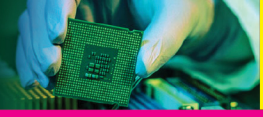


THE BUDGET: Implications for Electronics Industry

SEMICON & DISPLAY FABS: Growth Opportunities for All



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MARCH 2022

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WHAT IS THIS METAVERSE?

The word is popping up everywhere. What does it mean? How is it shaping our future?



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- AI Camera For Tracking Suspicious Activities
- Data Logging Using microSD And Raspberry PI Pico
- Simulation Of Interrupt Based Matrix Keypad Embedded-C Driver For A Microcontroller

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Vol. 54 No. 3
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Pages: 110
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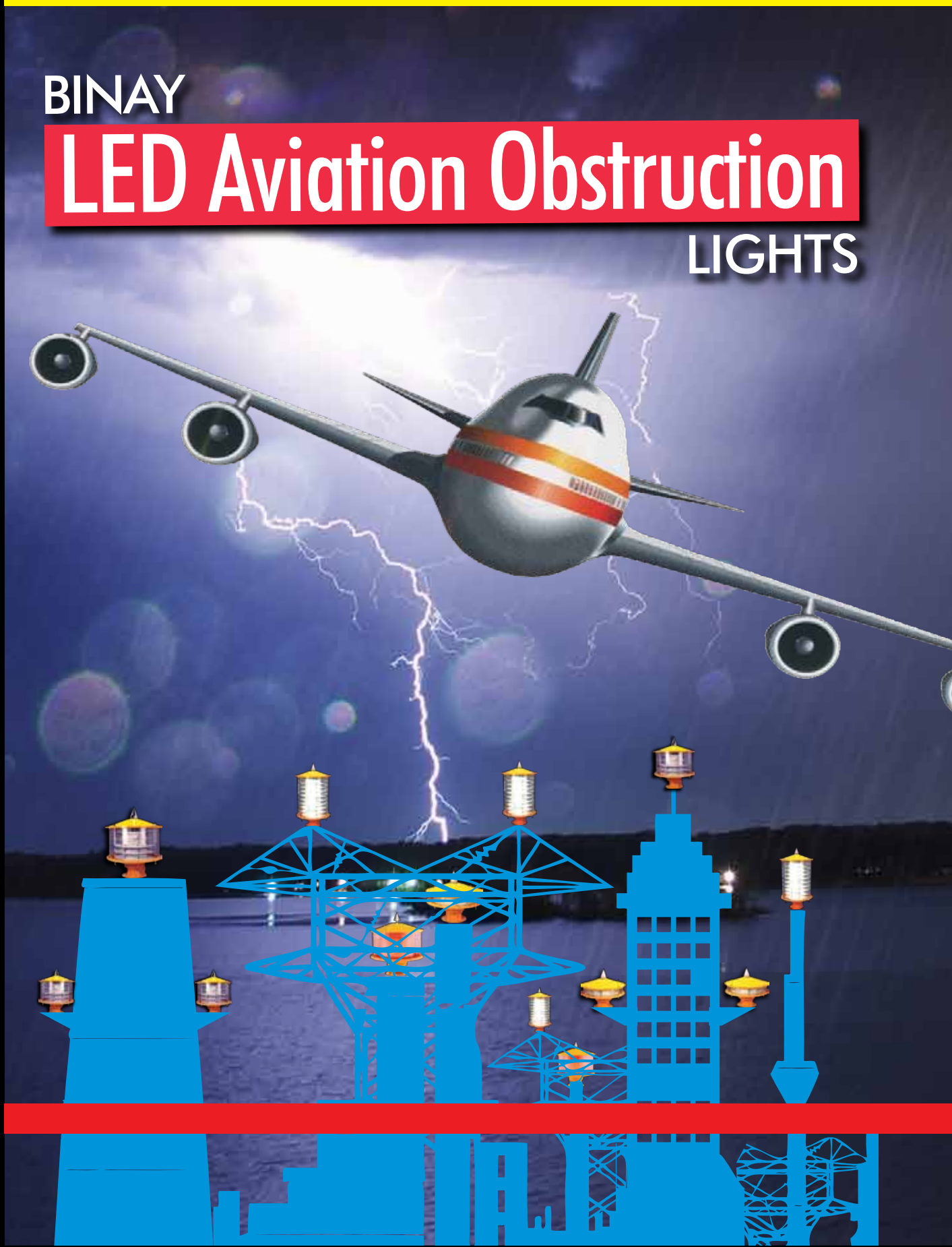
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TECHNOLOGIES SINCE 1983

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

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



High Intensity
200,000 candela
(Flashing White LEDs)



Medium Intensity
20,000 candela
(Flashing White LEDs)



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



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

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

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

The BINAY LED Aviation Obstruction Light offers the following advantages:

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

LED Obstruction Lighting for:

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

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

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

Ph.:+91 (33) 4006 9875, 2475 0062, 2475 0030
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Smart HMI Solution

Graphics, Touchscreen and ML All in One

The Integrated Graphics and Touch (IGaT) Curiosity Evaluation Kit is a low-cost reference demo board integrating graphics, touch and Machine Learning (ML) features all in one convenient solution. Microchip's SAM E51 microcontroller powered by an Arm® Cortex® core can single-handedly drive image processing/ generation, display, mid-range touchscreen and machine learning with gesture recognition.

Minimize system cost, size and design complexity by using the integrated Peripheral Touch Controller (PTC) for touch, instead of using an external touch controller.

All firmware and demos are included in MPLAB® Harmony v3 Software Framework and preloaded out of the box to reduce the learning curve and lower the risk of expensive bug fixes. Full schematic and layout are also provided for shorter design cycles with proven implementation.

Key Features

- Eliminates external dedicated touch controller
- All firmware and demos included in MPLAB Harmony v3 Software Framework
- Full schematic and layout info provided
- Readily available display module with touch panel
- Fully programmable

Contact Information
Microchip Technology India
Email: asia.inquiry@microchip.com
Phone:
• Bangalore (080) 3090-4444 • New Delhi (012) 0496-3497 • Pune (020) 4121-0141





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FROM YOU

YOUR SUGGESTIONS AND THINGS YOU WANTED TO KNOW!

THE E-ZINE

Thanks for the e-zine issues! It was exciting to see various topics covered in your magazine, which makes it one of the most informative and advanced leading electronic technical magazines in India, no doubt. Keep it up! It's great to receive the e-zine; I am sharing it with my professional colleagues. Thanks!

Anthony D'Sa
Consultant, Control & Automation Systems

• • •

BATTERIES PROTECTION

Recently I read the 'Protection Mechanisms For Batteries And Their Charging Systems' article in January issue. It's really useful. I have learned a lot. Thanks to EFY and the author!

Prakash U.M.

EFY. Thanks for the feedback!

• • •

TOY CAR

I am interested in the 'Remote Controlled Toy Car Demystified' DIY article published in October 2021 issue. Can I get the PCB and other electronic items for this project?

Senthil

EFY. Please visit www.kitsnspares.com or write to *info@kitsnspares.com* for the project kit, including the PCB, electronic components, and project manual.

• • •

APPLIANCES PROTECTION CIRCUIT

I wish to draw your attention to an error in the circuit diagram of 'Circuit To Protect Appliances From High/Low Voltages' DIY article published in February issue. The diode across the relay coil is wrongly drawn. Its anode should be connected to the collector of transistor and cathode to the + ve line.

Ramprakash Venugopalan

• • •

HUMAN-PRESENCE SENSOR

There seems to be a typographical error in 'Human-presence Sensor' article under the Truly Innovative Tech section in January issue. In the first line, shouldn't "Ultra-sideband" be Ultra-Wideband?

Prakash U.M.

EFY. Thanks for pointing out the mistakes above! We highly appreciate your quick alerts, which would help the other readers.

• • •

BATTERY CHARGER

My 48V, 5A lead-acid battery charger is not working. So, I have following questions:

1. How can I repair my battery charger?
2. What are 25NF60N and 330MF250V codes in the charger circuit?
3. If the two MOSFETs and capacitors are replaced, would the MOSFETs blow off?
4. Would the charger function, if I replaced these components?
5. How to avoid blowing off components during soldering?

Roy
Kolkata

EFY. 1. While some battery chargers can be easily repaired, the chargers with SMD components are not so easy to repair. However, to repair, first you need to identify the exact problem. Check for any loose connection, short-circuit, faulty components, or a blown fuse (if used) in the circuit. Based on the problem you would need the required tools and parts to repair it.

2. The codes you are referring to seem be the part names of the components. Here, 25NF60N and 330MF250V could be an N-channel MOSFET and electrolytic capacitor, respectively.

3. It is not clear why you would like to replace MOSFETs and capacitors. If these are damaged, first try to find the root cause. If you replace them with wrong components or polarities, the MOSFETs could blow off or may not work.

4. After rectifying the root cause, if you replace the faulty components with appropriate components, it may function again, provided you have not damaged the PCB tracks and other associated components in the PCB.

5. SMD components often get damaged during soldering, but such cases are rare with through-hole components. One of the most common causes of damaging the SMD components is excessive heating with hot air gun. If you apply excessive heat to an SMD component, it may get damaged and even blow off or explode. To prevent that, first apply proper solder paste on the pads, place the components on their exact location on the PCB and then apply just the required amount of heat. Use a fine-tip tweezer to hold the component.

You need to look at typical thermal profiles of each component in the datasheet before soldering. Apply heat or set the temperature of the soldering machine accordingly. Cooling fan may be required, but do not bring the fan too close until solder melts. For lead/tin solder, you can set temperature between 260°C and 280°C and then heat a joint for about 15 to 20 seconds from the top, until solder melts and the component settles.

Sometimes improper soldering leads to solder bridging, where extra solder application shorts two points by mistake. When power is switched on, a solder bridge can burn or blow up a component and can even burn out a PCB track!

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



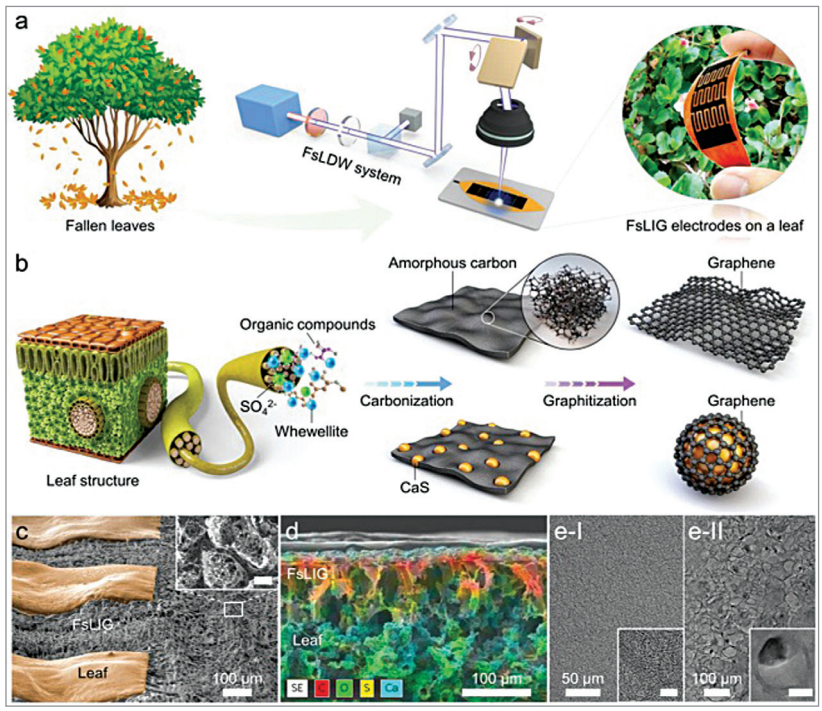
WHAT IF BATTERIES COULD HAVE A BETTER LIFE? AND THEN A BETTER REBIRTH?

If we could give EV batteries a better life, they could give us a brighter, greener future in return. But today, too many wind up wasted in a landfill. ADI's battery management solutions aid in optimizing charge and discharge—helping to give batteries a longer first life, and a smooth transition into a second life.

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See What If: analog.com/WhatIf

ANALOG DEVICES

Eco-friendly micro-supercapacitors built with fallen leaves



A KAIST research team has developed graphene-inorganic-hybrid micro-supercapacitors made of fallen leaves using femtosecond laser direct writing. By irradiating femtosecond laser pulses on the leaves in ambient air, high electrical conductivity can be achieved. This one-step fabrication does not require any additional materials or pre-treatment. The technique could quickly and easily produce porous graphene electrodes at a low price. Potential applications include fabricating graphene micro-supercapacitors to power an LED and an electronic watch.

The schematic illustration of the production of femtosecond laser-induced graphene (Credit: https://news.kaist.ac.kr)

Versatile power transfer technology for wireless charging

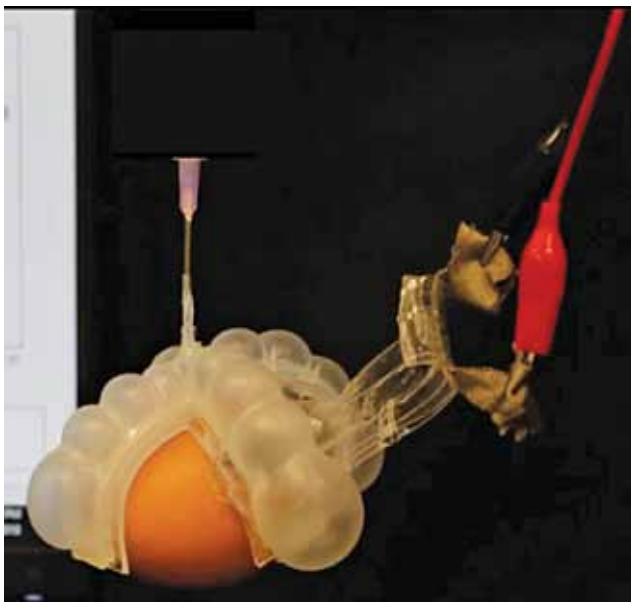
Researchers at Aalto University have developed a power transfer technology that works regardless of the position and orientation of the transmitter and receiver. The key idea is to arrange the transmitters in a grid with the current in neighbouring transmitters running in opposite directions—for example, a clockwise loop in one transmitter and counter-clockwise loops in its neighbours. This creates a chessboard-like grid of 'positive' and 'negative' transmitting coils with a magnetic flux between them. A receiver above the grid of transmitters captures the magnetic flux between positive and negative transmitters, which generates an electric current to charge the device.



Wireless charging of a retail robot at a test site (Credit: www.aalto.fi/en)

Soft, stretchable, self-powered thermometer

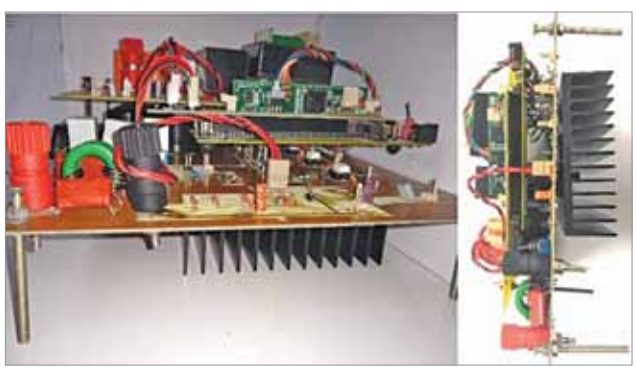
Researchers at the Harvard John A. Paulson School of Engineering and Applied Sciences (SEAS) have developed a soft, stretchable, self-powered thermometer that can be integrated into stretchable electronics and soft robots. The thermometer consists of three simple parts: an electrolyte, an electrode, and a dielectric material to separate the two. The electrolyte/dielectric interface accumulates ions while the dielectric/electrode interface accumulates electrons. The charge imbalance between the two sets up an ionic cloud in the electrolyte. When the temperature changes, the ionic cloud changes thickness, and a voltage is generated. The voltage is sensitive to temperature but insensitive to stretch.



A stretchable thermometer for soft robots (Credit: www.seas.harvard.edu)

On-board chargers for EVs

A team of researchers at IIT-BHU Varanasi, along with experts from IIT Guwahati and IIT Bhubaneswar, have developed a new, low-cost technology for the on-board charging of vehicles that can further bring down costs of two- and four-wheeler electric vehicles. The technology will also enhance the charging infrastructure of vehicles in India and contribute towards sustainable development of EVs by improving community health through the elimination of tailpipe emissions and reduced reliance on fossil fuels.



EV charging prototype (Credit: www.electronicsforu.com)

Face mask turned into smart monitoring device

Northwestern University engineers have developed a new smart sensor platform for face masks that they are calling a 'Fitbit for the face.' Dubbed 'FaceBit,' the lightweight, quarter-sized sensor uses a tiny magnet to attach to any N95, cloth, or surgical face mask. Not only can it sense the user's real-time respiration rate, heart rate, and mask wear time, it also may be able to replace cumbersome tests. All the information is wirelessly transmitted to a smartphone app, which contains a dashboard for real-time health monitoring. The app can immediately alert the user when issues such as elevated heart rate or a leak in the mask unexpectedly arise. The physiological data could also be used to predict fatigue, physical health status, and emotional state.



Inside of a mask with FaceBit device (Credit: https://news.northwestern.edu)

Glucose sensor based on boronic acids and graphene

Researchers at the University of Bath in collaboration with industrial partner, Integrated Graphene, have developed a new sensing technique based on graphene foam for the detection of glucose levels in the blood. Since it is a chemical

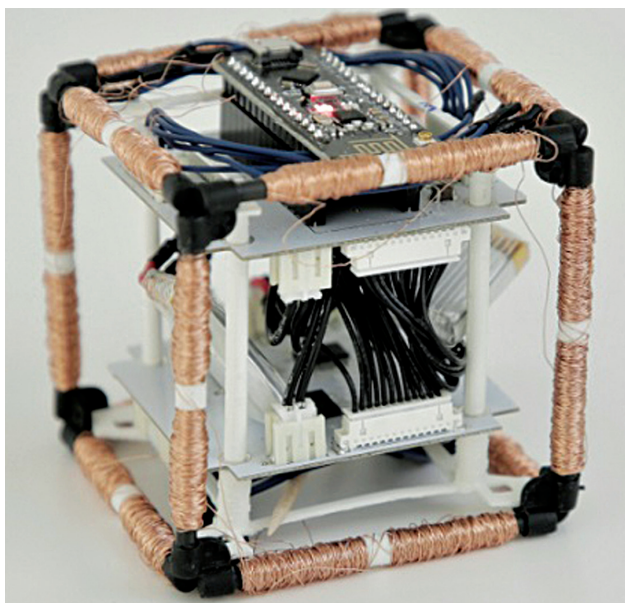


The enzyme-free sensor is more robust and not temperature sensitive, so could be particularly useful in hot countries or where refrigeration is limited (Credit: www.bath.ac.uk)

sensor instead of being enzyme-based, the new technology is robust, has a long shelf-life, and can be tuned to detect lower glucose concentrations than current systems.

Scalable and reconfigurable robots using electromagnets

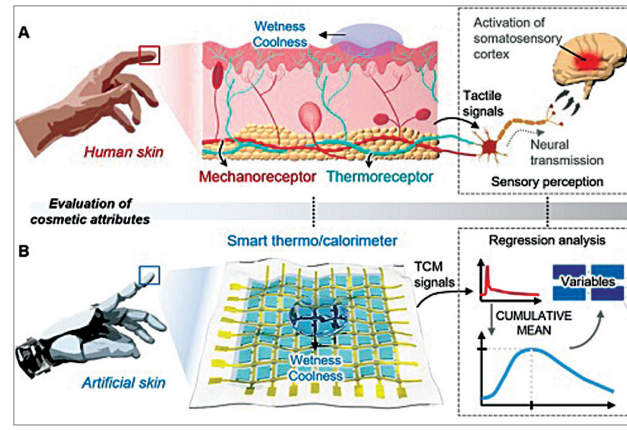
An engineering team from MIT CSAIL has devised a cube-shaped reconfigurable robot structure called ElectroVoxel that utilises an electromagnet based actuation framework to reconfigure in three dimensions via pivoting. The modular self-reconfigurable robot (MSRR) has electromagnets lined at the edges of each cube that attract or repel each other to reconfigure into different shapes and sizes. Powered by a LiPo battery, the 3D printed cube-shaped structure has nearly 800 turns of electromagnet wound around a ferromagnetic core. Applications include space exploration, search and rescue, shape-changing user interfaces, and endlessly more.



Elements of an electromagnetically actuated reconfigurable robot (Credit: MIT CSAIL)

Intelligent tactile sensor that measures skin sensations

Amorepacific, in collaboration with the Ulsan National Institute of Science and Technology (UNIST), has developed an intelligent tactile sensor that can measure skin



The intelligent tactile sensor co-developed by Amorepacific and UNIST (Credit: PR Newswire)

sensations by combining machine learning with measurement technology. By withstanding external pressure and staying intact, the ultra-thin flexible sensor can recognise and measure the temperature, moisture levels, and the type of solution used on the skin surface. The new sensor will enable the development of finetuned cosmetics and skin products.

Used face masks turned into batteries

Scientists at NUST MISIS, together with their foreign colleagues, have developed a new technology for producing

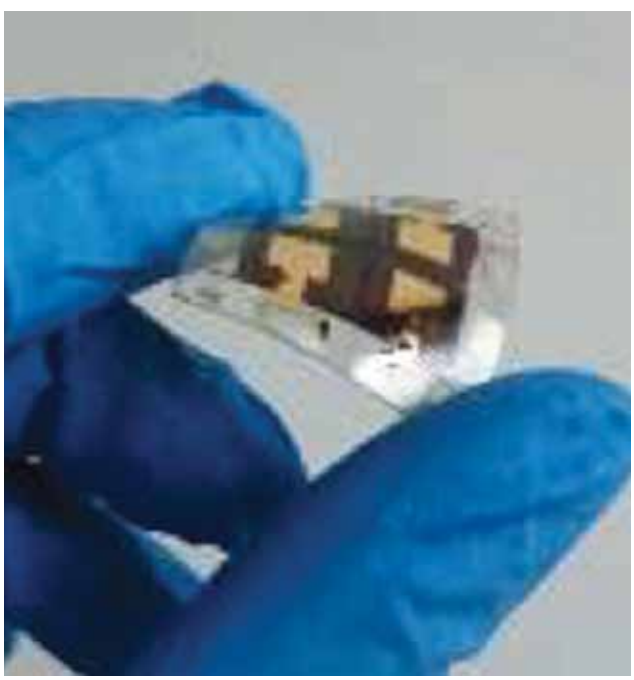


Tonnes of used face masks to be turned into energy (Credit: https://en.misis.ru)

cost-effective batteries from used masks. Thus, medical waste forms the basis for creating batteries. To create a battery of the supercapacitor type, the masks are first disinfected with ultrasound, then dipped in 'ink' made of graphene, which saturates the mask. Then the material is pressed under pressure and heated to 140°C. A separator (also made of mask material) with insulating properties is then placed between the two electrodes made of the new material. It is saturated with a special electrolyte, and then a protective shell is created from the material of medical blister packs (such as paracetamol). The new batteries can be used in household appliances from clocks to lamps.

Perovskite solar cell made with thin paper

A new method that uses a simple sheet of paper to deposit the perovskite films without any expensive equipment at all has been developed by a team from Tor Vergata University and University of Zanjan. The trick to achieve high performance with this remarkably cheap method is to soak the paper applicator in anti-solvent,



Photograph of the solar cell with PET/ITO/SnO2/perovskite/Spiro/Au architecture (Credit: Centre for Hybrid and Organic Solar Energy)

which almost doubles efficiencies compared to when using it dry, reaching 11% on flexible plastic substrates. Paper, compared to other soft applicators, possesses the right porosity and smoothness for deposition of high-quality perovskite films.

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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*

Low-power Bluetooth SoC

The ATM33 series Bluetooth 5.3 family of high-performance system-on-chip (SoC) enhances Atmosic's advanced

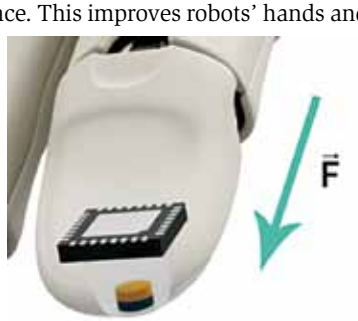


energy harvesting and ultra-low power technology. It integrates a power optimised Arm Cortex M33F that can operate up to 64MHz and supports Arm TrustZone for robust security. The SoC series has improved energy harvesting efficiency, a wider harvesting input range, a lower cold start voltage, lithium-ion battery support, and low-power voice processing. It can perform functions such as access memory and transmit beacons even while in deep sleep. The eco-friendly SoC series supports unparalleled battery life and battery-free operation.

Atmosic
www.atmosic.com

Tactile sensor

Tactaxis is a fully integrated tactile sensor that is compact, soft, and provides a 3D force vector acting on its surface. This improves robots' hands and



grippers, making delicate operations such as fruit picking possible. It features multiple 3D magnetometer pixels and is accompanied by a magnet which is embedded into an elastomer material. This presents a soft contact interface, emulating the attributes of human skin. The arrangement offers a high sensitivity so that detection of even small amounts of force generates a response. The sensor equips robots with the sense of touch to manipulate fragile objects.

Melexis
www.melexis.com

4D lidar with high resolution

The Aeries II is a 4D lidar sensor built with automotive-grade reliability to enable the next wave of autonomy across applications in automotive,

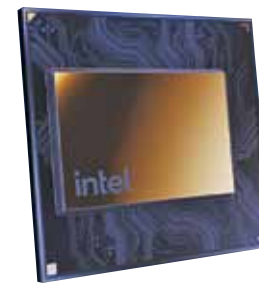


industrial, and beyond. Leveraging Frequency Modulated Continuous Wave (FMCW) technology and lidar-on-chip module design, the sensor uniquely detects the fourth dimension of instantaneous velocity for each point in addition to 3D position. Advanced 4D Perception software powers ground-breaking new features like 4D localisation and ultra-resolution, a camera-level image with up to 20 times the resolution of legacy lidar sensors. Built for reliability with automotive-grade ratings, the device ensures peak performance across a variety of road and environmental conditions.

Aeva
www.aeva.com

Chip for crypto mining

Intel Blockchain Accelerator chip is designed for crypto mining. It can offer 1000x better performance per watt



than mainstream GPUs on tasks like SHA-256 based mining. Existing ASICs consume a lot of power while mining, which now appears to be solved with the upcoming custom chip for blockchain-specific applications. The chip is designed to also solve the energy consumption problem by mining as it is a scalable and sustainable solution for replacing normal mining GPUs with custom-made blockchain accelerated chips. The Blockchain Accelerator Chip is implemented on a tiny piece of silicon, which does not affect mainstream computer processors like CPU and GPU.

Intel
www.intel.com

AI chip

The new chip's architecture delivers the performance required for next-generation applications such as AI model training, HPC, drug discovery,

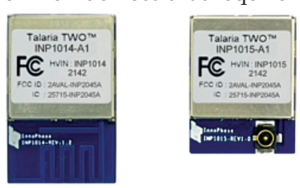


and metaverse processing. Designed in tune with advanced silicon geometry, the architecture solves high-performance computing needs in reliability, security, and power consumption at scale. It has been designed on cutting-edge 5nm process technology. The architecture offers a high level of scalability to fit seamlessly into multiple sectors such as data centres, AI supercomputing, automotive, robotics, metaverse processing, and life sciences.

Ceremorphic
www.ceremorphic.com

Ultra-low-power wireless modules

The INP1014 and INP1015 modules offer wireless connectivity and integrated microcontroller for edge-of-network IoT devices that require low



INP1014
(w/ PCB Antenna)

INP1015
(w/ U.FL Connector)

power consumption and a direct-to-cloud connection. The INP1014/1015 modules provide the industry's lowest power Wi-Fi connectivity with their unique, programmable, digital radio architecture, and include multi-protocol Wi-Fi and BLE5-Long Range for wireless data transfer. They can operate in stand-alone mode, in conjunction with an external MCU, or in a hybrid mode. The new modules offer 40% size reduction to provide greater design flexibility and extended battery life. The platform expedites the development of smart IoT products such as connected sensors, security cameras, asset tracking devices, health monitoring wearables, audio speakers, and many others.

InnoPhase
www.innophaseinc.com

Rugged tactical grade IMU

The Pulse-40 is a 6 degrees of Freedom inertial measurement unit (IMU) that offers unmatched performance in harsh conditions in a miniaturised size for applications where precision and robustness matter in all conditions. It



integrates cutting-edge MEMS three axes accelerometers and gyroscopes in a unique redundant design that allows to shrink the system size while pushing performance level to its maximum. Thanks to sensors featuring extremely low vibration rectification error (VRE), the Pulse-40 can sustain high vibration environments up to 10g RMS.

SBG Systems
www.sbg-systems.com

Switching power supply ICs

Two new AEC-Q100 qualified, 1700-volt rated ICs that expand Power Integrations' InnoSwitch 3-AQ family are the industry's first automotive-qualified switching power supply ICs

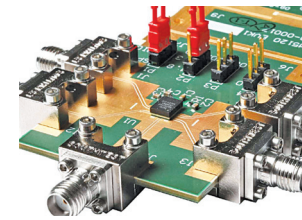


to incorporate a silicon carbide (SiC) primary switching MOSFET. Delivering up to 70 watts of output power, the new ICs are targeted for use in 600- and 800-volt battery and fuel-cell electric passenger vehicles, as well as electric buses, trucks, and a wide range of industrial power applications. The ICs reduce the number of components required to implement a power supply by as much as 50%, saving significant circuit-board space. The ICs can be implemented across a broad range of consumer, computer, communications, industrial, and automotive applications.

Power Integrations
www.power.com

High-power SP4T switch

The MM5120 is a high-power single-pole/four-throw (SP4T) DC-to-18GHz switch that provides high performance,

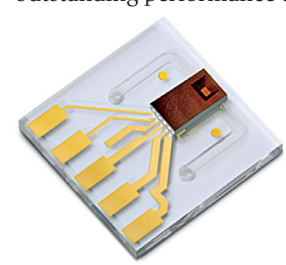


reliability, and integration for RF switching applications. It offers ultra-low insertion loss, 25W power handling, and the highest linearity in the industry, significantly outperforming conventional solid-state switches and electromechanical relays. The MM5120 switch eliminates the compromises developers face when deciding between electromechanical relays or solid-state switches for RF designs. It reduces cost and simplifies the development of numerous RF systems, including RF filters and front ends, device interface boards for semiconductor test and beamforming antennas used in advanced radio architectures and radar systems.

Menlo Microsystems
www.menlomicro.com

Mini liquid flow sensor

With a footprint of only 10x10 mm^2, the liquid flow sensor LPG10 series provides outstanding performance and speed in measuring liquid flow. It is a smart sensor solution that offers flow rates from the low microlitre-per-minute range up to one millilitre per minute. The use of glass as the only wetted material ensures optimal compatibility with biological and pharmaceutical processes. Due to its highly compact integration into any fluidic manifold system, it is ideal for high-volume applications with strict space limitations.



Sensirion
www.sensirion.com

NEW PRODUCTS

MAKE IN INDIA

COMPONENTS

Automotive distance sensor

The new A19360 wheel speed and distance sensor is suitable for use in emerging applications in advanced



driver assistance systems (ADAS). The cutting-edge magnetoresistance (GMR) sensor provides automakers with the signal resolution and reliability required for advanced levels of automation in passenger vehicles and mobility-as-a-service applications. It includes an eight-event-per-magnetic-cycle mode targeted at ADAS applications, providing an increment for every ~5mm of tyre roll. It also includes a four-event-per-magnetic-cycle mode that doubles the number of outputs per magnetic cycle that allows designers to halve the number of poles on in-wheel ring magnets to save costs, or increase the air gap and still obtain the same number of increments per revolution.

Allegro MicroSystems
www.allegromicro.com

Low-current Zener diodes

These 50µA low-current voltage regulator Zener diodes are ideal for low bias and portable battery-powered devices in mobile, wearable, automotive, and



industrial applications. Available in three different surface-mountable (SMD) package options, in an ultra-small discrete flat no-leads (DFN) package and AEC-Q101 qualified parts, they are the ultimate in customer choice and flexibility. The Zeners feature a non-repetitive peak reverse power dissipation of ≤40W, total power dissipation ≤300mW, and low dynamic resistance. They are also available as Q-portfolio parts, meeting the AEC-Q101 and ISO/TS16949 automotive quality standards.

Nexperia
www.nexperia.com

MEMS solution

The XCalibur active resonator solves supply chain constraints using programmable semiconductors to deliver a drop-in replacement for quartz

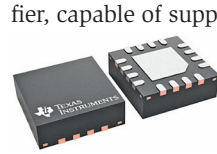


crystal resonators. Additionally, XCalibur provides higher performance and reliability while reducing development time by up to two months in automotive, enterprise, and industrial applications. XCalibur's active resonators provide 10x better reliability than quartz, making them ideal for robustness and long life in harsh environments. The many benefits of these MEMS based resonators also extend to communications and networking, enterprise, consumer electronics, mobile and IoT, and aerospace and defence applications.

SiTime
www.sitime.com

Buffer amplifier

The BUF802 is a wide-bandwidth high-input-impedance (Hi-Z) buffer amplifier, capable of supporting frequency

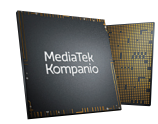


bandwidths as high as 3GHz. The wider bandwidth and high slew rates enable higher signal throughput and minimal input settling time. By eliminating ASICs, designers who use this buffer can get to market faster while achieving a wide dynamic range at a fraction of the cost. Designers can leverage this faster throughput to measure higher-frequency signals more accurately in test and measurement applications including oscilloscopes, active probes, and high-frequency data-acquisition systems.

Texas Instruments
www.ti.com

System-on-chip

The Kompanio 1380 chip offers a new level of performance and best-in-class features for premium Chromebooks,



such as the new Acer Chromebook Spin 513. The Kompanio 1380 delivers incredible portable computing experiences with superb battery life, all in a compact form factor for slim and lightweight devices. Features include powerful processing with an octa-core CPU having four high-performance Arm Cortex-A78 cores with speeds up to 3GHz for improved responsiveness, powerful multi-core AI processor, 4K60 HDR display support, giving device makers a wide variety of resolution, performance, and external connectivity choices to meet any product design, AV1 hardware decoding, voice assistance, and ultra-fast connectivity.

MediaTek
www.mediatek.com

NFC Type 2 tag ICs

The ST25TN512 and ST25TN01K NFC Forum Type 2 tag ICs deliver a new



balance of cost and performance for high-volume use cases like consumer engagement, product information, and brand protection. Also suitable for smart-city applications and access control, the ST25TN512/01K NFC tag ICs support multiple user-protection

and privacy mechanisms including a 7-byte unique chip-identifier code, TruST25 digital signature, NFC Forum T2T permanent write locks at block level, and a configurable kill mode that permanently deactivates the tag. Additional benefits include a wide operating-temperature range of -40°C to +85°C and long data retention.

STMicroelectronics
www.st.com

Non-isolated offline switcher IC

The AP3928 is a universal AC high-voltage input non-isolated offline switcher IC that addresses the challenges associated with using a bias



power supply. It delivers safe and reliable power, while simultaneously maintaining elevated performance figures and enabling significant cost savings. This switcher IC is optimised for situations where higher power levels are mandated, such as in industrial control or home automation systems, home appliances and IoT devices. A key differentiator of this high-voltage switcher IC is that it supports conventional offline non-isolated flyback configurations as well as more streamlined non-isolated buck configurations, keeping the bill-of-materials (BOM) to a minimum.

DIODES Incorporated
www.diodes.com

GaN MMIC power amplifier

The new GMICP2731-10 GaN MMIC power amplifier helps deliver high RF output power while simultaneously ensuring the data signals retain their desired characteristics. The GMICP2731-10 is fabricated using GaN-on-silicon carbide (SiC) technology. It delivers up to 10W of saturated RF output power across the 3.5GHz

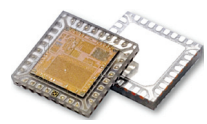


bandwidth between 27.5 and 31GHz. Its power-added efficiency is 20%, with 22dB small-signal gain and 15dB return loss. A balanced architecture allows the GMICP2731-10 to be well matched to 50 ohms and includes integrated DC blocking capacitors at the output to simplify design integration. It is designed for use in commercial and defence satellite communications, 5G networks, and other aerospace and defence systems.

Microchip Technology
www.microchip.com

Optical encoder sensors

The FlexSense series is a revolutionary technology designed to optimise



optical encoder applications and consists of the FS210 transmissive incremental encoder and the FS310 reflective incremental encoder sensors. The FlexSense encoder sensor array vastly reduces the design complexities of optical encoder solutions and integrates several key features including auto-alignment capability, a closed-loop LED driver, on-chip diagnostics, and a state-of-the-art 8x interpolator. In addition, the fully programmable array system on chip (SOC) provides a versatile solution that can adapt to a multiple range of code-disk diameters and pulses per revolution as well as several LEDs.

TT Electronics
www.ttelectronics.com

MODULES & BOARDS

IoT starter kit

The Wiliot Starter Kit contains everything retailers need to experience the IoT transformation. It includes postage stamp sized computers—the

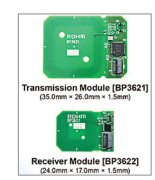


IoT Pixels—pre-mounted on both cardboard and a coffee cup. The IoT Pixels can sense a range of physical and environment data, such as temperature, fill level, motion, location changes, humidity, and proximity. The kit also includes small Bluetooth bridge devices that energise and read the IoT Pixel tags. The harvested data is relayed to the Wiliot Cloud via gateways. Through the starter kit, retailers can explore projects that enable a host of new retail use cases—from enhanced inventory management to consumption monitoring, anti-counterfeiting, product traceability, and more.

Wiliot
www.wiliot.com

Wireless charger modules

The BP3621 (transmitter) and the BP3622 (receiver) modules allow



adding wireless power supply functionality to smaller devices, such as smart tags/cards or PC peripherals. The 13.56MHz wireless charging modules allow users to easily add wireless power functionality to thin and compact devices. Measuring just 20mm² to 30mm² each, the BP3621 and BP3622 incorporate an optimised antenna (coil) layout. It



WE LOVE TO SHOWCASE NEW PRODUCTS!

Launched a New Product related to electronics?
Share its details with us at newproduct@efy.in
Send a photo too. We will be happy to review it, and if it matches our guidelines—we will publish it here, for FREE!

enables configuration of a compact wireless charging system using the 13.56MHz frequency band to deliver up to 200mW. Using the transmitter and receiver modules as a pair can significantly reduce the development load for prototyping and evaluation.
ROHM Semiconductor
www.rohm.com

DC-DC converter

The BMR350 is a non-isolated DC-DC converter in a quarter brick format, rated at 860W continuous and 1200W peak power.



BMR350 is ideal as an intermediate bus converter for powering processors and ASICs with peak power demands. The product features an input of 40-60V (80V/100ms) and a fully regulated output of 12V at 100A maximum, adjustable from 8V to 13.2V. An innovative transformer-coupled, non-isolated topology reduces component count and current stress and yields an efficiency level peaking at >97.8% at half load 48V input voltage. Derating for the BMR350 is characterised by the innovative 3D thermal data graphs, which specify available output power for given real-world pin and baseplate temperatures up to 100°C.
Flex Power Modules
www.flexpowermodules.com

LTE Cat 1 modules

The LARA-R6 is the smallest LTE Cat 1 module with global coverage on the market. The u-blox LENA-R8 includes a global navigation satellite system (GNSS) receiver based on the u-blox M10 platform. Together, the modules comprise five certified global, multi-regional, and regional product variants, simplifying logistics for product developers and increasing design flexibility. The modules offer device makers facing imminent 2G and 3G network sunsets a future-proof migration path to 4G technology for data streaming applications.





u-blox
www.u-blox.com

Modules with 12th Gen processors

The 12th Gen Intel Core processor based computer-on-modules (COM) are available in two form factors—COM-HPC Client Type and COM Express Type 6. ADLINK COMs with the Intel 12th Gen Intel Core processor family (Codename: Alder Lake-H) allow for a unique design that can be adapted for single-thread or multithread performance. The advanced hybrid architecture can be used for stationary, mobile, and portable solutions. It also provides system integrators with future-proof design that supports both current and future best-in-class peripherals.



ADLINK Technology
www.adlinktech.com

AC-DC power supplies

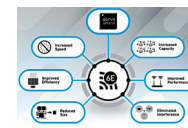
The TPI 180 and TPP 180 are a set of encapsulated AC-DC power supplies coming as open frame and encased versions. They feature a reinforced double I/O isolation (3000V AC) system according to the latest medical safety standards (60601-1 3rd edition, 2 x MOPP). The leakage current is below 300µA and makes the units suitable for BF (body floating) applications. The excellent efficiency of up to 94% allows a high power-density and compact design (3" x 2" for open frame and 3.6" x 2.44" for encased version). High reliability is provided by using high-quality components and an excellent thermal management, making the TPI 180 and TPP 180 an ideal solution for industrial and medical devices, and for demanding safety and space critical applications.



TRACO Power
www.tracopower.com

Wi-Fi front-end module

QPF4730 is the first wideband Wi-Fi front-end module (FEM) covering the 5.1GHz to 7.1GHz bands for customer premises equipment (CPE). It can provide full-frequency support for both Wi-Fi 6 and Wi-Fi 6E enterprise solutions. The QPF4730 enhances efficiency in Wi-Fi 6/Wi-Fi 6E architectures and is optimised for power over Ethernet (PoE), improving quality of service (QoS), range, and throughput. This solution maximises user capacity and leverages the full available spectrum. It also enables manufacturers to design smaller form factors than current gateways to meet user expectations for more compact, sleek and efficient designs.



Qorvo
www.qorvo.com

Safety relay module

The X90 control system by B&R now comes with an option board that allows floating-ground connection of external safety devices, making mobile machines even safer. With the new safety relay module, external safety components, such as drives or laser scanners, can now be connected to the X90 controller via a floating-ground emergency stop circuit. A safety level of PLe/SIL3 can be achieved. The option board is particularly suitable for autonomous agricultural and construction vehicles.



B&R Industrial Automation
www.br-automation.com

T&M SOLUTIONS

5G test platform

The new R&S CMX500 one-box tester provides extensive device testing capability, including support for all 5G NR deployments covering LTE, 5G NR FR1 and FR2 in non-standalone (NSA) and

standalone (SA) mode, for both FDD and TDD, with an effortless setup and an outstanding performance. Manufacturers of cutting-edge 5G NR capable chipsets and devices as well as certification providers can cover the entire product lifecycle with the R&S CMX500 one-box tester, from all early R&D design phases to end-to-end application testing, including device certification. Data-hungry enhanced mobile broadband (eMBB) applications like 8K video streaming or augmented and virtual reality can fulfil high data rates in uplink and downlink.



Rohde & Schwarz
www.rohde-schwarz.com

Calibration solutions

Existing and new customers of the PicoVNA 108 8.5GHz vector network analyser can now benefit from automated E-Cal calibration and TRL/TRM calibration. The PicoVNA 108 achieves calibration automation through either male SMA or female SMA E-Cal modules. Simply power the module, make a single connection of the E-Cal standard between the PicoVNA test ports and then initiate the automated procedure from within the PicoVNA 108 user interface. The TRL (Through Reflect Line) and TRM (Through Reflect Match) calibration typically measure substrate-mounted DUTs, for example surface-mounted networks or components on a PCB or ceramic.



Pico Technology
www.picotech.com

Enhanced mixed signal oscilloscope

With numerous enhancements, the 5 Series B mixed signal oscilloscope (MSO) delivers even more versatility while continuing to provide high-fidelity waveforms, unique spectrum analysis capabilities, and flexible signal access. Built on the performance and integrity that engineers rely on with the original 5 Series MSO, the B version includes customer-centric updates led by a new auxiliary trigger input that lets users synchronise the oscilloscope to an external signal without consuming any of the 4, 6, or 8 full-capability input channels. For the optional, built-in arbitrary/function generator, the maximum frequency output increases from 50MHz to 100MHz, enabling higher frequency stimulus for Bode plots and impedance measurements.



Tektronix
www.tektronix.com

High-speed 800G test portfolio

To enable the optical transceiver ecosystem for improving the power efficiency of components and modules used in data centre equipment, Keysight's portfolio of high-speed digital 800G test solutions has been expanded. These additions are new design and validation solutions that support multimode interfaces, which are critical for an energy-efficient data centre infrastructure. The 800G multimode test solutions uniquely support high-speed data interconnect speeds of up to 100 gigabit per second (Gbps). The extended portfolio supports 400G and 800G design validation from early research and development to manufacturing.



Keysight Technologies
www.keysight.com

SOFTWARE

Software for PCB design

Altair PollEx, an electronic system design (ESD) software tool for Altium users, empowers printed circuit board (PCB) designers to predict and maximise overall PCB performance and verify manufacturability. Altair PollEx for Altium is a free version of PollEx designed to support various electrical computer-aided design (ECAD) software products, the first of which is Altium Designer, as announced at AltiumLive. Altair PollEx for Altium will make board-level simulation and design verification features seamlessly accessible to Altium Designer users.



Altair
www.altair.com

NOR memories design tool

With the SEMPER Solutions Hub, a one-stop portal with all the building blocks needed to integrate SEMPER NOR Flash into an application, developers can quickly design safety-critical and inherently secured automotive, industrial, and communications systems. The SEMPER Solutions Hub provides the development edge needed to accelerate the design process. The web portal offers easy access to software development kits (SDKs) containing production-grade drivers and application code examples. Additionally, it offers hardware kits for prototyping with microcontroller (MCU) system boards from both Infineon and third-party suppliers, MCUs and available integrated development environments (IDEs).



Infineon Technologies
www.infineon.com

Data diagnosis software

The PCAN-OBD-2 Viewer offers an easy way to develop own applications based on the OBD-2 communication standard. The tool and the API can be used with all PC-CAN interfaces from PEAK-System. The PCAN-OBD-2 Viewer supports all OBD-2 services that are transmitted via CAN. A virtual cockpit displays the data graphically in analogue and digital instruments. Optionally, individual parameters can also be displayed as

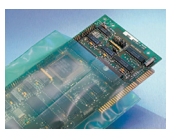


graphs, including the option of exporting graphs and data sets. In addition, diagnostic trouble codes and available test results are displayed.
PEAK System
www.peak-system.com

CHEMICALS & ADHESIVES

Recyclable static dissipative stretch film

A new recyclable speciality film, Eco-Sonic VpCl Static Dissipative Stretch Film, has been developed for applications where static discharge could result in dangerous packaging conditions, such as electronics and fertilisers. The new stretch film meets the anti-static requirements under MIL-PR F-81705 E, while featuring multi-metal corrosion inhibitors and EDS protection. The stretch film reportedly eliminates the static discharge that can typically arise from the pressure and friction of stretch-wrapping applications, which cannot be dissipated by grounding. Additionally, the stretch film does not interfere with electrical, optical, or mechanical surface properties and does not require costly barrier packaging.



Cortec Laboratories
www.cortecvci.com

MANUFACTURING EQUIPMENT

Intelligent SMT component assembler

The new intelligent freeform feeder gives manufacturers a fast and effective alternative to taping loose components. It also serves to eliminate one process step and reduce the possibility of human error. The system comprises a pair of trays (one white, one black, to optimise optical contrast against the loose components), each featuring nine separate cells to hold different components. These are simply dropped into the 25mm × 18mm cells without the need for any orientation or alignment. Using machine vision, advanced component recognition algorithms identify the devices held in each cell irrespective of angle, physical position, or polarity, allowing the placement machine to pick and place perfectly.



Europlacer
www.europlacer.com

Solder paste inspection equipment

The new dual-mode MRS sensor for the SE3000 SPI system provides maximum flexibility for dedicated solder paste inspection applications, with one mode for high speed inspection and another mode for high resolution inspection. The new sensor is an extension of the proprietary Multi-Reflection Suppression sensor portfolio that provides industry-leading performance in semiconductor and SMT markets. The SE3000 is ideal for measuring height, area, volume, registration, and bridging, as well as detecting insufficient paste, excess height, smear, offset, and more.



CyberOptics
www.cyberoptics.com

ENTERPRISE CLASS

Industrial grade PCs

The 38cm and 54.6cm (15-inch and 21.5-inch) SPC-1533-B1 and SPC-2133-B1 rugged industrial-grade panel PCs offer significant improvement in water resistance and structure, which ensure uninterrupted and efficient operation even in a rigorous operating environment. They meet the stringent requirements of the industrial automation market as they target IIoT applications in public utilities, maritime sector, transportation, and industrial automation.



Avalue Technology
www.avalue-tech.com

Rackmount network appliance

The INA3600 is a highly reliable 1U rackmount network appliance designed to handle complex and demanding networking tasks for both large and growing businesses. It delivers powerful networking performance optimised for high-density deployments in applications such as network security, SDN, NFV, SD-WAN, data management and analytics. The INA3600 high performance 1U-sized appliances are powered by 10th Gen Intel Core and Xeon W processors (codenamed Comet Lake) and support up to 14Gb Ethernet ports with IBASE proprietary network interface cards.



IBASE Technology
www.ibase.com.tw

Advanced thermostat and humidistat

The HyperStat is a device that senses temperature, humidity, CO_2, occupancy, light, sound, volatile organic compounds (VOCs), and optional particulate matter, making it an affordable one-stop device for WELL Building Standard support. Data from these sensors feed wirelessly into a real-time analytics package and inform 75F's built-in, Guideline 36-compliant control algorithms. In addition, the HyperStat comes packed with four analogue inputs, three analogue outputs, and six relays that leverage software-defined control capabilities for all types of standalone multi-stage and modulating packaged HVAC equipment found in commercial buildings.



75F
www.75f.io

IMPORTANCE Of DRONES And TYPES Of DRONES For WILDLIFE MONITORING

Drones, or unmanned aerial vehicles (UAVs), are rapidly changing the face of wildlife and conservation industry. They have the potential to revolutionise conservation and spatial ecology. At the core of conservation is the monitoring of species' population and their habitats



DR ANAND NAYYAR is PhD in wireless sensor networks and swarms intelligence. He works at Duy Tan University, Vietnam. He loves to explore open source technologies, IoT, cloud computing, deep learning, and cyber security



DR MAGESH KASTHURI is a senior distinguished member of the technical staff and principal consultant at Wipro Ltd. This article expresses his views and not that of Wipro



A drone used for wildlife monitoring (Source: www.airbornedrones.co)

Traditional approaches and devices used for wildlife monitoring have been high-cost, sometimes inefficient and not so practical when used in remote or rough terrain areas. A major issue in monitoring systems is that the species can feel threatened and attack the monitoring devices and personnel, which could potentially impact the monitoring activities and lead to time and money wastage.

Drones fitted with thermal cameras can circumvent these problems and obtain accurate data and high-resolution images in a better, faster, cheaper, and safer manner. The use of drones in conservation sector need not be limited to monitoring and can be extended to management, technical services, eco-tourism marketing, law enforcement, anti-poaching, and search-and-rescue efforts.

Drone users categorised as ecologists or hobbyists need to understand the anatomy of eco-system that they handle. During wildlife monitoring, animals may not get directly disturbed but birds can get



Technical Specifications:

- Payload capacity: 2kg
- Max speed: 120km/hr
- Ceiling: 3048m
- Max take-off weight: 21kg
- Width: 2.6m
- Length: 1.6m
- Endurance: 10hr
- Range: 643km

Fig. 1: Super Bat DA-50

disturbed when they are incubating an egg or hatching it for protection. Hence the drones used should not be noisy or emitting laser lights to avoid disturbance.

Recent research shows that traditional approaches for wildlife monitoring can be dangerous and tedious, while drones can efficiently collect precise observational data for wildlife monitoring. Based on this advantage, research is going on for wildlife monitoring with drones, including thermal monitoring during night or dense forest monitoring. Some of the best practices derived by scientists to manage situations and mitigate, or even alleviate potential physical disturbances to wildlife, when using drones include:

- Expert advice and local resources be used to study the location before using drones for monitoring.
- Appropriate approval and permissions be taken from authorities for using the drones.
- Proper training and dry run experiments be conducted in simulated environment to avoid unforeseen failures in real-time monitoring.
- Proper understanding of civil aviation rules—including restrictions in flying distance/height, border conditions, altitude guidelines, night-time monitoring guidelines—be ensured first.
- Drones be used only for the research and not to disturb animals and threaten their regular life.
- Launch and operation of drones be managed from recoverable distance to avoid failure or accident.
- Drones should be designed to monitor behavioural and physiological stress responses, when possible, and record for study purpose.
- Be ready to abort drone operation when there is excessive disturbance caused to animals.

Drones and AI (artificial intelligence) technology are advancing and evolving wildlife surveys. Tracking species through collaring can be dangerous and may be invasive and disruptive to the animals. Gathering data via drones is more efficient and safer for both animals and the researchers. Using drones, biologists can collect the information they need through specialised sensing technology, including lidar, RGB, corona, hyperspectral, and thermal sensors. Importance of drones is recognised for environmental monitoring to track the health and population growth of indicator species and monitoring the overall health of habitats and ecosystems.

Drones for wildlife monitoring

Wildlife monitoring is a challenging activity among environmental activities like wildlife's social environment, birds, and natural resources such as volcano, waterfalls, and rivers. Since drones are equipped with cameras, laser lights, GPS tracking, altimeters, etc, they are highly effective for wildlife monitoring.

Modern conservation drones also use thermal and long-distance focal-point cameras to monitor wildlife



Technical Specifications:

- Endurance: Up to 5 hours
- Maximum service altitude: 1,220 metres
- Maximum control range: 50km
- 30km live video stream
- Daytime video: 10x zoom Sony block camera
- Night time operations: Flir 640 Vue Pro, Tamarisk 320 or 640 Thermal Imager
- Gimbal: Stabilised 2- and 3-axis with brushless motors
- On-board GPS
- Waypoint navigation
- Flight stability systems

Fig. 2: Air Shepherd ZT-TIC

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

LWI Electronics Inc.

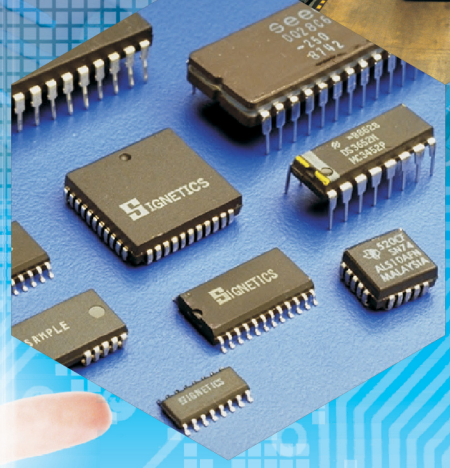
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LIVE WIRE Electronics

ISO 9001:2015 COMPANY

QUALITY 100% ASSURED

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62, 14th Cross, I Block, R.T. Nagar, Bangalore 560032, India
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Cell: +91-9844048366, 9901499900, 9844003611, 9901199900
Email: sales@livewireinfo.com
www.livewireinfo.com

For jobs/career contact: hr@livewireinfo.com

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Live Wire Group: World Sourcing



Technical Specifications:

- Wingspan: 116cm (45.7 in)
- Weight (incl. camera and battery): 1.3kg-1.6kg depending on camera and battery
- Electric motor: Low-noise, brushless
- Radio link range: 3km nominal (up to 8km)/1.9 mi (up to 5 mi)
- Detachable wings: Yes
- Cameras (optional): senseFly S.O.D.A. 3D, senseFly Aerial X, senseFly Duet T, Parrot Sequoia+, senseFly S.O.D.A., senseFly Corridor, MicaSense RedEdge MX
- GNSS grade: Survey
- Carry backpack dimensions: 75×50×29cm
- Backapack weight (empty): 4.6kg
- Carry case dimensions: 75×48×33cm

Fig. 3: Sensefly eBee X

during day as well as night-time. In addition, they use motion sensors and accelerometers for calculating and recording the vehicle movement and even the direction of wildlife animals and/or birds.

Modern AI solutions like footprint identification technique (FIT) are being experimented with for wildlife population tracking and census, animal movement and migration in different seasons, and any occasional or regular seasonal health issues or threats to wildlife animals and birds. The recorded data can be stored in a data pool and used for analytics such as historical data evaluation, any regional and climatic understanding of specific and rare wildlife, and environmental changes over a period of time to study their eco-system.

Following are some of the best wildlife monitoring drones known at present:

Super Bat DA-50. Powered by batteries, its flight time ranges from eight to ten hours. It has a 2-stroke gasoline engine for flight efficiency and longevity. Its operational flight altitude peaks at about 4,600 metres (15,000 feet) at 72.5 to 129 kilometres an hour. Plus, its antenna can send information to the system's ground station along with receiving and sending telemetry.

Air Shepherd ZT-TIC. It was developed specifically for anti-poaching and is in use in several parks in Africa. With a service ceiling of about 1,220 metres (4,000 feet) and an endurance of around five hours, it includes a day and a night camera capable of sending live video feed to an operator up to 30km away. Can fly an automated route and has a control range of 50km line-of-site.

The long-endurance, high-altitude powerful camera and range make the Super Bat and Air Shepherd ideal for covering large areas that encompass most refuges. Both cover ground faster than anyone on foot or by ground vehicle that could alert poachers about rangers looking to catch them. Typical employment of these drones is to determine, based on past patterns, where poachers are most likely to enter the park and operate.

Sensefly eBee X. This is one of the first kind of a fixed-wing mapping and surveying drone, which is usually light-weight and can be launched from hand. It is used by forest rangers, surveyors, and geospatial professionals to manage, monitor, and collect various aerial mapping data, location details, and environmental conditions using built-in sensors and camera.

The raw data collected by Sensefly can be used to maintain and dynamically create stunning high-resolution orthomosaic images. Or it can be used by photogrammetry software, such as Pix4Dmapper, to design and create topographic maps, including DSMs, DEMs, 3D points clouds, and more. We can get critical project insights from these topographic data, which can be shared with wildlife researchers, bird photographers, and animal healthcare professionals for better decision-making.

eBee X is also available with RTK or PPK for greater positional accuracy.

The future of drones isn't in the skies. It's in the ocean. "It feels like an amusement park ride—except it's real. You're really driving around underwater, exploring."—Gizmodo

OpenROV. It is a remotely operated 15cm x 20cm x 30cm mini-submarine that weighs 2.6kg. This submarine is powered by eight 26650-format Li-ion batteries and can be assembled from common items, with the most expensive being Beaglebone Black Linux computer. The submarine is controlled from a laptop computer connected to the submarine via a tether and is equipped with on-board LEDs and a camera. OpenROV is an open source hardware project. Website: *http://openrov.com*; Latest version: 30.1.0

Wildlife surveillance and counter poaching

Constant wildlife surveillance is always useful to avoid man-animal clashes when they cross their paths. There are many wild animals that have been categorised as rare

animals in last fifteen years, such as wild boar and tiger. There are multiple reasons for their poaching and hunting, such as their valuable organs like tusk, bone, and teeth. At times animals attack because of their health issues, environmental changes, and food unavailability issues.

Hence, constant monitoring and surveillance of the wildlife is important to protect them. Conservation drones and modern technologies help in designing a robust solution to handle this efficiently. Using these drones, we can do surveillance remotely and understand the lifestyle of animals and help them to manage life better.

According to a research report from the studies published in *wwf.org.uk*, the fourth largest illegal activity across globe is wildlife poaching. (First three are drug trafficing, child/women trafficking, and counterfeiting.) Modern drone solutions like ideaForge Drones help develop an AI-driven solution for image pattern matching where the endurance cameras capture images continuously. The images are transmitted to remote cloud servers and analysed using AI solutions to understand the anomaly in wildlife movement. This helps in designing a counter poaching approach like alarm signals, diversions using sound notifications, and sensor based protection like dynamic electric fence.

The most popular anti-poaching solutions enabled and equipped by drone systems, which are popular for research and industrial usage, are listed below:

- 100km Skywalker
- Air Shepherd ZT-TIC
- DJI Inspire 1
- Sensefly eBee Plus
- Silent Falcon
- Super Bat Da-50
- Zeta FX-61 Phantom

Such anti-poaching solutions are specially designed for wildlife monitoring and are powered by AI-enabled customised software applications (as bundled license). These can be used for wildlife research related activities like census, animal tracking and migration tracing, habitat management for wildlife in seasonal changes, nest monitoring during incubation, and species identification.



Physical Specifications:

- Weight: 2.6kg
- Dimensions: 30×20×15cm
- Nominal battery life: 2-3 hours

Performance Specifications:

- Maximum depth: 75m (we have taken them past 100m, but true depth depends on build quality)
- Maximum tether length: 300m (100m tether provided)
- Maximum forward speed: 2 knots
- LED brightness: 180 lm

Key Features:

- Live HD video with wide-angle lens and tilt function
- LED lighting for low-light environments
- Easy-to-use Web browser user interface
- Beagle bone Black AND Arduino MEGA microprocessors for a flexible and powerful developer platform with dozens of input/output channels and plenty of computing power for user-designed features and experiments
- Rechargeable lithium batteries (sold separately)
- 100m lightweight 2-wire tether
- Compact and lightweight backpack or carry-on ready
- Payload area for additional hardware or equipment

Fig. 4: OpenROV

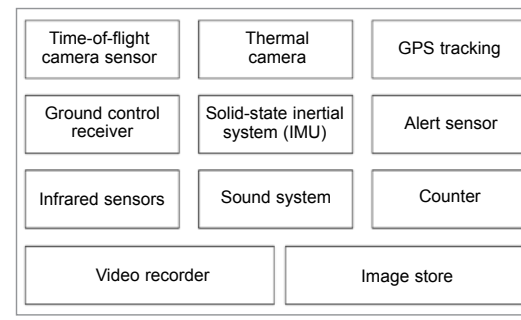


Fig. 5: Conservation drone system for wildlife monitoring

Marine and land mapping

Geospatial information system based drone services are very helpful for both forest and marine (sea/ocean) level monitoring and mapping. These help to understand and study the landscapes, the density of animals and wildlife movements in different zones, climatic changes and their impact on the lifestyle of wildlife and, above all, tracking the poaching activities and devise an anti-poaching solution.

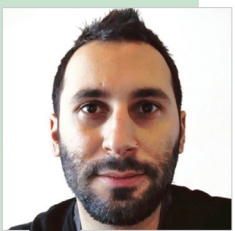
Radio telemetry can be used for animal tracking in forest and marine species monitoring in sea/ocean. For radio tracking animals, they must be tagged with VHF-radio tags to track from remote drone sensors to know their movement and count the animals.

Image analysis software like Agisoft and ImageJ, along with machine learning technique for wildlife availability, can be very useful for data analysis of thermal images captured from drones and used for animal counting and tracking.

These applications are popular in Britain, Germany, and Australia in dense forests and marine areas for wildlife monitoring and tracking. They reduce the poaching activities to a great extent. EFY

Why And How To Become AN OPEN SOURCE CONTRIBUTOR

Open source is often associated with coding, giving the impression it's meant only for computer geeks. But anybody can become an open source contributor—even if they haven't written a line of code their entire life. Sounds interesting? Read on



YOHAN LASORSA is a Senior Developer Advocate at Microsoft

The beginning of the new year calls you to bring about a change in yourself. It could be learning a new skill, becoming healthy, performing your best at work or studies, or anything fruitful that will improve you. In the process, you also want that change to benefit others. Here is an interesting proposition to help you become an open source contributor.

But why?

Why not? After all, it is exciting and will help you achieve your objectives. And, most importantly, you do not need to be an expert in coding. You can contribute without possessing any prior coding experience.

Interested? Let's do it. But first a bit of basic background. The formal definition of open source software goes like this:

Open source software is a software whose source code is released under a license that grants anyone the right to inspect, modify, and distribute it for any purpose. The two important things to note in this definition are 'source code' and 'license.'

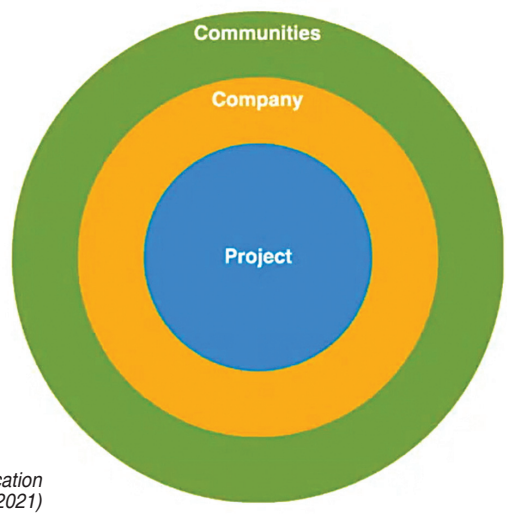


Fig. 1: Circles of communication (Credit: OSI 2021)

Releasing a source code for free does not hinder you from selling the result of your creation. It is possible to earn money based on open source software and make a living out of it. Companies including GitHub and MongoDB, to name a few, are doing just that. Nevertheless, there is a lot more to simply giving away all your software for free.

There is also a difference between free software and open source software. While free software is part of the larger open source community, the opposite is untrue. Open source software allows everyone the right to inspect, modify, and distribute its code. However, free software also forces you to redistribute any changes you made to it under the original license.

Popular open source licenses

There are essentially two different categories. First, there are permissive licenses that allow modifications to the original software code and sell the modified version. Open source codes can be combined and released with little to no constraints, as long as the original licenses and copyrights are not altered. Some common examples of this license category are the MIT license (MIT), Apache license 2.0 (Apache 2.0), and 3-clause BSD license (BSD-3-Clause).

Second, there are copyleft licenses.

The most commonly used one is the GNU General Public License (GPL). If a code is included to a project that is under GPL license, then the final modified version must be released under GPL. The GPL code cannot be mixed with any other proprietary source code. Other examples of this category are GNU Lesser General Public License (LGPL) and Mozilla Public License 2.0 (MPL 2.0).

So, it is the license that separates the general open source community from the free software community.

Why contribute to open source?

Open source software plays an essential part in the functioning of daily-use devices, such as PCs, smartphones, and even cars. Thanks to open source software global tech has evolved at a rapid pace since 2000. Without this transformation, the startup ecosystem would not have thrived.

A key benefit of taking the help of open source while starting a new project is that it saves time and energy spent reinventing everything from scratch. You can simply reuse some of the previous work released under an open source license. By building upon it, you can create something new and innovative. With open source, you can focus on what's important for your work instead of every time going through the basics.

Another benefit that open source brings is that it can open many new opportunities and careers by helping you become a part of several open-knowledge communities out there. Open source is one of the most efficient ways to learn and hone your technical skills and knowledge because you get to work on highly-technical projects.

You may have heard of open data for sharing datasets for machine learning model training and to access any previous research work. This 'open community' approach helps support various sectors such as education, business, creatives, and many more to achieve their objectives. Imagine reviewing and sharing codes for such purposes while also learning to collaborate with very smart people around the globe. Sounds fun?

Speaking of community interaction, by collaborating with other project developers, you come across different people and ideas. And that helps you build your network.

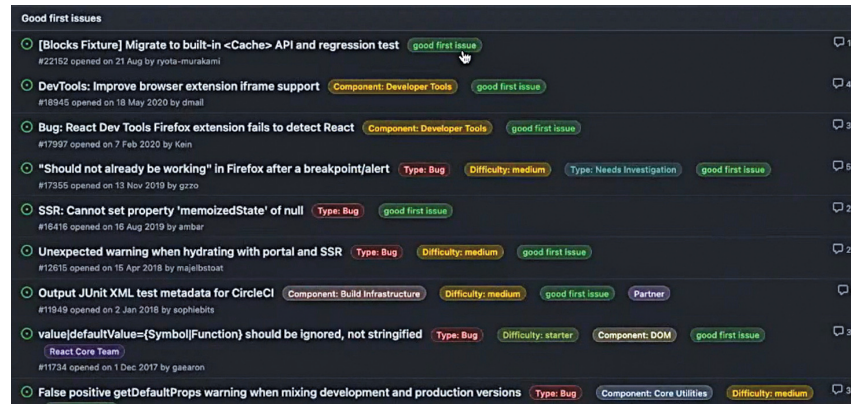


Fig. 2: Screenshot of the GitHub page showing different good first issues (Credit: OSI 2021)

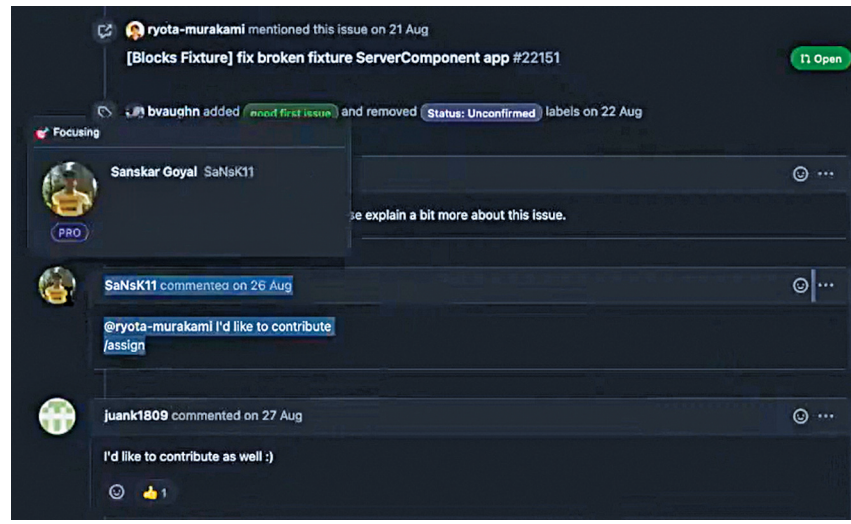


Fig. 3: Screenshot showing a user who has already taken up an issue (Credit: OSI 2021)

Far from the stereotype

Whenever someone is told to describe a developer, most people think of a person working alone with machines. But the truth is the opposite when it comes to real-life work. A big part of software development is communication. Yes, you have to write code for machines. But more importantly, you need to work with your peers and other developers.

