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electronics FOR YOU PLUS

FEBRUARY 2017
VOL. 05 | NO. 10
ISSN-2454-4426

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EDITOR : Ramesh Chopra

EDITORIAL CORRESPONDENCE : Editorial Secretary
Phone: 011-26810601; E-mail: editsec@efy.in
(Technical queries: efylab@efy.in)

SUBSCRIPTIONS & MISSING ISSUES : Phone: 011-26810601 or 02 or 03
E-mail: support@efy.in

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FEEDBACK

YOUR SUGGESTIONS

THANKS!

The 'Top 20 Android Project Ideas' under Software Projects on *www.electronicsforu.com* has some really great articles!

Ajith Parma
Through email

EFY. Thanks for the feedback!

REMOTE-CONTROLLED SMARTFAN

This is regarding 'Remote Controlled Smartfan Using AT89C2051' DIY article published in December 2016 issue. I would like to thank the author for designing an interesting and useful circuit and EFY for publishing the same.

Resistors R6 through R9 are mentioned as 100E/2W each. These will be used in series with the fan/light, which will carry full-load current at full speed or brightness. Considering the load as an average of 75W (say), series resistors should be much more than 2W. A tapped resistor (wire-wound) with higher wattage is OK.

Resistor network RNW1 could have been replaced with three 10-kilo-ohm, 1/4W resistors, which is economical and saves space. Moreover, ULN2003 could have been used in place of the three transistors to make the design compact.

M. Hyder Hossain
Through email

The author Pamarthi Kanakaraj replies:
In the circuit, the resistors are completely bypassed (so there is no voltage drop) when the fan is at full speed. In my prototype, I have used a tapped resistor as mentioned in the article.

Three 10-kilo-ohm resistors can be used for compactness as suggested by you. ULN2003 is made up of seven transistors (an array of seven npn Darlington transistors). But I used only three. Moreover, ULN2003 is costlier as compared to three BC547 transistors.

Corrections

In 'IoT-Enabled Air pollution Meter' DIY article published in January issue, 5V for relay operating voltage is not specified and the freewheeling diode across the relay is missing.

Tapan Mojidra
Through email

EFY. Thanks for pointing out the mistake!

In Q&A section of January issue, the last point in the answer to Q4 is wrong. Arduino Uno has 20 input/output pins—14 digital pins and six analogue pins. So there is no difference between the two as far as the number of input/output pins is concerned.

P. Rakesh, Tapan Mojidra and Ayush Khandelwal
Through email

EFY. Thanks for pointing out the mistake!

IR SENSOR BASED POWER SAVER

I constructed the infrared sensor based power saver based on the DIY article of the same name, published in March 2016 issue. It is in running condition but I have a doubt. Resistor R3 (220-kilo-ohm) caused too much voltage drop. So I removed potmeter VR1 (1-mega-ohm) and resistor R3, and replaced these with a 2.2-kilo-ohm resistor.

Muhammad Farhan
Through email

The author Fayaz Hassan replies:
I am happy that someone tried out the circuit and it is working fine. The main purpose of VR1 and R3 is to slowly charge capacitor C3 (1000µF), so that it increases time delay of the PIR or infrared sensor, which has a limited triggering time. If C3 has more internal leakage than the charge input through VR1 and R3, then C3 will never get charged and output of IC1 (NE555) will never change. So use a new and good quality capacitor with at least 25V rating. By changing the charging resistance, only relay hold time will vary and the circuit will function normally.

❏ Can 'Infrared Sensor Based Power Saver' project automatically switch on/off light and fan? Will the project work if two or three people enter the room while one goes out of the room?

Ayan Bhakta
Through email

The author Fayaz Hassan replies:
Yes, it will work. The circuit does not count the number of people. The PIR sensor triggers whenever a person comes in front of it within its range. (Refer datasheet for full details.) If no movement is observed in front of the sensor for a long time, the relay may get switched off. So time delay is adjusted with 1-mega-ohm variable resistor (VR1). Please read Construction and Testing section of the article for details.

MOTOR AND DRIVE SYSTEM

I read 'Selecting an Electric Motor and Drive System' buyers' guide article published in December 2016 issue with great interest. However, the speeds indicated for AC motors on page 82 may need correction. 3600rpm (2-pole), 1800rpm (4-pole) and 1200rpm (6-pole) are applicable to 60Hz line frequency.

For 50Hz line-frequency supply available in India, these should be 3000rpm (2-pole), 1500rpm (4-pole) and 1000rpm (6-pole). This is not a big error, if line frequency is mentioned.

V. Ramprakash
Madurai

EFY. Yes, line frequency (60Hz) was missing in the article. Thanks for pointing out the mistake!

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Q&A

THINGS YOU WANTED TO KNOW!

Ques. WHAT IS DEEP LEARNING?

Ishita Bhatnagar

Ans. Deep learning allows computers to learn on their own, with some guidance. It is machine learning that tries to mimic the way a human brain works, to get closer to the real meaning of artificial intelligence (AI). Machine learning is about teaching a machine to do something. This technology uses a combination of feature extraction and modality-specific machine learning algorithms, along with thousands of examples, to teach a machine to identify things like handwriting and speech.

The process is not as easy as it sounds. It requires a large set of data, heavy computing power and a lot of background work. And, despite tedious efforts, such systems are not foolproof. Deep learning tries to solve these problems and take machine learning one step ahead.

A deep learning computer learns by itself. It is made up of multilayered deep neural networks that mimic the activities of the layers of neurons in the neo-cortex part of human brain. Deep learning uses large number of processors and equally huge amounts of data to feed to those processors.

You may refer to 'Uncanny Vision Uses Deep Learning To Sense Unfamiliar Happenings' and 'Deep Learning Makes Conventional Machine Learning Look Dumb' articles published in January issue.

Q2. HOW DOES AN INKJET PRINTER WORK?

Himanshu S.

A2. An ink-filled print cartridge attached to the inkjet's print-head moves sideways across the width of a sheet of paper that is fed through the printer below the print head. The print-head usually contains four ink cartridges—one each for magneta (red), cyan (blue), yellow and black. Each cartridge is made up of around 50 ink-filled firing chambers, each attached to a nozzle smaller than a human hair.

An electrical pulse flows through thin resistors at the bottom of all chambers of all colours that the printer uses to form a small section of a character or picture on paper. When an electrical current flows through a resistor, it heats a thin layer of ink at the bottom of the chamber to more than 482°C for several millionths of a second. The ink boils and forms a bubble of vapour.

As the vapour bubble expands, it pushes ink through the nozzle to form a droplet at the tip of a nozzle. The droplet overcomes the surface tension of ink, and pressure of the vapour bubble forces the droplet onto the paper. Volume of the ejected ink is about one-millionth of a drop of water from an eyedropper. A typical character is formed by an array of these drops, 20 across and 20 high.

As the resistor cools, the bubble collapses. The resulting suction pulls fresh ink from the attached reservoir into the firing chamber.

Q3. HOW DO DIGITAL SUBSCRIBER LINES, OR xDSLS, WORK?

N. Tiwari

A3. There are several forms of digital subscriber lines, or xDSLs, with x depending on a particular variety of DSL. All xDSL connections use the same ordinary pair of twisted copper wires that already carry phone calls among homes and businesses.

Unlike cable modem connections, which broadcast everyone's cable signals to everyone on a cable hub, xDSLs are point-to-point connections, unshared with others using the service.

Signals travel between a network interface in your PC and an xDSL modem. You do not have to dial up an Internet service provider; your net connection is always on. Most modems have proprietary designs that require the local phone company to use specific equipment.

You can use the same phone line for the Internet service at the same time it is carrying a voice call because the two signals use widely-separated areas of the frequency spectrum. A splitter next to your xDSL modem combines low-frequency voice signals and higher-frequency data signals.

The most common form of xDSL is ADSL, where A stands for asynchronous, meaning that, more bandwidth or data-carrying capacity is devoted to data travelling downstream from the Internet to your PC as compared to upstream data travelling from your PC to the Internet. The reason for the imbalance is that, upstream traffic tends to be limited to a few words at a time.

Transmission rates depend on the quality of the phone line, type of equipment it uses, distance from the PC to a phone company switching office and type of xDSL being used. A splitter on the other end of the line breaks voice and data signals apart again, sending voice calls into the plain old telephone system and computer data through high-speed lines to the Internet.

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

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Diamonds to power quantum computers

Scientists have developed a way to mass-produce tiny diamond crystals shaped like needles and threads, which may power the next generation of quantum computing. Physicists from Lomonosov Moscow State University in Russia have described structural peculiarities of micrometre-sized diamond crystals in needle- and thread-like shapes, and their interrelation with luminescence features and field electron emission efficiency.

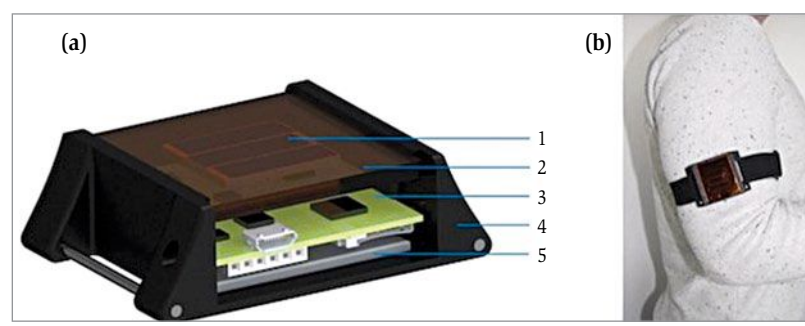
They have shown that low-quality diamond films containing separate, unconnected crystallites could be used for production of diamonds in the form of needle- or thread-like shapes. In order to achieve this, it is necessary to heat such films in an oxygen-containing environment. When heated, a part of the film material begins oxidising and gasifies. Due to the fact that diamond crystallite oxidation requires maximum temperature, it is possible to adjust the temperature so that all material except diamond crystallites is gasified.

This relatively simple technology combines production of polycrystalline diamond films with specific structural characteristics via heating in oxygen. It enables mass-production of diamond crystallites of various shapes. The crystallites could be used, for instance, as high-hardness elements, cutters for high-precision processing, or indenters or probes for scanning microscopes.

Powering medical implants with solar cells

The notion of using solar cells placed under the skin to continuously recharge implanted electronic medical devices is a viable one. Swiss researchers have found that a 3.6-square-centimetre solar cell is all that is needed to generate enough power during winter and summer seasons to power a typical pacemaker.

The study is the first to provide real-life data about the potential of using solar cells to power devices such as pacemakers and deep brain stimulators. According to lead author Lukas Bereuter of Bern University Hospital and University of Bern in Switzerland, wearing power-generating solar cells under the skin can one day save patients the discomfort of having to continuously undergo procedures to change the batteries of such life-saving devices.



(a) Cross-sectional view of the measurement device. The solar cells (1) are located directly below the optical filters (2), while the PCB (3) and the battery (5) are enclosed in the housing (4). (b) Measurement device on the upper arm (Image courtesy: www.energymatters.com.au)

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Researchers achieve breakthrough in flexible electronics

Semiconductors are the very basic components of electronic devices, and these have improved our lives in many ways. These can be found in lighting, displays, solar modules and microprocessors that are installed in almost all modern-day devices, from mobile phones, washing machines and cars, to the emerging Internet of Things.

Dr Png Rui-Qi (left), Mervin Ang (middle) and Cindy Tang (right) working on conducting polymers that can provide unprecedented ohmic contacts for better performance in a wide range of organic semiconductor devices (Image courtesy: www.newelectronics.co.uk)

To make high-performance devices, however, good ohmic contacts with low electrical resistances are required to allow the maximum current to flow both ways between the electrode and the semiconductor layers. A team of scientists from National University of Singapore has successfully developed conducting polymer films that can provide unprecedented ohmic contacts to give superior performance in plastic electronics, including organic light-emitting diodes, solar cells and transistors.

The researchers discovered how to design polymer films with the desired extreme work functions needed to generally make ohmic contacts. Work function is the minimum amount of energy needed to liberate an electron from the film surface into vacuum. They showed that work functions as high as 5.8 electron-volts and as low as 3.0 electron-volts can now be attained for films that can be processed from solutions at low cost.

Flexible transparent conductor free of reflection and scattering

An effort is being made to search alternative transparent conductor materials that could replace indium-tin-oxide (ITO), especially for device flexibility. While the scientific community has investigated materials such as Al-doped ZnO, carbon nanotubes, metal nanowires, ultra-thin metals, conducting polymers and most recently graphene, none of these have been able to present optimal properties that would make these replace ITO.

Flexible transparent conductor (Image courtesy: ICFO-The Institute of Photonic Sciences)

Ultra-thin metal films have been shown to present very low resistance, although their transmission is also low, unless anti-reflection undercoat and overcoat layers are added to the structure. ICFO-The Institute of Photonic Sciences researchers Rinu Abraham Maniyara, Vahagn K. Mkhitaryan, Tong Lai Chen and Dhriti Sundar Ghosh, under the guidance of Valerio Pruneri, ICREA Prof. at ICFO, have developed a room temperature processed multilayer transparent conductor optimising the anti-reflection properties to obtain high optical transmissions and low losses, with large mechanical flexibility properties.

In their study, they applied an Al-doped ZnO overcoat and a TiO2 undercoat layer with precise thicknesses to a highly-conductive silver ultra-thin film. By using destructive interference, the researchers showed that the proposed multilayer structure could lead to an optical loss of approximately 1.6 per cent and an optical transmission greater than 98 per cent in the visible.

The study shows the potential that this multilayered structure could have in technologies that aim at efficient and flexible electronic and optoelectronic devices.

Indian students create disaster recovery and surveillance robot

Fourteen-year-olds Anuj Verma and Shlok Jhawar, students of Delhi Public School, Bengaluru, India, under the mentorship of National Instruments, have successfully created a four-wheeled, all-terrain, multi-purpose robot named, Recon Rover. In their quest to do something for the society, these budding engineers aspired and built the disaster recovery and surveillance robot, Recon Rover, that can be used for surveillance during disasters and natural calamities.

The robot incorporates data from various actuators and sensors to give users the best control and accurate data from areas struck by natural calamities. It uses ultrasonic sensors to automatically avoid obstacles and prevent crashes along with sensing the presence of humans stuck in disaster zones. It sends real-time images and data from the disaster site while being controlled remotely.

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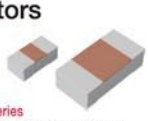

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Future smartphone could be powered by bacteria

The technique could be used to generate energy on a tiny scale and, if used widely enough, may make a big difference and help tackle the growing energy crisis (Image courtesy: www.dailymail.co.uk)

A team of scientists from Oxford University has showed how the natural movement of bacteria could be harnessed to assemble and power microscopic wind farms or other man-made micro-machines such as smartphone components. The team has used computer simulations to demonstrate that the chaotic swarming effect of dense active matter such as bacteria can be organised to turn cylindrical rotors and provide a steady power source.

Researchers say that these biologically-driven power plants could some day be the microscopic engines for tiny, man-made devices that are self-assembled and self-powered—everything from optical switches to smartphone microphones.

Dense bacterial suspensions are the quintessential example of active fluids that flow spontaneously. While swimming bacteria are capable of swarming and driving disorganised living flows, these are normally too disordered to extract any useful power from.

Wearables can tell if you are sick before you can

New research from Stanford shows that fitness monitors and other wearable biosensors can tell when your heart rate, skin temperature and other measures are abnormal, suggesting possible illness.

Wearable sensors that monitor heart rate, activity, skin temperature and other variables can reveal a lot about what is going on inside you, including the onset of infection, inflammation and even insulin resistance, according to a study by researchers at Stanford University School of Medicine.

Geneticist Michael Snyder was wearing seven biosensors collecting data about his health when he noticed changes in his heart rate and oxygen level during a flight (Image courtesy: www.geekwire.com)

An important component of the ongoing study is to establish a range of normal, or baseline values for each person in the study and when they are ill. "We want to study people at an individual level," said Michael Snyder, PhD, professor and chair of genetics.

Lie-detecting kiosks are here

The Automated Virtual Agent for Truth Assessments in Real Time (AVATAR) is currently being tested in conjunction with Canadian Border Services Agency to help border security agents determine whether travellers coming into Canada may have undisclosed motives for entering the country.

AVATAR can detect changes in physiology and behavior during interviews with travellers (Image courtesy: San Diego State University)

According to San Diego State University management information systems professor, Aaron Elkins, "AVATAR is a kiosk, much like an airport check-in or grocery store self-checkout kiosk. However, it has a face on the screen that asks travellers questions, and can detect changes in physiology and behaviour during the interview. The system can detect changes in the eyes, voice, gestures and posture to determine potential risk. It can even tell when they are curling their toes."

Once the kiosk detects deception, it would flag those passengers for further scrutiny by human agents.

ICAROS is the fitness machine that simulates flying

ICAROS is a full-body system with a gyroscopic design, which aims to make working out more enjoyable. In this setup you have to use your core strength to control the movements of the machine and in the game itself. You have to lie in a plank-like position the entire time while flying through an array of virtual settings. You can choose games depending on your physical abilities, and work up to more difficult settings to increase the benefits of the exercise.

Icaros active VR gives you a full-body workout as you swivel to control flight (Image courtesy: www.icaros.net)

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THE BLUE BRAIN PROJECT:
Unraveling The Brain's Mystery

Deepak Halan
is associate professor at School of Management Sciences, Apeejay Stya University

The human brain is the most remarkable creation of God and also the reason behind human intelligence. Blue Brain is the name of the world's first virtual brain—a machine that works on the same lines as human brain. The Blue Brain System is an endeavour to reverse-engineer the human brain and rebuild it at the molecular level via computer simulation. The project was initiated in May 2005 by Prof. Henry Markram at Ecole Polytechnique Fédérale de Lausanne (EPFL) in Lausanne, Switzerland.

IBM (fondly known as The Big Blue) and Swiss University team, associated with fabricating a custom-made supercomputer based on IBM's Blue Gene design, have been working together on Blue Brain Project. IBM brings to the table expertise in visualisation, simulations, algorithms, Blue Gene optimisations and development of innovative computational methods.

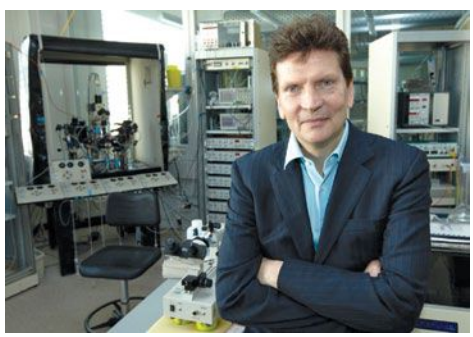

Fig. 1: Professor Henry Markram, father of Blue Brain Project (Image courtesy: Frankenstein Project)

Fig. 2: Blue Brain is the name of the world's first virtual brain (Image courtesy: www.aiyellowpage.com)

Blue Brain Project expects researchers to develop their own models of various brain areas in dissimilar species and at altered levels of detail using Blue Brain Software for simulation on Blue Gene. The objective is to collect these models in a central Internet database from which Blue Brain Software can mine and link models together to form brain regions. This would finally lead to the first whole brain simulation.

It is hoped that Blue Brain Project will enable building up the virtual brain, which will ultimately unravel the mysteries of the key facets of human cognition, such as perception, memory and, may be, consciousness, too. For the first time, we will be able to witness the electrical code our brains use to denote the world, in real-time basis. We also expect to gain an understanding of how certain failures of the brain's microcircuits lead to psychiatric disorders such as autism, schizophrenia and depression.

Reconstructing the enigmatic human brain using IT

Typically, a human brain has over 100 billion neurons or brain cells and about 100 trillion synapses, thus making it a very complex multilevel system. The interneuron connections make up a hierarchy of circuits that range from local microcircuits to macro-circuits that form the entire brain. At the unit level, each neuron and synapse is a complex molecular machine in itself. It is the interactions between these levels that leads to human behaviour, human emotion and human cognition, as we know it.

Blue Brain Project aspires to develop wide-ranging digital reconstructions, that is, computer models of the brain including its diverse levels of organisation and interactions. Blue Brain Project's reconstruction approach pinpoints interdependencies in experimental data; for example, dependencies between the size of neurons and neuron densities, dependencies between the shapes of neurons and the synapses these form, and dependencies between the number of boutons on axons and synapse numbers. It then uses these to coerce the reconstruction procedure. Multiple and intersecting constraints enable the project to develop the most accurate reconstructions possible from the scanty experimental data available, thus

doing away with the need to measure everything.

Digital reconstructions of the brain tissue characterise a snapshot of the anatomy and physiology of the brain at a single moment in time. Blue Brain Project simulations use mathematical models of individual neurons and synapses to calculate the electrical activity of the network as it progresses over time. This demands a very high computational power that can only be delivered via large supercomputers. In fact, the larger the volume of tissue that needs to be simulated and higher the accuracy, the higher is the required computing power.

The range of experiments that can be enabled is proportional to the size and accuracy of digital reconstructions. Blue Brain Project is now constructing neuro-robotics tools wherein brain simulations are coupled to simulated robots and a simulated environment, in a closed loop. These novel tools enable replication of cognitive and behavioural experiments in animals, wherein the sensory organs capture and encode data about their environment, and their brain produces a motor response. The supercomputer based reconstructions and simulations put together by the project suggest a profoundly new strategy for comprehending the multilevel structure and function of the brain.

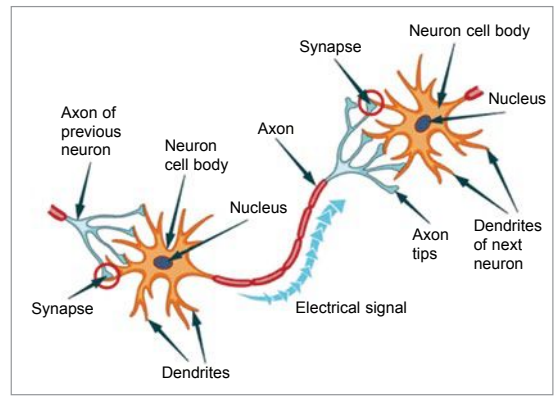

Fig. 3: Illustration showing the basic elements of the human brain (Image courtesy: www.study.com)

Fig. 4: BlueGene/L supercomputer used in the very early stages of the project (Image courtesy: www.ibm.com)

Fig. 5: BlueGene/Q isthe latest supercomputer being used in Blue Brain Project (Image courtesy: www.ibm.com)

The Blue Gene Supercomputer

The Blue Brain workflow demands large-scale computing and data infrastructure. The hardware typically consists of the following configuration:

1. IBM 65,536-core BlueGene/Q supercomputer for modelling and simulation (hosted at CSCS), providing extended capabilities for data-intensive supercomputing (Blue Gene Active Storage)

2. Fourty-node analysis and visualisation cluster

3. OpenStack/Ceph private Cloud running in two regions

4. Different storage systems for data archiving and neuroinformatics

5. Modern continuous integration, collaborative software-development platform

State-of-the-art technology for acquisition of data on various brain levels of the brain organisation comprises multi-patch clamp set-ups for studies of the electrophysiological behaviour of neural circuits, multi-electrode arrays enabling the stimulation of and recording from brain slices, services for the formation and study of cell lines expressing specific ion channels, a multiplicity of imaging systems and systems for the 3D reconstruction of neural morphologies.

This infrastructure has been made available in partnership with EPFL's Laboratory for Neural Micro Circuitry. Accomplishment of Blue Brain Project hinges on very high volumes of standardised and high-quality experimental data that encompasses all likely levels of brain organisation. Data is sourced from the literature (via the project's automatic information extraction tools), from Human Brain Project, from large data-acquisition initiatives outside the project, and from EPFL's Laboratory for Neural Micro Circuitry.

Blue Brain workflow generates a huge need for computational power that falls in high-performance computing arena. In Blue Brain cellular-level models, depiction of detailed electrophysiology and communication of one neuron is estimated to require as high as 20,000 differential equations. While there are modern multi-core workstations, it is very challenging to solve such a high number of equations in biological real time.

Blue Brain Project's simulation of

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the neocortical column incorporates detailed representations of a minimum of 30,000 neurons. Generally, in order to facilitate valid boundary conditions, N times this number is required.

In early stages, IBM BlueGene/L supercomputer running on 8192 processors was being used. BlueGene/L system is a totally new approach in supercomputer design optimised for bandwidth, scalability and the ability to handle large amounts of data while consuming a fraction of power and floor space required by some of the leading supercomputing systems.

The system needs the floor space of about four large fridges, and has a peak processing speed of a minimum of 22.8 trillion floating-point operations per second (22.8 teraflops). This means that the supercomputer can theoretically carry out 22.8 trillion calculations per second. By mapping one or two simulated brain neurons to each processor, the computer becomes a silicon replica of 10,000 neurons communicating back and forth.

BlueGene/L System was designed to simulate high-speed atomic interactions, which also provide the optimal architecture to simulating neural interactions. Simulations optimsed for clusters using MPI messaging can easily be ported to run on Blue Gene. BlueGene/L Prototype System allows parallel processing of virtually any number of processors to meet the memory and speed demands of a simulation. It can be scaled up enormously to meet further computational demand, and has provided the foundation for further development on BlueGene/P, the next-generation IBM supercomputer that constitutes a quantum leap in memory capacity, processing speed and whole-brain simulations.

Till recently, the project was powered by a 16,384-core IBM BlueGene/P supercomputer that had a memory about eight times more than the memory of IBM BlueGene/L. This makes IBM BlueGene/P capable of touching pet flops speeds and quadrillions of calculations per second.

Fig. 6: 3D neuron morphology reconstruction in progress (Image courtesy: www.artificialbrains.com/blue-brain-project)

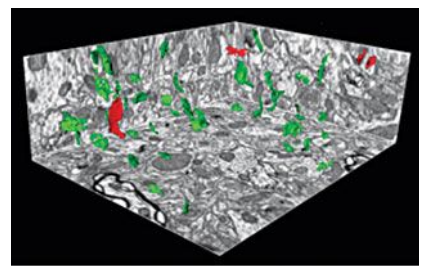

Fig. 7: Three-dimensional reconstruction of synapses. The colour shows whether the synapse is symmetric (red) or asymmetric (green) (Image courtesy: www.upm.es)

Presently, IBM BlueGene/Q supercomputer with 65,536 cores and extended memory capabilities hosted by Swiss National Supercomputing Center in Lugano has been deployed.

The Blue Brain Software

The human neocortex region has millions of microcircuits called neocortical columns and, hence, it is important to create a molecular-level modelling of a neocortical column using sophisticated software. This software version is transformed into a hardware version—a molecular-level neocortical column chip—which can then be duplicated. While there are many software for simple/point neurons, there are no optimised software programs that can carry out very large-scale, that is, tens of thousands, simulations of morphologically-complex neurons. The software for such simulations consists of a hybrid between two powerful software approaches: one for large-scale neural network simulations called Neocortical Simulator and the other is a well-established program called NEURON.

Microcircuit databases are critical as Laboratory of Neural Micro Circuitry has attained a huge quantum of data on the composition and connectivity of the neocortical column. Microcircuit data from many other labs all over the globe will also be included. The new database, NEOBASE, is constructed on ROOT platform and modelled on the lines of CERN's innovative work that has facilitated thousands of researchers to work as one team on the same project.

The ultimate objectives are to enable full-scale researcher interactions through NEOBASE for further construction of microcircuit database, partnered visualisations and planned simulations. Microcircuit visualisation is possible since BlueBuilder has been built to design, upload and connect thousands of model neurons. BlueBuilder uploads Neurolucida files with complete morphological data.

In parallel, the model neurons need to be modelled in NEURON to include the physiological properties. The export from BlueBuilder references NEURON files for BlueColumn simulations, while BlueBuilder pulls out neurons directly from NEOBASE. Connections are formed according to established connectivity rules. Phenomenological and biophysical models of synapses are assigned to the connections within BlueBuilder. It generates two types of output files: first for simulations by NCS or Neurodamus on Blue Gene and second for visualisation in BlueVision.

Visualisation consists of diverse

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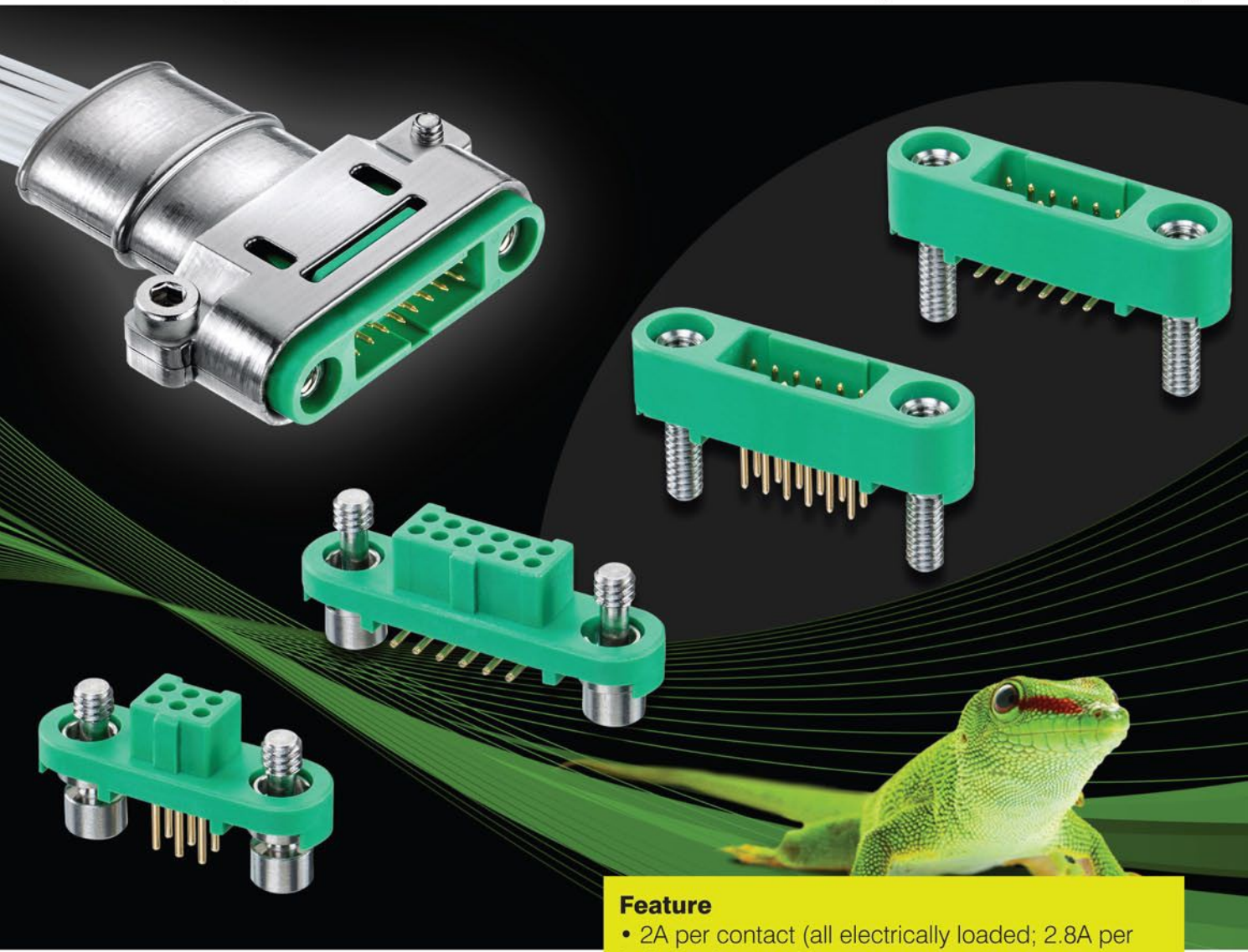

Harwin's Gecko range has now been expanded to include the much-anticipated screw fixings variations, known as Gecko Screw-Lok (or Gecko-SL). The range is being launched with Vertical Throughboard, Vertical Surface Mount and Cable options, all in Male and Female connector types. The same high performance of the existing latched versions is maintained, with the added security of screw fixings.

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graphic formats ranging from neurolucida reconstructions, lines, triangles, particles to NURBS. Ultra-high-resolution graphics are designed by deploying interactive walk inside and navigation technologies. 2D, 3D and 3D immersive visualisation systems are also likely to be used.

BlueImage is a software module connected to BlueVision that permits in silico imaging of the activity produced in the neocortical column. All values that emerge as an output of the simulation can be imaged. Microcircuit analysis is possible as Blue Gene simulations can generate terabytes of data in a span of minutes of simulations.

BlueAnalysis is used to graphically display, analyse, discard and archive data at a speed as high as feasible. Microcircuit simulations are feasible since the neocortical microcircuit is simulated via NeoCortical Simulator, which is capable of large-scale simulations. NeoCortical Simulator is optimised for parallel simulations with MPI messaging and permits easy expansion of the complexity of the simulation.

NeoCortical Simulator is deployed for all large-scale simulations using the least neuronal models. As many as ten compartmental models can be used in NeoCortical Simulator. Detailed neuron simulations are conducted via NEURON developed and implemented for simulations on Blue Gene. A merged NeoCortical Simulator-NEURON simulator called Neurodamus carries out large-scale NEURON simulations. Neurodamus is likely to evolve further for optimal large-scale Blue Gene simulations of multi-compartmental neuron models.

BlueStim is a software interface to Neurodamus that enables mapping of external input into any one of the 100 million synapses in the column. Stimulus Generator permits connecting of columns with the external world or with other columns and other brain regions.

BlueRead, a software interface to NeoCortical Simulator and Neurodamus, enables us to define values that are to be read out of the simulator for visualisation, display and analysis.

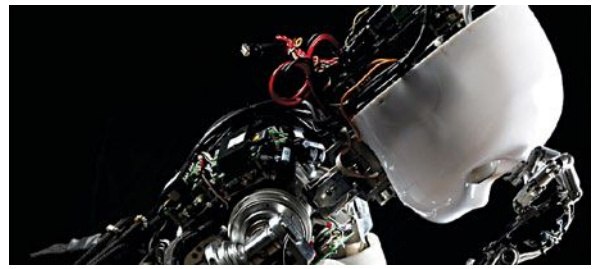

Fig. 8: Neuro-Robotics project aims to understand essential brain mechanisms (Image courtesy: neurorobot.kaist.ac.kr)

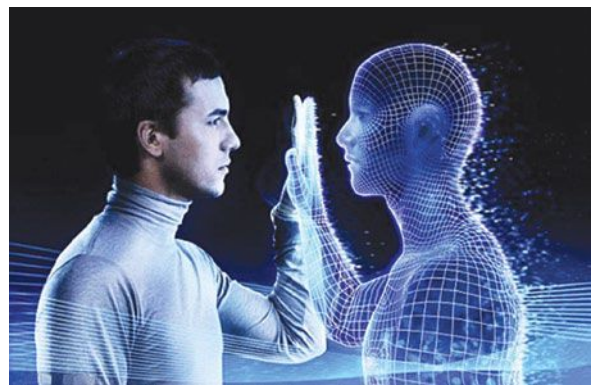

Fig. 9: In the future, we might be able to upload our memories and personalities to virtual avatars, after our death (Image courtesy: www.journal.com.ph)

What the future holds

The brain carries out several analogue operations that computers are not capable of performing and, in many cases, it manages to carry out hybrid digital-analogue computing. The biggest differentiating factor between the brain and computers is that the brain is constantly changing with time. Imagine, if components such as integrated circuits and transistors started changing, then a computer would actually end up becoming unusable. You can imagine the brain as a dynamically-morphing computer, considerably different from other organs like the heart or lungs.

Understanding the brain is vital, not just to understand the biological mechanisms that give us our thoughts and emotions, and that make us human, but for practical reasons. Understanding how it processes information can make a fundamental contribution to the development of new computing technologies—neurorobotics and neuromorphic computing. More important still, understanding the brain is essential to understand, diagnose and treat brain diseases that are imposing a rapidly-increasing burden on the world's aging population.

The present configuration of Blue Gene, that is, BlueGene/Q, is capable of touching pet flops speeds and quadrillions of calculations per second. This supercomputer has as many as 65,536 cores and extended memory capabilities. The next generation of Blue Gene supercomputers is expected to be able to deliver an even higher level of computing power and, hence, be able to simulate even more neurons with significant complexity.

However, sky is the limit, as today scientists are thinking beyond all this and conducting challenging research studies. They are hoping to create an artificial brain that can think, respond, take decisions and store any type of data in its memory. Key objective is to upload a human brain into a machine, which will enable man to think and take decisions effortlessly.

After the death of the human body, the virtual brain will actually be able to act as the deceased. Hence, there will be no loss of knowledge, intelligence, personalities, feelings and memories of humans. In a way, man is on his way to becoming immortal. EFY

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How STARTUPS Can HASTEN DESIGN WITHOUT Burning Through FUNDS

Ramani Sundaresan is managing director, Avnet India

Dilin Anand is executive editor at EFY. He is B.Tech in ECE from University of Calicut, and MBA from Christ University, Bengaluru

Developing a project from scratch is every designer's dream. Unfortunately, most ideas are not designed for manufacturing from the beginning. Often, the changes required are significant enough to prevent a product from even shipping. Tony Fadell, known as one of fathers of iPod, said at a conference, "There is a reason they call it hardware—it is hard."

This does not mean it is impossible, but the designers require access to not only the components and equipment for design, but also the know-how to put it together into a functional product. This means ensuring that their design can be built by the limited capabilities of a manufacturing facility or withstand the noisy analogue world we live in.

This article will give you an industry veteran's take on the best way to reduce time-to-market for a successful design while ensuring you do not draw flak from your investors.

OpEx is better than CapEx

While there are advantages to having state-of-the-art test equipment in your lab, design houses still find it difficult to get experienced design and test engineers who are capable of crafting test strategies and executing test automation and design. Adding the cost of experienced engineers and high-end equipment together is enough to make most angel investors fly away.

> "There is a reason they call it hardware—it is hard."
>
> ***—Tony Fadell, father of the iPod***

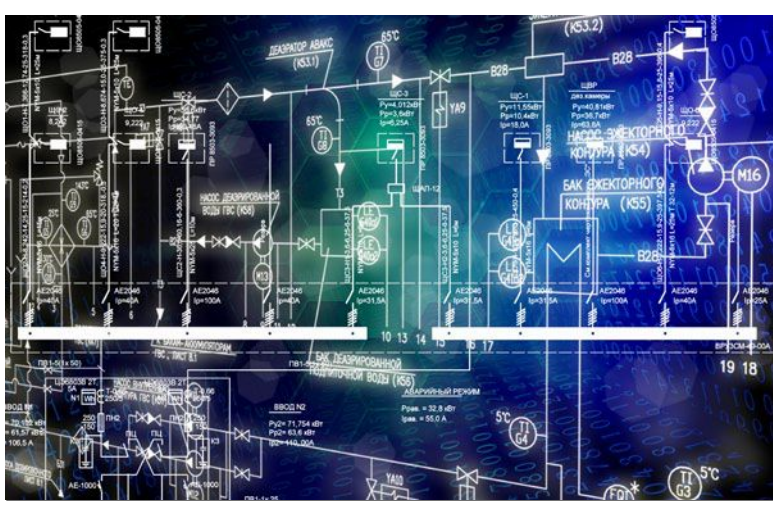
One way to overcome this challenge is to outsource certain elements of design and test to service providers. This ensures that your team focuses on ensuring that the core competencies of your product are delivered.

Everyone loves a smaller bill

There are two ways in which you can lower costs. One is by having your bill of materials (BoM) optimised, and second is by reducing the design cycle time so that you are able to push out two projects or revisions in the time of one.

Most startups begin prototyping on Arduino or use 3D printing for certain components. These methods are almost always way too expensive to be taken to market and do not scale well. You need to move on to a custom-designed circuit board that delivers the feature set you need and nothing else. This is where elements like the power supply and peripherals that you took for granted earlier begin hatching plans to ditch you.

What you could do here is to put together the proof-of-concept, no matter how bulky it is, and then approach the manufacturer to communicate your idea. The manufacturer will help you in refin-



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ing the design further.

You can also optimise your BoM by speaking to the design teams at semiconductor vendors, distributors or even at certain electronics manufacturing service providers. Sometimes, certain manufacturers may be able to let you get lower prices on components by piggy-backing on another order and, thus, combining the volume of two projects to bring down prices.

Nobody likes iterating over and over

Always remember to take great care of your mechanical design. Because no matter how nice your 3D-printed version looks, you will now need to work with real computer-aided design tools to design something that works within the tolerances of your manufacturer. Not to mention ensuring that the structure is strong and robust enough to work after being manhandled during the delivery process.

You will also need to account for that product's use cases. A completely-sealed housing might get your product to work in your air-conditioned lab but may fizzle out when used in the mid-day Sun. Any mistake made in the manufacturing stage could set you back by a lot of time. Re-tooling is expensive and an expense that you can only avoid by being careful.

Design for manufacturing is the most important part here, and there is no easy way out of it. Connecting with manufacturers early on is one good idea that you can try by using your personal network, your investor's network, forums or meeting these firms at exhibitions and conferences.

Your relationship with your component vendor, supplier and manufacturer are all very important. But always remember that a component vendor will always try to push their own components over competitors' (they are running a business after all). The best way to ensure unbiased input is to work with one of the many distributors since they represent a large number of vendors together. This could also help you benefit from a more comprehensive BoM optimisation than what would have been possible earlier.

Expertise ≠ Experience

This is one important lesson that all engineers need to understand. Expertise is when you have expert skill or knowledge in a particular field. It is the total skill and knowledge of a field that a person has. Definitions give the idea that expertise is a super-set of experience. However, experience provides a lot of hidden expertise gained through having done something in the past, faced a challenge and figuring out a new way to solve that challenge.

Experienced engineers can help take startups through challenges, and sometimes even proactively guide them around challenges before these even happen.

The best way around most problems is to have experienced people in your team (which is expensive) or to partner with experienced agencies that can provide guidance to your team of experts.

Testing without spending a bomb

Test equipment is very useful but often quite expensive. These are a must-have for any design house, but not all startups have the funds to afford such a lab—not to mention the staff to run it. Working with a testing service provider or facility will let you make the most of their expertise at a much lower cost.

The other bonus of working with a testing service provider is that you will very often get free design help without having to explicitly pay for it. Test service providers are perfectly positioned to employ the best engineers available in the industry because use of their skills at a testing facility are maximised. Getting an experienced pair of eyes to look at your products and review could help you identify quirks or implement tweaks that could help take your product up a notch.

We once had a firm that wanted to get Federal Communications Commission (FCC) certification for a wireless product that they had designed. Since it is pretty expensive to get FCC certification where the process is an arduous one, they got their products tested and fine-tuned by external authorities before they were confident enough to attempt and get it FCC-certified, which they eventually did. The customer not only saved a lot of money in the process, but also precious time-to-market.

However, more often than not, standalone testing labs charge for pay-per-use scenario, and you end up doing just the testing. Some companies like Avnet India are now coming out with testing as a service. As previously seen in the software testing space, testing as a service lets you leverage test equipment in addition to design service consultation, schematic and layout design and review, firmware development, and final design testing and verification.

Go ahead, make your investor proud

Whether it is an angel investor in the form of your family or a venture capitalist who trusts you to multiply his money, startups owe them a successful project.

Today, we are living in a world where we can give startups a faster start. The objective for any successful project is faster time-to-market. Advice shared in this article is not about addressing a lack of skills, but to optimise the way you leverage people around you to save money and time. EFY

BIOMEDICAL SENSORS Advancing Medical And Biotechnology

Anand Nayyar is assistant professor in Department of Computer Applications & IT, KCL Institute of Management and Technology, Jalandhar, Punjab. He has chaired many national and international conferences, and has published more than 250 research papers. He is life member of CSI-India, and senior member of ACM

Vikram Puri is member (ACM), theIRED, International Association of Engineers. He is interested in embedded systems, real-time systems, robotics, microcontrollers and programming in C/C++

Sensors are small, tiny and intelligent devices that are used to measure physical variables like temperature, humidity, gas, velocity, flow rate, pressure and so on. According to American National Standards Institute, a sensor is defined as a device that provides a usable output in response to a specified measure.

A sensor acquires a physical quantity and converts it into a signal suitable for processing, for example, optical, electrical and mechanical, whereas a transducer converts a signal in one form of energy to a signal in another form.

According to the basic sensing principle, sensors can be classified into mechanical, electrochemical, bio, optical, semiconductor, magnetic and thermal types.

According to physical parameters measured by sensors, these can be classified into resistance displacement, inductive displacement, capacitive displacement, piezoelectric pressure, laser interferometer displacement, bore gagging displacement, ultrasonic displacement, optical encoder displacement, optical fibre displacement, optical beam deformation, flow, imaging, temperature, intelligent and chemical ingredient types.

The medical sensors market

The global medical sensors market is estimated to reach US$ 15.01 billion by 2022, at a CAGR of 8.5 per cent between 2016 and 2022. People are increasingly adopting home healthcare services owing to the rising costs of medical treatments in hospitals and medical care clinics. With this, demand for various healthcare devices is expected to increase in the next few years. Introduction of new medical sensors in the global market is expected to contribute towards the growth of the global medical sensors market in the years to come.

Market sizing for global medical sensors was done by top-down and bottom-up methods. In the bottom-up approach, market size, in terms of volume, for each type of medical sensors was calculated with their average selling price and then each type was mapped with applications. Summation of revenue from all types of sensors and applications gave the overall market size.

In the top-down approach, top companies in the market were analysed and their product portfolio studied to get the global market size for medical sensors. This overall market was analysed by percentage contribution of segments such as geography. Finally, geographic split of segments was further analysed to arrive at region- and country-wise break-up of the overall market.

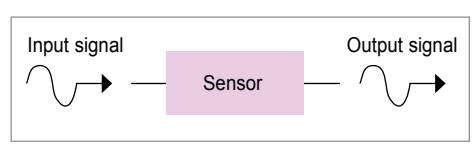

Fig. 1: Block diagram of a sensor

Sensors in medical and biotechnology

In medicine and biotechnology, sensors detect specific biological, chemical or physical processes and then transmit or report this data. Some sensors work outside the body, while some are implanted inside the body.

Sensors used in the medical sector range from temperature sensors, pressure detectors, flow sensors, acoustic sensors and gas sensors to cameras, image sensors and magnetic field sensors. Image sensors and cameras used in the medical sector can be optical, X-ray and ultrasonic.

Use of sensors in the medical sector depends strongly on the application. The market for biomedical sensors and cameras as well as image sensors is growing in importance. MEMS sensors are expected to enable the design and production of

smaller, smarter and lower-priced medical devices and systems with more functionalities. Global demand of wearable, wireless and disposable medical sensors continues to rise.

In medical diagnostics, various sensors are required for digital blood pressure meters, digital thermometers, breath analysers, spirometers, peak-flow meters, respiration pulse oximeters and sleep apnea monitoring devices, among others.

Biomedical sensors

In medicine and biotechnology, biomedical sensors can detect specific biological, chemical or physical processes and then transmit or report data. These sensors can also be components in systems that process clinical samples, such as increasingly common lab-on-a-chip devices.

Biomedical sensors are also used to monitor the safety of medicines, food, environmental conditions and other substances we may encounter. Upgrades in patient treatments can come to fruition through distinguished proof of new markers of malady, quick findings and more successive or non-stop observing, in the healing centre.

The empowering innovation for these energising advancements ranges from sub-atomic tests to entire estimation frameworks, and envelops substance sensors and biosensors, low-power circuits for information preparing and remote transmission, and novel ongoing sign handling.

The ecosystem of medical sensors includes research and development, assembly and manufacturing, suppliers, system integrators, distribution, marketing and sales, and end users.

Medical sensors can be categorised on the basis of type, application and placement.

On the basis of type. Temperature sensors, blood glucose sensors, blood oxygen sensors, ECG sensors, image sensors, motion sensors, inertial sensors, pressure sensors

On the basis of application. Diagnostics, monitoring, medical therapeutics, imaging, wellness and fitness

Fig. 2: DMI device

Fig. 3: Vital sign monitoring platform

Fig. 4: Eigen Lifescience device

On the basis of sensor placement. Strip sensors, wearable sensors, implantable sensors, invasive/non-invasive sensors, ingestible sensors

Special features of a biosensor are:

- Immobilised biological active material is used as a catalyst, and expensive reagents could be repeatedly used to detect same biological parameters.
- A biosensor has intensive specificity. Biomaterial only senses definitive ingredient and it is not affected by colour and concentration of measured material.
- A biosensor could quickly analyse the result of the measurand.
- A biosensor's accuracy is very high, and a relative error could reach one per cent.
- A biosensor's analysing system is very simple.
- Cost of a biosensor is low.

Next-generation biomedical sensors

DMI. DMI stands for DNA Medical Institute. DMI device is a portable, compact device that uses a single drop of blood to perform hundreds of clinical lab tests, telling patients with gold-standard accuracy whether they have anything from the common cold to Ebola. DMI has a wide reach, focusing on global health, emergency and critical care, and Space medicine.

Vital sign monitoring platform. This device is strapped to the upper arm, where it measures a wide variety of data as patients go about their daily lives. Measurements include temperature, blood oxygenation, movement and activity, heart rate, and cutaneous blood perfusion and volume, among others. Data is then uploaded to the Cloud and viewed on a smartphone or computer.

Eigen Lifescience device. Eigen Lifescience device enables Hepatitis B rapid blood tests that can be analysed in minutes using the microprocessor on a smartphone. Designed for use in developing countries, the test can pinpoint patients who need treatment the most, thus, allocating services where these are most necessary. For instance, a child whose mother is infected with Hepatitis B must be treated within 12 hours. The experimental device might one day lead to testing for problems such as HIV, heart diseases and more.

Endotronix wireless health monitoring. Endotronix has patented a new type of wireless sensor reader. The experimental product is designed with a sensor that is

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implanted during a routine catheterisation procedure. It requires no leads or implanted batteries, and sends data to a secure Web platform. The sensor is designed to improve the quality of life and medical outcomes, as well as lower costs for those who suffer from congestive heart failure and other cardiac ailments.

Fig. 5: Endotronix wireless health monitoring

Fig. 6: Golden Gopher Magnetic Biosensing system

Fig. 7: Electronic Aspirin

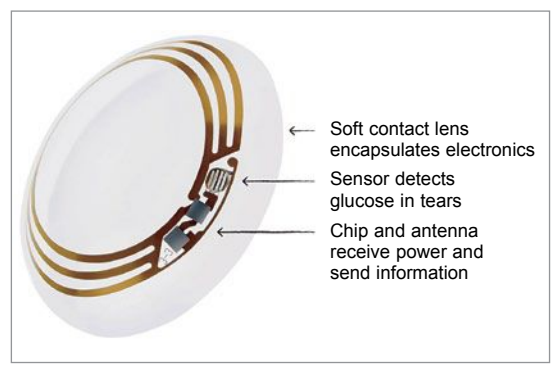

Fig. 8: Google's smart contact lenses

Golden Gopher Magnetic Biosensing system. This portable, low-cost and easy-to-use device detects biomarkers in human serum and urine, as well as heavy metals in lake water. Known as Z-lab, this highly-sensitive sensor is now in development for smaller, more portable models.

Electronic Aspirin. For people who suffer from migraines, cluster headaches and other causes of chronic, excruciating head or facial pain, the 'take two aspirins and call me in the morning' method is useless. Doctors have long associated the most severe, chronic forms of headache with sphenopalatine ganglion (SPG), a facial nerve bundle, but have not yet found a treatment that has a long-term effect on SPG.

Electronic Aspirin is a patient-powered tool for blocking SPG signals at the first sign of a headache, and involves the permanent implant of a small nerve-stimulating device in the upper gum on the side of the head normally affected by headache. Lead tip of the implant connects with the SPG bundle, and when a patient senses the onset of a headache, he or she places a handheld remote controller on the cheek nearest to the implant. Resulting signals stimulate SPG nerves and block pain-causing neurotransmitters.

Google smart contact lenses. Google has created smart contact lenses made for people who suffer from diabetes and those who simply wear glasses. The technology is engineered to take the tears in a person's eye and measure glucose levels. For people who wear glasses, the lens would be engineered to what the companies say is 'to restore the eye's natural autofocus.' EFY

DIGITAL MONEY For Digital India

Manu Prasad is M.Tech in VLSI and embedded systems, and is currently working as assistant professor at AWH Engineering College, Kerala. His interests include VLSI, EDA tools, MATLAB and Latex

On November 8, 2016, at 20:15, Prime Minister of India Narendra Modi addressed the nation through an unscheduled television speech. He declared that from November 9, 2016, the government of India would cease the usage of all 500- and 1000-rupee notes as legal tender, and instead new 500- and 2000-rupee notes would be available for exchange. The government claimed that this was being done to stop terrorism funding, crack down on black money, and reduce corruption and smuggling in India. However, after the announcement, banks and ATMs in the whole country faced severe shortages of currency.

The government of India is now trying to implement a cashless society. After the demonetisation move, several initiatives were taken to further encourage cashless transactions. Almost 300 per cent increase in digital payment activities has been observed since early November 2016.

In this article we present some of the many digital alternatives for making payments.

Debit and credit cards

A debit card is used to withdraw money from ATMs and to make purchases online and offline. The money is debited directly from your bank account. The card has a black magnetic strip on the back or a chip on one side, in which your account information and other details are embedded.

Fig. 1: Some popular mobile wallets in India

Fig. 2: Adding a beneficiary account

For making payments using a debit card, the merchant uses a point of sale (POS) machine to swipe or insert the card. Steps to be followed in this method are as follows:

1. While accepting a payment, the merchant submits the details after swiping or inserting the debit card on the POS machine.

2. You provide your personal identification number (PIN) though the machine.

3. After submission, the device communicates with your bank and deducts the amount from your account.

4. Two receipts are printed, one for you and the other for the merchant on the POS machine after successful payment.

5. An SMS from the bank confirming the transaction is sent to your registered mobile number.

In case of a credit card, the payment amount is not deducted while using the card; the payment is made later by the user.

Most online shopping websites support the use of debit and credit cards. Here, shopping venders direct you to the selected bank payment portals, where you enter your debit or credit card details like card number (16-digit number provided on the card), validity date and CVV number (last three digits provided on the back of the card next to your signature). Then, you have to provide a one-time password sent by your bank to your phone or your Internet password for netbanking. A successful transaction message page is displayed after the payment is done.

RuPay is an Indian domestic card launched by National Payment Corp. of India. It facilitates electronic payments from all Indian banks. The procedure for using RuPay is the same as that of other debit cards.

Mobile/digital wallets

A mobile wallet is a virtual wallet where you can preload a certain amount of money from your bank account, and use this amount as cash. For example, if you go to a coffee shop and the coffee shop supports, say, PayTM wallet, you can pay your bill using the same.

There are four types of mobile wallets in India, namely, open, semi-open, closed and semi-closed. Open wallets allow you to buy goods and services, withdraw cash at

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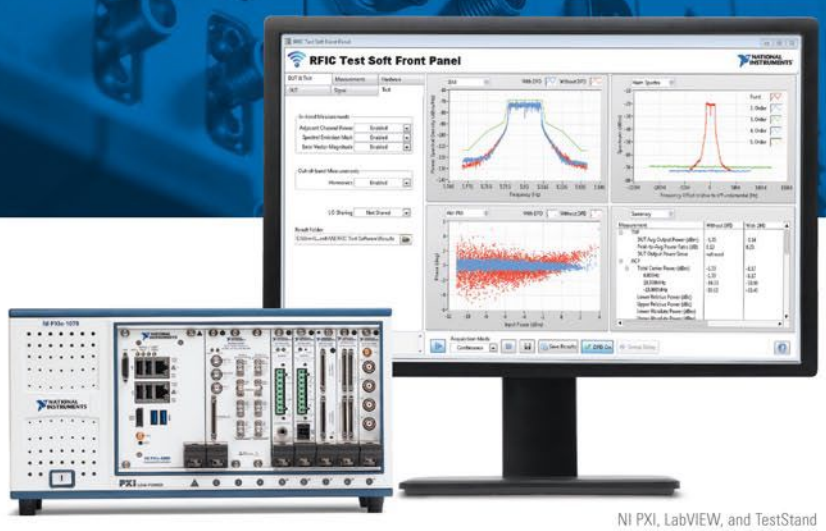

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ATMs or banks and transfer funds. These services can only be jointly launched with a bank; for example, M-Pesa by Vodafone and ICICI.

Airtel Money is an example of a semi-open wallet. To transact, the merchant must have a contract with Airtel. You have to spend what you add in the wallet, and would not be able to withdraw cash or get it back.

