum of trained manpower in 5G. Right from the design to implementation and commissioning and finally to operation and maintenance. And then repair and maintenance services," says Dr Kalsi.

It is no surprise that most upskilling and reskilling today happens at the workplace. But as the demand for the technology grows, a stronger foundation needs to be set.

Adding courses on 5G development in the syllabus of engineering college students can help, but a more effective way could be to also provide them with an easy way to opt out by making these courses optional, so that only the ones interested are enrolled. A smaller group also provides space to improve the quality of the course through apprenticeship programmes and partnerships with the industry and fluid practical assignments.

Providing this early on can help make the youth job-ready by the time they come out of the college. Subsequently, creating modules of 60-190 minutes that form the base of the technology can be distributed across the school level to start the process sooner. These modules can also help reskill entry-level employees who have little to no idea about what 5G entails.

Training the trainers

A major roadblock in successfully upskilling the workforce is finding people who are adept enough to impart the necessary skill. Rehman Khan Suri, Professor at DSEU, notes, "The main challenge today is providing training to the faculty which can train the skill in the particular skill-set. With the pace at which technology is changing, academia cannot really match that pace without skilled academicians."

Good faculty development programmes, as such, are not an option anymore. They are necessary to make way for a larger skilled man-

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power base. New innovations only come when there is a fresh flow of ideas and a stronger collaboration between the trainers and students is the path for it.

One possible solution to this could be to make it mandatory for master's degree holders and PhD holders to spend at least a year in an educator's role, training not just the students but also helping upskill the rest of the trainers in academic institutions.

The debate around the quality of academia needs to be hotter. This is the only way to help provide quality educators who can help bring about the next technological disruptions through their training.

Industry, government, and academia

The facets of 5G are such that there is every possibility to create a pathbreaking framework where workplaces, educational institutions, and skilling centres can talk to each other. This conversation means that everybody involved needs to pool in their effort. It requires a holistic approach.

For the talent to take lead in not just India but the rest of the world, there needs to be a true public partnership. "A public partnership comes from the perspective of recognition and standardisation," says Ved Mani Tiwari, COO, NSDC.

A common complaint from the industry is that there is a lack of skilled talent, while the workforce complains about the refusal of the industry to make an effort to provide that skilling on the job. A better connection with the industry is the crucial step to putting an end to this chicken and egg situation. As a first step, skilling institutes need to make certifications of such a level that the industry loves to take those certified people.

The whole point of training the trainers also needs to ride on the back of the industry. The industry-academia integration needs to take a stronger and more supportive approach. Providing the institutes with the necessary equipment, which otherwise takes ages to reach them as they pass through multiple levels of authorisations and tenders, can be a helpful step.

As for academia, it needs to have a more open approach toward upskilling the existing workforce in the industry. A big part of why upskilling seems tedious to the workforce is the number of efforts they waste in learning from scratch, something that they might not necessarily require.

Modules and courses have to be framed in a less conservative and more flexible way. For instance, counting a certain number of years of work experience as credits. With these credits, they may skip the initial foundational education and move on to the meat of the curriculum in the second or third year of college. Offering apprenticeship modes (ranging from a few weeks to a few months) can be another way to smoothly upskill/reskill the workforce.

This is how true integration and balance between academia and industry can take place.

A multi-faceted approach

IoT, drones, Industry 4.0—all these new technologies need assistance from the telecom sector to reach their true potential. Although the opportunities are riled up, the challenges to fairly skill/upskill/reskill the workforce need to be overcome to truly achieve the target.

A proper partnership by various stakeholders in the economy is the need of the hour. Skilling needs to be not just multidisciplinary but also multi-ministerial. After all, becoming a global power in the technology manufacturing space is a team effort. It is high time we treat it like one. EFY

This article, based on panel discussions hosted by Telecom Sector Skill Council during the Annual Telecom Report Release, has been transcribed and curated by EFY Business Journalist Siddha Dhar.

Speakers

Arvind Bali, CEO, TSSC

Dr N.S. Kalsi, Chairman, NCVET

Ramesh Kasetty, CEO and Co-founder, Duranc

Rehman Khan Suri, Professor, DSEU

T.R. Dua, Director General, DIPA

Ved Mani Tiwari, COO, NSDC

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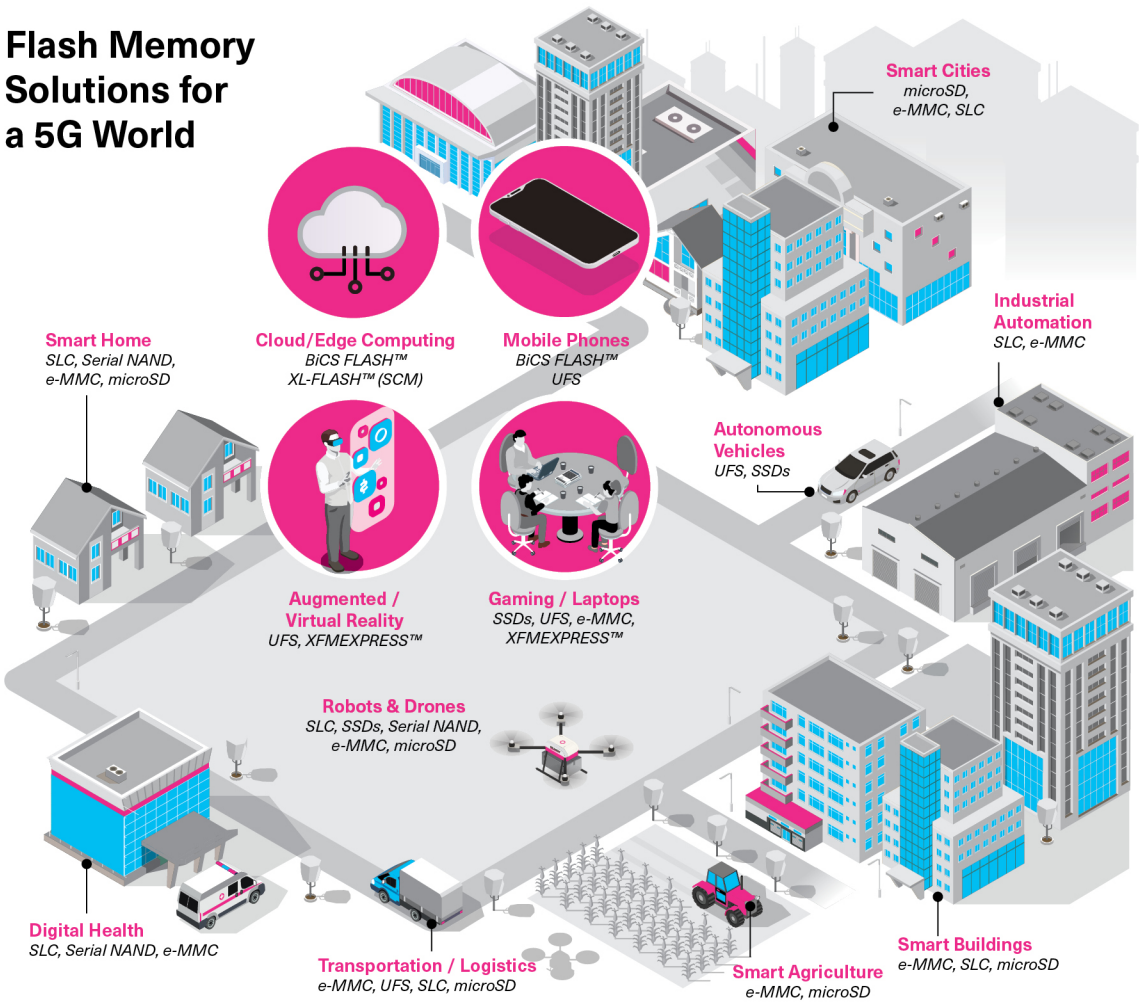

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Opportunities And Challenges For DRONES IN THE MINING SECTOR

The Centre has introduced 'The Drone Rules, 2021' to regulate the use and operation of drones in India. It is safe to say that drones are heralded to bring about major changes in modernising various sectors in the country. A glimpse of it can already be seen with how fast it has transformed agriculture in the country, which has inadvertently resulted in various new agri-tech companies coming up. The mining sector is envisioned to increase the GDP contribution in India from 1.75% to 2.5% in the financial year 2022-23. However, one of the setbacks that the industry faces is its trepidation to adopt newer, faster technologies. Mining companies have realised how drones, as miniaturised flying machines, help the industry not only save time and money but also provide access to the inaccessible, besides having a lasting impact on safety and health regulations in the mining sector

ASSOCHAM and **SIDDHA DHAR**

While the use of drones in mining was at a validation stage till a few years ago, it has now crossed that stage and reached a point where we see an early adoption of drone technology throughout the lifecycle of a mine, starting from the exploration phase to the operations, right till the closure phase. "The tangible value that drones as a technology bring into mining has crossed the early adoption phase. We have reached the stage where we are now seeing a larger, quicker adoption of drones happening in mining," notes Mrinal Pai, COO and Co-founder, Skylark Drones.

The notable amendment made to the drone policy in 2021 stands as a testament to how the industries across the board have started to recognise the importance of drones as a technology. "I think that's a recognition to what drones technology has been doing across multiple industries and we believe that mining in specific has

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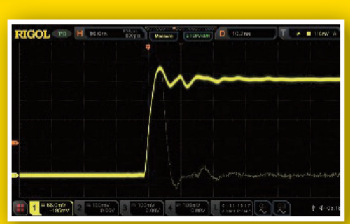

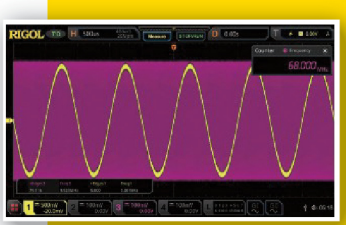

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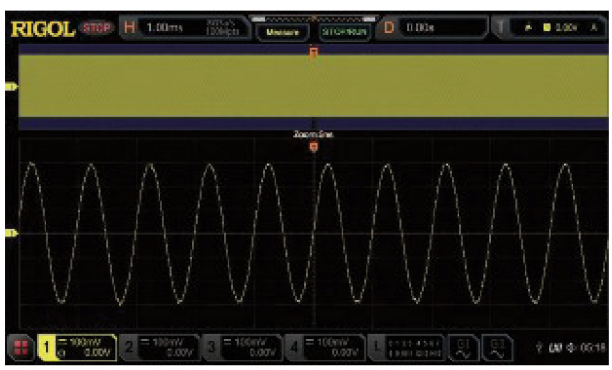

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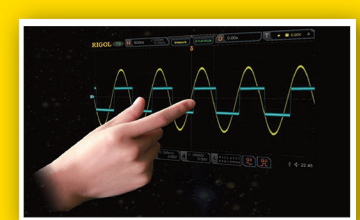

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a lot of value that can be uncovered using this technology," Pai adds.

Immense opportunities

Drone technology is disrupting the way mining operations, data collection, and insight generation in mining are transformed. "I believe any technology that simplifies the operation of a mine, and makes the life of a geologist mining engineer safe, is here to stay to prosper, and drones are one such technology," says Ajit Sahu, Chief of Exploration and Technology, Vedanta Ltd.

That being said, there is a long way the technology needs to travel, especially in terms of its impact on greenfield exploration. "While the easier ones have been discovered, the less easy ones are yet to be made. I would like to see some breakthrough happening in greenfield exploration use of drones, where the inaccessible become accessible for a geologist and the difficult terrains are traversed," adds Sahu.

It is, therefore, crucial to understand where the mining process lacks behind and what the drone industry can particularly help them tackle.

