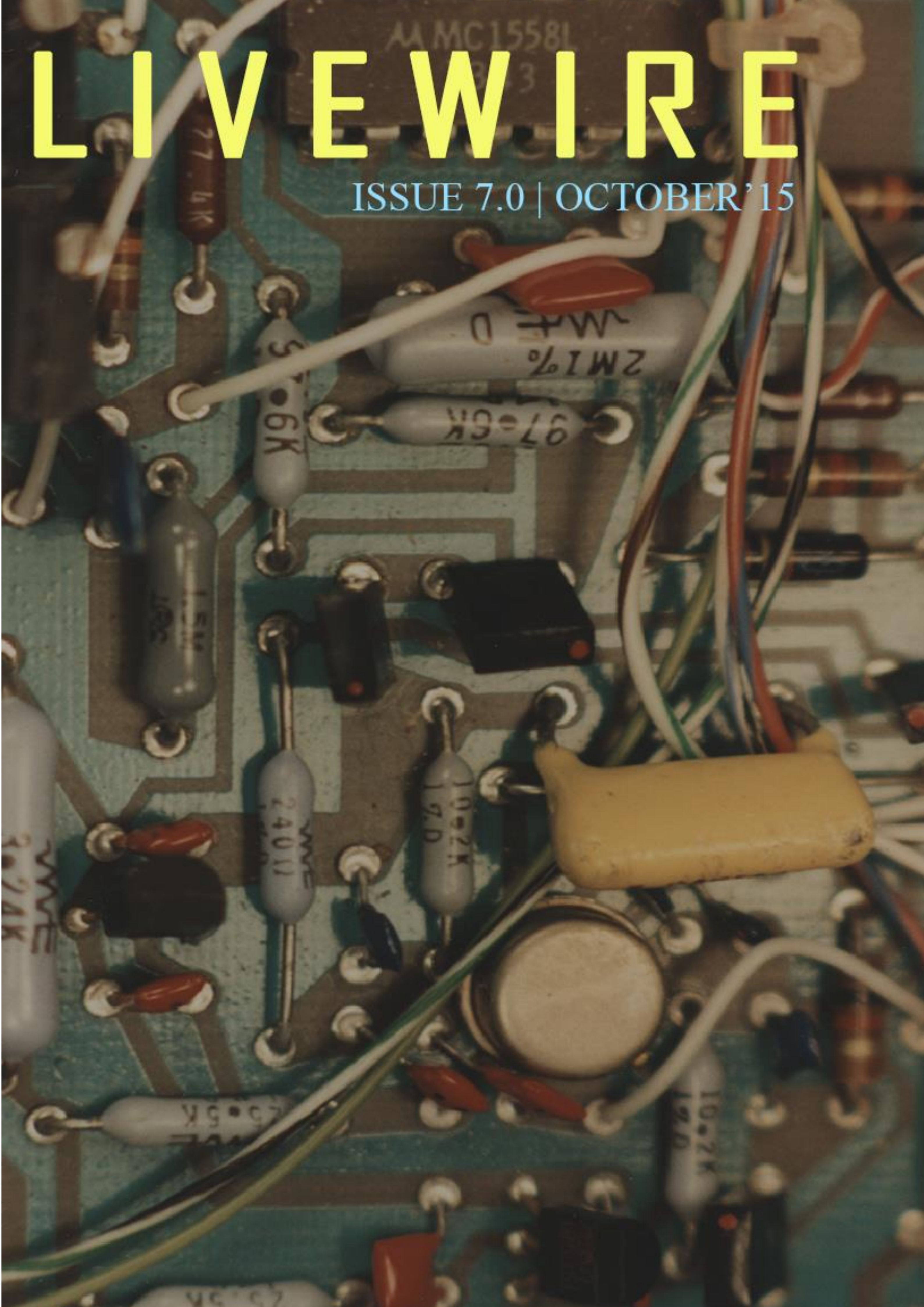
LIVEWIRE

ISSUE 7.0 | OCTOBER'15



BITS-PILANI,

Department of Electrical Engineering

Office of 2015-16

October-15

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Foreword

It gives me immense pleasure to write this foreword of Livewire 7.0. Like every edition, this one too, is filled with a wide range of articles about the latest happenings in the world of electronics. Since these innovations are of current buzz, it gives a great deal of “current affairs” edge to the readers.

“Livewire” has been a source of inspiration, fact finding and also a common ground for a lot of enthusiastic readers. Hence, I hope this magazine evolves further. It recently went online on the PHoEnix website, making it open to a larger group of interested readers. Keeping in mind the rapid strides of progress taking place in the field of electronics and communications, I would suggest that these magazines should be published more and more frequently.

Regards

Prof. Y. Yoganandam

From the PHoEnix Office

Electrical and Electronics Association, BITS-Pilani, Hyderabad Campus, has shown unwavering commitment year after year. The PHoEnix working body has worked all along with a persistent vision – to improve the technical culture of our campus. We aim to stand up to the expectations of each and every member of our 1200 strong general body. It has been an overwhelming task indeed. However, the PHoEnix office, from day one, has taken this challenge very positively and has remained unfaltering in this endeavor ever since.

This year PHoEnix has collaborated with National Instruments for workshop during ATMOS'15 on Internet of Things. Keeping in mind the interests of our generation, a workshop on Quad copters was also organized, where the participants got a chance to build and fly their own copters. Also conducted, keeping in view the objectives of PHoEnix, were the Pre-ATMOS Workshop Series, numerous talks, lectures and events. And we are also coming back with our adrenaline pumping headliner – Robowars'15. We wish to convey a heartfelt gratitude to our FICs, Dr. P. K. Pattnaik and Mr. Chetan Kumar for their constant support, guidance, and motivation. We would also like to extend our deepest gratitude to the PHoEnix Editorial Board, which is single-handedly responsible for materializing this edition.

We hope this October edition of LIVEWIRE would serve as a veritable feast to all the technical minds out there.

Regards

Chandra Kiran,

President, PHoEnix Association

Editorial

Live Wire is the brain child of the PHoEnix association. This magazine not only exposes electronics engineers to trending topics that are generating active interest across the globe, but would also arouse the interest of students of other disciplines, as electrical engineering colludes with a large number of fields namely biology, computer science, and mechanics.

Live Wire 7.0 is the result of the hard work done by the Phoenix Editorial Board. The Editorial board has made an effort to introduce the student community to some new and old concepts and fields in electrical and electronics sciences alike. We have also made an attempt to bring to you the latest technological developments.

This magazine has been solely designed so that the reader may enjoy each and every piece written here. We want you to take back something once you have flipped through the pages. And it is around this thought, that the whole magazine has been designed.

We are deeply indebted to the faculty for their articles and their valuable inputs on current research, our HOD Prof. Y. Yoganandam for ensuring hassle-free arrangements. We thank the other office bearers for all their logistic assistance and student contributors for keeping this wire live.

We now bid you to flip these pages, and immerse yourself into the engaging new Live Wire.

