

electronicsForYou EXPRESS

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Vol. 2 Issue No. 8 • Pages: 90

MUST READ

AI Computers Get
Expensive Very Fast.
You Can End Up
Spending \$1000”
— Jim Keller, CTO and
President, Tenstorrent

Evolving Mobility
Landscape Set to Boost
Automotive Electronics
Market In India

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Making India The
Hub For Quantum
Cybersecurity

AGUSTIN CRUZ

Making Metal
3D Printers More
Accessible
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“
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RUNS
IN MY
BLOOD”
”

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PROVIDING LED POWERED

BINAY

LED Aviation Obstruction

LIGHTS



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)

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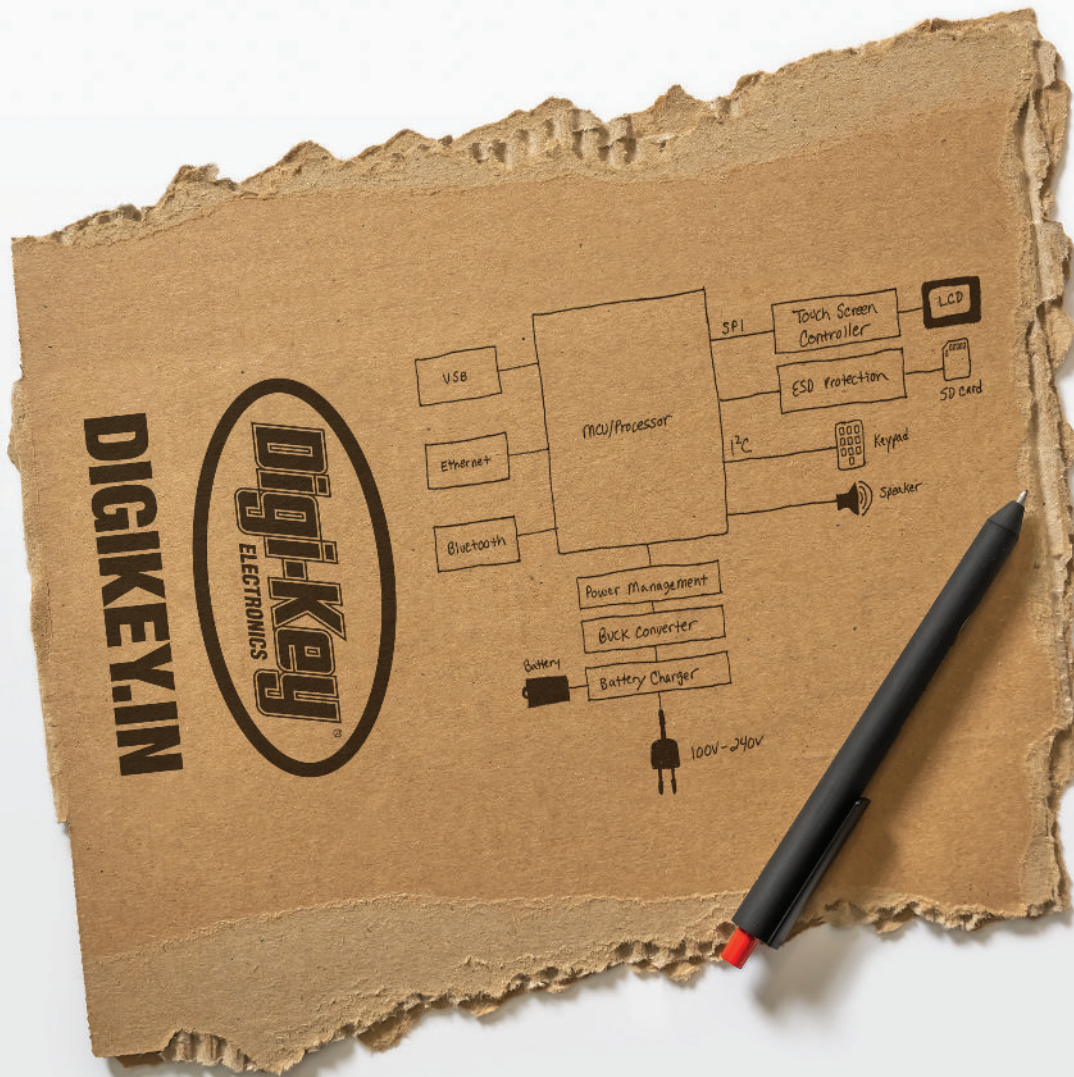
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Put the “Smart” in Smart Home

Easy Design with the PIC16F18076 Family of MCUs

No matter what you’re building, the PIC16F18076 family of MCUs can help you create faster, more feature-rich smart home technology. Now, you can easily add capacitive touch buttons, control motors, integrate IoT connectivity and monitor system health using the family’s on-chip smart peripherals. And, these cost-effective MCUs integrate seamlessly with our latest GUI-based code configuration tools for a refreshingly simple development experience. Start building your next smart home appliance today using Curiosity Nano rapid prototyping hardware.

Key Features

- 8 to 44-pin packages
- 3.5 KB to 28 KB of internal memory
- CPU Speed up to 32 MHz
- 10-bit Analog-to-Digital Converter with Computation (ADCC)
- Automated Capacitive Voltage Divider (CVD)
- 8-bit Digital-to-Analog Converter (DAC) module

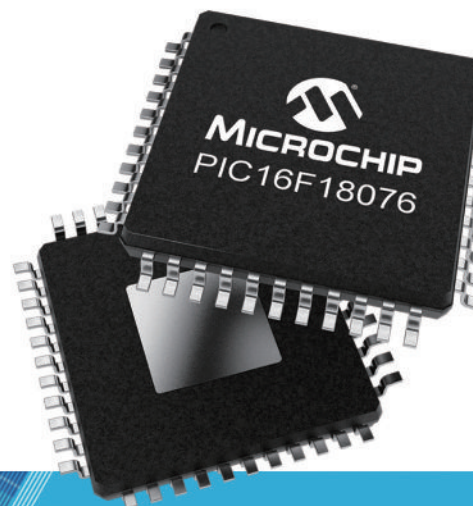
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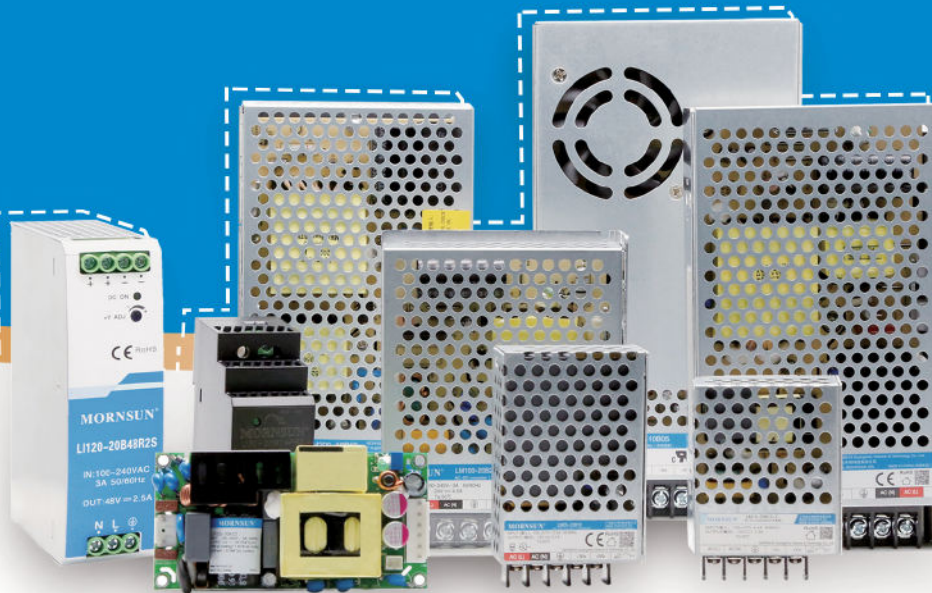
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FROM YOU

YOUR SUGGESTIONS AND THINGS YOU WANTED TO KNOW!

EV CHARGING CIRCUIT

I need battery charging and DC converter circuits that are used in an electric vehicle (EV). Earlier I sent an email to you regarding this, but it seems you have not published any article on EV circuits yet.

Ravi Sankar

EFY. Please check 'Design Your Own Electric Vehicle Battery Charging Solutions' available on EFY website at <https://www.electronicsforu.com/electronics-projects/electronics-design-guides/electric-vehicle-battery-charging-solutions>

•••

PROJECTS WITH PCBs

I want EFY magazine issue that has projects with printed circuit boards (PCBs).

Yashu

EFY. There are DIY projects with PCB layouts in almost every issue of EFY magazine. Some of the projects with PCBs are also available on EFY website at <https://electronicsforu.com>

•••

ARDUINO BASED PROJECTS

I am looking for Arduino based projects. Please let me know some of the latest Arduino based projects published in EFY.

Karthi

EFY. Some of the latest Arduino based projects published in EFY are:

1. Weather Station With Device Control Using Touch Screen Display (April issue)
2. Study Of Rectified Waveforms Using Arduino Uno (March issue)
3. Smart Switch Box For Electric Iron (March issue)
4. Bluetooth Controlled Data Logger Robot For Soil Testing (February issue)
5. Contactless Smart Bin (December 2021 issue)
6. Automatic School Bell That Also Announces Alert Messages (December 2021 issue)
7. Taxi Fare Meter (Dec. 2021 issue)

ARDUINO BOARD

How to upload source code in an Arduino board and work with the board? Where can I buy an Arduino board?

Ganesh

EFY. Getting started with Arduino board and uploading the code could be a little confusing for some beginners. Because getting all the details from one source is not always easy. To get started with Arduino board, first you would need to install drivers, Arduino software or Integrated Development Environment (IDE), and then upload the code (called sketch) to the Arduino board.

The step-by-step procedure to work with an Arduino board is given below. It is applicable for the PCs using Windows as the operating system (OS), including Windows 7, 8, and 10 versions. The steps are also applicable for Windows XP but some of the dialogue windows may be different.

Follow the steps below to start with Arduino board:

1. Install Arduino IDE in your PC. You can download the latest version of Arduino software from <https://www.arduino.cc/en/software>
2. Connect your Arduino board to PC using a USB cable and wait for Windows to begin USB driver installa-

tion process.

3. If the Windows installer does not start automatically, open the Windows Device Manager from Start→Control Panel option and find the Arduino under Ports (COM&LPT) list.

4. If Arduino is not found, go to Other Devices and select the Unknown Device option. Then update the driver.

5. Select 'Browse my computer for driver software' option and go to the Arduino software download location and select Arduino.inf file/Arduino uno.inf (depending on your software version) to install the driver.

6. After successful installation of the driver, from the Arduino IDE select Tools/Board option. From here select your Arduino board among those listed, such as Arduino Uno, Arduino Mega 2560, Arduino Leonardo, etc.

7. Choose the correct serial COM port for your board. The COM port number will be visible under Device Manager.

8. Open the source code/sketch, compile it and upload the code to Arduino board by clicking the Upload button. If you do not have the sketch ready, the easiest way to start with the Arduino programming is to use the 'Blink' sketch from the Examples in Arduino. You can access Blink source code from File→Examples→Basics option, as shown in Fig. 1.

9. Compile the code and upload it to the Arduino board.

After uploading the code, you can access the Arduino pins or interface the pins with other devices. For example, the above Blink sketch is used to control (turn on/off) an LED through Arduino pin 13. You can change the LED blinking frequency by changing the code in Blink sketch.

Arduino boards—including Arduino Uno, Arduino Mega 2560, and Arduino Leonardo—are available from various online shops. You can also buy them from www.kitsnspares.com or contact them on info@kitsnspares.com

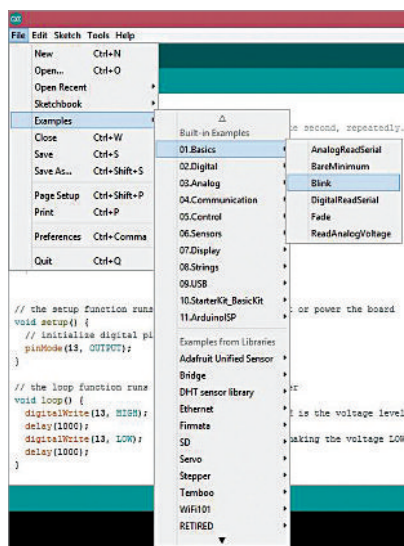


Fig. 1: Blink example from Arduino IDE

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RESEARCH

& INNOVATION UPDATES

World's first robot-painted art car unveiled



ABB Robotics has created the world's first robot-painted art car in collaboration with world-renowned artists: Advait Kolarkar, an eight-year-old Indian child prodigy, and Illusorr, a Dubai based digital design group. Without the need for human intervention, ABB's award-winning PixelPaint technology has perfectly recreated Advait's whirling monochromatic design as well as Illusorr's tri-colour geometrical patterns. PixelPaint technology captures complex, elaborate detail that would be hard to produce by hand with extraordinary precision and speed. The paint can be applied in a single application if it is well regulated. This breakthrough in paint automation allows the car industry to offer more specific and individualised designs.

ABB Robotics unveils world's first robot-painted art car (Credit: <https://www.automation.com/en-us>)

Vibration based neckband for cervical spondylosis

A team from Anant National University, led by Assistant Professor Parth Atulkumar Shah, worked on developing a neck band that focuses on addressing issues of muscle stiffness and nerve compression. The neck band consists of electromagnetic vibrator motors whose intensity of vibration can be controlled using a voltage regulator. These vibrators are placed at the accurate pressure points on the neck such that they stimulate those pressure points. They further increase the blood flow through the veins and help the neck area get more oxygen from blood. The team has also designed an app, known as Pysiocare, using which the users can connect to local doctors and find the solutions to problems related to muscle pain.



The team along with their vibration-based heating neckband for cervical spondylosis (Credit: Parth Atulkumar Shah)



AI can work without internet with this device

A new research project from the University of Central Florida aims to make artificial intelligence (AI) work without the use of the internet. The sophisticated neuromorphic or brain-like devices developed by the researchers are built



UCF NanoScience Technology Center Assistant Professor Tania Roy and Electrical and Computer Engineering doctoral student Adithi Krishnaprasad are working to give technology brain-like computing power (Credit: UCF)

on small, rectangular chips that are about 2.5cm across. Two-dimensional (2D) materials have been used to create transparent, flexible, ultra-thin memristive synapses for neuromorphic computing. By using a different method of production, the researchers were able to change the way the current passes through the device. Their next step will be to improve the technology, which will include the creation of networks with devices that will enable new applications like image recognition.

This robot will help understand how bacteria swims

Brown University students and faculty have constructed a self-propelled robotic swimmer that could aid academics in better understanding the intricate swimming behaviour of bacteria and other microbes. The device is based on the E. coli bacterium's shape and was created using a 3D printer. A small engine, a power supply, and other electronics are

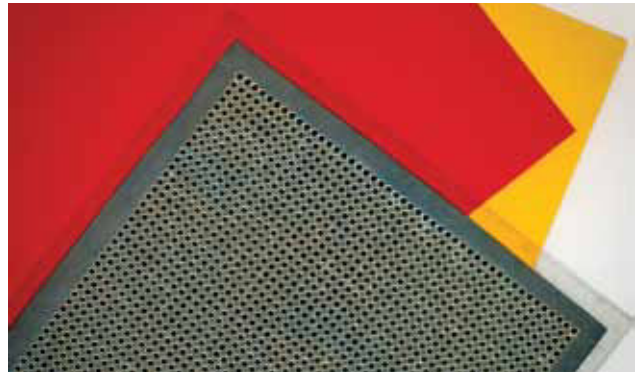


housed in the waterproof head. The engine propels a helical tail which can be changed to experiment with different helix angles and geometries. The motor speed and rotation direction are controlled using a remote control. "What this gives us is the ability to do macroscopic experiments that we have full control over," says Daniel Harris, Assistant Professor of Engineering at Brown.

Self-propelled robotic swimmer (Credit: <https://www.brown.edu>)

A loudspeaker as thin as paper

Engineers at MIT have created a paper-thin loudspeaker that can turn any surface into a sound source. It generates low-distortion sound while consuming a fraction of the energy required by regular loudspeakers. The research simpli-

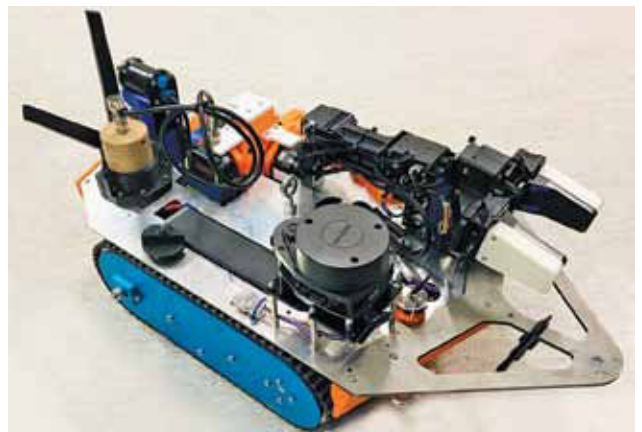


MIT researchers have developed an ultrathin loudspeaker that can turn any rigid surface into a high-quality, active audio source. The straightforward fabrication process they introduced can enable the thin-film devices to be produced at scale (Credit: <https://news.mit.edu>)

fies speaker design by employing a thin layer of shaped piezoelectric material that moves when electricity is applied to it, thus moving the air above it and producing sound. "It feels remarkable to take what looks like a slender sheet of paper, attach two clips to it, plug it into the headphone port of your computer, and start hearing sounds emanating from it," says Vladimir Bulović, the Fariborz Maseeh, lead author of the study.

A robot built for nuclear infrastructure inspection

Lyra, a robot, was employed to investigate a ventilation duct and map radioactive elements in a redundant nuclear laboratory in Dounreay (UK). It was built as a low-cost robot with five radiation detectors, a laser scanner for



Lyra robot for nuclear infrastructure inspection (Credit: www.manchester.ac.uk)



location, two cameras, lights, and a manipulator arm for swabbing radioactive pollution from the duct's wall or floor. Lyra's radiation sensor package was built to measure beta, gamma, x-ray, and neutron radiations. Its front and the manipulator's end were both fitted with cameras. Lyra is controlled via a joystick for driving and a supplementary manipulator arm whose motion is replicated by the robot's arm. This allowed for the creation of a 3D, time stamped video with the measured radiation readings overlaid onto the video.

Researchers develop super-sensitive e-skin

A research team from Chemnitz and Dresden has made significant progress in the development of sensitive



Artificial electronic skin (Credit: <https://www.tu-chemnitz.de/tu>)

electronic skin (e-skin) with integrated artificial hair. The team looked at a new way to develop very sensitive and direction-dependent 3D magnetic field sensors that may be used in an e-skin system. An anisotropic magnetoresistance (AMR) sensor lies at the heart of the sensor system, which was created using the 'micro-origami method.' Similar to real skin, which is interwoven with nerves, this e-skin is made of an elastomeric material into which the electronics and sensors are placed.

AI-enabled bot that cleans water bodies

Clearbot Neo is a sleek AI-enabled robotic boat designed by Open Ocean Engineering, a Hong Kong based startup, that gathers tonnes of floating debris. The bot, which is only three metres long and is propelled by a solar battery-

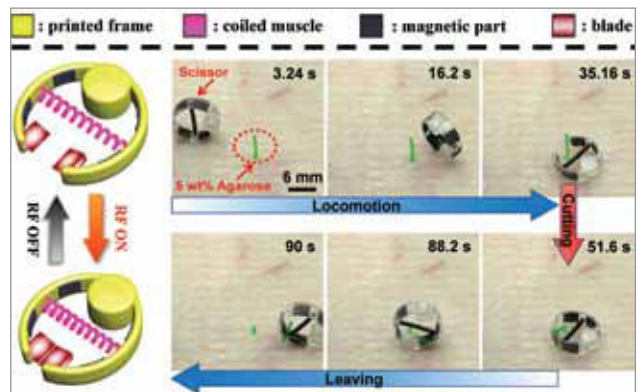


AI-enabled robotic boat by Open Ocean Engineering, Clearbot Neo, collects data to track and tackle pollution at source using Microsoft Azure (Credit: Clearbot)

powered electric motor, systematically skims the surface and sweeps up floating debris. It uses artificial intelligence to distinguish and log the types of rubbish it collects and where it finds it. It can collect data for companies, governments, non-governmental organisations, and individuals using Microsoft Azure and monitor the origins of marine debris. Subsequently, it can combat pollution at the source.

Soft bots to perform surgery

Researchers at Stuttgart's Max Planck Institute for Intelligent Systems have developed a small-scale coiled muscle actuator that uses tunable mechanical properties and radio frequency magnetic heating to perform surgical tasks that require a high force output and work capacity, such as suturing,



Magnetic control: A scissoring device rolls to the target location and cuts a tissue-like structure using radiofrequency heating (Credit: <https://physicsworld.com>)

cutting, drilling, and clamping tissues. "Our new approach extends the capabilities of wireless medical soft robots to surgical applications. As next step, we will demonstrate such functions in small animal surgeries in *in-vivo* conditions," explain senior authors Wenqi Hu and Metin Sitti.

Lunar colony being planned for Mars exploration

NASA's planned Artemis lunar colony will serve as a ground for eventual human exploration of Mars. The base camp will have independent mining and fuel processing facilities. Sandia National Laboratories is creating an electrical system controller for the mining and processing centre's microgrid. According to Jack Flicker, a Sandia electrical engineer, NASA is designing the electrical system controller for the habitation unit because the system will be quite similar to the direct-current electrical system on the International Space Station. Flicker and his colleagues are working on the technology that will connect the two microgrids as well as the power flow and operation between them.



Control system for quantum computers on FPGA

Quantum Instrumentation Control Kit, or QICK, a revolutionary control and readout electronics system developed by experts at the US Department of Energy’s Fermi National Accelerator Laboratory, has proven to dramatically improve quantum computer performance while lowering



Gustavo Cancelo led a team of Fermilab engineers to create a new compact electronics board. It has the capabilities of an entire rack of equipment that is compatible with many designs of superconducting qubits at a fraction of the cost (Credit: <https://news.fnal.gov>)

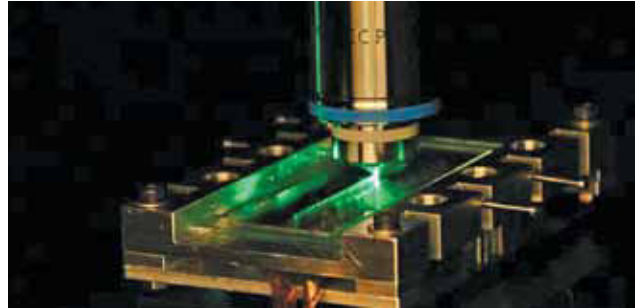
control equipment costs. A single electronics board, slightly larger than a laptop, houses the capability of a complete rack of equipment. Microwave pulses are used to control and read qubits. The Fermilab team’s radio frequency (RF) board has over 200 components, including mixers, filters, amplifiers, attenuators, and switches. The RF board, when combined with a commercial FPGA board, gives scientists everything they need to connect successfully with the quantum realm.

A new wireless charging system for buses

Researchers from Taiwan’s National Chiayi University have created a revolutionary UAV based charging method for city-wide sensor networks that use public transportation like buses. In this system, the bus provides the energy required for effective UAV operation, while flight energy consumption is kept to a minimum. The research contributes to the advancement of this technology in various ways. First, a method for coordinating bus schedules and UAVs has been established. Second, charging algorithms based on real-world bus data and metropolitan maps have been developed to increase UAV recharging and sensor power supply. Finally, the authors analysed three different charging tactics for the suggested system.

Sapphire fibre sensor that can withstand over 2000°C

Researchers at Oxford University have invented a sapphire fibre sensor that can withstand severe temperatures, with the potential to enhance efficiency and reduce emissions in aircrafts. The researchers have used a sapphire optical fibre—a thread of industrially grown sapphire less than

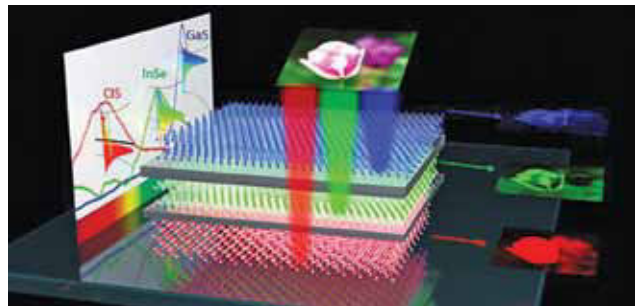


Sapphire optical fibre (Credit: <https://phys.org>)

half a millimetre thick—which can withstand temperatures of over 2000°C. The first demonstration used a 1cm-long sapphire fibre, but the researchers believe that lengths of up to several metres will be conceivable, with multiple sensors spaced along the length. This would, for example, allow temperature data to be taken throughout a jet engine.