Common issues faced in mines

Here are some areas where the drones can help:

Blasting. Measuring bench geometry before and after the blasting process is an essential part of any mining exercise. The traditional method of using total stations is slow, cumbersome and puts personnel in mortal danger. (A total station is used to record the absolute location of the tunnel walls, ceilings (backs), and floors as the drifts of an underground mine are driven.) There is no way to verify if drill holes for explosives are positioned as planned. Drones can help by reducing cost and time overruns due to improper management of men, material, and safety surveillance.

Drones aiding in magnetic surveys

The process of mineral discovery and block development in mining is a long and winding process. Surveying is the first phase of the discovery process. This includes geological mapping, physical mapping, and geochemical mapping. All these datasets narrow down the area from there, so that a 10,000-15,000sq km of metallic deposit site can be condensed to 100sq km. As this process continues, the deposit area is further narrowed down to a 1x1sq km of mineral deposit.

This, as per Dr D.S. Jeere, Director of Geology at GSI, is where drones can come in handy. He says, "I find that there is a very big role for drones to play here because what we need in this 1sq km is a 1x4000 scale data graphic mapping."

A high-resolution magnetic survey is another area where drones, especially with their small sensors, can play a major role in the mine development process. But the quality of sensors plays a major role in how the end data comes out.

Sahu says, "We did a drone-aided magnetic survey recently and found that it is good in terms of well-located data. It could be done in a small time period; whatever objectives were set were met. But I also know that the quality of data was not great. It could be because of the sensor. In terms of the survey, one of the problems that we had in our mind was that we may struggle to find well-located data. But that was not the case—it turned out to be good."

Output. Miners have historically made rough assumptions as to the volume of outputs generated, which leads to underreported numbers. Any mistake at the bottom of the funnel leads to resource mismanagement at a macro operational level. A drone can measure critical volumes 2-3 times faster from source to stockpile in near real-time. It can monitor volumes of pits, overburden, dumps, stockpiles, and other critical volumes across the mine 2-3 times faster.

Transport. The design of haul roads and systems using satellite imagery is inefficient as the data is outdated and inaccurate to the extent of several metres. Improperly designed transport routes lead to loss in output production and operating revenues. Drones being highly-accurate, can reduce automated post-processing errors to the minimum. Stockpile volumes can be estimated with an accuracy of 99%.

The challenge of integrating software and hardware

The introduction of drones in mining industry has yielded path-breaking results even in the short amount of time that they have been around. However, as is the case with any nascent technology, there are certain voids that drones are yet to fill. "To my mind, it's not the drones which is the most important thing but how we use the software," remarks Piyush Srivastava, Chief of Natural Resources at Tata Steel.

Drones so far have only aided in the collection and capture of data. Even though drones are capable of carrying both the laser cameras as well as multispectral cameras, operators are yet to learn the integration of software with the data set that they receive from drones to turn them into usable data.

One of the biggest challenges that photogrammetry cloud data collection poses is the trouble of dealing with its sheer size. As per Srivastava, the size of the data for scanning up to five square kilometres of land can reach up to 60GB. Software that the industry currently uses widely is yet to catch up with the demands of such heavy data. "Now to process the data for when there are images from multiple file paths and then you do cognition and then aero-triangulation, the speed is a limiting factor. Sometimes it takes a few days to process the data," notes Srivastava.

One of the possible solutions to deal with this could be the adoption of a hub-and-spoke model, where

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ULD-02 Laser Soldering

The new product laser soldering unit ULD-02 has enhanced the control and optimization of the soldering process compared to conventional product. By adopting a unique temperature control method and by combining a radiation thermometer and laser output, it can simultaneously monitor and control the laser output and temperature during soldering. The temperature during soldering is visualized and can be saved as log data, which can later be used as soldering process management data. In addition, the personal computer software Soldering Manager enables editing laser output conditions, acquiring log data during soldering, and saving video during soldering. It has realized the visualization of the soldering process.

UNIX-GF Series: Gantry Soldering Platform

The UNIX-GF Series constitutes a Gantry soldering platform that can fl exibly handle soldering processes and workpiece shapes. It inherits the ease of use of desktop robots developed by the company. It is an orthogonal- type robot with four axes for soldering iron and three axes for soldering laser and has an option for extra two axes. It comes together with an easy instruction program for soldering similar to that of the desktop soldering robot, which is one of the major products of the company. Selection is possible among various options such as changing the shaft length, image processing, thermometer, QR scanner, etc. In addition, by using the Soldering Manager soldering robot control software the company has developed, it can display its operation procedure, monitor the soldering process, and save operation logs.

Soldering Manager: Software for Controlling Soldering Robot

The new product laser soldering unit ULD-02 has enhanced the control and optimization of the soldering process compared to conventional product. By adopting a unique temperature control method and by combining a radiation thermometer and laser output, it can simultaneously monitor and control the laser output and temperature during soldering. The temperature during soldering is visualized and can be saved as log data, which can later be used as soldering process management data. In addition, the personal computer software Soldering Manager enables editing laser output conditions, acquiring log data during soldering, and saving video during soldering. It has realized the visualization of the soldering process.

everything is centralised within one hub and multiple tall stations can work in tandem in order to be able to process the data.

Transferring this data is another cumbersome task. Most drones come with a chip that is not allowed by secured systems, which makes the data transfer a big hassle. And let's not get started on the condition of 4G connectivity prevalent in the country.

Srivastava suggests opting for a cloud space where they can install and use software like ArcGIS. This helps in centralisation of the data without the need to transfer it from one system to another. Output can be monitored, and the 3D mine models can be viewed in real time. But then again, licensing for such software creates a hurdle, as everyone involved in approving a mine survey is always required to be in possession of it.

Srivastava points out, "There are few people who need to create, but there are many people who need to monitor; the GM of the area might like to see the mine. How does it look? He may like to see the land-use plans, but he may not have the software."

This is where the open source community can come to the rescue, as they create a middleware where the viewership can be done irrespective of whether one has that software or not.

Similarly, integration between the mining software and the point cloud data is also required. This would allow the point cloud data to be used on a software and allow the geologist to update their model from the real-time data, thus enabling a faster upgradation of models.

The other way is to make the model using a UTM bridge network where one can directly import the data into a common framework that is used by everyone. This makes monitoring easier for the regulatory bodies and even for the mining bodies. It also becomes easier to integrate the mining software into the mine planning software, mine training software, and drones photogrammetry software.

Pai adds that emerging technologies like artificial intelligence and machine learning can also help accelerate how well-versed the hardware gets at solving major issues. He says, "While I don't think it completely eliminates the manual processes, because a surveyor on-site knows his mine better than anyone else, since drones capture visual 3-dimensional data, I think there is a tremendous scope of machine learning to automate a bunch of things."

It all starts with skill development

While drone deployment in the mining industry has its share of hardware- and software-related challenges, a major obstacle that precedes them all is the lack of skillset related to drone technology amongst regulators and operators. It is especially prominent among surveyors, according to Srivastava.

Though it requires no qualification and limited knowledge of GIS software, drone operation is a skill that the industry is desperately looking for. Naturally, like it is with any nascent technology, it is much easier to get hold of young surveyors, but they still lack the eye that a veteran surveyor who has been in the field for a much longer period has. Training these surveyors is a win-win for the industry.

In the case of regulators, geo-referencing becomes critically important. Learning the necessary software to analyse the drone data is necessary; an error in approval of land-use plans can have serious results.

Srivastava proposes the use of an open source SaaS model. These technologies cannot be used through local servers and laptops, and everything has to reside in the cloud. On the cloud, the licenses that are required will be different than the desktop licenses, and integration of mining software and the photogrammetry software requires more work to be done.

What the future looks like

Recent developments in the drone industry in India have brought about a huge opportunity for simplifying the mining process. The vision is in place, though the execution is still slow.

Sahu says, "I would like to see drones being used on a daily basis from surveillance to utilisation and monitoring of logistics, where there is enough room. The technology needs to be developed and taken to a level where continuous work is done and another tech can come in to make it robust."

He adds, "I would like to see where discoveries are being made using drones, because i strongly believe that is one area where it can play a vital role, and new mineral discoveries can be made using drones sensibly and wisely." Exploration through drones has definitely picked up the pace, but it is yet to reach the stage where the benefits can outweigh the benefits of other traditional exploration means.

Drone solutions providers need to address the issues quickly. While the golden period of drones use has just begun in the country, this is the perfect time for their use in a sector that is expected to grow at an unprecedented pace. With good research and collaboration, the scope of drone solution providers being able to provide scalable solutions that the mining sector desperately needs increases manifold, thus increasing the possibility of progress in the future. EFY

This article, transcribed and curated by EFY's Siddha Dhar, is based on the panel discussion on 'Drones In Mining' that was hosted recently by ASSOCHAM.

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1 SAFE DRINKING WATER FOR URBAN INDIA

DrinkPrime's water purifiers are trying to solve the problem of providing safe drinking water at reasonable price, without investing in the water purifiers. For this they take help of technology to keep track of water quality and provide the purifiers on a subscription model

Manas and Vijay with DrinkPrime's version 3 of water purifier

In spite of thirty years of the water purification industry, and new technologies being launched, the branded bottled water is believed to be much safer for drinking purposes. Besides, the migrant population finds it a better choice than investing in a water purifier. DrinkPrime addresses the issue of providing safe drinking water without the heavy investment on a good water purifier.

Started by computer science and MBA graduates Manas Ranjan Hota and Vijender Reddy Muthyala, respectively, in 2016, DrinkPrime looks at the root cause of the problem—the source of the water. Ignored for years, the water quality varies from one area to another, based on its source and seasonal changes.

A TDS (total dissolved solids) between 50 and 150ppm is considered good for a drinking water, but it does not give any idea about the amount of minerals present in the water. Hence, it cannot be considered a reliable measure of the water's quality.

DrinkPrime's unique feature is an IoT-enabled customised water purifier that is connected via Bluetooth for a continuous stream of data for a regular tracking of water quality. Its smart sensors can also monitor the amount of water consumed. The details are available on an app.

The various subscription plans available include hardware, installation, service, and capital costs. Technicians check and service the water purifier every four months to ensure it is in top condition to provide the best possible water quality. This helps in keeping track of the purifier's health so that the water consumed remains safe. Consumers are not charged for this service.

There are at present more than 100,000 consumers across Bengaluru, Hyderabad, and Delhi-NCR, with tenants being their major customers. Manas says, "The landlords are being advised to keep the purifier so that the next tenant takes it, making it a win-win situation for both."

DrinkPrime is currently looking for both financial and technical partners, as well as service technicians and customer acquisition executives. Currently, their financiers are Omidyar Network India, Sequoia Surge (₹210 million), Alteria Capital (₹60 million), UC Inclusive Credit (₹50 million), and Western Capital (₹30 million). Their current valuation is ₹2.02 billion.

The three challenges that they currently face concern testing, supply-chain, and innovation. From

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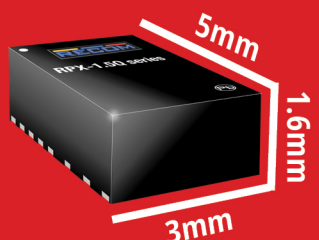

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the water samples collected from each area, over twenty parameters are checked, including TDS, turbidity, chloride levels, pH levels, minerals, and metals present.

But not everything can be tested online, as some samples need to be kept in a solvent, adding a catalyst to obtain results. "We would be happy to collaborate in a cost-effective way for our supply-chain management. Innovation to increase the life of the water purifier is also something we are dealing with," says Vijender Reddy.

The main vision currently before the founders is to ensure that the vast majority of India's population drinks the right water, starting with the rural areas. As time progresses, they would like to provide water at less than one rupee per litre, or set up community kiosks where people could fill water in rural India.