Communication also entails getting information and feedback from end-users, UX team, product designers, and everyone else directly involved in a project. Basically, a

Bounties

Websites like Bountysource and IssueHunt offer 'bounties' or compensations for fixing certain problems of various open source projects. This means you can make money by assigning yourself to specific issues and contributing to them. There are other websites as well where you can search for issues that offer a bounty.

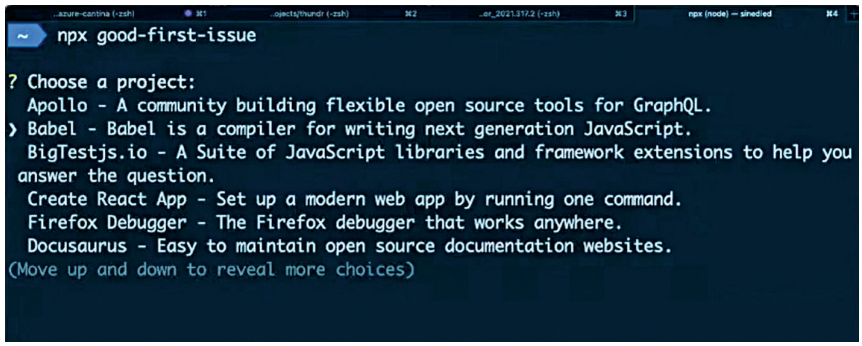


Fig. 4: Command type in and project selection options

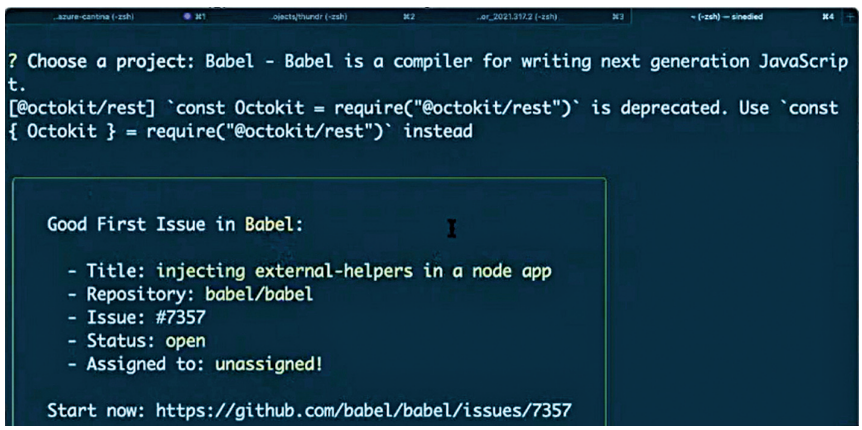


Fig. 5: Example of a good first issue in Babel (Credit: OSI 2021)

developer acts as a central point of communication of a project. All this can be regarded as the first circle of communication.

Outside the immediate circle, a developer is expected to interact with different people outside their project or company, especially with bigger development or open source communities. Doing so exposes the developer to different opinions and constructive feedback, which is very important for improving and building key technical skills.

More contributions = More visibility

As a member of the open source community and by contributing to open source projects, your profile will get more visibility. That means your professional profile will get more desirable views and requests from people looking to hire techies/developers.

Although this is a suggestion and not mandatory, it gives you an edge as it allows you to easily showcase your work results. And if lucky, your open source work can help you skip some of the tricky parts of interviews upon selection for a tech job.

Ground rules before contribution

1. Do not fear making your first contribution. You do not have to be an expert to begin.

2. Even if you have not written a line of code in your entire life, there are still different ways to contribute to open source. You do not necessarily have to learn to code.

3. You do not need to ask anyone's permission before contributing to an open source project. But it is nice to chat with the project maintenance team to have a better chance of your contribution being accepted.

4. Always start small rather than making a big contribution. If you do not know the people maintaining the project, their purpose for the project, and their expectations from your contribution, chances are your contribution will get rejected. You will get less frustrated if you decide to work small and get refused instead of working big for several weeks.

5. Never give up if your first try does not work out. Learn from the feedback to your contribution and make relevant improvements to your style of work. Your contribution will surely get accepted next time.

Steps to make first contribution

Choose a project. If you do not know where to start, there are some open source tools you can use. One of them is a website called First Contributions where you can find a lot of open source projects with specific issues that are friendly for first-time contributions. Simply go through them and select.

On selecting a project, you will be taken to the GitHub page of the project into the Issues section that is filtered with good first issues for first-time contributors. Go through the different issues and select whichever one interests you.

After selecting the issue, read the general description to know what you are expected to do. If someone has already assigned himself/herself to the project, look for any other issue to work upon.

If you do not wish to go through GitHub, there is another method for which Node.js should be installed in your machine. Type *npx good-first-issue* in the terminal and it will give you a list of available projects. For instance, if you choose to contribute to Babel, a random issue will be automatically picked. To start working on the issue, go to the given GitHub link.

Before making any contribution, check whether the project has been actively maintained over time so that your contribution request gets

accepted soon.

Work on a project. To make a pull request for starting your first contribution, go to the link *aka.ms/first-pr* that will take you to the GitHub repository called First Contributions. There you can access a tutorial on how to create your first pull request, which includes forking the repository, cloning the repository on your local machine, making a change to a file (for example, adding your username by creating a new branch), committing the change to a local copy of the project, pushing those changes to Github, and then creating the actual pull request where the project maintenance will be able to review your pull request, give a feedback, and accept/reject your changes.

As stated earlier, coding is not the only way to contribute to an open source project. There are many other ways. The first one is to promote the project and share it on different social media platforms. If you have experience with a particular project, you can answer some of the questions related to it on Stack Overflow or GitHub. It will be very helpful for project maintenance.

Another good way to make the first contribution is to go through the project documentation and fix errors. You can also write tutorials and translate the documentation into different languages. Making the project accessible to a lot of different people is well appreciated.

If you come across any bug, then do report it. If you do not report, then nobody's going to have a look and timely fix it. Although not a fun way, if you like writing unit tests for projects, especially after witnessing a bug that escaped someone else's notice, you can do so as it is one of the good ways to contribute to any open source project.

If you are a good designer, you can design a nice logo for a particular open source project. Like this, there are multiple ways to contribute.

If you plan to work on an issue of a specific project, do assign yourself to the issue so that other people can know that someone else is working on it.

Submit your pull request. Certain things can increase the chances of your pull request getting accepted. The first thing is to read the contribution guidelines before submission. It is good to describe the changes made and why for the project.

Just be mindful that some of the people maintaining an open source project won't be able to regularly check the repository. So, be patient and allow them time to go through your pull request.

Giving and receiving feedback is an essential part of the open source cycle. It helps to understand what needs to be changed. If you receive criticism, do not take it as a personal attack but as a means to further improve your skills. Since hundreds of big open source projects get reviewed every day, feedback on your contribution may take days—even months. Nevertheless, don't worry, you will eventually receive it.

Get ready for a new adventure

After all your hard work, unfortunately, everything may not work out the first time. May be your contribution did not fit the project's objective or someone else contributed in a better way. Do not worry, it happens. Remember to never give up. Once your contribution gets accepted, you will be motivated to contribute further.

So, if you love the philosophy of sharing content, receiving feedback, and being a part of a larger tech ecosystem, the life of an open source contributor is meant for you. EFY

The article is based on the talk 'How and why become an open source contributor' held at Open Source India 2021. The article has been compiled by Vinay Prabhakar Minj, a technology enthusiast



QUANTUM KEY DISTRIBUTION
The Future Of Secure Communication

We all know that security of information is important, more so when the information concerns banking and financial services, military and defence networks, and various government offices spread all over the globe. The challenge would increase with the introduction of quantum computers that are expected sooner than later. So, let's find out what's being done



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Modern communication technologies and data security are heavily dependent on encryptions to maintain the secrecy of the information being transmitted or stored. In any cryptographic algorithm, information security depends entirely on the privacy of keys. Today's state-of-the-art public key infrastructure (PKI), which is mostly used across the globe to secure the internet, is based on mathematically complex algorithms. The security is based on the assumption that it is virtually impossible, even for the most advanced classical computer, to perform certain mathematical functions, like prime factorisation of a very large integer, in a reasonable time.

However, with the rapid advancements in quantum computing and quantum algorithms, this assumption does not hold very strong. Google's claim of quantum supremacy in October 2019, to perform a sequence of operations in 200 seconds that would take a classical supercomputer about thousands of years to complete, points toward the vulnerability of the existing cryptographic systems in front of an adversary having access to a quantum computer.

Quantum key distribution (QKD) is a method of key exchange that eliminates any probability of eavesdropping. Fundamental rules of quantum mechanics ensure that any case of eavesdropping changes the system irreversibly, and the attempts of eavesdropping get detected.

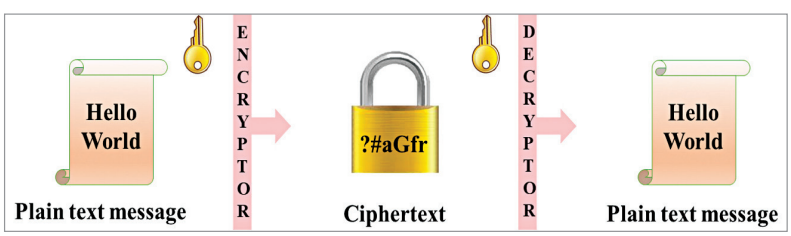


Fig. 1: Process of encryption and decryption

Basics of cryptography

Cryptography is commonly used in communication networks to protect the data being transmitted from the hands of malicious or unwanted users. Before transmission, the information (plain text message) is encrypted to form a ciphertext that is unreadable without access to the corresponding decrypting key. At the receiver, the ciphertext is decrypted to get back the original plain text message. The process is depicted in Fig. 1.

Depending on the key used during the encryption and decryption processes, the cryptographic algorithms can be broadly classified into two categories:

Symmetric key cryptography. In this case, the same key is used for encryption as well as decryption. The key lengths are relatively smaller (128-256 bits). Examples: Advanced Encryption System (AES), Data Encryption Standard (DES).

Asymmetric/Public key cryptography. In this case, the keys used for the encryption and decryption process are different. A public key is used for encryption and a mathematically related private key is used for decryption. Data encrypted with a public key can only be decrypted with

the corresponding private key. Also, it is impossible to derive the private key from the public key. Key lengths for asymmetric key cryptography are relatively longer (>2048 bits). Examples: RSA, DSA, ECC, Diffie-Hellman algorithm.

Challenges with present cryptography

The existing cryptographic algorithms suffer from several shortcomings, such as:

- Intrusions in the system remain undetectable. There have been instances of huge financial and reputational loss when intrusions got unidentified for a long time.
- The security is based on the assumption that certain mathematical operations are impossible to be performed in considerable time, even by the most sophisticated classical computer. But security will be compromised with the advent of quantum computers.
- Brute force attacks on keys are also increasing due to the low frequency of key updates.
- Asymmetric encryption is 2-3 times slower than symmetric encryption due to longer key lengths and the complexity of the encryption algorithms used in asymmetric encryption. As one of the keys is public, both longer key lengths and complex algorithms are prerequisites.

Given the above facts, should we be worried? The answer is, yes. The report of IBM Security titled 'Cost of a Data Breach Report 2020' states the average total cost of a data breach is $3.86 million, having an approximately 10% increase since 2014. In 2015, Michele Mosca presented a detailed overview of cybersecurity in the threat of possible advancements in quantum computing. He came up with an equation, popularly known as Mosca's inequality:

$$D + T \geq Q_C$$

where D stands for the amount of time we need to keep our data secure, T the time it will take our systems to transition from classical to post-quantum, and Q_C the time it will take quantum processors to reach a scale where they can breach existing encryption protocols. There has been a consensus among experts that this inequality has already been breached in the year 2017.

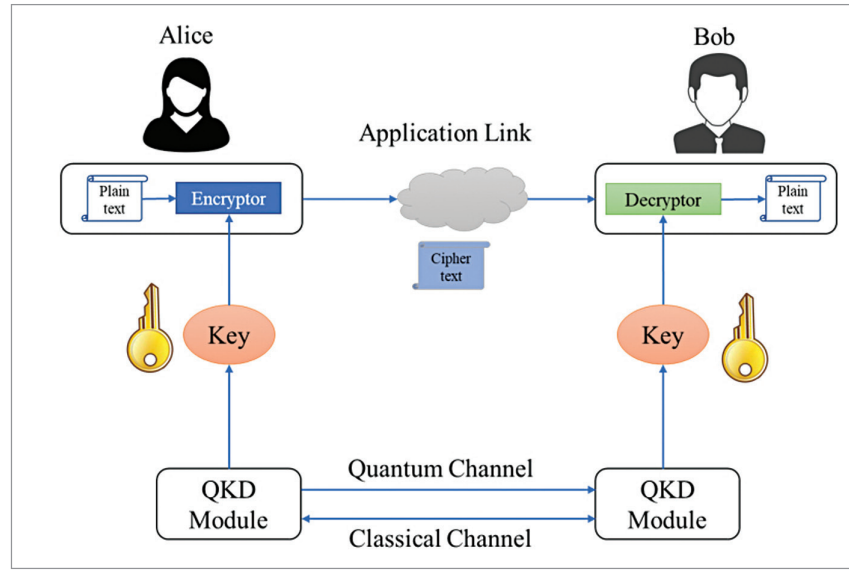


Fig. 2: P2P QKD link architecture

QKD and its architecture

Quantum mechanics, formulated around 100 years back, is now maturing to an extent that its practical applications in the area of computing, communications, sensors, devices, etc have the potential to revolutionise these with unprecedented advances having far-reaching implications. QKD is one of the most emerging applications of quantum communications and will see a plethora of uses and deployments in the years to come.

QKD is a key sharing mechanism implemented in quantum cryptography to generate a perfectly random key that is shared between two nodes (traditionally called Alice and Bob). It is based on the principles of quantum mechanics, that is, Heisenberg's uncertainty principle and no-cloning principle, to guarantee secure key distribution. These principles enable Alice and Bob to generate a shared random secure key that is known only to them. This secure key is used to encrypt the messages that need to be sent by Alice and to extract the original messages from received signals by Bob (and vice-versa). An important and unique feature of QKD is that both Alice and Bob can detect the presence of a third party trying to learn about the key, which inherently makes the generated keys highly secure from eavesdropping.

The sharing of keys between Alice and Bob takes place securely employing a quantum channel and an authenticated classical channel. The quantum channel for this system is typically either single-mode fibre or free space, whereas the classical channel can be a transmission over the internet. Quantum channel and classical channel together form a QKD link. The architecture of a point-to-point (P2P) QKD link is shown in Fig. 2.

The generation of shared secret keys through QKD involves several steps as follows:

- Alice (application sender) and Bob (application receiver) are connected through a classical channel

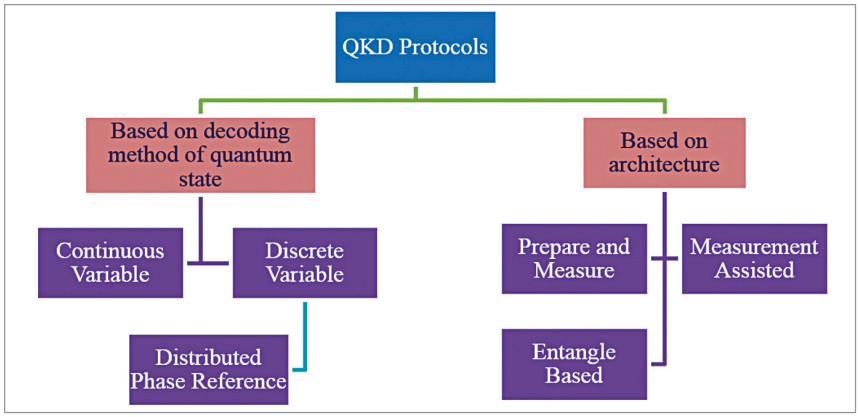


Fig. 3: Types of QKD protocols

that is pre-authenticated. It can be any IP/Ethernet link.

• Alice sends the quantum information, called qubits, over the quantum channel. Depending upon the QKD protocol used Alice can use the quantum properties of light, such as polarisation, phase, or time-of-arrival.

• Bob performs quantum measurements on the received qubits as per the QKD protocol used. There are always some losses in the quantum channel.

• Alice and Bob share some information over the classical channel to arrive at a common secret key. Eavesdropping on the classical channel does not affect the secrecy of the key.

• The raw key undergoes a sifting process in which Alice and Bob discard incompatible qubits based on the protocol used.

• Alice and Bob check the quantum bit error rate (QBER) to check for eavesdropping (by an adversary, commonly called Eve) on the quantum channel. If QBER is less than a defined threshold, the key is further processed. Otherwise, the communication is aborted.

• Due to imperfections in the source, detector, and transmission media, the sifted keys may have some errors that are corrected using error correction algorithms.

• Finally, the keys undergo a privacy amplification process. The keys are compressed by suitable factors to conceal any information that may have gone to Eve during the key generation process.

• The generated keys are stored along with key-ID and delivered to the application on request.

• Keys generated in the QKD system can be mathematically proved to be secure and it is not based on any assumption.

QKD protocols

Charles Bennett and Gilles Brassard proposed the first quantum cryptography protocol in 1984 at a conference in Bangalore (now Bengaluru). This protocol is popularly known as BB84. After that several QKD protocols have been proposed and proved to be information-theoretically secure. The evolution of various QKD protocols was influenced by the following factors:

• Ease of implementation on a physical system

• Rate of secret key generation

• Supported distance between Alice and Bob

• Immunity from quantum hacking activities that exploit the imperfections in QKD devices

Based on the decoding method of quantum states, QKD protocols can be broadly divided into two categories:

Continuous variable (CV) QKD. Here information is encoded using the position and momentum quadrature of a quantised electromagnetic field in an infinite-dimensional Hilbert space.

Discrete variable (DV) QKD. DV-QKD protocols encode information with discrete variables of finite dimension, such as phase, polarisation, or time bin of single photons.

A special type of DV-QKD protocol uses the time and phase of weak coherent pulses to prepare qubits, and coherence between consecutive pulses are checked to identify eavesdropping. This is called distributed phase reference (DPR) protocol. Differential phase shift (DPS) and coherent one-way (COW) are examples of DPR protocols. They are widely used due to the long range and high rate of key generation.

On the other side, based on the architecture of protocols, QKD protocols can be grouped into three categories:

Prepare and measure (P&M). A transmitter (Alice) prepares and sends a quantum state to a receiver (Bob) that measures it to arrive at the final shared key. Example: BB84 protocol.

Measurement assisted. Two transmitters prepare and send quantum states to a receiver (traditionally called Charlie) that performs a joint measurement. The final key is shared between two transmitters. Here both Alice and Bob act as transmitters. Examples: Measurement Device-Independent (MDI) and Twin-Field (TF) QKD protocols.

Entangle based. A transmitter (Charlie) prepares a bipartite entangled quantum state and sends its two parts to two receivers that measure the quantum state. The final key is shared between two receivers. Here both Alice and Bob act as receivers. Example: E91 QKD protocol.

Standardisation activities

Different standard development organisations—like the European Telecommunication Standards Institute (ETSI), the International Telecom-

munication Union (ITU), and the International Standards Organization (ISO)—are developing standards for QKD. This will eventually allow multi-vendor interoperability and open new development opportunities. ITU has come up with a series of standards for the QKD network. Also, a few standards are under preparation.

The ITU-T standards in force are:

- Y.3800: Overview on networks supporting quantum key distribution
- Y.3801: Functional requirements for quantum key distribution networks
- Y.3802: Quantum key distribution networks—Functional architecture
- Y.3803: Quantum key distribution networks—Key management
- Y.3804: Quantum key distribution networks—Control and management

Application

There has been a substantial increase in the internet population along with the number of devices per capita and average data usage. With the roll-out of 5G networks, a much greater number of devices are expected to be connected to the internet. Data security will be more challenging and crucial than ever. As per the report from The Insight Partners titled 'Quantum Cryptography Market To 2027,' the Global QKD market is expected to touch $2 billion by 2027 with a CAGR of 39.2%.

The induction of QKD systems in existing networks to make them quantum secure does not require the entire network to be redesigned. The existing infrastructure can be upgraded with quantum security. The government of India in its Budget 2020 announced a National Mission on Quantum Technologies & Applications (NM-QTA) with a total budget outlay of ₹8,000 crore ($1.2 billion approx.) for five years to be implemented by the Department of Science & Technology (DST).

QKD systems have their relevance in all the networks that carry confidential, sensitive, financially important, or strategic data. Leakage of this data to a malicious user can cause financial, reputational, or strategic loss. The potential users are:

- Banking, financial services, and insurance (BFSI) sectors
- Networks encompassing government offices located across the country
- Healthcare and pharmaceutical industries
- Military and defence networks
- Telecommunications and the IT industry

Contribution of C-DOT in QKD

C-DOT is a premier telecom R&D institute under the Department of Telecommunications, government of India. C-DOT has the legacy of delivering cutting-edge indigenous technology, hardware, and software solutions that are especially targeted to meet the requirements of the rural areas that were digitally unserved for a long time. In the field of QKD, C-DOT has achieved the following milestones:

- Indigenously developed complete hardware and software for both Alice and Bob nodes using both DPS and COW QKD protocols
- Achieved a secure key rate of greater than 1kbps over 100km fibre with a quantum bit error rate (QBER) of 5%
- Successfully simulated photon number splitting (PNS) attack
- Filed two patents with Indian Patent Office:

(i) Device and Method of Synchronisation in Quantum Key Distribution (QKD) System

(ii) An Efficient Method to Automatically Align Phase Modulator with Pulse Generator/Intensity Modulator in the Alice Node of DPS-QKD System

- Integrated the QKD system with C-DOT router as well as post-quantum cryptography (PQC) system as per ETSI standard EFY



ENTER THE METAVERSE
For Better Or For Worse

If we told you that another universe is evolving in the digital space, where people can live just as in ours, would you believe it or write it off as fan fiction? It is time to take a serious look at the metaverse, which coexists—and even interoperates—with our real world, because it is poised to get bigger



HoloLens enables collaboration among surgeons worldwide (Courtesy: Microsoft)



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

You cannot escape the term Metaverse. It stares back at you from the newspapers, television, social media, conferences, investor meets—practically every place except maybe your grandma's living room. (Then again, you might be visiting your grandma in the metaverse!)

Facebook changed the name of the parent company to Meta, while Microsoft is betting big on collaboration using Mesh. Boeing and Airbus want to build their next planes on the metaverse. Barbados is building an embassy in Decentraland. Sotheby's has a store there too, by the way, and Christie's recently sold one of the most expensive pieces of digital art in the metaverse for nearly US$70 million. Adidas opened a virtual showroom in The Sandbox, and Ariane Grande performed a grand concert in Fortnite.

People are buying land and building malls and mansions in the metaverse, while youngsters in Philippines are giving up their real-world jobs as they earn more money by winning battles on Axie Infinity. Closer home, people are depositing their cryptocurrency in fixed deposits on Zionverse, while two Potterheads in Tamil Nadu hosted their Harry Potter themed wedding reception on TardiWorld. The metaverse is all over the place—but what really is it?

The metaverse, 29 years after its conceptualisation

A lot of the advanced technology we see in reality today was once the realm of fiction. Neal Stephenson coined the term metaverse in his 1992 book *Snow Crash*. He described it as a parallel digital world where humans interact with each other in *avatar* form. Almost three decades later, venture capitalist Matthew Ball describes the metaverse as a massively-scaled and interoperable network of real-time rendered three-dimensional (3D) virtual worlds, which can be experienced synchronously and persistently by an effectively unlimited number of users.

That answers all of you who are asking how the metaverse is different from the massively multi-player online (MMO) games, which are so popular today. The multiverse is not one virtual world—rather, it is a universe that brings together multiple virtual worlds. Over time, the virtual worlds will be connected and people will be able to go from world to world, carrying with them their things and money. Basically, their activities will not be tied to one world, but be spread across multiple platforms in the metaverse. That is the broad picture—although it is going to take time to get there.

Not just that, the metaverse will also be a realm that blends real and digital worlds. For example, you will be mingling with real people, and making real money on the metaverse. It is not an entirely fictional world or a game. Satya Nadella, CEO of Microsoft, nailed it when he said the idea is to embed computing into the real world and to embed the real world into computing, bringing real presence to any digital space.

For the love of the game

Filipinos loved to play Axie Infinity. So, they earned Smooth Love Potions (SLP) and Axie Infinity Shards (AXS) by winning battles against zombies! They converted these crypto-tokens into ETH and subsequently to US$ and found that this was more than what some of them were earning in real-world jobs, especially during the covid lockdowns. So, many of them gave up their real jobs to earn money playing their favourite game!

Opportunities for All

The metaverse means opportunities galore, for contributors from various fields. If there is another universe evolving, it means more demand for goods and services, so more jobs are created too.

Here is a small sample:

Chipmakers. Huge amounts of data and heavy processing obviously means huge demand for semiconductors. Likewise, the heavy use of ultrasonic and infrared sensors, force and strain sensing, and motion sensing in VR headsets creates a demand for micro-electro-mechanical systems (MEMS).

Developers. A few months ago, Mark Zuckerberg said Meta would create 10,000 jobs in Europe over five years to make a metaverse. Developers can use the software development kits (SDKs) available for various platforms to build immersive applications for the metaverse.

Designers. When we talk about creating virtual spaces, it obviously requires designers to do the job. In fact, people buying plots on virtual worlds and building houses in them are sometimes engaging real-life architects to do the job. And there is a lot of scope for creativity here, because what you build can defy all the laws of physics!

Creators. Creators of anything digital can sell their wares in the virtual worlds and make real money out of it. The biggest example is Beeple, a digital artist who had erstwhile not sold a single print for over US$10, being able to sell an NFT for nearly US$70 million!

Dissecting the definitions

As we cut through the jargon, you will see that the metaverse is actually made up of several components—virtual worlds, virtual reality gear, digital currency, etc. This will also help you understand the spate of acquisitions going on in this space, as the tech majors like Meta and Microsoft try to bring together the different cogs that make the metaverse run.

"The metaverse is a concept of virtual collaboration where people join shared three-dimensional (3D) environments as *avatars*, where they can talk, teach, learn, work, play and can also transact using blockchain tokens. Overall, it is a combination of 3D collaboration platforms, blockchain, non-fungible tokens (NFT), crypto-currency and gamification," explains Pushpak Kypuram, Founder-Director, NextMeet, a Hyderabad based startup that has developed an immersive metaverse platform for meetups.

The metaverse is made up of virtual worlds

The metaverse, as we said, is made up of several virtual worlds, many of which are evolved gaming platforms. Second Life, for example, was launched in 2003. Although it seems like a game from the outside, its 'residents' take it quite seriously—it is their chance at a second life, where the first one has not met their expectations. It feels like being in a real world, where the residents explore, meet other residents, socialise, build, create, shop, and trade virtual property and services with one another.

Way back in 2008, a couple even married each other on Second Life. They later met each other in the real world, and, thankfully hit it off. But it can also be the other way round; with couples getting divorced due to affairs in the virtual world.

Not all virtual worlds are, like, complete worlds. Some of them focus on some activities alone. For example, in World of Warcraft, Fortnite, Call of Duty, or Axie Infinity, you battle with villains to save the world. In Farmville, you focus on developing an awesome and profitable farm. In The Sandbox, you play God's assistant, exploring and bringing together resources like water, soil, humans, wildlife, and machines to create stuff.

If you are tired of superhuman environments, then maybe you can go for the LokaLocal, a virtual world based on 3D maps of real-world

Digital Justice

As the lines between real and virtual worlds blur, our *avatars* need to be as alert as us, because the dangers of the real world are bound to occur in the virtual one too. We need to be aware of cyber frauds and privacy infringement. Cases of groping on MR platforms have also been reported. Soon after Meta launched Horizon Worlds, a beta tester reported on their website that she had been groped by a stranger on Horizon Worlds. Meta reviewed the incident internally, and suggested that this could have been averted if the tester had used a tool called Safe Zone, which is a protective bubble users can activate when feeling threatened. Within it, no one can touch them, talk to them, or interact in any way until they signal that they would like the Safe Zone lifted. While some platforms have such features in place, many do not. And even where such features are available, most users do not know about it. So, more awareness has to be created.

Tech futurist and author Dr Ayesha Khanna suggested in one of her interviews that all virtual worlds must have some systems in place for digital justice and good governance, to prevent digital harm and cyber-crime, and to punish such occurrences if they occur despite best efforts.

cities and locations, where players can chill out in 3D versions of their favourite hangouts like Connaught Place in Delhi, Marine Drive in Mumbai, or MG Road in Bengaluru.

There are also virtual spaces for more serious work, like Microsoft Mesh and Meta's Horizon Workplaces for collaborative meetings and design sessions, or NextMeet for meetups, and VRXtream for organising events.

Meta hopes to also bring you closer to your family and friends with Horizon Worlds and Horizon Homes, where, rather than fighting to save the world, you will be building escape rooms, social hangout spaces and party games to foster relationships.

So, now we know that there are multiple virtual worlds in this metaverse, each with different themes and purposes. If you look at it very objectively, these worlds are nothing but interoperable software platforms that you log in to for work or play. What makes them worthy of being called 'worlds' is their immersive nature, and ability to host thousands of people in a single instance of the server.

These worlds are immersive, and you enter them as *avatars*

Take Zoom or Google Meet—these are also ways of interacting with people. But everyone, including you, is just a thumbnail in it. You can see and talk to each other, but you are not really in the same space. The metaverse, on the other hand, is immersive and experiential. You enter this 3D digital space and become part of it, along with others. So, if you are playing with friends in Horizon Worlds, your *avatars* will be together in the same park or beach. If you are attending a math session, you will be sitting in a virtual classroom next to your friend.

So, to experience the metaverse, you first need an *avatar*, and then you need the tech gear to immerse yourself in the virtual world. Your *avatar* is, simply put, a 3D character that represents you in the digital world. You can create your own *avatar*, or customise available ones, most of which look like animated characters. However, the more serious and real-world applications emerging today will feel better if your *avatar* looks something like you. So, Epic Games owned company Unreal Engine has developed a tool called MetaHuman Creator, which would help you develop digital humans that look and behave pretty much like you.

Once you have an *avatar*, you enter the virtual world. "Metaverse can be experienced using personal computers (PCs), laptops, mobiles, etc. Virtual reality (VR) and augmented reality (AR) are hardware technologies used to experience the metaverse. With VR, you are in a 360-degree immersive environment, whereas with AR you augment the 3D elements with the real world," explains Kypuram. Going a step forward, we now have mixed reality (MR)—a form of AR where the real world and digital objects are not just visually interleaved but also interact with each other.

As the Rs (VR, AR, MR) keep increasing, we see them being brought under one umbrella term called extended reality (XR). According to VRdirect, the term simply represents any sort of technology that alters reality for the user by blurring the line between real and digital worlds. So, it combines VR, AR, and MR, as well as any new technologies that will come up in the future.

VR/MR headsets need no introduction to gaming enthusiasts—Oculus from Meta, HoloLens from Microsoft, and Playstation VR headsets from Sony, to name a few. VR headsets, most commonly used by serious gamers, will totally immerse you in a simulated environment using 3D vision, spatial sound, and motion trackers that sense movement of your eyeballs, and sometimes even jaw movements. The headsets usually come with handheld gaming controllers too. Some advanced sets might also include cameras to detect full body movement, and haptic feedback vests to give you a sense of touch—so you can feel it when your opponent punches you!

MR headsets go a step further to combine real-world and digital elements, usually using holographic display tech. Not an easy task, and right now they cost a whopping lot, but MR headsets might be the actual solution to balancing real and digital lives. Betting big on the metaverse, most of the industry majors are working on developing advanced MR headsets. Last year, Meta revealed two such projects—Project Nazare and Project Cambria. Apple is also developing an MR headset. Microsoft HoloLens 2 is a preferred MR headset for professional and industrial uses—but its lowest-end model costs most than US$3,000.

The problem with most headsets

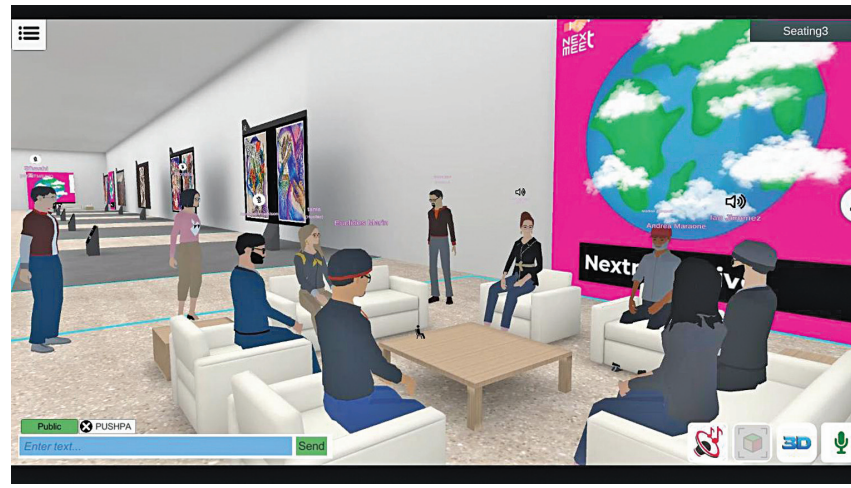
today is that they are not comfortable to wear for long durations, and do look a little odd when worn in public. Or perhaps it is a saving grace, as it naturally pulls out someone who tends to spend too much time in the virtual world.

You can manage without these Rs too

Leave alone an expensive MR set, the average internet user does not even have a VR headset. So, if you are conducting a university course on the metaverse, or a company town hall, how can all the employees participate?

"The metaverse can be experienced via PC and mobiles, but a VR or MR headset would enable users to experience real immersion. Right now, a decent VR headset would cost around US$300 and an MR headset would be around US$2,000. VR and MR technology is in motion, and it has gained good traction in some niche markets like industrial training and simulation. Once more affordable and comfortable VR/ MR headsets are in the market, it will become a consumer product. Right now, people who want to attend an event in the metaverse—say, a townhall conducted by their company—can come either on PC, mobile, or VR depending on the convenience and availability," says Kypuram of NextMeet.

Vignesh Selvaraj, CEO, TardiVerse, shares similar sentiments. TardiVerse developed a Harry Potter themed space in their block-chain powered TardiWorld for Dinesh and Janaganandhini to celebrate their wedding reception with friends and family, without any restrictions on the number of guests! Given the cost of headsets, it would not have been possible for all the attendees to login with one. So, they decided to keep it simple. While they had special equipment for the wedding couple to be present at Hogwarts' Great Hall, others just had to click on a web link, create a login for themselves, choose and customise an *avatar*, and enter. They could participate in events and games using simple mouse or touch screen controls. This is what is practically possible currently, but over time as headsets become more prevalent, people can immerse themselves fully—just like video gaming enthusiasts do already!



Art event at Broward College, Florida, USA, powered by NextMeet (Courtesy: NextMeet)



NFTs priced at US$10 were sold on BeyondLife.club to celebrate Dinesh and Janaganandhini's metaverse wedding reception (Courtesy: BeyondLife.club)

The metaverse supports economic activity

Virtual reality platforms are not new—we have been watching this space for a long time. The real twist in the metaverse story probably came when these make-believe worlds suddenly became hotbeds of commercial activity, and people started minting money. This is a subject in its own right, but for the sake of completeness we will attempt to give you a short overview of commerce in the metaverse.

When you think of trade, the two basic elements that come to mind are assets and currency. In a virtual world, these are powered by blockchain technology.

Assets are represented by non-fungible tokens or NFTs. A non-fungible token is a non-interchangeable unit of data stored on a blockchain. Think of it as a unique digital token that represents a digital asset. So, buying an NFT gives you ownership of the associated digital asset. Once an NFT has been encoded using blockchain technology, no one can alter its ownership data or metadata. Owners can prove its validity using blockchain verification. NFTs can be moved across different ecosystems owing to the open nature of block chain standards. So, you can trade NFTs outside the world in which you bought them! Ethereum is the most popular blockchain platform used for encoding NFTs, but one can also use others like Tezos, Algorand, or Polkadot.

Just as NFTs represent assets, crypto-currencies serve the equivalent of money. These are fungible tokens, that is, they can be inter-



Daler Mehndi hosted a Republic Day concert on the PartyNite metaverse from Gamitronics, becoming the first Indian to perform on the metaverse (Courtesy: Daler Mehndi on Instagram)

changed. They are identical to each other and traded, hence an ideal medium for commercial transactions. Ether (ETH) is the native crypto-currency of the Ethereum platform. Every virtual world can have its own native currency, which can be converted into other crypto-currencies, or even real-world money based on prevailing conversion rates. For example, MANA is the native crypto-currency in Decentraland. Approximately 1123 MANA equals 1 ETH, and 1 ETH equals US$3,137.5 (you heard it right!), so 1 MANA is roughly US$2.8.

With the basic building blocks—assets and currencies—in place, marketplaces began to emerge in the virtual world. Some of the well-known ones are Decentraland to buy, develop, and sell virtual plots of land; OpenSea to trade in rare digital items and crypto-collectibles; SoRare for digital player cards and virtual teams; SuperRare and MakersPlace for authentic digital art; and so on. Almost every virtual world, in fact, has a marketplace that sells related ware.

Last year, Sotheby's bought a plot of land in Decentraland and developed a metaverse store, which is an exact replica of its London store. In March 2021, Mike Winkelmann, a digital artist popularly known as Beeple, sold the NFT of one of his digital works for US$69 million at Christie's. In December 2021, Adidas released its first range of NFTs (that sell for approximately 0.2ETH) at its showroom in The Sandbox. Nike has filed several trademark applications in the past couple of months for upcoming virtual rollouts. Last year, in February, the US based National Basketball Association's online platform for NFT Basketball cards registered a sale of about US$250 million.

Gucci, Christian Dior, Ralph Lauren, all the fashion biggies have stores in 3D virtual worlds! And on the other end of the spectrum, Pizza Hut, Pringles, and Taco Bell are also selling themed NFTs.

One of the reasons for the popularity of these meta marketplaces is the ease of trading. You just setup a digital wallet, buy crypto-currency, connect your wallet to an NFT marketplace and start selling or bidding for an NFT—be it a plot of land, a collectible football card, or a rare piece of digital art.

Putting it to real use

A technology can garner attention but not sustain itself unless it proves to be really useful. Entertainment is a given, but will the meta worlds also improve the quality of our lives in the real world?

"People have been playing 3D games since the last three decades. Now, since remote working and learning is the norm, gamification will become necessary in these spaces too. Just like businesses have been developing websites on the internet for nearly three decades, now every brand will start having 3D experiential stores. Like mobile devices replacing desktop computers, eventually holographic projections will replace TV. Holographic eyewear are being manufactured by giants like Microsoft and Apple. It is not like we will be living inside 3D, but 3D will be a superimposed element in everyone's life. Just like we have moved from button phones to touch phones, in the future we will operate gadgets using gestures as the user interfaces and user experiences shift to the 3D paradigm," says Kypuram.

Experts say they are unable to visualise even the tip of the iceberg fully yet, because the possibilities are endless. Jog your mind, and you can list at least a dozen within a minute! Here is a small sample of what is possible.

Learning. The pandemic has taught us the importance of remote working. With the metaverse, learning could be so much more interactive and fun at school and university levels. You can get the feel of being in a real classroom with your friends, and it would be easier for the teacher too to explain stuff with holograms and 3D working models.

Work. Effective collaboration is expected to be one of the biggest benefits of the metaverse—and one that companies like Meta and Microsoft are betting big on. Colleagues can interact and brainstorm as if they were in the same room. Plus, the standards of collaboration—especially in design—would go up significantly with MR platforms.

In December 2021, a Reuter report spoke of Boeing's plans to build its next plane in the metaverse. Its future factory will bring together engineers around the world using Microsoft HoloLens headsets, robots that speak to each other, and immersive 3D designs using holograms. I know that sounds like Tony Stark building something in the Marvel universe, but well it is bound to happen.

Events and workshops. Perhaps what people miss the most in remote working are the occasional events and workshops that liven things up and create opportunities to interact across the spectrum. Now, close-to-

real events are possible in the virtual world.

NextMeet, for instance, has worked with Indian and international universities to organise virtual events and conferences. Their immersive 3D environment comes replete with *avatars* that can move around the space, 3D spatial voice, expo halls with banner hosting stands, presentation screens in the conference hall, help desks and networking lounges! VRXtream is another metaverse for events, where you can even buy spaces (stalls) and rent them out, or vice versa.

Healthcare. From training medical students to remote consultation and counselling, the metaverse is expected to benefit the medical world notably—and we can already see fragments of it in use. In a blog post that Microsoft put up last year showcasing their immersive MR platform, Mesh, the company imagined *avatars* of medical students learning about human anatomy, gathered around a holographic model and peeling back muscles to see what's underneath. Hospitals are using MR platforms to help paramedics give first aid to patients, the World Health Organisation (WHO) used AR and smart phones to train Covid-19 response teams in remote areas, and psychiatrists are using VR to treat post-traumatic stress among combat soldiers.

Fitness and training. Maybe, exercising in the metaverse would be more fun! Zippy is a virtual world for runners, where people can run across major marathon cities like Boston, London, Mumbai, and Tokyo, or through scenic environments like jungle trails and beach runs. The virtual environment syncs with the real-world kinematics of the runners using their fitness wearables or treadmill sensors.

If you love fiction, then OliveX could have just the solution to add a spot of fun to your run! In association with award-winning novelist Naomi Alderman, the company has developed an ultra-immersive running game called *Zombies, Run!*, where every run is a mission to save the world. You run faster when you are chased by the zombies, and slow down to pick up supplies. The accompanying narration and music set the tempo for your run. What a fun way to exercise!

Or, if it is serious athletic practice that you are thinking about, Ghost Pacer might be of help. A solution developed by runners, for runners, these AR glasses project a live holographic opponent into your field of view, for you to compete with and train against.

Retail. Everyone loves to shop. But the pandemic made us realise that physical store shopping is not something we can take for granted. So, for those times when you want to shop but cannot go out, or if you are too busy to shop hop, then you can turn to the showrooms that are slowly mushrooming in the metaverse. From real estate to automobiles, sellers are building unique experiences to woo shoppers. Real estate agents could give you virtual tours of their properties, you could walk around a virtual clothing store and experience the latest in fashion, or test drive a car virtually!

Social media. This is one space Meta is betting big on. Imagine what happens when your social media apps become immersive? Your friends from different parts of the world could manifest in your living room as holograms! Quite some time for that level of interaction to become mainstream, but, as of now, we commonly see friends hanging out together in shared virtual spaces.

Honestly, there is too much to dream about in the metaverse. *Avatars* might be living in huge mansions in plush downtown neighbourhoods, driving luxury cars, going on cruises and watching their favourite movies on wall-sized screens. But, in real life, the same people might be living in hostels, having no television, not even a bicycle, and maybe no real friends to call their own.

When one snaps out of the dream, it might be very difficult to come to terms with reality. The huge disparity between the real and virtual lives could even lead to psychological disorders. So, we need to know where to draw the line, as in the case of any technological advancement. EFY

Block and Tackle

"We're moving from a mobile and cloud era to an era of ubiquitous computing and ambient intelligence, an era that will experience more digitisation over the next 10 years than the last 40. We need that next level of real-time hyper-connectivity between businesses and between consumers and businesses, where data and intelligence flow freely to tackle the challenges of supply and demand." **— *Satya Nadella, CEO, Microsoft***

"I don't know if I necessarily buy into this metaverse stuff, although people talk to me a lot about it. You know, when I grew up it was like, 'Don't sit too close to the TV, it's gonna ruin your eyesight,' and now TV is like literally right here (puts his hand very close to his face), I'm like, umm, what? Is that good for you? I don't see someone strapping a friggin' screen to their face all day." **— *Elon Musk, CEO of SpaceX and Tesla***

"The next platform will be even more immersive—an embodied internet where you're in the experience, not just looking at it. We call this the metaverse, and it will touch every product we build. The defining quality of the metaverse will be a feeling of presence—like you are right there with another person or in another place. Feeling truly present with another person is the ultimate dream of social technology. That is why we are focused on building this." **— *Mark Zuckerberg, founder, chairman and CEO of Meta***

"With digital risks already being high, especially for vulnerable groups, safety risks could be more prevalent in the metaverse. There are numerous ways such risks could be exacerbated in the metaverse. Unwanted contact could become more intrusive. The rise of virtual currencies is another challenge. Finding ways to incentivise better behaviours and reward positive interactions may need to become a bigger part of a safer digital future." **— *Cathy Li and Farah Lalani, World Economic Forum***

The EVOLUTION Of LCD DISPLAYS And HOW It MATTERS

In a competitive market where fast designing is needed, how far will liquid crystal displays (LCDs) be an option for design engineers? Let's find out

DAVID YANG is Deputy General Manager, SHARP, Singapore

Ten years ago, my senior told me that the LCD is going to die, but it has paved its way into our everyday life, starting from our phones to our vehicles. Segment LCDs were simple in design where an input channel was given directly to display digits. Even if videos could not be displayed, these LCDs were used on old auto meters and were pre-designed. Though a little complicated in design, thin film transistor liquid crystal displays (TFT LCDs) are becoming quite popular in smartphones and vehicles nowadays.

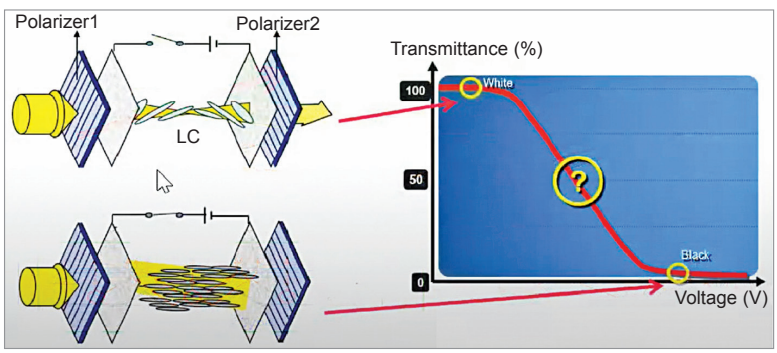


Fig. 1: Working of a liquid crystal

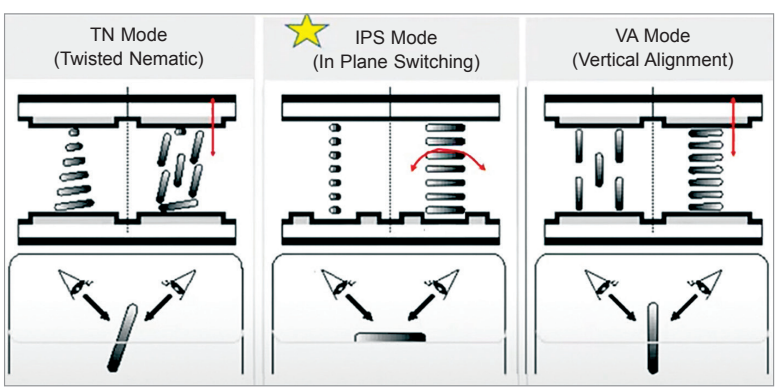


Fig. 2: Three modes of liquid crystal rotation

Liquid crystal can guide the light. For a TN LCD when the transistor of the TFT circuit is turned off and the LC changes the orientation of light rotation. After light passes through both the polarizers, we see the LCD completely white. However, when the circuit is turned on, the polarizer blocks the light, resulting in a black image. Hence liquid crystal is the core of the design that can direct the light as per its rotation.

Modes

Based on the liquid crystal rotation, there are three modes, namely, In Plane Switching (IPS), Vertical Alignment (VA), and Twisted Nematic (TN) mode. In the IPS mode, the crystal switches horizontally and in the VA mode it switches vertically. Both have a wider viewing angle and a larger colour coverage but are high in terms of cost. The best performance can be obtained in the IPS mode. The TN mode has a narrow viewing angle with a small colour coverage, but it has the largest market as it is very cheap.

Fig. 3 shows the comparison for the same photo on two different displays when the liquid crystal is rotated in the IPS and TN modes. The performance varies as the angle changes. We notice that IPS has a better performance.

Thin film transistor LCD

It is a display panel that uses liquid crystal to control the amount of light that comes from the backlight. The TFT acts like a switch that controls the liquid crystal. Each segment of liquid crystal is like a shutter that either blocks or allows light to pass through. Fig. 4 shows a TFT LCD where the top is an open cell and the bot-

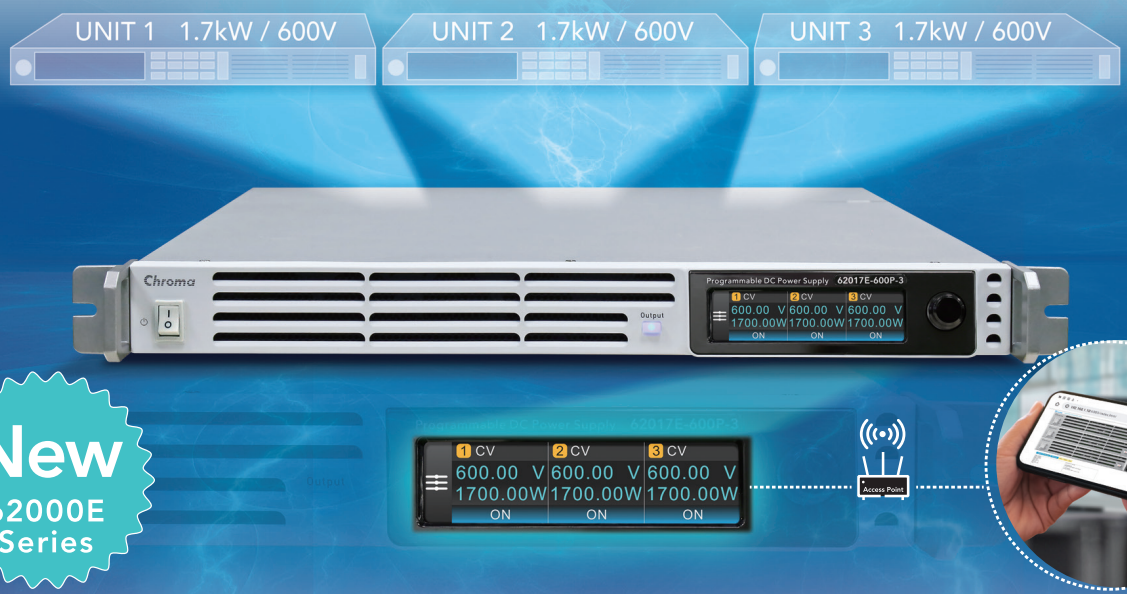
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Fig. 3: IPS and TN comparison of the first image

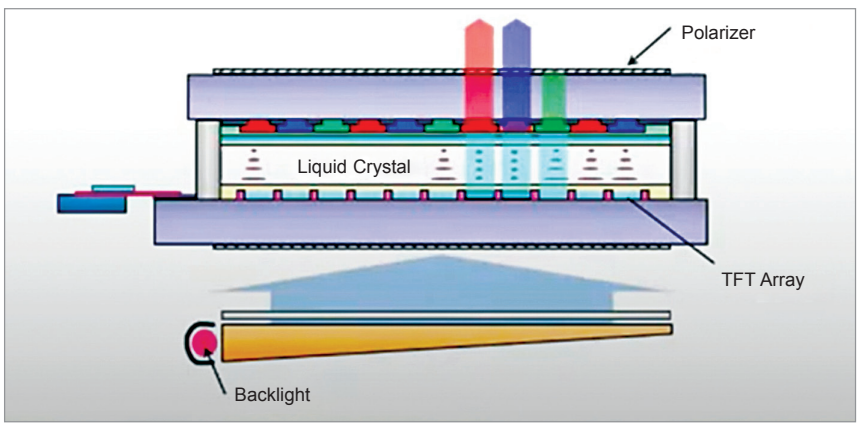


Fig. 4: Thin film transistor liquid crystal display (TFT LCD)

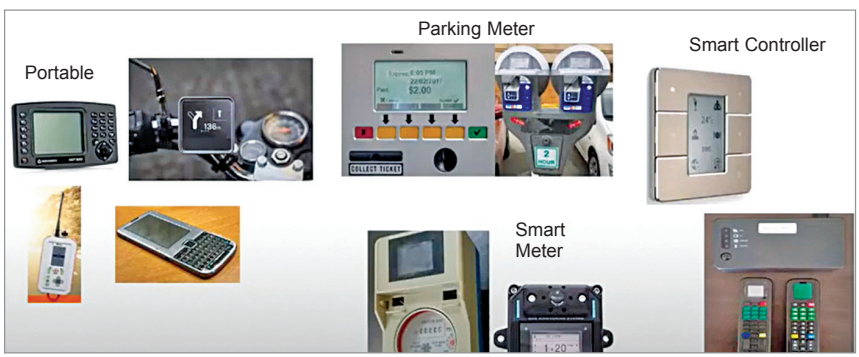


Fig. 5: Memory LCD applications

tom is the backlight.

The open cell has a nickel crystal sandwiched between the colour filter glass and the TFT array glass on which the transistor is built. The backlight structure contains a lot of optical sheets like diffuser, prisms, light guide, and reflectors. Backlight is of two types, namely, direct light that refers to the LEDs which are directly laid below the LCD. This method is used for big-size LCDs like TV or signage. For small- and medium-size LCDs, like phones or laptops, the side light is used where the LEDs are to the side of the LCDs.

Memory LCD for IoT displays

Memory LCD is the integration of one-bit memory into each LCD pixel. This makes sure that data transmission from outside the module is not needed when the displayed image does not change. The advantages that they offer are:

Low energy and power consumption. Two main reasons exist for the same. First the reflective displays do not need a backlight. Second, the memory needed integrated with the pixel does not need to be refreshed when showing a statistical image. For instance, in a 6.9cm (2.7-inch) screen, the power consumed is only 50µW when there is no image updating, whereas when an image data updates the power consumed is 175µW. The important thing to note here is that, unlike conventional LCDs where power is consumed at milliwatt (mW) level, TFT LCDs consume power at a microwatt (µW) level, confirming the long life of the battery.

Stylish display quality. The high resolution and crisp graphic image help for both indoor and outdoor readability. The high reflectivity makes it feel as though a paper is being read.

Engineer-friendly. The design interface is very simple with a 3-wire serial signal input (clock, data, and chip select), along with a ground and power supply.

Since the location of the sensors in IoT must be remote and needs a longer battery life, memory LCDs are widely recommended. Fig. 5 shows applications where memory LCDs can be majorly used, which are available from 2.5cm (1 inch) to 11.2cm (4.4 inch), in both black-and-white and colour. They can also be used in smart watches.

IGZO LCD for smartphones

The materials used to build the TFT LCD are indium, gallium, zinc, and oxygen (IGZO).

First, compared to the a-Sil (conventional silicon series materials), the electron can easily pass through the IGZO circuit. The electron mobility is 20 to 50 times faster than the a-Sil, resulting in the physical size of IGZO TFT being 1/7th of the a-Si TFT. This helps in achieving very high resolution.

Second is low power consumption. As we know the LCD runs at 60Hz in one frame. When the IGZO is turned on we only need a part of the frame and not the whole, resulting in a lot of power being saved.

Third, we achieve a LCD bezel. For instance, in a-Si TFT, the gate driver (COG) is at one side of the LCD, which cannot minimise the LCD side border. But for IGZO, monolithic gate drivers are used to build on both sides of the LCD, thus achieving a narrow frame.

Then there is the touch display. The touch and LCD signals are bound to interfere with each other, causing a problem. This is avoided in IGZO panels, as the touch detection can be activated when the IGZO TFT is in a rest mode. When the LCD is off, the touch is turned on and vice versa.

Reflective LCDs are eco friendly

The beauty of reflective LCD panels is their suitability for outdoor displays. Transmissive displays use a light source as the backlight, which, unfortunately, because of the ambient light, dulls the display. However, in reflective displays, the ambient light is utilised instead of a backlight. The features in a reflective IGZO are:

1. High visibility and full colour display
2. Low power consumption since there is zero backlight power
3. Video support since it runs at 60Hz
4. Easy on the eyes; usage of natural light can avoid strain to the eyes
5. Implementation of backlight is optional; usage is promoted in a dark room

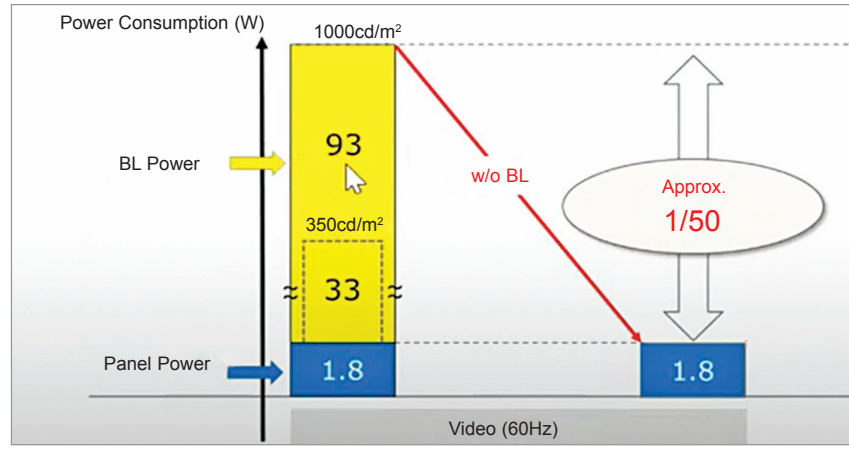


Fig. 6: Power consumption for transmissive and reflective displays

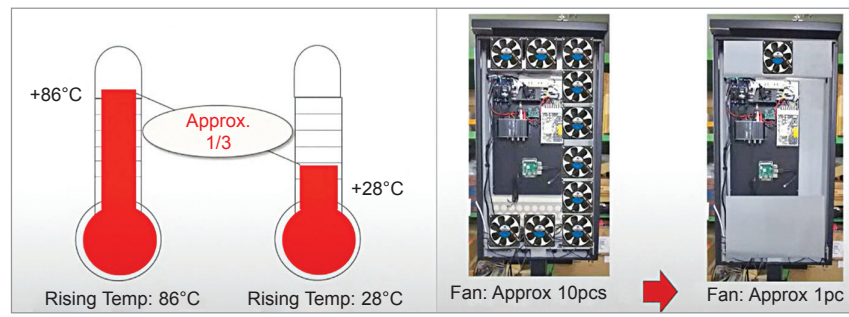


Fig. 7: Heat generated, and fans needed for transmissive and reflective displays

With no backlight being needed, we notice from the figures that around 95% of the power consumed is reduced. Similarly, the amount of heat generated is also reduced, leading to the fact that the number of fans needed to cool down the LCD drastically decreases. This makes the reflective LCDs much more reliable.

The remarkable fact is that, even an 80cm (31.5-inch) LCD can be run on a mobile battery (2500mAh) with a video being played for 24 hours without charging. Solar panels provide the freedom to move the system to different places. The solar panels along with the mobile batteries can help in signages located at bus stops, avoiding a lot of trouble. Not only bus stops, but this can also be implemented at petrol stations, vending machines, etc. There are various panel sizes available as samples and for mass production.

Regarding interfaces, there exist RGB and LVDS interfaces in the market, for many years. The RGB interface (for low-resolution panels) is mainly used for cars and motorcycles. The LVDS interface (for high resolution) is commonly used for industrial usage. Smartphones are using MIPI interface (low power consumption). EDP (power saving) is widely being used for laptop and monitor panels.

With such advantages that LCDs offer, design engineers have a tough job in choosing the right one. David suggests that it is best to match a design with different systems and interfaces before making the final selection. LCDs surely have the potential of being chosen as the best option for any application. EFY

The article is based on a tech talk by David Yang, Deputy General Manager, SHARP, Singapore at TechWorldCongress.com. Transcribed by Sharon Abhignya Katta.

Why TRANSITION From NOR To NAND Flash Memory

While NOR has a fast read speed that is beneficial for quick software loading in embedded devices, it cannot meet the storage power of NAND. So, when should you make the shift? Read to know more

ONG CHUEN WEE
is Engineering Manager at Memory Marketing Department, KIOXIA Singapore

In the current market scenario, almost all the embedded systems are becoming smarter, resulting in the development of innovative smart TVs, smartwatches, and many other IoT devices every one to five years. Part of this increased smartness is due to fast communication protocols like 4G LTE, 5G, Wi-Fi, and GPON that have connected everything—no matter how far they are.

While all this brings added intelligence and richer user interface (UI) that makes our tasks a tad less difficult, consequently, it requires higher processing capacity, for which flash memory plays an essential role. Commonly used flash memory types in modern digital systems include NOR and NAND. Traditionally, NOR types are used in digital devices owing to their fast read capability with respect to a large firmware.

But NOR devices are quite expensive and consume a lot of power, which decreases in standby mode. Moreover, for applications requiring high write speed, NOR is not adequate. This is where NAND with its faster write speeds and higher memory capacity can make a difference.

So, before we dive deep into the technicalities of NAND, let us see the Table below for a quick comparison between NAND and NOR types.

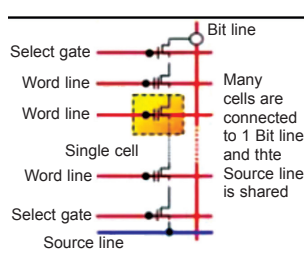
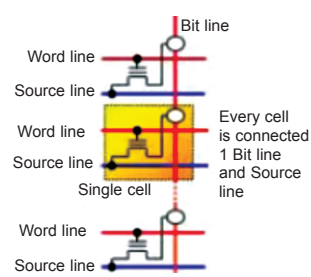
For the NAND flash, a single memory cell is at least 2.5 times smaller than the NOR flash, making NAND less expensive. To understand more about the internal structure of NAND and how successful transition can be made from NOR, let us look at the following.

NAND flash memory structure

In the diagram shown in Fig. 1 for 1-gigabit (1Gb) NAND flash memory, there are two data caches of 1 and 0. Below them, all are memory cells or arrays. For 1Gb serial NAND, we have a page size of 2048 bytes plus 64 bytes for spare. The structure is enabled with internal error code correction (ECC) that can be disabled as well.

When 64 pages are brought together, it becomes a single block, that is, 64 pages = 1 block. It comprises 128-kilobyte (kB) memory size plus 4kB for spare. Total 1024 blocks make up 1-gigabit (Gb), which equals 128 (or 125) megabytes (MB), as eight bits equal one byte.

NAND AND NOR COMPARISON

Specifications	NAND	NOR
Cell array	Single Source line connected to a single Bit line share many memory cells. Multiple Word lines together pass through the Bit line. 	Several Source lines connected to a single Bit line. Word lines above each Source line pass through the Bit line. 
Cell size	$2F \times 2F = 4F^2$	$5F \times 2F = 10F^2$
Average read speed	20.5MBps	61.5MBps
Average write speed	3.2MBps	0.47MBps

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Prepare the list of equipment in excel sheet and upload it (Bulk Upload)/Option to add new equipment one by one/edit further if needed
(Option is provided to use in future)

Keep checking the request from users in Pending and request users to clarify any doubts if exists before allocation of slots

Allow internal/external users to book the slots and use the R&D equipment in a transparent manners

Keep updating the equipment calendar/Status of Health (Up/Down/under Repair) to make available the details in public on booking calendar

Add the details, such as, Description/Accessories/Usage Rate (Category wise)/mapping of the technologists with Equipment/add Suppliers and Service Providers details

Use in-built Discussion forum (Chat box) to clarify the details
(using FBR No.)

Allocate the slot (Adding the other charges for Overhead and Accessories) as per availability and convenience of the users and request for samples

Once allocated, user will find an option to pay "Online/Offline"

Collect the Samples at the host Institution
(as per mutual agreement)

In case of the sudden failure, operator may re-schedule the slots/ or reject the request with suitable reasons

Execute the slots physically at the Equipment (in presence of the User either in Online or Offline Mode)
[Use Webex Platform provided by the I-STEM at no cost]

Write the Feedback about the users (Status of FBR will get automatically changed)

Collect the Usage Report/GST Collection Details etc. on monthly basis from the Portal

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Migration from NOR to NAND

To shift from NOR flash to NAND flash memory, some partitions of 1Gb serial NAND memory can be done. Traditionally, the NOR flash could be 128kB or even 1MB. So, with 128MB, nearly 256 blocks can be put with an additional 32MB. It now becomes a boot-code firmware, RTOS, or some application software.

Maybe, one-quarter of that is good enough for some embedded system in your device. Partition it so that the rest can be used for user data or the system log data. Some areas also have to be reserved for driver use.

The NAND block may contain some bad blocks, meaning, some blocks could be damaged. So, the reserve area can replace the bad blocks.

When you migrate from NOR to NAND flash, a software driver is required, which could include a serial peripheral interface (SPI). As mentioned earlier, NAND is suitable for applications with intensive write/erase requirements or storage, such as smart-

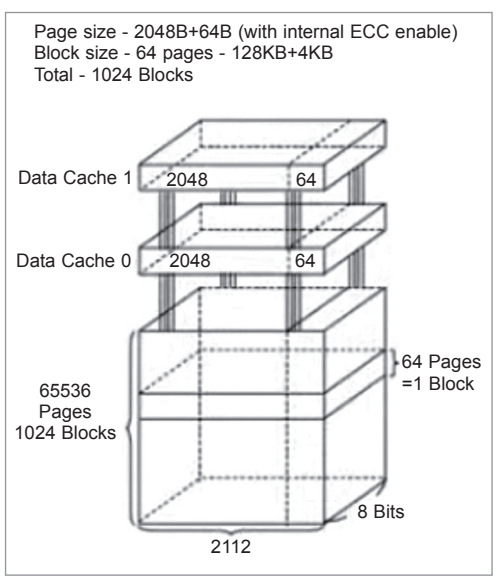


Fig. 1: 1Gb NAND flash memory structure (Credit: KIOXIA)

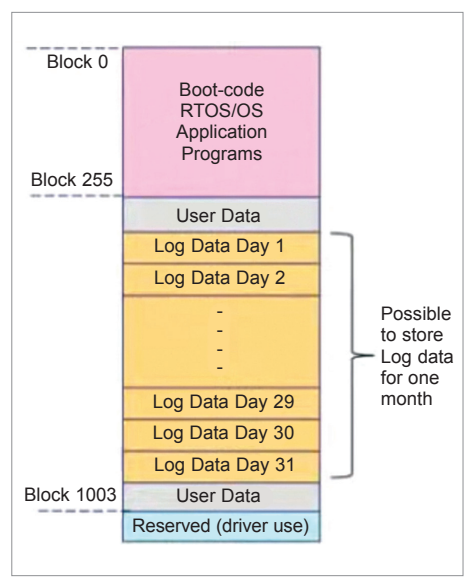


Fig. 2: Example of 1Gb NAND flash partition

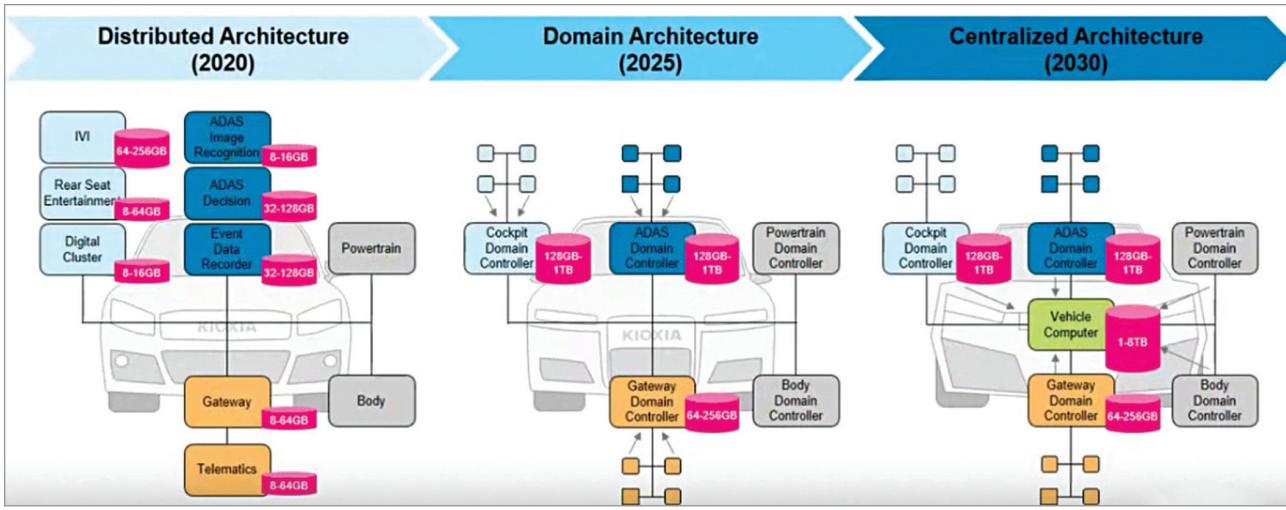


Fig. 3: Evolution of the automotive system (Credit: KIOXIA)

Different flavours of SLC NAND Flash Memory

- ***KIOXIA.*** A Toshiba spin-out, KIOXIA offers memory solutions such as SLC NAND, BENAND and Serial Interface NAND. Except for Serial Interface NAND that uses SPI driver for the host controller interface, the other two use NAND driver for the same. While the BENAND and Serial Interface NAND have built-in error code correction (ECC), the SLC NAND does not.
- ***Micron Technology.*** Its products address growing opportunities for memory and storage hierarchy innovation. Products include 3D NAND, TLC NAND, MLC NAND, and SLC NAND.
- ***Cypress Semiconductor.*** It has a vast range of RoHS-compliant NAND flash memory ICs.