In a closed wallet, there is a certain amount in your account that will be locked with the merchant in case of cancellations or returns.

Semi-closed wallets do not permit any cash withdrawals or returns, but allow you to make purchases that support the wallet. The best example here is PayTM.

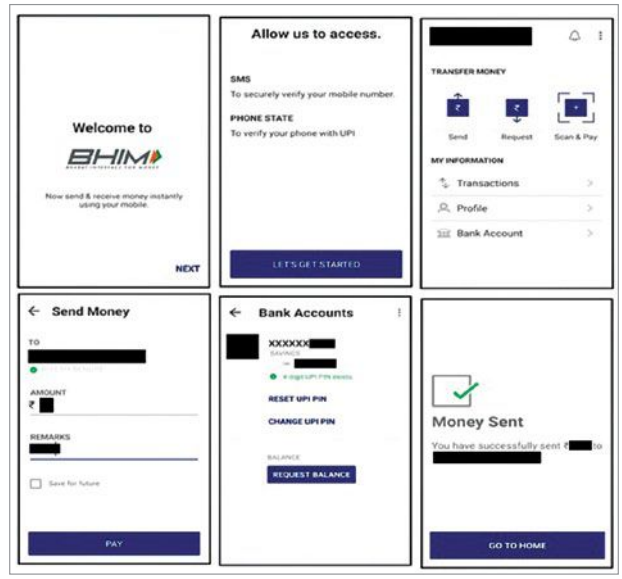

Fig. 3: BHIM app screenshots

Steps to use a mobile wallet are:

1. Download the mobile wallet app on your mobile.

2. In the application, go to wallet section and add money to the wallet using the payment procedure.

3. After checkout from merchants who participate in the particular mobile wallet model, choose the mobile wallet option and pay. There are different types of verifications available in wallets like one-time password, PIN, scan code and so on.

NEFT, IMPS and RTGS

National Electronic Fund Transfer (NEFT), Immediate Payment Service (IMPS) and Real Time Gross Settlement (RTGS) allow fund transfer from bank to bank for individuals as well as companies. This can be done through the Internet banking facility, and it is possible to transfer money within the country only. To use these, you need to first add the beneficiaries to your account.

Please note that minimum amount for transferring through RTGS is ₹ 200,000. NEFT is settled in batches at the time defined by RBI, while RTGS and IMPS are settled immediately.

Steps for using NEFT/RTGS for State Bank of India Internet banking are:

1. Login to the Internet banking account.

2. On the account page, choose Third-Party Transfer option in the drop-down list. You will be directed to Add Beneficiary link; click on it (Fig. 2). You might have to provide your security password for that.

3. On this page, add beneficiary account details in relevent fields.

4. After successful addition of beneficiary details, the bank will take 24 hours to approve payment to the beneficiary account.

5. Once approved, go to Inter Bank Transfer option under Payment/Transfer tab. Opt for RTGS, NEFT or State Bank Group.

6. On the next page provide the amount and remarks, and select the beneficiary account. Transfer can also be scheduled for a later time. After giving the required details, you can transfer the money.

7. A successful transaction message will appear if the process is successful.

State Bank of India also provides quick fund transfer option, where adding the beneficiary is not needed. You can directly provide account details and amount to transfer, and send the money. A small service charge based on a slab may be applicable while transferring money through NEFT/RTGS.

IMPS facility is provided in banks to transfer amounts up to ₹ 200,000 immediately, after proper registration of the beneficiary.

UPI

Unified Payment Interface (UPI) is a system that helps combine multiple bank accounts into a single mobile application. It merges all bank features and other activities in one place. UPI helps you to pay directly from a bank account to another in online and offline modes. You do not have to add any beneficiary or insert any card details or IFSC code, etc. UPI applications are available for different banks. Since you only need to share the virtual address and not any sensitive bank information, UPI is much safer and faster.

After downloading and installing the application on your smartphone, follow the steps given below:

1. Set up application login information. Your mobile phone number must be the registered number in your account.

2. In UPI registration, you have to give a unique virtual address for the account. This account address will be in the bank domain according to the installed app. You can select the bank in which you have the account.

3. Enter other details and submit after accepting the terms and conditions.

4. After registration, create a password to login to the application.

5. Set up a UPI PIN. For this, select your options, and a one-time password will be sent to your reg-

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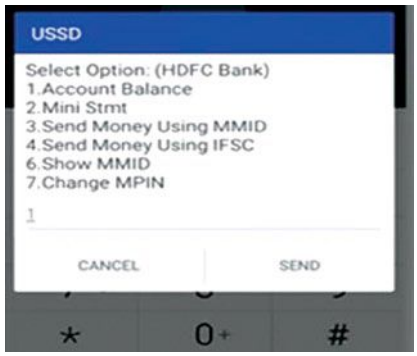

Fig. 4: Option screen for USSD

Fig. 5: Steps for fund transfer through USSD code

istered mobile number. Using this password, you can create your UPI PIN (MPIN). After necessary setups, you can transfer money using this method to any bank account.

6. In UPI app (for example, SBI Pay) it is possible to pay through UPI or bank account method. If you choose UPI, you need to enter your UPI virtual address and details. For bank account transfer, you need to enter account number, IFSC code, payee name, etc.

7. While transferring using UPI, once you enter the virtual address, all other details will get automatically filled in various fields. You will be guided to security MPIN entry, and the transaction will be complete.

Note that, to transfer money through UPI, your bank must support UPI. Most major banks support it, including State Bank of India, Canara Bank, ICICI, UCO Bank, Federal Bank and Punjab National Bank.

BHIM app

Bharat Interface for Money or BHIM (Fig. 3), is a common application for all banks and financial institutions. The app does not require an Internet connection, so it can also work on feature phones. An Aadhaar based payment system will be added soon. After that, for transactions, BHIM will not even need a mobile phone or the Internet; thumb impression would be enough.

BHIM has features like linking bank accounts, sending and receiving money, profile saving, adding beneficiaries, changing languages and balance enquiry. Banks supporting UPI are already supporting BHIM app, and there will be more banks supporting it soon.

Steps for using BHIM are the same as UPI. You can use the existing UPI account for BHIM app.

USSD based mobile banking

Until now you saw applications and methods, except in case of BHIM, that needed at least a smartphone and Internet connectivity. But there are times when you do not have access to the Internet or even a smartphone, and that is when USSD based mobile banking can come to your rescue.

USSD is short for Unstructured Supplementary Service Data. Its platform is built by National Unified USSD Platform. Communication between telecom operators and banks is done through global system for mobile (GSM), since it works on phones with basic calling functions. This method aims to reach rural areas and non-English speaking people, and it supports up to 11 Indian languages. You can access your bank account and transactions using your registered mobile number. You also need a Mobile Money Identifier (MMID) and an MPIN, which will be sent to you by your bank.

Steps for using this method are:

1. Dial *99# from our mobile number. You will get a greeting message asking for the first three letters of your bank's name or its four-letter IFSC code. For example, for HDFC bank, type HFD (Fig. 4). If you are dialling for the first time, then you will get a welcome message asking you to register.

2. The second screen gives you options where you can type and send the option number and get the information of the bank. For example, if you want to know your account balance, type 1 and click on Send. You will receive the account balance.

Similarly, to transfer funds using MMID, type 3 in numeric and send. You will then have to enter the ten-digit beneficiary mobile number followed by the recipient's MMID.

3. Enter the transaction amount, followed by space and transaction remarks. Then you will be asked to enter the four-digit MPIN and last four digits of your account number separated by space.

4. Once the transaction is authenticated, funds will be transferred to the beneficiary account.

As of now, there are limitations in options and some error message pops up from time to time. Also, transaction limit is ₹ 5000 per transaction.

Gift cards

A gift card is a pre-stored value money card issued by a merchant or bank. It can be used as an alternate to cash for purchasing in a store or from a retailer. It is similar to a debit/credit card, which has a specific number or code; sometimes, information is available on the magnetic strip at the back.

You can purchase a gift card directly from the merchant or bank, or can also get it online. The person you gift the card to can use it to buy something of his or her choice. The balance can be carried over to the next purchase(s). EFY

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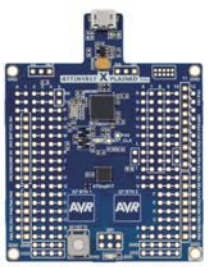

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From Lightweight Ceramic HEAT-SINKS To INTERFACE SOLUTIONS For Heat Dissipation

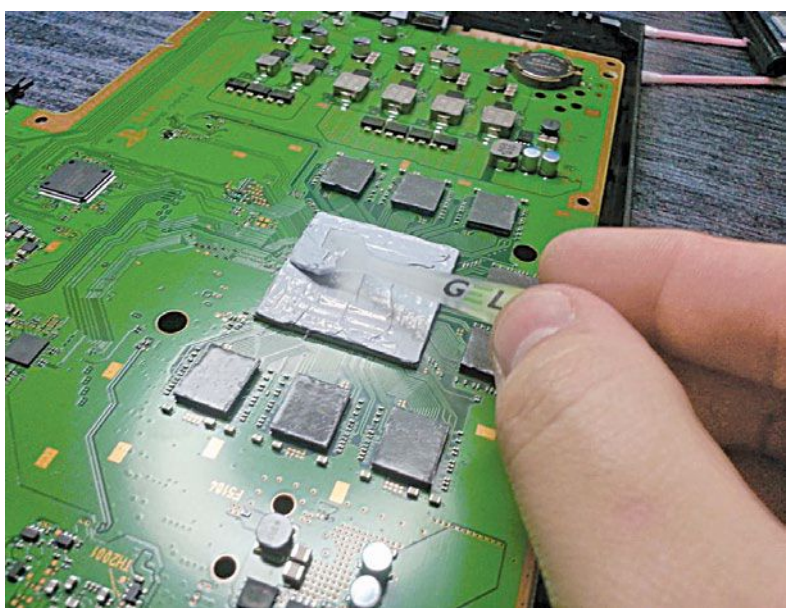
Saurabh Durgapal is working as technology journalist at EFY

While going through electronics product reviews, you might have come across phrases like, "The phone heats up on intensive gaming" or "The device feels warm after constant use." According to Ramanan, vice president - engineering, defence solutions, Mistral Solutions, "Inefficiency of electronics products leads to heat dissipation, which results in thermal analysis requirement."

Electronics products generate heat on usage, most of which is by switching devices like metal oxide semiconductor field effect transistors and integrated circuits. This heat has to be removed from the device for efficient functioning.

Thermal solutions come in handy while thinking of a way to solve this problem. Heat dissipation needs of today's components are more challenging than ever. System airflow and its impact on heat-sink design is a very important factor in applications generating sufficient heat. "Telecom, automobiles and lighting are some applications that require major use of thermal solutions," says Dr Misra, director - research and development, Henkel Adhesive Technologies.

Fig. 1: Applying thermal paste on the processor



Consider an efficient heat-sink

Ongoing increase in power usage among devices such as processors and insulated-gate bipolar transistors results in higher capacity cooling requirements to remove excess heat. To cool hotter components, you may use large fans, heat-sinks and increase surface area. Cooling performance can also be improved by using a higher-performance interface material between the case and the heat-sink.

Heat transfer occurs when two surfaces have different temperatures, thus causing heat energy to transfer from the hotter surface to the colder one. Some tips from industry experts in the box titled 'Application tips for heat-sink design,' should be helpful in designing one.

The latest in heat removal

"The amount of heat generated and the rate of generation are essential to arrive at the size and design of the heat-sink," says Ramanan. "We tend to choose the thermal pad based on these two factors," he adds. On a more general note, radial and grid patterns (pin fin) are being used by designers today for better heat dissipation. Radial fins provide ease in design, while grid patterns allow for a much higher surface area to aid heat loss.

As for the material, aluminium has been the metal of choice for the past decade for efficient cooling. Aluminium also remains popular for its conductivity, light weight and low cost, relative to other metals such as copper. To create more complex designs, manufacturers have also employed high-quality alloys like forged aluminium.

Ceramics, thermally-conductive plastics and graphite are also being experi-

Application tips for a heat-sink design

- Interfaces for heat transfer should be smooth and flat. Use thermal grease or interface pads wherever possible.
- Semiconductors should be spaced so as to obtain uniform power density.
- Cabinets and racks should be adequately vented at the top and bottom of the enclosure.
- Maximise expose area to increase surface emissivity.
- Use a high conductivity material for designing a heat-sink.
- The material's thickness and interface areas of enclosure should be adequate to handle expected power density.

mented with. Inorganic ceramics, non-metallic and non-corrosive materials are already being used in LEDs. Heat conduction and electric insulation make these ideal for heat-sink applications.

Thermally-conductive plastics, or thermoplastics that are loaded with a conductive material, such as aluminium nitride are naturally non-corrosive, making these ideal for outdoor applications. Thermoplastics are also 20 to 30 per cent less expensive than aluminium as these are simpler to make.

Italian luminaire manufacturer, Reggiani Lighting, combines copper and extruded aluminium to reap the best of both metals in LEDs. There are a lot of experiments being done with these materials. Made from graphite, hitherm is a lightweight flexible material. Carbon being an excellent conductor of heat, it enables this material to be a very good heat-sink. However, price point of these solutions is relatively high.

Liquid cooling solutions. There might come a time while designing a system when a simple fan or heat-sink is not enough. Ramanan explains, "If the rate of generation of heat is very high, where we cannot go for simpler heat-sinks, we can go for liquid cooling." This calls for solutions that can manage a higher rate of heat transfer.

Parameters in design

A thermal vent in a system cannot be designed willy-nilly. One of the biggest parameters with thermal solution design is integration with system design and cost. If a thermal solution makes your mobile bulky, it would not be much of a solution now, would it? Some of the other design constraints include:

- Induced approach flow velocity
- Cross-sectional geometry of incoming flow
- Amount of required heat dissipation
- Maximum heat-sink temperature
- Size of heat-sink

Keeping these challenges in mind, the available parameters for a designer to modify are:

- Number of fins
- Thickness of fins
- Shape of fins
- Material

One solution is to allow a coolant to flow in between the plates of the heat-sink. This coolant would absorb heat from the heat-sink and allow for a more maintained environment of operation. A common coolant in such a solution would be distilled water mixed with ethylene glycol. "Proportion of these two would form the required temperature," explains Ramanan.

Interface materials are too often forgotten

Thermal interface materials applied between the conductive layer and the heat-sink to facilitate heat transfer are too often forgotten. For efficient transfer of heat from the circuit to the sink, a proper interface becomes necessary. "The heat-sink in most cases will be rigid, hence reducing the contact area, resulting in a lower level of heat transfer," says Padmanabha Shakthivelu, general manager, Electrolube India. As a result, thermal interfaces become integral to a system.

Depending on the material, this layer can cause significant difference in the effectiveness of the heat-sink. Thermal solutions are also available in the form of adhesives, greases, gels, pads or solder alloys. Dr Misra says, "Low hardness and high conductivity are the necessary requirements for interface materials."

Some solutions are solid. Flexible solid interface materials consisting of silicon in ceramic are in high demand. However, a lot of forums raise the question of local vendors preferring one over the other, depending on the area of usage. Thermal pads and thermal compounds are used to fill air gaps caused by imperfectly flat or smooth surfaces, which should be in thermal contact. Thermal pads are solid, rubber-like materials, often based on various silicone compounds or paraffin wax. These are relatively firm at room temperature, but become soft and are well able to fill gaps at higher temperatures.

Average usage lifetime for a solution usually goes from one to three years. However, with thermal pastes, this can be more towards the lower end of the spectrum, due to their tendency to dry out. There is always a risk of thermal grease dispersing over time, leaving no interface material between the heat source and the sink.

Others are liquid. The liquid approach offers infinite thickness variations with little to no stress to sensitive components during assembly. Gap-filler 3500LV from Henkel is a two-part, high thermal conductivity, liquid gap-filling material. Made of polymer and thermally-conductive elements, it offers mechanical property benefits of a silicone material with low outgassing.

ER2224 epoxy resin from Electrolube caters to a wide range of automotive applications. These generally require high thermal conductivity and good thermal cycling performance.

Shakthivelu explains the design of grease solutions for heat management. "We have a range of grease, for example, one-watt, three-watt or five-watt grease." These have to be designed so that these are the perfect balance of spread and conductivity. He adds, "We have small metal conductors inside the paste, which transfer the heat. Sizes of these conductors change with the amount and rate of transfer of heat."

Where does this trend take devices

The role of thermal compound is simple—to fill the tiny gaps between the cooler and the integrated heat spreader, and to promote thermal conductivity. Some reports suggest that, introducing active cooling systems reduces the size of heat-sinks by 90 per cent. Now, if you could design a system with a smaller size, that would be a dream for designers.

Manufacturers are sceptical, however, about the reliability of fans and the noise these could create. Misra says, "Heat absorbers is an area that shows promise." Introduction of new materials and form factors has been a very welcome change in designing heat-dissipation solutions. These improvements should lead to things that have never before been possible. EFY

Fig. 2: Thermal pad and paste after prolonged usage

A turn of events in LEDs

A common misconception with LEDs is that these do not often release heat. LEDs are cool to touch since these usually do not produce heat in the form of infrared radiation. There is, however, a lot of unwanted heat generated within the devices. This is the heat generated due to the inefficiency of semiconductors that generate light. For reference, radiant efficiency of typical LEDs is about five per cent to 40 per cent, which translates to 95 per cent to 60 per cent of energy loss through heat.

Recently, some LEDs are being marketed with claims of no heat-sink at all. However, that is not entirely true, as the heat-sink is integrated into the device for improvement in aesthetics. You did not really think these had done away with the heat-sink altogether, did you?

Major contributors to this report

- Dr Misra, director - research and development, Henkel Adhesive Technologies
- Padmanabha Shakthivelu, general manager, Electrolube India
- Ramanan, vice president - engineering, defence solutions, Mistral Solutions

EMBEDDED SYSTEMS
In Automobiles

Akul Sabharwal is an electronics and communication engineer. He is currently working as R&D head at Sammi Electronics India Pvt Ltd

In today's world, most electronic devices are based on embedded systems. From home appliances like microwaves and washing machines to entertainment and security systems, embedded systems have found a way into every field.

What an embedded system is

An embedded system is a computer system with a dedicated function within a large mechanical or electrical system, often with real-time computing constraints. Key characteristics of an embedded system are:

1. Sophisticated functionality
2. Real-time operation
3. Low manufacturing cost
4. Low power

Mechanical systems in automobiles have largely been replaced by electronic systems. Today, the automobile industry is making great use of embedded systems. Ranging from wiper controls to complex anti-lock brake controls and air bags, embedded systems have gained overall control of automobiles.

Automobiles that are built around microcontrollers, digital signal processors or both processors are commonly called electronic control units. Many luxury vehicles have come up with a large number of embedded controllers. The first embedded system based automobile, Volkswagen, came in 1968.

Some current trends of embedded systems in automobiles include air bags, event data recorders, anti-lock brake systems, cruise control, rain-sensing wipers, emission control, traction control, automatic parking, in-vehicle entertainment, back-up collision sensors, navigation systems and tire-pressure monitors.

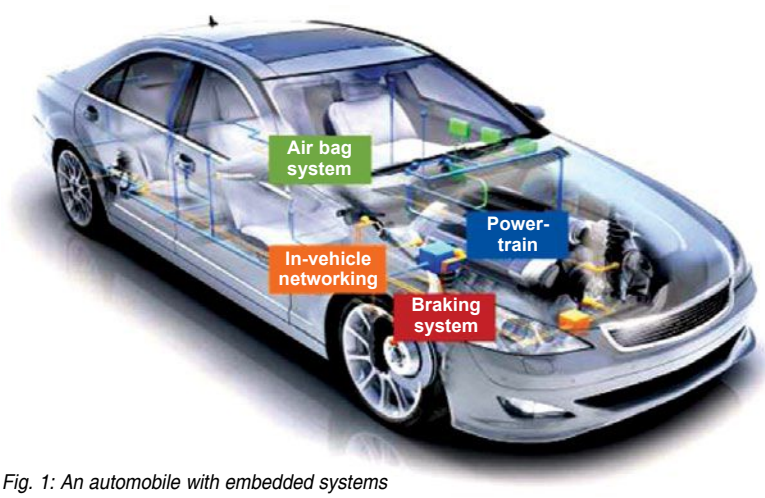


Fig. 1: An automobile with embedded systems

Airbags

The airbag system is an important safety device that provides extra protection against head-on crash for the passengers, by giving a soft surface to land on. This system works on commands from the airbag control unit, which has a microcontroller. The controller gets power from the battery.

If the collision sensor detects an accident, a signal is sent to the airbag control unit and it is processed by the airbag control unit to determine severity of the impact. If airbag deployment is necessary, the airbag control unit sends a signal to initiate airbag inflators. Inflators are activated through an igniter, causing a chemical reaction that emits nitrogen gas, resulting in the deployment of the airbag cushion.

An occupant detection system is used to determine if a person is seated in the passenger seat and if he or she is of adequate size to be protected in the event of deployment of the passenger seat airbag. It measures the weight of the passenger to determine if the corresponding airbag should deploy.

In 2012-13, a new type of occupant detection system called electrostatic capacitance sensor was implemented. This system does not use weight to determine whether to turn the occupant detection system on or off.

Electrostatic capacitance represents a material's capability of storing an electrical charge. When someone is seated or when

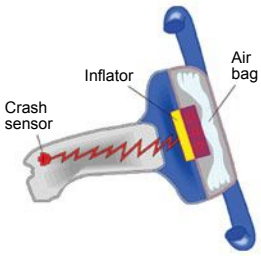


Fig. 2: An airbag deployment system

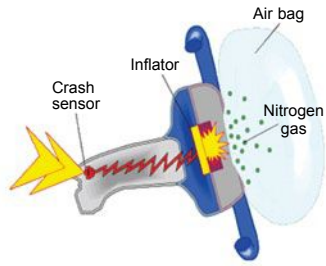


Fig. 3: An airbag deployment system after crash

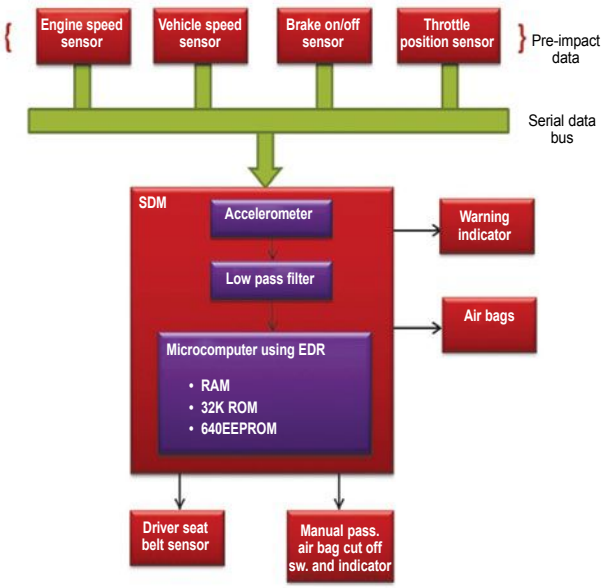


Fig. 4: Block diagram of an event data recorder

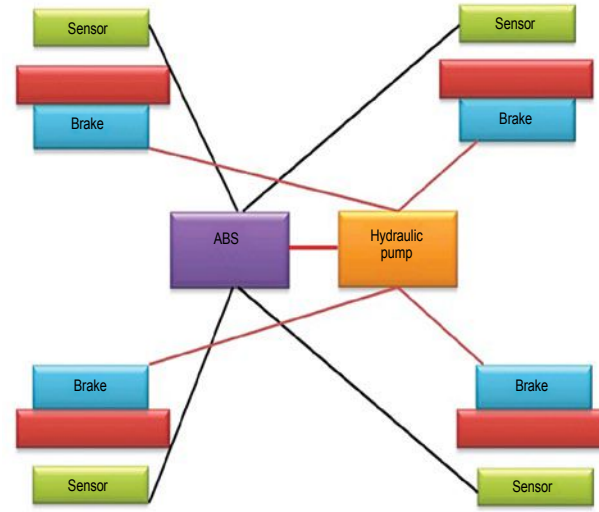


Fig. 5: A basic anti-lock brake system

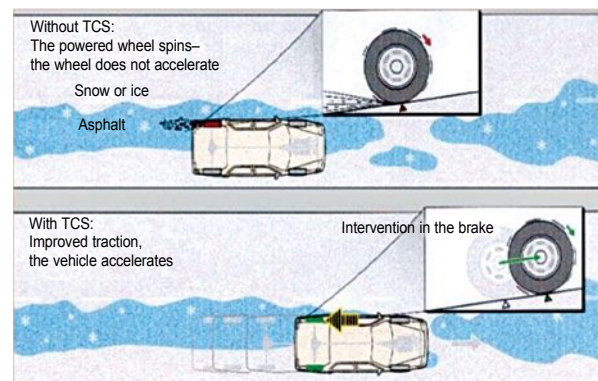


Fig. 6: Functioning of a traction control system with brakes

something is placed on the passenger seat, there is a change to that capacitance value. Change in capacitance value is what electrostatic capacitance sensor occupant detection system uses to determine whether the passenger seat airbag will be on or off.

Event data recorder

An event data recorder is a device installed in automobiles to record information related to vehicle crashes or accidents. It is also known as a black box. The sensing and diagnostics module, which is controlled by a microprocessor, has multiple functions, as given below:

1. Determines if a severe enough impact has occurred to warrant deployment of the airbag
2. Monitors the airbag's components
3. Permanently records information

Event data recorders record a wide range of data, including whether brakes were applied, speed and time of impact, steering angle and whether seat belt circuits were shown as buckled or unbuckled at the time of the crash.

Anti-lock braking system

Up until the 1970s, hitting the brakes too hard could lead to an accident. If the coefficient of slip between tires and the road was too low, hitting the brakes could lead to wheel lock-up. The vehicle would no longer be steerable and would start skidding. The danger is present specially when:

1. Roads are wet and slippery.
2. There are different levels of grip between the tires and the road.

Wheel-speed sensors detect whether a wheel is showing a tendency to lock-up. In case it is, the electronic control unit reduces the braking pressure individually at the wheel concerned. High-speed correction of the braking pressure takes place before the lock-up threshold. The brake-fluid return together with closed-loop brake circuits makes this a safe, reliable and cost-effective system.

An anti-lock brake system is advantageous as:

1. Vehicle remains steerable even during panic braking
2. Shorter stopping distances on all road surfaces

Dynamic traction and stability control

The traction control system is required to prevent driver error from

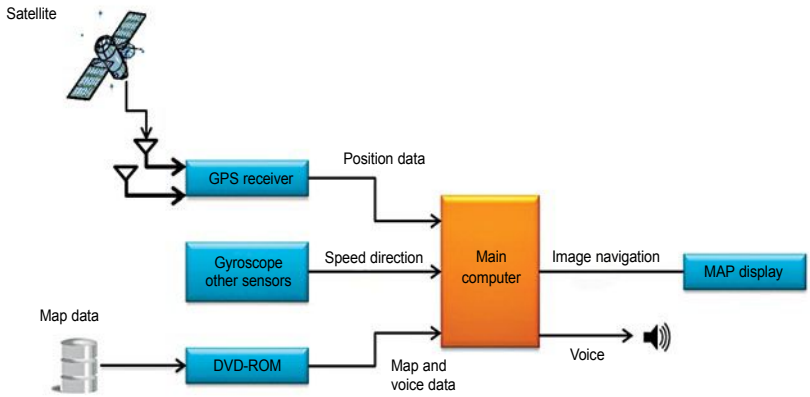


Fig. 7: Block diagram of an embedded navigation system

Fig. 8: An embedded rain-sensing system

overloading any of the four wheels and causing a slip, through either throttle or brake application. When the drive wheels start losing traction, the dynamic stability control automatically begins stabilisation measures. The dynamic stability control system curbs engine output and stops slips on the wheels. In exceptional situations, however, a small amount of wheel slip can be an advantage.

The principle of the traction control system is the adaptation of wheel torque to the coefficient of friction between the wheel and the road surface.

When the traction control computer detects one or more driven wheels spinning significantly faster than another, it invokes the anti-lock braking system's electronic control unit to apply brake friction to wheels spinning with lessened traction. Braking action on slipping wheel(s) cause power transfer to wheel axle(s) with traction due to the mechanical action within the differential. All-wheel drive vehicles often have an electronically-controlled coupling system in the transfer case to supply non-slipping wheels with torque.

A traction control system has three main components: a sensor equipped in each wheel that senses changes in speed due to traction, an electronic control unit that receives the sensed speed from each wheel and an automatic traction control valve that supports in braking after the electronic control unit processes information from the wheels.

Embedded navigation system

The navigation system consists of an embedded circuitry built with a GPS receiver, gyroscope, DVD-ROM and display system. The GPS receiver receives current longitude and latitude values that are compared with the stored map. The gyroscope and other sensors provide road direction and speed. From all the information gathered at the main controller, the display system displays a navigation or route map of the destination on the display screen.

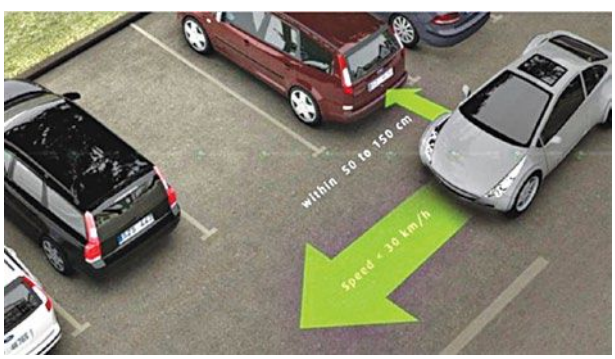


Fig. 9: Parking spotted by driver with distance mentioned between vehicle and parked vehicle

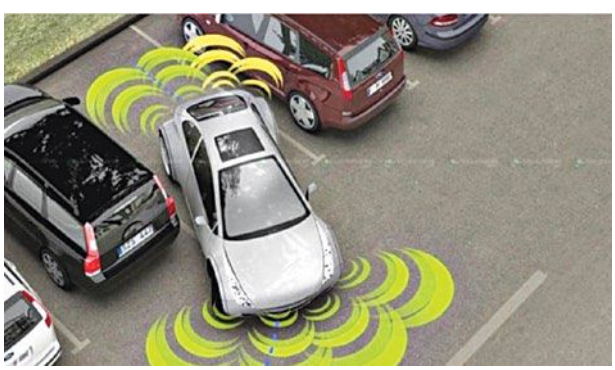


Fig. 10: Automatic parking using sensors

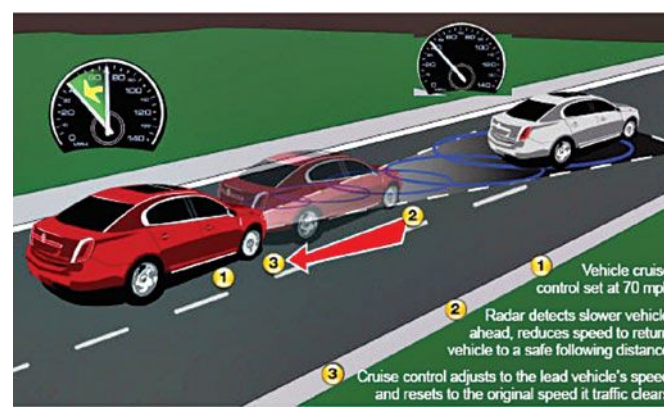


Fig. 11: Cruise control

Embedded rain-sensing system

In a rain-sensing system, an optical sensor is placed on a small area on the front windshield glass opposite to the rear-view mirror. This optical sensor emits infrared light and is placed at a 45-degree angle to the windshield. If the glass is dry, most of this light is reflected back into the sensor. If water droplets are on the glass, these reflect light in different directions. The wetter the glass, the lesser the light that makes back to the sensor.

The electronics and software in the sensor turn on the wipers when the amount of light reflected onto the sensor decreases to a preset level. The software sets the speed of the wipers based on how fast the moisture builds up between wipes. It can operate the wipers at any speed. The system adjusts the speed as often as necessary to match with the rate of moisture accumulation.

Embedded based automatic car parking system

This automatic car parking system is an independent car-manipulation system that moves a car from a traffic lane into a parking spot to perform parallel, perpendicular and angle parking.

The system mainly uses different methods to detect objects around the car. Sensors installed on the front of the vehicle and rear bumpers act as both a transmitter and a receiver. These send a signal that is replicated back when it meets an obstacle near the vehicle and then the car computer receives the time signal and the bumper uses the radar to decide the position of the obstacle. The car senses the parking space and distance from the side of the road and helps the driver drive the car into the parking place.

Future prospects

With the ever-increasing use of embedded systems in automobiles, new technologies and enhancements are being developed to increase usability.

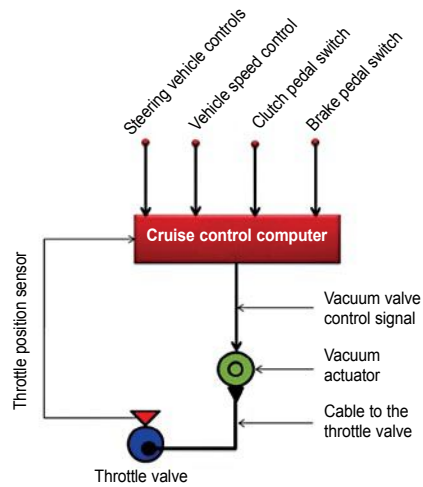


Fig. 12: Working of a cruise control system

Fig. 13: Drive by wire concept car

Intelligent adaptive cruise control. By using this technology we can make driverless vehicle control a reality. Many automobile manufacturers are already engaged with this concept. This adaptive cruise control allows cars to keep safe distances from other vehicles on busy highways. The driver of the car can set the speed of the vehicle and the distance between his car and other vehicles. When traffic slows down, adaptive cruise control changes vehicle speed using moderate braking.

Each car has a laser transceiver or a microwave radar unit, which is fixed in front of the car to find out the speed and distance of the any other vehicle in the pathway. This works on the principle of Doppler Effect, which is basically change in the frequency of waves. It uses a forward-facing radar, installed behind the grill of a vehicle, to detect the speed and the vehicle ahead of it. It can automatically adjust speed in order to maintain proper distance between vehicles in the same lane.

It is hard to implement this system around a curve, when there are elevation changes, during cut-ins, during dense traffic and other situations.

Drive by wire. Drive by wire system replaces mechanical connections like push rods, rack and pinion, steering columns, overhead cams and cables by mechatronic connections like sensors, actuators, embedded microprocessors and control software.

Throttle by wire. This system helps accomplish vehicle propulsion by means of an electric throttle without any cables from the accelerator pedal to the throttle valve at the engine. It controls electric motors by sensing accelerator pedal input and sending commands to power inverter modules.

Brake by wire. A pure brake by wire system eliminates the need for hydraulics completely by using motors to actuate calipers and lock the wheels in comparison to the current technology where the system is designed to provide braking effort by building hydraulic pressure in brake lines.

Shift by wire. Direction of motion of the vehicle (forward or reverse) is set by commanding the actuators inside the transmission through electronic commands based on current input from the driver (park, reverse, neutral or drive).

Steer by wire. This system provides steering control of a car with fewer mechanical components/linkages between the steering wheel and the wheels. Control of the wheels' direction is established through electric motor(s), which are actuated by electronic control units monitoring steering wheel inputs from the driver. EFY

MACHINE LEARNING BASICS
For Newbies

Vivek Ratan
currently works as an automation test engineer at Infosys, Pune

When we start the journey of life as new-born babies, we inherit the characteristics of our parents. We do not know what to do and when to do what. As we grow up, our parents and elders teach us how to walk, talk and take various decisions in our lives and, as time passes, we gain experience and knowledge. Finally, we start taking our own decisions based on our learning and experience.

Similarly, when we write any code to make a system do any work, the system only does what we ask it to do—it cannot think or take any extra decisions on its own, nor perform actions on that basis. Machine learning teaches the system to learn and take decisions when exposed to a new set of data on the basis of the experience it gains while performing different actions.

Machine learning is an emerging technology that is widely being implemented across all types of industries. Google's self-driving cars, flying drones, anomaly detection and Big Data processing are among the recent examples.

Machine learning is a type of artificial intelligence that provides computers with the ability to learn without being explicitly programmed. It uses pattern recognition and computational learning theory to study and develop algorithms (which can learn from the sets of available data), on the basis of which it takes decisions. These algorithms work by building a model (such as predictive model or neural network model) from sample inputs in order to take data-driven decisions. These models help in developing decision trees, using which the system takes its decision.

Machine learning makes use of mathematical optimisation to deliver different theories, methods and application domains for a specific field. It uses the data-mining technique to perform exploratory data analysis over a set of data in order to make predictions. This is referred to as unsupervised learning.

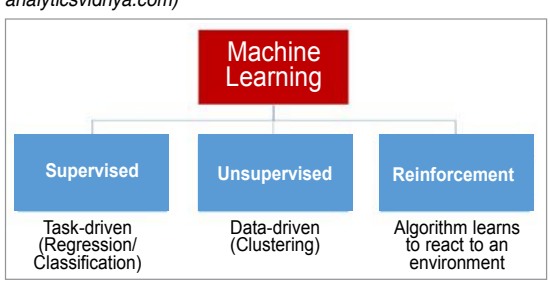


Fig. 1: Classification of machine learning techniques (Image courtesy: www.analyticsvidhya.com)

Machine learning helps data scientists, engineers, researchers and analysts take a reliable decision by uncovering the hidden insights acquired through the analysis of historical trends in data.

Types of machine learning

Tasks performed using machine learning are classified broadly into three categories, based on the nature of the learning signal available to a learning system (that helps take decisions).

Supervised learning. This is a type of machine learning in which the system is presented with a set of labelled training data (inputs and their corresponding set of outputs). Now, it is the task of supervised machine learning to predict a new set of outputs for a given new set of inputs by learning or finding out a general rule or pattern that maps the given set of inputs to their corresponding outputs. The pattern or rule that helps in predicting output is generally denoted by a specific function. Supervised learning is further classified as regression and classification problems, on the basis of the methodology that is implemented to find a specific pattern.

Unsupervised learning. This machine learning technique is implemented when there is only a set of inputs available with the system, with no corresponding outputs. Now, it is left to the system to learn and identify the pattern or rule governing the available inputs by using unsupervised learning and, further, that hypothesis or rule is used to find the output for the given set of inputs.

There can be many possible hypotheses, but the optimal one is considered for finding the output. Again, unsupervised learning technique is further classified as k means and hierarchical clustering problems, on the basis of the different techniques used to find the final hypothesis.

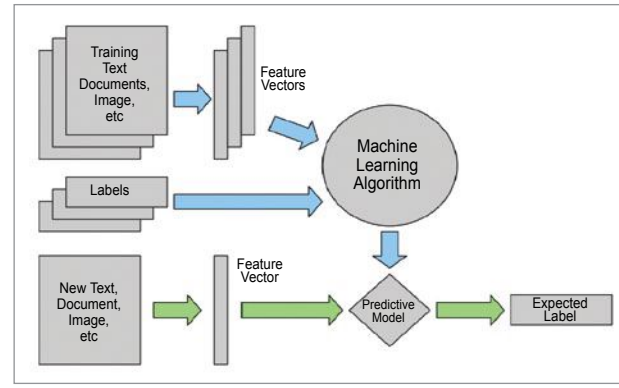


Fig. 2: Supervised learning model (Image courtesy: Google images)

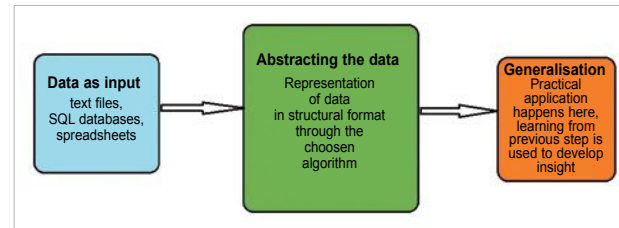


Fig. 3: Steps to implement machine learning

Reinforcement learning. Here, the system is given two different sets of input data and it needs to implement reinforcement machine learning technique to learn and identify the general pattern or hypothesis in one of the given set of inputs.

There can be more than one hypothesis derived but, finally, the optimal one is used by the system to derive the output for the other set of inputs. This is like learning the rules of a game by playing against an opponent.

Implementing machine learning in real life

Let us now look at implementing machine learning in real-life scenarios. You need to check how you can teach machines to take decisions and do your work just as you would do it by applying your own sense or logic.

In the course of teaching machines, every stage of the process helps to build a better version of the machine. There are five basic steps that need to be followed prior to letting a machine perform any unsupervised task.

Collecting data. This is one of the first and foremost steps in implementing any type of machine learning technique. Data plays a significant role in machine learning, whether it is in the form of raw data from MS Excel, Access or even text files. This step lays the foundation of future learning. We must be aware of the fact that the better the variety, volume and density of relevant data, the better will be the learning prospects for the machine.

Preparing data. Once data is collected, check the quality of what will be fed as training data to the system. You need to spend time in order to determine the quality of data and, accordingly, take steps to fix issues such as treat-

ment of outliers and missing data. Exploratory analysis is one such methodology used to study the differences of data in detail, thereby strengthening nutritional content.

Training a model. This step involves selecting the appropriate algorithm and representing data in the form of a model. The final purified data is split into two parts—training and test (proportion of data depends on prerequisite requirements). The first part (training data) is used to develop the model, whereas the second part (test data) is used as reference.

Evaluating the model. This step involves evaluation of the machine learning model you have chosen to implement. Second part of data (test data) is used to test the accuracy of the learning model. This step determines how precise the algorithm selected is, based on outcome.

There is also a better test to check accuracy of the model, which sees how the model performs on data that has not been used at all while building it.

Improving the performance. This step may involve choosing a different model altogether or even introducing more variables to improve the efficiency of the learning model. If the model is changed, then it again needs to be evaluated and its performance checked, which is why a lot of time needs to be spent in collecting and preparing data.

Tools for implementing machine learning

In order to implement machine learning on a system for any scenario, there are enough open source tools, software or frameworks available for you to choose from, based on your preference for a specific language or environment. Let us take a look at some of these.

Shogun. Shogun is one of the oldest and most venerable machine learning libraries available in the market. It was first developed in 1999 using C++, but now it is not limited to working in C++ only; rather, it can be used transparently in many languages and environments such as Java, C#, Python, Ruby, R, Octave, Lua and MATLAB. It is easy to use, and is quite fast at compilation and execution.

Weka. Weka was developed at University of Waikato in New Zealand. It collects a set of Java machine learning algorithms that are engineered specifically for data mining. This GNU GPLv3-licensed collection possesses a package system, which can be used to extend its functionality. It has both official and unofficial packages available.

Weka comes with a book that explains the software and the techniques used in it. While Weka is not aimed specifically at Hadoop users, it can be used with Hadoop as well, because of the set of wrappers that have been produced for the most recent versions of it. It does not support Spark, but Clojure users can also use Weka.

CUDA-Convnet. CUDA-Convnet is a machine learning library especially used for neural network applications. It is written in C++ in order to exploit Nvidia's CUDA GPU processing technology. It can even be used by those

who prefer Python over C++. The resulting neural nets obtained as output from this library can be saved as Python-pickled objects and, hence, can be accessed from Python.

Note that the original version of the project is no longer being developed, but has been reworked into a successor named CUDA-Convnet2. It supports multiple GPUs and Kepler-generation GPUs.

H2O. H2O is an open source machine learning framework developed by Oxdata. H2O's algorithms are basically geared for business processes like fraud or trend predictions. H2O can easily interact in a standalone fashion with different HDFS stores. It can be in MapReduce, on top of YARN or directly in an Amazon EC2 instance.

Hadoop Mavens can use Java for interaction with H2O, but this framework also provides bindings for R, Python and Scala. It enables cross-interaction with all libraries available on those platforms.

Applications of machine learning

The world is on the path to becoming smarter through automation of all possible manual tasks. Google and Facebook use machine learning to push their respective advertisements to relevant users. Given below are a few applications that you should know of.

Banking and financial services. Machine learning is widely used to predict customers who are likely to be defaulters in paying credit card bills or repaying loans. This is of utmost importance as machine learning helps banks identify customers who can be given credit cards and loans.

Healthcare. It is widely used to diagnose various deadly diseases (like cancer) on the basis of patients' symptoms, and tallying these with the past data available for similar kinds of patients.

Retail. Machine learning is used to identify products that sell fast and those that do not. It helps retailers decide on the kind of products to introduce or remove from their stock. Also, machine learning algorithms can be very effective in finding two or more products that will sell together. This is basically done to encourage customer loyalty initiatives which, in turn, help different retailers develop and maintain loyal customers. Walmart, Amazon, Big Bazaar and other such retail chains extensively make use of machine learning.

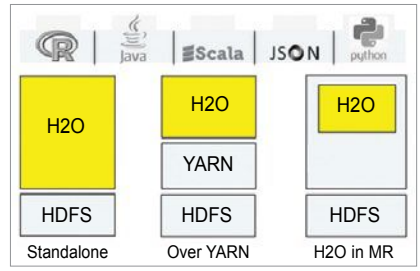


Fig. 4: H2O on Hadoop (Image courtesy: www.infoworld.com)

Publishing and social media. There are publishing firms like LexisNexis and Tata McGraw Hill that make use of machine learning to run queries and fetch documents required by their users online, based on their preferences and requirements. Google and Facebook also use these techniques to rank their search outputs and news feeds. Facebook provides a list of possible friends under Friend Suggestions using this.

Robot locomotion. Robot locomotion is a collective term used for the different methods that robots use to transport themselves from one place to other. A major challenge in this field lies in developing capabilities for different robots to autonomously decide how, when and where to move. Machine learning helps them do this quite easily.

Apart from this, there are various decisions that robots need to take instantaneously while they perform activities, which is possible using different machine learning techniques.

Game playing. A strategy game is one in which the player's autonomous decision-making skills are significant in determining the final outcome. Almost all strategy games require internal decision tree style of thinking, and very high situational awareness. Machine learning meets all these requirements and, hence, is widely used in gaming.

Advantages of machine learning

Machine learning techniques help the system take decisions on the basis of training data in dynamic or uncertain situations.

It can handle multi-dimensional, multi-variety data, and can extract implicit relationships within large data sets in a dynamic, complex and chaotic environment.

It allows reduction of the time cycle and improves resource utilisation. It also provides different tools for continuous quality improvement in any large or complex process.

Another advantage of machine learning techniques is the increased usability of various applications of algorithms due to source programs like Rapidminer. Machine learning allows easy application and comfortable adjustment of parameters to improve classification performance.

Challenges of machine learning

A very common challenge is acquisition of relevant data. Once available data is secured, it often has to be pre-processed depending on the requirements of the specific algorithm used, which has a critical impact on the final results.

Sometimes, interpretation of results also becomes a challenge, as these need to be interpreted according to the algorithm chosen. Different machine learning techniques can be implemented in order to let the system decide on what action it needs to take and when it needs to be taken.

Machine learning can give an edge to automation, and has already helped in making the world a lot smarter. But machines have not stopped learning, and the next level of this technology is being worked on. EFY

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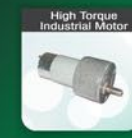
The Largest & Cheapest Robotics Store in India

MAC-NET TECHNOLOGY

ROBOTICS



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SMART FABRICS: The Comfortable Way To Wear Your Tech

Janani Gopalakrishnan Vikram is a technically-qualified freelance writer, editor and hands-on mom based in Chennai

Wearable devices are the rage today, and these are getting better day by day—lighter, cooler, trendier, smarter. Nevertheless, it can be a pain wearing a chunky watch on a hot summer day. The fewer devices you have to wear, the more comfortable you will feel. Not to forget the fact that you may forget to wear your smartwatch or fitness monitor before you step out of the house.

For those who are more focused on fashion than comfort, once again devices fail to please. You might all remember how a few years ago Apple tried to make its Apple Watch a style statement—people like Raf Simons of Dior and Anna Wintour of Vogue were seen wearing it. But the trend soon changed. Nobody expressed the reason as precisely as writer Vanessa Friedman, in *The New York Times*, "No matter how attractive Apple Watch is in the context of other smartwatches or smartbands, no matter how much of an aesthetic advance its rounded corners and rectangular display, it still looks like a gadget." Is there a way out, to wear your technology without it being so obvious?

Fig. 1: Ohio State University researchers have developed a way of embroidering electronic components into clothing (Image courtesy: Ohio State University)

Smart fabrics is what we are getting at. These might not be as well-known as smartwatches, bracelets and pendants, but these are real, and one day in the near future, you might find these in your neighbourhood apparel stores and sports shops. According to a report by ABI Research, the smart clothing market will top 18 million clothing articles annually by 2021, representing a 48 per cent compound annual growth rate (CAGR).

Smart fabrics, or clothing into which technology is embedded or woven, is proving to be a boon for athletes, fitness lovers, first responders like firemen and policemen, people in need of special health care and others. Such garments range from jackets to underwear, which can monitor health parameters, activity, location and more. Together with mobile apps, these can help athletes train and normal people get back into shape, keep kids safe and elders comfortable.

It is not all about functionality either. Some of the world's greatest fashion designers are now using novel materials embedded with technology, for purely aesthetic purposes—like clothes that change colour or brightness according to the environment. The realisation that electronic/smart textiles need not necessarily be wearable also helps widen our view of possibilities. These fabrics can, for example, be used to make smart curtains, car seat covers or bed spreads for children or patients.

It is now becoming increasingly practicable to develop and manufacture such smart fabrics, thanks to developments in materials and nano technologies. We have super-strong, technology-conducive materials like spider silk, flexible batteries and electronics that can power themselves from the body's heat or vibrations. These are all contributing directly and indirectly to the field of smart fabrics. Let us take a look at how smart garments are today, and what makes these so.

Ways and means: Inks, yarns and embroidery, too

To bring technology into your clothes, you need some way of weaving the electronics into mainstream materials, because nobody likes to wear a plastic dress. Here are some of the ways in which this can be achieved:

Touch of silver turns fabrics into electronics. DuPont is one of the well-known manufacturers of stretchable electronic materials like conductors, encapsulants and sensors, made with silver and dielectric inks. You can use these manufacturing-ready materials to make thin, form-fitting circuits that can be easily fused into any kind of fabric. These electronic materials are supposedly durable and stretchable, and can be washed along with the fabric in a regular washing machine using normal detergents. DuPont claims that these can withstand around 100 wash cycles.

Other technologies such as Noble Biomaterials' Circuitex also use silver for making fabrics conductive. Circuitex works by bonding a non-conductive polymer like nylon with 99.99 per cent pure silver. The silver covers the whole surface around the fibre, which creates a highly conductive and uniform material that can be processed in traditional textile manufacturing machinery. Circuitex technology is used in products like Adidas miCoach and Ralph Lauren's PoloTech Shirt.

The National Physical Laboratory of the UK takes a similar approach to integrating electronics into any type of clothing, including cotton fabrics. Their method begins by attaching a nano-metal seed layer to the fibres. This acts as a catalyst towards a secondary electro-less metal-plating process, which encapsulates the fibres. The resulting textile is very conductive, flexible and durable enough to withstand around 100 wash cycles. The inks are printed using an inkjet printer, which can manage complex multi-track circuits as well as entire fabric coverage. So your garment itself becomes a printed circuit board (PCB).

Graphene based inks. According to a report published in the journal *Carbon*, a team of scientists at University of Cambridge in the UK and Jiangnan University in China has developed a method of making cotton textiles conductive by impregnating these with graphene based ink. Cotton is one of the most popular, durable and comfortable materials used for making clothing, and should ideally be used for e-textiles, too, if we want any kind of mass adoption.

To achieve this, the team has developed inks of chemically-modified graphene flakes that are more adhesive to cotton fibres than unmodified graphene. The ink is deposited on the fabric and then subjected to heat treatment for improving its conductivity. The modified graphene adheres to the cotton just like any other colour dye, which ensures that the fabric remains conductive even after several washes. The team demonstrated the effectiveness of the technique using a motion sensor based on the conductive cotton.

This method is expected to become quite popular in the future because graphene ink is chemically-compatible with cotton, unlike certain methods that require a polymer or plastic base. Also, it is less expensive and environment-friendly compared to metal based conductive inks, especially those using pure silver.

Techie yarn. Project Jacquard by Google proposes another method of weaving electronics into garments.

A new generation of smart fabrics

Smart fabrics might not seem so novel to you if you just think of these as garments with a chip attached to these. Clipping devices onto one's dress, or even stitching a chip into it, is old news. We are beginning to see a new generation of clothing, woven with fibres that themselves are sensors and computers.

It hopes to make it so easy that electronics can be woven into everyday garments! Their solution is based on conductive yarns, which combine thin, metallic alloys with natural and synthetic yarns like cotton, polyester or silk. The resulting Jacquard yarns are just like traditional yarns, and can be woven on any industrial loom. These yarns can be attached to discreet connectors and miniaturised circuits, to weave different kinds of technological applications into the dress. Some areas, for example, can be touch- and gesture-sensitive, while others can be sensor grids. Collected data can be wirelessly transmitted to mobile devices to provide varied services to the user.

Fig. 2: Owlet Smart Sock is a comfortable way to monitor babies (Image courtesy: Owlet)

The ability to manufacture the yarns and fabrics on standard looms used by mills across the world is, according to Google, the biggest benefit of this method. They have partnered with Levi's to create interactive garments, which combine the traditional charm of denim with the benefits of technology.

One such product is Levi's Commuter Trucker Jacket for urban bike commuters. When they are driving and cannot access their smartphones, wearers can control their mobile experience and connect to a variety of services such as music or maps, directly from the jacket.

A plasticky solution. At K 2016 plastics trade fair, Covestro, one of the world's leading polymer companies showcased luminous clothing made with freely-formable electronic systems, which are responsive to movements without losing their functionality. The garments use a flexible and formable film made of thermoplastic polyurethane (TPU) from Covestro.

TPU is the substrate for printed copper circuits, which are arranged in a meandering pattern and can, thus, also be bent and stretched. This technology is based on stretchable circuit board (SCB) technology developed earlier as part of European STELLA project, led by Fraunhofer Institute for Reliability and Microintegration (IZM) and Technical University of Berlin.

According to the press release, the smart circuits are manufactured using an efficient, multi-stage process. The release states, "First, copper films are laminated onto polyurethane films. Printed circuits are produced in a subsequent structuring operation featuring highly effective adhesion. Coated films are then shaped as required using conventional thermoforming. Formable electronic systems can be directly laminated into textiles."

Pretty and purposeful embroidery. A team at The Ohio State University is developing a way of embroidering antennae and circuits into fabrics, with 0.1mm precision—a size ideal for integrating components like sensors and computer memory devices into clothing. Their method can be implemented using a typical tabletop sewing machine, except that it embroiders its patterns with fine silver metal wires. The thread has a diameter of 0.1mm and is made of seven filaments. Each filament has a core of copper, enamelled with pure silver.

The shape of the embroidery determines its functionality, say, frequency of operation in the case of an antenna. A broadband antenna, for example, comprises more than six small interlocking geometric shapes that form an intricate circle a few centimetres wide. Each piece of the circle transmits energy at a different frequency, so that these cover a broad spectrum of energies when working together, thereby enabling broadband capability for mobile phone and Internet access.

Other shapes serve other functions. There is a spiral-shaped antenna that helps improve mobile phone signal reception. Measuring 15.2cm (6-inch) across, this antenna can transmit signals at frequencies of 1GHz to 5GHz with near-perfect efficiency. Embroidered on the back of your dress, this spiral pattern could help boost the reception of your mobile device.

Screen printing tech onto fabrics. Screen printing is another common method used to print designs on fabrics. Germany's Fraunhofer Institute for Silicate Research hopes to use this process to bring tech into textiles. They have developed piezoelectric polymer sensor printing pastes that can be applied to fabrics using a simple screen printing process. After printing, the sensors are subjected to an electric field, making the piezoelectric polymers align to adopt the targeted pressure sensitivity.

The ferroelectric polymer paste registers pressure and deformation, which means that it can act as a touch-and-motion sensor. It is also pyroelectric or sensitive to changes in temperature, and can be used as a proximity sensor. The printed sensors are non-toxic, thinner than human hair, transparent and flexible. The team claims that the biggest benefit of this technology is that it does not require a power source. It can run using energy harvested from the wearer's movements.

Powering up. To be embedded into fabrics, batteries need to be flexible and, preferably, stretchable. Inspired by a Japanese paper-folding technique called Kirigami, a team from Arizona State University has developed a lithium-ion based battery that can be stretched to 150 per

cent of its initial length without any change in its power supply properties. The team demonstrated the stretchiness of the battery by embedding it into an elastic armband.