Yours sincerely,

The Editorial Board

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PHoEnix Events in ATMOS'15 – A Glimpse

-Bhargav Tej Udayabhanu

PHoEnix with its great plethora of events like RoboWars, LAW follower, OMC, CA, Workshops from industry giants like National Instruments, had been always a back-bone in the grandness and success of ATMOS, since its very first year. PHoEnix Association has always been committed towards improving the technical culture on campus. Last year saw PHoEnix collaborate with National Instruments over a hugely successful workshop during ATMOS '14. With events like Robowars'14, LAW Follower'14, Circuit Art'14, iVision Workshop that sent crowds and participants alike into an adrenaline tinged euphoria, PHoEnix events were as much about the fun involved in learning, as learning itself.

An ERA has ended and A New ERA is about to begin. As a kick start to the New ERA, this October, PHoEnix has lined up great events for ATMOS '15. Here is a brief account of the Events from PHoEnix for ATMOS '15.

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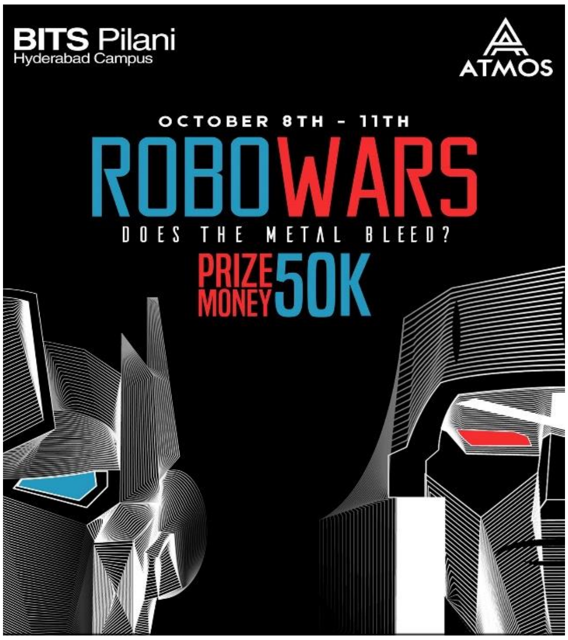

RoboWars

The headliner, the crowd-puller, the pure visual euphoria in any ATMOS always had just one name - RoboWars! See the rebirth of the majestic medieval knights in their 21st century avatar. See the robots battle it all out at the Colosseum in BITS Pilani Hyderabad Campus. Behold a futuristic projection of Gladiatorial days of combat.

Quadcopter

You think you are one of those who are born to fly? Well, you might be and yes, this is where you choose to fly, fly your imaginations your skills and take them to a whole new level. Challenges that make them difficult at each level and challengers that overtake you at each point of time. So, build your quadcops and give your skills a flight.

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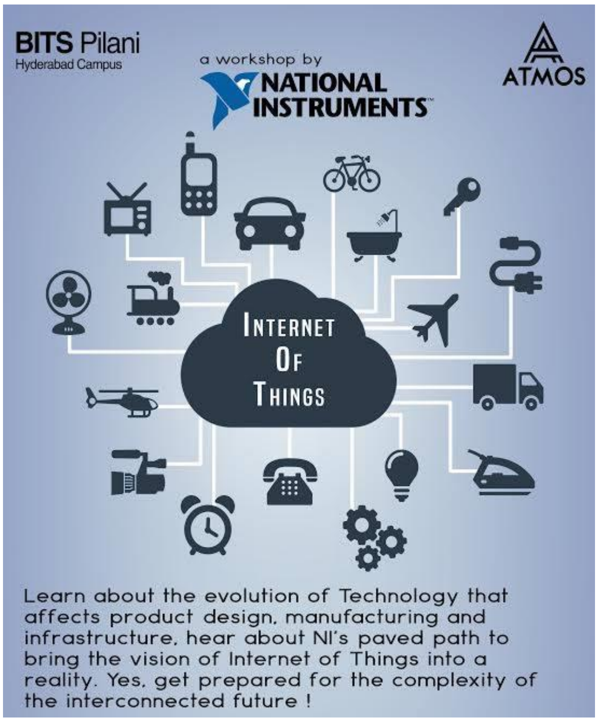

National Instruments Workshop

Internet of Things

The Internet of Things (IoT) is having a profound effect on the discipline of system design. Product design, manufacturing and infrastructure are all affected by this technology evolution. So how are the students of today being prepared for the complexity of our interconnected future? In this workshop, you will hear more about the ways that NI is partnering with educators and academic researchers to bring the vision of IoT to reality.

SenseFil Workshop

Multi Touch & Augmented Reality

If there is anything that has the potential of blending our reality into our dream future with the electronics embedded deep into our lives, its Augmented Reality. Multi Touch and Augmented Reality Workshop is by SenseFil Technologies, which is the most pronounced company when coming to the product engineering services and technology.

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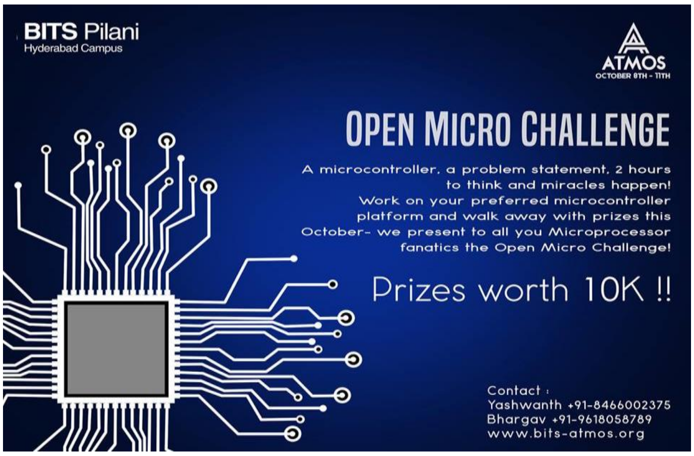
Line and Wall Follower

This is a championship where the brainiest algorithms and the most intelligent bot-designs take the cup. Show the world the 'Artificial Intelligence' born out of your Intelligence. A testing journey awaits you and your bot, but there are lines and walls to lead the way.

Open Micro Challenge

A microcontroller, a problem statement, 2 hours to think and miracles happen! That is how the judges described the Open Micro Challenge (OMC) last time. Work on your preferred microcontroller platform and walk away with prizes this October- we present to all you Microprocessor fanatics the Open Micro Challenge!