No matter the company, they all come with page sizes ranging from (2048+64)x8 to (4096+256)x8 and block sizes of (128k+4k)x8 to (256k+16k)x8 across bit sizes of 1Gbit, 2Gbit, and 4Gbit. They also perform bad block management, wear levelling, and garbage collection.

phones, digital cameras, and USB flash drives.

Future automotive requirements

The increased enhancement in embedded systems is rapidly transforming the automotive sector. The next-generation vehicles, particularly autonomous vehicles, rely on high computing power for managing electrical/electronic (E/E) architecture that includes complex embedded control systems and related hardware/software.

Over here, both NAND and NOR—along with EEPROM, DRAM, and FRAM—play a significant role in automotive E/E systems. In 2020, the distributed architecture, which included ADAS image recognition, ADAS detection, and event data recorder was introduced. On the infotainment side, there was in-vehicle infotainment (IVI), rear seat entertainment, and digital cluster. For the gateway, there was Gateway and Telematics. Today, up to 256GB for infotainment and 16GB or 32GB for safety and gateway systems can be achieved.

With enhanced centralised storage and processing capabilities, the year 2025 will see distributed architecture turn into domain architecture with all the parts/blocks getting integrated. So, the IVI and rear-seat entertainment system, along with other infotainment systems, will get under the cockpit domain controller, requiring up to 1TB.

The safety system will become the ADAS domain controller that will include all the recognition and detection, even the data recorder. It will also be up to 1TB. The gateway domain controller, including telematics, may need more than 256GB. Powertrain and body domain controllers will not require much storage.

By 2030, all the above are expected to move to a centralised architecture, which will be controlled by vehicle's computer, a high-speed processor requiring 1TB to 8TB. It will also control the cockpit domain, safety domain, and gateway domain. Together, they will require 10TB or more. Obviously, it would be a drastic increase in the storage requirements for the vehicle of the future.

Outcome

After going through the above details, a question comes to mind. Should all NOR devices be changed to NAND devices? Well, it all boils down to the application. NOR can efficiently handle boot speeds as it has better data reading capability. But where NOR fails at adequate data storage, NAND can step in as it has better write speed. EFY

The article is based on a talk by Ong Chuen Wee, Engineering Manager at Memory Marketing Department, KIOXIA Singapore. It has been transcribed and curated by Vinay Prabhakar Minj, an IoT and audio electronics enthusiast.

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ANALOGUE FRONT ENDS For HEART RATE MONITORS

Analogue front ends (AFEs) are a set of analogue signal conditioning circuitry that are used to interface sensors to an ADC or a microcontroller. In applications like heart rate monitors, AFEs bear tremendous importance. Let's find out why

VLADYSLAV KOZLOV and
AARYAA PADHYEGURJAR

Heart rate is one of the critical vital signs in humans. For a healthy adult, it should be somewhere between 60 to 80 beats per minute. Like all other vital signs, the heart rate can change according to the person's location, physical and mental health, and even emotions. Naturally, the heart rate increases in response to an accident, injury, or trauma. Not just that, the rhythm, strength, and the time gap between the beats of your heart can also fluctuate.

The monitoring and tracking of heart rate is a relatively simple task for modern electronics. Moreover, keeping track of your heart rate can be very helpful, not just for medical precautionary purposes but also for developing a fitness regime. That's why modern wearable devices like smartwatches and activity trackers widely utilise the heart rate monitoring function. It is especially useful in determining whether one is exercising at the correct intensity or not.



PE3000 by Polar Electro, one of the first wearable heart rate monitors with an integrated computer interface (Credit: www.healthchecksystems.com)

In addition, such devices can detect possible diseases like tachycardia (fast heart rate), bradycardia (slow heart rate), arrhythmia (often changed heart rate), and others. Also, heart rate monitors are widely used in sports. With the help of a heart rate measurement, athletes can define appropriate load and rest intervals.

Fitness tracking and history of heart rate monitoring

It was in 1977 that Polar Electro, a Finnish company, invented the first wireless electrocardiogram (ECG) heart rate monitor. It was meant to be a training aid for the Finnish National Cross Country Ski team. Soon, people realised that monitoring vital signs like heart rate and other exercise metrics are best left to technology, and heart rate monitors became popular. In 1984, Polar Electro launched the PE3000, a watch-like heart rate monitor with an integrated display. Today, heart rate monitoring is common and nearly everyone owns some sort of fitness tracking device.

Why heart rate monitors need AFEs

Generally, heart rate monitors employ sensors that are analogue in nature. The contractions and relaxations of the heart while it pumps blood can be viewed as electrical activities and hence, the signals or pulses are shown as waveforms. However, the controllers employed in a hear rate monitor can only interpret binary data, that is, digital signals. Hence, an analogue-to-digital converter (ADC) is needed. Moreover, the signal needs to be amplified and filtered to remove noise.

This is why AFEs are so important. They contain all the necessary components and circuitry to perform signal conditioning on the signals that come right from the sensors. In general, AFEs include analogue amplifiers, operational amplifiers, filters, sample and hold circuits, and

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A FEW CIRCUIT BLOCKS THAT ARE LIKELY TO BE PRESENT IN ANY AFE

Name of Circuit	Description	Use Case	Importance in AFEs
Trans-impedance Amplifier (TIA)	Commonly implemented on an op-amp, TIAs convert current to voltage and amplify the output to a suitable value.	They're used for sensors where the current response is more linear than the voltage response. This is true for photodiodes and optical sensors.	Since many applications like heart rate monitors employ LEDs and photodiodes, TIAs are essential. Depending on the sensors involved, different configurations of TIAs are used in AFEs. Apart from TIAs, many AFEs feature VGAs, PGAs, and many other kinds of amplifiers.
Filters	Filters remove unwanted frequency components from the applied signal and enhance the ones that are wanted.	A lot of times, signals coming from sensors are subjected to noise and interference, and hence these unwanted signals are removed using filters (high-pass, low-pass, or band-pass, depending on the sensor/application).	In AFEs, filters are used in many stages. Typically, they are used before passing a signal to an amplifier in the circuit. They are also used for anti-aliasing.
Sample and Hold (S&H) Circuits	These circuits are responsible for taking samples of the voltage given to them as input, and after that holding these samples for a definite time. This is usually done using an analogue switch, a capacitor, and a buffer.	They are generally used to improve the accuracy of ADCs. There are some ADCs that even have S&H circuits inbuilt.	Like in most applications, S&H circuits in AFEs are also present between filters and ADCs to maintain the accuracy of signals and to prevent errors due to amplitude change or skewing.
Analogue-to-Digital Converters (ADCs)	ADCs convert analogue signals into digital signals, usually in the two's complement binary form.	Most sensors like accelerometers, temperature sensors, flex sensors, etc are analogue sensors, and hence ADCs are used in most applications. Microcontroller development boards have ADCs onboard.	ADC is usually the final step in an AFE. The output of the ADC is given to the microcontroller or the next processing unit.
Instrumentation Amplifiers (InAmp)	InAmps are differential op-amps that provide high input impedances with gain adjustment to the heart rate through the variation of just one resistor.	They are useful in data-acquisition systems involving transducers and even RF signal systems.	In some AFEs, high-pass filters are coupled with instrumentation amplifiers so that large gain and high-pass filtering is possible in a single stage.

sometimes even application-specific integrated circuits (ASICs).

Heart rate monitoring techniques

There are several techniques for monitoring heart rate. All of these use different types of signals.

Phonocardiography (PCG). This technique uses the sound signal produced by the opening and closing of heart valves. As a rule, the signal is filtered and processed with the help of a digital signal processor (DSP). After proper filtering, it is possible to detect not only heart rate but also abnormalities of the heart. This is done with the help of a machine called phonocardiograph.

Electrocardiography (ECG). This technique is based on the measurement of the electric field produced by the heart. There must be two or more electrodes placed on specific points of the human body. Graphic representation of ECG consists of six peaks and valleys called P, Q, R, S, T, and U. The heart rate is measured by averaging RR interval between two R peaks (Fig. 1) over a defined period (for example, 15, 30, or 60 seconds).

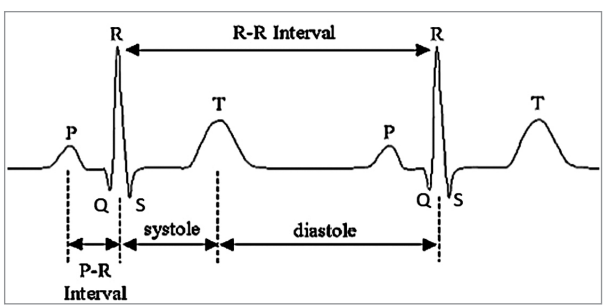


Fig. 1: Typical ECG of a healthy heart

Pressure sensing technique. This technique utilises a signal from a piezo sensor attached to one of the defined places on the human body, for example, on the wrist.

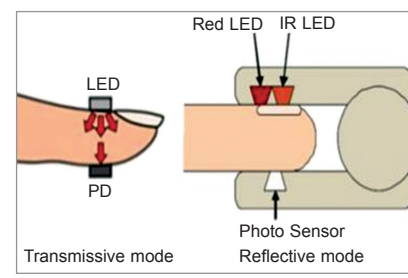


Fig. 2: The principle behind photoplethysmography (Credit: www.rfwireless-world.com)

Contraction and relaxation of the heart cause a corresponding change of pressure in the blood vessels, and therefore on the skin as well.

Photoplethysmography. This technique is based on the measurement of the volume variations of light reflected from the skin. When light emitted from an LED passes the heart through a blood vessel, the received light has pulsations that correspond to the heartbeat. Typically, a green or infrared LED is used as a light source because of the blood's tendency to absorb light with spe-

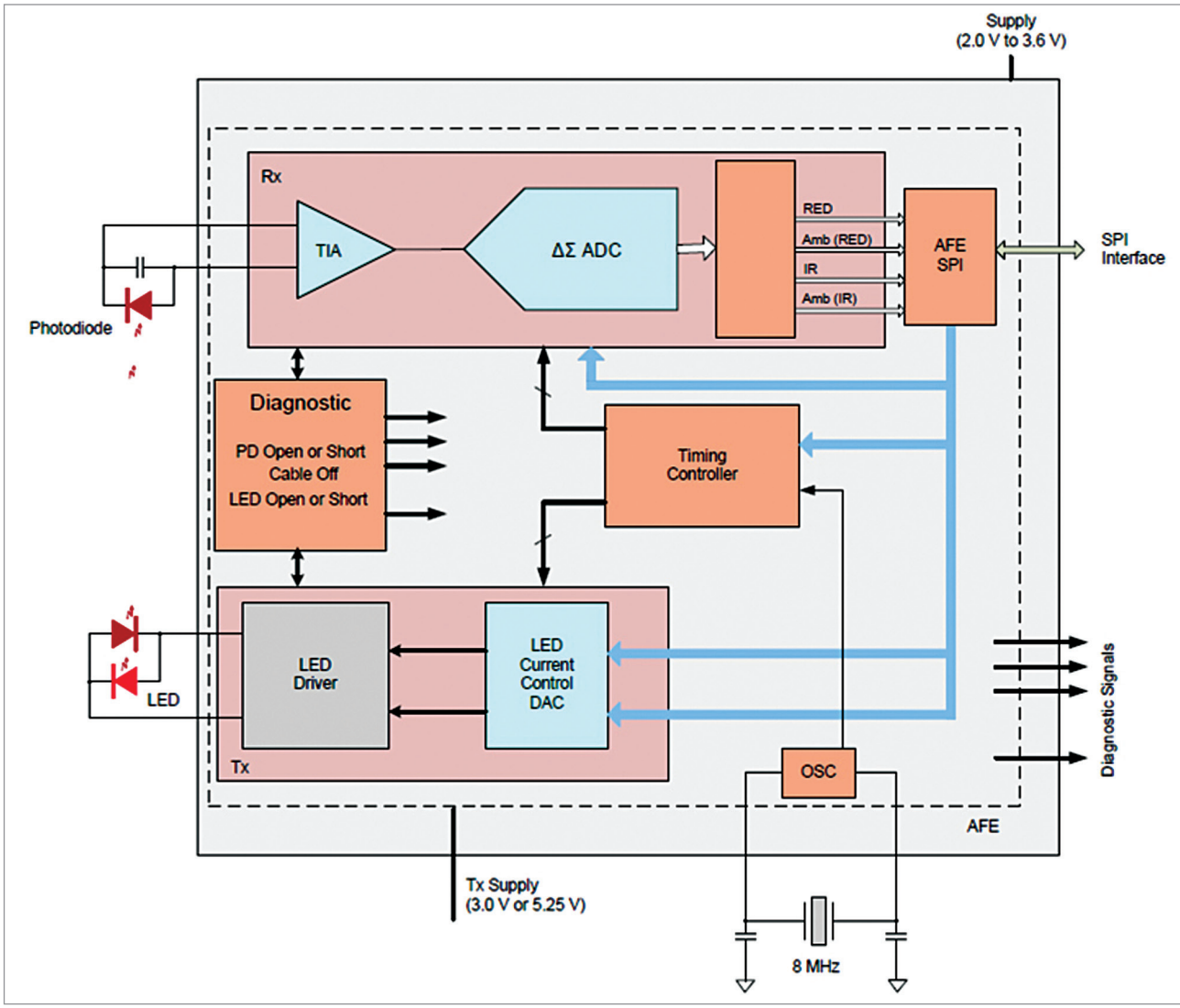


Fig. 3: Block diagram of AFE4403 (Credit: Texas Instruments)

cific wavelengths. This technique is the most common way of heart rate monitoring in wearables.

Main components of an AFE

Given in the Table on previous page are a few circuit blocks that are likely to be present in any AFE. Apart from the other application-specific circuitry present in an AFE, combinations of these blocks are present. It is important to note that for any application involving an AFE, selecting a suitable IC can be a challenge. By understanding the important blocks present in AFEs, the process of selection becomes easier and less time-consuming.

Important considerations while selecting AFEs

EMI susceptibility. Like all analogue circuits, AFEs are also susceptible to electromagnetic interferences. Analogue and digital circuits need to co-exist on a single chip, and hence AFEs need good EMI immunity. Since op-amps are sensitive to EMI, it is important to make sure your selected AFE has a good EMI immunity. For example, AFE4403 from Texas Instruments has an EMI filter.

EOS susceptibility. Electrical overstress is a failure state where the device or circuit is subjected to undesirable voltage, current, or power. Analogue circuits are susceptible to EOS as much as they are to EMI. Hence, one must handle AFEs with proper ESD (electrostatic discharge) precautions. Also, check the ESD ratings given in the datasheet.

Some analogue front ends

The rest of this article will look at a few AFEs that are particularly tailored for medical applications that involve heart-rate sensing. These are ICs that are not very expensive and can be easily integrated into medical or fitness tech applications.

AFE4403 by Texas Instruments. The AFE4403 is suited for pulse oximeter applications, optical heart rate monitoring as well as industrial photometry applications. This

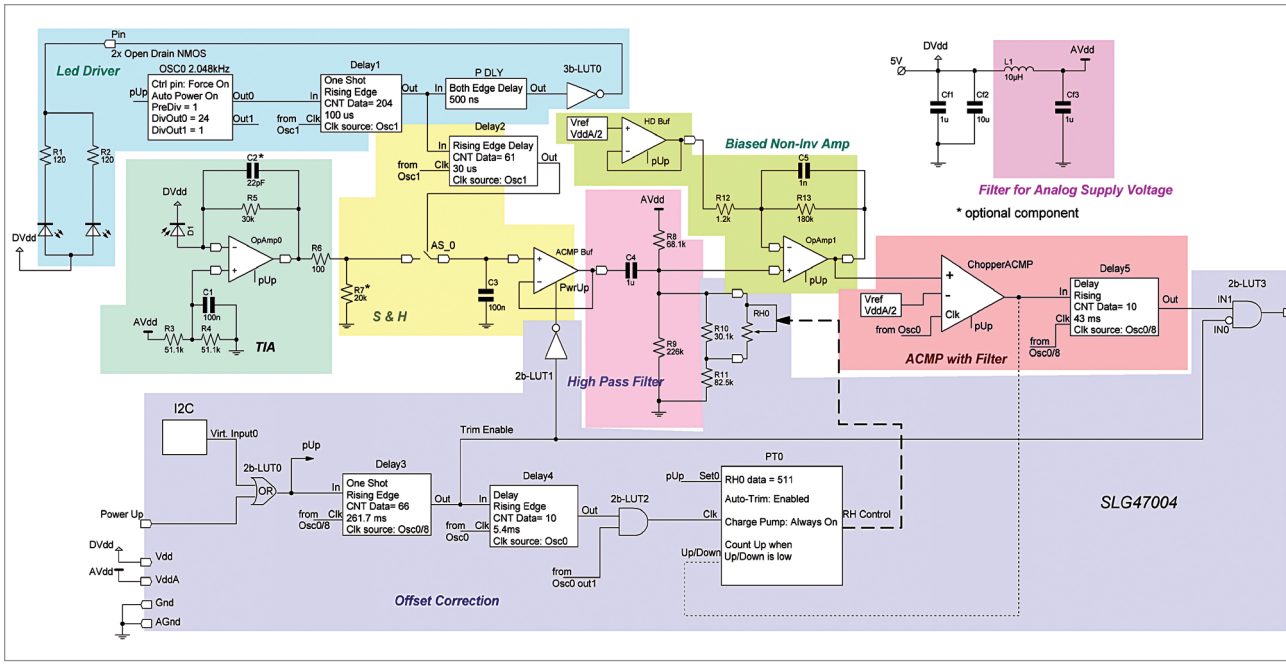


Fig. 4: The proposed analogue front-end structure (Credit: Dialog Semiconductor, a Renesas company)

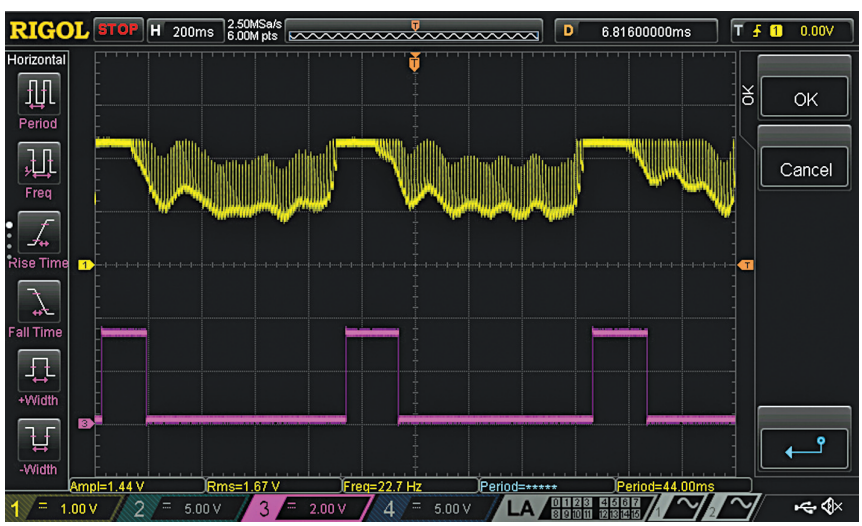


Fig. 5: Analogue (yellow) and digital (pink) output signals of AFE applied to finger (Credit: Dialog Semiconductor, a Renesas company)

means that it employs the principles of photoplethysmography. It can communicate with microcontrollers or any processing unit using an SPI interface.

AFE4403 contains an ADC, an LED transmit section, and diagnostics for sensor and LED fault detection. Moreover, it is equipped with an oscillator that functions from an external crystal. It is highly configurable and allows the user to control the timing characteristics of the device.

AD4403 consists of five main blocks:

- Receiver channel
- Clocking and timing signal generation block
- Timer module
- Receiver subsystem power path
- Transmit section

The receiver channel receives the light signal from the photodiode and contains a TIA, filters, and an ADC. The transmit section contains an LED driver that turns the IR and red LEDs on and off. What's interesting is that the transmit section has an option for a third LED to be attached, apart from the IR and red LED. This is particularly important for oximeter applications where the third LED can be used for heart rate monitoring while the other two are used for detecting SPO_2 levels.

SLG47004 AnaloguePAK by Dialog Semiconductor, a Renesas company. Dialog Semiconductor proposed a design of an AFE for a heart rate monitor that is largely based on SLG47004, a programmable mixed-signal IC. Both signal processing and LED control are performed by a single SLG47004. Additional sample and hold circuitry allow greatly reduced current consumption.

The performance of the heart rate monitor depends on the optical system setup: the direction of light from LEDs, the wavelength of LEDs, the distance and angle between LEDs and photodiode. Also, the measurements are affected by ambi-

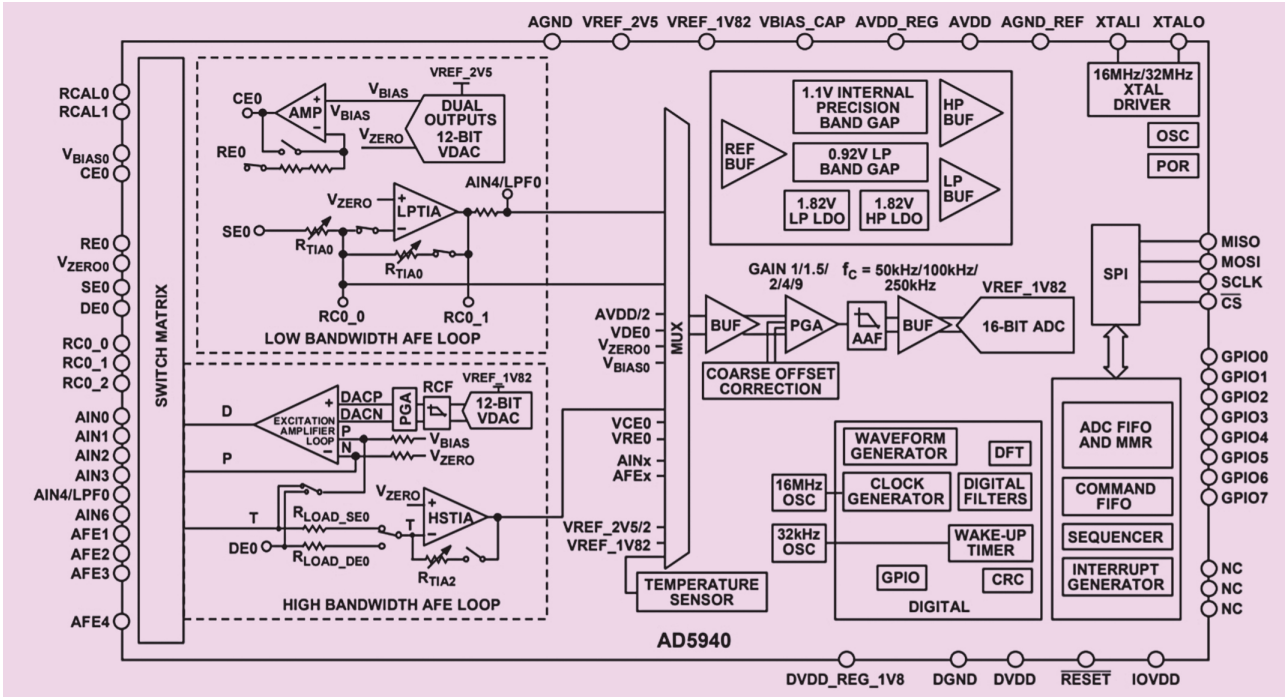


Fig. 6: The functional block diagram of AD5940 (Credit: Analogue Devices)

ent light and small movements of the sensor. If the heart rate signal is relatively small, like a signal from the human wrist, additional software signal processing might be required.

This proposed design, as seen in Fig. 4, is divided into eight major blocks:

- LED driver
- Transimpedance amplifier (TIA)
- Sample and hold circuit
- High-pass filter
- Offset correction circuit
- Biased non-inverting amplifier
- Analogue comparator with digital filter
- Analogue power supply filter and grounding considerations

The waveforms of the hardware prototype testing are shown in Fig. 5.

AD5940 and AD5941 by Analogue Devices. The AD5940 and AD5941 are high-precision, low power analogue front ends (AFEs), designed for skin impedance and body impedance measurements. Therefore, they are suited for bioelectric or biopotential measurement systems and for wearable applications too. These can even sense electrochemical toxic gases. They also contain some on-chip peripherals, including SPI serial input/output, wake-up timer, and interrupt controller.

The AD5940 can be used in conjunction with AD8232 or AD8233 to perform bioimpedance and ECG measurements. AD8232 and AD8233 are integrated signal conditioning blocks for ECG and other biopotential measurement applications.

For instance, when a bioimpedance measurement (for example, body composition, hydration, and electrodermal activity (EDA)) is required, AD8232/AD8233 are disconnected from the electrodes and AD5940/AD5941 are used. Likewise, when ECG measurements are needed, the opposite of this process happens.

These ICs have a structure different from the ones mentioned above. The AD5940 and AD5941 ICs contain two high-precision excitation loops. One is a low-power excitation loop and the second consists of a 12-bit DAC referred to as the high-speed DAC. They have one measurement channel featuring a multichannel successive approximation register (SAR), ADC with input buffers, a built-in anti-alias filter, and a programmable gain amplifier (PGA). The measurement channel enables a wide capability of measurements of a sensor under test.

AFEs are not limited to medical/fitness applications. They can be used in any application that involves analogue sensing. Many IoT applications involve sensors being connected to a microcontroller and many of these sensors are analogue in nature. However, microcontrollers like Arduino Uno do not have a good analogue resolution and sensitivity. In such a scenario, one can consider interfacing AFEs with microcontrollers. EFY

This feature is inspired by an article written by Vladyslav Kozlov (Team Lead, Product Development Engineering), at Dialog Semiconductor, a Renesas company. The co-author, Aaryaa Padhyegurjar, is an Industry 4.0 enthusiast with a keen interest in innovation and research.

EFY TESTED
S.C. Dwivedi & Sani Theo

STUDY OF RECTIFIED WAVEFORMS
Using Arduino Uno

VINAY KUMAR K.

This project can be used in the laboratories of industrial training institutes (ITIs), polytechnics, and engineering colleges to study the half-wave and full-wave rectifier waveforms using an Arduino Uno. While electrical power from the mains supply is available as AC, almost all electronic equipment use DC power supply.

The author's prototype is shown in Fig. 1 and circuit diagram of a rectifier using Arduino Uno is shown in Fig. 2. This circuit is built around Arduino Uno, centre-tap transformer X1, two diodes, a dual channel relay module, and a few other components. The circuit provides different types of rectifier outputs, such as full-wave and half-wave with and without filters.

Arduino Uno's digital pins 8 and 7 are connected to input pins IN1 and IN2 of the dual-channel relay module, respectively. Common (COM1) and normally open (NO1) terminals of the relay are connected to transformer's secondary terminal and anode of diode D2, respectively. NO2 terminal of the relay is connected to positive terminal of electrolytic capacitor C1 and COM2 terminal of the relay is connected to the junction of cathodes of diodes D1and D2 and resistor R1. Negative

PARTS LIST

Semiconductors:
Board1 - Arduino Uno board
D1-D2 - 1N4007 rectifier diode
Resistor (1/4-watt, ±5% carbon):
R1 - 100-kilo-ohm
Capacitor:
C1 - 100uF, 25V electrolytic
Miscellaneous:
X1 - 230V AC primary to 9V-0-9V, 250mA secondary transformer
- Dual-channel relay module (5V DPDT relay module)
- Cathode ray oscilloscope (CRO)
- Voltmeter

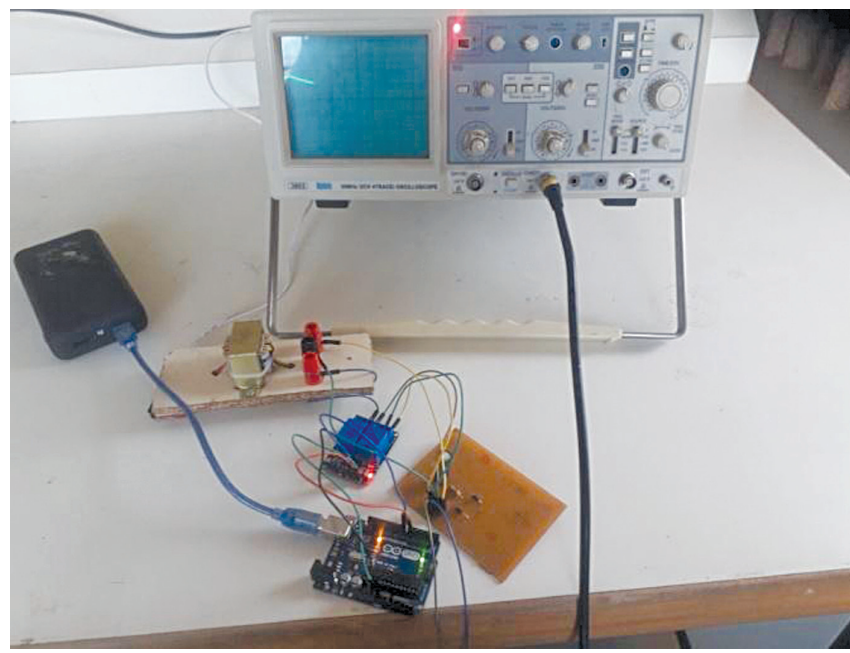


Fig. 1: Author's prototype

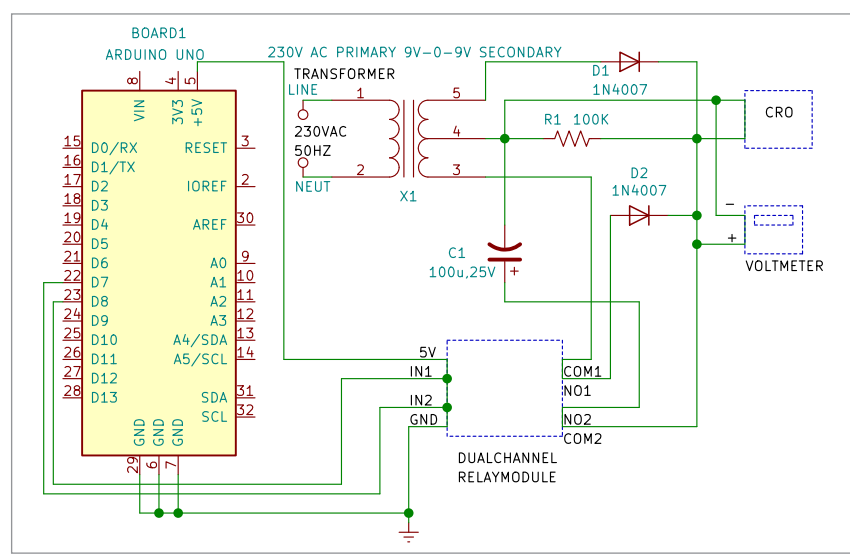


Fig. 2: Circuit diagram

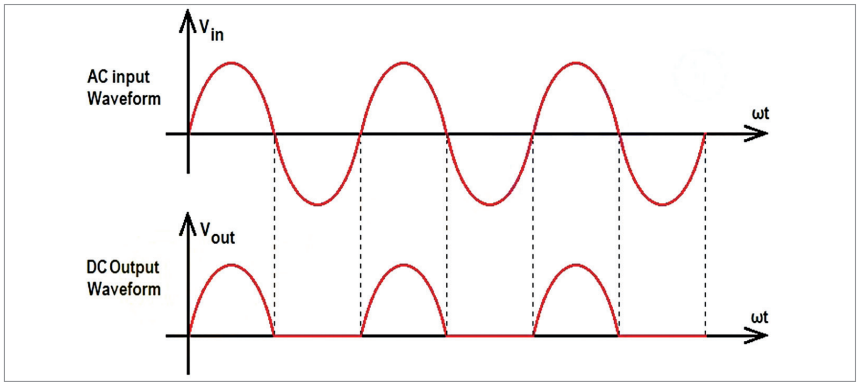


Fig. 3: Input and output waveform of half-wave rectifier without filter

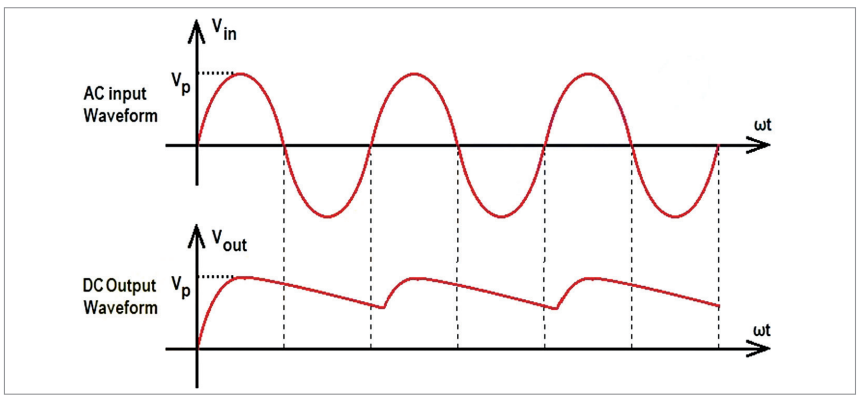


Fig. 4: Input and output waveforms of half-wave rectifier with filter

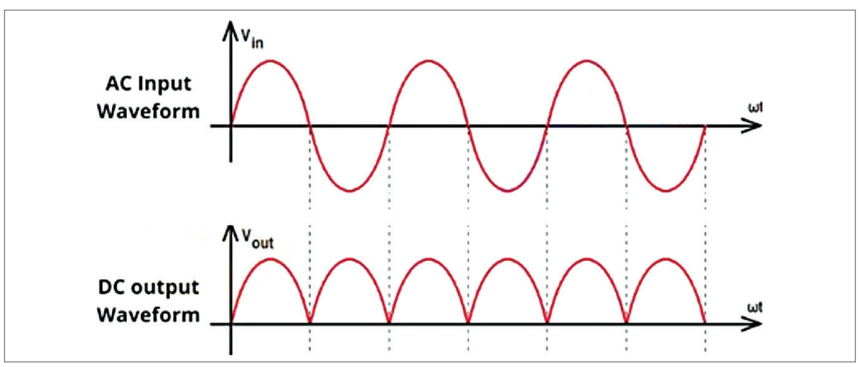


Fig. 5: Input and output waveforms of full-wave rectifier without filter

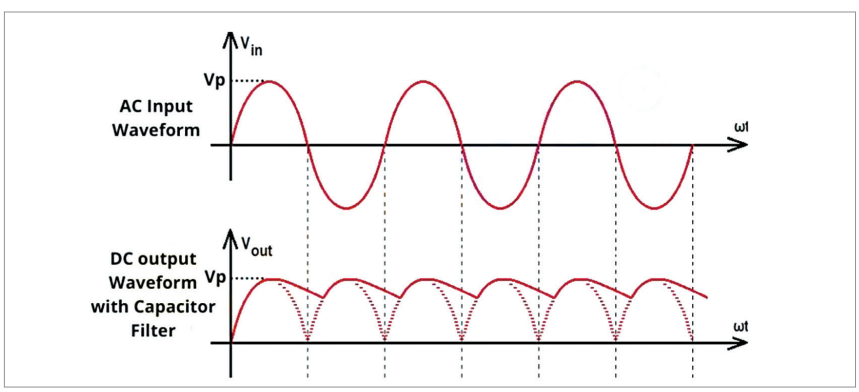


Fig. 6: Input and output waveforms of full-wave rectifier with filter

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

terminal of capacitor C1 is connected to centre-tap on secondary side of the transformer. The output waveform can be observed on an oscilloscope connected across resistor R1.

The centre-tap transformer is used to step down the supply voltage from 230V to 9V-0-9V.

The two 1N4007 diodes (D1 and D2) and 100µF, 25V electrolytic capacitor (C1) are used to get different output waveforms.

Construction and testing

Solder all the components on a Veroboard and upload the source code (Study.ino) on Arduino Uno board using Arduino IDE. Place the CRO probes across resistor R1.

When the circuit is switched on, you get half-wave output without filter capacitor C1, as shown in Fig. 3. Next, the program automatically outputs half-wave output, as shown in Fig. 4. This is followed by full-wave output without filter, as shown in Fig. 5, and full-wave output with filter, as shown in Fig. 6. The program keeps repeating in this sequence to output different waveforms.

As can be seen from Fig. 3 through Fig. 6, the waveforms available include the input and output voltages for comparison. The DC output obtained from pulsating DC input can be smoothened by increasing the value of filter capacitor C1. You can also connect a voltmeter across the diodes and centre-tap of transformer to measure the output voltage. EFY



Vinaya Kumar K. is an instructor in EEE Department of NIE Institute of Technology, Mysuru (Karnataka)

EFY TESTED Sani Theo

Design Of Interrupt Based MATRIX KEYPAD EMBEDDED-C DRIVER For A Microcontroller

N. ABID ALI KHAN

Embedded system project that generally involves a microcontroller unit (MCU) user interface (UI) is a common and inevitable requirement. The simple form of arriving this option of UI is with the help of a monochrome LCD, which serves as a basic output device and a matrix keypad interface for accepting inputs from the user. In fact, majority of the UI designs are with 2x16 LCD ASCII compliant display, typically JHD162A along with either 4x4 or 4x3 matrix keypads.

Here, we start with the development of a device driver for a matrix keypad, typically written in embedded-C for microcontroller. We will consider an 8-bit AT89S52 MCU (works well for any C51 MCU), which is easily available and whose architecture is familiar to many of us. We will implement a C driver for scanning a key in the polled mode first and see how to test it without implementing or coupling the output driver (LCD).

We shall then investigate the design aspects of converting this driver by binding/locking it into an asynchronous external interrupt pin (/INT0 pin) and present the implementation and testing aspects involved in achieving driver in embedded C. It is advised to consider further aspects with Keil µVision 5 IDE with C51 cross-compiler (that support legacy C51 microcontroller families) installed in Windows 10 host PC along with simulation software such as Proteus 7.7 or above for validation.

The project has four parts where the source program (Project1 through Project4) of each part is written in embedded C programming language. The hex code generated through Keil µVision 5 IDE is used for simulation and verification using Proteus software.

Before we dig into the technicality, we need to understand the need for this conversion. Since majority of the embedded projects deal with this standard polled-loop driver for keypad, the need to convert arises in following cases:

(a) When the MCU is expected to handle the traffic over serial (typically UART) port for achieving networking. Let us consider an example of handling the data using GSM's ASCII terminal commands (AT) in the form of SMS. While the MCU is busy in handling this SMS traffic using handshaking options, if user presses any input, forcing

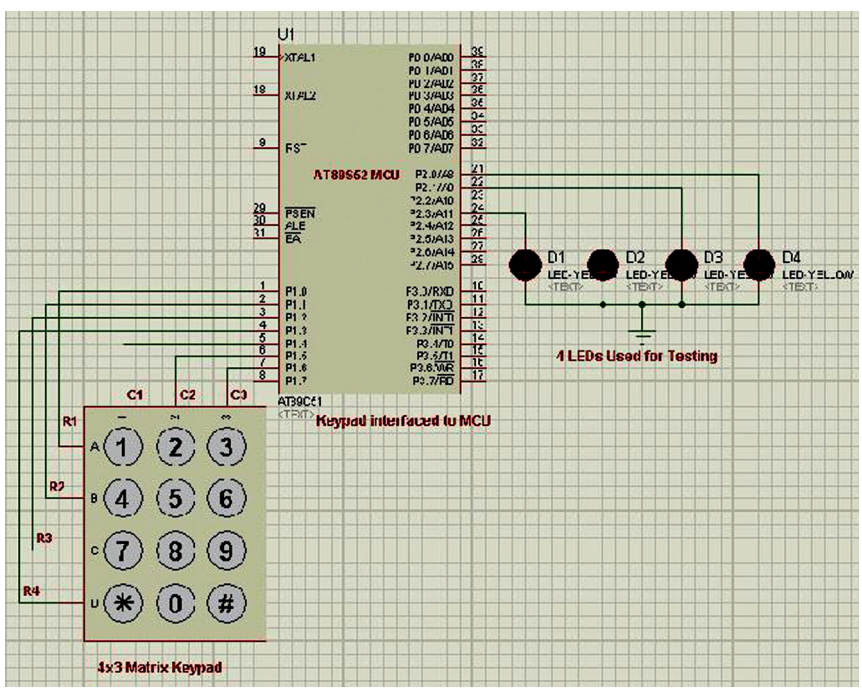


Fig. 1: Experimental setup for interfacing keypad and testing its driver

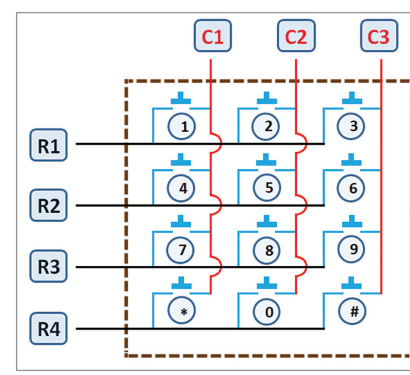


Fig. 2: Typical keypad layout diagram

the microcontroller's attention, the traditional approach of polled-loop driver fails to recognise the user inputs. This requirement causes a serious problem when the user is attempting to configure the data and traffic is flooding over networking (in this case serial) interface.

(b) If the MCU is busy in performing the sensor data processing, either using the off-chip ADC interface option or on-chip ADC register polling, and the user is triggering an input using the input device. In this case also, the user attention will be unanswered as the MCU is already busy in sensory task.

```
1. unsigned char KeyScan(void)
2.  {
3.              R1=R2=R3=R4=0;
4.              C1=C2=C3=1;
5.              while (1)
6.              {
7.               MSDelay(20); //This delay is used to avoid key debouncing.
8.  if((C1==0||C2==0||C3==0))              //Is there any key is pressed?
9.              {
10.              R1=0; R2=R3=R4=1;
11.              if(C1==0)  return '1';     //ASCII('1')=0x31 in Hex.
12.              if(C2==0)  return '2';
13.              if(C3==0)  return '3';
14.
15.              R2=0;R1=R3=R4=1;
16.              if(C1==0)  return '4';
17.              if(C2==0)  return '5';
18.              if(C3==0)  return '6';
19.
20.              R3=0;R1=R2=R4=1;
21.              if(C1==0)  return '7';
22.              if(C2==0)  return '8';
23.              if(C3==0)  return '9';
24.
25.              R4=0;R1=R2=R3=1;
26.              if(C1==0)  return '*';
27.              if(C2==0)  return '0';
28.              if(C3==0)  return '#';
29.              }
30.             }
31. }
```

Fig. 3: Source listing for polled-loop key scanning implemented in embedded-C

Polled mode 4x3 embedded C driver and its validation for C51 MCU

Let us consider the 4x3 matrix keypad with four rows and three columns being connected to Port 1 of AT89S52 MCU, as shown in Fig. 1. This is basically the connections in Proteus simulation software. The four LEDs are used only for testing and are connected to P2.0 through P2.3. A typical keypad layout diagram is shown in Fig. 2. The polled-loop key-scanning algorithm is very simple and straightforward, as shown in steps 1 through 7 given below:

```
Step-1: Configure the columns as inputs
(logic-1) and rows as outputs (logic-0)
Step-2: Start polling the KeyScan by
looking for any change in column (1 to 0)
Step-3: Is there any change in columns
(i.e., C1=0 or C2=0 or C3=0)
   If yes,
      then, go to Step – 4.
   else
      Go to Step-2.
Step-4: Make R1=0 and keep R2=R3=R4=1
and,
   If C1=0 then,
      pressed key is – '1' and return.
   else if C2=0 then,
      pressed key is – '2' and return.
   else if C3=0 then,
      pressed key is – '3' and return.
   else
      go to step – 5:
Step-5: Make R2=0 and keep R1=R3=R4=1
and,
   If C1=0 then,
      pressed key is – '4' and return.
   else if C2=0 then,
      pressed key is – '5' and return.
   else if C3=0 then,
      pressed key is – '6' and return.
   else
      go to step – 6:
Step-6: Make R3=0 and keep R1=R2=R4=1
and,
   If C1=0 then,
      pressed key is – '7' and return.
   else if C2=0 then,
      pressed key is – '8' and return.
   else if C3=0 then,
      pressed key is – '9' and return.
   else
      go to step – 7
Step-7: Make R4=0 and keep R1=R2=R3=1
and,
   If C1=0 then,
      pressed key is – '*' and return.
   else if C2=0 then,
      pressed key is – '0' and return.
   else if C3=0 then,
      pressed key is – '#' and return.
   else
      go to step – 2
```

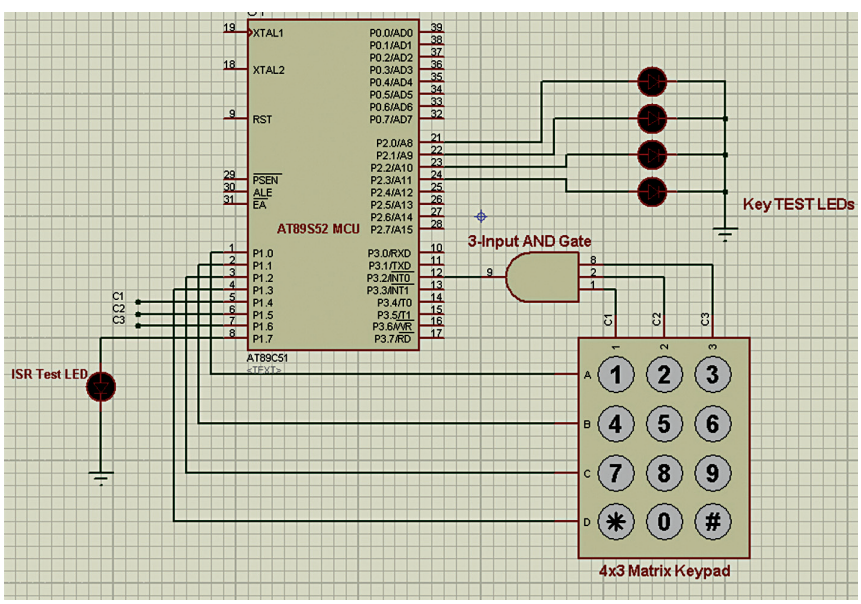


Fig. 4: Circuit diagram for interrupt driven keypad

The implementation of this first part (Project1) in embedded C func-

tion is shown in Fig. 3. Upon any key press, the ASCII equivalent of the pressed key is identified and is returned. Hence, in the testing of the circuit given in Fig. 1, the lower nibble alone is sufficient as the LEDs indicate the pressed digit.

As an example, if the user presses key-'1', the ASCII of '1', which is 0x31, i.e., 0110 0001, is shown on the LEDs. In the same way, all the keys of the keypad may be tested by observing their equivalent binary outputs on LEDs.

Let us now look at the approach of converting the above polled-loop driver by binding the interrupt and demonstrate the process of context switching from the application to interrupt service routine (ISR), and vice-versa.

Circuit diagram for interrupt-driven keypad

There are two external interrupt pins /INT0 and /INT1 of AT89S52, which are available as alternate-pin functions of the P3.2 and P3.3 GPIOs, respectively. Among these, let us consider usage of /INT0 pin, the P3.2 pin. A three-input AND gate 4073 IC is used such that its output must be connected to /INT0 (P3.2), while the inputs are connected to the three columns C1, C2, and C3, as shown in Fig. 4.

Implementation of interrupt-driven driver

For achieving the key input, as the columns were locked to interrupt pin, any key pressed will result into a change of column signal and thereby generate an interrupt at /INT0 pin. We must enable the interrupt /INT0 pin by configuring the IE register. Moreover, we must configure it as an edge-triggered type of interrupt using TCON register in main application.

The basic configuration in the code for Project3 is shown in Fig. 5. The MCU's C-ISR function 'Keypad_ISR' is implemented as indicated in Fig. 6.

Some very important observations of the implemented ISR are:

1. The interrupt must be configured as edge triggered. This is achieved in AT89S52 by configuring TCON register. Otherwise, even for a single press the interrupt will keep on running as if multiple events are occurring.

2. An interrupt service routine function must not return any value. Hence, we use the concept of global shared resource, which in our case will be the global variable. In the implementation, the variable 'Key' will be acting as a shared resource. Notice that this shared resource is accessible not only in the main but also in the ISR.

3. In the implementation given here an LED is intentionally connected to the unused GPIO P1.7 pin of AT89S52, which will toggle upon the key press due to line-3 of Fig. 6.

4. Whenever a key is pressed by the user, the corresponding column status in the keypad will be changed to 1. As a result, the interrupt will be triggered, and the application will be paused as it enters into /INT0 ISR. This process is called hardware context switching. Notice that during this time, the system stack will be used. (Bank-1 in RAM)

```
1. static unsigned char Key;
2. void main(void)
3.  {
4.              int i=0;
5.              P2=0;
6.              R1=R2=R3=R4=0;
7.              C1=C2=C3=1;
8.              IE = 0x81; //Enable INT0 interrupt.
9.              TCON = 0x01; //Edge-triggered interrupt.
10. Key=0;
11.             while(1); //Actual Application can be implemented here.
12. }
```

Fig. 5: Device initialisation routine in the main code for interrupt driven keypad driver

```
1. void Keypad_ISR(void) interrupt 0
2.  {
3.    ISR_LED=~ISR_LED;//LED used for testing ISR
4.    R1=0;R2=R3=R4=1;
5.    if(C1==0)
6.    {
7.            Key='1';
8.            return;
9.    }
10.           else if(C2==0)
11.           {
12.                   Key='2';
13.                   return;
14.           }
15.           else if(C3==0)
16.           {
17.                   Key='3';
18.                   return;
19.           }
20.
21.           R2=0;R1=R3=R4=1;
22.           if(C1==0)
23.           {
24.                   Key='4';
25.                   return;
26.           }
27.           else if(C2==0)
28.           {
29.                   Key='5';
30.                   return;
31.           }
32.           else if(C3==0)
33.           {
34.                   Key='6';
35.                   return;
36.           }
37.
38.           R3=0;R1=R2=R4=1;
39.
40.           if(C1==0)
41.           {
42.                   Key='7';
43.                   return;
44.           }
45.           else if(C2==0)
46.           {
47.                   Key='8';
48.                   return;
49.           }
50.           else if(C3==0)
51.           {
52.                   Key='9';
53.                   return;
54.           }
55.
56.           R4=0;R1=R2=R3=1;
57.           if(C1==0)
58.           {
59.                   Key='*';
60.                   return;
61.           }
62.           else if(C2==0)
63.           {
64.                   Key='0';
65.                   return;
66.           }
67.           else if(C3==0)
68.           {
69.                   Key='#';
70.                   return;
71.           }
72. }
```

Fig. 6: Keypad C ISR for AT89S52 MCU

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

```
1.  do
2.  {
3.              Key=0;
4.              R1=R2=R3=R4=0;
5.              while(Key==0);
6.  }while(Key!='#');
```

Fig. 7: Pseudo-code source listing for detecting a keypress in main application

5. Inside the ISR, the actual checking or identifying the specific row's key, which is responsible for the key press, is detected and the confirmed key is kept in the shared resource variable 'Key' and the ISR ends by forcing it to return. The suspended application will now be ready by context retrieval using stack's POP operations.

6. The pseudo-code shown in Fig. 7 is proposed for detecting a valid key pressed in main code for further application development.

7. Another important inference is that there will be no key debouncing problem, unlike in polled-loop keypad. As a result, the intentional delay for every consecutive key press is not necessary.

By considering this approach of interrupt-based keypad driver, one can implement and achieve the real-time response for UI without porting the RTOS into the MCU. This is because the ISR will run irrespective of what the application is doing, forcing the CPU's attention. Therefore, as a result if the design is done with this recommended UI, apart from achieving the real-time response, the memory footprint (both Flash and RAM) is also greatly reduced.

After downloading the source programs from EFY website, using circuit shown in Fig.8 along with Project2, the polled-loop application is tested with any 4-digit input as user ID and '1982' as password. The ISR-locked keypad driver is tested using Fig.4 and Project3. Finally, the same application with LCD is tested using Fig. 9 and Project4. EFY

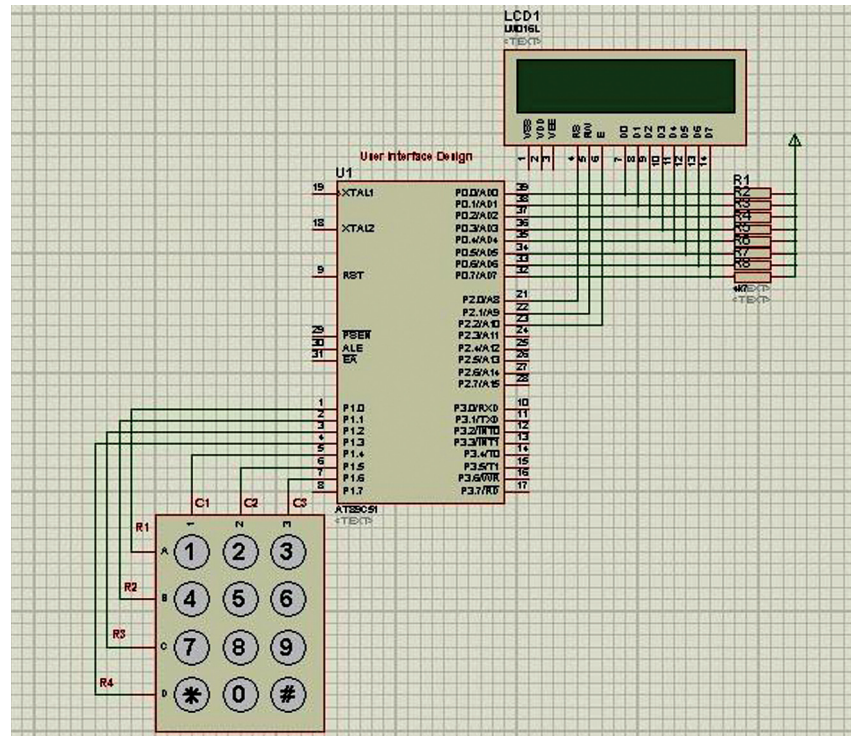


Fig. 8: User interface design with interrupt based matrix keypad and LCD (8-bit)

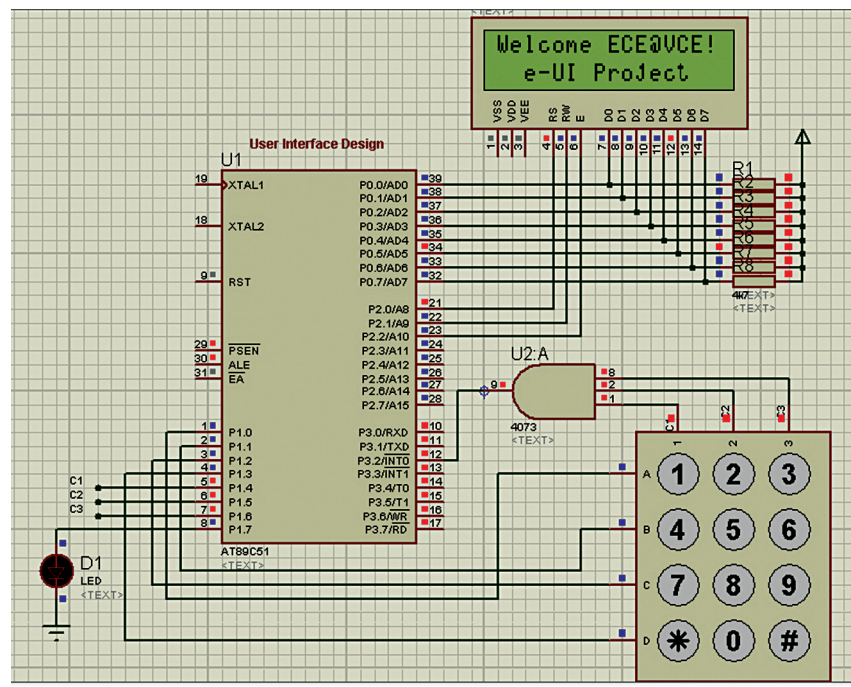


Fig. 9: User interface design with interrupt based matrix keypad using LCD and LED

N. Abid Ali Khan is Assistant Professor in the Department of ECE at Vasavi College of Engineering (Autonomous), Hyderabad. He has been working on power-efficient embedded networking architectures and is passionate about microcontrollers, ARM, RTOS, embedded systems, and programming

EFY TESTED S.C. Dwivedi

SMART SWITCH BOX
For Electric Iron

K. MURALI KRISHNA

As smart devices are increasing day by day, there is need to add smartness to the old, rugged iron box. An iron box contains a simple resistive heater and thermostat to control iron's temperature according to the fabric. Sometimes mishandling of the iron box can cause severe fire accidents. Here is a smart method to control the iron box by switching it off and on at appropriate time.

Motion and position sensors are used to detect the motion and position (vertical or horizontal) of the iron box, respectively. The iron box is switched on only when it is in motion during ironing. When it is placed in vertical position, it gets switched off. The author's prototype wired on breadboard is shown in Fig. 1.

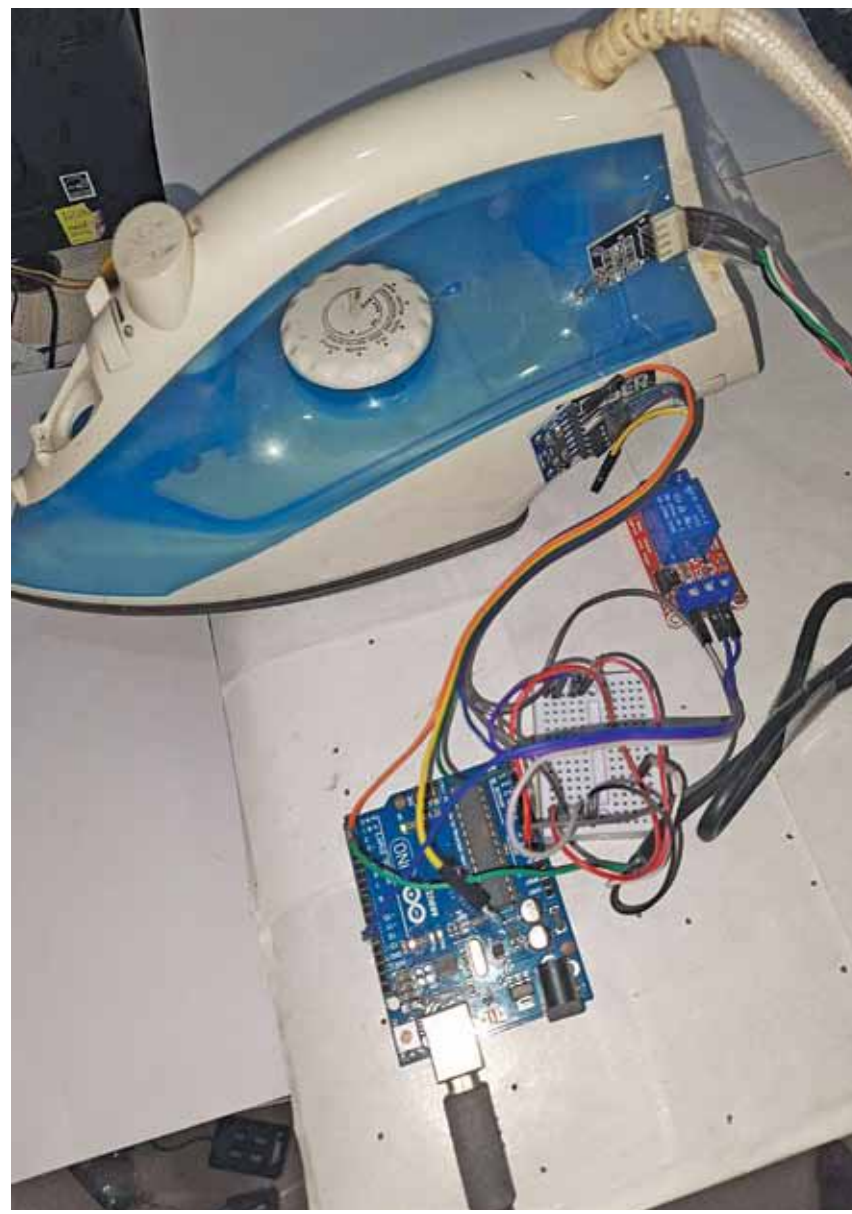


Fig. 1: Author's prototype

Circuit and working

As shown in Fig. 2, the circuit built around Arduino Uno Board1 includes single-changeover relay module MOD1, MPU6050 module MOD2, mercury tilt switch module MOD3, 12V power supply, and a few other components. The block diagram is shown in Fig. 3.

The output is connected to a single-channel relay board, which is connected to a 3-pin electrical socket for connecting to the electric iron. A bypass switch is used to bypass the relay board whenever smart action is not required. A 12V supply is used to power the Arduino board.

Accelerometer and gyroscope module

The MPU6050 accelerometer cum gyroscope module has eight pins, but only five pins are used to interface with Arduino Uno board in this project. The module is a micro electro-mechanical system (MEMS) with 3-axis accelerometer and 3-axis gyroscope inside it. This facilitates calculation of acceleration, velocity, orientation, displacement, and many

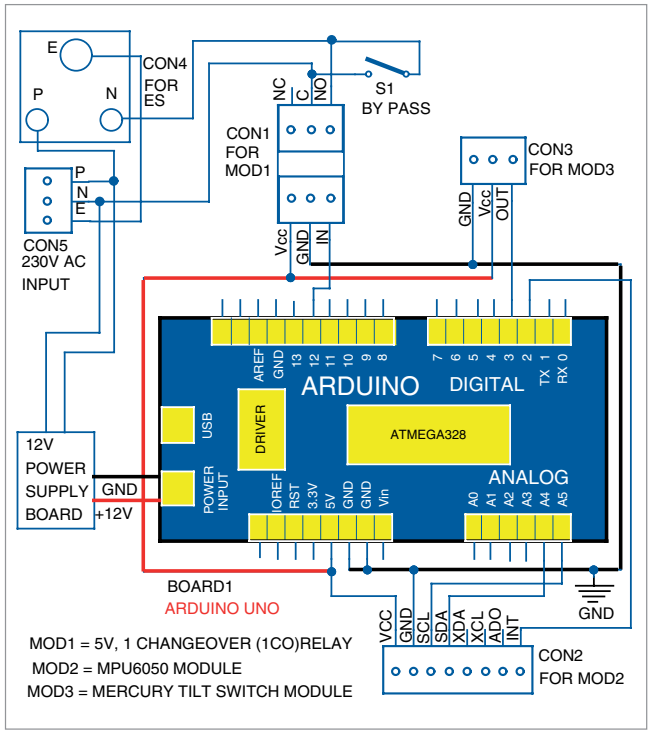


Fig. 2: Circuit diagram

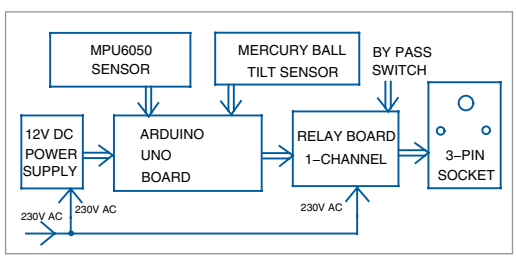


Fig. 3: Block diagram

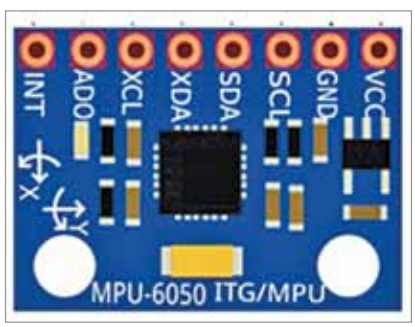


Fig. 4: MPU6050 module

other motion related parameters of a system or an object. The MPU6050 module is shown in Fig. 4.

MPU6050 works on +3V to +5V power supply. In this circuit it is connected to +5V pin of Arduino Uno. Its serial clock (SCL) and serial data (SDA) pins are used for I2C communication between the module and Arduino Uno for providing clock pulse and for transferring data, respectively. The interrupt (INT) pin of Arduino is an output pin used to indicate that new data is available to be read from MPU6050.

MPU6050 module is placed inside or outside the iron box at a suitable position. Five wires are used to connect the module to Arduino Uno. Whenever the iron box moves during ironing, the positional data changes according to the movement of the iron box in different directions. The changes are analysed in the Arduino Uno board and, according to the program, the output relay energises and switches on the electric iron.

In this project, the iron's position is tracked in x, y, and z directions. When the change in position or direction is detected, the relay gets switched on. The data from MPU6050 is read by Arduino Uno after a delay of one second. If the position or direction of the iron box is not likely to change during one second while ironing, a delay of two seconds can be given instead. The delay can be changed by changing the value of 'i' in the program.

The output sample values (x, y, z) of MPU6050, as obtained in serial monitor, are shown in Fig. 5.

The mercury tilt switch module, shown in Fig. 6, can sense when it is tilted at an angle. It works because the mercury ball flows into the gap between two electrodes and closes the circuit when the module is tilted at an angle. The switch has pins for Gnd, Vcc, and Output. Its operating voltage is 5V.

The tilt switch should be placed in the iron box in such a way that it switches off when iron is placed in vertical position. The three pins of the module should be extended to the circuit.

Single-pole, double-throw (SPDT) high-level trigger AC relay board, shown in Fig. 7, can be controlled directly via a microcontroller and switch up to 10A at 250V AC. The inputs of the relay module are isolated from 230V mains to protect the delicate control circuitry. The relay output pins are connected to 3-pin 250V, 6A electrical socket.

```
19:18:24.537 -> ============================================================
19:18:24.605 -> temp : 28.04
19:18:24.639 -> accX : -0.05    accY : -0.80    accZ : 0.46
19:18:24.673 -> gyroX : 0.06    gyroY : 0.06    gyroZ : 0.28
19:18:24.707 -> accAngleX : -59.78      accAngleY : 3.38
19:18:24.742 -> gyroAngleX : 3.35       gyroAngleY : -0.51      gyroAngleZ : -0.05
19:18:24.809 -> angleX : -58.47 angleY : 3.30   angleZ : -0.05
19:18:24.843 -> ============================================================
```

Fig. 5: Output sample values of MPU6050 module



Fig. 6: Mercury tilt switch

The phase of the 3-pin electrical socket is connected to normally open (NO) pin of the relay output pin. The neutral from the mains is connected to common (COM) pin of the relay module. An additional 6A SPST electrical switch (S1), connected across NO and normally closed (NC) terminals, acts as a bypass switch when smart switching action is not needed.

The Table shows pin connections between Arduino Uno board and various modules in the project. Arduino Uno is a microcontroller board based on 8-bit ATmega328P microcontroller, which is very simple to use and interface. Use a 12V, 1A SMPS power supply to power up the Arduino Uno board.