Batteries have always posed a problem for the smart fabrics industry, flexibility being one issue and battery life being another. In order to overcome this, the industry is looking at solutions that enable smart fabrics to harness energy from the environment.

In a recent report in the journal *ACS Nano*, scientists Wenjie Mai, Xing Fan and team have described fibres that can capture and release solar energy. The fibres are suitable for weaving into fabrics that can be tailored normally. The team has devised two types of fibres. One comprises titanium or manganese-coated polymer along with zinc oxide, a dye and an electrolyte. These fibres are interlaced with copper-coated polymer wires to create the solar cell section of the textile.

A second type of fibre helps store power. It is made of titanium, titanium nitride, a thin carbon shell to prevent oxidation and an electrolyte. These fibres can be woven with cotton yarn to make smart garments. The fibres can apparently power small electronics like tablets and phones as well.

Cool fabrics, literally. Can you imagine smart clothes that adjust their temperature automatically according to the wearer's needs, say, to keep a patient comfortable or to cool an athlete's body during intensive workouts? Well, VTT Technical Research Centre of Finland Ltd appears to have a solution, which addresses the thermal, moisture and flow-technical behaviour of smart clothing.

The technology uses VTT's Human Thermal Model calculation tool to calculate a person's individual thermal sensation from collected data and prevailing conditions. The technology can calculate whether and how much the wearer needs to be cooled or warmed. As an example, a smart blanket made with this technology can identify the person's needs, measure the ambient temperature and adjust the blanket's temperature to keep the person comfortable. According to a press release, Taiwan Textile Research Institute has already tested VTT's methods in designing clothing for long-distance runners in different temperatures.

Applications with attitude

A pair of smart shorts or socks is more likely to stay on a hurdle jumper than a smartwatch. A soldier will feel more secure if his or her shirt had sensors and telecommunication equipment than gear in the backpack. An unobtrusive, smart bedsheet is definitely going to be more effective in monitoring the parameters of an aged, senile and bed-ridden patient than a wristband, which he or she will want to remove and perhaps even throw away.

Indeed, there is no need to explain the necessity of making fabrics smarter. Products using smart fabrics, for various purposes, are already available today, and it is interesting to note that elsewhere in the world people included some these products in their Thanksgiving and Christmas shopping lists.

Sports and fitness. Sensoria Fitness has a range of motion- and activity-tracking smart clothing for sports and fitness. From t-shirts to socks and smartbras, they have a wide range of smart clothing. Their socks are infused with textile sensors that can detect foot pressure. Conductive fibres in the socks relay this data to a Bluetooth-powered anklet that communicates with a mobile app, thereby adding a touch of artificial intelligence.

Although initially focused on fitness, Sensoria's solutions have also found a market in healthcare. In association with Orthotic Holdings, Sensoria has developed a solution called Smart MBB, which uses sensors in the plantar region of the foot to detect and prevent falls in elderly patients. Medical journals acclaim

Sensoria's sensors as being skin-safe, having tested these against several pH ranges. These are also less than 1mm in thickness, providing flexibility in form factor for a wide range of clinical applications like diabetic foot management, prosthetics and rehabilitation.

OMSignal's OMbra is also targeted at athletes. Sensors in the sports bra monitor body signals like real-time breathing, heart rate and body movement metrics. This data is sent to an app, which suggests running zones, provides breathing rhythm analysis for increased running efficiency, maximises fat burn, reduces the risk of injury and unnecessary fatigue, and more.

Another much talked about piece of smart clothing is Hexoskin Smart, which has been acclaimed as a biometric shirt. This sports shirt is made of comfortable, durable, machine-washable, odour-resistant Italian fabric, and houses a range of sensors that monitor and record your heart rate, breathing and movement. It works with mobile apps as well as sports watches to provide insights on the intensity of workout, fatigue and recovery, calories burned and quality of sleep.

Hexoskin has 14-plus hours of battery life, and supports Bluetooth connectivity. According to news reports, Hexoskin is also collaborating with Analog Devices and Microsoft to develop an innovative Internet of Things (IoT) solution for team performance management. The solution would allow coaches to monitor players' movements, heart rate and other useful metrics gathered by sensor-equipped vests worn by the players. This information, along with location and environmental data, is sent to a secure, Cloud based analytics platform via Microsoft's Azure IoT technology.

Samsung, too, has a few products up its sleeve. Its workout shirt, Body Compass, monitors biometric data, while its golf shirt includes weather and ultra-violet (UV) rating monitoring.

For the overly fashion conscious, of course, there is Ralph Lauren's PoloTech Shirt, which does pretty much the same stuff like monitoring breathing, heart rate and so on. The PSAL/067 PoloTech Biometric Sensing Technology is screen-printed on the right sleeve, and there is a detachable black-box that uses Bluetooth to transmit key data directly to your iPhone or Apple Watch. This black-box has to be removed before washing. PoloTech shirt is powered by OMSignal.

Fig. 3: Exchange business cards, control devices and do more with Samsung's NFC-enabled smartsuit (Image courtesy: Samsung)

Flex and MAS Holdings, which have forged a long-term relationship to advance smart clothing, have developed several interesting products. Lumo Run is one such solution developed with Lumo Bodytech. Designed as running shorts and capris, it is supposed to be an athlete's portable running coach. The clothes have sensors that can monitor running-oriented metrics like cadence, ground contact time, pelvic rotation and stride length, and provide real-time feedback through headphones.

A little more advanced than the rest of the breed, Athos clothing is woven with advanced medical technology like micro-EMG sensors that detect the muscles that are working, and transfer this data to an app via Bluetooth. Apart from measuring effort, heart rate and breathing, the app also provides insights to correct your methods and avoid injury.

Baby care. The smart clothing industry is betting big on baby care, because wearables of other kinds are obviously not comfortable for babies. Owlet Smart Sock monitors the baby's heart rate using pulse oximetry to make sure the baby's breathing and sleep are normal. It charges through a small base station and pairs up with a smartphone through Bluetooth.

Neopenda Smart Baby Hat has a vital signs monitor fitted inside a hat for newborns. Developed by Sona Shah and Teresa Cauvel, two biomedical engineering graduates from Columbia University, the smarthat measures temperature, heart rate, respiratory rate and blood oxygen saturation. It connects via Bluetooth to a mobile device running a custom app. The app can sync up to 24 baby hats, which can help doctors and nurses watch over all kids in a bay.

Lending a helping hand to premature babies is ARTUS, devised by Hohenstein Institute in Bönnigheim. They have used smart textiles to develop an artificial uterus, which provides the sensory stimulation required for premature babies to develop. The smart textile provides the baby with acoustic stimuli like the mother's heartbeat and voice, as well as mechanical sensations like the gentle rocking experienced in the mother's body. It is currently being assessed by neonatologists.

Suits for near-field communication. Near-field communication (NFC) is a protocol for sharing data, contactless payments and so on. Smart clothing imbibing NFC technology is trending now. Samsung and Rogatis have developed an NFC smartsuit that lets the wearers do a lot things like exchange business cards, unlock their phones, control their gadgets and more.

Barclaycard and Lyle & Scott have also designed a contactless payment jacket powered by bPay. The right cuff of this jacket hides a contactless payment chip, like the ones found in debit/credit cards. Wearers can pay for values up to £ 30 across 300,000 outlets in the UK, with just a wave of their hand.

Comfort in healthcare. With-

Fig. 4: Contactless payment jacket by Barclaycard and Lyle & Scott (Image courtesy: Barclaycard)

out doubt, healthcare is one of the most valuable applications of smart clothing, and several products are emerging in this space, ranging from simple bedsheets that monitor health parameters of the patient, to super innovative gait trainers. Ekso Bionics has special wearable bionic suits that help in neuro-rehabilitation, for victims of stroke or spinal cord injury. The suits help patients to walk again, through gait-training exercises.

Combining a bit of fashion with utility, fashion designer Pauline van Dongen has developed a knitted cardigan, which has integrated stretch sensors that measure the movements of elderly persons wearing the cardigan, and communicate this data to the service provider. This cardigan is comfortable enough to be used as daily clothing. In fact, van Dongen specialises in such tech-powered fashion. She has also developed garments that help correct posture, as well as water-resistant jackets with flexible solar panels that help the wearers charge their devices when outdoors.

An intelligent t-shirt developed by scientists in Madrid can locate patients within a hospital using a GPS system that works in closed spaces. It also finds out whether the patient is seated, lying down, walking or running. This is very useful to monitor people with memory loss problems.

SensFloor goes one step further—the tech does not even have to be worn. The textile is embedded with sensors that measure capacitance, and is designed as an underlay for carpets. Basically, by measuring capacitance, sensors can detect when someone walks, sits or lies on the carpet. Radio modules help the sensors transfer collected data to a control module, which analyses the activity.

SensFloor can be assembled at healthcare centres or at assisted accommodations. It lets patients carry out simple activities by themselves, without being bound to their beds. At the same time, it helps to keep the caregivers aware of the patients' movements. The system can be adapted to act when certain conditions are observed. For example, it can alert the patient with lights or beeps when there is the risk of collision with walls or furniture, or when he or she is too close to the staircase. It can also be made to alert caregivers. The smartcarpet underlay can also be used for other purposes like home care and energy conservation.

This is just the tip of the iceberg when it comes to smart fabrics for healthcare.

A dash of fun with smart fabrics

Applications of smart fabrics are not all serious. There is a major fun element to it, too. Wearable Experiments (We:eX), for example, have developed a product called Alert Shirt for Australian television group Foxtel, to give viewers of a football game the physical sensation of being part of the game. They can choose a player, whose movements they wish to experience. The football players wear a smartjersey, which is equipped with sensors that capture various physical aspects such as heartbeat, impact with the ball, collision with other players, falls and so on. Sensor data is sent to the base station and broadcast along with the video footage.

Viewers, in turn, wear jerseys that have several tiny motors to replicate the physical sensations felt by the players. The jerseys are

connected via Bluetooth to Alert Shirt app on their mobile phone. When viewers watch the game on TV, the jersey, helped by the app, makes them experience the same physical sensations impacting the selected players. It is basically haptic feedback on a larger scale.

Several years ago Philips demonstrated its Emotions Jacket, an experimental product that creates an immersive cinema experience. It allowed users to experience the intense emotions felt by on-screen characters. The jacket could simulate the sense of touch to create certain moods. This prototype can, if you think about it, be applied to other purposes, too. For example, you can sense when a baby is restless and then simulate the right emotions to help it settle down. You can also use a sense of touch to comfort and de-stress patients.

CuteCircuit has devised some such beautiful garments. One of the founders' first prototypes was Hug Shirt, which lets you send hugs over a distance. The sender's shirt has sensors that measure the strength, duration, location of touch, skin's warmth and heartbeat rate of the sender. The receiver's shirt has actuators that recreate the same hug, although they are a good distance apart. Of course, the shirt pairs with a mobile phone.

Recently, CuteCircuit developed a variant of this shirt, called Sound Shirt, which helps hearing impaired people experience music. Sound Shirt is packed with tiny actuators. It connects to a computer system, which picks up audio from microphones placed at various points on the stage, and makes the actuators cause a vibration according to the intensity of music being played in real time.

They used a bit of intuition to map the music to physical sensing. For example, deeper, heavier bass notes activate the actuators in lower parts of torso, and lighter notes like those produced by a violin activate the actuators further up on the body, around the neck area. As the wearers watch the orchestra and feel the pressure on certain areas, they gradually understand the correlation between actuation and notes, and start experiencing the music.

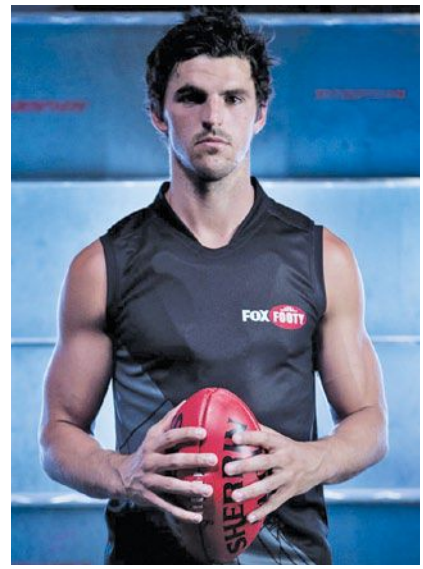

Fig. 5: Foxtel's Alert Shirt lets fans experience what their favourite football players feel on the field (Image courtesy: Wearable Experiments)

A bit of work remains to be done

All said, smart clothing is not without its hitches. Some problems still need to be ironed out before the mannequin in your neighbourhood store sports smart attire. Battery technology is still a real challenge. Truly stretchable and flexible batteries tend to be a bit expensive. And even then, their limited battery life requires the garments to be charged through universal serial bus or a power socket once in a while. This can get a little cumbersome for, say, a hiker who wants to wear a smartjacket and go on a long expedition; he or she might have trouble charging it.

So the industry is seriously exploring energy harvesting, which is energy from the Sun or from the wearer's movements, to power devices. Earlier attempts to put solar panels into fabrics have been a bit difficult—a bit stiff and not so good looking. Naturally, there is also a lot more focus on miniaturisation and aesthetics. Several such prototypes are emerging.

Another real problem is how to make the smart garments more rugged. Nobody wants to buy a smartshirt and learn that it will last only 100 washes or so. In sultry and polluted environments such as those common in India, you have to wash the clothes frequently, which means these last much less. Plus, most of the current smart clothes cannot be dried in dryers because high temperatures as well as mechanical tumbling tend to spoil the electronics.

Then, there is the question of standards. Richard Poate, consumer products manager at TUV SUD Product Service, a global testing, certification, inspection and training provider, remarked in a media report that there are several problems with testing smart fabrics. As an example, he pointed out that there are numerous electrical standards for water and solid ingress. However, when it comes to smart textiles, available tests are not necessarily suitable. If we take the example of water ingress, available tests are for enclosures; these are not relevant to what smart textiles will experience.

He concluded by adding, "While technology moves quickly, standards tend to move painfully slowly. While there are general product directives and specific absorption rate tests, most of this technology relies on wireless technology, such as Bluetooth, to communicate. I would suggest developers to take their smart fabrics and treat these as these would be treated in the real world. Create your own tests."

Indeed, this situation, too, will change soon. Just like standards emerged for every other field of technology, these will emerge strong in the smart fabric space, too. It is a vicious cycle in the field of emerging tech. We wait for standards. Standards wait for adoption. And by some unsaid law of technological markets, everything ultimately works out fine! EFY

CLUMPING ALL YOUR ENTERTAINMENT In A Clumpe

Shanosh Kumar is technology journalist at EFY. He is BCA from Bangalore University and MBA from Christ University, Bengaluru

"We are all connected to the Internet, like neurons in a giant brain," said Sir Stephen Hawking, one of the greatest known physicists of our times. The exact words of Stephen Hawking correlate to our innovation here because it works its way into streaming much-needed entertainment and educational content by creating its own network, while its intelligent algorithms sort out the latest in the world clicks. Creating a sense of offline connectivity, no matter what the status of your service provider is, Clumpe, the access point, can keep you engaged.

A solution in case of no connectivity

It is the realisation that every product today is conceptualised and built to meet the general needs of the customer. Products are merely adopted until a newer version rolls out next year. "When Clumpe was conceptualised, we wanted it to be a humble attempt to conceptualise a single access point to data in form of media (movies, ebooks, music, etc), much suited to situations in a country like ours where people do not have to adjust into the product; instead, the product fits into their need. We even went into taking into consideration wireless connectivity under power breakages," says Sajith Kandiyil, co-founder and chief executive officer, Avench systems.

This innovation derives its roots from Denmark, which is a developed country and provides uninterrupted Internet to its citizens, much like other countries in that part of the globe. Founded by Steffen Rind Helsbro, MOVIS has focused on developing offline entertainment systems at high quality in offline mode, for travel and retail business. Deriving similar values, Clumpe is taking things to the next level of engagement, while battling the persisting connectivity problems and portability issues while syncing data preferred by users in their hard drives as quickly as a possible.

Inside Clumpe

- Wi-Fi 802.11 a/b/g/n, wired gigabit Ethernet, optional 3G and LTE
- Wi-Fi access point performance; up to 50 students can be simultaneously connected
- Optional 1TB storage; 400GB for pre-loaded content, with another 600GB for educator's supplemental content
- Lithium-ion built-in battery, 10,400mAh (up to four hours of battery life)
- Intel Celeron processor N2830/core i3 4010U

Connected challenges

When the technology team at Avench started cracking the challenges down one by one, they realised that it was not only the concept but also every problem that MOVIS was trying to solve was in European perspective, and very different from here in India. Current statistics point to the fact that, only 20 per cent of Indians have access to the Internet. Considering that there is a huge market much larger than the European one, India has its own challenges that need an Indian way of addressing.

After coming down to Bengaluru, one major well-thought-out problem to be solved was powering

Fig. 1: Clumpe, the content access point

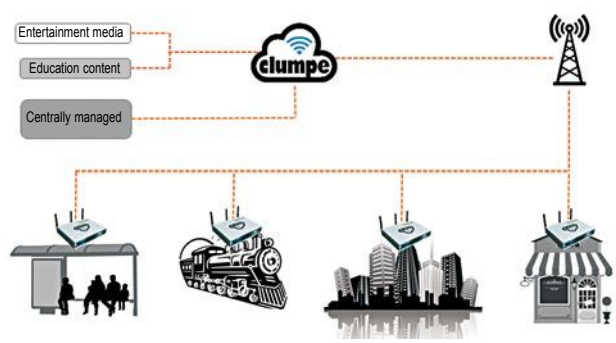

Fig. 2: Clumpe access-point and content streaming through virtual private network

up Clumpe with an inbuilt battery that would provide uninterrupted streaming for up to four hours, even if a power outage occurs, using a 10,400mAh lithium-ion built-in battery.

While all other generic components such as routing engines and processors are available for building the prototype, the second and the most important factor was addressing price sensitivity with respect to the content being streamed and the hardware to support a hundred connected users at the same time.

"There are about seven or eight people who have actually tried before us to capture this mode of entertainment segment in India; most of them quit," says Kandiyil. Learning from competitors, hardware-first was one target Avench solved by having the tech team design everything from the outer shell to the motherboard of Clumpe. Inside the durable encasing, there is a solid-state hard drive of 400GB to 1TB (optional storage varying with price) to store media content.

The smart engine that takes care of selecting the most popular content and placing it down on the hard drive is something Clumpe is running on. Intel Celeron processor runs the intelligent algorithm that sorts the contents over a moving network.

The moving network

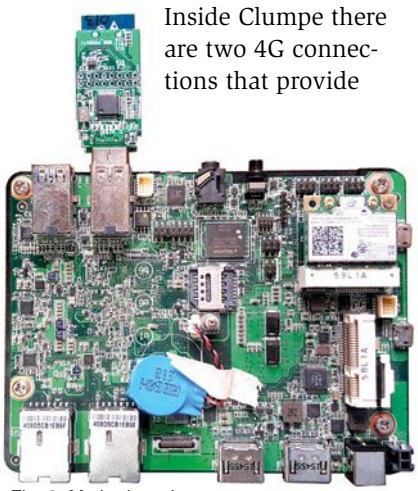

Fig. 3: Motherboard

Inside Clumpe there are two 4G connections that provide the bandwidth required for users at about 50MB per second. In this secured platform of a closed Intranet-like system, content sharing happens whenever the admin or user finds an external Internet connection or another Clumpe access point in its vicinity. The user can login and access, and start viewing the content instantly.

While accessing Clumpe you can download content from another Clumpe in the vicinity and keep the downloaded content in the hard drive present in the bus or car that you are travelling in. That is the part that brings in the moving network into the picture. Copying happens over 802.11 ac Wi-Fi, which is the fastest of all Wi-Fi connections available today. This process is being initiated manually, probably from bus to bus.

There are categories of content managed by the algorithm that smartly picks and updates new movie trailers, music video and the like from the Internet whenever available. Metrics of videos are created by an algorithm, which works like a ranking algorithm. PageRank is a way of measuring the importance of website pages. Likewise, higher viewerships are taken into account by this algorithm and categorised on top as per listing. Content with lower viewership fades away from user's sight.

The idea is to use time effectively

We live in a world where time has to be used effectively. Clumpe makes use of pushing the right content to you at the right time, and you find what you want. Using contextual advertising based on the type of services that customers have availed, additional offers and actionable ad contents could also be streamed, much like what *YouTube* does while playing a long video. This way the advertisers get the right target audience they are looking for.

On the academic front, educational institutions could use this platform to stream informative videos in universities, colleges, schools and labs while controlling what the students are accessing. Techies can gain access to training material in the visual form of e-books, and train themselves while travelling to add more productivity to their work day.

Clumpe is also targeted at hotels for streaming content in pay-per-view segment. Additional revenue generation is done using add-on services that would require the user to pay. EFY

Team Avench

Spearheaded by Sajith Kandiyil, the team of five members is trying to mobilise effective solutions to rather complex problems through their innovations. Addressing the pain points and finding technologically-viable solutions brings the vision of Avench systems to life.

The team is into embedded product design and engineering, involving field-programmable gate array, firmware, and hardware design and software development. It is also into smartcity projects and is working towards linking everything possible to the Internet of Things for a data-driven future.

(L to R) Sajith Kandiyil, Anuroop M., Rajeend U.R., Sandeep G. Nair and Diljith

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TEST DRIVING AUTONOMOUS VEHICLES: Smart Becoming Smarter

Saurabh Durgapal is working as technology journalist at EFY

Vehicles, system components and machines are becoming increasingly autonomous and network with each other via wireless technologies. Touchscreen based controls, remote diagnostics, vehicle status and control are being implemented using controller area network bus for interconnects. However, with the best of vehicles, all issues cannot be solved in the vehicle itself. Puneet Gupta, chief technology officer, Brillio Technologies, categorises the testing of modules into a couple of categories. He says, "First, we have the immediate threats that need to be handled at the user end. Then, there are some problems that can be solved in the Cloud."

Immediate threats cause physical harm

Electronic stability control (ESC) is the involvement of electronics in braking systems. Such systems help drivers avoid crashes by reducing the occurance of skidding or losing control. Mehul Garg, embedded design engineer, Padmini VNA Mechatronics Pvt Ltd, explains, "On detecting a loss of control, a number of intelligent sensors automatically apply brakes to the relevant wheel." ESC becomes active when a driver loses control of the car. It uses computer-controlled technology to apply individual brakes and help bring the car safely back on track, without the danger of fishtailing.

Under-steering and over-steering may be fun while playing games, but these can be disastrous in real life. Garg highlights the reasons to be wary of over-steering. Over-steering, for example, on slippery roads, could result in fishtailing and cause serious injury to multiple vehicles. These kinds of systems cannot be left to be processed in the Cloud. Immediate action has to be taken, that would require a support system after sensing a discourse.

Besides the dangers that require immediate attention, there are several threats over the long term. Infotainment, for example, might not allow a Bluetooth connection due to some issues. This can be diagnosed over the Cloud, resulting in in-vehicle processing focused on saving lives. So once we know the threats, what are the areas to test for?

Areas for focus in testing

Even with the most basic of vehicles, acceleration and deceleration form the crux of driving. These systems need to be tested properly with as low a chance of error as possible. Then, the vehicle should be checked to see if it follows the rules and guidelines of proper driving including acknowledging traffic lights and lane-driving. Any autonomous system at its heart employs a battery for operation. Nisarg Nirmalkumar, senior software developer, RA Consulting GmbH, adds, "The battery needs to be tested as well."

Connected devices prone to hacks. Wireless connectivity features like Wi-Fi, Bluetooth and 3G or LTE present possibilities of remote attacks. Keyless entry and ignition do not require the attacker to have physical access to the vehicle. The number of wireless standards available has created the need for similar equipment to generate signals for testing those

Automotive infotainment test system for testing four infotainment modules simultaneously

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modules. "If we have a wireless infotainment system, we need to test it for wireless standardisations as well," says Kalyan Verma, vice president, products, TUV Rheinland India. Test solutions would typically require maximum radio frequency (RF) testing performance with flexible chip control through several software layers.

With autonomous vehicles making rapid paces in recent times, advanced driver-assistance systems (ADASes) have been on the rise. ADASes today are about taking control of the vehicle away from the driver. Sensor technologies like radars, ultrasounds, cameras and dedicated short range communication for vehicle to everything (DSRC for V2X) present attack surfaces that could seriously impact the safety of the vehicle. Radar or DSRC signals can also be easily spoofed, confusing ADAS algorithms into steering in the wrong direction, or driving into an obstacle.

With smartphones coming into play, another issue of security arises with software applications. A Trojan Horse computer program can easily gain entry into the infotainment system through a paired Bluetooth device or Wi-Fi connection. Media content played via USB and CD are issues along similar lines. Vulnerabilities in the media code can be exploited to plant malicious software in the infotainment system. Weak information technology security further adds to the problems.

Case study

HARMAN/Becker Automotive Systems and Noffz Technologies created a scalable and reusable test station. Requirement for shorter test times per device under test (DUT) combined with a higher throughput in general was achieved by RF instrument sharing or multi-DUT testing. The resulting system allowed the testing of four DUTs with four ports, each including the cellular main and diversity antenna, GNSS and Bluetooth/WLAN.

EQUIPMENT FOR VARIOUS PRODUCTS

Name of product	Testing done
NCS Titan by IFEN	GNSS simulators
NI PXI platform	Infotainment systems
Automotive tool box from Microlease	Infotainment systems
ADAS radar test solution from National Instruments	RF measurements and target simulation for radar sensors
RSA7100A signal analyser from Tektronix	Wide-band radar and electronic warfare systems
M8040A from Keysight	Physical-layer characterisation and compliance testing
Modular automotive simulator from Cruden	ADAS, anti-virus and HMI testing
AST-1000 RF signal source from Averna	Automotive infotainment systems
UTP 9010 series from Noffz Technologies	Functional test, Infotainment test and RF test
Rohde & Schwarz ESW EMI test receiver	Electromagnetic compatibility tests

Increasing number of modules in the infotainment system. Modular testing systems have been a big help in this regard. PXI platform from National Instruments is one solution for modular hardware platforms that can be configured with key software tools. With traditional approach to automotive infotainment RF tuner testing, test engineers need multiple instruments to generate different broadcast and navigational standards. Modular systems allow testing of multiple parameters using the same instruments. For example, the same signal vector generator can be used to simulate GPS and digital video broadcast by simply reprogramming PXI platform.

"Human-machine interface/user interface (HMI/UI), infotainment features or functionalities, common tests and stress tests are the four major perspectives with current infotainment platform validation," says Deepak Hebbur, co-founder, Skillfinity. He adds, "The features are tested as per requirements and functionality." Common tests are for quality, response time and power consumption. Stress tests include voltage curves, electromagnetic compatibility and heat emissions.

Traditional RF tuner testing required multiple instruments to generate different broadcast standards. Multiple instruments were required to generate multiple carrier signals to test the critical functionalities in the infotainment systems, including channel search, alternate frequency selection, emergency and traffic announcements, among others.

Multiple high-definition acquisitions and synchronisation is required to detect issues arising from such systems. Surround sound, encryption schemes and full-HD video in latest infotainment systems have made multimedia test applications increasingly more complex. One example of automotive test that requires an integrated, high-performance solution is ensuring the synchronisation of multiple screens for an infotainment system. Hebbur says, "Validations are also done to confirm the robustness of the UI where you try multiple button presses in a crazy sequence to check if the system handles all the presses gracefully."

Testing electronics

All electronics in a vehicle must do their tasks properly. Verma says, "Different modules are supposed to work as an environment and, hence, call for testing at various stages."

"For proper autonomous vehicles, we work on individual modules, testing these against the required parameters. After module testing, the environment as a whole is tested," adds Gupta. "Lab car is used to simulate the vehicle's running environments, and parameters are measured to check its proper

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Major contributors to this report

- **Deepak Hebbur,** co-founder, Skillfinity
- **Kalyan Verma,** vice president, products, TUV Rheinland India
- **Mehul Garg,** embedded design engineer, Padmini VNA Mechatronics Pvt Ltd
- **Nisarg Nirmalkumar,** senior software developer, RA Consulting GmbH
- **Puneet Gupta,** chief technology officer, Brillio Technologies

functioning," explains Nirmalkumar.

"We simulate the running conditions in a lab and then capture the readings," explains Verma.

Testing these modules, however, raises the question of quantity. Lexus LIT IS, for example, is one-of-a-kind vehicle with about 42,000 LEDs. These LEDs in 2017 model of Lexus LIT IS are programmed to change colour in response to human gestures and music. People's fascination aside, testing the electronics is already a humongous task with such devices.

Automated testing is the way to go. Testing of automotive systems has been growing in size and complexity over the past few years. A modern luxury car may very well have up to 100 engine control units. At such high numbers, regular testing just does not cut it, and calls for appropriate test platforms to address the need for automation, automotive specific I/O and flexibility.

Automation has become increasingly valuable to automotive applications due to the complexity involved in testing whole infotainment systems. Testing an infotainment system without automation may take weeks and many man-hours. An automated infotainment test system, however, does it much faster. Test time can now be reduced to a day or two at most. Test procedures can be run in parallel for multiple software stacks for highly-aggressive development.

Safety and security are important

Current systems employ RF based protocols for detection and authentication of owners to unlock doors and start the engine. These protocols allow remote eavesdropping and have done so in the past. Due to the large code size and complexity, these extend the range of remote attacks to many tens of metres, or even kilometres.

The megamos crypto transponder, commonly found in keys and key fobs for wireless entry systems, is supposed to stop an engine from starting without the transponder being near the vehicle. However, fake frequency modulation transmitters broadcasting radio data system traffic message channel (RDS-TMC) information, adversely influencing the navigation system in cars, have been found to attack.

Tyre-pressure-monitoring systems also employ RF protocols to send pressure sensor information from within the tyre to an engine control unit in the vehicle. These protocols have been sniffed and spoofed to fool the engine control unit into reporting a false tyre-pressure warning to the driver. An attack on the system at the wrong time could have safety consequences in case the driver is distracted or alarmed.

The need for smart(er) cars

Smartcars still lack reliable means of communication. With vehicles, even a minuscule chance of error could lead to major disasters. Human involvement in driving provides for swift action being taken in real time. Autonomous vehicles leave a lot of open areas for question. A smart vehicle runs on algorithms, which is to create a parallel to the human mind. However, unlike the human mind, any number of algorithm or security-breach problems can lead to disaster. Tesla or Google cars' accidents are prime examples. Proper testing can help root out problem areas, so that the next Uber you take is much safer. EFY

Next Generation Test Sourcing Solutions

Rental of test equipment is finally starting to become a part of Indian technology culture, as a growing number of companies learn about the array of benefits it has compared to direct purchase. The fast moving nature of the India market, with new technology standards being adopted all the time, means that key test requirements continue to evolve at a dramatic pace. Consequently there are serious risks that purchased equipment could quickly become outdated and the investment made in it might not be recouped. Also budgetary constraints are now dictating that test hardware should be obtained without having to make heavy upfront payments.

Test equipment sourcing specialist Livingston first established an Indian operation in 2010. The company has, since then, witnessed substantial growth in its market share and expanded its client base considerably. Headquartered in Gurgaon, **Livingston India** offers an extensive range of test equipment from leading manufacturers like Keysight, Rohde & Schwarz, Anritsu, JDSU, Yokogawa, EXFO, Kaelus, Fluke, Tektronix, Fujikura and Sumitomo. Its comprehensive portfolio includes OTDRs, fibre splicers, OSAs, PIM testers, cable antenna testers, network analysers, power meters, oscilloscopes, signal generators, spectrum analysers, etc. This is backed up by in-depth engineering and application advice from its highly skilled locally based staff.

Livingston India presents the Indian market with wide array of equipment sourcing options - allowing customers to find the perfect match for their particular needs. In addition to short/medium term rental plans, the company offers long term leasing and rent-to-buy services. It also provides companies with highly effective asset management services.

Clearly test equipments require periodic servicing, maintenance and recalibrations at relatively frequent intervals. It is crucial to have mechanisms in place to safeguard against downtime during such activities - otherwise costs will be accrued. Furthermore, if rented equipment is 5 or 6 years old then its performance must be brought into question. Aware of all these issues **Livingston India** offers substitute units for those being serviced or recalibrated. Furthermore, the company only employs the newest equipment, replacing it every 3 years.

To complement its test equipment rental and leasing offerings, **Livingston India** presents its customers with industry-leading asset management services. Livingston has developed its own proprietary software packages for hire management, asset management and calibration management purposes. Through these services and by utilising our sophisticated on-line tools, equipment utilisation can be increased dramatically (by as much as 70% in some cases) and last minute purchases to cover any unforeseen shortfalls can be avoided. Equipment that is redundant in one location can made use of elsewhere in the organisation, or alternatively it can be sold off so as to generate extra cash for reinvestment back into the business.

Livingston India differentiates itself from other rental firms within the Indian market in terms of the scope of products it offers and the high degree of quality these products attain. As part of the Microlease group it can draw the support of a global network with longstanding expertise in test equipment rental and asset management with products suitable for the telecom and semiconductor sectors. By working with **Livingston India**, customers can implement far better strategies when it comes to the sourcing and managing of test equipment. They are able to mitigate the financial penalties associated with underutilisation of equipment, equipment failure, inadequate downtime cover, or poor organisation of test assets.

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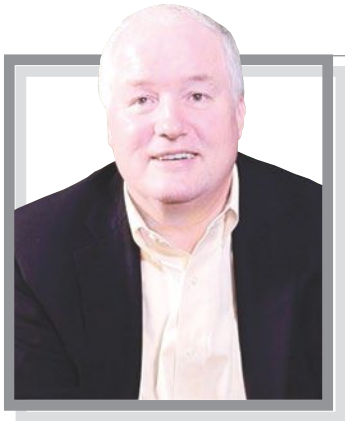

e-Payments:

"BLOCKCHAIN Essentially Creates A Trusted Environment To Operate On Multi-Company Supply Chain Ecosystems"

BRUCE ANDERSON
ELECTRONICS INDUSTRY GLOBAL MANAGING DIRECTOR, IBM

The Internet of Things, cognitive manufacturing and connected systems have one thing in common—all work on data that has been collected. Cognitive tools start to analyse all things that have been brought in. So how does it work? Bruce Anderson, electronics industry global managing director at IBM, speaks with Shanosh Kumar from EFY

Q. Please give an example of a cognitive machine learning to use natural language?

A. When IBM Watson played Jeopardy, early versions were only getting half of the questions right. It later managed to dramatically improve with almost no training on data. How? The learning aspect is critical. Human beings, as experts, came in to help this cognitive system understand the taxonomy of the problem being worked on.

Q. Can you explain the role of taxonomy here?

A. The literal and logical meaning of words is understood by the cognitive system after it builds a lot of context to understand domain knowledge. This is very natural for a human being, but not so much for a computer. Engineers need to realise that, with cognitive, half the problem is about capturing the right data, while the other half is about training the system using acquired domain knowledge. They must use that corpus of data to interrogate the system using natural language.

Q. Coming back to the electronics industry, where do blockchains fall in the world of connected devices?

A. The electronics industry is very complex and multi-layered, and companies that interact with each other are sending transactions back and forth. If minor problems occur, companies often need to spend millions of dollars to resolve supply chain issues. Blockchain essentially creates a trusted environment to operate on multi-company supply chain ecosystems, as it helps eliminate friction that can occur due to lack of trust, especially when you consider the huge amount of verification and agents involved with transactions.

Q. Are blockchains all about evolving into an automated, secure methodology of handling business transactions?

A. In certain cases, automation of tasks can be used to eliminate manual pieces. In the most extreme cases, it can eliminate human tasks itself. If you think about automation using blockchain, tasks could be done intelligently. Blockchain may act as a ledger between the two companies, where data from a variety of sources need to be retrieved even for something as simple as payment processing.

Now, all these tasks could be supported in a blockchain application. In some cases, human beings are still going to be involved for setting up the blockchain system and to make appropriate approvals and verifications.

Q. How does cognitive technology emerge with blockchain, and how deep does it go working hand in hand?

A. Putting cognitive analytics on top of blockchain provides the capability to look for emerging patterns and trends. There are opportunities to detect fraud, discrepancies and root cause analysis to create a trusted source of data that form the core of business processes. Cognitive analytics and blockchain are not really tightly mixed. Cognitive analytics is about studying patterns from data that has been vetted by blockchain.

More importantly, data in blockchain ledger can be structured or unstructured, requiring cognitive technology for analysis. The source of information could come from a manufacturing sector, traditional business system or a variety of other areas.

Q. How do these two technologies look at data?

A. Blockchain looks at a massive amount of fairly-organised information. The cognitive layer tries to understand the data layer formed by the blockchain and builds the indices that are necessary to answer questions in natural language. This is the way cognitive systems understand, reason and learn.

With data in the blockchain from many other data sources, applications can be built on top to literally interrogate the system using natural language, just like how humans talk to each other. EFY

RALF BUEHLER
SENIOR VICE PRESIDENT, SALES AND MARKETING, ELEMENT14

Product Design:

"The REAL SELL Is In The SOFTWARE And Its TRANSACTIONAL MODEL"

We see a lot of startups and small design teams working on Internet of Things projects that aim to let people control household appliances from a smartphone. Is that really where the potential lies? Ralf Buehler, senior vice president, sales and marketing, element14, takes a look at this and other insights for successful product design in a conversation with Dilin Anand of EFY

Q. What is the biggest opportunity for electronics engineers today?

A. It is one thing being able to turn your lights off from your smartphone, but what really makes this work is a step further, where technology responds to users' normal living patterns, rather than merely providing them with the opportunity to control things around them through a different mechanism. It is a big hardware opportunity but it is probably a much bigger software ecosystem opportunity.

A lot of next-generation companies in this space will not be the ones existing today but will result in new entrepreneurial ideas. This means that engineers or inventors with great ideas have a chance of making it big.

Q. What are some popular areas of engineering R&D today?

A. In the Internet of Things, the trend is about connecting to something and controlling it via a communications setup. While simply sensing what was happening in a remote area was a very big part of things, the segment is developing rapidly. Today, people are less content with simply sensing and are thinking about developing their system to do the next big thing—autonomously controlling a machine using what it learns from the various sensors connected to it.

It is no longer about simply sending a message, but more about using actuators to act upon the messages it sends and receives. Power is at the heart of challenges that any wireless device faces. Energy harvesting and other methods to improve the uptime of devices is a big area of research.

Q. What is the biggest R&D challenge for those entering this space?

A. The current situation is such that the problem that needs to be solved will probably need a piece of hardware that is not specified as yet. The big challenge then is that, engineers need to learn how to leverage new hardware technology as soon as possible without having to build it from scratch while they are still playing around with a proof of concept.

Hardware should not be a limitation but a tool or platform that engineers can rapidly build their business case on. Once the business case is proven, engineers can come back to the hardware world to figure out how to get their hardware into mass production.

Q. How has the importance of hardware evolved in the last couple of years?

A. When you look at the hardware trends over the last three years, you will notice that there were a lot of concepts that did not even exist before. Fitness trackers were non-existent until some people realised that these could be made into a business. I would say that it was more of a hardware play than a software one.

On the other hand, a majority of Internet of Things solutions outside of industrial applications are truly more of a software ecosystem development than hardware. This is true even when we look at things like Amazon's Alexa. There is a piece of hardware but it is kind of almost a throwaway product because the real sell is in the software and its transactional model. EFY

Market Survey:

Keeping An Eye On THE INDIAN EMS INDUSTRY Growth Curve

Sudeshna Das is senior executive editor at EFY. She prepared this article with inputs from Baishakhi Dutta, business journalist at EFY

The Indian electronics industry has emerged as one of the fastest-growing segments in the country. Demand for electronics has been rising constantly and is estimated to reach a market size of US$ 400 billion by 2020. Of this, electronics manufacturing service (EMS) is expected to contribute a significant share.

Over the years, India, as an investment destination, has witnessed renewed interest among global as well as domestic EMS players. According to a Frost & Sullivan report, the Indian EMS market is expected to reach a market size of US$ 7.92 billion by 2018. The Indian government is also making earnest efforts to increase domestic manufacturing levels to seize the enormous opportunity presented by the industry.

Considering the importance of EMS, we decided to take a holistic look at how the growing demand impacts this industry. We asked a few questions to senior stakeholders from within the industry as part of our monthly industry poll. In this article we try to get the pulse of the EMS industry in India.

Opportunities galore

Among the survey participants, 97 per cent predict (Fig. 1) that the EMS market in India will be highly dynamic in 2017 since India promises to emerge as a hotspot for electronics manufacturing among the existing South-Asian nations. This is because of benefits like low operating costs and low competitive scenario, which provide ample potential for penetration by original equipment manufacturers (OEMs) and EMS providers across different sets of verticals.

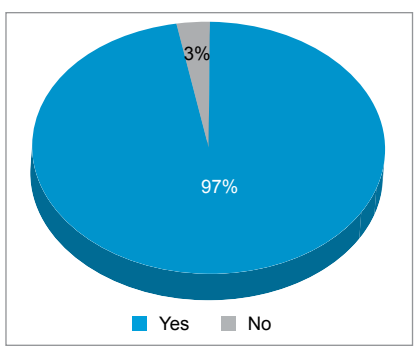

Fig. 1: Forecast on the growth potential of the Indian EMS industry

Survey participants indicate that the top three growth-driving application sectors (Fig. 2) that will need EMS providers in the country will be:

1. LED lighting
2. Telecom and mobile devices
3. Consumer electronics

Manufacturing partnerships in these segments have been growing steadily, as market demand for the products is very high and OEMs are striving to cut costs to maintain their competitive advantage in the face of rapidly-changing market conditions, technological advances and global competition.

There are opportunities for EMS providers outside these three segments, namely, in medical and strategic electronics (including aerospace, defence and railways). According to survey participants, demand for EMS in medical electronics is totally driven by high market demand for medical electronics products. This is because people are becoming health conscious and average life expectancy rate has increased. Moreover, the medical electronics segment is not impacted by any economic reform.

Aerospace and defence OEMs have been increasingly depending on EMS providers to address risk management, logistics and aftermarket service needs. EMS companies

Methodology

For this report, we received inputs from 12 senior-level professionals involved in the EMS industry. This sample group is a microcosmic representation of India's EMS industry ecosystem. These senior professionals shared their insights on:

- Major growth drivers of EMS industry in India
- Key application sectors
- Strategies to get competitive advantage
- Importance of turnkey manufacturing services to expand business in India
- Need for original design manufacturing in India
- Possible demand for reverse logistics services (repair, rework, refurbishment and the like)
- Challenges faced by EMS companies in India

A trend analysis was done on the basis of their inputs. Results of the analysis are presented here.

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that have a global supply chain and advanced technological capabilities can easily exploit this trend.

Riding high on policy booster

Survey participants have mentioned that the EMS industry in India is expecting significant benefits from 'Make in India' campaign in the days to come. Global players have already started showing interest in investing in India. This, coupled with the government's assurance to provide assistance to the electronics industry for setting up world-class infrastructure, is expected to provide the much-needed momentum to domestic manufacturers.

This campaign, which is backed and fully supported by Defence Procurement Policy (DPP) 2016, Preferential Market Access (PMA) Policy and incentives like MSIPS, has attracted OEMs to explore the option of manufacturing in India. This, in turn, will create more business opportunities for Indian EMS players in the times to come.

Industry dynamics

EMS companies operate as strategic partners of OEMs by providing them with a full range of services that include contract design service, prototyping, final system assembly, configuration, order fulfilment and after-market services including repair. By using the services of EMS providers, OEMs can concentrate on their core competencies such as research and product development, brand building, and sales and marketing.

Outsourcing to EMS providers also enables OEMs to gain access to the latest equipment, process knowledge and manufacturing know-how without having to make substantial capital investments, as the risks are converted into variable costs.

Survey participants feel that ever-increasing end-user demands and fast-paced technological developments compel OEMs to continuously introduce new and innovative products in the electronics market. Consequently, OEMs have to increasingly depend on EMS providers who offer significant benefits such as cost savings, reduced time-to-market, reduced time-to-volume, quality and flexibility.

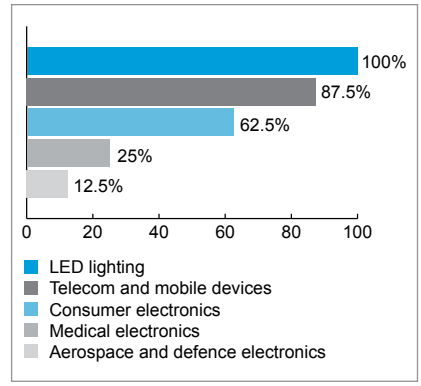

Fig. 2: Forecast on major growth-driving sectors

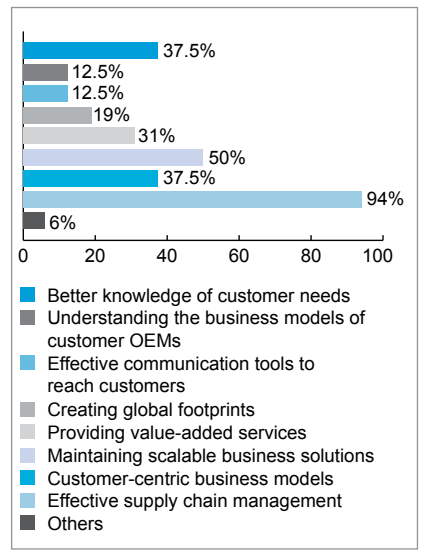

Fig. 3: Suggested business strategies for growth

While discussing the market mix, all survey participants have indicated the long shown affinity of the Indian EMS providers towards a low-mix, high-volume module, which is a contract manufacturing setup where only a few number of assemblies are produced in large quantities. Such a production arrangement may last for weeks or even months using the same setup.

This technique allows changeovers to be kept at minimum levels and equipment utilisation rates to be significantly high. Contract manufacturers have proven to be more efficient when running at high volumes, which requires minimal engineering changes. This pattern is mostly prevalent in India as EMS companies are driven by the high volume quotient of this proposition. Considering the low margin scenario, optimisation of supply chain cost is crucial to the success of this model.

While the low-mix, high-volume method of production is adopted by EMS companies catering to the mass-manufacturing segment, the recent industry trends show a shift towards a high-mix, low-volume production process, which puts high focus on quality and customisation as per customer requirements.

Considering high margins and niche market scenarios, even major changes in market dynamics often do not impact such a production process heavily. This kind of production arrangement mostly caters to the strategic electronics sector, and the emphasis is on faster throughput and high-quality finished product. OEMs that prefer such solutions are willing to pay a higher price without compromising on quality. However, in this model success depends on controlling and improving supply chain efficiently.

Growth strategies

Since OEMs are very selective in choosing their EMS partners, the latter need to focus on nurturing long-term relationships with their customers through enhanced value-added services, strategic partnerships and alliances, as well as through diversification.

In response to growing competition in the industry, EMS providers continuously adopt innovative and strategic business models. These include better knowledge of customer needs, understanding the business models of customers/OEMs, effec-

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tive communication tools, creating global footprints and focusing on core competencies.

According to survey participants, the top-three business strategies (Fig. 3) to get a competitive advantage while acquiring business in the consumer electronics segment are:

1. Effective supply chain management
2. Maintaining scalable business solutions
3. Better knowledge of customer needs and customer-centric business models

EMS providers should also focus on penetration into niche markets and effective information technology tools.

Moreover, considering the intense competition, participants feel that EMS providers need to enhance their value proposition by offering integrated and end-to-end solutions. They also suggest that a strategic partnership with OEMs can enable EMS providers as well as OEMs to contribute effectively to the success of the end product. This, in turn, will help both the parties to achieve high profitability and good market share.

One-stop shops are in demand

Survey participants unanimously accept the importance of turnkey manufacturing services, as the need of the hour is to fulfil the increasing demand for one-stop shops for EMS in the consumer electronics segment.

Sometimes, OEMs follow the consignment contract manufacturing model to maintain greater control over material planning and the acquisition process. This also minimises the risks associated with a vendor-managed pipeline.

A common best practice among OEMs is to have systems that can analyse the total acquisition cost and use it to evaluate EMS suppliers as well as other types of contract manufacturers. These systems assign values to intangibles such as ease of working with a vendor. An OEM assessing an outsourcer must have a way to measure the other elements of the relationship that add to cost.

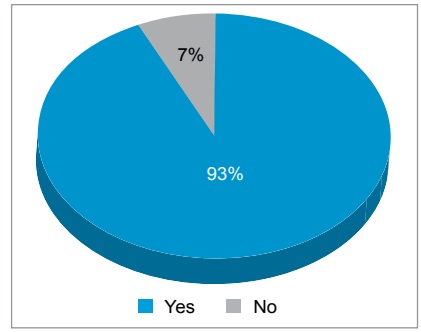

Fig. 4: Predicted demand for original design manufacturer in the consumer electronics sector

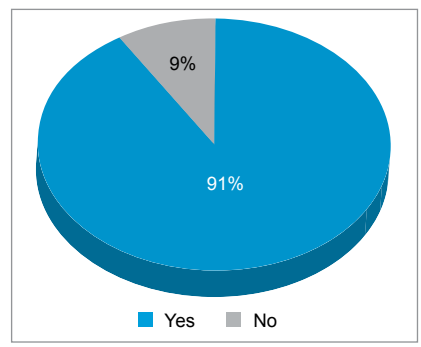

Fig. 5: Predicted demand for reverse logistics in the consumer electronics sector

Turnkey projects need a high degree of technical skills that can be customised according to specific requirements of the OEMs. Only a few Indian EMS providers offer turnkey solutions for PCBAs, utilising chip-on-board, surface mount and through-hole technologies. They also provide complete assemblies including plastic mouldings, metal-die castings and sheet metal fabrications, apart from finishing, painting and printing—in short, deliver the final assembly of completed units. This opens up vast business expansion opportunities for Indian EMS companies.

Original design manufacturing gains importance

Electronics products need constant design revisions as end users expect creativity and continuous innovation. Therefore consumer electronics product design and development is often outsourced to original design manufacturers. In such cases, the sooner an OEM engages the contract manufacturer for product design and development services, the better—particularly when the product being designed moves into production and ramp-to-volume phases.

In instances where the original design manufacturer is hired by the OEM for strategic reasons, the former is expected to have experience in designing and manufacturing similar products. This enables the OEM to minimise costly design iterations, helps bring the OEM product to market sooner and adds several other benefits to the contract manufacturing relationship.

Among the survey participants, 93 per cent (Fig. 4) have indicated that services of original design manufacturers are in demand. They feel that it is important to effectively control overall manufacturing costs in the highly cost-competitive market.

EMS providers can help customers achieve this goal by offering turnkey solutions with value-added services. Design is the best value-added service that an EMS company can provide. Hence, original design manufacturer services become a very important and cost-effective solution for customers.

However, seven per cent of survey participants do not see any value of original design manufacturers in the Indian market. They feel that Indian products need efficient manufacturing strategies rather than original design manufacturers.

Scope in reverse logistics

India is still not a use-and-throw market for consumer electronics products. After-sales services including repair and maintenance

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are quite important for the Indian consumer. Echoing this view, 91 per cent (Fig. 5) of participants have said that additional scope for business lies in the area of reverse logistics. They feel that services related to repair/reworking and refurbishment work will not only help EMS firms get additional business from OEMs but also enable them to play a role in e-waste management. However, considering the complexity of reverse logistics processes, only a few expert EMS providers in India can enter this space.

The way ahead

We asked the participants to suggest possible challenges that could derail the growth of this industry in India. Here is a collation of their concerns:

- Unorganised nature of the sector puts cost pressures on quality service providers and creates issues in the entire value chain
- Inefficient supply chain for required electronic components is a major concern
- An unfair playing field, since companies from competing countries (China, Vietnam, Indonesia, etc) have access to finance at much lower costs
- Logistics inefficiencies and infrastructural bottlenecks, resulting in greater turnaround time and costs
- Higher cost of infrastructure
- Shortage of skilled manpower

Survey participants felt that the successful resolution of the above-mentioned issues through appropriate industry initiatives and government interventions will help this industry move ahead. EFY

Major contributors to this report

- Amit Bhargava, managing director, Asha Electronics
- Ankit Jain, director, Ankit Electronics
- Deepak G. Sawant, managing director, Interfab Electronics India Pvt Ltd
- Indrajit Vank, proprietor, Arkay Technologies
- Milan Patel, chief executive officer, Aminij Embedded Solutions
- Muneesh Dhawan, vice president, Dixon technologies (India) Pvt Ltd
- R.K. Kapur, partner, Vital Electronics & Manufacturing Co.
- Ronak Sonthalia, director, Silizon
- Sreeram Srinivasan, chief executive officer, Syrma Technologies
- Subhash Goyal, managing director, Digital Circuits Pvt Ltd
- Vijay Gujarathi, director, EOS Power India

Cabinet gives nod to incentives for electronics

Union Cabinet has approved the amendment in Modified Special Incentive Package Scheme (M-SIPS) to incentivise investments in the electronics sector by cutting down the application window by about one and a half year to December 31, 2018, and capping the outflow at ₹ 100 billion.

The previous amendment in M-SIPS was made in August 2015 and had extended the scheme till July 27, 2020. Law and information technology minister Ravi Shankar Prasad has said, "If the investment is more than of US$ 1 billion, then a high-powered committee presided by the Cabinet secretary will approve it."

Applications will be received under the scheme up to 31st December 2018 or till such time that an incentive commitment of ₹ 100 billion is reached, whichever is earlier. In case the incentive commitment of ₹ 100 billion is reached, a review will be held to decide further financial commitments.

Electronics clusters to be set up in 400 cities

Electronics and information technology minister Ravi Shankar Prasad said while speaking at Pravasi Haryana Diwas 2017, in Gurugram (Haryana) that, with focus on electronics manufacturing in the country, the government of India has planned to establish electronics clusters in 400 cities and towns across India. He added that, the electronics manufacturing market in India would be around US$ 400 billion by 2020.

The minister has praised the initiatives taken by Haryana chief minister Manohar Lal Khattar and his government to encourage information technology services in the state. He said that when he took over charge of his ministry, India's exports were ₹ 11 billion, which have now grown to ₹ 126 billion as of end of December 2016. Haryana has a lot of possibilities and potential for innovations in the areas of digital payments, artificial intelligence, the Internet, cyber security and digital education. These can become great platforms for the growth of mid- and small-level enterprises.

He also said that the number of mobile phones users in India is equivalent to the combined population of Italy and France, and around 42 mobile phone manufacturing firms and 30 component manufacturing units have already been set up in the country.

On The Move

LG Electronics rejigs India leadership

LG Electronics India has rejigged its senior leadership team, as it tries to spruce up the business after a year of dismal growth, and when white goods sales are forecast to remain muted for at least another quarter due to demonetisation. The company has made changes in about 30 key roles at its local headquarters as well as regional and branch levels, apart from deciding to decentralise the marketing function to focus on localised initiatives and consumer promotions.

Amit Gujral, who is head of mobile business marketing, has now been given the additional responsibility of chief marketing officer of the company. The erstwhile chief marketing officer, Niladri Datta, has been moved to a sales role to head the washing machine business.

Rishi Tandon, who was head of Delhi region, has been made the head of home entertainment business to lead sales for LED televisions and home theatres. The earlier head for LED TV business, Anuj Ayodhyawasi, has been made head for refrigerator business.

Movements at IBM India

IBM has appointed Karan Bajwa as managing director of its India business, succeeding Vanitha Narayanan. Narayanan was named chairman of the unit, a newly-created position. Bajwa joined IBM in 2016 as executive for strategy and transformation in Asia-Pacific. He was previously managing director of Microsoft's India business.

Anil Jalali has quit IBM as executive director-HR, IBM India. He has moved to Capgemini as head-HR for India operations.

Flipkart names new CEO

Kalyan Krishnamurthy, earlier chief of category design organisation, has been elevated to the position of chief executive officer, taking over from Binny Bansal. Bansal now heads Flipkart Group organisation.

Emerson Network Power appoints new CEO

The business until now known as Emerson Network Power has announced the appointment of Rob Johnson as chief executive officer, and officially commenced a campaign to rebrand the standalone company as Vertiv.

Corning appoints Amit Bansal MD for India

Corning Inc. has appointed Amit Bansal as the company's managing director for its operations in India. Bansal will be based in Gurugram, Haryana, to spearhead the company's growth and operations while contributing to strategic planning for Corning in India.