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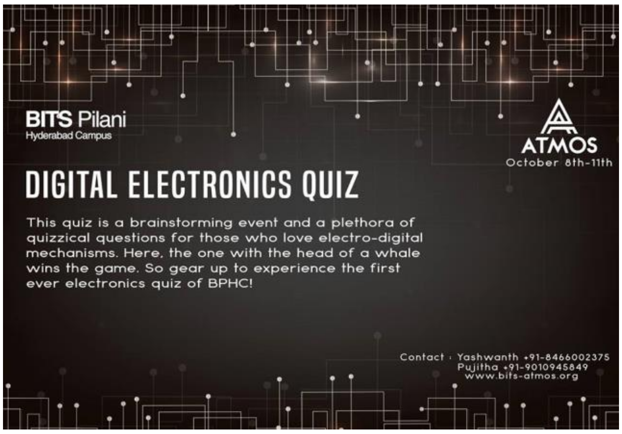
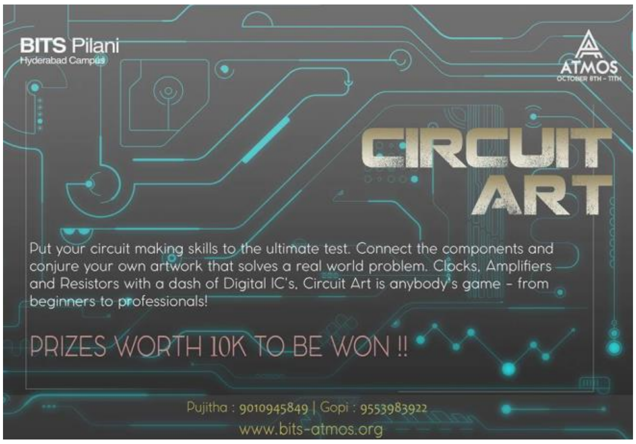
Digital Electronics Quiz



A brainstorming event and a plethora of quizzical questions for those that love electro-digital mechanisms. Here the one with the head of a whale wins the game. So gear up for a quiz bonanza.

Circuit Art

Put your circuit making skills to the ultimate test. Connect the components and conjure your own artwork that solves a real world problem. Clocks, Amplifiers and Resistors with a dash of Digital IC's, Circuit Art is anybody's game - from beginners to professionals!



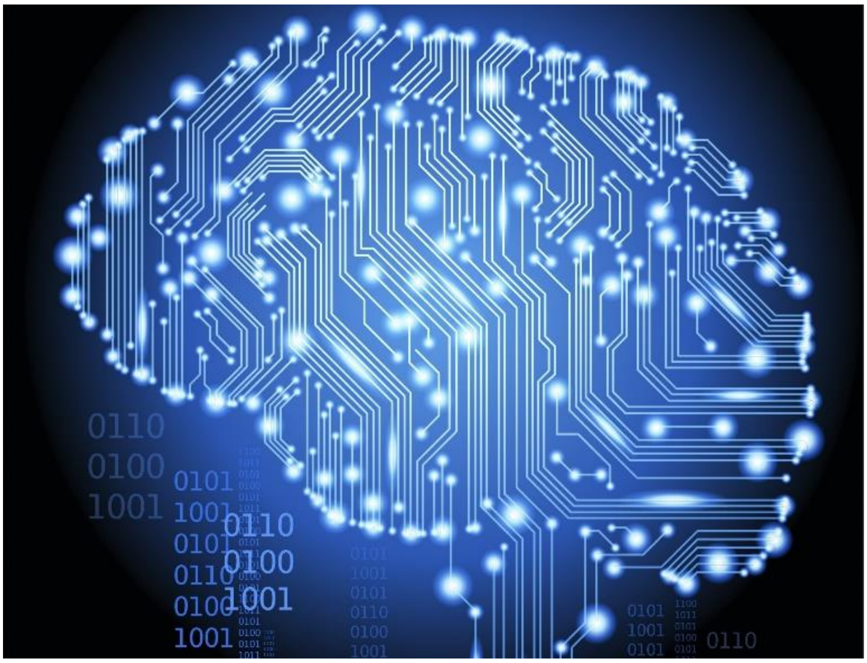
Paper Presentation

This is a highlight event of the fest every year. Screening and selection have traditionally been an arduous task. We provide a platform for great works by brilliant brains out there in the crowd to be reviewed by top-guns from academia and industry!

Computational Neuroscience: Where Neuroscience meets Electrical, Electronics and Computer Sciences

-Dhruv Garg

"A hundred billion neurons, connected by a hundred thousand billion synapsis, the human brain is the most complex machine we know of, and the most mysterious one."



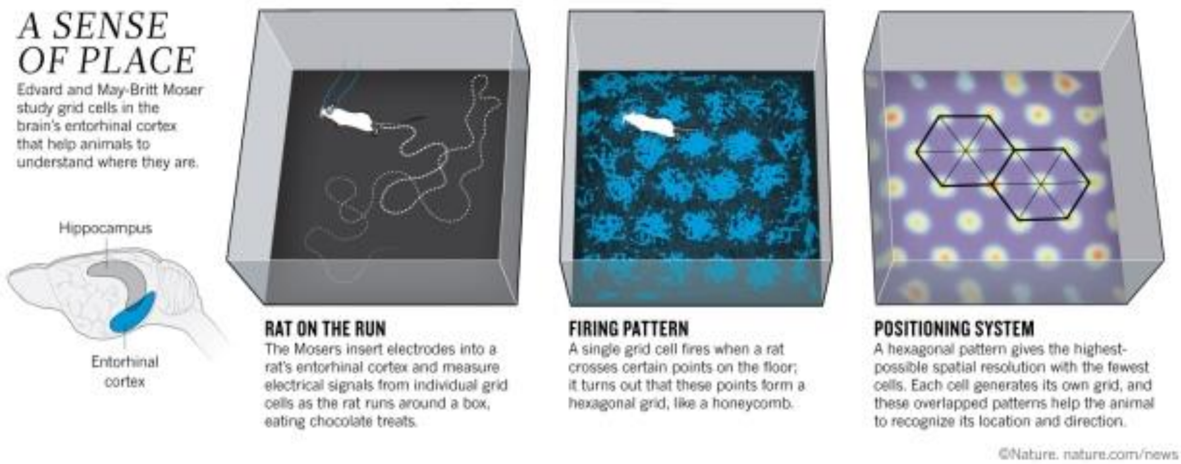
The human brain has always intrigued us. As much as we use it to solve the mysteries of the universe, we know very little about the mysteries of our brain. Cited as the most complex machine we know of, the functioning, organization, and replication of the human brain is still beyond our scope. We have been able to replicate various natural systems - be it flying, running, storing energy and data, or swimming – we have surpassed the nature in most processes. But there is one process; one organ; which we haven't been able to replicate or surpass – the human brain. It is the unlocking of this treasure box, which holds the answers to all our questions. And this is what computational neuroscientists are trying to accomplish.

Computational neuroscience is the study of brain function in terms of the information processing properties of the structures that make up the nervous system. This rapidly growing field is a confluence of electrical, electronics and computational engineering with neuroscience. It is aimed at solving two of the grandest scientific challenges of this century:

- Discovering and learning about neurobiological mechanisms that hold the key to intelligence
- Engineering systems that can replicate intelligence i.e. developing artificial intelligence.