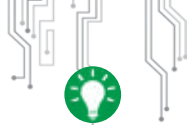
An electric eye with a vertical colour sensor

Researchers at Georgia State University have created a new form of artificial vision device that uses a novel vertical stacking architecture to enable higher colour recognition depth and micro scalability. According to the team, the van



Development of electric eye (Credit: <https://news.gsu.edu>)

der Waals semiconductor-empowered vertical colour sensing structure has exact colour identification capabilities, which simplifies the design of an optical lens system for artificial vision. Compared with conventional semiconductors, such as silicon, this sensor can precisely control the van der Waals material band structure, thickness, and other critical parameters to sense red, green, and blue colours.



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*

Skin-like covering for humanoid robots that adds tactile awareness

RoboSkin line from BeBop Sensors is a skin-like covering that adds tactile awareness to humanoid robots. It can

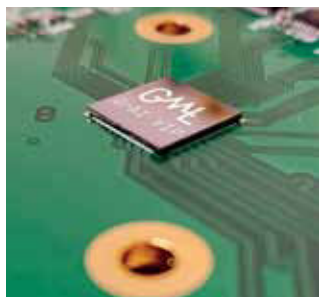


be fitted into the prosthetics, thus providing higher sensitivity and spatial resolution to the wearer. The sensor comes in a small package, which is less than a millimetre thick, making it the first available solution suitable for use in all robotic body parts, including fingers, limbs, head, torso, feet, etc. The Roboskin uses web based, real-time data visualisation and has multiple data visualisation modes that include live data charts and 3D renders.

BeBop Sensors
<https://bebopsensors.com>

Chip with near-sensor AI solution developed

GrAI VIP is an industry-first near-sensor AI solution with 16-bit floating-

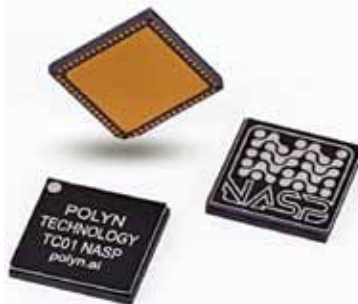


point capability. It has twenty times better power efficiency compared to alternatives available in the market. GrAI VIP provides a few millisecond inference latencies for networks like Resnet-50 and comes in a compact package of 8mm × 8mm with an integrated memory which enhances the privacy of your system. It achieves best in class performance and can deliver life-ready AI to industrial automation applications, such as pick and place robots, cobots, and warehouse robots. The chip has ready-to-use popular audio and vision networks for faster TTM.

GrAI Matter Labs
<https://www.graimatterlabs.ai>

Ultra-low-power neuromorphic analogue signal processor

Polyn Technology has announced their first neuromorphic analogue signal processor (NASP) chip. The ultra-low-power, high-performance chip can



replicate the pre-processing of the primary cortical area of the human brain. It is the first Tiny AI true analogue design to be used next to sensors. It can be used to demonstrate the proof of the technology's brain-mimicking architecture. The chip enables full data processing disaggregation between the sensor node and cloud. It finds usage in applications such as wearables,

Industry 4.0, Connected Health 4.0, etc.

Polyn Technology
<https://polyn.ai>

A processor that unifies functionalities of CPU, GPU, and TPU

Tachyum Prodigy from Tachyum is the world's first universal processor. Prodigy unifies the functionality of a CPU, GPU, and TPU in a single processor,



thus creating a homogeneous architecture and reducing performance degradation caused due to improper integration of different models. The universal processor is capable of delivering up to 6x performance for AI applications and 3x performance each for the best performing GPUs for HPC and highest-performing x86 processors for cloud workload available in the market. A universal processor can reduce power consumption and heat losses along with reducing the footprint

Tachyum
<https://www.tachyum.com>

World's first CXL memory expander controller

Montage Technology M88MX5891 is the world's first compute express link (CXL) memory eXpander controller (MXC). It is compatible with both the DDR4 and DDR5 JEDEC standards.



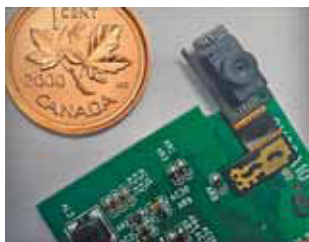
The MXC enables significant scaling of memory capacity and bandwidth and provides high-bandwidth and low-latency interconnect between CXL



based devices and the CPU. It can be used in backplanes or EDSFF memory modules to enable significant scaling of memory capacity, which allows it to be used in data-intensive applications, such as high-performance computing (HPC) and artificial intelligence (AI).
Montage Technology
<https://www.montage-tech.com>

World's thinnest camera module for laptops and tablets

Immersion has announced the world's thinnest camera module for laptops and tablets. The 8MP ultra-wide-angle lens-and-sensor combination comes in a compact package

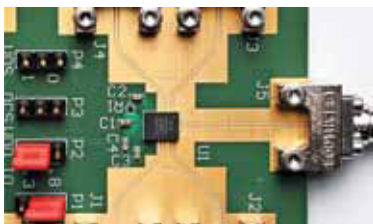


measuring only 3.8mm at its thickest point. The slim camera module can be used in conjunction with Immersion's wide-angle distortion correction de-warping algorithms, with face- and body-protection algorithm that allows clear video quality.
Immersion
<https://www.immersion.com>

SP4T switch with built-in high-voltage charge pump

MENLO MICRO MM5140 is a single-pole/four-throw (SP4T) DC-to-6GHz

switch. It is capable of handling up to 25W power with a low insertion loss of 0.2dB at 3GHz. The switch features a built-in high-voltage charge pump embedded in a 5.2mm x 4.2mm LGA



package, eliminating the need for external components. The integrated charge pump circuit offers both flexible SPI and GPIO digital interfaces, enabling easy control from any host processor or test system. It is suitable for applications requiring high reliability, such as antenna tuning, beam-steering types of equipment in 5G base, and other high-power RF switching applications.
MENLO MICRO
<https://menlomicro.com>

A sensor that matches human eye's colour and light perception

OSRAM AS7343 is a spectral sensor capable of matching 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. The



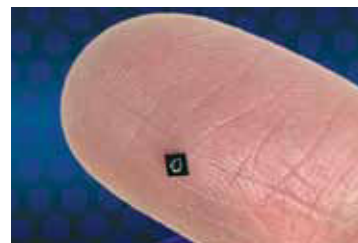
compact size of the sensor makes it easy to accommodate it in space-constrained applications. The AS7343 is suitable for colour analysis in applications which require frequent, accurate measurements, such as in horticulture, smoke detection, etc.
AMS OSRAM
<https://ams-osram.com>

Powerful low light energy harvesting PV cells produced

Ambient Photonics claims to have produced the world's most powerful low light energy harvesting photovoltaic (PV) cells. The cells are said to generate as much as 3x more power than amorphous silicon cells. These cells can harvest energy from almost all types of illumination, ranging from candlelight to sunlight, and have the ability to be calibrated for specific applications. Their single-cell architecture not only improves aesthetics by eliminating grid lines, it also makes the solution impervious to blackouts caused by partial shading
Ambient Photonics
<https://ambientphotonics.com>

Capacitive, inductive, Hall effect, ambient sensors in a single processor

Synaptics Inc.'s FlexSense family of sensor processors integrates four sensors in an ultra-low-power, tiny, single chip. The sensors include capacitive, inductive, Hall effect, and ambient sensors in a single processor with



proprietary algorithms. The IC incorporates a central microcontroller that connects to two proprietary low-power, fast analogue front end (AFE) engines. This solution offers lower latency along with easier sensor calibration and configuration. FlexSense can reduce system design, cost, configuration, and supply chain complexity in applications such as wireless stereo (TWS) earbuds, gaming controllers, AR/VR headsets, fitness bands, smart thermostats, and many other IoT devices.
Synaptics
<https://www.synaptics.com>



NEW PRODUCTS

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COMPONENTS

Software-defined EV chips

ST Microelectronics Stellar E'MCU microcontrollers are specifically for software-defined electric vehicles (EVs). The E'MCU family includes the Stellar P series for integration and vehicle control and the Stellar G series for body applications. These MCUs are dedicated to facilitating centralised (domain and zonal) electronics architectures and simplifying high-efficiency power modules for e-drivetrain charging and digital power conversion. The MCUs can easily be upgraded in the future through secure over-the-air (OTA) updates.

ST Microelectronics
<https://www.st.com>

12th Gen mobile processors

The 12th gen Intel core HX processors are designed to provide high-level performance of mobile workstation platforms. These include seven new



mobile processors available in the existing configuration of Core i5, Core i7, and Core i9 models.

The desktop-caliber mobile processors have eight performance cores and eight efficient cores with 24 threads running at a base power of 55W.

These are suitable for power-intensive tasks, such as gaming and professional workflows like visual effects, CAD, and video rendering.

Intel
<https://www.intel.com>

3kA surge-protection thyristors

Littelfuse Pxxx0S3N SIDACTor Protection thyristor series safeguard exposed interfaces in industrial and ICT

applications, including RS-485 data interfaces used in factory automation and AC/DC power supplies used in energy storage systems and electric vehicle wall chargers. The thyristors provide 3kA (8/20) high-power surge protection with low thermal accumulation during long-term overvoltage events, so can be incorporated in equipment used in harsh environments.



Littelfuse
<https://www.littelfuse.com>

Radiation-tolerant flash

Microchip's SST26LF064RT is a 64-Mbit serial quad I/O NOR flash memory device for use in harsh aerospace and defense system environments. The commercial off-the-shelf memory device



has high radiation tolerance and is capable of withstanding 50-kilorad total ionizing dose (TID). The space-qualified second SuperFlash device from Microchip reduces development time, cost, and risk in the systems. The IC also reduces the complexity of power management switching to achieve the high TID even while the flash is still biased and operating in systems such as satellite onboard computers.

Microchip
<https://www.microchip.com>

IPM for 3-phase inverters

CIPOS Tiny IM323-L6G is a new addition to Infineon Technologies' intelligent power module (IPM) series. The IPM module is optimised for 3-phase

inverters with an operating range of 1 to 20kHz. It is rated for 600V, 15A and is based on the TRENCHSTOP IGNT



RC-D2 switches and the advanced SOI gate drivers. The IM323-L6G offers high efficiency and better reliability even with lower size and cost. It protects from short circuits, over-current, and under-voltage.

Infineon Technologies
<https://www.infineon.com>

Fast-recovery MOSFETs

The R60xxVNx series of MOSFETs provide a low on-resistance along with one of the fastest reverse recovery times. The series is optimised for power circuits in industrial equipment requiring high power, such as servers, EV charging, motor drives, etc. According to the company, the move towards a carbon-neutral world has forced us to become more energy-efficient, demanding power semiconductors to further reduce power loss. To meet the expectations, the R60xxVNx series uses the latest proprietary processes to achieve the industry's fastest reverse recovery time while reducing on resistance (which is in a trade-off relationship) by up to 20% compared to equivalent products.

ROHM Semiconductor
<https://www.rohm.com>

Solid-state EV relays

Texas Instruments TPSI3050-Q1 is an isolated switch driver with an integrated 10V gate supply and the TPSI2140-Q1, a 1400V, 50 mA isolated switch. The new series has a smaller size and lower power consumption along with a lower cost, making them suitable for use in electric vehicles (EVs). These solid-state relays are capable of achieving higher system

reliability with integrated isolation technology, thus making the EVs safer. The relays provide a smaller solution size compared to others, which further helps in reducing the bill-of-materials for systems like powertrain and 800V battery management systems.

Texas Instruments
<https://www.ti.com>

Wi-Fi 7-ready networking ICs

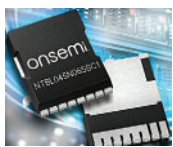
Qualcomm has announced the third-generation of Wi-Fi 7-ready family of professional networking platform

called the Networking Pro Series. The Wi-Fi 7 leverages advanced technology to maximise overall capacity, decrease latency, and increase the speed of every device. It is capable of achieving 4x data transfer rates compared to its predecessor Wi-Fi 6E. The lineup of Wi-Fi chips supports multiple channels and has been developed for enterprise access points, premium home routers, and advanced mesh systems.

Qualcomm
<https://www.qualcomm.com>

TO-Leadless SiC MOSFET

Onsemi NTBL045N065SC1 is the world's first TO-Leadless (TOLL)



packaged 650V silicon carbide (SiC) MOSFET. It comes in a compact package and offers enhanced performance with higher efficiency. The component offers better thermal performance, lower gate noise, and lower switching losses. With a foot-

print of just 9.90mmx11.68mm, and a profile of just 2.30mm, the new TOLL package offers 30% savings in the PCB area over a D2PAK package and it occupies 60% less volume than the commonly used D2PAK package.

On Semiconductor
<https://www.onsemi.com>

3-axis MEMS accelerator

The three-axis MEMS accelerometer ADXL367 from Analog Devices is designed for healthcare and industrial applications and offers an improved



power consumption and better noise performance than its predecessor. The new accelerometer also provides extended

field time that maximises battery life and reduces maintenance frequency and cost. It also employs a temperature sensor, an internal ADC, and tap detection feature along with a state machine to prevent false triggering.

Analog Devices, Inc.
<https://www.analog.com>

Ultra-compact connectors

LEMO's new high-power connectors with gold-plated contacts are robust, light, and compact with high



conductance. The conductors are capable of accommodating cables of 10mm² (AWG 8) to 50mm² (AWG 1) and come in unipole and multipole configurations for single- and three-phase requirements. The connectors are said to have the smallest shell size in the market capable of handling up to

430A current. The M series of connectors are oil- and fuel-resistant, which makes them suitable for high-temperature applications in automobiles and aerospace. They offer complete 360-degree screening for full EMC shielding.

Lemo Connectors
<https://www.lemo.com>

600V snap-in capacitors

The Cornell Dubilier Electronics (CDE) has added new capacitors rated for up to 600V to its signature 380LX and



381LX aluminium electrolytic capacitor series. The new series offers capacitors with multiple capacitances at 550V

and 600V with enhanced ripple current capability, up to 3.7A at full-rated conditions. Offering a work-life of over 3,000 hours, the snap-in capacitors can be used in the latest inverter circuits for renewable energy, UPS systems, battery chargers, motor drives, welders, and other applications that require the highest performance components to improve system reliability.

Cornell Dubilier Electronics
<https://www.cde.com>

EMBEDDED

Mass-producible ICP

Aurora is the first-generation intel-



ligent computing platform (ICP) from Desay AV. One of the world's first mass-producible ICP in the automotive electronics industry, it comes



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in a small package and can help in reducing the carbon emission in automobiles. Aurora meets automotive safety integrity level D and reduces energy consumption by about 42% and carbon emissions by about 62% when compared with other domain controllers.

Desay SV
<https://en.desaysv.com>

Tri-radio module

U-blox MAYA-W2 is a compact tri-radio module capable of supporting Wi-Fi 6, low energy Bluetooth 5.2, and



the IEEE 802.15.4 (Thread and Zigbee). The module supports both Bluetooth classic and Bluetooth LE

along with Bluetooth LE audio. It can work in a wide temperature range of -40°C to 85°C. The module is available in four variants with three antenna options, including antenna pins, U.FL connectors, or a PCB antenna. The tri-radio module can easily be designed into any type of IoT device.

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

Solderable SoM

iW-Rainbow-G46M is a solderable i.MX8XLite LGA system on module (SoM) from iWave for use in industrial IoT, connected and autonomous



vehicles, and V2X. Its main advantages are its compact size,

high resistance to vibration, and provision for technology scalability, so it provides designers an ideal mix of scalability, form factor, and cost. It features high-speed interfaces, such as Ethernet, PCIe Gen3, USB 2.0, and CAN Ports, and is powered by 2x Cortex A-35 cores and 1 Cortex-M4 core. The processor is available in both single- and dual-core variants.

iWave Systems
<https://www.iwavesystems.com>

TEST & MEASUREMENT

VPP-native DPI engine

R&SvPACE is a vector packet processing (VPP)-native deep packet inspection (DPI) engine designed to meet the IP traffic visibility needs in cloud computing environments. It is capable of handling masked traffic and traffic that is delivered via CDNs and VPNs. The engine powers virtualised and cloud-native functions and comes equipped with network functions, which include policy control and traffic management along with the analytics functions with application awareness.

Rohde & Schwarz, Inc.
<https://www.rohde-schwarz.com/us>

3D automatic AOI system

TR7500QE Plus from Test Research, Inc. (TRI) is a multi-camera 3D automatic optical inspection (AOI) solution. The metrology-grade 3D AOI solution is built on a stable mechanical platform that improves inspection stability, accuracy, and precision while reducing inspection time. The TR7500QE features an AI-powered algorithm with smart programming and is designed to interoperate with other manufacturing equipment to minimise downtime, optimise production quality, and reduce operator workload.

Test Research, Inc.
www.tri.com.tw

Dual-camera module

Hadron 640R is a high-performance, dual thermal and OEM camera module. The 64MP camera combines a radiometric thermal and visible dual-camera module and is optimised for integration into applications where battery life and run-time are mission-



critical, such as unmanned aerial and ground vehicles, robotic platforms, and emerging AI-ready applications. The camera can see through smoke, fog, complete darkness, and glare and provides temperature measurements for every pixel in the scene. The radiometry feature in this camera makes it suitable for application in an inspection over larger areas, such as in solar farms.

Teledyne FLIR
<https://www.flir.com>

Plating and coatings analyser

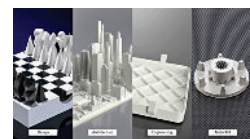
Hitachi FT230 for plating and coatings analysis is designed to enhance the time to analyse the parts and eliminate the time wasted on preparing a measurement or manipulating the results. In addition to simplifying and accelerating testing of components and assemblies it enables better quality control. The device can be used by electronics and component-level manufacturers, general metal finishers, and plating-on-plastic facilities to inspect and tightly meet the specifications of their products.

Hitachi High-Tech Analytical Science
<https://hha.hitachi-hightech.com>

MISCELLANEOUS

Open source slicer

Cura 5.0 is the latest addition to the famous line of free, open source, slicing software from Ultimaker. It achieves 20% faster print and can be used for unique applications in design, architecture, engineering, and metal 3D printing. The software features a new variable line width capability that improves its ability to print fine details and thinner walls. This feature helps in achieving fewer gaps on the inside





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of printed parts, making the piece more solid, which leads to a stronger print with strength closely matching those produced using injection moulding. The software now has support for Apple's M1 chips and is capable of printing stronger parts.

Ultimaker

<https://ultimaker.com>

Reversible flow fans

Orion Fan has released a new series of microcontroller based, reversible flow



fans in 12V, 24V, 48V, and 60V versions. Their speed and airflow direction can be controlled

without supplementing excess wires or circuitry by utilising PWM signals. These fans can eliminate the need for a dual fan setup and provide a solution for difficult cooling requirements. They can be used in HVAC systems, vending machines, cooler display cases, and lighting.

Orion Fan

RF power supply

Alta is an RF power supply from Advanced Energy that provides full



digital control and dynamic response to rapid plasma changes for robust and reliable

delivery. It features an accurate digital impedance matching network and also comes with features such as frequency tuning, real-time power and impedance measurement, arc management, phase synchronisation, etc. For communication, it uses communication interfaces, such as EtherCAT and Profinet. Alta platform comes with a 13.56MHz rack-mounted power supply with power levels of 1.5kW to 6kW and a 13.56MHz tapped digital matching network.

Advanced Energy

<https://www.advancedenergy.com>

Multi-domain simulation software

Altair Simulation 2022 software offers circuit board and electronics design capabilities along with simulation and design for power supplies, microgrids, and other power electronics compo-



nents. It adds multiphysics analysis for PCBs and thermal manage-

ment simulation. The software focuses on next-generation connectivity and features advanced tools and easier interfaces for faster and more efficient work. The connectivity features include support for improved computational performance when simulating larger, more complex antennas and their operating environment. The software covers multiple domains, from electrical design to architecture, engineering, and construction (AEC).

Altair

<https://www.altair.com>

Robotics starter kit

Last year, AMD-Xilinx announced the Kria portfolio of adaptive system-on-modules (SoM). Now, AMD-Xilinx is expanding its Kria SoM family with



a new out-of-the-box ready robotics starter kit for software and hardware developers,

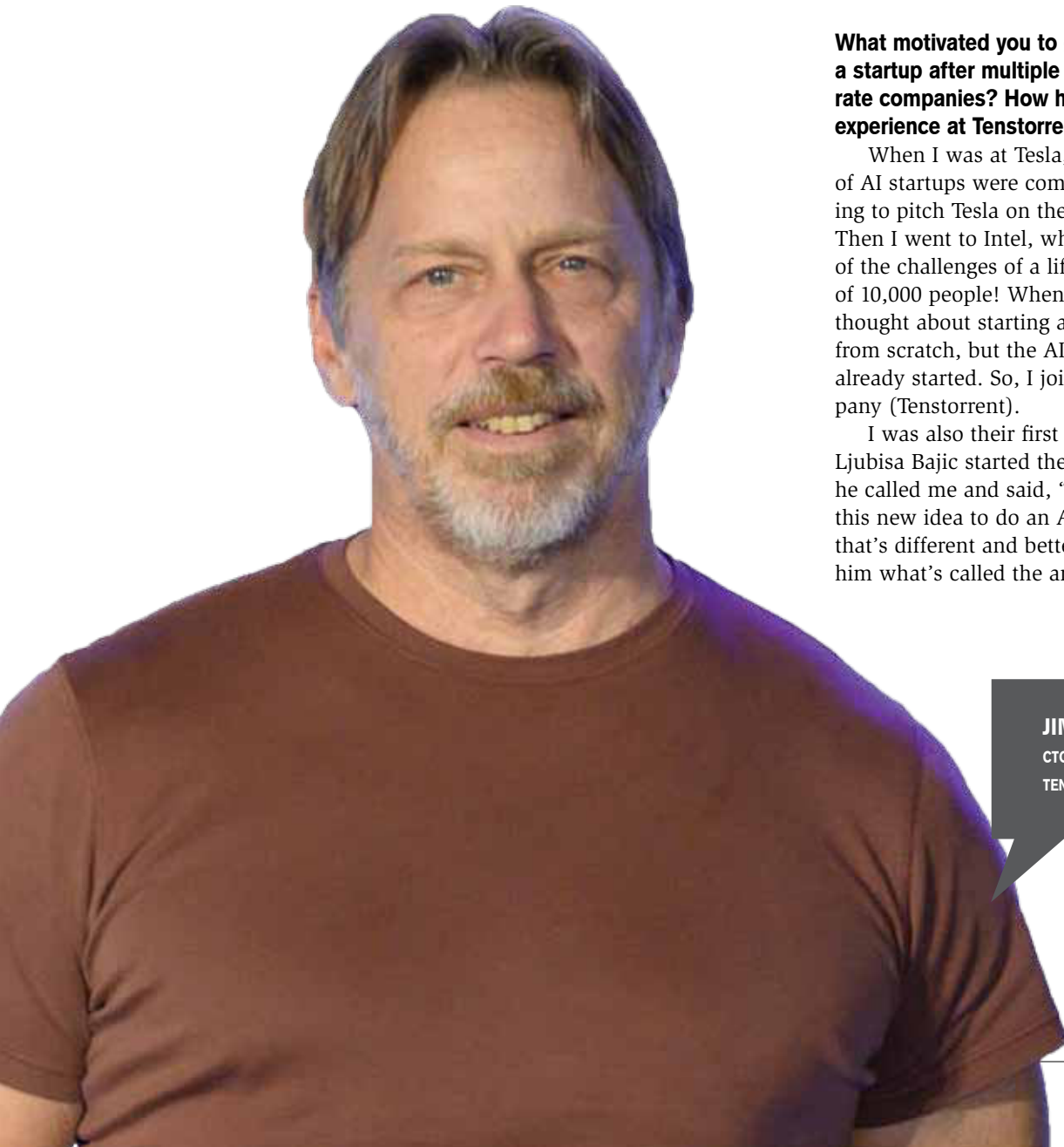
addressing the computational needs of this growing sector. The kit is an end-to-end adaptive robotics platform that promises 5x productivity advantages over GPU based solutions and a simplified design environment for software developers and roboticists with no prior experience with FPGAs. It provides a ROS-centric development environment, and, according to AMD-Xilinx, production-ready accelerated applications may be up and operating in less than an hour.

AMD-Xilinx

Future

“AI COMPUTERS Get EXPENSIVE Very FAST. You Can End Up Spending \$1000”

Over the past few years, a lot has been happening in AI in both hardware and software. We have seen new algorithms, new processing techniques, and new AI chips. Jim Keller, CTO and President of Tenstorrent, an AI startup, sheds light on these cutting-edge technologies in interview with EFY



What motivated you to get involved in a startup after multiple roles in corporate companies? How has been your experience at Tenstorrent?

