LIVE WIRE

2013 ANNUAL ISSUE

MATLAB FUN STUFF

MOTION SENSING

'BAND' WIDTH-IN SYNC WITH LIFE

BIONICS
-THE ARTIFICIAL EYE

ELECTRONICS AND MODERN WARFARE

COVER STORY:
WAR OF CURRENTS

FROM THE H.O.D'S DESK

It gives me great pleasure in writing this note for the LIVE WIRE 2013. It is indeed a humongous task to motivate and collect technical articles from the faculty and student authors which the editorial board has done with extreme care and diligence. My congratulations to them. It is my earnest request to the readers of these articles to contribute more for the next issue of LIVEWIRE. It is also my advice that the next issue may include articles on the projects carried out by the students, competitions and success stories.

I wish all success to the PHoEnix association for doing a wonderful job year after year.

- Prof Y Yoganandam

(Head of Dept of EEE)

FROM THE EDITOR'S DESK

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 3.0 is the culmination of a semester-long effort by the Phoenix Editorial Board. However, we are greatly indebted to the student community for a great influx of articles from which we had the luxury of choosing. Good articles are usually hard to come by. This time, however, we unfortunately had to relegate some good pieces to future forums.

The Editorial board has taken the liberty of introducing a few new concepts into this year's edition. For starters, we have introduced pictures in High Definition for a superior visual experience. We know for a fact that MATLAB is an essential tool for most electrical engineers and will probably plague us for many years to come. But it can be fun too, and that's what we've sought to show our readers.

Our fresh cover story, articulates the differences between alternating and direct current, and the two big forces behind those schools of thought. While the scientific community is heavily biased in this regard, we give you the entire low-down and what's what. Just facts, no opinions.

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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COVER STORY

WAR OF CURRENTS

Solar cells – An overview

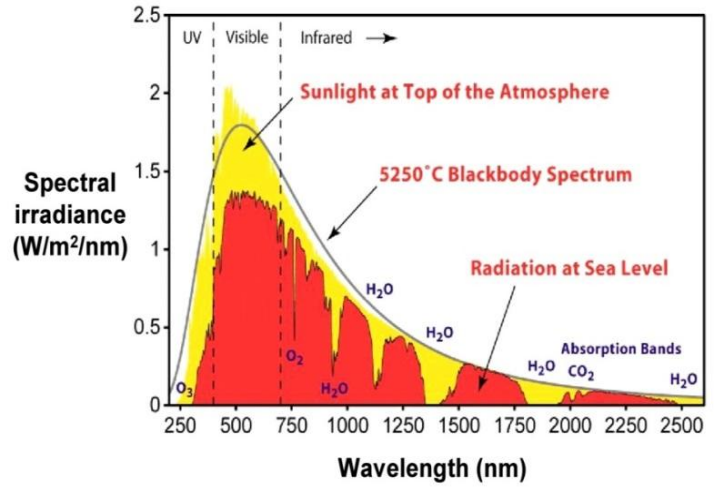
- Ananth Saradhi
(Lecturer, Dept of EE, BPHC)

Introduction and need for solar energy

Solar Energy is the energy radiated from the Sun. The sun radiates tremendous amount of energy and a small part of it reaches the Earth in about 8 minutes. However, this energy is so huge that it is sufficient to satisfy all our energy needs. The conventional resources available for fulfilling our needs are finite and will be exhausted in a few decades. The need for alternative sources of energy to satisfy the increasing demand has led us skyward, towards the sun. Solar energy is safer than nuclear energy and therefore, more attractive as an alternative to conventional fossil fuels. The conversion of solar energy into electricity is based on the photovoltaic effect. The photovoltaic effect was first observed by Alexandre-Edmond Becquerel in 1839 at the age of 19, in his father's laboratory. The search for a device to convert solar energy into electricity culminated in the birth of the solar cell in the year 1883, built by Charles Fritts, who coated the semiconductor selenium with an extremely thin layer of gold to form the junctions. The device was only around 1% efficient. The modern junction semiconductor solar cell was patented by Russell Ohl in 1946. As research progressed, there was improvement in the efficiency due to the consistent efforts of researchers around the world.

Solar Spectrum

The solar spectrum shown below indicates the Spectral Irradiance as a function of the wavelength of light. As observed in the figure, the atmosphere absorbs some energy and the rest reaches the surface of the earth. The radiation is mostly in the infrared region, with most of the higher energy

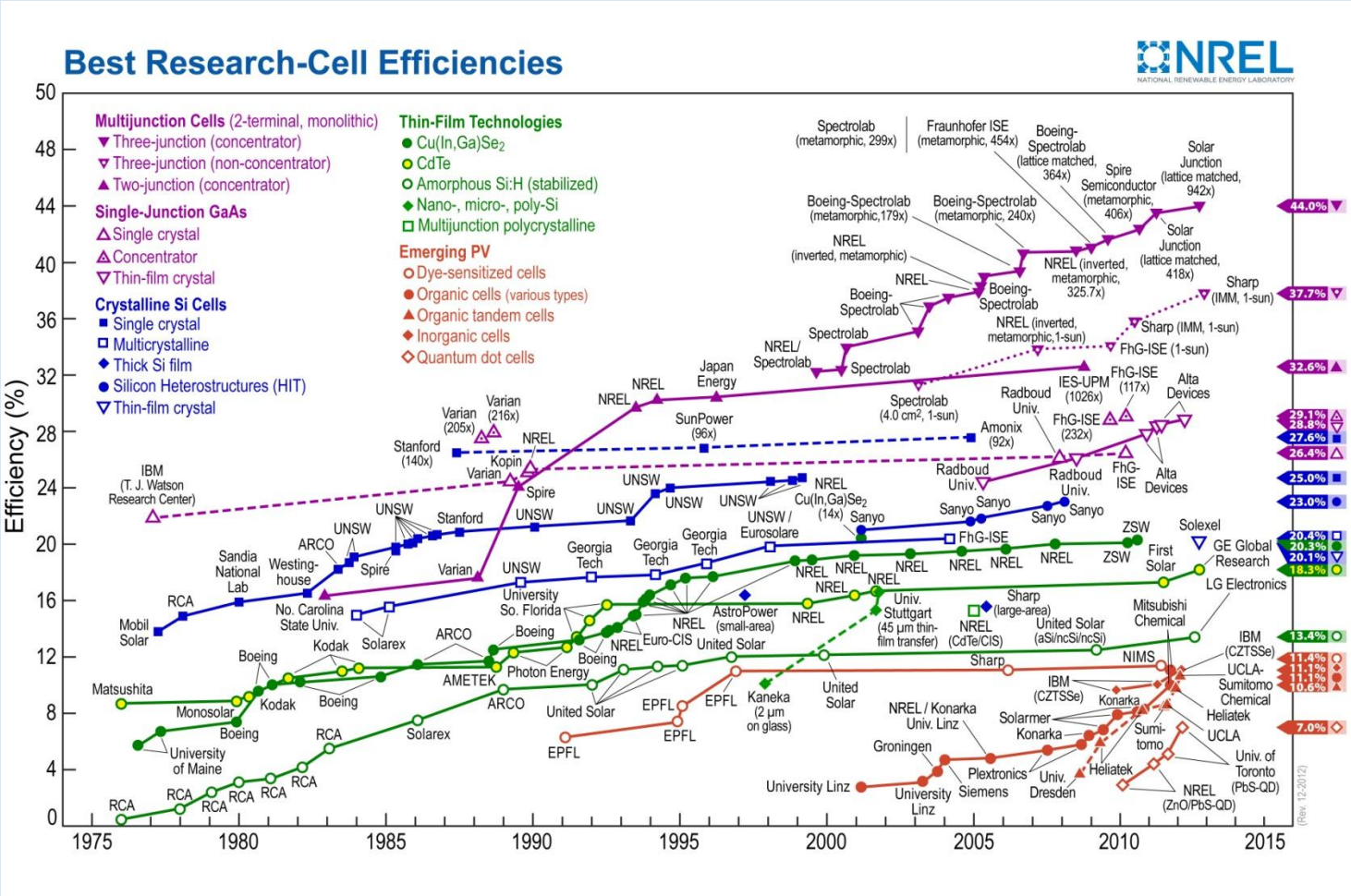


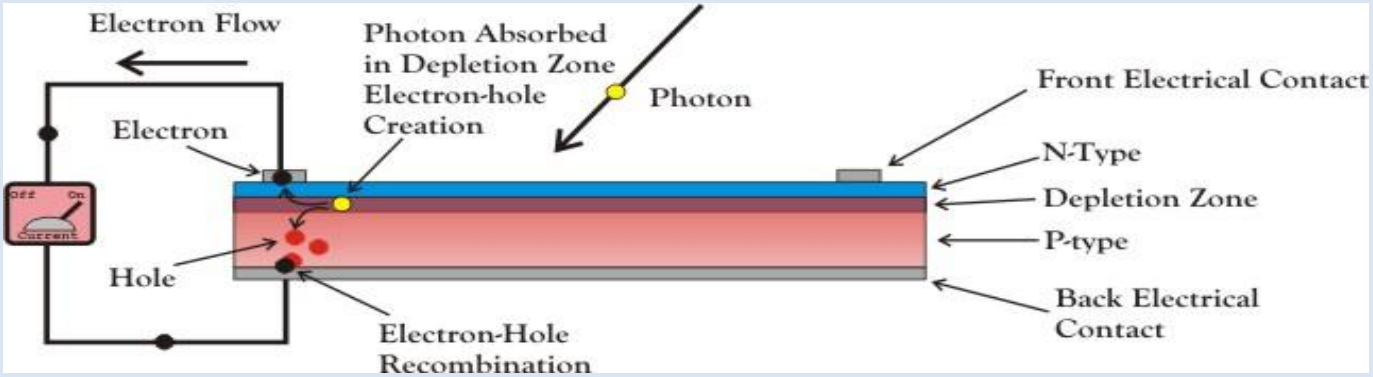
wavelengths not being absorbed by silicon- based solar cells.

Solar Cells are fabricated using different materials, each having its own advantages and disadvantages. The first generation of solar cells is made of silicon. The second generation use inorganic thin films such as CdTe and Copper Indium gallium Diselenide (CIGS). The third generation uses special organic materials which behave as semiconductors. The driving forces for innovations in the development of solar cells have been cost and efficiency with organic solar cells promising lower production costs than silicon. However, organic solar cells are not as efficient as silicon cells as shown in the chart below, published by the National Renewable Energy Laboratory (USA). The chart also shows the growth of efficiencies of solar cells using various technologies with time and the various companies and laboratories who are participating in this effort.

Solar Cells – p-n junction solar cells

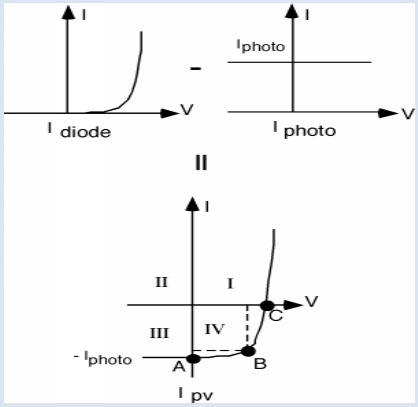
The picture below shows the operation of the p-n junction solar cell. The light shining on the depletion region of the p-n junction creates charge carriers- electrons and holes, which are driven to the electrodes by the built-in potential of the junction. The holes accumulate at the p- electrode and the electrons at the n-electrode. When an external circuit is connected, electrons flow from n-electrode to the p-electrode in the external circuit creating a current and dissipating power in the external circuit. The current –voltage characteristics shown in the figure below (bottom) indicate that as the current drawn in the external circuit increases, the terminal voltage across the solar cell decreases, with maximum current flowing under short circuit conditions and the terminal voltage is maximum under open circuit conditions.





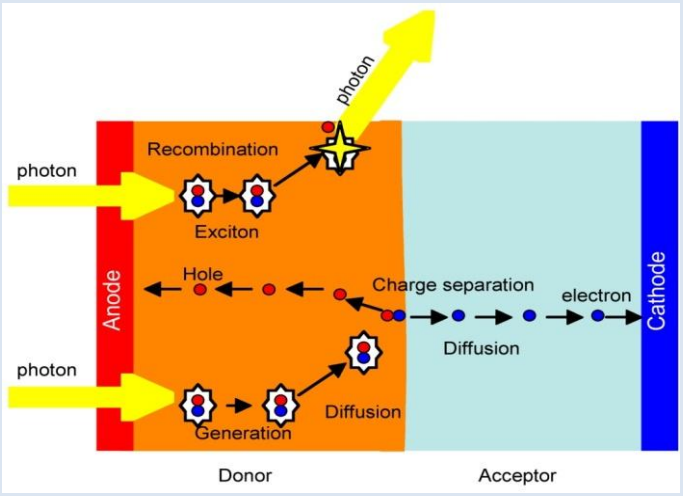
Need for organic solar cells

As the efficiencies of silicon and thin film solar cells increased, so did the cost of production. The processing of silicon, which is the raw material for silicon, involves high temperature and expensive vacuum processing technology. Thin film solar cells use materials such as Indium which are rare and Cadmium, which is toxic to humans. In contrast, organic materials are cheaper and are amenable to solution processing, which is relatively cheaper than vacuum technology. Silicon is a brittle material and cannot be easily molded into different shapes to utilize the increased surface area to absorb more light and thus increase efficiency. Organic semiconductors are flexible and can be coated on curved surfaces to increase surface area and hence the absorption efficiency. They are also compatible to roll-roll processing and hence provide an opportunity to reduce production cost, despite their significantly lower efficiencies.