And it is for this purpose that this field had received a new boost in the form of **The Human Brain Project** of European Union and The **BRAIN Initiative** of the United States of America. Both these projects were started in 2013, with funding amounting to 1 billion dollars each. However, the history of computational neuroscience is as electronics itself.

The intersection of electrical engineering and neuroscience can be traced back to Luigi Galvani, Alessandro Volta and Hermann von Helmholtz. In modern times, the work of Norbert Wiener and his colleagues in the 1940s was instrumental in development of Computational Neuroscience as a proper field of science. The 1952 paper by Alan Hodgkin and Andrew Huxley titled, "*A quantitative description of membrane current and its application to conduction and excitation in nerve*" proposed an electrical circuit model of the nervous system. Carver Mead's 1989 work on neuromorphic engineering – the use of Very Large Integrated Circuits (VLSIs) to mimic biological circuitry – titled "*Analog VLSI and Neural Systems"*, was influential in development of electronic replications of nervous systems. These were some of the starting steps of computational neuroscience. Today, the research opportunities in this field are large. With the establishment of Organization of Computational Neuroscience (OCNS), this field has been given a structure and proper direction to develop. The term Computational Neuroscience was coined by Prof Eric Schwartz or Boston University in June 1987.



Electrical engineering has long been used to understand the nervous system and the various diseases like Alzheimer's, Schizophrenia, tumors, etc. that affect it. Electroencephalography (EEG) and Functional Magnetic Resonance Imaging (fMRI) have long been employed to study the brain. However, computational neuroscience aims at going deeper into this connection and figuring out the functioning and interaction of neurons. It is a vast interdisciplinary field, and its practitioners have different objectives and approaches towards the subject. From medicine point of view, researchers to understand the functioning of the brain and deal with the various ailments it is affected with. On the other hand, electrical and computer scientists wants to study the brain circuitry and implement it in digital systems to produce artificial intelligence. Besides these, a mathematicians, physicists and chemists want to capture the functioning of brain in terms of equations and formulae. With such a wide scope, the study of this field will increase human understanding in unbound ways and this is what researchers are trying to do.

With such a wide scope, the question arises that what is the role of electrical, electronics and computer engineer in this field? What can we do as engineers, to advance the scope of human knowledge in this vast and unknown territory? And the answer to this question is best answered by Mark D. Mcdonnell, Kwabena Boahen, Auke Ijspeert, and Terrence J. Sejnowski, in the IEEE issue titled *"Engineering Intelligent Electronic Systems Based on Computational Neuroscience"*

According to the authors, the three ways in which electrical, electronic, and computer science (EECS) engineers can best contribute to the problems of understanding computation in the brain and building intelligent systems that utilize this knowledge are:

1) *enabling technologies*: the development of scientific sensors, data processing algorithms, and simulation platforms used by computational neuroscientists;
2) *reverse engineering the brain*: research that links empirical neuroscience evidence with hypotheses about how neurobiological systems manipulate information;
3) *Biomimetic/neuromorphic computation and robotics:* imitation of neurobiological computation mechanisms in designed applications.

The first way in which an EECS engineer can contribute is by developing technologies which can be used to study the neural network. The work starts with scanning and signal processing technologies, which can map different regions of the brain at neuron level – capturing the billions of synaptic connections inside our brain. This has to be followed by unparalleled supercomputing power which can store and process all the data which has been mapped. This includes development of parallel computing networks, which can process all the data at a given time. It is estimated that a supercomputer thousand times more powerful than the present supercomputers is required to accomplish this task. The hardware implementation has to be followed by implementation of deep machine learning capabilities and real-time simulations of the neural network – including use of data mining.

The second way is developing artificial models of a living brain. This involves reverse-engineering the human brain and processing information in a similar manner. The biological brain can process large amounts of data with considerably lower consumption of energy as based to electronic systems. The challenge is, therefore, to replicate the same machinery with similar optimization and efficiency. This involves development of new technologies and new mathematical models for processing and routing information through artificial systems.

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The third and ultimate way an EECS engineer can contribute is by combining all the information and technology and developing new technology, to mimic neurobiology, because as Richard P. Feynman once remarked, "*What I do not create, I do not understand*." This would involve development of digital systems capable of cognitive thinking (artificial intelligence) and which can perform various cognitive tasks parallel to each other. These systems must process large chunks of data at considerably lower energy rates. And these systems must adapt themselves to the changing environment. This means that engineers have to develop an architecture which mimics the neural network of our brain and is ultimately able to surpass natural limits – something which all our inventions aim to do. The last idea, is however, far-fetched and requires years of research before reaching realization.

Thus, we find that computational neuroscience is one of the biggest endeavors in human history. The realization of its objectives will lead to a better understanding of our brain, or cognitive processes and ultimately a better understanding of the universe. Moreover, it is a field in which electrical, electronic and computer science engineers can contribute (and do contribute) immensely. The role of an electronic engineer in mimicking neural networks is of utmost important to this

Field. And given this and other role, we can conclude that there is going to be continued growth in the interaction of neuroscience and electrical engineering in engineering electrical systems that can emulate biological intelligence and this is the essence computational neuroscience – symbiotic growth and development of various fields of science and engineering.

The World of FPGAs

-Rushabh Gandhi

Introduction:

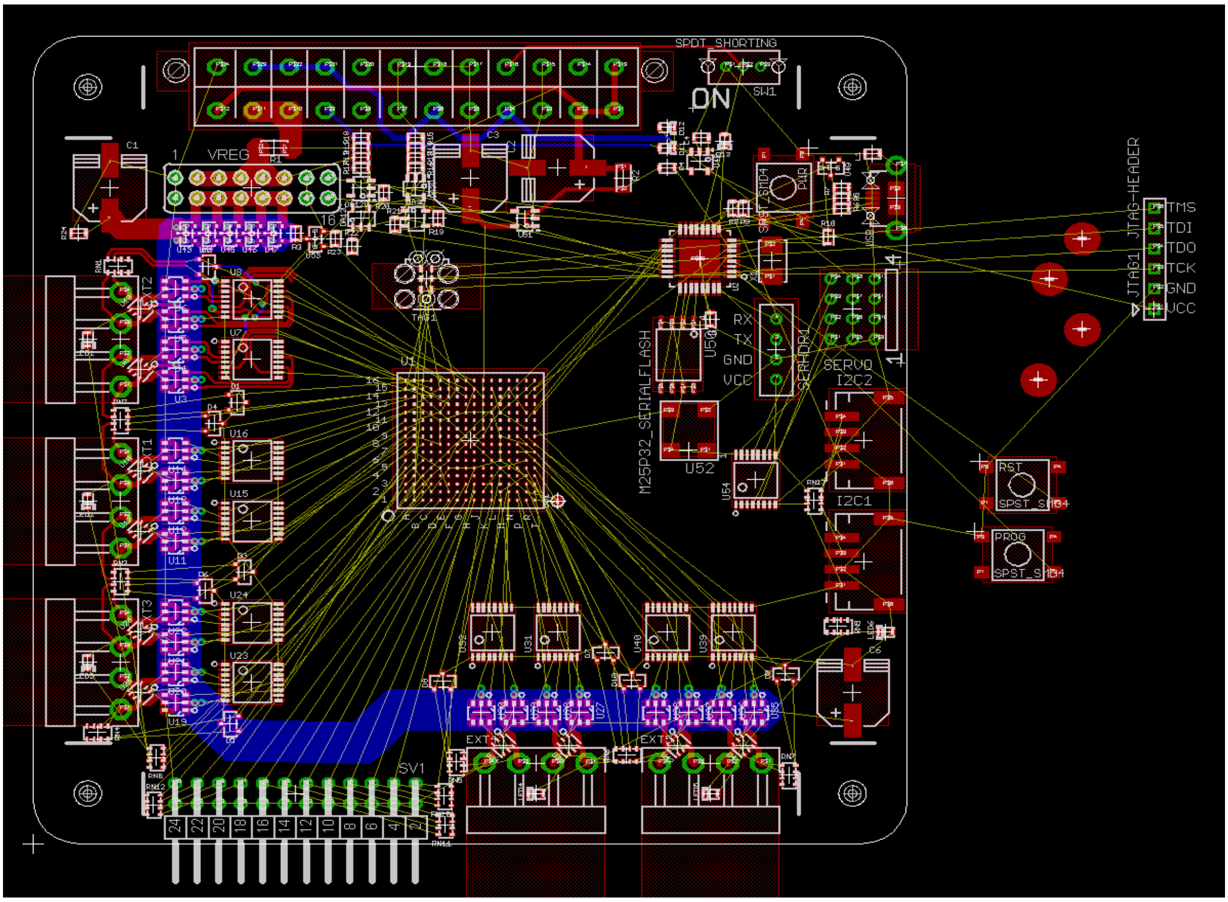
A Field Programmable Gate Array (FPGA) is an integrated circuit that allows the user to modify its configuration and functionality according to the application requirements. One of the most sophisticated PLDs (Programmable Logical Devices), FPGAs consist of up to hundreds of thousands of logic elements, programmable interconnects and switches which can be manipulated using Hardware Description Language (HDL). Owing to the huge scope of variations that FPGAs provide, they are primarily used for prototyping Application-Specific Integrated Circuits (ASIC) and System-on-Chip (SoC) designs.

History:

The inception of the era of programmable digital circuits can be traced back to the early 1970s when the design of the first PLD was put forward by Ron Cline from Signetics The first PLDs were called PROMs (Programmable read only memory) and used an array of transistors and fuses to change the hardware configuration. Eventually, these were modified into Erasable Programmable Read Only Memories (EPROMS) which were further developed into Electrically Erasable Programmable Read Only Memories (EEPROMS). PROMS were the first forms of SPLDs which were capable of implementing hundreds of gates. In principle, FPGAs are quite similar to SPLDs, generally differing only in the magnitude of logical blocks enclosed by them. The first FPGA was invented in the mid-1980s by one of the founder of Xilinx, Ross Freeman.

FPGA v/s microcontrollers:

In an FPGA, as the hardware itself is configurable, it is possible to run a number of operations simultaneously and independently, without compromising the speed of each operation. As opposed to this, in a microcontroller, parallel operations take a toll on its CPU, ensuing dwindled data processing efficiency. Also, by programming the hardware wisely, it is possible to optimize the number of input and output terminals in an FPGA, which is a constant in microcontrollers. Thanks to more processing accomplished in one clock cycle, FPGAs have opened up a plethora of opportunities in the fields of Digital Image Processing and high performance computing.



Microcontrollers are preferable for some applications because of their cost effectiveness. Hardware costs are quite high in FPGAs. Also, it is relatively difficult and expensive to find experienced FPGA developers, thus increasing the development costs. Further, power consumption of high end FPGAs is significantly greater than microcontrollers. However, low end FPGAs can be power optimized to consume power comparable to corresponding microcontrollers. In fact, in reconfigurable computing, it is possible to optimize the hardware to make the power consumption lesser than that of a general purpose processor.

FPGA v/s ASIC:

ASICs are integrated circuits optimized for a specific functionality, tailored explicitly for the problem at hand. A lot of space of FPGAs is wasted in reconfigurable interconnects and thus the processing and computational efficiency of FPGAs is not as much as that of ASICs. Further ASICs prove to be cheaper when dealing with designs of large volumes and are also more proficient in terms of power consumption.

By uploading a new bit stream, FPGAs can be reprogrammed instantly. However, ASICs do not provide a designer the luxury of manipulating the hardware design so easily. Reprogramming an ASIC can require an expenditure of $50,000 and a time of 4-6 months. This feature handicaps the ASIC users from keeping abreast with the changing demands and expectations from the devices in which these are used. Also, in case of bugs in the hardware, it is possible for FPGA users to trace the bug by reprogramming the whole thing without having to go through the hassles of disassembling the hardware. While designing an FPGA the designer does not have to go through cumbrous manufacturing processes like layout, masks, etc. Also, FPGA users can avoid the Non-Recurring Expenses that an ASIC user has to bear the brunt of.

Applications and current research scenario:

Apart from ASIC prototyping, FPGAs also have a wide range of applications in the fields of digital signal processing, software-defined radio, ASIC prototyping, medical imaging, computer vision, speech recognition, cryptography, bioinformatics, computer hardware emulation, radio astronomy and metal detection among others.

FPGA, which academically falls broadly in the area of VLSI, has got a lot of ongoing cutting edge research focusing primarily in the fields of high performance computing and reconfigurable computing. In high performance computing, the parallelism and customizable nature inherent of an FPGA is tapped in to use a large number of computing resources concurrently to accomplish an intricate computational task. In the case of reconfigurable computing the flexible nature and the high speed processing of FPGAs is exploited to make significant changes in the data path itself in addition to control flow.

Conclusion:

FPGA is an ingenious concept and has offered a lot of paradigms in speeding up calculations by its reconfigurable nature and scope for parallelism. With the demand for computations accelerating at the current rate and the colossal amount of research happening in this area, FPGAs have an enormous scope in the future.

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USB TYPE-C CONTROLLER

-Yashwanth Kolla

The TPS65982 USB Type-C and power delivery controller integrates a port power switch and port data multiplexer. It supports data as a downstream- or an upstream-facing port, provides cable plug and orientation detection, and communicates on the CC wire using the USB PD protocol.

When cable detection and USB PD negotiation are complete, the IC enables the appropriate power path and configures alternate mode settings for internal and (optional) external multiplexers. The mixed-signal front end provides 0.5, 1.5, or 3 A for Type-C power sources. The port data multiplexer passes data from top or bottom D+/D– signal pair at the port for USB 2.0 HS, and has a USB 2.0 Low Speed Endpoint. Data rates as high as 5.4-Gbits/s can be obtained with using a HD3SS460 cross-point switch IC. The TPS65982 comes in a 6 x 6-mm MicroStar Junior BGA package and costs $4.99/1,000.