When I was at Tesla, a whole bunch of AI startups were coming and trying to pitch Tesla on their AI stuff. Then I went to Intel, which was one of the challenges of a lifetime—a team of 10,000 people! When I left Intel, I thought about starting a new company from scratch, but the AI revolution had already started. So, I joined the company (Tenstorrent).

I was also their first investor. Ljubisa Bajic started the company and he called me and said, “Hey, we have this new idea to do an AI processor that’s different and better” and I gave him what’s called the angel investment.

JIM KELLER
CTO AND PRESIDENT,
TENSTORRENT

We thought we could bring forth something unique by combining a really great AI processor and a GPU together in a way no other AI startup was doing.

But for certain reasons, I also took over the business side—operations, HR, and legal stuff. And I enjoyed that kind of work as well. In a small company, you get to do these things from scratch. You get exposed to the details of everything. It's very refreshing. It's a big contrast from a big company.

How are AI programs different from traditional ones?

So, first of all, AI programs are very different from regular programs. In those programs, there's a serial or sequential flow. You have some branches back and forth. You may have many processors, but each one is running threads. It's easy for humans to read it because humans write the code.

AI programs say something like this, "Take some information, represent it like an image or a very long string of sentences, and then multiply it by a very large array of numbers, and then do that a thousand times." As you multiply by the numbers, you're finding out the associations of bad information with previously stored information in some subtle but distributed way. It goes through two steps; you train the model (the set of operations is called a model) and you have an expected result.

Say, I want to complete this sentence, or I want to identify an object in a picture. When you start the model, it has no information in it. So, as you train the model, it starts to understand the relationship between the inputs and the stored information. And that's the AI revolution.

Why do you feel we need to go above and beyond GPUs when it comes to AI processing?

The number of calculations you do in AI programs is very large. As

it turns out, GPUs were better at running lots of math than regular CPUs. GPUs are actually built to run programs on pixels, which are independent. It was not a bad start and, obviously, people had real success with speeding that up.

If you actually look at the code for GPT3—when they trained it, they used five to ten thousand GPUs in a very large cluster. That must have cost something like a hundred million dollars! Also, the program itself is probably just a thousand lines of PyTorch. So, there are more GPUs than lines of code!

TODAY THE AI REVOLUTION IS BIG AND WE'RE GOING TO BRING SOMETHING INTERESTING WITH THE COMBINATION OF GPUS AND AI PROCESSORS

And some of the lines of code, say something like, "Do a matrix multiply that's 10,000 by 10,000"—that's a very large amount of computation. To actually run that program on 10,000 GPUs is very complicated because the GPUs don't just collaborate like 10,000 computers in one big thing. There are multiple layers. There might be about seven to ten layers of software depending on how you define it.

Hence, something different is needed here. For example, one of the things we at Tenstorrent like to do is—you write a thousand lines of code, we have a popular compiler that figures out how to break that problem up on a large number of processors. Our compiler can target from one to many chips. Right now, we're working on the first 256 chips

and we're going to work our way up to 1000, which we think would be an interesting number for these kinds of training problems.

What, according to you, is the right way to balance the power and performance of an AI chip?

Some AI models have very large sections of data. You would think making a really big RAM and putting the processing next to it would work. The problem with that is that every time you want to read the data, it has to read across the big RAM, which is a high-power process.

So, the other way to do it is to take the data and break it into small pieces, and then put the processing next to the small piece. That's how you get the power efficiency of having the data local to the processing, and not having to go so far across the chip—because a lot of power is used in moving data across the chip.

And you want the data and the processing to be local, but you also want enough data there to be interesting from a computing point of view. So, that's one part. The other is that you want the data from one computation to go right to the next computation. You want to keep all the data on the chip and have it move through the pipeline without getting stuck, delayed, or written to memory. So, these two steps make the computation much more power-efficient.

Most AI systems suffer from bottleneck problems. How can one create a perfect sync between data sharing and processing?

Keeping most of the data on-chip would solve this issue. The bottleneck is in the processing, and not the memory. So, at the chip level, we can work around that bottleneck by keeping the data on-chip.

At the higher level, in the long run, this is going to be solved by reading data into AI models and

having these AI models talk to each other, instead of re-reading lots of data over and over. Like when you learn a new thing, you don't re-read all the stuff you've ever learned, right? You keep updating yourself. For example, when you add a word to a language model, it's one word. You don't add all the words you've ever learned. That's a really interesting dynamic.

What are your thoughts on open source software and hardware, especially in AI systems?

Intel, when they built their CPU, became the open hardware standard because they did a very good job of documenting, exposing their instruction set, and providing tools so everyone could use it. Way back, Intel architecture was built by seven different manufacturers. People were willing to write Assembly language programs for that.

Now on GPUs, the low-level instruction set is actually somewhat difficult to use, and the GPU vendors provide all the compiler software. You can write code at a high level and then compile it through the hardware. The GPU vendors actually change their instruction set almost every generation, so the user never sees the hardware directly. Tenstorrent is building the hardware and the software stack both. Now, we're going to open-source that software stack. So, people, if they want to, can go to the hardware level.

Could you elaborate on a few concepts that have come up recently—like Software 2.0 and brain-like execution?

The big idea is, in Software 1.0 people write programs to do things. For 2.0, people use data to train models. For example, you can train a chess program with a billion chess moves. Or you can build a model of chess and a simulator, and then have the simulator compete with itself and slowly learn

what the good moves are.

Where do you get the data for Software 2.0? You could get data from the simulation, from scraping the internet, etc. The data could be images, text, or scientific equations. At the hardware level, we don't really care about where the data comes from. Pretty much no matter what, it turns into these graphs of computations.

You don't want to fill the whole GPU with one big computation. But the way the models on GPUs are written, they essentially do the whole thing. Even in executing AI graphs, you go through the whole graph, no matter what. That's not how your brain works; your brain does lots of small computations. If you're thinking about animals, it fires up one part of your brain. If you're thinking about a book, it fires up a different part. That's called conditional execution.

Do you see AI computing becoming more accessible to the general public than before?

Consumer products are very successful when they're under a thousand dollars right now. Years ago, when an American consumer went to a store to buy a TV, and if it was under \$500, he could just buy it. If it was over \$500, they would go home and research it first and figure out which one to buy. Right now, due to inflation, that number is about \$1200.

AI computers get expensive very fast. You can end up spending \$1000 over a weekend running some models! Many startups are working to make this affordable. For example, Tenstorrent's list price plan for AI processing is to be about 5 to 10 times cheaper than the current market rate. We think that makes it more accessible. On the software side, if we can say we have a model compiling and running easily without requiring five IT people for support, it is more accessible. **EFY**

www.efy.in

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“

Branding is what people say about you when you are not in the room.

”



-Jeff Bezos



TIME TO REMOVE THE TRASH From Space Around Earth

Consequent to increase in number of artificial objects orbiting Earth, collision hazards have become more probable. Spacecraft enabling communication, navigation, scientific, and other missions now share Earth orbit with spent rocket bodies, nonfunctional spacecraft, fragments from spacecraft breakups, and other debris created as a byproduct of space operations. Millions of tiny pieces of junk orbiting the Earth could have a major impact on space. Orbital debris removal has become a very critical part of the commercial and scientific space management. It is an aggregating risk which needs to be addressed to prevent loss of spacecraft to debris collision. This article aims to create awareness about this risk. Innovative techniques have been proposed to solve the problem



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From almost the first moment that man started traveling beyond Earth's atmosphere, all sorts of debris in space has been left. Not only is it wasteful, space junk can be dangerous to satellites, to space stations, and when some of it plummets back to Earth, to human life on the ground.

Two years ago, an 18-ton Chinese rocket plummeted toward Earth and landed in the Atlantic Ocean, becoming one of the largest pieces of space debris to fall uncontrolled back to Earth in recent times. The *Times of India* in their issue dated 11th April 2022 reported that India alone has 103 active or defunct spacecraft and 114 objects categorised as space debris.

Such space debris is composed of spent boost stages, collision fragments, human discards, inactive or defunct

satellites, rocket bodies, ISS construction material, and other parts of spacecraft that have been left behind.

Some space junk results from collisions or anti-satellite tests in orbit. When two satellites collide, they can smash apart into thousands of new pieces, creating lots of new debris. This is rare, but several countries including the US, China, and India have used missiles to practice blowing up their own satellites.

There are estimated to be over 128 million pieces of debris smaller than one centimetre. There are approximately 900,000 pieces from one to ten centimetre in size. The current count of large debris (10cm across or larger) is 34,000.

Space debris is mostly concentrated in the near-Earth space region, in the Low Earth Orbit (LEO) and Geostationary Earth Orbit (GEO) regions. Low Earth Orbit is defined as the region of space around Earth within an altitude of 160 to 2000km wherein a large number of active satellites operate. This causes a substantial operational risk, ranging from the need to perform evasive maneuvers to defects or even obliteration of spacecraft due to collisions with pieces of debris, which at orbital speeds of approximately 7.5km/s can cause considerable damage.

NASA estimates that currently there are some 21,000 pieces of space junk larger than a softball orbiting the Earth



Fig. 1: Since humans first went up in space in 1961, the amount of space junk around Earth has hit a critical point

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

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that can damage a satellite or spacecraft. According to experts, the problem will get worse. By 2025 as many as 1100 satellites could be launching each year. The number of satellites orbiting Earth is projected to quintuple over the next decade.

The estimated 8800 tons of objects that humans have left in space are becoming a danger. Near misses are common these days. In September 2019, there was one near miss between Elon Musk's SpaceX satellite and one from the European Space Agency.

But so far, there has been just one major collision. In 2009, American satellite Iridium 33 and Cosmos 2251, a Russian satellite, crashed, destroying both over northern Siberia. In January 2020, a satellite run by AT&T's DirecTV was found to be in danger of exploding and needed to be moved, or else it could harm other satellites.

In April 2020, the FCC of USA voted to require more disclosures from satellite operators seeking licenses but declined to introduce any new laws governing the removal of orbital debris. Space debris is emerging one of the main threats for an affordable and safe space exploration and exploitation.

Background

One may ask, "What is orbital debris?" Though one doesn't see space junk in the sky, beyond the clouds and further than the eye can see, it enters Low Earth Orbit (LEO), which has become an orbital space junk yard. There are millions of pieces of space junk flying in LEO. Most orbital debris comprises human-generated objects, such as pieces of spacecraft, tiny flecks of paint from a spacecraft, parts of rockets, satellites that are no longer working, or explosions of objects in orbit flying around in space at high speeds.

Most space junk is moving very fast and can reach speeds of



Fig. 2: Lockheed Martin has announced the construction of a Space Fence on the Marshall Islands in the central Pacific Ocean to track and identify space objects

28,000km per hour, almost seven times faster than a bullet. Due to the rate of speed and volume of debris in LEO, current and future space based services, explorations, and operations pose a safety risk to people and property in space and on Earth.

There are no international space laws to clean up debris in LEO. It's very expensive to remove space debris. The NASA Orbital Debris Program officially began in 1979 in the Space Sciences Branch at the Johnson Space Center (JSC) in Houston, Texas. The program looks for ways to create less orbital debris, and designs equipment to track and remove the debris already in space.

In coming years, the number of satellites will increase by an order of magnitude, with multiple mega-constellations made up of hundreds or even thousands of satellites planned for LEO to deliver wide-coverage, low-latency telecommunications, and monitoring services. Space junk is no one country's responsibility, but the responsibility of every space-faring country. The space around our planet is filled with rubbish. It's time to take out the trash!

Innovative strategies

Lockheed Martin announced the construction of a Space Fence on

the Marshall Islands in the central Pacific Ocean to track and identify space objects. Astroscale, a private company in Japan, whose mission is to clean up such space debris, is leading the charge to clean up our space pathways. The Japanese company is currently working with Japan's Aerospace Exploration Agency (JAXA) to carry out the agency's Commercial Removal of Debris Demonstration (CRD2) project.

The JAXA mission plans to complete its first phase by the end of 2022. The goal of the mission is to launch a satellite that will observe and acquire data on the rocket upper stage that the second phase will seek to deorbit. The idea is to find out how the debris moves in space and set up a safe and successful removal.

Northrop Grumman launched its first Mission Extension Vehicle spacecraft (MEV-1) in 2019 to prove it could intercept falling satellites, remove them from traffic, repair them, and put them back in orbit. Swiss start-up ClearSpace, meanwhile, has a more specific goal to remove a 100kg Vega Secondary Payload Adapter (Vespa) upper-stage rocket orbiting around 645km (400 miles) above Earth.

It plans to do that in 2025.

The ClearSpace-1 ‘chaser’ will be launched into a lower 500km orbit for commissioning and critical tests before being raised to the target orbit for rendezvous and capture using a quartet of robotic arms under ESA supervision. The combined chaser plus Vespa will then be deorbited to burn up in the atmosphere.

According to Dr Holger Krag, head of the Space Safety Program Office at the European Space Agency, the agency is looking into using lasers to gently push the objects off the path. Chris Blackerby, Group COO and Director, Japan for Astroscale said, “I think the idea that space debris is an active threat to our current satellite population is becoming more widely accepted.”

NASA scientist Donald Kessler asserted that an exploding chain of space debris can make exploring space and the use of satellites impossible for generations. The fear is that we get to a level of unsustainability of orbit.

An active debris removal mission, if successful, has a positive effect (risk reduction) for all satellites in the same orbital band. This may lead to a dilemma: each stakeholder has an incentive to delay its actions and wait for others to respond. This makes the space debris removal an interesting strategic dilemma. As all actors share the same environment, actions by one have a potential immediate and future impact on all others. This gives rise to a social dilemma in which the benefits of individual investment are shared by all while the costs are not.

To counter this risk, mitigation strategies are now implemented in newly launched satellites.

Following a competitive process, a consortium led by Swiss startup ClearSpace—a spin-off company established by an experienced team of space debris researchers based at Ecole Polytechnique Fédérale de Lausanne (EPFL) research institute—submitted their final proposal.

“This is the right time for such a mission,” says Luc Piguet, founder and CEO of ClearSpace. “The space debris issue is more pressing than ever before. Today we have nearly 2000 live satellites in space and more than 3000 failed ones.

“The need is clear for a ‘tow truck’ to remove failed satellites from this highly trafficked region.”

At Space19+, which took place in Seville, Spain, ESA’s Ministerial Council agreed to place a service contract with a commercial provider for the safe removal of an inactive ESA-owned object from LEO.

Supported within ESA’s new Space Safety program, the aim is to contribute actively to cleaning up space, while also demonstrating the technologies needed for debris removal.

“Even if all space launches were halted tomorrow, projections show that the overall orbital debris population will continue to grow, as collisions between items generate fresh debris in a cascade effect,” says Luisa Innocenti, heading ESA’s Clean Space initiative. “We need to develop technologies to avoid creating new debris and removing the debris already up there.”

NASA and ESA studies show that the only way to stabilise the orbital environment is to actively remove large debris items. The ClearSpace-1 mission will target the Vespa (Vega Secondary Payload Adapter) upper stage left in an approximately



Fig. 3: ClearSpace-1 will be the first space mission to remove an item of debris from orbit, planned for launch in 2025. The mission is being procured as a service contract with a startup-led commercial consortium, to help establish a new market for in-orbit servicing and debris removal

800km by 660km altitude orbit after the second flight of ESA’s Vega launcher back in 2013. With a mass of 100kg, the Vespa is close in size to a small satellite, while its relatively simple shape and sturdy construction make it a suitable first goal, before progressing to larger, more challenging captures by follow-up missions—eventually including multi-object capture.

Other novel concepts

There are many possible means of reducing the debris hazard to future space operations. There is no shortage of concepts for cleaning up the junk we have left behind in orbit, even if some of them seem far-fetched. Here’s an overview of some of the ideas being proposed for cleaning up space debris.

Fig. 4 illustrates a novel concept

for space debris removal by bi-directional momentum ejection from a satellite. When plasmas carrying momentum fluxes F_1 and F_2 are expelled from two axially opposite satellite exits, the respective forces shown by the horizontal arrows F_1 (pointing to the left and providing the acceleration of the satellite with respect to the orbit velocity) and F_2 (providing the deceleration)

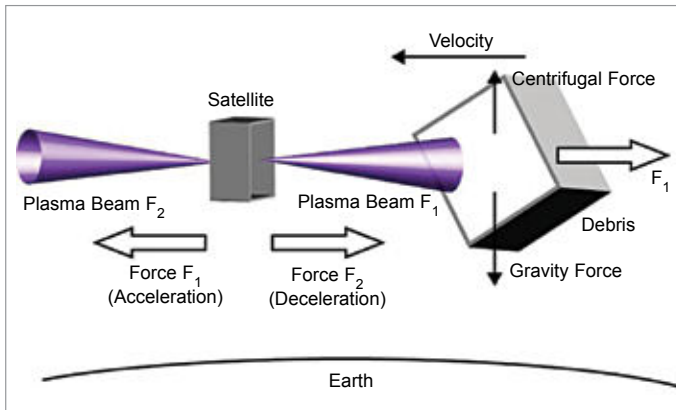


Fig. 4: Space debris removal by bi-directional momentum ejection from a satellite

are generated and used to adjust the satellite velocity relative to the debris. Continuously imparting momentum flux F_1 to the debris (horizontal arrow F_1 pointing to the right) will cause its deceleration, final re-entry into the Earth atmosphere and natural burn up.

Recycling satellites. Instead of just trashing space debris, some dead satellites could be ‘mined’ by other satellites for useable components. DARPA’s Phoenix plan could create new technology to enable harvesting of some valuable components from satellites in so-called ‘graveyard’ orbits. The plan would work to devise nano-satellites that would be cheaper to launch and could essentially complete their own construction by latching onto an existing satellite in the graveyard orbit and using the parts it needs.

Space garbage trucks. The US Defense Advanced Research Project Agency (DARPA) is investing in the Electrodynamic Debris Eliminator, or EDDE, a space ‘garbage truck’ equipped with 200 giant nets, which could be extended out to scoop up space garbage. The EDDE could then either fling the garbage back to Earth to land in the oceans, or push the objects into a closer orbit, which would keep them out of the way of current satellites until they decay and fall back to Earth.

Self-destructing janitor satel-

lites. Swiss researchers at the Federal Institute of Technology have devised a small satellite, called CleanSpace One, which could find and then grab onto space junk with jellyfish-like tentacles. The device would then plummet back towards Earth, where both the satellite and the space debris would be destroyed by the heat and friction of re-entry.

Giant lasers. Using high-powered pulsed lasers based on Earth to focus plasma jets on space debris could cause them to slow down slightly and to then re-enter and either burn up in the atmosphere or fall into the oceans. “The method is called Laser Orbital Debris Removal (LODR) and it wouldn’t require new technology to be developed—it would use laser technology that has been around for 15 years. It would be relatively cheap, and readily available.” The biggest hitch, other than adding more litter to the oceans, is the estimated \$1 million per object price tag.

Space balloons. The Gossamer Orbit Lowering Device, or GOLD system, uses an ultra-thin balloon (thinner than a plastic sandwich bag), which is inflated with gas to the size of a football field and then attached to large pieces of space debris. The GOLD balloon will increase the drag of objects enough so that the space junk will enter the earth’s atmosphere and

burn up. If the system works, it could speed up the re-entry of some objects from a couple of hundred years to just a few months.

Wall of water.

Another idea for cleaning up space junk, from James Hulloper of GIT Satellite, is to launch rockets full of water into space. The rockets would release their payload to create a wall

of water that orbiting junk would bump into, slow down, and fall out of orbit. The Ballistic Orbital Removal System is said to be able to be put into action inexpensively, by launching water on decommissioned missiles.

Space pods. Russia’s space corporation, Energia, is planning to build a space pod to knock junk out of orbit and back down to Earth. The pod is said to use a nuclear power core to keep it fueled for about 15 years as it orbits the earth, knocking defunct satellites out of orbit. The debris would either burn up in the atmosphere or drop into the ocean. It is claimed to clean up the space around Earth in just ten years, by collecting around 600 dead satellites (all on the same geosynchronous orbit) and then sinking them into the ocean.

Sticky booms. Altius Space Machines is currently developing a robotic arm system it calls a ‘sticky boom,’ which can extend up to 100 metres, and uses electro-adhesion to induce electrostatic charges onto any material (metal, plastics, glass, even asteroids) it comes into contact with, and then clamp onto the object because of the difference in charges. The sticky boom can attach to any space object, even if it was not designed to be handled by a robotic arm. The sticky boom could be used to latch onto space debris for disposal. **EFY**

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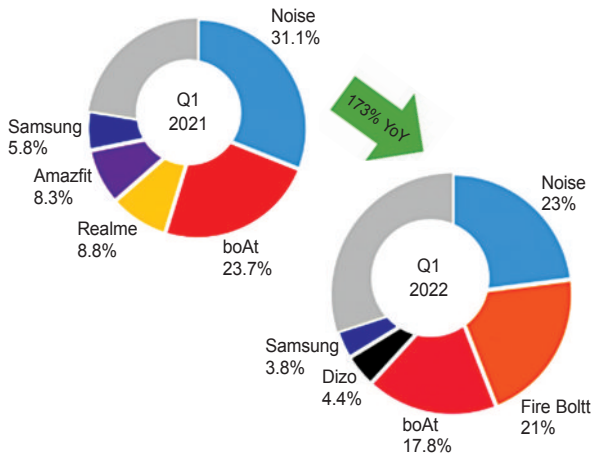
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THE DASHBOARD



India's Smartwatch Market Grew by 173% YoY in Q1 2022

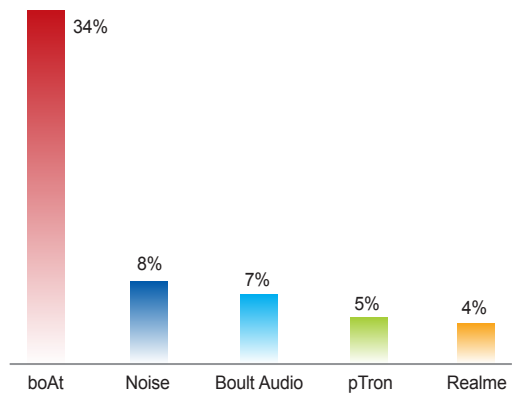
The smartwatch market has consumer interest growing towards it. Noise continues the lead with its shipments doubling YoY. Fire-Bolt takes the second position for the first time with a 21% share. boAt takes the third position, while Dizo enters the top five for the first time. Ten new brands have also entered the market in this Q1.



(Source: Counterpoint Research)

India TWS Shipments Witness 66% YoY Growth in Q1 2022

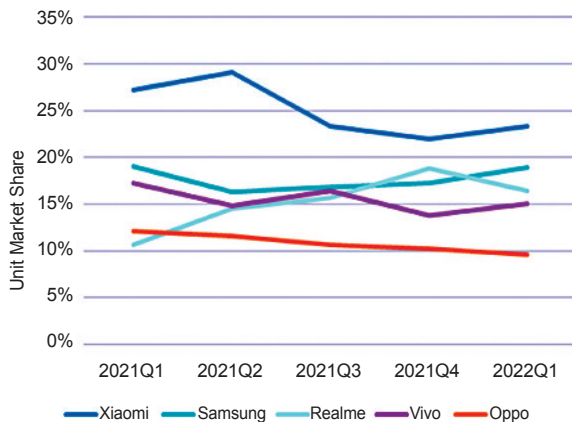
The growth of India's TWS (true wireless earbuds) market was driven by the strong value proposition offered by local brands to outshine the Chinese vendors. boAt led the market for the seventh consecutive quarter, followed by Noise, which maintained its second spot for the second quarter in a row with a 214% YoY growth.



(Source: Counterpoint Research)

India Continues to See a Decline in Smartphone Shipments for Third Consecutive Quarter

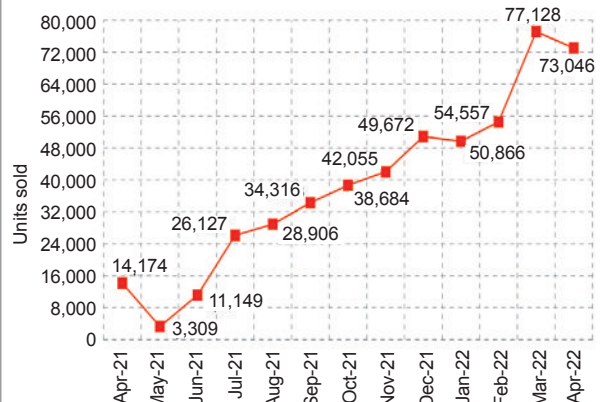
The reasons for the 5% YoY (37 million shipment) decline include tight supplies and rising inflation leading to increasing end consumer prices. Xiaomi continued to retain its top position, followed by Samsung and Realme. Among the top brands, Realme is the only one that has seen positive growth. 5G smartphone shipments contribute to 28% of total shipments. This is expected to increase to 40% by the end of 2022.