Organic solar cells – physics and operation

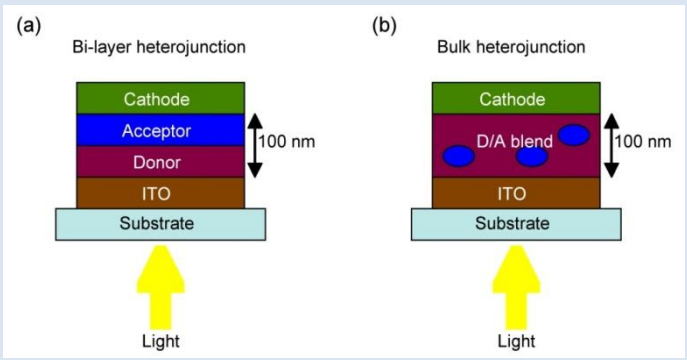
The fundamental difference between the organic and inorganic solar cells is the charge carrier generation mechanism. As the picture below indicates, a photon incident on the material does not immediately create electron-hole pairs. Instead, particles called excitons are formed, which are bound electron-hole pairs. They must be dissociated into electrons and holes using some mechanism, usually an electric field. The required electric field is obtained using a heterojunction, formed by using two different organic materials and (hence the name heterojunction). The excitons that are formed reach the junction from wherever they are formed by the process of diffusion. In the process of diffusion, many excitons recombine i.e the bound electrons



and holes recombine resulting in loss of potential charge carriers. The diffusion length of the exciton characterizes the distance which an exciton, on an average travels before recombination. The electrons and holes are formed as a result of exciton dissociation at the junction and they must be driven to the respective electrodes using an electric field or concentration gradient. The charge carriers are then collected by the electrodes and flow into the external circuit.

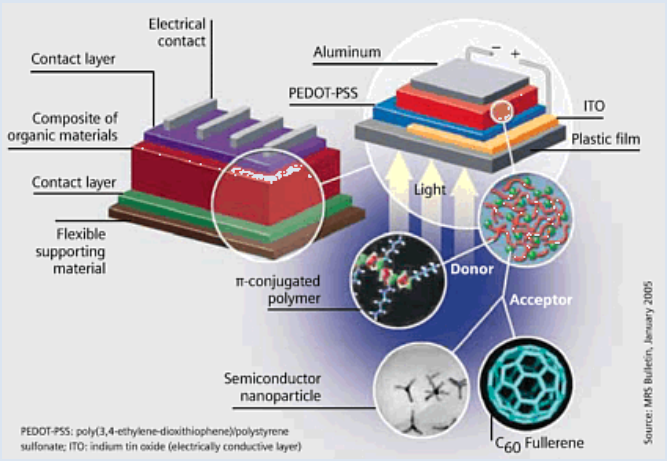
Structures in OSCs

The desire to improve the charge collection efficiency has led to development of alternative



structures for organic solar cells. The bulk heterojunction solar cell addresses the exciton recombination problem by reducing the distance

between source of excitons and the heterojunction.



This is achieved by intermixing both the organic semiconductors so that the heterojunction extends into the bulk of the solar cell instead of a small region, as in the case of the bi-layer heterojunction cells.

Applications and roadmap for future

The organic semiconductors in general have many potential applications such as electricity generating windows and walls in houses, and alternate lighting in the office space.

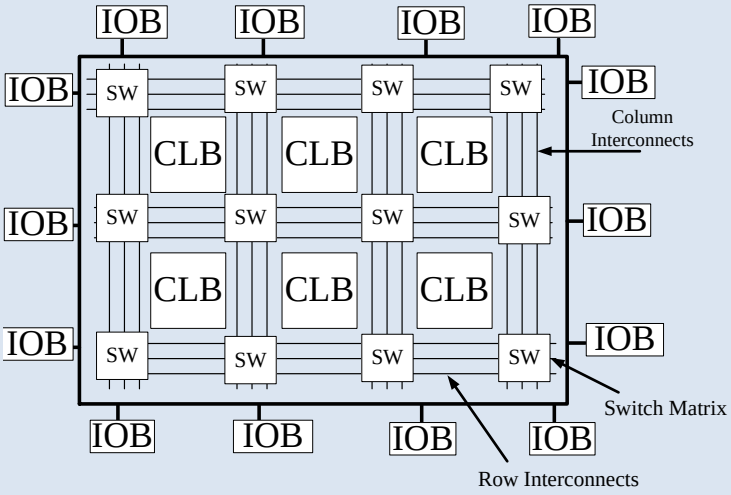
Hardware Chameleon (Reconfigurable Hardware Systems)

- Chetan Kumar V
(Lecturer, Dept of EE, BPHC)

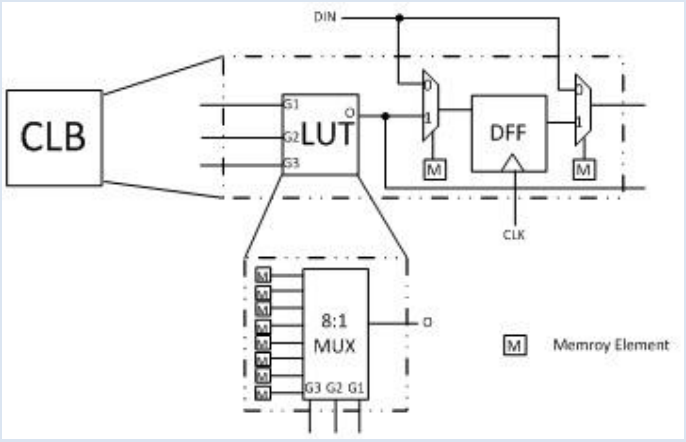
Chameleon: What is so interesting about this creature? Well this creature has unique skin which changes color according to the surrounding it is in. This feature of adaptability has a counterpart in Digital systems known as Reconfigurable (programmable) hardware systems. Before we move on to the programmable hardware let us look into the classification of hardware systems.

Hardware systems are basically classified in to four major categories 1) ASIC (Application specific Integrated circuit): This is a circuit designed for specific applications. An example of ASIC can be the RF module in our mobile phones. 2) General Purpose Processors: This system executes instructions (one by one), which are stored in the memory. The type of instructions stored in the memory decides the overall application. By changing the instruction memory the same system can be used for different applications. Hence they are called software programmable. Intel's, ARMs, AMDs etc. fall into this category of hardware systems. 3) Specific Purpose Processor: These systems are programmable just like the general purpose processors, but have specific set of applications. Examples include Graphic Processors, Digital signal Processors etc.4) Reconfigurable Systems: These systems are hardware programmable and are sometimes called as programmable hardware systems. These systems contain an array of programmable hardware blocks like OR array, AND array etc. Along with hardware units the systems also contain programmable interconnections. The examples for hardware programmable systems are PLA (Programmable Logic Arrays), PAL (Programmable Array Logics),

FPGA (Field Programmable Gate Arrays) etc. Among the above mentioned examples FPGAs are most widely used reconfigurable systems.

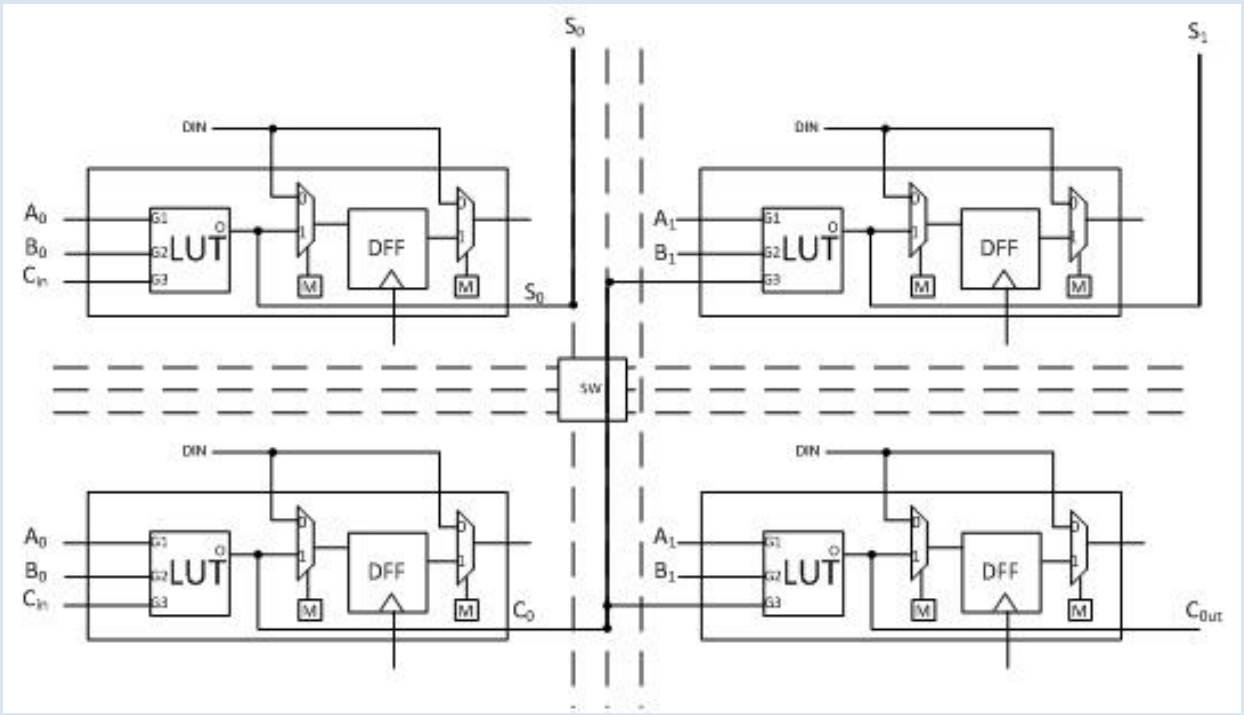


Todays advanced FPGA may contain millions of logic gates with programmable interconnects and are available to the users for custom hardware programming to realize desired functions. A typical FPGA consists of IO buffers for external connection, CLBs (Configurable Logic Blocks) and Programmable interconnects (switch matrix). Figure 1 shows typical structure of FPGA. The most important element of any FPGA is the configurable logic block. CLBs are the basic hardware programmable blocks. A simple CLB may contain user programmable multiplexers, a D flip-flop and LUT (Look up Table). A Look up table consists of memory elements connected as inputs to a multiplexer. The memory elements can be programmed by user to have either logic 0 or logic 1. Figure 2 shows an example structure for CLB. The CLB contains two programmable multiplexers, a D flip-flop and a 3-input LUT. The figure also shows the implementation of a 3 input LUT using memory elements and an 8:1 Multiplexer.



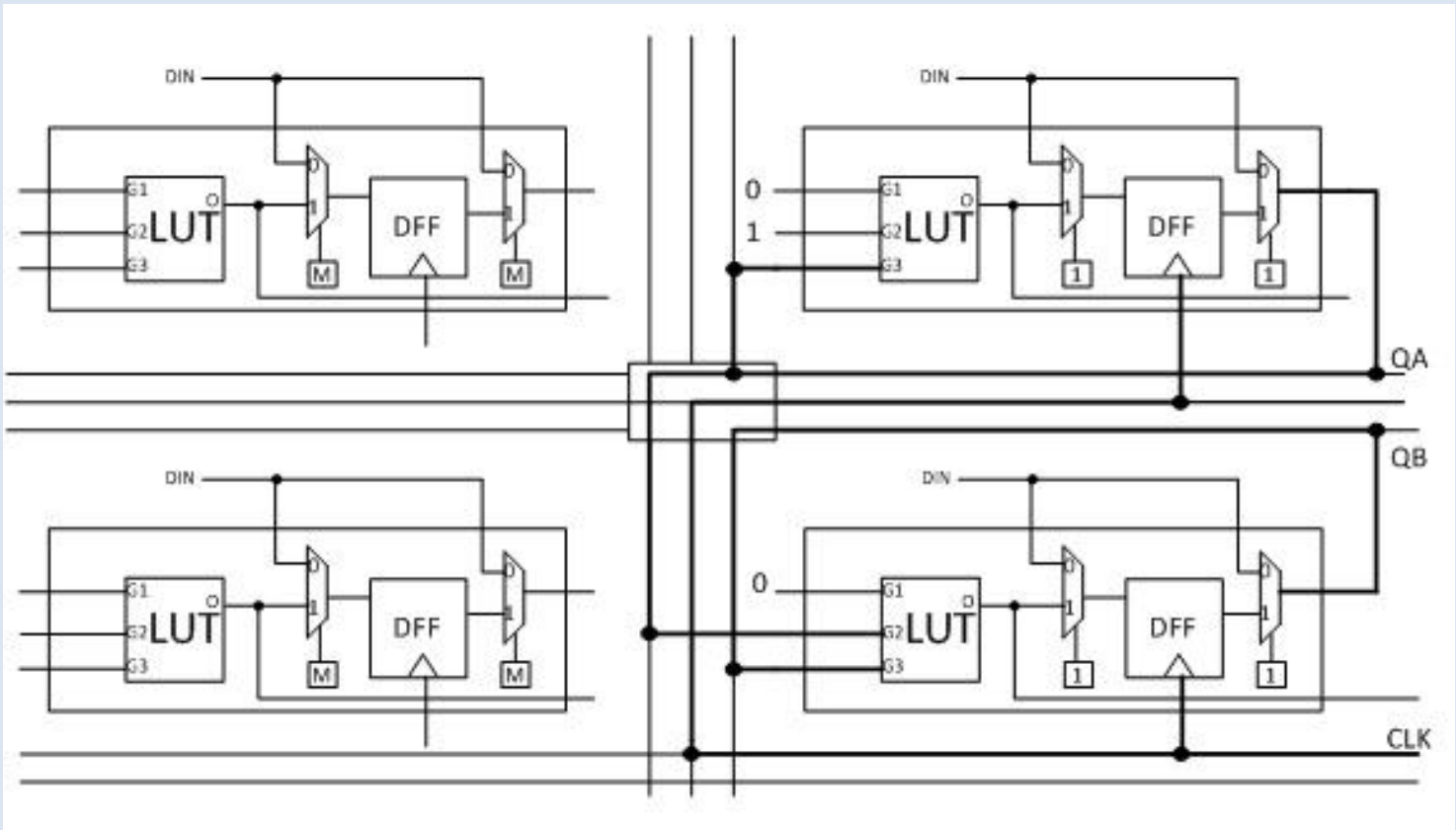
The 3 input LUT can be used to implement any 2^8 possible 3 variable functions.