ARDUINO UNO PIN CONNECTIONS

Arduino Uno Pins	Components
5V	• Connected to MPU6050 module Vcc pin • Connected to Vcc pin of relay board • Connected to mercury tilt switch pin 2
Pin 2	MPU6050 module INT pin
Pin 3	Mercury tilt switch output pin 3
A4	SDA pin of MPU6050 module
A5	SCL pin of MPU6050 module
Pin 12	Input signal pin of relay board
GND	• Connected to GND pin of relay board • Connected to MPU6050 module GND pin • Connected to mercury tilt switch module GND pin



Fig. 7: 5V single-channel relay module

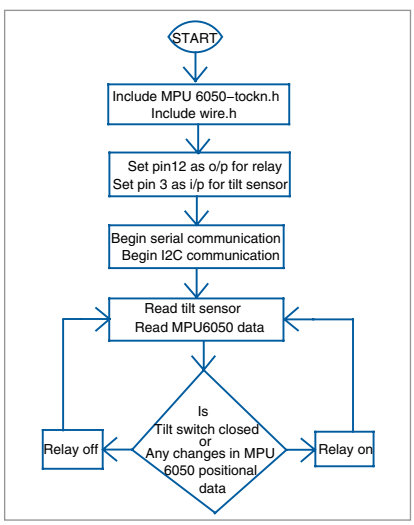


Fig. 8: Flow chart of smart switch box program

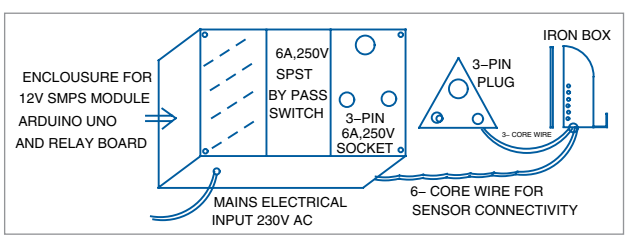


Fig. 9: Proposed construction details

The software

The circuit operation is performed through the software program loaded into the internal memory of Arduino Uno. The program/sketch (*ironbox.ino*) is written in Arduino programming language. ATmega328P on Arduino Uno comes with a pre-programmed boot loader that allows users to upload a new code to it without using a peripheral hardware programmer.

Arduino IDE is used to compile and upload the program. The sketch is the heart of the system and carries out all major functions. The program is easy and simple to understand. Comments are given at the end of each command line. Fig. 8 shows the flow chart of the program.

When input and output pins of Arduino board are initialised, the following functions and libraries are used.

Serial.begin(). Establishes serial communication between Arduino Uno board and another device via a USB cable. It permits the two devices to communicate using a serial protocol. Here serial communication is used only to read the data from the MPU6050 via Arduino Uno onto the screen. The displayed data allows us to know the changes in the values during movement of the iron box. Sample values are shown in Fig. 5.

#include < Wire.h >. The Wire library allows communication through I2C devices, also called '2 wire' or 'TWI' (two-wire interface). The SDA (data line) and SCL (clock line) are used for communicating with MPU6050 module.

#include < MPU6050_tockn.h >. It is the Arduino library for easy communication with the MPU6050 module. It can be downloaded from the *link https://github.com/tockn/MPU6050_tockn*

mpu6050.update(). We must execute *mpu6050.update()* to fetch all the data from MPU6050.

There are some important variables in the code. The '*value_1*' variable sums up the angle values in the three directions at a time and passes the absolute value (negative sign is not considered). Similarly, '*value_2*' variable sums up the angle values in the three directions at another point of time and passes the absolute value.

The '*diff*' variable contains the difference of *value_1* and *value_2*. When iron box is stationary, the *diff* value will be zero or close to zero. Based on the value in the *diff* variable, the movement of the iron box is detected. The '*i*' value is used to provide some delay to switch off the relay after no movement of the iron box is detected.

Construction and testing

Fix a 6A, 250V electrical socket on top of a suitable plastic box. Enclose the whole circuit including Arduino

PARTS LIST

Semiconductors:

Board1	- Arduino Uno board
MOD1	- 5V, single changeover (1CO) relay module
MOD2	- MPU6050 module
MOD3	- Mercury tilt switch module

Miscellaneous:

S1	- On/off switch (6A)
	- 12V, 1A DC power supply
	- Electric iron
	- Jumper wires
	- 2.1mm DC power jack
	- 3-pin power socket

Uno, 12V SMPS power supply, and the relay module inside the plastic box. The MPU6050 module and mercury tilt switch module should be placed inside the iron box at appropriate orientations to sense the vertical and horizontal positions of the iron box.

Use a 6-core soft cable to connect (common ground and common 5V, SDA, SCL, INT pins of MPU6050 module, signal out pin of tilt switch module) to the Arduino Uno module, which is enclosed in the plastic box. The relay remains switched on as long as the iron box is in motion, but it switches off when the iron box is placed in vertical position.

Use bypass switch S1 to disconnect the circuit when smart switch action is not needed. Fig. 9 shows the proposed construction details of the project.

Precautions

The Arduino Uno board is highly sensitive. Handle it carefully. Check the DC power supply jack input polarity (2.1mm centre-positive plug into the board's power jack). Take care while placing the 12V SMPS module and the Arduino Uno board into the plastic switch box. Use of a 1000W iron box is recommended.

Choose an appropriate place inside or outside the iron box to place the sensors. The position of the tilt switch is very important. Place the tilt switch in such a way that it can detect vertical and horizontal positions of the iron box easily. EFY

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



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EFY TESTED Sani Theo

Simple TWO-WAY INTERCOM

S.C. DWIVEDI

If you have to frequently get up to talk to someone in your place, this intercom can save you the trouble. You can just switch it on from both sides to communicate. It can also come in handy if you have someone observing isolation at home due to Corona. Block diagram of the intercom is shown in Fig. 1.

Circuit diagram of the intercom is shown in Fig. 2. The simple, low-cost intercom is built around two condenser microphones (MIC1 and MIC2), four 2N2222 transistors (T1 through T4), and two LM380N audio amplifiers (IC1 and IC2).

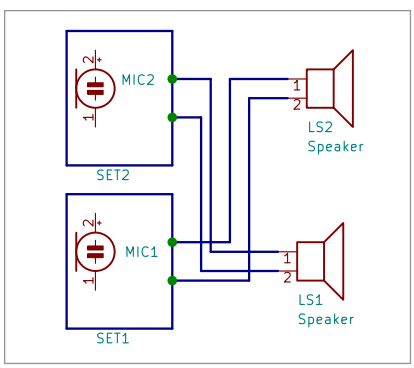


Fig. 1: Block diagram

A condenser microphone is like a capacitor (also called condenser) with two parallel plates placed close to each other. One of the plates is made of a very light and thin material that acts as the diaphragm. The diaphragm vibrates when struck by sound waves, changing the distance between the two plates, and thereby varying the capacitance. The resulting fluctuation in capacitance creates the corresponding electrical signal, which is amplified.

Most intercoms do not use a pre-amplifier circuit, because of which you get distorted sound output. This circuit employs pre-amplifiers to enhance the inputs for loud and clear sound from the loudspeakers.

PARTS LIST

Semiconductors:
IC1-IC2 - LM380N audio amplifier
T1-T4 - 2N2222 NPN transistor
Resistors (all 1/4-watt, ±5% carbon), unless stated otherwise:
R1, R2 - 10-kilo-ohm
R3, R4, R7, R8 - 100-kilo-ohm
R5, R6, R9, R10 - 1-kilo-ohm
R11, R12 - 18-ohm
VR1, VR2 - 100-kilo-ohm potmeter
Capacitors:
C1-C4 - 10µF, 25V electrolytic
C5, C6 - 47µF, 25V electrolytic
C7, C8 - 100µF, 25V electrolytic
Miscellaneous:
S1, S2 - On/off switch
MIC1, MIC2 - Electret condenser microphone
BATT.1, BATT.2 - 9V battery
LS1, LS2 - 8-ohm, 1-watt speaker

As shown in Fig. 2, there are two identical circuits. In the lower circuit, R1 works as a current-limiting resistor for MIC1. The electrical signal produced by sound flows through coupling capacitor C1, which blocks any DC signal and allows only AC signals to pass through. This signal is boosted by the amplifier sections formed by transistors T1 and T2 and IC LM380N.

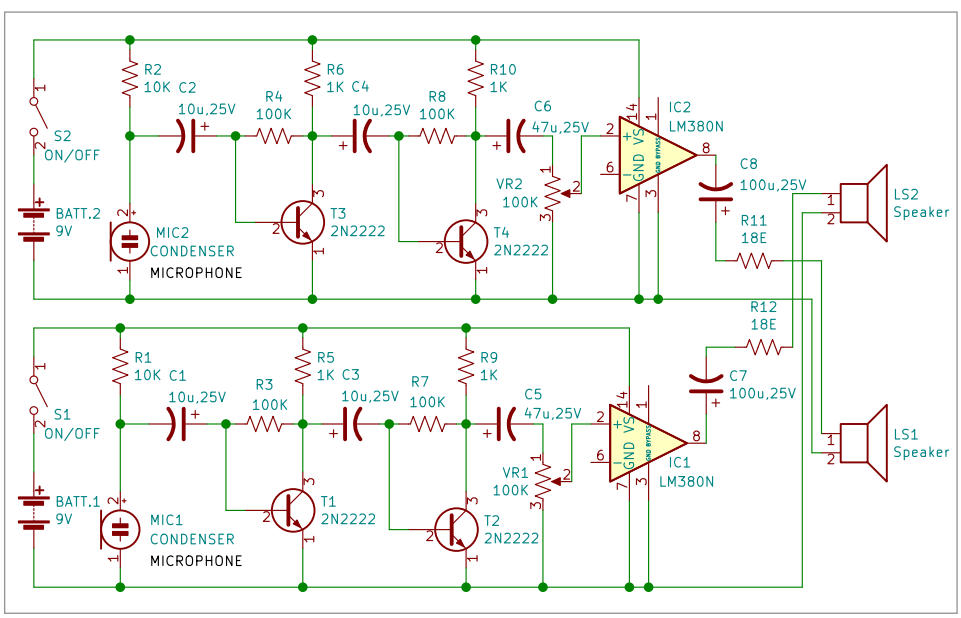


Fig. 2: Circuit diagram

The signal is first boosted by the amplifier built around transistor T1 and further by the second amplifier built around transistor T2. The output at collector of T2 goes to LM380N (IC1) through its pin 2, via capacitor C5, and the pot VR1.

The 8-ohm speaker (LS2) connected to output of

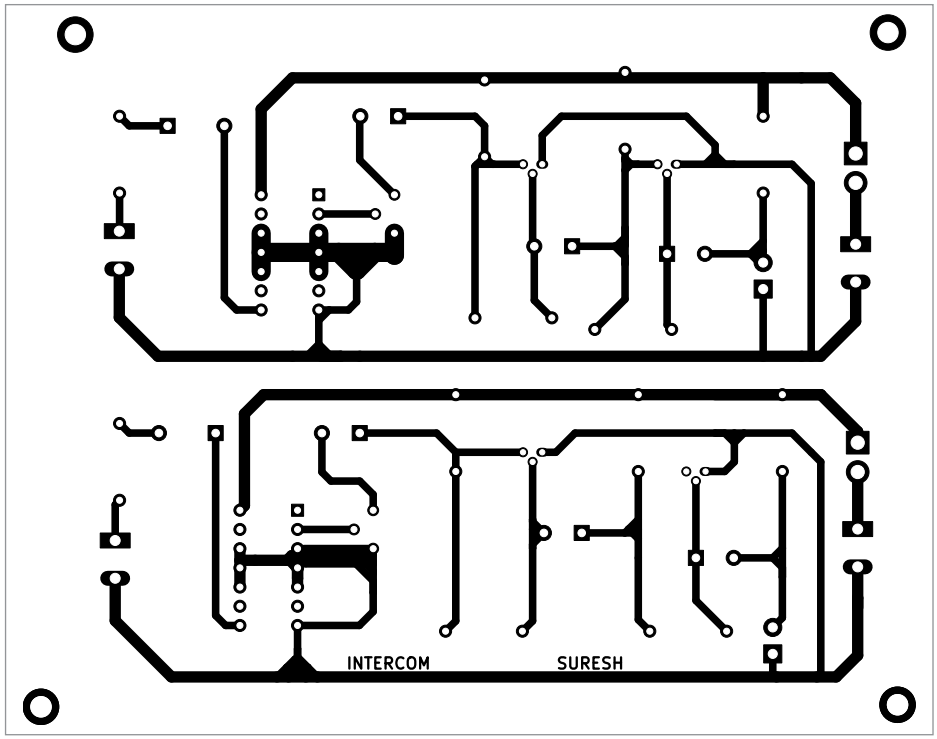


Fig. 3: Actual-size PCB layout

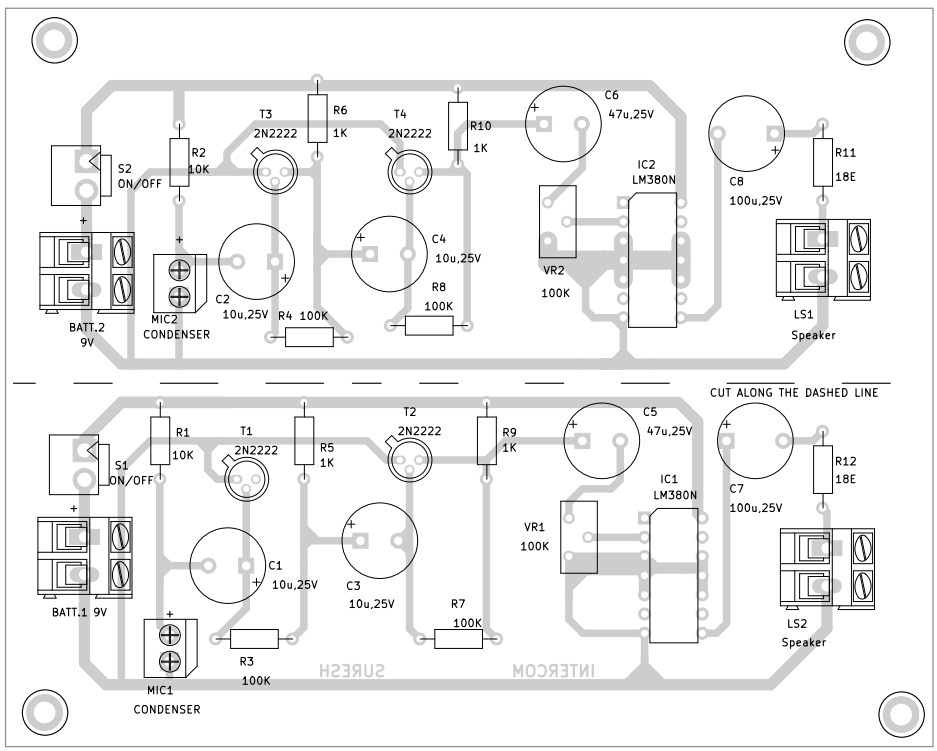


Fig. 4: Component layout of the PCB

LM380N via capacitor C7 and resistor R12 reproduces the sound. A 9V regulated supply or 9V battery each is required to power the upper and lower sections of the circuit.

The upper section of the circuit is identical and works the same way. When you speak in front of microphone MIC1, your voice can be heard from speaker LS2. And when you speak in front of microphone MIC2, your voice can be heard from speaker LS1. Thus, 2-way communication becomes possible.

Construction and testing

An actual-size PCB layout for the intercom is shown in Fig. 3 and its component layout in Fig. 4.

Assemble the circuit on the PCB or a general-purpose board. Cut the PCB into two parts (SET1 and SET2) along the dotted line marked on it. Enclose each PCB separately in a suitable box. Place SET1 in one room and SET2 in another. Connect LS2 in SET1 in first room to SET2 in the second room and LS1 from SET2 to SET1 in first room using a twin wire.

Fix MIC1 on the front side and LS2 on the rear side of the SET1 enclosure. Similarly, fix MIC2 on the front side and LS1 on the rear side of SET2 enclosure. Switch on S1 in SET1 and S2 in SET2 to start communication from both sides.

When you speak into microphone MIC1 in SET1, the person in the second room will hear you through loudspeaker LS2. Similarly, when he speaks into microphone MIC2, you will hear him through loudspeaker LS1.

Please note, there will be acoustical feedback between the microphone and loudspeaker if they are close and facing each other. So, keep distance between the microphones and loudspeakers while assembling and fixing them on the enclosures. EFY

S.C. Dwivedi is an electronics enthusiast, circuit designer and technical article writer

EFY TESTED S.C. Dwivedi

DATA LOGGING Using microSD And RASPBERRY PI PICO

SANI THEO

This data logging system can be used to interface an external or internal sensor of Raspberry Pi Pico board. The project has many advantages, including the use of internal temperature sensor of Raspberry Pi Pico board; so an external temperature sensor is not required. Second, the easily detachable microSD card can be used to record different temperature data at a particular place or industrial setup. The SD card can be removed and carried to laboratory or control room for analysis or future reference. The project also includes optional external sensors, such as force and light sensors.

Components required for the project are given in the Table below.

The author's prototype wired on the breadboard is shown in Fig. 1 and the connection of data logging system with microSD card and Raspberry Pi Pico is shown in Fig. 2. An LDR or any other suitable analogue sensor, such as the force sensor shown, may be used.

The setup uses serial peripheral interface (SPI) pins MOSI, MISO, CS, and CLK of Raspberry Pi Pico

COMPONENTS REQUIRED

Components	Quantity	Purpose
Raspberry Pi Pico	1	Computing
microSD Card (16GB) with adaptor	1	Data storage
LDR	1	External sensor
Force sensor	1	External sensor
Resistor (10-kilo-ohm)	1	Current limiter
Jumper wires	9	Connections

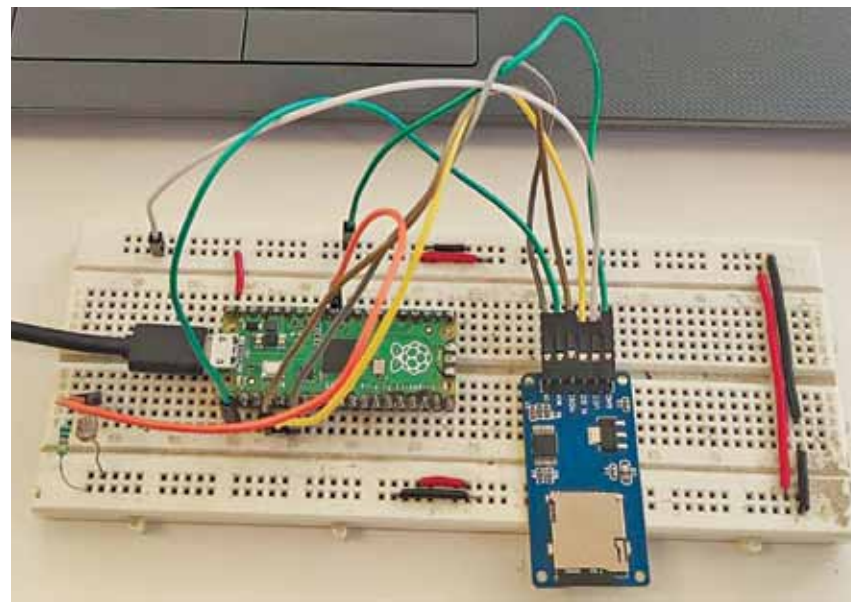


Fig. 1: Author's prototype

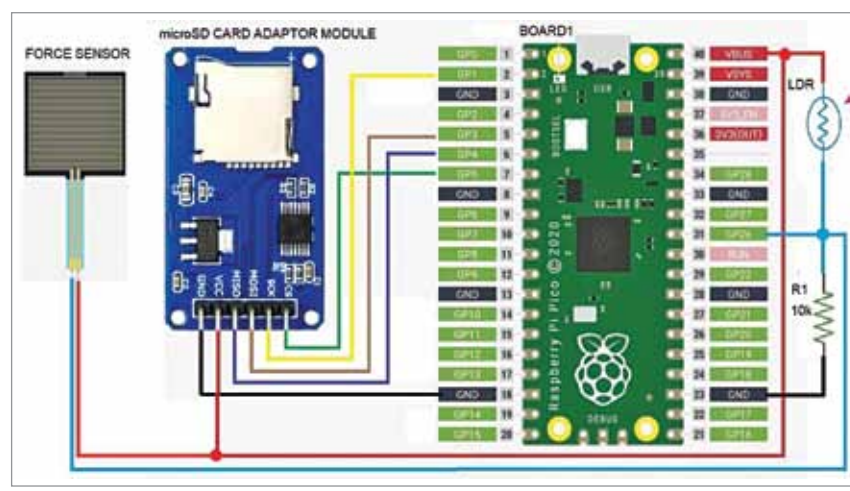


Fig. 2: Connection of the data logging system with micoSD card and Raspberry Pi Pico

Board1. External sensor (light sensor, light dependent resistor, or force sensor) is connected to GP26 pin of Board1.

LDR sensor is used to record light condition in the area where it is installed. The microSD card module is interfaced with Raspberry Pi Pico board pins GP1, GP3, GP4, and GP5. VBUS from the board is used as power supply for microSD card and LDR. A 10k pull-down

resistor is connected to GP26 pin of Board1 for interfacing external sensors.

Software

The project is controlled by the Python program developed on Mu editor. Mu editor is a simple code editor that works with Adafruit CircuitPython boards, including Raspberry Pi Pico, and on most operating systems, including Windows and Linux. CircuitPython is based on Python programming language and is easy to understand.

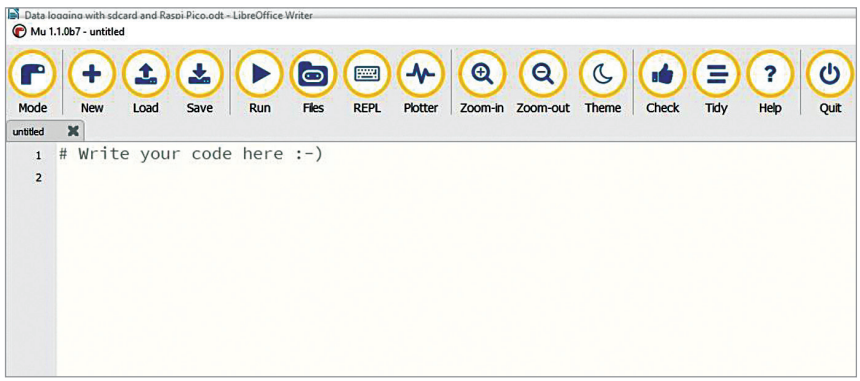


Fig. 3: Mu editor window

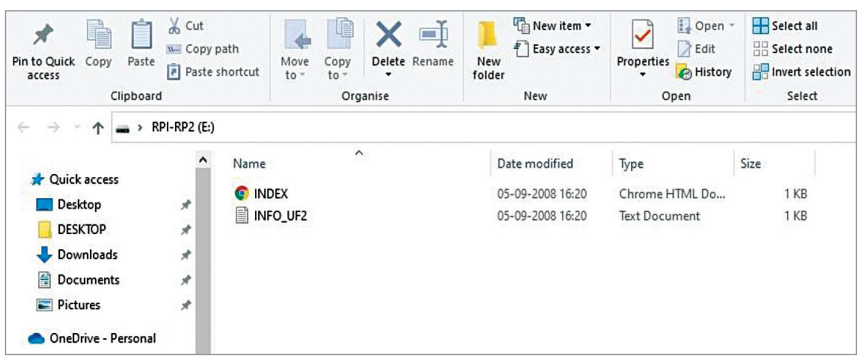


Fig. 4: New drive window

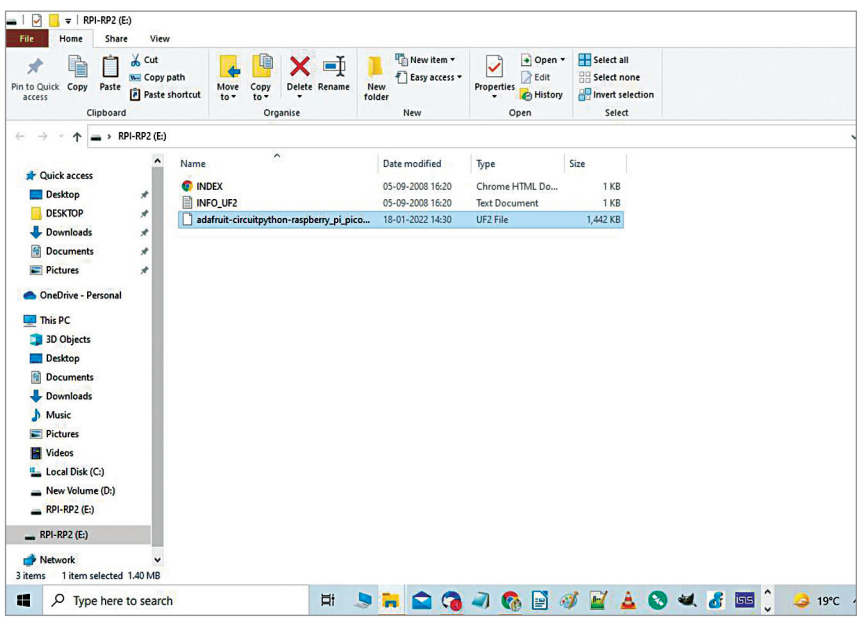


Fig. 5: CircuitPython file in the drive

Both Mu and CircuitPython are required for this project. Mu editor can be downloaded from *https://codewith.mu* and then installed using instructions given at *https://learn.adafruit.com/getting-started-with-raspberry-pi-pico-circuitpython/installing-mu-editor*. After installing Mu editor, run it and you will see the window shown in Fig. 3.

CircuitPython version 7.1.1 was used during testing of this project. CircuitPython board requires a bootloader called UF2 (USB flashing format) that makes installing and updating CircuitPython a quick and easy process. Download the most recent version of CircuitPython bootloader .UF2 file from *https://circuitpython.org/board/raspberry_pi_pico/*

Installing CircuitPython on the board is easy. Just copy and paste the file as explained here. First press the BOOTSEL button on the Raspberry Pi Pico board, while inserting the USB cable of the RPI board to laptop/PC, and release it after a new drive (RPI-RP2) window appears, as shown in Fig. 4.

Next, copy *adafruit-circuitpython-raspberry_pi_pico-en_US-7.1.1.uf2* file downloaded in previous step. Paste it into the new window, as shown in Fig. 5. Now open Mu editor window and close all other windows.

Next, the first thing to do in Mu is to select 'Mode' from the main menu. In this project, you should select RP2040 option in Select Mode window, as shown in Fig. 6.

Start coding on the Mu editor window or load the existing code. You can load the *analog_sensor.py* code that comes along with this project. This code will work with either LDR or force sensor but not with both at the same time.

Connect LDR to the circuit, as shown in the schematic, and run the code by clicking Run button. When you cover the LDR with an opaque

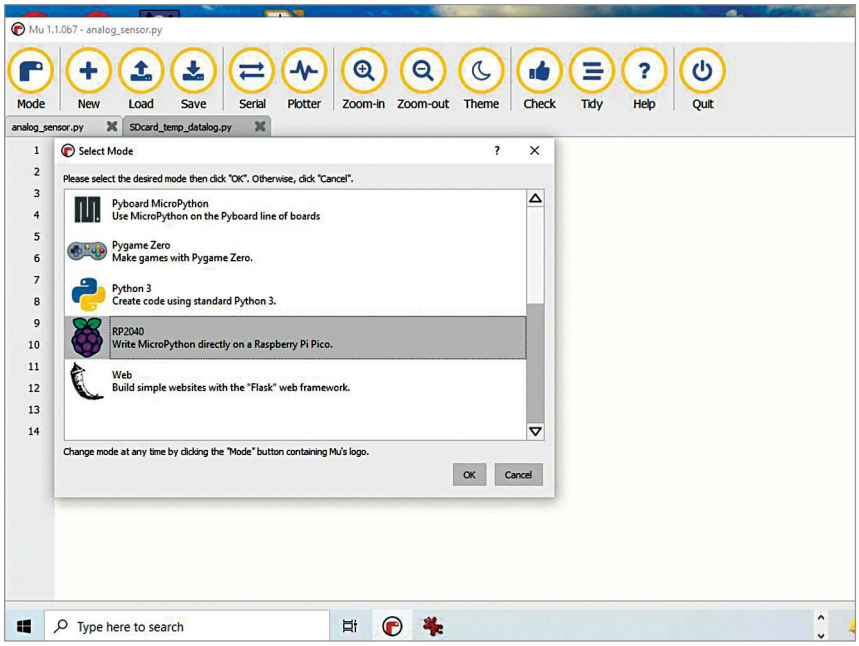


Fig. 6: Mode selection

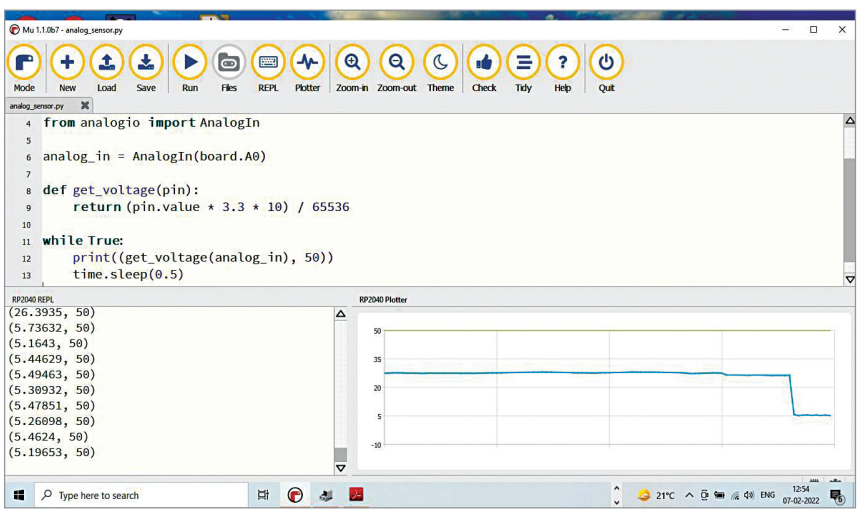


Fig. 7: LDR sensor output waveform

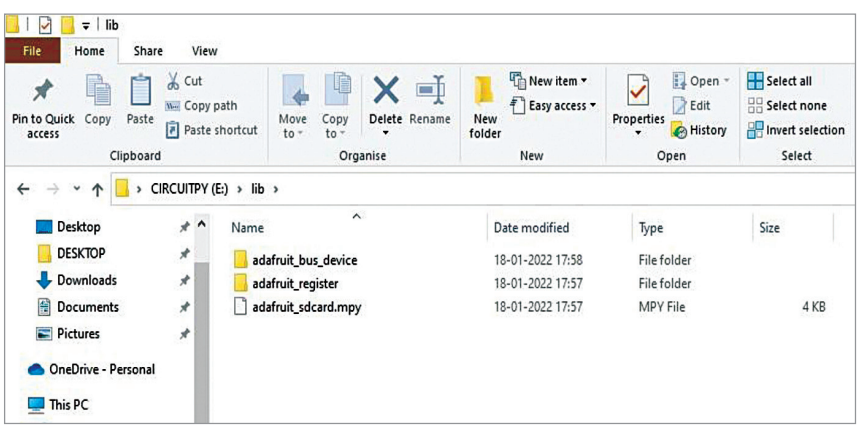


Fig. 8: CIRCUITPY drive

object and uncover it again, you will see the light intensity's arbitrary values vary between 0 and 32, with 0 being the darkest and 32 being the brightest light.

An additional feature of Mu is its ability to display the data waveform. When you select the Plotter option from the main menu, you will see the output waveform, as shown in Fig. 7. Similarly, you can replace LDR with any other analogue sensor like force sensor. The sensor data will be displayed on the screen along with the waveform.

Let us now explore the inbuilt temperature sensor on Raspberry Pi Pico board and store the temperature data on the microSD card that is normally used in your mobile phone. Here, we use CircuitPython libraries along with the main code (*Sdcard_temp_data.py*). You need to import adafruit libraries for SD card to interface it with the Raspberry Pi Pico board. For that download the libraries (Bundle for Version 7.x) from *https://circuitpython.org/libraries*.

Unzip the Bundle folder and copy *adafruit_bus_device* and *adafruit_register* folders, paste them into 'lib' folder in CIRCUITPY(E) drive. Also copy *adafruit_sdcard.mpy* file from the Bundle folder and paste into 'lib' folder, as shown in Fig. 8.

Open Mu editor and load the main code under *Code.py* file. Save the file and run it. If something goes wrong, you will get error message at the bottom of the Mu editor window. For example, if SD card is not connected properly to the circuit, you will get "OSError: no SD card" error message, as shown in Fig. 9.

If everything is fine, instead of error message you will see following text (see Fig. 10) below the Mu editor window: "The first line of text on SD card, Check temperature data on SD card"

```
import microcontroller
from time import sleep

SD_CS = board.GP5

spi = io.SPI(board.GP2, board.GP3, board.GP4)
cs = digitalio.DigitalInOut(SD_CS)
```

```
RP2040 REPL
>OK
soft reboot
raw REPL; CTRL-B to exit
>OK

Traceback (most recent call last):
  File "<stdin>", line 14, in <module>
  File "adafruit_sdcard.py", line 100, in __init__
  File "adafruit_sdcard.py", line 121, in _init_card
OSError: no SD card
```

Fig. 9: Error message

```
import digitalio
import storage
import adafruit_sdcard
import microcontroller
from time import sleep

SD_CS = board.GP5

spi = io.SPI(board.GP2, board.GP3, board.GP4)
cs = digitalio.DigitalInOut(SD_CS)
sdcard = adafruit_sdcard.SDCard(spi, cs)
vfs = storage.VfsFat(sdcard)
```

```
RP2040 REPL
soft reboot
raw REPL; CTRL-B to exit
>OK

The first line of text on SD Card

Check temperature data on SD Card
```

Fig. 10: Final output

Now, quit Mu editor and unplug the SD card from its adaptor. Insert SD card into the microSD card slot in your laptop/PC and check the various temperature values available in text file format.

Construction and testing

The whole circuit can be assembled on a breadboard or general-purpose PCB. Most Raspberry Pi Pico boards do not come with header pins connected or soldered on the boards. Without these pins, the board cannot be interfaced with external devices, such as sensors, motors, or any device required for the project. Wires can be soldered directly onto the holes provided on the board, but that is a bit risky as you may damage the board.

So, to access GPIO pins, solder each pin carefully using male Berg strip connectors with an appropriate soldering iron. You can then either mount the pins on the breadboard or connect each pin with jumper wire to other components or modules.

After all connections are done, recheck correct polarities, specially Vcc and ground pins. Note that VBUS at pin 40 is typically 5V, which is the main Vcc supply in the circuit. Before inserting the microSD card first format it in FAT32 system and only then insert it into the slot provided in the adaptor.

When you plug in your Raspberry Pi Pico to your laptop the first time, Mu editor attempts to auto-detect your board on start-up and searches for CIRCUITPY drive in the board. So, prior to this, ensure that CircuitPython is properly installed in the drive, as explained above. Next, select the mode and run the code *analog_sensor.py*.

If you get proper sensor output data and waveform, open the main code by clicking on Load option on the main menu bar. Run the code and make sure you get the output message at the bottom of the Mu editor window. You can quit the program and switch off the circuit any time you wish to check the sensor data on the SD card from any computer having microSD card slot. EFY

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

Sani Theo is an electronics enthusiast, circuit designer, and technical editor

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EFY TESTED Ashwini K. Sinha

AI CAMERA FOR TRACKING Suspicious Activities

ASHWINI KUMAR SINHA

Tracking and detecting suspicious activities is one of the most demanding tasks for security personnel and systems. If a security system fails in a place like airport or bank, criminals can rob at gunpoint. Out of fear, the victims are usually unable to call the police in time for help.

But if a smart camera could detect any suspicious activity and automatically trigger an alarm to call the police, such criminal acts are likely to reduce significantly. So, let's see how to build such an alarm.

Training the camera

Create a machine learning (ML) model having datasets of normal activities, such as walking, talking, reading, and sitting. Feed the datasets of suspicious activities like fighting, boxing, pointing a gun, or any other violent movement deemed suspicious, into the ML model.

Perform the above-mentioned activities in front of the smart camera so that various movements are captured. This will help train the ML model and deploy it on Raspberry Pi as a smart artificial intelligence (AI) camera.

There are several flexible options, such as TensorFlow, Google Teachable, Edge Impulse, and Lobeo to create and train an ML model.

TABLE 1
MATERIALS REQUIRED

Component name	Quantity	Description
Raspberry Pi 4	1	Zero W or RPi 4
RPi Camera	1	Camera module
Speaker/Amplifier	1	Speaker module

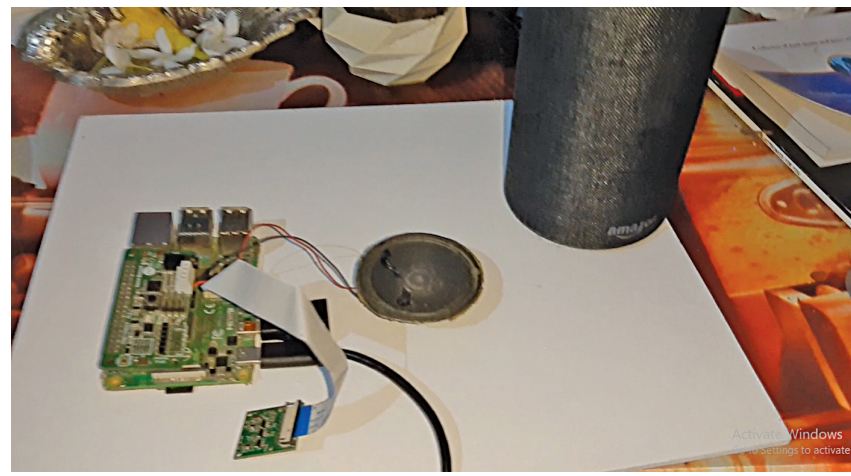


Fig. 1: RPi AI camera



Fig. 2: Author's prototype

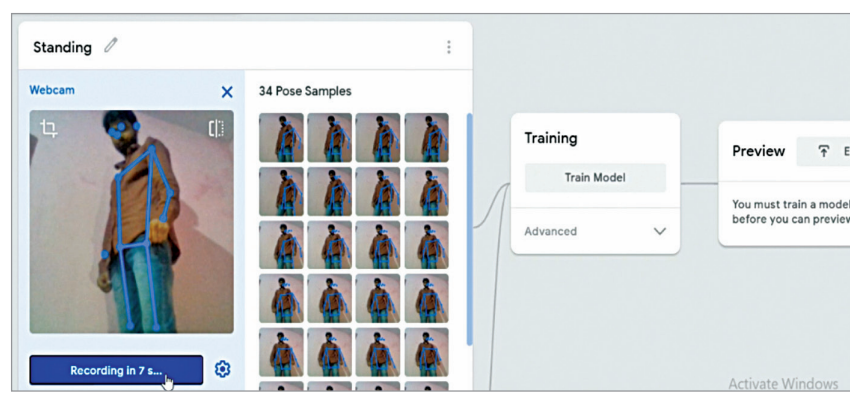


Fig. 3: Feeding the normal activity datasets to create ML model

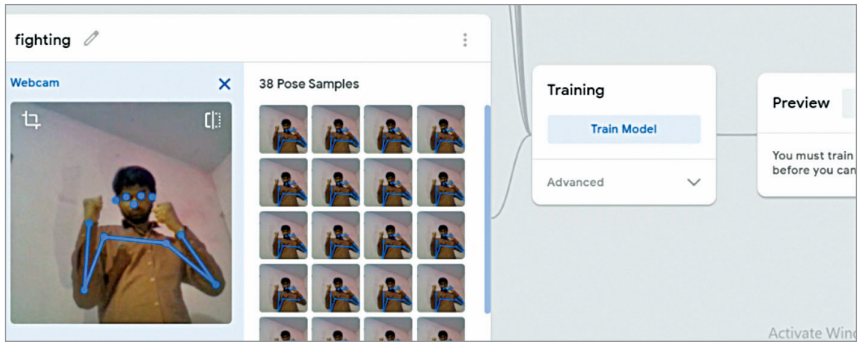


Fig. 4: Feeding suspicious activity datasheet

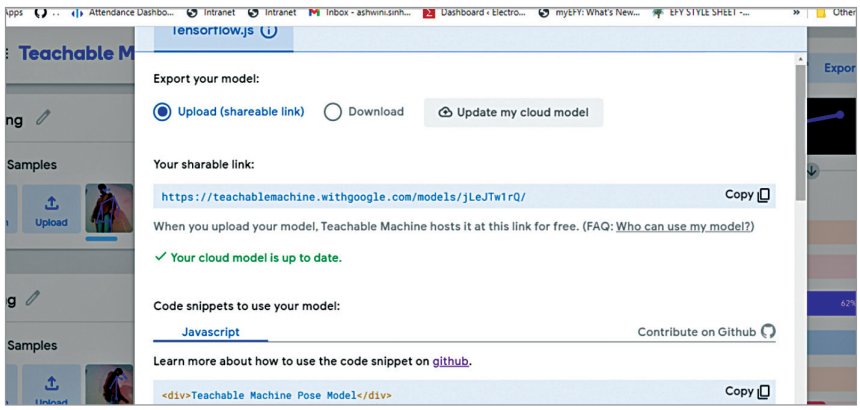


Fig. 5: Getting the ML trained

```
<!DOCTYPE html>
<html>
<body>

<h1>Ashwini Sinha AI sepicious activity detector camera</h1>
<p>Recognise Movement</p>

<p id="output"></p>

<div>  </div>
<button type="button" onclick="init()">Start</button>
<div><canvas id="canvas"></canvas></div>
<div id="label-container"></div>
<script src="https://cdn.jsdelivr.net/npm/@tensorflow/tfjs@1.3.1/dist/tf.min.js"></script>
<script src="https://cdn.jsdelivr.net/npm/@teachablemachine/pose@0.8/dist/teachablemachine-pose.min.js"></script>
<script type="text/javascript">
    // More API functions here:
    // https://github.com/googlecreativelab/teachablemachine-community/tree/master/libraries/pose

    // the link to your model provided by Teachable Machine export panel
    const URL = "https://teachablemachine.withgoogle.com/models/jLeJTw1rQ/";
    let model, webcam, ctx, labelContainer, maxPredictions;

    async function init() {
        const modelURL = URL + "model.json";
        const metadataURL = URL + "metadata.json";
```

Fig. 6: JavaScript code

```
        // Prediction #1: run input through posenet
        // estimatePose can take in an image, video or canvas html element
        const { pose, posenetOutput } = await model.estimatePose(webcam.canvas);
        // Prediction 2: run input through teachable machine classification model
        const prediction = await model.predict(posenetOutput);

        for (let i = 0; i < maxPredictions; i++) {
            const classPrediction =
                prediction[i].className + ": " + prediction[i].probability.toFixed(2);
            labelContainer.childNodes[i].innerHTML = classPrediction;
            if( (prediction[3].probability.toFixed(2)) >= 0.98 || (prediction[4].probability.toFixed(2)) >= 0.98 || (prediction[5].probability.toFixed(2)) >= 0.98 )
            {
             document.getElementById("output").innerHTML = "Sepicious activity";
              var audio = new Audio("/home/pi/siren.mp4");
              audio.play();
            }else{
                        document.getElementById("output").innerHTML = "Normal activity";

            }
           // document.getElementById("output").innerHTML = prediction[2].className + prediction[2].probability.toFixed(2);

        }

        // finally draw the poses
        drawPose(pose);
```

Fig. 7: Code for setting path of sound to play



```
async function predict() {
    // Prediction #1: run input through posenet
    // estimatePose can take in an image, video or canvas html element
    const { pose, posenetOutput } = await model.estimatePose(webcam.canvas);
    // Prediction 2: run input through teachable machine classification model
    const prediction = await model.predict(posenetOutput);

    for (let i = 0; i < maxPredictions; i++) {
        const classPrediction =
            prediction[i].className + ": " + prediction[i].probability.toFixed(2);
        labelContainer.childNodes[i].innerHTML = classPrediction;
        if( (prediction[3].probability.toFixed(2)) >= 0.98 || (prediction[4].probability.toFixed(2)) >= 0.98 || (prediction[5].pro
        {
         document.getElementById("output").innerHTML = "Sepicious activity";
          var audio = new Audio("/home/pi/siren.mp4");
          audio.play();
        }else{
                    document.getElementById("output").innerHTML = "Normal activity";

        }
       // document.getElementById("output").innerHTML = prediction[2].className + prediction[2].probability.toFixed(2);

    }
```

Fig. 8: Code for play alert sound

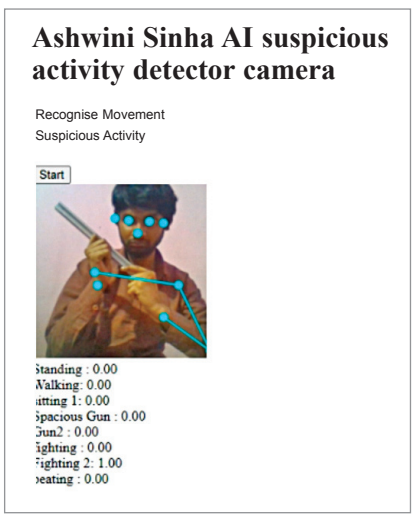


Fig. 9: Testing and output of camera

Any of these can be chosen for the project. To demonstrate, Google Teachable is being used here.

In Google Teachable, select the PoseNet option for tracking Correctly various body movements and actions. Correctly label the actions performed earlier of walking, talking, eating, standing, etc. Feed these datasets into the ML model. Similarly, correctly label and feed the datasets of activities like pointing guns, firing guns, fighting, beating, etc.

After feeding the required datasets, click on Train Model. The option to export the ML model or upload it to the cloud will appear. Uploaded the ML model to the cloud to safely store it there and let users access and deploy it anywhere in the world.

On uploading to the cloud, you will receive a URL for using the ML model. The URL of the ML model created by the author is: *https://teachablemachine.withgoogle.com/models/jLeJTw1rQ/*

Deploy the ML model on the camera and connect a speaker so that the Raspberry Pi triggers an alarm when any suspicious activity gets detected.

Coding

To deploy the ML model in Raspberry Pi coding is required. While uploading the ML model you would have received an example code snippet. Copy and paste it into your JavaScript (JS) code. JS coding and testing can be done with the help of any code editor, offline or online. You can name the camera in HTML for the ML model.

Import the ML model that was previously uploaded to the cloud. Then check whether activities such as beating, gun firing, and gun possession are detected by the ML model during video processing.

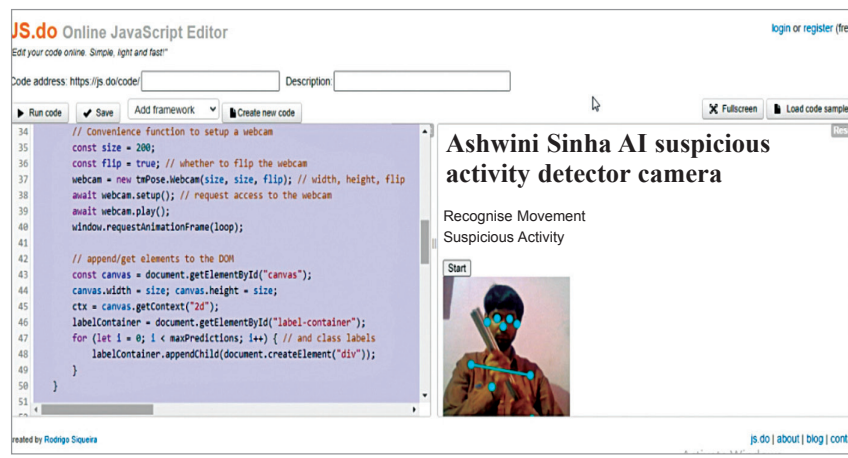


Fig. 10: Testing in .js online editor and compiler

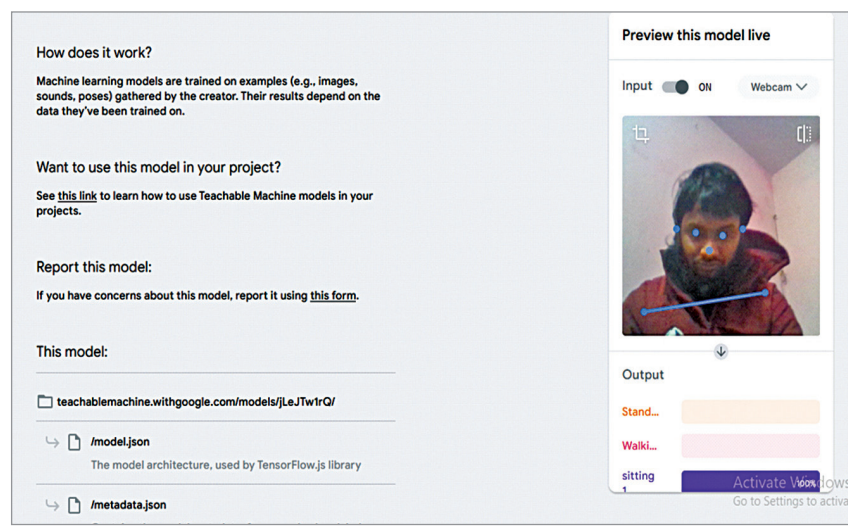


Fig. 11: Testing camera using URL of trained ML model

The model gives the likelihood of a particular activity to occur in the range of 0.00 to 1.00. So, by using an 'if' condition, if the output is greater than 0.98 then it means a person is either pointing a gun or fighting. At this point, an alarm gets triggered to alert people nearby.

Testing

Save the JavaScript code as .html and open it in any browser with JavaScript enabled. Click on the Start button and perform the suspicious activity in front of the camera. The ML model will try to recognise it and, if found unusual, will issue an alert. You can also add functions for automatically calling or messaging the police.

Sometimes Chrome on Raspberry Pi is unable to open or access the camera and it hangs. In such a case try installing the latest version of Chrome or switch to another browser like Firefox or use an online/offline .js compiler. If problem persists, you can use the the URL of trained ML model and directly see the output using the URL *https://teachablemachine.withgoogle.com/models/jLeJTw1rQ/*

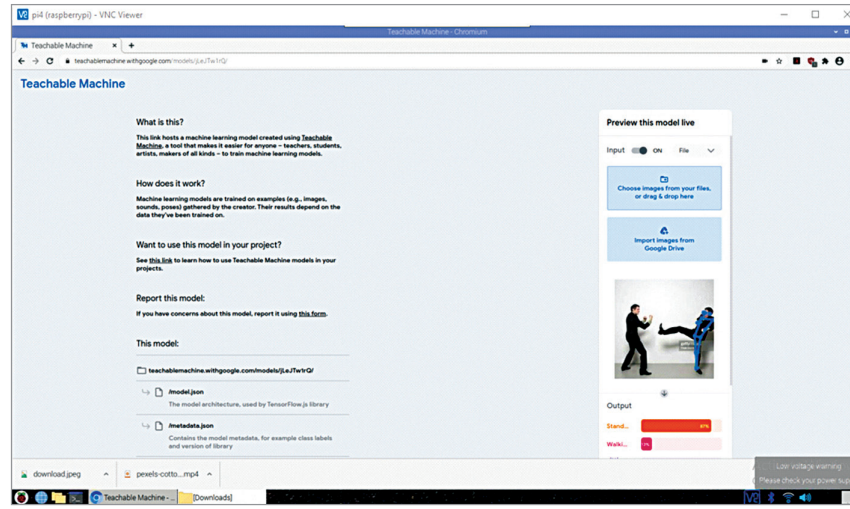


Fig. 12: Testing ML model through manual file input

You can also use the Files option and upload if the browser is unable to access the camera to test the ML model you have created in RPi. EFY

Ashwini Kumar Sinha is a technology enthusiast

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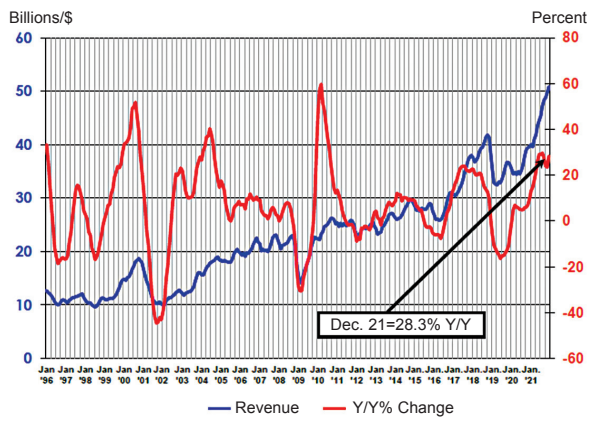
Date: 28-2-2022

Ramesh Chopra
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THE DASHBOARD

Global Chip Market Saw Highest-Ever Annual Sales Total in 2021

Global semiconductor sales totaled $555.9 billion in 2021, the highest-ever annual total and an increase of 26.2% compared to the 2020 total of $440.4 billion. China remained the largest individual market for semiconductors, with sales there totaling $192.5 billion in 2021, an increase of 27.1%. Analog had the highest annual growth rate of 33.1%, reaching $74 billion in 2021 sales. Logic ($154.8 billion in 2021 sales) and memory ($153.8 billion) were the largest semiconductor categories by sales.



(Source: www.semiconductors.org)

Top 10 Chip Buyers Increased Chip Spending by 25.2% in 2021

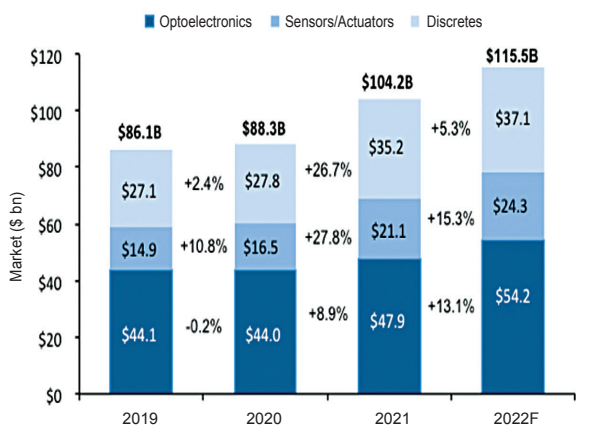
2021 Rank	2020 Rank	Vendor	2021 Spending	2021 Market Share (%)	2020 Spending	2020-2021 Growth (%)
1	1	Apple	68,269	11.7	54,180	26.0
2	2	Samsung Electronics	45,775	7.8	35,622	28.5
3	4	Lenovo	25,283	4.3	19,023	32.9
4	6	BBK Electronics	23,350	4.0	14,258	63.8
5	5	Dell Technologies	21,092	3.6	16,814	25.4
6	8	Xiaomi	17,251	3.0	10,254	68.2
7	3	Huawei	15,382	2.6	22,710	-32.3
8	7	HP Inc.	13,789	2.4	10,745	28.3
9	9	Hon Hai Precision	8,855	1.5	7,387	19.9
10	10	Hewlett-Packard Enterprise	6,736	1.2	5,395	24.8
		Others (outside top 10)	337,695	57.9	269,849	25.1
		Total semiconductor	**583,477**	**100.0**	**466,237**	**25.1**

Top 10 original equipment manufacturers (OEMs) increased their chip spending by 25.2% and accounted for 42.1% of the total market in 2021. The average selling prices (ASPs) of semiconductor chips and a wide variety of application-specific semiconductors increased by 15% or more in 2021. Apple remained at the top, having increased its spending on memory by 36.8% and on non-memory chips by 20.2% in 2021.

(Source: www.gartner.com/en)

Sensor/Actuator and Discrete Sales Surge in 2021

Total optoelectronics, sensors and actuators, and discrete semiconductors (O-S-D) revenues crossed $100 billion for the first time ever in 2021, growing 18% to $104.2 billion compared to $88.3 billion in 2020, when combined sales in the three markets increased by less than 3% as the virus first took hold. Optoelectronics sales growth was muted in the 2021 rebound due to the lack of a surge in CMOS image sensors.



(Source: IC Insights)

India-Based Vendors Dominate Truly Wireless (TWS) Market in 2021

(Shipments are in thousands of units)

Company	2021 Market Share	2020 Market Share	Year-on-Year unit change (2021 vs 2020)
1. Imagine Marketing (BoAt)	39.3%	23.9%	187.9%
2. Realme	7.7%	13.1%	2.8%
3. Nexxbase (Noise)	7.5%	4.5%	194.7%
4. Palred (pTron)	6.0%	7.6%	36.8%
5. Samsung	4.7%	10.6%	-23.0%
Others	34.8%	40.3%	50.6%
Total	**100%**	**100%**	**74.7%**

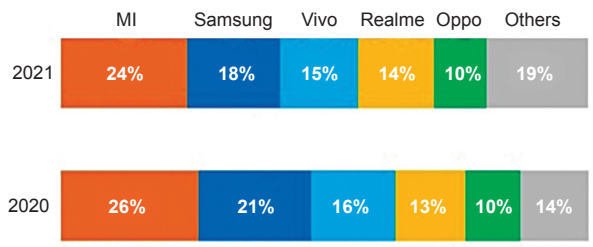
India's TWS market witnessed a record year, with shipments reaching 20.3 million units and growing 74.7% YoY (year-on-year) in 2021. Year 2021 saw India-based vendors capture over 65% shipments in the TWS category, compared to about half of the market last year. BoAt emerged as the leader with two-fifth of the shipments during the year, which is more than the combined share of the next seven vendors.

(Source: www.idc.com)

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

India Smartphone Market Records Highest Ever Shipments and Revenue in 2021

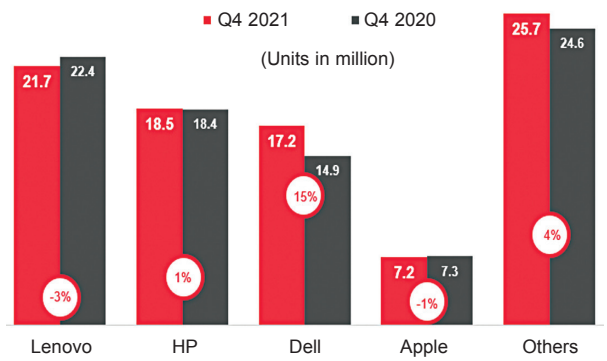
India's smartphone shipments grew 11% YoY to reach 169 million units in 2021. Xiaomi maintained the top position in India's smartphone market in 2021 with 2% YoY growth. India's smartphone market retail ASP (average selling price) grew 14% YoY in 2021 to reach its highest ever at $227.



(Source: www.counterpointresearch.com)

Global PC Shipments Up 3.1% YoY in Q4 2021

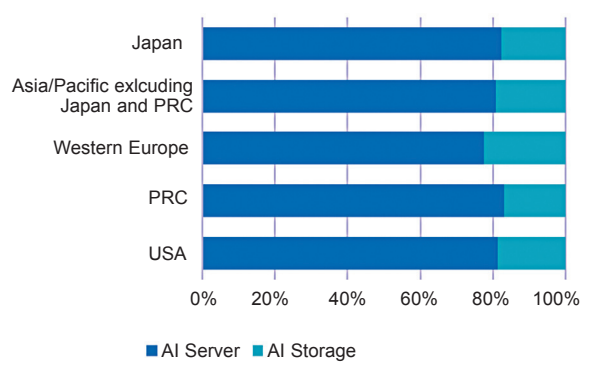
Global PC shipments reached 90.3 million in Q4 2021 to maintain their YoY growth momentum at 3.1%, coming on a relatively high base in 2020. In Q4 2021, the supply gap for the most important PC components narrowed. Lenovo continued to lead the global PC market in Q4 2021 with a 24% share, having its highest unit sales in 2021 at 21.7 million.



(Source: www.counterpointresearch.com)

Global AI Hardware to Reach 5% Market Share in 2022

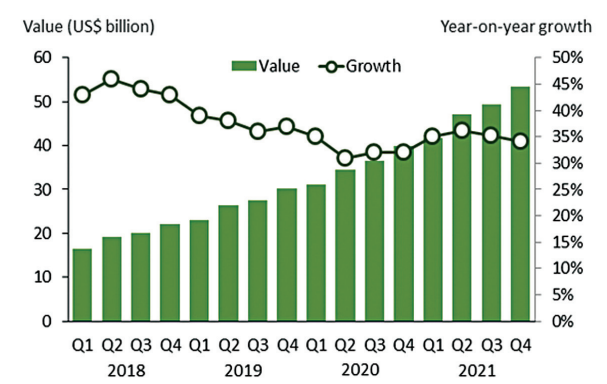
Worldwide revenues for the artificial intelligence (AI) market, including software, hardware, and services, is forecast to grow 19.6% year-on-year in 2022 to $432.8 billion. In 2021, the AI Hardware category grew the most in terms of market share in the first half of 2021 with a jump of 0.5% share. It is forecast to reach 5% market share in 2022 with year-on-year growth of 24.9%. AI Storage saw stronger growth relative to AI Server during the first half of 2021.



(Source: www.idc.com)

Global Cloud Services Spend Exceeds US$50 billion in Q4 2021

Worldwide cloud infrastructure services expenditure topped US$50 billion in a quarter for the first time in Q4 2021. Total spending grew 34% to US$53.5 billion, up US$13.6 billion in the same period a year ago. The top three in Q4 2021, namely AWS, Microsoft Azure and Google Cloud, collectively grew 45%, to account for a combined 64% share of customer spend.



(Source: https://canalys.com)

INDIA'S EV INDUSTRY SUCCESS Depends On How Soon It Stops SEEING IT From A GLOBAL LENS

In a year where the phrase 'new normal' became part of our daily vocabulary in ways never before imagined, India set parameters for the new normal in India's transport sector



ASHISH KUMAR is Founder and CEO of Amosta Solutions

The government has set ambitious targets to achieve its goals of zero emissions, one of which includes phasing out of petrol-run vehicles and replacing them with electric ones by 30% by the onset of next decade. To put things in perspective, the United States has earmarked half of its total vehicle sales to be EV by 2030. Neighbour China, on the other hand, has a target of 40%.

Notably, these countries began their journey to electric mobility long before India. To achieve such high numbers, India has to be at par with these countries in terms of not just manufacturing but also adoption.

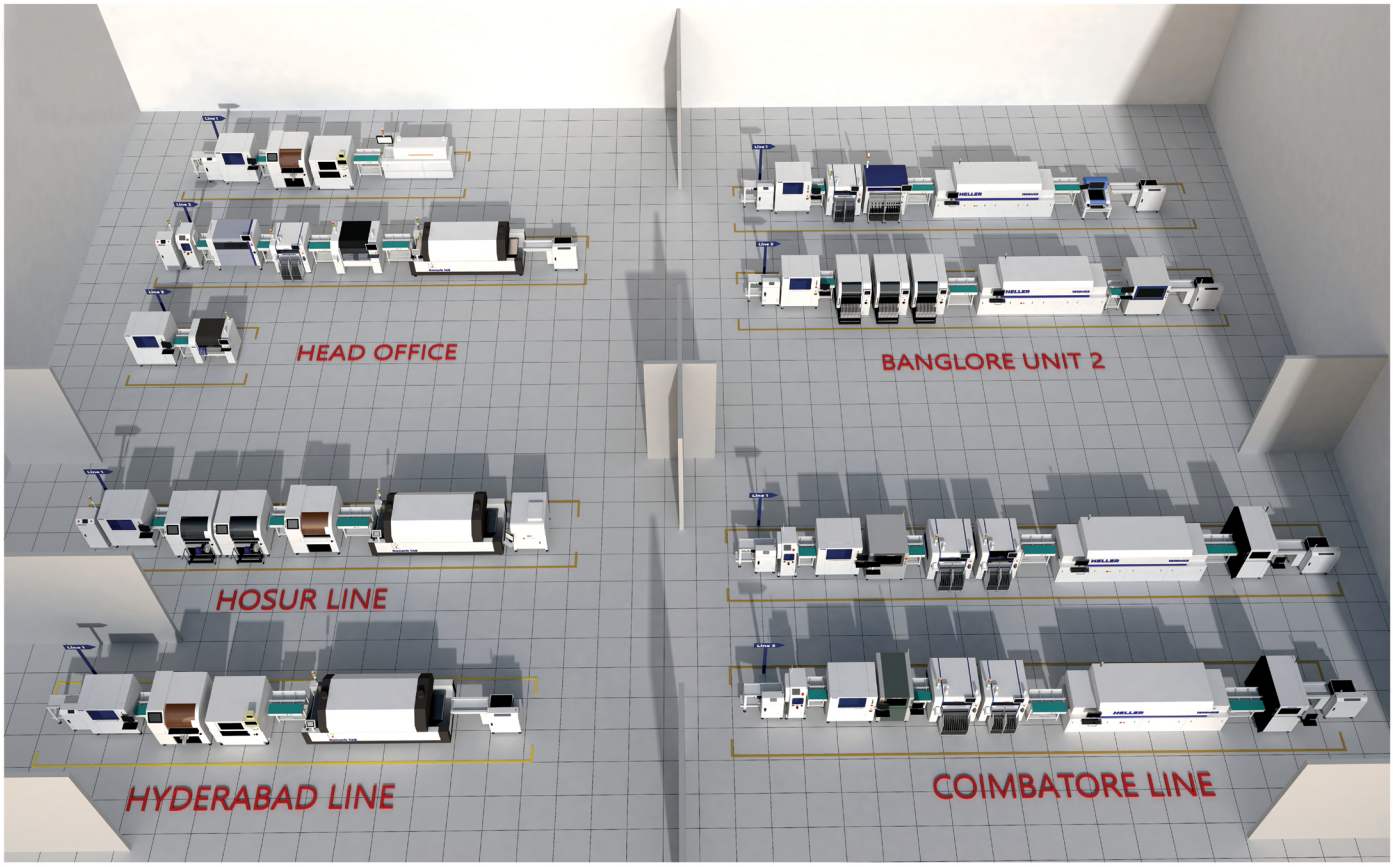
But in a country with over 1.3 billion population, it has been proven time and again that demands of India vastly contradict those of the West. Then why are we still following the same global formula



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Charging infrastructure, or the lack thereof, is currently seen as the biggest hurdle to EV adoption

while heralding the clean mobility millennium in the subcontinent?

Look away from the electric 4-wheeler

The roads, climate conditions, traffic management, and even the way owners handle their vehicles in India are incomparable to the developed nations, which have set similar goals like India's but seem far more doable.

That is not to say that Indian OEMs have lagged behind in the race. The automobile industry has always been a game that the Indian businesses have been able to massively cash in on. So, it is evident that interested parties who have recognised the inevitably of the shift to electric mobility would expect to rake similar points here as well.

As per a report by the World Economic Forum (WEF), India made up only 0.5% of the global EV market in 2018. The numbers need to increase massively to meet the expectations of the behemoth target of 30% EVs in the country, and for that OEMs have to put in the work.

The world has been watching closely the developments in the space and already has big players, in the form of renowned OEMs, working in the field to help them get a head start. To beat them, India needs to build the same level of expertise and resourcefulness. For that, it needs to choose the target segment wisely.

Here's the catch. While most countries have focused on the 4-wheeler segment, the 2-wheeler segment in EV market has been left virtually untouched. Experts have concluded that the 2- and 3-wheeler segments are where India can capitalise on.

The 2-wheeler market, which has been a thriving market in the Indian automobile industry pre-EVs, is still just as much of a business opportunity, if not more. In fact, market reports suggest that 50% of India's EV goals would be met by 2-wheelers.

Interestingly, there is no one company that has taken the biggest piece of the pie yet. Yes, there are OEMs that are steadily treading the route to become a force to reckon with, but it still keeps a lot of space for newer participation.

Let business model suit the ecosystem

Over the past couple of months, various Indian OEMs have invested heavily in increasing their production capacity, some even going as far as creating the world's largest factories. But is manufacturing the one-stop solution to our woes? There are aspects of the ecosystem that need to grow at the same pace in order to keep up with the manufacturing boom.

For starters, charging infrastructure, or the lack thereof, is currently seen as the biggest hurdle to EV adoption. Similarly, a lack of servicing support also raises doubts in the minds of consumers. Businesses need to come up with models that can eliminate these hurdles.

The various permutations and combinations of possible businesses in the EV industry know no end. It is pretty evident that the EV industry is in its infancy in India, which is precisely the perfect time to set up shop in this burgeoning sector. Be it in charging, or servicing, or support, or financing, companies can leverage any aspect of the ecosystem and emerge victorious, as long as they solve a problem.

The introduction of electric mobility is going to need some convincing to make the entire country discard their ICE vehicles for electric models, what with range anxiety and the price disparity.

The brand identity of OEMs is just as crucial of a deciding factor when converting previous ICE vehicle owners to EV owners. Brands and OEMs that have been around for a long time and have had a considerably good repo with customers definitely have an advantage over newer startups, and this is where they have to break the ice. Forming a brand identity that can convince the skeptical customer to take the plunge is going to be the biggest hurdle.

Put the tech talent to work

India has another aspect in its favour: its vast technical know-how. There is, of course, no doubt that India churns out some of the world's brightest tech minds and, in order to make electric mobility in India become a class-apart, it is

imperative that we put these bright minds to work. We must come up with innovations that can rightly balance the design and electronics part of building highly efficient electric vehicles that are suitable for the unprecedented nature of India's automobile industry.

The EV industry is bound to be a tech-driven industry. The fundamental groundwork of what makes it a league apart from its predecessors is the very role of technology in bringing about new innovations to the sector. Design and electronics must go hand in hand. This is not a phase where we can distinguish between the two anymore. The vehicles can be transformed from what they are traditionally known to do and serve different yet specific needs of each customer in this diverse country.

The pain points of the average Indian vehicle-owner are many, which have been effectively recognised by some who have begun resolving them, whether it is through IoT-enabled vehicles or some other technology, giving meaning to the phrase 'Necessity is the mother of invention.' It is only a matter of time, until another necessity of the Indian customer gives birth to an invention that can resolve the pain of customers around the globe. As such, the role of tech startups becomes much more significant in heralding the new wave.