—Sharon Abhignya Katta

2 SECURITY THAT HELPS ORGANISATIONS ADAPT TO IoT WITH CONFIDENCE

Security systems are extremely advanced in some areas of application, as much as there are vulnerabilities in others. Redinent Innovations, a Bengaluru based startup, aims to change this and establish security tools for CCTV cameras and unmanaged IoT devices, which are often exposed to cyber-attacks

As the number of IoT devices deployed by businesses grows every day, so do the cyber threats to them. As a result, businesses risk losing their privacy, security, and brand value in the market if they fall victim to IoT based cyber-attacks. Hence, Redinent's technology is a much-needed advancement.

The founders of Redinent Innovations, L to R: Cdr K. Arun (Co-Founder, COO), Arko Dhar (Co-Founder, CTO), and Divyanshu Verma (Co-Founder, CEO)

"Redinent Innovations helps organisations protect their CCTV and other IoT devices against cyber-attacks," says Divaynshu Verma, Co-Founder and CEO of Redinent Innovations. "We offer a platform that helps organisations mitigate the risk of cyber-attacks on their IoT infrastructure, especially CCTV cameras."

According to studies, the number of connected IoT devices has already outnumbered the world's population. Unfortunately, the threat to IoT devices is increasing exponentially, since not much security is built into IoT devices. This is a field that is quite challenging since it requires extensive knowledge of protocols, embedded architecture, threat modeling, and near-real-time decision-making.

This is where Redinent's Threat Scanner comes into the picture. Redinent's threat scanning platform is a deep tech innovation that opens a whole new business strategy and opportunity around IoT device security. The technology is heavily influenced by the practices of the defense and security industry and uses some of the best TTPs of cyber defense. "This technology stack inside Redinent acts as a protective backbone to secure the IoT deployments inside enterprise," says Arko Dhar, Co-Founder and CTO of Redinent Innovations.

"Redinent is easy to deploy and is truly cloud scalable, which means that organisations which have multi-location operations can use Redinent Scanner centrally to secure their CCTV and IoT endpoints," says Cdr K. Arun, Co-Founder and COO of Redinent Innovations. "It covers the maximum number of threat scenarios and the widest range of CCTV/IoT brands, apart from evaluating all the brand-agnostic features at the protocol level itself," explains Verma.

The company uses patented threat detection algorithms to discover threats at multiple levels inside endpoint devices and also helps to remediate these threats. With such a solution, organisations will be able to evaluate the vulnerabilities in their IoT/CCTV devices and close them before a cyber-attack can take place.

The solution is already commercially ready. "We are fortunate enough to get very early access to some of the largest brands as our customers and partners. Within a span of five months, we had airports, power plants, SEZs, hospitality and resorts, rail networks, and banks as our clients," says Verma.

Redinent's first customer breakthrough came within two weeks of launch, and they had their first five customers within just 120 days of

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launch! The company has also raised capital funding from angel investors and is in talks with investors to raise further funds.

Today, Redinent is looking to increase its product footprint at critical infrastructure institutions across the globe and increase its revenue base significantly. Consequently, the company is hiring top talent resources with expertise in security and IoT-related product development, UX professionals, and automation engineers.

For a company that was founded a little over a year ago—right in the middle of a pandemic—Redinent has come a long, long way. Surely, it is safe to say that Redinent Innovations is building a strong foundation for IoT security in India and abroad.

—Aaryaa Padhyegurjar

3 TENSTORRENT'S UNIQUE APPROACH TO AI HARDWARE AND SOFTWARE

Over the past few years, a lot has been happening in AI—both hardware and software. We have seen new algorithms, new processing techniques, and new AI chips. Tenstorrent Inc., an AI startup headquartered in Canada, aims to build a specialised software and hardware stack that can perform billions of operations per second

AI programs are very different from traditional ones. Because the demand for AI is growing at a meteoric rate, the way AI is processed needs to be changed too. That's what Tenstorrent Inc. aims to do—it is addressing the rapidly growing compute demands for software 2.0. The company wants to bring forth something unique by combining an AI processor and a GPU together in a way no other AI startup is doing.

"Today, the AI revolution is big and we're going to bring something interesting with the combination of GPUs and AI processors," says Jim Keller, CTO and President of Tenstorrent. There's a GPU and an AI program, and they figured out how to write software to connect the two.

They are not emulating an AI program, but instead running the AI program very close to how it's written. And that gives them efficiency and a better pass to write new AI programs and compile them into the hardware.

GraySkull, one of Tenstorrent's primary products, has a PCI Express interface and plugs into a server, like an AMD or an Intel server. What's interesting is the mode of delivery that Tenstorrent offers—customers can customise their purchases.

For example, some customers who already have servers can buy boards from Tenstorrent but use their own GPUs. AI startups working from home can use their cloud services. "We don't want to tell people how to buy it. We want them to tell us what they want," says Keller.

From a business point of view, Tenstorrent wants to focus on AI startups and small researchers. "We wanted to find a hundred small customers and not ten big ones," says Keller. "We've talked to various people—medical imaging people, biotech people—and some of them have very interesting models that are different."

Keller, who has worked at big players like Intel and Tesla, talks about his colleague Ljubisa Bajic (Founder and CEO at Tenstorrent Inc). "Ljubisa Bajic started the company and I had worked with him before at AMD. He was one of the few people I met who had knowledge of four different domains. He understood what the AI algorithms were doing and could translate that to software. And I gave him what's called the angel investment,"

AI is moving really fast right now. Our phones have a CPU, GPU, camera processor, and an AI processor too. And with each generation,

Jim Keller, CTO and President, Tenstorrent

it's getting bigger and also more expensive. "You can end up spending $1000 over a weekend running some models," says Keller. But thanks to Tenstorrent, AI processing can soon become more accessible to everyone. Tenstorrent's price plan is to be about five to ten times cheaper than the current market rate.

Also, the company has huge plans for expansion. In April 2022, Tenstorrent opened a new office in Bengaluru. Apart from that, the company has operations in Toronto (headquarters), Austin, Santa Clara, and Belgrade.

Tenstorrent has come a long way since it was founded—from proof-of-concept on an FPGA to a full-fledged AI hardware-software stack that's extremely unique. We can surely expect great things from Tenstorrent in the near future. EFY

—Aaryaa Padhyegurjar

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MeitY forms an advisory board to help meet manufacturing targets

With the aim of making India a $300 billion electronics manufacturing hub by 2026, The Ministry of Electronics and Information Technology (MeitY) has formed an advisory board called the Digital India Electronics Mission $300 Billion. To achieve this target, mobile manufacturing has to increase from $30 billion in 2021 to $126 billion by 2026, while IT hardware manufacturing has to go up from $3 billion presently to $25 billion, and so on.

Representational image

MAIT holds discussion with industry to leverage PLI-driven growth

MAIT recently held a discussion that delved into steps required to enable MSMEs to leverage the PLI-driven growth and become the bedrock of the local electronic manufacturing ecosystem of India. The meeting was attended by industry leaders from major global and Indian IT hardware companies including Acer, Dell, Cisco, Flex, HPE, Apple, HPI, Lenovo, Oppo, Prose Technology Private limited (a Rosenberger company), Samsung, and Indian industry players from Netweb, Sahasra (InfoPower), Tube Investments, and Velankanni, among others.

PEOPLE (on the move)

Vikas Puri as Business Head for India operations for Cosmo Ferrites

A seasoned business leader with over 29 years of experience, Vikas Puri will now be responsible for devising strategic solutions to everyday operations and will be expected to strengthen Cosmo Ferrites' presence in the fast-growing ferrites market space. He has served in a number of leadership roles, including Business Head (India) of Varroc Lighting Systems.

Neeraj Bhardwaj and Prasad MN to head ASM India sales and service

ASM Assembly Systems India has appointed Neeraj Bhardwaj (left) and Prasad MN (right), two long-term ASM team members, as Head of Equipment Sales (South Asia) and Head of Equipment Service (South Asia) to further drive the business in South Asian countries.

RattanIndia Enterprises appoints Sarath Chandra as CEO

An alumnus of XLRI, Jamshedpur, Sarath Chandra Gudlavalleti has over 20 years of experience in technology and retail sector with expertise in setting and scaling up businesses. Prior to joining RattanIndia Enterprises, Gudlavalleti worked in organisations like Quikr, Microsoft, Nokia, and Coca-Cola in various leadership roles.

Alvin Tse appointed as head of India business

A British national with a key role in the company's expansion, Xiaomi Global's Alvin Tse has been appointed as the head of its Indian business. He succeeds Manu Jain, who had moved on last year to a global role.

CORPORATE news

Redcliffe and Skye Air tie-up to introduce drones in healthcare

Redcliffe Labs has come up with its first commercial drone flight in the country's healthcare sector. The drone delivered 5kg payload in temperature-controlled boxes from Gyansu, Uttarkashi to Vivek Vihar, Dehradun, which is at 60km aerial distance. The project was a part of Redcliffe and Skye Air tie-up; in the past three months they have done 40 successful trials in North India.

Ananth Technologies starts spacecraft manufacturing unit in Bengaluru

The 15,000sq-m spacecraft manufacturing unit of Ananth Technologies at Karnataka Industrial Areas Development Board Aerospace Park in Bengaluru was recently inaugurated by ISRO Chairman S. Somanath. The unit can conduct assembly, integration, and testing of four large spacecraft simultaneously. Ananth Technologies has contributed towards the manufacture of 89 satellites and 69 launch vehicles built/launched by ISRO.

Tata Motors bags the biggest-ever EV fleet order in India

An order for supply of 10,000 XPRES-T EV units from BluSmart Electric Mobility has been bagged by Tata Motors. The deployment of 10,000 units makes this the biggest ever EV fleet order in India.

Representational image

With deliveries starting soon, these vehicles will be used across the country for commuters, in turn helping minimise the carbon footprint. The company is delighted to continue its association with BluSmart Electric Mobility.

Mitsubishi Electric to produce inverters and factory automation in Pune

Mitsubishi Electric Corporation will be investing ₹2.2 billion to establish a new factory in India, which will manufacture inverters and other factory automation (FA) control systems. The new two-floor, 15,400sq-m factory will be built on 40,000sq-m land near Pune in Maharashtra. It will help expand Mitsubishi Electric's production capabilities to meet local demand, thus contributing to the Make in India initiative promoted by the Indian government.

TVS Motors to raise money for EV business expansion

Automaker TVS Motor Co. Ltd is riding high on its plans to grow its EV business as it engages in advanced talks to raise ₹40-50 billion from private equity firms. It could use the proceeds of the proposed fundraising to create new electric vehicle and battery manufacturing facilities. It is doubling down on electric vehicles as India sharpens its focus on reducing vehicular pollution in cities and cutting dependence on fossil fuels amid surging fuel prices.

Bajaj Auto subsidiary and vendors investing further in EV manufacturing facility

Bajaj Auto's wholly-owned subsidiary Chetak Technology Ltd and its vendor partners will be investing nearly ₹7.5 billion in the electric vehicle (EV) manufacturing plant that is spread across 6.5 acres of land. The plant's 500,000 annual capacity aims to cater to both domestic and export markets and is said to have sold over 14,000 Chetak e-scooters since its launch, and has received more than 16,000 bookings.

eInfochips to open a new design centre in Indore

Recently awarded the Design Services Company of the Year by IESA, eInfochips plans to hire approximately one hundred engineers in the next six months as it opens a new design centre in Indore. The hiring will be focused on embedded systems, hardware design, silicon design, and digital technologies—such as artificial intelligence, cybersecurity, cloud, and blockchain.