Typical design using FPGA starts with a behavioral description using HDL (hardware description language). The design is synthesized and mapped in to the circuit as logic cells by sophisticated tools. Let us assume that a 2-bit adder with carry-in is to be designed on to an FPGA. This adder design is described using HDL and after synthesis the 2-bit adder might map onto an FPGA as shown in the figure below. The A0, B0, A1, B1 and Cin are the input bit signals coming from IO buffers. In the 2-bit adder implementation four CLBs are used. For 1 bit addition A0, B0 and Cin are taken as inputs to two LUTs one of the LUT is configured to implement the sum function i.e. $S_0 = A_0 \oplus B_0 \oplus C_{in}$. The second LUT with A0, B0 and Cin as inputs implements the carry function i.e. $C_0 = A_0B_0 + B_0C_0 + C_0A_0$. This C_0 is taken as input to the second 1-bit adder realized using 2 more CLBs.

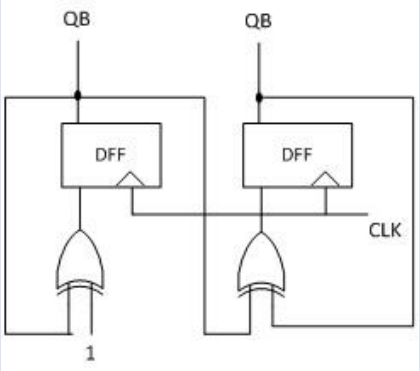


implementation of a 2-bit counter and along with the FPGA implementation is shown in the figure. Two CLBs are necessary to implement the 2-bot counter. The LUTs of the counters are configured as 3 input XOR gates. As per the design there 2 input XOR gates are needed hence one of the input of the LUT is connected to logic 0.

The same array of configurable logic blocks and programmable interconnects can be reprogrammed to implement a different circuit by programming the LUT and the available programmable multiplexers. Normal



As seen from the two examples on the page any hardware circuit can be realized by using the FPGA CLBs and programmable interconnects. The FPGAs are used for rapid prototyping of cost effective low volume applications. There are many other applications of FPGAs in different fields like reconfigurable computing, simulation of multicore architectures etc.



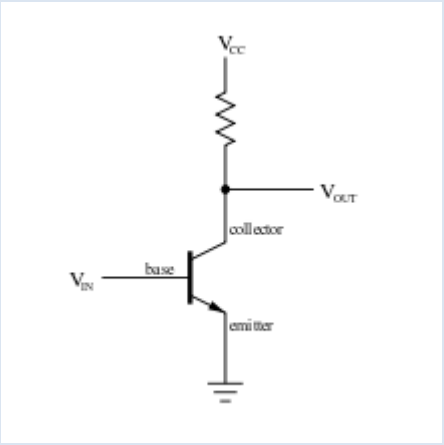
The CLB presented in this article is just for example. Today's CLBs are more sophisticated with each CLB containing up to four 6-input

LUTs and two D flip-flops. There are many companies which design FPGA devices. Notable among these companies are Xilinx, Altera and Microsemi. These companies also provide the synthesis and mapping tools required for FPGA design flow.

Electronics' perpetual motion machine

- Pratyush Mahapatra
(Student, Dept of EE, BPHC)

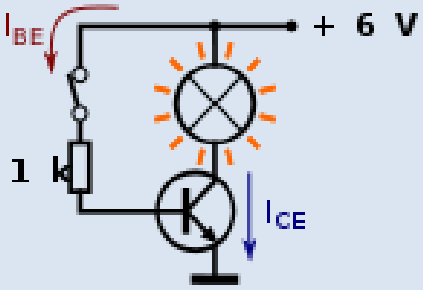
1947 - That was the year our world took a step forward in innovating the change. Two scientists, Walter Brattain and John Bardeen working at the AT&T's Bell Labs performed a series of experiments that would affect our lives forever. Yes, the "Transistor" was invented.

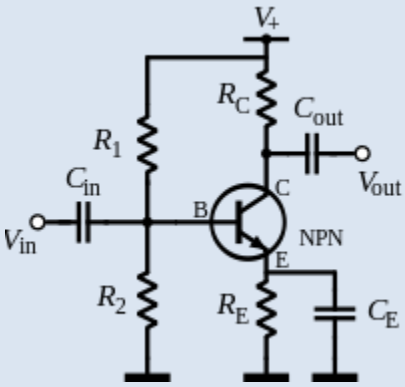


A transistor, few people have heard of it but still can't recognize it, fewer people know about it and a miniscule portion of us, I might even say proportional to its size know how to work it but yet this one device has imbued itself into our lives like nothing ever has.

What is a transistor? Before explaining, let me talk a bit about digital logic. All our electronic devices, be it computers, mobiles or even the calculator works on digital logic. Digital logic has two parts- on and off, 1 and 0 and all the functions are just based on these two binary digits. Let me take the example of a computer here. It performs innumerable operations, but it actually boils down to just a choice between two digits, 1 and 0. Now my laptop has a dual-core processor with 2.3GHz processing speed. That

means the processor can do 2.3 billion operations per second. That in its essence means that the processor has to check for more than 2.3 billion 1 or 0s in a single second. Try thinking of a normal switch that has to be switched on or off, billion times in a single second. Well that doesn't just seem impossible, it is. This is where the transistors come into play. They have very low switching times which allows them to be switched on and off multiple number of times and not just that, they also act as amplifiers converting very weak signals into stronger ones. It is these tiny devices that are not clearly visible to the human eye that determine how fast our computers work.



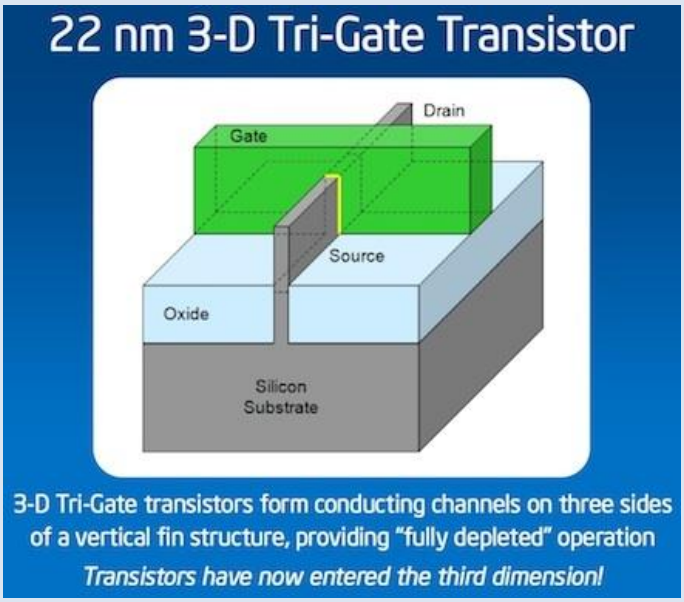


Transistors have come a long way from when they were invented and according to Moore's Law - "Every two years the number of transistors that can be accommodated in a chip doubles", they have become smaller than ever, with the latest size being as small as 22 nanometers.

There have a been a few developments in the last 2 years that promise, more research opportunities for the interested and faster computer processing speeds for all of us.

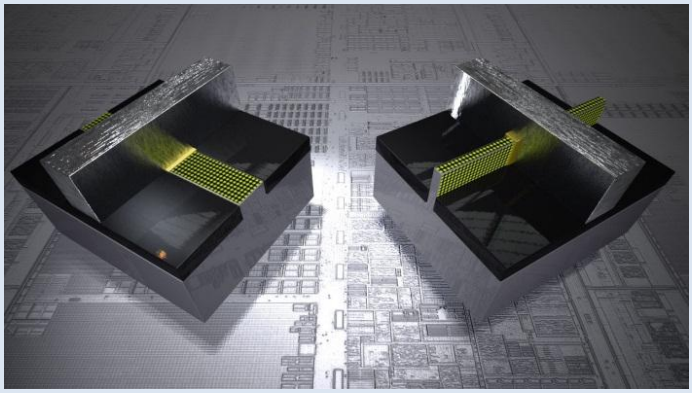
The transistor is going through a major overhaul and at the forefront of all this is Intel, the semi-conductor giant of our age. On May 4, 2011 Intel announced the world's first 3D transistor known as Tri-Gate.

Citing Intel's website, "The three-dimensional Tri-Gate transistors represent a fundamental departure from the two-dimensional planar transistor structure that has powered not only all computers, mobile phones and consumer electronics to-date, but also the electronic controls within cars, spacecraft, household appliances, medical devices and virtually thousands of other everyday devices for decades.



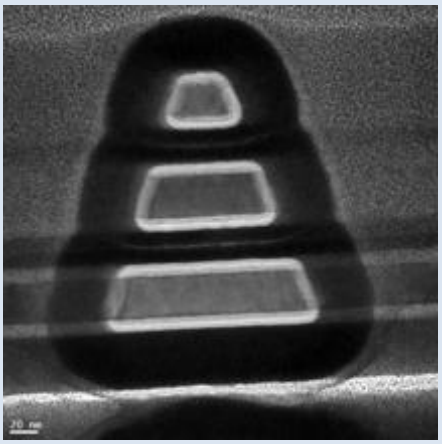
The 22nm 3-D Tri-Gate transistors provide up to 37 percent performance increase at low voltage versus Intel's 32nm planar transistors. This incredible gain means that they are ideal for use in small handheld devices, which operate using less energy to "switch" back and forth. Alternatively, the new transistors consume less than half the power when at the same performance as 2-D planar transistors on 32nm chips."

The 3-D Tri-Gate transistors are a reinvention of the transistor. The traditional "flat" two-dimensional planar gate is replaced with an incredibly thin three-dimensional silicon fin that rises up vertically from the silicon substrate. Control of current is accomplished by implementing a gate on each of the three sides of the fin – two on each side and one across the top -- rather than just one on top, as is the case with the 2-D planar transistor. The additional control enables as much transistor current flowing as possible when the transistor is in the "on" state (for performance), and as close to zero as possible when it is in the "off" state (to minimize power), and enables the transistor to switch very quickly between the two states (again, for performance).



With Intel being the called the "Superman" of the Microprocessor Market, nothing less can be expected but the inventions made in MIT, Harvard and Purdue during the last few months have also caught a lot of attention.

