PHoEnix

BITS-PILANI,

Department of Electrical Engineering

Office of 2014-15

05-Mar-15

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FROM THE HOD'S DESK

A great deal of effort has been put into the making of this magazine LIVEWIRE 6.0 and I would like to congratulate all those who have contributed into the making of such a wonderful piece of literature.

This magazine has covered broad topics ranging from communications, microelectronics, and wireless charging to abstract concepts. The objective of the magazine is rightfully fulfilled due the wide scope of the articles and 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 and has its own online version in the near future, making it open to a larger group of interested readers. Since, the fields of electronics and communications are experiencing a phase of rapid research and development, I'd suggest that LIVEWIRE should be a triannual magazine.

Regards

Prof. Y. Yoganandam

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FROM THE OFFICE

Commitment is one unflagging quality which is often associated with the office of the Electrical and Electronics Association, BITS-Pilani, Hyderabad Campus, year after year. The weight of expectations, the sense of responsibility, and a persistent vision to enhance the technical culture on campus have been the driving forces behind all PHoEnix activities. Being in-charge of the largest technical association on campus, with a 1200 strong general body is an overwhelming task indeed. The PHoEnix office, from day one, has taken this challenge very positively and has remained unfaltering in this endeavor ever since.

This year saw PHoEnix collaborate with National Instruments over a hugely successful workshop during ATMOS'14. Also conducted, keeping in view the objectives of PHoEnix, were the Pre-Atmos Workshop Series, numerous talks, lectures and events. The upcoming 65K Innovation Contest and the PHoEnix Project Repository are efforts to the same effect. With events like Robowars'14, 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.

A first of its kind, The PHoEnix Vs Mechanical Association Faculty Cricket Match also saw fervent participation by professors and PHD scholars from both the departments. One could easily sense the electric atmosphere throughout the match.

PHoEnix has always striven to improve the technical acumen of our campus. In the light of realization of the same, 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 they imparted on us.

We would also like to extend our deepest gratitude to the PHoEnix Editorial Board, who have diligently covered every event, with utmost detail, and are single-handedly responsible for materializing the PHoEnix official magazine. We hope this March edition of LIVEWIRE would serve as a veritable feast to all the technical minds out there, and bring to their memory all the technical splendor they witnessed this year.

FROM THE EDITORIAL BOARD

Welcome to the March 2015 issue of Livewire. As you read its contents, you will observe that it is a source of 'unique' information for electronics and communication enthusiasts. From the latest news in the world of electronics to the future-controlling big players in the field of technology all rolled into one that is LIVEWIRE is directed to readers like yourself, who savour learning more about the latest developments in the world of electrical, electronics and instrumentation engineering, Livewire shows you what is new, how stuff works, how to use it, and construction plans for useful electronics devices.

This issue of Livewire focuses primarily on latest trendsetters in the field of electronics and communication. We also aim to channelise your enthusiasm to the formidable world of semiconductors, meta-materials, renewable energy, so on and so forth.

Included inside are the events and competitions hosted during the first semester of 2014-15, a report of all activities that were conducted by the office. There is a reason people succumb their jaws to gravity over PHoEnix, and we welcome you to the club!

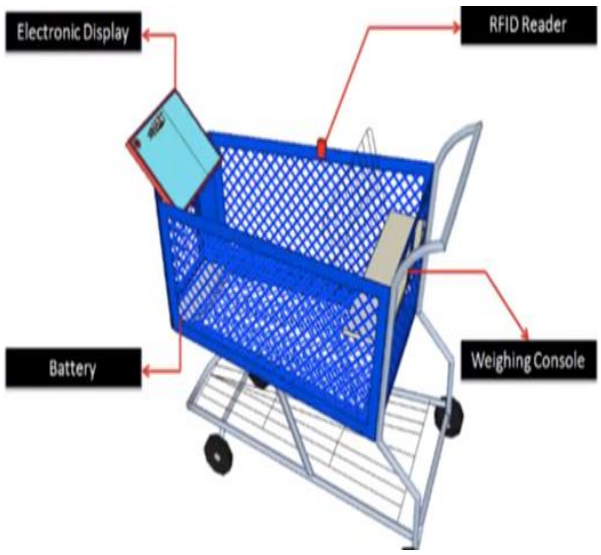
We have tried our best to avoid all sorts of typographical errors, however we are deeply apologetic if any are found.

This magazine was an amazing experience. The effort that all the people have contributed to it is worthy of emulation. We are open for all sorts of comments, help us improve, we promise you worthiness.

ELECTRONICS NEWS

(1) Smart Trolleys

Smart Trolleys might revolutionize the shopping experience of customers in the near future. This innovation greatly improves the quality of grocery shopping. The smart trolley is equipped with multiple features like the ability to harvest energy from the rotation of the wheel, interact with the customers (who are mostly reluctant to download android apps) and suggest discount vouchers based on their location in the supermarket. This low cost, energy efficient technology can be easily integrated with the existing retail equipment. This in turn improves the efficiency for both the retailer and the customer. The 'smart' trolley improves the quality of the frustrated customer's shopping of standing in long queues to a leisure by mapping the position of the customer and finding out the most efficient route through a store, based on the customer's shopping list.



(2) An Air Conditioner that follows you around

The Senseable City Lab, are debuting a prototype heater and air-conditioner with an idea stating, 'Why waste the energy to heat or cool an entire building or room when you could micro-target the space of a human, instead?' The heater is called Local Warming, which was installed in Venice, uses servo motors, infrared lamps, and motion tracking to direct rays onto people.

The Senseable City lab comment 'Measuring the time interval between sending the signal and receiving the echo to determine the distance to the floor, visitors passing between the sensor and the floor will produce an increase or decrease in this time interval, having either absorbed or reflected the sound waves respectively. Data from these sensors is fed to a central control system used to trigger hydro-valves and LED lights in proximity to the detected target.'

(2) Arduberry

Arduberry, the one shield that allows designs compatible with both the Arduino and the Raspberry Pi computing platform, is up in the market for $23. This shield simply slides over the Raspberry Pi and allows a further stacking of Arduino shields. A claim says that no physical configurations are required whatsoever and that Arduino programs can be directly written onto the Raspberry Pi. This device is being manufactured by Dexter Industries, a US-based embedded design store, the Arduberry is compatible with the Raspberry Pi models B, and B+. Also, the shield is compatible with C and Python programming languages.

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Report of Activities (until 22nd April '14)

PHoEnix Introductory Talk 3.0:

Date: 13th August 2014

A brief orientation session was conducted for all the students of the department (of Electrical Engineering) to familiarize them with the different fields of engineering dealt and the ongoing research being conducted by our department. The speakers for the session included Prof. Y. Yoganandam, Prof. Bhuvaneshwari, Dr. P.K. Pattnaik, Mr. U.M. Rao and Mr. V Chetan Kumar, who enlightening us about their research and the subjects dealt by them in the curriculum.

Freshers' Meet:

Date: 26st August 2014

The freshers were formally welcomed to the association on this day. The occasion was graced by the presence of both the Faculty-In-Charges of the association, Dr. Prasant Kumar Pattnaik and Mr. V Chetan Kumar. Along with the newly elected body, few of the ex-office bearers gave them the insights into the technical culture of the campus and encouraged the new members to add their value to the association. Followed by a long line-up of cultural events, the seniors and juniors interacted all along the way thus breaking the barriers to live together, work together and learn together in the coming years.

Pre-ATMOS workshop:

Date: 23rd and 24th September 2014

A workshop on the basics of digital electronics, using Arduino and its practical applications attracted a lot of first year folks. The workshop gave an introduction of the Arduino to all the novices. This workshop helped a lot of students to participate in further events held during the period of the semester.