SNIPPETS

- $20 billion plus revenue ambition by STMicroelectronics was spoken about in their webcast focussing on sustainable and profitable growth.
- Ola Electric is keeping an eye out for 1000 acres of land to set up its cell and electric car factories. The factories are expected to attract an investment of ₹100 billion; some states have already jumped on the opportunity.
- With eyes set on expansion, EV battery recycling company Attero Recycling is planning to invest $1 billion over five years to build lithium-ion battery recycling plants in Europe, the US, and Indonesia.
- Japanese electric motors company Nidec is looking to spend $78 million in building a new building at its existing plant for motors for home appliances and automobiles. It plans to produce more than one million units per year by 2025.
- Lava International is gearing up to intensify competition in the sub-₹10,000 smartphone segment with focus on new designs and service.
- Auto and railway components maker Jupiter Wagons Ltd is entering the electric mobility market with the launch of Jupiter Electric Mobility (JEM) focusing on commercial EV vehicles.
- The construction of the new $60 million, 14,000sq-m global headquarters in South Burlington, Vermont, by OnLogic has begun. The new facility will be able to fully accommodate their planned growth in Vermont for the next 7-10 years.
- In a bid to cater to the growing demand for electric vehicles in the last-mile delivery segment, Omega Seiki Mobility has formed a strategic partnership with Grip Invest for lease financing to retail investors.
- Digi-Key Electronics has enhanced its myLists tool to now include price quotes to improve ordering efficiency.
- OpenLight has introduced the world's first open silicon photonics platform with integrated lasers. Chip design firms can use it to integrate the technology into their chips.
- The India traditional PC market—which includes desktops, notebooks, and workstations—shipped over 4.3 million units with a YoY growth of 37.7%. While online channels had a share of 13.4% and witnessed YoY growth of 17.5%, offline channels witnessed the bigger spike as they grew by 41.4% YoY.
- Reports project that solar tariffs will climb even further following the recent imposition of a basic customs duty of 40% and 25% on imported solar modules and cells respectively, and the implementation of the Approved List of Models and Manufacturers—a non-tariff barrier covering complying solar modules that excludes modules made outside India.
- The Broadcom Software Group will rebrand and operate as VMware, incorporating Broadcom's existing infrastructure and security software solutions as part of an expanded VMware portfolio.

Adani Defence & Aerospace acquires strategic stake in General Aeronautics

Working closely with farmers and agricultural chemical companies that offer tech-enabled crop protection services and health monitoring, a 50% equity stake has been taken by Adani Defence

Representational image

& Aerospace in General Aeronautics. This helps in providing a platform for startups and MSMEs for rapid growth and scalability of innovative technologies.

ABB acquires controlling stake in Numocity

Increasing its shareholding to a controlling majority of 72%, ABB has acquired a major stake in Numocity. India, South East Asia, and the Middle East are target regions for Numocity, which offers a cloud based digital platform allowing consumers and fleet operators to use a network of fixed chargers or, in simple words, 'pay as you go' basis.

Pact between Ather Energy and Magenta to install EV charging grids

Ather Energy and Magenta have entered into a pact, which gives Ather access to Magenta ChargeGrid's multiple locations across India. It aims to collectively accelerate the pace of expansion of public charging networks and the adoption of EVs in India. Magenta ChargeGrid is currently expanding its charging network to 35-40 cities in India and aiming to set up 11,000 chargers by the end of FY23.

GMES signs MoU to skill CCTV security system technicians

At the launch of CCTV Technician Training and Certification programme 'Surveillance Unmasked,' by GeniusMinds Educational Services (GMES), a memorandum of understanding (MoU) was signed with Electronics Sector Skills Council of India (ESSCI). This multi-city programme is a day event under the terms of the MoU. GMES will provide an 8-hour certificate refresher course for CCTV installers (field technicians), trainers, and industry subject matter experts.

Hero Electric and Zypp Electric expand partnership

To support the growth of the logistics and delivery segment, Hero Electric has expanded its partnership with Zypp Electric. Under the partnership, Hero Electric will be deploying 150,000 electric scooters for Zypp Electric's fleet in the next three years. With a fleet size of 5000 electric scooters, Zypp is currently present in Delhi-NCR and plans to expand to Mumbai, Bengaluru, Hyderabad, and Pune this year.

Tata Motors subsidiary to acquire Ford India's Gujarat plant

A Memorandum of Understanding (MoU) has been signed with the Gujarat government for the potential acquisition of Ford India's Sanand plant by Tata Passenger Electric Mobility Limited (TPEML), a subsidiary of Tata Motors for EVs. TPEML would invest in new machinery and equipment at the plant to make the unit ready to produce its vehicles. The agreement includes a transfer of Ford India's land and buildings, vehicle manufacturing plant, machinery, and transfer of all eligible employees.

ElectricPe partners with Electric One to expand EV charging ecosystem

EV charging platform ElectricPe has partnered with EV store chain Electric One to provide charging infrastructure and encourage EV adoption. Through this alliance, Electric One customers across 82 stores in India will get access to ElectricPe's EV platform. It will also strengthen ElectricPe's network, which has already onboarded 2500 public charging points in Bengaluru, the largest network in the city.

Inventus India now known as Athera Venture Partners

Inventus India, an early stage venture capital firm, has rebranded itself as Athera Venture Partners. It also announced the launch of its fourth fund with a target corpus of ₹9 billion ($120 million). Athera is a Sanskrit word meaning 'path' and direction. This new identity reveals the Indian-ness while having a focus towards investing in the Indian start-up ecosystem.

Mobile calibration van launched by WIKA for door-step service

Launched by WIKA Instruments, the mobile calibration van has been transformed into a value-added service by providing services at the customer doorstep while delivering convenience. Appointments can be booked easily through various channels like toll-free number, email IDs, and WebApp. Apart from being available for calibration, the mobile laboratory gives a report which shows the measurement error.

Vedanta gets board approval to raise funds for chip and display units

Vedanta has a total planned investment outlay of $20 billion for two separate units for chip and display manufacturing. It has received approval to raise up to ₹40.89 billion from its board of directors. The funding will be via debentures on a private placement basis. Vedanta is seeking incentives from the Central government and is also in talks with several Indian state governments on the units' location.

SJVN to invest over ₹10 billion to set up solar projects in UP

Satluj Jal Vidyut Nigam (SJVN) is looking to set up three renewable energy projects in Uttar Pradesh. Two solar projects with a capacity of 75MW each will be set up at villages Parasan and Gurha in district Jalauna and one of 50MW will be set up at village Gujarai in Kanpur Dehat. A total of ₹10.57 billion is being invested in these projects in Uttar Pradesh.

Waaree Energies receives NCLT approval to buy Indosolar

Waaree Energies has received NCLT approval to buy Indosolar Ltd, which will facilitate augmentation of the solar cell manufacturing capacity of Waaree Energies to 5.4GW from the currently planned 4GW. It is expected to start manufacturing operations within six months from acquisition of the Indosolar plant, after assessing the infrastructure and ensuring that relevant equipment complementing the expansion plans are in place.

Spacetech firm Bellatrix secures $8 million in Series A funding round

Bellatrix Aerospace has raised $8 million in a Series A funding round led by BASF Venture Capital GmbH and Inflexor Ventures. The funds will be used for expanding Bellatrix's product portfolio, hiring talent, and developing its infrastructure. The startup competes with the likes of SatSure, Skyroot Aerospace, Agnikul Cosmos, and Dhruva Space. The government has been focusing on boosting spacetech startups in the country. It is also looking at allowing FDI in the spacetech sector.

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INTERNATIONAL news

IFA 2022 in large-scale and real-life

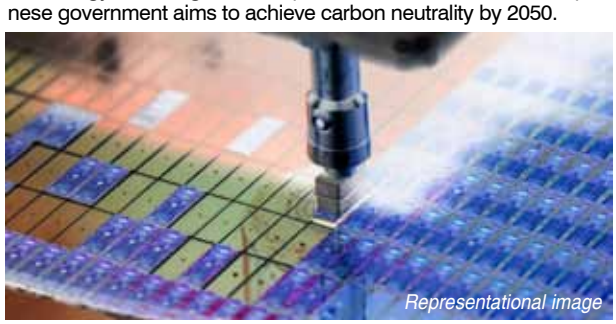
IFA Berlin—the world's most important trade show for consumer electronics and household appliances—is making a large-scale and real-life return this year, from 2-6 September 2022. Two-thirds of IFA's top exhibitors have already confirmed their attendance, with a huge number of exhibitors planning to return at the same scale as in 2019, the last IFA year before the pandemic.

Victor sets up a new power modules facility in the US

Opened at 400 Federal Street, Andover, this mobile manufacturing facility enables scalable, automated, cost-effective manufacturing of power modules in the United States. Celebrating 41 years of its global power electronics industry, Vicor's new facility utilises patented fabrication processes to differentiate Vicor power modules.

20cm SiC wafers being developed by Showa Denko

The New Energy and Industrial Technology Development Organisation (NEDO) has selected Showa Denko's 'Project to Develop SiC Wafers Technology for Next-generation Green Power Semiconductors,' as a candidate for projects to develop 20cm (8-inch) wafers technology for next-generation power semiconductors. The Japanese government aims to achieve carbon neutrality by 2050.



Representational image

Ligado Networks partners with Sony Semiconductor Israel

Partnering with Sony Semiconductor Israel, Ligado Networks has developed advanced connectivity services across North America, enabling provision of chipsets for standalone satellite and terrestrial connections. The two companies have indicated that the initial technology trials would be taking place by the end of the year.

Partnership between Nexperia and KYOCERA for GaN power modules

Gallium nitride (GaN) devices are manufactured at Nexperia using mature mass production techniques, which have proven to meet the highest reliability requirements for devices to achieve AEC-Q101 certification. KYOCERA AVX Components (Salzburg) GmbH, on other hand, supplies advanced electronic components for the automotive industry. The partnership between both the companies is to focus on power components with the aim of jointly developing GaN applications for electric vehicles.

STMicroelectronics and MACOM successfully produce RF GaN-on-Si prototypes

STMicroelectronics and MACOM Technology Solutions Holdings Inc. have announced successful production of radio-frequency Gallium-Nitride-on Silicon (RF GaN-on-Si) prototypes. RF GaN-on-Si offers high potential for 5G and 6G infrastructure. GaN can offer superior RF characteristics and significantly higher output power than LDMOS for these RF PAs. Further, it can be manufactured on either silicon or silicon-carbide (SiC) wafers. The GaN-on-Si technology is expected to offer competitive performance paired with large economies of scale, enabled by its integration into standard semiconductor process flows.

Intel investing in mega R&D lab for innovative data centre tech

Intel has unveiled plans to invest more than $700 million in a 20,000sq-m, R&D mega lab focused on innovative data centre technologies. It also introduced the technology industry's first open intellectual property (open IP) immersion liquid cooling solution and reference design. Construction on the lab will begin this year at the Jones Farm campus in Hillsboro, Oregon, with opening expected in late 2023.

High-voltage fuses with onboard charging protection for EVs from Eaton

Eaton has introduced their EVK series of high-voltage fuses for high-powered electric vehicles. One unique feature is the onboard charging protection. The EV fuses from Eaton meet the requirement of current ratings up to 1000V DC and 600A. They are also able to dissipate the heat appropriately from such areas that are prone to overheating and related damages.

dRISK to build the ultimate test for self-driving cars

dRISK's statistical robustness and auditability has allowed it to win the largest grant from the UK's Centre for Connected and Autonomous Vehicles, enabling dRISK to build the ultimate test for self-driving cars. The global market for AI training data alone is currently valued at $1.5 billion. FWT's investment will accelerate the development and growth of dRISK as a central technology for AV development.

EnSilica on London Stock Exchange's AIM market

Listed on the London Stock Exchange's AIM market, EnSilica has raised £6 million ($7.4 million) through a placing and subscription of 12 million ordinary shares at a price of 50p per share. It will open with a market capitalisation of £37.6 million ($46.6 million).