HEAT LIGHTS THE DARK!

-Sahana Reddy

“Earth provides enough to satisfy every man's needs, but not every man's greed.” Was once quoted by Mahatma Gandhi. There is only so much food, timber, petroleum, and other material to go around, the more we consume, the less must be available for others. The global economy cannot grow indefinitely on a finite planet. As populations increase and economies expand, natural resources must be depleted; prices will rise, and humanity -- especially the poor and future generations at all income levels -- will suffer as a result.

Power. It’s arguably the most precious commodity of the modern age, and the obsession of brilliant minds around the world. Scientists scramble to harness and hone earth’s natural resources, the brilliance of the sun and the awesome potential of the wind. Engineers run countless configurations to determine the most effective ways to charge our homes and vehicles. For so many of us, unlimited power is a given, something we’ve learned to take for granted.

For more than a billion people across the planet, however, electricity is a limited, rare commodity. A High school student learned of this reality and dedicated a science fair project to the situation. Her hand-heat-powered “Hollow Flashlight” was, in her mind, a practical solution to a pretty big problem. To the science community at large, it was a stroke of genius to recognize that power originates within every one of us—every day, all the time. Thermoelectricity took a step forward.

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From a sleeping bag that charges your gadgets to entire buildings warmed by body heat, scientists are harvesting the heat emitted by humans as a source of renewable energy. Not until recently did researchers look into ways to capture excess body heat as a means of powering devices like hearing aids and pacemakers. Four years ago, engineers in Sweden figured out a clever (and somewhat sneaky) way to siphon the bio-thermal energy of passengers at a central train station to heat nearby office buildings. Still, much of the challenge in developing these technologies has to do with the fact that electricity produced from residual thermal energy is usually too weak to run most common devices. The inner ear, for instance, produces just 70 to 100 millivolts of potential electricity, which isn't even enough to power a sensor or Wi-Fi chip, according to a report in the Wall Street Journal. But the latest development in thermoelectric energy generation doesn't come from a high-tech lab at MIT; it comes from Ann Makosinski, a 15-year-old Canadian girl who developed a flashlight that is powered by the heat from a human hand. With the aim of reducing the number of single-use batteries that are thrown in landfills, Makosinski developed

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the innovative flashlight, which can be developed cheaply and deployed to populations that can’t afford electricity to light their homes.

Makosinski, a high school sophomore at St. Michaels University School in Victoria, British Columbia, initially thought of the idea after learning that a friend in the Philippines, who didn't have electricity, was failing in school because she didn't have enough time to study during daylight hours. Her friend's dilemma is surprisingly common among a growing number of people in developing regions that either can't afford or don't have access to a power grid. For Makosinski, it served as an impetus to apply what she had learned about energy-harvesting materials from experiments she's been conducting since the seventh grade.

Still, Makosinski was unsure whether heat from a person's hand was enough to fuel a flashlight equipped with an LED bulb. To capture and convert energy, she settled on Peltier tiles, which produces electricity when the temperature differential between the two sides is 5 degrees Celsius, a phenomenon known as the Peltier effect. The durable material, which has no moving parts and an indefinite lifespan, was built into the flashlight's casing to simultaneously absorb heat from a person's hand along the outside of the flashlight along with the cool ambient air on the inside of the gadget.

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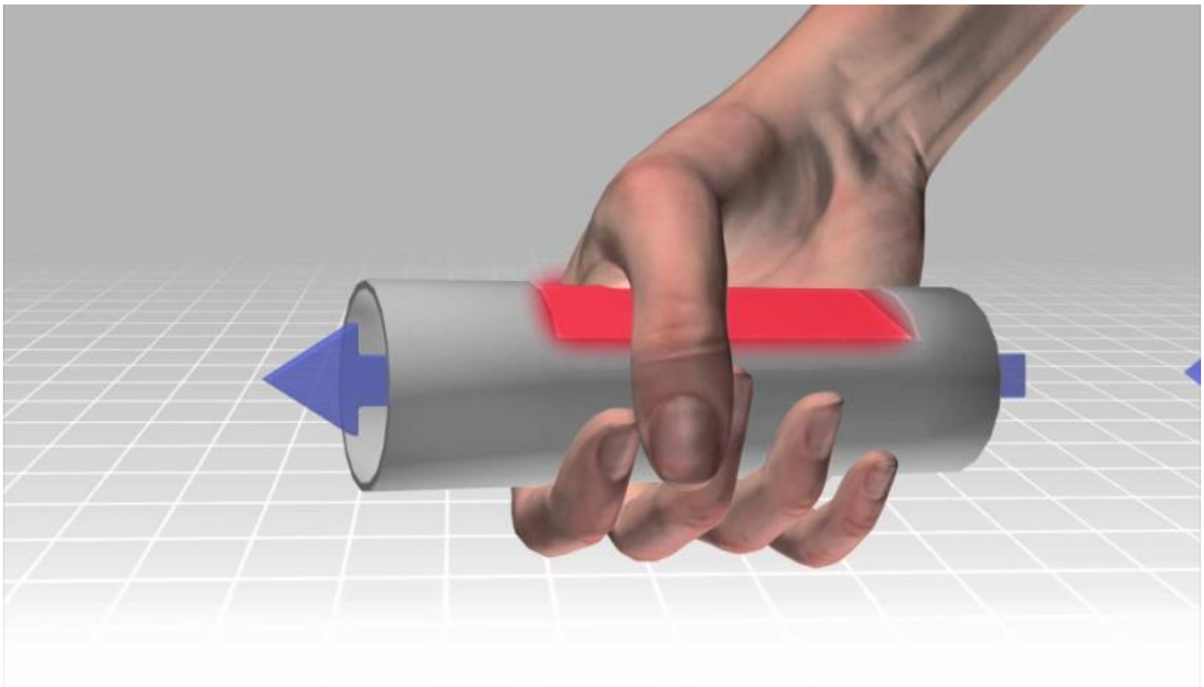


But while the tiles can, according to her calculations, generate beyond the minimum wattage necessary to power a flashlight (5.7 mill watts), she discovered that the resulting voltage output wasn't enough. To up the voltage, she added a transformer, and later, a circuit, to supply what turned out to be more than enough usable electricity (5 Volts AC).

Once she got the flashlight to turn on, Makosinski tested her new invention and found that the light tended to shine brighter as the outside air got colder. For instance, the flashlight started to work better when the outdoor temperature dropped from 10 to 5 degrees Celsius. But even in warmer environments, the hollowed flashlight sustained a strong beam of light for more than 20 minutes.

What's perhaps most impressive is the materials Makosinski used to build the product amounted to just $26; if the device is mass manufactured, the total cost is expected to be significantly less.

In the spring of last year, Makosinski submitted her patent-pending invention to the 2013 Google Science Fair, where she was awarded the top prize in the age 15-16 category and took home a $25,000 scholarship.