Pre-ATMOS Line Follower (Follow the Line):

Follow the Line was organized to encourage budding robotics enthusiasts to showcase their mettle and challenge time and accuracy. Around 30 member teams faced off to be crowned perfectionists; the top two teams were rewarded for their efforts.

ATMOS Events

Date: 10th, 11th and 12th October

NI (National Instruments) Workshop:

A two day event hosted during ATMOS-14 addressing a problem statement, BYOES which stands for 'Build your own embedded system' design using LabVIEW. The workshop was hosted by a National Instruments employee and a faculty for Indo US Collaboration for Engineering Education (IUCEE) and Faculty Leadership Program at NI. This event saw a registrations of over 300 teams from different colleges across Hyderabad.

Robowars:

This Headliner event of ATMOS-14 saw one of the largest audience in the history of BITS-Pilani, Hyderabad Campus. With an increased participation of 17 teams from last year's 10 teams, arriving from various colleges from Maharashtra to Orissa along with two of our very own home teams, this was easily one of the biggest attention grabbers of the technical festival.

Open Micro Challenge:

OMC, recognized for its uniqueness as an event dealing with simple yet innovative electronic solutions to day to day problems (using Microprocessor Interfacing), drew a large chunk of participation from the overall audience of the technical festival.

LAW Follower:

LAW follower short for 'Line and Wall follower', was easily one of the attention seekers of ATMOS '14. Huge audience poured in at regular intervals. The event that was first organised last year, had a significant increase in participation compared to last year with a few home teams to cheer for.

iVision:

Interested in Image Processing! Want to save the world using your robot. An event so unique in nature. It had a very difficult screening process in the initial rounds as only two teams were able to clear to the final round of the event. It was considered as one of the most interesting and challenging competitions held during the festival.

innovate achieve lead
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Circuit Art:

Circuit Art, a digital circuit building competition known for its teasing simplicity hidden in complexity, saw a very decent participation of about 55 teams. The event that spanned across two days with two rounds inspired participants to treat real life problems the electronic way.

Paper Presentation:

ATMOS provided the participants an opportunity to showcase their ideas on a unique platform in the form of an integrated paper presentation. This event, stretched over 8 hours, on two days had a great turnout participants from across the country. Select participants invited were judged based on the originality of the idea, the presentation and the technical details/results of the paper. Well, most of the prizes were bagged by BPHC students.

PHoEnix Talks 3.1 (focusing on Placement):

Date: 15st November 2013

The alumnus of our very own college who have a work experience of over a year at core companies, viz. Rishav Rej (currently working at Qualcomm), C.R. Vishnu Vardhan (currently working at Redpine Signals), along with the HOD Prof. Y. Yoganandam graced their presence to resolve the increasing queries of uncertain and concerned students. They explained their job profiles and also addressed all the issues that most students were concerned about. This session turned out to be very productive and gave a lot of aspiring students, new directions to think of.

Quiz on Digital Electronics:

Date: 25th November 2013

A quiz based on Digital Design, a course taught to the 2nd years' of ECE, EEE, EIE and CSE disciplines. This quiz was conducted in order to increase the quality of understanding (especially for the 2nd years') and for them to realize the importance of the course and the various applications that it serves. This quiz saw a huge participation, and thanks to it, a great deal of interests generated among all folks.

LIST OF OFFICE BEARERS FOR THE YEAR 2014-15

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(Secretary)
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(Joint-Secretary)
Chandan Bothra
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Mohit Prasad
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Satyam Damele
Vishal Sharma

STANDARDS (IEEE 802.11)

-Abhishek Sure

What is a standard?

Standards are published documents that establish specifications and procedures designed to ensure the reliability of the materials, products, methods, and/or services people use every day. Standards address a range of issues, including but not limited to various protocols that help ensure product functionality and compatibility, facilitate interoperability and support consumer safety and public health.

What is the importance of standards?

Standards form the fundamental building blocks for product development by establishing consistent protocols that can be universally understood and adopted. This helps fuel compatibility and interoperability and simplifies product development, and speeds time-to-market. Standards also make it easier to understand and compare competing products. As standards are globally adopted and applied in many markets, they also fuel international trade.

It is only through the use of standards that the requirements of interconnectivity and interoperability can be assured. It is only through the application of standards that the credibility of new products and new markets can be verified. In summary standards fuel the development and implementation of technologies that influence and transform the way we live, work and communicate.

What is the role of IEEE?

The Institute of Electrical and Electronics Engineers Standards Association (IEEE-SA) is a non-profit organization within IEEE that develops global standards in a broad range of industries, including: power and energy, biomedical and health care, information technology, telecommunication, transportation, nanotechnology, information assurance, and many more.

IEEE-SA is not a body formally authorized by any government, but rather a community. Formally recognized international standards organizations (ISO, IEC, ITU, CEN) are federations of national standards bodies.

What is the work done by them??

The IEEE-SA brings together a broad range of individuals and organizations from different technical and geographic points of origin to facilitate standards development and standards related collaboration.

IEEE-SA members are the driving force behind the development of standards, providing technical expertise and innovation, driving global participation, and pursuing the ongoing advancement and promotion of new concepts.

Types of Standards

- Official Standard:

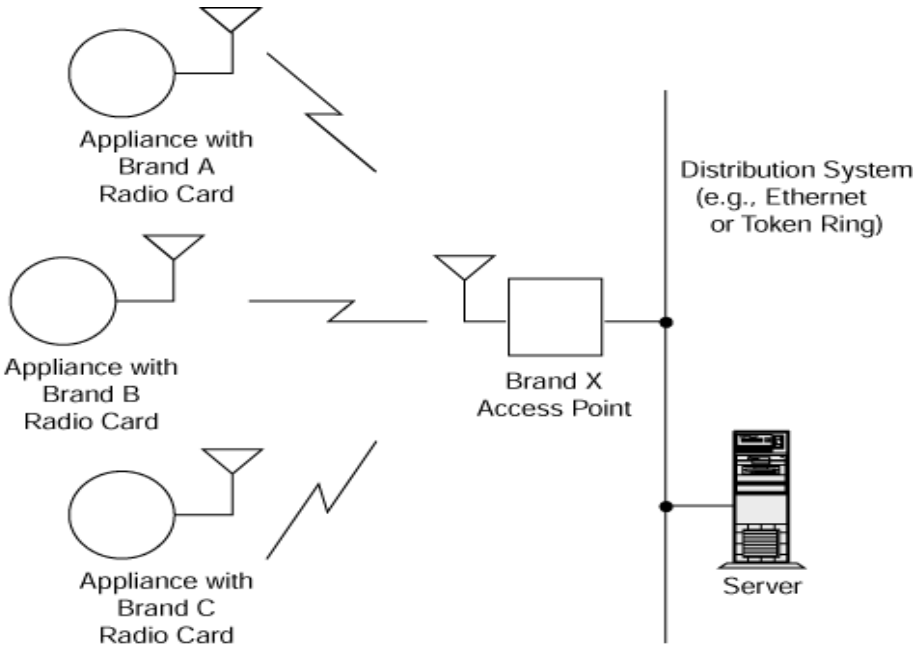
An official standard is published and known to the public, but it is controlled by an official standards organization, such as IEEE. Government or industry consortiums normally sponsor official standards groups. Official standards organizations generally ensure coordination at both the international and domestic level.

- Public Standard:

A public standard is similar to an official standard, except it is controlled by a private organization, such as the Wireless LAN Interoperability Forum. Public standards, often called de facto standards, are common practices that have not been produced or accepted by an official standards organization.

IEEE 802.11 Wireless LAN Standard (one of greatest application standard world-wide)

Vendors and some end users initially expected markets to dive head first into implementing wireless networks. Markets did not respond as predicted, and flat sales growth of wireless networking components prevailed through most of the 1990s. Relatively low data rates, high prices, and especially the lack of standards kept many end users from purchasing the wire-free forms of media.