Calendar of Forthcoming Electronics Fairs/Exhibitions/Seminars/Events

Name, Date and Venue	Topics	Contact address for details
India Industrial Automation Show 2017 February 2-4, 2017 Pragati Maidan, New Delhi	International exhibition and conference on automation industry	Confederation of Indian Industry Website: www.cii.in
Electronics West February 7-9, 2017 California, USA	Cutting-edge solutions for electronics manufacturing needs	UBM Americas Website: http://ubmamericas.com, www.electronicswestshow.com
India Medical Device 2017 February 9-11, 2017 Bangalore International Exhibition Centre, Bengaluru	Platform for medical electronics and equipment manufacturers to showcase their products and technology to Indian and international business visitors from the healthcare sector	India Medical Device 2017 Website: www.indiamediexpo.in
Converting Technology Exhibition 2017 February 15-17, 2017 Tokyo, Japan	Combines six specialised exhibitions, namely, Convertech JAPAN, neo functional material, Printable Electronics, 3D Surface Decoration Technology Exhibition, Advanced Printing Technology Exhibition and Prototype and Contracted Manufacturing Exhibition	Converting Technical Institute Website: www.convertechexpo.com
India Electronics Week March 2-4, 2017 Bangalore International Exhibition Centre, Bengaluru	An exhibition for the global electronics industry showcasing concurrently seven events: Electronics For You Expo, DIY Expo, Electronics Rocks, T&M India, LED Asia, Raksha India and IoT Show	EFY Enterprises Pvt Ltd Phone: +91-11-40596605 Website: www.indiaelectronicsweek.com
Conference on Automotive R&D Trends March 9, 2017 Hotel Taj Coromandel, Chennai	Conference that aims to help stakeholders understand the current scenario of automotive R&D, challenges ahead, technologies involved and share their expectations	Confederation of Indian Industry Websites: www.cii.in, www.tntdpc.com
Embedded World 2017 March 14-16, 2017 Nuremberg, Germany	Fair with the focus exclusively on embedded technologies, it reflects the trends in the sector	Embedded World 2016 Website: www.embedded-world.de/en
IoT Summit 2017 March 16-17, 2017 Convention Center, Santa Clara, California, USA	Forum to present and highlight the latest trends, products, applications, development and business opportunities in the IoT	Iot Summit 2017 Website: www.iot-summit.org
Chinese Information Technology Expo (CITE) April 9-11, 2017 Shenzhen Convention & Exhibition Center, Shenzhen, China	Organised by Ministry of Industry and Information Technology (MIIT) and The Municipal Government of Shenzhen, CITE is designed to be a national platform for the next-generation information technology industry	The Organizing Committee of CITE Website: www.citexpo.org/en
Hong Kong Electronics Fair (spring edition) April 13-16, 2017 Hong Kong Convention and Exhibition Centre, Hong Kong	Exhibition for leading-edge electronics products	Hong Kong Electronics Fair Website: http://m.hktdc.com/fair/hkelectronicsfairse-en/HKTDC-Hong-Kong-Electronics-Fair-Spring-Edition.html
Hannover Messe 2017 April 24-28, 2017 Hannover, Germany	Trade fair for industrial technology	Hannover Messe 2017 Website: http://www.hannovermesse.de/home
Windergy India 2017 International Conference & Exhibition April 25-27, 2017 The Ashok, New Delhi	Wind power event in India that provides networking opportunity for members of the wind industry	Windergy India 2017 Website: www.windergy.in
Consumer Electronics China (CE China) May 4-6, 2017	Global IFA event, designed to be China's premier trade show for consumer electronics and home appliances brands in China	Berlin Exhibition (Guangzhou) Co. Ltd cechina-ifa@messe-berlin.com
China Coil Winding and Electronic Transformer Expo 2017 May 18-20, 2017 Shenzhen Convention and Exhibition Center, China	Professional exhibition for small motor, magnetic material, electronic transformer, coil winding and insulation material	Wise Exhibition (Guangdong) Co. Ltd Website: www.motor-expo.cn/En/
Computex Taipei 2017 May 30-June 3, 2017 Taipei, Taiwan	B2B ICT/Internet of Things trade show	Computex Taipei organising team Website: http://www.computextaipei.com.tw
E3 2017 June 13-15, 2017 Los Angeles, California, USA	Annual video game conference and show	Entertainment Software Association Website: www.e3expo.com
IFA 2017 September 1-6, 2017 Berlin, Germany	Meeting place for key retailers, buyers, and experts from the consumer electronics industry and the media	The German Association for Entertainment and Communications Electronics and Messe Berlin Website: http://b2b.ifa-berlin.com
Open Source India October 13-14, 2017 NIMHANS Convention Center, Bengaluru, India	Asia's annual convention to celebrate open source computing	Open Source India Website: http://opensourceindia.in/osidays/
ELEXCON 2017 December 21-23, 2017 Shenzhen Convention & Exhibition Center, China	Annual expo for the electronics industry based in Shenzhen	ELEXCON 2017 Website: www.elexcon.com/elexcon/en

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

Govt to review mobile manufacturing policy

The government is reviewing its entire policy on mobile phone manufacturing as part of an effort to promote Make in India initiative, but will not offer any special concessions to Apple. This could meet some of the demands that Apple has made apart from benefitting other phone makers as well.

Apple had sought concessions to set up plants in the country. The issue will be examined in depth at a high-level meeting with Apple executives. Apple wants a 15-year customs duty holiday on the import of iPhone kits, new and used capital equipment, and consumables. Apple's requests are being considered by three government departments, namely, revenue, industry and information technology.

India to get electronic evidence authenticators

In a move that will aid investigators and prosecutors, the Centre has decided to appoint 'examiners of electronic evidence' who will be the only ones authorised to tell courts if an e-evidence is authentic. The decision comes 17 years after Information Technology Act 2000 came into existence and nine years after it was amended to mandate appointment of such examiners in 2008. Experts have said that such examiners will aid in prosecution as it will now become easier to convince the court of the veracity of evidence.

"The Ministry of Electronics and Information Technology (MeitY) has now put in place a scheme for notifying 'examiners of electronic evidence.' For identification and selection of such examiners, the ministry will initially assess and notify examiners on a pilot basis with three to five labs," Arvind Kumar, group coordinator (cyber laws and e-security) and in charge of IT Act enforcement at MeitY, has said.

Snippets

Panasonic bets on apps to catch up with rivals

To woo potential smartphone buyers in India, electronics major Panasonic is working on mobile apps to catch up with rivals like Samsung and Micromax. The company has called itself a late entrant in Indian mobile phone market and plans to roll out the new apps in the next few months.

Samsung smartphone sales back on track

Mobile phone sales have come back to normal in January after a sudden slump due to demonetisation, on the back of quick responses from retailers and marketers. Retailers quickly adopted digital payment options and companies rolled out easy finance options and other consumer offers to help the industry quickly overcome a slowdown.

Japanese electronics brand Akai re-enters India

Japanese consumer brand Akai has re-entered the Indian market and has tied up with a local Indian electronics distributor to begin sales. The company, which enjoyed sizeable operations here in the late nineties through its range of televisions and home theatres, will be retailed by Paras Group that has bought the licence rights for the Indian market.

Truvison plans to expand in India

Europe based consumer electronics and appliances company Truvison is officially launching its brand in India, with 36 branches across the country. The products already launched are LED TVs and home audio, and a complete range of home appliances like washing machines, air-conditioners, air-coolers and air-purifiers will be launched shortly.

Apple to manufacture locally in India

Apple Inc is in talks with the Indian government to explore making products locally in India, as per a report in *Wall Street Journal*, as the American firm aims to make deeper inroads in the world's second-largest mobile phone market. Prime Minister Narendra Modi is trying to boost technology manufacturing in the country through Make in India initiative. His government in June 2016 exempted foreign retailers for three years from a requirement to locally source 30 per cent of goods sold in their stores.

Govt plans to phase out incandescent bulbs

The government has plans to phase out incandescent bulbs by 2020, by putting gradual bans on production and sale starting with high-voltage lamps, and encouraging consumers to use energy-efficient alternatives. Incandescent lamps consume 80 per cent more electricity than LED lamps, but are widely used in smaller cities and rural areas because these cost much less.

Private sector yet to warm up to smart cities

A year after Narendra Modi government selected the first 20 cities for its Smart Cities Mission, reports show that the private sector is yet to warm up to the programme that banks on private support for big-ticket urban infrastructure projects.

EFY'S design community crosses one million on Facebook

The official Facebook page of *Electronics For You* has now over one million fans. Established in December 2010, EFY's Electronics Design Community (EDC) has now become the destination for electronics engineers, hobbyists and enthusiasts for its technology-related discussions on circuit designs and electronics.

Andhra Pradesh to set up EMCs

According to Aruna Sundararajan, secretary of Ministry of Electronics and Information Technology (MeitY) of India, the state of Andhra Pradesh has a huge potential to set up electronics manufacturing clusters (EMCs). Five EMCs were sanctioned for the state, of which two at Tirupati and Sri City in Chittoor district have already commenced operations. Remaining three are coming up at Vizag, Kakinada and Anantapur.

She has also said that the Centre is trying to develop a medical electronics park in Visakhapatnam. The government has allotted around 100 acres in Pendurthi assembly constituency for the project.

She has added that, presently, the information technology sector contributes 10.3 per cent to India's GDP, which the centre wants to increase to 15 per cent in the next four to five years. This transformation will make the country the largest digital identity base in the world.

Odisha jails to be fortified with 4G jammers

Alarmed by last month's twin jailbreaks in Bhopal and Punjab, Odisha government has started the process of fortifying all 91 prisons in the state of Bhubaneshwar. To start with, existing 2G signal jammers in most jails will be replaced with high-power 3G and 4G mobile-jamming equipment to curb illegal use of mobile phones by inmates.

Arun Kumar Ray, additional director general (prisons), in a recent letter to the home department, has mentioned that proposals have been received from two empanelled firms, Electronics Corp. of India Ltd and Bharat Electronics Ltd, to upgrade the jamming systems in jails.

Qualcomm invests US$ 8.5 million in design in India

American chip major Qualcomm has decided to invest US$ 8.5 million to expand its design initiatives in the country while the government is looking to boost local electronics designing for driving innovation in the country. The investment will go towards Design in India programme to support firms working on rural technology, payment terminals and biometrics devices.

The US company, as part of Qualcomm Design in India Challenge programme, is helping innovators transform their ideas in its Innovation Lab in Bengaluru to prototypes. The initiative is on the backdrop of Narendra Modi-led NDA government's push to increase local design capabilities under Make in India initiative.

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UMHDL (design and simulation)

An education tool by nature, this software is aimed at making you an expert in learning hardware description language (HDL). Its integrated development environment is intended for learning digital designing with programmable logic devices through simulation. To make it more interactive and easily understandable, it invokes an external VHDL compiler and simulator (such as GHDL), and displays the result of the simulation graphically as waveforms (invoking GTKWave). This application runs on all major platforms including Windows, Linux and Mac OS X.

LibreCAD (design and simulation)

From drawing a point, line or polyline on your computer screen to working on co-ordinates and layers of your design, LibreCAD does it all. This software is an open source 2D computer-aided design (CAD) application. It is based on Qt, which is a leading cross-platform application and user interface development framework. LibreCAD has layers, blocks, splines, polylines, ellipse tools, advanced tangent lines, circle tools, transformation tools and an advanced snapping system for creating complex designs of tools and machine parts. It is one of those few lightning fast and lightweight CAD software that make use of 2D geometry.

KiCad (PCB)

KiCad handles all your PCB designing complexities and helps create production-ready electronic schematic diagrams and PCB artwork in no time. KiCad is an open source software tool that can handle up to 32 copper layers, 14 technical layers and four auxiliary layers. It additionally creates all files necessary for building printed boards, Gerber files for photo-plotters, drilling files and component location files. This software also packs a 3D interface for inspecting designs on an interactive canvas. Designers can rotate and pan around so you can inspect details that are difficult to inspect on a 2D view.

Multiple rendering options allow modifications to the appearance of the board, too. KiCad does not present any board size limitation, and its open source capabilities make it the ideal tool for projects oriented towards the creation of electronic hardware, and successful development and maintenance of complex electronic boards.

Some popular resources

Amanda. If you are looking for backup software to back up your data, especially on the server, your search ends here. This stable and free version of software runs on almost all platforms of Linux, Solaris and Windows. Amanda helps back up and archive data from many computers in a network to disk drive or Cloud storage. Written in C and Perl, this software also maintains a catalogue of files that are being backed up from their location on the media.

ClamAV. This antivirus software comes from a family of free, cross-platform and open source toolkits that are programmed to detect malicious software and viruses. It could serve as a server-side email virus scanner, too. The application was primarily developed for Unix and has third-party versions available for AIX, BSD, HP-UX, Linux, OS X, OpenVMS, OSF (Tru64) and Solaris. This version is coded to also run on Microsoft Windows platform. Regular updates help keep malicious emails and malwares at bay.

ScadaBR (SCADA)

SCADA, or supervisory control and data acquisition, are dedicated software application programs for process control and real-time data gathering from remote locations. ScadaBR is a Java based platform that offers visualisation of variables, graphs, statistics, protocol configurations, alarms, construction of HMI screens and a number of configuration options. If an unlikely situation is encountered at the factory shop-floor, it sends real-time event and alarm notifications to notify the concerned engineers, who can look for solutions.

Apache Ambari (utility)

Imagine a complex automated manufacturing factory. It would be ridiculous to have no Cloud based system to monitor and gather data from all machines that are communicating. Apache Ambari project could help monitor clusters of servers that feed into machine data. Ambari makes Hadoop management simpler by providing a consistent, secure platform for operational control. Its Web user interface helps in automating cluster operations while providing centralised security features and additional capabilities using Kerberos and Apache rangers for advanced security. This open source software helps Big Data software fit right into the enterprise environment.

Alluxio (utility)

With engineering industries relying heavily on data-driven platforms for increasing efficiency and outputs, Alluxio performs best in a distributed environment for Big Data workloads. Engineers who work on Big Data software can utilise its full data-management capabilities by deploying this in existing server clusters through the installation file provided in the DVD accompanying this month's *EFY Plus*. EFY

Shanosh Kumar is technology journalist at EFY. He is BCA from Bangalore University and MBA from Christ University, Bengaluru

IndigoSCADA: A Small Footprint SCADA System

ANKITA K.S.

Processes like controlling, supervising, collecting and analysing data and generating reports are crucial for any industry. It is always wise to automate these processes. For the same, there are a number of such control system software available, but supervisory control and data acquisition (SCADA) tools have always been reliable. One such SCADA system is IndigoSCADA.

Noteworthy traits of IndigoSCADA

IndigoSCADA is a powerful SCADA tool used in small custom projects where MODBUS, DNP3, OPC DA 2.05, OPC A&E 1.1, IEC 60870-5-101, IEC 60870-5-103 and IEC 60870-5-104 are used. There are a lot of special features that make IndigoSCADA useful when compared to other SCADA software.

The deal with data. IndigoSCADA uses data to generate daily, weekly or monthly management of reports and graphically presents both historical and real-time data. It consists of an inbuilt structured query language (SQL) editor that allows for online maintenance of real-time and historical databases. In this system, resources such as people and plant assets are optimised, thus, promising high-level control over the plant environment.

Amenities by general-purpose licences. A key feature of IndigoSCADA is that it is an open source software, distributed under GNU lesser general-public licence, and some of the drivers under non-FLOSS licence. However, being open source, the whole software is well grounded because of the number of iterations and revisions it has gone through. Also, frequent developments in the code make constant updating of features possible.

The language boon. This system is developed entirely in C and C++ with multiple operating system support and multiple front-end protocol drivers. This makes it

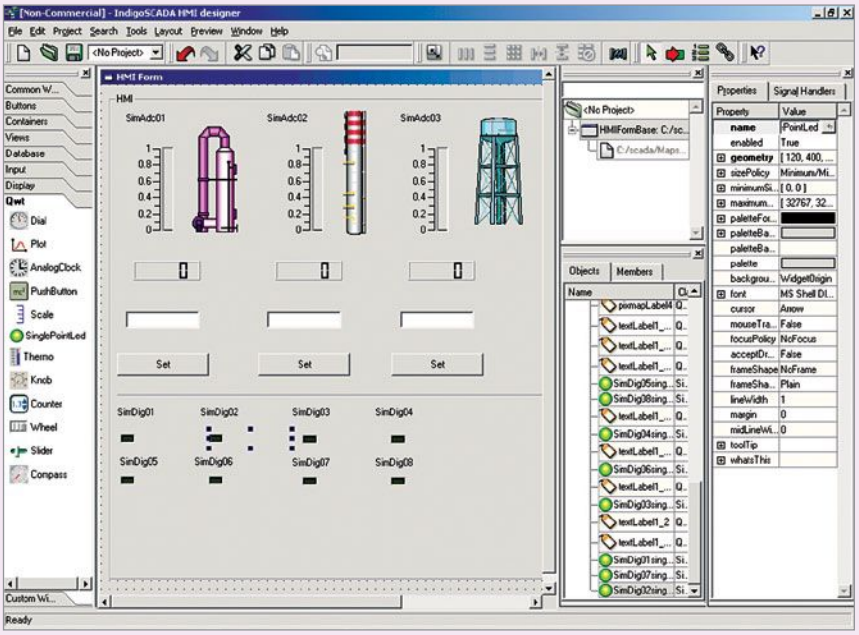

Fig. 1: IndigoSCADA HMI designer

Overview of SCADA

SCADA is an industrial control system where a computer system monitors and controls a process. A SCADA system coordinates but does not control the process in real time. To perform real-time operations, it often includes distributed control system components.

A typical SCADA system consists of five main components. These are HMI, supervisory system, remote terminal unit, programmable logic controller and communication infrastructure.

Functions of the components. HMI acts as an interface that presents processed data to a human operator. Whereas, a supervisory system is nothing but a computer that gathers data from the process and sends commands or control signals to the process. The main function of a remote terminal unit is to connect to sensors in the process, thereby converting sensor signals to digital data and sending digital data to the supervisory system.

There are special-purpose remote terminal units available too, but programmable logic controllers are preferable because these are more economical, versatile, flexible and configurable. When it comes to communication infrastructure, these provide connectivity between supervisory systems and remote terminal units.

easier for industries to customise the code according to their needs. IndigoSCADA also makes sure that they work with lower-level languages as much as possible.

Worker's point of view. Safety of workers and equipment is increased through predefined processes managed by SCADA system. This, thereby, reduces engineering costs, time risk and also provides easy integration with all plant devices. Further, maintenance costs are also reduced through centralised control monitoring that minimises downtime.

Better productivity and quality. Productivity is increased via analysis of processes used to improve plant and production efficiencies. When it comes to quality, it is improved because of repetitive analysis of process data, which prevents errors even before these occur. Operators are more effective here because it consolidates various plant processes and provides users with a comprehensive overview of operations. Also, mobility solutions in SCADA provide operators with the freedom to observe operations in the first hand no matter where they are.

Extended benefits. IndigoSCADA supports multiple users with different access rights, which makes it easier to control the whole system. IndigoSCADA supports multiple human-machine interface (HMI) windows and multiple dedicated lines on the front-end that make multiprocessing easier. Alarms are centrally-managed, which improves operational effectiveness by not overwhelming operators unnecessarily and also provides real-time event and alarm notifications.

Software architecture

The inter-process communication of IndigoSCADA is based on client/server and publish/subscribe pattern. Inside a process, the observer pattern (a subset of publish/subscribe pattern) is used. It uses signals and slots language construct, introduced in Qt, which makes it easy to implement the observer pattern. HMI designer of IndigoSCADA acts as a tool that allows you to use data for generating management reports. In this, you can insert and edit elements such as widgets, buttons and containers. All of these are highly-customisable and can be manipulated with ease.

Being a volunteer-driven project, IndigoSCADA welcomes contributions in the form of code, bug fixes, bug reports, contributed documentation, advocacy and supporting other users on IndigoSCADA forum.

Also, there are a lot of financial contributors providing funding and sponsorships to IndigoSCADA. This ensures that when you work on Indigo SCADA, there are many helping hands to resolve your issue in many ways, thereby making IndigoSCADA a conducive SCADA software. EFY

HARDWARE REQUIREMENTS

To work with IndigoSCADA, you need a keyboard or mouse, RS232 serial interface and PC or laptop with the following minimum specifications:

Operating system	Minimum requirements		
	Processor	RAM	Graphics
MS Windows Professional XP	800MHz	512GB	XGA 1024×768 16-bit colour depth
MS Windows Server 2003	2.4GHz	1GB	XGA 1024×768 16-bit colour depth
MS Windows Vista	1GHz	1GB	XGA 1024×768 16-bit colour depth
MS Windows 7	1GHz	1GB	XGA 1024×768 16-bit colour depth

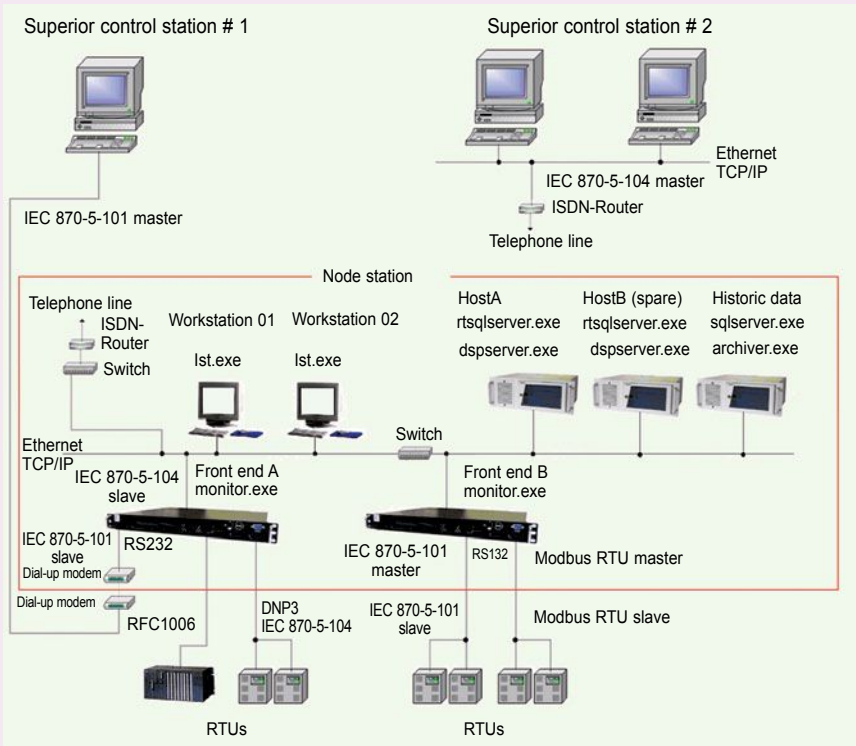

Fig. 2: Architecture of IndigoSCADA with communication protocols

Ankita K.S. is an engineering graduate and a volunteer with IEEE. She is currently based at EFY, Bengaluru, where she writes articles on engineering and technology

GTKWave: Look At Your Waveforms, Openly

ASHWIN GOPINATH

That opening line aside, this article is less about the pun and more about the information. If you are finding yourself on the search for a waveform viewer, then you are at the right page. In this article we cover a solution for the same.

GTKWave, developed by Tony Bybell, is a cross-platform waveform viewer that reads Verilog VHDL files and displays their forms. Though initially developed for Linux, it now operates on Microsoft Windows as well as Apple Mac OS X. As far as open source alternatives for waveform viewing go, it is the only software that runs on all three major operating systems.

GTKWave has been developed to handle debugging of large systems on chips (SoCs), as it is run on a workstation with sufficient amount of physical memory to handle the task. Commonly-used file formats like LXT2 and VZT have been developed to handle real-world designs, whereas formats like AET2 and FST have been designed to handle extremely-large designs.

TABLE I
VARIOUS FORMATS FOR GTKWAVE

Format	Abbreviation for	What it is
VCD	Value change dump	Industry standard format generated by most simulators; slow but ubiquitous
LXT	interLacedeXtensible Trace	Optimised for use; processes faster but used only by GTKWave and a handful others
LXT2	interLacedeXtensible Trace v2	Block based variant; allows for greater compression; supported additionally by Icarus
VZT	Verilog Zipped Trace	Cousin of LXT but file sizes much smaller; slowest write performance but fast on microprocessors
GHW	GHDL Wave file	GHDL wave file; nine-state file format

Components of GTKWave

GTKWave tool has two separate but interlocking tools, that is, gtkwave viewer and rtlbrowse. There are a bunch of applications under the hood that assist in the working while working themselves under independent situations.

gtkwave is the name of the primary tool under use, which helps with all major visualisations. If a full simulation dump is input, then it can help in data visualisation of analogue and digital data, while allowing for search operations, temporal manipulations and save partial results. For hard copies, you can export the results in PostScript and FrameMaker output.

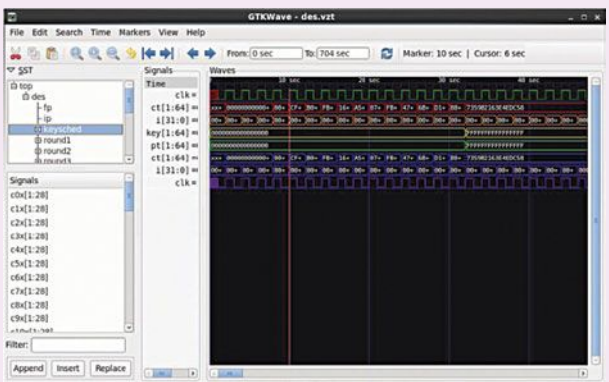

Fig. 1: GTKWave running under Linux

rtlbrowse is used to view and navigate through RTL source code that has been passed and processed into a stems file by vermin—another helper application. It allows for viewing of RTL at file and module levels. To annotate the code at this level, invoke it by gtkwave. Functions like file conversion, RTL parsing and other data-manipulation operations are performed by the aforementioned helper applications.

Multiple signal processing

GTKWave is designed to process a host of signals at once. As such, it is home to three different signal-searching modes, namely, signal search, hierarchy and tree.

Signal search. In this mode, the search requester accepts a search string as a regular expression. If a signal is found matching the string, it is listed in Matches section. These can be controlled and manipulated by either dragging one or more into gtkwave viewer. After selecting, there are options to append, replace or insert, as required.

Hierarchy search. Hierarchy search, as the name suggests, provides a view of the hierarchy in a format similar to the current working directory. In essence, it is the same as the file explorer for any operating system. It contains the

TABLE II
WAVEFORMS VIEWERS

Name	Developer	Platform	Wave formats
Styx	Norman Hendrich	Unix	Only Hades file formats
Dinotrace	Wilson Snyder and Allen Gallotta	Linux, Solaris, Windows	.vcd, .ascii
EPWave	Victor EDA	Web browser based	.vcd

Fig. 2: Demonstrating application integration with Mac OSX/Quartz

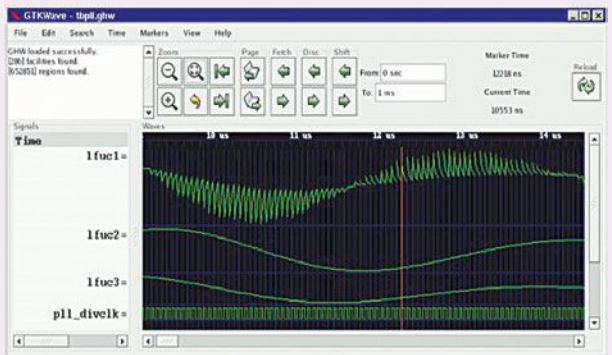

Fig. 3: GTKWave running under Windows

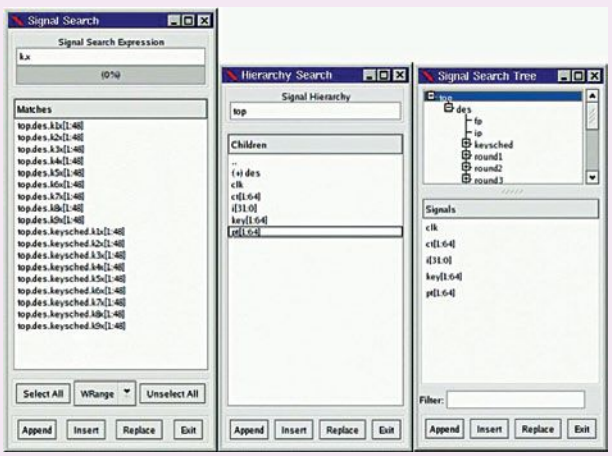

Fig. 4: Types of searches

current hierarchy as well as the children box, which contains all signals in the immediate hierarchy below the searched parent term. In this format, in order to append, replace or insert, you need to select individual ones, otherwise the selected parent and children will be acted upon.

Tree search. This is the most used search requester, as it can be directly embedded onto GTKWave versions 2.4 and above. It has a top tree selection box, signals box and POSIX regular expression filter. The filter allows you to filter a specific sect of signals that you might want to investigate further. If, for example, you are working on a synthesised netlist, then you will find that this tree-searching feature helps you filter signal names at the highest level, saving you a lot of time.

Why you should go for GTKWave

GTKWave has provisions in its code for remote control by other applications. This can be enabled because of the availability of TCL scripting and call-back capability.

Another important feature is called TwinWave, which is a GTKPlug helping you manage two or more sessions of GTKWave in either a single window or in two separate windows. Scrolling and other GUI manipulations can be performed in lockstep across both sessions.

Traditionally, in integrated circuit design, waveform viewers are typically used in conjunction with a simulator. Not only does this help in individual assessment of signals but it also shows the effect of signals interacting with each other in the circuit. In the industry, though, operation is not as dynamic, as engineers run batches of simulations including all possible sets before running the waveforms to check for consistency. Value change dump (VCD) is the most preferred format for saving simulation dump files, while some companies have their own proprietary formats that include extra details depending on the developer.

Techniques like named pipes and shared memory proxies are used to facilitate the same. It allows you to navigate the dump as it is being written to the pipe and watch the simulation in real time. GTKPlug mechanism further allows you to integrate the viewer with other simulators in order to provide an interactive environment, all in one window.

Curiously enough, GTKWave is the only open source waveform viewer that supports post-mortem viewing as well as interactive viewing of VCD files. Presence of this feature allows you to write the output of a simulator and then feed the same to the waveform viewer. EFY

Ashwin Gopinath is an engineer who enjoys following innovators, Arduinos and migratory birds

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Calling PerfDesign For Perf Boards, Strip Boards

PRIYA RAVINDRAN

A breadboard is like staple food to every electronics enthusiast. This is the first thing you would turn to when there is a circuit to design. Converting the lines and curves into signals on the oscilloscope or figures on a digital display is what you as a designer would put your entire efforts into.

Everything works and then comes the most important piece—the board. It is the board that decides the fate of the circuit. But what if you are working with perf and strip boards? How do you go about laying out the circuit? PerfDesign is here to help you!

PerfDesign is a tool for quickly designing or sketching projects on perf and strip boards. Get your Windows laptop, fire up your system and install the package. In a matter of minutes, you will be good to go. But do you even need software to create a design on a simple perf board?

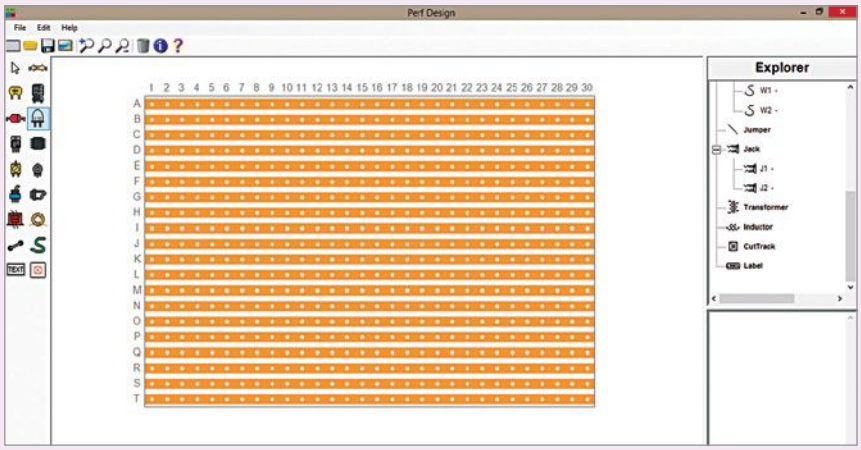

Fig. 1: PerfDesign layout with a strip board

Why PerfDesign

When I worked on my first big project, I started off by creating a working prototype on a breadboard. My professor then told me to replicate the same on a general-purpose PCB—a plain flat board with rows and columns of holes. Translating to the new board, which I later got to know was indeed the perf board, resulted in more stability, lesser noise, an easy-to-handle board and basically better results.

I remember sitting down with a pencil and paper in hand, tracing out graph-like checked squares and trying to put down components on it to scale. I began by drawing a resistor as big as the original one at hand, counting the number of dots before placing the second resistor to make space for node B, and so it went.

After many a drawing and erasing, I managed to get my final circuit to look the way I wanted—component placement, solder, wires and spacing between everything, all taken care of. I wanted the circuit to be neat, after all!

The main problem with designing like this, apart from the sheer number of iterations, is for a layout that involves a lot of cross-crossing; the drawing needs to be that much more accurate!

How much more difficult would it be for creating paths for connecting the ports for I/O devices, or maybe revamping the circuit to accommodate a new design? Enter, PerfDesign!

The crosschecks

PerfDesign is a software that lets you design perf or strip board layouts. This is an easy-to-use tool that helps you quickly put together a layout on a custom PCB. Begin by laying out the components, make way for nodes by moving everything around and finish by connecting the design via traces. I find it easier to use and debug by keeping the layout as close to the schematic as possible.

When you start a new project on PerfDesign, you either choose the perf board or go with the strip board model. How do you choose, though?

The perf board is a set of holes arranged in neat rows and columns. The strip board is exactly the same, except that the holes along each row are connected via copper traces. The former lets you design everything just the way you want, while the latter is easier to work on if all you want to do is replicate the design on

A look at PerfDesign

- Software written in C#
- Released under GNU GPL licence
- Requires Microsoft NET framework 4 or higher
- Authored by AndyBandy
- Works best on Windows 7
- PerfDesign 1.0.0.0 is the latest version

the breadboard. You can create boards of different sizes, up to 100 × 100 holes.

Pick and place, create and edit, on a single screen

The graphical user interface (GUI) of PerfDesign is neat and simple, designed for easy usage. Resistor, diode, transistor, capacitor, integrated circuit, trimmer, LED, potentiometer, switch and jumper—all design components including connectors, wires and track cutters are placed right at one end of the screen. At the other end, there is Explorer window that lets you play with different combinations of values and fine-tune circuits to achieve desired results, instead of changing, say, the resistor each time.

As you add each component, you can choose properties to have a basic design to begin with. The board is created right at the centre of the screen. Just below the board, there is a component overview area that lists out all components used (parts list) in the design, along with their details.

Working your way around the board is very easy. Just a few clicks of the mouse lets you add new components, drag these around to create the intended design, resize these, change properties and basically create, re-create or tune the board to achieve perfection. You can also zoom in to ensure proper connectivity, or pan the entire design to one end in order to re-structure the board. If the board is too huge and complicated, use Component Explorer menu to get a compact view, with components listed, sorted by type and name.

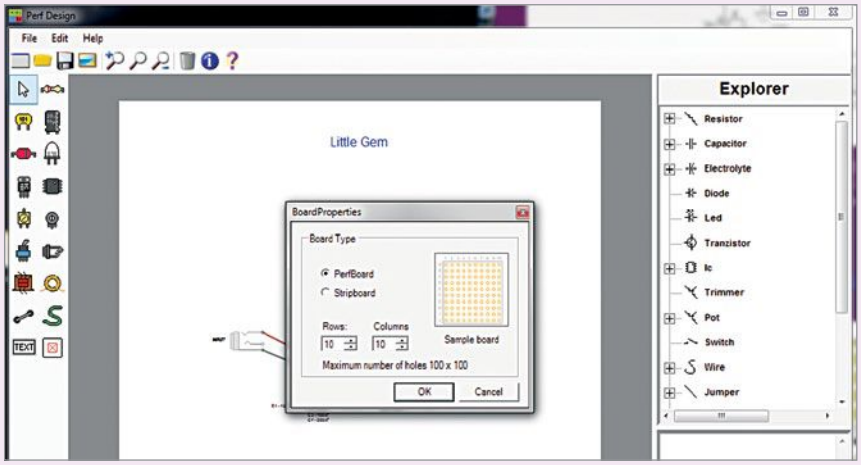

Fig. 2: Customise your board

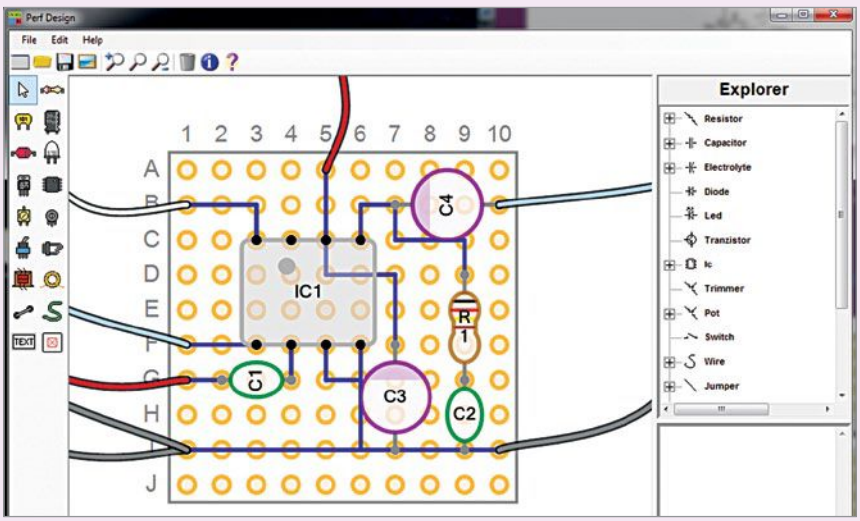

Fig. 3: Designing on a perf board

The board is designed, what next

Overwhelmed by the number of easy-to-design PCB tools, we rarely use perf or strip boards anymore. But the fact remains that such boards are probably the best choices for quick prototypes and, if well done, long lasting ones, too. When compared to printed boards, these are certainly easier to work with and, more importantly, to debug. Yes, you might end up putting the capacitor leads into wrong holes, or solder something wrong, but redoing it will not take too much effort.

You have created your design and laid it out neatly on the perf or strip board. Now, all you need to do is copy the same on the real board. This is a cheap solution that lets you check your circuit's functions instantly and modify these in a short span. Just make sure to get the soldering techniques right, remember to scrap off unnecessary connections if working with a strip board, and you have a nice design on the front side and a neat layout at the back of the board.

A project for every board

While working with PerfDesign, remember to save each design as a new project. Each time you save one, the files get stored in binary format in dat extension. As you create your circuit, you can take snapshots that can then directly go into reports. PerfDesign stores such images in jpeg format.

PerfDesign has been completely created using C# and released under GNU GPL licence. There are a few other tools that let you create designs on strip boards like Stripboard Designer, VeeCAD, BlackBoard Circuit Designer, VeroDes and LochMaster, to name a few. EFY

Priya Ravindran is M.Sc (electronics) from VIT University, Vellore, Tamil Nadu. She loves to explore new avenues and is passionate about writing

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In addition, high-reproducibility BER measurements are achieved by high-quality output waveforms and high input-sensitivity performance. MX180014A software controls MP1800A to generate two-channel test-signal burst patterns and set skew.

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Digitiser

Spectrum GmbH has released a range of high-speed 14- and 16-bit LXI based digitiser products for applications where multiple electronic signals need to be acquired and analysed.

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High sampling rates and resolutions make DN6.44x series perfect for wide-band signal capture. High-channel density makes the instruments suitable for applications where arrays of receivers, sensors, detectors, rectifiers, antennae and other electronic devices are to be used and tested.

Spectrum Systementwicklung GmbH
http://spectrum-instrumentation.com/en

EQUIPMENT

Videoscope

HDV600 videoscope is designed for ruggedness, upgradable versatility and high-definition clarity. It features a

large colour display, SD memory, LED-illuminated handset probes and glove-friendly controller handsets. It has various optional camera probes to fit individual application needs.

The videoscope is waterproof (IP67) and features 14.5cm (5.7-inch) colour LCD TFT with high-definition 640 × 480 resolution. It can store up to 4600 images and video recording of up to four hours with voice annotation. Data can be transferred to a PC via SD card or USB output. It is ideal for industrial, automotive and aerospace applications.

FLIR Systems India Pvt Ltd
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Twilight Timer

This product has been designed to automate the display board's (backlit) light. The photo sensor in it senses the atmospheric light and turns the light on when atmospheric light falls below certain threshold (pre-defined) value. There are seven modes of working for this timer, where six allow setting from one to six hours and the seventh is a complete automatic mode.

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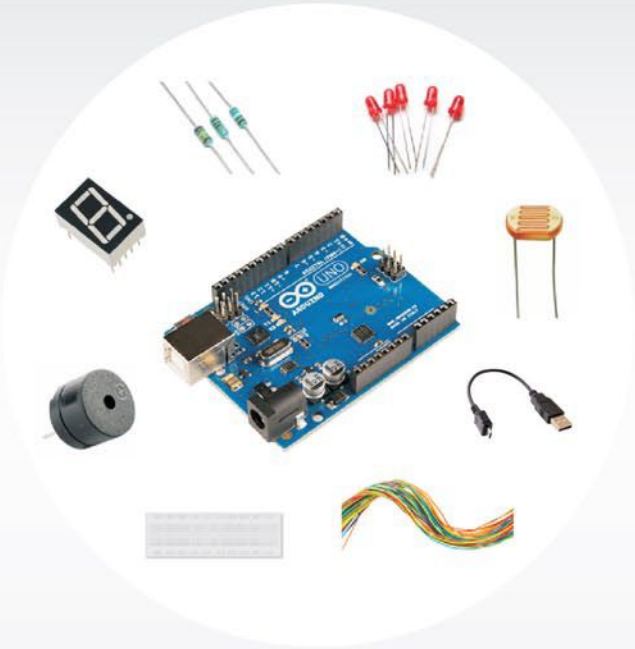

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die-casting and aluminium alloy with chrome-, gold-, nickel- and silver-plated finish. These are reliable in quality, have complete type specs and are compliant with UL and TUV certifications.

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Chipset

ROHM and LAPIS Semiconductor have announced the availability of chipsets designed to drive and control automotive LCDs including larger high-resolution monitors used for navigation and instrument cluster. The chipsets integrate a gamma correction IC, timing controller, source driver and gate driver for driving HD/FHD-class displays (highest resolution currently on the market), along with a power-management IC to ensure optimum drive operation. Each IC is designed to share information as needed, achieving automotive-grade reliability and functional safety. Compatibility with LCDs for side mirrors and speedometers that can lead to accidents is also provided.

ROHM Semiconductor India Pvt Ltd
www.rohm.com

Microcontroller

Renesas Electronics has announced its first RH850 based, 32-bit, automotive radar microcontroller series, RH850/V1R, that will deliver high performance and features required for enabling future advanced driver-assistance systems and autonomous driving vehicles.

RH850/V1R-M, the first product from RH850/V1R series, includes a digital signal processor and high-speed serial interfaces, and is specifically designed for middle- to long-range radars.

Renesas Electronics Corp.
www.renesas.com

AC-DC converter

TMF series AC/DC power supply modules by TRACO Power are fully-encapsulated modules for PCB mounting, and come in the power classes of 5W, 10W, 20W and 30W with fixed output voltages of 5V DC, 12V DC, 15V DC and 24V DC. These are designed for protection class II applications (no earth connection) and feature a low leakage current below 100µA. These are approved to IEC/EN/ES 60601-1 edition 3.1 for 2 x MOPP (means of patient protection) and come with an ISO 14971 risk-management file.

Rebutor Electronics Pvt Ltd
www.rebutor.com

LED LIGHTS

LED inverter bulb

Su-Kam Power Systems has launched LED inverter bulb, which is powered by an inbuilt lithium-ion battery and is much cooler than conventional lights, thus, reducing the risk of combustion or burnt fingers. LED emergency bulb is fitted with lithium-ion battery to keep the bulb glowing even when the main (grid) electric supply fails.

When the LED is connected to the electric supply, it glows, and its internal battery is charged through the electric supply. In case of main (grid) electric supply failure, the bulb keeps glowing, powered by the internal battery, giving a backup of up to four hours under fully-charged battery conditions.

Su-Kam Power Systems Ltd
www.su-kam.com

LED light

HyLite LED Lighting has introduced the new Lotus LED line, which has been designed with versatility in mind. Its 180° adjustable mounting arm allows the Lotus lamp to be installed in multiple positions, and at different lengths.

LED Lotus is available in wattages ranging from 20W to 100W to replace anything up to 400W metal halide and high-pressure sodium lamps, resulting in energy savings of up to 80 per cent. An optimal 120° beam angle and ultra-efficient 140lpw deliver high-quality illumination with energy savings. Lotus comes with a free 20kA inline surge protection device.

HyLite LED Lighting
www.hyliteledlighting.com

MISCELLANEOUS

Remote tuner solution

Using this remote tuner solution, designers can significantly simplify the head unit design of a vehicle and reduce the number of cables. MAX2175 RF-to-bits tuner within the solution eliminates the need to rework the vehicle's hardware to support worldwide radio standards, allowing updates by simply changing the vehicle's software.

Key advantages are:

- Design flexibility and scalability
- Ease of design and space savings
- Enhanced radio performance
- Improved vehicle mileage

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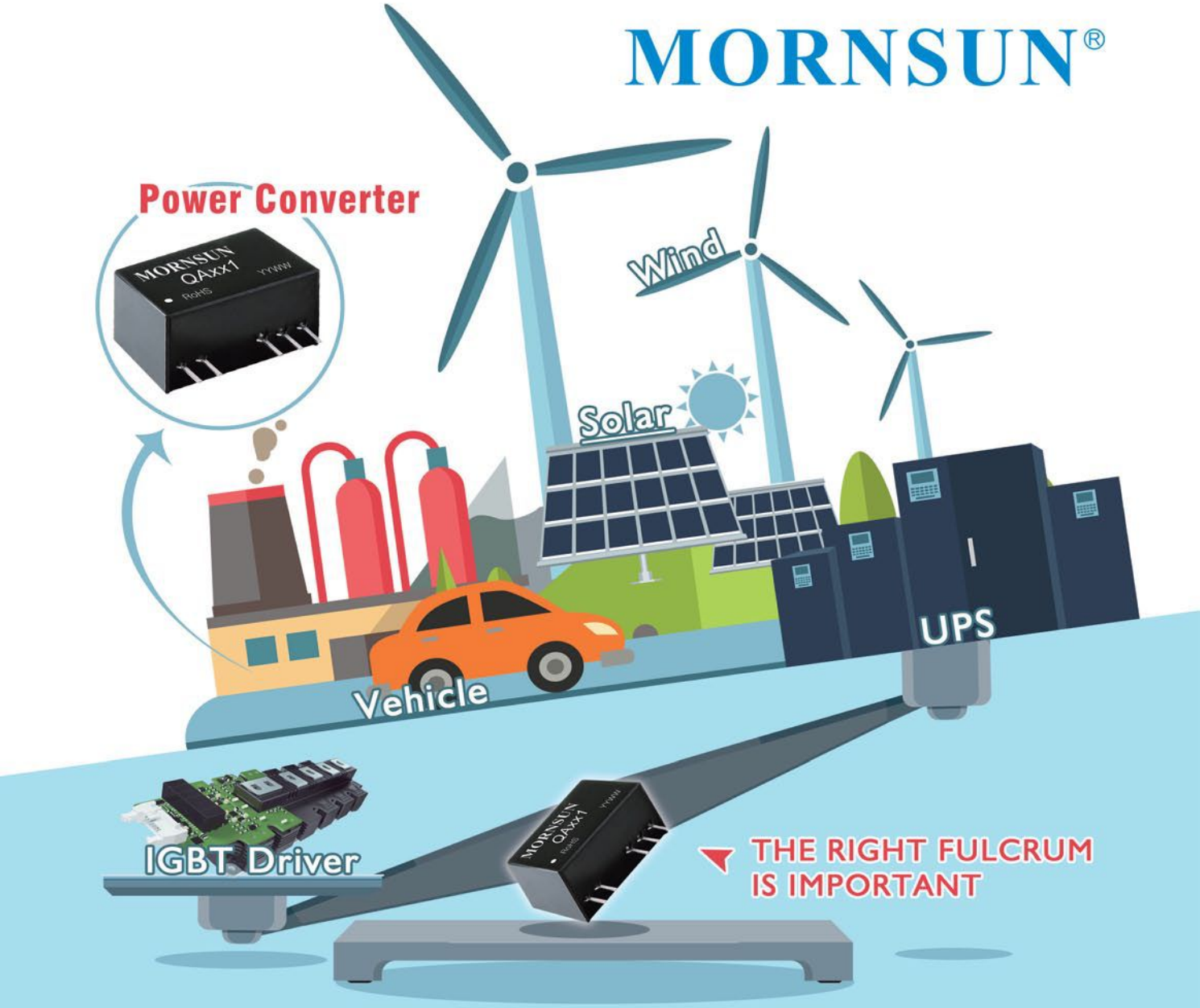

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Smartwatch by ASUS

With time-honoured craftsmanship and smart customisation

ASUS ZenWatch 3 follows the tradition of fine watch-making with its luxurious, detail-focused design and construction from high-quality materials. It provides timely information at a glance, offers a wealth of useful features that make your life easier and features a customisable design so you can create your own perfect watch. Innovative quick-charging technology keeps ASUS ZenWatch 3 on your wrist longer, so you can always stay informed and be in the moment.

With meticulous craftsmanship and timeless design of a fine mechanical watch, ASUS ZenWatch 3's design is inspired by an annular solar eclipse. It is fashioned from jewellery-grade 316L stainless steel. This premium, cold-forged steel is 82 per cent stronger than traditional steel to ensure that ASUS ZenWatch 3 stands up to the rigours of daily wear. A diamond-cut bezel and intricately detailed setting add a further touch of refinement and precision.

DIGISOL launches wireless broadband router

With provision for connecting USB drives for storing and sharing files on the network

DIGISOL Systems has launched AC 1200 dual-band wireless broadband router, DG-BR5400QAC. It works on IEEE 802.11ac technology, which provides a better wireless performance for your network than the previous-generation 802.11b/g/n. DG-BR5400QAC uses intelligent antenna technology to transmit multiple streams of data that enables you to receive wireless signals faster at your home.

IEEE802.11ac technology not only extends the wireless range, it also works with previous-generation IEEE802.11b/g/n wireless devices. The wireless router includes quality of service prioritisation technology that analyses and separates multiple data streams based on sensitivity to delay, enabling multiple applications to stream smoothly across your network.

Acer launches projector

For your dream home theatre system

Acer has launched A1500 projector, aimed at the home entertainment and AV segment of projectors. It is a full-HD projector, and comes with a brightness level of 3000 AL and a contrast ratio of 20000:1. It stands out with its sleek design, which compliments any modern home. The detachable top cover provides flexibility for installing dongles and help hide cables, adding to its clean aesthetics.

Equipped with LumiSense+ light sensor, A1500 can intelligently detect ambient light conditions. Acer LumiSense+ then automatically optimises brightness levels and colour saturation accordingly. LumiSense+ also incorporates a clever content-aware process. It analyses projected content frame by frame and dynamically adjusts image visibility to optimum levels, while its four-corner keystone ensures perfect picture even if you project it from the corner of the room.

AOC launches gaming monitors

For the most versatile gaming experience

AOC has launched a new range of AGON X series gaming monitors exclusively for professional gamers. The new AGON series is a brand extension of AOC series of monitors, ingrained with premium AOC technology to provide you with the most versatile gaming experience. The series includes models enriched with FreeSync and flicker-free technology. The monitors offer a record response time of 1ms (TN) and a vivid quad-HD resolution of 2560 × 1440 pixels.

AGON X series with AOC flicker-free technology and blue light mode reduces eyestrain—a side-effect of long-term gaming sessions. The monitors support Adaptive-Sync technology to eliminate tearing, stuttering and input lag.

Wearable air-conditioner from DOEL

Beat the heat and cold with an electric scarf

DOEL introduces an electric scarf, also known as a personal air-conditioner, which is a heating and cooling wearable device with adjustable neck size. It is easy to operate and is lightweight for use in any environment whether to cool down on a hot summer day or to keep warm in winter. The wearable device allows you to enjoy comfortable temperature without the need for any centralised air-conditioner, decreasing energy consumption. This automatic safety shutoff device prevents over-current and over-heating. The smart device is energy-efficient; it controls individual temperatures according to the environment. It runs on an external battery pack and can be carried anywhere.

Yoga Book by Lenovo

Mobile productivity enters a new era with a two-in-one tablet

Lenovo Yoga Book (Windows) is powered by 2.4GHz quad-core Intel Atom x5-Z8550 processor, and comes with 4GB of RAM, 64GB of internal storage that can be expanded up to 128GB via a microSD card, 8MP rear camera and 2MP front camera. Lenovo Yoga Book (Windows) runs Windows 10 and is powered by 8500mAh lithium-ion-polymer battery. It is a single-SIM tablet that accepts a nano-SIM. Applications including Office Mobile Excel, Office Mobile PowerPoint, Office Mobile Word, OneNote and ArtRage (Lite Trial) come pre-installed.

The tablet features the on-demand Halo keyboard with haptic feedback—open the Yoga Book in type mode and type away. The software-optimised keyboard auto-completes and auto-corrects as you type—letting you work quickly and accurately. Its haptic feedback and keyboard shortcuts provide an experience that is like using a real keyboard.

Xiaomi launches power bank

With quick charge 3.0 support

Keep phones, tablets, cameras and other electronic devices powered on travels with the massive 20,000mAh Mi power bank. Its lithium-ion-polymer batteries supplied by Panasonic/LG have energy densities of up to 728Wh/L. You can charge two devices simultaneously using its dual USB output.

The Texas Instruments control chip in each power bank supports rapid charging. Compatible with 5V/2A, 9V/2A and 12V/1.5A charging, it takes only three hours to charge 11,000mAh and seven hours to charge fully. It maximises time on-the-go so you spend less downtime on charging.

GizMo ByTes

Unocoin launches Bitcoin mobile app

Unocoin, India's leading Bitcoin company, has launched its mobile app for iOS and Android devices. The app will allow you to buy, sell, send, receive and store Bitcoin all in one place, from any remote device. Unocoin becomes the first company in India to offer a full-featured mobile Bitcoin app, with 24/7 access to real-time Bitcoin market prices and instantaneous trading transactions.

DoT launching portal to check radiation status of mobile towers

Department of Telecom (DoT) is set to launch Tarang Sanchar portal that will let you check radiation compliance status of mobile towers and transmitters across the country. Through this portal you can also request a particular BTS tested by DoT to assess its electro-magnetic frequency compliance level. The portal has data from 1.25 million base transceiver stations, and will enable you to view tower-specific details such as the operator, supporting technology (2G/3G/4G).

BHIM app to make e-payments easier

Prime Minister Narendra Modi has launched mobile payment app BHIM (Bharat Interface for Money) based on Unified Payments Interface (UPI). It will let you send and receive money to other non-UPI accounts or addresses. You can also send money via IFSC and MMID codes to users who do not have UPI based bank accounts. There is also the option of scanning a QR code and making a direct payment. You can create your own QR code for a certain fixed amount of money and then the merchant can scan it, and the deduction will be made.

Hub Keyboard from Microsoft

Hub Keyboard, a Microsoft Garage project, lets you stay in context by bringing information from different services to your fingertips and help complete your tasks faster. With Hub Keyboard, you can insert one of your recently-copied items, grab and share URLs of Office 365 documents in OneDrive and SharePoint, share information of a contact from your phone or your Office 365 account, search for and share website and news, powered by Bing, translate what you are writing to another language, powered by Microsoft Translator, find thesaurus entries to help you type and so on.

The prices, features and specifications are based on information provided to us, or as available on various websites and portals. EFY cannot vouch for their accuracy.

Selecting The New Breed Of SMART SECURITY CAMERAS

Shanosh Kumar is technology journalist at EFY. He is BCA from Bangalore University and MBA from Christ University, Bengaluru

Security cameras are handy devices that watch over your security perimeters. Shrinking form factor, faster image- and video-processing capabilities, inbuilt graphic processors, features such as access control, analytics engine, intrusion detection, night vision and wireless connectivity, help these cameras to provide round-the-clock surveillance.

The term 'security camera' is often associated with surveillance cameras. Surveillance cameras are passive in nature, which means that their objectives are to observe and record the events in their field-of-view.