India for the world

The introduction of electric vehicles is seen as quite a coming-of-age moment for the automobile sector. This is possibly one of the first times when mobility seems both non-threatening to the environment and with multiple new possibilities of innovation. And as we know, Indians have a knack for innovation.

The EV industry is a huge opportunity for success, and while multinational companies look at India as a huge market for consumption, it has the potential to turn into a provider for the rest of the world.

Deviating from the path that we took during the onset of the first automobile revolution of the country, this is possibly the time when we focus on creating vehicles that cater to the Indian market first and then take them on to the global front instead of the other way round. As the saying goes, 'Charity begins at home.' Similarly, the success of EV players eyeing to take on as a global player relies on how well they can serve the domestic market.

We are seeing the emergence of different brands that cater to particularly Tier 2 and Tier 3 cities, while some target urban markets in Tier 1 cities. While some focus on low-speed vehicles, some provide high-speed options. These offerings are not just useful for boosting the Indian EV market but also similar markets in Africa, South America, and South Asia.

Moreover, it is recommended for Indian companies to turn their gaze from glamorous markets in the West and instead focus on smaller markets where they have a much bigger competitive advantage to make a bigger impact.

Manufacturing vs adoption: The tougher nut to crack

Manufacturing is an issue that has been promptly handled by the government by providing subsidies and incentives. But adoption tricks have not yielded the desired results. The Faster Adoption and Manufacturing of Electric Vehicles in India Scheme Phase 1 (FAME-I) failed to achieve its targets despite the government spending over eight billion (800 crore) rupees on it. The subsequent Phase 2 of the scheme has also so far not come close to achieving the targets set, despite a deadline extension.

The production linked incentive (PLI) for the manufacturing of the lithium-ion batteries also acknowledges only one part of the problem. And while many like to put the issue of rising fuel prices to be a contributing factor to push consumers to switch, it seldom is so easy to completely transform the public consuming habits.

> INDIA MUST COME UP WITH INNOVATIONS THAT CAN RIGHTLY BALANCE THE DESIGN AND ELECTRONICS PART OF BUILDING HIGHLY EFFICIENT ELECTRIC VEHICLES THAT ARE SUITABLE FOR THE UNPRECEDENTED NATURE OF INDIA'S AUTOMOBILE INDUSTRY.

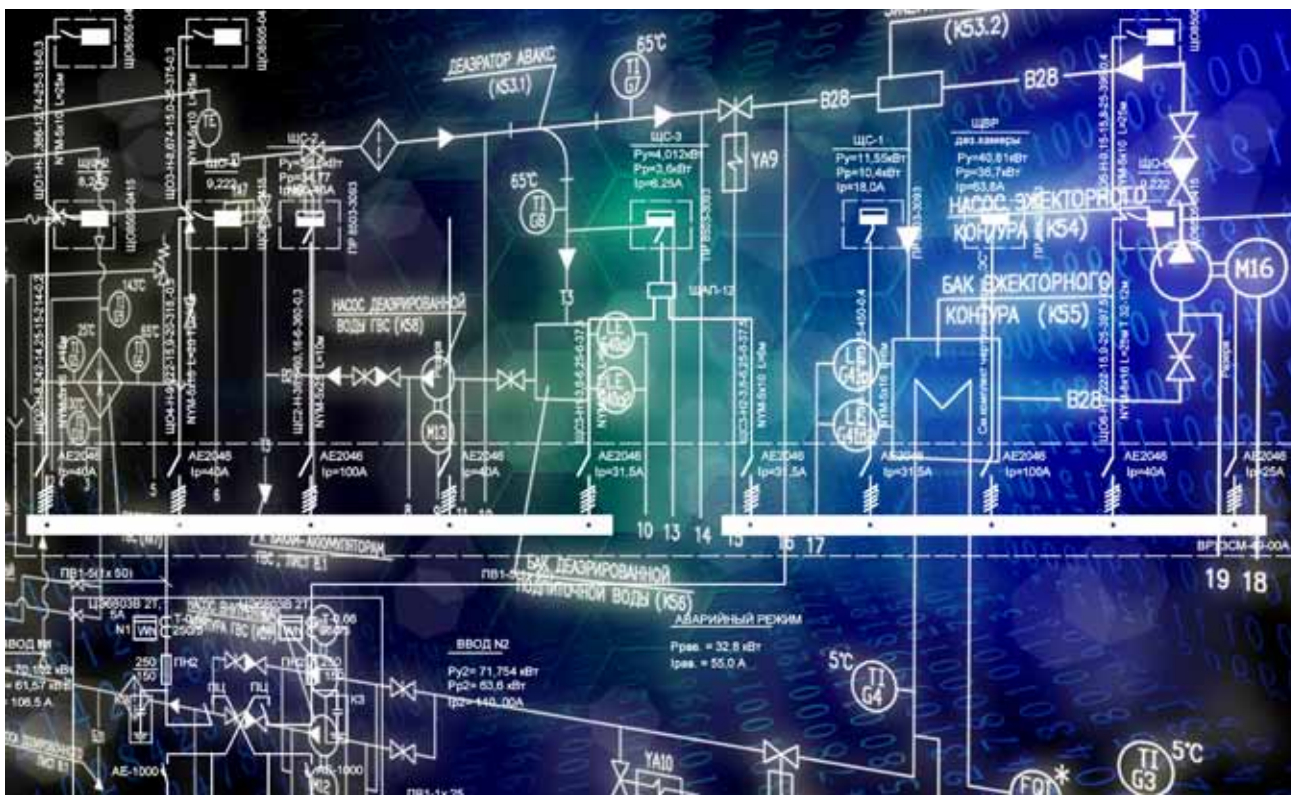
We all know that the EV phase in the country has only just begun. The seed of innovation is sprouting in the industry where many OEMs want to grab a share of the pie, but in their own unique ways. This is the beauty of any nascent market—the sheer number of possibilities. Business models can take any shape and form, be it manufacturing, support, supply chain, or recycling.

India's EV industry has all the required ingredients to mimic the proven success it attained in the automotive industry decades ago. But one thing is certain, the space must harbour an ecosystem of collaboration and cooperation, which needs to start at the grassroots level. EFY

This article is based on the session 'Transition To Total Electric: Opportunities & Challenges' by Ashish Kumar, Founder and CEO of Amosta Solutions, which was presented at the November edition of Tech World Congress 2021, and has been prepared by Siddha Dhar, Business Journalist at EFY.

Why PRODUCTS For GLOBAL MARKETS Need To Meet Standards

Complying to standards calls for a structured approach. In every phase of the product development, impact of standard compliance has to be assessed and actions have to be taken. This is very important. If a list of the items to be checked is prepared, it will run into a book. Here is some guidance on the subject





S.A. SRINIVASA MOORTHY is Director Engineering Design, D4X Technologies Pvt Ltd

When products are designed there are three aspects that are critical: The product's usability, performance, and compliance to standards. All three aspects are focused on the users to ensure they get the best when they buy a product.

For example, let us say the product is a washing machine. The user interface of the product should be easy to use, intuitive, and consistent, so that no training is needed for operating it. Second aspect is performance, where the washing machine has to meet all the product specifications and claims made by the manufacturer. Third is the compliance to standards.

Standards are drafted to address three aspects:

1. Safety of the user (both electrical and mechanical)

2. Use of environmentally safe manufacturing processes

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STANDARDS' NON-COMPLIANCE

Product life cycle	Activity	Impact due to
Concept	Usability like ergonomics, mandated user interface like avionics	• Ergonomics—Product usage doesn't impact the user. Complying to standards laid out by the designated regulatory agencies like FAA/FDA etc.
Design	Products need to meet safety, emission, and environment requirements	• Compliance to safety is a design issue which also increases the design time and cost. Incorporating them early is a must as at the end of design compliance issues ultimately end up in redesign, leading to an escalation in cost and time to market. • The situation is the same for products which need to meet stringent environmental standards compliance by way of selecting the right components, right manufacturing process, and low energy consumption; it calls for design of the product factoring these needs.
Engineering (NPI)	Component selection, material selection for enclosures, plastic/die-cast tooling and ability to recycle	• Most important aspect is the component selection. Right component selection is key to the manufacturing process as well as products complying to standards. Good example is industrial-grade components, which withstand high temperature and vibration compared to commercial version. Right components are also needed for complying to green manufacturing processes. • Choice of materials for the enclosures. It could be sheet metal, metal diecast, or plastic, depending on the environment the products work in and corresponding standard applicable. • Third key is the ability to recycle the product after its active life. This calls for first the right design and second proper material selection.
Manufacturing	In electronics manufacturing, the main compliance today is that manufacturing lines have to comply to the avoidance of lead in the process and any traces of usage of CFC (which earlier processes used)	• Today, almost all products have to comply to the RoHS (Reduction of Hazardous Substance – aka lead-free) process. In addition, they have to document the composition of the materials used in the products as per the REACH standard. • Another aspect that is missed is the packing materials used for shipping. Most European countries mandate these have to be compliant to green laws, especially to be pest-free and safe to decompose.
Support	This phase concerns repair of faulty products. More critical is the management of component obsolescence. In addition, making the products comply to standards	• Impact of standards is in two ways. One, when the components become obsolete, the replacement normally calls for a redesign as very rarely you get a drio-in compatible part. This calls for retesting, which is time consuming and needs planning. • Second, when the product is repaired, replication of the process to meet the standard is critical. For example, most industrial products are coated with a 'conformal coating' to prevent moisture impacting the product. Normally, the coating is done when all the testing and calibration of the product/PCB is complete. So, when the PCBA is repaired, the technician removes the coating to repair but most of the time does not reapply the coating, which leads to moisture impacting.
Withdraw	Finally, when the product is discarded, most countries mandate It is safely dismantled and recycled, or disposed of (disposable part is much less than 1%)	• Unless the design addresses the issue early on, meeting the recycling standards will be a challenge. And if not incorporated, practically it is very difficult to do it later. This again shows that the importance of compliance to standards has to be addressed early on.

3. Safe electrical emission and susceptibility

Complying to the standards is mandatory and exporting to different countries depends on the standards laid. Typically, standards are defined by international agencies like FDA, FAA, IEEE, IEC, etc. In India we have Bureau of Indian Standards (BIS) (earlier was known as Indian Standards Institute) which has standards for products made and used in India. Almost all the countries have made compliance to standards mandatory.

For complex products like aircrafts and military systems, most countries tend to follow FAA (Federal Aviation Administration) and FDA (Food and Drug Administration) standards. Similarly, standards like Electrical Radiation Emission and Susceptibility, FCC (Federal Communication Commission) of the USA, or CE (Conformité Européenne) for European Union are used across countries as these standards have been well drafted and have stood the test of time. With the increased integration into global economy, India is also now mandating standards for use in India.

Most designers tend to assume that compliance to standards is a separate step and can be done once the design is complete. However, compliance to standards needs attention from the design phase. In fact, one of the design parameters should be the standards to which the product has to comply. For example, if the product has to meet FCC Class B emission level, it is better to have metallic enclosure rather than a plastic enclosure—if the design allows. So, designers need to understand the standards to which the product should comply and ensure the design goals meet that.

Why this is critical

First and foremost reason for compliance is the impact on business. Products that do not meet the standards cannot be sold in the market.

NeoDen Auto SMT Pick and Place Assembly Line



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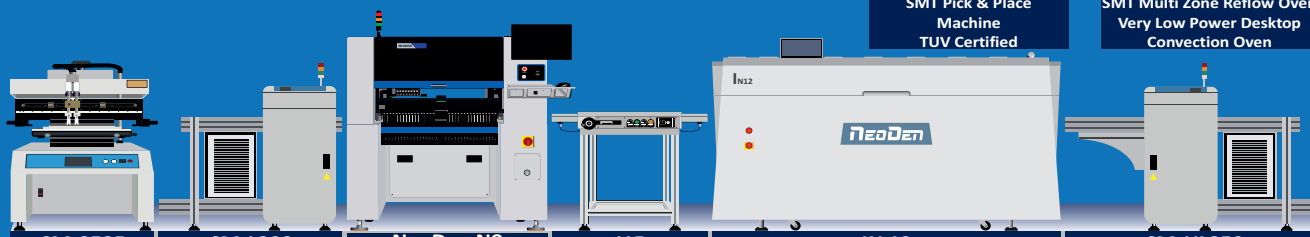
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-Jeff Bezos



Second, assuming there are markets where the standards compliance is lax and the products can be sold, risk of safety issues and the litigation due to that can far outweigh the compliance to standards. Complying to standards must start from design stage and not after the design is complete. Let us see which activities get impacted due to standards' non-compliance in the Table.

Some examples

Just to show the importance, two instances of compliance to standards not being met are briefly described below along with the mess they created.

First, we were designing an advanced antenna that could adjust its lobe width by operating a motor mechanism. We completed the testing and certification. However, when this antenna was installed in a European nation known for low temperature, we noticed two things. One, the motor froze, and second, the processor failed to start. In both cases what we found later was that the components we had used for testing and those used for manufacturing (even though the datasheet said they were equivalent) were different, leading to the failure. While we could sort the motor issue, we found that most crystals don't start at -15°C, so we ended up preheating the component used in the design to ensure there were no issues.

Second was a networking product, which was packed in small wooden crates to be shipped to Europe. When the contents landed in European airport the authorities sent the material back due to pests and decay in the wood used. We had to import the crating wood for packaging! This taught us a lesson that even a small miss can cost lots of money and time.

What need to be factored

There are three critical things that need to be factored in when designing products for compliance to standards:

1. Know the country the product is supposed to be sold in and get to know the compliance laws and standards well. If the product is being designed in one country and exported to another, the best way to manage is to use global certification agencies like TUV to get the certification as they have the experience and knowledge to address global standards.

2. Spend time in selecting components and their equivalents. Above all, even if the product has custom parts made by suppliers, the responsibility of those parts meeting the standards is always yours. Never leave it to the suppliers as they invariably don't appreciate the need for complying to standards. (An entire lot of advanced remote access server we shipped to the US was sent back as the welded portions rusted while they were in US airport for a week.)

3. It is advisable to have a full-time engineer to address the issues if the products are being targeted for global markets. This helps in keeping the compliances issues to the minimum.

Points to keep in mind

Complying to standards calls for a structured approach. In every phase of the product development, impact of standard compliance has to be assessed and actions have to be taken. This is very important. If a list of the items to be checked is prepared, it will run into a book. For a reliable and very useful book on the subject, check *https://emcfastpass.com/cert-ebook*. It is a good book for MSMEs and startups to understand global standard compliance and how to deal with it. But remember, it addresses all the electrical standards. Designers have to understand the standards for other certifications as well, especially the environmental ones. EFY

SEMICONDUCTOR & DISPLAY FABS: Devil Is In The Execution SUCCESS In COLLABORATION

The government of India has come up with a 760 billion rupee layout plan for semiconductor and display fabs. How do the industry heavyweights perceive this plan? What are they doing to be successful, and what's their advice for smaller companies?



Silicon Wafer Under Cleanroom Fabrication

MUKUL YUDHVEER KUMAR and **SIDDHA DHAR**

A tweet "Intel-Welcome to India" posted by India's IT Minister Ashwini Vaishnaw sent ripples down the core of the semiconductor ecosystem of the world. This tweet was a result of Intel's Foundry Services president Randhir Thakur praising the government of India for the recently announced 760 billion rupee India Semiconductor Program. The aim of the Program, similar to the National Electronics Policy and every scheme announced under it, is to make India the hub of semiconductor manufacturing. The Program attempts to set up a semiconductor as well as display manufacturing ecosystem in India.

India currently depends fully on imports for meeting its semiconductor needs, but that has been said a thousand times before. What's different this time is the intent, and the list of leaders and India based corporate houses joining the struggle to set up a semiconductor and display base in the country. Their aim is the same, and they all want to make sure that India does not miss the bus of semiconductor manufacturing once again.

"The recently announced comprehensive program for the development of sustainable electronics and display ecosystem in the coun-

try with an outlay of ₹76,000 Cr confirms the PM's vision of *AtmaNirbhar Bharat*, and positioning India as a global hub of electronics system design and manufacturing. Displays constitute a large portion of the bill of materials of many high-volume electronics products. India's display market is estimated to be $7 billion, and it could grow up to $19 billion by 2025. Current demands are met exclusively through imports," says Sanjay Agarwal, President of ELCINA and MD of Globe Capacitors.

Semiconductors and display units are generally referred to as the soul of modern electronics. These are also said to be among the top factors that are driving the ongoing Industry 4.0 revolution. The challenge is that both semiconductor and display manufacturing require huge capital investment, and these need to be done with the help of most modern technology. Rapid changes in technology further require investments for sustenance and gestation.

"The benefits of establishing this industry includes greater than $11 billion dollars domestic value creation, display export opportunities of up to $10 billion, and domestic employment generation of more than 200 thousand," adds Sanjay.

Amrit Manwani, MD, Sahasra Electronics notes, "The leadership of India, in the past six to seven years, has rightly highlighted and worked on the importance of electronics manufacturing. Several incentive schemes like EMC, SPECS, and PLI have also been introduced. But for the first time the Ministry of Electronics under the leadership of Ashwini Vaishnav and Rajeev Chandrasejhar has truly engaged with the industry to recognise the challenges and mitigate them through various reforms."

"So far, we have virtually had the absence of semiconductor manufacturing in India, even though we had strength in semiconductor design where we do designs for the entire world. Now, because of strategic reasons and also because of the fact that our import bill will only keep on mounting if we don't have a semiconductor foundry in place or an IDM in place, this is why there is a renewed effort in bringing semiconductor manufacturing into India. There have been efforts before but what is different this time is, firstly the size of the Indian market is today standing at 3.5% of global electronics manufacturing. We expect it to become 10% of global electronics manufacturing in the next four to five years. As more and more products get manufactured in India, one way is to keep on importing the components. The other way is that, now that there are strong brands here who control the supply chains, if a fab is there, then they may well be inclined to get their memory and logic pieces out of India as well as power devices," says Saurab Gaur, Joint Secretary, MeitY.

The government and the heavyweights

The road to making India a hub of semiconductor and display manufacturing is not going to be an easy one. Not only will the players deciding to join the game will have to take lessons from the past, but players from the equipment, materials, designing, services, and all other verticals of these two ecosystems will have to work together to make India the hub of manufacturing these.

"The global conglomerate has started seeing India as a place now. Government has walked the talk and now is the turn of the private players to showcase what they can do. Indians are very intelligent, and you may see very cost-effective TVs, smartphones. and more consumer goods getting manufactured and exported from here. It is all about backward integration and we all know what has happened in the automotive sector in the country. Hyundai exports cars at prices it cannot achieve in its home country Korea," says Pranav.

He adds, "The scenario at the moment is now or never as the country is already on its way to have bigger exports bills of components than oil. It's not a short-term game. The horizon should be for at least 20 to 30 years."

Taiwan and China are the perfect examples of the semiconductor and display fabs being a long-term game. While the former is now a world leader in terms of semiconductor manufacturing, it still keeps investing in developing the latest tech. The latter, which started its semiconductor journey about a decade ago, is still investing in huge numbers to make sure it becomes a world leader in the next few decades. The government of China helping semiconductor companies in the country is not a hidden fact at all.

"Money going into these initiatives is hearty as the returns will take much longer time. But then it is a very stable business over the long term. You can also grow very rapidly. I have myself worked for companies which were a manufacturing start-up and they became a multi-billion dollar business over time," says Raja.

The Tata's are said to be putting more than 3.5 billion rupees for setting up an ATMP/OSAT in the country. Raja Manickam, who had earlier founded Tessolve, was roped in by Tata last year to head the project. Several other biggies from the semiconductor ecosystem have also joined Tata's in the new venture. "In my mind, all of this has to play together to make India the favourite destination for manufacturing electronics," feels Raja Manickam, CEO, Tata OSAT.

Vedanta Group joining the initiative to make displays in India is probably one of the best developments that the Indian electronics industry has come across in the recent days. Of course, the Tata's have already forayed into semiconductor packag-

Leaders' Speak



"The benefits of establishing this industry includes greater than $11 billion dollars domestic value creation, display export opportunities of up to $10 billion, and domestic employment generation of more than 200,000," says **Sanjay Agarwal, President of ELCINA and MD of Globe Capacitors.**

"When everything was still being planned and not yet announced, I asked a leading industry expert what kind of incentives they would like, and he said, 'If the government can put up 50 cents for every dollar spent, that would be great'. But today, when we came out with the policy, we gave them one dollar for each of their dollar," says **President, VLSI Society of India and CEO, EPIC Foundation.**



"For the first time the Ministry of Electronics, under the leadership of Ashwini Vaishnav and Rajeev Chandrasejhar, has truly engaged with the industry to recognise the challenges and mitigate them through various reforms," shares **Amrit Manwani, MD, Sahasra Electronics.**



"In light of the semiconductor shortage, it is the perfect time for India to take off and with all the government initiatives and the experience we have created. I think we should invest both in IPs and products. The government has done its part. Now it's up to the MNCs, the academics, the people in the software ecosystem to make it a grand success," says **Sambit Sahu, VP Network and Edge Products, GM IOTG, Intel Corp.**



"I think that we are sitting on a huge opportunity as far as India is concerned. What I would like to see on a personal level is that a lot of product innovation needs to happen in India. End product innovation and end device development needs to happen in India too," says **Balajee S., MD, Samsung Semiconductor India R&D Centre.**



"It actually is natural for suppliers and partners to set up shop near their clients as the same makes business decisions easy. The technical term used by the industry players in the electronics ecosystem is 'Co-design' and Co-development'. Once the display set up is set in India, a lot of co-developers and builders working in the semiconductor as well as the display ecosystem will be encouraged to expand in India," says **Sudhir N. Pilai, MD, Corning Incorporated.**



"Money going into these initiatives is hearty as the returns will take much longer time. But then it is a very stable business over the long term. You can also grow very rapidly. I have myself worked for companies which were a manufacturing start-up and they became a multi-billion dollar business over time," says **Raja Manickam, CEO, Tata OSAT.**

"Korea, Japan, Taiwan, and China have different systems. The Korean government and the Chinese government support big companies and these big companies support small companies in turn. The governments in Japan and Taiwan usually support small companies and these small companies in turn support big companies," says **Sung Huk Lee, CEO, TnvisiON.**



"Whether you look at TSMC, or any other such company, the academia has played a very important role in their success. The key for companies will be to find out how they can collaborate with academia and fine tune relationship building," shares **Sudheer Kumar, COO, NCFlexE, IIT Kanpur.**

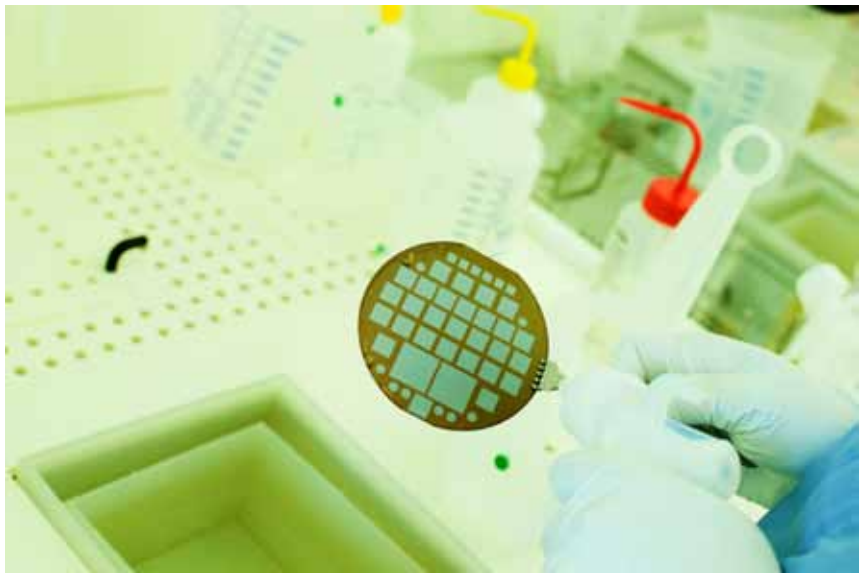
ing but Vedanta Group announcing an investment of 600 billion rupees for chip and display manufacturing is the cherry on the cake.

"We want to enter into integrated fabs, both in semiconductor as well as display. We plan to set up internationally competitive facilities. Initially there will be support from the government, but we will achieve leadership in due course of time. Apart from capturing the domestic market, we are also going to focus on export plans. We don't just want to achieve fabs, but we want to enable India and Vedanta as Electronic Hubs. That should bring in the entire ecosystem into play," says Pranav Komerwar, CEO Electronics Display & Semiconductors, Vedanta Limited.

The group already has a presence in EMS and PCB assembly verticals of the electronics ecosystem. It is of the view that OSATs and semicon fabs can bring in good value addition. "Out of about $20 billion investment, Vedanta will be making $8 to $10 billion in the OSATs and semicon fabs segment. We want to work under Make in India and put products in the world under our domain," says Pranav.

Reliance Industries Limited has already started work on constructing the Dhirubhai Ambani Green Energy Giga Complex. Located in Jamnagar, Gujarat, the complex will house not one but four gigafactories. These would include an integrated solar photovoltaic module factory, an energy storage battery factory, an electrolyser factory, and a fuel-cell factory for converting hydrogen into motive and stationary power.

"The confidence behind that (India's share in global electronics manufacturing) is because of the interest global champion companies have shown to participate in our PLIs for mobile, where Apple and Samsung as two big players have



Scientist fabricating sensors on semiconductor wafer

committed huge manufacturing investment into India or in IT hardware where, again, we have Dell, HP, Acer manufacturing in India," notes Saurabh.

There are four parts of the scheme. The first one is regarding semiconductor fab where the government is committing almost $10 billion for the overall project. For fab alone it is committing 500 billion rupees, which is almost $7 billion; three or three-and-a-half billion dollars for each fab. Then there is display fab scheme, where again there are various form factors of displays. In the compound semiconductor, that is, in the RF and power category, there already are companies who have registered on the portal. The government, as per Gaur, has received good response in semiconductor packaging as well. Fourth is the semiconductor design linked incentive scheme, where the government has already received 25 odd registrations on the portal.

Saurabh adds, "So we have full registration on the third part and on the first two pieces also have a limited window available, and there is a lot of homework that is required, and we are in constant touch with the potential applicants, and we hope to get a good response in that as well."

The road ahead

Though biggies like Tata and Vedanta have announced big investments and plans, this is not the first time that the country is looking to establish a local ecosystem for semiconductor manufacturing. There has been more than one attempt in the past. As a matter of fact, Vedanta itself had to back out from setting up a display manufacturing unit in India a couple of years ago. The manufacturing in other sectors of electronics has also not come to India as was expected in the past.

"Corning's display glass manufacturing strategy involves disciplined growth to ensure that the global display industry and end-market demand are aligned. One example of disciplined growth is our track record of co-locating with our customers. Our glass plants are directly connected to our customers' fabs. This eliminates packaging, maintains the glass quality, and reduces costs. It also makes us an irreplaceable part of our customers' operations. We are excited about what is yet to come in the display business and by Corning's role in driving this industry ahead," says Sudhir.

"I believe the impetus is now on value adding. First of all, anywhere the assembly section would start like an EMS play, which might not be much of value add but is needed. The PLI schemes by the government are driving the low-investment assembly plants. Today the demand is huge. Our chairman always says that even if you exclude China, and if you count the population of the countries neighbouring India, it still counts for one-third of the world's population. Forget these countries, the majority of homes in India still do not have TV in their house. 500 million Indians do not have a smartphone. This is just the domestic demand I am talking about. Companies and people migrate only when there is a core mass," says Pranav.

He adds, "Display and semiconductor fabs can only come when there is core mass. They act as anchors. There is no place in the world where these industries have come up without the presence of these anchors. We find that the policy is excellent for fab set-up. The third dimension now is to get into quick movement. One way is to invent on our own and do it in 10 to 20 years, while the other way is to partner and learn from the masters."

The technology partnerships would indeed be crucial for companies setting up display or semiconductor fabs in the country. China, Korea, Japan, or the United States of America have been successful and profitable at what they do because the governments, and the private players, never hesitated in collaborating outside their borders. Yes, they assessed all the risks and possibilities, but they were clear from the beginning about their success plans going through the bridge of collaborations, partnerships, and technology transfer.

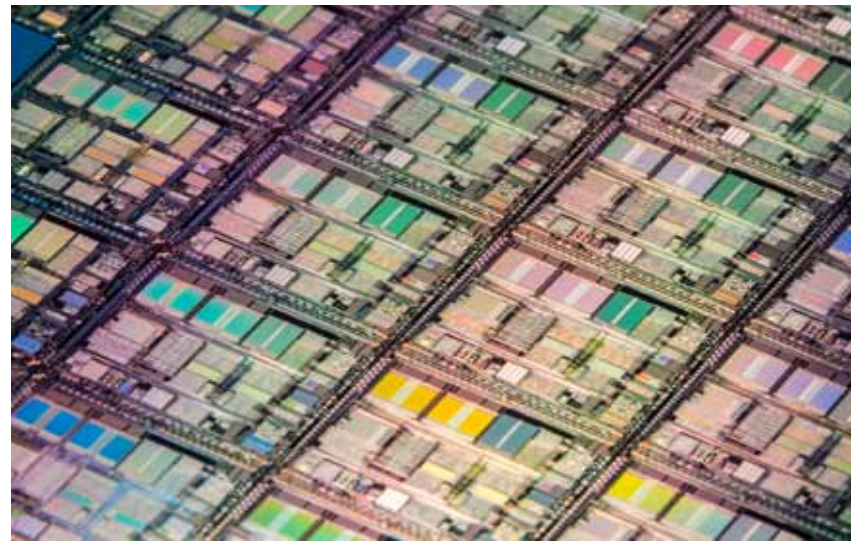
"The demand is huge right now worldwide with AI coming in and trying to mimic the human brain.

Today, AI doesn't even match 1% of the human brain, so you can imagine how far we have to go. Then we have 5G companies, then we have edge computing—so there are so many new areas which are driven by all the applications in many segments, whether healthcare or industrial or agriculture. All these applications need more and more semiconductor chips to be built," shares Sambit.

He adds, "I think India can lead in the areas where there are huge demands in the country, particularly in the areas of healthcare, education, and agriculture. These are great opportunities for India to tap into. And to make this successful, people have to innovate, be risk taking, and I think the ecosystem needs to come together more cohesively.

"Here we are looking at one mega cluster like Hsinchu in Taiwan. And having that 500-acre space with water and power, semiconductor resources available there; that is a collaboration that is gonna happen with government of India and state governments like a partnership, but also more of a challenge that whichever state comes out with the most policies that single-window the process which makes it easier for companies. Because these are huge resources and capital intensive decisions that companies are going to take and it is not a decision linked to this policy alone. And this policy is not the only thing that's gonna happen in this sector. The government is also looking at very long term engagement. So, while this 76,000 crore looks like a big number, we cannot stop there. The government is willing to invest more and there's a reason for that.

He adds, "And my request to the whole industry is that if we can have more risk capital, patient capital driving this. Because hardware is difficult. It's not like enterprise or software where you have immediate wins available, and you can have ten times valuation available in a year or two. Hardware is a game of patience and it requires much deeper collaboration, and we would want more risk capital to get associated with it, and we would definitely see more emergence of electronics and hardware companies also out of India."



CPU silicon wafer seen at 15x magnification under UV lights

Opportunity for start-ups and MSMEs

A look at how the heavyweights like TSMC, Samsung and others function immediately draws attention to how they have developed an ecosystem where hundreds, and even thousands of small companies are supporting their efforts. It would not be wrong to say that these heavyweights are in turn supporting these hundreds of small companies. These hundreds and thousands of small companies specialise in one thing and pass on that thing to the likes of Samsung. The key to success lies in finding out how these heavyweights support these hundreds of companies.

"Korea, Japan, Taiwan, and China have different systems. The Korean government and the Chinese government support big companies and these big companies support small companies in turn. The governments in Japan and Taiwan usually support small companies and these small companies in turn support big companies," says Sung Huk Lee, CEO, TnvisiON.

Then there is more than one example of these small companies becoming a heavyweight over time. The biggest of these is TSMC itself. The company started in 1987 and took around eight years to go public. Additionally, there are examples of smaller companies merging with bigger ones. The news of heavyweights acquiring smaller ones is always there on the circuit. These smaller and bigger companies are able to achieve success together because their thinking process is aligned to each other.

"These companies, from a business or a technology point of view, are able to taste success together because they think alike and they think global. Anywhere you go in the world you will definitely hear about the Samsungs and the LGs. In present times you will also hear about the companies that are supporting them. I think the message is to always have a global part in your approach. Whether you are thinking of supporting Tata or Vedanta, you should always think of marketing yourself globally as well. That is

what is going to sustain," advises Raja.

"What I would like to see on a personal level is that a lot of product innovation happens in India. End product innovation and end device development needs to happen in India too. Because a lot of start-ups today focus more on applications and software, and this focus has to now change into devices, which makes more sense to India. Given the kind of chip manufacturing capability that we have we can do even more innovation. Many of the design houses here can make for India. Made in India and Make in India are great slogans but I would also like to see Design for India as a very key aspect coming in and government driving in more incentives and policy in that front," shares Balaji.

Saurabh adds, "I liked what Balaji said in the sense that if Indian companies are able to grow at scale and engage with these global companies, there is a possibility that in the long term they might be acquired. Even though there is a motive to keep the IP domestic but we would still want more Indian innovation to feed into global companies and hopefully see Indian companies also become global champions in this process."

Support from academia

Academia will also have to play an important role in enabling India as the hub of semiconductor and display manufacturing. Such companies originating in the likes of Taiwan, China, Korea, and Japan owe a lot of their success to academia, and the scenario in India, as Raja explains, will be no different. Raja further explains that as larger companies avoid taking risks, MSMEs might be the right ones to extend their capabilities and try hands at researching with the right institute(s). One such research agency has already existed at IIT Kanpur for more than 15 years and it is known as the National Centre for Flexible Electronics.

"Whether you look at TSMC, or any other such company, the academia has played a very important role in their success. The key for companies will be to find out how they can collaborate with academia and fine tune relationship building," shares Sudheer Kumar, COO, NCFlexE, IIT Kanpur.

Satya adds, "I think academia has a very big role to play here by having more MS and PhD programmes targeted at semiconductors. Going back to the success of Silicon Valley, one of the key reasons of their success was how the two big universities, Stanford and Berkeley, worked with the industry and then had the right skills and the right kind of innovation. It was done in collaboration between industry and the academia, so I urge all the academia to do the same thing and drive the innovation spirit."

He adds, "I think how MNCs like Intel, Samsung, and Qualcomm create alliances in India is also an interesting piece. We have to start collaborating with education institutions and academia more. So, I believe we need to have more programmes on chip manufacturing, because silicon design is complex. But the great news is that we have a good base to start with and we can only get better from here."

"To make embedded systems and VLSI more attractive, I think there needs to be more core work with Academia because there's more to it. AI/ML is important but it's not everything. Unless you get your basic VLSI architecture right, these things won't work because they operate at a much higher level. So, this would mean that a lot of collaboration from the industry is required," says Balaji.

The first-mover advantage

The proverb 'The early bird catches the worm' will be of much relevance to companies deciding to establish semiconductor and display fabs in the country. As explained earlier, there is a huge market waiting to be tapped and then there is the scope of possible exports as the world has started looking for alternatives to China. India is already a market of ten fabs and there exists none in the country.

"There is a first-mover advantage because primarily this is a capital-intensive industry. It is not easy to make an entry, unless there is good support available from the government. Whoever comes forward with initial two-three fabs in each of the sectors will have an advantage. However, what is also true is one or two fabs in the country are not going to satisfy the domestic market. The early movers will have a better learning curve in comparison to others as it is a very long-term game," says Pranav.

India, as suggested by most of the leaders, is at once-in-a-generation inflection point. The country has a huge market, a market that is only starting to mature. The next three decades are forecast to be centered around India. Corning's Sudhir is of the view that good implementation of already announced programmes and a consistency of the same will make India more conducive for conglomerates.

"The devil is in the execution. That is what will keep the market attractive for us," says Sudhir. EFY

Siddha is a business journalist who is fond of recognising and presenting how tech is shaping up the business world. When not writing about EVs and government policies, she enjoys reading non-fiction for fun. Mukul is passionate about how technology can change lives for good, and skeptical about how the same technology can make matters complicated for the very existence of human beings.

This article was developed thanks to sessions held by ELCINA in collaboration with EFY titled "Establishing an Eco-System For Semiconductor & Display Products in India," and by Society of VLSI in collaboration with Times Techies titled "Techade For Semiconductors - The Road Ahead."

UNION BUDGET 2022-23: What It Means For India's Tech And Electronics Industry

Many dream projects of Prof. (Dr) Ashok Jhunjhunwala, IIT Madras, like battery swapping and rural ATMs, seem to be coming true, albeit a bit late. Guess he will be happy to see them coming better late than never



The Union Minister for Finance and Corporate Affairs Nirmala Sitharaman, along with the Ministers of State for Finance Pankaj Chaowdhary and Dr Bhagwat Kishanrao Karad, arrives at Parliament House to present the Union Budget 2022-23 in New Delhi on February 01, 2022 (Credit: pib.nic.in)

RAHUL CHOPRA and **SIDDHA DHAR**

The first thought that went through my mind while trying to compile this list of key Budget announcements was that Prof. (Dr) Ashok Jhunjhunwala at IIT Madras would at last be happy and satisfied. We are working on a story on Prof. Jhunjhunwala, inspired by his vision and grit. Throughout his 30-plus-year career, he has made bold attempts to bridge the gap between Bharat and India. It's frustrating to see how bureaucrats can kill dream projects of technocrats. But that's a different story to be told, and we will be sharing it with you soon.

On the morning of February 1, 2022, the Finance Minister Nirmala Sitharaman jolted the nation through her Union Budget 2022-23 speech. While the speech in itself was not alarming, what

Some points to be mindful of

Rachit Jain, Partner at Lakshmikumaran and Sridharan, advises importers to keep a check on a few important points that are yet to be fully clarified by the government, such as:

A general suggestion would be to be extremely careful in going forward and claiming an exemption which you have been claiming henceforth, because there have been structural changes in terms of phase wise withdrawal of exemptions.

Do not rely solely on the websites and online repositories. Making changes on the websites takes time and there have been errors in the past. So, relying on these sources for filing a Bill of Exemption and claiming those exemptions could be problematic.

Also, be mindful of when those exemptions are proposed to be withdrawn.

The last Union Budget introduced Section 25 (4A), under which a two-year expiry of shelf life has been brought about. In exercise of those powers, expiry dates have been introduced in various items this year. Please be mindful if you are impacted by those dates. If yes, it may be a responsibility of the industry to represent this to the CBIC (Central Board of Indirect Taxes) and request exemption. Otherwise, they will expire.

made this Budget different from those of the past years were the surprising and exceptional elements added in it, making it one whose purported impact would be remembered for a long time.

While the implementation and impact of these decisions can only be seen by those who choose to wait patiently, here are some ways in which the Union Budget 2022-23 could prove to be a game-changer for the electronics industry of India.

The fundamentals

Let us first look at the broader initiatives announced by the government of India and how they are liable to impact the tech and electronics demand in the country:

1. Capex up by 35.4%. Capex target has been increased from ₹5,540 billion to ₹7,500 billion with FY23's effective capex seen to be at ₹1,070 billion. With increasing share of tech in any capex investment, can this translate into a good increase in demand for tech solutions?

2. 150,000 new banks. All the 150,000 post offices will come on the core banking system, enabling financial inclusion and access to accounts through net banking, mobile banking, ATMs, etc. Can this result in greater demand for ATMs, computers, networking, security, and related electronics?

3. 400 new trains. 400 new-generation Vande Bharat trains will be developed and manufactured in the next three years. Again, can this result in increased demand for display screens, cameras, and other tech solutions involved in trains?

4. Digital currency! Digital Rupee, using blockchain, to be launched by RBI in 2023. Now this could be a game changer—it could end or reduce demand for many products like currency counting machines and ATMs, and increase demand for mobile devices to enable transactions—if we need anything other than our mobile phones.

5. 5G in 2022. 5G spectrum auctions to be conducted this year, which may result in greater demand for 5G related electronics, both at the back end and front end.

6. Rating for MSMEs. ₹60 billion programme to rate MSMEs to be rolled out over five years. This may make it easier and safer for us to select the right firms to do business with or extend credit to.

7. E-procurement system. A completely paperless, e-bill system will be launched by ministries for procurement. Will this increase demand for paperless tech, including scanners, computers, and networks? Plus, will this enable faster and more transparent (and less corrupt) procurement?

8. Indigenous rail network. 2,000km rail network to be brought under indigenous technology (KAWACH) for safety and capacity augmentation. Will this result in demand for various tech solutions related to safety, security, and signaling?

9. Domestic defence. 68% of capital procurement budget in defence will be earmarked for domestic industry in 2022-23 (up from the 58% last fiscal). Hopefully, this too should result in increased demand for indigenous electronics and tech solutions.

Change in tariff and notifications

There have been numerous changes in customs tariffs, especially keeping in mind the goal of the government to provide a boost to the electronics manufacturing sector and make the country a manufacturing hub. More than 350 obsolete exemption notifications have been deleted. However, various rate changes and structural changes have made it difficult to gauge how it would affect importers who are looking to claim an exemption that has been revised.

There has also been a change in customs notifications and customs tariffs, wherein many exemptions have been moved from notification to the tariff. Such movement, in certain cases, has resulted in change in effective rate of duty. But in some cases, there are no changes in the effective rate of duty. A lot of new tariffs have also been introduced. New entries with respect to wireless products have also been introduced.

The industry, in general, has been glad that the government has taken in consideration their several recommendations and introduced changes in duties on inputs through customs duty in several products, such as chargers, transformers, solar cell inputs and reviewing Customs Notification 25/1999 and 50/2017, thereby rationalising the duty considerations for various electronic components and subassemblies.

While there have been many changes made to customs tariffs, some of the significant ones are included in Table 1.

There have been ongoing disputes at various ports with regards to classification of wireless headphones and earphones as to whether they would be classified under Chapter 8518 or they can be classified under 8517 62 90 as wireless communication devices. There is an old WCO ruling also being followed as a 2000 circular by the board, which deals with single-piece wireless earphones, wherein the board classified that those products would be classified under 8517. Following the same logic, a lot of importers have been adopting the same classification for their wireless earphones and headphones because the rate of duty by virtue of exemption became nil or 10%.

Now, however, these entries for wireless earphones and headphones have been brought out specifically in 8518. It helps importers to the extent that at least now these entries have been particularly put under this particular heading.

Photovoltaic cells have had an increase in rate of duty. This is an interesting move since these parts are also part of India's commitment to WTO with regards to exempting these parts as part of ITA commitment. Whether it will be a violation of India's commitment will be a matter to be seen.

Various entries have been amended and substituted. It becomes important to look into these exemptions carefully and specifically. Further, vide Customs Notif 02/2022 (NT), major changes have been made in ICGR items (Customs 25/1999), thereby easing the procedure for availing end-use based duty exemption on capital goods.

In terms of the concessional rate on basic customs duty on capital goods that are used for manufacturing electronic items, a sunset date has been introduced for these since capital goods manufacturing and capacity building has been a big goal of the government. Considering that, there is a phase-wise reduction in tariff now and by 31.03.2024 all these would be liable to tariff rate and duties and exemptions would be withdrawn. Businesses importing such goods need to be wary of this and make sure that all imports are made before this date.

Similarly, in notifications on the import of raw materials for electronics manufacturing, multiple entries have been deleted, the objective being to take care of overlap and duplication of notifications. It is not that by dele-

TABLE 1
TARIFF RATE CHANGES IN SCHEDULE 1 TO THE CUSTOMS TARIFF EFFECTIVE 02.02.2022 (ELECTRICAL AND ELECTRONICS SECTOR)

S.No.	CTH/Tariff item	Commodity	From	To
1	8518 21, 8518 22, 8518 29	Single or multiple loudspeakers, whether or not mounted in their enclosure	15%	20%
		(Effective BCD rate on these goods, other than hearable devices would continue to be '15%' vide Notification No. 12//2022-Customs dated 01.02.2022)		
2	8518 30	Headphones and earphones, whether or not combined with a microphone, and sets consisting of a microphone and one or more loudspeakers	15%	20%
		(Effective BCD rate on these goods, other than hearable devices would continue to be '15%' vide Notification No. 12//2022-Customs dated 01.02.2022)		
3	9028 30 10	Smart Meters	15%	25%
		(Effective BCD rate on these goods would continue to be '15%' till 31.03.2022 vide Notification No. 50//2017-Customs dated 30.06.2017)		
4	9028 90 10	Smart Meters PCBA	10%	20%
		(Effective BCD rate on these goods would continue to be '15%' till 31.03.2022 vide Notification No. 50//2017-Customs dated 30.06.2017)		
5	Any Chapter	Camera Lens for use in manufacture of camera module of cellular mobile phones	10/15%	2.5% (effective from 2.2.2022)
6	3208 90 49	Specified parts of transformers for use in manufacture of chargers/ adaptors		
	3919 90 90	Varnish, insulation tape, ferrite core, copper wires enameled, triple insulated winding wire	10/15%	5% (From 2.2.2022 till 31.03.2024)
	8504 90 10			
	8544 11 10			
	8544 49 99			
7	39, 74, 75, 76	Materials used in manufacture of PCBs, metal-clad PCBs	Tariff rate of the respective imported goods falling under Chapters mentioned above	Nil
		a. Composite copper-clad materials consisting of paper + epoxy + glass cloth; b. Glass epoxy copper-clad laminates or paper phenolic copper-clad laminates; c. aluminium based copper-clad laminate; d. copper based copper-clad laminate		
8	8541 42 00	Photovoltaic cells N-T assembled in modules or made up into panels	20% (Tariff rate)	25% (effective from 2.2.2021)
9	8541 43 00	Photovoltaic cells assembled in modules or made up into panels	20% (Tariff rate)	40% (from 2.2.2022)
10	84, 85 or any chapter	Goods imported for providing public mobile radio trunked service by a person licensed by the Department of Telecommunications of the Government of India and parts required for manufacture of the said goods	Nil	Tariff rate (from 2.2.2022)
11	8518 30 00	Parts of line telephone handsets under Sl. No. 9 of NN 25/2005-CUS has been substituted (2.2.2022) with "Line telephone handsets" NOTE: Parts of line telephone handsets will attract the tariff rate	15% (tariff rate)	Nil

TABLE 2
TARIFF RATE CHANGES IN SCHEDULE 1 TO THE CUSTOMS TARIFF EFFECTIVE 02.02.2022

S.No.	CTH/Tariff item	Commodity	From	To
1	9018 32 30, 9018 50 20, 9018 90 21, 9018 90 24, 9018 90 43, 9018 90 95, 9018 90 96, 9018 90 97, 9018 90 98	Specific instruments and appliances used in medical, surgical, dental, or veterinary sciences like tonometer, tubular needles for medical sutures, etc	10%	5%
2	9018 (other than above items and 9018 90 99)	Other medical equipment and medical related goods used in medical, surgical, dental, or veterinary sciences like catheters, cannulae, defribrillator, etc	10%	7.50%
3	9022 14 20 or 9022 14 90	X-ray machines for medical, surgical, dental, or veterinary use	7.50%	10%

TABLE 3
PMP FOR WRIST WEARABLE DEVICES (SMART WATCHES)

S.No.	Chapter, heading, sub-heading, or tariff item	Commodity	From	To			
				2022-23	2023-24	2024-25	2025-26
1	8517 79 10	PCBA	NIL	NIL	10%	15%	15%
2	8544	Charging cable	10%	NIL	5%	10%	15%
3	39, 73, 85	Specified parts of wearable devices	As per CTH	NIL	5%	10%	15%
4	8507 60 00/ 8507 80 00	Battery	15%	NIL	5%	10%	15%
5	8517 79 90	Display Assembly	NIL	NIL	NIL	5%	10%
6	8501	Vibrator Motor	10%	10%	10%	10%	10%
7	Any Chapter	Parts, sub-parts, and raw materials for use in the manufacture of the S. No. 1-6 above	As per CTH	NIL	NIL	NIL	NIL
8	8517 62 90	Wrist wearable devices (commonly known as smart watches)	20%	20%	20%	20%	20%

tion of these entries the exemption is completely lost, because there are alternative exemptions which are also available. This is more of a rationalisation or fine tuning of notifications.

Phased manufacturing programme (PMP)

Phased manufacturing schemes for wearable and hearable devices—a growing market segment in electronics—as well as smart meters, has also been a welcome move of the government, which is expected to put these high-growth sectors on track for domestic value added manufacturing. It provides the opportunity for the industry to have access to raw materials in India. As expected, there have been tweaks made in the exemptions, with rates being increased in a phased manner.

PMP for wrist-wearable devices. Regarding PMP for wrist-wearable devices (smart watches), parts (1 to 7) in Table 3 for manufacture of wearable devices fall under Tariff item 8517 62 90 of the Customs Tariff.

For smartwatches, the tariff rate had been 20% under Chapter 8917 and there was no exemption. Chapter 8517, however, specifically excludes smartwatches from exemption. As far as other items included in the exemption Notification 11/22, they have been given exemption as of now, but the rates are going to increase over a period of time.

PMP for hearable devices. Parts (1 to 7) in Table 4 for manufacture of hearable devices fall under Tariff item 8518 21, 8518 22, 8518 29 or 8518 30 of the Customs Tariff.

For hearable devices, the notification provides a clear definition as to what would be considered as a hearable device. Similarly, items for these have also been given exemption in a phased manner.

PMP for smart meters. The parts in Table 5 for manufacture of hearable devices fall under Tariff item 9028 30 10 of the Customs Tariff.

The Lackeys

While the exemptions are much appreciated, they still have plenty of gray areas. There are items which have been listed under multiple chapters that have different exemption rates. For instance, a communication module is an item listed under smart meters' exemption under 8517 69 60, but there are some communication modules which will also go under 8517 62 90 because they have the ability to communicate on their own on a standalone basis. In that case, under which chapter should these be classified by the importer to be able to get the exemption?

"It is important that before any change has been effected in terms of imports, there must be a clarity as regards the availability of exemption notification and the chances of litigation once the exemption is claimed by the importers. This is just one example to show how changes have been made to the tariffs but there are some things lacking which should be addressed or they may bite us later," says Jain.

To dos promised

Here's a list of initiatives promised by the FM, which relate directly to tech.

1. Optical fibre solutions. Contracts for laying optical fibre in villages to be awarded under BharatNet project under PPP in 2022-23. When executed, this should result in good demand for fibre-optics and related electronics.

2. 5G equipment and devices. Scheme for design led manufacturing to be launched for 5G ecosystem as part of PLI scheme to enable affordable broadband and mobile communication in rural and remote areas. This will provide and promote R&D and commercialisation of tech and solutions.

3. E-passports with chips. The issuance of E-passports using em-

bedded chips and futuristic technology will be rolled out in 2022-23 to enhance the convenience for the citizens in their overseas travel. The back cover is expected to have a small silicon chip!

4. Tax benefits for startups extended. Existing tax benefits for startups, which were offered redemption of taxes for three consecutive years, to be extended by one more year. That's good news for electronics startups!

5. Duty concessions for electronics. Duty concessions being given to promote electronics manufacturing of mobiles, wearable and hearable devices.

6. Increased PLI for solar modules. ₹195 billion additional allocation for PLI for manufacturing high-efficiency solar modules has been made. This should result in further boost to 'Made in India' solar modules.

The promising statements

Here are promising statements that the FM made, which, if executed, could affect the electronics industry.

1. Opening of defence R&D. Defense R&D will be opened up for industry, startups, and academia with 25% of defense R&D budget. Private industry will be encouraged to take up the design and development of military platforms and equipment in collaboration with DRDO and other organisations through SPV model. Can this be the game-changer for India's electronics industry?

2. Battery swapping policy. A battery-swapping policy to be brought out with interoperability standards to boost EV ecosystem. While India had an opportunity to lead this space—had the Government executed Prof. Jhunjhunwala's plans in 2019—one hopes that this policy (whenever announced) will ensure we are not left behind, and EVs will become as budget-friendly as their ICE counterparts, and thereby provide tremendous demand for electronics.

TABLE 4
PMP FOR HEARABLE DEVICES

S. No.	Chapter, heading, sub-heading, or tariff item	Commodity	From	To			
				2022-23	2023-24	2024-25	2025-26
1	8517 79 10	PCBA	NIL	NIL	10%	15%	15%
2	8544	Charging cable	10%	NIL	5%	10%	15%
3	39, 73, 85	Specified parts of wearable devices	As per CTH	NIL	5%	10%	15%
4	8507 60 00/ 8507 80 00	Battery	15%	NIL	5%	10%	15%
5	8517 79 90	Display Assembly	NIL	NIL	NIL	5%	10%
6	8501	Vibrator Motor	10%	10%	10%	10%	10%
7	Any Chapter	Parts, sub-parts, and raw materials for use in the manufacture of the S.No. 1-6 above	As per CTH	NIL	NIL	NIL	NIL
8	8517 62 90	Wrist wearable devices (commonly known as smart watches)	20%	20%	20%	20%	20%

TABLE 5
PMP FOR SMART METERS

S. No.	Chapter, heading, sub-heading, or tariff item	Commodity	From	To			
				2022-23	2023-24	2024-25	2025-26
1	9028 90 10	Assembled/ Populated PCB for smart meters	7.50%	20%	20%	20%	20%
2	8517 69 90	Communication module	10%	Nil	Nil	5%	10%
3	8536 49 00	Relay	10%	5%	10%	10%	15%
4	8517 71 00	Antenna	Nil	Nil	Nil	5%	10%
5	8524 11 00/ 8524 91 00	LCD and backlight for LCD	15%	Nil	5%	10%	10%
6	8506 50 00	Battery	10%	Nil	5%	10%	10%
7	Any Chapter	Parts, sub-parts, and raw materials for use in the manufacture of the S.No. 1 to 6 above	As per CTH	Nil	Nil	Nil	Nil
8	9028 30 10	Smart Meters	15%	25%	25%	25%	25%

3. Private sector in EV. Private sector will be encouraged to create sustainable and innovative business models for battery and energy as a service, improving the efficiency in the EV ecosystem. Great thought. Look forward to greater execution.

4. Digital health. An open platform for the National Digital Health Ecosystem will be rolled out. It will consist of digital registries of health providers and health facilities, unique health identity and universal access to health facilities. Again, can create demand for multiple tech solutions and products to test and measure health parameters and store that data.

5. Drones for agri. Kisan Drones for crop assessment, land records, spraying of insecticides expected to drive a wave of technology in the agri sector. Thankfully, we do see a bit of action already on the ground.

6. Data centres and energy storage to be infra. Data centres and energy storage systems to be given infrastructure status; this would provide easy financing.

In essence, the Union Budget has highlighted an objective that the Centre has been vehemently addressing for the past couple of years—the *Atmanirbhar Bharat* initiative. With the various electronics-related production linked Incentive (PLI) schemes and policies that the government of India has approved in the past year, it's eagerness to grow the EDSM sector of the country has only grown with the Union Budget. It is now for us to see how far these benefits take our country in the race to become a global leader in the electronics and tech industry. EFY

India becomes second largest mobile handsets manufacturer in the world

India has become the second largest manufacturer of mobile handsets in the world, revealed Niti Aayog CEO Amitabh Kant. Over 200 units are manufacturing cellular mobile phones, up from only two units in the year 2014. Production has gone up from 60 million mobile phones in 2014-15 to approximately 300 million mobile phones in 2020-21.

Government to announce battery swapping policy for EVs soon

Finance Minister Nirmala Sitharaman announced during the Union Budget 2022-23 that the government is going to propose a new policy for battery swapping to boost sales of EVs. Sitharaman said companies will also be encouraged to develop sustainable and innovative business models for battery or energy as a service, which will improve efficiency in the EV ecosystem.



Representational image

PEOPLE (on the move)

Viswanathan appointed as MD for Intel India



Intel has appointed Santhosh Viswanathan as Managing Director-Sales, Marketing and Communications Group (SMG) for Intel India. Santhosh is Vice President in Intel's Sales, Marketing and Communications Group. He will be responsible for Intel's overall business in India, including driving new revenue opportunities, engaging with the local ecosystem, and strengthening existing customer and partner relationships.

Tejas Networks appoints new directors



Tejas Networks has appointed N. Ganapathy Subramaniam (left) and Amur S. Lakshminarayanan (right) as Nominee Directors from Panatone Finvest Limited, a subsidiary of Tata Sons Private Limited. N. Ganapathy Subramaniam is Chief Operating Officer (COO) of Tata Consultancy Services Limited (TCS) since February 2017. Amur S. Lakshminarayanan is CEO and MD of Tata Communications.



Guruswamy appointed as NexGen's Chief Systems Officer



GaN power electronics maker NexGen Power Systems has appointed Ganesh Guruswamy as its Chief Systems Officer. Guruswamy will oversee NexGen's Global Systems Engineering group, with established engineering facilities located in Santa Clara, California and Syracuse, N.Y., and the Center of R&D Excellence in Bangalore, India.

Log9 strengthens its 'people' team



Log9 Materials has appointed two industry veterans—Raman S.R. (left) as Chief People Officer and Abhishek Joshi (right) as Head of People Transformation. In their newly-appointed positions at Log9, Raman would be reporting directly to Log9 founder Dr Akshay Singhal, whereas Abhishek will be reporting to Raman.



CORPORATE news

Vedanta and Foxconn JV to manufacture semiconductors

Vedanta and Hon Hai Technology Group (Foxconn) have signed an MOU to form a joint venture (JV) company for manufacturing semiconductors in India. The former, as per the MoU, will hold majority share in the company. Vedanta Chairman has been nominated to be the Chairman of the joint venture company. The company is already engaged in talks with various state governments to finalise the location of the factory.

Reliance buys majority stake in Addverb Technologies

Addverb Technologies has received a funding boost of $132 million from Ambani-led Reliance Retail, following which Reliance will own 55.7% stake in the firm. The funding values the firm at $270 million. The founders continue to hold about 25% stake in the firm.

BoAt files for IPO, signs JV with Dixon Technologies

Imagine Marketing, the holding company of brand BoAt, has filed for an IPO of up to ₹20 billion. The company has plans to issue fresh shares worth up to ₹9 billion and an offer for sale of shares worth up to ₹11 billion. Additionally, Imagine Marketing and Dixon Technologies have signed a joint venture. The duo will be working together to design and manufacture wireless audio solutions. They also have plans to invest in the mobile accessory market under the Make in India Initiative.

Hero Electric and Mahindra Group join hands to manufacture EVs

Hero Electric and Mahindra Group have joined hands to manufacture EVs for Indian as well as the international markets. The partnership announced by the duo is worth ₹1.5 billion and is valid till the next five years. Hero Electric, with help from Mahindra Group, aims to manufacture one million electric vehicles every year. There are plans to increase the numbers as well. Both the companies will be working together to expand Hero Electric's already existing Ludhiana, Punjab facility.



Representational image

Ford looking to make EVs in India and make it export base

Months after shutting its shops in India, Ford Motor is once again looking to restart its production of vehicles in the country, but for EVs this time. Ford said that it is considering producing EVs in India for export, and possibly also for sale in the domestic market. The plant that the company had in the country for manufacturing ICE vehicles is likely to be used as an export base for EV manufacturing.

Ola Electric raises $200 million and sets up R&D centre in the UK

Ola Electric Mobility has raised $200 million (about ₹15 billion) in a funding round from Tekne Private Ventures, Alpine Opportunity Fund, Edelweiss, and others at a valuation of $5 billion. Further, it plans to invest over $100 million (about ₹7.5 billion) in the UK over the next five years to set up a global centre for advanced engineering and vehicle design in the UK, called the Ola Futurefoundry. The factory will be based in Coventry, UK, and work in sync with the design and engineering teams based at Ola Campus in Bengaluru and employ over 200 designers and automotive engineers.

SNIPPETS

- Silicon Labs records $209 million increase in IoT revenue in 4Q21
- ReNew Power forms JV with US based energy storage firm Fluence to bring localised energy storage solutions to India
- BEL signs deal with Hyperion Global to develop IoT devices for US market
- STL wins ₹1.7 billion deal from PGCIL to provide integrated network management systems across their regional communications networks
- Electric One strikes deal with Ipower Batteries for battery retailing
- HOP Electric opens new megaplex in Jaipur, can produce 100 E2Ws per day
- Around 75 space startups have registered in Startup India Portal, says Space Minister
- Chroma ATE Inc. has acquired all shares of Environmental Stress Systems, Inc. (ESS)
- Beowulf Mining and India's Epsilon Advanced Materials to establish anode materials production facility in the city of Vaasa in Finland
- Reliance to invest ₹501.6 million in Altigreen through share subscription

Central Electronics Limited is not privatised yet

The government of India has put on hold the Letter of Intent (LoI) to the successful bidder of Central Electronics Ltd (CEL). The same has been done on the basis of pending examination of specific allegations regarding the bidder. This is after a Congress party spokesperson claimed that the sale was undervalued.

ReNew Power sells its 117MW rooftop solar portfolio to Fourth Partner

ReNew Power has sold 117MW of its rooftop solar portfolio to Fourth Partner Energy for ₹6.72 billion. The company said it sold the distributed rooftop solar portfolio to relocate capital into higher-return opportunities and focus on large utility-scale projects. Net proceeds from the sale stood at ₹5.35 billion after accounting for an outstanding debt of ₹1.37 billion.

Exxelia acquires majority stake in Nashik's Alcon Electronics for $100 million

France based components and sub-systems manufacturer Exxelia has spent about $100 million to acquire a majority stake in Nashik's Alcon Electronics. Alcon is a designer and manufacturer of catalogue and custom-designed film and aluminium electrolytic capacitors, specifically serving the renewable energy, induction heating equipment, medical imaging, power generation, and railways end markets.

Solar PLI scheme to get additional funding

During her Budget speech, Finance Minister Nirmala Sitharaman said that the government has proposed increasing the Production Linked Incentive (PLI) scheme for domestic solar cells and module manufacturing to ₹240 billion from the existing ₹45 billion to make India an exporting nation, outlining an additional ₹195 billion to the scheme.



Representational image

India Semiconductor Mission looking for CXOs

The India Semiconductor Mission (ISM) is looking for a Chief Executive Officer (CEO), Chief Financial Officer (CFO), and Chief Technical Officer (CTO). To apply for the CEO position, one must have at least 25 years of semiconductor industry experience, which should include 10+ years of experience at the global level.

India's first fab unit likely by 2024

India's first fabrication unit is likely to be set up by 2024 as the government targets to approve the application of at least one big global semiconductor fabrication company before March 31. As per a report, the ministry plans to give the winning bidder 700-750 days to allow the construction of the new unit. Apart from the main factory unit, a plan for on-site housing of all employees may also be approved.

MeitY invites applications for financial support to Indian firms to make chips

MeitY has invited appilcations for providing financial support to domestic companies to set up shop for chip manufacturing. Proposals have been invited from Indian companies with indigenous technologies at commercialisation stage in semiconductor and sensor domain focusing on semiconductor fabrication, display fabrication, designing for ICs, chipsets, SoCs, and so on. Last date to submit the proposal is March 26, 2022.

MeitY releases 5-year vision chart to grow electronics manufacturing

The government has released a 5-year roadmap and vision document to grow electronics manufacturing and exports into a $300 billion market by 2026. The report provides a year-wise break-up and production projections for various products. It also seeks a competitive tariff structure for electronic components and removal of all regulatory uncertainty.

Centre notifies drone certification scheme and bans import of drones

The government has notified drone certification scheme to ensure minimum safety and quality and make certification of drones simpler, faster, and transparent. The manufacturer, while applying for certification of a drone, will have to submit various data and test results on topics such as weight, type of launch and recovery mechanism installed, speed, range, endurance, battery performance, and type of material used in construction. Additionally, the Centre has put a ban on the import of drones with immediate effect. The Ministry of Civil Aviation said that while exceptions were provided for R&D, defense, and security, importing drones for these purposes will require due clearances.

Phased manufacturing plan to promote indigenous manufacture of EVs

The Ministry of Heavy Industries has notified a phased manufacturing programme (PMP) to promote indigenous manufacturing of EVs, its assemblies/sub-assemblies and parts/sub-parts/inputs of the sub-assemblies. GST on EVs has also been reduced from 12% to 5%; GST on chargers/charging stations for EVs has been reduced from 18% to 5%.

IT Hardware PLI: India saw production worth ₹672.75 billion in 2021

The Economic Survey of 2021-22 presented by Finance Minister Nirmala Sitharaman revealed that India saw production worth ₹672.75 billion under Production Linked Incentive (PLI) scheme for large-scale electronics. The country saw an investment of ₹25.95 billion and production worth ₹672.75 billion under the PLI scheme, out of which, ₹205.68 billion worth of products were exported till June 2021.

Engineering goods exports grew by 54% YoY in Jan-Apr 2021

Engineering goods exports surged to $81.8 billion during April-December 2021 as compared to $52.9 billion

INTERNATIONAL news

Nvidia-ARM acquisition likely to be shelved

Nvidia Corp's anticipated $40 billion acquisition of UK based ARM Ltd from SoftBank is likely to fall through as it has failed to receive approval to go ahead with the deal. SoftBank is preparing to file an initial public offering for ARM as an alternative to the Nvidia takeover. SoftBank and ARM are entitled to keep $2 billion Nvidia paid at signing, including a $1.25 billion breakup fee, whether the deal goes through or not.

AMD receives all approvals to go ahead with Xilinx acquisition

Advanced Micro Devices Inc. (AMD) is set to go ahead with its $35 billion proposed acquisition of Xilinx, Inc after it received approval from all necessary authorities for the same. AMD said it will combine its CPUs, GPUs, and FPGAs for cloud and edge offerings.

Intel invests $20 billion in chip factories and acquires Tower Semiconductor

Intel has announced plans for an initial investment of more than $20 billion in the construction of two new chip factories in Ohio, USA. At full buildout, the total investment in the site could grow to as much as $100 billion over the next decade, making it one of the largest semiconductor manufacturing sites in the world.

It has also announced a new $1 billion fund to support early-stage startups and established companies building disruptive technologies for the foundry ecosystem. The fund will prioritise investments in intellectual property (IP), software tools, innovative chip architectures, and advanced packaging technologies.

Intel will acquire Israel's Tower Semiconductor for $53 per share in cash, representing a total enterprise value of approximately $5.4 billion.

Toshiba to separate into two companies, invest in new chip fab in Japan

Toshiba is splitting into two standalone companies, both of which will be publicly traded. The separate entities will now consist of Toshiba/Infrastructure Service Co., and Device Co. 1. The corporation will invest around 125 billion yen ($1.09 billion) to construct a new 300mm wafer fabrication facility for power semiconductors, which will be located at its main discrete semiconductor production base, Kaga Toshiba Electronics Corporation, in Ishikawa Prefecture.

Micron to shut its DRAM unit in China's Shanghai

Micron Technology has revealed that it will shut its DRAM chip designing operations in Shanghai by the end of this year. The centre would focus on developing NAND and SSD technology moving forward. The 150 Chinese engineers at the site will reportedly be asked to relocate to the United States or India.

BYD partners with Nuro to make electric autonomous vehicles

BYD has partnered with autonomous vehicle company Nuro. BYD will begin producing the company's third-generation electric autonomous delivery vehicle. BYD will finish assembly of the hardware platform at its Lancaster plant in the United States. Nuro will then complete the vehicle manufacturing process by installing and testing the autonomy systems that will make the platform capable of operation at the company's new facilities in southern Nevada.

GM and LG Energy Solution to build Ultium Cells' manufacturing plant

Ultium Cells, a joint venture of LG Energy Solution and General Motors, will invest $2.6 billion to build its third battery cell manufacturing plant in the United States. The facility will be located in Lansing, Michigan. Ultium Cells will build the new plant on land leased from GM.

Mouser Electronics becomes Liquid Instruments' new global distributor

Mouser Electronics has signed a global distribution agreement with Liquid Instruments. Liquid Instruments makes a new breed of test equipment with Instrument-on-Chip technology. With this, Mouser will now offer the latest Liquid Instruments products, including Moku:Pro, Moku:Lab, and Moku:Go.

Amcor invests $5 million in PragmatIC Semiconductor

Amcor has made a strategic investment in UK based PragmatIC Semiconductor. The latter is known as one of the top players in the world of low-cost electronics. Amcor's $5 million investment was part of the Series C funding round of more than $90 million for PragmatIC Semiconductor.

during the same period in 2020, registering a growth of 54%. In the month of December 2021, exports of engineering goods touched $9.79 billion, registering a growth of 38.41% over $7.07 billion logged in December 2020.

Electronics goods exports rose by 45% YoY in Apr-Dec 2021

Exports of electronics goods from India saw a 49% year-on-year (YoY) surge in the April-December 2021 period, rising to $11 billion as against $7.4 billion recorded in the corresponding period of last year. The overall exports of electronics goods in the financial year 2020-21 stood at $11.11 billion. In just three quarters of the current financial year the exports stand at $11.0 billion, nearly the same as what was achieved in the full year of 2020-21 FY.