Rajasthan government releases its electric vehicle policy

The primary objective of Rajasthan government's EV policy is to encourage electric vehicles' adoption in the state. As part of the policy, the Rajasthan government has approved an additional budgetary support of ₹400 million for the SGST pay back to the eligible beneficiaries. A reimbursement of ₹5,000 to 10,000 (via SGST) was announced for electric two-wheelers and ₹10,000 to 20,000 for electric three-wheelers. Moreover, electric vehicles are not taxed under the Motor Vehicle Tax in Rajasthan.

ICEA writes to Central government over indiscriminate ED actions

ICEA has written to the Central government saying that the Enforcement Directorate's (ED's) recent actions against smartphone brands' royalty payments on intellectual property has sent "shivers through the industry." The letter claimed that a case is being built against royalty payments, which is duly acknowledged by the Indian law. This would also have a potential impact on the 'Make in India' programme.

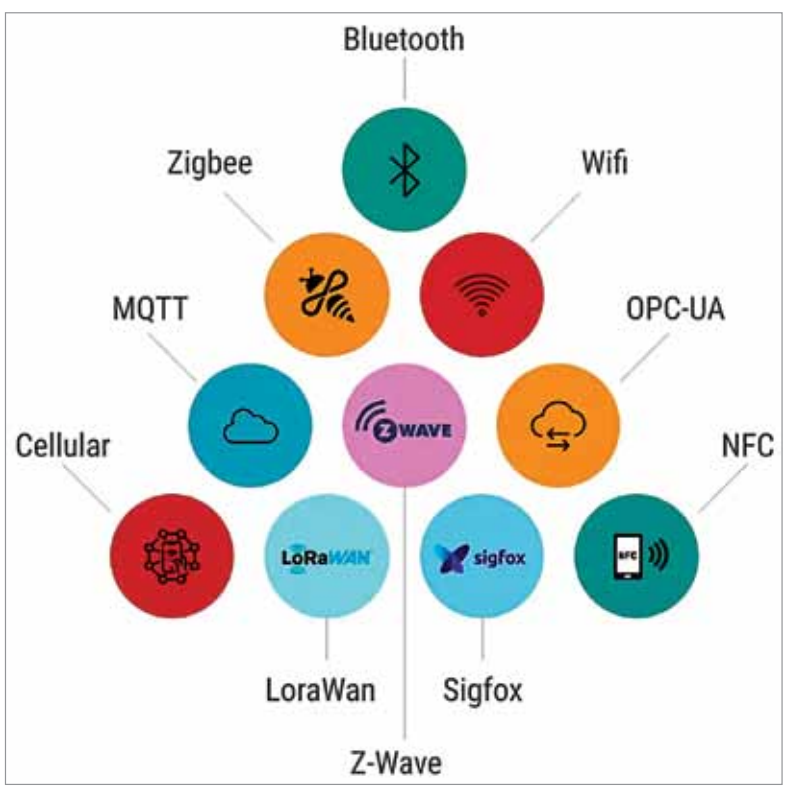
15 THINGS TO REMEMBER While Selecting An IoT Platform

How to compare the IoT platforms available in the market and select the right platform? Let us take a look at some of the platforms available in the market and their features and see the selection guide presented in this article

AARYAA PADHYEGURJAR

Around 2015, there were 260 IoT platforms in the market. In just one year, the number rose to 360! By 2017, there were 450 IoT platforms and today, there are over 600. This exponential growth in the number of IoT platforms proves that IoT has already become mainstream.

But this large number can lead to a lot of confusion when it comes to selecting the right platform for a particular business. There are so many factors that need to be considered and assessed. One needs to keep in mind at least the following 15 things while selecting an IoT platform.



Popular IoT protocols (Credit: Hashstudioz)

1. Vendor/parent company

You need to ensure that the platform you are choosing comes from a reliable and credible vendor—one that has been in the market for a considerable amount of time. You can try checking out other products from the same vendor and see if they have a good life expectancy in the market. You can consider looking at clients and customers of the vendor as well, especially those who have invested in the same platform as you are planning to. Trust is a key factor in the IoT platform market—you are trusting a platform with your data after all.

2. Scalability

A scalable system is a stable system. Over time, businesses grow, expand and sometimes even pivot. Your IoT platform must be scalable enough and should accommodate all these changes—especially the large influx of data as a company matures in the market. To make your selection process easier, check how the IoT platform has grown from the time it was launched. Did it compete with the changing technologies? Has it adopted newer protocols?

3. Protocol support

Does your IoT platform support the data protocols, device protocols, or communication protocols that your development team is accustomed to? For example, if you, a decision-maker, select a platform that does not support general data formats, your developers will have to spend time to get used to the format that the platform does support. Hence, select a

TABLE 1
IoT PLATFORMS FOCUSED ON CONNECTIVITY

Details	Cisco IoT Control Center	EMnify	Vodafone IoT
Type	SaaS solution	SaaS solution	SaaS solution
Account Types	2 - Essential (Simple IoT) and Advantage (Complex IoT). Pricing, features, and services differ in each type.	EMnify has a single plan type but has two types of coverage options -- Basic and Extended	N/A
API Support	Available	Available	Available
Visualisation	The Control Centre is an environment for real-time evaluation, testing, and deployment	Dashboard	Dashboard, Web interface
Services	Data (GPRS, LTE, NB-IoT, 5G NSA, 5G SA), SMS, Voice	Data (2G, 3G, 4G, LTE-M, NB-IoT), SMS, USSD	LTE, LPWA Technologies, 4G, 5G, NB-IoT, SMS, Voice
Pricing	Multiple pricing plans are available - monthly fixed pool, monthly flexible pool, prepaid and monthly individual. Pricing depends on the account type	Pricing varies based on the number of active SIMS and device consumption. They have a pay-as-you-go option as well as an inclusive volume option	Outcome-based pricing depending on your solution.
Additional Features	Multiple add-on packages that enterprises can subscribe to as their needs evolve	Automated integration into cloud (AWS, Azure, Google Cloud)	Vodafone Business App-Invent: This is an Application-as-a-Service solution that helps companies create IoT apps quickly and cost-effectively.
Getting Started	Cisco provides a Starter Kit, making it easier to launch your connected device services	The company provides a free trial as well as a Factory Test Mode for pre-deployment connectivity testing.	N/A (Contact Vodafone IoT to obtain onboarding details)
Website	https://www.cisco.com/c/en/us/solutions/internet-of-things/iot-control-center.html	https://www.emnify.com/	https://www.vodafone.com/business/iot/managed-iot-connectivity/iot-platform

platform that caters to your development needs, and not vice versa.

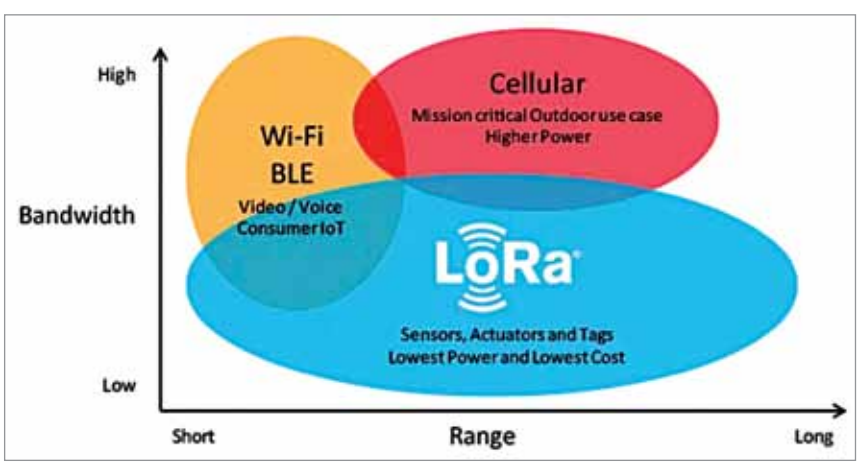
4. Customer support

Another important parameter to consider is whether your platform comes with the necessary support for your application. Also, if you do not have cloud engineers in your team, you can consider a vendor that provides in-person support in setting up your platform. Certain platforms cater to only software and cloud needs. In such a scenario, if your application is more hardware-centric, you will end up doing a lot of work yourself.

5. User-friendliness

A complex platform that is not easy to use involves a learning curve even for IoT professionals. But it does not make sense to spend time learning the platform instead of working on the solution itself. As a decision-maker, you need to consider the user-friendliness of the platform—whether the platform offers dashboards, graphs, and reports.

Young IoT platforms may not have user-friendly user interface (UI) as the developers are more concerned with connectivity, data security, and other issues. Before selecting, you can try using the trial version of the platforms you shortlisted, just to check if these are flexible and user-friendly.



Bandwidth vs range of connection protocols (Credit: The Things Network)

6. Developer-friendliness

Does the platform connect easily with your existing systems, including the IoT hardware? Does it provide a good test and development environment? Does it use open source technologies that your developers might already be aware of? Perhaps the most critical feature of any IoT platform is how easy it is for developers to use.

You need to ensure that the platform supports integrations like RTOS and SDKs in various programming languages, and API support. Many platforms provide custom APIs

TABLE 2
IoT PLATFORMS FOCUSED ON DEVICE MANAGEMENT AND AI

Details	C3 AI	Particle IoT Platform	Kaa IoT Platform
Type	SaaS solution	PaaS solution	PaaS solution
Integrations	Its architecture is scalable with cloud services like AWS Cloud	It can integrate with GCP, Azure IoT Hub, IFTTT, QuestDB	REST API, WebSockets, Data Analytics, Business tools like SAP, Salesforce
API Support	REST APIs, Customisable API integration	REST API	REST API
Features	• Data Query & Analysis • Data Integration • Data Abstraction • Machine Learning • Application Management • Application Logic • Application Deployment • Operations Workflow Management	• Edge-to-Cloud Stack • IoT Device Management • Data Pipeline • IoT Hardware and Tracking	• Handle millions of devices • Ease of use • Third-party integration • Data security • Multicloud architecture
Noteworthy Characteristics	Users can select from a set of pre-built applications. The C3.ai platform also provides a development environment for building custom IoT applications	Particle supports Over-The-Air (OTA) firmware updates. Also, the program structure for Particle is built with Arduino compatibility.	It is a completely open source solution
Interface	Web based, Desktop	Web IDE, Desktop IDE(Dev) and a CLI (Command Line Interface)	N/A
Visualisation	Reports, dashboards, visualisations, and actionable insights	Dashboard, Google Maps	Built-in Dashboard or third-party tools like Grafana. Users can stream data from IoT devices to any data analytics system via the pre-integrated Kafka channel.
Pricing	Depends on features selected, Quote-based	Three pricing levels: Enterprise, Starter, Tracking	Multiple plans are available, depending on hosting and number of devices
Website	https://c3.ai/c3-ai-suite/	https://www.particle.io/what-is-particle/	https://www.kaaiot.com/

during the implementation phase, which makes it easy for developers to get started.

7. Disaster recovery and downtime

In any application, it is only natural for technical problems to occur. What matters is how the parent company deals with such problems, and how long its recovery takes. While selecting an IoT platform for your application, you need to make sure that the platform provides the necessary infrastructure to handle such occurrences without any data loss. Check if the company provides a backup solution for your data, either locally or on cloud.

8. Updates and upgrades

Although it is mainstream, IoT can still be called a relatively new technology. Your needs might change, your company might grow. So, does your IoT platform support such updates in your company's infrastructure? Does it support the newer versions of IoT protocols? Does it provide facilities to update your firmware over-the-air? If yes, are these facilities in your budget? These are important questions that you need to ask before taking any decision and selecting an IoT platform.

9. Device management

IoT device management is significantly crucial because all your devices need to be secure and connected for your system to function properly. Ideally, the IoT platform should enable you to register a device easily, provide means to delete or update it, provide its status updates, and notify you if it gets disconnected from the system or malfunctions. All of this needs to be done in real time.