(Source: www.idc.com)

India's EV Sales Decline by 5.3% MoM

The overall EV sales in April 2022 declined m-o-m by 5.3% to reach 73,046 units. There was however a y-o-y leap of 415%. EV registrations in April 2022 saw electric two-wheelers and passenger-type electric three-wheelers accounting for 92.92% of total registrations in the month, followed by E-Cars (3.64%), cargo-type electric three-wheelers (3.17%), and so on.

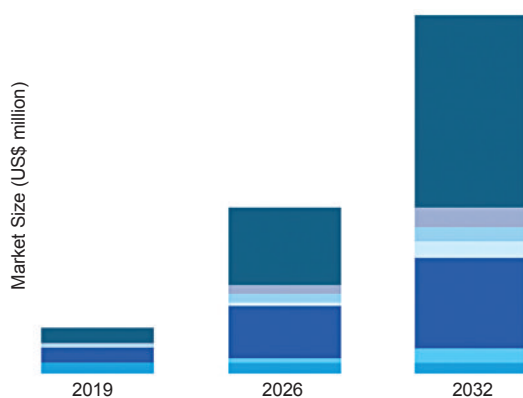


(Source: JMK Research)

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

Service Robots Set to Revolutionise Various Industries

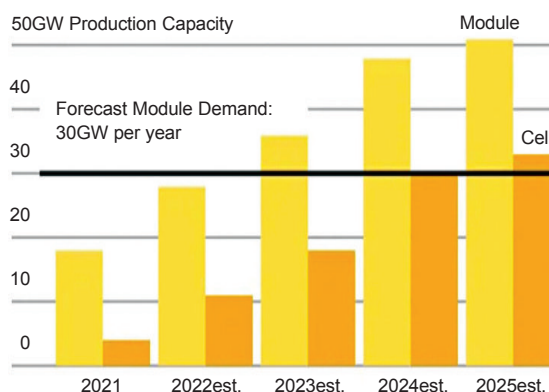
Covid has accelerated some service robot applications, and many authorities have begun to loosen restrictions, allowing utilisation in reality. Working in a well-controlled environment typically leads to low technical complexities and low prices. Therefore, it is not a surprise to see that logistics/delivery robots and cleaning robots have the largest markets and will continue to be in a dominant position over the next ten years.



(Source: www.idtechex.com)

Photovoltaic Manufacturing Outlook

Dozens of companies are trying to make a mark in the Indian solar sector to achieve the national target of 300GW of solar power generation capacity by 2030. The PLI scheme for integrated PV manufacturing along with the 2022 Budget has the potential to produce at least 40GW of solar modules. For raw materials, India relies on imports highlighting the need for a sustainable, solar manufacturing ecosystem. As of today, China accounts for 61% of global solar module manufacturing.



(Source: JMK Research)

Top 10 Companies Holding 57% of Global Semi Market Share (Excluding Pure-Play Foundries)

Rank	1993		2000		2008		2019		2021						
	Company	Sales (\$ bn)	Share	Company	Sales (\$ bn)	Share	Company	Sales (\$ bn)	Share	Company	Sales (\$ bn)	Share			
1	Intel	7.6	9.2%	Intel	29.7	13.6%	Intel	34.5	13.0%	Intel	70.8	15.9%	Samsung	82.0	13.3%
2	NEC	7.1	8.6%	Toshiba	11.0	5.0%	Samsung	20.3	7.6%	Samsung	55.7	12.5%	Intel	76.7	12.5%
3	Toshiba	6.3	7.6%	NEC	10.9	5.0%	TI	11.6	4.4%	SK Hynix	23.2	5.2%	SK Hynix	37.4	6.1%
4	Motorola	5.8	7.0%	Samsung	10.6	4.8%	Toshiba	10.4	3.9%	Micron	20.2	4.6%	Micron	30.0	4.9%
5	Hitachi	5.2	6.3%	TI	9.6	4.4%	ST	10.3	3.9%	Broadcom ¹	17.2	3.9%	Qualcomm ¹	29.3	4.8%
6	TI	4.0	4.8%	Motorola	7.9	3.6%	Renesas	7.0	2.6%	Qualcomm ¹	14.4	3.2%	Nvidia ¹	23.2	3.8%
7	Samsung	3.1	3.8%	ST	7.9	3.6%	Qualcomm ¹	6.5	2.4%	TI	13.7	3.1%	Broadcom ¹	21.0	3.4%
8	Mitsubishi	3.0	3.6%	Hitachi	7.4	3.4%	Sony	6.4	2.4%	Infineon	11.3	2.5%	MediaTek ¹	17.7	2.9%
9	Fujitsu	2.9	3.5%	Infineon	6.8	3.1%	Hynix	6.2	2.3%	Nvidia ¹	10.8	2.4%	TI	17.3	2.8%
10	Matsushita	2.3	2.8%	Philips	6.3	2.9%	Infineon	5.9	2.2%	ST	9.5	2.1%	AMD ¹	16.4	2.7%
Top 10 Total (\$ bn)		47.2	57.2%	–	108.1	49.4%	–	119.1	44.9%	–	246.9	55.5%	–	351.2	57.1%
Semi Market (\$ bn)		82.6	100%	–	219.0	100%	–	265.2	100%	–	444.5	100%	–	614.6	100%

From one fabless company out of the ten in 2008, to five fabless supplier companies in 2021, the top ten companies had sales of at least \$16.4 billion in 2021. Excluding foundries, the two new entrants in 2021 were MediaTek and AMD. These companies have replaced Apple and Infineon in the top ten ranking from last year.

¹=Fabless (Source: www.icinsights.com)



“Silicon runs in my blood”

How often do you find someone willing to give up even the highest of honours, only to build something for his country? Not many. And that too from someone who went from not being able to write well in English to heading a division in one of the biggest corporations in the world? He is an inspiration for many entrepreneurs in the electronics and semiconductor industry and he is striving endlessly to make the dream of the country's many chip design startups a reality by pushing forward the India Semiconductor Mission. This is Dr Satya Gupta's story as narrated to EFY's Siddha Dhar

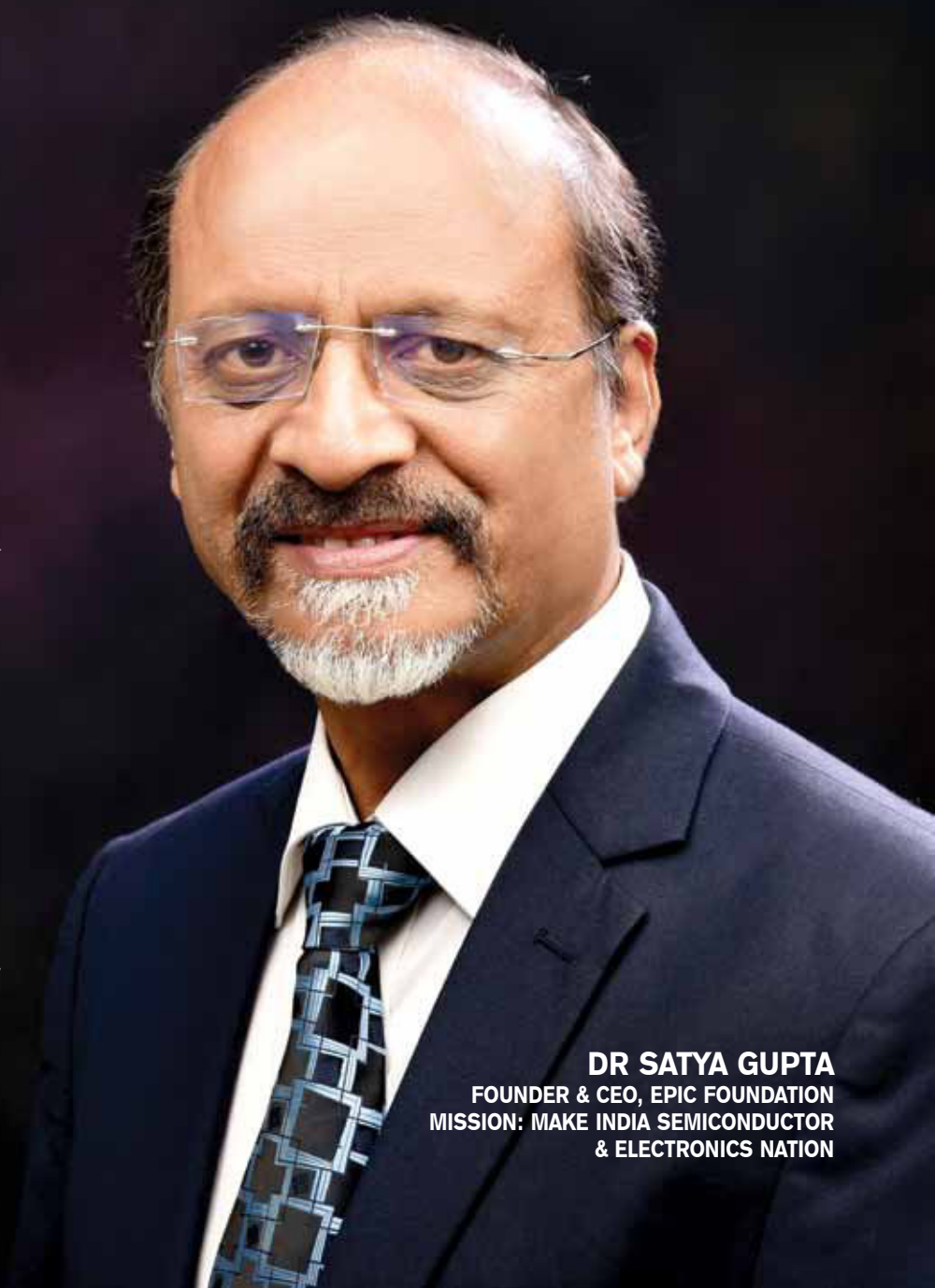
Born in the city of Jaipur, Dr Satya Gupta comes from a family of eight with five siblings. His father worked in the Income Tax Department and mother was a homemaker.

Fascination with carpentry, BITS Pilani and the struggle with English

While he is currently pioneering the development of the semiconductor industry in India, Satya's tryst with building things started from an early age. "I was fascinated by the work of carpenters. They would finish their work and leave their tools behind, and I would ransack those tools and use them to make something useful."

He would spend hours looking at the carpenters chopping wood and sculpting it to make something out of it. Looking back, Satya believes it was this interest in seeing things getting built from scratch that helped develop his interest in electronics and semiconductors later in his life.

After finishing his schooling, Satya looked to pursue an engineering degree from one of the premier institutes in the country—BITS Pilani. And that is when the trouble



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began. “I came from a Hindi-medium school background and was not very well-versed in English. Fifteen of us from the same school got into BITS Pilani together and none of us could speak in English fluently!”

Being part of an institute like BITS, where students came in from all over the country and were fluent in English, language was a huge barrier for Satya in the initial days. He remembers how he would take down English notes in Hindi. “Once, during placements, a recruiter asked me what Osmosis was. I said ‘Sir, I don’t know what Osmosis means. If you can translate it for me in Hindi, then I can give you the answer’,” he laughs.

But not one to be bogged down by challenges, Satya quickly caught up with the others as he slowly and steadily learnt the language with the help of his peers. Whether it was teamwork, the importance of perseverance, or dedication and hard work, Satya credits his time at BITS Pilani with having helped build a different set of personality traits in him, which would otherwise not have been built.

Interestingly, while most final-year students eagerly wait for place-

Dr Satya Gupta’s Career Chart

- 1978** - Joined BITS Pilani
- 1983** - Joined IIT Delhi as a research assistant and received MTech
- 1988** - Went on to pursue his PhD from Old Dominion University in the USA
- 1992** - Joined Intel Corporation and became Director, ASIC Design, Intel Micro Electronics
- 2003** - Started his first venture – Open-Silicon
- 2005** - Co-Founded IESA
- 2009** - Started his second venture – Concept2Silicon
- 2012** - IESA Chairman for 2012-2013
- 2015** - Started his third venture – SenZopt Technologies
- 2018** - President, VLSI Society of India
- 2020** - Chairman, IESA for 2020-2021
- 2021** - Started EPIC Foundation along with Ajai Chowdhry and Arjun Malhotra, both HCL Founders
- Current Mission** - Self Reliant Semiconductor & Electronics India

ments to take place, Satya had his eyes set on a different prize. It was a time when placements were not as structured as they are now, but companies like TCS, which provided high packages, were dream companies for students. But not for Satya.

Refusing to move with the crowd, Satya chose to pursue a different path for himself by opting for a Research Assistant position at IIT Delhi, where his first real interest in semiconductors began. Joining a project under the renowned Prof. Anshul Kumar, Satya learnt the intricacies of silicon while working at IIT Delhi, where he also obtained his master’s degree.

“I met a lot of fantastic people there and learnt a lot while working with tech-savvy people who helped me in understanding the complexities of tech.” And with these learnings in his heart and mind, Satya was ready to come yet another step closer to strengthening his relationship with silicon.

Love for teaching and moving to the USA

In 1988, while supercomputing was taking the technology world by storm, Satya decided to further his knowledge of technology

by moving to the United States to pursue his PhD at the Old Dominion University.

Living so far away from home in a different country with different cultures was a trying period for Satya. In a time when a one-minute call cost \$3, Satya tried hard to save his paltry student stipend and instead wrote letters back home. He also learnt how to cook Indian dishes as he tried to ease his homesickness and settle down in the United States where vegetarian food was a rare sight. He quickly became the go-to-guy if any student wanted to eat fresh *chapati* or *paratha*.

Satya, however, did not stray away from his desire to learn. He spent four years in Virginia, where he spent two years as a research assistant at NASA Langley Research Center, where he deepened his understanding of supercomputing.

During this time, Satya also took note of his love for teaching. “I always loved teaching people. I was always helping fellow students, clearing their doubts, and helping them with their assignments. I would spend time clearing their doubts and then go to my room to study at midnight.”

Hailing from Rajasthan, a state known for its harsh summers, the severity of the winters in the USA was not something that Satya was familiar with. One day, after attending a conference in Chicago during peak winter season, with no suitable winter clothing, Satya walked



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Leaving for US for PhD

back stopping every fifty metres at a shop to warm himself up. While that day changed Satya’s perception of the winter in America, it was also the day he was properly introduced to someone who would become a lifelong friend, mentor, and business partner.

Journey with Intel and return to India

Soon after finishing his PhD, Satya joined one of the giants in the semiconductor industry—Intel Corporation—while they were just starting out their supercomputing division. He recalls, “Before they became famous for their iCore and Pentium processors, Intel was looking to make supercomputers using their own processors. I joined in to help develop breakthrough technology.”

Those two years working on building supercomputers were the most satisfying and important part of his career. Satya says, “I learnt a lot while at Intel—the values of creating an organisational structure, values of disciplined engineering, attention to detail, delegation which nobody teaches you. You learn by

being part of the process.”

“We were working on ground-breaking technology. We developed the fastest computer at that time and broke the teraflop barrier in a single machine. Nobody had been able to do that before. We were 2.5x faster than the previous fastest computer,” he continues.

After working on supercomputers for two years, Satya moved on to become part of the Strategic Cad Labs at Intel, where he spent another four years. Intel was also where Satya worked very closely with the man he met while attending the Chicago conference—Naveed Sherwani.



Dr Satya Gupta with Dr A.P.J. Kalam

A fine morning in 1999, Naveed came to Satya with a proposal of starting a new initiative at Intel to build ASICs. A precursor to Intel’s Foundry Services initiative today, the goal of this new initiative would be to create chips for any customer. And thus, under the leadership of Naveed and Satya, Intel Microelectronics Systems (IME) was formed. But six months into the implementation of the initiative, they realised they need to build capabilities in India to help them grow this venture.

This was a period when Satya’s career in the USA was flourishing by leaps and bounds as a semiconductor leader. From being a young student at BITS Pilani, who struggled with English, he now held the esteemed position of Director, Intel at the headquarters—a position many professionals aspire to reach. But fancy titles did not tempt him as much as the desire to contribute to building his country did.

“I thought it was the right time and I always wanted to do things for India in India,” he recalls.

And within a week’s time, Satya packed his bags and left everything behind to come back to India to build Intel Microelectronics Systems.

Back in India, Intel’s operations had very limited chip design activity. As such, Satya and his team were only provided with a small

office on Infantry Road in Bangalore to work. Even then, Satya made the most of the situation, focusing on building the expertise of the team.

Satya says, “This team has produced some of the biggest names in the industry who have gone on to become VPs and MDs of global chip companies.” Heading the production of something so important allowed Satya to be involved in the intricacies of end-to-end

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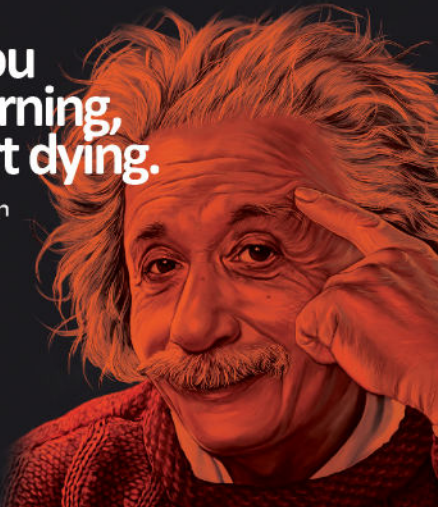
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chip designing.

Satya comments, “Chip design is an extremely difficult process, and one mistake can cost you millions. Making it work after months of pouring in your sweat and tears is so satisfying. You have to live and breathe silicon. Which is why I say that silicon runs in my blood.”

But with his arrival in India, something bigger was waiting for Satya.

Beginning to startups

After toiling for years for the IME, in 2003, Intel decided not to pursue ASICs business. Satya saw this as a chance to do something more, out of the bounds of being tied to a corporation. “We built a beautiful model to build ASICs and we used to call it an Open-Model of chip design. So, we deliberated and decided to do this independently.”

And thus, despite having all the abilities to move up the ladder of professional success at Intel, Satya decided to leave as Director from the corporation—a place where he had his first and last corporate job. On being asked why he chose the tough road of startup and leaving a comfortable position at the world’s biggest MNC, Satya says that it was his desire to build something from scratch, much like the carpentry he adored in his childhood.

He says, “I wanted to do something in India for India.” But most importantly, like a true leader, he wanted to build a team and see them grow. “Seeing them become a VP or a Director gives immense satisfaction, telling me that we did something right because of which



Dr Satya Gupta receiving Open-Silicon GSA Award

so many people are growing in the industry.”

With this in mind, Satya started his first venture—OpenSilicon—along with Naveed Sherwani. While Naveed was in Portland, Satya was in India. They now had to make a commitment.

“We knew that if we wanted it to take off, we’d have to start in the Silicon Valley. We packed bags and decided to give us three months to find funding, otherwise we would go back and find new jobs.” During this time, they spent nights at hotels for \$30 a night and ate meals for 1.5 dollars, just to save every penny they had and put it into their company. Luckily for both the co-founders, they succeeded in bagging funding from some of the top VCs, Sequoia Capital, Norwest Venture Partners, and Goldman Sachs, in just two months of setting up shop in the USA.

But for a person who just escaped the constraints of working in a large corporation, the reality of building a startup with their own resources soon started to catch up. He says, “When you work in an MNC, you tend

to take a lot of things for granted. Even things like HR, finance and infrastructure become a big deal to take care of when you are building a startup. Money also has to be spent judiciously since it is not company funds anymore, but your own money or funds.”

One space where Satya made sure OpenSilicon strived for the best was the team. Onboarding not just the big shots in the industry, Satya wanted to get people who had the zeal and drive to make something happen. He opines, “In a startup, you have to get employees motivated to work.”

Channelising the teacher in him who taught peers in college, Satya imbibed it into his team building and leadership style. He would sit down to tape-out chips along with his team, despite being the co-founder of the company. “You need to sit down with them and get down to business. Work in the trenches with them as a team member instead of supervising them as a manager because that is not going to motivate your team. Sitting down with them makes the biggest difference instead of a few lofty words. It builds a bond that shows in the work.”

This zeal to build the team also

Top-5 Professional Moments

1. Receiving Best Semiconductor Company award from Global Semiconductor Association (GSA) for Open-Silicon
2. Receiving IEEE Gordon Bell award for breaking tera-flop barrier first time and the fastest supercomputer at Intel
3. Completing 150 tape-outs and shipping first ten million
4. Open-Silicon acquisition for \$245 million
5. Foundation of India Electronics & Semiconductor Association



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Son Abhishek after graduation

helped Satya and his team bag the award of Best Silicon Design team from EE-Times. Notably, this is just one of the many awards OpenSilicon, under Satya’s leadership, won for its remarkable work.

After working on OpenSilicon for more than four years, the company was acquired in 2007 for \$245 million, marking it as one of the biggest exits in the chip industry.

Satya went on to start two more ventures—Concept2Silicon and SenZopt Technologies. While Concept2Silicon had a similar idea as OpenSilicon, which was to design ARM-based chips, it was acquired by HCL Technologies. SenZopt dealt with sensors and IoT solutions for automating buildings and turning them into smart buildings.

Satya’s association with Intel, however, was far from finished. “I have worked with Intel for one project or the other in every startup of mine,” he says. Even though he held the senior-most position in his ventures, Satya is someone who does not shy away from doing the dirty work, and quite literally so.

In 2008, Intel wanted to build a fully automated parking facility in Bangalore and SenZopt

was roped in to handle the work. “We had to install the sensors at a multi-storey parking lot while the construction was going on, and for 3 months, along with my co-founder Chitra Hariharan, we worked in that dust and rubble for 16 hours, doing the installation and completing work in time.”

Such is Satya’s commitment to work! But Satya humbly adds, “The commitment is needed but more than that, the willingness to get down in the trenches and do it is what is very important.”

In 2019, SenZopt was acquired. Parting with a startup as a founder is undoubtedly one of the toughest things to do. It is like your baby, but Satya believes that as long as it does good, it does not matter whose hands it is in. “Just like your child

needs to go out and learn from others to grow, a startup acquisition is a push for that idea to blossom which you began it with. It is not the money that matters, pursuing an idea does.”

Building the core of India’s electronics industry

Satya’s love for his work translated into doing something big, but he was not satisfied with those efforts. He wanted to help propel India as one of the global leaders in electronics and semiconductors, which he slowly started doing.

Satya says, “When I moved to India, after a couple of years we felt that there was no platform for semiconductor companies in India. So, a few of us got together and started the Indian Semiconductor Association.” This association grew on to become the Indian Electronics and Semiconductor Association (IESA), one of the biggest industry associations in the electronics industry. “We realised that electronics cannot work without semiconductors which is why we changed it to IESA.”

Satya is currently the President of the VLSI Society of India, an association helping to grow Indian R&D and talent in semiconductors and chip design. Many of these efforts of Satya and others, right from the early 2000s, have resulted in the India Semiconductor Mission—a mission aiming to make India grab a seat at the global chip design and manufacturing table.

But building a strong chip ecosystem is not enough. “Products drive manufacturing rather than manufacturing driving products.” With this in mind, Satya along with two HCL founders, Ajai Chowdhry and Arjun Malhotra, began the EPIC Foundation—a consortium of leaders aiming to drive electronics product development in India and build Indian brands.

Satya makes sure to not let his

Some Unknown Facts About Dr Satya Gupta

- Favourite Singer** : Kishor Kumar
- Favourite Actress** : Madhubala
- Favourite Actor** : Rajesh Khanna, Anupam Kher
- Favourite Leader** : Narendra Modi, Andy Grove
- Favourite Cuisine** : Indian
- Favourite Book** : Premchand, Harry Potter
- Favourite Movie** : Guide, the original Jungle Book
- Favourite Sport** : Cricket
- Favourite Bike** : Royal Enfield Classic-350

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passion for teaching die. He is a visiting faculty at IIT Roorkee and other academic institutions. But Satya refuses to take a permanent post. He says, "I felt I will not be suitable for regular teaching. I would rather guide them toward the right kind of technology and the right kind of design expertise rather than teaching a semester-long course."

Finding love at IIT, keeping up with hobbies and retirement plans

Satya might be a trailblazer in the semiconductor industry, but he is a romantic at heart. He has been married to his wife for 32 years now. Although it was a love marriage, it has had its twists and turns, just like every aspect of Satya's life. Satya and his wife were working on the same project at IIT Delhi, and while there, they developed a close bond as friends. He recalls, "We were very close. It reached a point where she and a couple of my friends were trying to find a girl for me!"

They ended up in the U.S. together when both Satya and Madhurima went on to pursue their PhDs. His wife was a strong support system for him there, and it was during a meeting with their advisor that they realised that what they had could not be dismissed as just friendship. He says, "Our advisor told us: You guys must be mad. You are so close, why don't you try being in a relationship."

These words resonated with the couple, who soon decided to tie the knot. But since his wife was a Bengali, Satya had some convincing to do at home. "They eventually agreed and we got married in a Hindu-Bengali wedding in 1990, while I was two years into my PhD," Satya recalls.