China's contribution to India's electronics trade deficit rising since 2019

India's electronics trade deficit in 2021 comprised $7.13 billion from China. Data released by the Ministry of Commerce shows that China's contribution in India's elecronics trade deficit has been on a rise since 2019. China contributed 59.11% to India's electronics trade deficit as of November 2021. These figures, in 2020, were 51.88%.

New EMCs likely to come up soon in Telangana, Maharashtra, Uttarakhand

The government is considering approving three new proposals which it has received for setting up electronics manufacturing clusters (EMCs) from the states of Telangana, Maharashtra, and Uttarakhand. STPI Director General Arvind Kumar added that states such as Himachal Pradesh, Tamil Nadu, Karnataka, and Bihar are in the process to apply for the Central scheme.

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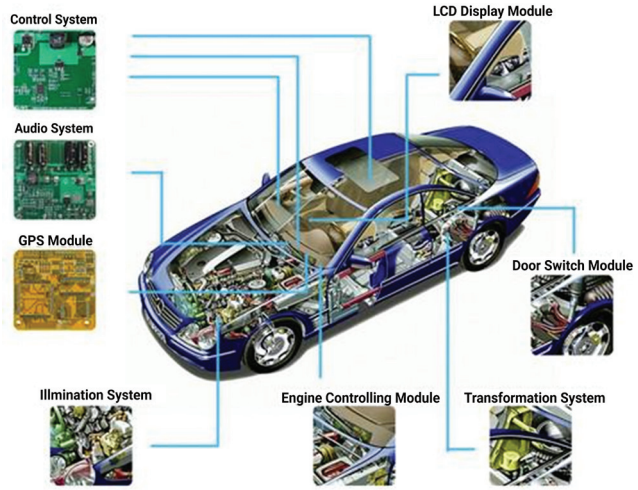
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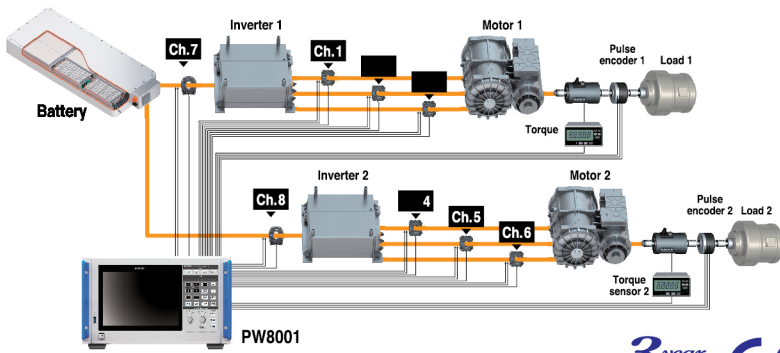


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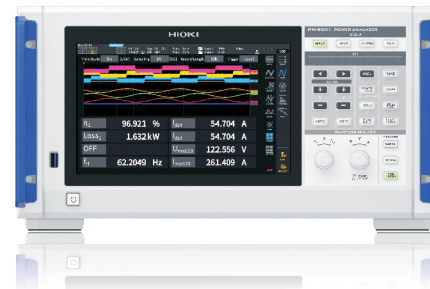
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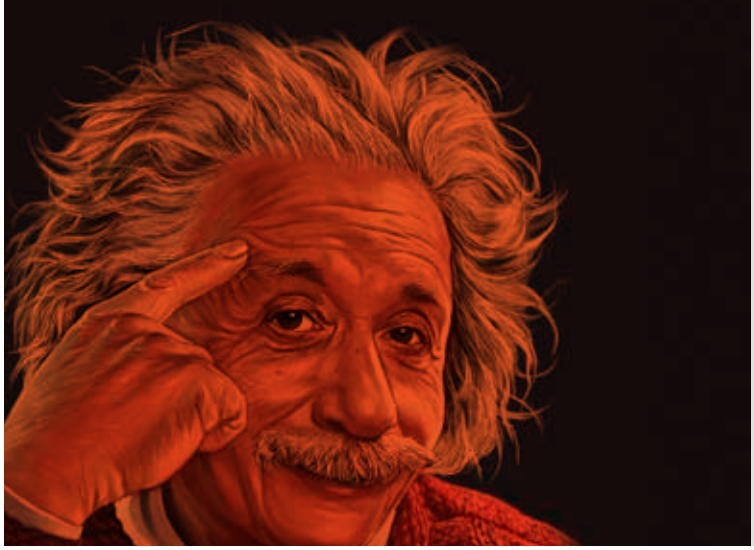
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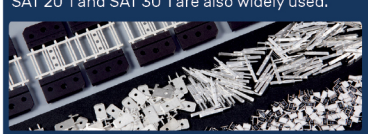
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Application Blocking	Deep Learning Malware Analysis	Exploit Prevention	URL Blocking
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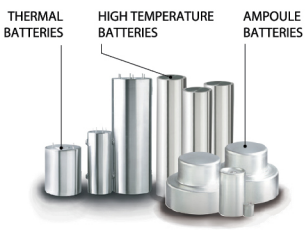
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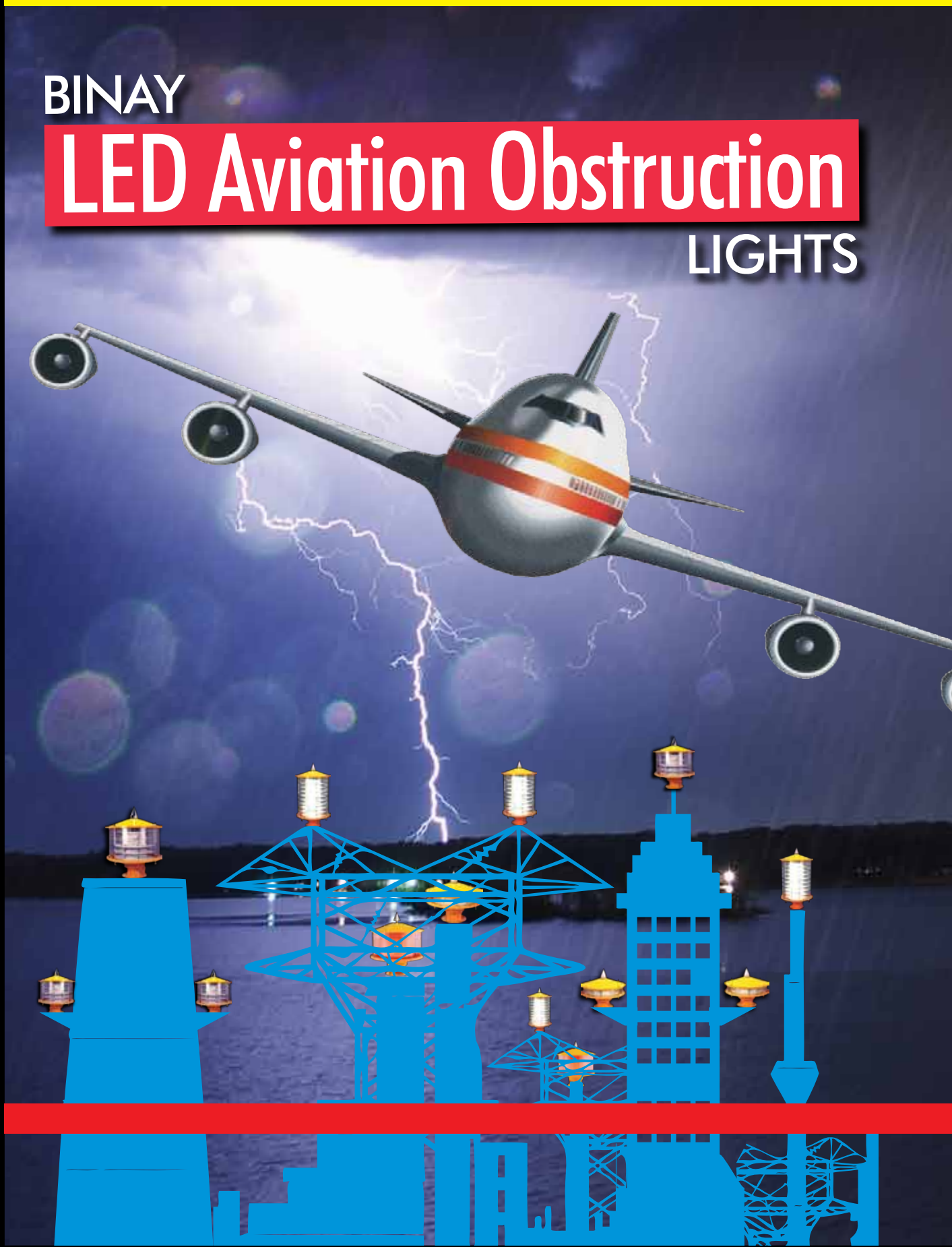
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As per International Civil Aviation Organisation (ICAO) requirements
Available in Low Intensity, Medium Intensity and High Intensity versions (as per International Civil Aviation Organization guidelines), BINAY's patented LED Aviation Lights come with 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

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Smart HMI Solution

Graphics, Touchscreen and ML All in One

The Integrated Graphics and Touch (IGaT) Curiosity Evaluation Kit is a low-cost reference demo board integrating graphics, touch and Machine Learning (ML) features all in one convenient solution. Microchip's SAM E51 microcontroller powered by an Arm® Cortex® core can single-handedly drive image processing/ generation, display, mid-range touchscreen and machine learning with gesture recognition.

Minimize system cost, size and design complexity by using the integrated Peripheral Touch Controller (PTC) for touch, instead of using an external touch controller.

All firmware and demos are included in MPLAB® Harmony v3 Software Framework and preloaded out of the box to reduce the learning curve and lower the risk of expensive bug fixes. Full schematic and layout are also provided for shorter design cycles with proven implementation.

Key Features

- Eliminates external dedicated touch controller
- All firmware and demos included in MPLAB Harmony v3 Software Framework
- Full schematic and layout info provided
- Readily available display module with touch panel
- Fully programmable

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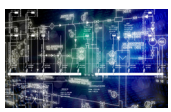
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FROM YOU

YOUR SUGGESTIONS AND THINGS YOU WANTED TO KNOW!

THE E-ZINE

Thanks for the e-zine issues! It was exciting to see various topics covered in your magazine, which makes it one of the most informative and advanced leading electronic technical magazines in India, no doubt. Keep it up! It's great to receive the e-zine; I am sharing it with my professional colleagues. Thanks!

Anthony D'Sa
Consultant, Control & Automation Systems

• • •

BATTERIES PROTECTION

Recently I read the 'Protection Mechanisms For Batteries And Their Charging Systems' article in January issue. It's really useful. I have learned a lot. Thanks to EFY and the author!

Prakash U.M.

EFY. Thanks for the feedback!

• • •

TOY CAR

I am interested in the 'Remote Controlled Toy Car Demystified' DIY article published in October 2021 issue. Can I get the PCB and other electronic items for this project?

Senthil

EFY. Please visit www.kitsnspares.com or write to *info@kitsnspares.com* for the project kit, including the PCB, electronic components, and project manual.

• • •

APPLIANCES PROTECTION CIRCUIT

I wish to draw your attention to an error in the circuit diagram of 'Circuit To Protect Appliances From High/Low Voltages' DIY article published in February issue. The diode across the relay coil is wrongly drawn. Its anode should be connected to the collector of transistor and cathode to the + ve line.

Ramprakash Venugopalan

• • •

HUMAN-PRESENCE SENSOR

There seems to be a typographical error in 'Human-presence Sensor' article under the Truly Innovative Tech section in January issue. In the first line, shouldn't "Ultra-sideband" be Ultra-Wideband?

Prakash U.M.

EFY. Thanks for pointing out the mistakes above! We highly appreciate your quick alerts, which would help the other readers.

• • •

BATTERY CHARGER

My 48V, 5A lead-acid battery charger is not working. So, I have following questions:

1. How can I repair my battery charger?
2. What are 25NF60N and 330MF250V codes in the charger circuit?
3. If the two MOSFETs and capacitors are replaced, would the MOSFETs blow off?
4. Would the charger function, if I replaced these components?
5. How to avoid blowing off components during soldering?

Roy
Kolkata

EFY. 1. While some battery chargers can be easily repaired, the chargers with SMD components are not so easy to repair. However, to repair, first you need to identify the exact problem. Check for any loose connection, short-circuit, faulty components, or a blown fuse (if used) in the circuit. Based on the problem you would need the required tools and parts to repair it.

2. The codes you are referring to seem be the part names of the components. Here, 25NF60N and 330MF250V could be an N-channel MOSFET and electrolytic capacitor, respectively.

3. It is not clear why you would like to replace MOSFETs and capacitors. If these are damaged, first try to find the root cause. If you replace them with wrong components or polarities, the MOSFETs could blow off or may not work.

4. After rectifying the root cause, if you replace the faulty components with appropriate components, it may function again, provided you have not damaged the PCB tracks and other associated components in the PCB.

5. SMD components often get damaged during soldering, but such cases are rare with through-hole components. One of the most common causes of damaging the SMD components is excessive heating with hot air gun. If you apply excessive heat to an SMD component, it may get damaged and even blow off or explode. To prevent that, first apply proper solder paste on the pads, place the components on their exact location on the PCB and then apply just the required amount of heat. Use a fine-tip tweezer to hold the component.

You need to look at typical thermal profiles of each component in the datasheet before soldering. Apply heat or set the temperature of the soldering machine accordingly. Cooling fan may be required, but do not bring the fan too close until solder melts. For lead/tin solder, you can set temperature between 260°C and 280°C and then heat a joint for about 15 to 20 seconds from the top, until solder melts and the component settles.

Sometimes improper soldering leads to solder bridging, where extra solder application shorts two points by mistake. When power is switched on, a solder bridge can burn or blow up a component and can even burn out a PCB track!

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



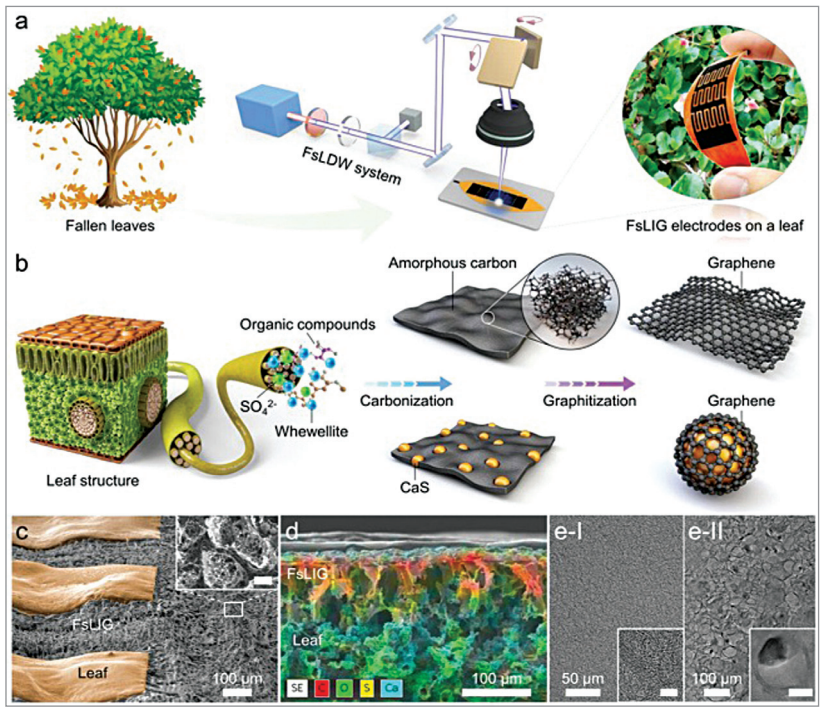
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ANALOG DEVICES

Eco-friendly micro-supercapacitors built with fallen leaves



A KAIST research team has developed graphene-inorganic-hybrid micro-supercapacitors made of fallen leaves using femtosecond laser direct writing. By irradiating femtosecond laser pulses on the leaves in ambient air, high electrical conductivity can be achieved. This one-step fabrication does not require any additional materials or pre-treatment. The technique could quickly and easily produce porous graphene electrodes at a low price. Potential applications include fabricating graphene micro-supercapacitors to power an LED and an electronic watch.

The schematic illustration of the production of femtosecond laser-induced graphene (Credit: https://news.kaist.ac.kr)

Versatile power transfer technology for wireless charging

Researchers at Aalto University have developed a power transfer technology that works regardless of the position and orientation of the transmitter and receiver. The key idea is to arrange the transmitters in a grid with the current in neighbouring transmitters running in opposite directions—for example, a clockwise loop in one transmitter and counter-clockwise loops in its neighbours. This creates a chessboard-like grid of 'positive' and 'negative' transmitting coils with a magnetic flux between them. A receiver above the grid of transmitters captures the magnetic flux between positive and negative transmitters, which generates an electric current to charge the device.



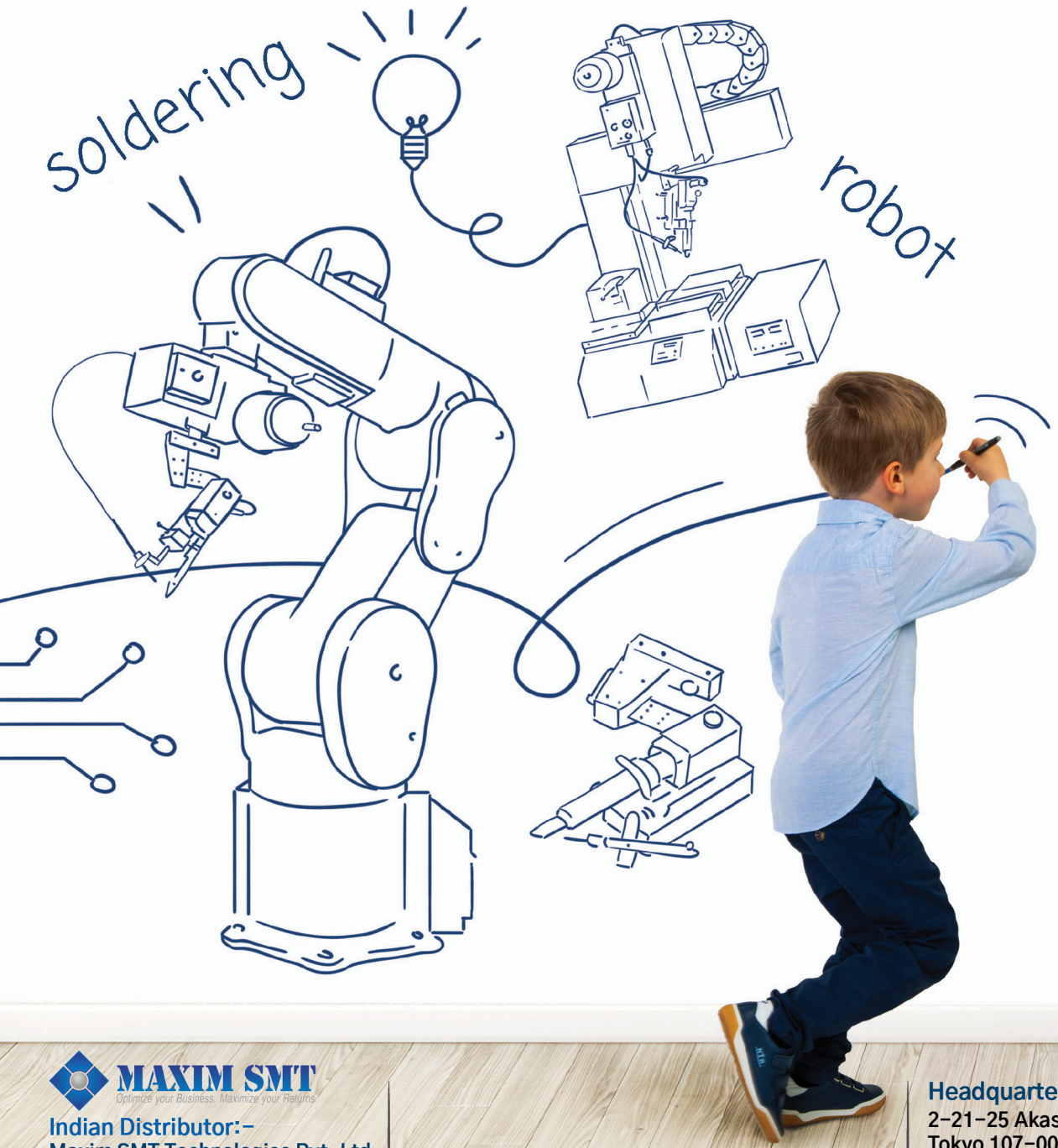
Wireless charging of a retail robot at a test site (Credit: www.aalto.fi/en)

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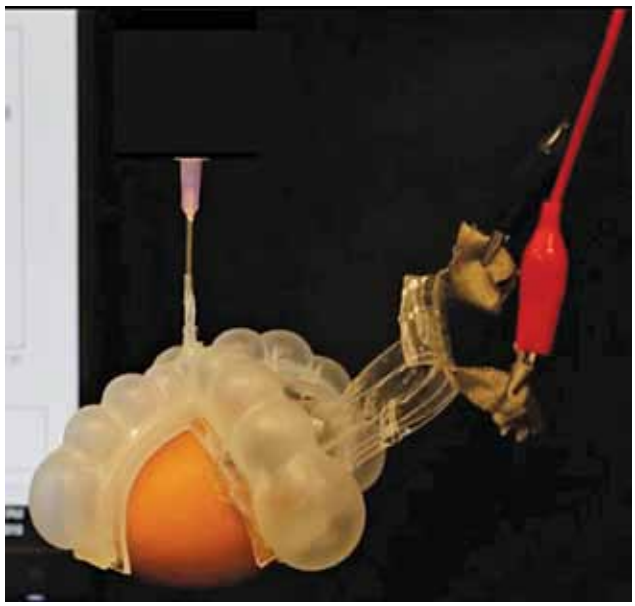
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Soft, stretchable, self-powered thermometer

Researchers at the Harvard John A. Paulson School of Engineering and Applied Sciences (SEAS) have developed a soft, stretchable, self-powered thermometer that can be integrated

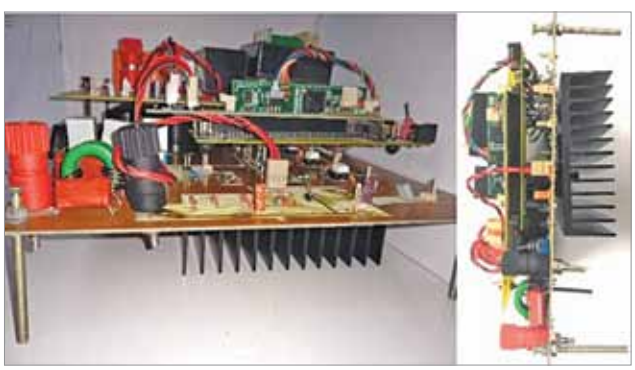


A stretchable thermometer for soft robots (Credit: www.seas.harvard.edu)

into stretchable electronics and soft robots. The thermometer consists of three simple parts: an electrolyte, an electrode, and a dielectric material to separate the two. The electrolyte/dielectric interface accumulates ions while the dielectric/electrode interface accumulates electrons. The charge imbalance between the two sets up an ionic cloud in the electrolyte. When the temperature changes, the ionic cloud changes thickness, and a voltage is generated. The voltage is sensitive to temperature but insensitive to stretch.

On-board chargers for EVs

A team of researchers at IIT-BHU Varanasi, along with experts from IIT Guwahati and IIT Bhubaneswar, have developed a new, low-cost technology for the on-board charging of vehicles that can further bring down costs of two- and four-wheeler electric vehicles. The technology will also enhance the charging infrastructure of vehicles in India and contribute towards sustainable development of EVs by improving community health through the elimination of tailpipe emissions and reduced reliance on fossil fuels.



EV charging prototype (Credit: www.electronicsforu.com)

Face mask turned into smart monitoring device

Northwestern University engineers have developed a new smart sensor platform for face masks that they are calling a 'Fitbit for the face.' Dubbed 'FaceBit,' the lightweight,



Inside of a mask with FaceBit device (Credit: https://news.northwestern.edu)

quarter-sized sensor uses a tiny magnet to attach to any N95, cloth, or surgical face mask. Not only can it sense the user's real-time respiration rate, heart rate, and mask wear time, it also may be able to replace cumbersome tests. All the information is wirelessly transmitted to a smartphone app, which contains a dashboard for real-time health monitoring. The app can immediately alert the user when issues such as elevated heart rate or a leak in the mask unexpectedly arise. The physiological data could also be used to predict fatigue, physical health status, and emotional state.

Glucose sensor based on boronic acids and graphene

Researchers at the University of Bath in collaboration with industrial partner, Integrated Graphene, have developed a new sensing technique based on graphene foam for the detection of glucose levels in the blood. Since it is a chemical



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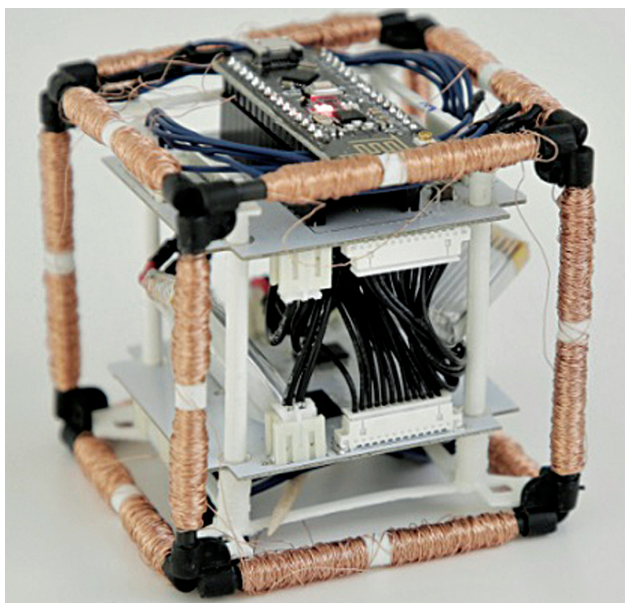


The enzyme-free sensor is more robust and not temperature sensitive, so could be particularly useful in hot countries or where refrigeration is limited (Credit: www.bath.ac.uk)

sensor instead of being enzyme-based, the new technology is robust, has a long shelf-life, and can be tuned to detect lower glucose concentrations than current systems.

Scalable and reconfigurable robots using electromagnets

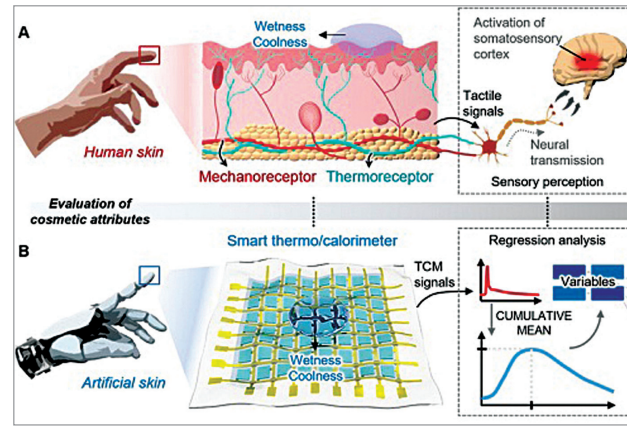
An engineering team from MIT CSAIL has devised a cube-shaped reconfigurable robot structure called ElectroVoxel that utilises an electromagnet based actuation framework to reconfigure in three dimensions via pivoting. The modular self-reconfigurable robot (MSRR) has electromagnets lined at the edges of each cube that attract or repel each other to reconfigure into different shapes and sizes. Powered by a LiPo battery, the 3D printed cube-shaped structure has nearly 800 turns of electromagnet wound around a ferromagnetic core. Applications include space exploration, search and rescue, shape-changing user interfaces, and endlessly more.



Elements of an electromagnetically actuated reconfigurable robot (Credit: MIT CSAIL)

Intelligent tactile sensor that measures skin sensations

Amorepacific, in collaboration with the Ulsan National Institute of Science and Technology (UNIST), has developed an intelligent tactile sensor that can measure skin



The intelligent tactile sensor co-developed by Amorepacific and UNIST (Credit: PR Newswire)

sensations by combining machine learning with measurement technology. By withstanding external pressure and staying intact, the ultra-thin flexible sensor can recognise and measure the temperature, moisture levels, and the type of solution used on the skin surface. The new sensor will enable the development of finetuned cosmetics and skin products.

Used face masks turned into batteries

Scientists at NUST MISIS, together with their foreign colleagues, have developed a new technology for producing

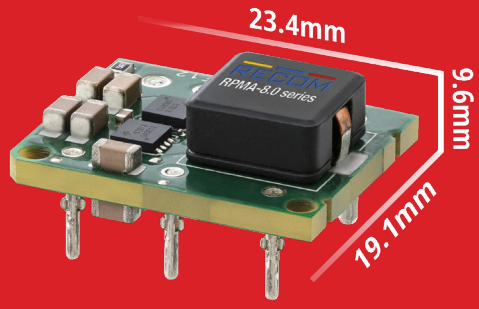


Tonnes of used face masks to be turned into energy (Credit: https://en.misis.ru)

RPMA-8.0 SERIES: 8A DC/DC CONVERTER WITH HIGH EFFICIENCY AND WIDE INPUT

Cost effective, industrial grade buck converter in 1/32nd brick designed for high power applications use

- Input voltage: 9-53VDC
- 3.3-16.5VDC adjustable Output
- Operating temperature: -40°C to +85°C
- Efficiency up to 98%, no heatsinks required
- Ultra compact: 23.4 mm (L) x 19.1 mm (W) x 9.6 mm (H)
- MTBF: > 31M hours
- Fully-protected with SCP, OCP, OTP and UVLO



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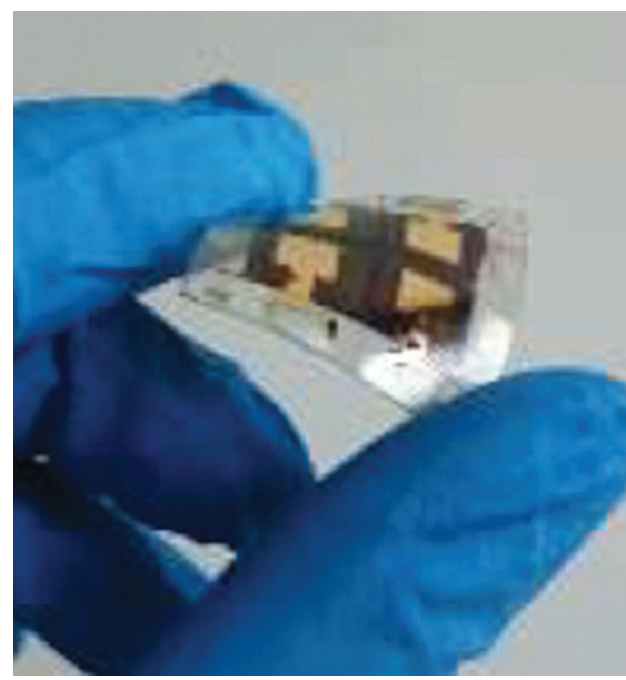
Referred to as ESDC, the Centre will help students improve their hands-on skills, make exciting projects of their own and understand the latest technologies

For more details, please call: Shyam (+91-8800100761)
email: efyenq@efy.in or visit: https://efymag.com/ESDC

cost-effective batteries from used masks. Thus, medical waste forms the basis for creating batteries. To create a battery of the supercapacitor type, the masks are first disinfected with ultrasound, then dipped in 'ink' made of graphene, which saturates the mask. Then the material is pressed under pressure and heated to 140°C. A separator (also made of mask material) with insulating properties is then placed between the two electrodes made of the new material. It is saturated with a special electrolyte, and then a protective shell is created from the material of medical blister packs (such as paracetamol). The new batteries can be used in household appliances from clocks to lamps.

Perovskite solar cell made with thin paper

A new method that uses a simple sheet of paper to deposit the perovskite films without any expensive equipment at all has been developed by a team from Tor Vergata University and University of Zanjan. The trick to achieve high performance with this remarkably cheap method is to soak the paper applicator in anti-solvent,



Photograph of the solar cell with PET/ITO/SnO2/perovskite/Spiro/Au architecture (Credit: Centre for Hybrid and Organic Solar Energy)

which almost doubles efficiencies compared to when using it dry, reaching 11% on flexible plastic substrates. Paper, compared to other soft applicators, possesses the right porosity and smoothness for deposition of high-quality perovskite films.

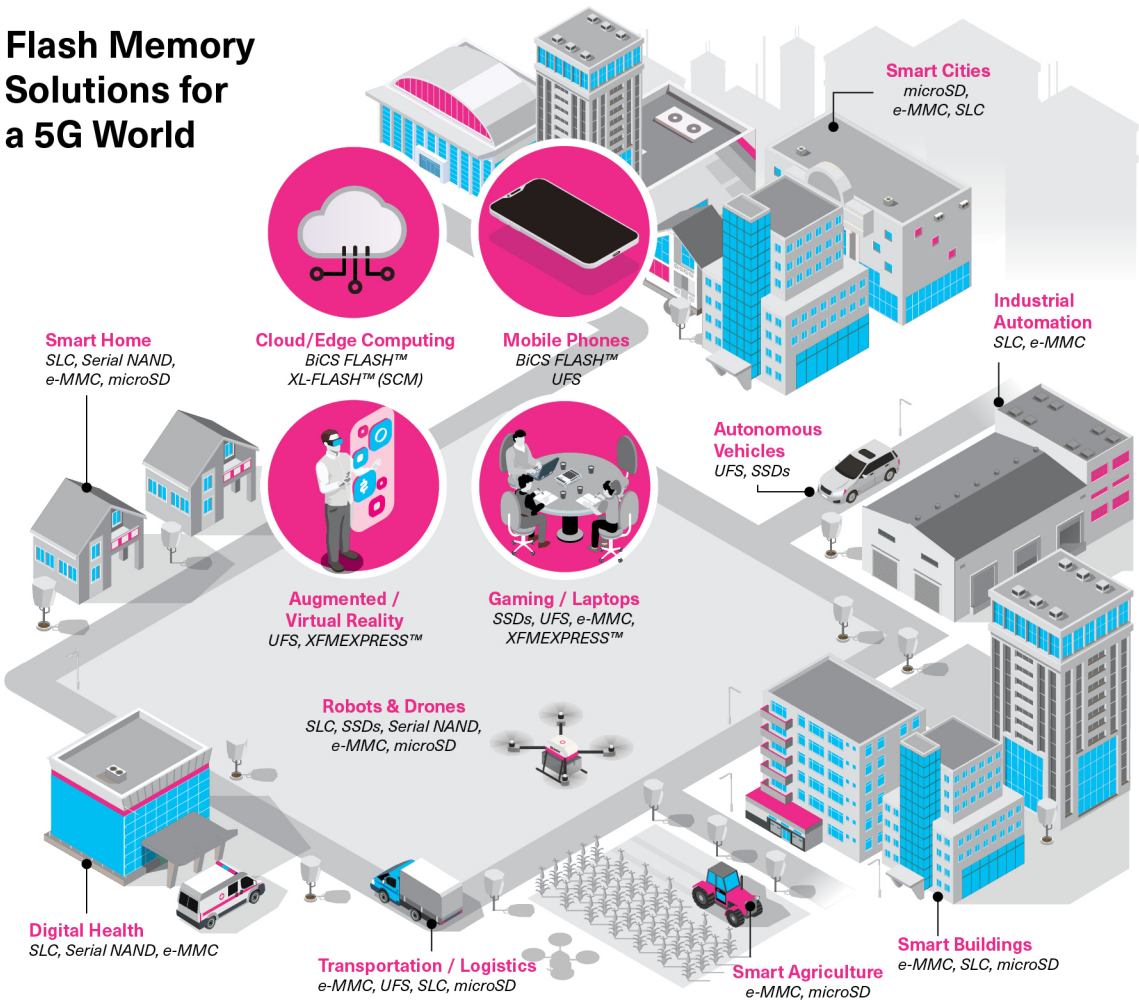
Fueling the 5G Data Revolution

KIOXIA

5G networks are poised to deliver levels of speed, scale and complexities that far surpass those of today's mobile networks. KIOXIA has the advanced flash technology that applications built for the next generation mobile broadband and cellular standard require.

One of the largest flash memory makers in the world, KIOXIA delivers high performance, high density, cost-effective memory storage solutions to address the data growth of today – and tomorrow.

Flash Memory Solutions for a 5G World



The Memory Fueling a 5G-Enabled Future



KIOXIA Memory – Key Features for 5G Applications

- Fast Read/ Write
- Low Latency
- Low Power
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- Wide Range of Densities
- Longevity of Support

Universal Flash Storage (UFS) is a product category for a class of embedded memory products built to the JEDEC UFS standard specification.

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460 Alexandra Road, #09-04/06, mTower, Singapore 119963

For sales and other queries: v1.prasad@kioxia.com / +91-9632822733

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*

Low-power Bluetooth SoC

The ATM33 series Bluetooth 5.3 family of high-performance system-on-chip (SoC) enhances Atmosic's advanced

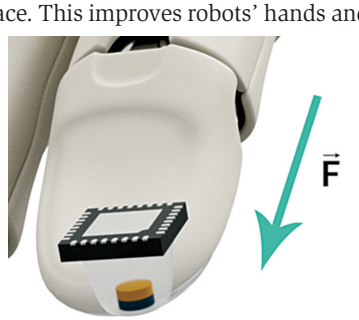


energy harvesting and ultra-low power technology. It integrates a power optimised Arm Cortex M33F that can operate up to 64MHz and supports Arm TrustZone for robust security. The SoC series has improved energy harvesting efficiency, a wider harvesting input range, a lower cold start voltage, lithium-ion battery support, and low-power voice processing. It can perform functions such as access memory and transmit beacons even while in deep sleep. The eco-friendly SoC series supports unparalleled battery life and battery-free operation.

Atmosic
www.atmosic.com

Tactile sensor

Tactaxis is a fully integrated tactile sensor that is compact, soft, and provides a 3D force vector acting on its surface. This improves robots' hands and

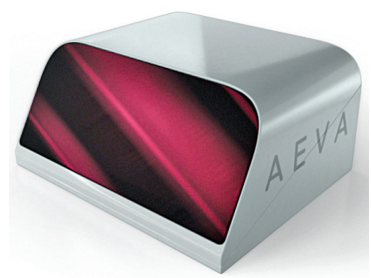


grippers, making delicate operations such as fruit picking possible. It features multiple 3D magnetometer pixels and is accompanied by a magnet which is embedded into an elastomer material. This presents a soft contact interface, emulating the attributes of human skin. The arrangement offers a high sensitivity so that detection of even small amounts of force generates a response. The sensor equips robots with the sense of touch to manipulate fragile objects.

Melexis
www.melexis.com

4D lidar with high resolution

The Aeries II is a 4D lidar sensor built with automotive-grade reliability to enable the next wave of autonomy across applications in automotive,

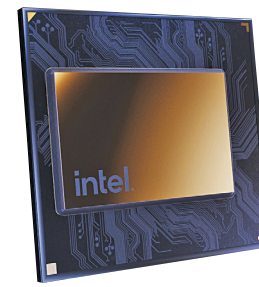


industrial, and beyond. Leveraging Frequency Modulated Continuous Wave (FMCW) technology and lidar-on-chip module design, the sensor uniquely detects the fourth dimension of instantaneous velocity for each point in addition to 3D position. Advanced 4D Perception software powers ground-breaking new features like 4D localisation and ultra-resolution, a camera-level image with up to 20 times the resolution of legacy lidar sensors. Built for reliability with automotive-grade ratings, the device ensures peak performance across a variety of road and environmental conditions.

Aeva
www.aeva.com

Chip for crypto mining

Intel Blockchain Accelerator chip is designed for crypto mining. It can offer 1000x better performance per watt



than mainstream GPUs on tasks like SHA-256 based mining. Existing ASICs consume a lot of power while mining, which now appears to be solved with the upcoming custom chip for blockchain-specific applications. The chip is designed to also solve the energy consumption problem by mining as it is a scalable and sustainable solution for replacing normal mining GPUs with custom-made blockchain accelerated chips. The Blockchain Accelerator Chip is implemented on a tiny piece of silicon, which does not affect mainstream computer processors like CPU and GPU.

Intel
www.intel.com

AI chip

The new chip's architecture delivers the performance required for next-generation applications such as AI model training, HPC, drug discovery,



RIGOL Introduces its Most Powerful Oscilloscope Ever





RIGOL Technologies announces its next generation of technological innovation with the release of StationMax Digital Oscilloscopes powered by the new UltraVision III platform. The new DS70000 Series is available in either 3 or 5 GHz bandwidths and combines the new UltraVision III oscilloscope technology and UltraReal spectrum analysis technology into RIGOL's most powerful test and measurement instrument ever. The innovative UltraVision III platform combines updated oscilloscope and spectrum analysis technology with its custom front-end Phoenix ASIC chipset to expand RIGOL solutions into new applications. In addition to 3 or 5 GHz bandwidths, StationMax provides 4 channels, 20 GSamples/sec sample rate (10 GSa/sec on all channels), 1 million waveforms/sec capture rate, 2 Gpts maximum storage depth, and high resolution measurements up to 16 bits.

StationMax leverages technology to provide Real-Time Oscilloscope and Spectrum Analyzer functionality. The DS70000 series delivers new performance, speed and analysis capabilities, as well as a completely new interface designed for the 15.6" multi-touch display. Powerful analysis capabilities include real-time spectrum analysis, multi-domain analysis, eye diagram and jitter analysis, high speed bus compliance, and serial bus decoding.

We are extremely proud to introduce such a dynamic technology set to engineers and excited for all of the new applications it fulfills," stated Chris Armstrong, Director of Product Marketing for RIGOL USA. "StationMax allows us to provide outstanding solutions for high-speed analog and digital design verification. With our new probe solutions up to 7 GHz, engineers can now capture and analyze their most sensitive signals with an instrument that provides RIGOL's well known combination of capability and value. Design and failure analysis engineers working in research, semiconductor, RF, and IoT markets can now utilize RIGOL solutions at the chip, device, and system level for their debugging and testing applications."

StationMax is designed for ease of use and convenience. The 15.6" display features an electronically controlled tilt function to optimize viewing and usability. This intuitive touch multi-panel display simplifies analysis by isolating important measurements in separate windows including real-time spectrum view, multiple FFT and math functions, jitter, and real-time eye. For engineers who prefer tactile control, the instrument has separate scale and position knobs for each channel and the horizontal. Channel controls are backlit and color coded with RIGOL probes.

Complementing this powerful instrument is a new family of high-speed precision probe solutions. These active differential probes are available in 3.5 and 7 GHz models delivering excellent 3 and 5GHz measurements to the probe tip. These probes also have automatic spacing controls with 3 user- defined settings at the touch of a button, a work light for easier connections, and automatic color-coded LEDs to match the signal on the display.

New StationMax oscilloscopes allow engineers to communicate, control and access their test data with ease, addressing a key challenge facing engineers performing advanced testing and analysis. DS70000 oscilloscopes include USB 3.0 host and device communication for storage and computer control, gigabit LAN for high-speed data transfer, all new and advanced web control, HDMI for external display, and onboard FTP data sharing. All of this makes it possible to move gigabits of data at high speed with less instrument downtime for offline analysis and data archival.

"The technology advances incorporated into our new UltraVision III platform empowers engineers to problem solve with RIGOL instrumentation even on their newest designs." continues Chris Armstrong. "Our performance specifications, analysis capabilities, enhanced usability in both display and probes, as well as our improved data access compares favorably with the current market leaders. We are excited to deliver this high-performance system and we encourage engineers in these applications to consider the performance, reliability, and value that RIGOL can bring to bear on your high- speed design challenges."

About RIGOL Technologies: At RIGOL, we unite highly innovative and visionary talents to build a testing and measurement foundation for creating an intelligent world. We serve customers in more than 150 countries with advanced test solutions. We help our customers reduce test and measurement costs, speed debugging for new designs and projects, and quickly deploy new products and technologies to market. Our engineers provide measurement support to engineers around the world to create more possibilities for their exploration. We believe that innovation is the source of development. Since its inception in 1998, RIGOL has focused on cutting-edge technologies in the field of test and measurement, with a total of more than 587 patents issued or pending. Our passionate and creative engineers are working together to promote the next generation of test and measurement solutions.

For more info/Contact: **RIGOL India, Email: info.in@rigol.com | Website: in.rigol.com**

and metaverse processing. Designed in tune with advanced silicon geometry, the architecture solves high-performance computing needs in reliability, security, and power consumption at scale. It has been designed on cutting-edge 5nm process technology. The architecture offers a high level of scalability to fit seamlessly into multiple sectors such as data centres, AI supercomputing, automotive, robotics, metaverse processing, and life sciences.

Ceremorphic
www.ceremorphic.com

Ultra-low-power wireless modules

The INP1014 and INP1015 modules offer wireless connectivity and integrated microcontroller for edge-of-network IoT devices that require low



INP1014
(w/ PCB Antenna)

INP1015
(w/ U.FL Connector)

power consumption and a direct-to-cloud connection. The INP1014/1015 modules provide the industry's lowest power Wi-Fi connectivity with their unique, programmable, digital radio architecture, and include multi-protocol Wi-Fi and BLE5-Long Range for wireless data transfer. They can operate in stand-alone mode, in conjunction with an external MCU, or in a hybrid mode. The new modules offer 40% size reduction to provide greater design flexibility and extended battery life. The platform expedites the development of smart IoT products such as connected sensors, security cameras, asset tracking devices, health monitoring wearables, audio speakers, and many others.

InnoPhase
www.innophaseinc.com

Rugged tactical grade IMU

The Pulse-40 is a 6 degrees of Freedom inertial measurement unit (IMU) that offers unmatched performance in harsh conditions in a miniaturised size for applications where precision and robustness matter in all conditions. It



integrates cutting-edge MEMS three axes accelerometers and gyroscopes in a unique redundant design that allows to shrink the system size while pushing performance level to its maximum. Thanks to sensors featuring extremely low vibration rectification error (VRE), the Pulse-40 can sustain high vibration environments up to 10g RMS.

SBG Systems
www.sbg-systems.com

Switching power supply ICs

Two new AEC-Q100 qualified, 1700-volt rated ICs that expand Power Integrations' InnoSwitch 3-AQ family are the industry's first automotive-qualified switching power supply ICs

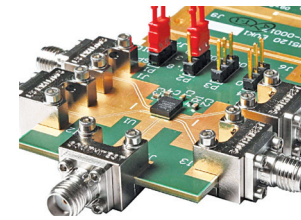


to incorporate a silicon carbide (SiC) primary switching MOSFET. Delivering up to 70 watts of output power, the new ICs are targeted for use in 600- and 800-volt battery and fuel-cell electric passenger vehicles, as well as electric buses, trucks, and a wide range of industrial power applications. The ICs reduce the number of components required to implement a power supply by as much as 50%, saving significant circuit-board space. The ICs can be implemented across a broad range of consumer, computer, communications, industrial, and automotive applications.

Power Integrations
www.power.com

High-power SP4T switch

The MM5120 is a high-power single-pole/four-throw (SP4T) DC-to-18GHz switch that provides high performance,

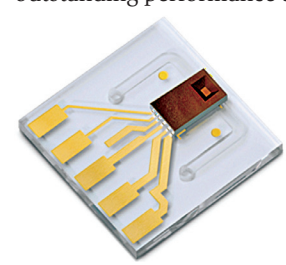


reliability, and integration for RF switching applications. It offers ultra-low insertion loss, 25W power handling, and the highest linearity in the industry, significantly outperforming conventional solid-state switches and electromechanical relays. The MM5120 switch eliminates the compromises developers face when deciding between electromechanical relays or solid-state switches for RF designs. It reduces cost and simplifies the development of numerous RF systems, including RF filters and front ends, device interface boards for semiconductor test and beamforming antennas used in advanced radio architectures and radar systems.

Menlo Microsystems
www.menlomicro.com

Mini liquid flow sensor

With a footprint of only 10x10 mm^2, the liquid flow sensor LPG10 series provides outstanding performance and speed in



measuring liquid flow. It is a smart sensor solution that offers flow rates from the low microlitre-per-minute range up to one millilitre per minute. The use of glass as the only wetted material ensures optimal compatibility with biological and pharmaceutical processes. Due to its highly compact integration into any fluidic manifold system, it is ideal for high-volume applications with strict space limitations.

Sensirion
www.sensirion.com

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NEW PRODUCTS

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Automotive distance sensor

The new A19360 wheel speed and distance sensor is suitable for use in emerging applications in advanced



driver assistance systems (ADAS). The cutting-edge magnetoresistance (GMR) sensor provides automakers with the signal resolution and reliability required for advanced levels of automation in passenger vehicles and mobility-as-a-service applications. It includes an eight-event-per-magnetic-cycle mode targeted at ADAS applications, providing an increment for every ~5mm of tyre roll. It also includes a four-event-per-magnetic-cycle mode that doubles the number of outputs per magnetic cycle that allows designers to halve the number of poles on in-wheel ring magnets to save costs, or increase the air gap and still obtain the same number of increments per revolution.

Allegro MicroSystems
www.allegromicro.com

Low-current Zener diodes

These 50µA low-current voltage regulator Zener diodes are ideal for low bias and portable battery-powered devices in mobile, wearable, automotive, and



industrial applications. Available in three different surface-mountable (SMD) package options, in an ultra-small discrete flat no-leads (DFN) package and AEC-Q101 qualified parts, they are the ultimate in customer choice and flexibility. The Zeners feature a non-repetitive peak reverse power dissipation of ≤40W, total power dissipation ≤300mW, and low dynamic resistance. They are also available as Q-portfolio parts, meeting the AEC-Q101 and ISO/TS16949 automotive quality standards.

Nexperia
www.nexperia.com

MEMS solution

The XCalibur active resonator solves supply chain constraints using programmable semiconductors to deliver a drop-in replacement for quartz

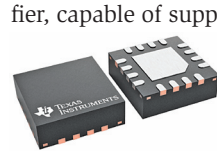


crystal resonators. Additionally, XCalibur provides higher performance and reliability while reducing development time by up to two months in automotive, enterprise, and industrial applications. XCalibur's active resonators provide 10x better reliability than quartz, making them ideal for robustness and long life in harsh environments. The many benefits of these MEMS based resonators also extend to communications and networking, enterprise, consumer electronics, mobile and IoT, and aerospace and defence applications.

SiTime
www.sitime.com

Buffer amplifier

The BUF802 is a wide-bandwidth high-input-impedance (Hi-Z) buffer amplifier, capable of supporting frequency

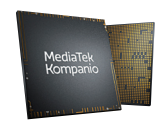


bandwidths as high as 3GHz. The wider bandwidth and high slew rates enable higher signal throughput and minimal input settling time. By eliminating ASICs, designers who use this buffer can get to market faster while achieving a wide dynamic range at a fraction of the cost. Designers can leverage this faster throughput to measure higher-frequency signals more accurately in test and measurement applications including oscilloscopes, active probes, and high-frequency data-acquisition systems.

Texas Instruments
www.ti.com

System-on-chip

The Kompanio 1380 chip offers a new level of performance and best-in-class features for premium Chromebooks,



such as the new Acer Chromebook Spin 513. The Kompanio 1380 delivers incredible portable computing experiences with superb battery life, all in a compact form factor for slim and lightweight devices. Features include powerful processing with an octa-core CPU having four high-performance Arm Cortex-A78 cores with speeds up to 3GHz for improved responsiveness, powerful multi-core AI processor, 4K60 HDR display support, giving device makers a wide variety of resolution, performance, and external connectivity choices to meet any product design, AV1 hardware decoding, voice assistance, and ultra-fast connectivity.

MediaTek
www.mediatek.com

NFC Type 2 tag ICs

The ST25TN512 and ST25TN01K NFC Forum Type 2 tag ICs deliver a new



balance of cost and performance for high-volume use cases like consumer engagement, product information, and brand protection. Also suitable for smart-city applications and access control, the ST25TN512/01K NFC tag ICs support multiple user-protection

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

LWI Electronics Inc.

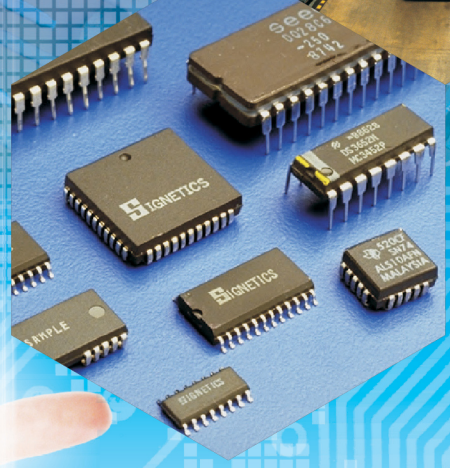
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Email: sales@livewireinfo.com
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Live Wire Group: World Sourcing

and privacy mechanisms including a 7-byte unique chip-identifier code, TruST25 digital signature, NFC Forum T2T permanent write locks at block level, and a configurable kill mode that permanently deactivates the tag. Additional benefits include a wide operating-temperature range of -40°C to +85°C and long data retention.

STMicroelectronics
www.st.com

Non-isolated offline switcher IC

The AP3928 is a universal AC high-voltage input non-isolated offline switcher IC that addresses the challenges associated with using a bias



power supply. It delivers safe and reliable power, while simultaneously maintaining elevated performance figures and enabling significant cost savings. This switcher IC is optimised for situations where higher power levels are mandated, such as in industrial control or home automation systems, home appliances and IoT devices. A key differentiator of this high-voltage switcher IC is that it supports conventional offline non-isolated flyback configurations as well as more streamlined non-isolated buck configurations, keeping the bill-of-materials (BOM) to a minimum.

DIODES Incorporated
www.diodes.com

GaN MMIC power amplifier

The new GMICP2731-10 GaN MMIC power amplifier helps deliver high RF output power while simultaneously ensuring the data signals retain their desired characteristics. The GMICP2731-10 is fabricated using GaN-on-silicon carbide (SiC) technology. It delivers up to 10W of saturated RF output power across the 3.5GHz

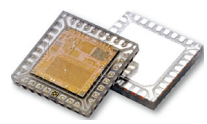


bandwidth between 27.5 and 31GHz. Its power-added efficiency is 20%, with 22dB small-signal gain and 15dB return loss. A balanced architecture allows the GMICP2731-10 to be well matched to 50 ohms and includes integrated DC blocking capacitors at the output to simplify design integration. It is designed for use in commercial and defence satellite communications, 5G networks, and other aerospace and defence systems.

Microchip Technology
www.microchip.com

Optical encoder sensors

The FlexSense series is a revolutionary technology designed to optimise



optical encoder applications and consists of the FS210 transmissive incremental encoder and the FS310 reflective incremental encoder sensors. The FlexSense encoder sensor array vastly reduces the design complexities of optical encoder solutions and integrates several key features including auto-alignment capability, a closed-loop LED driver, on-chip diagnostics, and a state-of-the-art 8x interpolator. In addition, the fully programmable array system on chip (SOC) provides a versatile solution that can adapt to a multiple range of code-disk diameters and pulses per revolution as well as several LEDs.

TT Electronics
www.ttelectronics.com

MODULES & BOARDS

IoT starter kit

The Wiliot Starter Kit contains everything retailers need to experience the IoT transformation. It includes postage stamp sized computers—the

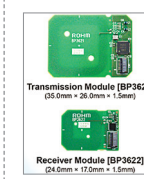


IoT Pixels—pre-mounted on both cardboard and a coffee cup. The IoT Pixels can sense a range of physical and environment data, such as temperature, fill level, motion, location changes, humidity, and proximity. The kit also includes small Bluetooth bridge devices that energise and read the IoT Pixel tags. The harvested data is relayed to the Wiliot Cloud via gateways. Through the starter kit, retailers can explore projects that enable a host of new retail use cases—from enhanced inventory management to consumption monitoring, anti-counterfeiting, product traceability, and more.

Wiliot
www.wiliot.com

Wireless charger modules

The BP3621 (transmitter) and the BP3622 (receiver) modules allow



adding wireless power supply functionality to smaller devices, such as smart tags/cards or PC peripherals. The 13.56MHz wireless charging modules allow users to easily add wireless power functionality to thin and compact devices. Measuring just 20mm² to 30mm² each, the BP3621 and BP3622 incorporate an optimised antenna (coil) layout. It



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enables configuration of a compact wireless charging system using the 13.56MHz frequency band to deliver up to 200mW. Using the transmitter and receiver modules as a pair can significantly reduce the development load for prototyping and evaluation.
ROHM Semiconductor
www.rohm.com

DC-DC converter

The BMR350 is a non-isolated DC-DC converter in a quarter brick format, rated at 860W continuous and 1200W peak power.



BMR350 is ideal as an intermediate bus converter for powering processors and ASICs with peak power demands. The product features an input of 40-60V (80V/100ms) and a fully regulated output of 12V at 100A maximum, adjustable from 8V to 13.2V. An innovative transformer-coupled, non-isolated topology reduces component count and current stress and yields an efficiency level peaking at >97.8% at half load 48V input voltage. Derating for the BMR350 is characterised by the innovative 3D thermal data graphs, which specify available output power for given real-world pin and baseplate temperatures up to 100°C.
Flex Power Modules
www.flexpowermodules.com

LTE Cat 1 modules

The LARA-R6 is the smallest LTE Cat 1 module with global coverage on the market. The u-blox LENA-R8 includes a global navigation satellite system (GNSS) receiver based on the u-blox M10 platform. Together, the modules comprise five certified global, multi-regional, and regional product variants, simplifying logistics for product developers and increasing design flexibility. The modules offer device makers facing imminent 2G and 3G network sunsets a future-proof migration path to 4G technology for data streaming applications.





u-blox
www.u-blox.com

Modules with 12th Gen processors

The 12th Gen Intel Core processor based computer-on-modules (COM) are available in two form factors—COM-HPC Client Type and COM Express Type 6. ADLINK COMs with the Intel 12th Gen Intel Core processor family (Codename: Alder Lake-H) allow for a unique design that can be adapted for single-thread or multithread performance. The advanced hybrid architecture can be used for stationary, mobile, and portable solutions. It also provides system integrators with future-proof design that supports both current and future best-in-class peripherals.



ADLINK Technology
www.adlinktech.com

AC-DC power supplies

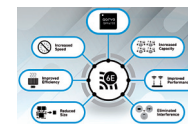
The TPI 180 and TPP 180 are a set of encapsulated AC-DC power supplies coming as open frame and encased versions. They feature a reinforced double I/O isolation (3000V AC) system according to the latest medical safety standards (60601-1 3rd edition, 2 x MOPP). The leakage current is below 300µA and makes the units suitable for BF (body floating) applications. The excellent efficiency of up to 94% allows a high power-density and compact design (3" x 2" for open frame and 3.6" x 2.44" for encased version). High reliability is provided by using high-quality components and an excellent thermal management, making the TPI 180 and TPP 180 an ideal solution for industrial and medical devices, and for demanding safety and space critical applications.



TRACO Power
www.tracopower.com

Wi-Fi front-end module

QPF4730 is the first wideband Wi-Fi front-end module (FEM) covering the 5.1GHz to 7.1GHz bands for customer premises equipment (CPE). It can provide full-frequency support for both Wi-Fi 6 and Wi-Fi 6E enterprise solutions. The QPF4730 enhances efficiency in Wi-Fi 6/Wi-Fi 6E architectures and is optimised for power over Ethernet (PoE), improving quality of service (QoS), range, and throughput. This solution maximises user capacity and leverages the full available spectrum. It also enables manufacturers to design smaller form factors than current gateways to meet user expectations for more compact, sleek and efficient designs.



Qorvo
www.qorvo.com

Safety relay module

The X90 control system by B&R now comes with an option board that allows floating-ground connection of external safety devices, making mobile machines even safer. With the new safety relay module, external safety components, such as drives or laser scanners, can now be connected to the X90 controller via a floating-ground emergency stop circuit. A safety level of PLe/SIL3 can be achieved. The option board is particularly suitable for autonomous agricultural and construction vehicles.



B&R Industrial Automation
www.br-automation.com

T&M SOLUTIONS

5G test platform

The new R&S CMX500 one-box tester provides extensive device testing capability, including support for all 5G NR deployments covering LTE, 5G NR FR1 and FR2 in non-standalone (NSA) and

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standalone (SA) mode, for both FDD and TDD, with an effortless setup and an outstanding performance. Manufacturers of cutting-edge 5G NR capable chipsets and devices as well as certification providers can cover the entire product lifecycle with the R&S CMX500 one-box tester, from all early R&D design phases to end-to-end application testing, including device certification. Data-hungry enhanced mobile broadband (eMBB) applications like 8K video streaming or augmented and virtual reality can fulfil high data rates in uplink and downlink.



Rohde & Schwarz
www.rohde-schwarz.com

Calibration solutions

Existing and new customers of the PicoVNA 108 8.5GHz vector network analyser can now benefit from automated E-Cal calibration and TRL/TRM calibration. The PicoVNA 108 achieves calibration automation through either male SMA or female SMA E-Cal modules. Simply power the module, make a single connection of the E-Cal standard between the PicoVNA test ports and then initiate the automated procedure from within the PicoVNA 108 user interface. The TRL (Through Reflect Line) and TRM (Through Reflect Match) calibration typically measure substrate-mounted DUTs, for example surface-mounted networks or components on a PCB or ceramic.



Pico Technology
www.picotech.com

Enhanced mixed signal oscilloscope

With numerous enhancements, the 5 Series B mixed signal oscilloscope (MSO) delivers even more versatility while continuing to provide high-fidelity waveforms, unique spectrum analysis capabilities, and flexible signal access. Built on the performance and integrity that engineers rely on with the original 5 Series MSO, the B version includes customer-centric updates led by a new auxiliary trigger input that lets users synchronise the oscilloscope to an external signal without consuming any of the 4, 6, or 8 full-capability input channels. For the optional, built-in arbitrary/function generator, the maximum frequency output increases from 50MHz to 100MHz, enabling higher frequency stimulus for Bode plots and impedance measurements.



Tektronix
www.tektronix.com

High-speed 800G test portfolio

To enable the optical transceiver ecosystem for improving the power efficiency of components and modules used in data centre equipment, Keysight's portfolio of high-speed digital 800G test solutions has been expanded. These additions are new design and validation solutions that support multimode interfaces, which are critical for an energy-efficient data centre infrastructure. The 800G multimode test solutions uniquely support high-speed data interconnect speeds of up to 100 gigabit per second (Gbps). The extended portfolio supports 400G and 800G design validation from early research and development to manufacturing.



Keysight Technologies
www.keysight.com

SOFTWARE

Software for PCB design

Altair PollEx, an electronic system design (ESD) software tool for Altium users, empowers printed circuit board (PCB) designers to predict and maximise overall PCB performance and verify manufacturability. Altair PollEx for Altium is a free version of PollEx designed to support various electrical computer-aided design (ECAD) software products, the first of which is Altium Designer, as announced at AltiumLive. Altair PollEx for Altium will make board-level simulation and design verification features seamlessly accessible to Altium Designer users.



Altair
www.altair.com

NOR memories design tool

With the SEMPER Solutions Hub, a one-stop portal with all the building blocks needed to integrate SEMPER NOR Flash into an application, developers can quickly design safety-critical and inherently secured automotive, industrial, and communications systems. The SEMPER Solutions Hub provides the development edge needed to accelerate the design process. The web portal offers easy access to software development kits (SDKs) containing production-grade drivers and application code examples. Additionally, it offers hardware kits for prototyping with microcontroller (MCU) system boards from both Infineon and third-party suppliers, MCUs and available integrated development environments (IDEs).



Infineon Technologies
www.infineon.com

Data diagnosis software

The PCAN-OBD-2 Viewer offers an easy way to develop own applications based on the OBD-2 communication standard. The tool and the API can be used with all PC-CAN interfaces from PEAK-System. The PCAN-OBD-2 Viewer supports all OBD-2 services that are transmitted via CAN. A virtual cockpit displays the data graphically in analogue and digital instruments. Optionally, individual parameters can also be displayed as



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- Allow internal/external users to book the slots and use the R&D equipment in a transparent manners
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- Use in-built Discussion forum (Chat box) to clarify the details
  (using FBR No.)
- Allocate the slot (Adding the other charges for Overhead and Accessories) as per availability and convenience of the users and request for samples
- Once allocated, user will find an option to pay "Online/Offline"
- Collect the Samples at the host Institution
  (as per mutual agreement)
- Collect the Usage Report/GST Collection Details etc. on monthly basis from the Portal
- Write the Feedback about the users (Status of FBR will get automatically changed)
- Execute the slots physically at the Equipment (in presence of the User either in Online or Offline Mode) [Use Webex Platform provided by the I-STEM at no cost]
- In case of the sudden failure, operator may re-schedule the slots/ or reject the request with suitable reasons

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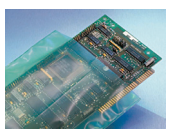
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Recyclable static dissipative stretch film

A new recyclable speciality film, Eco-Sonic VpCl Static Dissipative Stretch Film, has been developed for applications where static discharge could result in dangerous packaging conditions, such as electronics and fertilisers. The new stretch film meets the anti-static requirements under MIL-PR F-81705 E, while featuring multi-metal corrosion inhibitors and EDS protection. The stretch film reportedly eliminates the static discharge that can typically arise from the pressure and friction of stretch-wrapping applications, which cannot be dissipated by grounding. Additionally, the stretch film does not interfere with electrical, optical, or mechanical surface properties and does not require costly barrier packaging.



Cortec Laboratories
www.cortecvci.com

MANUFACTURING EQUIPMENT

Intelligent SMT component assembler

The new intelligent freeform feeder gives manufacturers a fast and effective alternative to taping loose components. It also serves to eliminate one process step and reduce the possibility of human error. The system comprises a pair of trays (one white, one black, to optimise optical contrast against the loose components), each featuring nine separate cells to hold different components. These are simply dropped into the 25mm × 18mm cells without the need for any orientation or alignment. Using machine vision, advanced component recognition algorithms identify the devices held in each cell irrespective of angle, physical position, or polarity, allowing the placement machine to pick and place perfectly.



Europlacer
www.europlacer.com

Solder paste inspection equipment

The new dual-mode MRS sensor for the SE3000 SPI system provides maximum flexibility for dedicated solder paste inspection applications, with one mode for high speed inspection and another mode for high resolution inspection. The new sensor is an extension of the proprietary Multi-Reflection Suppression sensor portfolio that provides industry-leading performance in semiconductor and SMT markets. The SE3000 is ideal for measuring height, area, volume, registration, and bridging, as well as detecting insufficient paste, excess height, smear, offset, and more.



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www.cyberoptics.com

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www.avalue-tech.com

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The INA3600 is a highly reliable 1U rackmount network appliance designed to handle complex and demanding networking tasks for both large and growing businesses. It delivers powerful networking performance optimised for high-density deployments in applications such as network security, SDN, NFV, SD-WAN, data management and analytics. The INA3600 high performance 1U-sized appliances are powered by 10th Gen Intel Core and Xeon W processors (codenamed Comet Lake) and support up to 14Gb Ethernet ports with IBASE proprietary network interface cards.



IBASE Technology
www.ibase.com.tw

Advanced thermostat and humidistat

The HyperStat is a device that senses temperature, humidity, CO_2, occupancy, light, sound, volatile organic compounds (VOCs), and optional particulate matter, making it an affordable one-stop device for WELL Building Standard support. Data from these sensors feed wirelessly into a real-time analytics package and inform 75F's built-in, Guideline 36-compliant control algorithms. In addition, the HyperStat comes packed with four analogue inputs, three analogue outputs, and six relays that leverage software-defined control capabilities for all types of standalone multi-stage and modulating packaged HVAC equipment found in commercial buildings.



75F
www.75f.io

IMPORTANCE Of DRONES And TYPES Of DRONES For WILDLIFE MONITORING

Drones, or unmanned aerial vehicles (UAVs), are rapidly changing the face of wildlife and conservation industry. They have the potential to revolutionise conservation and spatial ecology. At the core of conservation is the monitoring of species' population and their habitats



DR ANAND NAYYAR is PhD in wireless sensor networks and swarms intelligence. He works at Duy Tan University, Vietnam. He loves to explore open source technologies, IoT, cloud computing, deep learning, and cyber security



DR MAGESH KASTHURI is a senior distinguished member of the technical staff and principal consultant at Wipro Ltd. This article expresses his views and not that of Wipro



A drone used for wildlife monitoring (Source: www.airbornedrones.co)

Traditional approaches and devices used for wildlife monitoring have been high-cost, sometimes inefficient and not so practical when used in remote or rough terrain areas. A major issue in monitoring systems is that the species can feel threatened and attack the monitoring devices and personnel, which could potentially impact the monitoring activities and lead to time and money wastage.

Drones fitted with thermal cameras can circumvent these problems and obtain accurate data and high-resolution images in a better, faster, cheaper, and safer manner. The use of drones in conservation sector need not be limited to monitoring and can be extended to management, technical services, eco-tourism marketing, law enforcement, anti-poaching, and search-and-rescue efforts.