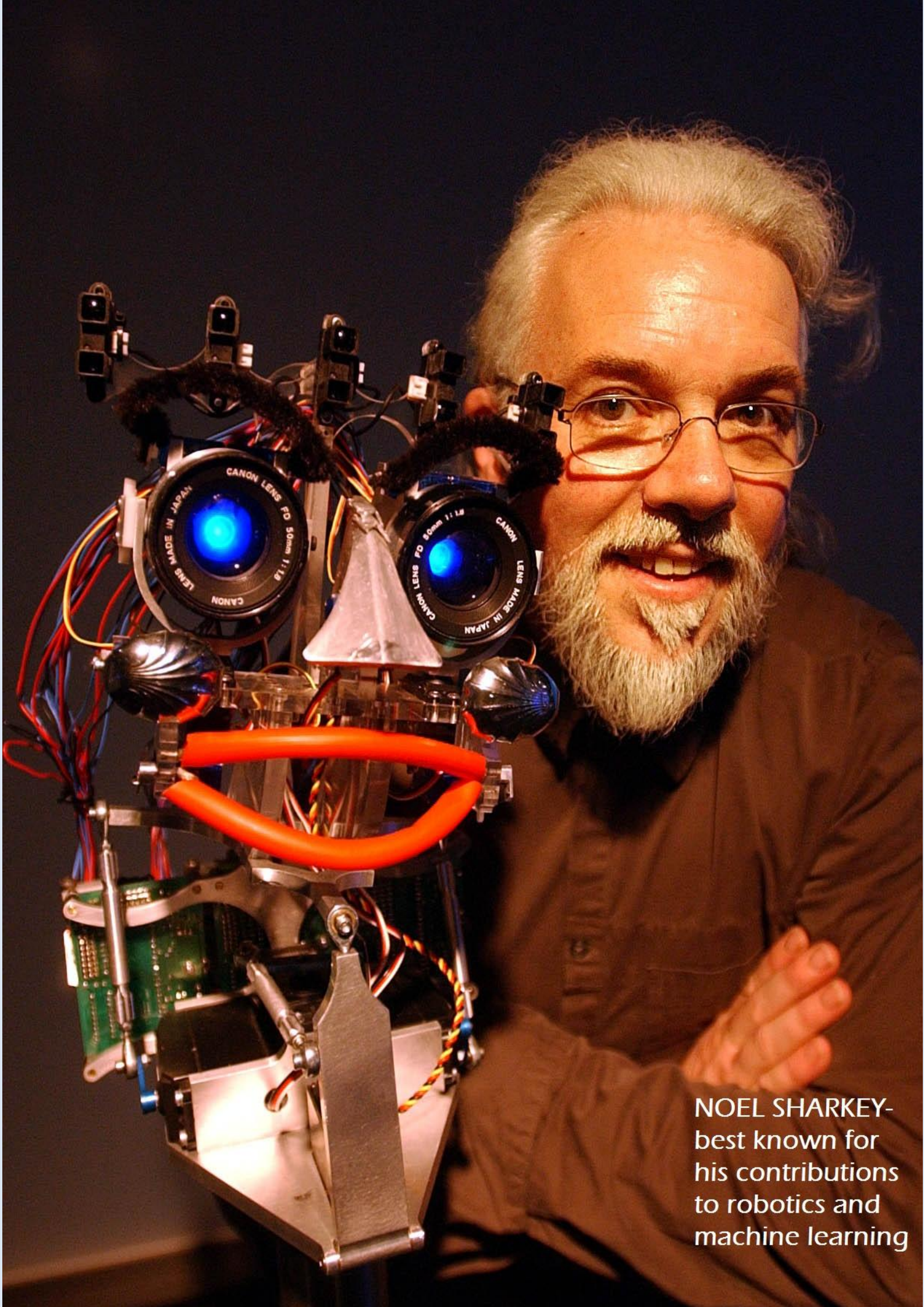
Progressing on the work done by Intel on 3D transistors, researchers at Harvard and Purdue have come up with a 4D transistor which looks like a Christmas tree and is made up of a different material, an alloy of Indium, Gallium and Arsenic called Indium- Gallium- Arsenide. Engineers are working to develop transistors that use even smaller gate lengths; 14nm are expected by 2015, and 10nm by 2018. However, size reductions beyond 10nm and additional performance improvements are most likely not possible using silicon. Meaning, new materials will be needed to continue progress. Creating smaller transistors also will require finding a new type of insulating material, or a dielectric layer that allows the gate to switch off. As gate lengths shrink smaller than 14nm, the dielectric used in conventional transistors fails to perform properly and is said to "leak" electrical charge when the transistor is turned off.



This is where the researchers at MIT come in. On 11 December, 2012 researchers produced the smallest transistor ever to be built from a non-silicon material, which makes Indium-Gallium-Arsenide a prospect as a future replacement and this is not the only invention to come out of MIT in the last month. To quote MIT's website- "At the IEEE's International Electron Devices Meeting (IEDM) in December, researchers from MIT's Microsystems Technology Laboratories (MTL) presented a p-type transistor with the highest "carrier mobility" yet measured. By that standard, the device is twice as fast as previous experimental p-type transistors and almost four times as fast as the best commercial p-type

transistors. Like other experimental high-performance transistors, the new device derives its speed from its use of a material other than silicon: in this case, germanium. Alloys of germanium are already found in commercial chips, so germanium transistors could be easier to integrate into existing chip-manufacturing processes than transistors made from more exotic materials."

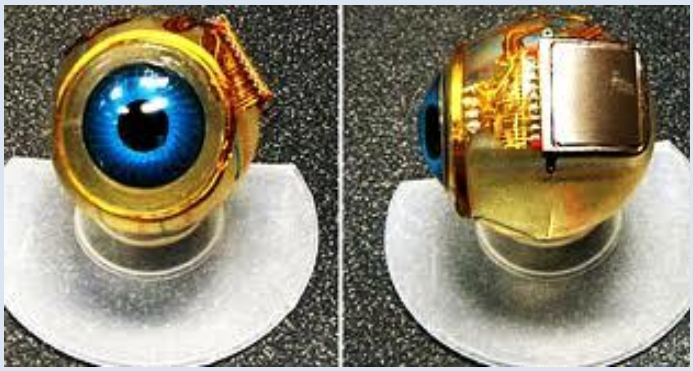
The transistor has changed a lot of lives and it still continues to inspire several other innovations. It is the one device that heralds the modern era and is still driving it with its enormous potential, untamed.



NOEL SHARKEY-
best known for
his contributions
to robotics and
machine learning

Bionics

- K.V.N. Aishwarya Reddy
(Student, Dept of EE, BPHC)



What do you get when you couple biology with electronics, well the obvious answer might be something that sounds like a complex branch of engineering but we aren't talking "geek". So, to put plainly what we humans find excessively laid out or simple enough is actually quite complex and diverse. Every biologically manufactured body part is not just difficult to replicate but furthermore, the execution and functioning involves a complex set of measures which are to be taken before construction and nurturing that would be worse than cradling a new born baby. Here is one such attempt at replication with the primary focus being on the human eye.

Bionics are prosthetic medical devices implanted in the body. In most cases they mimic the role of a nonfunctional or damaged body part. Most bionics such as the prosthetic arms, legs and heart implants have existed for centuries. The bionic eye however is a breakthrough technology in the family of bionics, considering the complexity of the human eye and its functioning.

The bionics have successfully mimicked the functioning of one of the five senses by inventing the cochlear ear implant. The bionic eye however is in its experimental phase and is a great hope for the visually challenged.

The bionic eye has five main components:

- A digital camera that captures high quality images.
- A microchip to process images into electrical pulses that represent patterns of colors.
- A transmitter to transmit the electrical pulses.
- A receiver and
- An array of electrodes implanted on the retina

Mechanism:

The camera captures and inputs the image of an object viewed by the person. This image is perceived as a picture with light and dark pixels. The image is then sent to the processor that converts the pixels into an array of electrical pulses that represent different shades from light to dark. The pulses are then sent to the retinal implant in the bionic eye to excite the electrode array present in the device. The electrodes are then simulated in accordance with the encoded pattern of different shades that represent the object. The electrical signals or pulses generated by the simulated electrodes reach the visual centre of the brain as neural signals. These neural signals are generated similar to those that would be generated by the actual human eye and can thus be transmitted through the optic nerves-the original pathways. The brain in

turn interprets these signals and informs the person about what he/she is looking at.

Though the initial versions of the bionic eye provided the person with capabilities no better than perceiving outlines of the objects, the upcoming versions even promise facial recognition abilities. This can only be made possible by greatly increasing the number of electrodes within the space parameters of the eye.

What seems more interesting about this device is the scope of obtaining power from the human body itself! Researchers claim that the ear can serve as a potential source of power to the bionic eye through a potential battery located in a chamber of the cochlea. When an imbalance of potassium and sodium ions is created on opposite sides of the membrane, it results in an electrical voltage across the membrane. But this energy cannot be used to its fullest as it would disrupt the normal hearing capabilities of the person. Hence, only a fraction of its power can be utilized.

Having said that, do not start dreaming about charging smartphones or iPods by putting them up to the ear as scientists only claim a minute proof to this theory and require extensive researching to get it working.

War of Currents

- Pratyush Mahapatra
(Student, Dept of EE, BPHC)

Direct current

"Cometh the hour cometh the man" and Edison was just that man. Electricity, something which we pretty much take for granted these days, is something we just cannot live without. Our own survival can be attributed to this man's contributions and we all owe him a lot indeed. With the world plunged in darkness this is the person who showed it light.

Through all of it all, Direct Current (DC) was the staple fodder for this man, not just because of his blind belief in this system, but because of some of its inherent advantages over AC. standards that were on the verge of uprisal at that point of time. Now before we go any

Further, it'd be wise to go over the basics and understand what exactly direct current is.

Direct current (DC) is the unidirectional flow of electric charge. It is produced by sources such as batteries, thermocouples, solar cells, and commutator-type electric machines of the dynamo type. Direct current may flow in a conductor such as a wire, but can also flow through semiconductors, insulators, or even through a vacuum as in electron or ion beams. So basically DC is the constant flow, the straight line you get in a VI graph unlike the messy sinusoidal curve of an AC.

DC with its many inherent advantages was backed by the genius of Edison. Furthermore DC

at low voltage was also overall much safer to use in comparison with AC. This was shown in an experiment by Edison in which he electrocuted an Elephant by using AC current.

Even the electric chair used for death sentences use AC current.

A statement by Edison proves the relative innocence of DC as compared to the notoriety of AC, "Direct current is like a river flowing peacefully to sea, while alternating current is like a torrent rushing violently over a precipice."

Unfortunately and despite Edison's many attempts, DC lost out to AC and the world chose AC as its medium for current transmission. The war was thought to be over, but was it?

In the current, progressive world with an ever growing demand for energy and the rising costs of supplying energy DC is once again showing why it's the system that should have been adopted. Most of the appliances that are in use run on DC. With the advent of digital system and electronics, DC has come back into the picture through our laptops and mobiles to even the simple LEDs. But that leads to an even bigger problem, as every single appliance being used now running on DC, we have to be continuously converting AC into DC.

Have you ever wondered why all the laptops have those heavy charging bricks? Now you have your answer. Every single time we want to charge our laptop, we have to plug in our charger to a source say it is your house or a hostel room. The current that the source provides is in alternating form and unless you want to blow up your laptop you wouldn't want to use it directly. It has to be converted to the direct form of current which is finally used by our laptop, and that is where the brick comes into play, converting the alternating current into direct current.

Now the question that would come to your mind is what's the big deal? What is the problem with continuing with the same system of converting AC into DC when using an electronic device? But the problem here comes in the conversion; each conversion wastes some electricity. And taking into account the number of electronic devices and the number of conversions required and just by doing some simple math of adding and multiplying we get an astronomical sum. To put it in a simpler way, about 10 percent of the total electricity generated in the world is lost in such AC to DC conversions and that's a quite a huge amount indeed. Adding to that is the emergence of solar panels and other renewable sources of energy. Solar panels produce DC source of current and the user is also usually in proximity to the source, this makes converting the current into AC and back into DC meaningless, it would be much simpler and more efficient to directly use DC.

DC also has a fundamental advantage over AC which is usually ignored. Remember the types of obstructions to current flow we have read about? We have resistance, inductive reluctance and capacitive reluctance. Now an alternating current has to take into account all the three types but direct current for one is only affected by resistance. So in a circuit containing an impedance and resistance, which is usually

present in most of the normal electrical circuits, AC faces higher impedance than DC, meaning power loss in AC is much higher than in DC.

With the world moving towards a better, brighter and a cleaner future, it's high time we do the same. It's time we opt for a better and a cleaner transmission system than what is existent today. The war however is still on, I'm afraid.

Alternating Current

Have you heard about David and Goliath? David the small but just warrior against the mighty and fear inducing Goliath which thus went on to be unfold as the victory of the underdog!

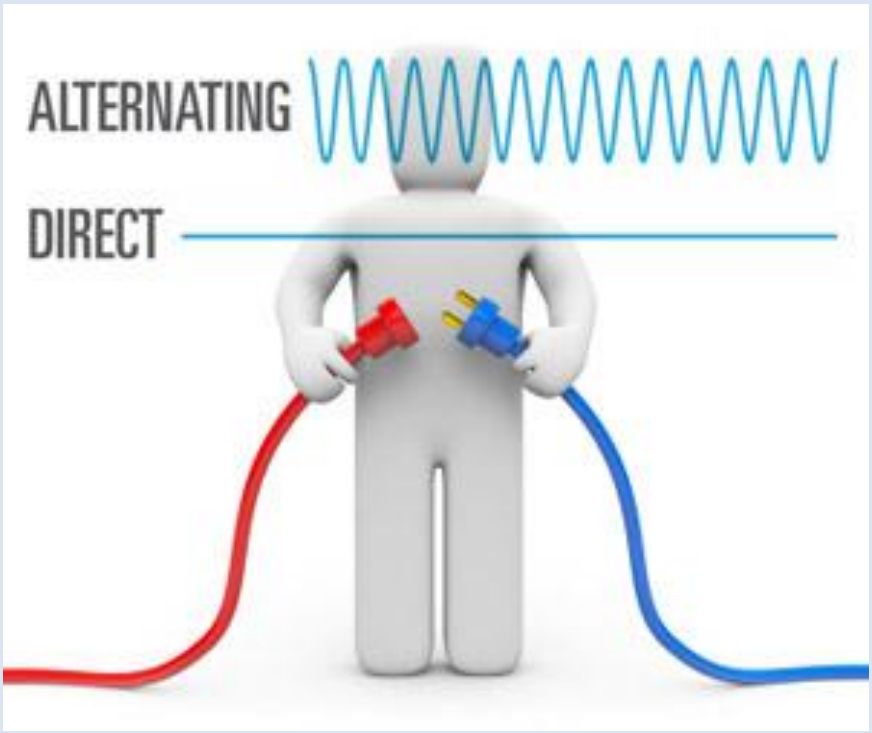
The war of the currents wasn't very different. AC with its superior technology was just coming up and was matched against DC which had the profound backing of Thomas Edison, who was followed blindly by many and which already had a head start on AC. Despite all that, AC won the war and the right to electrify the world.

Now before proceeding any further and discussing about the advantages of AC over DC, it would be better if we could go over the basics of AC. Alternating current (AC) occurs when charge carriers in a conductor or semiconductor periodically reverse their direction of movement. Household utility current in most countries is AC with a frequency of 60 hertz (60 complete cycles per second), although in some countries it is 50 Hz. An AC waveform can be sinusoidal, square, or sawtooth-shaped but some are irregular or complicated. So why prefer this erratic always changing current over the constant reliable DC source? To answer it we need to go back to the 1880s.