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For those having applications suitable for lower data rates and enough cost savings to warrant purchasing wireless connections, the only choice before 1998 was to install proprietary hardware to satisfy requirements. As a result, some organizations today still have proprietary wireless networks for which you have to replace both hardware and software to be compliant with the IEEE 802.11 standard. In response to lacking standards, the Institute for Electrical and Electronic Engineers (IEEE) developed the first internationally recognized wireless LAN standard: IEEE 802.11.

Compliance with the IEEE 802.11 standard makes possible interoperability between multiple-vendor appliances and the chosen wireless network type. This means you can purchase an 802.11-compliant scanner from Symbol and a Pathfinder Ultra handheld scanner/printer from Monarch Marking Systems and they will both interoperate within an equivalent 802.11 wireless network, assuming 802.11 configuration parameters are set equally in both devices. Standard compliance increases price competition and enables companies to develop wireless LAN components with lower research and development costs. This enables a greater number of smaller companies to develop wireless components.

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VEDIC MATHS: *Redefining technology*

-Ishan Kumar

Welcome to the wonderful world of "Vedic" Mathematics, a science that its founder claims was lost due to the advent of modern mathematics. Vedic mathematics is said to be a gift to this world by the ancient sages of India, though there is no historical evidence whatsoever for this claim. It is a system for limited arithmetic and polynomial calculation which is simpler and more enjoyable than the equivalent algorithms of modern mathematics.

'Vedic Mathematics' is the name given to the ancient system of mathematics , or , to be precise , a unique technique of calculations based on simple rules and principles , with which any mathematical problem –be it arithmetic , algebra , geometry or trigonometry –can be solved , hold your breath , *orally*.

The Vedas, written around 1500-900 BC, by Sri Bharati Krushna Tirthaji Maharaj are ancient Indian texts containing a record of human experience and knowledge. Thousands of years ago, Vedic mathematicians authored various theses and dissertations on mathematics. It is now commonly believed and widely accepted that these treatises laid down the foundations of algebra, algorithm, square roots, cube roots and various methods of calculations and the concept of zero. Perhaps the most striking feature of the Tirthaji system is its coherence. The whole system is interrelated and unified: the general multiplication method, for example, is easily reversed to allow one line-divisions, and the simple squaring method can be reversed to give one-line square roots. And, these are easily understood. This unifying quality is very satisfying, it makes arithmetic easy and enjoyable, and it encourages innovation.

Difficult arithmetic problems and huge sums can be often be solved immediately by Tirthaji's methods. These striking and beautiful methods are a part of a system of arithmetic which Tirthaji claims to be far more methodical than the modern system. "Vedic "Mathematics is said to manifest the coherent and unified structure of arithmetic, and its methods are complementary, direct and easy.

The simplicity of the Tirthaji system means that calculations can be carried out mentally, though the methods can also be written down. There are many advantages in using a flexible,

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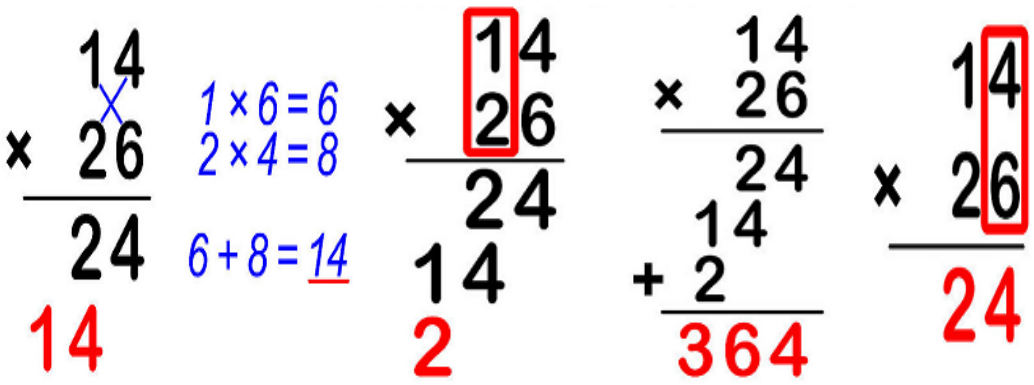
mental system. We can invent our own methods; they are not limited to one method. This leads to more creative, interested and intelligent ways to solve problems.

Interest in the Tirthaji's system is growing in education, where mathematics teachers are looking for something better and finding the Vedic system is the answer. Research is being carried out in many areas including the effects learning the Tirthaji system has no children; developing new, powerful but easy applications of these Sutras in arithmetic and algebra.

Now it's time to learn some cool tricks:-

- If you want to find the square of 45, you can employ the *Ekadhikena Purvena sutra* ("By one more than the one before"). The rule says since the first digit is 4 and the second one is 5, you will first have to multiply 4(4 +1), that is 4 X 5, which is equal to 20 and then multiply 5 with 5, which is 25. Viola! The answer is 2025.Now, you can employ this method to multiply all numbers ending with 5.
- If you want to subtract 4679 from 10000, you can easily apply the *Nikhilam Navatashcaramam Dashatah sutra* ("All from 9 and the last from 10"). Each figure in 4679 is subtracted from 9 and the last figure is subtracted from 10, yielding 5321. Similarly, other *sutras* lay down such simple rules of calculation.
- If you want to multiply two numbers let's say 14 X 26. This can be done using Sutra "Vertically and Cross wise". First multiply 6 with 4 to get 24. Write down unit answer i.e. 4 then cross multiply 6 with 1 and 2 with 4 and add the previous carry generated. Now multiply 2 with 1 and add as shown in the images to get the answer.



The real beauty and effectiveness of the Tirthaji system cannot be fully appreciated without practising the system. One can then see why its enthusiasts claim that it is the most refined and efficient calculating system known.

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Application of Multipliers in Digital Signal Processors.

In today's fast technologically developing world, the shift has been towards construction of small and portable devices. As the number of these battery operated, processor driven equipment increase and their performance demand is expected to be more, there is a need of increasing their processing speed and reducing their power dissipation. In such a consumer controlled scenario, these demands mean a serious look into the construction of the devices. These processors used for such purposes but also, in these processors , major operations such as FIR filter design, DCT, etc. are done through multipliers . As multipliers are the major components of DSP, optimization in multiplier design will surely lead to a better operating DSP.

Computational performance of a DSP system is limited by its multiplication performance and since, multiplication dominates the execution time of most DSP algorithms therefore high speed multiplier is much desired. Currently, multiplication time is still the dominant factor in determining the instruction cycle time of a DSP chip. With an ever-increasing quest for greater computing power on battery-operated mobile devices, design emphasis has shifted from optimizing conventional delay time area size to minimize power dissipation while still maintaining the high performance. Traditionally shift and add algorithm has been implemented to design however this is not suitable for VLSI implementation and also from delay point of view. Some of the important algorithm used for multiplication process are Booth, Array, Carry save, Modified Booth algorithms and Wallace tree. A number of interesting parallel and serial-parallel multiplier architectures have been proposed based on aforesaid algorithm which improve the cost- throughput efficiency.

Different Types of Multipliers:

In an array multiplier multiplication of two binary numbers can be obtained with one micro-operation by using a combinational circuit that forms the product bits all at once thus making it a fast way of multiplying two numbers since the only delay is the time for the signals to propagate through the gates that form the multiplication array. However, an array multiplier requires a large no gates and for this reason it is less economical.

The other aspect of improving the multiplier efficiency is through the arrangement of adders. As methods of arrangement of adders are concern, there are two methods: a carry save array (CSA) method and a Wallace tree method. In the CSA method, bits are processed one by one to supply a carry signal to an adder located at a one bit higher position. This is in fact much similar to a manual calculation method, where the layout thereof corresponds to the logic and is regular, and hence the design of layout is easy. The CSA method has its own limitation since

an execution time depends upon the number of bits of the multiplier; there is some difficulty in achieving high speed operation.