Security cameras, on the other hand, are active, which means that these are capable of sending out messages or alerts to concerned people in case of unexpected events in their field-of-view.

Types of cameras

Security cameras can be divided into two types: digital and analogue. Digital—Internet Protocol (IP)—variants send encoded video signals to a network video recorder (NVR) through IP. Whereas analogue cameras direct the video signals to a recorder.

Today, IP cameras are preferred as these provide better resolution, whereas analogue systems often buff up resolutions and the bulky old television lines often have connectivity problems. These are also hard to track and repair.

IP cameras use Power over Ethernet (PoE), so one single cable does the job of handling power and video signals.

Then, there are some video cameras that have artificial intelligence and deep learning based platforms inbuilt, complete with additional graphic processing and storage. Equipped with better resolution and robust technology, these can give up to 4K resolution, crystal-clear video, and are apt for computer vision based security systems to observe and learn while conveniently integrating themselves with analytical platforms. The security system over the IP can be used to take a look at your property from anywhere in the world through any suitable device connected over the Internet.

Choosing the right one

An intelligent security system should be able to send out a message or alert in real time, in case there is a burglary or theft in your premises.

Observing and categorising the types of threat could also be taught to the camera or the processing unit in the background. This is done using advanced graphic simulations, image based analytics and deep learning platforms installed in these. So before buying a security camera kit, go through the aspects discussed in this buyers' guide.

Field-of-view. This is the area at which the security camera is directed. Position of the camera also depends on this attribute, and it is important because it helps in gauging the number of cameras needed

and their placement.

Resolution. Security cameras have resolution in the range of 700 TV lines to 1000 TV lines. This is roughly equal to 720- to 1080-pixel resolution. Higher the pixels, better the video quality and clarity. Cameras with higher resolution would help identify people, faces, things and places better, and the images and video could be reproduced, transferred without losing the overall quality.

Wi-Fi connectivity. Security cameras having Wi-Fi connectivity would find their place in homes, offices and vehicles. These have no visible wires and can be easily installed and instantly connected. Moreover, cameras connected over Wi-Fi and private networks help in active surveillance in real time over long distances, and are hard to be tampered with in case of a physical hack. Cameras with computer vision software can also be linked to high-speed Wi-Fi for advanced level of security surveillance and alert capabilities over the wireless network.

Night vision. Security cameras now have infrared LEDs to capture clear black-and-white images in the dark. Look out for a high luminosity range while looking for video capturing and surveillance at night.

Weather-proof. Security cameras that operate in outdoors need weather-proofing. Look out for rain hoods and camera housings that keep rain, dust and other debris from accumulating on the camera lens.

Movement. Cameras that can pan, rotate or tilt to provide a larger area of view are better than stationary ones. This functionality saves installation cost, and one single camera could serve the purpose of surveillance as against multiple static cameras.

Motion detection. Security cameras have evolved to capture motion and send alerts. Image based analytics and deep learning frameworks like Caffe have helped security cameras evolve to observe different motions within their field-of-view and get meaningful insights and type of movements. Some cameras could be set to switch on only when these detect some movement.

Best ones available in India

Wireless monitoring with JOYSTEK. Security cameras from JOYSTEK come in all forms and sizes, and provide up to 300-metre wireless transmission range. With aviation connectors for stability, anti-jamming features, lightening protection and over-voltage protection, these are great for total outdoor surveillance.

A large field-of-vision with ZOSI. ZOSI finds itself on this list because of the features it packs. Great for indoor and outdoor installation, the cameras are capable of producing 1080p high-resolution video. These are equipped with better night vision and large field-of-view of about 72 degrees.

Extended storage space with Alibi. Recording high-resolution video needs higher storage space. Alibi's system provides up to 500GB hard drive space, and internally compresses video to H.264 video size to further save space. It also packs features like event search, event log and event notifications via email.

Motion detection with Nest Cam. Nest Cam promises 24/7 live video streaming capability on a smartphone in high-definition 1080p HD resolution. Nest Cam senses motion and gives out sound alerts in case something out of the ordinary is observed.

The cost-effective Vimtag. These cameras come with digital zoom feature, which is rare. These can stream live video with 720p to 1080p resolution. Cameras from Vimtag are known to give good night vision in high definition at night for up to 10 metres, which is ideal for homes and residential buildings. EFY

How To Upgrade To WINDOWS 10 For Free

EFY BUREAU

When Windows 10 was announced, Microsoft was offering a free update for existing PC users, but you could only do that before July 29, 2016. If you are one of those who did not upgrade your Windows 7 or Windows 8.1 PCs when the free upgrade offer was on but would like to do so now, do not fret! The free upgrade offer is still available. Let us show you how—you need a PC running a genuine, activated Windows 7 or 8.1 to get the upgrade.

If you are working on something on your PC, save and close it. Follow the steps given below to update your Windows 7 or Windows 8.1 to Windows 10 for free:

1. Open the Windows 10 download page.
2. Click Download tool now.
3. Once the download is complete, double-click on the downloaded file.
4. Click Accept at Terms and Conditions prompt screen.
5. Click Upgrade this PC now to upgrade the machine.
6. Now sit back and wait until Windows 10 download is complete.
7. After the download is complete, the tool will automatically verify the download. This tends to stay at zero per cent for a few minutes and then zips to 90 per cent and beyond, so be patient.
8. After this, the tool will automatically begin creating Windows 10 media. Wait until that is done.
9. Once again, you will be asked to check some licence terms. Click Accept.
10. Now, the tool will download updates. After this, you will not be able to work until Windows 10 installation is complete.
11. The tool will now tell you that it is ready to install Windows 10. Click Install. (It might take an hour or so for Windows 10 upgrade to complete on the PC, so be patient.) The PC will restart a few times and finally boot into Windows 10.

Windows 10 version 1607, showing Start menu and Action Center (Image courtesy: en.wikipedia.org)

Once the upgrade is complete, you may face some minor issues, like the display resolution could lock to 4:3 aspect ratio on a 16:9 monitor. A restart should fix the problem. So try doing this first before looking for other troubleshooting methods. EFY

81-LED CHASER LIGHT Using CD4017

PAMARTHI KANAKARAJA

This is a simple 81-LED chaser light using two CD4017 decade counters. NE555 timer is used for clock generation for CD4017. We have used only two CD4017 ICs to construct the project in 9x9 matrix format. The circuit is useful for applications like running light systems in halls, decorations, dance programmes, counting and so on. Fig. 1 shows the author's prototype.

Circuit and working

Circuit diagram of the 81-LED chaser light using CD4017 is shown in Fig. 2. It has two CD4017 decade counters (IC3 and IC4) and an NE555 timer (IC2). The 9V battery power supply is stepped down to 5V using a 7805 voltage regulator along with two 0.1µF capacitors (C3 and C4) to eliminate any ripples in supply voltage.

IC2 is wired in astable multivibrator mode. For clock frequency generation, 10µF capacitor (C1), resistor R20 and potmeter VR1 are used. VR1 is used to change the LEDs' flashing rate. Frequency (f) can be calculated using the relationship:

$$f = 1/(0.69(R20 + 2 \times VR1) \times C1)$$

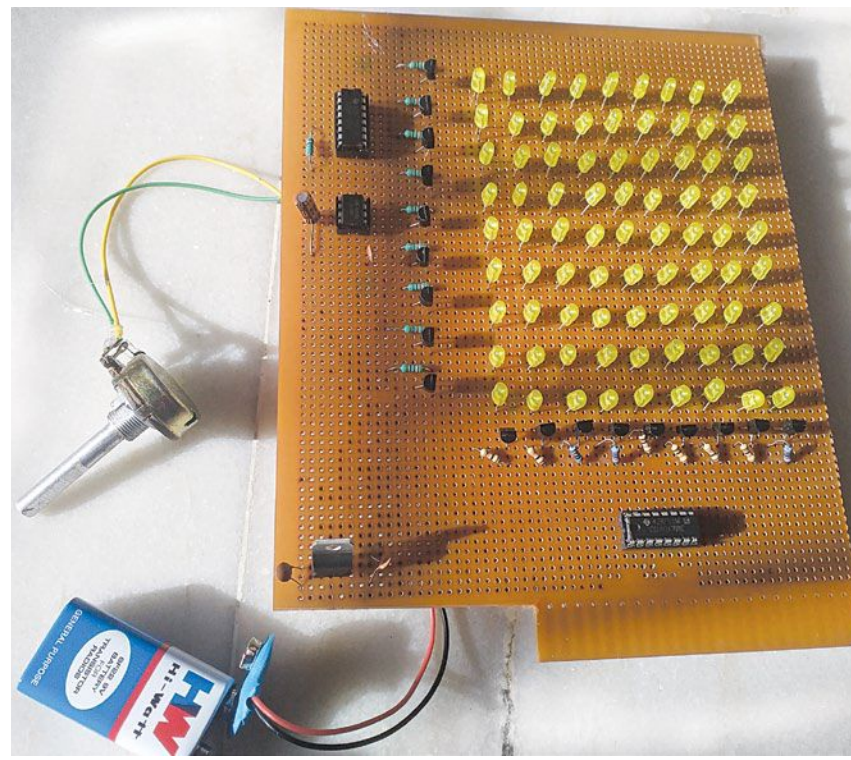


Fig. 1: Author's prototype

PARTS LIST

Semiconductors:	
IC1	- 7805 5V regulator
IC2	- NE555 timer
IC3, IC4	- CD4017 decade counter
T1-T18	- BC547 npn transistor
LED1-LED81	- 5mm LED
Resistors (all 1/4-watt, ±5% carbon):	
R1-R9	- 220-ohm
R10-R18	- 10-kilo-ohm
R19	- 4.7-kilo-ohm
R20	- 1-kilo-ohm
VR1	- 5-kilo-ohm potmeter
Capacitors:	
C1	- 10µF, 16V electrolytic
C2-C4	- 0.01µF ceramic disk
Miscellaneous:	
CON1	- 2-pin terminal connector
S1	- On/off switch
	- 9V battery

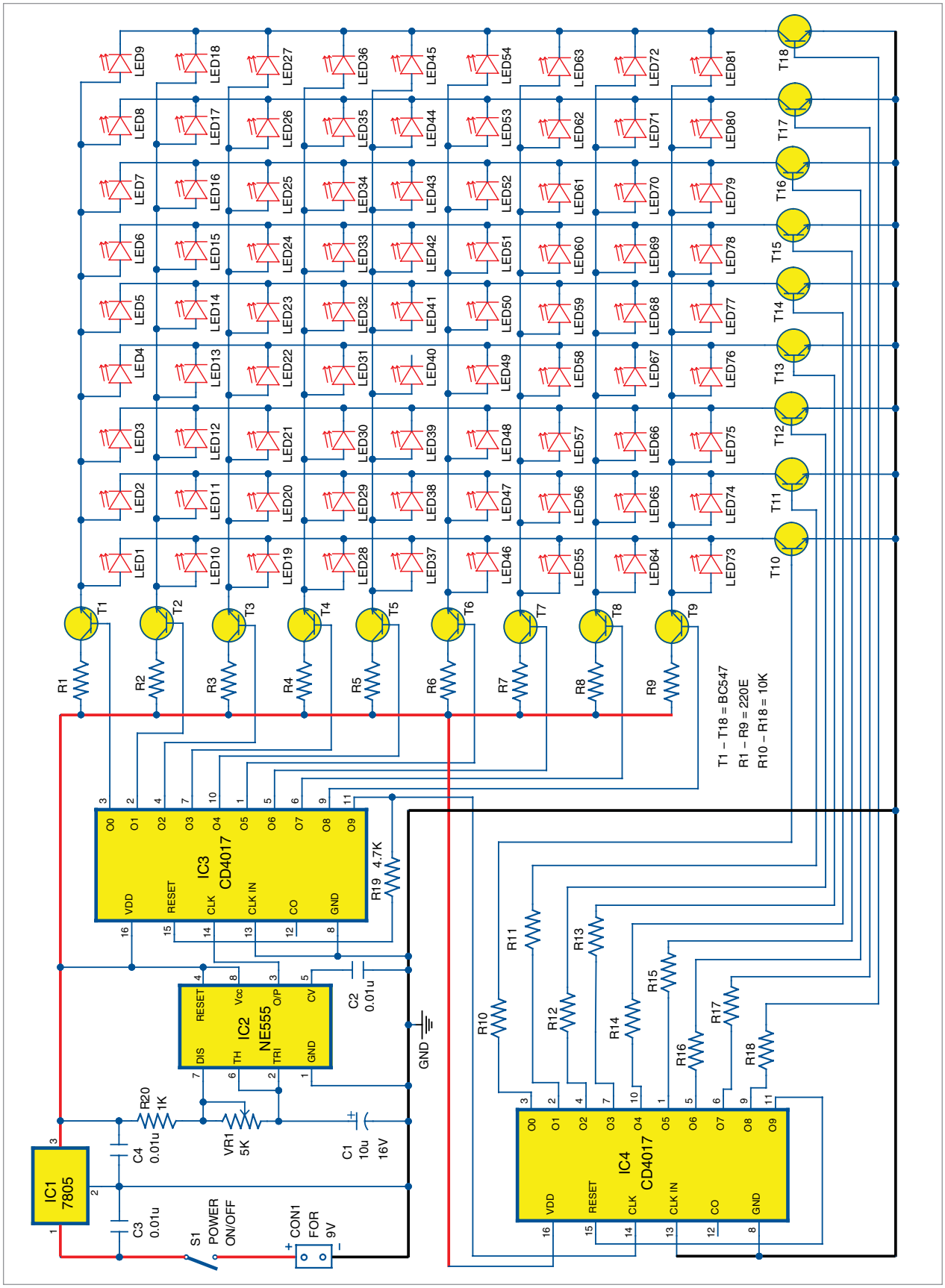


Fig. 2: Circuit diagram of the 81-LED chaser light using double IC CD4017

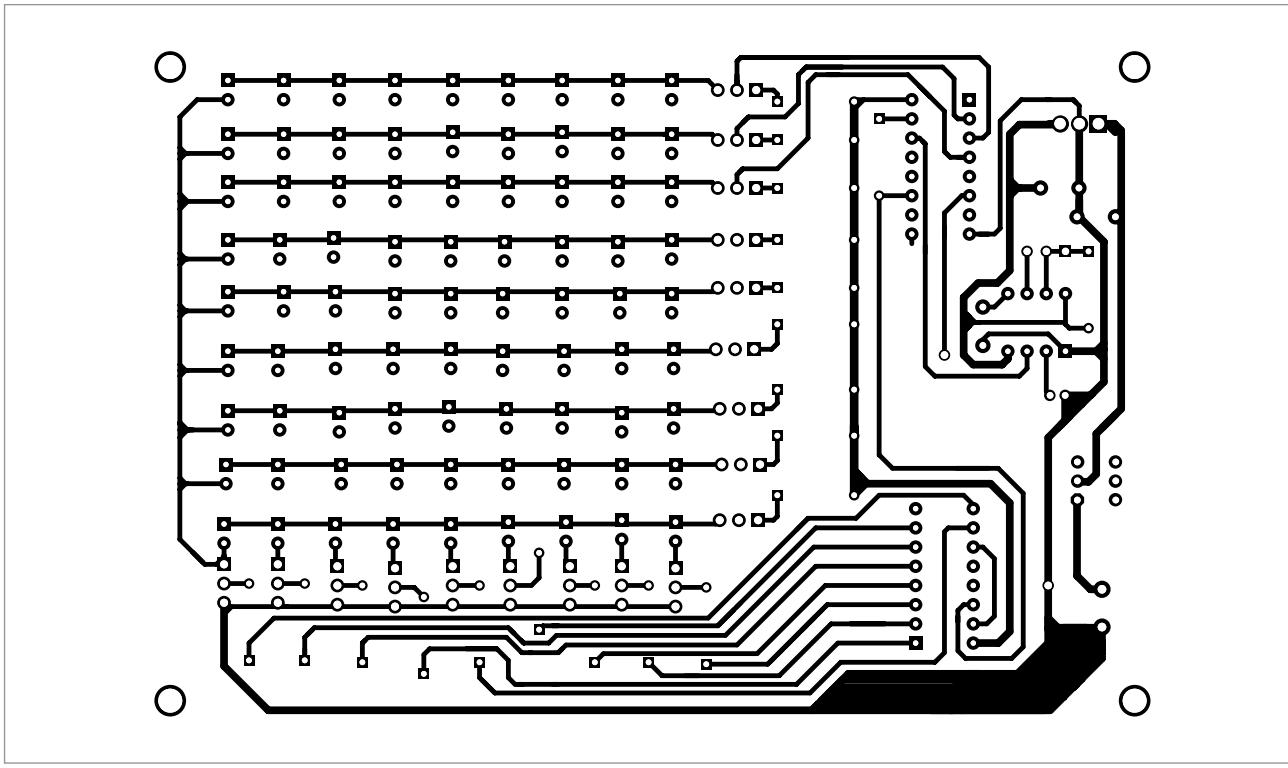


Fig. 3: Actual-size, solder-side PCB layout of the 81-LED chaser light

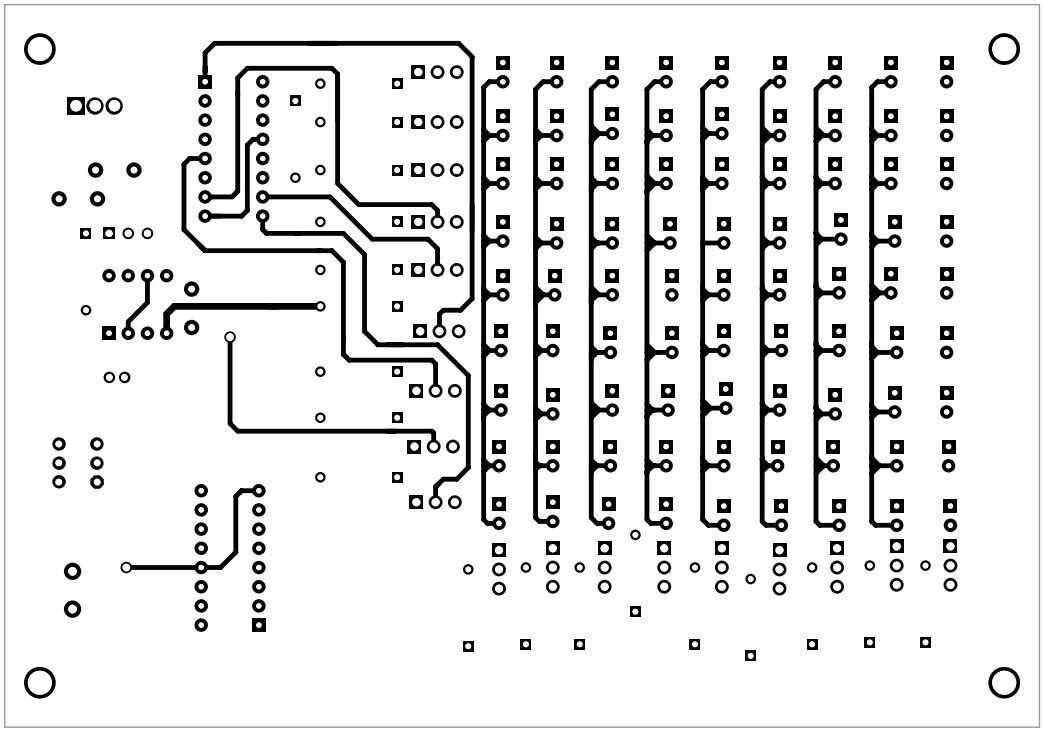


Fig. 4: Actual-size, top-side of the PCB shown in Fig. 3

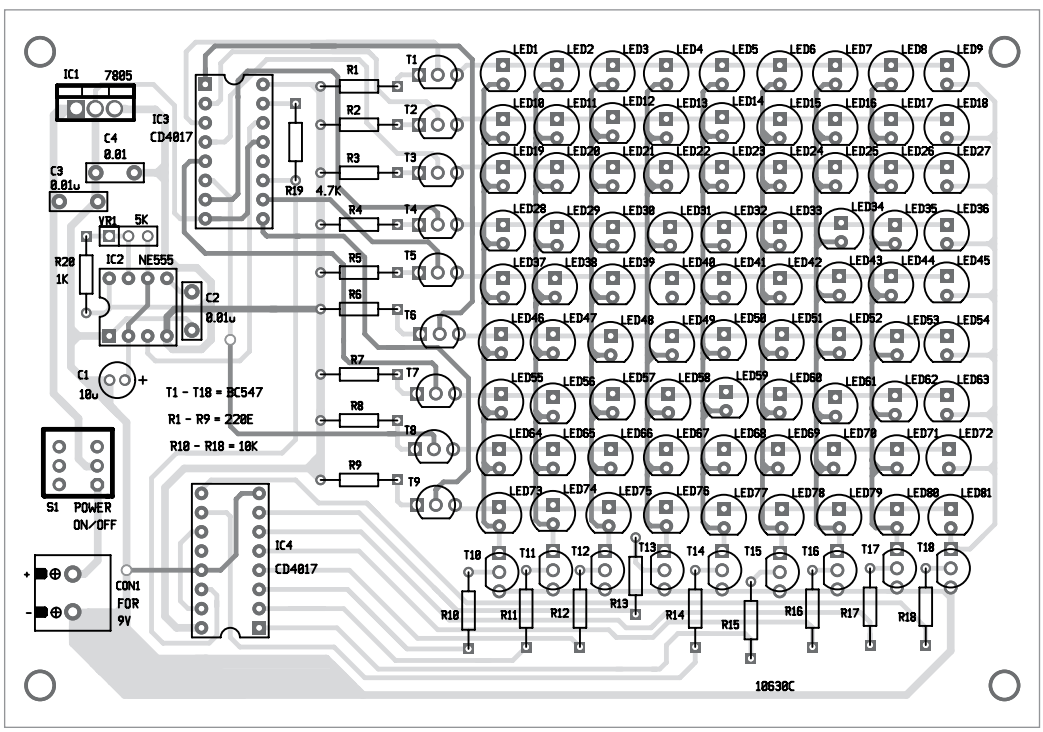


Fig. 5: Component side of the PCB shown in Fig. 3

IC2 generates clock for the first decade counter (IC3). This counter controls the rows (anodes of LEDs) with the help of nine BC547 transistors (T1 through T9). These transistors can be controlled by output pins (O0 through O9) of IC3 along with 220-ohm resistors (R1 through R9) that are connected to collectors of T1 through T9 for current-limiting purpose.

Tenth output (O9) is fed to pin 14 (CLK) of CD4017 (IC4) as clock input. Columns of the LEDs can be controlled through collectors of BC547 transistors (T10 through T18) that are connected to cathodes of LED columns. Outputs of IC4 are connected to bases of transistors T10 through T18 through resistors R10 through R18, respectively.

Clock rate can be varied with the help of 5-kilo-ohm potmeter (VR1) to produce stunning running lights effect based on the concept of persistence of vision.

Construction and testing

Actual-size, double-side PCB layouts for the 81-LED chaser light using two CD4017 ICs are shown in Figs 3 and 4, respectively, and their component layouts in Fig. 5. After assembling the circuit on the PCB, enclose it in a suitable plastic box.

The circuit works off a 9V battery. EFY

Pamarthi Kanakaraja is assistant professor in Usha Rama College of Engineering and Technology, Andhra Pradesh

LINE FREQUENCY METER
Based On Reciprocal Counting

P. PRIYADHARSHINI AND R. PREETHI

Precise measurement of line-signal frequency is very important in many applications, especially in the management of power grid systems. Tasks like calibration of governors of engines that run generators in power plants need a resolution up to 0.01Hz. Frequency is also an important parameter in load sharing among several power plants in the grid.

When the required resolution of the displayed frequency is 1Hz, the instrument becomes simple. Direct frequency counting is one of the many possible methods as shown in Fig. 1.

However, when the resolution required is other than 1Hz, like, say, 0.1Hz or 0.01Hz, value of frequency is obtained from its period. Period is measured in microseconds and frequency is calculated from it. But this method suffers from errors caused by zero-crossing detectors.

In Fig. 2, input conditioning is mainly a zero-crossing detector that produces a pulse for each zero crossing of the sine wave. But here, errors can be caused by comparators whose threshold value may change due to temperature.

Also, hysteresis present in the comparator can cause detection errors. Fig. 3 shows the cause of error in the measurement of the period of a signal.

Reciprocal counter is a class of counter that makes a period measurement on input signal. But it does not use a single- or multi-period counter. Instead, it uses two counters called event and time. Value of frequency can be displayed directly by taking the reciprocal of the period measured as shown in Fig. 4.

Superiority of the reciprocal counting method over other two methods is given below:

1. Integral cycle of input signal cycles is used so that ±1 quantisation error is eliminated. This prevents comparator errors from affecting accuracy.

2. Higher resolution is obtained without a long measuring time.

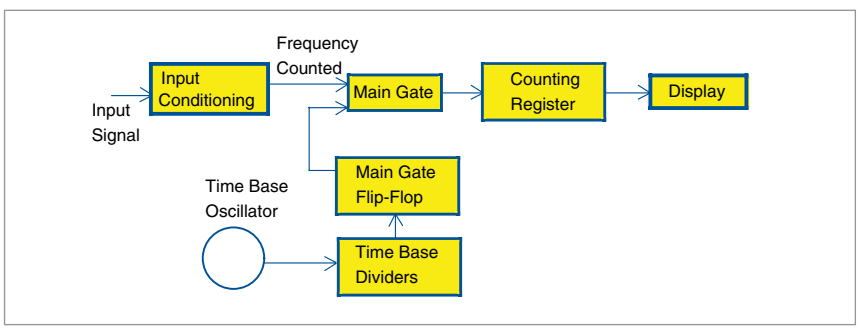


Fig. 1: Block diagram for direct frequency counting

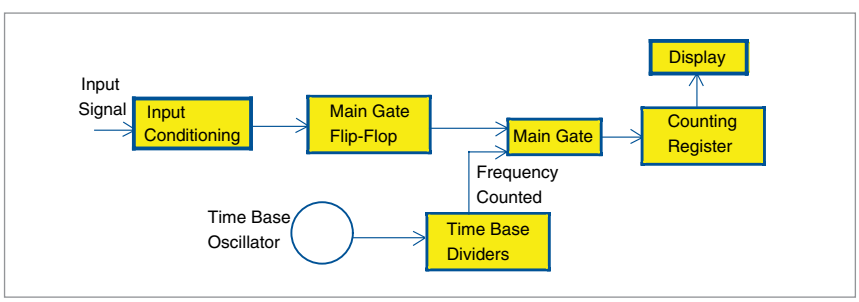


Fig. 2: Block diagram for period measurement

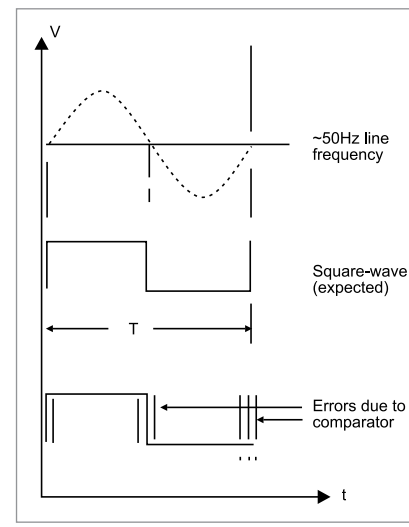


Fig. 3: Zero-crossing errors caused by comparators

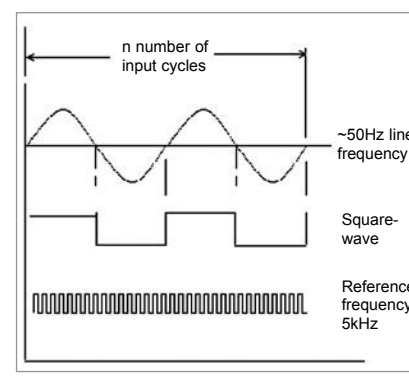


Fig. 4: Diagram showing line-frequency waveform and reference signal

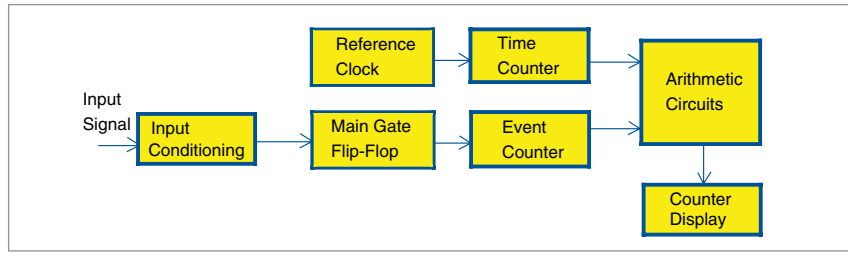


Fig. 5: Block diagram of a general frequency meter with reciprocal counting

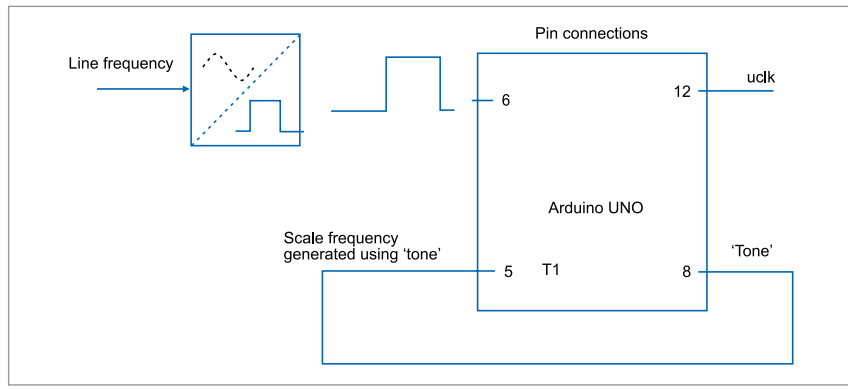


Fig. 6: Simplified block diagram of the line-frequency meter

Principle of operation

A generalised frequency meter with reciprocal counting is shown in Fig. 5.

An exact number of input cycles are counted in event counter and, simultaneously, the reference clock is counted in time counter for the same duration.

An equation can be written as:

$Ns \times Ts = Nr \times Tr$

where Ns is the number of cycles of the input frequency (50 counts in this case) and Ts is the period of the input signal. Nr is the number of cycles of the reference frequency counted within this time and Tr is the period of the reference clock (0.2 milliseconds or 0.2ms in this case).

Frequency of signal is given by:

$Fs = 1/Ts = Ns/(Nr \times Tr)$

$= 50/(Nr \times 0.2ms) = 250000/Nr$

If line frequency is exactly 50Hz, this equation will give:

$Fs = (250000/5000) = 50$

That is, to obtain a resolution of 0.01Hz, value in the display will be 50.00.

Arduino Uno is an excellent platform for the measurement of line frequency using the reciprocal counting method. A simplified block diagram of the line-frequency meter is shown in Fig. 6.

In this figure, line-voltage sine-wave is converted into a square wave of TTL levels using only a transistor. This is sufficient because the event counter counts only integral cycles and that eliminates zero-crossing errors. This square wave is applied to port pin 6 of Arduino Uno.

Square-wave cycles are counted by the software and the event counter. Clock frequency for the time counter is obtained from Arduino itself by the use of Tone() function in the Arduino code as explained in software section. This signal is applied to counter T1.

1. Event counter software counts exactly 50 cycles of the input signal.

2. Time counter simultaneously counts the number of reference pulses.

3. A simple reciprocal calculation then finds the frequency.

A counter similar to the circuits based on ICL7217 or NS74C926 can

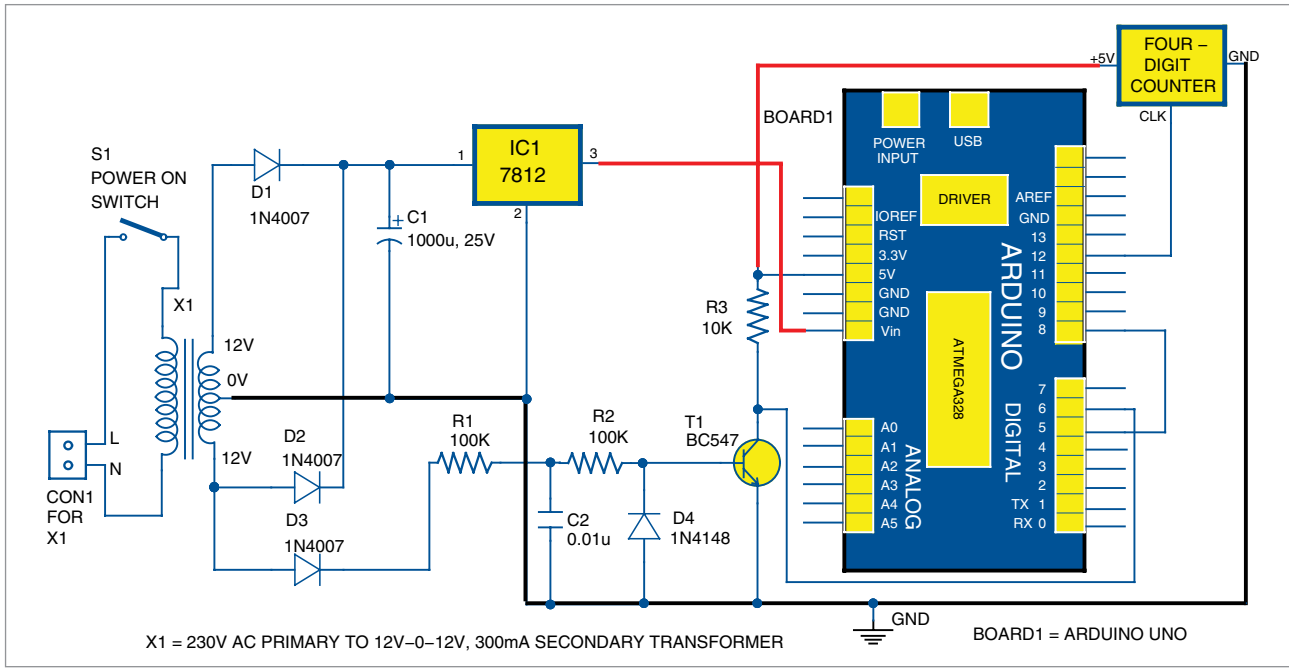


Fig. 7: Circuit diagram of the line-frequency meter with reciprocal counting

be used as a four-digit display for Arduino Uno (Fig. 7). For example, if 1234 has to be displayed, all that is needed is to send 1234 clock pulses. But these counters (7217 and the like) require three signals: reset, latch and clock. That will take three pins of Arduino.

Note. A special counter named ICOUNT is available from a manufacturer in Madurai. This counter requires only one port pin from Arduino. Reset and latch signals are automatically generated by ICOUNT. The number to be displayed is transferred from any available output port of Arduino as a train of pulses. When pulses stop to arrive, the display is updated.

Circuit and working

Circuit diagram of the line-frequency meter with reciprocal counting is shown in Fig. 7. A 230V primary to 12V-0-12V, 300mA secondary step-down transformer (X1) is used for the power supply input and to get a signal to drive transistor BC547 (T1) that provides a square-wave output corresponding to line-frequency input.

Diode D3 applies only positive half cycles of the sine wave to base resistors (R1 and R2) of the transistor. A low-pass filter is applied to this wave so that spikes present in the line are suppressed. The transistor saturates for the value of base and collector resistors shown. This square wave is applied to input pin 6 of Arduino Uno (Board1).

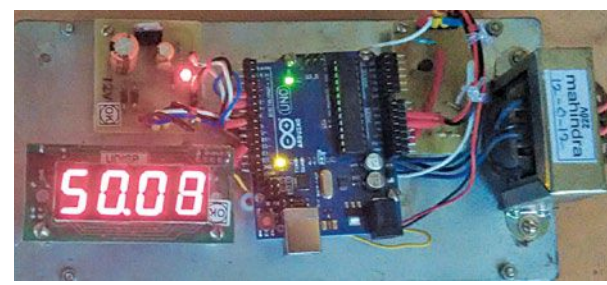


Fig. 8: Author's prototype

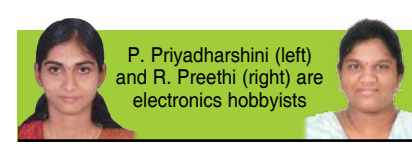
Software

The code (LFM.ino) is written in Arduino programming language. Tone() function produces a 5kHz clock pulse at pin 8 of Board1, and this is connected to Timer1 input at pin 5. Clock pulse train from pin 12 of Board1 is given to the four-digit counter display module. The +5V supply to the display module is taken from Arduino (Board1) itself as the current needed is very small. The author's prototype with 50.08Hz line frequency having a precision of 0.01Hz is shown in Fig. 8.

ATmega328 is programmed using Arduino IDE software. Select the correct board from Tools→Board menu in Arduino IDE, and burn the program (sketch) through the standard USB port in your computer. EFY

EFY Note

The source code of this project is included in this month's EFY DVD and is also available for free download at *source.efymag.com*



P. Priyadharshini (left) and R. Preethi (right) are electronics hobbyists

EFY TESTED S.C. DWIVEDI EFY TESTED

Vibration SENSOR

D. MOHAN KUMAR

Presented here is a sensitive vibration alarm for use as a simple surveillance system for protecting doors and windows. It can also be used as a luggage or locker protector. It beeps and lights a white LED when it detects even a slight vibration. It is compact, battery-operated and can be enclosed in a small box.

The circuit uses a miniature vibration sensor SW18020 P from Gaoxin. It can be used in different ways to sense mechanical vibrations to activate alarms and other surveillance systems in a variety of vibration-detection projects.

The vibration sensor has two electrical contacts that do not touch each other in idle condition. When any movement or vibration occurs, the sensor's contacts close and touch each other. When the movement or vibration stops, the sensor's contacts return back to their original positions, away from each other. The closed contacts during vibration trigger the circuit connected to it. The author's prototype is shown in Fig. 1.

The vibration sensor has a small spring mechanism that makes the contacts touch each other when vibration occurs above a certain threshold level. Two pins coming out of the sensor are insulated by a resistance of more than 10-mega-ohm. During vibration the spring inside the sensor vibrates and makes a momentary short-circuit between the two terminals.

Terminals of the vibration sensor have no polarity but one pin is thick. It is connected to Vcc through a resistor and the thin pin is connected to the circuit to be triggered.

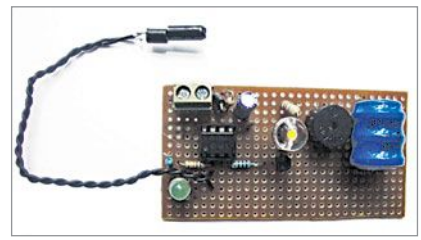


Fig. 1: Author's prototype

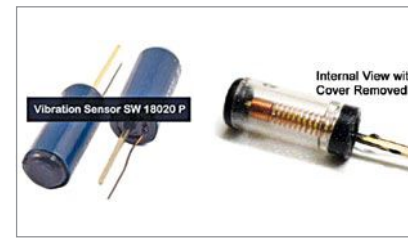


Fig. 2: Vibration sensor

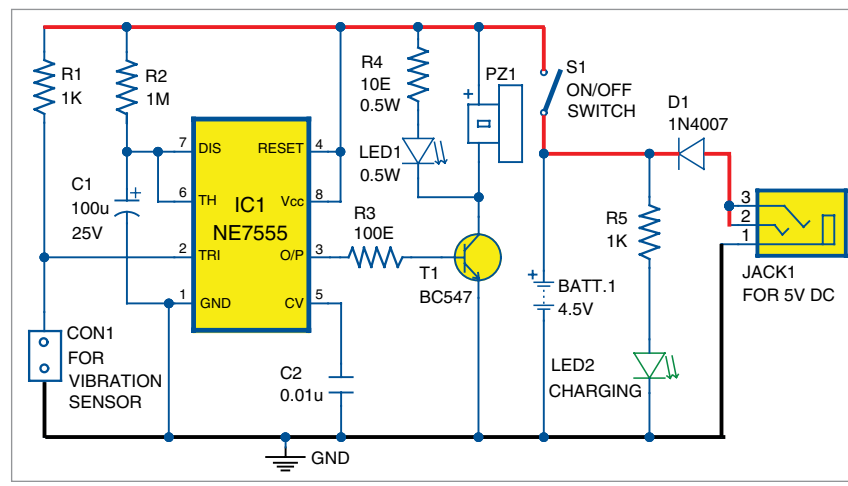


Fig. 3: Circuit diagram of the vibration sensor

The sensor's maximum working voltage is 12V DC but it works even at three volts. When using it in a circuit, it consumes less than 5mA current and offers around 10-mega-ohm contact resistance in open state and less than 5-ohm in contact state. It is highly reliable and its response time is less than 2ms. It works more than 500,000 times without breakdown. The vibration sensor is shown in Fig. 2.

Circuit and working

Circuit diagram of the vibration sensor is shown in Fig. 3. It is built around NE7555 timer (IC1), npn transistor BC547 (T1), piezo buzzer (PZ1) and a few other components.

The circuit is simple. NE7555

PARTS LIST

Semiconductors:
IC1 - NE7555 timer
T1 - BC547 npn transistor
LED1 - White LED, 0.5W
LED2 - 5mm LED
D1 - 1N4007 rectifier diode

Resistors (all 1/4-watt, ±5% carbon, unless stated otherwise):
R1, R5 - 1-kilo-ohm
R2 - 1-mega-ohm
R3 - 100-ohm
R4 - 10-ohm, 0.5W

Capacitors:
C1 - 100µF, 25V electrolytic
C2 - 0.1µF ceramic disk

Miscellaneous:
CON1 - 2-pin connector
JACK1 - DC power jack
PZ1 - Piezo buzzer
S1 - On/off switch
BATT.1 - 4.5V rechargable battery
- Vibration sensor SW18020 P
- 5V DC power supply adaptor with power plug

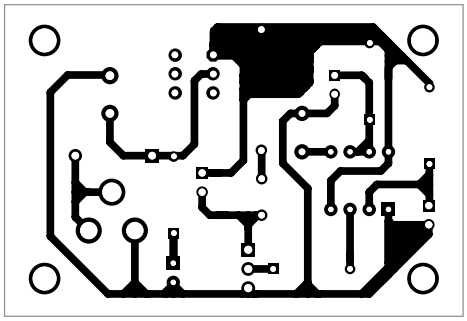


Fig. 4: Actual-size PCB layout of the vibration sensor

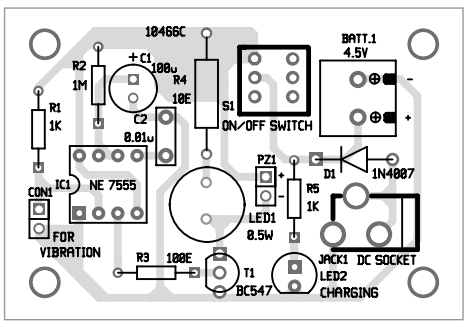


Fig. 5: Component layout of the PCB

timer is configured in monostable mode to activate the buzzer and the white LED for around two minutes when the sensor detects vibration. The vibration sensor is directly connected between trigger pin 2 and ground pin 1 of IC1. NE7555 is the CMOS version of NE555 timer and works off three volts.

The sensor is biased by resistor R1, which also keeps trigger pin 2 of IC1 in high state during standby. When the sensor senses a small vibration, its contacts close and takes pin 2 of timer to ground level. This triggers the timer and its output goes high for around two minutes based on the values of timing components R2 and C1. When output of the timer turns high, transistor T1 conducts to drive the 0.5W white LED and the buzzer.

The circuit is powered by a 4.5-volt rechargeable battery pack generally used in cordless phones. It can be charged using a mobile phone charger if a suitable socket is provided. LED2 indicates charging of the battery.

Construction and testing

An actual-size, single-side PCB layout for the vibration sensor is shown in Fig. 3 and its component layout in Fig. 4. Assemble the circuit on the PCB and enclose in a suitable box.

Connect the vibration sensor to the circuit using connector CON1. Glue the sensor on top of the box if it is to be used as a luggage protector, or on the window or door if used as a vibration alarm.

The circuit works off a 4.5V battery. The 5V regulated power supply is required to charge the battery. EFY

D. Mohan Kumar was associate professor at Government College for Women, Thiruvananthapuram, Kerala

CISTERN OVERFLOW Alert System

T.K. HAREENDRAN

The system presented here will electronically monitor cistern (tank that holds water to flush the toilet) overflows that can otherwise cause seepage in the flats below in a multi-storied building. In case the cistern's mechanism falters and water starts overflowing, it will sound an alarm to alert you with noticeable audible and visual warnings.

The sensor of the system comprises stainless-steel electrodes (needles) housed in a 2.54cm (1-inch) diameter connector (with a small outlet tube attached) for fitting directly into the side overflow pipe of a concealed flushing cistern that also has an internal overflow arrangement. It can be inserted easily into the overflow hole, and detection level can be set as per requirement. Signals from the sensor can be channelled to the master (alarm) unit with a low-voltage twin cable.

The master unit is housed in a wall-mounted plastic enclosure. Power supply is provided from a standard 9V battery. Besides, a volt-free switch terminal is provided for optional remote overflow indication to the building's caretaker for a central common alarm.

Fig. 1(a) shows the sensor of the cistern overflow alert system, Fig. 1(b) the sensor made by the author with the help of a 2.54cm diameter bottle cap, two sewing machine needles and one small PVC tube, and Fig 1(c) the shell of a discarded restroom air-freshener used as prototype enclosure, wall-mounted in the author's toilet.

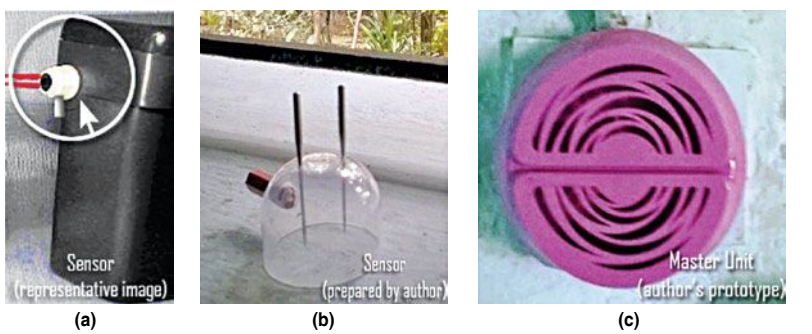


Fig. 1: Author's sensor and prototype: (a) sensor of a cistern overflow alert system, (b) sensor made with the help of a 2.54cm diameter bottle cap, two sewing machine needles and one small PVC tube, and (c) shell of a discarded restroom air-freshener as prototype enclosure, wall-mounted in a toilet

Circuit and working

Circuit diagram of the master unit of the cistern overflow alert system is shown in Fig. 2.

The master unit is built around quad-bilateral switch CD4066 (IC1), in which switches IC1A and IC1B simultaneously extend positive supply to the output. These are driven by the water sensor (connected to J1) through IC1A.

Overflow alert visual indicator

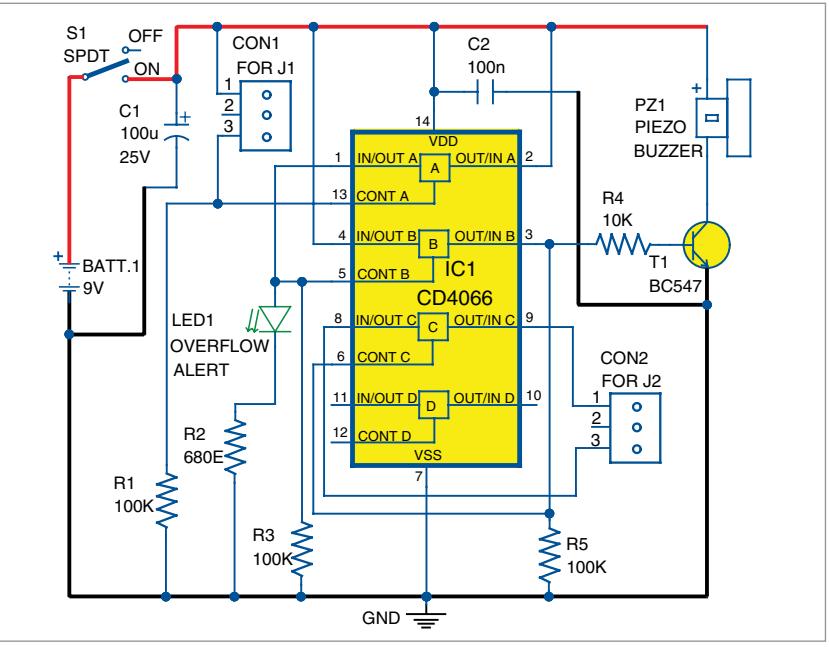


Fig. 2: Circuit diagram of the master unit of the cistern overflow alert system

PARTS LIST

Semiconductors:	
IC1	- CD4066 quad-bilateral switch
T1	- BC547 npn transistor
LED1	- 5mm LED
Resistors (all 1/4-watt, ±5% carbon):	
R1, R3, R5	- 100-kilo-ohm
R2	- 680-ohm
R4	- 10-kilo-ohm
Capacitors:	
C1	- 100µF, 25V electrolytic
C2	- 100nF ceramic disk
Miscellaneous:	
PZ1	- Piezo buzzer
S1	- On/off switch
J1	- Two copper wires for connecting to two needles (sensors)
J2	- Two copper wires for optional remote indication
CON1, CON2	- 3-pin connector
	- 2-pin connector for BATT.1
	- 2-pin connector for PZ1
	- 9V PP3 battery
	- Two sewing machine needles
	- One small PVC tube

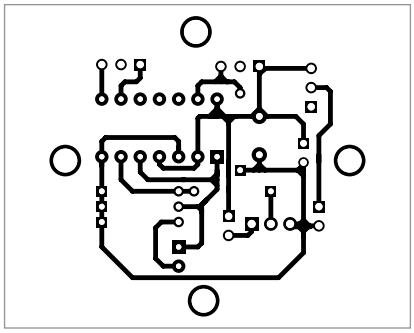


Fig. 3: Actual-size PCB layout of the cistern overflow alert system

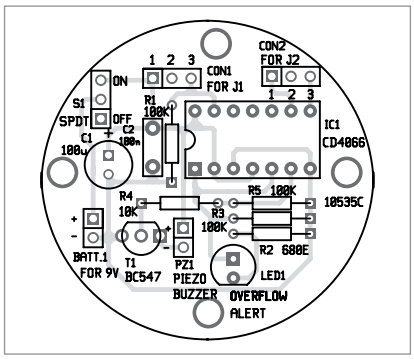


Fig. 4: Component layout of the PCB

(LED1) is driven by IC1A, and the aural indicator (PZ1) is switched on by IC1B with the help of BC547 transistor (T1). IC1C (connected to J2) works as a volt-free normally-open (N/O) bilateral switch for optional remote overflow indication. Maximum current through this switch should be less than 20mA.

As shown in the circuit, three (of the four) electronic switches in CD4066 control device operation. In the case of an overflow, IC1A is closed due to the high level at its control input (pin 13); LED1 lights up to indicate its status. At the same time, IC1B is closed too, causing PZ1 to be active.

In idle state, voltage at the control inputs of all switches in IC1 drops to zero, causing the switches to open. Overflow detection threshold may be adjusted by using appropriate value of resistor R1. Switch S1, when opened, prevents the battery from being discharged when the device is not in use for some reason.

Further, output from the active piezo buzzer should be loud enough to alert you. If desired, a more powerful piezo sounder can be used instead.

Construction and testing

An actual-size, single-side PCB layout of the cistern overflow alert system is shown in Fig. 3 and its component layout in Fig. 4. Assemble the circuit on the PCB.

Use a 9V PP3 battery or suitable DC power supply. Connect the cistern sensors to the PCB at CON1 using two wires (J1). Connect two copper wires at CON2 for extension to optional remote indication (detail not shown here). Place the assembled unit at a suitable location for monitoring water overflow condition. EFY

T.K. Hareendran is founder and promoter of TechNode Protolabz

MINI CANDLE LIGHT
Using Old Mobile Phone Battery

A. SAMIUDDHIN

According to the three Rs—reuse, reduce and recycle—we must save our planet from e-waste. Sometimes we have a dead mobile phone whose battery is in good working condition. The circuit given here is used to utilise such batteries for making a mini candle light using bright LEDs.

The circuit is built around MC34063 DC-to-DC converter IC. It is a monolithic controller that consists of internal temperature-compensated voltage reference, comparator, controlled duty-cycle oscillator with an active current-limit circuit, driver and high-current output switch. This IC was specifically designed to step-down, step-up and for voltage-inverting applications with a minimum number of external components.

Circuit and working

Circuit diagram of the mini candle light using an old mobile phone battery is shown in Fig. 1. It is built around monolithic DC-to-DC converter controller MC34063 (IC1), 100µH inductor (L1), Schottky barrier diode 1N5819 (D1), four 5mm bright white LEDs and a few other components.

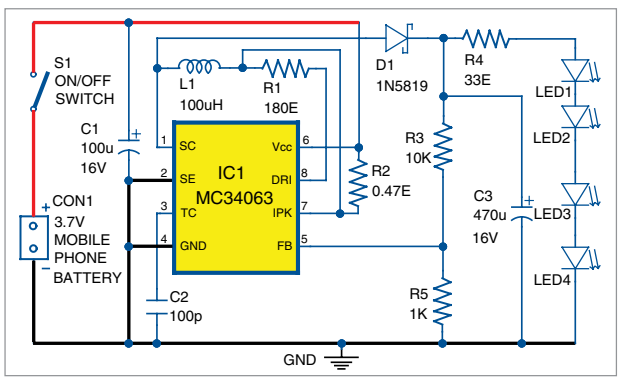


Fig. 1: Circuit diagram of the mini candle light

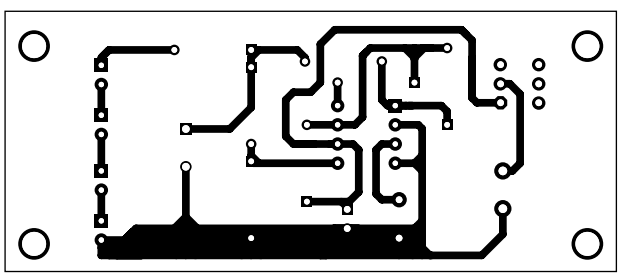


Fig. 2: Actual-size PCB layout of the mini candle light

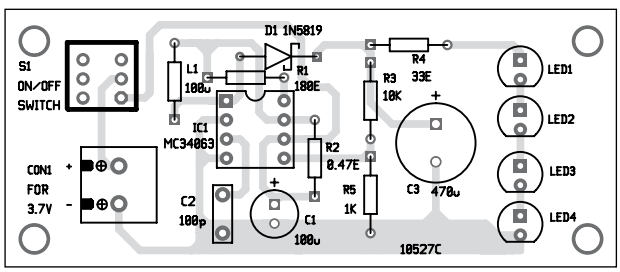


Fig. 3: Component layout of the PCB

Here, IC1 is configured in step-up configuration to drive the bright white LEDs using an old mobile phone battery. The 33-ohm resistor (R4) limits the current flowing through the LEDs. Capacitor C2 determines the operating frequency of IC1, and R3 and R5 determine the output voltage.

Output voltage can be calculated by using the relationship:

$V_{out} = 1.25\ [1 + (R3/R5)]$

When switch S1 is closed, IC1, inductor L1 and Schotky barrier diode D1 perform step-up operation and LEDs (LED1 through LED4) glow.

IC 78S40 can be used in place of MC34063. Any Schottky barrier diode works fine in this circuit. By using a low-ESR capacitor, you can increase the efficiency of the circuit.

The circuit can be converted into a small emergency light by adding a charger and a few more components.

PARTS LIST

Semiconductors:
IC1 - MC34063A DC-to-DC converter
D1 - 1N5819 Schottky diode
LED1-LED4 - 5mm bright white LED

Resistors (all 1/4-watt, ±5% carbon):
R1 - 180-ohm
R2 - 0.47-ohm
R3 - 10-kilo-ohm
R4 - 33-ohm
R5 - 1-kilo-ohm

Capacitors:
C1 - 100µF, 16V electrolytic
C2 - 100pF ceramic disk
C3 - 470µF, 16V electrolytic

Miscellaneous:
CON1 - 2-pin terminal connector
S1 - On/off switch
- 3.7V old mobile phone battery

Construction and testing

An actual-size, single-side PCB layout for the mini candle light using an old mobile phone battery is shown in Fig. 2 and its component layout in Fig. 3. After assembling the circuit on the PCB, enclose it in a suitable plastic box.