The 1880s saw the emergence of the DC distribution system pioneered by Thomas Edison. Whole cities were being powered by DC. But that is when the problem of DC came to light. DC cannot be transmitted over large distances; the signal strength drastically decreases with increasing distance. During the 1880s, DC could only be successfully transmitted over one mile. This meant that the metropolitan cities had to have DC generators near every neighbourhood and boosters in place to amplify the signal. Not just that, since in DC, electricity only flowed in one direction, the flowing electric current frequently melted the copper wires through which it flowed, causing transmission of DC over long distances to be hazardous and nearly impossible. The solution was to use bulky copper wires but then that led to the cities appearing like cobwebs.

That is when Nikola Tesla came into picture. A talented immigrant who was highly recommended by his superiors in the Transnational Edison Company migrated to the USA and started working in Edison's Lab. He realized the problems in the DC system and worked to try and improve on it, but seeing Edison's reluctance to adopt any other form of system especially AC he left the job and started his own lab, perfecting the AC motor which was soon purchased by Edison's competitor George Westinghouse. The greatest advantage the AC system had over DC was in power transmission. With AC, transformers could be used which could change high voltage low current to low

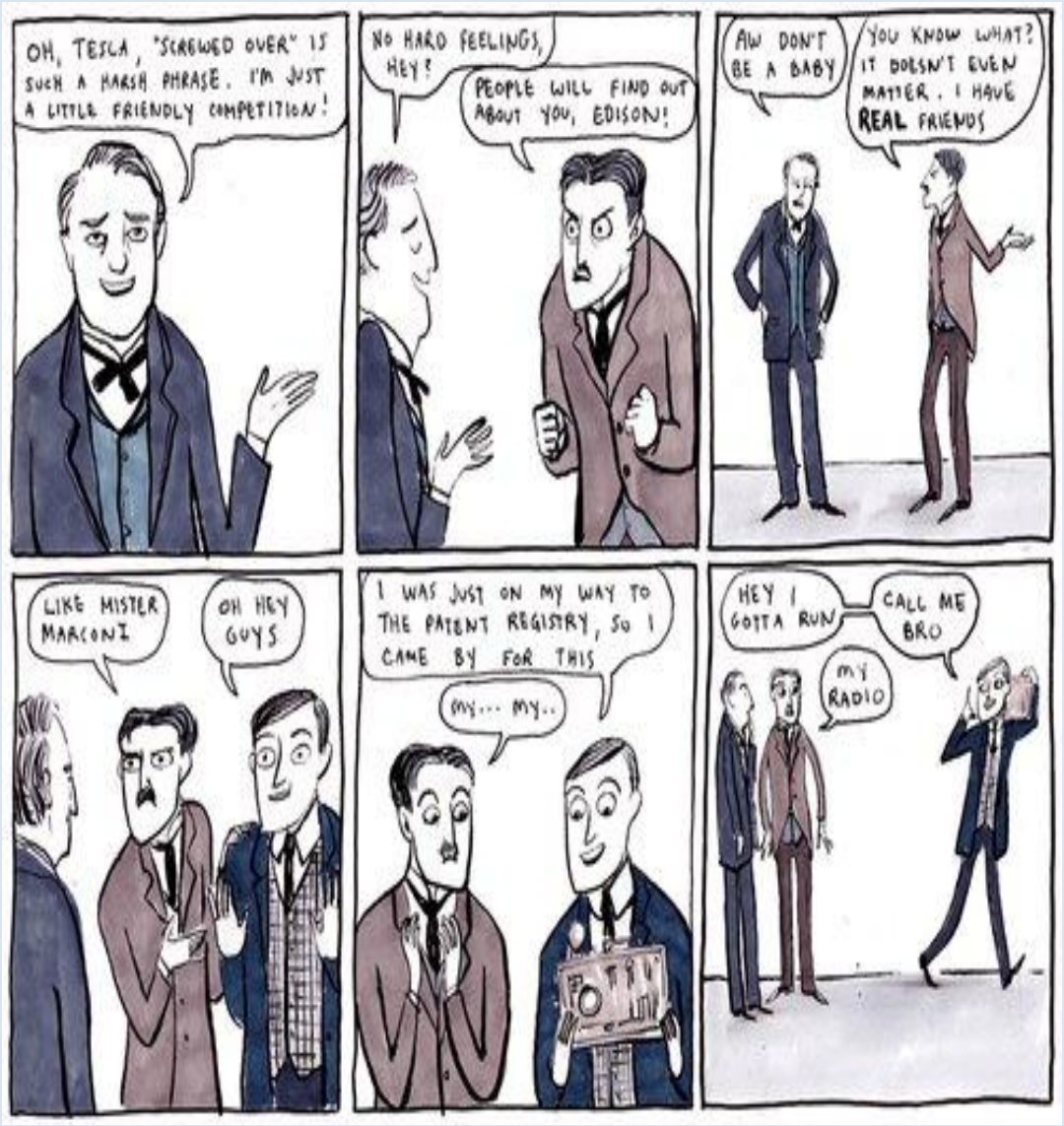
voltage high current and hence ensure minimum power loss by transmitting currents at higher voltages and stepping down the voltage for domestic use. Now source could be thousands of miles away from the consumer and yet current could easily be transmitted. That solved a huge headache of the city authorities who did not have to worry about installing boosters or dynamos every mile. Moreover in AC the current goes to zero multiple times in a second, which meant that the problem of heating of wires was also not an issue, so thinner wires which were much more commercially viable could be used and cities no longer looked like the spider webs they used to. Also due to the capability of AC to transmit more power and the higher efficiency of the AC motors it was adopted almost without any protest in almost all of the heavy industries. It became the driving force of the economy.



The superior technology had to win and it did win. Though the last decade has brought along new challenges to the hegemony of AC but the continued advantage of AC transmission over that of DC should ensure its continued dominance. Even though there are concerns over many devices using DC and AC being converted to DC before being used, it must also be noted that AC to DC conversion is far simpler and easier than DC to AC conversion. Hence a DC system if put in place will mean much higher losses especially in the industrial sectors, the backbone of any country's economy as DC would continuously have to be converted into AC before being used by the heavy load AC machines.

Just like David the rightful and just conqueror of Goliath went on to claim his rightful throne as the King of Israel and immortalised his name in legend, in the same way AC has also taken up the responsibility to lighten up the world and will continue to do so.

AURORA BOREALIS - auroral light is produced by a high-vacuum electrical discharge


OH, TESLA, "SCREWED OVER" IS SUCH A HARSH PHRASE. I'M JUST A LITTLE FRIENDLY COMPETITION!
NO HARD FEELINGS, HEY?
PEOPLE WILL FIND OUT ABOUT YOU, EDISON!
AW DON'T BE A BABY
YOU KNOW WHAT? IT DOESN'T EVEN MATTER. I HAVE REAL FRIENDS
LIKE MISTER MARCONI
OH HEY GUYS
I WAS JUST ON MY WAY TO THE PATENT REGISTRY, SO I CAME BY FOR THIS
my... my..
HEY I GOTTA RUN
CALL ME BRO
my RADIO

Entertainment, Electronics and Ennui (EEE)

- By Nitin Kishore
(Student, Dept of EE, BPHC)

Engineering, How did we get ambushed into this insidious profession? Parents? Peers? No. In retrospect…it was entertainment .Puzzled? How could entertainment be so vindictive towards us?

The answer lies in the fact that we watched all those movies and TV shows without enough consciousness tantamount to the acumen required to not fall into the process of worshipping sentient robots and other cool gadgets. Your dissent to this, is appropriate, so take a respite from whatever you were doing prior to this and continue reading.

So what makes us awkward now? Is it the high standard bar we unconsciously set for electronic engineering? Partly true. Your mind does have an efficient way of fixing you to another object by an inclined plane wrapped helically around an axis. If, you didn't get that…then you pretty much are screwed. Let's take a history check here. As a species, we are tool makers first and foremost. That's why we love to see gadgets in our movies, and to watch Batman defeat the bad guys with technology we know we'll never own. Depraved killers and kidnappers who need to disguise their voice all seem to shop at the same voice modulator store. The preferred varieties either make you sound like 1) you need a Heimlich maneuver for the coin you are choking on ...2) Darth Vader...or 3), actually that's about it. How many times have we seen James Bond pick up some incredibly useful new technological gadget that ends up saving his life, only to completely forget it exists in his next movie? Sitting in your room while your surrogate starts being cool, having hair, chasing guys, with weapons that will rip the eye balls out of their rusty metallic sockets, around is really reassuring in extended human life but that notion again is contradicted by Will smith and Robocop getting prosthetics for their recklessness. And the batmobile!! How can we forget the batmobile. Every kid's dream car!!

But in the course of trying to dazzle us with their fancy spaceships, gadgets and battle vehicles, sometimes Hollywood forgets to make sense. Now, the contemplation starts. How did all of this affect you?

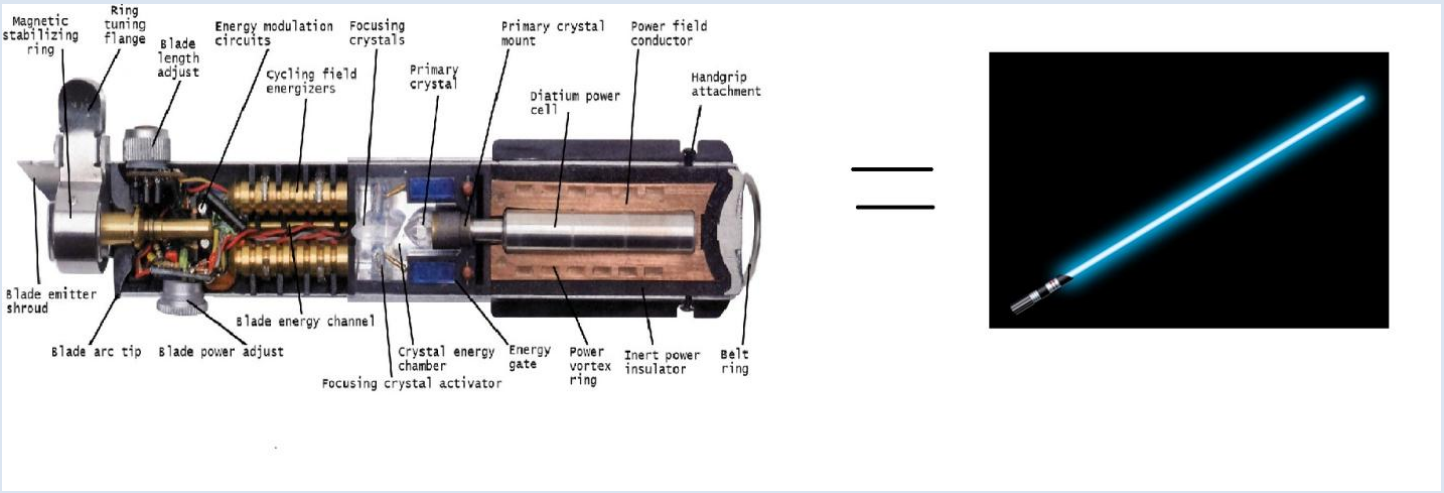
Remember when you were a kid and your parents refused to buy you a cool toy you wanted. What did you do? You pretended another one of your toys was the one you actually wanted to buy and kept playing spy games with it anyway. Saving galaxies with a

broom, you believe was your light saber. What? So, it's just me!! Anyway, that really doesn't help the point I was trying to make. Entertainment has programmed us into thinking anything is possible with a bit of imagination. Digital watches helping you to teleport to parallel universes and kill yourself 123 times to become (Jet Li) THE ONE or just stop the motion of time like in that movie, Clockstoppers.What is that watch?

Just a bit of circuits and the green board thing right? How hard can it be to learn to do something like that? Little bit of Verilog maybe, and some cheap stuff from a local electronics store. As kids, you all probably wanted to build mommy dearest a robot to do all the household work . Let's just hold those thoughts and take it a step further. If it were that easy, someone must have actually made it by now right? Technology these days must be really cheap, huh? Owing to the fact that Tom Cruise can chuck his iPhone into another car to track the driving route through GPS. So all you have to do right now…is get as rich as Scrooge Mcduck and buy them.. but that's a longshot really, you know "placement" packages and all. So what's left. Make them yourself???That's completely absurd. Yeah, I can hear you say that but now do you see how you got sucked into the vortex of entropy in your life?

Well, subtly hinting here, YOU thought they were easy!!Studies show human beings get dumber as they grow older. So your younger self thought that you are capable of building the batmobile but your current self thinks it can't build a bicycle.Quit quibbling over the fact that your courses are tough and unbearable. You thought you could do better when you were a kid. Right now, you probably think that a light saber was actually just a tube light. How can you call yourself an engineer if you did that?

Nah, I'm just kidding. The point that I wanted to get through to your mind is that in the midst of tests we forgot about our inner child self that thought that everything would be easy and possible. Everything would be interesting. Reach out and grab hold of it. Do not let go. Every day is a new start. Stop growing old. The world doesn't need those who give up hope. Get motivated to build all those cool gadgets that you won't have enough money to buy. Become the Batman!!You have endowed yourself with this task. See it through to the end. How do you start? Technical workshops? Robotic workshops? Yeah they are just baby steps you take to building your own Transformer from cybertron, that also drives you around being a yellow Camaro, and by transformer I don't mean the one you operate under load and no load condition



Now that you have read this by taking some time off your perfectly non busy schedule of playing LAN games and watching TV shows and whining about your branch I implore you to peek into your mind .If you consider yourself in a predicament for not having inkling about your subject, and then quit the blame game. Get up and realize that you are stuck. There’s no going back now, so start to make something of it. Subvert the ennui in your life. Stand up and finish everything you wanted to start. Go on, Get started on that Iron Man suit. C’mon admit it, that’s one of the main reasons you chose to be an engineer.