In the Wallace tree method, three bit signals are passed to a one bit full adder ("3W") which is called a three input Wallace tree circuit, and the output signal (sum signal) is supplied to the next stage full adder of the same bit, and the carry output signal thereof is passed to the next stage full adder of the same no of bit, and the carry output signal thereof is supplied to the next stage of the full adder located at a one bit higher position. In the Wallace tree method, the circuit layout is not easy although the speed of the operation is high since the circuit is quite irregular.
Another improvement in the multiplier is by reducing the numbers of partial products generated.

The Booth recording multiplier is one such multiplier; it scans the three bits at a time to reduce the number of partial products. These three bits are: the two bit from the present pair; and a third bit from the high order bit of an adjacent lower order pair. After examining each triplet of bits, the triplets are converted by Booth logic into a set of five control signals used by the adder cells in the array to control the operations performed by the adder cells. The method of Booth recording reduces the numbers of adders and hence the delay required to produce the partial sums by examining three bits at a time. The high performance of Booth multiplier comes with the drawback of power consumption. The reason for this is the large number of adder cells (15cells for 8 rows-120 core cells) that consume power. The conclusion is that the current methodology of multiplication leads to more consumption of power and reduction in efficiency.

Vedic Multiplier: Space, Time, Memory efficient

Multiplier based on Vedic Mathematics is one of the fast and low power multiplier. Minimizing power consumption for digital systems involves optimization at all levels of the design. This optimization includes the technology used to implement the digital circuits, the circuit style and topology, the architecture for implementing the circuits and at the highest level the algorithms that are being implemented. Digital multipliers are the most commonly used components in any digital circuit design. They are fast, reliable and efficient components that are utilized to implement any operation. This Vedic multiplier is based on an algorithm Urdhva Tiryakbhyam (Vertical & Crosswise) of ancient Indian Vedic Mathematics. It is based on a novel concept through which the generation of all partial products can be done with the concurrent addition of these partial products. The parallelism in generation of partial products

and their summation is obtained by using Urdhava Triyakbhyam. The algorithm can be generalized for n x n bit number. Since the partial products and their sums are calculated in parallel, the multiplier is independent of the clock frequency of the processor. Thus the multiplier will require the same amount of time to calculate the product and hence is independent of the clock frequency. The net advantage is that it reduces the need of microprocessors to operate at increasingly high clock frequencies. While a higher clock frequency generally results in increased processing power, its disadvantage is that it also increases power dissipation, resulting in higher device operating temperatures. By adopting the proposed multiplier, microprocessors designers can easily circumvent these problems to avoid catastrophic device failures. The processing power of multiplier can easily be increased by increasing the input and output data bus widths since it has a quite a regular structure. Due to its regular structure it can be easily layout in a silicon chip. The Multiplier has the advantage that as the number of bits increases its gate delay and area increases very slowly as compared to other multipliers. Therefore it is, time, space and power efficient. It is demonstrated that this architecture is quite efficient in terms of silicon area/speed. And as they say picture says it all.

Fig 1: Comparison of Multipliers With respect to Timing Delay in Spartan FPGA

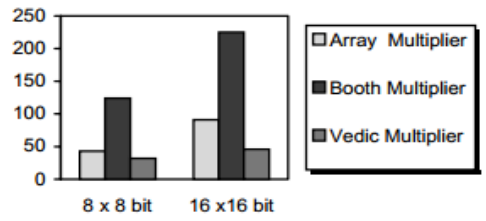


Fig 2: Graph Showing the growth in delays in Multipliers as Number of Bits Increases

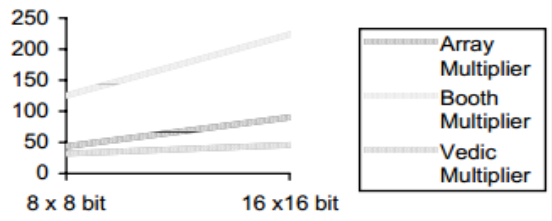


Fig 3: Comparison of Vedic Square With Multipliers With respect to Timing Delay in Spartan FPGA

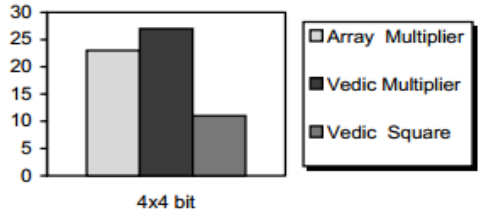
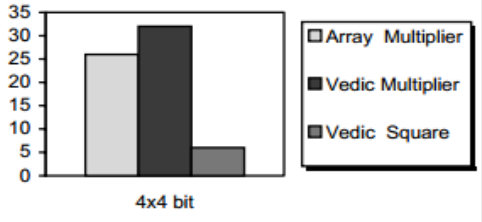


Fig 4: Comparison of Vedic Square With Multipliers With respect to Devices Used in Spartan FPGA



WIND TO THE RESCUE!

-Sanchit Mishra

A semester after my arrival at BPHC I was awestruck by the use of technology in the college. From large projector class rooms, to centralised air conditioned library. Now, all of these comes at a price. Students admitted before 2013 might remember the notices on the college notice monitors about the increment in electricity usage by the college as a whole. This article is about the very same issue.

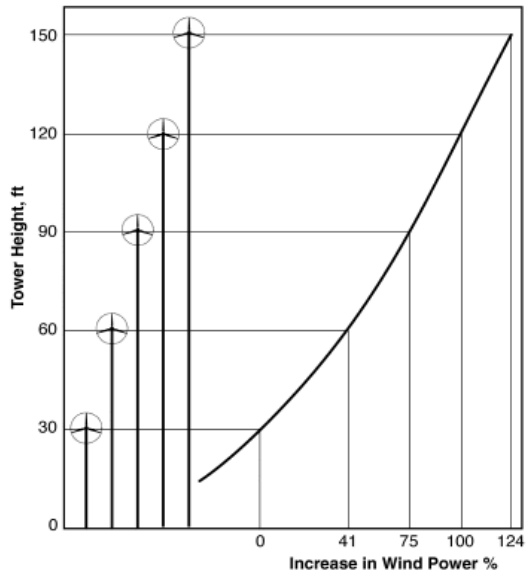
We all lead a more or less consistent lifestyle, vis-à-vis we eat, sleep, do chores, and entertain ourselves. This lifestyle correlates to our energy demands. With time the energy demand per capita kWh is only going to go up. We buy new devices with better energy efficiency but the number of these devices is on the up as they keep getting cheaper and cheaper due to mass production. Time for a fun fact. India is only behind China when it comes to cell phones in use. It has a whopping 9.2 x 10^8 cell phones in use as of 2014, for a population of 1.2 x 10^9. That's 74% of the population that can potentially have a cell phone a piece. The massively popular, a bomb of a phone, Motorola Moto G has a battery of 3.8V/2070mAh. That is roughly 7.6/7.9 Watt-hour. Too less? Charge is 60 times a month it comes out to be 0.48 kWh. That's half a unit, and in the state of Telangana you will be charged Rs 2.6 for it. That is surely chump change. Did we forget something? Oh, right! The 3000 some students living in our college. So, that's Rs. 10, 000 nearly from cell phones alone. Some people leave their laptops and tube lights on all day. That's got to cost something. Then, there are a/c running 7 days a week, 10 hours a day. In a few words, we have a rather heavy demands. The sad part is not everything can be curbed. We can't simply go by the "consume less, save more" rule. Given the heat of the days and that students in college require to access the internet on the laptops, the demands are justified. So, what now? No solution to the problem? This is where you read the title again, "Wind to the rescue". Wind (*wind*: The perceptible natural movement of the air, especially in the form of a current of air blowing from a particular direction: Oxford Dictionary) as you know is free. It's just there. Nobody caused it. But, why aren't we tapping it? (Pun intended)

Wind is a very viable solution to our energy problems. A number of colleges have turned to alternate energy, the energy form of the future. Dayalbaag Educational Institute, Agra has resorted to a 5kW solar plus wind setup. Carleton College, Minnesota installed their 2nd wind turbine in the year 2011 after the first one in 2004, and are doing great. Their first turbine was a small wind turbine, with a generation capacity of 1.6 Mega Watt. Not a lot, but with the second in place they now serve 25% of their loads via the two turbine. That's pretty neat for a college with a student population of 2000. Not much different than ours. A number of schools in the US are thinking about it. The crux of the matter is—why should we lag behind if it has been proven that wind is a sustainable source of energy, viable in all sense of the word?