The circuit works off an old mobile phone's 3.7V battery. It will also, of course, work with any 3.7V DC power supply. EFY

A. Samiuddhin is an electronics hobbyist. His interests include LED lightings, power electronics, microcontrollers and Arduino programming

Simple Low-Cost and Versatile BATTERY CHARGER

PETRE TZV PETROV

Presented here is a versatile circuit to charge batteries ranging from 6V through 48V. At home, garage or laboratory, you may have several rechargeable batteries with voltages rated at 6V, 12V, 24V, 36V, 48V or more. If so, you would need battery chargers for all of these with output currents of 0.5A to 1.5A, or more.

There is a large variety of battery chargers in the market. But linear chargers with mains power transformers are heavy, expensive and dissipate lot of heat. Chargers with pulsed technologies are relatively expensive and create a large spectrum of electromagnetic noise.

Circuit and working

Fig. 1 shows a simple low-cost and versatile battery charger circuit. The circuit is simple and lightweight, and does not generate any electromagnetic noise or heat. The only problem is that, it is not isolated from the mains power line.

The circuit uses high-voltage capacitors C1 through C4. Values for these can be from 1µF to 22µF, with at least 400V rating. These are used to limit the charging current of the battery. Use of capacitors and switches is a flexible solution because it allows charging of batteries with voltage ratings of 6V to 48V, and even more.

Charging current is selected with switches S1 through S4. It can be controlled before the bridge rectifier comprising diodes D1 through D4, or after the bridge. For that purpose, voltmeters should be connected to connectors CON2 and/or CON3. Battery under charge (BUC) is connected between CON5 and CON6 using a two-wire cable with a crocodile clip.

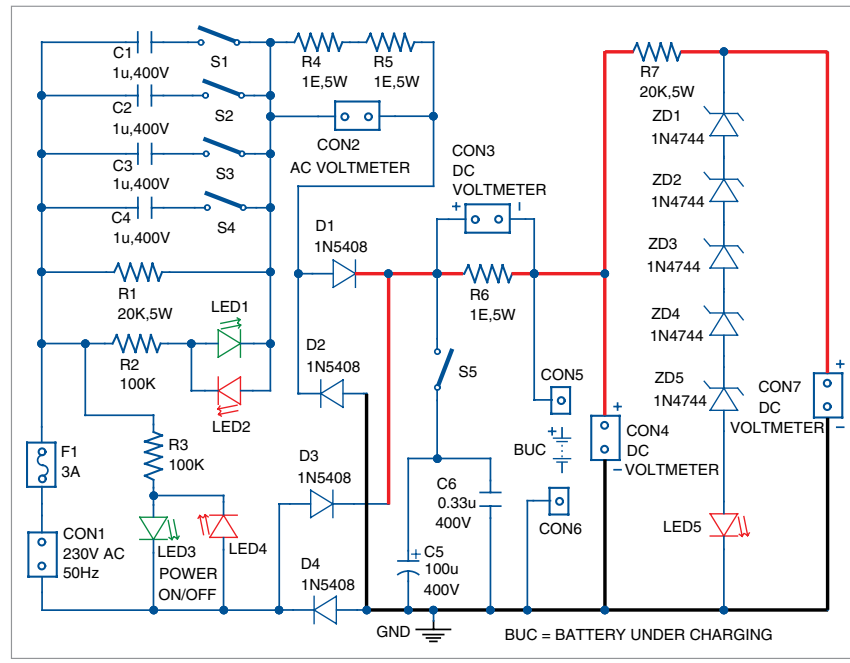


Fig. 1: Circuit diagram of the simple low-cost and versatile battery charger

The circuit can be used without a battery as an unregulated power supply. For that purpose, close switch S5. Capacitors C5 and C6 are used as filters for the power supply. Load can be connected in place of the battery across BUC terminals.

Voltage across BUC is measured using a DC voltmeter connected to CON4. Note that, without the battery across BUC, and if the battery has an internal open circuit, output voltage across CON4 can rise to around 300V.

Voltage across CON7 is restricted to 75V to 80V to protect the voltmeter. Zener diodes (ZD1 through ZD5) are rated at 15V, 1.3W. Zener diodes 1N4744, BZX85C15 or similar can be used. LED5 is on only if output is higher than 75V—this means the charger is working without load.

LED3 and LED4 are used as power on/off indicators.

PARTS LIST

Semiconductors:

D1-D4	- 1N5408 rectifier diode
LED1-LED5	- 5mm LED
ZD1-ZD5	- 1N4744, 15V, 1.3W Zener diode

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

R1, R7	- 20-kilo-ohm, 5W
R2, R3	- 100-kilo-ohm
R4-R6	- 1-ohm, 5W

Capacitors:

C1-C4	- 1µF, 400V polyster
C5	- 100µF, 400V electrolytic
C6	- 0.33µF, 400V polyster

Miscellaneous:

S1-S5	- SPST switch
F1	- 3A fuse with holder
CON1	- 2-pin terminal connector
CON2-CON4, CON7	- 2-pin connector - Crocodile clip for battery terminal connections - Voltmeter

Construction and testing

An actual-size, single-side PCB layout for the simple low-cost, versatile battery charger is shown in Fig. 2

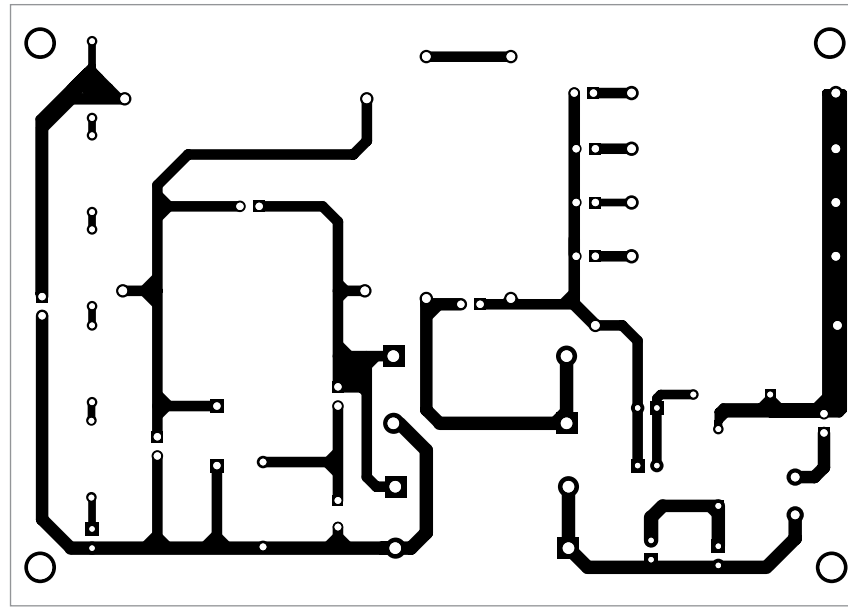


Fig. 2: Actual-size PCB pattern for the low-cost and versatile battery charger

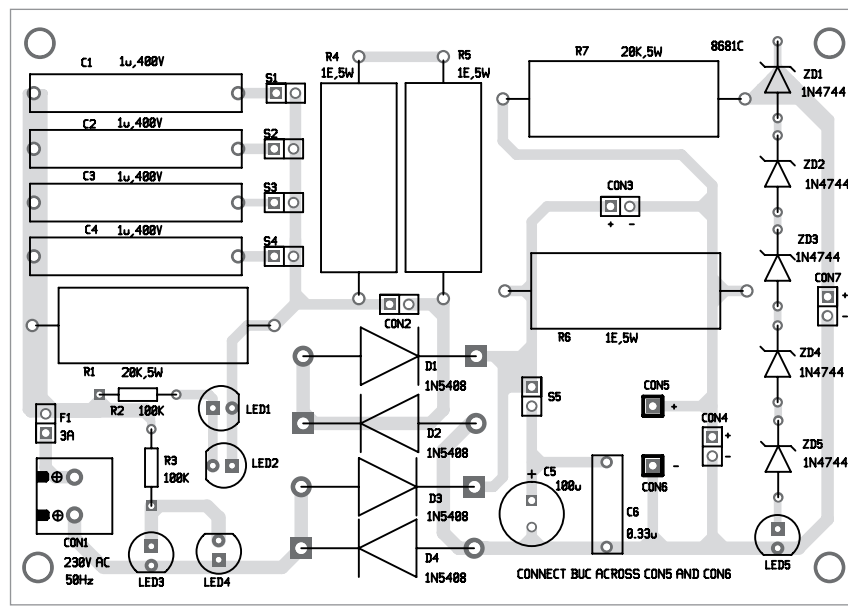


Fig. 3: Component layout of the PCB

and its component layout in Fig. 3. After assembling the circuit on the PCB, enclose it in a suitable box.

The circuit is simple and, hence, does not need any adjustments after proper wiring has been done. The most important thing is to select C1 through C4 according to the targeted batteries. You can increase the resistors R4, R5 and R6 according to the needs.

The number of switches (S1 through S4) and associated capacitors (C1 through C4) can be increased or decreased according to specific needs, making the solution very flexible. Fix all switches and LEDs on the front side of the box. EFY

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

How To Make A BUSINESS CARD FLASHLIGHT

PREM SAGAR

The aim of this article is to make a business/visiting card useful, something that people really do not want to throw away and use as a piece of advertising. Essence of this project is that anyone can make it at home without any soldering, PCB and so on, as it requires none of these. The project can be extended to multiple interactive marketing media like posters. It only requires some basic materials as listed below and shown in Fig. 1:

1. Aluminium foil/aluminium tape/copper tape

Fig. 1: Materials and tools required for the project

Fig. 2: Tracing the circuit on the card

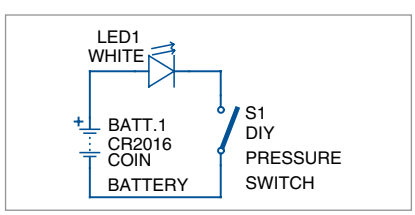


Fig. 3: Circuit diagram of the business card flashlight

2. 3mm white LED
3. CR2016 button-cell battery
4. Piece of foam or cardboard
5. Two visiting/business cards
6. Sheet of paper (optional)
7. Pencil
8. Adhesive (like Fevicol)

Tools required:

1. Scissors
2. Cutter
3. Vernier calipers (optional)

Construction and testing

Step 1. Tracing the circuit. Take a lighter-grade pencil (3H/4H) and make a rough layout or path on one of your business cards along which the circuit will be placed (Fig. 2). Circuit diagram of the business card flashlight is shown in Fig. 3. Place the tape, LED and battery on the marked areas.

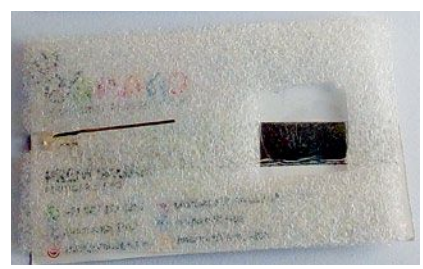


Fig. 4: Cutting the foam to make space for LED and battery

Fig. 5: Aluminium tape

Fig. 6: Placing aluminium tape and LED on the visiting card

The switch (explained in subsequent steps) will be at the location of the battery. Place the switch along the visual element of your business card, signifying a look of a button. Here, I have placed it along my company logo of a hand.

Interestingly, the circuit here does not need any resistance since we are using a white LED that has a typical forward voltage of 3.2 volts with a battery that has a maximum rated voltage of 3V. Current through the battery does not exceed the rated 25mA. Also, the battery has an internal resistance of 150-ohm, which is sufficient enough; hence, no external resistance is required.

In case you plan to use a red or green LED, consider using a resistor of 100- to 150-ohm.

Step 2. Cutting the cardboard/foam. The cardboard/foam is used to provide spacing between the two visiting cards. That is, the foam will be sandwiched between the two cards. It also makes a modular casing for LED and battery (Fig. 4).

First, cut the foam/cardboard as per the dimensions of the visiting card. Then, cut small openings for placing the LED and battery. I prefer foam because it adds negligible weight, and is available in various colours.

Thickness of the foam should be greater than that of battery. You may need Vernier calipers to measure that but a standard 3mm to 4mm foam will work. Table I shows the thickness of various button cells—we choose CR2016 because it has minimum thickness.

Step 3. Making an aluminium

TABLE I
THICKNESS OF VARIOUS BUTTON CELLS

Battery IEC names	Dimensions in mm (Diameter×Height)
CR2016	20×1.6
CR2020	20×2
CR2025	20×2.5
CR2032	20×3.2

Fig. 7: Placing LED and battery on the foam

tape with aluminium foil. Take a sheet of aluminium foil and give it several folds because most aluminium foils are too thin to use. The aluminium tape formed by folding aluminium foil is shown in Fig. 5.

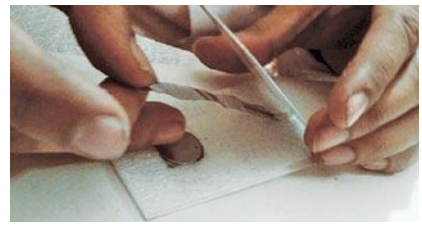


Fig. 8: Placing the other card over the foam

Fig. 9: Final assembly of the business card flashlight

Step 4. Assembling the circuit. Pull the LED legs apart and place one leg along the pencil trace and stick on the card with the aluminium tape using adhesive (Fig. 6).

Note the correct polarity of the LED leads so as to place the battery correctly. Aluminium tape should extend till the battery (Fig. 6). Place the foam cutout over it and stick on the card using adhesive (Fig. 7).

Step 5. Final step. Carefully place the second card over the LED and battery so that the hanging leg of the LED is fixed onto the backside of the second card using aluminium tape (Fig. 8). Place it in a secure manner using adhesive like Fevicol.

Press the switch marked on the card. Voila, it is up and running (Fig. 9)! When you release the switch, flashing will stop. You have successfully made one unique business card with a flashlight! EFY

Prem Sagar is founder and chief executive officer, Banaao—A Maker's Playground

SURVEILLANCE CAMERA Using RaspiCam And ANDROID APP

BISWAJIT DAS

This project describes how to build a surveillance camera based on Raspberry Pi (Raspi) that records HD video only when something moves in the monitored area. Live feed can be viewed from any Web browser, including one on a mobile phone.

Security cameras are common in most industries around the world. Their applications can range from preventing theft or vandalism to traffic and weather monitoring and much more. Due to a small form factor, affordable price and low power consumption, Raspberry Pi can be easily integrated in a surveillance camera.

In this project we will first connect Raspi camera to Raspi, and stream live video from it. We can also watch the streaming of content from our Android device. We will also take photographs with different effects.

Raspi is a credit-card-sized low-cost microcomputer that can run Linux operating system, and has endless extension possibilities.

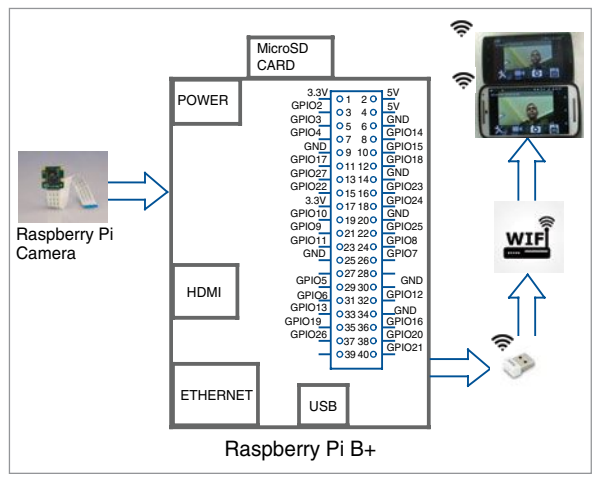


Fig. 1: Raspi and RaspiCam

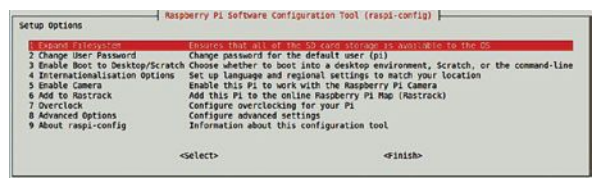


Fig. 2: Raspi-config configuration window

Hardware components

We require the following hardware for this project:

Raspberry Pi model B+. This model of Raspi system runs at 700MHz and its 512MB RAM supports HD video.

Raspberry Pi camera module. This module is specially built for the Raspi microcomputer. It has a connector that can be plugged directly into Raspi board, and it also supports HD video.

Power supply. Any power supply can be used that has a micro-USB plug, and which can supply at least 1A of current.

MicroSD card. Raspi does not have any storage on board, so you need to use a MicroSD card to install and run the operating system for this device.

Wi-Fi USB adaptor. You need this to connect the camera to your network.

Block diagram of the project is shown in Fig. 1.

Software

Get the software ready. To start, you need Raspi with an Internet connection. Update its operating system to ensure that it has all the latest features and drivers. Run the command given below, in the terminal, to update the operating system installed on Raspi:

```
$ sudo apt-get update
$ sudo apt-get upgrade
```

Install RaspiCam Remote for Android. RaspiCam Remote is an app to view Raspi camera module on your Android device. In this project:

1. No software needs to be installed or configured on Raspi; it uses standard NOOBS setup.
2. Pictures can be saved to your phone's gallery.
3. Continuous video mode (around one frame per second) for camera monitoring can be used on your Android device.
4. It is easily configurable and allows testing the camera's image filters.

Configure raspi-config. Raspi-config is Raspi's configuration tool, written and maintained by Raspbian operating system.

You will be shown raspi-config on booting into Raspbian for the first time. To open the configuration tool, run the following from the command line:

```
$ sudo raspi-config
```

You will see a blue screen with options in a gray box in the centre as shown in Fig. 2.

Use up and down arrow keys to move the highlighted selection between the options available. In order to use Raspi camera module, select Enable Camera option as shown in Fig. 2. This will ensure that at least 128MB of RAM is dedi-

Fig. 3: Installing RaspiCam Remote app

cated to the GPU.

Note. Selecting raspi-config utility tool provides a way of doing initial configuration of Raspi. Although, it can be run any time.

Click on Finish when you are done making changes. You will be asked whether you want to reboot or not. When used for the first time, it is best to reboot the system.

To test that the system is installed and working, and to take a photo with your Raspi camera module, type the following command:

```
$ raspistill -o image.jpg // image is the name of your image
```

raspistill is a command-line application that allows you to capture images with your camera module.

Setting up RaspiCam Remote app. You may download the app from *https://play.google.com/store/apps/details?id=com.pibits.raspberrypiremotecam*

Install the app on the Android device on which you want to see remote video.

Testing the surveillance camera

RaspiCam Remote app. Open RaspiCam Remote app and you will

Fig. 4: Remote video display in multiple phones

get an initial view to provide login details such as IP address, username and password as shown in Fig. 3. It uses default login account details and SSH port.

You will only need the IP address if you have the default installation in place. You can even access your camera over the Internet if you enable port forwarding for port 22.

IP address on your Raspi. Double-check to see if your Raspi is connected to the network by typing the following command:

```
$ sudo ifconfig
```

If Raspi is connected to the network, it would have been given an IP address, such as 192.168.3.113 (yours will be different).

Type the IP address of your Raspi as shown in Fig. 3, and refresh the screen until your Raspi IP address is displayed on the screen. Select your Raspi IP address to connect and view the remote display straight-away.

Alternatively, you can set different settings—flip, mirror, rotate, 3D, zoom, negative, solarise, sketch, denoise, emboss, oil paint, hatch, gpen, water colour, film and so on. Also, you can use multiple phones to observe remote video simultaneously (Fig. 4). EFY

Biswajit Das is an electronics hobbyist

USB INTERFACE Using Python Software

A. ROBSON BENJAMIN

This is a simple transistor's output characteristic curve-tracer program through the interfacing of USB and PIC microcontroller using Python programming language. Output characteristic curve of a transistor is automated using Python software and USB interface. The application software for collecting the measured value and displaying it on the monitor screen is developed using Python.

Types of USB

In recent PCs, legacy ports such as parallel port, serial port and so on have been replaced with USB. A USB's plug-and-play feature can be used to automate laboratory instruments/data-acquisition systems. To meet the needs of various applications using USB interface, three speeds of operation have been designed in USB V2.0 specification, namely, low speed (1.5Mbps), full speed (12Mbps) and high speed (480Mbps).

Recently, USB3.0 specification has introduced super speed with 5Gbps. The physical USB connection uses four wires. Two wires are used to carry the differential signal (D+ and D-), and the other two are for power and ground. To transfer data between the host PC and the device USB V2.0 supports four types of data transfers, namely, control, bulk, interrupt and isochronous.

Control transfer is mainly used to configure a device when it is first connected to the PC. The process of configuration is known as enumeration. It is defined as the initial exchange of information by which the host learns about the device and assigns an appropriate device driver.

Bulk data transfers are used when data is generated or consumed in relatively large quantities.

PARTS LIST

Semiconductors:	
IC1	- PIC18F4550 microcontroller
IC2	- AD780 voltage regulator
IC3	- MAX5154 low-power, 12-bit digital-to-analogue converter
IC4	- LM358 low-power dual op-amp
LED1-LED2	- 5mm LED
D1-D3	- 1N4148 signal diode
T1	- BC547 npn transistor
T2	- SL100 npn power transistor
Resistors (all 1/4-watt, ±5% carbon):	
R1, R21	- 5.7-kilo-ohm
R2-R3	- 220-ohm
R4-R10	- 150-kilo-ohm
R11, R12	- 10-kilo-ohm
R13-R16	- 3.9-kilo-ohm
R17	- 47-kilo-ohm
R18	- 1-kilo-ohm
R19, R20	- 10-kilo-ohm
R22	- 1-ohm
Capacitors:	
C1	- 470pF ceramic disk
C2, C3	- 33pF ceramic disk
Miscellaneous:	
XTAL1	- 20MHz crystal oscillator
CON1	- 4-pin connector for USB A-type
CON2	- 2-pin connector for 12V battery
CON3	- 2-pin connector for 5V

Interrupt data transfers are used for timely but reliable delivery of data.

Isochronous data transfers occupy a pre-negotiated amount of USB bandwidth with pre-negotiated delivery latency (also called streaming real-time transfers).

One of the major barriers to designers of USB peripherals is developing device drivers for custom-built USB devices. This has been removed with the use of LibUSB-Win32, which is an open source driver.

Host software

USB supports master-slave configuration. Master is always the PC. Software that resides and controls the communication flow in the PC is known as host software. In this article, the host software used to communicate with the USB mass storage class/communication device class is Python.

Python is an interpreted language, which can save considerable time during program development because no compilation and linking are necessary. It is a popular programming language used for both standalone programs and scripting applications. It is free, portable, powerful and remarkably easy to use.

The interpreter can be used interactively, which makes it easy to experiment with features of the language. Programs written in Python are typically much shorter than equivalent C or C++ programs. There are two ways to use the interpreters, namely, interactive mode and script mode. In interactive mode, the interpreter prints the result as the program is typed.

The chevron, >>>, is the prompt the interpreter uses to indicate that it is ready. Alternatively, you can store the code in a file and use the interpreter to execute the contents of the file, which is called a script.

Software required. The required software include Python 2.5 (python-2.5.2) or higher IDE, Win32 Python (pywin32-210.win32-py2.5), Matplot Library (matplotlib-0.91.2.win32-Py2.5), Numeric Python (numpy-1.0.4.win32-py2.5) and PyUSB-1.0.0a2.

PyUSB-1.0.0a2 is a Python library allowing easy USB access. PyUSB-1.0.0a2 version is written in Python, which allows Python programmers with no background in C to understand how PyUSB works. PyUSB can run on any platform with Python 2.4 and later version. Communicating with a USB device has never been so easy. USB is a complex protocol, but PyUSB has all the necessary functions needed to configure a USB-supported device. PyUSB modules have two

sub-modules: usb.core as the main module and usb.util containing utility functions.

PyUSB 1.0 tutorial gives the basic information about the complex USB protocol. If you want to know all information related to USB, refer the books *USB Design by Example* by John Hyde and *USB Complete* by Jan Axelson.

Functions needed for USB configuration and data acquisition are incorporated in pic18f4550.py, namely, __init__(self,val1,val2), set_portb_output(self,val), set_portd_output(self,val), read_analog_0(self), read_analog_1(self) and set_voltage12(self, val).

Details are as follows:

- __init__(self,val1,val2) takes care of USB communication.
- set_portb_output(self,val) helps set port B values from 0 to 255.
- set_portd_output(self,val) helps set port D values from 0 to 255.
- read_analog_0(self) helps read analogue values from channel 0.
- read_analog_1(self) helps read analogue values from channel 1.
- set_voltage12(self, val) helps send a 12-bit value to DAC MAX5154.

Software installation. Install Python2.5.2 IDE or higher in Windows 7 operating system. Then, install the supporting tools one by one. Default folder is C folder (C:Python25). Extract PyUSB-1.0.0a2 zip file to Python25 folder. Now, using Command Prompt, go to PyUSB folder, which is inside Python25 folder, and install PyUSB using the following command (also shown in Fig. 1):

```
>python setup.py install
```

Having installed the necessary software, place pic18f4550.py and efy_trans.py files inside Python25 folder.

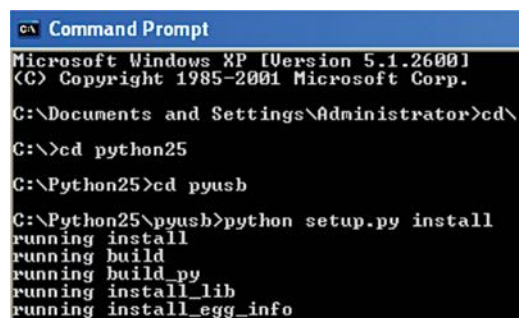


Fig. 1: Command Prompt screenshot

Circuit and working

Circuit diagram of the USB interface using Python and transistor curve tracer is shown in Fig. 2. It is built around PIC18F4550 microcontroller, MAX5154 12-bit digital-to-analogue converter, voltage regulator AD780, voltage amplifier LM358, current-to-voltage converter OP741, power transistor SL100/CL100, transistor under study BC547 (T1) and other essential components needed for USB configuration.

The microcontroller has an on-chip USB transceiver, which is connected to the host PC through a USB cable. Clock frequency required for full-speed USB operation is derived from external 20MHz crystal. A pull-up resistor internal to the microcontroller configures the USB device as a full-speed device. In this design, power required for PIC18F4550 operation is drawn from the bus.

Base current of the transistor under study is varied from 0µA to175µA in eight steps using port

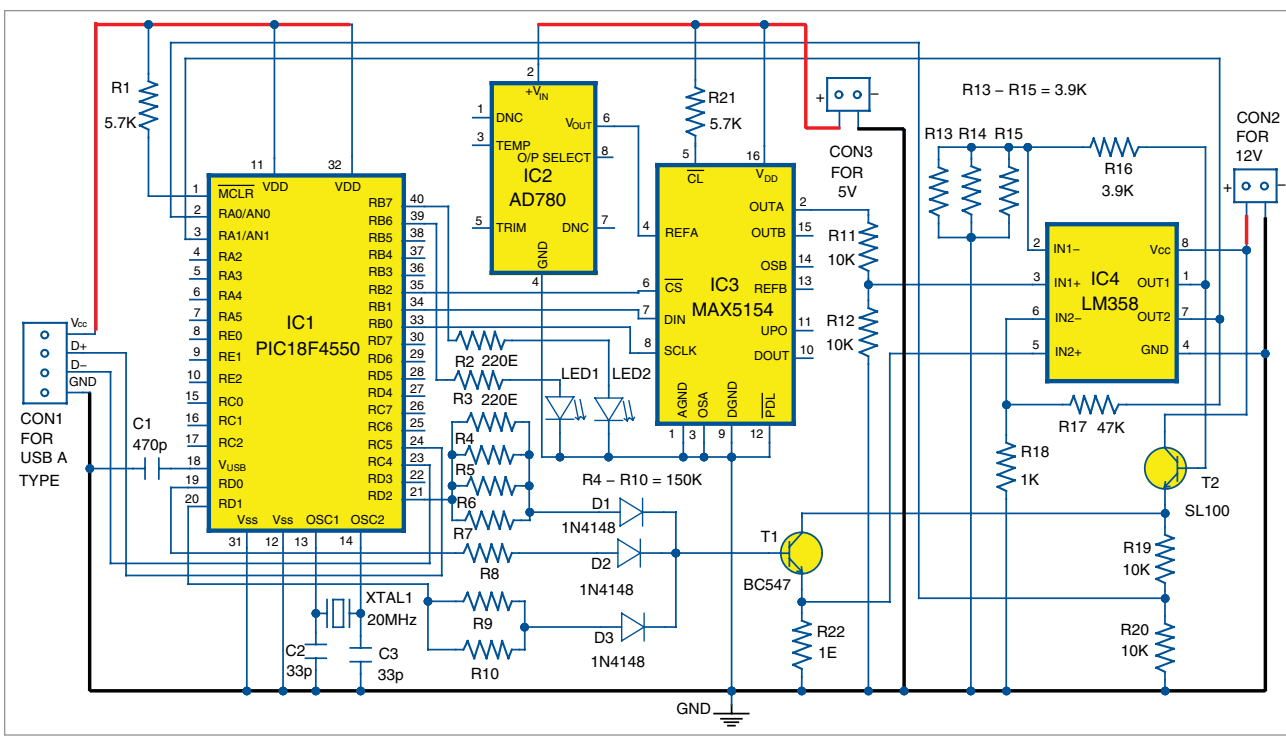


Fig. 2: Circuit diagram of the USB interface and transistor curve tracer

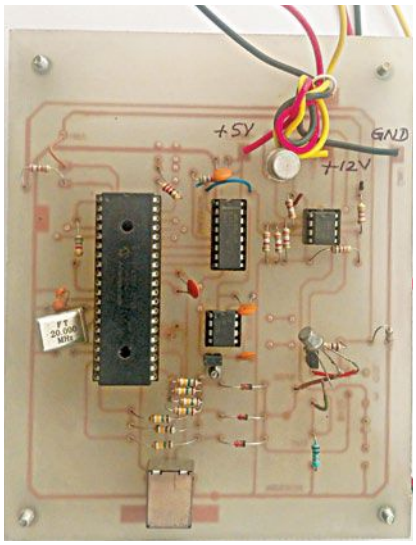


Fig. 3: Author's prototype

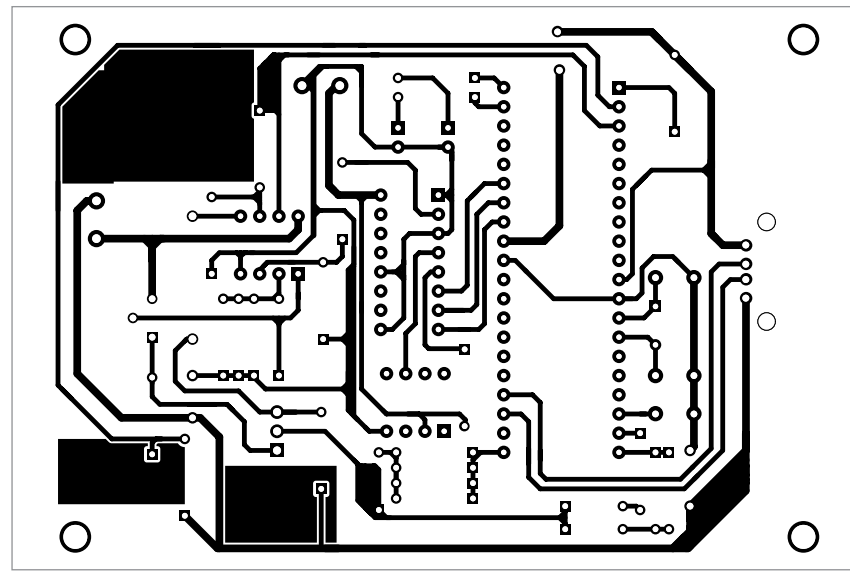


Fig. 4: Actual-size PCB layout of the USB interface using Python software

D pins (D0, D1 and D2). Collector voltage is varied from 0V to 2.5V in eight steps to the digital-to-analogue converter from port B.

Output voltage from the digital-to-analogue converter is subsequently amplified about four times using LM358 and given to the base of the power transistor. Emitter of power transistor SL100 is connected to the collector of the transistor whose voltage is being varied.

Collector voltage is given to channel 0 of the built-in analogue-to-digital converter after dividing the voltage exactly by half using a potential divider arrangement to meet the voltage limitation of the microcontroller. Assuming that collector current is equal to emitter current, output is taken across the one-ohm resistance, and drop across one-ohm resistance is amplified about 50 times and given to channel 1 of the built-in analogue-to-digital converter.

The author's prototype is shown in Fig. 3.

Construction

An actual-size, single-side PCB layout for the USB interface is shown in Fig. 4 and its component layout in Fig. 5. After assembling the circuit on the PCB, enclose it in a suitable box.

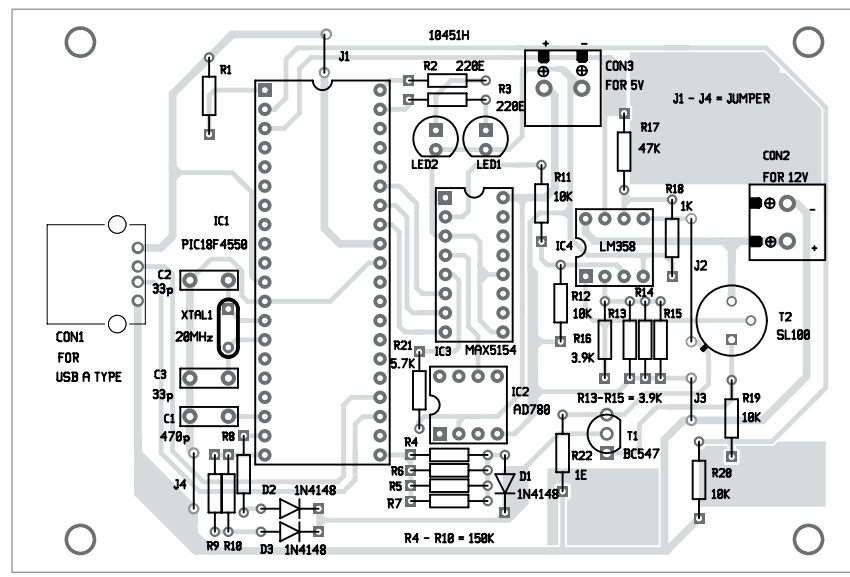


Fig. 5: Component layout of the PCB

Firmware

All USB devices handle a standard set of requests, described in the USB specification. It is implemented using pic18_usb header file provided in CCS C compiler. The compiler provides the basic framework for enumeration. During enumeration, the host requests data structures called descriptors from the device. These

Fig. 6: Hardware Wizard screen

Fig. 7: Device Manager window

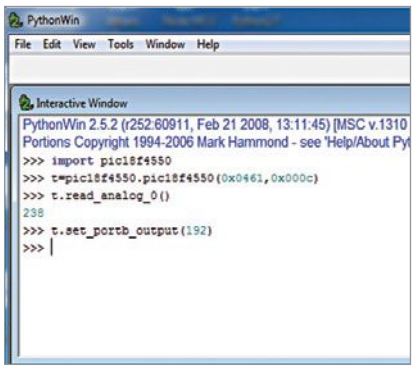


Fig. 8: Interactive Python shell

descriptors contain information about the USB device and type of communication. If you want to design your own USB device, be aware of the endpoint details, vender IDs and product IDs. This information is necessary for device enumeration and is given in usb_desc_cdc1.h file. The firmware, in addition to USB requirement, implements the following tasks:

- Generates different base voltages
- Generates different emitter currents
- Measures collector voltages
- Sends data to PC

The USB host communicates with the USB peripheral through the device driver. The device driver is a software component that enables an application to access a hardware device. USB device drivers for Windows must conform to Win32 driver model.

Windows includes application programmer's interface functions that enable applications to communicate with device drivers. The device driver is generated using Library USB Wizard, and the device is installed in the host computer. Libusb-win32 is a port of the USB library for Windows operating system. The library allows user space applications to access any USB device on Windows in a generic way without writing any line of kernel driver code.

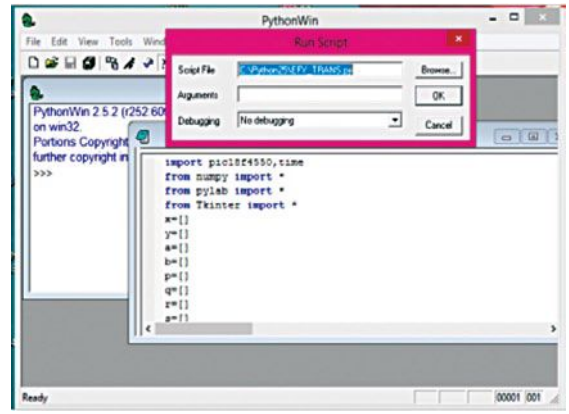


Fig. 9: Opening efy_trans.py file and running it using pywin32

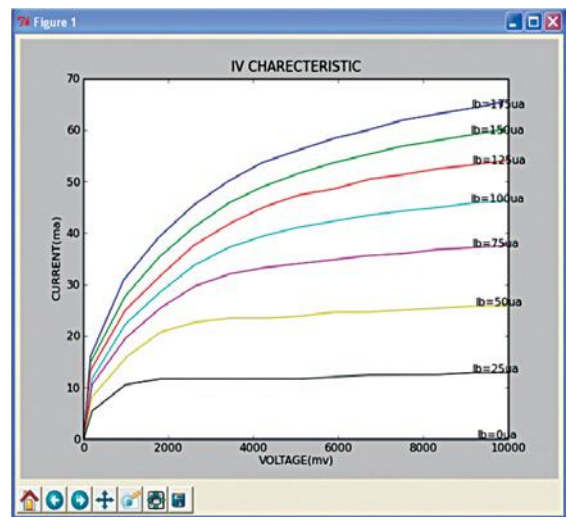


Fig. 10: Program output of IV characteristic curve of transistor

Hardware installation procedure

Step 1. After fusing the program (hex file) into the microcontroller, connect the board to the PC. As soon as the two are connected, a pop-up screen appears, as shown in Fig. 6.

Step 2. Use inf- wizard found in libusb-win32-device-bin-1.2.6.0 folder to generate the driver for the attached device. If the driver is installed properly, the attached device will appear in Device Manager, as shown in Fig. 7.

Step 3. Basic functions including USB configuration, setting port B bits and reading analogue voltages can be tested using default interactive Python window. Using set_portb_ output (192) command, connected LEDs (LED1 and LED2) can be lit.

Similarly, analogue voltages can be measured by connecting the terminal (AN0) to 5V. The value corresponding to 5V is 255. It is better to test the basic function using interactive Python window (Fig. 8) before testing the actual board.

Step 4. Open efy_trans.py file from PythonWin 2.5.2 Interactive Window and run the script as shown in Fig. 9. The program output pattern is displayed using Tkinter software, which is shown in Fig. 10.

The USB based data-acquisition system using Python interface and open source general-purpose device driver reduces the complexity involved in USB connectivity. Interactive nature of Python software makes USB connectivity more user-friendly as compared to other visual languages. EFY

EFY Note

The source code of this project is included in this month's EFY DVD and is also available for free download at *source.efymag.com*

A. Robson Benjamin is associate professor of Physics at American College, Madurai, Tamil Nadu. His interests include design and development of USB based data acquisition and automation of electronic gadgets

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INDIA ELECTRONICS WEEK
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The 2nd Edition

India Electronics Week 2017- For Those Who Value Technology

One thing that set India Electronics Week (IEW) 2016 apart was the fact that a large percentage of its visitors were not regulars. For many, this was the first event that got them out of their offices and homes

After the success of the first edition of India Electronics Week (IEW), EFY Group brings to you the second edition on the same theme, 'Invest in India,' to celebrate the achievements of India's electronics industry and showcase its capabilities to the world. This week-long celebration will be triggered by small events held in key cities across India, and will culminate in the main B2B industry event.

Six reasons why IEW attracts techies

- ***Much more than an expo.*** IEW hosts multiple tech conferences, seminars and workshops that together create immense value for technical decision-makers and influencers to treat IEW as a must-visit event.
- ***Electronics For You's readers.*** Our flagship magazine is known as the techies' magazine. Techies are our primary audience.

KEY FACTS

Show dates: **March 2-4, 2017**

Location: **Bangalore International Exhibition Centre (BIEC), Bengaluru, Karnataka, India**

March 2, 2017
- ELCINA CEO Summit
- IoT: Million Dollar Opportunity
- IoT: Security, Standardisation and Analytics

March 3, 2017
- IoT: Smart Humans and Health
- ELCOMA LED Summit
- eRocks: Power Management
- eRocks: Wireless Communication

March 4, 2017
- IoT: Smart Homes and Cities
- IoT: Smart Industry (IIoT)
- eRocks: LED Tech
- eRocks: Rapid Prototyping (DIY Conference)

A perfect mix of visitors

IEW being a conglomerate of seven shows, following categories of visitors are assured:

- ***ELCINA CEO Summit.*** CEOs and policymakers connecting with electronics ecosystem
- ***EFY Expo.*** Manufacturers of electronics products
- ***Electronics Rocks.*** Design and R&D engineers
- ***LEDAsia.in.*** LED lighting manufacturers
- ***IoTshow.in.*** Manufacturers of IoT products
- ***Raksha India.*** Defence electronics manufacturers
- ***IEW.*** Investors and trade channel partners seeking business opportunities

MeitY confirms support to India Electronics Week 2017

The Ministry of Electronics and IT (MeitY) has extended its support to IEW 2017 in recognition of the fact that the expo provides the right platform for showcasing the electronic system design and manufacturing (ESDM) sector in India.

Expect more updates shortly on the various activities that will unfold at IEW 2017. These activities will help you gain a better understanding of the government policies and schemes available for the ESDM industry.

They connect with the brand, and like to visit the event its team produces.

- ***Cutting-edge topics.*** The Internet of Things (IoT), smart lighting, Industry 4.0, embedded systems, rapid prototyping and 3D printers form the themes of various events happening at IEW. These being unique and cutting-edge topics, techies find value.
- ***Conferences.*** We conduct multiple conferences across three days and five halls at IEW. These conferences drive the attendance of senior leadership and their key team members at IEW.
- ***Speakers.*** Experts from India and across the globe speak at tech conferences at IEW. These experts form a major attraction for techies to visit IEW. Experts themselves promote IEW among their networks, and together form a high-value segment with respect to visitors of IEW.
- ***Tech workshops.*** Workshops are a major attraction for techies and IEW hosts multiple workshops in parallel. These attract quality visitors and speakers, too.

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- Electronics design professionals
- Systems integration professionals
- R&D professionals
- Academicians
- Policy makers and influencers
- Institutional buyers
- Channel partners (traders, systems integrators, etc)
- Technical decision-makers from LED product manufacturing firms
- Purchase decision-makers from LED product manufacturers
- Channel partners of LED products (traders, systems integrators, etc)
- Entrepreneurs and investors seeking opportunities in the LED sector
- Technical decision-makers from LED component manufacturing firms
- Purchase decision-makers from LED component manufacturing firms
- Technical decision-makers interested in IoT products
- Business decision-makers interested in IoT products
- IoT developers (software and embedded)
- Entrepreneurs and venture capitalists interested in the IoT sector
- Technical decision-makers of embedded products
- Business decision-makers of embedded products
- Test engineers
- Quality control engineers
- Technical decision-makers from defence and aerospace
- Purchase decision-makers from defence and aerospace (CEOs, MDs, purchase managers, etc)
- R&D engineers and embedded systems design engineers from defence and aerospace
- Channel partners for defence and aerospace (traders, systems integrators, etc)
- CXOs and business decision-makers from LED product companies

IEW 2017 to be bigger than last year

Considering the great response to IEW 2016, we have allocated almost 50 per cent more space for IEW 2017. The area for the expo is now 10,000sqm, and the conference area is spread across an additional 5000sqm.

Why exhibit at IEW 2017

- ***We are proud organisers of the world's #1 IoT event.*** The first edition of *IoT show.in*, a part of IEW 2016, has been voted as the People's Choice World's number one IoT show.
- ***Our conferences attract the who's-who of the industry.*** With various conferences co-located at IEW, the who's-who of the electronics industry converge as speakers or as delegates. Connect with them!
- ***Fifty times more customers***. A typical expo allows you to connect with those customers who visit your booth, but thanks to *EFY Expo Supplement* in our monthly publications, *Electronics For You* and *Electronics Bazaar* (with a readership of more than 600,000), your company's profile and contact details reach an audience that is 50 times larger than any other B2B electronics show in India.
- ***Zero loss of visitor data.*** The hassle of managing visitors' data is now eliminated. Simply use barcode scanners and get the data of all visitors on your desktop.
- ***Targets south India—one of the country's fastest growing markets.*** Key decision-makers and influencers of electronics in south India attend IEW, 2017.
- ***Meet with the big buyers.*** EFY Expo India's 2016 edition had 17 large buyers with annual budgets of over ₹ 1 billion. For 2017, we are targeting 50 big buyers. A fruitful meeting with a good buyer helps you recover your investment and more.

IMAGES SAY IT BETTER THAN WORDS


R.V. Deshpande, hon'ble minister, large- and medium-scale industries, government of Karnataka, inaugurating IEW 2016

Panel discussion at IoT conference

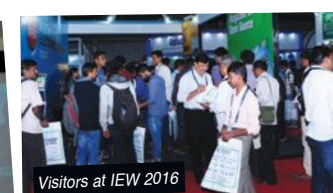
Inaugural session at CEO Summit


IPC India hand soldering competition


Audience at the inaugural ceremony

Panel discussion on 'Standardisation for the IoT Ecosystem'

Inaugural session at LED Lighting Summit


Visitors at IEW 2016

Panel discussion on 'How to Handle Security for the IoT'


A workshop on 'How to Build a Keyless Start System for a Car' by Deepak Gupta (L) and Aneesha Pillai, co-founders, Fresher Foundry

Looking back at the success of IEW 2016

Exhibitors' Feedback

"Through this show, we introduced a couple of new products in the Indian market and got some genuine customers from Bosch, BEL, Variosystems (Sri Lanka), etc."
Padmanabha Shakthivelu, national sales manager, India operations, Electrolube

"What I like about EFY's event is the transparent way of attending to customers, supporting them in media write-ups and editorial coverage. This allows us to showcase products online as well as in print."
Paresh Vasani, MD, PCB Power (Circuit Systems India Ltd)

"We received a good response from scientists, decision-makers, academicians and venture capitalists, all under one roof!"
Arjun Goel, director-technical, Saraswati Dynamics Pvt Ltd

"We received some good enquiries. We plan to come here next year also."
Rajiv Toshniwal, MD, Toshniwal Sensing Devices Pvt Ltd

"A much better show than last time. Attendance was really good!"
Chris Palin, EMEIA manager, Humiseal

"Fantastic! Looking forward to participate next year."
Madhur Dogra, senior client engagement manager – India, Microchip

"The conferences and exhibitions allowed us to interact with new designers from India."
Niranjan G., GM (ASEAN and India), business development and technical marketing, ROHM Semiconductor

"A valuable platform that helped us meet with those from the overall electronics industry ecosystem. We got many new customers."
Mukul Pareek, marketing program manager, Keysight Technologies

"Being a national company, it was exciting to see good-quality crowd from across India."
Sumit Sharma, marketing manager, Good Will Instruments Co. Ltd

"This exhibition has been quite successful for us. We got some good leads, especially from the south Indian market."
Sudhanshu Gupta, sales director, India operations, Lumens Technologies

"Participating in this expo has given us a fantastic response. We saw limited but high-quality visitors from various industries like automation, education, EMS and more. We are really keen to participate in more in such events."
Azeem Merchant, CEO, Messung Erfi

"This is a great platform! We got a good opportunity to talk to a lot of companies. The conferences were also good."
Sai Venkat Kumar B., country marcomm, Tektronix (India)

Experts' Feedback

I compliment EFY, ELCINA and other organisers for putting together such a great show and I wish them great success for the event."
K. Ratnaprabha, additional chief secretary to the government of Karnataka, Department of Commerce and Industries

"We got very good feedback from people and also potential investors!"
Prasad H. L. Bhat, chairman and CTO, Astrome Technologies Pvt Ltd

"It was an absolute pleasure to be a part of this event, and I hope to be able to speak here again."
Martin Woolley, technical programme manager, Bluetooth SIG (Special Interests Group)

"Kudos for bringing together different shows/expos to IEW 2016. A well-organised buyer-seller meet! It was well conducted by executives who were always available to help."
Lt. Colonel Ashutosh Verma, Directorate of Indigenisation, Ministry of Defence

Buyers' Feedback

"I have been participating as a VIP buyer since 2012. During my visits, I have met many potential vendors."
Shanaka Perera, purchase manager, Variosystems (Sri Lanka)

"Well organised! Online appointments were very useful to plan meetings. I met close to 20 sellers in two days' time."
Nandha Gopala Krishnan R., assistant manager, Asia, global sourcing management, Stanley Black & Decker Inc.

"Excellent initiative! Enables buyers to focus better on potential vendors."
Ganesh Babu Sreenivasan, global planning and supply manager, Lenovo India Pvt Ltd

"Buyer-Seller Meet was very well organised. I appreciate EFY for making continuous efforts to improve its event."
Prashant Singh Garhwaliya, sourcing, Panasonic Automotive (India)

"Meetings were organised in a controlled environment, which was good for discussions."
Vijay Anand, sourcing leader, electronics, GE Healthcare

"Overall organisation was very good. However, there is a need to categorise the vendor industries and enable members to meet particular industry buyers."
A.R.Yuvaraj, AGM (Bengaluru), Bharat Electronics Ltd

"Good arrangements and hospitality! Well-organised show! I feel non-exhibitors should also be invited to participate."
S. Ramachandran, DGM, operations, Syrma Technology

"Well-organised. I look forward to more such meets with respect to the wind energy sector."
Palani Rajan C., purchase department, Gamesa Renewable Pvt Ltd

Knowledge & Exhibition Partner
ELCINA | Electronics ForYou expo
Innovate. Design. Manufacture. Source.

The 7th Edition

EFY Expo 2017

Promoting The Latest In Electronic Components

'Latest in Electronic Components' is the theme for EFY Expo 2017. Being co-located at IEW 2017, EFY Expo is now India's best show for electronic components

As in earlier editions, EFY Expo exclusively focuses on the entire electronics value chain, including components, parts, materials, manufacturing services and equipment. The expo is a comprehensive platform for the electronics industry, where exhibitors comprise innovators, designers, manufacturers and sellers. It attracts visitors from across various functional branches and verticals of the electronics industry, including buyers, production managers as well as engineers (from R&D and design) and innovators.

Previous editions of the expo witnessed the introduction of a number of new initiatives like Buyer-Seller Meet, live SMT line, conferences and more to promote the industry. EFY Expo 2017, too, will offer an exciting array of new initiatives.

This event is an amalgamation of seven major events covering various facets of the electronics industry. Launched in 2011, EFY Expo has emerged among the leading B2B events for the electronics industry in India.

KEY FACTS

Show dates: **March 2-4, 2017**

Location: **Bangalore International Exhibition Centre (BIEC), Bengaluru, Karnataka, India**

For more information, visit:
http://www.efyexpo.com

Highlights

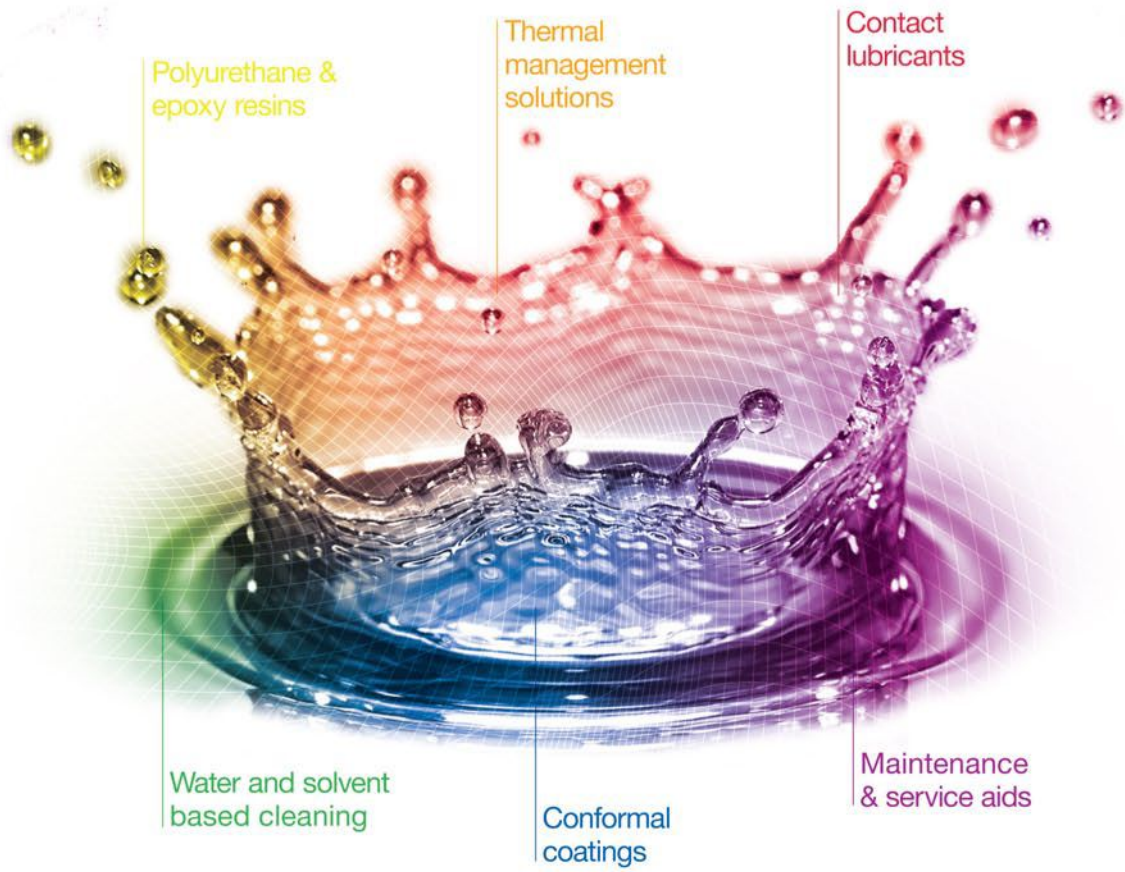
- Buyer-Seller Meet for large buyers to have one-on-one meetings with leading suppliers of electronic products, services, components and manufacturing equipment.
- CEO Summit is a summit of India's top industrialists, CXOs, policy makers and influencers. A 'By Invitation Only' event, it is attended by the who's-who of the global electronics industry.
- International exhibitors from Japan, Taiwan, South Korea, the USA, the UK, Singapore and China will be exhibiting at the event. Besides regular business, strategic business deals such as joint ventures and distributorships are possible.
- At Innovators' Zone, a unique part of the show, you get to witness the latest innovations (by Indians), spread across a range of applications and industries. You are bound to get new business ideas from this zone and may also end up partnering with these innovators.

What it aims to achieve

- To be a platform where the latest components get showcased.
- To serve as a platform where OEMs meet suppliers of products and services, including suppliers of components, manufacturing equipment, consumables, test and measurement equipment, contract manufacturers, design houses, certification agencies, infrastructure providers and so on.
- To be a platform where business opportunities are showcased and networking is facilitated to bring these to fruition.
- To create one common platform for the entire electronics industry where innovators, design engineers and implementation engineers can meet manufacturers, traders and institutional buyers.
- To lay strong emphasis on creating appealing content (in terms of conferences, workshops and seminars) to attract the right audience. Thus, the event is packed with a series of conferences, seminars and technical workshops.

Four reasons EFY Expo the best show for electronic components:

- **Organised in partnership with ELCINA**
- **Promotes the latest in electronic components**
- **Is the perfect mix of visitors**
- **Gives special packages for component OEMs**



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Co-Partner

The 2nd Edition

LEDAsia.in 2017

Focusing On The Technology That Powers The Light

The LED bulb itself is a culmination of advancement in technology. And, such a product category and its associated industry cannot grow without focusing on latest technologies. While there are some good B2B shows for LED lighting in India, none focuses on the technology that powers the light. Thus, the need for LEDAsia.in

LEDAsia.in is a dedicated show being organised for the second consecutive year. It seeks to promote LED lighting and its various components like chips, drivers, heat-sinks and modules. From components to consumables, manufacturing equipment to T&M devices, all aspects of electronics linked to LED lighting are showcased here.