VOLCANO CHAITEN, CHILE -
volcanic eruptions are often accompanied by stunning electrical activity

"BAND" WIDTH: IN SYNC WITH LIFE!

Aalhad Parulekar
(Student, Dept of EE, BPHC)

Gone are the days when wrist bands used to be part of our apparel, to merely add to our fashion quotient. Today Lark Technologies has come up with something that shall enable us in leading a smarter life. I know, it does sound a bit artificial, and to be honest it is, but here's the deal.

Firstly this product gets its "smartness" so as to speak from merely studying biological patterns. It not only monitors the amount of sleep an individual gets in a day, but also keeps a count on the calories consumed. As an added bonus it tells you when you're tired and need a quick bite to replenish your reserves as well.

How does it work, and what makes it unique?

Well simple, it was developed by a series of experts ranging from: people who are qualified sleep coaches (of professional football and basketball teams) to biologists whose field of expertise lies in developing proper sleep patterns

Major Functions:

1) It helps you in exercising smarter by helping in customizing the workouts on a daily basis.

2) It helps in eating smarter so we don't put on extra weight by showing is what we eat and how many calories we add to our diet.

3) It helps in sleeping smarter so one is refreshed and remains healthy in the day.

Features:

1) Fitness Coaching: Developed with top experts who coach pro athletes and business executives, lark life's activity tips reinforce positive behaviors and help you to learn new ones to incorporate into your daily routine. By getting more consistent, effective activity each day, you'll notice improvement in your energy levels and your health.

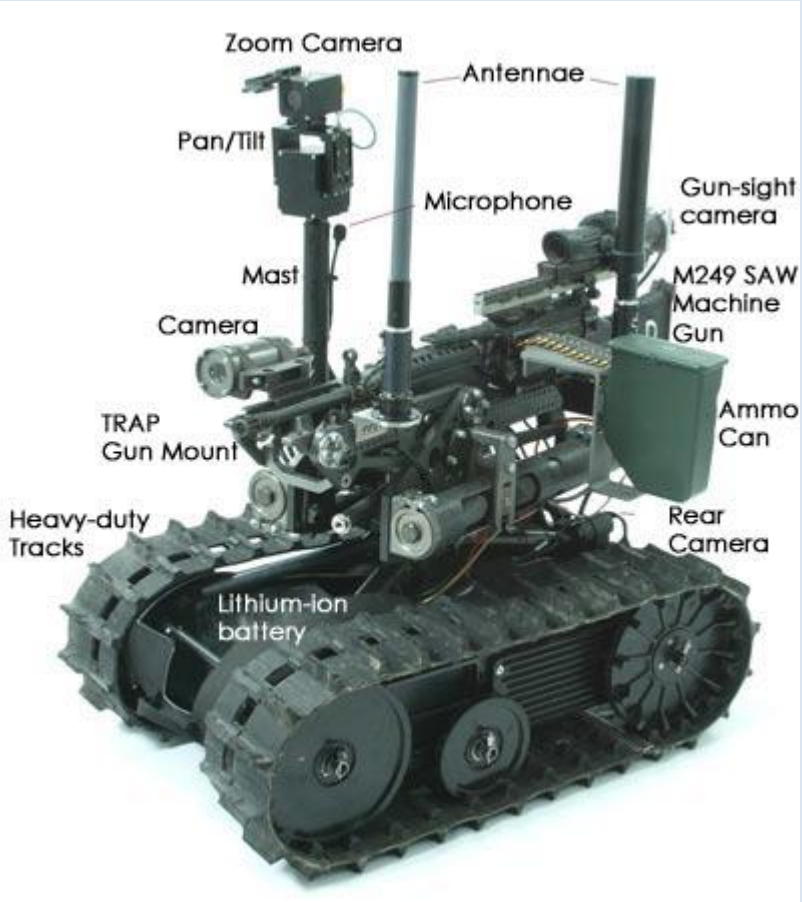
2) Nutrition Coaching: Meal tips are designed by top nutrition experts. Learn about the super foods and eating habits that help you maintain a healthy weight and stay energized throughout the day. The smart accelerometer in the sensor tracks your daily activity level, which larklife translates into expert nutrition coaching for your optimal meal times and the types of foods you should eat.

Clearly utilized wisely this is the way forward in building a smarter planet.


TESLA COIL-
invented in 1891,
used in wireless
data transmission

Electronics and Modern Warfare: Boon or Bane?

- By Bhanu Srivatsav
(Student, Dept of EE, BPHC)



Blaring Gun Shot..Blaring Gun Shot... Nope we're not in middle of a Counter Strike Tournament, in which if one fails to deliver the head-shot the game simply restarts itself. Yes ladies and gentlemen we are talking war and in this game of life or death there is only one winner. Lives of soldiers aren't easy; it is because of their continuous attempts at defending our borders that we breathe a sigh of relief every night on our ever so comfortable beds and then go to sleep. Let's actually look at what electronics does to improve the military and how engineers can add teeth to the existing defense

Robots are fun to work with"- this is how your typical teenager who has managed to build a robot to play soccer with him, or to make it just do pushups (or even gangnam style for that matter) would react. However the bigger picture at this point of time should be "Robots being useful in aiding human life". What I'm trying to get at is pretty simple.

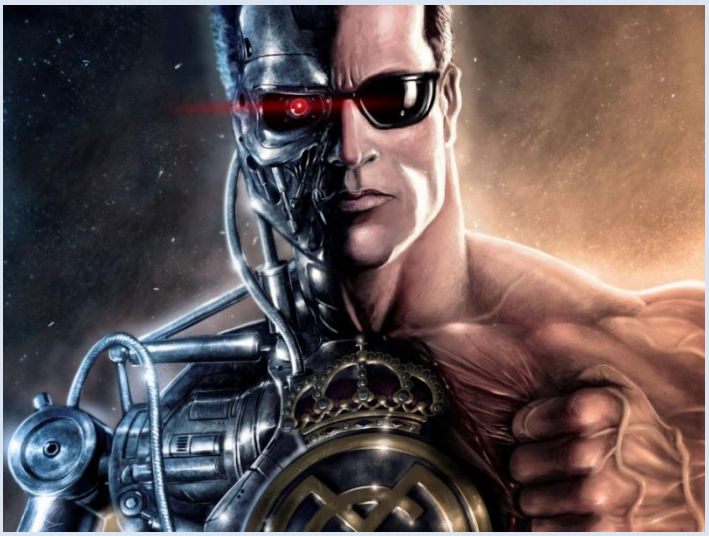
If we had robots manning our borders and fighting our wars the loss of human life can easily be prevented. Be it Will Smith's "iRobo", Rajnikanth's "Robot", or Arnold Schwarzenegger's "Terminator" series, one thing is for sure: Robots if used effectively, and effectively is the important part folks (if not they shall backfire in the most violent of ways) can play a crucial role in saving human lives, maintaining peace at borders, and to an extent protecting the environment from the ever so destructive nuclear materials (and thus the weapons of mass destruction).

Apart from this they can be used to aid the police as well (maybe not as effectively as shown in "Robocop"). The major advantage being the element of versatility which is limited to an extent due to human nature. Robots as obvious as it might be seem are slaves and these slaves come in all shapes and sizes. Thus they end up fitting into places where the human either cannot or does not wish to go. Be it a swampy marsh which stinks, a terrain that cannot be trekked by the best of mountaineers

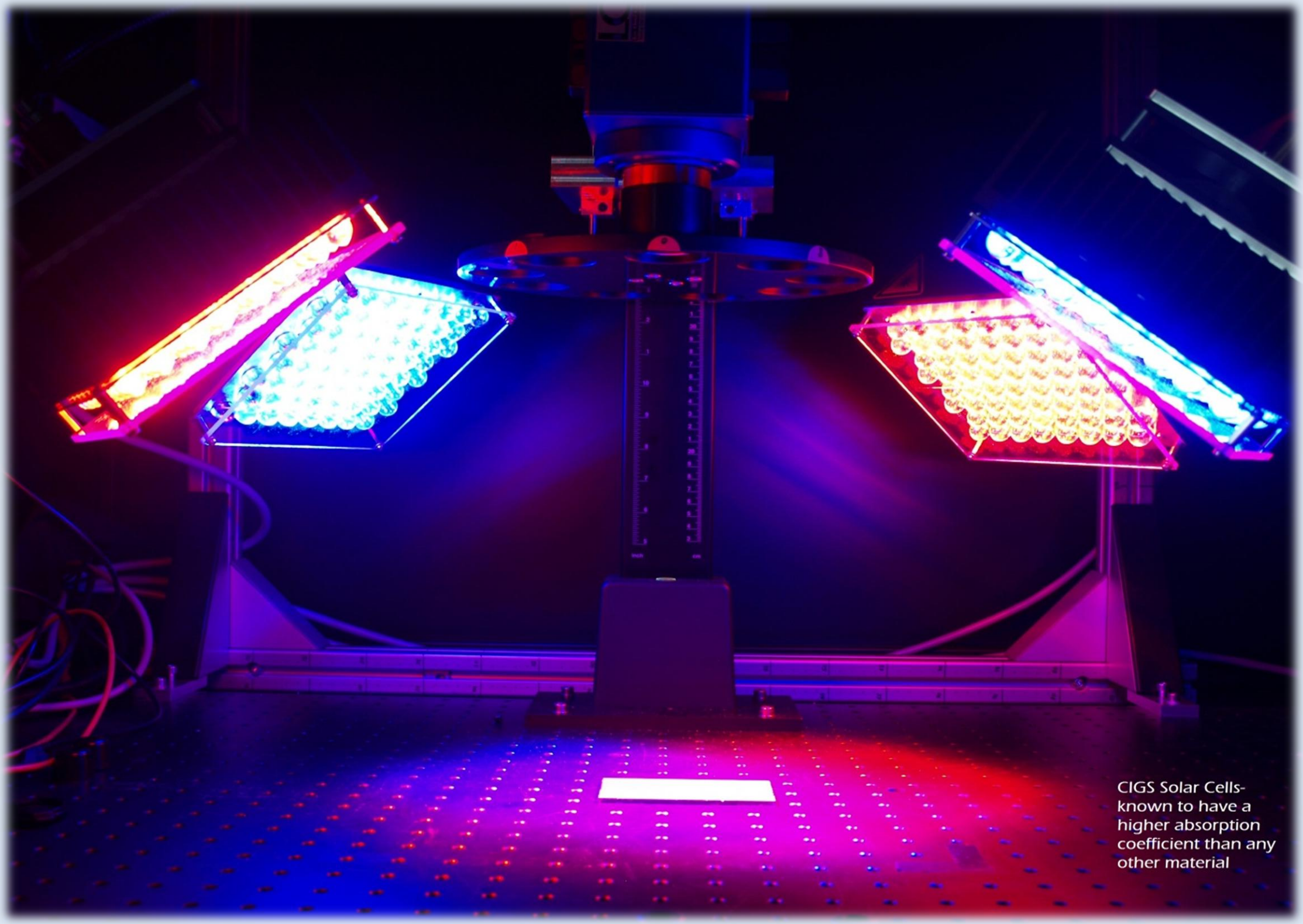
or even the most hostile military base studded with the deadliest of landmines and the harshest of fences a robot gets the job done. With robots installed and deployed at appropriate places, we hope that unfortunate events like the recent one in our national capital would be rare. Imagine an AjmalKasab being shot, before he even came close to committing the crime; months before our judicial machinery. So harnessed properly they can be a boon at times.

What a standard robot comprises of is not as complex as it might seem to the ordinary eye. Throw in a few mechanical parts like wheels, bases which are close to the streamline shape, few arms and legs (mimicking the animal limbs) and you have your basic mechanical design. As for the electrical part it is a bunch of wires, actuators(motors) which work harnessing electrical energy, a basic circuit design (comprising of the classic components such as capacitors, resistors, diodes and few others), and a remote to control the whole apparatus.

However impressive all this might seem, sometimes experiments with robotics end up yielding horrendous results indeed. How you might ask? Fallen into the wrong hands, even Rajnikanth's 'Chitti' became destructive. The same robot which was supposedly employed to kill Kasab could be easily manipulated to be used against innocent Indians. These linear thinking machines could be ineffective in handling real-world situations requiring human discretion.



Finding the right balance in the world which is unbalanced is not an easy task. But provided this cutting edge technology is used in a way that does not threaten the existence of mankind to an excessive extent, it can prove to be a major tool in adroitly harnessing technology.


CIGS Solar Cells-
known to have a
higher absorption
coefficient than any
other material

Motion sensing- Entering the world of Gyroscopes and Accelerometers

- By Sidharth Sahadev
(Student, Dept of EE, BPHC)

Well, you must be familiar with the word sensors. What comes to your mind when you hear the word "sensor"? The text book definition of a sensor is "a detector/converter that measures any physical quantity and converts it into a signal which can be read by an observer or by an instrument."