His wife is also in the

Satya's Learnings from being A Serial Entrepreneur

- Don't build anything that you can't sell. Coming from the technology field, we have this notion that technology is everything in a startup, which is not true most of the time. No matter how good your technology is, if you can't sell it then it is of no use.
- Not every CTO makes a good CEO. You might think that it is your idea so you should be the CEO, but you may be more suitable as a CTO since the CEO is also your Chief Sales Officer and Chief Spokesperson.
- People buy products, not just technology. Focus on product engineering and product marketing. If your product has a global look and feel, half your selling is done anyway.

chip design industry but she quit her job in Qualcomm a few years ago to teach underprivileged children at an NGO based in Bengaluru. The couple have a son, Abhishek, who is on his way to becoming a faculty member at the University of Washington at Seattle.

Despite handling multiple fronts of multiple organisations, Satya finds time to keep up with his varied interests and hobbies. His love for carpentry still prevails. "When I was in the USA, I used to watch a TV show, The New Yankee Workshop, on carpentry, after which I bought a few carpentry tools and started building furniture myself. When we shifted to India, half of the luggage consisted of woodworking tools!"

Satya is also an avid painter. While he was interested in charcoal sketching initially, digital painting has been his recent hobby. If all this

was not enough, Satya also enjoys music—although he says he does not have the voice to sing—and knows how to play the keyboard.

For a person handling so many fronts successfully while also keeping up with his interest, we had to ask—when does Satya plan to rest? "I have no retirement plans," he concludes. "If I do not work, what will I do? I can pursue my hobbies, but if I do not do something professionally, I don't think I'm going to enjoy it. I want to keep working till my mind and body works."

Showing a glimpse of his impeccable commitment to his craft, Satya refuses to work for money anymore. "I only want to work on a pro-bono basis, I opt-out if someone offers me money."

Having spent so many years building multiple startups and working tirelessly on a common mission, what is something Satya would like to say to his younger self?

"I'd say, be committed to whatever you're doing. If you are committed to whatever you are doing, it will make everything better. Whenever opportunities come, take judicious risks, because risks are going to be there whenever you want to do something special. Also, don't make decisions based on work-life balance—your decision should be based on your commitment to your profession and then focus on having a balanced lifestyle." **EFY**



Man, woman and child—A painting by Dr Satya Gupta

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EVOLVING MOBILITY LANDSCAPE Set to Boost AUTOMOTIVE ELECTRONICS MARKET In India

Engine control unit, EV/HV, HVAC, infotainment, and lighting account for 95% of the automotive electronics demand in the country. Government initiatives, such as the Automotive Mission Plan, which aims to produce 940 million vehicles by FY26, are expected to generate significant demand for automotive electronics over the next five years. According to Frost & Sullivan, the Indian automotive electronics market has the potential to generate revenue of \$9.2 billion by 2025



RUDRANIL ROYSHARMA is Director, Energy & Environment Practice at Frost & Sullivan

The automotive industry in India is transforming because of its sustained growth and profitability. Indian automotive industry currently accounts for 7.1% of GDP and 49% of manufacturing output, generating 32 million direct or indirect employments. Based on the Automotive Mission Plan 2019-2026, a collective vision of the government of India and the Indian automotive industry, the sector is expected to employ 36 million people by 2026,

according to the Automotive Skill Development Council.

The industry has made a strong recovery in CY2021, with the passenger vehicle segment registering a record 26% Y-O-Y growth, as per the Society of Indian Automobile Manufacturers. The Indian automotive market, particularly the passenger vehicle segment, is expected to grow at a CAGR of 10% to 12% (as per CRISIL) over the next five years. This will be driven by increasing urbani-





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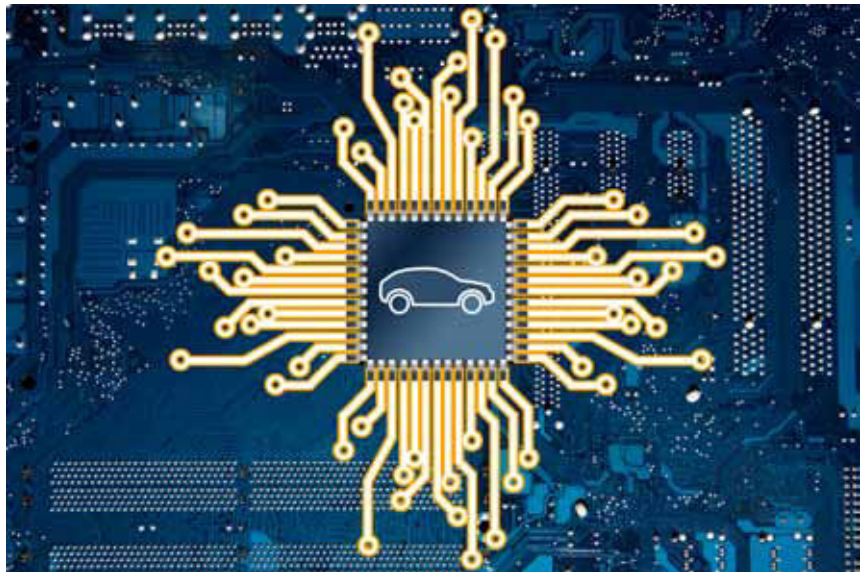
sation, higher disposable income, expanding domestic customer base, favourable demographics, supportive infrastructure, and increased foreign investment.

The landscape of the Indian automotive industry is changing rapidly with emerging business models and trends, such as connected, autonomous, shared, and electric (CASE). Technologies that support the shift toward connected, autonomous, and electric vehicles, along with customer-centric parameters, such as user experience and infotainment, are expected to boost the demand for automotive electronics in the coming years.

According to Frost & Sullivan, the Indian automotive electronics market has the potential to generate revenue of \$9.2 billion by 2025. Body control module (BCM), anti-lock braking system (ABS), in-care entertainment system (ICES), tire pressure monitoring system (TPMS), telematics, and battery management system (BMS) are some of the prominent technologies that will drive this market. About 65 to 70% of India's demand for automotive electronics is currently met through imports.

Various measures and policy incentives have been announced in recent years to boost the domestic electronics system design and manufacturing (ESDM) and strengthen the domestic automotive electronics manufacturing ecosystem. Customer expectations, regulations, and evolving mobility infrastructure are the drivers.

Evolving customer expectations. Indian automotive industry continues to evolve with increasing customer expectations from products, price sensitivity, shorter product life cycles, frequent changes in product ownership, focus on safety and entertainment features, and personalised experiences. Next-generation digital solutions will play a pivotal role in this transformation, which



will drive the automotive electronics business.

Regulatory interventions. India's vehicle safety standards have improved noticeably in recent years with next-gen technologies, such as the advanced driver assistance system (ADAS), expected to be introduced soon. Government safety standards, such as AIS 145, the adoption of telematics systems, and consumer demand for safer vehicles, will act as a catalyst for increased adoption of automotive electronics in India in the future, with estimates indicating that safety, ADAS, and infotainment will account for 60% of this demand.

Changing face of mobility infrastructure. Technologies like self-driving vehicles revolutionise the mobility sector. The development of alternative means of transportation and smart infrastructure (smart cities, parking optimisation, AI-driven traffic lights, and enabling EV-charging infrastructure) is expected to transform India's mobility infrastructure and generate the business potential for automotive electronics industry.

Next-gen technologies

Multiple next-gen technologies will be commercialised over the next

4-5 years. The passenger vehicles segment is expected to contribute two-thirds revenue of the Indian automotive electronics market. This would be driven by the increasing usage of the telematics control unit (TCU), infotainment, electronic control unit (ECU), onboard diagnostics (OBD), and anti-lock braking system (ABS). Head-up display (HUD), blind-spot detection, advanced driver assistance systems (ADAS), auto-dimming mirror, and automatic transmission features will remain mainstream for the premium segment cars.

Advancements in electronics for various vehicle components will require the installation of electronic control and communication systems. Advanced electronic systems should be directed to operate active safety features like dual airbags, electronic stability control, advanced braking systems, and tire pressure monitoring systems. Stringent regulations, such as Corporate Average Fuel Efficiency II and Bharat Stage-VI, are also significant drivers of the rising electronic content in a car. The government's focus on promoting electric mobility through various policy measures will propel the demand for automotive electronics in the coming years.

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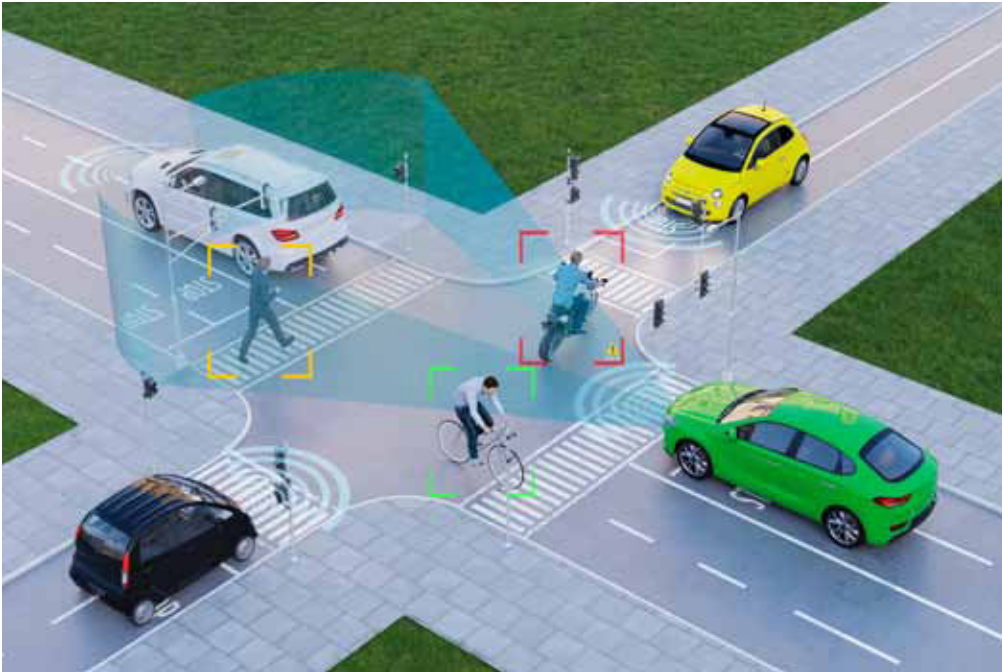
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try through incentive schemes. Incentive support is being provided to companies/consortia that are engaged in silicon semiconductor fabs, display fabs and compound semiconductors/silicon photonics/sensors (including MEMS), fabs semiconductor packaging (ATMP/OSAT) and semiconductor design (design linked incentive or DLI).

PLI for IT hardware and large scale electronics

Production linked incentive (PLI) schemes

The Internet of Things (IoT) would be crucial for vehicle connectivity. The connected vehicles capable of communicating with the surrounding environment will lead to the emergence of new-age business opportunities through connected data. These enabling technologies for futuristic vehicles will be commercially available in the next 4-5 years.

The two-wheeler segment will also witness increased adoption of electronics in the future. The three-wheeler segment is a laggard in the adoption of electronics. Embedded telematics and infotainment offerings are occasional in the three-wheelers category and are expected to remain the same over the short to medium term.

Domestic capacity building

Domestic capacity building would be a key to tapping this potential. Indian suppliers have built a strong capability in hardware manufacturing, forging, and machining of the components but are comparatively new in electronics design and manufacturing. As a result, majority of the demand for automotive electron-

ics is met through imports, primarily from China, Taiwan, and Korea.

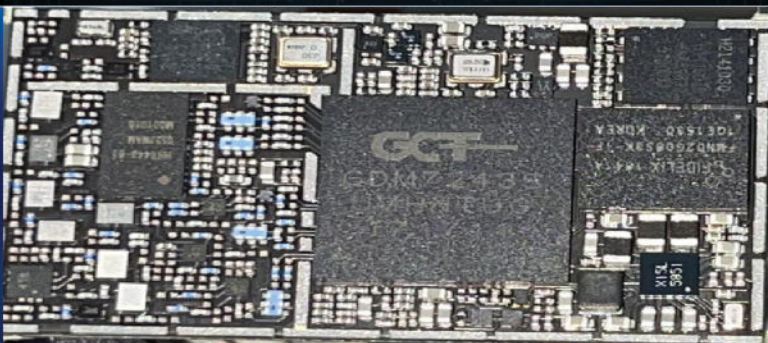
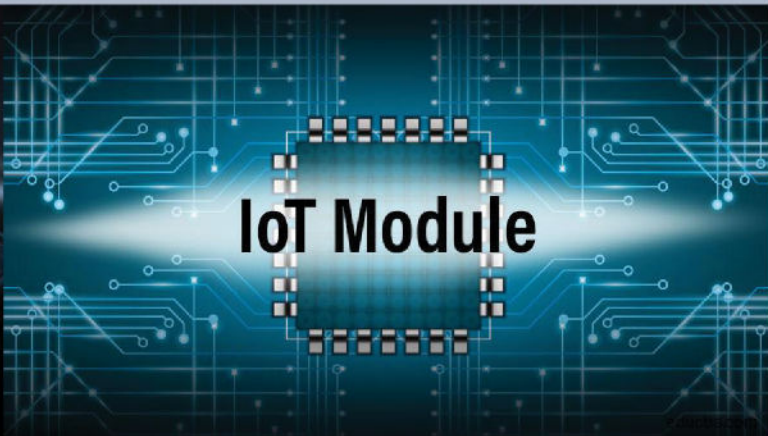
The top five products, namely, engine control unit (ECU), EV/HV, HVAC, infotainment, and lighting, account for 95% of the automotive electronics demand in the country, according to Frost & Sullivan's analysis. Government initiatives, such as the Automotive Mission Plan, which aims to produce 940 million vehicles by FY26, are expected to generate significant demand for automotive electronics over the next five years.

The National Policy on Electronics (NPE 2019) aims to position India as a global hub for electronics system design and manufacturing (ESDM) by encouraging and driving country capabilities to develop core components, including chipsets, and create an enabling environment for the industry to compete globally. The NPE 2019 also envisions the creation of a vibrant and dynamic semiconductor design ecosystem in the country by incentivising the start-ups and making design infrastructure accessible to them.

Towards this, the government has promoted the entire ecosystem of the Indian electronics indus-

will boost investment in the entire value chain of the Indian electronics industry, including designing, ensuring local availability of components (ICs, chipsets, systems on chip, systems or IP cores, etc), and make Indian electronics industry more self-reliant and export-oriented. Developing the local manufacturing ecosystem will strengthen the local supply chain, thereby improving time to market, reducing lead times, saving precious foreign exchange, reducing component and logistics costs, and making electronics products more affordable in the coming years.

Electronics manufacturers can now focus on improving capabilities in such areas as PCB manufacturing techniques, SMT based automated production lines, ESD precautions in handling electronic components, in-circuit testing procedures, and PLC based automated techniques, to name a few. Additionally, Indian manufacturers need to build superior capability in hardware design, testing, software integration, in-vehicle networking, and Simulink tools for creating and simulating interface systems. **EFY**



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Opportunity For COMPONENTS INDUSTRY In Telangana's SpaceTech Framework

The state of Telangana's new policy getting ready, SpaceTech Framework, holds a great promise for the development of specialised components required for the high-tech sector. The state government is going all out to support the sector. Read on to find out how, and the new opportunities that are likely to arise as a result

Telangana government launches SpaceTech Framework on metaverse
(Credit: <https://indiaheadnews.com>)



ADITYA PAREEK is a researcher and analyst working on high-tech geopolitics and strategic studies

The state of Telangana introduced a new policy document called SpaceTech Framework online on 18th April. It had virtual participation of ISRO Chairman S. Somnath, Niti Aayog CEO Amitabh Kant, and India's space sector regulator IN-SPACe Chairman Pawan Goenka, along with Telangana's IT Minister KT Rama Rao.

The policy's key focus, as the name suggests, is nurturing space technology industry. However, the policy pays due regard to other related sectors as well, both upstream

and downstream, to enable the high-tech industry. As with any high-tech industry, SpaceTech can only exist with a reliable supply base for the required electronic components.

Synergising the value chain

In the document, the government of Telangana has identified a 'space market value chain,' which includes everything from identifying end users to the upstream manufacturing sub sectors. To enable this value chain, the policy suggests public private partnerships. These partnerships will involve the sharing of expensive high-tech testing and R&D facilities between government institutions and small private players that cannot afford to set up their own.

Some specifically identified institutions in the policy for such a prospective R&D and testing facilities sharing arrangement are Electronics Corporation of India Limited (ECIL) at Hyderabad, International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI), and Defence Research and

Development Organisation (DRDO).

The policy is likely inspired by India's 2020 private space sector reforms. Under the reforms, India's space sector regulatory body IN-SPACe was set up. Among its many other tasks, IN-SPACe is to offer and streamline access to ISRO's infrastructure and testing facilities to India's emerging private space companies. Cooperation and infrastructure sharing across R&D and testing will be a shot in the arm for lowering entry costs and maximising efficiency. However, how seamless would the access to R&D and testing facilities be for the intended MSMEs and startups remains to be seen.

As a broad objective, the policy seeks to attract global investment and partnerships as well as boost space-related manufacturing in the state. This will naturally extend to component and subassembly suppliers too and likely include manufacturers and suppliers that can provide microelectronics and ICs that meet the stringent specifications necessary for the extreme physical condi-



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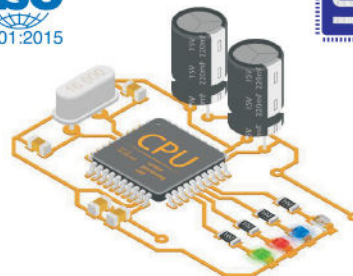
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tions of outer space.

The government of Telangana plans to provide land at subsidised rate in strategic locations for setting up ground based satellite tracking stations. These tracking stations will require a plethora of customised high-tech components and parts for operation, which would be an additional niche to fill for the Indian electronic components industry.

Telangana is also setting up a ₹13 billion fund to support startups under its Information and Communicational Tech (ICT) policy, which already provides incentive for setting up electronics design and manufacturing units in the state. With space tech focused applications being specifically encouraged, some companies could start specialising in the components and parts required for it. The required components have to operate in extreme environment encountered in outer space or the deep sea, where extreme variable pressure, lack of gravity, and high radiation levels make regular components fail. This highly specialised design and manufacturing capability can give India a strategic edge and possibly make it a global supplier.

Government of Telangana also plans to support individuals and startups with intellectual property (IP) development and preservation by providing advisory services in filing patents and ensuring legal compliance, both domestically and internationally. Securing their IP is a major concern for companies of all sizes operating in the high-tech space. And if state support can streamline the process, it can help many small players save significant legal consultancy and litigation costs.

The synergising efforts also extend to the insurance, banking, and financial services sectors that, as the policy states, have a historical “disconnect with the SpaceTech ecosystem.” The policy highlights the need for a better understanding in analysing the risk associated with building and operating big-ticket items, such as privately owned and built space launch vehicles and satellites. This will enable insurers to provide appropriately priced solutions for regulatory compliance and general safety norms. There is a close overlap between the insurance and associated claim investigations and certification expertise needed for offering such solutions in India and upskilling workforces.

The policy pegs skill development, training, and facilitating research and innovation as an important fulcrum. Telangana hopes to support R&D partnerships across academia, public sector units, international bodies, and industry with grants, fellowships, and infrastructure. However, if this effort is concentrated in developing key expertise in manufacturing and certification across sectors like composite materials, silicon photolithography processes, and packaging and testing ICs, there would be much quicker and meaningful dividends for the state and country's economy. **EFY**

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STARTUPS

& INNOVATORS

1 Making India The Hub For Quantum Cybersecurity

2 Making Metal 3D Printers More Accessible

1 MAKING INDIA THE HUB FOR QUANTUM CYBERSECURITY

QNu Labs, pronounced as Q-New, is India's only quantum-tech cybersecurity company. It is trying to reimagine cybersecurity in a futuristic way, build it here in India, and then take it to the whole world



Sunil Gupta, Co-founder and CEO of QNu Labs

Encryption today is nothing more than a mathematical problem, and just like you can solve mathematical problems, mathematics based encryption systems can be hacked. QNu Labs has hence redefined cybersecurity and built its foundation on the quantum physics engine instead of relying on mathematics. "Our products are an integration of three things—elec-

tronics, photonics (photon-based electronics), and quantum physics," says Sunil Gupta, Co-founder and CEO of QNu Labs.

Their Quantum Cryptography platform is based on four engines—Tropos, Armos, Hodos, and Qosmos. While Hodos and Qosmos are software engines, Tropos and Armos are hardware based and employ some specialised optoelectronic compo-

nents. For example, in Tropos—the quantum random number generator (QRNG)—photons generated from a laser are eventually used to generate random numbers. Since this is a hardware based process with no human intervention, these random numbers are truly random!

QNu Labs has also built several packaged solutions on top of their quantum engines. Some of them are Quantum Entropy-as-a-Service, Quantum Secure Email, Quantum end-to-end encrypted chat application called Qverse, and Quantum VPN Tunnel. Moreover, their random number generator can be bought as an appliance, used as a cloud service via AWS, and is also available as a small chip for IoT devices. "We think that for the new technologies—5G, AI, ML, IoT, blockchains, etc—quantum cryptography has very interesting applications," says Gupta.

QNu Labs has huge plans for expansion. The company has already put India on the quantum map of the world. They strongly believe that India is the right place to build such technology and deploy it. Talking about QNu Labs' expansion strategy, Gupta says, "India is a digital economy with so many people using digital solutions. Indian philosophy

“

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...and I am still
reading it, as a student”

—CEO, Design House



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and scriptures have been talking about quantum, and it is the basis of the Indian Vedanta system. So, we want to build it here and take it to the world.” Thanks to QNu Labs, India might soon become the go-to place for quantum cybersecurity.

QNu Labs has partners all across the globe. In India, they have partnered with big players like BEL (Bharat Electronics Limited) and provide services to govern-

ment and defense organisations. The company was a part of several incubation platforms like Cisco Launchpad, Intel Startup Program, Nasscom Deep Tech Club and of course, IIT Madras, where it was founded.

It all started in 2016, when India had just started becoming a digital economy. “We felt that if a billion people have to use digital platforms on a daily basis, then the

security needs to be very different,” says Gupta. The existing security systems are about 30 to 40 years old and have already been exposed. They’re vulnerable to algorithms. “We’re helping enterprises adopt quantum tech today so that in the future, technology equipped with quantum computing cannot compromise our data and systems,” adds Gupta.

—Aaryaa Padhyegurjar

2 MAKING METAL 3D PRINTERS MORE ACCESSIBLE

Imagine being able to print your metal parts at your place without requiring any expensive machining tools. A Chile based inventor, Agustin Cruz, has developed a working prototype of a low-cost metal 3D printer, thus accelerating innovations and reducing barriers to scientific research

To democratise science and accelerate research and innovations in the lower-income societies, Agustin, an electrical engineer with over ten years of experience in building laser machines, robots, laboratory equipment, and many other exciting tools, decided to build a 3D metal printer. “3D metal printing is an impactful tool and making it more accessible will democratise science and engineering and empower people. This low-cost hardware will be able to accelerate innovations and lower barriers to scientific research,” says Agustin, when asked about his motives behind investing time and resources in this project.

3D printers that use a plastic filament are common these days. They are cost-effective and convenient for rapid prototyping, especially during the proof-of-concept phase. But when asked what advantages 3D metal printers offer over regular printers, Agustin says, “Regular 3D printers are used to make plastic objects, which are good for prototypes



Agustin Cruz, the innovator of metal 3D printer

and specific applications, whereas 3D metal printers work with titanium powder, stainless steel powder, aluminium alloys, and other alloys. So, if you need a durable, strong part that is resistant to high temperatures, regular printers are definitely not the

best choice.”

A metal 3D printer is a machine capable of making intricate metal parts. Unlike the other metal fabrication processes, like CNC and lathing, which are based on subtractive manufacturing, metal 3D printing is

El Camino Technologies Pvt Ltd

PACKAGING DEVELOPMENTS IN 6G AND QUANTUM TECHNOLOGIES

Drivers, Timescale, and significance of 6G/Quantum Technologies.

In continuation to our packaging solutions, we would like to highlight in this article the recent Webinar excerpts from Palomar Technologies Inc., USA presented by Dr Anthony O' Sullivan, Kyle Schaefer, and Nicolas Evans. The subject touched upon is the nascent one – **Drivers, Timescale and significance of 6G/Quantum Technologies.**

The key question raised in this webinar was connection next generation **mobile communication and quantum technologies.** How to utilise pick-n-place systems for next generation 6G infrastructure and devices?

The answer lies in Quantum computing which is 100 million times faster than today's fastest sophisticated supercomputer. This leaves all our cyber securities protocols redundant, which makes our digital world unsafe place. Fortunately, there is a solution-Quantum encryption. For this, it requires free space infrastructure, which is where 6G comes in.