The show attracts visitors from various branches of LED lighting including technical and purchase decision-makers, component manufacturers, channel partners and entrepreneurs seeking to invest in the sector.

The platform provides an opportunity for LED lighting product manufacturers to reach out to businesses and government decision-makers. It also serves as a platform to forge alliances between manufacturers, component suppliers and channel partners in south and west India. Additionally, a special package titled 'Make in India' has been announced for exhibitors in this category.

KEY FACTS

Show dates: **March 2-4, 2017**

Location: **Bangalore International Exhibition Centre (BIEC), Bengaluru, Karnataka, India**

For more information, visit: *http://www.ledasia.in*

Once again, ELCOMA and EFY partner for *LEDAsia.in*

ELCOMA, the apex trade body of lighting manufacturers in India, has partnered with EFY to promote *LEDAsia.in*. Besides driving visitor footfall and encouraging members to exhibit at this show, ELCOMA is organising

Highlights of *LEDAsia.in* 2017

LED lighting summits in partnership with ELCOMA. A business summit on smart lighting, investment opportunities in different states and trade talks on business opportunities for LED channel partners

Buyer-Seller Meet. One-on-one meetings between large buyers and leading suppliers of LED products, solutions, components and manufacturing equipment

Technical conference. Conference on electronics design for LEDs that targets the electronics design fraternity

International exhibitors. Exhibitors from Japan, Taiwan, South Korea, the USA, the UK, Singapore and China exhibit at the event. Besides regular business, strategic business deals such as joint-ventures and distributorships possible

a day-long summit at which thought leaders from the industry, the government and large institutional buyers come together and discuss the roadmap ahead.

Who will visit

- Technical decision-makers from LED product manufacturing firms
- Purchase decision-makers from LED product manufacturing firms
- Channel partners (traders, systems integrators, etc)
- Entrepreneurs and investors seeking opportunities in the LED sector
- Technical decision-makers from LED component manufacturing firms
- Purchase decision-makers from LED component manufacturing firms
- CXOs and business decision-makers from LED product companies

Looking back at the success of *LEDAsia.in* 2016

Exhibitors' **Feedback**

"We were extremely satisfied as far as visitors were concerned. We are looking forward to next year."
C.A. Shyam S. Jindal, MD, Olive Exports Pvt Ltd

"This is the first time we participated in this event. We are very happy to be a part of it and expect a lot of business from this event."
L. Peter, manager, Ready LED Lighting Pvt Ltd

"This exhibition has been quite successful for us. We got some good leads, especially from the south Indian market."
Sudhanshu Gupta, sales director - India operations, Lumens Technologies

"We participated in this event for the first time and found it delivered value for our money. We plan to be here next year."
Jiten Mahajan, MD, Innovative Premier Lighting Pvt Ltd

LEDAsia.in provides a great platform for manufacturers and suppliers of LED lighting to reach out to B2G and B2B decision-makers as well as channel partners. From components to consumables, manufacturing equipment to T&M equipment, all aspects of electronics that go into LED lighting will be showcased at this event

iotshow.in

The 2nd Edition

How You Profit From The IoT

IoTshow.in conference is a platform to promote the development and adoption of IoT solutions. It aims to achieve this goal by highlighting the benefits for all stakeholders involved, as explained by its motto, 'Profit from the IoT'

Why attend

The conference gives you invaluable insight into the amazing IoT systems. Listen to thought leaders as they share their inspiring views on the future of the IoT. Learn to build at workshops, all while socialising with the best among the Indian engineering community.

Who should visit, and why

If you want to know how you can profit from IoT, this is the show to visit. The combination of a B2B exposition and a tech-plus-business conference is unique to *IoTshow.in*. And, it is this unique combination that offers different reasons for different audiences to visit the show.

The creators

Developers of IoT products and solutions attend the multiple technical conference tracks and workshops that are put together to address this specific audience.

Entrepreneurs who have invested in IoT products and solutions (including startups) can enjoy a unique opportunity to network with the enablers, suppliers and peers from the industry that await them at *IoTshow.in*. There will also be a conference on business opportunities.

The enablers

Systems integrators of IoT solutions connect with players in the IoT products and solutions space to try and partner with them, or connect with enterprise and SME customers interested in the IoT. You can also discover the business opportunities that IoT presents to your firm. Trade channel partners focusing on the IoT landscape can connect with IoT product and solutions providers, as well as enterprise and SME customers to get a first-hand update on the business opportunities in the IoT.

KEY FACTS

Show dates: **March 2-4, 2017**

Location: **Bangalore International Exhibition Centre (BIEC), Bengaluru, Karnataka, India**

For more information, visit:
http://www.iotshow.in

The media

IoT-focused media find this to be the biggest IoT event to attend in India and, perhaps, in Asia. Make sure your readers get a chance to know what happened here and the latest tech trends being created by the IoT. Business media houses can also get updated on the latest business trends related to the IoT sector, and the business implications of the IoT as a whole.

The end users

Enterprises and SMEs get an answer to the question, "Can the IoT help reduce expenditure or increase sales?" At *IoTshow.in*, you can speak with leading IoT solutions providers to discover new opportunities. you can also, get convinced by listening to your peers presenting their case studies and success stories, as you network with them in the breakout sessions.

Tracks and specials of *IoTshow.in*

- Smart Cities
- Smart Automotive
- Smart Industry
- Smart Humans
- The IoT Deployment and case studies
- Profit from the IoT

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20 YEARS OF EXCELLENCE

The 6th Edition

EFY Conferences: Inter-Disciplinary Innovation Needs Multiple Disciplines

We decided to learn a lesson about integration from semiconductors. No longer a singular conference, over 11 independent tech conferences are developed and co-located to build a multi-disciplinary mega-convention at IEW 2017

More than 10,000 excited techies and 200 amazing speakers flew in to be part of the 2016 edition of our *IoTShow.in* and Electronics Rocks conferences, after which it was also awarded 'IoT Event of the Year (2016),' by Postscapes. It is a proud achievement, but do we intend to rest on our laurels? No!

In 2017, we are building more than a single conference. Over 11 independent conferences are being developed and co-located to build a multi-disciplinary mega-convention at BIEC (India's first LEED-certified green exhibition and conference facility) in Bengaluru, India. Each conference has its own schedule, talks, workshops, networking opportunities and a lot more!

Join us, and be a part of the thousands joining our community as we build the next revolutionary platform for influential technologists.

Themes

The IoT is now important in every field; from hardware design to software development, and all the way to solving real-world problems. Our conferences focus on:

- Analytics, Algorithms and Artificial Intelligence (AI)
- Cyber security
- Industrial Internet of Things (IIoT)
- Smart Humans (Medical IoT)
- Smart Homes and Cities
- Profit from the IoT
- LED Lighting Design
- Smart Automotive
- Power Management and Design
- Wireless Communications Design

What really happens here. One mighty dose of the IoT

- Engage in awesome technology talks and workshops at the conferences
- Demo new tools at the expo
- Discover brilliant ideas from techies
- Learn new techniques to grow your career
- Meet influential technologists, design engineers, developers, entrepreneurs and investors to grow your own business
- Engage in intelligent conversations with potential new employers or colleagues

This is just a glimpse of the things that make our multi-disciplinary mega-convention special for any true technologist!

KEY FACTS

Show dates: **March 2-4, 2017**

Location: **Bangalore International Exhibition Centre (BIEC), Bengaluru, Karnataka, India**

For more information, visit:
https://conferences.electronicsforu.com

Highlights

This conference is designed to host more than 200 speakers and thousands of delegates. Why will they all be here?

Intensive sessions from the industry's best speakers. Our speakers are a combination of experienced industry leaders, high-value engineers and founder-innovators, all driven by a passion for technology and engineering.

- Get to know the latest cutting-edge technology from the folks who developed it.

- Absorb the energy and drive from the pros—get better at what you do.
- Take away skills that you can apply to your work, straight away.

Amazing networking benefits. Our conferences enable your team to network with thousands of new potential customers, vendors and professionals in the electronics industry. Meet and network with the kind of people who could define your future career and help you become a thought leader.

- Feel the pulse of what is happening in tools, technologies and customer requirements.
- Get connected with our line-up of speakers, some of whom are the most reputed people in the electronics industry.
- Listen to ideas that your team was not even aware of!

Team building was never this cool. This conference exposes your team to extreme learning, to create a tighter-knit and superbly efficient team.

- Team members can discuss new technologies, tools and processes with advice from the best in the industry.
- Hold discussions on how to apply these new ideas back in the company to improve your products, performance and overall results.

Enhance innovation. Want to design an innovative product for the market place? This is the conference for you!

- Learn from the founders of some latest successfully funded startups.
- Attend workshops to learn how to create prototypes on five popular development boards.

> Resistance is frutile. The future is coming, but what will the future bring with it? As Peter Drucker puts it, "The best way to predict the future, is to create it."

- Do not just dream; be a doer and learn how to make your dreams come alive.

Get better at what you do. Our speakers are experienced industry leaders, high-value engineers and founder-innovators, and are driven by a passion for technology and engineering. With experienced hands taking you through their struggles, absorb the energy and drive from the pros—get better at what you do.

- 200-plus expert speakers spread over three days.
- Get the low-down on hardware and software technologies that are critical to the IoT. Hear it from the best in the business.
- Learn the smartest ways to build a product, from the best design engineers, developers, technical architects and project managers in the country.

TEST & Measurement India

The 6th Edition

Know About The Latest In The Test & Measurement Space

Organised by EFY Group, Test & Measurement India (T&M India) is India's only show on T&M equipment. Launched in 2012 as a co-located show along with EFY Expo, it has established itself as the must-attend event for users of T&M equipment, and a must-exhibit event for suppliers of T&M products and services

Being held as part of IEW 2017, it is the second time that this event is being held at Bengaluru along with EFY Expo, Electronics Rocks, *LEDAsia.in*, *IoTshow.in* and Raksha India. T&M India 2017 will feature T&M Showcase, too, where new products will be demonstrated live to the audience.

Who should visit

- Test engineers
- Design engineers
- Quality control engineers
- Technical and business decision-makers (CEOs, MDs, purchase managers, etc)
- Channel partners (traders, systems integrators, etc)

Highlights

- T&M Showcase, a platform for live demonstrations of T&M products under two categories: power and wireless.
- Buyer-Seller Meet for large buyers to have one-on-one meetings with leading suppliers of electronic products, services, components and manufacturing equipment.
- Vendor Development Talks to enable top buyers to share their sourcing requirements and vendor-selection parameters with a larger number of sellers.
- International exhibitors from Japan, Taiwan, South Korea, the USA, the UK, Singapore and China exhibit at the event. Besides regular business, strategic business deals such as joint ventures and distributorships are possible.
- VIP Lounge is a well-managed space to help exhibitors and guests close business deals in the right environment.

KEY FACTS

Show dates: **March 2-4, 2017**

Location: **Bangalore International Exhibition Centre (BIEC), Bengaluru, Karnataka, India**

For more information, visit:
https://www.indiaelectronicsweek.com/test-measurement-india

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raksha India

The 2nd Edition

Raksha India

India's first event to connect with business and technical decision-makers related to the use of electronics in strategic sectors including defence, aerospace and homeland security

Organised by EFY Group, Raksha India brings together a B2B exposition, Buyer-Seller Meet and Technical Conference to bring the entire ecosystem together under one single roof.

Being held in the southern part of India, which is one of the fastest growing markets, the event is focused on the latest technologies that can drive innovation in strategic electronics for defence and homeland security.

Opportunities galore

Visitors can discuss new technologies, tools and processes with advice from the best in the industry. Eight dedicated conferences bring together the best minds and practitioners from the aerospace and defence industries, offering visitors the best opportunity to hear about experiences and views, first hand.

Rekindle the spark in your team

This is an ideal chance for teams to expose themselves to the experience of extreme learning, to bond better to form superbly-efficient groups. This is where you get to hear of ideas you were not even aware about, carry these back and apply in your company to improve your product's performance and end results.

KEY FACTS

Show dates: **March 2-4, 2017**

Location: **Bangalore International Exhibition Centre (BIEC), Bengaluru, Karnataka, India**

For more information, visit: *http://raksha-india.com*

Meet with business leaders

Where there are business leaders, decision-makers and business creators follow. Raksha India attracts a congregation of the biggest businesses in the industry today, throwing open exciting networking opportunities for the established, the just-started and the soon-to-start.

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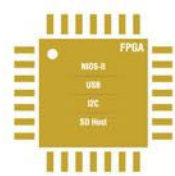

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DIY EXPO
For the MAKER in you

The 1st Edition

Launching DIY Expo: For The Maker In You!

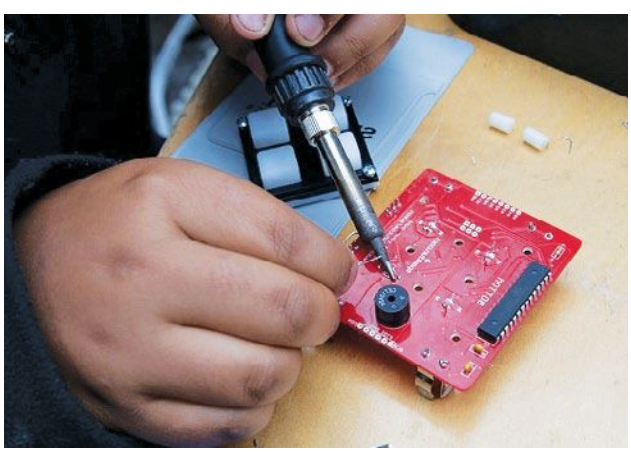
We want the dream of 'Make in India' to become a reality. But is it possible without the real makers? Definitely not, which is why EFY Group has conceived this platform, where makers and DIY enthusiasts meet each other and those from the electronics industry

Do we have a platform to make things happen, one where the latest development boards, DIY kits, 3D printers and robotics kits can be experienced under one single roof, a platform where DIY experts from across the country are present to share their tips, where business opportunities around electronics related DIY are discussed, and DIY brands from India and the globe compete for your attention?

At DIY Expo 2017, you have the chance to immerse yourself in the latest technology that is driving this movement.

Tinkering—known these days by such nicknames as DIY and the makers' movement—is making a dramatic comeback worldwide, enabling you to build, and even invent, viable technological creations of your own.

Keeping this in mind, DIY Expo aims to unite, inspire, inform and entertain a growing community of resourceful people who undertake amazing DIY projects in their backyards, basements and garages.



KEY FACTS

Show dates: **March 2-4, 2017**

Location: **Bangalore International Exhibition Centre (BIEC), Bengaluru, Karnataka, India**

For more information, visit: *www.diyexpo.in*

DIY Expo is the epicentre for breakthrough education technology solutions. There is simply no better place to get up close and hands-on with today's most innovative technologies and applications.

From 3D printing to robotics, and assessment solutions to educational software, DIY Expo Hall hosts leading manufacturers, each featuring the latest technologies and newest products in the market. Plus, you see, feel and experience the latest education technology, first hand. Be blown away by the hands-on demos and all the ideas you take home with you!

Highlights of DIY Expo 2017

- India's first and only show focused on DIY
- New product demo on expo floor
- Rapid prototyping conference for DIY enthusiasts
- Held in Bengaluru, the city of engineers, makers and DIYers

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exhibitors

The India Electronics Week 2017 brings together a gamut of exhibitors from electronics, LED and Internet of Things (IoT) sectors. They showcase the latest innovations across various product categories. Presented in this section is a curtain raiser of some of the exhibitors, with many more to follow

ANAND ENTERPRISES

Anand Enterprises was established in 1987 to manufacture a wide range of PCB-mounting hardware items moulded in Nylon6, HDPE and ABS plastics. These products are injection-moulded on automatic/semi-automatic moulding machines by a specially-trained workforce following strict quality norms. These components are useful in applications like PCB mounting, heat-sink mounting, transformer mounting, fuse link mounting, bus bar mounting and so on.

Product range includes round spacers, round bushes, washers, transistor bushes, transistor pads, three-pin regulators, IC bases, trimpot bushes, LED holders for PCB mounting, panel-mounting clamps, base legs, insulating bushes for transformers, square spacers, hex spacers, hex spacers moulded with inserts, through-hole spacers, knobs for Philips pots, door knobs, resistor bases, bus bar supports and insulators.

Contact details: *www.pcbspacers.com, www.anandspacers.co.in, anandspacers@gmail.com*

ANRITSU INDIA PVT LTD

Anritsu Corp., headquartered in Japan, has been a global provider of innovative communications T&M solutions for more than 115 years.

Anritsu India Pvt Ltd, a 100 per cent owned subsidiary of Anritsu Corp., has its head office in Bengaluru and branch offices in Noida and Hyderabad. Anritsu India, which has an ISO 9001:2008 and NABL-certified quality management system, brings together the functions of sales, marketing, engineering, service and technical support for better and broader support to its growing customer base in India. The India Calibration & Service Centre in Bengaluru is well-equipped and capable of servicing the range of Anritsu products, resulting in better support to local Indian customers. Its customers in India, which include mobile R&D/manufacturing companies, defence/aerospace companies, mobile- and fixed-line operators/NEMs and education institutes, are supported by Anritsu's team of more than 50 members.

Contact details: *acin-sales@anritsu.com, 080-40581300*

ANSYS

ANSYS is the global leader in engineering simulation. They bring clarity and insight to the customer's most complex design challenges through the broadest portfolio of fast, accurate and reliable simulation tools. Their technology enables organisations in all industries to create high-quality, innovative product designs that are sustainable and have an accelerated time-to-market.

Founded in 1970, ANSYS employs almost 3000 professionals, of which more than 700 have PhDs in engineering fields like finite element analysis, computational fluid dynamics, electronics and electromagnetics, embedded software, system simulation and design optimisation. Headquartered south of Pittsburgh, USA, the company has more than 75 strategic sales and development locations throughout the world with a network of channel partners in 40-plus countries.

Contact details: *www.ansys.com*

AQTRONICS

Semikart.com is a first-of-its-kind pan-India online marketplace to consolidate search and purchase of electronic components in India. This is designed to simplify the process of sourcing components for small- and medium-inventory requirements. *Semikart.com* acts as a one-stop shop to browse through the entire inventory of multiple distributors.

Semikart.com envisions supporting the ecosystem around silicon. It is an answer to the rapid growth of the entrepreneurial community in India designed around 'Make in India' campaign. With more than 35 years of sales and marketing experience, founding members of Semikart Inc. understands the rising demand for a unified platform that provides customers a hassle-free opportunity for sourcing necessary components for their projects, incubating latest and emerging technologies, building and testing prototypes, manufacturing and marketing the end products.

Contact details: *ranga@semikart.com, ramesh@semikart.com, Ph: 91-9845049091/9880848036, 080-26605892/26605373*

ASCENT CIRCUITS

Ascent Circuits is an integral part of the premier business group with diverse commercial interests. The company is one of the leading manufacturers of single-side, double-side and multilayer PCBs in India.

The company's business philosophy is based on a judicious blend of innovative deployment of technology and exceptional customer service. With a distant accent on quality, Ascent Circuits delivers customised products without compromising on time-to-market. This is enabled by a promising engineering talent pool, spearheaded by a dynamic and young management.

Ascent Circuits is the futuristic plant in India with a state-of-the-art reverse pulse plating line, that ensures high reliability in PTH, especially for high-end applications like telecom, military, aerospace, microwave and RF applications.

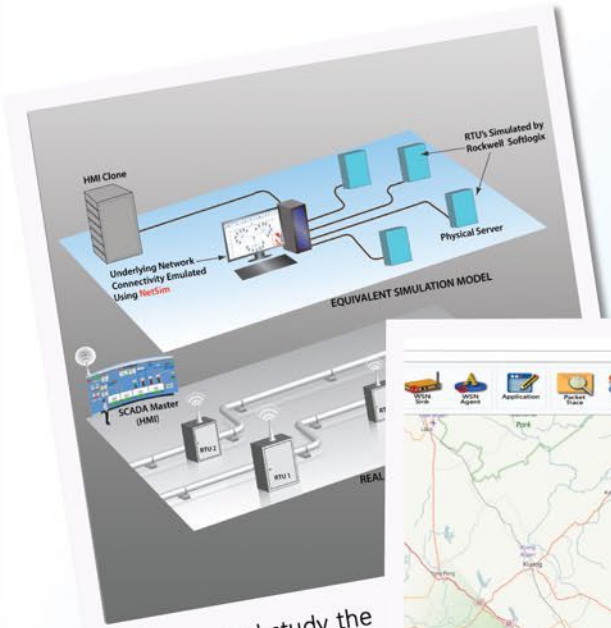
Contact details: *acplexports@ascentcircuits.com, 91-9486004599*

ASTTECS

astTECS is india's fastest-growing open source telephony brand and a one-stop shop for enterprise solutions like IP PBXes, call center dialers, video-conference solutions and IVR solutions. They provide world-class 24X7 support to global customers through the in-house global support management centre. The company is ISO 9001:2008 certified and follows strict quality management measures.

astTECS have been awarded the top 100 global companies 2013 by Red Herring for path-breaking innovations in telecom products. They have been adjudged the top 20 most-promising open source solutions and service providers and brand of the year 2016 by *Silicon India* magazine and top 10 made in India brand by *SME Channel* magazine. astTECS have grown as a nation-wide enterprise with customers and channel partners spread across the globe, and are constantly growing its presence.

Contact details: *www.asttecs.com, sales@asttecs.com, 080-66406640*



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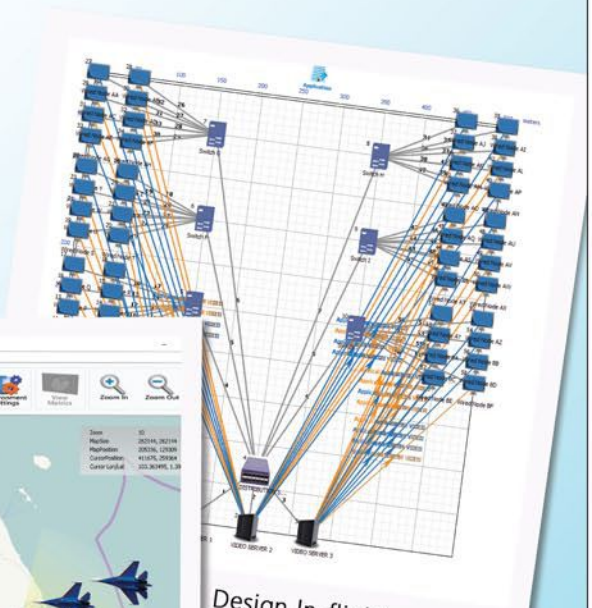

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CIRKIT ELECTRO COMPONENTS PVT LTD

Cirkit Electro Components Pvt Ltd was established in 1990 with headquarters on Lamington Road electronics market in Mumbai. A leading professional and independent distributor of electronic components, it deals with many reputed brands such as IR, Vishay, Incharge Semiconductors, Microchip, Power Integrations, JHD LCD, Guerte Rectifier, ADI, Texas Instruments, Fairchild, STMicroelectronics, Atmel, NXP, Maxim, Altera, Xilinx, Infineon, On Semiconductors, Intel, Linear, AVX and Mitsubishi, offering full series of electronic components including ICs, diodes, transistors, tantalum capacitors, inductors, capacitors, crystals, beads and optocouplers. These products are widely used in high-tech, civil, automobile, instrumentation, UPS, inverter, power supply, LED lighting, communication, manufacturing and military fields.

Contact details: *sales@jskurja.com, 022-28852248*

CLOUDTHAT TECHNOLOGIES

Incorporated in March 2012, CloudThat Technologies provide training, consulting and managed services in the Cloud and IoT space for mid-market and enterprise clients around the world. With expertise in major Cloud platforms including Amazon Web Services (AWS) and Microsoft Azure, CloudThat is uniquely positioned to be the single technology source for organisations looking to use the flexibility and power that Cloud computing and IoT provides.

The company was co-founded by Bhavesh Goswami, an ex-Amazonian who was part of AWS product development team, and Himanshu Mody, who has 15 years of experience in IT training and consulting business.

CloudThat has trained more than 5000 IT professionals and has conducted corporate trainings for Fortune 500 companies like General Electric, Tata Consultancy Services, Hewlett Packard, SAP, Oracle, Philips, Madura Coats, Flipkart, Larsen & Toubro and Samsung.

Contact details: *www.cloudthat.com, salim@cloudthat.com*

COMPONENT MASTERS

Established in 1978, Component Masters is one of the leading retailers, wholesalers, importers and exporters involved in trading in a wide range of high-quality industrial electronic components such as ICs, MOSFETs, IGBTs, SMD components, DC-DC converters, capacitors and transistors. All products are sourced from some of the most prominent companies. This ensures that all products adhere to the various national and international quality, performance and safety standards.

ComponentMall.com is an online venture of component masters that will serve its clients more efficiently, where they can order components online, download datasheets, compare product specifications, check availability and print quotations for more than 300,000 products.

Contact details: *www.componentmall.com, 022-23896420/23826278*

CSA GROUP

CSA Group is an independent organisation dedicated to safety, social good and sustainability. Its knowledge and expertise encompass standards development, training and advisory solutions, global testing and certification services across key areas like hazardous locations and industrial; transportation, plumbing and construction; medical, safety and technology; appliances and gas, lighting and sustainability; as well as consumer product evaluation services. CSA certification mark appears on billions of products worldwide.

In India, CSA Group has grown substantially in capabilities over the past few years. They now offer testing and certification services in the areas of industrial and hazardous location products, process control and automation products, medical devices and components. They also offer testing services for ingress protection and IT, AV and self-ballasted LED under BIS CRS scheme. Recently, it received CB accreditation for IT, medical and lab, as well as test and measurement equipment.

Contact details: *csaindiasupport@csagroup.org, 080-45340200*

CYTECH GLOBAL PTE LTD

Cytech is one of Pan-Asia's leading technology-oriented value-added distributors. Established in 1998 and headquartered in Hong Kong, they have a workforce of more than 400 employees spanning over 20 offices. In the financial year that ended on March 31, 2009, Cytech Technology Ltd became a member of Macnica group.

Cytech Global is a new division of Cytech and was established in June 2009 to lead the expansion into India and ASEAN countries, with Singapore as the regional headquarter. Cytech Global is the authorised distributor/reseller for Intel PSG, Cypress, Bittware, On Semiconductor, Infineon, Linear Technology, Cavium Networks, Ortustech, Semtech and Terasic.

Contact details: *www.cytechglobal.com, cyg_enquiry@cytech.com, 080-32438765/23336763*

DDS INTERNATIONAL

DDS International is engaged in manufacturing and importing switches, sockets and connectors since 2009. Founded by Diwan Chand Sachdeva, who had great experience in the highly-technical sector of switches and connectors. His thoughts and business ethics are now followed by Ashish Sachdeva and Chiranjeev Sachdeva.

The company deals in all kinds of tactile switches, rocker switches, slider switches, glass fuses, fuse holders, potentiometers, pin headers and connectors. They launched these products in the market for reliable manufacturing of appliances like inverters, DTH players, DVD players, induction cookers, USB players, torches, computers and LCD/LED/colour TVs, diodes, ICs, transistors and more.

Contact details: *www.ddsinternational.in, ddsinternational11@gmail.com, 91-9818082777*

DELTA POWER SOLUTIONS

Delta Group, founded in 1971, is a world-class provider of energy-saving solutions and a global leader in switching power supply solutions since 2002 and DC brushless fans since 2006. In April 2016, Austria based LOYTEC joined Delta Group, enhancing the group's automation competence and solution portfolio.

LOYTEC's lighting control solution is a full-featured lighting control system based on the open DALI standard, which allows full integration with other systems in the building. Compared to light-only solutions, LOYTEC's solution not only allows using existing building management system infrastructure, but also, by interacting with other systems in the building, delivers smarter solutions, leading to significantly higher energy savings. Whether using PCs, touch panels or mobile devices, visualisation and operation of all control functions are performed via consistent user interfaces. This saves money as resources are shared, and also significantly increases user satisfaction.

Contact details: *rajat.bhambri@deltaww.com, 91-8826419191*

DIGI-KEY

Digi-Key is one of the fastest-growing distributors of electronic components in the world. Since its founding in 1972, Digi-Key has been committed to offering the broadest selection of in-stock electronic components, as well as providing the best service possible to its customers, aiding engineers through the entire design process, from prototype to production. This has led the company to be highly ranked year after year in industry surveys, in North America as well as Europe and Asia, in categories covering such facets of business as availability of product, speed of service, responsiveness to problems and more.

Digi-Key's website is the top-rated and most-visited website in the electronic distribution industry. Content and services they offer on their website continue to rapidly evolve, and they are committed to providing customers with full access to Digi-Key's products and services through the Internet.

Contact details: *sales@digikey.com, 1-800-344-4539, 001-2186816674 (USA)*

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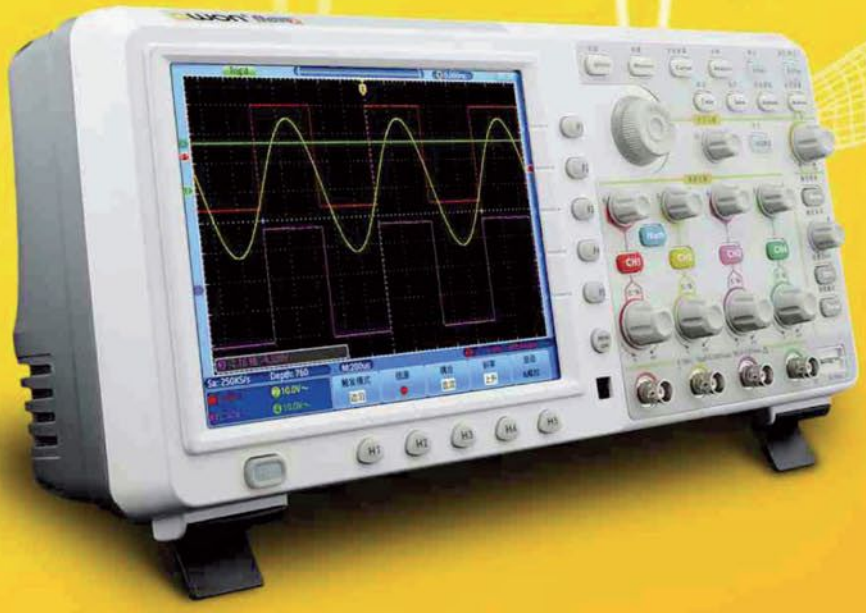

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DRIVE TECHNOLOGIES

Drive Technologies is a 17-year-old company working in the field of circuit assembly equipment, circuit conformal coating materials, equipment and accessories, precision cleaning chemicals for circuits, stencils, pallets, metal, glass, optics and semiconductors, cleaning equipment, as well as thermal and EMI/EMC management materials.

Drive Technologies will display world-class HumiSeal conformal coating products at IEW 2017. They expect multi-nationals and local companies to visit their stall at the show to engage in a dialogue with the senior staff from HumiSeal, who will be available for discussions with interested users.

Contact details: *prasad@drivetech.in, prparulekar@gmail.com*

E CONTROL DEVICES

E Control Devices was established in 2012 by Nawal Singh with a vision to offer genuine and innovative products to customers to meet their design requirements and improve their product quality. The company is committed in offering the widest selection of in-stock electronic components as well as international procurement to their valuable customers. With support from the broad network of electronic component suppliers across the world, they specialise in hard-to-find components, too.

E Control Devices have a 5000-plus customer base from all major segments and cater to the field of automotive, lighting, consumer electronics, solar, industrial, wireless, defence and EMS.

Contact details: *in_sales@econtroldevices.com*

ELECTROCONNECT SYSTEMS

Electroconnect Systems, a professionally-managed organisation, was established in 1990. Its brand, Ocean, is one of the leading market players in plastic-moulded enclosures for process control instruments. These products are manufactured in accordance to international standards and are supplied to thousands of satisfied clients across the globe.

The firm encourages new customers to make a trail order for enclosures before making a final decision. It follows a no-minimum quantity policy, which allows customers to experiment and find enclosures that would best fit their needs for a particular project.

Electroconnect has an in-house manufacturing facility, where all production work is done on the most advanced machines. It is proud of its consistent commitment towards providing world-class production and prompt deliveries. It invites enquiries from clients, to which it reverts back promptly.

Contact details: *www.oceanindia.com, admin@oceanindia.com, 022-28471917/28471960*

ELECTROLUBE

Electrolube has its roots stretching back to 1941, when Henry Kingsbury formed Kingsbury Components to manufacture volume controls. That was when Kingbury formulated a special oil that enhanced the electrical performance and lifetime of the contact surface, in addition to reducing friction from moving parts.

Electrolube offers a vast array of products including thermal management materials, conformal coatings, encapsulation resins, electronic cleaning solutions and general maintenance products, and is heralded as the brand leader across many of these product groups.

With a presence in 55 countries and expanding, Electrolube has a clear reputation for excellence. Its ethos in innovation and service remains paramount. Its products are used in industries like automotive, military, transport, aerospace, marine and education. All its product ranges are manufactured at its factories in the UK and China, to ISO 9001, ISO 14001 and OHSA 18001 certification standards.

Contact details: *www.electrolube.in*

ELEMENT14 INDIA PVT LTD

Element14 is a leading global distributor for electronic components, single-board computers and development kits, tools, test and measurement, software and design services. As a development distributor, the company supports a broad customer base to whom they are committed to offer the broadest selection of in-stock electronic components at very competitive pricing.

The company has consistently outperformed industry norms on key parameters like availability of products, shipping speed and customer responsiveness. At any given time, Element14 have more than 650,000 products across categories like electronic components, interconnect and emech products, electrical, tools, and test and measurement from more than 3500 industry-leading suppliers like Analog Devices, NXP, Molex, TE Connectivity, Microchip, Texas Instruments, Vishay, Fluke, Tektronix, Keysight and so on. The company also offers first and only community *www.element14.com* for design engineers and electronics enthusiasts.

Contact details: *in.element14.com, insales@element14.com, 080-40003888*

EMBDES TECHNOLOGIES PVT LTD

EmbDes Technologies is a Bengaluru based embedded design service company that offers innovative and flexible solutions/services for every stage of an electronic product development lifecycle, which includes hardware design, PCB design, enclosure design, PCB fabrication, sheet metal work, rapid prototyping using 3D printers and many more. The company is a complete end-to-end solutions provider from proof-of-concept to end prototype production.

The company ensures that the solutions offered always deliver high level of integration, quality, extended product life and, at the same time, lower overall system cost, while enabling faster time-to-market. EmbDes believes in achieving customer confidence with its strong capabilities in software and hardware areas of the embedded industry.

The company also deals with sales and marketing of a few development kits and products from Cubietech.

Contact details: *krinshnakumar.c@embdestech.co.in, 080-25537562*

EMST MARKETING PVT LTD

Based in Pune, EMST Marketing is one of the pioneers in the field of PCB assembly and cable-processing equipment. It has 25 years of experience in this field. It offers a wide range of equipment for both through-hole as well as SMT PCB assemblies, many of which are manufactured by its group company, EMS Technologies Pvt Ltd, Pune. It is a leader in wave-soldering machines, with a vast installed base across India and abroad. In SMT, it has established itself as the only local source for eight- and seven-zone reflow ovens, and five-zone reflow ovens and semi-automatic stencil printers.

EMST has branches at New Delhi, Rudrapur, Ahmedabad, Bengaluru, Hyderabad and Chennai with trained manpower to provide effective sales and service support. The company also exports to countries like South Africa, Turkey, Russia and Iran.

Contact details: *www.emstonline.com, contact@emstonline.com, 91-9595525010*

ENERGY SAVING INDIA

Energy Saving India mainly aims at energy conservation. The company supports 'Make in India' campaign initiated by Prime Minister Narendra Modi. The company is engaged in manufacturing LED lighting products with driver-less technology, which is the latest trend in the international market.

Due to eco-friendly LED lighting, the company's products save 80 per cent of electric energy, emits less amount of carbon and generates very little heat in comparison with ordinary lighting products.

Energy Saving India are specialised in providing household, commercial and industrial lighting solutions for optimum utilisation of energy. Their products are safe and approved by BIS.

Contact details: *91-8860430298/9899258647, 011-45063567*

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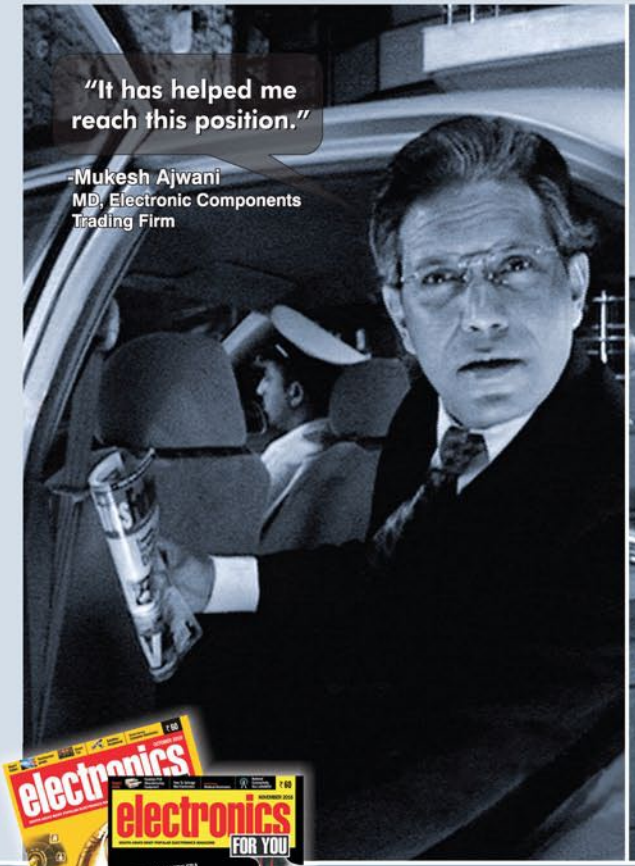

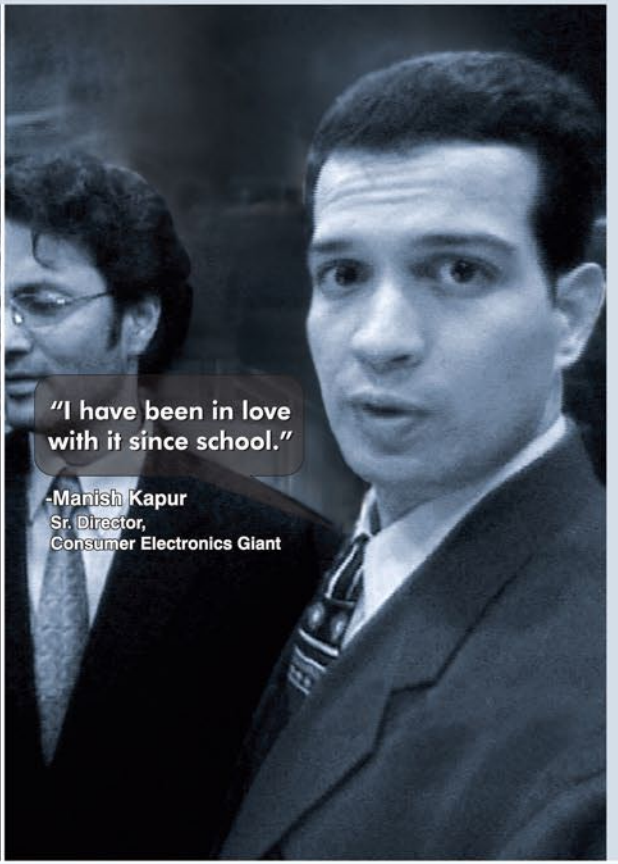

Mr Kapur, Mr Ajwani and Mr Verma are not the only ones who owe their success to *Electronics For You*. The technology magazine that started off in 1969 is today South Asia's most popular one. Covering the latest on emerging technologies, changing industry trends, evolving trade practices...

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ELECTRONIC RELAYS INDIA (ERI)

ERI, an ISO9001:2008 certified company, was set up in 1979—the year it started manufacturing solid-state relays and input/output modules. The company began its journey by exporting a major part of its production to the USA. Subsequently, it expanded activities in India and began catering to the huge demand in the domestic market, too. Its customers remain highly satisfied and hugely appreciative of ERI's preoccupation with quality and strict professionalism. Products manufactured by the company are solid-state relays, input/output modules, electronic sub-assemblies and power supplies.

Contact details: *www.electronicrelaysindia.com*

ELECTRONICS SECTOR SKILLS COUNCIL OF INDIA (ESSCI)

ESSCI has been promoted by six industry associations, namely, CEAMA, ELCINA, IESA (formerly ISA), IPCA, MAIT and ELCOMA, with financial support from National Skill Development Corp. Its focus is on establishing an effective and efficient ecosystem for developing and imparting outcome-oriented skills for the ESD sector.

ESSCI has more than 125 training partners with more than 1700 training centres across the country, and is well-equipped to undertake skills development across jobs in all segments of ESDM.

ESSCI has developed 149 qualification packs and 450 national occupation standards to cater to skills enhancement across the electronics sector.

Contact details: *http://essc-india.org, info@essc-india.org, 011-46035050*

FLIR SYSTEMS INDIA PVT LTD

FLIR's infrared cameras are well known for their quality. As one of the largest commercial infrared companies in the world, FLIR has nearly 50 years of experience in building and integrating high-performance infrared cameras. This has given it a unique insight into specialised technologies.

FLIR has been a pioneer in the commercial infrared camera industry, supplying thermography equipment to various industries for over 50 years. From predictive maintenance (electrical and mechanical applications in manufacturing, service and electronics industries), condition monitoring, building diagnostics, non-destructive testing and R&D, to temperature measurement and manufacturing process control, FLIR offers the widest selection of infrared cameras for beginners and advanced professionals.

FLIR also offers a new line of T&M instruments, built on its commitment to innovation, quality and reliability.

Contact details: *www.flir.in, flirindia@flir.com.hk, 011-45603555*

FUSION POWER SYSTEMS

Fusion Power Systems is an ISO 9001:2000 certified enterprise engaged in the development and supply of rechargeable, sealed lead-acid batteries and lithium-ion batteries under its brand name Amptek, which is among the top ten SLA battery brands in India. Amptek has nation-wide sales, service and distribution capabilities, providing state-of-the-art batteries to its customers. Amptek has branch offices in Chennai and Hyderabad to take care of sales and after-sales service needs of the south Indian market. It also has an office in China to take care of the inspection of containers before shipment, timely dispatch of orders and other QC-related issues.

Amptek batteries strictly comply with JIS and IEC standards. Their battery models, 12V24 and 12V33, are the first in India to be approved by International Centre for Automotive Technology (ICAT) for use in EV vehicles.

Contact details: *www.amptekbatteries.com, info@amptekindia.com, 011-49495200*

GEOSENSORS

Geosensors was established in 2008, and they manufacture resistivity meters and water-level indicators, and supply to most government and private sectors. Apart from manufacturing the above, Geosensors are the authorised dealers for handheld group and Pelican transit cases, and are recognised as the solution provider in the field of industrial-grade handhelds and industrial packing.

For industrial-grade handhelds, they provide support for the hardware. They also provide customised transit cases and panel enclosures to defence, security services, media, medical, OEMs and industrial sectors.

Contact details: *www.geosensors.in, sales@geosensors.in*

GOOD WILL INSTRUMENT CO. LTD

Founded in 1975, Good Will Instrument Co. Ltd was the first professional manufacturer in Taiwan to specialise in electrical T&M instruments. They began as the manufacturer of power supplies and quickly expanded into the development of high-precision electronic T&M instruments with brand identity, GW Instek.

After 41 years in the T&M industry, GW Instek has grown to become one of the most-recognised manufacturers of T&M instruments in the world. Today, the company offers more than 300 products across five key lines, namely, oscilloscopes, spectrum analysers, function generators, power supplies and basic T&M instruments. Just like the wide product range, the industries GW Instek serves are as diverse as these are specialised. These include automotive, defence and avionics, semiconductors, telecommunications, consumer and industrial electronics, automation, research and education industries.

Contact details: *www.gwinstek.com, sumit_sharma@goodwill.com.tw, +886-222680389 (Taiwan)*

GT MAGNETICS PVT LTD

GT Magnetics Pvt Ltd is a leading manufacturer of wound magnetics, that is, a wide range of coils and ferrite transformers. The company is ISO 9001:2008 certified. Its manufacturing unit was established in 1997 and, since then, it has established a reputation for reliable quality and on-time execution of orders. It is a customer-focused organisation and strives to provide total satisfaction to all.

Its major products include wound components for the lighting industry, LED driver transformers, solar lighting products, CFL driver transformers, wound components (for audio-video and automotive applications), inverter and UPS systems (for telecom and charger industries), as well as filter and choke coils, and customised ferrite transformers and coils.

Contact details: *www.gtmagnetic.com, development@gtmagnetic.com, po@coilsntransformer.com, 011-45527299*

IGNITARIUM TECHNOLOGY SOLUTION PVT LTD

Ignitarium is a silicon and embedded system design house, built around a core team of technologists, who have a collective experience of more than 100 years, with expertise in IC design and implementation, FPGA design, embedded system design and software development. Ignitarium is headquartered in Bengaluru and has an office in Kochi, serving India-captive centres of leading companies. Ignitarium Inc., a wholly-owned subsidiary in the USA, serves local customers. Ignitarium's current focus is on executing turnkey projects in semiconductor and embedded software spaces.

Ignitarium's customer portfolio includes leading multimedia companies, Indian research labs, semiconductor companies and technology startups. They have a strong R&D team, focusing on building innovative solutions in video and imaging addressed for security, automotive and healthcare domains. They are partnered with companies for IoT product development.

Contact details: *www.ignitarium.com, ramesh@ignitarium.com, 080-42054217*

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INCHANGE SEMICONDUCTOR CO. LTD

Inchange Semiconductor Co. (ISC) is an outstanding manufacturer of transistors, MOSFETs, thyristors, Schottky diodes, rectifiers and ICs, and offers more than 7000 part numbers.

Founded in 1991 and headquartered in Wuxi, Jiangsu province, China, ISC persists in manufacturing top-quality products, conforming to global standards, and fostering independent innovation.

The company is RoHS, REACH and ISO9001 certified to drive high-quality products and new innovation. It has a highly-experienced engineering team and an extensive product portfolio that helps in delivering industry-standard, application-specific and customer-specific devices to its customers, giving them a cutting-edge advantage to succeed in today's dynamic market.

Contact details: *mdd@iscsemi.com, +86-5108534630*

INDUS TECHNOTRONICS PVT LTD

Indus Technotronics Pvt Ltd is one of the leading electronic components distributors in India, having its registered office in Bengaluru with a subsidiary company in Singapore. Indus has established channel partners with strength in both technical solutions and commercial feasibility since 2008.

At present, the company has excellent infrastructure with dedicated engineers, and gives the customers get full-time techno-commercial support. The company has eight years of electronic components distribution and customer focus experience.

Currently, the company is conducting businesses in the areas of electronic components distribution and stocking, electronic designs solutions and support, BOM kitting services, RoHS compliance and obsolescence management, hard-to-find and obsolete component sourcing, and connectors and harnessing solutions.

Contact details: *info@industechno.com, +91-9886703446*

INFISWIFT

Infiswift helps enterprises collect better data, make better decisions and streamline operations by providing the plumbing to connect and manage devices, users and Cloud based services. A unique platform architecture powers scalability to billions of endpoints using world-class security.

The company's powerful development environment and analytics front-end enable quick development for custom implementations. Pre-configured features allow users to focus on getting their solution to the market rather than back-end details.

Whether a company is looking to develop a very large and complex IoT implementation or a smaller one, Infiswift has a cost-effective option that provides a robust foundation for development and monetisation. The ultra-lightweight design and extremely efficient operation make it ideal for intermittently-connected and power-deficient environments that require real-time operation.

Contact details: *info@infiswift.com, 91-9259839555*

INTUITTHINGS

IntuitThings is an IoT based home and office automation startup with game-changing products, opening completely different market segment that present players are unable to attract.

Home/office automation products in the market currently have a huge hurdle due to messy and complicated installation, which involves rewiring or civil work. IntuitThings has created a range of hi-tech, low-cost products. This opens up a huge market of existing homes.

The company provides a range of IoT based switches and sensors that are compatible with existing switch board brands. Their smart switches simply replace manual switches without any rewiring or civil work. Products work with a Wi-Fi- and ZigBee-enabled centralised gateway. The company has a patent pending for their unique hardware. Products are CE class A compliant.

IntuitThings team includes ten hardware and software engineers, well-versed with circuit design, power electronics and wireless technology.

Contact details: *www.intuitthings.com, +91-96202048*

JSK INNOVATIVE TECHNOLOGY PVT LTD

JSK Innovative Technology Pvt Ltd is a fast-growing electronics company that specialises in automation-compatible electronic products for domestic, commercial and industrial use. It has state-of-the-art infrastructure at its plant in Mumbai. The plant is equipped with advanced machinery and tools required for smooth operations when manufacturing sophisticated products.

The company is a part of a diverse business conglomerate operating in different verticals like electronics, food, confectioneries, IT solutions and pharmaceuticals. It is a venture started by professionals with in-depth industry experience, market know-how and domain expertise in varied fields, with around five decades of collective industry experience.

Contact details: *email.sales@jskurja.com, 022-28852248*

KWALITY PHOTONICS PVT LTD

Kwality Photonics Pvt Ltd has been a pioneer in manufacturing professional-grade LEDs in the country since the last 30 years. With quality that matches global standards, Kwality has received India's 'Top LED Brand' award from EFY for the past few consecutive years. The company was established in 1987 under the guidance of its managing director, Vijay Kumar Gupta, who is a noted scientist and engineer, and an expert in LEDs, having been associated with LED manufacturing technology for over 35 years.

Kwality's PolyWa series comprises over 20 popular LED devices, ranging from 12 lumens to 10,000 lumens. Three of its most popular SMD LEDs that are used across every application are 2835, 3030 and 5630 LEDs.

In the past one year, Kwality Photonics' market share in power LEDs and white LEDs has shot up by 200 per cent, thanks to its single bin uniformity, LM80 compliance and aggressive pricing policy.

Contact details: *www.kwalityphotonics.com, www.ledchip.in*

MARTIN'S ELECTRONIC DEVICES & INSTRUMENTS (MEDI)

MEDI is an R&D firm involved in the design and development of electronic products for industrial and commercial applications. Established in 1987, MEDI's intention has been to provide cutting-edge technologies to manufacturers that can be practically implemented and marketed at a competitive price.

MEDI is involved in R&D of electronics—hardware and software, development of new and innovative electronic products and transfer of technology to manufacturers.

Some of its popular designs are single- and three-phase static voltage stabiliser, three-phase solar pump control with MPPT and VFD, and solar inverters and MPPT chargers.

Contact details: *www.medielectronics.com, bangalore@medielectronics.net, ranjana@medielectronics.net, 0484-2356429*

MAXIM INTEGRATED

Maxim Integrated develops innovative analogue and mixed-signal products and technologies to make systems smaller and smarter, with enhanced security and increased energy efficiency. The company has empowering design innovation for its automotive, industrial, healthcare, mobile consumer, and Cloud data center customers to deliver industry-leading solutions that help change the world.

Contact details: *www.maximintegrated.com*

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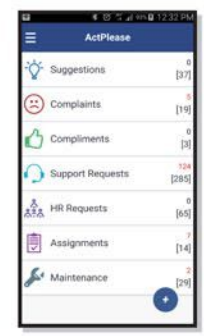

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MECTRONICS MARKETING SERVICES

Mectronics Marketing Services is a leading name in the Indian electronics manufacturing industry, and is known for its high-quality PCB assembly consumables and equipment. For the last 22 years, the company has been serving the market with a team of experienced and qualified engineers. To ensure smooth operations in each part of the country, Mectronics has opened offices in Delhi, Bengaluru, Chennai, Hyderabad and Pune.

The company deals in consumables like SMT adhesives, solder pastes, conformal coatings, cleaning chemicals, reflow profilers, splice tapes, metal squeegees and blades, electronic screwdrivers, clean room wipes and a complete range of ESD products. It deals in equipment like paste printers, PCB and stencil cleaning machines, BGA inspection systems and reflow process inspection systems.

The company's main principals are Heraeus, Zestron, Humiseal, Metcal, KIC, Sudong, Samsung, PBT, EPS and so on.

Contact details: *manish@mectronics.in, pankaj@mectronics.in, 011-42208256*

MELUX CONTROL GEARS PVT LTD

Melux Control Gears Pvt Ltd is an ISO-9001-2015 manufacturing company. It was founded to design, develop and manufacture energy-conservation products, and has now entered the lighting field with electronic ballasts, LED drivers and innovative products driven by professional customer needs.

The company has built its reputation in two verticals: one with the range of LED drivers, SMPSes and LED lighting; and second with automation control cards. Mission of the company is to develop creative, reliable and value-oriented energy-conservation products and solutions, and distributing these nation- and world-wide with an uncompromising level of service and support.

Contact details: *sales@melconindia.com, 020-24264895 (ext. 30), +91-9326002099*

MESSUNG GLOBAL CONNECT

Messung is a pioneer in automation, and offers world-class industry-hardened electronic products and solutions. With more than three decades of experience, Messung has developed the capability, expertise and resources to operate at any scale. Today, it is a globally-respected leader that is passionate about ideas and solutions.

Messung Erfi brings German technology to the field of ergonomic, smart workplace systems. The aim is to revolutionise the work environment in the Indian T&M domain, impacting R&D labs, testing labs, manufacturing departments and training centres, spanning many industry verticals.

Another venture, Messung Werksitz, offers German-made workplace chairs for use in ESD rooms, laboratories, clean rooms, wet rooms, GMP areas, factories and workshops.

Contact details: *020-66492800*

METRO ELECTRONIC PRODUCTS

Metro Electronic Products is more than 50 years old, and deals in testing and soldering equipment. The company was started in 1960 by Prem Prakash Kwatra.

Their product range includes multimeters (digital and analogue), soldering and desoldering stations, oscilloscopes (CRO and DSO), LED and environment testing equipment, function generators, power supplies, frequency counters and various other instruments.

They have a strong presence in test equipment, with a range of brands like Metro-Q, Mastech and Owon that have a high customer recall. They have a wide dealer network, which is one of the largest in India, for its products. They are the sole distributor for Max Gold range of soldering equipment. They have two retail showrooms, one each in Lajpat Rai Market and Bhagirath Place, Delhi.

Contact details: *www.metroq.in, sales@metroq.in, 011-23868195/47508195/23875355*

MICRON

Based in Mumbai, Micron endeavours to build and sustain the standards in the electronic world with its proficient skills and undying commitment to progress and advance. It is primarily an R&D based company in the fields of robotics and embedded system design since 2009.

MICRON is a renowned name among a huge network of dealers in robotics and electronic components throughout India. It is an efficient and trusted supplier with over 18 years of experience in the dealer market.

MICRON is counted as one of the leading importers and stockists of high-performing industrial sensors and other electronic components. The company's products are procured from leading manufactures across Hong Kong, China, Singapore and the USA.

Wide distribution network, competitive pricing, total customer satisfaction and customised products are some of its advantageous features.

Contact details: *micronelectronics8@gmail.com*

MOBILOITTE

Mobiloitte is a premier, full-service mobile and Web application development group with special focus on security, scale and performance across BOTS, APPS, digital and IoT landscape. Mobiloitte is headquartered in New Delhi with client proximity centres in Singapore, the UK and the USA.

Mobiloitte Foundation is dedicated to the cause of mobile technology empowerment of underprivileged, marginalised sections of society working in the unorganised sector, with financially-sustainable digital, IoT solutions. Services and solutions provided by the company are enterprise mobility, consumer mobile and Web applications, iOS, Android, Windows, Titanium, Phone gap, Xamarin, HTML 5 app development, ROR, JAVA, PHP, .Net, Python based custom Web development, app performance, app maintenance, digital app promotion and more.

Contact details: *011-46499900, +91-9999525801*

MOUSER ELECTRONICS

Mouser Electronics, a subsidiary of TTI Inc., is part of Warren Buffett's Berkshire Hathaway family of companies. It is an award-winning, authorised semiconductor and electronic component distributor, focused on rapid new product introductions from its manufacturing partners for electronic design engineers and buyers.

The global distributor's website, *Mouser.com*, is available in multiple languages and currencies and features more than four million products from more than 600 manufacturers. Mouser offers 22 support locations around the world to provide best-in-class customer service and ships globally to over 500,000 customers in 170 countries from its 69677.28sqm (750,000-sqft) state-of-the-art facility south of Dallas, Texas.