There are sensors which are used to guide us in many applications that deal with self-correction or motion based. Among these are the two very versatile sensors known as the gyroscopes and accelerometers

An accelerometer is a sensor that measures acceleration relative to a free-falling frame of reference. They can measure the magnitude and direction of the acceleration, and can be used to sense the orientation of the device. Always keep this in mind: the accelerometer is measuring just the linear acceleration of the device. It doesn't take into account the orientation. At rest, it'll give you the force of gravity acting on the device, and correspondent to the roll and pitch of the device (in atleast x-y directions). When the device is in motion, it gives us the acceleration due to gravity, plus the acceleration of the device relative to its rest frame. A two axis accelerometer will give us the direction of gravity on our balancing instrument. Accelerometer measures vibrations. It has extensive applications in engineering, machinery monitoring, building and structural monitoring, navigation, and transport and consumer electronics.

These are used in smart phones and your PS-3 and Wii remotes. Also now, they have been incorporated in new generation laptops and notebooks.

So what are pitch, roll and yaw?

For the people with some kind of background in aero-modeling, these terms would sound pretty familiar. For others to understand these terms, imagine 3 lines running through an airplane, all at right angles to each other, meeting at the center of gravity of the plane.

The rotation around the front-to-back axis is called Roll. Known as the dipping of the plane's wing. The movement is done about a horizontal axis stretching from the nose to the tail of the aircraft. Something known as Ailerons (located on the trailing edge of both wings) control the roll.

Rotation around side-to-side axis is called pitch. It is a measure of the plane's movement either up or down. The movement is done about the horizontal axis stretching from one wing tip to the other. It is controlled by the elevator located on the rear of the aircraft on the tail, along with the rudder.

And the rotation around the vertical axis is called yaw. Yaw allows the plane to move left or

right while in flight. The movement is done about a vertical axis. The yaw is controlled by the rudder which is located at the rear of the aircraft on the tail.

A gyroscope is another sensor that can be used to either measure, or maintain, the orientation of a device. Unlike an accelerometer, which measures the linear acceleration of the device, a gyroscope measures the orientation directly. Mechanically speaking, a gyro is a spinning wheel/disk in which the axle is free to take any orientation. The orientation will change in response to the external torque in a different direction than it would without the large angular momentum associated with the disk's high rate of spin and moment of inertia. Now, the external torque can be minimized by mounting the device in gimbals, so its orientation remains nearly fixed, regardless of any motion of the platform on which it is mounted.

Gyros based on other operating principles also exist, like the electronic, microchip-packaged MEMS gyroscope devices found in consumer electronic devices, solid-state ring lasers, fibre-optic gyroscopes and the extremely sensitive quantum-gyroscope.

Typically a gyro is used to measure angular position using the principle of rigidity of space of the gyroscope. It has many practical applications. It can be used for navigation, on unmanned aerial vehicles, and radio controlled helicopters and has very large scope in consumer electronic devices too.

Gyroscope and Accelerometer together

When combining a 3 axis gyroscope and a 3 axis accelerometer, it will provide a six-axis (3+3) interpretation of movement through space. This is especially useful in robotics and other hand applications, because it can now easily filter out the unintended ambient movement and vibration of a user's hand or any other external noise, thereby allowing a more accurate measurement of movements. When a gyro and accelerometer are combined, it becomes possible to simultaneously measure the acceleration and gravitational placements in the x, y and z axis. This integration gives us a total of six orientation measurements. Hence it's possible to better balance a robot/bot which usually is a very unstable set-up in itself. Both of them are used together to create a more accurate measurement of the overall movement and location through space. The purpose of this sensor fusion is to take each sensor measurement data as inputs and then apply digital filtering algorithms to compensate each other and give out the accurate and responsive dynamic altitude (pitch/roll/yaw) results.

A very small Application:

Whenever you hear the word gyroscope, your mind tends to think of mechanical gyroscopes, the ones with a spinning disc that is mounted inside multiple gimbals allowing it to take any orientation. However, the gyros inside the iPhone 4 are a MEMS-based gyro (more like the three independent MEMS gyroscopes). A MEMS gyroscope takes the idea of the Foucault pendulum and uses a vibrating element, known as a Micro Electro-Mechanical System.

The original iPhone, and first generation iPod Touch, use the LIS302DL 3-axis MEMS based accelerometer produced by STMicroelectronics. Later iPhone and iPod Touch models use a similar LIS331DL chip, also manufactured by STMicroelectronics.

The iPhone's accelerometer measures the linear acceleration of the device so that it can report its roll and pitch, but not its yaw. If you are dealing with an iPhone 3GS, which has a digital compass, you can combine the accelerometer and magnetometer readings to have roll, pitch, and yaw measurements

When the iPhone's accelerometer measurements are combined with the gyroscope measurements, developers can create applications that can sense motion on six-axes: up and down, left and right, forward and backwards, as well as the roll, pitch and yaw rotations.

So now we know how all our motion sensing games actually work!

MATLAB FUN STUFF

- By Pratyush Mahapatra
(Student, Dept of EE,BPHC)

MATLAB Easter Eggs

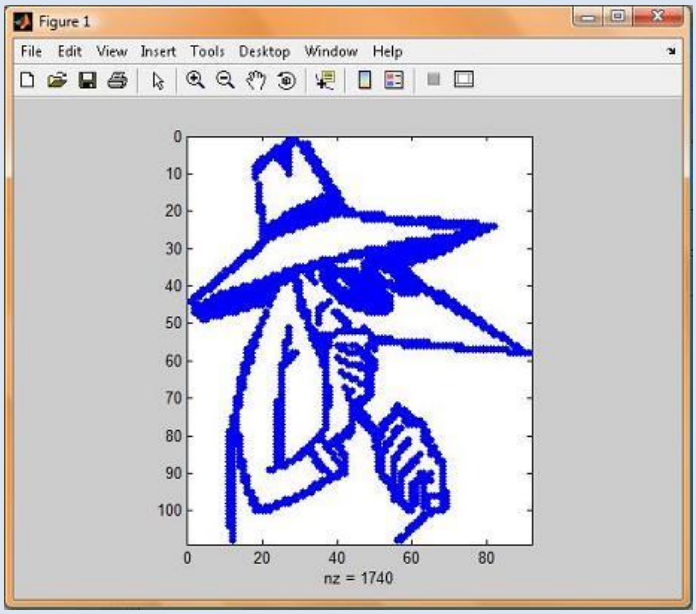
How often is it that we feel terribly bored while working through the puzzle that is MATLAB! Sometimes it is the code that we are never able to get, sometimes it is a different logic that we are unable to unravel and sometimes it is just a small bug, a little tiny bug that takes ages to figure out. But whatever it is, there are times when we just want to throw our hands in the air with an air of finality.

Buddy, you need a break.

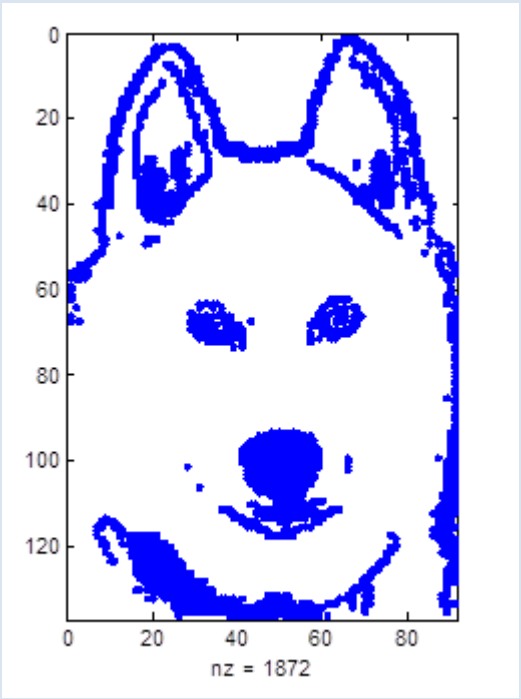
MATLAB developers recognized this and integrated some pretty cool stuff into some real crafty commands. From simple games to references to popular culture, MATLAB ensures that you get that little break you deserve.

(Disclaimer- PhoEniX is in no way responsible for screaming instructors, reduced lab marks and a general increase in average minesweeper scores.)

>>spy
Relive the classic wordless comic strip on your MATLAB graph window. This command gives the classic Spy vs. Spy picture.

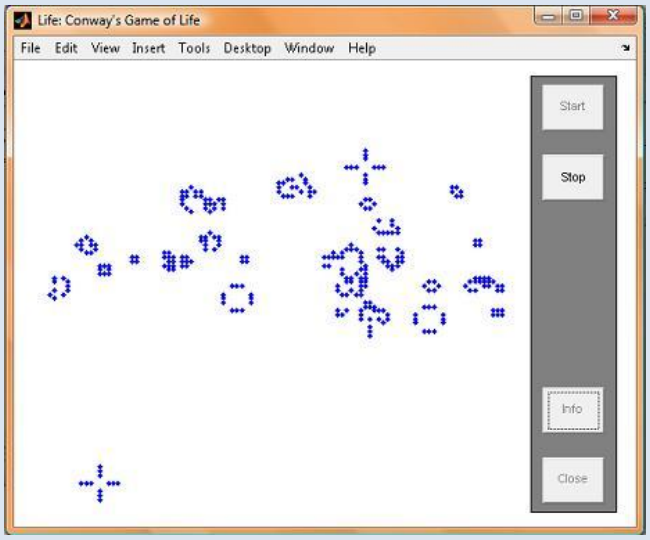


The latest version gives-



>>life

Conway's Game of Life is a popular cellular automaton based on complexity sciences and theoretical biology, which you interact with by setting a certain initial state. Honestly, I just like to watch those squiggly things move around like jellyfish.



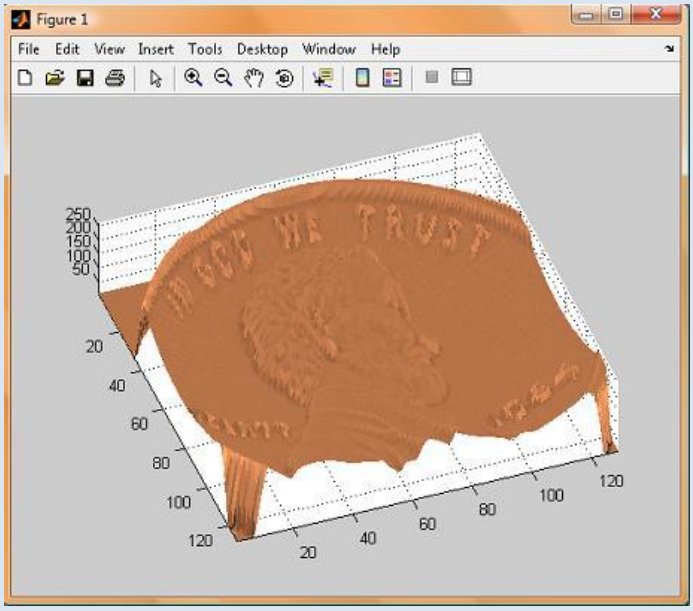
>>why

why even bother working? If these questions plague your mind and you're looking for some real inspiration, then look somewhere else. Because MATLAB thinks it's a silly question. And as the old saying goes: Ask a silly question, and you get a silly answer.

```
>> why
The computer did it.
>> why
She asked some system manager.
>> why
Don't you have something better to do?
>> why
Some good engineer wanted it.
>> why
Pete insisted on it.
>> why
Because Bill obeyed a tall and bald kid.
>> why
For the approval from her.
>> why
For the approval of Bill.
>> why
Barney obeyed the rich and rich mathematician.
>> why
In the beginning, God created the heavens and the earth...
>>
```

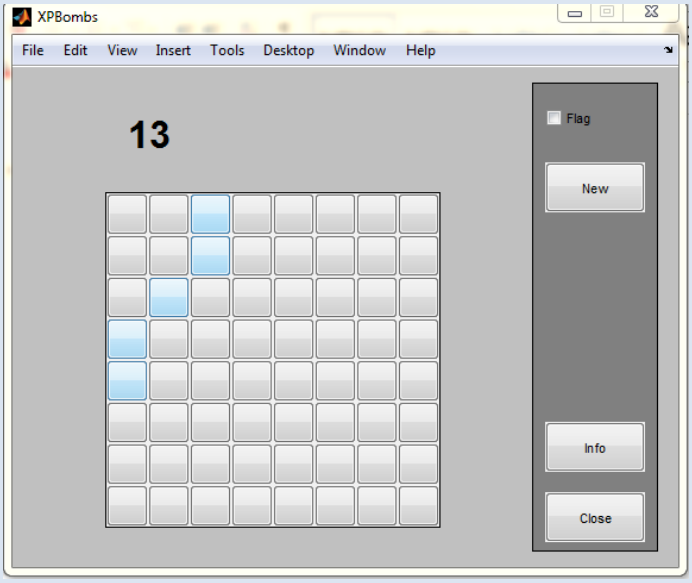
>>penny

this command gives you a stunning replica of the typical American penny.