For a moment just think…imagine what is BPHC got its first wind turbine?

For starters there will be a story in the newspaper. Huge in itself. Something more to brag about to your friends in other campuses. Other institutions are bound to take notice, and it will be a huge step towards "Green Campus", a buzz word these days. The campus is surrounded my tons of open space, away from tall buildings, which block wind and cause turbulence. This is ideal for a wind-turbine installation. Typically, a small scale wind turbine does not require much of land, but the more the better, and the higher the better. Small wind turbines go as high 7 to 24 meters. That's a 6 storey building. Not a lot because of the simplicity in the structure. It's just a tall tower with a fan blade, not rocket science!

Here is a neat formula to calculate the kWh the turbine produces over a year:
Energy [kWh] = 2.09 • Diameter^2 [m] • Wind^3 [m/s]



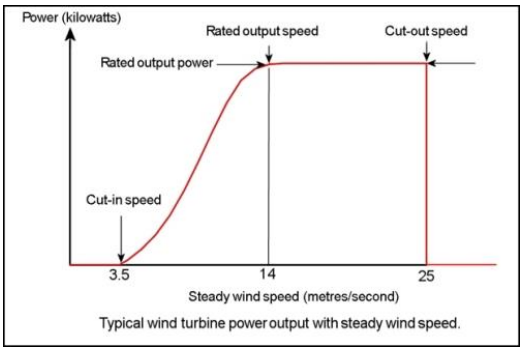
Say, the rotor diameter is 8m (rather large for a small turbine), and the wind speed is at a moderate 5m/s average annual speed. At that rate over the year it produces 16,125kWh. The equation uses a Weibull wind distribution with a factor of K=2, which is about right for inland sites. An overall efficiency of the turbine, from wind to electrical grid, of 30% is used. That is a reasonable, real-world efficiency number. To put things in perspective, the tube light in our rooms have a power rating of 35W, the laptops say, 90W, and the fan, say, 50W. That is a total of 175W roughly. Take that for 3000 rooms, and for 10 hours a day. The number comes out to be 5250kWh per day. Over 9 months, it is a whopping 14, 17,500kWh. By those numbers, our demand massively exceeds the supply. One turbine like that simply can't help bring down the whole electricity bill. But, it makes more sense to give part of it, say the shopping area, or the labs, or the library to be satisfied by the wind turbine alone. In that case, it might even end up making what is required, and if not rerouted there is extra energy available. This energy came from somewhere, so it must go somewhere. Yes! It can go into the utility grid from where we conventionally draw power. A contract can be struck with the utility service providers regarding excess power being supplied back to the grid. It's not a thing of the future. The meter runs backwards if you supply power back to the grid. It is quite common of meters to run backwards, in absence of a 'backstop', with solar power installations in the UK, not in India because we have not, yet, adopted solar power like they have. We still rely on the conventional power supply method, the grid supply.

The cost of installation might be large because of the simple reason that its market is still growing. You won't find a ton of choices when it comes to vendors, although more than you will need. After installation comes the easy part. The part where you just let it be. Obviously after connecting it to a power bank, which saves all the power if immediate requirement is

absent. Imagine it to be a huge room, full of batteries inter-connected, supplying DC power which can be inverted to get AC supply which our devices need. The breaking even period of the wind turbine takes some time, but when it comes the turbine essentially will produce free energy. Unless you buy a rather faulty turbine it will not require huge maintenance. So, the main cost remains in the installation.

With that being said, it is time for some myth busting.

- ***People tend to believe wind turbines only work for 25% of the turbine.*** The facts are, a wind turbine works nearly 75%-85% of the time in a given time span. Modern wind turbines are made in a way such that their cut-in speed (the minimum speed to generate) are low enough to suit mildly windy areas. These are modern because they are taller, eliminate the use of gear-box (a major area of losses) and use much better mechanical components, optimized and more efficient than their early counter-parts. This means, even when there is not a strong gust of wind they turbine will still be producing. The term **capacity factor** is the cause of the confusion. Capacity factor is the % of energy a wind turbine is capable of producing over a year. Say, the capacity factor of a wind turbine, rated at 1.5 MW is 40%, then over the year it produces only .6 MW in the year.



Typical wind turbine power output with steady wind speed.

- ***The costs of installation, operation, and maintenance tends (collectively known as the Life Cycle Cost of Energy) to be out of proportions for wind turbines.*** This is generally calculating the amount of money spent in all, divided by the megawatt-hours it generates over its lifetime. These costs do not include greenhouse emissions, and other potential environmental problems associated with the conventional means of energy productions. These are known as 'externalities' for a setup in financial terms, and these are extremely low for a wind powered system.
- ***If wind supply is so intermittent, why should one spend in it when more stable forms of energy are available?***
  This is not a myth. Wind power production is intermittent, with a capacity factor of the mid-40s. For a nuclear power plant the capacity factor would be in the high 80s. But, this is predictable. Wind power relies on a natural source which fluctuates a lot, while nuclear power relies on just how much radioactive elements humans can harness from the earth. But, they are running out, while wind is there to stay. Now, and forever! Wind turbines in conjunction with conventional power supply methods are optimum for now.

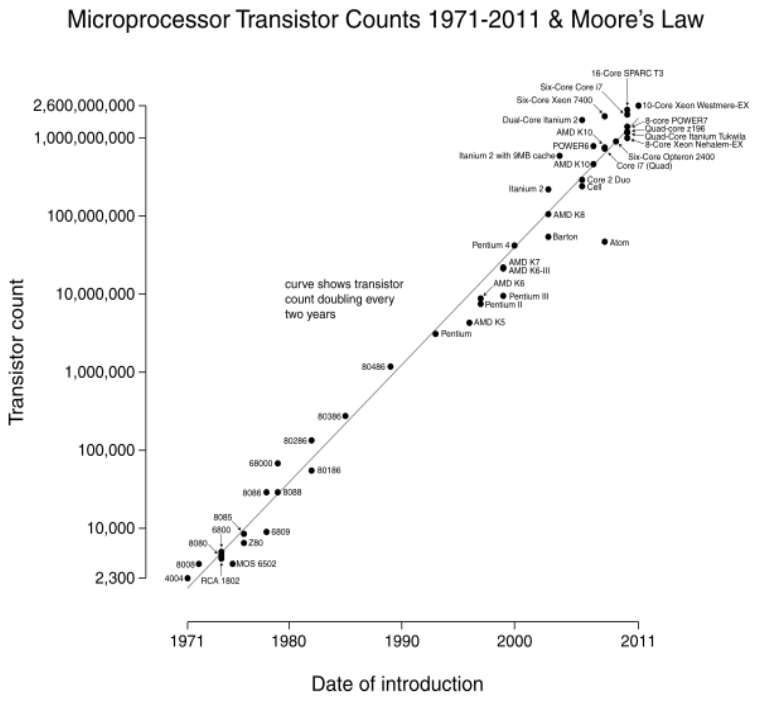
Need of the hour:

It all sounds good on paper but the work needs to be actually done. The survey for the best installation site requires spending time to find the average wind speed in the area. This is usually done by installing an anemometer and saving the data over a long time, to get the annual average. The data that the government collects will only give u a hint of what is there in actuality. Normally, a 3 year survey is great, as only a yearlong survey can give grossly wrong annual average speeds. And, this is important because the output is related to the cube of this speed. Other operations include contacting the manufacturers, setting up a battery bank, and striking a contract with the government, if we end up producing extra. All this is a long drawn process, and takes effort, but the end results might be worth the money and time spent. In the end, we must take care of the environment. This will be the first, and a necessary step towards a green future.