Moreover, the platform should enable you to remotely control your devices over the internet. It should support a wide variety of devices and should have a good mechanism to sort them into types. It should also have low latency even if the number of devices increases and should easily allow bidirectional communication between devices and the cloud.

10. Data handling

The data that you receive from your IoT hardware needs to be properly stored and analysed. This becomes challenging as more and more devices are introduced into the system and the volume of data increases. While selecting a platform, try to find out how your vendor handles data from your system. Keep in mind that, at times, the pricing model heavily depends on the data. Also, make sure to be well informed about data ownership rights and regulations.

11. Security features

While selecting an IoT platform, one must choose a platform with good security solutions. You should also check if the vendor has the latest security certifications and compli-

TABLE 3
THE BIG 5

Details	AWS IoT	Microsoft Azure IoT	Google Cloud IoT	IBM Watson IoT	Oracle IoT
Security	Link Encryption (TLS), Authentication (Sig V4, X.509)	Link Encryption (SSL/TSL)	SSL/TLS	Link Encryption (TLS), Authentication (IBM cloud SSO), Identity Management (LDAP)	REST API
Data analytics	Real-Time analytics (Rule engine, Kinesis, AWS Lambda)	Real-Time analytics	Real-Time analytics (Cloud IoT Core)	Real-Time analytics (IBM IoT Real-Time insights)	Real-Time analytics
Data format	JSON	JSON	JSON	JSON, CSV	CSV. REST API
Application Environment	Java, C, NodeJs, Javascript, Python, SDK for Arduino, iOS, Android	.Net, UWP, Java, C, NodeJS. Ruby, Android, iOS	Go, Java, Python, .NET, NodeJS	C, Python, Java, NodeJS	Java, iOS, Javascript, C, Android
Protocols	MQTT, HTTP1.1	MQTT, HTTP, AMQP	MQTT	MQTT, HTTPS	MQTT. HTTP
Visualisation	AWS IoT dashboard	Web Dashboard	Google data studio (Dashboard)	Web Dashboard	Web Dashboard
Edge Computing Options	AWS Greengrass	IoT Edge	Google Edge TPU	IBM Edge Application Manager	Oracle Roving Edge
Pricing	AWS allows you to pay for the services you use. You can calculate your pricing using the AWS Pricing Calculator.	A free version, basic version, and a standard version are available. Pricing varies for each.	Cloud IoT Core is priced according to the data volume used in a calendar month.	Three plans are available, depending on the service selected: Connection, Analytics, or Blockchain.	Oracle offers uniform pricing across all global regions and also provides a cost estimator similar to AWS.
Website	https://aws.amazon.com/iot-core/?nc=sn&loc=0	https://azure.microsoft.com/en-in/services/iot-hub	https://cloud.google.com/solutions/iot	https://internetofthings.ibmcloud.com	https://www.oracle.com/in/internet-of-things

ances, like SoC 2 Type II, which is a report that captures how a company safeguards customer data. It would also be wise to check the encryption protocols that are being used along with a thorough inspection of how the vendor's privacy laws might affect your company in the future.

12. Edge support

IoT is moving towards edge computing, AI, and ML. Hence, the support for such features is important, even if your solution does not employ them at this point in time. There are many platforms in the market that are dedicated to analytics and edge intelligence, but even if your selected platform is not one of them, it is a good sign if they still accommodate new topologies and utilise edge intelligence.

13. Bandwidth and range

High bandwidth means low latency. For fast movement of data and good connectivity, the system should consume extremely little power, have a huge range, and should be able to transmit a large volume of data. Hence, bandwidth management for IoT devices should not be overlooked. At the same time, the system should have a good enough range to accommodate your hardware—there will always be a tradeoff.

14. Time-to-market and platform migration

To reduce time-to-market, some IoT platform providers offer quick-start packages for new customers, and some offer drag-and-drop functionality to generate simple applications. Overall, the IoT platform you select must allow you to go to market in your projected timeline. Furthermore, in the unlikely event that you need to change your platform after going to market, the transition needs to be smooth, and your initial platform needs to permit this migration in a hassle-free manner.

15. Pricing model

This is one of the most important considerations. Most IoT platforms provide multiple pricing options depending on features, similar to how Gmail provides services to enterprises. But some might try to sneak in some additional costs that you might overlook while selecting! Some IoT platforms might charge according to the number of reads and writes; so it becomes costlier as your company grows! Also, you can try to check if the company is flexible enough to accommodate your needs and modify the pricing accordingly.

Comparison of some IoT platforms

Let us take a look at a few IoT platforms and compare their features and pricing as given in Table 1 to 3.

Once all relevant platforms are analysed according to the fifteen points mentioned above, you will be able to decide which one suits your application the best. EFY

The author, Aaryaa Padhyegurjar, is an Industry 4.0 enthusiast at EFY with a keen interest in innovation and research.

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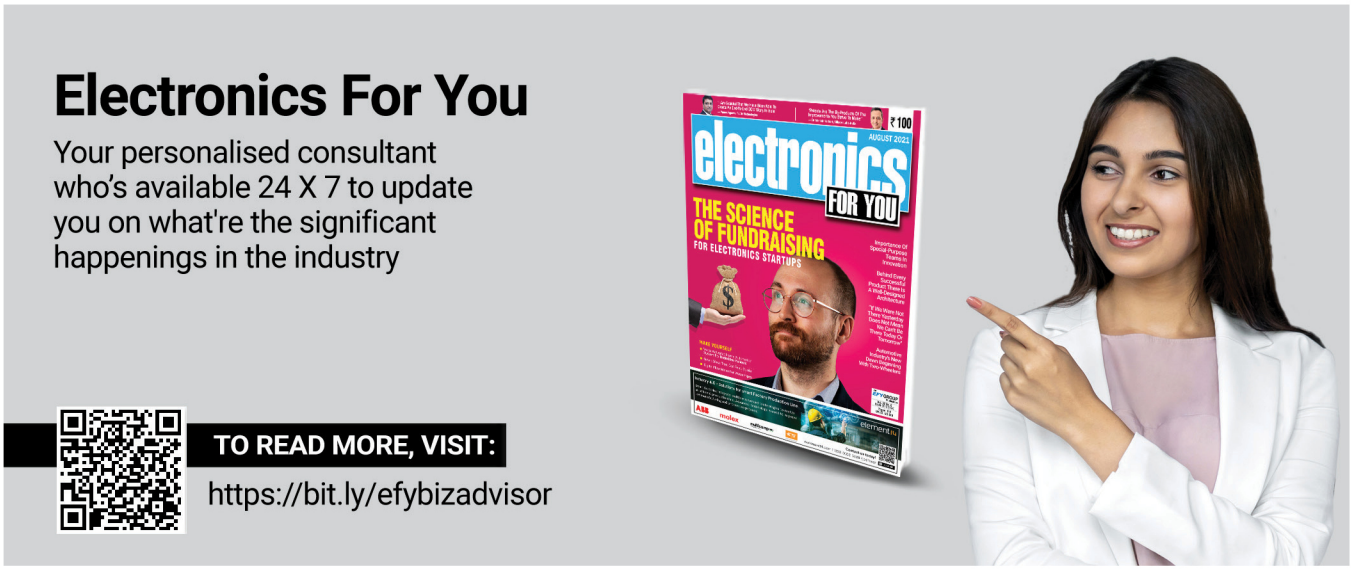
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MagSafe Enabled WIRELESS POWER BANK

ASHWINI KUMAR SINHA

MagSafe, a magnetic technology embedded into the internal engineering of iPhone 12 model, was originally created as a safety feature for MacBook charging cords. It creates a new ecosystem of accessories for easy attachment and faster wireless charging. The cost of a wireless

BILL OF MATERIAL

Component name	Quantity	Description
Inductor coil	1	For wireless power
5V stepup charging BMS	3	5V stepup charging module
Wireless power TX module	1	Power transmitter
3.3V rechargeable battery	2	2000mAh or 1000mAh
3D printed case	1	Powerbank case