Basic Quantum Principle

Basic Quantum Principle

In **classical physics** polarity is either at 1 or 0.

In **quantum realities** polarity is both 1 and 0, and neither, and all.

- This weird behavior that allows for quantum speeds.
- Also exposes the exact moment that data hacking is attempted.

QU BIT

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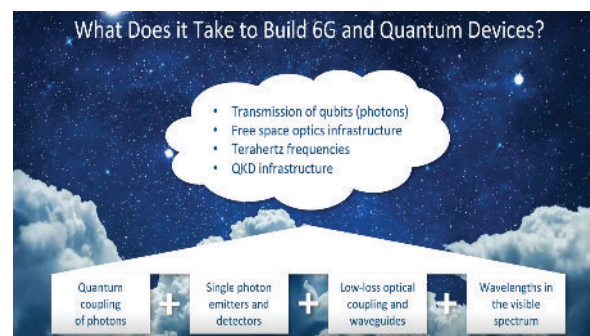
We see two vital technologies plays the important role here- **Quantum processing and encryption protection.** While talking about physical infrastructure, there is one insurmountable problem, while individual photons transmit over fibre optics, quantum signals quickly degrade. At that point, normal transmission the signals would be simply amplified and sent on its way. However, quantum properties of such signal particle makes such amplification impossible. Amplification breaks Quantum encryption making it redundant.

One solution to avoid long distance fibre altogether and replacing them with free space optics. Free space optics sends photons from-point to point through the atmosphere, above the atmosphere, through space. Photons are sent to free space combined with short-haul fiber which allows for of a truly global quantum network. Already there is work going on for a 4000km short-haul free-optic network making it clear that 6G is far closer to reality than otherwise be apparent. While Quantum encryption would drive this development,

Quantum computers need to communicate globally. Therefore, infrastructure based on free-space optics becomes necessity.

Adding to these growing demands for data, high speed and greater bandwidths together would be estimation growth of devices and urgency of 6G to develop sooner rather than later become important.

Assembly challenges -Technology and Equipment



The machines that will build 6G infrastructure and devices used in quantum technologies which requires coupling of photon, -producing wavelength have to be incorporated into a small package. With stringent requirements such as high accuracy, high precision required for quantum devices for hybrid at sub-micron scale. Quantum 6G technologies makes it difficult to package. With flexible platforms that can adapt to variations in legacy, methods will always be in demand. . In specific, Industry standard machines will be required to be upgraded to customer specific requirements



We, along with Palomar Technologies have solutions to build cutting edge devices with legacy assembly techniques. With fully automated with low risks, process control for high device quality yield. With technological and commercial solutions, we are ready for Future Industry leaders.

- Chetna Mohan
President, El Camino Technologies Pvt Ltd



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Prototype of Cruz's metal 3D printer

an additive manufacturing process that reduces the amount of wastage of materials. The printer works by depositing powdered metals and sintering them to form a 3D object. With R&D for more than five years, Agustin has developed a 3D printer that uses an electron beam for sintering the metal powder.

“The most important technical challenges are already 70% solved. The functional prototype is composed of a vacuum chamber made of stainless steel, a vacuum pump system, an electron gun, high voltage power sources, electrical connections, cooling systems, sensors, among others,” says Cruz “This printer uses an electron beam to selectively melt each layer of metal powder, causing the powder particles to fuse. After one layer is completed, the build platform is moved down one layer in height. The re-coater comes in again with a fresh layer of powder, and the electron beam starts to induce the fusion of powder particles, causing the new layer to form. This process is repeated until the entire part is finished, making a solid metal part.”

Cruz believes that to keep the metal printer accessible for all, it is necessary to utilise open source hardware and software. “This 3D metal printer will use an already

available open source 3D printing software—like Cura, Slic3r, and others—and the hardware algorithm is programmed in Arduino boards to make it easier to modify and distribute by anyone,” he says.

Agustin expects that his tool will not only help innovators but people from all walks of life. It can be extremely useful in hospitals in remote locations. “3D metal printing will be practical when supplies run low in hospitals located away from major cities. For example, patients from the nearby fields who come in with work-related injuries could be outfitted with custom splints that are custom printed as needed,” says Cruz. “We also find that entrepreneurs will benefit from this project, especially early-stage entrepreneurs that are not yet financially secure enough to easily afford a consumer 3D metal printer. Increasing access for these entrepreneurs ensures greater representation and impact, paving pathways to get these deep-tech innovations more efficiently into the market.”

Currently, Cruz is working full-time in the development of this metal 3D printer, which, according to him, is an extremely resource-intensive job. Hence, he plans to open the project to the community and jump on the crowdfunding bandwagon. **EFY**

—Sharad Bhowmick



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INDUSTRY NEWS

INDUSTRY UPDATES

Finance minister meets global chip companies for investment in India

Looking to drive in more foreign investment in building the semiconductor industry of the country, Finance Minister Nirmala Sitharaman recently held a meeting with

representatives of the semiconductor industry of the US and invited them to make further investments in India. Participating in the meeting Devinder Kumar, Chief Financial Officer and

Treasurer of AMD, spoke about the company's growth in India and how India is poised to grow strongly with the vision of *Atmanirbhar Bharat* driving it.

CTMS relaunched on World Telecom Day

Center for Telecom and Management Studies (popularly known as CTMS), a neutral body which was founded in 1989 by Dr T.H. Chowdary, former CMD of VSNL, with the patronage of F.C. Kohli, former CEO of TCS, was relaunched on World Telecom Day 2022. Distinguished dignitaries including Dr R.S. Sharma, T.V. Ramachandran, Sudheendra Kulkarni, Dr Shailendra Hajela, along with eminent leaders from the ICT fraternity, graced the relaunch

occasion. CTMS Honorary Convener, Mohan Raju, presided over the relaunch event and set forth the Charter that focusses on enabling the Indian ICT ecosystem in a neutral and inclusive manner. Dr T.H. Chowdary was presented Lifetime Achievement Award by Ramesh Chopra, Executive Chairman, EFY Group.

Dr T.H. Chowdary



PEOPLE (on the move)



IESA appoints Rajeev Khushu as Chairperson



Rajeev Khushu succeeds Satya Gupta as Chairperson of IESA, but the latter will continue as an advisor to the board. The former, who is also Director of Corporate Affairs and Govt Relations, Texas Instruments, will be supported by Vivek Tyagi, GM (BU Head), RP Tech India as the new Vice Chairperson along with Ruchir Dixit, Country Manager, Mentor Graphics serving as

the new Treasurer of IESA.

Alkesh Kumar Sharma appointed as MeitY Secretary

Alkesh Kumar Sharma, who previously served as the Secretary (Coordination) at the Cabinet Secretariat, has been appointed as Secretary, Ministry of Electronics and Information Technology (MeitY). He will now be responsible for smooth implementation of the futuristic DIR-V initiative.



Subhasis gets ACCS-CDAC Foundation Award

Given to eminent scholars and researchers in the field of advanced computing and communications, the ACCS-CDAC Foundation Award for 2021 has been conferred on Prof. Subhasis Chaudhuri

by his teacher and mentor Prof. Biswanath Chatterji. Professor Chaudhuri is the Director of Indian Institute of Technology Bombay (IIT-B).

Chandra Rangan appointed as CMO of Neo4j



With over two decades of technology infrastructure experience, Chandra Rangan has been appointed as the CMO for Neo4j, the developers of graph database management system. He has worked at companies like Symantec, Gartner, McKinsey, IBM, and Hewlett Packard Enterprise earlier.



Subramaniam appointed Non-executive Chairman for Tejas Networks

After Balakrishnan V., Chairman of telecom gear manufacturing firm Tejas Networks, resigned from his position, the board has approved the appointment of TCS chief operating officer and executive director N. Ganapathy Subramaniam as Non-executive Chairman with effect from May 18.





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CORPORATE news



Vedanta looking for buyers of its chips that are yet to be made

Vedanta Group is in talks with various electronics brands to keep a pipeline of clients ready when it rolls out chips from its soon-to-be-announced semiconductor plant in India. It had announced a JV with Taiwanese electronics manufacturer Foxconn in January for a multi-billion dollar semiconductor manufacturing plan that would draw on the Centre's \$10-billion incentive package unveiled late last year. The group is talking to several states, including Gujarat, Maharashtra, and Telangana, to set up its semiconductor plant in India.

EPIC Foundation to set up Electronics City in Delhi

A 100-acre Electronics City in Delhi is being set up by EPIC Foundation to develop the electronics product design and manufacturing ecosystem. It has already signed an MoU with the state government for the same. HCL founder Arjun Malhotra, one of the founding members said, "It will be a plug-and-play facility modelled around flatted factories and has the potential to generate 80,000 jobs. The idea is to have 40 manufacturing facilities that are vertically integrated." Dr Satya Gupta, one of the other founders adds, "The long-term charter is to have 25% market share for Indian products, that represents a \$45 billion opportunity, and we are going after that."

Applied Materials to invest in India, seeks land in Bengaluru

Applied Materials has announced a cumulative investment of ₹18 billion to help build chips in India over the next few years. As a material engineering solution and one of the largest semiconductor display equipment manufacturers in the world, it is also investing \$50 million to purchase land in Whitefield, Bengaluru, where the company plans to expand its engineering infrastructure and support the next phase of growth.

BrainChip and MosChip Technologies to co-present at IESA summit

The joint session being organised by BrainChip Holding and MosChip Technologies at the India Electronics & Semiconductor Association (IESA) AI Summit would discuss how the companies are working collaboratively to enable neural network IP for edge applications. A demonstration of BrainChip's Akida neural processor IP, enabling high performance and ultra-low power on-chip inference and learning and MosChip's ASIC platform for smart edge devices would also be held.

SEMI and ELCINA discuss opportunities for the industry

The two associations, SEMI and ELCINA, have agreed to foster collaboration and identify potential opportunities in the upcoming semiconductor and microelectronics sector in the country. The vision of the industry leaders is to catalyse the industry in India and support investors by ensuring that the benefits of the semiconductor and other schemes under National Policy on Electronics are delivered to them and targets achieved.

ISMC to set up India's first chip manufacturing plant

International Semiconductor Consortium (ISMC) is setting up India's first semiconductor manufacturing plant for which it will invest \$3 billion in Karnataka. They have requested 150 acres of land in Mysuru's Kochanahalli Industrial Area for the unit. ISMC is a joint venture between Abu Dhabi based Next Orbit Ventures and Israel's Tower Semiconductor, which was recently proposed to be acquired by Intel Corp.

Qualcomm and C-DAC team up to provide mentorship

Up to ten Indian semiconductor startups will be shortlisted for QSMP 2022. Each of them will be paired with a Qualcomm India

SNIPPETS

- Apple seems to now trail Samsung in the overall global market share. The market surge has risen to 20% in the past one year for the former while the latter has seen a rise from 22% to 24%.
- Silicon Labs has reported strong financial results for Q1. Revenue exceeded \$234 million, up 12% sequentially and 48% year-on-year.
- Intel Corporation in Q1 has generated \$5.9 billion in cash from operations and paid dividends of \$1.5 billion.
- Infineon Technologies AG reported results for Q2 of its 2022 fiscal year, with its group revenue growing up from €139 million or 4% to €3298 million, compared with €3159 million in the previous three months.
- ARM, which makes the basic blueprint used to design chips, had revenue of \$2.7 billion last year, up 35% from the previous year. Licensing business revenue rose 61% to \$1.13 billion and royalties, tracking the numbers of chips sold using Arm technology, rose 20% to \$1.54 billion.
- Ola Electric clocked operational revenue of just ₹8.6 million as it did not sell a single product during this period and also incurred ₹2 billion in losses for the financial year 2021.
- The JV between Exide Industries and Lelanche's Battery has begun mass production at the nation's largest lithium-ion battery plant in the western state of Gujarat and is eyeing global markets.
- The United Nations Industrial Development Organisation (UNIDO) regional office and Bureau of Energy Efficiency (BEE) together are implementing the Facility for Low Carbon Technology Deployment (FLCTD) Challenge 2022.
- Pico Technology has won the Queen's Award for Enterprise for the second time.

leader for mentorship on product planning and development. The startup and the mentor will meet on a periodic basis either in person or online. Qualcomm India will also facilitate 'Master-class' workshops for the shortlisted startups on semiconductor design aspects, such as design, testing, and verification packaging, as well as on non-technical topics, such as pitches, IPR, marketing, government incentives/opportunities, and scaling up teams. C-DAC and Qualcomm India will facilitate exposure for these startups to government stakeholders through meetings, webinars, seminars, or trade shows.

Videotex to set up a new TV manufacturing plant in NCR

The new plant of Videotex International will increase its manufacturing capacity to 3.2 million TVs through an investment of one billion rupees. The capacity of the current plants are 1.4 million units. The company also said that it will be hiring new employees to meet the expanded manufacturing capacity, that includes back office staff along with those on the manufacturing floor and more at the new TV manufacturing plant in Greater Noida in the National Capital Region (NCR). The company is also a beneficiary of the government's production linked incentive (PLI) scheme for mobile phones announced in March 2020.

HMD Global looking to scale up mobile exports from India

HMD Global is keen to scale up its mobile exports from India as the company looks at various levers, including sourcing more components locally, to deepen its commitment towards the manufacturing ecosystem in the country. The firm recently announced a slew of devices—Nokia G21 smartphone, Nokia C01 Plus, and feature phones Nokia 105 Plus and Nokia 105.

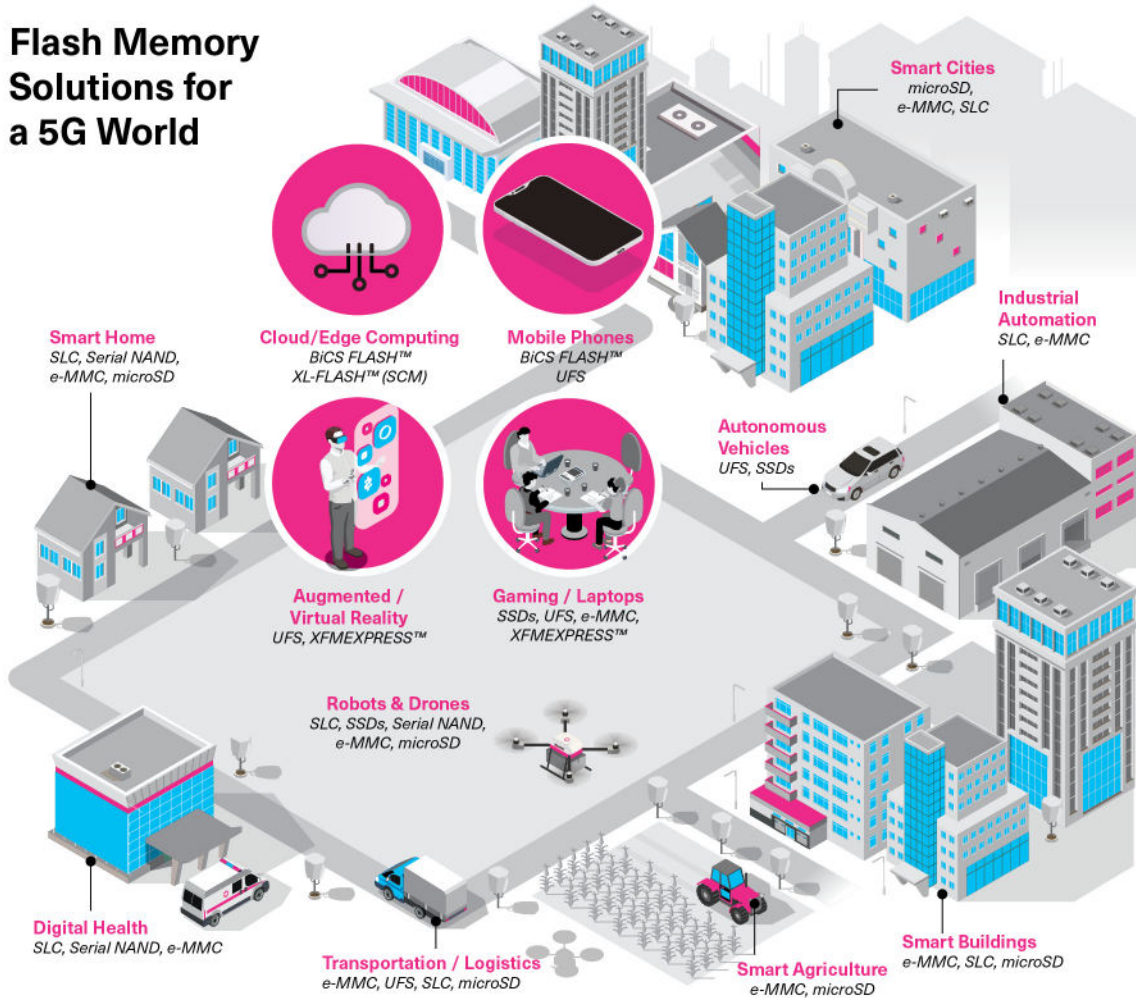
Ather Energy raises \$128 million in Series E funding round

Led by the National Investment and Infrastructure Fund's (NIIF) Strategic Opportunities Fund (SOF) and Hero MotoCorp, electric

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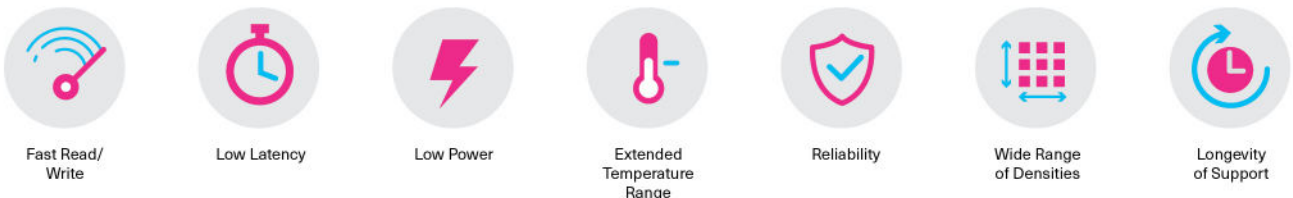
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two-wheeler giant, Ather Energy has raised \$128 million in a Series E round of funding. The funds will be used to expand manufacturing facilities, research and development, charging infrastructure, and retail network growth. There are 100 odd suppliers who provide customised components as the scooter has been built from scratch. The founder says they will support these suppliers so that they can ramp up production to 60,000-70,000 a month.

Toyota planning to make EV parts in Karnataka

Looking to develop electric vehicle (EV) parts in India, automaker Toyota group firms are planning to invest about ₹48 billion in Karnataka for local production of powertrain parts and other components of electric vehicles. They plan to utilise their existing facilities in the state. A memorandum of understanding (MoU) has been signed with the Karnataka government in this regard. While TKM and Toyota Kirloskar Auto Parts (TKAP) will invest ₹41 billion, Toyota Industries Engine India will pitch in with another ₹7 billion. The Toyota group companies have already invested ₹118.12 billion in the country and employ more than 8000 people at present.

HOP Electric raises \$2.6 million as part of \$10 million fundraiser

Growing at an MoM rate of 50%, HOP Electric Mobility has closed a strategic round of \$2.6 million as part of an ongoing \$10 million pre-series fundraising. The EV maker is targeting a 10x growth in 2022. HOP Electric Mobility, a diversified business venture of Rays Power Infra, is one of the three new non-automotive investors to qualify under the production linked incentive scheme for OEMs earlier this year. It has also embarked on its multi-battery modular platform's design and engineering journey developing Gen 2 smart batteries and swapping stations.

BEL to manufacture battery packs for Triton electric trucks

An MoU has been signed between Triton and the Gujarat State Government for setting up an iconic EV truck manufacturing plant with a commitment to invest around Rs 108 billion over a span of five years. Li-ion battery packs would be manufactured by the Pune unit of Navratna Defence PSU Bharat Electronics Limited (BEL). The partnership between BEL and Triton is set to give a major boost to the *Atmanirbhar Bharat* initiative.

Ford calls off EV manufacturing plans in India

Shortlisted among the twenty automakers under the Champion OEM scheme, Ford's plans to manufacture electric vehicles in India have now been called off. Last year, Ford India had announced the shutdown of its manufacturing units at Maraimalai Nagar in Tamil Nadu and Sanand in Gujarat. The decision of Ford to opt out of EV production in India has cast doubt on the future of workers at the company's now-shut Chennai plant. Tamil Nadu was betting big on EVs, with the state even extending its talks with players like Tesla. Approximately 4000 employees are expected to be affected by this.

IIT-M incubated EV sub-component manufacturing startup raises funds

IIT Madras (IIT-M) based electric vehicle (EV) sub-component manufacturing startup, Revoh Innovations Private Ltd, has raised \$150,000 in a seed round from angel investors Vel Kanniappan and Ravi Renganathan. Revoh's R&D division will continue to function from the IIT-M Research Park. Incorporated a couple of years ago by a group of electronics engineering graduates, Revoh's primary goal is to localise the electric vehicle sub-components' manufacturing and eventually reduce country's dependence on foreign manufacturers. It has also exported the BLDC controllers to clients in the UK and Netherlands.

Tata group may enter the battery business soon

Tata Group is preparing the blueprint to launch a battery company as part of its transition to be future-ready. Tata group is keen to see electric vehicle ecosystem growth in the country. While the existing business is undergoing transformation, the group has also entered new areas, like the Tata Neu super app, to prepare itself for an omni-channel consumer-facing ecosystem and the launch of a very large scale precision manufacturing electronics company, which has global aspirations.

Switch Mobility to develop EV range in the UK and India

Switch Mobility is planning to develop a range of electric vehicles that would create over 4000 skilled jobs in the UK and India. The UK venue is expected to start operation in June 2022 and will work closely with the company's existing R&D offices in Chennai, Leeds, and Valladolid employing a further 200 engineers.

Sun Mobility and Greaves Electric Mobility sign MoU for swappable EV batteries

As part of an MoU agreement, Greaves Electric Mobility (GEM) and Sun Mobility will deploy swappable batteries for electric vehicles in the country. With Sun Mobility's battery technology, GEM aims to use the infrastructure and battery for both electric two-wheelers and three-wheelers. Through this venture, GEM also aims to enhance the EV ecosystem by offering an array of multibrand smart mobility commuting.

Garuda Aerospace raises pre Series A funding for drones

Garuda Aerospace has raised an undisclosed sum as pre Series A funding from investors led by Ocgrow Ventures. The drone manufacturer and drone-as-a-service provider will ship out about 4000 drones to African countries. This investment round would serve more so as a primer before the startup's larger \$30 million series A round scheduled in June 2022. Garuda is also the lowest bidder in the RITES Ltd tender for lidar based survey.

IdeaForge raises Series B funding for drones

Drone manufacturer IdeaForge has raised \$20 million in a Series B funding round led by Florintree. The round also saw participation from the company's existing investors Celesta (a prominent technology investment fund), Infosys, Qualcomm, and Infina, along with the Exim Bank of India. Founded in 2007 by IIT Bombay alumni, IdeaForge has over fifteen years of R&D history and it owns more than 20 global patents.

Rays Power Infra sells its solar projects to global investors

Solar PV cell maker Rays Power Infra has sold its solar projects in Tamil Nadu, Karnataka, and Telangana to two global investors for over ₹7 billion. These projects had accumulated debt worth approximately ₹4 billion and had EBITDA of ₹950 million. The transactions have enabled the company to raise enough capital to support its future growth. Rays Power Infra has already completed more than 1GW of project commissioning and asset sale.

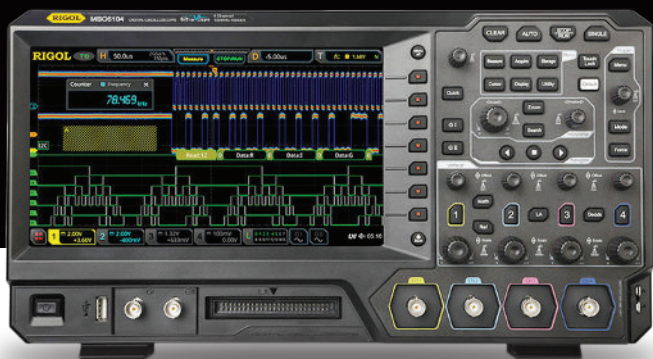
IIT-P signs MoU with IoT startup Redinent for R&D and innovation

Indian Institute of Technology Patna (IIT-P) has signed a memorandum of understanding (MoU) with Bangalore based IoT cybersecurity startup Redinent for research, development, and innovation in IoT and cybersecurity products. The MoU signing function was attended by senior officers from both sides.