OBEYING MOORE'S LAW: 3D IC'S GOT THIS

-Sri Harsha Moturi

Recent developments in the field of electronics haven't been catching up to the requirements that the Moore's law demands. The law states that, the number of transistors integrated on a chip increase to about twice the number of transistors in a period of about 18 to 24 months. So far, it has been diligently followed and has been accepted as the industry standard, but in the recent years concerns have spread among institutions and organizations as they might not catch up to the law's projected trajectory for a number of reasons viz. the requirements of the new ICs don't demand a significantly higher number of transistors rather require a higher efficiency in the existing number, also the significant increase in the number of transistor leads to a significant increase in heat density that the material might not be able to withstand. Also, the Moore's second law (or Rock Law) states that, as the cost of the computer power to the consumer fall, the cost for the producers to fulfill Moore's law shall rise due to research and development, manufacturing, and test costs. There has been an exponential increase in the expenditure for the fabrication of ICs.



What is a 3D IC?

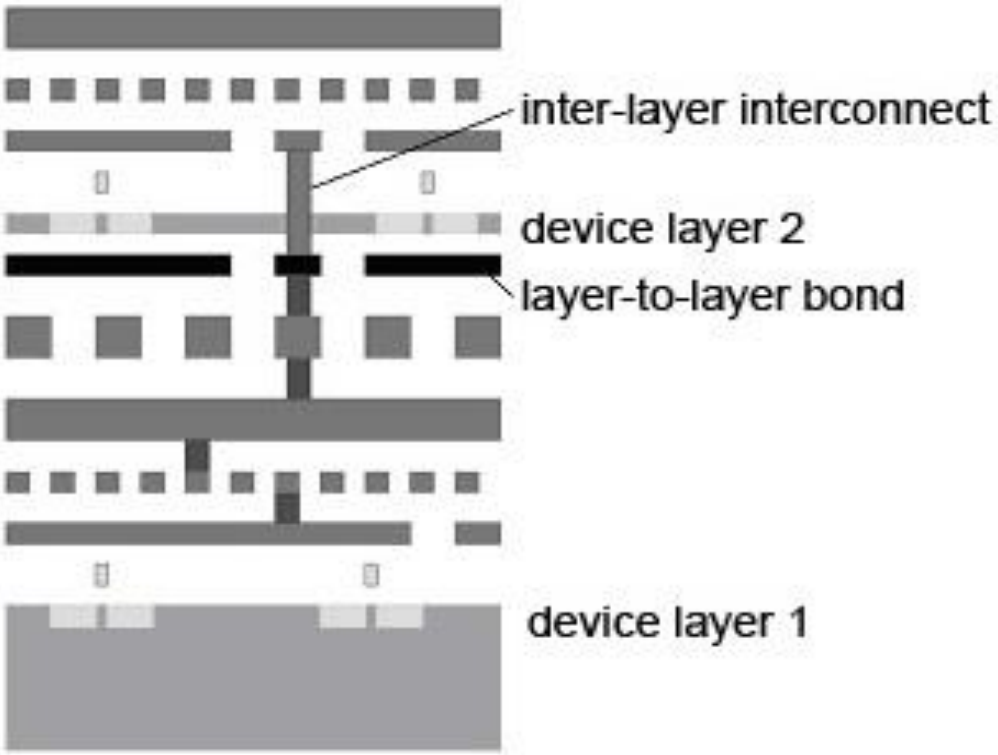
A three dimensional integrated circuit is a chip in which multiple layers of active components are integrated into a single chip. This technology is not widely used yet, due to lack of a solid definition of the technology in the semiconductor industry.

3D Packaging and 3D ICs, are they the same?

A 3D package isn't same as the 3D IC. At first, both of these might sound similar, but they are fundamentally different. In a 3D package (also known as system in package (SIP) or chip stack or multi-chip module), multiple chips are stacked onto a single package where as in a 3D IC multiple chips are integrated, both vertically and horizontally, together to form a single circuit.

Pursuing the manufacture of 3D ICs has portrayed multiple benefits like

- Obeying Moore's law.
- Dividing a large IC into several smaller dies improves the yield as well as reduces the cost of fabrication.
- An option to integrate wafers of different types which help in optimizing to a greater extent and also a choice to integrate components which would have been incompatible with a single wafer IC.
- The average length of the interconnect wires is reduced by about 10%.
- A significant reduction in power consumption and an even significant reduction of reduction in heat loss due to shorter interconnects (leading to lesser parasitic capacitance).
- Adds a lot of possibilities for designers and increases the order of connectivity.



Cross Section of a 3D IC

Current Scenario

While transistor switching speeds are being improved by means of developing research like strained silicon engineering, the metal interconnect (as the area of the microprocessor increases and the number of transistors increases, the metal interconnect length increases) have significantly deteriorated the performance due to high parasitic capacitance leading to increased power dissipation. Hence, the exploration into different possibilities.

Introducing this new technology also poses a few challenges like

- A few added steps in fabrication might increase the number of defects.
- Due to vertical proximity between the active electrical components, there is a risk of heat being trapped (i.e. lack of heat dissipation) leading to specific thermal hotspots which have to be carefully dealt with.
- A significant increase in the design complexity leading a requirement of new tools for the 3D IC to be designed.
- Integration of heterogeneous components in the 3D IC might be difficult as a delay of supply of one of the component might delay the production of the entire IC leading to a manufacturing standstill. Eventually, leading to a loss of revenue for all the suppliers and manufacturers involved in the process.
- The ownership of the 3D IC integration isn't clear.

To manufacture a 3D IC, two methods have been deployed so far, namely

The 'bottom up' wafer fabrication method builds silicon layers sequentially on top of each other. The first layer is formed and transistor devices are fabricated, followed by the deposition of the second layer and the subsequent fabrication of its devices. This method requires substantial changes to the manufacturing process. There are also quality concerns regarding the device reliability fabricated in subsequent layers deposited on top of the earlier ones. One advantage of this method is that the size of the inter-layer vias can scale down with the transistor devices. On the other hand, the 'top down' wafer fabrication method manufactures each layer separately and afterwards bonds them together. This is a more popular method for several reasons. Each wafer layer is qualified separately, and if a wafer meets quality criteria, it can then be assembled together with another already qualified wafer. Another advantage is that heterogeneous silicon layers, each one optimized for separate process functions, can be combined together. For example, one layer could be designed for memory density, while another is targeted at logic performance. One notable drawback of the 'top down' method is that the size of the inter-layer vias is not expected to scale at the same rate as the transistor devices. Even in the best case, vias cannot decrease below one micrometer in width, because of inter-inter layer bonding alignment tolerances. However this fabrication method requires the least amount of changes to existing processes, minimally perturbing manufacturing costs. In the top down method, wafers and dies can be bonded face to face, or face to back. In the straightforward face to face bonding method, the tops of two layers are stacked facing each

other, with their interconnect layers exposed and connected by vias. This results in the smallest possible inter-layer distance and hence smaller via sizes. In the more general face to back bonding approach, each layer is stacked on top of another, all having the same orientation. The distance between layers is larger and the vias must be larger as they have to go through the silicon substrate of each layer, forming a direct vertical interconnection. The wafer layers can be thinned, achieving better electrical characteristics and control. The thicker vias do take away surface area from transistors. However this is not expected to be a problem, since transistors in current designs are not arranged densely due to global interconnect issues. The transistors could be densely arranged around the vias to form islands of logic. For three dimensional stacking with more than two layers, face to back bonding is the only viable approach in unlocking the true promise and full benefits of the third dimension.