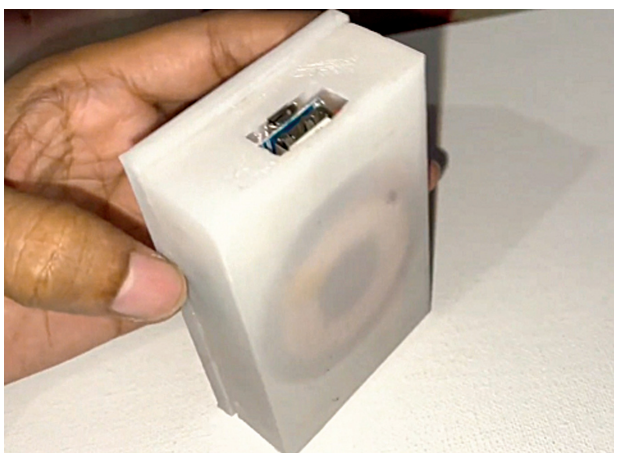

Fig. 1: MagSafe enabled wireless power bank

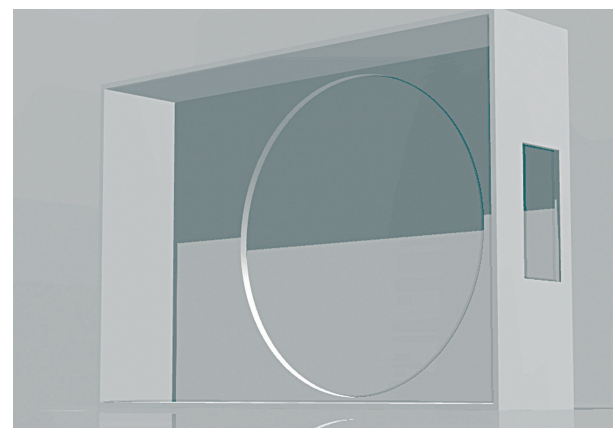

Fig. 3: Case design

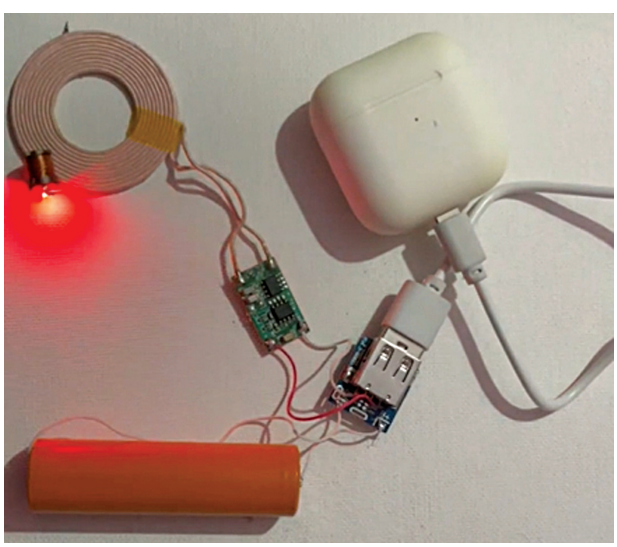

Fig. 2: Components used

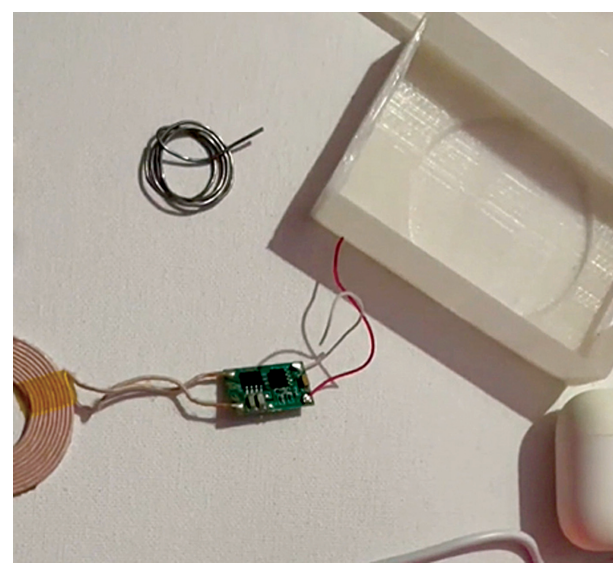

Fig. 4: 3D printed power bank case

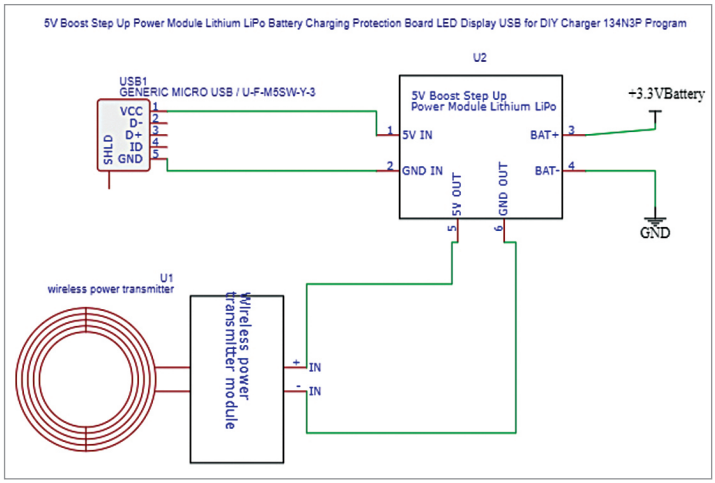

Fig. 5: Wireless power bank circuit

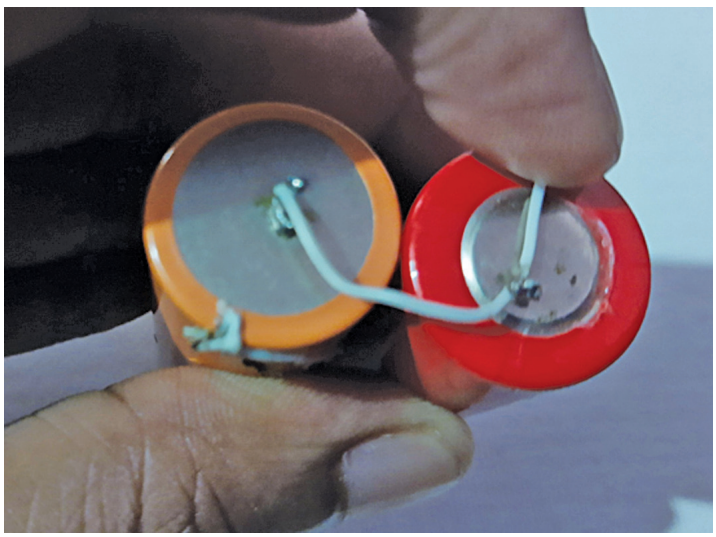

Fig. 6: Connecting the batteries in parallel

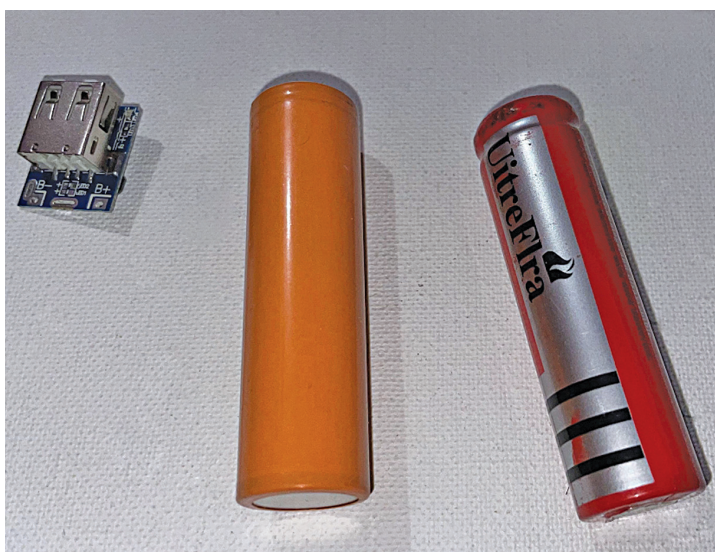

Fig. 7: The module and battery cells

power bank with MagSafe ranges from ₹5000 to ₹7000. Apart from being expensive, it is difficult to procure from the market.

This DIY project is of a wireless power bank with MagSafe, which can not only charge iPhones but also other compatible devices (including IoT devices). It offers the benefit of having a wireless powering system, MagSafe technology, and a USB charging system that is compatible with many devices.

Designing

The size of the battery is important for designing a proper case. Both the battery and the

Fig. 8: Battery terminal soldered

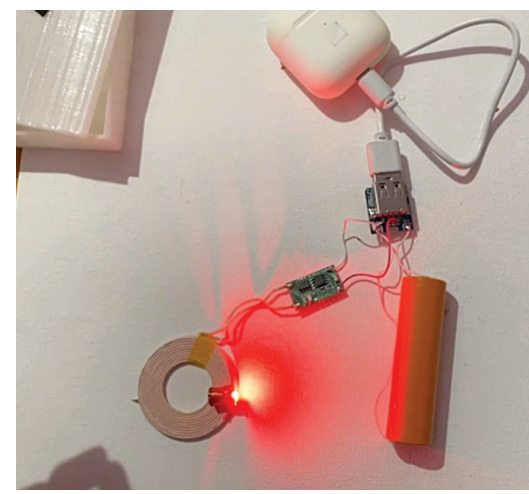

Fig. 9: Wireless transmitter charging module connected to the charger module

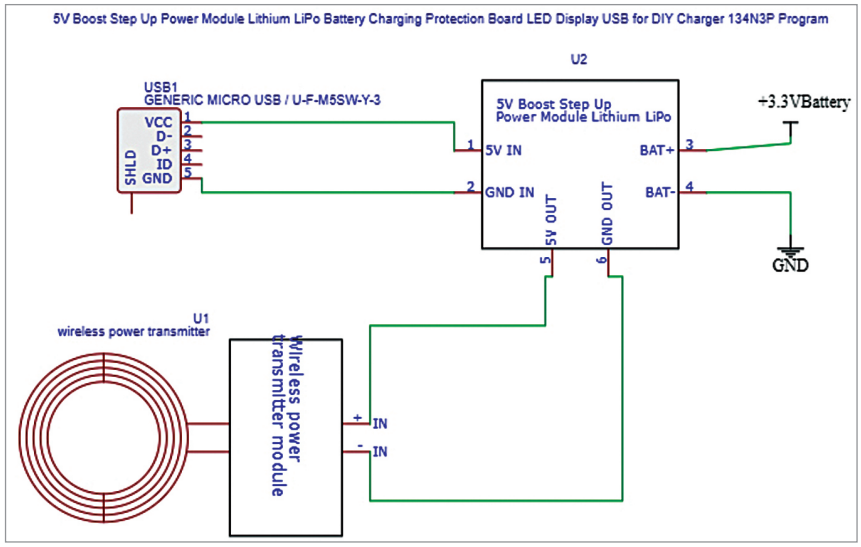

Fig. 10: The circuit diagram

charging module have to fit inside the case, which has to be cut to make provision for input power charging (USB) and output power. A cavity is also made on one wall of the case for the coil and MagSafe magnet to be placed, as shown in Fig. 3.

For the circuit, we can either use a 5V step-up battery management IC or a module. A TP4056 one-ampere battery charging module was used in the author's prototype. The module's output is connected to a wireless transmitter, as shown in Fig. 5.