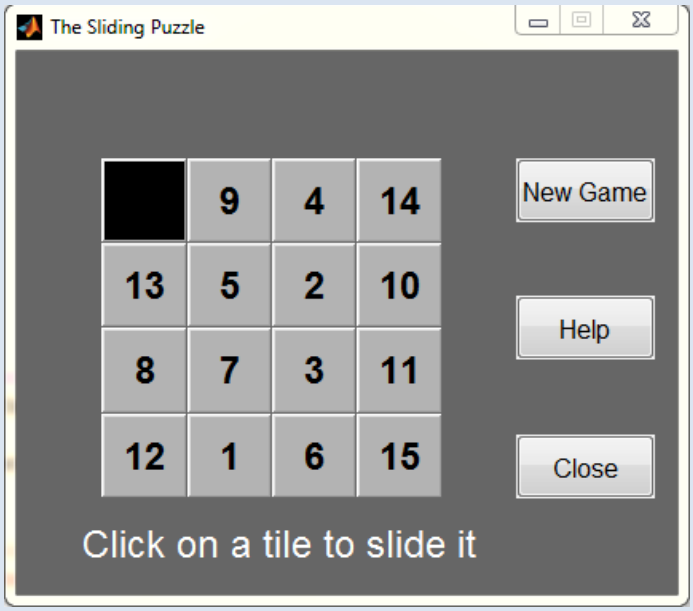
>>xpbombs

Because playing Mindsweeper from Windows is too damn mainstream.



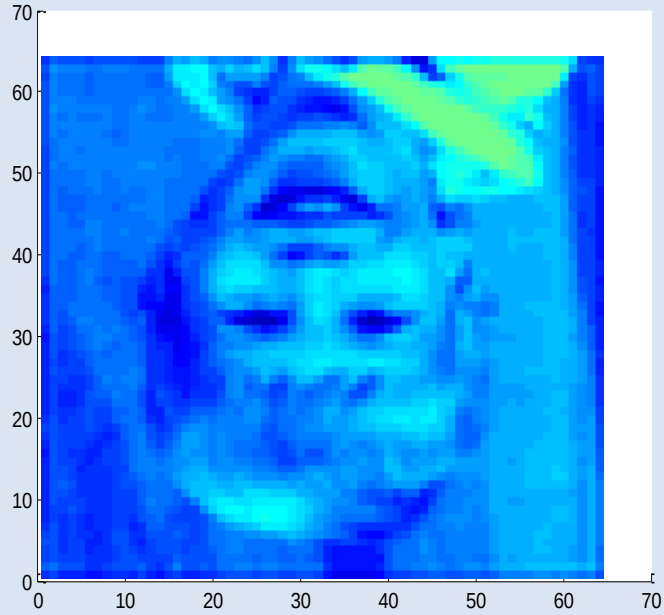
>>fifteen

The sliding puzzle game: simple, intuitive and classic. That ought to get those gray cells running.



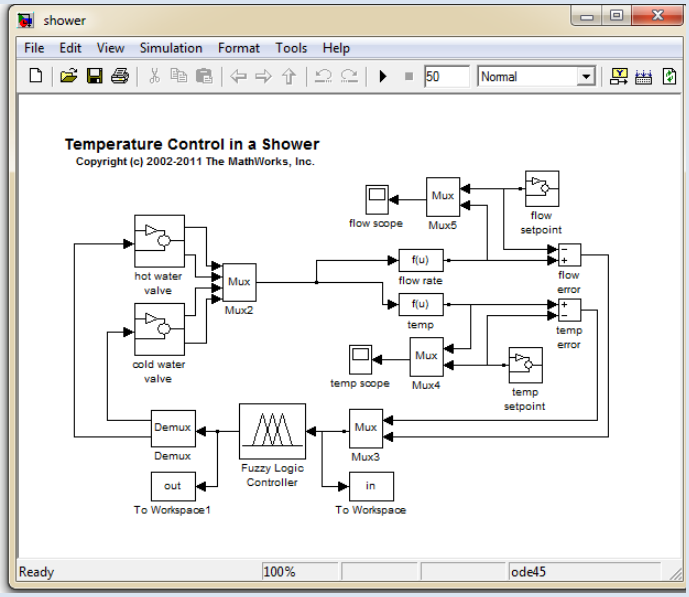
>>image

A big baby. Just like how you still are.



>>shower

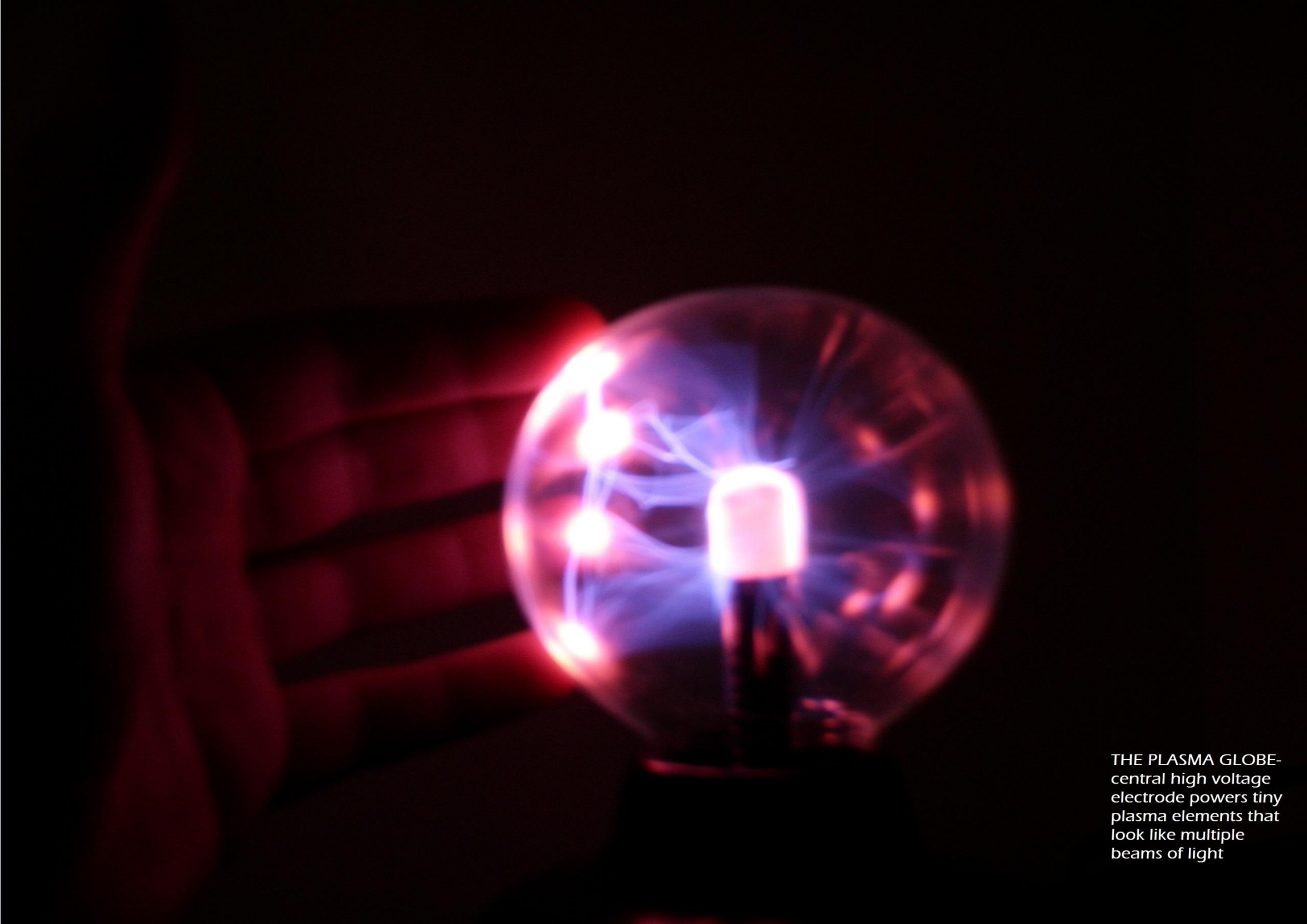
Get a detailed block diagram of a temperature control system in your shower. And you thought a shower was quick and easy.



>>load handel

>>sound(y,Fs)

Try it at home. You can also change the value of Fs (which is the sampling frequency) to note the various changes



THE PLASMA GLOBE-
central high voltage
electrode powers tiny
plasma elements that
look like multiple
beams of light

PHoEnix Events 2012-2013

1st Semester

1) Introductory Seminar on Autobotz AVR-Technophilia workshop

2) IEEE workshop on Embedded Systems

3) Autobotz AVR - Technophilia workshop

4) The first ever PHoEnix Talks - headed by Prof Y Yoganandam

5) TechniQ-Quiz

6) Newsletter release –THE E.T

ATMOS Events

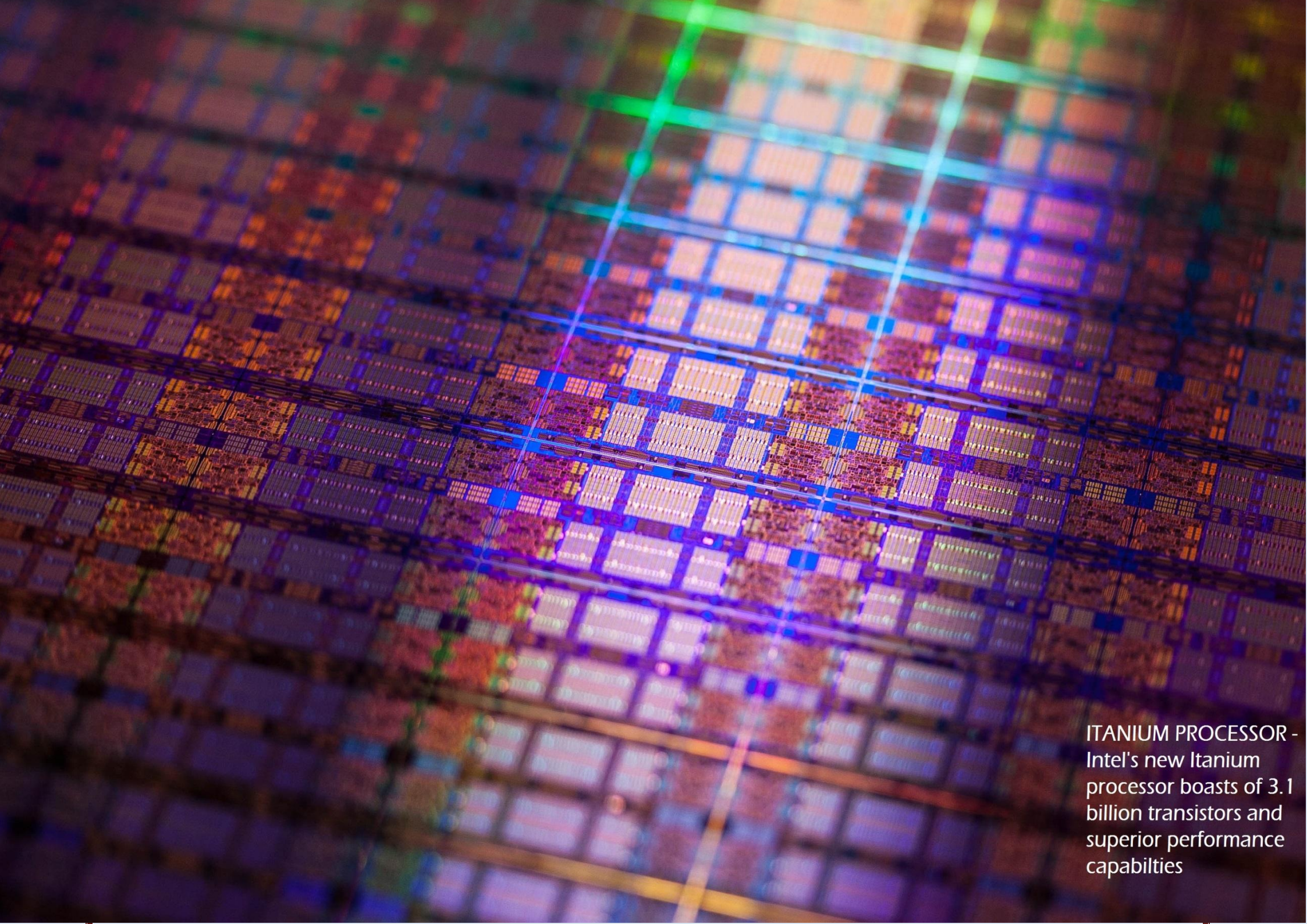
1) Open Micro Challenge
2) The Circuit ART
3) Rage of the Titans
4) A'MAZE'D
5) Paper Presentations
6) Sixth Sense Technology Workshop

2nd Semester

1) PHoEnix Talks on future of electronics and general opportunities in India - Mr. V Chetan Kumar

2) PHoEnix Talks on Wireless Technologies - Mr. M Kaushik

3) T Shirt Release



ITANIUM PROCESSOR - Intel's new Itanium processor boasts of 3.1 billion transistors and superior performance capabilties

NANO TREES-
new nano wires
built using tiny
droplets of
Gallium on a
Silicon surface

PHoEnix Office 2012-13

1st row (from left) : Anand Bharadwaj, A Yashaswy, P V Kalyan, Gopi Krishna, Pratyush Mahapatra, Varun Sai, A Ranjan, Bhanu Srivatsav, Aalhad Parulekar, Vineet Cherian
2nd row (from left) : Lakhan Shiva, Chandrasekhar Reddy P Avinash, Navaneeth Rao, Nikhil Velamati, Nikhita Kunati, Somya Agarwal, Priyanka Kachare, J Anusha
3rd row (from left) : Sneha Sindhu, Aishwarya Reddy, Sumedha Acharya, L Sai Krishna, C Sravya
Sitting : Prof. Y Yoganandam (HOD Dept of EEE), Mr. Syed Ershad Ahmed (FIC PHoEnix); Not in picture : Mrs. Madhuri Bayya (FIC PHoEnix)

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