An excerpt from the paper written by George E. Moore: "Cramming more components onto Integrated Circuits."
"Day of Reckoning
Clearly, we will be able to build such component crammed equipment. Next, we ask under what circumstances we should do it. The total cost of making a particular system function must be minimized. To do so, we could amortize the engineering over several identical items, or evolve flexible techniques for the engineering of large functions so that no disproportionate expense need be borne by a particular array. Perhaps newly devised design automation procedures could translate from logic diagram to technological realization without any special engineering.
It may prove to be more economical to build large systems out of smaller functions, which are separately packaged and interconnected. The availability of large functions, combined with functional design and construction, should allow the manufacturer of large systems to design and construct a considerable variety of equipment both rapidly and economically."

G. E. Moore is the co-founder of Intel Corporation, one of the largest organisation in the field of semiconductor and one of the early founders of Fairchild Semiconductors, where the roots of several founders of various other organisations lie, which have led to rise of the Silicon Valley (USA) and the reason for current two trillion dollar GDP contribution from the state of California alone.

SCREEN LESS DISPLAYS

-Pranavi Avadhanam

More rightly predicted by the Moore's Law, the human perspective of technological advancements in the present generation is about 32 times advanced and efficient to that in the past five years. But one thing that remains the same in all these years is the importance of vision; humans depend upon their vision for a better judgement.

But the medium has certainly been a victim to constant change. The current display technology –the Touch Screen technology that we use in our smart phones and tablets will soon be obsolete 'cause the future has in store the much more efficient and comfortable, **Screen less technology**.

The main aim of the Screen less Display is to display or transmit the information without the help of a screen or the projector. One can directly project images onto the human retina, open space and even to the human brain. It prevents the need of high weight hardware and it will provide privacy to a greater extent.

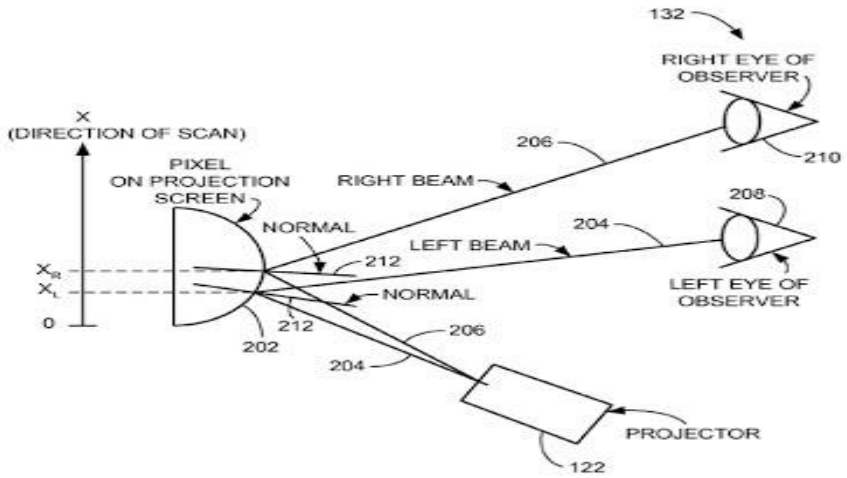
What are screen less displays?

It is the projection of visual information through the deflection of light. The light is usually deflected through fog, mirrors or plastic films. Research has not yet yielded any constructive results regarding the usage of air as a medium but research is still going on.

The Screen less displays which do not require a medium for projection can be categorized into Visual Image, Retina Display and Synaptic Interface.

(A) Visual Image: This kind of display usually requires a medium for the deflection of light; light is always deflected before reaching a person's eye. The much known examples include: holograms or the Virtual reality goggles and the Heads Up Display (HUD)

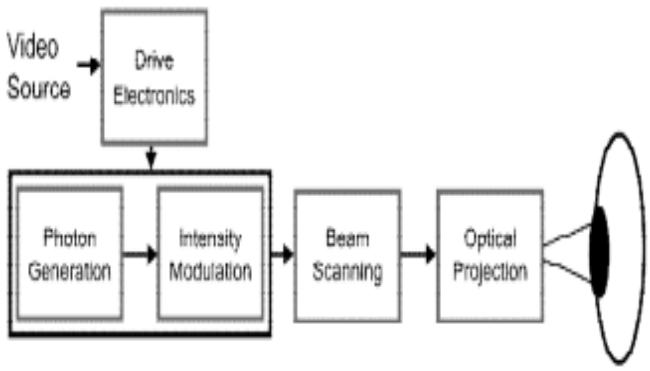
- **Holograms**: Holograms get around that by projecting light right to the spot where your eyes would focus: The light beams travel through that point and hit your eyes just as if they'd come from an object that was actually there, holograms work from any angle and don't require glasses. They allow the display of three dimensional images by using simple components like Helium – Neon Laser, a Lens, an object, mirror and a holographic film. When the laser and object beam coincides, 3D image will be projected.



WORKING PRINCIPLE OF A HOLOGRAM

- **HUD** is any transparent display that presents data without requiring users to look away from their usual viewpoints. One can view information with the head positioned "up" and looking forward, instead of angled down looking at lower instruments. It is majorly used for military operations.

(B) Retina Display: Virtual Retinal Display (VRD), a screen less display technology, allowing the image directly to be projected on to the retina. In VRD, no real image is produced. In this type of display, light is not deflected, rather it is projected directly onto the retina and thus only authorized personnel are able to see the information. This display can be extremely helpful in maintaining the privacy and security of the contents. The authorised personnel can control it using his voice.



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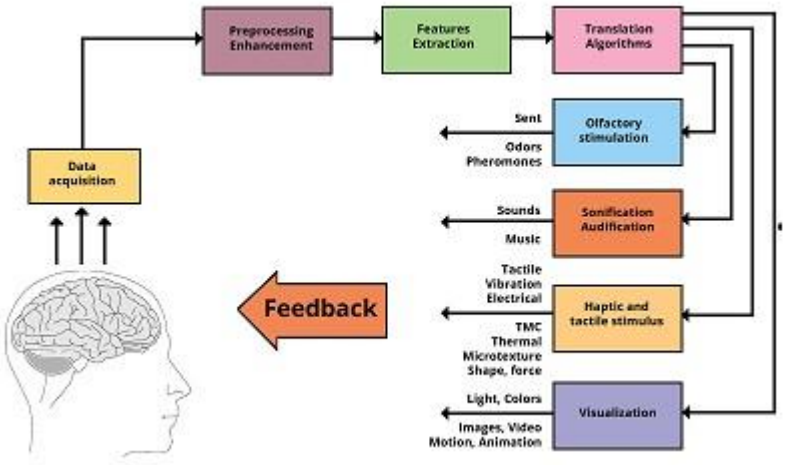
(C) Synaptic Interface: Synaptic Interfaces do not use light at all and the visual image is directly given to the brain. The technology is in the progression approach and it is now tested on humans also. It allows a great security system, efficient communication and broadcast. Scientists have shown success in sampling video signals from eyes of horseshoe crab through their nerves. The video signals from electronic cameras into the creatures' brains were also sent.