Connections

The battery terminals are soldered

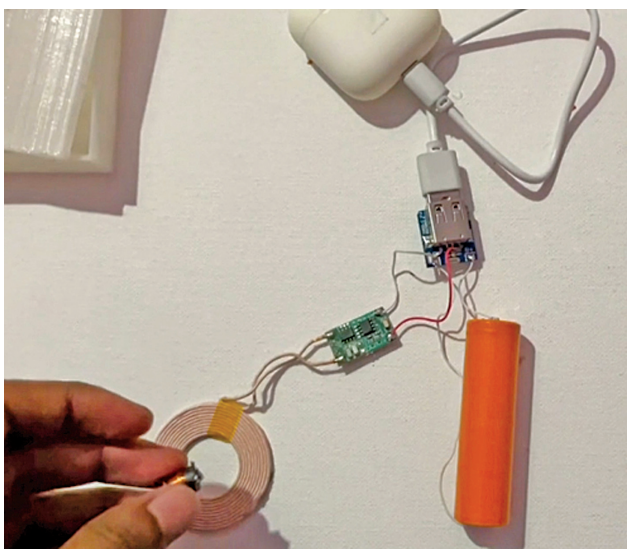

Fig. 11: Fixing the coil and magnet

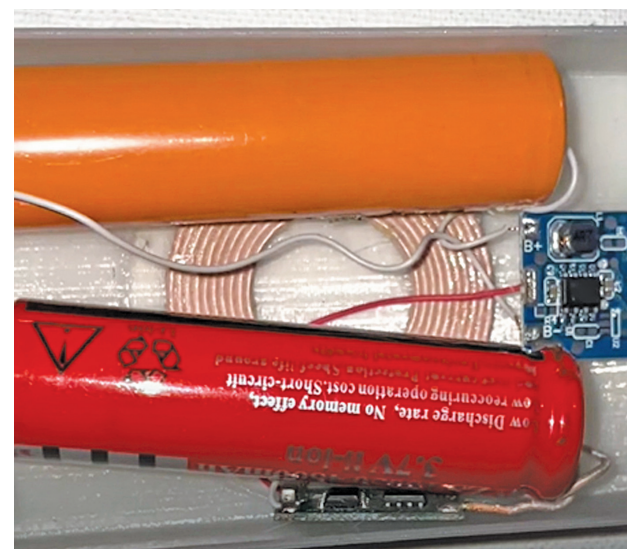

Fig. 13: An inside view

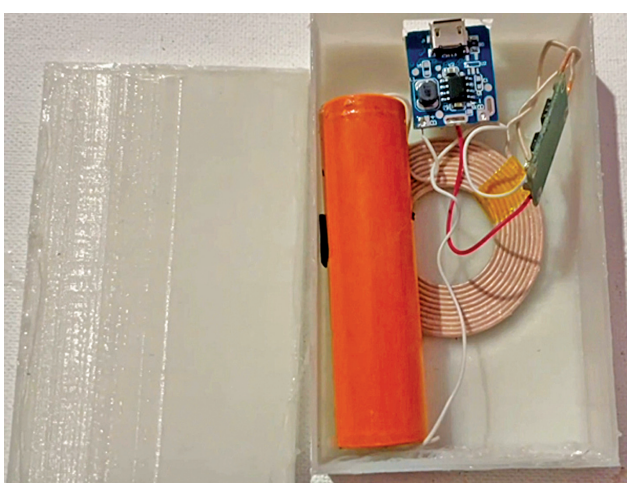

Fig. 12: Fixing the coil and circuit along with battery

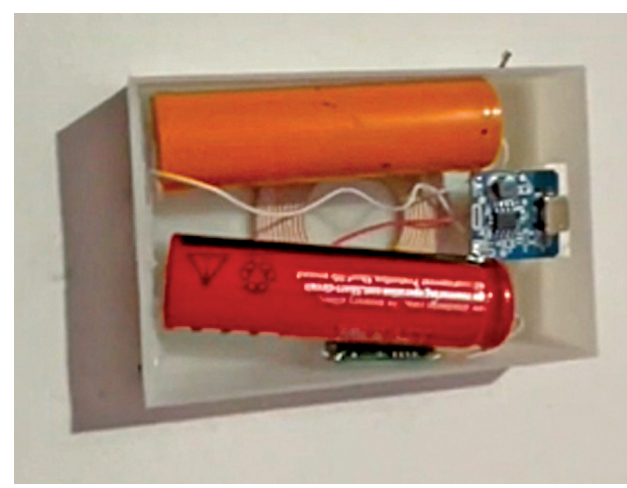

Fig. 14: Author's prototype without the top cpver

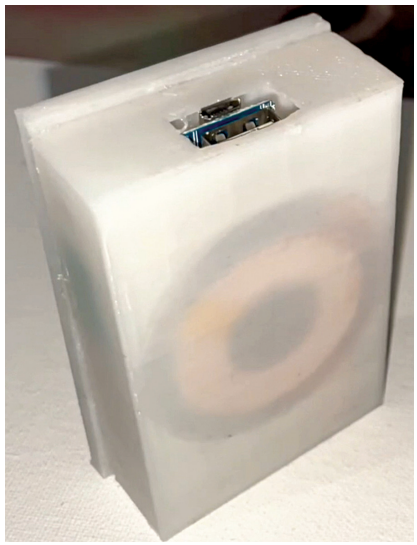

Fig. 15: The author's prototype

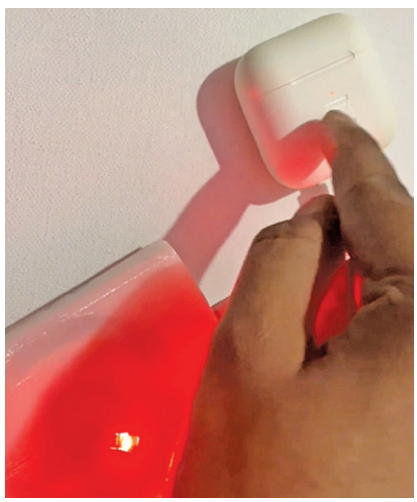

Fig. 16: Testing power bank and charging AirPods

Fig. 17: Testing power bank's wireless charging system by powering LED wirelessly

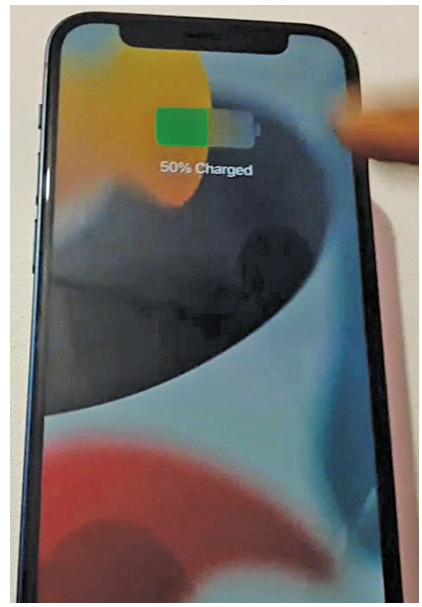

Fig. 18: A phone being charged

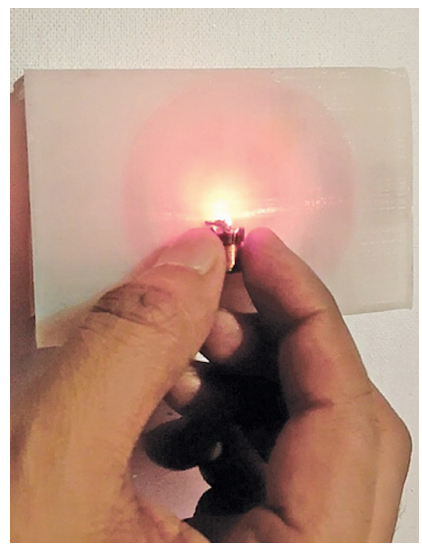

Fig. 19: LED glowing to indicate power transfer

either with the wires directly or a battery pack connector strip. In case of multiple batteries being used, make sure to connect the batteries in parallel (see Fig. 6). Next, connect the battery step-up charging module as shown in the circuit diagram. The wireless charging coil should now be soldered with the input of the wireless power transmitter module and its output with the charging module output pins (see Fig. 7 through Fig. 10).

The coil may now be fixed in the cavity with a magnet for MagSafe. Above this fix the battery along with the BMS module in USB cavity of the 3D-printed case. Finally, fix the top cover (see Fig. 11 through Fig. 14). For MagSafe, fix the circular magnet in cavity with glue.

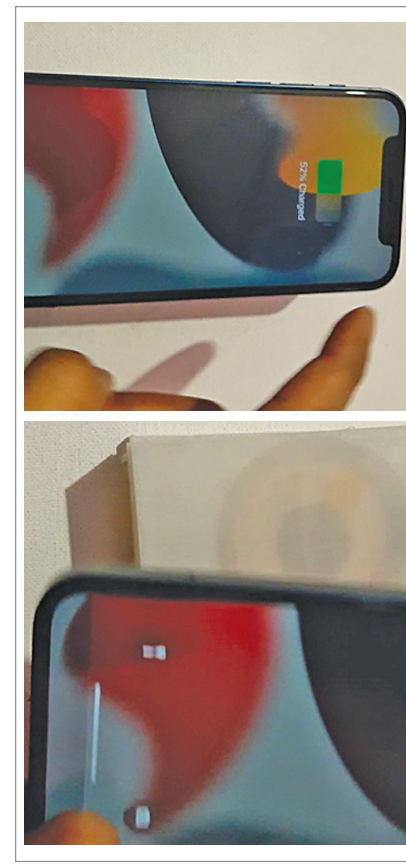

Fig. 20: Phone charging

Testing

To test the circuit, plug in any device to the USB and notice it charging. (In the pictures an Airpod case is shown plugged in.) Next, bring any wireless device (a wireless LED is shown in the pictures) and see the LED glowing, as shown in Fig. 19, as the power bank emits power in the form of electromagnetic waves. A phone can be charged by placing it on the device, as shown in Fig. 20. EFY

Ashwini Kumar Sinha is a technology enthusiast at EFY

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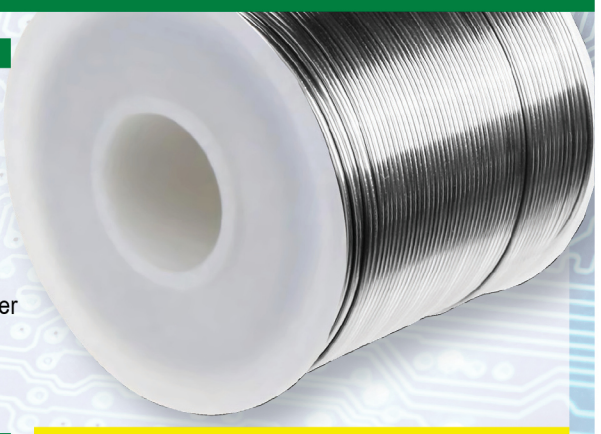

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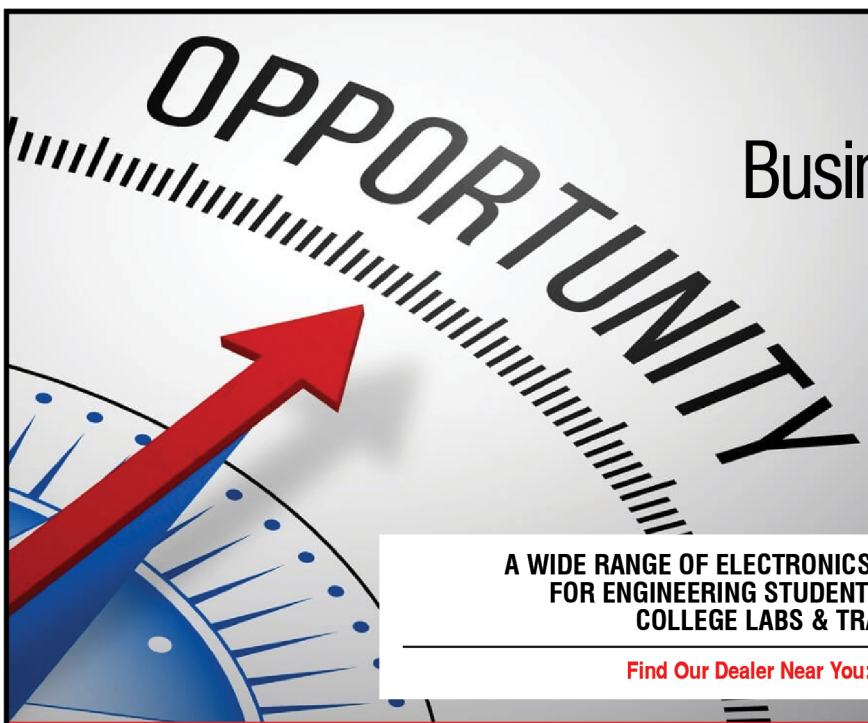

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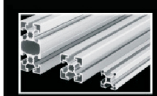
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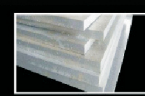
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WIZnet will be holding a design contest in June and offer free samples to our participants to encourage the advancement of IoT ecosystem and to coexist with other vendors. While the focus of the last contest was ethernet functionality, this upcoming contest will primarily focus on Wi-Fi functionality featuring our WizFi360 products. WizFi360 is registered as Arm's official shield for Open-CMSIS-Pack and is officially registered and used on various platforms such as Azure Certified. WizFi360 supports AWS AT Command as well as AWS SDK, and also supports various development environments, such as Arduino, C/C++, Python, Free-RTOS, and more.

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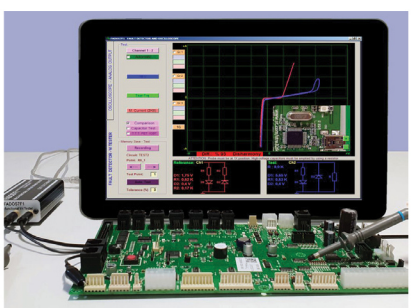
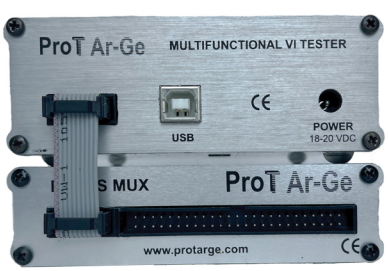


GSAS Micro Systems Pvt Ltd partnered with Prot Ar-Ge, Turkey, to provide one of the world's best PCB fault detection tool, FADOS. It is a PC-based VI (Voltage-Current) Analysis tool with unique features like an Equivalent Circuit Diagram, Components values such as a Resistor, Capacitor, and Diode, Memory Recording, Oscilloscope, Square Wave Generator, Analog Voltage Output, Power Analysis along with the Variable DC Power Supply from 0-16V with the resolution of 100mV at 1500mA and Temperature sensor measures 0 to 120 degrees according to the room temperature and much more.

FADOS Test System won the Expert Jury Award by Huber Verlag für Neue Medien, Germany in 2015.

FADOS will be a perfect companion for a service engineer to determine and troubleshoot faults in all types of Electronic circuit boards in a short time and with ease of use technology. Further, It helps to reduce the E-waste and Downtime of electronic equipment, thesis by protecting nature.



FADOS MUX Multiplexer is an accessory that increases the FADOS9F1 capability, by having 96 channels to test simultaneously.

More details:
Call: +91 98450 42967
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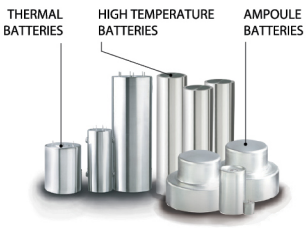
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