Alternative sources of energy is what everyone these days is looking out for and when a 16 year can come up with such a simple but creative idea using simple facts, it just builds up the hope for a lot more advances in this field in future. It leads us back to the saying that “energy conserved is life preserved”.

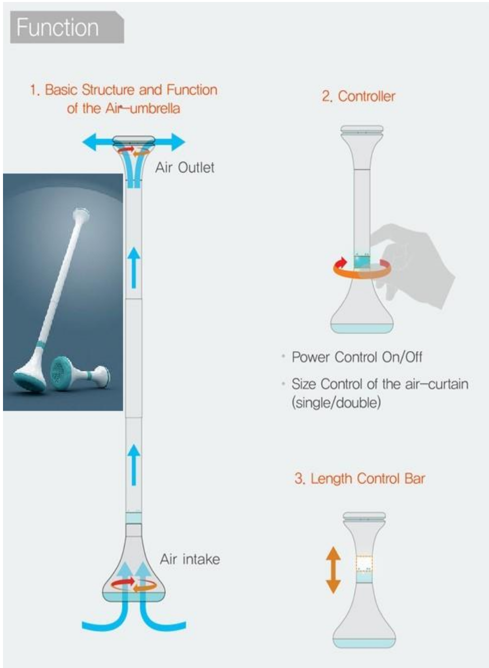
TOP 8 ULTIMATE GADGETS FOR TECH LOVERS

-Amasha Das

1. The Gamer's Keyboard

Gamers ready to experience the world of gaming will definitely love this piece. With all keys and mouse buttons easily accessible, this gadget has and would surely win a gamer's heart. It has curved key surface for better reach to all keys. Need I say more?

2. The Invisible Umbrella



This little thing is called the air umbrella. Well it might look like just a stick with a flat base but it does keep you out of rain. Air umbrella forms an air curtain above your head, as air is sucked up from the inlet and delivered out of the outlet. This curtain functions like an umbrella enough to keep out rain. In this, the size of the air curtain can be extended according to the number of persons under it. And its portability and reliability is at its maximum. Really a posh gadget so to say.

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3. The Bonsai Charger

Inspired by the great Japanese bonsai plant, designers and Developers came up with this cool tech toy. This charger is a specially built solar charger that can charge phones, tablets and laptops too. Design is cool, provides a home décor, and totally eco- friendly. Guess this is the future.

4. The Floating Speaker

The world's first levitating Bluetooth speaker. Designed by a team of world class industrial designers and audio engineers, is as functional as it is beautiful. The speaker orb is floating and spinning above a magnetic base, without touching any other object, it works with less amplifier power and better sound. The speaker Orb is portable for music on the go. Special sound guide cone designed to increase 3D surround Stereo. With NFC function, any smartphone or tablet with NFC function can pair automatically. What's more cool than a floating ball?

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5. The Recycling Printer

One of the smartest tech of all times. Don't have a pencil? Print it, using paper. Wait. What? Print a pencil using a paper. Yes exactly, this is what it does. It has lead pre-fed and glue to wrap up the incoming paper into a roll around the lead. It can turn any waste paper into a pencil. And it is Writeable, eco-friendly and refillable.

6. All Repair Stick

Bondic is a liquid plastic welder that can be used to bond, fill in, or even build plastic, metal, and wood parts. Repair everything from toys to eyeglasses to jewelry. The device's primary material is silicone. Its elastic property makes it perfect for creating a tactile surface you can grasp between your fingertips and squeeze. By using the frequency detecting and transforming techniques, users are able to absorb hundreds colors and beam it through the transparent and luminous body.

7. The Pocket Printer

This is the palm-sized wireless printer that produces pictures from a smartphone. The printer stores unobtrusively in a pocket and uses Bluetooth to access pictures on an iPhone (NFC for Android devices) to print 2" x 3" color photos in less than a minute. A free app allows users to center, caption, and add filters or borders to pictures prior to printing them at 640 x 1224 dpi on patented paper embedded with yellow, magenta, and cyan dye crystals, producing rich, vibrant photographs that are waterproof and resist fingerprints, dust, and scratches. The printer produces up to 20 prints after a 1 1/2-hour charge via the included micro USB adapter.

8. The Kinetic Charger

This clever gadget, called ***Activ***, makes it possible to harness the kinetic energy created by your own body and transform it into electricity! With each step, it juices up the battery a little more. After it’s full, just attach a USB cord directly to ***Activ*** to power your cell phone or other device. And you become your own power plant.

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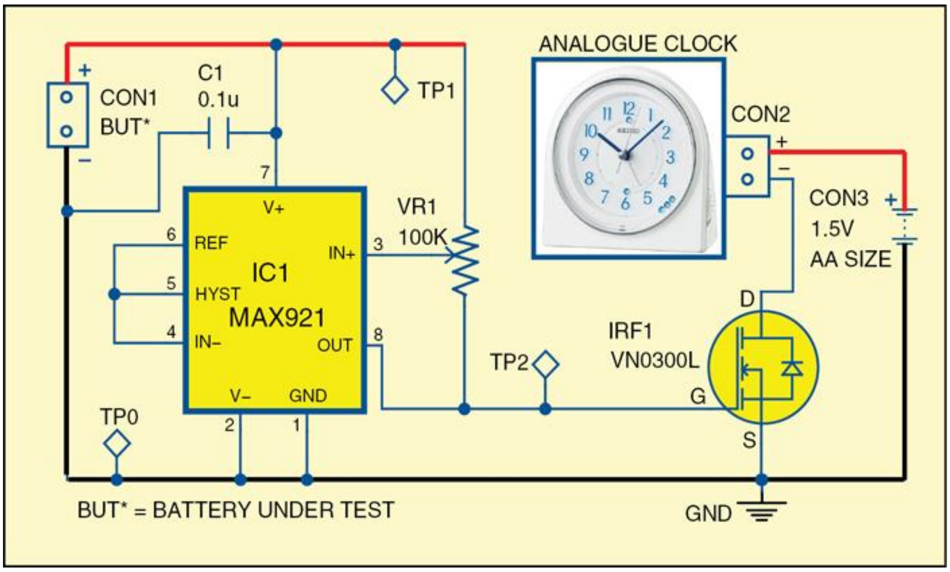
Battery-Discharge Measurement Circuit

- Yashwanth Kolla

Battery-life measurement for a portable system is a time-consuming task and many methods used for it do not give reliable results. Presented here, is a circuit using which you can measure the battery-life very easily. Here, an analogue clock tracks the discharge time of the battery Used in the battery-powered portable devices.

Circuit and working

The circuit for battery-discharge measurement is shown in Fig. 1. It is built using low-power single-/dual-supply comparator MAX921 (IC1), MOSFET VN0300L (IRF1), an analogue clock and a few other components.



IC1 monitors the life of the BUT (battery under test) and controls the power supply for the analogue clock. When the BUT voltage falls below the threshold value set by VR1, IC1's output becomes low, which turns off MOSFET IRF1. This means, power supply for the analogue clock is cut off and so the clock stops running. The reading on the clock at this point gives the discharge time of the BUT, provided you had set the clock to 12:00 before testing started. The circuit can test 2.5V to 11V batteries.