Drone users categorised as ecologists or hobbyists need to understand the anatomy of eco-system that they handle. During wildlife monitoring, animals may not get directly disturbed but birds can get



Technical Specifications:

- Payload capacity: 2kg
- Max speed: 120km/hr
- Ceiling: 3048m
- Max take-off weight: 21kg
- Width: 2.6m
- Length: 1.6m
- Endurance: 10hr
- Range: 643km

Fig. 1: Super Bat DA-50

disturbed when they are incubating an egg or hatching it for protection. Hence the drones used should not be noisy or emitting laser lights to avoid disturbance.

Recent research shows that traditional approaches for wildlife monitoring can be dangerous and tedious, while drones can efficiently collect precise observational data for wildlife monitoring. Based on this advantage, research is going on for wildlife monitoring with drones, including thermal monitoring during night or dense forest monitoring. Some of the best practices derived by scientists to manage situations and mitigate, or even alleviate potential physical disturbances to wildlife, when using drones include:

- Expert advice and local resources be used to study the location before using drones for monitoring.
- Appropriate approval and permissions be taken from authorities for using the drones.
- Proper training and dry run experiments be conducted in simulated environment to avoid unforeseen failures in real-time monitoring.
- Proper understanding of civil aviation rules—including restrictions in flying distance/height, border conditions, altitude guidelines, night-time monitoring guidelines—be ensured first.
- Drones be used only for the research and not to disturb animals and threaten their regular life.
- Launch and operation of drones be managed from recoverable distance to avoid failure or accident.
- Drones should be designed to monitor behavioural and physiological stress responses, when possible, and record for study purpose.
- Be ready to abort drone operation when there is excessive disturbance caused to animals.

Drones and AI (artificial intelligence) technology are advancing and evolving wildlife surveys. Tracking species through collaring can be dangerous and may be invasive and disruptive to the animals. Gathering data via drones is more efficient and safer for both animals and the researchers. Using drones, biologists can collect the information they need through specialised sensing technology, including lidar, RGB, corona, hyperspectral, and thermal sensors. Importance of drones is recognised for environmental monitoring to track the health and population growth of indicator species and monitoring the overall health of habitats and ecosystems.

Drones for wildlife monitoring

Wildlife monitoring is a challenging activity among environmental activities like wildlife's social environment, birds, and natural resources such as volcano, waterfalls, and rivers. Since drones are equipped with cameras, laser lights, GPS tracking, altimeters, etc, they are highly effective for wildlife monitoring.

Modern conservation drones also use thermal and long-distance focal-point cameras to monitor wildlife



Technical Specifications:

- Endurance: Up to 5 hours
- Maximum service altitude: 1,220 metres
- Maximum control range: 50km
- 30km live video stream
- Daytime video: 10x zoom Sony block camera
- Night time operations: Flir 640 Vue Pro, Tamarisk 320 or 640 Thermal Imager
- Gimbal: Stabilised 2- and 3-axis with brushless motors
- On-board GPS
- Waypoint navigation
- Flight stability systems

Fig. 2: Air Shepherd ZT-TIC

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Technical Specifications:

- Wingspan: 116cm (45.7 in)
- Weight (incl. camera and battery): 1.3kg-1.6kg depending on camera and battery
- Electric motor: Low-noise, brushless
- Radio link range: 3km nominal (up to 8km)/1.9 mi (up to 5 mi)
- Detachable wings: Yes
- Cameras (optional): senseFly S.O.D.A. 3D, senseFly Aerial X, senseFly Duet T, Parrot Sequoia+, senseFly S.O.D.A., senseFly Corridor, MicaSense RedEdge MX
- GNSS grade: Survey
- Carry backpack dimensions: 75×50×29cm
- Backapack weight (empty): 4.6kg
- Carry case dimensions: 75×48×33cm

Fig. 3: Sensefly eBee X

during day as well as night-time. In addition, they use motion sensors and accelerometers for calculating and recording the vehicle movement and even the direction of wildlife animals and/or birds.

Modern AI solutions like footprint identification technique (FIT) are being experimented with for wildlife population tracking and census, animal movement and migration in different seasons, and any occasional or regular seasonal health issues or threats to wildlife animals and birds. The recorded data can be stored in a data pool and used for analytics such as historical data evaluation, any regional and climatic understanding of specific and rare wildlife, and environmental changes over a period of time to study their eco-system.

Following are some of the best wildlife monitoring drones known at present:

Super Bat DA-50. Powered by batteries, its flight time ranges from eight to ten hours. It has a 2-stroke gasoline engine for flight efficiency and longevity. Its operational flight altitude peaks at about 4,600 metres (15,000 feet) at 72.5 to 129 kilometres an hour. Plus, its antenna can send information to the system's ground station along with receiving and sending telemetry.

Air Shepherd ZT-TIC. It was developed specifically for anti-poaching and is in use in several parks in Africa. With a service ceiling of about 1,220 metres (4,000 feet) and an endurance of around five hours, it includes a day and a night camera capable of sending live video feed to an operator up to 30km away. Can fly an automated route and has a control range of 50km line-of-site.

The long-endurance, high-altitude powerful camera and range make the Super Bat and Air Shepherd ideal for covering large areas that encompass most refuges. Both cover ground faster than anyone on foot or by ground vehicle that could alert poachers about rangers looking to catch them. Typical employment of these drones is to determine, based on past patterns, where poachers are most likely to enter the park and operate.

Sensefly eBee X. This is one of the first kind of a fixed-wing mapping and surveying drone, which is usually light-weight and can be launched from hand. It is used by forest rangers, surveyors, and geospatial professionals to manage, monitor, and collect various aerial mapping data, location details, and environmental conditions using built-in sensors and camera.

The raw data collected by Sensefly can be used to maintain and dynamically create stunning high-resolution orthomosaic images. Or it can be used by photogrammetry software, such as Pix4Dmapper, to design and create topographic maps, including DSMs, DEMs, 3D points clouds, and more. We can get critical project insights from these topographic data, which can be shared with wildlife researchers, bird photographers, and animal healthcare professionals for better decision-making.

eBee X is also available with RTK or PPK for greater positional accuracy.

The future of drones isn't in the skies. It's in the ocean. "It feels like an amusement park ride—except it's real. You're really driving around underwater, exploring."—Gizmodo

OpenROV. It is a remotely operated 15cm x 20cm x 30cm mini-submarine that weighs 2.6kg. This submarine is powered by eight 26650-format Li-ion batteries and can be assembled from common items, with the most expensive being Beaglebone Black Linux computer. The submarine is controlled from a laptop computer connected to the submarine via a tether and is equipped with on-board LEDs and a camera. OpenROV is an open source hardware project. Website: *http://openrov.com*; Latest version: 30.1.0

Wildlife surveillance and counter poaching

Constant wildlife surveillance is always useful to avoid man-animal clashes when they cross their paths. There are many wild animals that have been categorised as rare

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animals in last fifteen years, such as wild boar and tiger. There are multiple reasons for their poaching and hunting, such as their valuable organs like tusk, bone, and teeth. At times animals attack because of their health issues, environmental changes, and food unavailability issues.

Hence, constant monitoring and surveillance of the wildlife is important to protect them. Conservation drones and modern technologies help in designing a robust solution to handle this efficiently. Using these drones, we can do surveillance remotely and understand the lifestyle of animals and help them to manage life better.

According to a research report from the studies published in *wwf.org.uk*, the fourth largest illegal activity across globe is wildlife poaching. (First three are drug trafficing, child/women trafficking, and counterfeiting.) Modern drone solutions like ideaForge Drones help develop an AI-driven solution for image pattern matching where the endurance cameras capture images continuously. The images are transmitted to remote cloud servers and analysed using AI solutions to understand the anomaly in wildlife movement. This helps in designing a counter poaching approach like alarm signals, diversions using sound notifications, and sensor based protection like dynamic electric fence.

The most popular anti-poaching solutions enabled and equipped by drone systems, which are popular for research and industrial usage, are listed below:

- 100km Skywalker
- Air Shepherd ZT-TIC
- DJI Inspire 1
- Sensefly eBee Plus
- Silent Falcon
- Super Bat Da-50
- Zeta FX-61 Phantom

Such anti-poaching solutions are specially designed for wildlife monitoring and are powered by AI-enabled customised software applications (as bundled license). These can be used for wildlife research related activities like census, animal tracking and migration tracing, habitat management for wildlife in seasonal changes, nest monitoring during incubation, and species identification.



Physical Specifications:
- Weight: 2.6kg
- Dimensions: 30×20×15cm
- Nominal battery life: 2-3 hours

Performance Specifications:
- Maximum depth: 75m (we have taken them past 100m, but true depth depends on build quality)
- Maximum tether length: 300m (100m tether provided)
- Maximum forward speed: 2 knots
- LED brightness: 180 lm

Key Features:
- Live HD video with wide-angle lens and tilt function
- LED lighting for low-light environments
- Easy-to-use Web browser user interface
- Beagle bone Black AND Arduino MEGA microprocessors for a flexible and powerful developer platform with dozens of input/output channels and plenty of computing power for user-designed features and experiments
- Rechargeable lithium batteries (sold separately)
- 100m lightweight 2-wire tether
- Compact and lightweight backpack or carry-on ready
- Payload area for additional hardware or equipment

Fig. 4: OpenROV

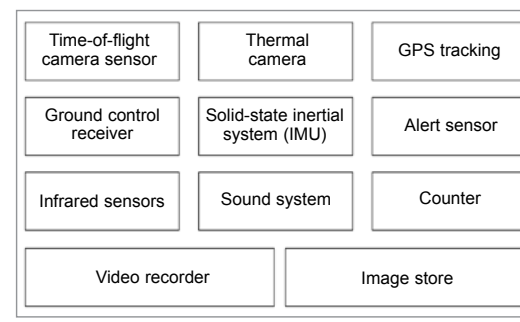


Fig. 5: Conservation drone system for wildlife monitoring

Marine and land mapping

Geospatial information system based drone services are very helpful for both forest and marine (sea/ocean) level monitoring and mapping. These help to understand and study the landscapes, the density of animals and wildlife movements in different zones, climatic changes and their impact on the lifestyle of wildlife and, above all, tracking the poaching activities and devise an anti-poaching solution.

Radio telemetry can be used for animal tracking in forest and marine species monitoring in sea/ocean. For radio tracking animals, they must be tagged with VHF-radio tags to track from remote drone sensors to know their movement and count the animals.

Image analysis software like Agisoft and ImageJ, along with machine learning technique for wildlife availability, can be very useful for data analysis of thermal images captured from drones and used for animal counting and tracking.

These applications are popular in Britain, Germany, and Australia in dense forests and marine areas for wildlife monitoring and tracking. They reduce the poaching activities to a great extent. EFY

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The EVOLUTION Of LCD DISPLAYS And HOW It MATTERS

In a competitive market where fast designing is needed, how far will liquid crystal displays (LCDs) be an option for design engineers? Let's find out

DAVID YANG is Deputy General Manager, SHARP, Singapore

Ten years ago, my senior told me that the LCD is going to die, but it has paved its way into our everyday life, starting from our phones to our vehicles. Segment LCDs were simple in design where an input channel was given directly to display digits. Even if videos could not be displayed, these LCDs were used on old auto meters and were pre-designed. Though a little complicated in design, thin film transistor liquid crystal displays (TFT LCDs) are becoming quite popular in smartphones and vehicles nowadays.

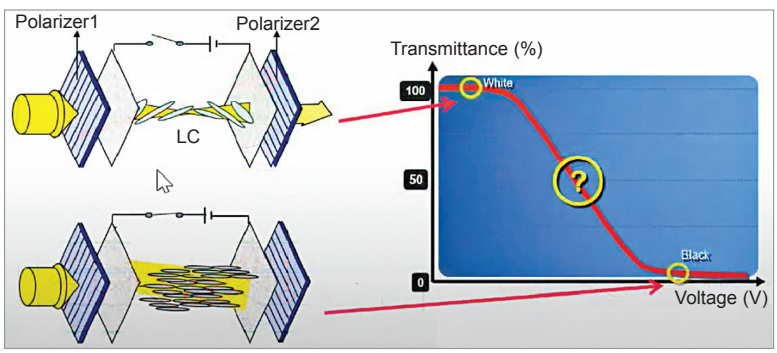


Fig. 1: Working of a liquid crystal

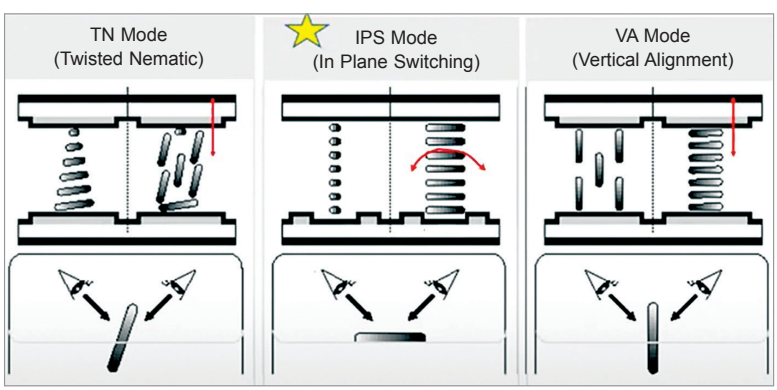


Fig. 2: Three modes of liquid crystal rotation

Liquid crystal can guide the light. For a TN LCD when the transistor of the TFT circuit is turned off and the LC changes the orientation of light rotation. After light passes through both the polarizers, we see the LCD completely white. However, when the circuit is turned on, the polarizer blocks the light, resulting in a black image. Hence liquid crystal is the core of the design that can direct the light as per its rotation.

Modes

Based on the liquid crystal rotation, there are three modes, namely, In Plane Switching (IPS), Vertical Alignment (VA), and Twisted Nematic (TN) mode. In the IPS mode, the crystal switches horizontally and in the VA mode it switches vertically. Both have a wider viewing angle and a larger colour coverage but are high in terms of cost. The best performance can be obtained in the IPS mode. The TN mode has a narrow viewing angle with a small colour coverage, but it has the largest market as it is very cheap.

Fig. 3 shows the comparison for the same photo on two different displays when the liquid crystal is rotated in the IPS and TN modes. The performance varies as the angle changes. We notice that IPS has a better performance.

Thin film transistor LCD

It is a display panel that uses liquid crystal to control the amount of light that comes from the backlight. The TFT acts like a switch that controls the liquid crystal. Each segment of liquid crystal is like a shutter that either blocks or allows light to pass through. Fig. 4 shows a TFT LCD where the top is an open cell and the bot-

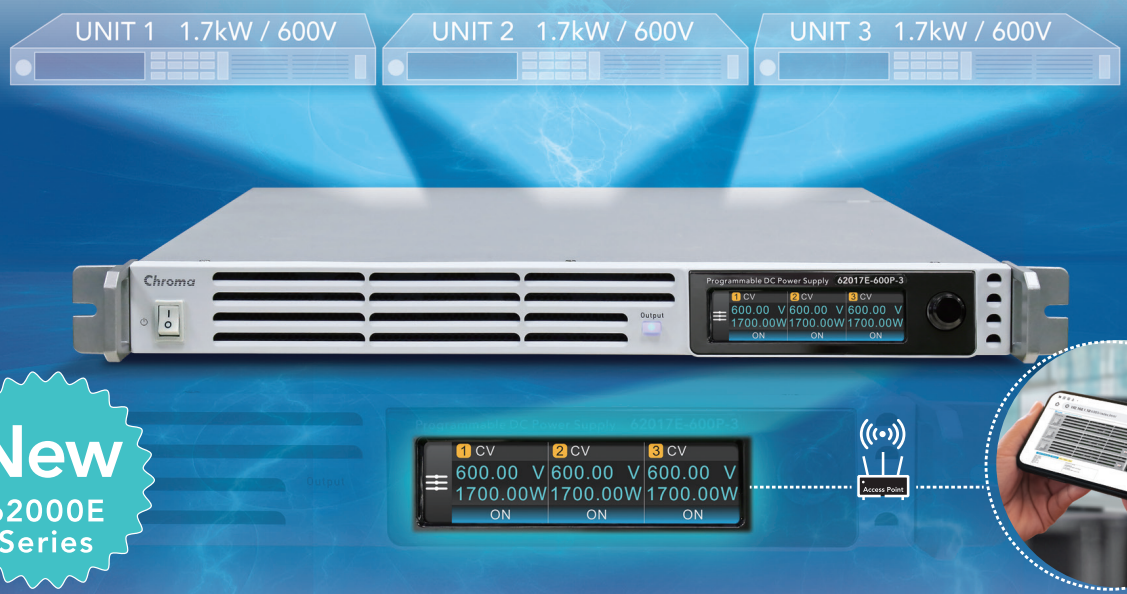
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Fig. 3: IPS and TN comparison of the first image

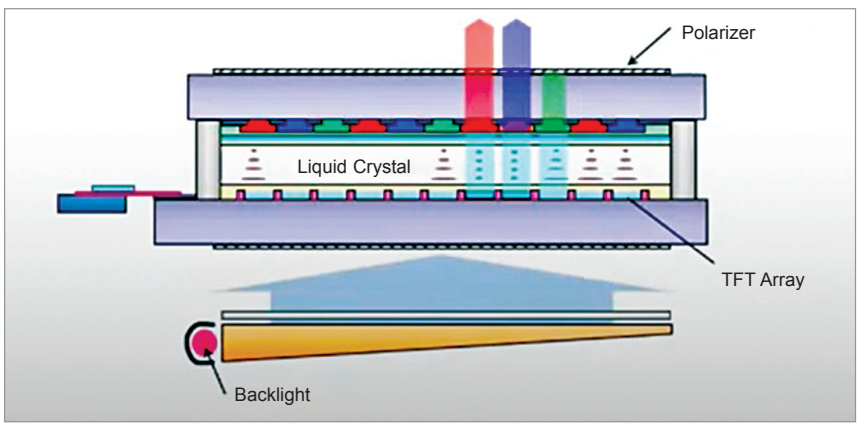


Fig. 4: Thin film transistor liquid crystal display (TFT LCD)



Fig. 5: Memory LCD applications

tom is the backlight.

The open cell has a nickel crystal sandwiched between the colour filter glass and the TFT array glass on which the transistor is built. The backlight structure contains a lot of optical sheets like diffuser, prisms, light guide, and reflectors. Backlight is of two types, namely, direct light that refers to the LEDs which are directly laid below the LCD. This method is used for big-size LCDs like TV or signage. For small- and medium-size LCDs, like phones or laptops, the side light is used where the LEDs are to the side of the LCDs.

Memory LCD for IoT displays

Memory LCD is the integration of one-bit memory into each LCD pixel. This makes sure that data transmission from outside the module is not needed when the displayed image does not change. The advantages that they offer are:

Low energy and power consumption. Two main reasons exist for the same. First the reflective displays do not need a backlight. Second, the memory needed integrated with the pixel does not need to be refreshed when showing a statistical image. For instance, in a 6.9cm (2.7-inch) screen, the power consumed is only 50µW when there is no image updating, whereas when an image data updates the power consumed is 175µW. The important thing to note here is that, unlike conventional LCDs where power is consumed at milliwatt (mW) level, TFT LCDs consume power at a microwatt (µW) level, confirming the long life of the battery.

Stylish display quality. The high resolution and crisp graphic image help for both indoor and outdoor readability. The high reflectivity makes it feel as though a paper is being read.

Engineer-friendly. The design interface is very simple with a 3-wire serial signal input (clock, data, and chip select), along with a ground and power supply.

Since the location of the sensors in IoT must be remote and needs a longer battery life, memory LCDs are widely recommended. Fig. 5 shows applications where memory LCDs can be majorly used, which are available from 2.5cm (1 inch) to 11.2cm (4.4 inch), in both black-and-white and colour. They can also be used in smart watches.

IGZO LCD for smartphones

The materials used to build the TFT LCD are indium, gallium, zinc, and oxygen (IGZO).

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First, compared to the a-Sil (conventional silicon series materials), the electron can easily pass through the IGZO circuit. The electron mobility is 20 to 50 times faster than the a-Sil, resulting in the physical size of IGZO TFT being 1/7th of the a-Si TFT. This helps in achieving very high resolution.

Second is low power consumption. As we know the LCD runs at 60Hz in one frame. When the IGZO is turned on we only need a part of the frame and not the whole, resulting in a lot of power being saved.

Third, we achieve a LCD bezel. For instance, in a-Si TFT, the gate driver (COG) is at one side of the LCD, which cannot minimise the LCD side border. But for IGZO, monolithic gate drivers are used to build on both sides of the LCD, thus achieving a narrow frame.

Then there is the touch display. The touch and LCD signals are bound to interfere with each other, causing a problem. This is avoided in IGZO panels, as the touch detection can be activated when the IGZO TFT is in a rest mode. When the LCD is off, the touch is turned on and vice versa.

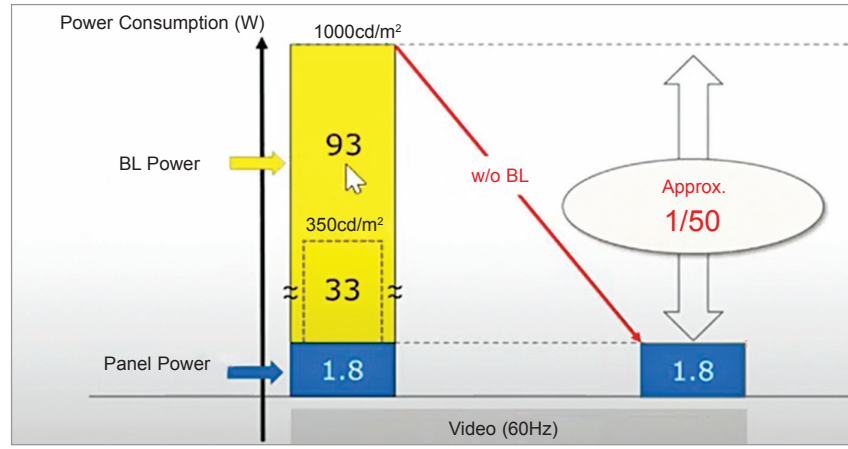


Fig. 6: Power consumption for transmissive and reflective displays

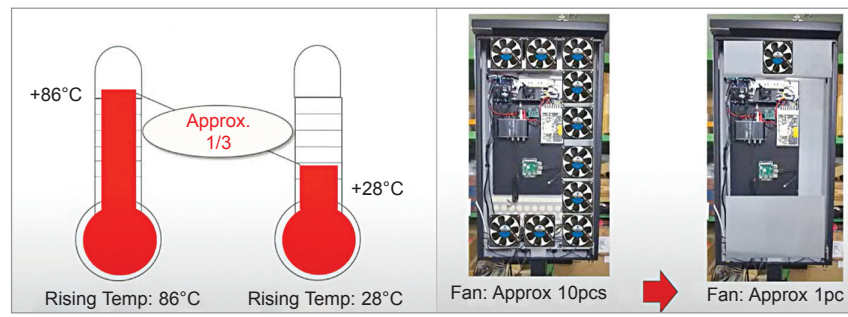


Fig. 7: Heat generated, and fans needed for transmissive and reflective displays

Reflective LCDs are eco friendly

The beauty of reflective LCD panels is their suitability for outdoor displays. Transmissive displays use a light source as the backlight, which, unfortunately, because of the ambient light, dulls the display. However, in reflective displays, the ambient light is utilised instead of a backlight. The features in a reflective IGZO are:

1. High visibility and full colour display
2. Low power consumption since there is zero backlight power
3. Video support since it runs at 60Hz
4. Easy on the eyes; usage of natural light can avoid strain to the eyes
5. Implementation of backlight is optional; usage is promoted in a dark room

With no backlight being needed, we notice from the figures that around 95% of the power consumed is reduced. Similarly, the amount of heat generated is also reduced, leading to the fact that the number of fans needed to cool down the LCD drastically decreases. This makes the reflective LCDs much more reliable.

The remarkable fact is that, even an 80cm (31.5-inch) LCD can be run on a mobile battery (2500mAh) with a video being played for 24 hours without charging. Solar panels provide the freedom to move the system to different places. The solar panels along with the mobile batteries can help in signages located at bus stops, avoiding a lot of trouble. Not only bus stops, but this can also be implemented at petrol stations, vending machines, etc. There are various panel sizes available as samples and for mass production.

Regarding interfaces, there exist RGB and LVDS interfaces in the market, for many years. The RGB interface (for low-resolution panels) is mainly used for cars and motorcycles. The LVDS interface (for high resolution) is commonly used for industrial usage. Smartphones are using MIPI interface (low power consumption). EDP (power saving) is widely being used for laptop and monitor panels.

With such advantages that LCDs offer, design engineers have a tough job in choosing the right one. David suggests that it is best to match a design with different systems and interfaces before making the final selection. LCDs surely have the potential of being chosen as the best option for any application. EFY

The article is based on a tech talk by David Yang, Deputy General Manager, SHARP, Singapore at TechWorldCongress.com. Transcribed by Sharon Abhignya Katta.

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S.C. Dwivedi & Sani Theo

STUDY OF RECTIFIED WAVEFORMS
Using Arduino Uno

VINAY KUMAR K.

This project can be used in the laboratories of industrial training institutes (ITIs), polytechnics, and engineering colleges to study the half-wave and full-wave rectifier waveforms using an Arduino Uno. While electrical power from the mains supply is available as AC, almost all electronic equipment use DC power supply.

The author's prototype is shown in Fig. 1 and circuit diagram of a rectifier using Arduino Uno is shown in Fig. 2. This circuit is built around Arduino Uno, centre-tap transformer X1, two diodes, a dual channel relay module, and a few other components. The circuit provides different types of rectifier outputs, such as full-wave and half-wave with and without filters.

Arduino Uno's digital pins 8 and 7 are connected to input pins IN1 and IN2 of the dual-channel relay module, respectively. Common (COM1) and normally open (NO1) terminals of the relay are connected to transformer's secondary terminal and anode of diode D2, respectively. NO2 terminal of the relay is connected to positive terminal of electrolytic capacitor C1 and COM2 terminal of the relay is connected to the junction of cathodes of diodes D1and D2 and resistor R1. Negative

PARTS LIST

Semiconductors:
Board1 - Arduino Uno board
D1-D2 - 1N4007 rectifier diode
Resistor (1/4-watt, ±5% carbon):
R1 - 100-kilo-ohm
Capacitor:
C1 - 100uF, 25V electrolytic
Miscellaneous:
X1 - 230V AC primary to 9V-0-9V, 250mA secondary transformer
- Dual-channel relay module (5V DPDT relay module)
- Cathode ray oscilloscope (CRO)
- Voltmeter

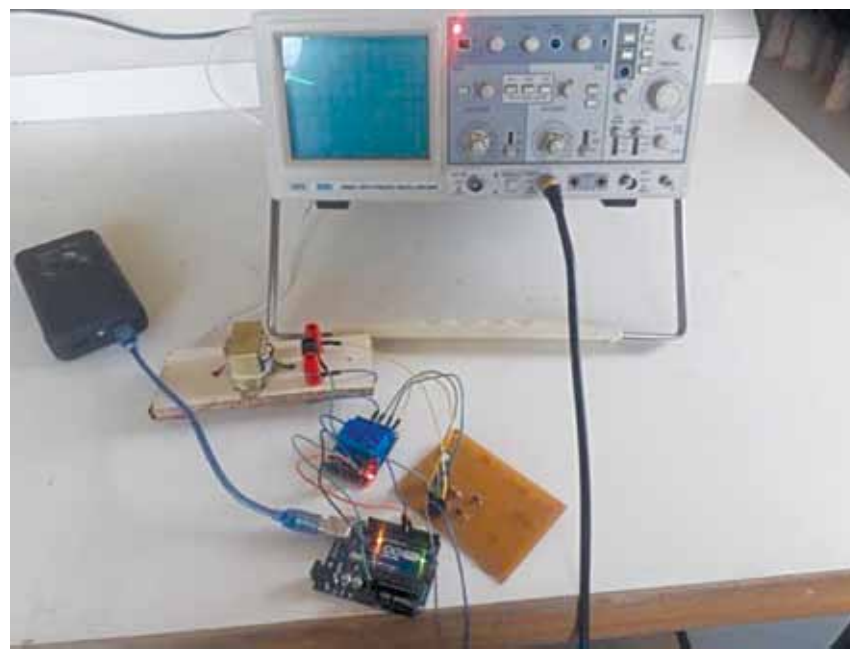


Fig. 1: Author's prototype

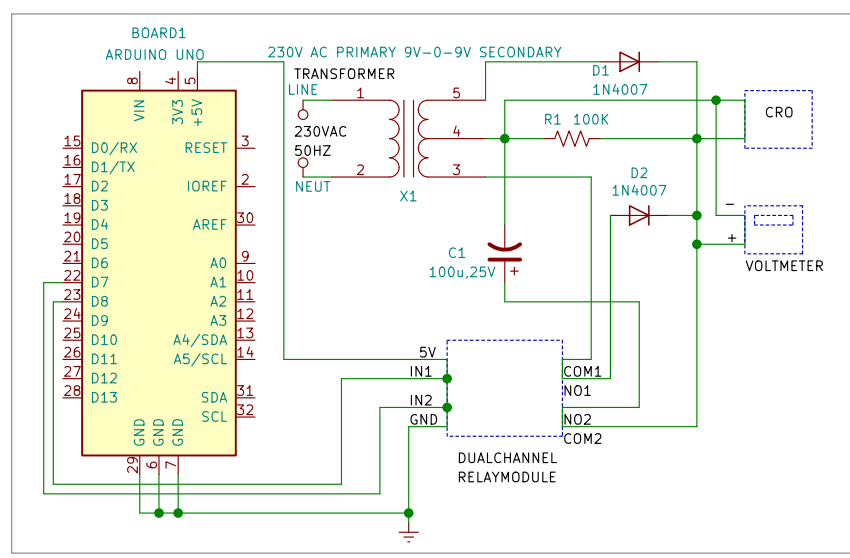


Fig. 2: Circuit diagram

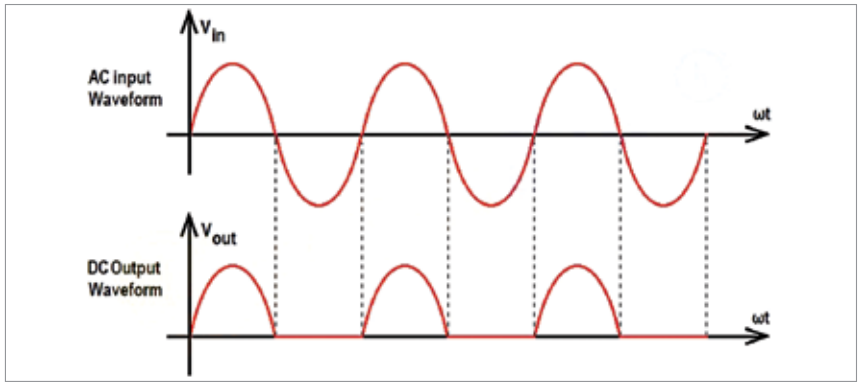


Fig. 3: Input and output waveform of half-wave rectifier without filter

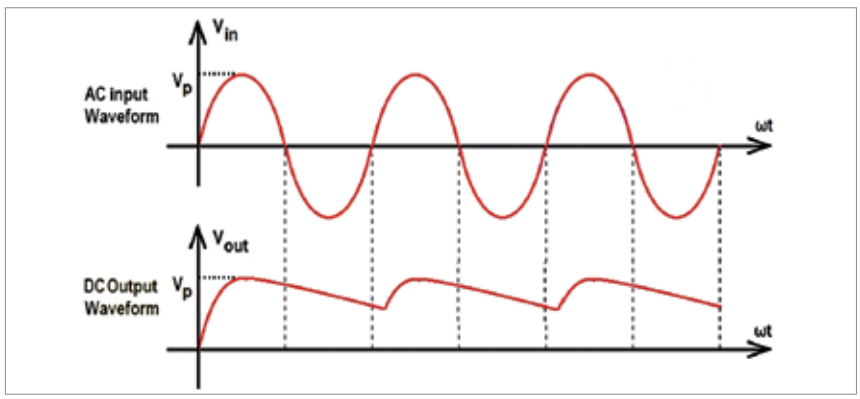


Fig. 4: Input and output waveforms of half-wave rectifier with filter

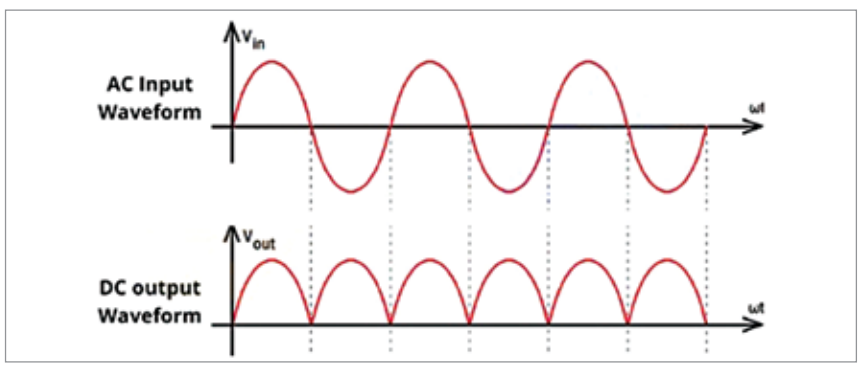


Fig. 5: Input and output waveforms of full-wave rectifier without filter

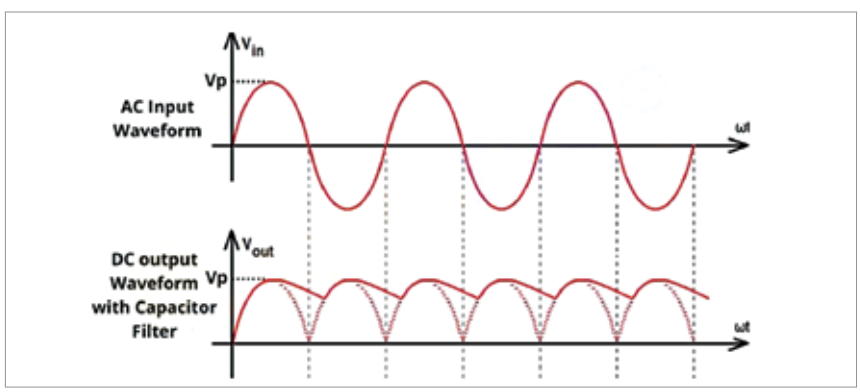


Fig. 6: Input and output waveforms of full-wave rectifier with filter

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

terminal of capacitor C1 is connected to centre-tap on secondary side of the transformer. The output waveform can be observed on an oscilloscope connected across resistor R1.

The centre-tap transformer is used to step down the supply voltage from 230V to 9V-0-9V.

The two 1N4007 diodes (D1 and D2) and 100µF, 25V electrolytic capacitor (C1) are used to get different output waveforms.

Construction and testing

Solder all the components on a Veroboard and upload the source code (Study.ino) on Arduino Uno board using Arduino IDE. Place the CRO probes across resistor R1.

When the circuit is switched on, you get half-wave output without filter capacitor C1, as shown in Fig. 3. Next, the program automatically outputs half-wave output, as shown in Fig. 4. This is followed by full-wave output without filter, as shown in Fig. 5, and full-wave output with filter, as shown in Fig. 6. The program keeps repeating in this sequence to output different waveforms.

As can be seen from Fig. 3 through Fig. 6, the waveforms available include the input and output voltages for comparison. The DC output obtained from pulsating DC input can be smoothened by increasing the value of filter capacitor C1. You can also connect a voltmeter across the diodes and centre-tap of transformer to measure the output voltage. EFY



Vinaya Kumar K. is an instructor in EEE Department of NIE Institute of Technology, Mysuru (Karnataka)

EFY TESTED Sani Theo

Simple TWO-WAY INTERCOM

S.C. DWIVEDI

If you have to frequently get up to talk to someone in your place, this intercom can save you the trouble. You can just switch it on from both sides to communicate. It can also come in handy if you have someone observing isolation at home due to Corona. Block diagram of the intercom is shown in Fig. 1.

Circuit diagram of the intercom is shown in Fig. 2. The simple, low-cost intercom is built around two condenser microphones (MIC1 and MIC2), four 2N2222 transistors (T1 through T4), and two LM380N audio amplifiers (IC1 and IC2).

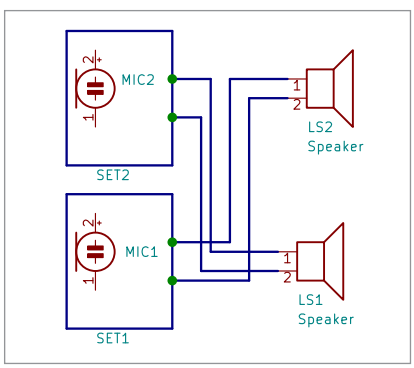


Fig. 1: Block diagram

A condenser microphone is like a capacitor (also called condenser) with two parallel plates placed close to each other. One of the plates is made of a very light and thin material that acts as the diaphragm. The diaphragm vibrates when struck by sound waves, changing the distance between the two plates, and thereby varying the capacitance. The resulting fluctuation in capacitance creates the corresponding electrical signal, which is amplified.

Most intercoms do not use a pre-amplifier circuit, because of which you get distorted sound output. This circuit employs pre-amplifiers to enhance the inputs for loud and clear sound from the loudspeakers.

PARTS LIST

Semiconductors:
IC1-IC2 - LM380N audio amplifier
T1-T4 - 2N2222 NPN transistor
Resistors (all 1/4-watt, ±5% carbon), unless stated otherwise:
R1, R2 - 10-kilo-ohm
R3, R4, R7, R8 - 100-kilo-ohm
R5, R6, R9, R10 - 1-kilo-ohm
R11, R12 - 18-ohm
VR1, VR2 - 100-kilo-ohm potmeter
Capacitors:
C1-C4 - 10µF, 25V electrolytic
C5, C6 - 47µF, 25V electrolytic
C7, C8 - 100µF, 25V electrolytic
Miscellaneous:
S1, S2 - On/off switch
MIC1, MIC2 - Electret condenser microphone
BATT.1, BATT.2 - 9V battery
LS1, LS2 - 8-ohm, 1-watt speaker

As shown in Fig. 2, there are two identical circuits. In the lower circuit, R1 works as a current-limiting resistor for MIC1. The electrical signal produced by sound flows through coupling capacitor C1, which blocks any DC signal and allows only AC signals to pass through. This signal is boosted by the amplifier sections formed by transistors T1 and T2 and IC LM380N.

The signal is first boosted by the amplifier built around transistor T1 and further by the second amplifier built around transistor T2. The output at collector of T2 goes to LM380N (IC1) through its pin 2, via capacitor C5, and the pot VR1.

The 8-ohm speaker (LS2) connected to output of

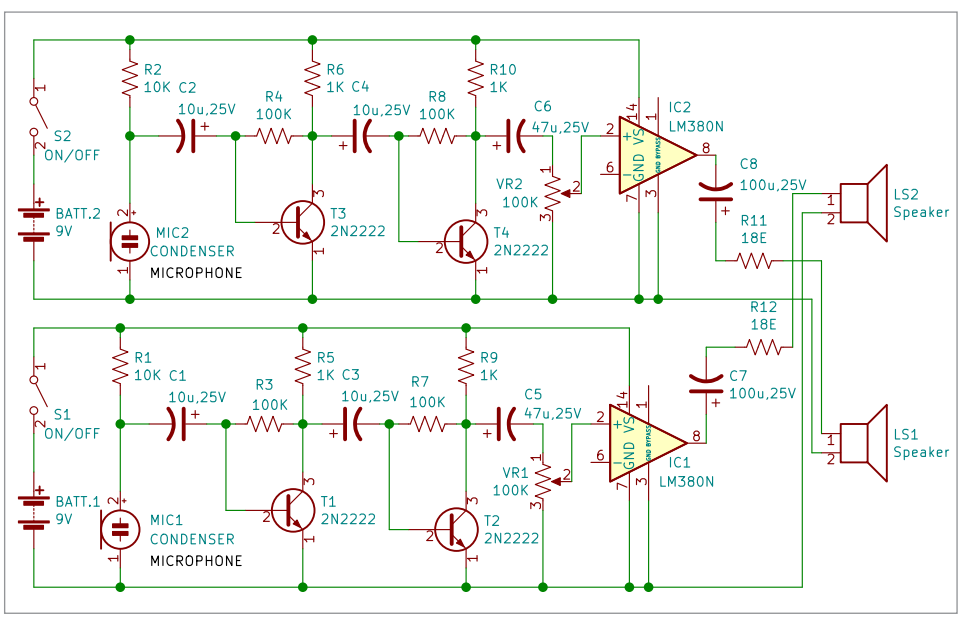


Fig. 2: Circuit diagram

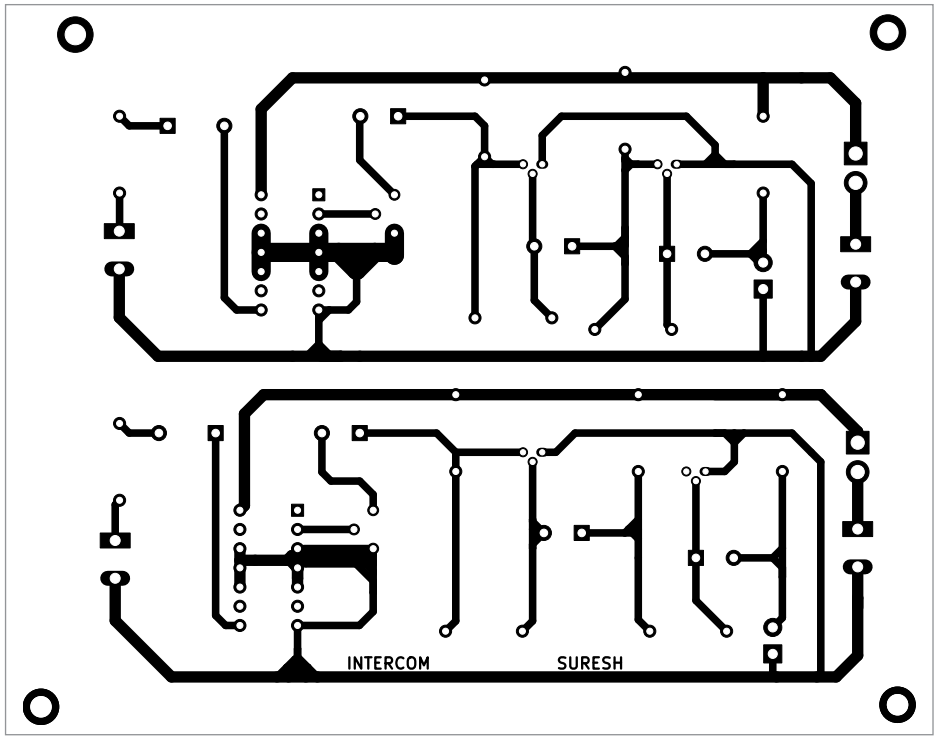


Fig. 3: Actual-size PCB layout

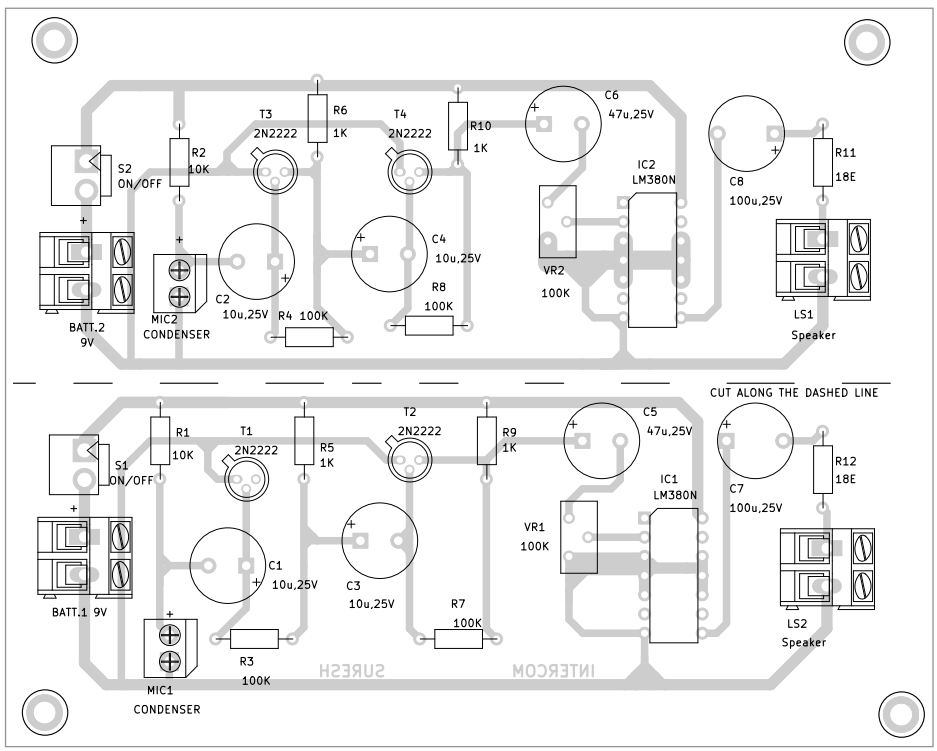


Fig. 4: Component layout of the PCB

LM380N via capacitor C7 and resistor R12 reproduces the sound. A 9V regulated supply or 9V battery each is required to power the upper and lower sections of the circuit.

The upper section of the circuit is identical and works the same way. When you speak in front of microphone MIC1, your voice can be heard from speaker LS2. And when you speak in front of microphone MIC2, your voice can be heard from speaker LS1. Thus, 2-way communication becomes possible.

Construction and testing

An actual-size PCB layout for the intercom is shown in Fig. 3 and its component layout in Fig. 4.

Assemble the circuit on the PCB or a general-purpose board. Cut the PCB into two parts (SET1 and SET2) along the dotted line marked on it. Enclose each PCB separately in a suitable box. Place SET1 in one room and SET2 in another. Connect LS2 in SET1 in first room to SET2 in the second room and LS1 from SET2 to SET1 in first room using a twin wire.

Fix MIC1 on the front side and LS2 on the rear side of the SET1 enclosure. Similarly, fix MIC2 on the front side and LS1 on the rear side of SET2 enclosure. Switch on S1 in SET1 and S2 in SET2 to start communication from both sides.

When you speak into microphone MIC1 in SET1, the person in the second room will hear you through loudspeaker LS2. Similarly, when he speaks into microphone MIC2, you will hear him through loudspeaker LS1.

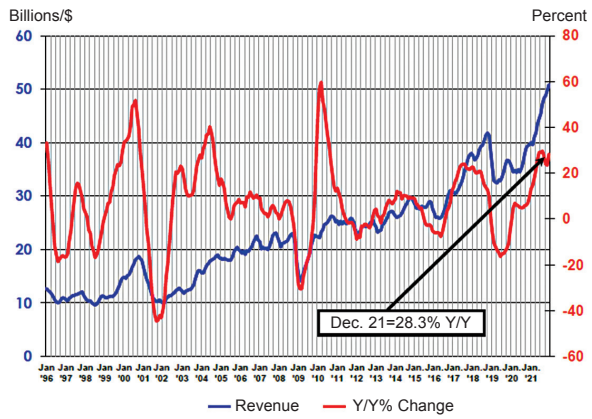
Please note, there will be acoustical feedback between the microphone and loudspeaker if they are close and facing each other. So, keep distance between the microphones and loudspeakers while assembling and fixing them on the enclosures. EFY

S.C. Dwivedi is an electronics enthusiast, circuit designer and technical article writer

THE DASHBOARD

Global Chip Market Saw Highest-Ever Annual Sales Total in 2021

Global semiconductor sales totaled $555.9 billion in 2021, the highest-ever annual total and an increase of 26.2% compared to the 2020 total of $440.4 billion. China remained the largest individual market for semiconductors, with sales there totaling $192.5 billion in 2021, an increase of 27.1%. Analog had the highest annual growth rate of 33.1%, reaching $74 billion in 2021 sales. Logic ($154.8 billion in 2021 sales) and memory ($153.8 billion) were the largest semiconductor categories by sales.



(Source: www.semiconductors.org)

Top 10 Chip Buyers Increased Chip Spending by 25.2% in 2021

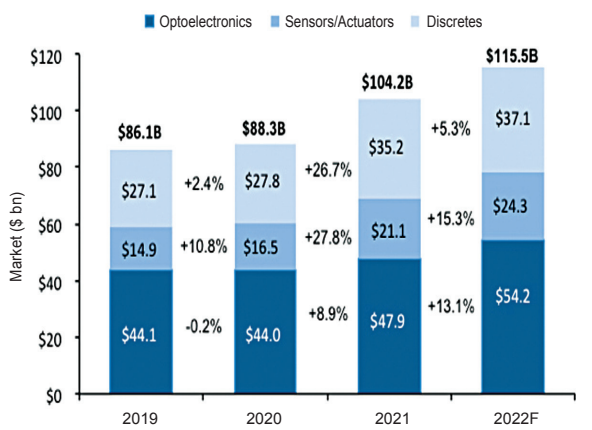
2021 Rank	2020 Rank	Vendor	2021 Spending	2021 Market Share (%)	2020 Spending	2020-2021 Growth (%)
1	1	Apple	68,269	11.7	54,180	26.0
2	2	Samsung Electronics	45,775	7.8	35,622	28.5
3	4	Lenovo	25,283	4.3	19,023	32.9
4	6	BBK Electronics	23,350	4.0	14,258	63.8
5	5	Dell Technologies	21,092	3.6	16,814	25.4
6	8	Xiaomi	17,251	3.0	10,254	68.2
7	3	Huawei	15,382	2.6	22,710	-32.3
8	7	HP Inc.	13,789	2.4	10,745	28.3
9	9	Hon Hai Precision	8,855	1.5	7,387	19.9
10	10	Hewlett-Packard Enterprise	6,736	1.2	5,395	24.8
		Others (outside top 10)	337,695	57.9	269,849	25.1
		Total semiconductor	**583,477**	**100.0**	**466,237**	**25.1**

Top 10 original equipment manufacturers (OEMs) increased their chip spending by 25.2% and accounted for 42.1% of the total market in 2021. The average selling prices (ASPs) of semiconductor chips and a wide variety of application-specific semiconductors increased by 15% or more in 2021. Apple remained at the top, having increased its spending on memory by 36.8% and on non-memory chips by 20.2% in 2021.

(Source: www.gartner.com/en)

Sensor/Actuator and Discrete Sales Surge in 2021

Total optoelectronics, sensors and actuators, and discrete semiconductors (O-S-D) revenues crossed $100 billion for the first time ever in 2021, growing 18% to $104.2 billion compared to $88.3 billion in 2020, when combined sales in the three markets increased by less than 3% as the virus first took hold. Optoelectronics sales growth was muted in the 2021 rebound due to the lack of a surge in CMOS image sensors.



(Source: IC Insights)

India-Based Vendors Dominate Truly Wireless (TWS) Market in 2021

(Shipments are in thousands of units)

Company	2021 Market Share	2020 Market Share	Year-on-Year unit change (2021 vs 2020)
1. Imagine Marketing (BoAt)	39.3%	23.9%	187.9%
2. Realme	7.7%	13.1%	2.8%
3. Nexxbase (Noise)	7.5%	4.5%	194.7%
4. Palred (pTron)	6.0%	7.6%	36.8%
5. Samsung	4.7%	10.6%	-23.0%
Others	34.8%	40.3%	50.6%
Total	**100%**	**100%**	**74.7%**

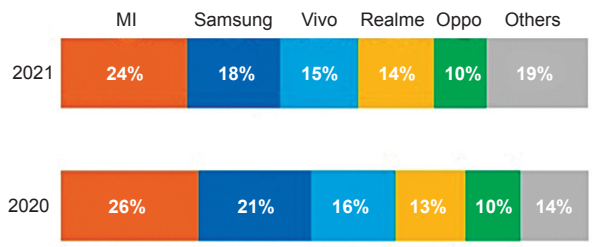
India's TWS market witnessed a record year, with shipments reaching 20.3 million units and growing 74.7% YoY (year-on-year) in 2021. Year 2021 saw India-based vendors capture over 65% shipments in the TWS category, compared to about half of the market last year. BoAt emerged as the leader with two-fifth of the shipments during the year, which is more than the combined share of the next seven vendors.

(Source: www.idc.com)

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

India Smartphone Market Records Highest Ever Shipments and Revenue in 2021

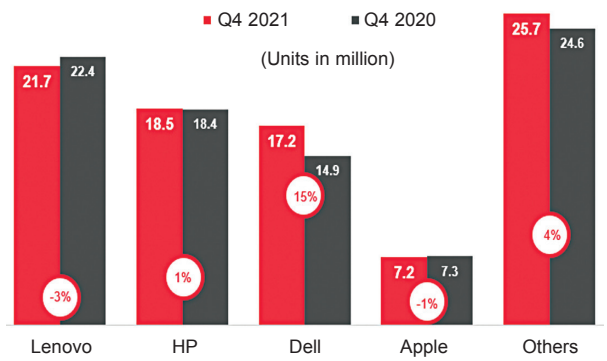
India's smartphone shipments grew 11% YoY to reach 169 million units in 2021. Xiaomi maintained the top position in India's smartphone market in 2021 with 2% YoY growth. India's smartphone market retail ASP (average selling price) grew 14% YoY in 2021 to reach its highest ever at $227.



(Source: www.counterpointresearch.com)

Global PC Shipments Up 3.1% YoY in Q4 2021

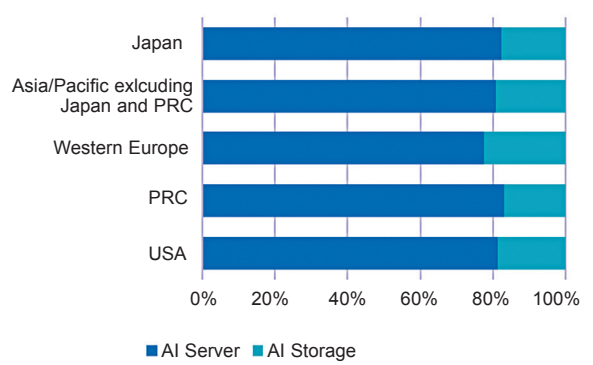
Global PC shipments reached 90.3 million in Q4 2021 to maintain their YoY growth momentum at 3.1%, coming on a relatively high base in 2020. In Q4 2021, the supply gap for the most important PC components narrowed. Lenovo continued to lead the global PC market in Q4 2021 with a 24% share, having its highest unit sales in 2021 at 21.7 million.



(Source: www.counterpointresearch.com)

Global AI Hardware to Reach 5% Market Share in 2022

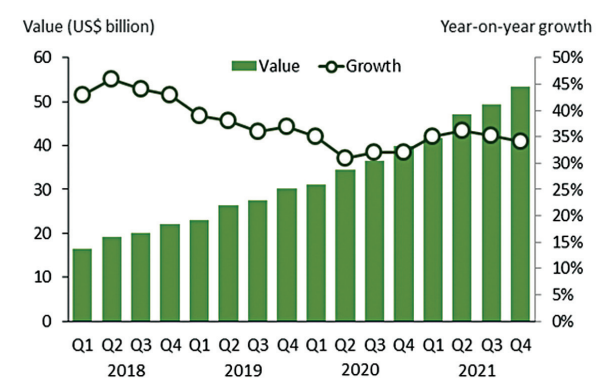
Worldwide revenues for the artificial intelligence (AI) market, including software, hardware, and services, is forecast to grow 19.6% year-on-year in 2022 to $432.8 billion. In 2021, the AI Hardware category grew the most in terms of market share in the first half of 2021 with a jump of 0.5% share. It is forecast to reach 5% market share in 2022 with year-on-year growth of 24.9%. AI Storage saw stronger growth relative to AI Server during the first half of 2021.



(Source: www.idc.com)

Global Cloud Services Spend Exceeds US$50 billion in Q4 2021

Worldwide cloud infrastructure services expenditure topped US$50 billion in a quarter for the first time in Q4 2021. Total spending grew 34% to US$53.5 billion, up US$13.6 billion in the same period a year ago. The top three in Q4 2021, namely AWS, Microsoft Azure and Google Cloud, collectively grew 45%, to account for a combined 64% share of customer spend.



(Source: https://canalys.com)

INDIA'S EV INDUSTRY SUCCESS Depends On How Soon It Stops SEEING IT From A GLOBAL LENS

In a year where the phrase 'new normal' became part of our daily vocabulary in ways never before imagined, India set parameters for the new normal in India's transport sector



ASHISH KUMAR is Founder and CEO of Amosta Solutions

The government has set ambitious targets to achieve its goals of zero emissions, one of which includes phasing out of petrol-run vehicles and replacing them with electric ones by 30% by the onset of next decade. To put things in perspective, the United States has earmarked half of its total vehicle sales to be EV by 2030. Neighbour China, on the other hand, has a target of 40%.

Notably, these countries began their journey to electric mobility long before India. To achieve such high numbers, India has to be at par with these countries in terms of not just manufacturing but also adoption.

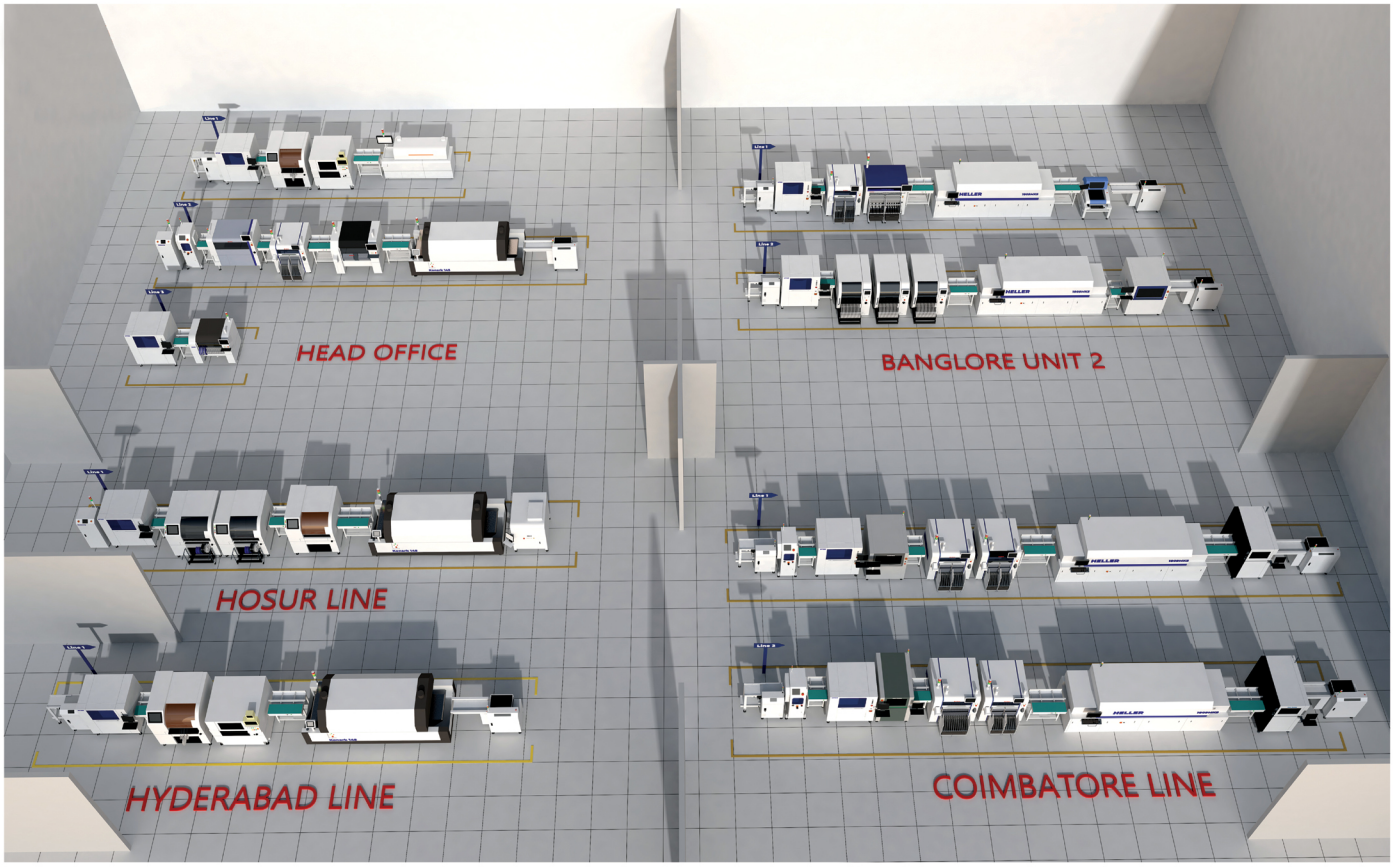
But in a country with over 1.3 billion population, it has been proven time and again that demands of India vastly contradict those of the West. Then why are we still following the same global formula



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Charging infrastructure, or the lack thereof, is currently seen as the biggest hurdle to EV adoption

while heralding the clean mobility millennium in the subcontinent?

Look away from the electric 4-wheeler

The roads, climate conditions, traffic management, and even the way owners handle their vehicles in India are incomparable to the developed nations, which have set similar goals like India's but seem far more doable.

That is not to say that Indian OEMs have lagged behind in the race. The automobile industry has always been a game that the Indian businesses have been able to massively cash in on. So, it is evident that interested parties who have recognised the inevitably of the shift to electric mobility would expect to rake similar points here as well.

As per a report by the World Economic Forum (WEF), India made up only 0.5% of the global EV market in 2018. The numbers need to increase massively to meet the expectations of the behemoth target of 30% EVs in the country, and for that OEMs have to put in the work.

The world has been watching closely the developments in the space and already has big players, in the form of renowned OEMs, working in the field to help them get a head start. To beat them, India needs to build the same level of expertise and resourcefulness. For that, it needs to choose the target segment wisely.

Here's the catch. While most countries have focused on the 4-wheeler segment, the 2-wheeler segment in EV market has been left virtually untouched. Experts have concluded that the 2- and 3-wheeler segments are where India can capitalise on.

The 2-wheeler market, which has been a thriving market in the Indian automobile industry pre-EVs, is still just as much of a business opportunity, if not more. In fact, market reports suggest that 50% of India's EV goals would be met by 2-wheelers.

Interestingly, there is no one company that has taken the biggest piece of the pie yet. Yes, there are OEMs that are steadily treading the route to become a force to reckon with, but it still keeps a lot of space for newer participation.

Let business model suit the ecosystem

Over the past couple of months, various Indian OEMs have invested heavily in increasing their production capacity, some even going as far as creating the world's largest factories. But is manufacturing the one-stop solution to our woes? There are aspects of the ecosystem that need to grow at the same pace in order to keep up with the manufacturing boom.

For starters, charging infrastructure, or the lack thereof, is currently seen as the biggest hurdle to EV adoption. Similarly, a lack of servicing support also raises doubts in the minds of consumers. Businesses need to come up with models that can eliminate these hurdles.

The various permutations and combinations of possible businesses in the EV industry know no end. It is pretty evident that the EV industry is in its infancy in India, which is precisely the perfect time to set up shop in this burgeoning sector. Be it in charging, or servicing, or support, or financing, companies can leverage any aspect of the ecosystem and emerge victorious, as long as they solve a problem.

The introduction of electric mobility is going to need some convincing to make the entire country discard their ICE vehicles for electric models, what with range anxiety and the price disparity.

The brand identity of OEMs is just as crucial of a deciding factor when converting previous ICE vehicle owners to EV owners. Brands and OEMs that have been around for a long time and have had a considerably good repo with customers definitely have an advantage over newer startups, and this is where they have to break the ice. Forming a brand identity that can convince the skeptical customer to take the plunge is going to be the biggest hurdle.

Put the tech talent to work

India has another aspect in its favour: its vast technical know-how. There is, of course, no doubt that India churns out some of the world's brightest tech minds and, in order to make electric mobility in India become a class-apart, it is

imperative that we put these bright minds to work. We must come up with innovations that can rightly balance the design and electronics part of building highly efficient electric vehicles that are suitable for the unprecedented nature of India's automobile industry.

The EV industry is bound to be a tech-driven industry. The fundamental groundwork of what makes it a league apart from its predecessors is the very role of technology in bringing about new innovations to the sector. Design and electronics must go hand in hand. This is not a phase where we can distinguish between the two anymore. The vehicles can be transformed from what they are traditionally known to do and serve different yet specific needs of each customer in this diverse country.

The pain points of the average Indian vehicle-owner are many, which have been effectively recognised by some who have begun resolving them, whether it is through IoT-enabled vehicles or some other technology, giving meaning to the phrase 'Necessity is the mother of invention.' It is only a matter of time, until another necessity of the Indian customer gives birth to an invention that can resolve the pain of customers around the globe. As such, the role of tech startups becomes much more significant in heralding the new wave.

India for the world

The introduction of electric vehicles is seen as quite a coming-of-age moment for the automobile sector. This is possibly one of the first times when mobility seems both non-threatening to the environment and with multiple new possibilities of innovation. And as we know, Indians have a knack for innovation.

The EV industry is a huge opportunity for success, and while multinational companies look at India as a huge market for consumption, it has the potential to turn into a provider for the rest of the world.

Deviating from the path that we took during the onset of the first automobile revolution of the country, this is possibly the time when we focus on creating vehicles that cater to the Indian market first and then take them on to the global front instead of the other way round. As the saying goes, 'Charity begins at home.' Similarly, the success of EV players eyeing to take on as a global player relies on how well they can serve the domestic market.

We are seeing the emergence of different brands that cater to particularly Tier 2 and Tier 3 cities, while some target urban markets in Tier 1 cities. While some focus on low-speed vehicles, some provide high-speed options. These offerings are not just useful for boosting the Indian EV market but also similar markets in Africa, South America, and South Asia.

Moreover, it is recommended for Indian companies to turn their gaze from glamorous markets in the West and instead focus on smaller markets where they have a much bigger competitive advantage to make a bigger impact.

Manufacturing vs adoption: The tougher nut to crack

Manufacturing is an issue that has been promptly handled by the government by providing subsidies and incentives. But adoption tricks have not yielded the desired results. The Faster Adoption and Manufacturing of Electric Vehicles in India Scheme Phase 1 (FAME-I) failed to achieve its targets despite the government spending over eight billion (800 crore) rupees on it. The subsequent Phase 2 of the scheme has also so far not come close to achieving the targets set, despite a deadline extension.

The production linked incentive (PLI) for the manufacturing of the lithium-ion batteries also acknowledges only one part of the problem. And while many like to put the issue of rising fuel prices to be a contributing factor to push consumers to switch, it seldom is so easy to completely transform the public consuming habits.

> INDIA MUST COME UP WITH INNOVATIONS THAT CAN RIGHTLY BALANCE THE DESIGN AND ELECTRONICS PART OF BUILDING HIGHLY EFFICIENT ELECTRIC VEHICLES THAT ARE SUITABLE FOR THE UNPRECEDENTED NATURE OF INDIA'S AUTOMOBILE INDUSTRY.

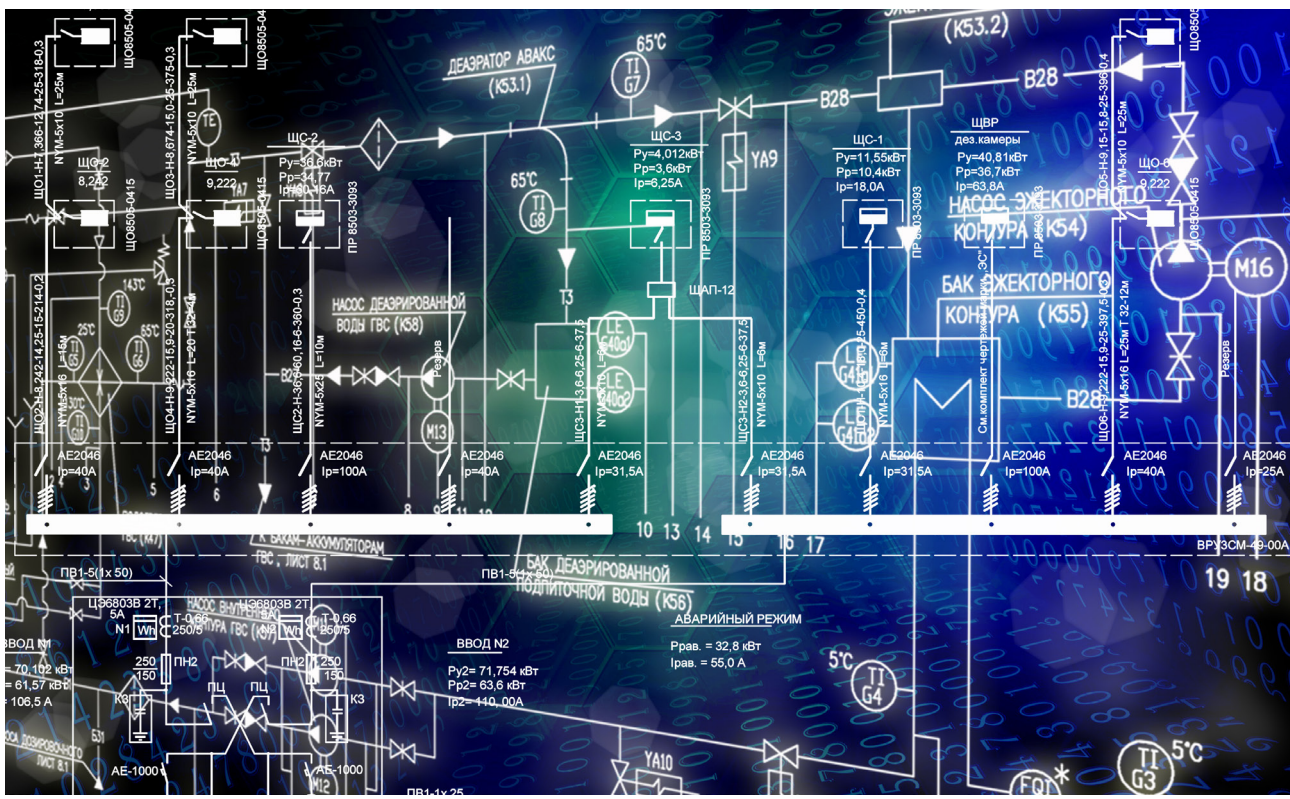
We all know that the EV phase in the country has only just begun. The seed of innovation is sprouting in the industry where many OEMs want to grab a share of the pie, but in their own unique ways. This is the beauty of any nascent market—the sheer number of possibilities. Business models can take any shape and form, be it manufacturing, support, supply chain, or recycling.