Contact details: *www.mouser.in, india@mouser.com, 080-42650000*

MOXA INDIA INDUSTRIAL NETWORKING PVT LTD

Moxa is a leading provider of edge connectivity, industrial computing and network infrastructure solutions for enabling connectivity for the industrial IoT. With over 25 years of industry experience, Moxa has connected more than 40 million devices worldwide, and has a distribution and service network that reaches customers in more than 70 countries.

Moxa offers a full spectrum of innovative, high-quality solutions that have been deployed in a wide variety of industries, including factory automation, smartrail, smartgrid, intelligent transportation, oil and gas, and marine. Moxa's expertise gives industry partners the tools they need to harness the power of automation network convergence and make their operations smarter, safer and more efficient. It delivers lasting business value by empowering industry with reliable networks and sincere service for industrial communications infrastructures.

Contact details: *www.moxa.com, 080-41729088 (ext.21), +91-9900370955*

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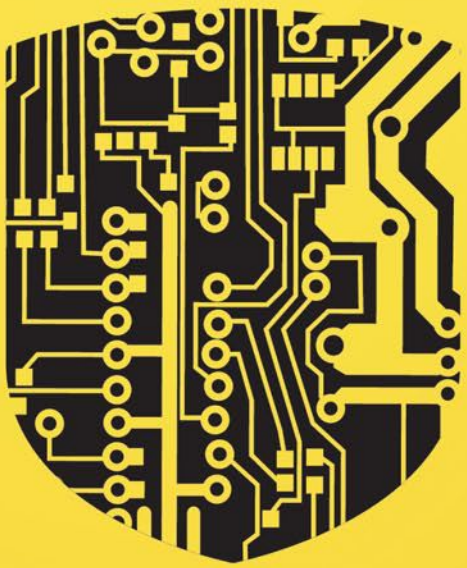

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NEE VEE COMMUNICATION TECHNOLOGIES PVT LTD

NEE VEE Communication Technologies Pvt Ltd is an independent embedded design solution-driven service provider, headquartered in Chennai. The company has design solutions targeted for, but not limited to, high-end multimedia design kits, USB 3.0 camera design kits and IoT design kits. NEE VEE also manufactures various add-on boards like human activity sensor, GPRS, OLED accessory, Raspberry Pi add-ons. Its main domain of expertise includes consumer electronics, the IoT, networking and telecommunication system development.

Nee Vee provides complete end-to-end product development services including hardware design, PCB layout, software, firmware development and Linux/Android BSP porting, and also provides training service to corporates and colleges.

Contact details: *www.neeveetech.com, nvhariharan@neeveetech.com*

PCB POWER/CIRCUIT SYSTEMS INDIA LTD

PCB Power/Circuit Systems India Ltd offers an arsenal of PCB products. It has been an electronics solutions provider that has carefully evolved over 21 years in the industry, to help customers find PCB solutions that best fit their needs.

Its constant endeavour is to offer quality PCBs, ease of ordering and industry's best on-time delivery performance. The company has become the preferred choice of the industry as an online PCB specialist, particularly for prompt deliveries of small volumes.

With a minimum order quantity of just one, no setup costs, no tooling or testing charges, the firm supports both startups and students' R&D efforts, as well as industrial electronics, automotive, telecom, aerospace, defence and railways.

Contact details: *www.pcbpower.com, sales@pcbpower.com, 079-23287086/87*

PEACH TECHNOVATIONS PVT LTD

Peach offers smart solutions such as ERP software and mobile apps to help empower and streamline Indian businesses. Some of its products are:

- ElectroERP is an ERP system for the electronics industry that covers key features like BOM, inventory, purchases, production and more, to suit the needs of electronics product manufacturers, EMS industry and traders.
- PCB Genie is an ERP system for PCB manufacturers. It addresses the specific needs of PCB manufacturers, helping them manage works-in-process, rejections, quality, orders, dispatch, laminate consumption, stores, purchase, preventive maintenance, and in HRM with logins for employees, customers and suppliers.
- ActPlease is a software for customer/product support ticketing that enables customers to submit specific support or service requests, which are auto-forwarded to the right executives for timely action, thereby enhancing customer satisfaction.

Contact details: *parth@peachcomp.com*

PHYTEC EMBEDDED PVT LTD

PHYTEC, with its 30 years of hardware expertise, develops and produces world-class high-quality OEM products (system-on-modules and SBCs). Its ARM based system-on-modules phyCARD, phyCORE, phyFLEX and phyWAVE are delivered with industrial-grade, highly-reliable BSP software.

PHYTEC's OEM and ODM services cover the complete spectrum of the product lifecycle from concept to design, through manufacturing and aftermarket services. Its engineering expertise encompasses complex PCB designs, operating systems, drivers, development environments and application-specific software support to reduce customer investments in the design stage and shorten time-to-market. It also takes care of lifecycle management from a single source to reduce development costs and avoid substantial risks in designing of products and getting these to the market.

Contact details: *www.phytec.in, 080-40867046/49*

PRECISION TECH ENTERPRISES/ NUVO MOBILES

NUVO, launched in 2014, has a vision to bring reliable and high-performance devices to consumers worldwide. NUVO is short for new voice, and the company promises to deliver supreme-quality products with customer satisfaction as the prime objective.

NUVO aims to revolutionise the way technology is consumed with special focus on the Indian market. The team has a mix of experienced leaders and young dynamic professionals with almost 30 years in manufacturing and technology.

NUVO stands by the Indian government's 'Make in India' initiative. It plans to innovate, develop skills and build world-class manufacturing facilities in the country. NUVO is Indian by origin and aims to be one of the most respected brands worldwide. Its current portfolio has feature phones starting from ₹ 599 and smartphones from ₹ 2499.

Contact details: *www.nuvo-info.com, deepak@nuvo-info.com, 0124-4010105*

PROTOCENTRAL (A UNIT OF CIRCUITECTS ELECTRONIC SOLUTIONS PVT LTD)

Protocentral can help customers with the required components for any electronics project, to quickly get it project off the ground. Whether the project is an advanced medical device or involves building the next-generation dog feeder, Protocentral has it covered.

Protocentral is the open source hardware and e-commerce division of Circuitects Electronic Solutions Pvt Ltd, a well-known solution provider in the areas of biomedical instrumentation and defence electronics development. The company is a distributor for Sparkfun Electronics, Adafruit, Arduino and Seeed Studio, among others.

Contact details: *www.protocentral.com, sales@protocentral.com, 080-41527072*

QUECTEL WIRELESS SOLUTIONS CO. LTD

Quectel Wireless Solutions is a dedicated supplier of M2M wireless modules. As one of the leading providers of GSM/GPRS, UMTS/HSPA/LTE, GNSS modules with many years of extensive experience, Quectel is always looking to be at the forefront of technology and maintaining its customers' full satisfaction. A comprehensive product portfolio, strong R&D capabilities, matchless support services and a global presence have established Quectel's leadership position in the M2M marketplace.

Quectel offers high-performance mobile and GNSS modules based on the state-of-art technology, which is aimed at tomorrow's demands. To completely satisfy customer needs, Quectel not only provides a wide product range with numerous integrated features capable of meeting the most sophisticated requirements from all market segments, but also provides comprehensive technical support for the development and testing phase.

Contact details: *www.quectel.com*

RAJ ENGINEERING INDUSTRIES

Raj Engineering Industries are the manufacturers of ABS plastic cabinets for electronic equipment. The company was founded by K. Subhash in 1987 to bridge the gap in the field of manufacturing basic cabinets for electronic equipments, with client services of decade of experiments with a client base covering the entire country.

Raj Engineering Industries is fully-equipped with hi-tech machines in 929sqm (10,000-sqft). The facility is backed by superior quality production, and has a strong skilled human resource including professionals.

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Rajguru Electronics is one a leading supplier and trader of active and passive components, sensors, switches, wireless modules, robotics products, items for engineering students projects, development boards, modems and modules. Their range also includes a wide variety of photo couplers, microcontrollers, regulators, gas sensors, GSM/GPRS modems, GPS modems, humidity sensors, friendly ARM boards, Bluetooth modems, fingerprint modules, smart card readers, barcode readers, gear motors, servo motors and so on. The products are long-lasting, reliable, easy-to-operate and have robust construction. The company keeps an inventory to meet the urgent needs and requirements of its esteemed clients. Its products are made as per international standards and are available at competitive prices.

Under the leadership of Rajesh Jogani, the company has earned a reputation for quality. His continuous motivation has been helpful in creating goodwill in the global market.

Contact details: *sales@rajguruelectronics.com, 022-23822040*

REDPINE SIGNALS

Headquartered in San Jose, California, USA, Redpine Signals is a wireless systems company with unique chipset and system-level products for wireless networks. Founded in 2001, Redpine has created advanced wireless technology that has gone into the creation of ultra-low-power and high-performance products for next-generation wireless applications. Redpine was the first in the industry to launch a single stream 802.11n chipset in late 2007.

Redpine technology spans complete end-to-end wireless solutions and includes an extensive patent portfolio on OFDM, MIMO, embedded processor architectures and low-power techniques.

Redpine's WyzBee is a comprehensive IoT platform that includes hardware boards, application development environment, Cloud software and services framework and a product synthesis solution for synthesising the final product. Redpine has a design centre in Hyderabad and other design centres in Chennai and Bengaluru.

Contact details: *sales_form@redpinesignals.com, +91-9845204957*

REVE AUTOMATION LLP

REVE Automation is a product based company focused on offering solutions with extensive experience in providing state-of-the-art electronic design, firmware and wireless sensor network on the IoT domain. It provides customised solutions for enterprises.

As per surveys done by various consulting companies, market size of smart technology will be to the tune of billions, and will grow exponentially for years to come. REVE does technology consultancy partnerships with customers, with main focus on solutions for high-end and complex technology problems. REVE also supports customers from concept to design stage, prototyping and testing stages, and in taking the product to mass production.

Contact details: *www.reveautomation.com, +91-9558763348/9913655787*

ROHM CO. LTD

ROHM Co. Ltd is an international semiconductor company headquartered in Kyoto, Japan, established in 1958. ROHM is an industry leader in system LSI, discrete components and module products, utilising the latest in semiconductor technology. ROHM's proprietary production system includes the latest automation equipment and processes, keeping it at the forefront of the electronic component manufacturing industry. ROHM also offers customised product development through a comprehensive, seamless manufacturing system focused on quality, using production equipment designed and built completely in-house.

ROHM Semiconductor India Pvt Ltd was established in 2011 to cater to the ever-growing electronics market in India. Headquartered in Bengaluru, it has sales offices in Delhi, Pune and Chennai. The design centre (Bengaluru) was established in 2014, and has application engineering, LSI design and product strategy functions, to enhance local product support and design products for India.

Contact details: *www.rohm.com*

ROYAL APPLIANCES

Royal Appliances is a home appliances company based in Mumbai since 2006. It deals in home appliances, electronic products, lifestyle and home decor products. It also manufactures air-cooling fans for domestic, commercial and industrial usage. These have been available in the market for over ten years. The company ensures best-quality products that have been certified and tested. It also provides good after-sales services across India.

The company participates in exhibitions all over India and abroad. It has successfully introduced its products in international markets such as Sri Lanka, Singapore, Dubai, Bangladesh and will soon enter other markets in Asia.

Contact details: *royal_appliances@yahoo.com, 022-65222265*

ROYAL ELEGANCE TECHNOLOGIES

Royal Elegance Technologies established in 2007 is a private Indian company based in Bengaluru. The company was formed for offering software and hardware development services to the high-technology industry.

Royal Elegance Technologies provides cost-effective and innovative embedded systems solutions to businesses including both hardware design and software development with expertise covering many processors/microcontrollers and real-time operating systems. The company relies heavily on innovation and cutting-edge technologies to provide a wide spectrum of reliable hardware solutions and applications.

Royal Elegance Technologies aims to be a major player in the areas of visual SMT machines, pick-and-place machines, re-flow ovens, Bluetooth printers, servicing, embedded system designing, dealing with OEMs and their tier 1 suppliers.

Contact details: *sandeepbc@elegancetech.co.in, +91-9483395994/8088322444*

RS COMPONENTS & CONTROLS INDIA PVT LTD

Trusted by over 1.8 million customers worldwide and 76 years of longevity, RS Components is widely known as the global distributor for engineers, providing high service distribution excellence in electronics and maintenance spheres.

The company's strong relationship with over 2500 major suppliers enables half a million products to be readily available ranging from semiconductors, T&M, industrial automation, process and control, optoelectronics, connectors, power tools and protective clothing.

With strong foundation for the last 20 years, RS India serves as the Indian subsidiary to the global giant and caters to the requirements of around 10,000 diverse businesses. With massive investments in electronics, RS Components has evolved a major electronics player in addition to sustaining its market leadership in MRO.

Contact details: *www.rsindia.com, sales@rs-components.co.in*

SCITECH TECHNOLOGIES

An ISO 9001:2015 certified company, Scitech Technologies focuses on design, developed and manufactured to provide T&M instrument solutions to the industry. Scitech is an authorised distributor for Rigol in India for more than 15 years and promote their T&M range in India.

The company has a wide range of analogue oscilloscopes, digital storage oscilloscopes, mixed-signal oscilloscope, function generators, arbitrary-waveform generators, spectrum analysers, RF signal generators, DC power supplies, programmable power supplies, digital multimeters including handheld and benchtop models, data-acquisition systems, clamp meters, LCR meter, distortion factor meters and soldering/desoldering stations.

Contact details: *spawar@scientech.bz, +91-9755591500*

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SEAGATE CORP.

Seagate Corp. was established in 1993 in Mumbai. The company offers a wide range of products that includes loadcells, Trontek 6V 4.5ah batteries, connectors, 7-segment displays, weighing scale parts and domes switches. The products are widely used in weighing, electronic, LED and instrument industries. Quality has been the backbone for the whole process of servicing. The company policy is to give complete customer satisfaction. Over the past years, it has emerged as a major supplier and distributor for an extensive range of products, given as under:

- ADI ARTECH loadcells (distributor)
- Keli loadcells
- Stainless-steel loadcells
- Green-label loadcells
- Trontek 6V 4.5ah batteries
- 7-segment displays
- FRC connectors
- FRC flat cables
- MRS connectors
- Berg strip connectors
- DB9 connectors
- Terminal connectors (126,128,129)
- Thermal printers
- Domes keys
- Spirit-level bubbles

Contact details: *www.seagate.com*

SECO SRL

SECO is a world leader in designing and manufacturing embedded systems. Spanning 38 years of experience, SECO has shown the ability to adapt its know-how to new, challenging customers' needs, and to provide cutting-edge solutions to its partners.

SECO offers complete modular solutions and single-board computers, using widely-recognised standard off-the-shelf form factors (Qseven, ComExpress, ETX) and leveraging leading semiconductor manufacturers with x86 and ARM architectures (Intel, NXP, AMD, NVIDIA). SECO sets itself apart by providing custom design, development and system integration for general-purpose applications or vertical markets such as medical, visual computing, the IoT, etc.

SECO produces all products in house in Italy, from concept to manufacturing to product lifecycle, operating worldwide, and with local offices in Boston (USA), Taipei (Taiwan) and Bengaluru (India).

Contact details: *www.seco.com, satheesh.subbiah@seco.com, marcom@seco.com, +91-9900082775*

SFO TECHNOLOGIES

SFO is the fastest growing, home-grown ESDM company in India with highly-diversified business interests across sectors like aerospace and defence, communications, energy, healthcare, industrial and automotive and transportation. SFO has emerged as the largest exporter of electronics hardware from India.SFO operates as a one-stop solution provider for technology services comprising R&D, hardware and software engineering and manufacturing services.

The design centres of SFO serve as a hub for joint innovation in technological advancements for OEMs, with their in-depth knowledge of multiple hardware platforms, firmware and application development strengths, and industrial designs.

SFO's state-of-the-art plants in Kochi and Bengaluru are certified for conformance to international standards like NADCAP Apprisal for Special Process in Electronics, ISO 9001:2015, ISO 14001, 1SO 13485, As 9100, TL 9000, CMMI ML5, Version 1.3, ISO 27001, ISO 26262 and ESD S20:20.

Contact details: *contact@sfotechnologies.net, +91-4846614300*

SGS INDIA PVT LTD

SGS is the world's leading inspection, verification, testing and certification company. Recognised as the global benchmark for quality and integrity, SGS has a workforce of over 85,000 employees, manning a gigantic network of more than 1800 offices and laboratories around the world.

As the leader in providing specialised business solutions that improve quality, safety and productivity and reduce risk, the company helps customers navigate an increasingly-regulated world.

Contact details: *vaibhav.raghuvanshi@sgs.com, +91-9560808847*

SHARANG CORP.

Sharang Corp. is an ISO 9001:2008 certified company, incorporated in August 1996 in Pune. The partners are well qualified and have more than 25 years of rich experience in the electronics industry. The company is supported by 19 dedicated team members.

The company undertakes projects involving setting up of electronic assembly lines. It supplies PCB assembly machines, PCB insertion and assembly conveyors, ESD flooring, ESD-control products, soldering consumables, soldering/desoldering equipment, SMD rework stations, cable and wire markers, and ultrasonic cleaning machines. It has also diversified into material-handling solutions like storage bins, shelving systems/crates, mobile compactors, rack systems and pallets.

Sharang's strength lies in product quality and service support it offers to over 1500 satisfied customers, comprising MNCs and very small companies.

Contact details: *www.sharang.co.in, info@sharang.co.in, 020-46705050*

SINCOM SINDHU ELECTRONICS & COMMUNICATIONS PVT LTD

SINCOM Sindhu Electronics & Communications Pvt Ltd is an ISO 9001:2008 certified company, pioneers in designing, manufacturing and marketing of electronics educational trainer kits and equipments since 1995.

Prof. Dr Pravin Raut, PhD in electronics engineering, founder and managing director, started SINCOM with the motto to produce best quality trainer kits for students in electronics domain.

SINCOM is dedicated to excellence in customer service and satisfaction with more than 1200 trainer kits under the belt, covering all corners of electronics and communication engineering.

Some of the labs covered by the company are basic and applied electronics, analogue communications, digital communications, fibre-optics communications, wireless communication and mobile communication.

Contact details: *www.sincomindia.com, sincom22@hotmail.com, 0712-2287174/2293303*

SRASHTA SCIENTIFIC SYSTEMS PVT LTD

Manogna Reddy is the founder and managing director of Srashta Scientific Systems. Srashta team has rich experience in the areas of 3D printing, IoT unmanned systems and robotics. Srashta aims to contribute to and make a strong impact in these fields, by creating an environment in which various industries meet their business needs by improving quality, reducing development costs and product development cycle time.

Srashta's journey with clients starts with telephonic and email support for their technical applications with the right tools. The firm also extends multi-disciplinary technical expertise, providing professional consulting to different industries at various stages of the product development cycle. It has been successful in mentoring individual DIY/makers to achieve their business goals with Zortrax ecosystem. With this, Srashta has taken on the task of providing affordable 3D printers, along with a one-stop-shop ecosystem solutions to industry, makers and institutes with its certified services, tools and products.

Contact details: *https://3dprinter.srashta.technology*

SUPERIOR FLUX & MANUFACTURING CO.

Superior Flux & Manufacturing Co. was founded in the USA in 1932. It was the first company to introduce an organic acid flux, number 30. Today, it offers a complete line of products for electronics and industrial uses. Its products are exported worldwide, and include solder pastes: no-clean/RMA/water-soluble, tacky fluxes: no-clean/RMA/water-soluble, BGA spheres, repair and rework pastes and fluxes, wave solder fluxes: VOC-free and alcohol based; no-clean, water-soluble, rosin RMA, no-clean fluxes for select soldering, saponifier, dross remover, descaler, solderability testing fluxes for tin/lead solder and lead-Free, ionic cleanliness test solution, lead tinning fluxes: halide and non-halide; VOC-free and water-base, and lead tinning and various industrial fluxes.

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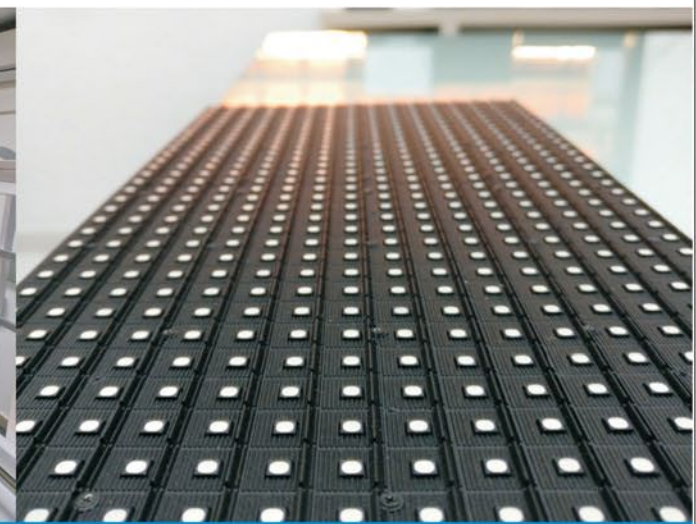

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SYSTEM LEVEL SOLUTIONS (INDIA) PVT LTD

Founded in 2001, System Level Solutions (SLS) is an integration specialist that offers the most innovative solutions, ranging from intellectual property (IP), hardware/software design, to manufacturing, among others. It provides the right solutions and products that allow designers to create a winning product and launch it in the market at a swift pace.

SLS provides unmatched creativity in design and integration, allowing developers to overcome the issues inherent in combining disparate hardware, software, Cloud and IP. It not only offers IP services as a core competency, but also provides design and manufacturing services, making it a one-stop solution point for all requirements.

SLS offers a wide array of services, which include USB, SD/eMMC, NAND flash, I2C and other IP cores design solutions, along with software, board design and product manufacturing.

Contact details: *www.slscorp.com, 02692-232501/2 (ext. 47)*

TECHNOSPHERE LABS PVT LTD

Technosphere Labs, headquartered in Bengaluru, helps clients design IoT devices and solutions with multiple sensors, embedded firmware and hardware and communication capabilities to connect to the Cloud. Success stories include wearables, tablets, energy and industrial monitoring solutions.

Core strength of technosphere is the experience in various wireless technologies like Bluetooth, BLE, Wi-Fi, 6LOWPAN, LoRa, ZigBee, CANBUS, MODBUS and protocols such as CANBUS, MODBUS, BACNET and LONWORKS.

Technosphere has recently launched WhizBlox, a multi-sensor, multi-protocol Hub, which can enable very rapid end-to-end proof-of-concept IoT solutions.

Technosphere is preferred for its ability to push the limits and achieve maximum performance at an exceptional price point.

Contact details: *www.technosphere.in, bhrao@technosphere.in, +91-9901319601*

TESTO INDIA PVT LTD

Testo is a world leader in design, development and manufacture of portable electronic T&M instruments, backed by more than 59 years of measurement engineering experience. Testo group is headquartered in Lenzkirch, Germany.

Established in 2006, Testo India Pvt Ltd, a 100 per cent subsidiary of Testo SE & Co KGaA, has shown phenomenal growth, with its head office located in Pune and a pan-India sales network.

The company offers portable measuring instruments and systems for temperature, humidity, dew point, pressure, air velocity, rpm, sound, light, compressed airflow, electrical measurement; data loggers and wireless data monitoring systems, portable flue gas analysers for combustion and emission analysis; thermal imagers for predictive and preventive maintenance, and a lot more.

Contact details: *www.testo.in, info@testoindia.com, 020-65600203*

TETCOS

TETCOS develops NetSim, a leading network simulation and emulation software for network R&D, training, defence applications and wireless equipment design. Users can create virtual networks and carry out capacity, growth and application performance analyses. NetSim emulator allows them to connect real hardware running live applications to NetSim. It is a cost-effective alternative to hardware emulators that have high costs, complicated configuration requirements and limited scale. NetSim is being actively used by 300 + customers across 15 countries.

Contact details: *www.tetcos.com, sales@tetcos.com, +91-7676054321*

TOOLS & COMPONENTS (TNC INDIA)

Incepted in the year 1982, TnC is an established organisation engaged in tool making for electrical and electronic industries, particularly with process control instruments. The company serves industries to fill their requirement of dies and molds for quality products, and jigs and fixtures to improve the rate of production and quality in assembly.

TnC has 30 years of association with industries that have helped it gain a lot of knowledge and experience in this field. It's production division has an area of 92.9sqm (1000-sqft) with ultra-modern and skilled operators, and 37sqm (400-sqft) of storage space for finished products. The in-house facility of 46.5sqm (500-sqft) is the biggest strength of the company, and has hi-tech machines and measuring instruments, and skilled and quality-conscious tool makers. TnC has a modern infrastructure in Mumbai.

Contact details: *www.tncindia.co*

TORADEX SYSTEMS (INDIA) PVT LTD

Toradex is a Switzerland based company with offices around the world, offering rugged and compact ARM based system on modules (SoMs) and customised SBCs. Powered by NVIDIA Tegra 2, Tegra 3 and Tegra K1 processors and NXP i.MX 6, i.MX 7 and Vybrid, the pin-compatible SoMs offer scalability in terms of price, performance, power consumption and I/Os. Complemented with direct online sales and long-term product availability, Toradex offers direct premium support and ex-stock availability with local warehouses.

Contact details: *www.toradex.com, lakshmi.naidu@toradex.com, 080-41119096*

TOSHNIWAL SENSING DEVICES PVT LTD

Toshniwal Sensing Devices Pvt Ltd was incorporated in Ajmer (India) in 1984, and became a leading supplier of a variety of instruments. The company has more than three decades of experience in gas sensors, RTD elements, data loggers, humidity products and warning lamps, odour meters, particle sensors, high-temperature ceramic products, and other temperature sensors and instruments. Its knowledgeable marketing professionals work in coordination with clients, understanding their requirements and providing the best solutions. The company's extended reach within the country enables it to deliver quality products and services within a stipulated time frame.

A determination to move up the value chain in processes, products and performance has resulted in Toshniwal being acknowledged for its excellence. The all-India network of branch offices and representatives provides local service and technical support.

Contact details: *www.tsdpl.com, sales@tsdpl.com, info@tsdpl.com, 0145-2695482*

TÜV RHEINLAND (INDIA) PVT LTD

TÜV Rheinland is one of the world's largest and most successful testing and certification groups. With over 143 years of experience, operating in more than 500 locations in 65 countries, offering more than 2500 services across more than 35 sectors, TÜV Rheinland Group is the one-stop shop for all pre-compliance/full-compliance testing, inspection, assessment, training and certification needs.

TÜV Rheinland (India) Pvt Ltd offers a wide range of services in the field of product testing and certification. They specialise in offering testing facilities and capabilities for electrical safety, wireless, EMC/EMI, environmental with respect to medical equipment, IT/telecom, power, PV, automation, lighting, household/commercial/industrial electrical and electronic products across a wide range of applications.

Contact details: *ashwini.kr@ind.tuv.com, +91-9620755547, 080-67233553*

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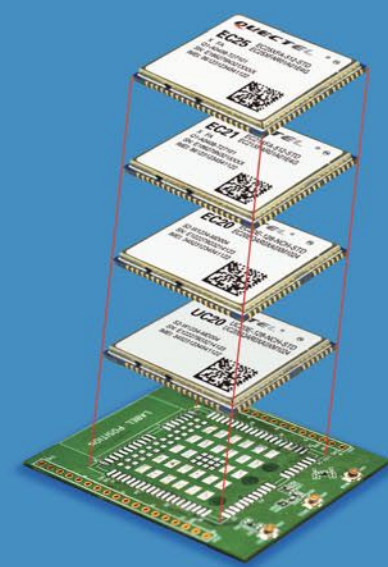

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Email : dinesh.patkar@quectel.com

UCHI EMBEDDED SOLUTIONS

Uchi Embedded Solutions works in the field of embedded system development tools. It provides tools and solutions right from the design, testing and production of embedded electronic products. The company aims to bring out quality products at affordable prices. It offers its clients an entirely new experience because its deals with customers like a consultant rather than a sales manager. It suggests the right solutions with risk-free terms like pre-sales demos, pre-sales evaluation, payment credits, buy-back policies, etc. With these policies, customers are happy to buy more whenever there is an opportunity. Its tagline is 'Customer oriented; Technically inclined.'

Products for software engineers are compilers and IDE, JTAG debuggers, evaluation boards, and for hardware design, testing and production are T&M tools, PCB design software, production programmers, wireless modules.

Contact details: *www.uchiembedded.co.in, sales@uchiembedded.co.in*

UH LED INDIA INC.

UH LED India Inc. manufactures and provides after-sales service for LED display screens. It is based in Ahmedabad, Gujarat, and has been in this field for the last seven years. With vast experience, the firm looks forward to learning about and inventing new products for the LED display screen market.

The firm believes in developing innovative, user-friendly, cost-effective new designs, as well as offering the best quality and after-sales support for its customers' satisfaction.

The company has a well-equipped manufacturing plant at Electronics Estate, G.I.D.C. Gandhinagar. Its products have been successfully installed in over 100 locations in India and overseas. Along with Elite Core, the company is implementing the smartcity project in Gandhinagar.

Contact details: *www.ledisplay.in, www.uhledisplay.tradeindia.com, ravi@ledisplay.in*

UNISEM ELECTRONICS PVT LTD

Unisem distributes electronic components and represents leading global component manufacturers. Here, designers innovate and help build proof of concepts for new products. Unisem offers its customers value-added services such as just-in-time, custom design capabilities, assembly and kitting and engineering services. Unisem helps translate great ideas into products by way of design hand-holding/component selection and manufacturing assistance. Unisem represents the world-renowned capacitor manufacturer, Cornell Dubilier-Illinois Cap of the USA. CDE specialises in capacitors for segments like renewable energy, audio amplifiers, power transmission, lighting, communications, medical power, automobile, military and aerospace. Unisem has also developed various solutions in the telematics/IoT space. Unisem is active in the IoT space by supporting its customers with SIMCOM GSM, GPS and GPRS modules and helping them in their design activities by designing end applications for them.

Contact details: *www.unisemholdings.com, vinay@unisemindia.com, 080-41131829*

UNIVERSAL PRECISION COMPONENTS CO.

Universal Precision Components (UPC), established in 1991, is one of the region's leading integrated solutions providers. Its geographic reach spans the Asia-Pacific region through a network of more than five locations mainly in Asia-Pacific region. UPC was acquired by a renounced Chinese group in June 2016. Thus, there is a larger team to serve the customers. Some product strengths of the company:

- Complies with QA standards
- Competitive prices
- Better lead time
- Supply chain advantage

Contact details: *prashanths@upcelectronics.com, +91-9845242991*

VISION MECHATRONICS PVT LTD

Vision Mechatronics Pvt Ltd, a technology company, was started in 2009 with very small robotics projects, and is now operating in various verticals. The company has been hugely motivated by 'Make in India' initiative launched by the government of India.

Vision Mechatronics products are developed and manufactured in India. The company operates in robotics, renewable energy and lithium energy storage. It is also making rapid developments in the field of solar and renewable energy solutions in India. The company has been certified and empanelled by Ministry of New and Renewable Energy.

In 2017, the company will launch smart lithium batteries ranging from 840Wh to 90MW.

Contact details: *www.vmechatronics.com, 022-25477750*

WISECOM INTERNATION CO. LTD

WISECOM Group, Shenzhen, China, has been an exporter of electronics for more than ten years and specialises in LED/TV/AV technology, kits and parts.

Wisecom Co. is a distributor for DSBJ Group, China, who are world leaders in LED display technologies. Ravi Khilnani, CEO, has more than 25 years of experience in TV/AV industry. Key products manufactured by the company are LED TV/panels, backlight, kits, components.

Contact details: *wisecom@wisecoint.com, ravikh96@hotmail.com, +91-9811253326*

YMD ELECTROMAC PVT LTD

YMD Electromac Pvt Ltd, Noida (UP), was established in 2008. It is a manufacturer of electronic magnetic wound components. Its annual turnover is ₹ 140 million. YMD is engaged with lighting and mobile industries, and provides them with LED driver transformers, EE inductors of CFLs, line filters, drum core inductors, mobile charger transformers, SMPS transformers, EE, EFD, EPC, UU, PQ and so on.

Drum core inductor is the premium product of YMD. YMD is the only company manufacturing these drums in India in a fully-automatic plant, beating China in drum inductors.

YMD is equipped with four fully-automatic, 12 spindle winding machine production lines for the manufacture of drum inductors and EE ferrite components. Unit capacity is five million pieces of EE core power inductors and LED driver transformers, and three million pieces of drum core inductors. YMD is the exclusive magnetic manufacturer for NTL Electronics India Ltd.

Contact details: *sumit@yaminimd.com*

ZEAL MANUFACTURING CO.

Zeal Manufacturing Co. was set up by Vikas Rathod and Charusheela Rathod. In February 2015, the company spun off a new firm called Zeal Services to offer better products and services. Zeal Manufacturing Co. is engaged in manufacturing, exporting and supplying electronic T&M instruments. The complete range offered includes power sources, calibrators, panel meters and testers. These equipment are well appreciated by clients for their reliability, precision and accuracy.

The motto of the company is to strive towards excellence in quality, which has been achieved by developing and implementing a quality management system maintained in line with ISO 9001:2008.

The firm's manufacturing unit helps introduce new products to its range of calibrators, power sources, panel meters and testers. The design and development wing also assists in updating the existing range and developing innovative equipment that find applications in different industries.

Contact details: *www.zeal-services.com, www.zealmfg.com, marketing@zeal-services.com, services.zeal@gmail.com, marketing@zealmfg.com*

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HLK - RM08K
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- LED display driver class
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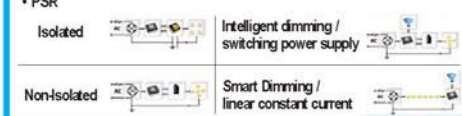
- Full color
- Display Control
- LED landscape Lighting category
- Series connection
- In parallel
- Constant
- LED digital display category



Shenzhen DongKe Semiconductor Co. Ltd

APPLICATIONS:

• Led Driver • Charger • Adaptor • Power supply

Type	Model NO.	Power
AC/DC Power Management IC (SSR)	DK106 DK112 DK1203 DK124	up to 9W up to 18W up to 18W up to 24W
AC/DC Power Management IC (SSR, Energy Star VI)	DK206 DK208 DK212	up to 9W up to 18W up to 18W up to 28W
AC/DC Power Management IC (PSR with CC/CV)	DK906 DK912	up to 9W up to 15W
Synchronous Rectifier (only two poles)	DK5V45R10 DK5V45R15 DK5V45R20	
Current / Voltage Stabilizing Series	DK401 DK450	
LED Driver IC	DK806 DK812 DK813	up to 14W up to 28W up to 20W
Sensor Control IC	DK701 DK702 DK704 DK705 DK708 DK709 DK712	

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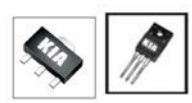

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APPLICATIONS

- TABLET PC
- SMART PHONE
- CAR NAVIGATION
- INVERTER
- BALLAST
- LED DRIVER POWER SUPPLY

KIA78L06

KIA30TB20

AFE ELECTRONICS

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- TELECOM RELAY
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advertising mantras

A good advertisement is one which sells the product without drawing attention to itself.

- David Ogilvy

If your advertising goes UNNOTICED everything else is ACADEMIC.

- William Bernbach

Good advertising does not circulate information. It penetrates the public mind with desires and belief.

- William Bernbach

The best advertising should make you nervous about what you are not buying.

- Mary Wells Lawrence

Creative without strategy is called ART. Creative with strategy is called ADVERTISING.

- Jef L. Richards

The Business That Considers Itself Immune to The Necessity for Advertising Sooner or Later Finds Itself Immune to Business.

- Derby Brown

Doing Business Without Advertising is Like Dancing in The Dark. You Know What You're Doing, But Nobody Else Does.

- Stuart H. Britt

Advertising, if done properly, can do wonders for any business. Here are 10 guru mantras to help you understand the impact of advertising and more importantly—how to do it right. Wish you speedy growth this year.

If it doesn't sell, it isn't creative.

- David Ogilvy

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

Many a small thing has been made large by the right kind of advertising.

- Mark Twain

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About Reve :

REVE Automation is an IoT (Internet of Things) technology/ product company focused on sensors & 'solution offering' with extensive experience in providing state of art IoT based sensors, Electronic Designs, Firmware, and WSN (Wireless Sensor Network). Reve is specialist in customized solutions for enterprises and can be utilised for safety, comfort, industrial automation, governance, research, healthcare, agro, commodities and education.

Reve Products

Universal IoT Device Control for Home Automation and IIOT (UDC)	All remote controllable devices like ACs, Curtains, TV, Set-top box, Fan, lights, switches etc can be controlled locally or globally through android applications/ web applications. It supports IR, RF, Wi-Fi, BLE protocols. UDC can be networked among themselves and can be routed to cloud via gateway
Track & Trace system for people and assets management	The cloud-based track-and-trace platform is specifically designed for hazardous manufacturing plant, supply chain management operators and retailers, offering them real-time visibility and goods information all the way from production floor, warehouse to retail outlets. The system can generate alerts, reports and maps through GIS.
Distributed Wireless Alarm System	Wireless Emergency Alarm system is used for a plant with multiple buildings and/ or multiple locations this system can be easily integrated with existing alarm systems.
Smart Door Guard	Smart Door Guard provides Security to Home/ Office for unwanted access. The device is battery operated, long life and equipped with IoT feature.
Industrial Vibration Sensor	The vibration velocity transducers are intended for continuous monitoring of rotating machinery for trending or shut down. The Sensor provides 4 to 20mA output proportionate to 0 to 25mm/s velocity.
Humidity/Temperature Sensor	Humidity/ Temperature Sensor senses relative humidity (%RH) and temperature from surrounding of sensor and alert according to threshold.
Home/ Colony Automation	Smart Home/ Colony Automation Provides access control, RFID base Boom Barrier System, Power management and safety device control systems.
Tunnel Light Management	Tunnel lights are monitored and controlled automatically through server and wireless remotes.
Tilt Sensor	Tilt sensor senses the tilt of street light polls and transmits data to server/ cloud through light management network.
PT MUX	Detects quality of power from multi- feed Power Grids and provide output for appropriate changeover. This find applications for METRO stations, DATA centers, Server Rooms, Hospitals etc.
Light Curtain	Light curtains are opto-electronic devices which contains one or more transmitting and receiving elements which form a sensing field with a specified minimum object resolution. These are used for human and machine safety

Reve Technologies

Protocol Converters — Reve has designed and executed projects using wireless networking technologies such as Ad-hoc wireless sensor network. Reve protocol Converter technology can be used to communicate data between number of protocols. It provides protocol conversion for UART, TCP/IP, WiFi, BLE (Bluetooth Low Energy), RF, RS-485 etc.

Heating/Cooling using solid state technology — Reve has developed state-of-the-art heating/ cooling technology to cool air, water or and other material (solid, liquid or Gaseous). The efficiency is closer to compressor based systems, with much lower weight, size or complexity. The biggest advantage is, this technology does not produce any pollution like air, water, vibration, sound, health hazards related nuisance. The popular applications are: Panel cooling/ heating, Air sample cooling, personal air conditioner, machine cooling/ heating etc

Soil Sensor — Soil sensor measures soil moisture, salty level/ conductivity, fertility, and pH at elementary level. The sensor responds in few 10s of seconds and it Sends data to cloud.

Smart lab — Reve Smart Sensor Lab provides the hardware components and software libraries to build vivid experiments and applications. This is compatible with Internet of Things (IoT). The application like Smart Building Automation, Energy Monitoring, M2M etc. can be built using supplied devices and libraries. This is well supported by Reve expertise.

Reve Achievements: REVE has executed successfully followings:

(1) Tunnel Light Management System for GIFT City, Gandhinagar (2) Traffic and Vehicle Positioning/Monitoring System (3) Machine Vibration Monitoring (4) Grid Power Monitoring System for GIFT City, Gandhinagar (5) Industrial Control Panel for Control and Automation (6) Street Light Poll Tilt Sensing for GIFT City, Gandhinagar (7) Environment (Temperature and Humidity) Sensing Network for CEPT, Ahmedabad (8) Design and Developed Temperature and Humidity Sensors for AXIS Solutions, Ahmedabad

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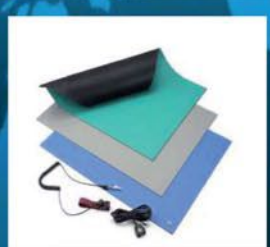


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A mobile computer is really just a tool used to help you do your work. So the cardinal rule for a user to find the right tool for the job. A wise purchaser of a mobile computer will carefully evaluate what kind of working conditions the unit will be exposed to and then dive into product specifications to find a unit that is rugged enough in the right categories to hold up under these conditions. It is also probably a good idea to select a unit which is a little more rugged than you actually need. It is far better to be too rugged than not rugged enough, and you may at some point encounter conditions more severe than you originally predicted.

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- Demo new tools at the Expo
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- Learn new techniques to grow your career
- Meet influential technologists, design engineers, developers, entrepreneurs and investors to grow your own business
- Engage in intelligent conversations with potential new employers or colleagues

To give you a taste of the dialogue that happens at the event, here are our first set of 30 speakers confirmed for EFY Conferences at IEW 2017:

Ravi Ramaswamy,
Head - Health Systems, Philips

Syam Madanapalli,
Global Lead for IoT Delivery, Dell

PVN PavanKumar,
Director - IOT Product Management, SAP Labs

Martin Woolley,
Technical Programme Manager, Bluetooth Special Interest Group (SIG). Inc.

Sri Chandra,
Director – Standards & Technology, IEEE-SA, IEEE

Pawan Dubey,
Senior Consultant, Infosys

Shanmuga Sunder T,
Project Manager, Robert Bosch Engineering

Naveen Balani,
IoT & Cognitive Leader, Accenture Labs

Kumaran Venkatesh,
VP - Strategy & Operations, IESA

Britto Edward Victor
Design Centre Head, ROHM Semiconductor India

Aravind Mangarsi,
Process and Factory Automation, B&R Industrial Automation

SK Sinha,
Professor, IISc

Mubeen Jukaku,
Technology Head, Emertxe

Anirban Chowdhury,
Co-founder and Director, Technology Frugal labs Tech Solutions Pvt Ltd

T. Anand,
Principal Architect, Knewron

Kaustubha Parkhi,
Principal Analyst, Insight-Corp

Vijay Bolloju,
Manager, Application Engineering, ROHM Semiconductor India

Ashissh Raichura,
CTO, HealthSaverz

Deepak Gupta,
Founder, Future Foundry

Rajeev Jha,
founder director, Yuktix

Sathvik Ashok,
IoT Specialist Developer, SAP labs

Anuj Deshpande,
founder director, Makerville

Kedar Sovani,
Staff Manager, Marvel Semiconductor

Deepak Hebbur,
Co-Founder and CEO - SKILLFINITY

Ninad Deshpande,
Specialist - Open Technologies, B&R Industrial Automation

Nihal Kashinath,
founder, IoTBLR

Bee Lee,
President, Regional Business Unit, Group Executive Board, Moxa

Jayakumar Balasubramanian,
Director, Emertxe

Vinod Bhargav B S
Senior System Architect, Robert Bosch Engineering

Aneesha Pillai,
Co-founder, Future Foundry

2-4 March 2017

Bangalore International Exhibition Centre (BIEC), Bangalore, India

Internet of Things is now important everywhere;

from hardware design to software development, and all the way through to solve real-world problems — and those are what our conferences focus on:

- Analytics, Algorithms & AI
- Cybersecurity
- Industrial Internet of Things (IIoT)
- Smart Humans (Medical IoT)
- Smart Homes & Cities
- Profit from IoT
- LED Lighting Design
- Smart Automotive
- Electronics Rocks
- Wireless Communications Design
- Power Management & Design

Due to limited seating available at the event, we have very limited conference passes available. Booking in advance is recommended.

Just a glimpse of the things that make our multidisciplinary mega-convention special for any true technologist

TESTIMONIALS

"Last year we participated in the conference as a state partner. We found the event showcased new trends, technologies and way of doing business etc. It offered a good platform to interact with the peers & prospects and understand each other better. Being a state it gave us the desired visibility and also allowed us to understand the needs of the prospective investors."

- S.A.Srinivasa Moorthy, Chief Executive Officer at Andhra Pradesh Electronics & IT Agency - An autonomous Society under Govt. of Andhra Pradesh

"We're at the tipping point of a huge technological shift, driven by the Internet of Things and a whole lot more. Those who want to understand the industry and discover opportunities, do not miss EFY's conference."

- Syam Madanapalli, Global Head - IoT Delivery, Dell

"This is an event where software development and electronics come together to produce a most informative and thought-provoking experience. Attendance is of a very high quality and includes a fascinating mix of thought leaders and policy makers as well as some very serious and innovative engineers. I'm very much looking forward to speaking at and attending this event again in 2017."

Martin Woolley, Technical Program Manager (EMEA), Bluetooth SIG

CONFERENCE BOOKING DETAILS

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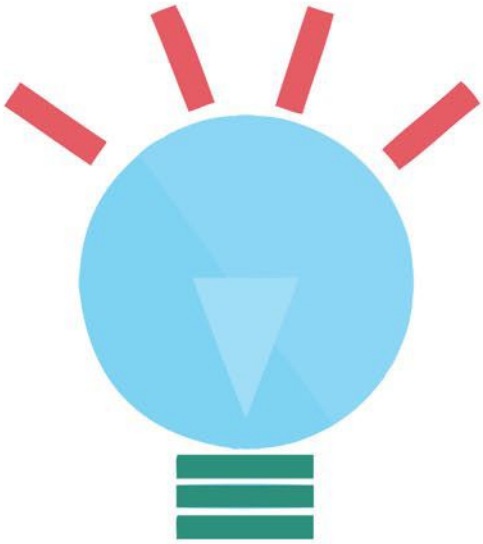

Amazing Workshops

Some of our workshops are detailed below, while more workshops will be added in the coming days.
You can find new workshops at
conferences.electronicsforu.com/workshops

BUILDING AN IOT ENABLED ASSISTIVE GLOVE FOR THE BLIND

By Deepak Gupta and Aneesha Pillari, co-founders, Future Foundry

Attendees will build a glove that can be used to by the blind to navigate using sonar sensors. It also lets you send SOS alerts to a preferred contact at the press of a button the glove.

HOW TO BUILD A GOOGLE WEAVE-ENABLED PRODUCT

By Amey Inamdar, Staff Engineering Manager, Marvell Semiconductors

This tutorial not only provides an insight into Google Weave protocol, but goes to an extent to show how to create a new product compatible with Google Weave based on Marvell's MW302 Wi-Fi microcontroller and then describes what it takes to convert the prototype into a product.

HOW TO INTEGRATE VOICE INTO YOUR PRODUCT

By Anuj Deshpande, founder, Makerville

In these times, it's necessary to understand how one can make their own hardware which works with these services as well as dd voice as a form of user control for their connected devices.

BUILDING INTERNET CONTROLLED ROBOTS AND APPLIANCES (FOR BEGINNERS)

By Pranav Pai Vernekar, Founder, Inventrom

Interfacing bolt hardware to Relay and appliance, and then building a Smartphone app UI for controlling appliance. We then link the App to Bolt Cloud for Internet control and monitoring of appliance. We also build an Internet Controlled robot including assembling hardware of Robot and interfacing with Bolt Platform.

BUILDING AN IOT TEMPERATURE MONITORING SYSTEM

By Pranav Pai Vernekar, Founder, Inventrom

Interfacing Bolt with temperature sensor and writing script for data collection and building a cloud UI for monitoring the temperature. Attendees then set up trigger based mechanisms based on temperature and script for tracking device status: 10 mins.

INTERNET OF THINGS: WHERE DOES THE DATA GO?

By Anirban Chowdhury, Co-founder and Director, Technology, Frugal Labs Tech Solutions Pvt Ltd

The workshop will focus on data handling in a IoT device under different application domains and how its different from the normal data. Also looked up on are djustments to be done due to the amount of data produced and its real time nature. And finally we discuss how to analyse it depending on the requirements.

TUTORIAL: HOW TO DESIGN USING 'DEFINE' FRAMEWORK

By Srinivasa Moorthy, CEO, Andhra Pradesh Electronics IT Agency (APEITA)

"DEFINE" (stands for Design, Environment, Functionality, Implementation, Necessities, Enablers) framework which enables the designers to develop the architecture of an y embedded systems. With startups and entrepreneurs, access to experienced consultants is a challenge and this framework allows them to develop the high level product architecture easily. The tutorial will have about 50 mins of lecture and 20 mins case study and 10 mins of Q&A.

WORKSHOP ON BUSINESS MODELS FOR IOT BUSINESSES

By Nihal Kashinath, founder, IoTBLR

This workshop teaches participants to evaluate the need for IoT in their businesses and also introduces them to some of the effective revenue models being used to extract value from IoT implementations. Following that, participants working in teams will take up specific IoT usecases (utilities in a smart city, industry automation, health tech for hospitals, smart agriculture, etc) prepare a business model for it, diving deep into concepts of value proposition, customers, revenue generation, profitability, etc.

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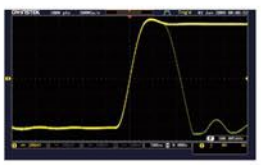
January	Computer Vision	Lowering Power Consumption	Electronic Component Manufacturing
February	Smart Fabrics	Improving Wireless Signal Performance	Electronics Manufacturing Services
March	Exciting Technologies Powering the IoT	Building More Reliable Printed Circuit Boards	Industry Outlook for 2017-18
April	Virtual and Augmented Reality	Developer Boards: DIY and Hobbyist Applications	Printed Circuit Boards
May	Smart Robotics	Fight of the Processors: Ultra-Low-Voltage Computing (Mobile and Portable Devices)	The Internet of Things
June	Artificial Intelligence	How to Get the Best Design for Manufacturing	Strategic Electronics
July	5G and Beyond	Developer Boards: Industrial Applications	Mobile Handset and Telecom Device Manufacturing
August	3D Printing	Improving Thermal Dissipation	LED Lighting
September	Industrial IoT	Which Input Technologies Should You Use	Solar
October	The Brains of Mobile Devices	Ruggedising Hardware	Electronics Manufacturing Equipment (Both SMT and Non-SMT Categories)
November	Security of the IoT	Fight of the Processors: High-Performance Computing	Test and Measurement
December	Implantable and Edible Electronics	Which Output Technologies Should You Use	Materials and Chemicals

Economical and Multi-functional MSO

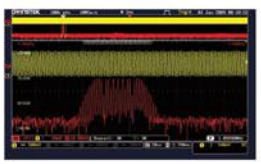
MSO-2000 Series 200/100/70MHz Mixed-signal Oscilloscope

The MSO-2000 series is a mixed-signal oscilloscope, which offers dual analog channels + 16 digital channels or 4 analog channels + 16 digital channels. The MSO-2000 series includes MSO-2000E and MSO-2000EA. MSO-2000E has a built-in 16-channel logic analyzer and MSO-2000EA has a built-in 16-channel logic analyzer and a dual channel 25MHz arbitrary waveform generator. The entire series features bandwidth selections of 200MHz, 100MH, and 70MHz. Dual analog channel models provide 1GSa/s real-time sampling rate per channel; four analog channel models provide 1GSa/s maximum real-time sampling rate. The 8-inch 800*480 TFT LCD and the minimum 1mV/div vertical range allow the MSO-2000 series to measure complex feeble signals and clearly display measurement results.

- **200/100/70MHz Bandwidth Selections : 2 or 4 Channels**
- **Real Time Sample Rate Per Channel : 1GSa/s (2 Channel Models); Maximum Real Time Sample Rate : 1 GSa/s (4 Channel Models)**
- **MSO-2000E Equips with a 16 Channel Logic Analyzer**
- **MSO-2000EA Equips with a 16 Channel Logic Analyzer and a Dual Channel 25MHz Arbitrary Waveform Generator**
- **Maximum 10M Memory Depth and VPO Waveform Ddisplay Technology**
- **Waveform Update Rate up to 120,000 wfm/s**
- **8 " WVGA TFT LCD**
- **Maximum 1M FFT Provides Higher Frequency Domain Resolution Measurements**
- **High Pass, Low Pass and Band Pass Filter Functions**
- **29,000 Segmented Memory Sections and Waveform Search Function**
- **I²C/SPI/UART/CAN/LIN Serial Bus Trigger and Decoding Functions**
- **Data Log Function is Able to Track Signal Changes up to 100 Hours**
- **Mask Test Function**
- **Network Storage Function**



Waveform update rate of 120,000wfm/s



1M FFT display

For more details, please contact your nearest distributor or you may directly write to India_marketing@goodwill.com.tw

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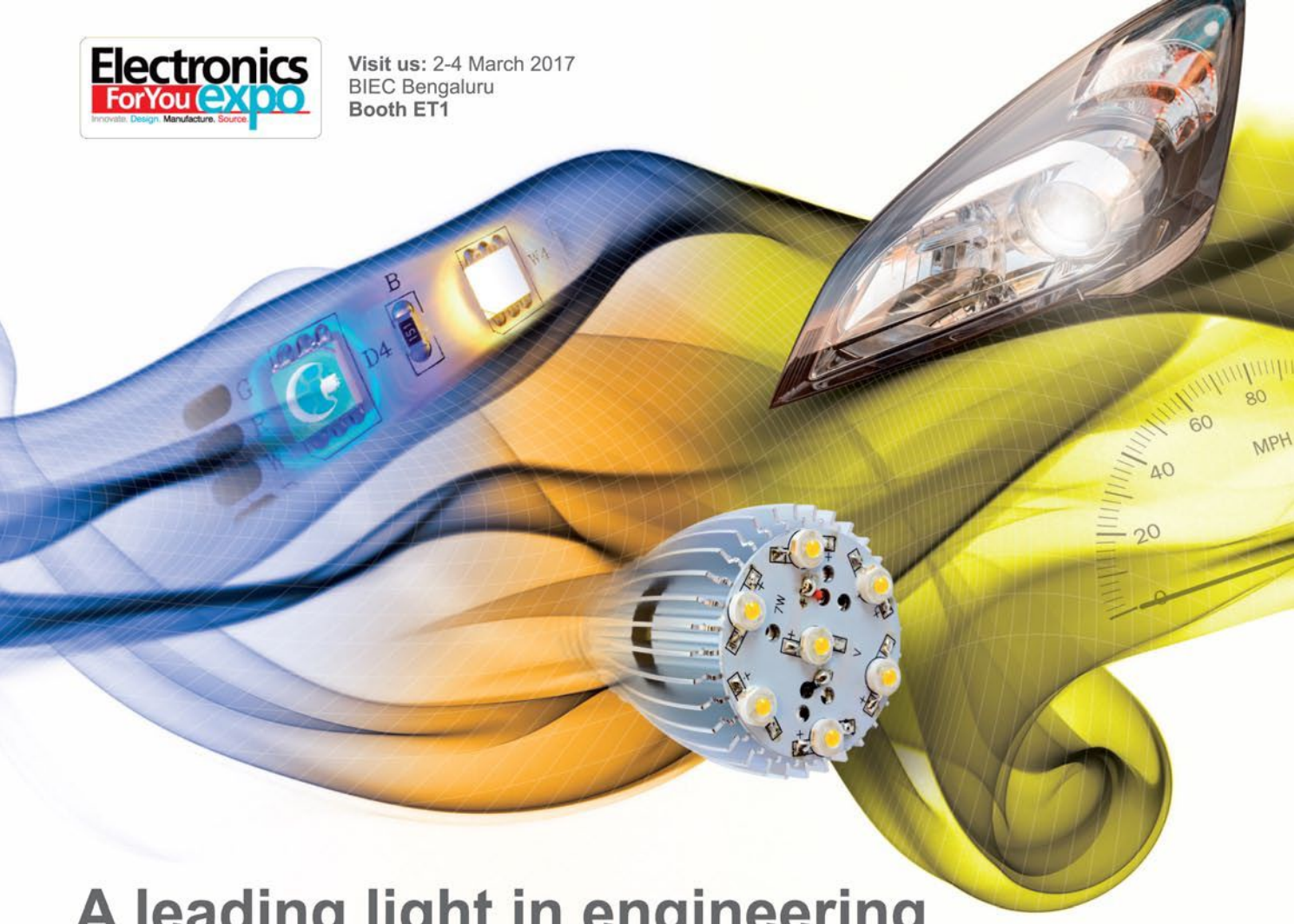

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RNI No. 17587/69, Mailed on 1st/2nd of same month Delhi Postal Regd. No.DL(S)-01/3097/2015-17
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