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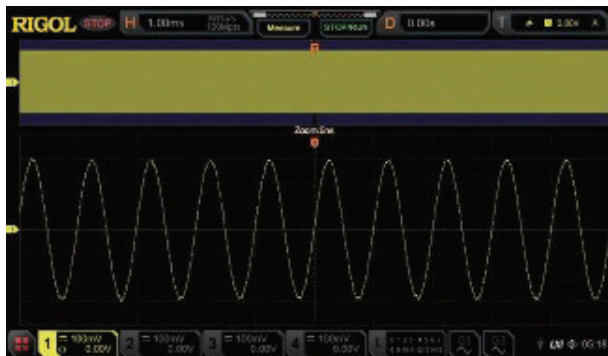
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INTERNATIONAL news

New semiconductor solution centre in Japan

Nidec Semiconductor Solution Centre opened on 16th May at Kawasaki-shi, Kanagawa (inside Nidec Research and Development Centre, Japan). The centre is looking to build strategic partnerships with suppliers for ensuring the supply-chain of semi-conductors. The company also plans to provide intelligent motor solutions that are environment friendly.

300mm line for EV power semiconductors from Renesas

The Kofu Factory that closed in October 2014 is now all set to re-open in 2024 to enhance production capacity for power semiconductors, such as IGBTs. A sum of 90 billion yen has been invested by Renesas into the 300mm power semiconductor fab in Kai City, Yamanashi Prefecture, citing the rise of electric vehicles as motivation.

Enyx acquired by Exegy with support from Marlin Equity

Exegy Incorporated has taken over Enyx. The global investment firm, Marlin Equity Partners, has supported this transaction. Exegy Inc. in its product suite now offers leveraging of low-latency field-programmable gate array (FPGA) technology at all stages of the trading lifecycle. Speeding the development of bespoke trading solutions, even Enyx's line of low-latency FPGA trading products is included in the deal.

Qualcomm announces \$100M Snapdragon Metaverse fund

The Snapdragon Metaverse fund is being set up to invest in innovative developers and companies building immersive experiences with AR, mixed reality, and VR. The fund will deploy capital through a combination of venture investments in leading XR companies by Qualcomm Ventures and a grant by Qualcomm Technologies for developer ecosystem funding in XR experiences.

MakerBot and Ultimaker merging to accelerate additive manufacturing globally

The business combination agreement between MakerBot and Ultimaker will accelerate the adoption of additive manufacturing

by providing a comprehensive desktop 3D printing ecosystem of hardware, software, and material. It would be backed by existing investors (NPM Capital and Stratasys) and will benefit from a planned cash investment of \$62.4 million to fuel innovation and expansion into new markets. The aim is to offer easy-to-use and accessible desktop 3D printing solutions for any application while inspiring the industry to a future state of responsible and sustainable manufacturing.

Meta partners with AMD for mobile infrastructure program

The mobile internet infrastructure program, called Evenstar, would bring base station costs down to make broadband more accessible around the world. Launched by Meta in early 2020, this promotes a platform called OpenRan that makes it possible for cellular network operators to mix and match hardware and software for building base stations instead of buying all of it from one equipment maker. AMD said its radio chip, Xilinx Zynq UltraScale RFSoc, will be used in the Evenstar radio units.

Blue-chip companies commit to cloud-native security

Capital One Ventures, Snowflake Ventures, Verizon Ventures, and Wipro Ventures have joined the previously announced \$1B+ growth investment in Securonix led by Vista Equity Partners. These strategic investments allow Securonix to build and expand relationships with existing customers and partners as it continues to set the standard for cloud-native security analytics and operations.

GlobalLogic launches Women Influencers Program

The Women Influencers Program launched by GlobalLogic is designed to encourage and enable women employees interested in exploring cross-functional management positions within the technology firm. It is specifically focused to promote greater gender diversity, especially among the company's leadership ranks. The Program will provide developmental and mentoring opportunities through GlobalLogic's people development function and individual business units. The entire Program journey is expected to last five to six months.

MeitY aims to train 85,000 engineers on chip design

As the country's chip design aspirations pick up pace, the Ministry of Electronics and IT (MeitY) aims to train over 85,000 engineers on chip design by expanding the infrastructure available for the technology to 120 academic institutions across the country in the next five years. A pilot deployment in 2021 was done, under special manpower development programme for Chips to System Design (SMDP-C2SD), wherein a centralised design facility at state-run C-DAC was enabled for remote access by over 50,000 engineering students at sixty academic institutions for designing chips.

Government may revise chip DLI norms: Rajeev Chandrasekhar

The government of India is mulling revising the mandates of the ₹760 billion design linked incentive (DLI) programme after receiving feedback on the policy during the SemiCon India Conference 2022 held in Bengaluru, according to the Minister of State for Electronics and IT Rajeev Chandrasekhar. He also said the scheme will continue to be in place to support all product design projects and startups, among others.

White goods PLI: 19 companies apply in the second round

The Ministry of Commerce has

revealed that nineteen companies have filed applications for the Production Linked Incentive (PLI) Scheme for White Goods (ACs and LED lights) in the second round of applications with committed investments of ₹15.48 billion. This includes eight companies for AC components and eleven for LED Lights. Some of the companies are LG Electronics, Mitsubishi Electric, Adani Copper Tubes, Jindal Poly films, Crompton Greaves, Wipro, Zeco Aircon, Starion India, and Swaminathan Enterprises. Additional applications were invited under Clause 9.2 of the Scheme Guidelines for investments. The online application window for the second round of applications was open from the 10th March to 25th April, 2022.



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What's New In WIRELESS CHARGING

Wireless charging technology will give engineers the freedom to make devices smaller and lighter by eliminating the energy storage devices, such as bulky batteries, in them. The improvement in processing capabilities of our handheld devices makes wireless charging a convenient or rather an essential technology

SHARAD BHOWMICK

Wireless charging, a technology that was demonstrated over a century ago by Nikola Tesla but could not find any practical use for a long time is now becoming ubiquitous in a wide variety of devices, such as smartphones and smartwatches. A considerable amount of research and development is being done to improve the capabilities and even introduce wireless charging in highly power-intensive applications like electric vehicle (EV) charging. Wireless charging is of three types: resonant charging, inductive charging, and RF charging.

Wireless charging is a very hot topic at present; the wireless charging market is expected to experience a growth of 26%

CAGR from 2022 to 2027. The growth is reflected in the advancement in technology and the increase in the number of new launches. The latest trends in wireless charging modules are:

- Adoption of Qi 1.3
- Integration of antenna board
- More powerful processors
- Better protection features
- Higher power transfer rate
- Increased interfaces
- Smaller modules for smarter wearables

Adoption of Qi 1.3

Qi 1.3 is the latest update from WPC, rolled out in the middle of 2021. This is a major update since the launch of Qi 1.2 in

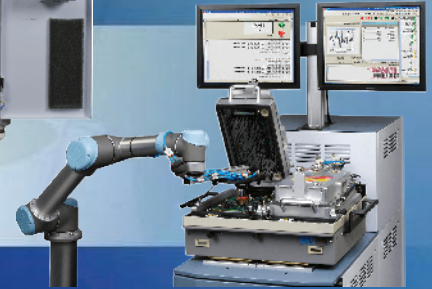


Fig. 1: Wireless charging of a mobile phone
(Source: Link)

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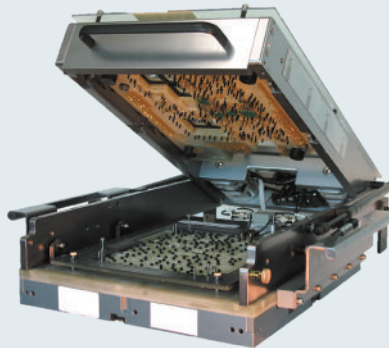
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Resonant charging

The commonly used inductive charging system works at a lower frequency in the kHz range while resonant wireless charging works at a higher frequency range. Resonant systems do work in different frequencies from as low as 20kHz all the way to 20MHz or more. The most common standard these days for resonant charging is 6.78MHz, which has been adopted as a standard by the AirFuel Resonance.

The higher frequency allows higher power transfer, greater range, and better efficiency. It also allows charging through thick surfaces with greater spatial freedom. Unlike the lower frequency inductive charging, which has to be tightly coupled, the resonant charging does not need to have similar-sized coils and thus can operate over a wide range of coupling as it has a high-quality factor, which also means less heating of the coil.

The coil size in resonant charging can be made smaller than that of inductive charging solutions. Furthermore, the coil need not be made from any special materials and can be created with regular copper wire or built on PCB materials. The coil can also be of a different shape, which is not possible in inductive charging. The metal heating is also negligible at a higher frequency.

The main advantage of resonant charging are:

- Lower cost
- Greater spatial freedom
- Faster charging speed
- Compact size
- Lower heat loss

2015. This standard improves control of the power transfer between the transmitter and receiver and mandates hardware based authentication for higher security. The Qi 1.3 allows for higher data transfer rates up to 15W. Modules such as Renesas's P9261 and STM's STWLC98 feature Qi 1.3 standard.

Integration of antenna board

The compact transmitter and receiver modules that utilise resonant charging working at a frequency of 13.56MHz are capable of transmitting both power and data. These modules come with an integrated

Specifications	Inductive Charging	Resonant Charging
Frequency range	100-300kHz	Up to 20MHz
Charging distance	Up to a few cm	Up to a few inches
Multi-device charging	No	Yes
Spatial freedom	Very low	High
Power range	A few watts	20W to 20kW
Efficiency	Good (up to 80%)	High (up to 95%)
Coil size	Large	Small
Rx-Tx communication	In-band communication	BLE/In-band communication



Fig. 2: The compatibility of Qi1.3 standard (Source: Link)

antenna in a small form factor, thus reducing the size of the product along with the time and cost of development.

These boards use the same frequency band as the NFC communication standard. These modules mostly support both bi-directional data communication (256B Max. at 212kbps) and NFC Forum Type 3 Tag transmission. The bi-directional data transfer allows for advanced functions, such as firmware download, secure data transfer, and rewriting of sensor, device, or authentication information to battery output voltage values.

Modules such as ROHM BP3621, ROHM BP3622, and ML7660 from Lapis Technologies have integrated antenna boards.

More powerful processors

The wireless charging technology has been adopting new features to improve the stability, efficiency, and security of the system, thus requiring more powerful processors. The microprocessor also allows for easier tuning for certifications along

with specification updates without PCBA change. Having a powerful processor helps in making functions extensible and enhances the capability to better customise the user interface (UI). The electromagnetic compatibility (EMC) performance depends on the microprocessor and its software operations.

Renesas's P9261-3C-CRBv2 design includes a Renesas RH850 automotive microprocessor as a host controller, which enables the system to provide functional safety features that comply with automotive safety integrity level B (ASIL B). NXP MWCT1x23 is built upon the Arm Cortex-M4 core operating at up to 168MHz with DSP and a floating-point unit. STM STSAFE-V110 runs on an Arm SecurCore SC300TM 32-bit RISC core, which features a secured operating system that enhances the cryptographic security of the module. STM STWBC2 HP is a digital controller for wireless transmitters and runs on a 32-bit Arm Cortex M0 processor running at frequencies up to 64MHz.

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TABLE 2
COMPARISON OF DIFFERENT TRANSMITTER AND RECEIVER MODULES

Model	Manufacturer	Transmitter/Receiver	Integrated Antenna	Frequency	Max Power	Qi Compatible
ML7660	Lapis Technology	Receiver	Yes	13.56MHz	1W	No
ML7661	Lapis Technology	Transmitter	Yes	13.56MHz	1W	No
BP3621	ROHM Semiconductor	Transmitter/Receiver	Yes	13.56MHz	240mW	No
BP3622	ROHM Semiconductor	Receiver	Yes	13.56MHz	240mW	No
BQ510103b	Texas Instruments	Receiver	-	110kHz to 205kHz	15W	WPC Qi v1.2
BQ50012A	Texas Instruments	Transmitter/Receiver	-	110kHz to 205kHz	15W	WPC Qi v1.2
MWCT1x23	NXP	Transmitter/Receiver	-	168MHz	65W	WPC Qi v1.2
P9235A-RB	Renesas	Receiver	-	110kHz to 205kHz	5W	WPC Qi v1.2
STWLC98	ST Microelectronics	Receiver/Transmitter	-	110kHz to 205kHz	70W	Qi 1.2, Qi 1.3
STWBC2	ST Microelectronics	Transmitter	-	110kHz to 205kHz	70W	Qi 1.2, Qi 1.3

Higher power transfer rate

Although the overall efficiency of portable devices, such as smartphones and smartwatches, is improving, the higher processing power and overall improvement in features mean that these devices are getting more power-intensive, thus requiring bigger batteries. To improve the battery charging speed, manufacturers have been trying to increase the power transfer rate by wireless charging.

STM STWLC98 is a Qi-compliant 70W inductive power receiver that can also act as a 15W wireless transmitter. The NXP MWCT1123 is a power transmitter controller module based on the WPC standard that can transmit power up to 65W.

Better protection features

Newer wireless transmitters and receivers are featuring a lot of functionality and are capable of transferring higher power, which makes them susceptible to cause unwanted problems like overheating, transfer-

ring overvoltage, etc. Therefore, the latest modules come with various protection features to ensure the reliability of the device.

TI BQ51013B-Q1 and STM STWLC98 feature foreign object detection, overcurrent and overvoltage protection, thermal shutdown, and fault host control. Some modules, such as NXP's MWCT1123, feature a memory protection unit whereas some devices, such as STM STSAFE-V110, provide cryptographical security.

More number of interfaces

With the inclusion of new features and powerful processors in the wireless charging modules it can be safely said that the new devices come with an increased number of interfaces.

For communication, the Lapis ML7660/7661, NXP MWCT1123, and STM STWBC2 use SPI/I2C master UART as a serial interface. The Renesas P9235A features five GPIOs while STM's STWBC2 has eight GPIOs for connecting with external devices.

Smaller modules for smarter wearables

Electronic gadgets are becoming more powerful and wireless at the same time, be it your smartwatch, wireless earphones, or any other gadget. Moreover, the increase in penetration of IoT in our everyday lives demands compact wireless charging modules. Companies such as TI, ROHM, and Lapis are competing to create compact modules.

Lapis ML7660/ML7661 is said to be the smallest wireless receiver capable of delivering 1W power while ROHM BP3621 and BP3622 wireless charging modules come with an integrated antenna and feature a small form factor, thus reducing the size of product along with time and cost of development.

However, there are many more upcoming trends. Some of these are described below.

GaN replacing silicon FET

Adoption of GaN transistors is the next big thing in wireless, which will improve the range and power transmission rate. GaN can help charge at rates from 30W up to several kilowatts, which was difficult to achieve using the silicon based charger. GaN based chargers are enabling higher charge transfer rates and better efficiency at a lower cost compared to silicon based solutions. The GaN based

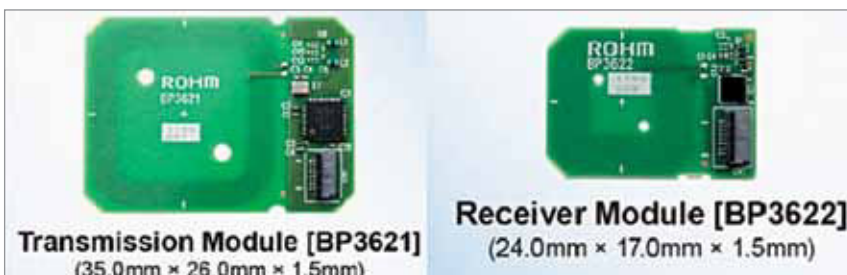


Fig. 3: ROHM BP3621 and BP3622 wireless charging modules (Source: Datasheet)



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Wireless charging

Advantages

- Low maintenance as there are no moving parts
- Non-wired connection makes it safer as it eliminates the risk of short circuit from any damaged wire or connectors
- Eliminates the need to carry charging accessories, such as chargers and charging cable
- Improves water and dust resistance of a device as there are no ports

Drawbacks

- The rate of power transfer is much lower than the wired method of charging
- Efficiency of wireless charging is lower than regular wired charging
- Charging distance is limited
- The charging coils need to align perfectly to charge efficiently in case of inductive charging

solutions enable higher transmitter and receiver frequencies of 6.78MHz or 13.56MHz, which are ideal for resonant charging.

The main advantages of the adoption of GaN FET are:

- Higher efficiency
- Lower cost
- Reduction in weight and size of the system
- Lower surface heat loss

Long distance charging

RF charging is hailed as the future of wireless energy harvesting for low-power IoT devices. The future scope of RF wireless charging was discussed at CES 2022. This charging technology allows charging at long distances from the transmitter.

At CES 2022, Motorola demonstrated over-the-air wireless charging of four phones simultaneously from a single transmitter for distances as far as 122cm (4 feet). Xiaomi and Oppo demonstrated their RF charging prototypes. Samsung also revealed an RF charging enabled remote, which was also featured in Best of CES 2020.

The RF frequency charging is capable of harnessing different frequencies from ambient energy. The technology is expected to mature in the coming years. RF charging is considered most suitable for smart wearable devices, IoT sensors, and applications in medical, military, sports, and many other industries.

The future

Wireless charging technology will give engineers the freedom to make devices smaller and lighter by eliminating the energy storage devices, such as bulky batteries, in them. The improvement in processing capabilities of our handheld devices makes wireless charging a convenient or rather an essential technology.

Wireless charging is not limited to consumer electronics, it also has scope in automotive industry. Recently, in March 2022, Volvo announced that its XC-40 model will be able to receiving power greater than 40kW, which is much more than the existing AC charging and almost comparable to the DC fast charging.

RF charging is the key to making batteryless devices. Thus, wireless charging holds a lot of scope in commercial, medical, smart wearable, and military applications. Further development in this technology will help us get rid of chargers, cables, and power banks. We may soon witness the adoption of wireless charging solutions in the public space. RF charging will enable sensors placed at remotest of the location to work perfectly without human intervention. **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.

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The circuit can be used to check 24V and 12V batteries both. The battery level is indicated by the ten LEDs. Each glowing LED indicates 10% of battery voltage level. So, when LED1 through LED5 are glowing, or just LED5 is glowing, it means the battery is around 50% charged. The circuit can help in checking the batteries for a car, inverter, solar system, etc.

The author's circuit rigged on a breadboard is shown in Fig. 1 while the circuit's block diagram is shown in Fig. 2.

As shown in the block diagram, when LED1 alone glows it means the battery level is only 10%. With

LED2 also glowing it means the battery level is 20%, and so on. When all the LEDs (LED1 through LED10) are glowing, it means the battery level is 100% and it is fit for use.

Switch S1 is used to monitor either 24V or 12V battery. Switch S2 helps select dot mode or bar mode display. In dot mode only the last LED representing the voltage glows

while in bar mode all the LEDs up to that LED glow. The choice is yours.

Circuit and working

Circuit diagram of the battery voltage level indicator is shown in Fig. 3. It is built around IC LM3914 dot/bar driver IC, 1N4007 diodes D1 and D2, ten 5mm LEDs

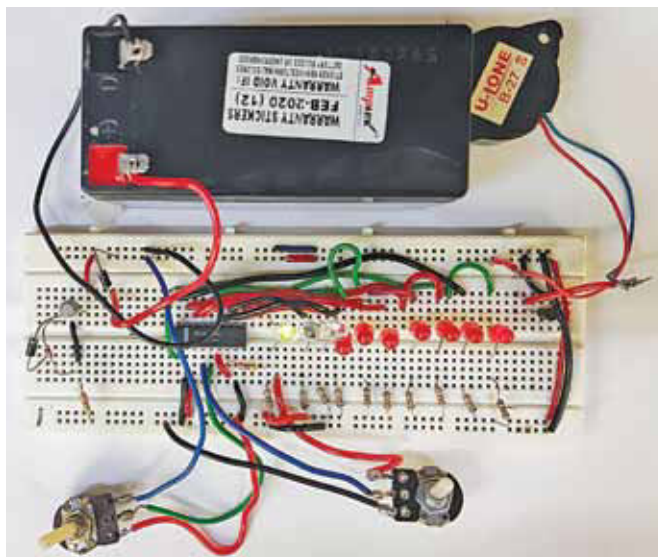


Fig. 1: Author's circuit on breadboard

PARTS LIST

Semiconductors:	
IC1	- LM3914 dot/bar display driver IC
T1	- BC547 NPN transistor
T2	- BC557 PNP transistor
D1, D2	- 1N4007 rectifier diode
LED1-LED10	- 5mm LED
ZD1	- 12.1V Zener diode
Resistors (all 1/4-watt, ±5% carbon):	
R1	- 3.3-kilo-ohm
R2	- 1.2-kilo-ohm
R3-R12	- 150-ohm
VR1	- 100-kilo-ohm preset
VR2	- 10-kilo-ohm preset
Miscellaneous:	
S1	- SPDT switch
S2	- On/off switch
PZ1	- Piezo buzzer
BATT.1	- 24V battery
BATT.2	- 12V battery

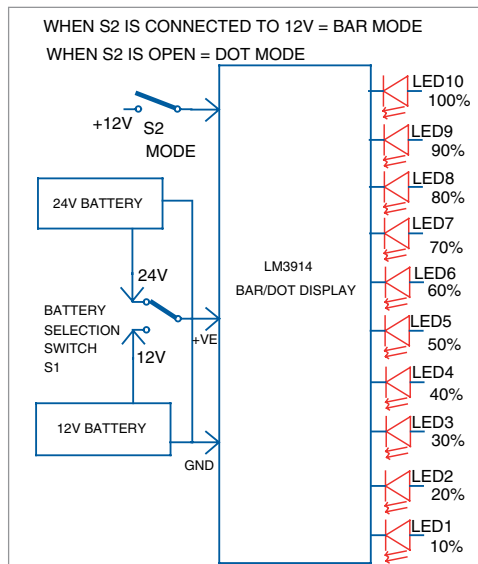


Fig. 2: Block diagram

(LED1 through LED10), 12.1V Zener diode (ZD1), BC547 transistor T1, BC557 transistor T2, presets VR1 and VR2, and piezo buzzer PZ1.

The LED display comprising LED1 through LED10 shows voltage level of the 24V or 12V battery selected. This display can be set in dot mode or bar mode. For showing the voltage level in bar mode, connect pin 9 of the IC to positive terminal of the battery using switch S2. For showing the voltage level in dot mode, simply open switch S2.

The 12.1V Zener diode ZD1 is used along with BC547 tran-



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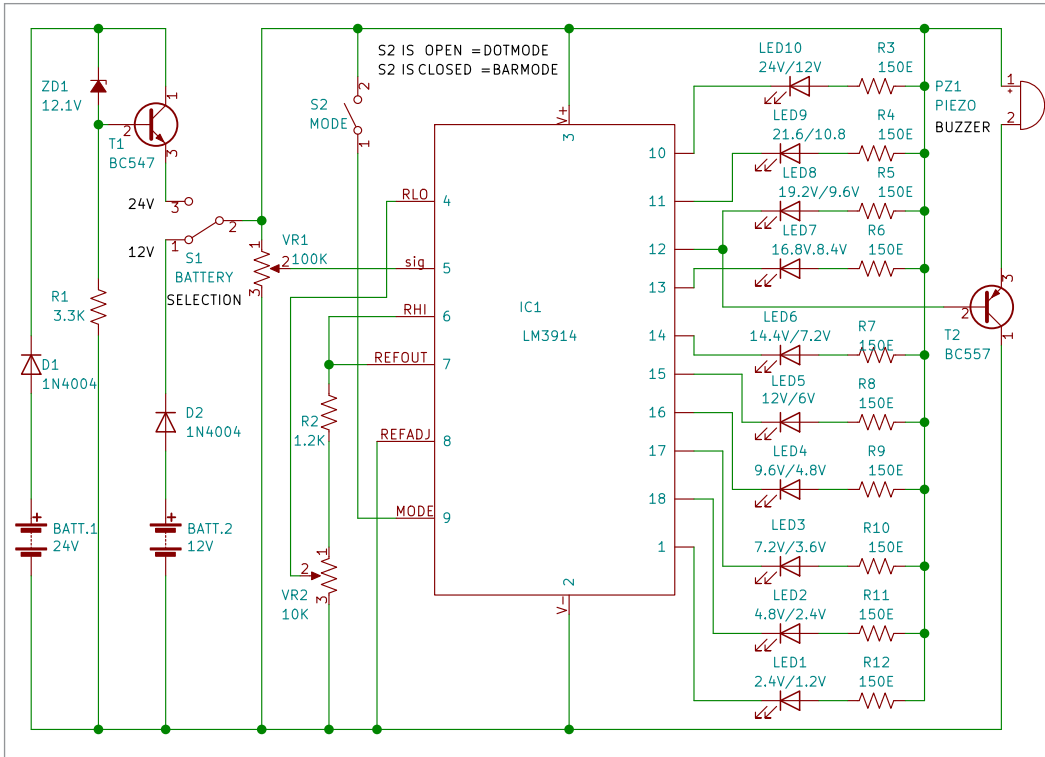


Fig. 3: Circuit diagram

sistor T1 to reduce the 24V battery voltage to 12V. Pin 3 of IC1 is connected to positive side of 12V to operate the circuit while its pin 2 is connected to ground.