India's EV industry has all the required ingredients to mimic the proven success it attained in the automotive industry decades ago. But one thing is certain, the space must harbour an ecosystem of collaboration and cooperation, which needs to start at the grassroots level. EFY

This article is based on the session 'Transition To Total Electric: Opportunities & Challenges' by Ashish Kumar, Founder and CEO of Amosta Solutions, which was presented at the November edition of Tech World Congress 2021, and has been prepared by Siddha Dhar, Business Journalist at EFY.

Why PRODUCTS For GLOBAL MARKETS Need To Meet Standards

Complying to standards calls for a structured approach. In every phase of the product development, impact of standard compliance has to be assessed and actions have to be taken. This is very important. If a list of the items to be checked is prepared, it will run into a book. Here is some guidance on the subject





S.A. SRINIVASA MOORTHY is Director Engineering Design, D4X Technologies Pvt Ltd

When products are designed there are three aspects that are critical: The product's usability, performance, and compliance to standards. All three aspects are focused on the users to ensure they get the best when they buy a product.

For example, let us say the product is a washing machine. The user interface of the product should be easy to use, intuitive, and consistent, so that no training is needed for operating it. Second aspect is performance, where the washing machine has to meet all the product specifications and claims made by the manufacturer. Third is the compliance to standards.

Standards are drafted to address three aspects:

1. Safety of the user (both electrical and mechanical)

2. Use of environmentally safe manufacturing processes

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STANDARDS' NON-COMPLIANCE

Product life cycle	Activity	Impact due to
Concept	Usability like ergonomics, mandated user interface like avionics	• Ergonomics—Product usage doesn't impact the user. Complying to standards laid out by the designated regulatory agencies like FAA/FDA etc.
Design	Products need to meet safety, emission, and environment requirements	• Compliance to safety is a design issue which also increases the design time and cost. Incorporating them early is a must as at the end of design compliance issues ultimately end up in redesign, leading to an escalation in cost and time to market. • The situation is the same for products which need to meet stringent environmental standards compliance by way of selecting the right components, right manufacturing process, and low energy consumption; it calls for design of the product factoring these needs.
Engineering (NPI)	Component selection, material selection for enclosures, plastic/die-cast tooling and ability to recycle	• Most important aspect is the component selection. Right component selection is key to the manufacturing process as well as products complying to standards. Good example is industrial-grade components, which withstand high temperature and vibration compared to commercial version. Right components are also needed for complying to green manufacturing processes. • Choice of materials for the enclosures. It could be sheet metal, metal diecast, or plastic, depending on the environment the products work in and corresponding standard applicable. • Third key is the ability to recycle the product after its active life. This calls for first the right design and second proper material selection.
Manufacturing	In electronics manufacturing, the main compliance today is that manufacturing lines have to comply to the avoidance of lead in the process and any traces of usage of CFC (which earlier processes used)	• Today, almost all products have to comply to the RoHS (Reduction of Hazardous Substance – aka lead-free) process. In addition, they have to document the composition of the materials used in the products as per the REACH standard. • Another aspect that is missed is the packing materials used for shipping. Most European countries mandate these have to be compliant to green laws, especially to be pest-free and safe to decompose.
Support	This phase concerns repair of faulty products. More critical is the management of component obsolescence. In addition, making the products comply to standards	• Impact of standards is in two ways. One, when the components become obsolete, the replacement normally calls for a redesign as very rarely you get a drio-in compatible part. This calls for retesting, which is time consuming and needs planning. • Second, when the product is repaired, replication of the process to meet the standard is critical. For example, most industrial products are coated with a 'conformal coating' to prevent moisture impacting the product. Normally, the coating is done when all the testing and calibration of the product/PCB is complete. So, when the PCBA is repaired, the technician removes the coating to repair but most of the time does not reapply the coating, which leads to moisture impacting.
Withdraw	Finally, when the product is discarded, most countries mandate It is safely dismantled and recycled, or disposed of (disposable part is much less than 1%)	• Unless the design addresses the issue early on, meeting the recycling standards will be a challenge. And if not incorporated, practically it is very difficult to do it later. This again shows that the importance of compliance to standards has to be addressed early on.

3. Safe electrical emission and susceptibility

Complying to the standards is mandatory and exporting to different countries depends on the standards laid. Typically, standards are defined by international agencies like FDA, FAA, IEEE, IEC, etc. In India we have Bureau of Indian Standards (BIS) (earlier was known as Indian Standards Institute) which has standards for products made and used in India. Almost all the countries have made compliance to standards mandatory.

For complex products like aircrafts and military systems, most countries tend to follow FAA (Federal Aviation Administration) and FDA (Food and Drug Administration) standards. Similarly, standards like Electrical Radiation Emission and Susceptibility, FCC (Federal Communication Commission) of the USA, or CE (Conformité Européenne) for European Union are used across countries as these standards have been well drafted and have stood the test of time. With the increased integration into global economy, India is also now mandating standards for use in India.

Most designers tend to assume that compliance to standards is a separate step and can be done once the design is complete. However, compliance to standards needs attention from the design phase. In fact, one of the design parameters should be the standards to which the product has to comply. For example, if the product has to meet FCC Class B emission level, it is better to have metallic enclosure rather than a plastic enclosure—if the design allows. So, designers need to understand the standards to which the product should comply and ensure the design goals meet that.

Why this is critical

First and foremost reason for compliance is the impact on business. Products that do not meet the standards cannot be sold in the market.

NeoDen Auto SMT Pick and Place Assembly Line



NeoDen

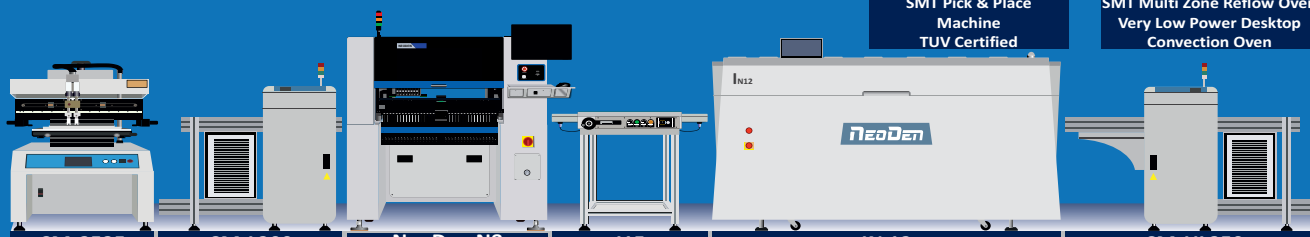
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Second, assuming there are markets where the standards compliance is lax and the products can be sold, risk of safety issues and the litigation due to that can far outweigh the compliance to standards. Complying to standards must start from design stage and not after the design is complete. Let us see which activities get impacted due to standards' non-compliance in the Table.

Some examples

Just to show the importance, two instances of compliance to standards not being met are briefly described below along with the mess they created.

First, we were designing an advanced antenna that could adjust its lobe width by operating a motor mechanism. We completed the testing and certification. However, when this antenna was installed in a European nation known for low temperature, we noticed two things. One, the motor froze, and second, the processor failed to start. In both cases what we found later was that the components we had used for testing and those used for manufacturing (even though the datasheet said they were equivalent) were different, leading to the failure. While we could sort the motor issue, we found that most crystals don't start at -15°C, so we ended up preheating the component used in the design to ensure there were no issues.

Second was a networking product, which was packed in small wooden crates to be shipped to Europe. When the contents landed in European airport the authorities sent the material back due to pests and decay in the wood used. We had to import the crating wood for packaging! This taught us a lesson that even a small miss can cost lots of money and time.

What need to be factored

There are three critical things that need to be factored in when designing products for compliance to standards:

1. Know the country the product is supposed to be sold in and get to know the compliance laws and standards well. If the product is being designed in one country and exported to another, the best way to manage is to use global certification agencies like TUV to get the certification as they have the experience and knowledge to address global standards.

2. Spend time in selecting components and their equivalents. Above all, even if the product has custom parts made by suppliers, the responsibility of those parts meeting the standards is always yours. Never leave it to the suppliers as they invariably don't appreciate the need for complying to standards. (An entire lot of advanced remote access server we shipped to the US was sent back as the welded portions rusted while they were in US airport for a week.)

3. It is advisable to have a full-time engineer to address the issues if the products are being targeted for global markets. This helps in keeping the compliances issues to the minimum.

Points to keep in mind

Complying to standards calls for a structured approach. In every phase of the product development, impact of standard compliance has to be assessed and actions have to be taken. This is very important. If a list of the items to be checked is prepared, it will run into a book. For a reliable and very useful book on the subject, check *https://emcfastpass.com/cert-ebook*. It is a good book for MSMEs and startups to understand global standard compliance and how to deal with it. But remember, it addresses all the electrical standards. Designers have to understand the standards for other certifications as well, especially the environmental ones. EFY

SEMICONDUCTOR & DISPLAY FABS: Devil Is In The Execution SUCCESS In COLLABORATION

The government of India has come up with a 760 billion rupee layout plan for semiconductor and display fabs. How do the industry heavyweights perceive this plan? What are they doing to be successful, and what's their advice for smaller companies?



Silicon Wafer Under Cleanroom Fabrication

MUKUL YUDHVEER KUMAR and **SIDDHA DHAR**

A tweet "Intel-Welcome to India" posted by India's IT Minister Ashwini Vaishnaw sent ripples down the core of the semiconductor ecosystem of the world. This tweet was a result of Intel's Foundry Services president Randhir Thakur praising the government of India for the recently announced 760 billion rupee India Semiconductor Program. The aim of the Program, similar to the National Electronics Policy and every scheme announced under it, is to make India the hub of semiconductor manufacturing. The Program attempts to set up a semiconductor as well as display manufacturing ecosystem in India.

India currently depends fully on imports for meeting its semiconductor needs, but that has been said a thousand times before. What's different this time is the intent, and the list of leaders and India based corporate houses joining the struggle to set up a semiconductor and display base in the country. Their aim is the same, and they all want to make sure that India does not miss the bus of semiconductor manufacturing once again.

"The recently announced comprehensive program for the development of sustainable electronics and display ecosystem in the coun-

try with an outlay of ₹76,000 Cr confirms the PM's vision of *AtmaNirbhar Bharat*, and positioning India as a global hub of electronics system design and manufacturing. Displays constitute a large portion of the bill of materials of many high-volume electronics products. India's display market is estimated to be $7 billion, and it could grow up to $19 billion by 2025. Current demands are met exclusively through imports," says Sanjay Agarwal, President of ELCINA and MD of Globe Capacitors.

Semiconductors and display units are generally referred to as the soul of modern electronics. These are also said to be among the top factors that are driving the ongoing Industry 4.0 revolution. The challenge is that both semiconductor and display manufacturing require huge capital investment, and these need to be done with the help of most modern technology. Rapid changes in technology further require investments for sustenance and gestation.

"The benefits of establishing this industry includes greater than $11 billion dollars domestic value creation, display export opportunities of up to $10 billion, and domestic employment generation of more than 200 thousand," adds Sanjay.

Amrit Manwani, MD, Sahasra Electronics notes, "The leadership of India, in the past six to seven years, has rightly highlighted and worked on the importance of electronics manufacturing. Several incentive schemes like EMC, SPECS, and PLI have also been introduced. But for the first time the Ministry of Electronics under the leadership of Ashwini Vaishnav and Rajeev Chandrasejhar has truly engaged with the industry to recognise the challenges and mitigate them through various reforms."

"So far, we have virtually had the absence of semiconductor manufacturing in India, even though we had strength in semiconductor design where we do designs for the entire world. Now, because of strategic reasons and also because of the fact that our import bill will only keep on mounting if we don't have a semiconductor foundry in place or an IDM in place, this is why there is a renewed effort in bringing semiconductor manufacturing into India. There have been efforts before but what is different this time is, firstly the size of the Indian market is today standing at 3.5% of global electronics manufacturing. We expect it to become 10% of global electronics manufacturing in the next four to five years. As more and more products get manufactured in India, one way is to keep on importing the components. The other way is that, now that there are strong brands here who control the supply chains, if a fab is there, then they may well be inclined to get their memory and logic pieces out of India as well as power devices," says Saurab Gaur, Joint Secretary, MeitY.

The government and the heavyweights

The road to making India a hub of semiconductor and display manufacturing is not going to be an easy one. Not only will the players deciding to join the game will have to take lessons from the past, but players from the equipment, materials, designing, services, and all other verticals of these two ecosystems will have to work together to make India the hub of manufacturing these.

"The global conglomerate has started seeing India as a place now. Government has walked the talk and now is the turn of the private players to showcase what they can do. Indians are very intelligent, and you may see very cost-effective TVs, smartphones. and more consumer goods getting manufactured and exported from here. It is all about backward integration and we all know what has happened in the automotive sector in the country. Hyundai exports cars at prices it cannot achieve in its home country Korea," says Pranav.

He adds, "The scenario at the moment is now or never as the country is already on its way to have bigger exports bills of components than oil. It's not a short-term game. The horizon should be for at least 20 to 30 years."

Taiwan and China are the perfect examples of the semiconductor and display fabs being a long-term game. While the former is now a world leader in terms of semiconductor manufacturing, it still keeps investing in developing the latest tech. The latter, which started its semiconductor journey about a decade ago, is still investing in huge numbers to make sure it becomes a world leader in the next few decades. The government of China helping semiconductor companies in the country is not a hidden fact at all.

"Money going into these initiatives is hearty as the returns will take much longer time. But then it is a very stable business over the long term. You can also grow very rapidly. I have myself worked for companies which were a manufacturing start-up and they became a multi-billion dollar business over time," says Raja.

The Tata's are said to be putting more than 3.5 billion rupees for setting up an ATMP/OSAT in the country. Raja Manickam, who had earlier founded Tessolve, was roped in by Tata last year to head the project. Several other biggies from the semiconductor ecosystem have also joined Tata's in the new venture. "In my mind, all of this has to play together to make India the favourite destination for manufacturing electronics," feels Raja Manickam, CEO, Tata OSAT.

Vedanta Group joining the initiative to make displays in India is probably one of the best developments that the Indian electronics industry has come across in the recent days. Of course, the Tata's have already forayed into semiconductor packag-

Leaders' Speak



"The benefits of establishing this industry includes greater than $11 billion dollars domestic value creation, display export opportunities of up to $10 billion, and domestic employment generation of more than 200,000," says **Sanjay Agarwal, President of ELCINA and MD of Globe Capacitors.**

"When everything was still being planned and not yet announced, I asked a leading industry expert what kind of incentives they would like, and he said, 'If the government can put up 50 cents for every dollar spent, that would be great'. But today, when we came out with the policy, we gave them one dollar for each of their dollar," says **President, VLSI Society of India and CEO, EPIC Foundation.**



"For the first time the Ministry of Electronics, under the leadership of Ashwini Vaishnav and Rajeev Chandrasejhar, has truly engaged with the industry to recognise the challenges and mitigate them through various reforms," shares **Amrit Manwani, MD, Sahasra Electronics.**



"In light of the semiconductor shortage, it is the perfect time for India to take off and with all the government initiatives and the experience we have created. I think we should invest both in IPs and products. The government has done its part. Now it's up to the MNCs, the academics, the people in the software ecosystem to make it a grand success," says **Sambit Sahu, VP Network and Edge Products, GM IOTG, Intel Corp.**



"I think that we are sitting on a huge opportunity as far as India is concerned. What I would like to see on a personal level is that a lot of product innovation needs to happen in India. End product innovation and end device development needs to happen in India too," says **Balajee S., MD, Samsung Semiconductor India R&D Centre.**



"It actually is natural for suppliers and partners to set up shop near their clients as the same makes business decisions easy. The technical term used by the industry players in the electronics ecosystem is 'Co-design' and Co-development'. Once the display set up is set in India, a lot of co-developers and builders working in the semiconductor as well as the display ecosystem will be encouraged to expand in India," says **Sudhir N. Pilai, MD, Corning Incorporated.**



"Money going into these initiatives is hearty as the returns will take much longer time. But then it is a very stable business over the long term. You can also grow very rapidly. I have myself worked for companies which were a manufacturing start-up and they became a multi-billion dollar business over time," says **Raja Manickam, CEO, Tata OSAT.**

"Korea, Japan, Taiwan, and China have different systems. The Korean government and the Chinese government support big companies and these big companies support small companies in turn. The governments in Japan and Taiwan usually support small companies and these small companies in turn support big companies," says **Sung Huk Lee, CEO, TnvisiON.**



"Whether you look at TSMC, or any other such company, the academia has played a very important role in their success. The key for companies will be to find out how they can collaborate with academia and fine tune relationship building," shares **Sudheer Kumar, COO, NCFlexE, IIT Kanpur.**

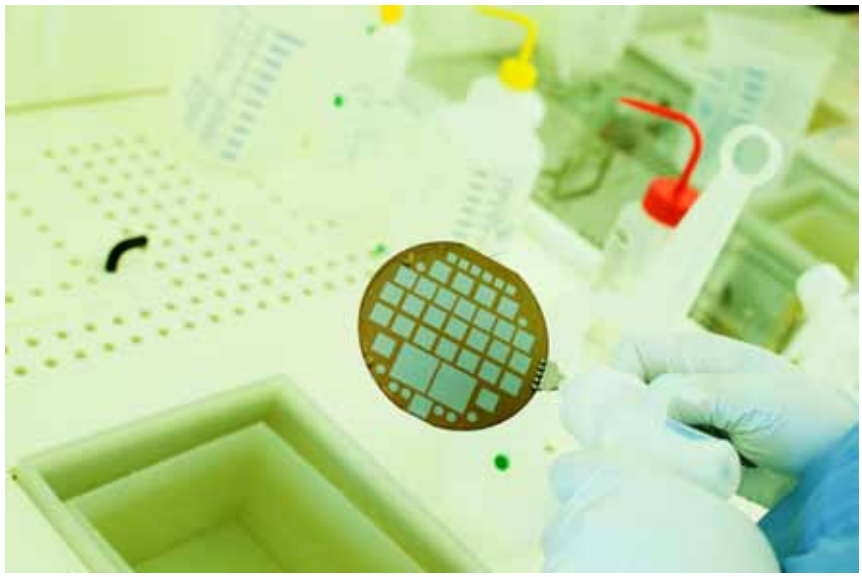
ing but Vedanta Group announcing an investment of 600 billion rupees for chip and display manufacturing is the cherry on the cake.

"We want to enter into integrated fabs, both in semiconductor as well as display. We plan to set up internationally competitive facilities. Initially there will be support from the government, but we will achieve leadership in due course of time. Apart from capturing the domestic market, we are also going to focus on export plans. We don't just want to achieve fabs, but we want to enable India and Vedanta as Electronic Hubs. That should bring in the entire ecosystem into play," says Pranav Komerwar, CEO Electronics Display & Semiconductors, Vedanta Limited.

The group already has a presence in EMS and PCB assembly verticals of the electronics ecosystem. It is of the view that OSATs and semicon fabs can bring in good value addition. "Out of about $20 billion investment, Vedanta will be making $8 to $10 billion in the OSATs and semicon fabs segment. We want to work under Make in India and put products in the world under our domain," says Pranav.

Reliance Industries Limited has already started work on constructing the Dhirubhai Ambani Green Energy Giga Complex. Located in Jamnagar, Gujarat, the complex will house not one but four gigafactories. These would include an integrated solar photovoltaic module factory, an energy storage battery factory, an electrolyser factory, and a fuel-cell factory for converting hydrogen into motive and stationary power.

"The confidence behind that (India's share in global electronics manufacturing) is because of the interest global champion companies have shown to participate in our PLIs for mobile, where Apple and Samsung as two big players have



Scientist fabricating sensors on semiconductor wafer

committed huge manufacturing investment into India or in IT hardware where, again, we have Dell, HP, Acer manufacturing in India," notes Saurabh.

There are four parts of the scheme. The first one is regarding semiconductor fab where the government is committing almost $10 billion for the overall project. For fab alone it is committing 500 billion rupees, which is almost $7 billion; three or three-and-a-half billion dollars for each fab. Then there is display fab scheme, where again there are various form factors of displays. In the compound semiconductor, that is, in the RF and power category, there already are companies who have registered on the portal. The government, as per Gaur, has received good response in semiconductor packaging as well. Fourth is the semiconductor design linked incentive scheme, where the government has already received 25 odd registrations on the portal.

Saurabh adds, "So we have full registration on the third part and on the first two pieces also have a limited window available, and there is a lot of homework that is required, and we are in constant touch with the potential applicants, and we hope to get a good response in that as well."

The road ahead

Though biggies like Tata and Vedanta have announced big investments and plans, this is not the first time that the country is looking to establish a local ecosystem for semiconductor manufacturing. There has been more than one attempt in the past. As a matter of fact, Vedanta itself had to back out from setting up a display manufacturing unit in India a couple of years ago. The manufacturing in other sectors of electronics has also not come to India as was expected in the past.

"Corning's display glass manufacturing strategy involves disciplined growth to ensure that the global display industry and end-market demand are aligned. One example of disciplined growth is our track record of co-locating with our customers. Our glass plants are directly connected to our customers' fabs. This eliminates packaging, maintains the glass quality, and reduces costs. It also makes us an irreplaceable part of our customers' operations. We are excited about what is yet to come in the display business and by Corning's role in driving this industry ahead," says Sudhir.

"I believe the impetus is now on value adding. First of all, anywhere the assembly section would start like an EMS play, which might not be much of value add but is needed. The PLI schemes by the government are driving the low-investment assembly plants. Today the demand is huge. Our chairman always says that even if you exclude China, and if you count the population of the countries neighbouring India, it still counts for one-third of the world's population. Forget these countries, the majority of homes in India still do not have TV in their house. 500 million Indians do not have a smartphone. This is just the domestic demand I am talking about. Companies and people migrate only when there is a core mass," says Pranav.

He adds, "Display and semiconductor fabs can only come when there is core mass. They act as anchors. There is no place in the world where these industries have come up without the presence of these anchors. We find that the policy is excellent for fab set-up. The third dimension now is to get into quick movement. One way is to invent on our own and do it in 10 to 20 years, while the other way is to partner and learn from the masters."

The technology partnerships would indeed be crucial for companies setting up display or semiconductor fabs in the country. China, Korea, Japan, or the United States of America have been successful and profitable at what they do because the governments, and the private players, never hesitated in collaborating outside their borders. Yes, they assessed all the risks and possibilities, but they were clear from the beginning about their success plans going through the bridge of collaborations, partnerships, and technology transfer.

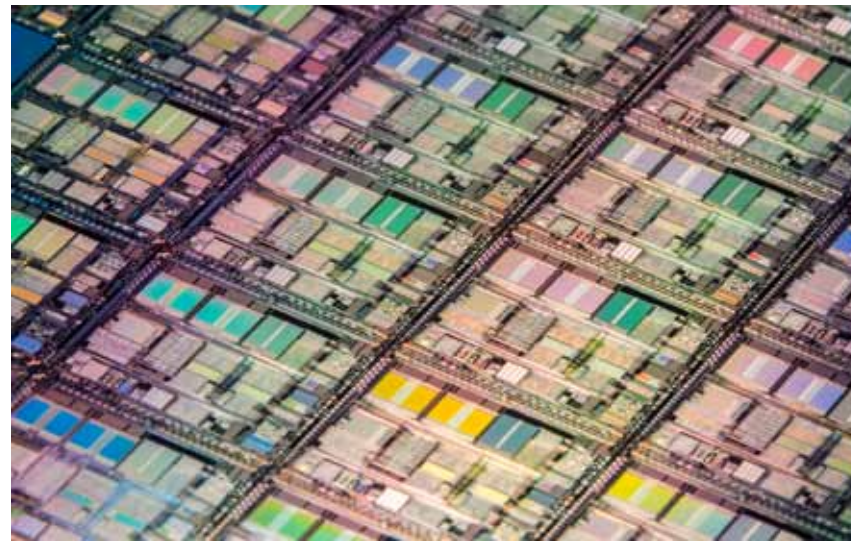
"The demand is huge right now worldwide with AI coming in and trying to mimic the human brain.

Today, AI doesn't even match 1% of the human brain, so you can imagine how far we have to go. Then we have 5G companies, then we have edge computing—so there are so many new areas which are driven by all the applications in many segments, whether healthcare or industrial or agriculture. All these applications need more and more semiconductor chips to be built," shares Sambit.

He adds, "I think India can lead in the areas where there are huge demands in the country, particularly in the areas of healthcare, education, and agriculture. These are great opportunities for India to tap into. And to make this successful, people have to innovate, be risk taking, and I think the ecosystem needs to come together more cohesively.

"Here we are looking at one mega cluster like Hsinchu in Taiwan. And having that 500-acre space with water and power, semiconductor resources available there; that is a collaboration that is gonna happen with government of India and state governments like a partnership, but also more of a challenge that whichever state comes out with the most policies that single-window the process which makes it easier for companies. Because these are huge resources and capital intensive decisions that companies are going to take and it is not a decision linked to this policy alone. And this policy is not the only thing that's gonna happen in this sector. The government is also looking at very long term engagement. So, while this 76,000 crore looks like a big number, we cannot stop there. The government is willing to invest more and there's a reason for that.

He adds, "And my request to the whole industry is that if we can have more risk capital, patient capital driving this. Because hardware is difficult. It's not like enterprise or software where you have immediate wins available, and you can have ten times valuation available in a year or two. Hardware is a game of patience and it requires much deeper collaboration, and we would want more risk capital to get associated with it, and we would definitely see more emergence of electronics and hardware companies also out of India."



CPU silicon wafer seen at 15x magnification under UV lights

Opportunity for start-ups and MSMEs

A look at how the heavyweights like TSMC, Samsung and others function immediately draws attention to how they have developed an ecosystem where hundreds, and even thousands of small companies are supporting their efforts. It would not be wrong to say that these heavyweights are in turn supporting these hundreds of small companies. These hundreds and thousands of small companies specialise in one thing and pass on that thing to the likes of Samsung. The key to success lies in finding out how these heavyweights support these hundreds of companies.

"Korea, Japan, Taiwan, and China have different systems. The Korean government and the Chinese government support big companies and these big companies support small companies in turn. The governments in Japan and Taiwan usually support small companies and these small companies in turn support big companies," says Sung Huk Lee, CEO, TnvisiON.

Then there is more than one example of these small companies becoming a heavyweight over time. The biggest of these is TSMC itself. The company started in 1987 and took around eight years to go public. Additionally, there are examples of smaller companies merging with bigger ones. The news of heavyweights acquiring smaller ones is always there on the circuit. These smaller and bigger companies are able to achieve success together because their thinking process is aligned to each other.

"These companies, from a business or a technology point of view, are able to taste success together because they think alike and they think global. Anywhere you go in the world you will definitely hear about the Samsungs and the LGs. In present times you will also hear about the companies that are supporting them. I think the message is to always have a global part in your approach. Whether you are thinking of supporting Tata or Vedanta, you should always think of marketing yourself globally as well. That is

what is going to sustain," advises Raja.

"What I would like to see on a personal level is that a lot of product innovation happens in India. End product innovation and end device development needs to happen in India too. Because a lot of start-ups today focus more on applications and software, and this focus has to now change into devices, which makes more sense to India. Given the kind of chip manufacturing capability that we have we can do even more innovation. Many of the design houses here can make for India. Made in India and Make in India are great slogans but I would also like to see Design for India as a very key aspect coming in and government driving in more incentives and policy in that front," shares Balaji.

Saurabh adds, "I liked what Balaji said in the sense that if Indian companies are able to grow at scale and engage with these global companies, there is a possibility that in the long term they might be acquired. Even though there is a motive to keep the IP domestic but we would still want more Indian innovation to feed into global companies and hopefully see Indian companies also become global champions in this process."

Support from academia

Academia will also have to play an important role in enabling India as the hub of semiconductor and display manufacturing. Such companies originating in the likes of Taiwan, China, Korea, and Japan owe a lot of their success to academia, and the scenario in India, as Raja explains, will be no different. Raja further explains that as larger companies avoid taking risks, MSMEs might be the right ones to extend their capabilities and try hands at researching with the right institute(s). One such research agency has already existed at IIT Kanpur for more than 15 years and it is known as the National Centre for Flexible Electronics.

"Whether you look at TSMC, or any other such company, the academia has played a very important role in their success. The key for companies will be to find out how they can collaborate with academia and fine tune relationship building," shares Sudheer Kumar, COO, NCFlexE, IIT Kanpur.

Satya adds, "I think academia has a very big role to play here by having more MS and PhD programmes targeted at semiconductors. Going back to the success of Silicon Valley, one of the key reasons of their success was how the two big universities, Stanford and Berkeley, worked with the industry and then had the right skills and the right kind of innovation. It was done in collaboration between industry and the academia, so I urge all the academia to do the same thing and drive the innovation spirit."

He adds, "I think how MNCs like Intel, Samsung, and Qualcomm create alliances in India is also an interesting piece. We have to start collaborating with education institutions and academia more. So, I believe we need to have more programmes on chip manufacturing, because silicon design is complex. But the great news is that we have a good base to start with and we can only get better from here."

"To make embedded systems and VLSI more attractive, I think there needs to be more core work with Academia because there's more to it. AI/ML is important but it's not everything. Unless you get your basic VLSI architecture right, these things won't work because they operate at a much higher level. So, this would mean that a lot of collaboration from the industry is required," says Balaji.

The first-mover advantage

The proverb 'The early bird catches the worm' will be of much relevance to companies deciding to establish semiconductor and display fabs in the country. As explained earlier, there is a huge market waiting to be tapped and then there is the scope of possible exports as the world has started looking for alternatives to China. India is already a market of ten fabs and there exists none in the country.

"There is a first-mover advantage because primarily this is a capital-intensive industry. It is not easy to make an entry, unless there is good support available from the government. Whoever comes forward with initial two-three fabs in each of the sectors will have an advantage. However, what is also true is one or two fabs in the country are not going to satisfy the domestic market. The early movers will have a better learning curve in comparison to others as it is a very long-term game," says Pranav.

India, as suggested by most of the leaders, is at once-in-a-generation inflection point. The country has a huge market, a market that is only starting to mature. The next three decades are forecast to be centered around India. Corning's Sudhir is of the view that good implementation of already announced programmes and a consistency of the same will make India more conducive for conglomerates.

"The devil is in the execution. That is what will keep the market attractive for us," says Sudhir. EFY

Siddha is a business journalist who is fond of recognising and presenting how tech is shaping up the business world. When not writing about EVs and government policies, she enjoys reading non-fiction for fun. Mukul is passionate about how technology can change lives for good, and skeptical about how the same technology can make matters complicated for the very existence of human beings.

This article was developed thanks to sessions held by ELCINA in collaboration with EFY titled "Establishing an Eco-System For Semiconductor & Display Products in India," and by Society of VLSI in collaboration with Times Techies titled "Techade For Semiconductors - The Road Ahead."

UNION BUDGET 2022-23: What It Means For India's Tech And Electronics Industry

Many dream projects of Prof. (Dr) Ashok Jhunjhunwala, IIT Madras, like battery swapping and rural ATMs, seem to be coming true, albeit a bit late. Guess he will be happy to see them coming better late than never



The Union Minister for Finance and Corporate Affairs Nirmala Sitharaman, along with the Ministers of State for Finance Pankaj Chaowdhary and Dr Bhagwat Kishanrao Karad, arrives at Parliament House to present the Union Budget 2022-23 in New Delhi on February 01, 2022 (Credit: pib.nic.in)

RAHUL CHOPRA and **SIDDHA DHAR**

The first thought that went through my mind while trying to compile this list of key Budget announcements was that Prof. (Dr) Ashok Jhunjhunwala at IIT Madras would at last be happy and satisfied. We are working on a story on Prof. Jhunjhunwala, inspired by his vision and grit. Throughout his 30-plus-year career, he has made bold attempts to bridge the gap between Bharat and India. It's frustrating to see how bureaucrats can kill dream projects of technocrats. But that's a different story to be told, and we will be sharing it with you soon.

On the morning of February 1, 2022, the Finance Minister Nirmala Sitharaman jolted the nation through her Union Budget 2022-23 speech. While the speech in itself was not alarming, what

Some points to be mindful of

Rachit Jain, Partner at Lakshmikumaran and Sridharan, advises importers to keep a check on a few important points that are yet to be fully clarified by the government, such as:

A general suggestion would be to be extremely careful in going forward and claiming an exemption which you have been claiming henceforth, because there have been structural changes in terms of phase wise withdrawal of exemptions.

Do not rely solely on the websites and online repositories. Making changes on the websites takes time and there have been errors in the past. So, relying on these sources for filing a Bill of Exemption and claiming those exemptions could be problematic.

Also, be mindful of when those exemptions are proposed to be withdrawn.

The last Union Budget introduced Section 25 (4A), under which a two-year expiry of shelf life has been brought about. In exercise of those powers, expiry dates have been introduced in various items this year. Please be mindful if you are impacted by those dates. If yes, it may be a responsibility of the industry to represent this to the CBIC (Central Board of Indirect Taxes) and request exemption. Otherwise, they will expire.

made this Budget different from those of the past years were the surprising and exceptional elements added in it, making it one whose purported impact would be remembered for a long time.

While the implementation and impact of these decisions can only be seen by those who choose to wait patiently, here are some ways in which the Union Budget 2022-23 could prove to be a game-changer for the electronics industry of India.

The fundamentals

Let us first look at the broader initiatives announced by the government of India and how they are liable to impact the tech and electronics demand in the country:

1. Capex up by 35.4%. Capex target has been increased from ₹5,540 billion to ₹7,500 billion with FY23's effective capex seen to be at ₹1,070 billion. With increasing share of tech in any capex investment, can this translate into a good increase in demand for tech solutions?

2. 150,000 new banks. All the 150,000 post offices will come on the core banking system, enabling financial inclusion and access to accounts through net banking, mobile banking, ATMs, etc. Can this result in greater demand for ATMs, computers, networking, security, and related electronics?

3. 400 new trains. 400 new-generation Vande Bharat trains will be developed and manufactured in the next three years. Again, can this result in increased demand for display screens, cameras, and other tech solutions involved in trains?

4. Digital currency! Digital Rupee, using blockchain, to be launched by RBI in 2023. Now this could be a game changer—it could end or reduce demand for many products like currency counting machines and ATMs, and increase demand for mobile devices to enable transactions—if we need anything other than our mobile phones.

5. 5G in 2022. 5G spectrum auctions to be conducted this year, which may result in greater demand for 5G related electronics, both at the back end and front end.

6. Rating for MSMEs. ₹60 billion programme to rate MSMEs to be rolled out over five years. This may make it easier and safer for us to select the right firms to do business with or extend credit to.

7. E-procurement system. A completely paperless, e-bill system will be launched by ministries for procurement. Will this increase demand for paperless tech, including scanners, computers, and networks? Plus, will this enable faster and more transparent (and less corrupt) procurement?

8. Indigenous rail network. 2,000km rail network to be brought under indigenous technology (KAWACH) for safety and capacity augmentation. Will this result in demand for various tech solutions related to safety, security, and signaling?

9. Domestic defence. 68% of capital procurement budget in defence will be earmarked for domestic industry in 2022-23 (up from the 58% last fiscal). Hopefully, this too should result in increased demand for indigenous electronics and tech solutions.

Change in tariff and notifications

There have been numerous changes in customs tariffs, especially keeping in mind the goal of the government to provide a boost to the electronics manufacturing sector and make the country a manufacturing hub. More than 350 obsolete exemption notifications have been deleted. However, various rate changes and structural changes have made it difficult to gauge how it would affect importers who are looking to claim an exemption that has been revised.

There has also been a change in customs notifications and customs tariffs, wherein many exemptions have been moved from notification to the tariff. Such movement, in certain cases, has resulted in change in effective rate of duty. But in some cases, there are no changes in the effective rate of duty. A lot of new tariffs have also been introduced. New entries with respect to wireless products have also been introduced.

The industry, in general, has been glad that the government has taken in consideration their several recommendations and introduced changes in duties on inputs through customs duty in several products, such as chargers, transformers, solar cell inputs and reviewing Customs Notification 25/1999 and 50/2017, thereby rationalising the duty considerations for various electronic components and subassemblies.

While there have been many changes made to customs tariffs, some of the significant ones are included in Table 1.

There have been ongoing disputes at various ports with regards to classification of wireless headphones and earphones as to whether they would be classified under Chapter 8518 or they can be classified under 8517 62 90 as wireless communication devices. There is an old WCO ruling also being followed as a 2000 circular by the board, which deals with single-piece wireless earphones, wherein the board classified that those products would be classified under 8517. Following the same logic, a lot of importers have been adopting the same classification for their wireless earphones and headphones because the rate of duty by virtue of exemption became nil or 10%.

Now, however, these entries for wireless earphones and headphones have been brought out specifically in 8518. It helps importers to the extent that at least now these entries have been particularly put under this particular heading.

Photovoltaic cells have had an increase in rate of duty. This is an interesting move since these parts are also part of India's commitment to WTO with regards to exempting these parts as part of ITA commitment. Whether it will be a violation of India's commitment will be a matter to be seen.

Various entries have been amended and substituted. It becomes important to look into these exemptions carefully and specifically. Further, vide Customs Notif 02/2022 (NT), major changes have been made in ICGR items (Customs 25/1999), thereby easing the procedure for availing end-use based duty exemption on capital goods.

In terms of the concessional rate on basic customs duty on capital goods that are used for manufacturing electronic items, a sunset date has been introduced for these since capital goods manufacturing and capacity building has been a big goal of the government. Considering that, there is a phase-wise reduction in tariff now and by 31.03.2024 all these would be liable to tariff rate and duties and exemptions would be withdrawn. Businesses importing such goods need to be wary of this and make sure that all imports are made before this date.

Similarly, in notifications on the import of raw materials for electronics manufacturing, multiple entries have been deleted, the objective being to take care of overlap and duplication of notifications. It is not that by dele-

TABLE 1
TARIFF RATE CHANGES IN SCHEDULE 1 TO THE CUSTOMS TARIFF EFFECTIVE 02.02.2022 (ELECTRICAL AND ELECTRONICS SECTOR)

S.No.	CTH/Tariff item	Commodity	From	To
1	8518 21, 8518 22, 8518 29	Single or multiple loudspeakers, whether or not mounted in their enclosure	15%	20%
		(Effective BCD rate on these goods, other than hearable devices would continue to be '15%' vide Notification No. 12//2022-Customs dated 01.02.2022)		
2	8518 30	Headphones and earphones, whether or not combined with a microphone, and sets consisting of a microphone and one or more loudspeakers	15%	20%
		(Effective BCD rate on these goods, other than hearable devices would continue to be '15%' vide Notification No. 12//2022-Customs dated 01.02.2022)		
3	9028 30 10	Smart Meters	15%	25%
		(Effective BCD rate on these goods would continue to be '15%' till 31.03.2022 vide Notification No. 50//2017-Customs dated 30.06.2017)		
4	9028 90 10	Smart Meters PCBA	10%	20%
		(Effective BCD rate on these goods would continue to be '15%' till 31.03.2022 vide Notification No. 50//2017-Customs dated 30.06.2017)		
5	Any Chapter	Camera Lens for use in manufacture of camera module of cellular mobile phones	10/15%	2.5% (effective from 2.2.2022)
6	3208 90 49	Specified parts of transformers for use in manufacture of chargers/ adaptors		
	3919 90 90	Varnish, insulation tape, ferrite core, copper wires enameled, triple insulated winding wire	10/15%	5% (From 2.2.2022 till 31.03.2024)
	8504 90 10			
	8544 11 10			
	8544 49 99			
7	39, 74, 75, 76	Materials used in manufacture of PCBs, metal-clad PCBs	Tariff rate of the respective imported goods falling under Chapters mentioned above	Nil
		a. Composite copper-clad materials consisting of paper + epoxy + glass cloth; b. Glass epoxy copper-clad laminates or paper phenolic copper-clad laminates; c. aluminium based copper-clad laminate; d. copper based copper-clad laminate		
8	8541 42 00	Photovoltaic cells N-T assembled in modules or made up into panels	20% (Tariff rate)	25% (effective from 2.2.2021)
9	8541 43 00	Photovoltaic cells assembled in modules or made up into panels	20% (Tariff rate)	40% (from 2.2.2022)
10	84, 85 or any chapter	Goods imported for providing public mobile radio trunked service by a person licensed by the Department of Telecommunications of the Government of India and parts required for manufacture of the said goods	Nil	Tariff rate (from 2.2.2022)
11	8518 30 00	Parts of line telephone handsets under Sl. No. 9 of NN 25/2005-CUS has been substituted (2.2.2022) with "Line telephone handsets" NOTE: Parts of line telephone handsets will attract the tariff rate	15% (tariff rate)	Nil

TABLE 2
TARIFF RATE CHANGES IN SCHEDULE 1 TO THE CUSTOMS TARIFF EFFECTIVE 02.02.2022

S.No.	CTH/Tariff item	Commodity	From	To
1	9018 32 30, 9018 50 20, 9018 90 21, 9018 90 24, 9018 90 43, 9018 90 95, 9018 90 96, 9018 90 97, 9018 90 98	Specific instruments and appliances used in medical, surgical, dental, or veterinary sciences like tonometer, tubular needles for medical sutures, etc	10%	5%
2	9018 (other than above items and 9018 90 99)	Other medical equipment and medical related goods used in medical, surgical, dental, or veterinary sciences like catheters, cannulae, defribrillator, etc	10%	7.50%
3	9022 14 20 or 9022 14 90	X-ray machines for medical, surgical, dental, or veterinary use	7.50%	10%

TABLE 3
PMP FOR WRIST WEARABLE DEVICES (SMART WATCHES)

S.No.	Chapter, heading, sub-heading, or tariff item	Commodity	From	To			
				2022-23	2023-24	2024-25	2025-26
1	8517 79 10	PCBA	NIL	NIL	10%	15%	15%
2	8544	Charging cable	10%	NIL	5%	10%	15%
3	39, 73, 85	Specified parts of wearable devices	As per CTH	NIL	5%	10%	15%
4	8507 60 00/ 8507 80 00	Battery	15%	NIL	5%	10%	15%
5	8517 79 90	Display Assembly	NIL	NIL	NIL	5%	10%
6	8501	Vibrator Motor	10%	10%	10%	10%	10%
7	Any Chapter	Parts, sub-parts, and raw materials for use in the manufacture of the S. No. 1-6 above	As per CTH	NIL	NIL	NIL	NIL
8	8517 62 90	Wrist wearable devices (commonly known as smart watches)	20%	20%	20%	20%	20%

tion of these entries the exemption is completely lost, because there are alternative exemptions which are also available. This is more of a rationalisation or fine tuning of notifications.

Phased manufacturing programme (PMP)

Phased manufacturing schemes for wearable and hearable devices—a growing market segment in electronics—as well as smart meters, has also been a welcome move of the government, which is expected to put these high-growth sectors on track for domestic value added manufacturing. It provides the opportunity for the industry to have access to raw materials in India. As expected, there have been tweaks made in the exemptions, with rates being increased in a phased manner.

PMP for wrist-wearable devices. Regarding PMP for wrist-wearable devices (smart watches), parts (1 to 7) in Table 3 for manufacture of wearable devices fall under Tariff item 8517 62 90 of the Customs Tariff.

For smartwatches, the tariff rate had been 20% under Chapter 8917 and there was no exemption. Chapter 8517, however, specifically excludes smartwatches from exemption. As far as other items included in the exemption Notification 11/22, they have been given exemption as of now, but the rates are going to increase over a period of time.

PMP for hearable devices. Parts (1 to 7) in Table 4 for manufacture of hearable devices fall under Tariff item 8518 21, 8518 22, 8518 29 or 8518 30 of the Customs Tariff.

For hearable devices, the notification provides a clear definition as to what would be considered as a hearable device. Similarly, items for these have also been given exemption in a phased manner.

PMP for smart meters. The parts in Table 5 for manufacture of hearable devices fall under Tariff item 9028 30 10 of the Customs Tariff.

The Lackeys

While the exemptions are much appreciated, they still have plenty of gray areas. There are items which have been listed under multiple chapters that have different exemption rates. For instance, a communication module is an item listed under smart meters' exemption under 8517 69 60, but there are some communication modules which will also go under 8517 62 90 because they have the ability to communicate on their own on a standalone basis. In that case, under which chapter should these be classified by the importer to be able to get the exemption?

"It is important that before any change has been effected in terms of imports, there must be a clarity as regards the availability of exemption notification and the chances of litigation once the exemption is claimed by the importers. This is just one example to show how changes have been made to the tariffs but there are some things lacking which should be addressed or they may bite us later," says Jain.

To dos promised

Here's a list of initiatives promised by the FM, which relate directly to tech.

1. Optical fibre solutions. Contracts for laying optical fibre in villages to be awarded under BharatNet project under PPP in 2022-23. When executed, this should result in good demand for fibre-optics and related electronics.

2. 5G equipment and devices. Scheme for design led manufacturing to be launched for 5G ecosystem as part of PLI scheme to enable affordable broadband and mobile communication in rural and remote areas. This will provide and promote R&D and commercialisation of tech and solutions.

3. E-passports with chips. The issuance of E-passports using em-

bedded chips and futuristic technology will be rolled out in 2022-23 to enhance the convenience for the citizens in their overseas travel. The back cover is expected to have a small silicon chip!

4. Tax benefits for startups extended. Existing tax benefits for startups, which were offered redemption of taxes for three consecutive years, to be extended by one more year. That's good news for electronics startups!

5. Duty concessions for electronics. Duty concessions being given to promote electronics manufacturing of mobiles, wearable and hearable devices.

6. Increased PLI for solar modules. ₹195 billion additional allocation for PLI for manufacturing high-efficiency solar modules has been made. This should result in further boost to 'Made in India' solar modules.

The promising statements

Here are promising statements that the FM made, which, if executed, could affect the electronics industry.

1. Opening of defence R&D. Defense R&D will be opened up for industry, startups, and academia with 25% of defense R&D budget. Private industry will be encouraged to take up the design and development of military platforms and equipment in collaboration with DRDO and other organisations through SPV model. Can this be the game-changer for India's electronics industry?

2. Battery swapping policy. A battery-swapping policy to be brought out with interoperability standards to boost EV ecosystem. While India had an opportunity to lead this space—had the Government executed Prof. Jhunjhunwala's plans in 2019—one hopes that this policy (whenever announced) will ensure we are not left behind, and EVs will become as budget-friendly as their ICE counterparts, and thereby provide tremendous demand for electronics.

3. Private sector in EV. Private sector will be encouraged to create sustainable and innovative business models for battery and energy as a service, improving the efficiency in the EV ecosystem. Great thought. Look forward to greater execution.

4. Digital health. An open platform for the National Digital Health Ecosystem will be rolled out. It will consist of digital registries of health providers and health facilities, unique health identity and universal access to health facilities. Again, can create demand for multiple tech solutions and products to test and measure health parameters and store that data.

5. Drones for agri. Kisan Drones for crop assessment, land records, spraying of insecticides expected to drive a wave of technology in the agri sector. Thankfully, we do see a bit of action already on the ground.

6. Data centres and energy storage to be infra. Data centres and energy storage systems to be given infrastructure status; this would provide easy financing.

In essence, the Union Budget has highlighted an objective that the Centre has been vehemently addressing for the past couple of years—the *Atmanirbhar Bharat* initiative. With the various electronics-related production linked Incentive (PLI) schemes and policies that the government of India has approved in the past year, it's eagerness to grow the EDSM sector of the country has only grown with the Union Budget. It is now for us to see how far these benefits take our country in the race to become a global leader in the electronics and tech industry. EFY

TABLE 4
PMP FOR HEARABLE DEVICES

S. No.	Chapter, heading, sub-heading, or tariff item	Commodity	From	To			
				2022-23	2023-24	2024-25	2025-26
1	8517 79 10	PCBA	NIL	NIL	10%	15%	15%
2	8544	Charging cable	10%	NIL	5%	10%	15%
3	39, 73, 85	Specified parts of wearable devices	As per CTH	NIL	5%	10%	15%
4	8507 60 00/ 8507 80 00	Battery	15%	NIL	5%	10%	15%
5	8517 79 90	Display Assembly	NIL	NIL	NIL	5%	10%
6	8501	Vibrator Motor	10%	10%	10%	10%	10%
7	Any Chapter	Parts, sub-parts, and raw materials for use in the manufacture of the S.No. 1-6 above	As per CTH	NIL	NIL	NIL	NIL
8	8517 62 90	Wrist wearable devices (commonly known as smart watches)	20%	20%	20%	20%	20%

TABLE 5
PMP FOR SMART METERS

S. No.	Chapter, heading, sub-heading, or tariff item	Commodity	From	To			
				2022-23	2023-24	2024-25	2025-26
1	9028 90 10	Assembled/ Populated PCB for smart meters	7.50%	20%	20%	20%	20%
2	8517 69 90	Communication module	10%	Nil	Nil	5%	10%
3	8536 49 00	Relay	10%	5%	10%	10%	15%
4	8517 71 00	Antenna	Nil	Nil	Nil	5%	10%
5	8524 11 00/ 8524 91 00	LCD and backlight for LCD	15%	Nil	5%	10%	10%
6	8506 50 00	Battery	10%	Nil	5%	10%	10%
7	Any Chapter	Parts, sub-parts, and raw materials for use in the manufacture of the S.No. 1 to 6 above	As per CTH	Nil	Nil	Nil	Nil
8	9028 30 10	Smart Meters	15%	25%	25%	25%	25%

India becomes second largest mobile handsets manufacturer in the world

India has become the second largest manufacturer of mobile handsets in the world, revealed Niti Aayog CEO Amitabh Kant. Over 200 units are manufacturing cellular mobile phones, up from only two units in the year 2014. Production has gone up from 60 million mobile phones in 2014-15 to approximately 300 million mobile phones in 2020-21.

Government to announce battery swapping policy for EVs soon

Finance Minister Nirmala Sitharaman announced during the Union Budget 2022-23 that the government is going to propose a new policy for battery swapping to boost sales of EVs. Sitharaman said companies will also be encouraged to develop sustainable and innovative business models for battery or energy as a service, which will improve efficiency in the EV ecosystem.



Representational image

PEOPLE (on the move)

Viswanathan appointed as MD for Intel India



Intel has appointed Santhosh Viswanathan as Managing Director-Sales, Marketing and Communications Group (SMG) for Intel India. Santhosh is Vice President in Intel's Sales, Marketing and Communications Group. He will be responsible for Intel's overall business in India, including driving new revenue opportunities, engaging with the local ecosystem, and strengthening existing customer and partner relationships.

Tejas Networks appoints new directors



Tejas Networks has appointed N. Ganapathy Subramaniam (left) and Amur S. Lakshminarayanan (right) as Nominee Directors from Panatone Finvest Limited, a subsidiary of Tata Sons Private Limited. N. Ganapathy Subramaniam is Chief Operating Officer (COO) of Tata Consultancy Services Limited (TCS) since February 2017. Amur S. Lakshminarayanan is CEO and MD of Tata Communications.



Guruswamy appointed as NexGen's Chief Systems Officer



GaN power electronics maker NexGen Power Systems has appointed Ganesh Guruswamy as its Chief Systems Officer. Guruswamy will oversee NexGen's Global Systems Engineering group, with established engineering facilities located in Santa Clara, California and Syracuse, N.Y., and the Center of R&D Excellence in Bangalore, India.

Log9 strengthens its 'people' team



Log9 Materials has appointed two industry veterans—Raman S.R. (left) as Chief People Officer and Abhishek Joshi (right) as Head of People Transformation. In their newly-appointed positions at Log9, Raman would be reporting directly to Log9 founder Dr Akshay Singhal, whereas Abhishek will be reporting to Raman.



CORPORATE news

Vedanta and Foxconn JV to manufacture semiconductors

Vedanta and Hon Hai Technology Group (Foxconn) have signed an MOU to form a joint venture (JV) company for manufacturing semiconductors in India. The former, as per the MoU, will hold majority share in the company. Vedanta Chairman has been nominated to be the Chairman of the joint venture company. The company is already engaged in talks with various state governments to finalise the location of the factory.

Reliance buys majority stake in Addverb Technologies

Addverb Technologies has received a funding boost of $132 million from Ambani-led Reliance Retail, following which Reliance will own 55.7% stake in the firm. The funding values the firm at $270 million. The founders continue to hold about 25% stake in the firm.

BoAt files for IPO, signs JV with Dixon Technologies

Imagine Marketing, the holding company of brand BoAt, has filed for an IPO of up to ₹20 billion. The company has plans to issue fresh shares worth up to ₹9 billion and an offer for sale of shares worth up to ₹11 billion. Additionally, Imagine Marketing and Dixon Technologies have signed a joint venture. The duo will be working together to design and manufacture wireless audio solutions. They also have plans to invest in the mobile accessory market under the Make in India Initiative.

Hero Electric and Mahindra Group join hands to manufacture EVs

Hero Electric and Mahindra Group have joined hands to manufacture EVs for Indian as well as the international markets. The partnership announced by the duo is worth ₹1.5 billion and is valid till the next five years. Hero Electric, with help from Mahindra Group, aims to manufacture one million electric vehicles every year. There are plans to increase the numbers as well. Both the companies will be working together to expand Hero Electric's already existing Ludhiana, Punjab facility.



Representational image

Ford looking to make EVs in India and make it export base

Months after shutting its shops in India, Ford Motor is once again looking to restart its production of vehicles in the country, but for EVs this time. Ford said that it is considering producing EVs in India for export, and possibly also for sale in the domestic market. The plant that the company had in the country for manufacturing ICE vehicles is likely to be used as an export base for EV manufacturing.

Ola Electric raises $200 million and sets up R&D centre in the UK

Ola Electric Mobility has raised $200 million (about ₹15 billion) in a funding round from Tekne Private Ventures, Alpine Opportunity Fund, Edelweiss, and others at a valuation of $5 billion. Further, it plans to invest over $100 million (about ₹7.5 billion) in the UK over the next five years to set up a global centre for advanced engineering and vehicle design in the UK, called the Ola Futurefoundry. The factory will be based in Coventry, UK, and work in sync with the design and engineering teams based at Ola Campus in Bengaluru and employ over 200 designers and automotive engineers.

SNIPPETS

- Silicon Labs records $209 million increase in IoT revenue in 4Q21
- ReNew Power forms JV with US based energy storage firm Fluence to bring localised energy storage solutions to India
- BEL signs deal with Hyperion Global to develop IoT devices for US market
- STL wins ₹1.7 billion deal from PGCIL to provide integrated network management systems across their regional communications networks
- Electric One strikes deal with Ipower Batteries for battery retailing
- HOP Electric opens new megaplex in Jaipur, can produce 100 E2Ws per day
- Around 75 space startups have registered in Startup India Portal, says Space Minister
- Chroma ATE Inc. has acquired all shares of Environmental Stress Systems, Inc. (ESS)
- Beowulf Mining and India's Epsilon Advanced Materials to establish anode materials production facility in the city of Vaasa in Finland
- Reliance to invest ₹501.6 million in Altigreen through share subscription

Central Electronics Limited is not privatised yet

The government of India has put on hold the Letter of Intent (LoI) to the successful bidder of Central Electronics Ltd (CEL). The same has been done on the basis of pending examination of specific allegations regarding the bidder. This is after a Congress party spokesperson claimed that the sale was undervalued.

ReNew Power sells its 117MW rooftop solar portfolio to Fourth Partner

ReNew Power has sold 117MW of its rooftop solar portfolio to Fourth Partner Energy for ₹6.72 billion. The company said it sold the distributed rooftop solar portfolio to relocate capital into higher-return opportunities and focus on large utility-scale projects. Net proceeds from the sale stood at ₹5.35 billion after accounting for an outstanding debt of ₹1.37 billion.

Exxelia acquires majority stake in Nashik's Alcon Electronics for $100 million

France based components and sub-systems manufacturer Exxelia has spent about $100 million to acquire a majority stake in Nashik's Alcon Electronics. Alcon is a designer and manufacturer of catalogue and custom-designed film and aluminium electrolytic capacitors, specifically serving the renewable energy, induction heating equipment, medical imaging, power generation, and railways end markets.

Solar PLI scheme to get additional funding

During her Budget speech, Finance Minister Nirmala Sitharaman said that the government has proposed increasing the Production Linked Incentive (PLI) scheme for domestic solar cells and module manufacturing to ₹240 billion from the existing ₹45 billion to make India an exporting nation, outlining an additional ₹195 billion to the scheme.



Representational image

India Semiconductor Mission looking for CXOs

The India Semiconductor Mission (ISM) is looking for a Chief Executive Officer (CEO), Chief Financial Officer (CFO), and Chief Technical Officer (CTO). To apply for the CEO position, one must have at least 25 years of semiconductor industry experience, which should include 10+ years of experience at the global level.

India's first fab unit likely by 2024

India's first fabrication unit is likely to be set up by 2024 as the government targets to approve the application of at least one big global semiconductor fabrication company before March 31. As per a report, the ministry plans to give the winning bidder 700-750 days to allow the construction of the new unit. Apart from the main factory unit, a plan for on-site housing of all employees may also be approved.

MeitY invites applications for financial support to Indian firms to make chips

MeitY has invited appilcations for providing financial support to domestic companies to set up shop for chip manufacturing. Proposals have been invited from Indian companies with indigenous technologies at commercialisation stage in semiconductor and sensor domain focusing on semiconductor fabrication, display fabrication, designing for ICs, chipsets, SoCs, and so on. Last date to submit the proposal is March 26, 2022.

MeitY releases 5-year vision chart to grow electronics manufacturing

The government has released a 5-year roadmap and vision document to grow electronics manufacturing and exports into a $300 billion market by 2026. The report provides a year-wise break-up and production projections for various products. It also seeks a competitive tariff structure for electronic components and removal of all regulatory uncertainty.

Centre notifies drone certification scheme and bans import of drones

The government has notified drone certification scheme to ensure minimum safety and quality and make certification of drones simpler, faster, and transparent. The manufacturer, while applying for certification of a drone, will have to submit various data and test results on topics such as weight, type of launch and recovery mechanism installed, speed, range, endurance, battery performance, and type of material used in construction. Additionally, the Centre has put a ban on the import of drones with immediate effect. The Ministry of Civil Aviation said that while exceptions were provided for R&D, defense, and security, importing drones for these purposes will require due clearances.

Phased manufacturing plan to promote indigenous manufacture of EVs

The Ministry of Heavy Industries has notified a phased manufacturing programme (PMP) to promote indigenous manufacturing of EVs, its assemblies/sub-assemblies and parts/sub-parts/inputs of the sub-assemblies. GST on EVs has also been reduced from 12% to 5%; GST on chargers/charging stations for EVs has been reduced from 18% to 5%.

IT Hardware PLI: India saw production worth ₹672.75 billion in 2021

The Economic Survey of 2021-22 presented by Finance Minister Nirmala Sitharaman revealed that India saw production worth ₹672.75 billion under Production Linked Incentive (PLI) scheme for large-scale electronics. The country saw an investment of ₹25.95 billion and production worth ₹672.75 billion under the PLI scheme, out of which, ₹205.68 billion worth of products were exported till June 2021.

Engineering goods exports grew by 54% YoY in Jan-Apr 2021

Engineering goods exports surged to $81.8 billion during April-December 2021 as compared to $52.9 billion

INTERNATIONAL news

Nvidia-ARM acquisition likely to be shelved

Nvidia Corp's anticipated $40 billion acquisition of UK based ARM Ltd from SoftBank is likely to fall through as it has failed to receive approval to go ahead with the deal. SoftBank is preparing to file an initial public offering for ARM as an alternative to the Nvidia takeover. SoftBank and ARM are entitled to keep $2 billion Nvidia paid at signing, including a $1.25 billion breakup fee, whether the deal goes through or not.

AMD receives all approvals to go ahead with Xilinx acquisition

Advanced Micro Devices Inc. (AMD) is set to go ahead with its $35 billion proposed acquisition of Xilinx, Inc after it received approval from all necessary authorities for the same. AMD said it will combine its CPUs, GPUs, and FPGAs for cloud and edge offerings.

Intel invests $20 billion in chip factories and acquires Tower Semiconductor

Intel has announced plans for an initial investment of more than $20 billion in the construction of two new chip factories in Ohio, USA. At full buildout, the total investment in the site could grow to as much as $100 billion over the next decade, making it one of the largest semiconductor manufacturing sites in the world.

It has also announced a new $1 billion fund to support early-stage startups and established companies building disruptive technologies for the foundry ecosystem. The fund will prioritise investments in intellectual property (IP), software tools, innovative chip architectures, and advanced packaging technologies.

Intel will acquire Israel's Tower Semiconductor for $53 per share in cash, representing a total enterprise value of approximately $5.4 billion.

Toshiba to separate into two companies, invest in new chip fab in Japan

Toshiba is splitting into two standalone companies, both of which will be publicly traded. The separate entities will now consist of Toshiba/Infrastructure Service Co., and Device Co. 1. The corporation will invest around 125 billion yen ($1.09 billion) to construct a new 300mm wafer fabrication facility for power semiconductors, which will be located at its main discrete semiconductor production base, Kaga Toshiba Electronics Corporation, in Ishikawa Prefecture.

Micron to shut its DRAM unit in China's Shanghai

Micron Technology has revealed that it will shut its DRAM chip designing operations in Shanghai by the end of this year. The centre would focus on developing NAND and SSD technology moving forward. The 150 Chinese engineers at the site will reportedly be asked to relocate to the United States or India.

BYD partners with Nuro to make electric autonomous vehicles

BYD has partnered with autonomous vehicle company Nuro. BYD will begin producing the company's third-generation electric autonomous delivery vehicle. BYD will finish assembly of the hardware platform at its Lancaster plant in the United States. Nuro will then complete the vehicle manufacturing process by installing and testing the autonomy systems that will make the platform capable of operation at the company's new facilities in southern Nevada.

GM and LG Energy Solution to build Ultium Cells' manufacturing plant

Ultium Cells, a joint venture of LG Energy Solution and General Motors, will invest $2.6 billion to build its third battery cell manufacturing plant in the United States. The facility will be located in Lansing, Michigan. Ultium Cells will build the new plant on land leased from GM.

Mouser Electronics becomes Liquid Instruments' new global distributor

Mouser Electronics has signed a global distribution agreement with Liquid Instruments. Liquid Instruments makes a new breed of test equipment with Instrument-on-Chip technology. With this, Mouser will now offer the latest Liquid Instruments products, including Moku:Pro, Moku:Lab, and Moku:Go.

Amcor invests $5 million in PragmatIC Semiconductor

Amcor has made a strategic investment in UK based PragmatIC Semiconductor. The latter is known as one of the top players in the world of low-cost electronics. Amcor's $5 million investment was part of the Series C funding round of more than $90 million for PragmatIC Semiconductor.

during the same period in 2020, registering a growth of 54%. In the month of December 2021, exports of engineering goods touched $9.79 billion, registering a growth of 38.41% over $7.07 billion logged in December 2020.

Electronics goods exports rose by 45% YoY in Apr-Dec 2021

Exports of electronics goods from India saw a 49% year-on-year (YoY) surge in the April-December 2021 period, rising to $11 billion as against $7.4 billion recorded in the corresponding period of last year. The overall exports of electronics goods in the financial year 2020-21 stood at $11.11 billion. In just three quarters of the current financial year the exports stand at $11.0 billion, nearly the same as what was achieved in the full year of 2020-21 FY.

China's contribution to India's electronics trade deficit rising since 2019

India's electronics trade deficit in 2021 comprised $7.13 billion from China. Data released by the Ministry of Commerce shows that China's contribution in India's elecronics trade deficit has been on a rise since 2019. China contributed 59.11% to India's electronics trade deficit as of November 2021. These figures, in 2020, were 51.88%.

New EMCs likely to come up soon in Telangana, Maharashtra, Uttarakhand

The government is considering approving three new proposals which it has received for setting up electronics manufacturing clusters (EMCs) from the states of Telangana, Maharashtra, and Uttarakhand. STPI Director General Arvind Kumar added that states such as Himachal Pradesh, Tamil Nadu, Karnataka, and Bihar are in the process to apply for the Central scheme.

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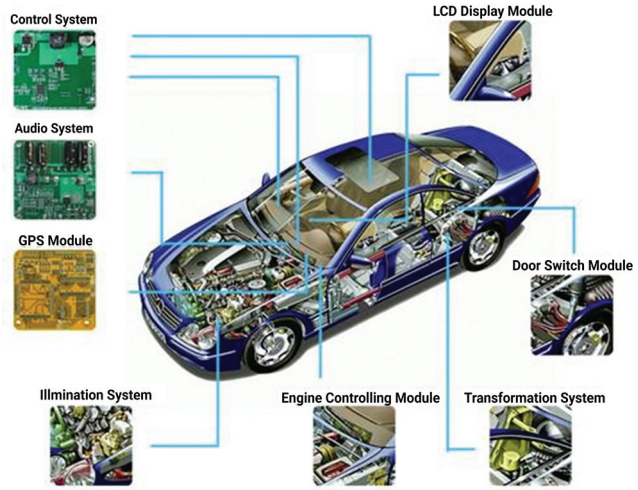
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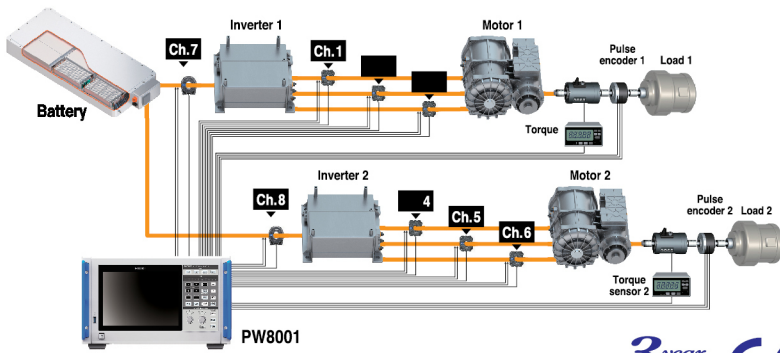


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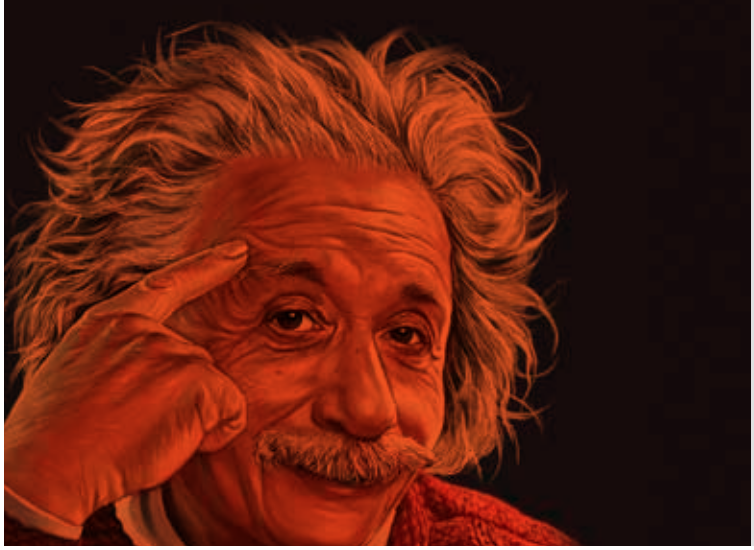
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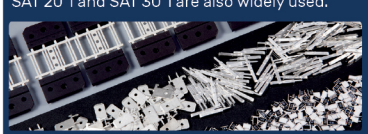
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