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Construction and testing

An actual-size, single-side PCB for the circuit is shown in Fig. 2 and its component layout in Fig. 3. After assembling the circuit on PCB, enclose it in a suitable plastic box. Connect positive terminal of the analogue clock to positive terminal of a 1.5V AA-size battery and negative terminal to the drain of MOSFET IRF1. Before using the circuit, verify that voltages at the test points are as per table.

PARTS LIST

Semiconductors:	
IC1	- MAX921 single-/dual-supply comparator
IRF1	- VN0300L MOSFET
Resistor:	
VR1	- 100-kilo-ohm potmeter
Capacitor:	
C1	- 0.1μF ceramic disk
Miscellaneous:	
CON1, CON3	- 2-pin terminal connector
CON2	- 2-pin connector
	- 1.5V AA-size battery
	- Analogue clock

Test Points

Test point	Details
TP0	0V
TP1	Voltage of the battery under test
TP2	High to low at threshold setting using VR1

For setting the threshold voltage, you need a variable DC power supply at CON1. For example, to measure the discharge time of a 6V battery (BUT), first decide its minimum threshold voltage, say 4.5V. Connect variable supply to CON1 and set it to 4.5V. Vary VR1 till the clock stops running. Now, remove the variable power supply, set the clock to 12:00 and connect the 6V battery at CON1. Connect the load across the battery. As the battery power is being consumed by the load, voltage level begins to drop. When BUT voltage drops below 4.5V, the clock stops running. The time shown on the analogue clock at this point is the discharge time.

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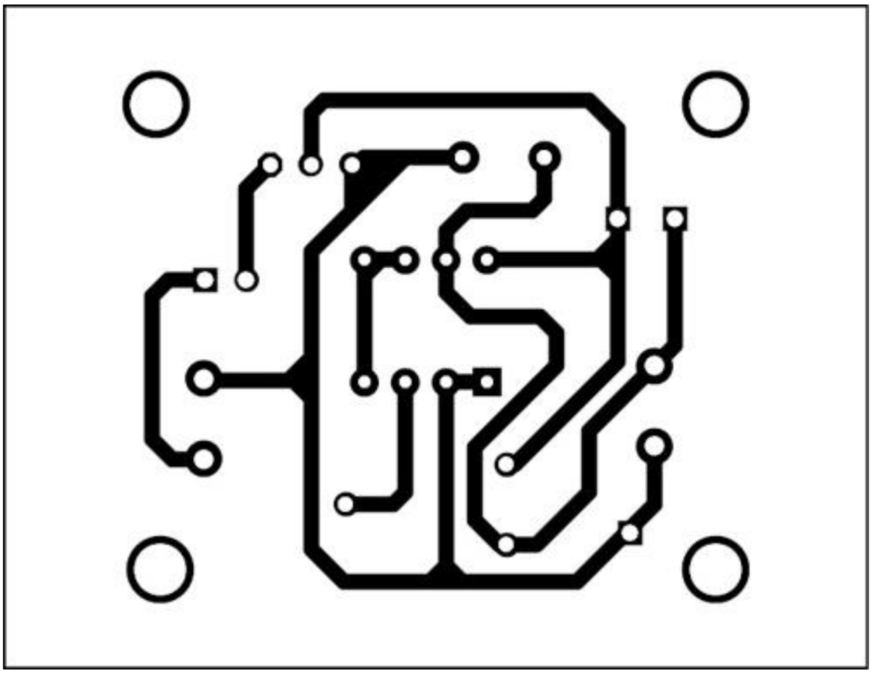

Fig. 2: An actual-size PCB pattern for the circuit

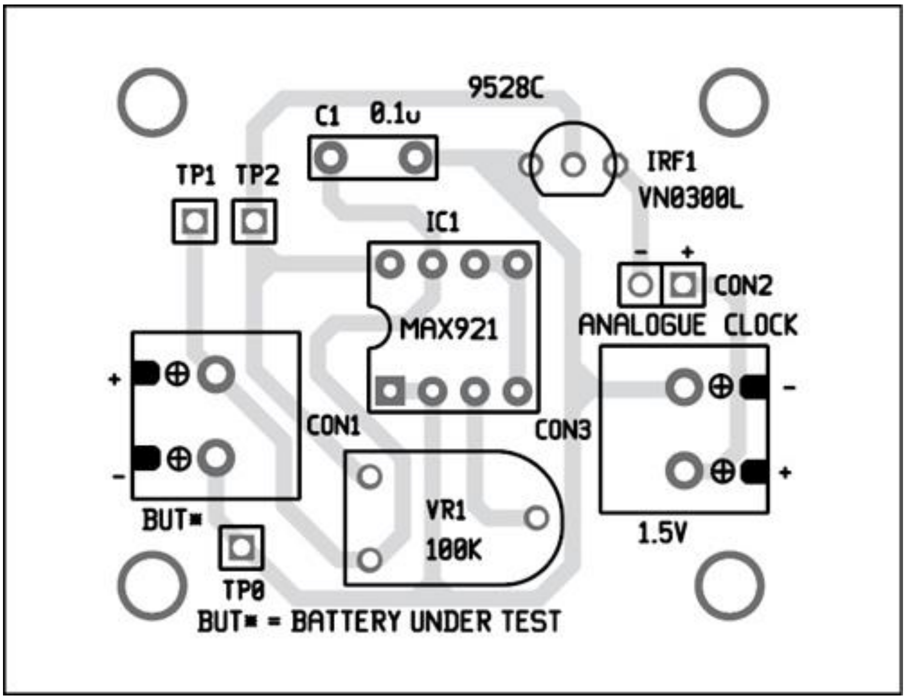

Fig. 3: Component layout for the PCB

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12 things to know about the INTERNET OF THINGS

In a recent survey of senior business leaders around the globe…

01

96%
plan to use IoT
in the next 3 years.
68% already investing.

- Wired

02

30%
believe IoT will unlock
new revenue from existing
products/services.

- The Economist

03

94%
have already seen
a return on their
investments in IoT.

- CM

04

"...IoT will have the biggest
impact in **customer service**
and **support**..."

- The Economist

05

25%
reduction in asset
maintenance costs.
35% reduction in downtime.

- ServiceMax

06

$970
saved per year
per fleet vehicle.

- Cisc

07

38%
believe IoT will have
a major impact over
the next 3 years.

- The Economist

08

$41 trillion
spent over the
next 20 years for
infrastructure upgrades.

- Intel

09

$10 trillion
could be added to
global GDP, doubling
the US economy.

10

22x
more data traffic
by 2020.

- Freescale

11

0.06%
of things that can
be connected
actually are in 2014.

- Baseline Magazine

12

40%
of all data generated
by 2020 will come
from connected sensors.

- Frost & Sulliv