To check voltage level of the battery, use two crocodile clips with about 30cm long wires soldered to each. One of the clips could be red with red wire soldered to it and the other black with black wire soldered to it. Connect red clip to positive terminal of the battery under test and

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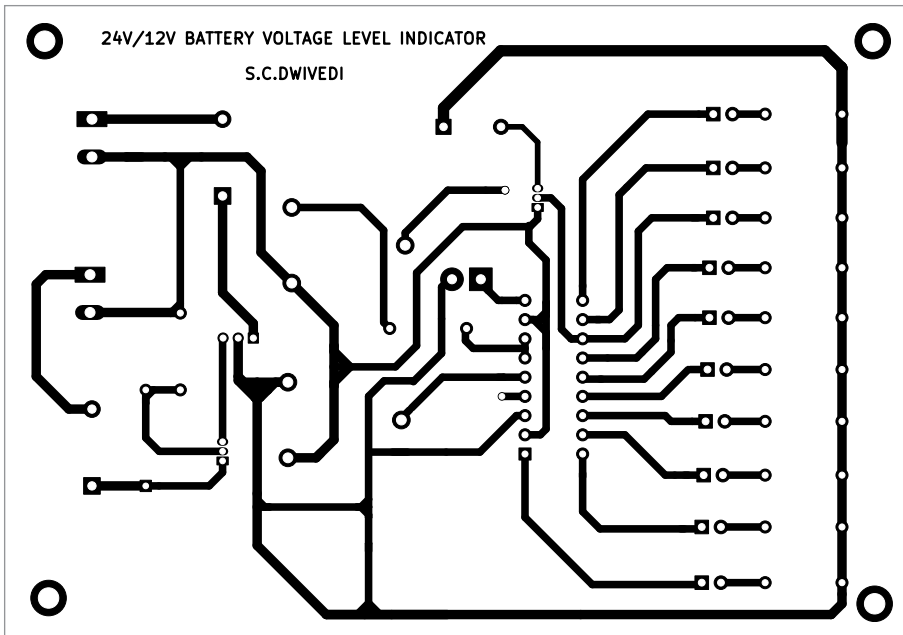


Fig. 4: Actual-size, single-side PCB layout

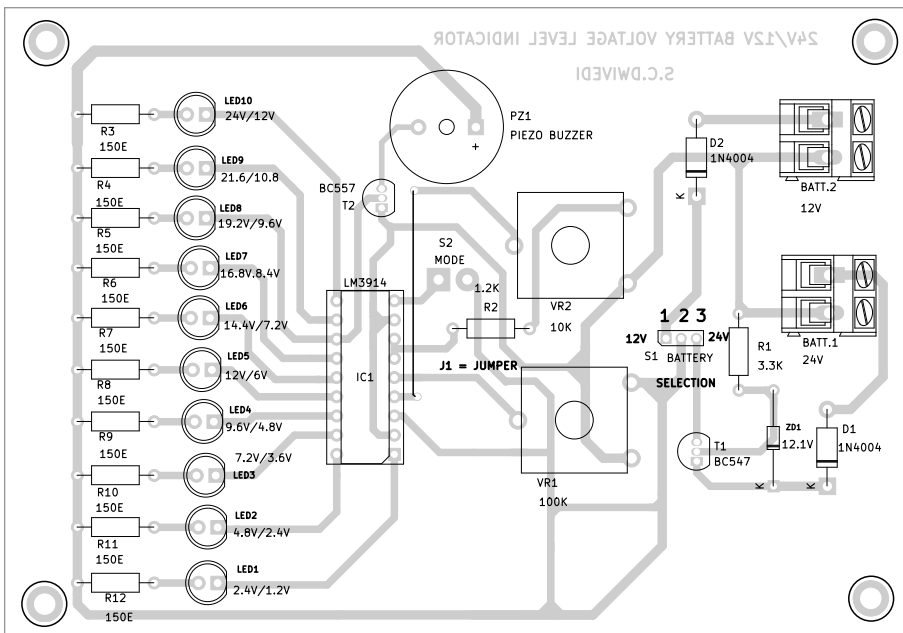


Fig. 5: Component layout of the PCB

black clip to its negative terminal. Flip switch S1 for checking a 24V battery's status. Position of switch S2 will depend on whether you want a dot display or a bar display.

Use presets VR1 and VR2 to calibrate the circuit. And you may use a 30V variable power supply instead of the 24V battery for calibration. Connect 12V from the variable power

supply in place of 24V battery in the circuit. Adjust preset VR1 such that LED1 just starts glowing. Now increase the input DC voltage slowly to 24V and observe the LED's glowing status. The first LED (LED1) will start glowing at 2.4V and the second (LED2) at 4.8V, and so on. The last LED (LED10) will glow at 24V.

After this calibration the circuit

is ready to use. If you want to check the level of a 24V battery, connect it to the circuit using the crocodile clips and flip switch S1 towards 24V position.

To see the voltage level in dot mode, keep switch S2 open. If, say, LED9 glows, it means voltage level of the battery is around 90% of 24V, that is, around 21.6V. If LED10 glows, it means the battery is fully charged.

To see the battery voltage level in bar mode, flip switch S1 towards 24V position and turn switch S2 on. If, say, LED1 through LED9 start glowing, it means voltage level of the battery is around 90% of 24V, that is, around 21.6V. If all the ten LEDs (LED1 through LED10) glow, it means voltage level of the battery is full 24V.

The buzzer in circuit sounds when the battery's voltage level falls to 80% to indicate that the battery needs to be charged. The base of transistor T2 connected to pin12 of IC1 drives the piezo buzzer.

Construction and testing

An actual-size, single-side PCB for the 24V/12V battery status indicator is shown in Fig. 3 and its component layout in Fig. 4. After assembling the circuit on PCB, enclose it in a suitable plastic box. Switches S1 through S2 may be fixed on back side of the cabinet. The assembled PCB may be fixed inside the box's front side in such a way that LED1 through LED10 are clearly visible.

BONUS: You can watch the VIDEO of the tutorial of this DIY project at: <https://www.electronicsforu.com/videos-slideshows/live-diy-battery-voltage-level-indicator> **EFY**

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

PC CONTROL WITH EYE MOVEMENT For Physically Challenged

ASHWINI KUMAR SINHA

Millions of people across the globe suffer from neuro conjugate disorder, or some other form of paralysis, which does not let them move any body part except their head and the eyes. To overcome this challenge, we can make a smart personal computer (PC) that empowers such physically challenged persons to control a computational system with the help of

facial movements. It enables control using face and eye movements and works even in low light or dark conditions.

Coordinate movements in the PC = (1080,720) to (0,0)

where $x = 1080$, $y = 720$
 $mapx = (x)$, $mapy = (y)$

The solution is based on three different functions:

1. Blinking detection of the right

eye for system operation

2. Detection of the eye movement using image processing

3. Translation of the eye movement and blink to control graphic user interface (GUI) of the PC

The challenges

The above three functions come with several challenges, which can be handled with various steps for the device to work perfectly. These are:

Differentiating between natural and intentional eye blink. Our eyes involuntarily blink at regular intervals so that they remain moist and free of dust. To perform a left or right mouse click, here an eye will have to blink intentionally. However, there has to be some way to distinguish between involuntary and intentional eye blinks so that the device functions properly.

To do that, two sensors (one corresponding to each eye) can be integrated in such a way that when both of them detect an eye blink at the same time, it is considered a natural eye blink. If the blinking happens in only one eye (either left or right), it is considered as an intentional eye blink, resulting in a left or right

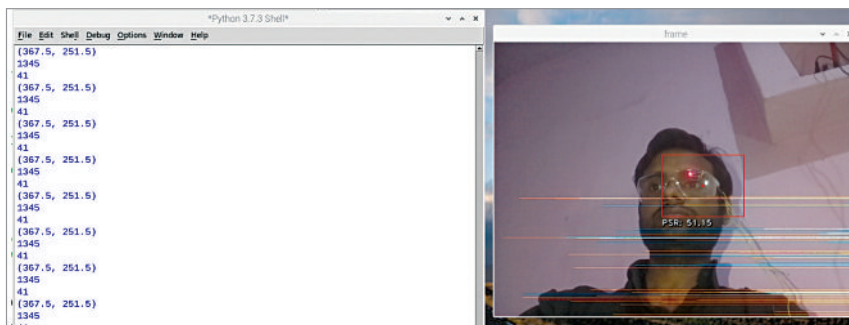


Fig. 1: Author's eye movement data converted to coordinates



Fig. 2: Author testing the blink sensor

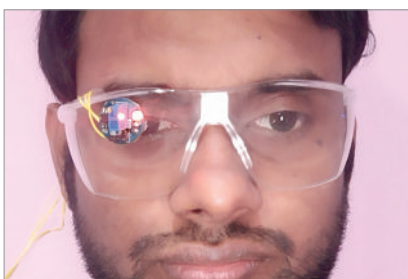


Fig. 3: The author with his prototype eyeglasses

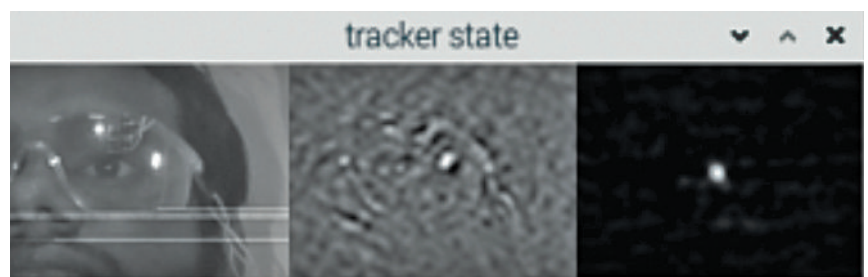


Fig. 4: Author's eye image processing



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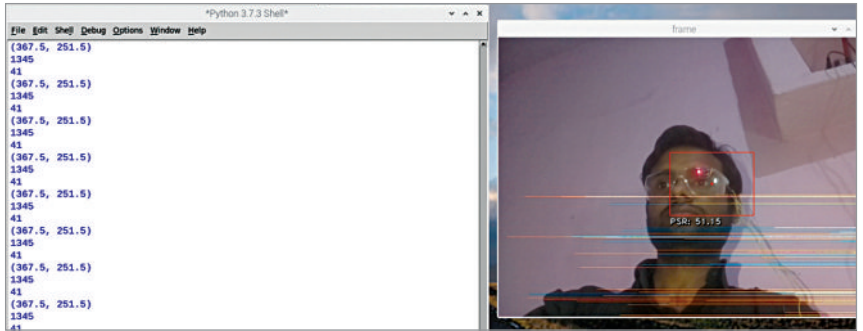


Fig. 5: Author testing the code

```
# Python 2/3 compatibility
from __future__ import print_function
import sys
PY3 = sys.version_info[0] == 3

if PY3:
    xrange = range
from pynput.mouse import Button, Controller
from nmap import nmap

import numpy as np
import cv2 as cv
from common import draw_str, RectSelector
import video
from gpiozero import Button as butt
from signal import pause
import mouse
import time
```

Fig. 6: Code snippet

```
prex=0
prey=0
button = butt(27)
mouse = Controller()

mapfnx = nmap(290, 400, 10, 1905, normfn=int)
mapfny = nmap(250, 300, 10, 1059, normfn=int)
```

Fig. 7: Code mapping eye movements to laptop GUI coordinates

```
:class MOSSE:
    def __init__(self, frame, rect):
        x1, y1, x2, y2 = rect
        w, h = map(cv.getOptimalDFTSize, [x2-x1, y2-y1])
        x1, y1 = (x1+x2-w)//2, (y1+y2-h)//2
        self.pos = x, y = x1+0.5*(w-1), y1+0.5*(h-1)
        self.size = w, h
        img = cv.getRectSubPix(frame, (w, h), (x, y))

        self.win = cv.createHanningWindow((w, h), cv.CV_32F)
        g = np.zeros((h, w), np.float32)
        g[h//2, w//2] = 1
        g = cv.GaussianBlur(g, (-1, -1), 2.0)
        g /= g.max()

        self.G = cv.dft(g, flags=cv.DFT_COMPLEX_OUTPUT)
        self.H1 = np.zeros_like(self.G)
        self.H2 = np.zeros_like(self.G)
        for _i in xrange(128):
            a = self.preprocess(rnd_warp(img))
            A = cv.dft(a, flags=cv.DFT_COMPLEX_OUTPUT)
            self.H1 += cv.mulSpectrums(self.G, A, 0, conjB=True)
            self.H2 += cv.mulSpectrums(A, A, 0, conjB=True)
        self.update_kernel()
        self.update(frame)
```

Fig. 8: Some more code

mouse click.

Although this technique is effective, there is one problem. It increases the bill of material to several hundred rupees. Also, people having problem with one eye cannot use this solution.

Therefore, this solution has been modified with the inclusion of a code. Now, if an eye blinks within a second, it is considered as natural. But if an eye blinks for more than a second (say, four seconds), it is considered as intentional.

```

def update(self, frame, rate = 0.125):
    (x, y), (w, h) = self.pos, self.size
    self.last_img = img = cv.getRectSubPix(frame, (w, h), (x, y))
    img = self.preprocess(img)
    self.last_resp, (dx, dy), self.psr = self.correlate(img)
    self.good = self.psr > 8.0
    if not self.good:
        return

    self.last_img = img = cv.getRectSubPix(frame, (w, h), self.pos)
    img = self.preprocess(img)
    A = cv.dft(img, flags=cv.DFT_COMPLEX_OUTPUT)
    H1 = cv.mulSpectrums(self.G, A, 0, conjB=True)
    H2 = cv.mulSpectrums(A, A, 0, conjB=True)
    self.H1 = self.H1 * (1.0-rate) + H1 * rate
    self.H2 = self.H2 * (1.0-rate) + H2 * rate
    self.update_kernel()

@property
def state_vis(self):
    f = cv.idft(self.H, flags=cv.DFT_SCALE | cv.DFT_REAL_OUTPUT)
    h, w = f.shape
    f = np.roll(f, -h//2, 0)
    f = np.roll(f, -w//2, 1)
    kernel = np.uint8((f-f.min()) / f.ptp()*255)
    resp = self.last_resp
    resp = np.uint8(np.clip(resp/resp.max(), 0, 1)*255)
    vis = np.hstack([self.last_img, kernel, resp])
    return vis

def draw_state(self, vis):
    (x, y), (w, h) = self.pos, self.size
    x1, y1, x2, y2 = int(x-0.5*w), int(y-0.5*h), int(x+0.5*w), int(y+0.5*h)
    cv.rectangle(vis, (x1, y1), (x2, y2), (0, 0, 255))
    if self.good:
        cv.circle(vis, (int(x), int(y)), 2, (0, 0, 255), -1)
        #print(x,y)
        self.pos = x, y
        print(self.pos)
        #mouse.move(x+dx,y+dy)
        xmove=mapfnx(x)
        ymove=mapfny(y)
        print(xmove)
        print(ymove)
        mouse.position = (xmove,ymove)

        #mouse.position = (x,y)

```

Fig. 9: Code for controlling mouse using converted coordinates data

```

cv.imshow('frame', vis)
ch = cv.waitKey(10)
if ch == 27:
    break
if ch == ord(' '):
    self.paused = not self.paused
if ch == ord('c'):
    self.trackers = []
if button.is_pressed:
    press=0
    # print("eyeblink")
    for x in range(0, 5):
        if button.is_pressed:
            press =press+1
            #print(press)
            if press==5:
                mouse.click(Button.left, 2)

    #print("mousepress")

```

Fig. 10: Eye blink converted into mouse click on GUI

Detecting eye movement using image processing. For a mouse cursor to move, the human eye needs to refer to an object and move the mouse relative to it. Using eye movement, a physically challenged person can effortlessly operate a PC. But image processing of eye movement does not give accurate results, does not work in low light or completely dark conditions, and the entire process is quite difficult.

Thus, a light mounted on the sensor can be used to track eye

movement whenever the person moves his/her head.

Translating eye movement and blink to control the PC. This solution detects eye blinks and moves the light mounted on the eyeglass. But it is useless without recording this movement on the PC's GUI to obtain accurate movement of the mouse cursor. While it needs to cover the entire length and width of a PC monitor, a human head can move only up to a certain degree. To solve this problem,

a small head movement needs to be converted into large pixel movement for the mouse cursor.

Prerequisites

To develop the basics, prepare the SD card with the latest Raspbian OS and check whether it has a pre-installed Python IDLE. Next, install the following Python libraries and modules for the project:

- OpenCV
- pynput
- numpy

- gpiozero

To do so, open the terminal and use the following commands:

```

sudo pip3 install python-opencv
sudo pip3 install numpy
sudo pip3 install gpiozero
sudo pip3 install pynput
sudo pip3 install nmap

```

After installing all the libraries, include the OpenCV official GitHub repository inside the Raspberry Pi using the following command:

```

git clone https://github.com/opencv/opencv

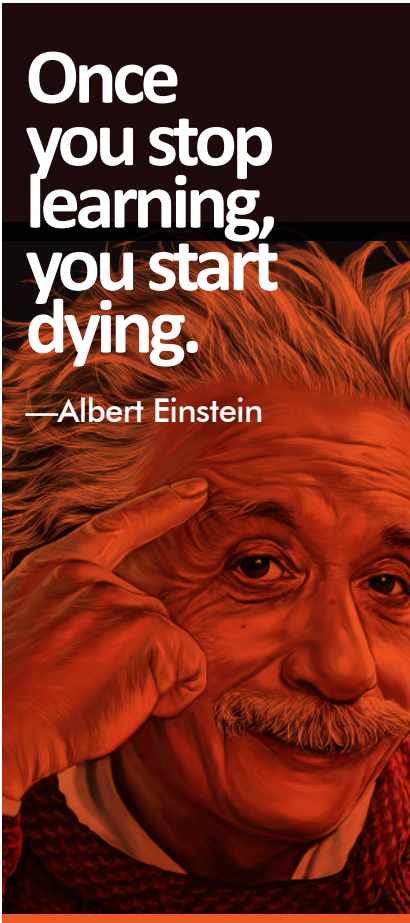
```

We are now ready to code.

Coding

You will need to modify the example code found in the OpenCV library folder and fuse your code in it to prepare the device. For that, open the OpenCV folder→platforms folder→python, and select the mouse.py code. Copy and paste it in a new text file named headcontrol-GUI.py and save it.

You will need to get the eye blink sequence from the sensor for a mouse click. To get it, access the gpio pins and import the gpiozero module into the code to read the



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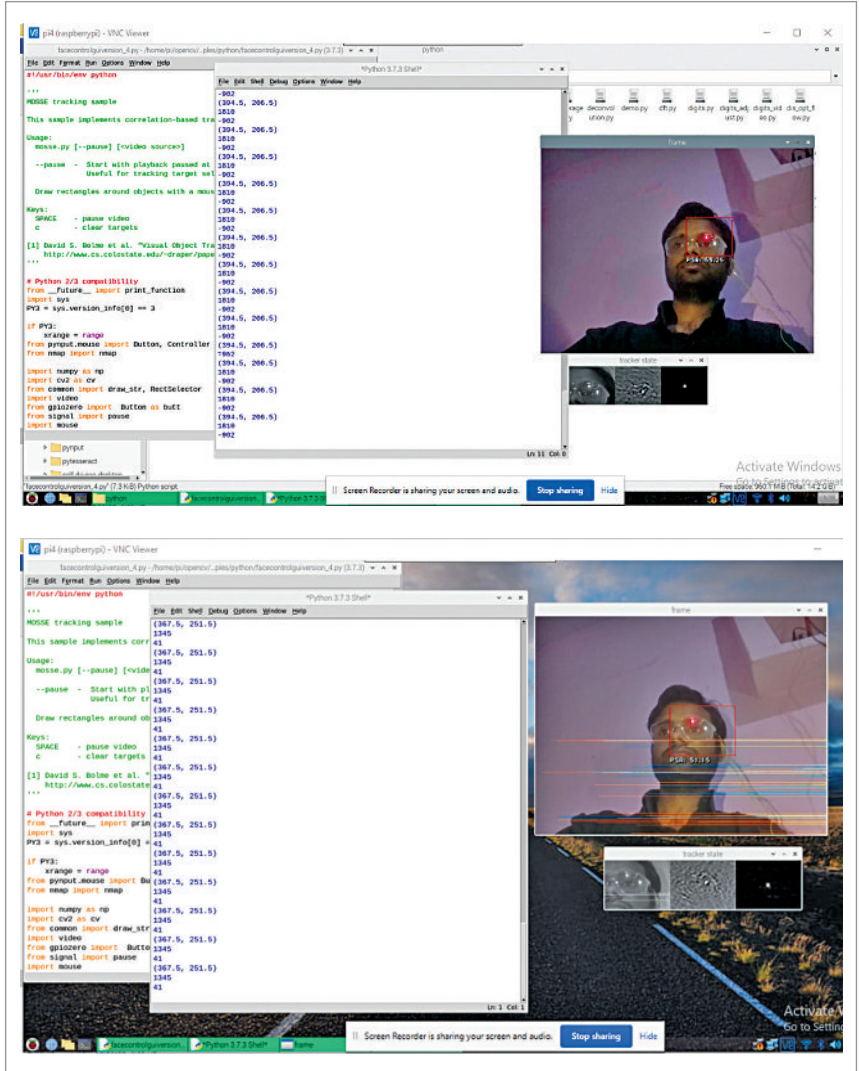


Fig. 11: Testing code and controlling GUI with an eye

blink sensor data.

Also, import the pynput module to create a virtual mouse input for the GUI of Raspberry Pi OS.

Next, create an *if* condition to check the eye status. If the eye status = blink, then set four seconds to determine if it is an intentional blink or a natural one. If the blink is intentional, pass the pynput command to virtual mouse left or right click.

Construction and testing

Put the eyeblink sensor on right side of the eye glasses and wire it to a Raspberry Pi pin. Connect a camera to the RPi board and place it more

than 15cm away from the middle of both the eyes, such that the entire face fits within the camera frame perfectly.

Wear the glasses and run the code. Make sure to mark the red light in the eye (as shown in Fig. 3) with a mouse to track. When successful, a person can operate a PC with eye movement. To move the mouse, move the eye in left, right, upward, and downward directions. To click the mouse, blink (shut) the eye for up to four seconds. **EFY**

Ashwini Kumar Sinha is a technology enthusiast at EFY

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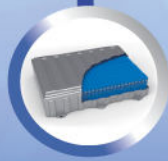
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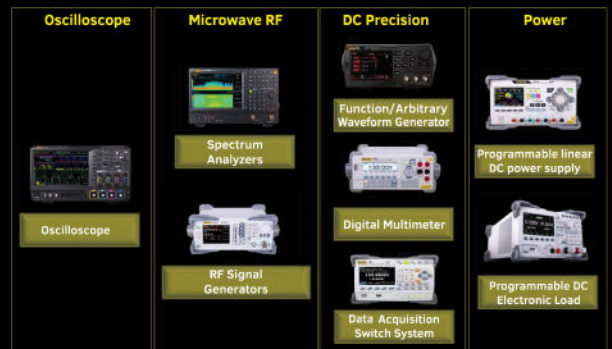
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- Distributors who has been worked with other T&M brands in the past like Tektronix, Keysight, R&S.

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PARTNERSHIP OPPORTUNITIES



Inviting Distributor / Agent To reach PAN India Market

Who we are?

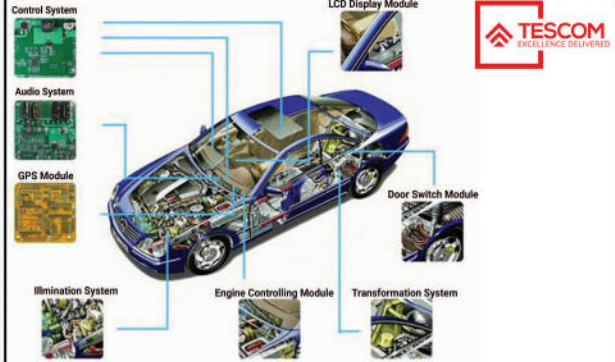
We are an IoT Solution Provider who is working on verticals across Agriculture, Industrial 4.0 and Smart Buildings. We also provide End to End IoT product development services, Electronics Manufacturing Services and Enclosure design services. We ensure our channel partners are touching one of the fastest-growing markets.

Minimum requirements

- Work with verticals like Smart buildings / Industries / Academic Institutions
- Able to promote our product in their portfolio
- Able to do business in latest technology

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Interested? Mr Moorthi Kanagaraj - Director-Business Development – 9940707197



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Partner with us to work on the product development and manufacturing Training projects.



INVITING

Agents

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 - EMI/EMC - RF Antenna - SI/PI
 - Open for other training partners also
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INVITING

Dealers

For Electronics Component Sourcing



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