SYNTHETIC TELEPATHIC INTERFACE

Advantages & Disadvantages

ADVANTAGES	DISADVANTAGES
Low power requirements- Only six diodes are required and a Few watts to deliver their images to the user's eyes	The principle disadvantage is that Virtual retinal display (VRD) is not yet available in significant number.
Higher resolution images- The pixels in the images projected by the diodes can be made smaller than is possible with any CRT or flat panel display, so higher resolution can be achieved.	Prototypes and special experimental models are now being built, but their cost per unit is high.
Greater portability- The combination of diodes, lenses, and processing components in a retinal projector system will weigh only a few ounces.	The VRD technology is still under progress and Development.

META MATERIALS AND INVISIBILITY CLOAKS

-Saahithi Reddy

*I bet most of you have wanted that **invisibility cloak** which Harry Potter had, when you wanted to do something naughty or some secret research on some friend of yours to catch him doing something he's been hiding from you.*

***Invisibility** has long been employed in the works of science fiction and fantasy, from "cloaking devices" on spaceships in the various Star Trek series to Harry Potter's magic cloak. But scientists are beginning to think they can actually make devices with just these properties.*

Let's look into it to see how……

STRATEGY FOR CLOAKING:

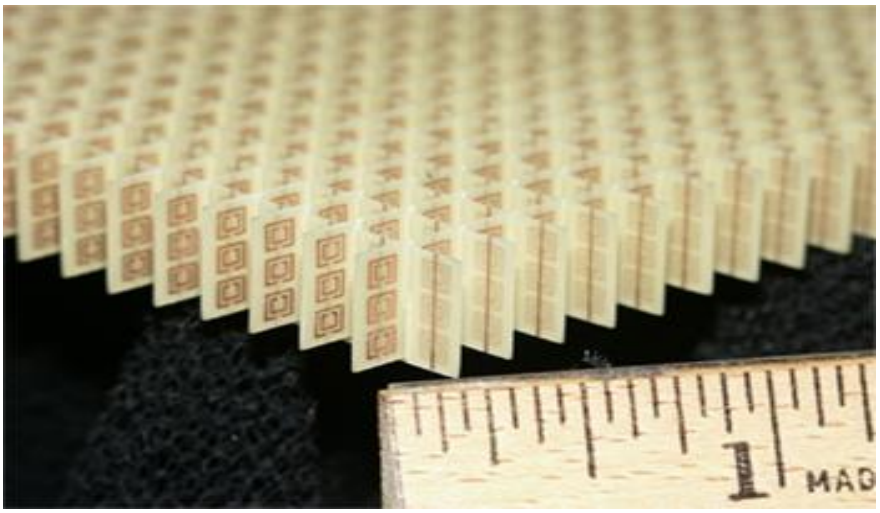
We are going to hide an object behind a mirage, bending light around the object, just like a road mirage. We do this by changing the refractive index of the cloak by some engineering methods so as to bend the rays by exactly the right amount.

The challenge is to design a material, say a cloak (say your body), which has exactly the right refractive index to deflect radiation around our body in the way we desire. In order to achieve this we need a technique for reshaping the trajectory of rays so that they avoid the objects we want to hide (here our body), but emerge from the cloak as though they had not been deflected as shown in the below figure.

However, it is not that simple. The light exiting the cloak must also match the polarization and the phase of the light that travels past the cloak, or it will show a visible presence.

Ordinary materials like glass are not adequate for this task and we have had to invent a new class of materials, **meta-materials**, whose properties can be engineered at our will.

There is no proper universally accepted definition of Meta-materials. **These materials can be thought of as artificial materials engineered to have properties that have not yet been found in nature.**



The science around meta-materials is enthralling and is currently the exciting area of research among scientists across the world. Metamaterials have burgeoned into a big area across the world plasmonics.

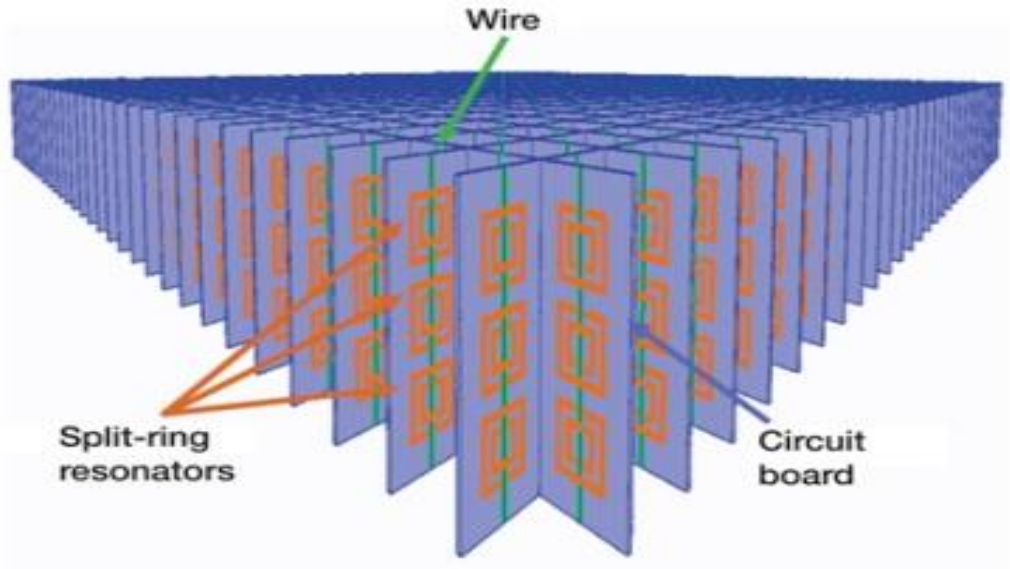
Meta-materials are made of the conventional plastic or metal. **They are characterised by their physical properties and not their chemical properties.** They are designed physically in such a way as to suit our application to have **negative refractive index.**

WHAT HAPPENS INSIDE META-MATERIALS??

Light is an electromagnetic radiation, made up of perpendicular vibrations of electric and magnetic fields. Natural materials usually only affect the electric component – this is what is behind the optics that we're all familiar with such as ordinary refraction.

But metamaterials can affect the magnetic component too, expanding the range of interactions that are possible.

The metamaterials used in attempts to make invisibility cloaks are made up of a lattice with the spacing between elements less than the wavelength of the light we wish to 'bend'. The figure shown below is an invisibility cloak designed using silk material….



This cloak was claimed to function within the Tera-hertz band i.e.; the range between Infrared and radio waves.

- To make an effective cloak over all optical wavelengths requires a remarkable level of control over the optical properties of the materials which make up the cloak.
- This control is supplied by some special kind of metamaterials, which are (usually) periodic nanostructured materials, where the periodic cells are tiny electromagnetic circuits that interact with both the electric and magnetic fields of light.

Research is still going on to make an effective cloak which functions over a wider range of electromagnetic spectrum.

The extra-ordinary freedom to control light by the meta-materials is likely to lead to hordes of applications in Transformation optics in near future.

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WIRELESS CHARGING

-Chandra Kiran

Better standards, integration methods and components have evolved over the past few years to make wireless charging a better technology. And it need not be confined to charging cell phones. Wireless charging is no more inferior to wired charging.

The multimedia-rich portable electronic devices available now end up consuming a lot of energy just to keep the device's graphics processing unit juiced up. Let us take a cell phone for instance. The traditional approach is to look for a wall socket and push in the wired charger's plug to charge the battery.

Though a cell phone can also be charged wirelessly, most people are wary of the time it takes to charge the phone wirelessly. No one wants to wait for hours to charge a phone's battery wirelessly, especially when you need to use the device in next 15-20 minutes. But does wireless charging still take a long time to power up a device?

Although called wireless, wireless charging is not totally without wires. The primary coil in the charger needs current from AC mains to produce magnetic flux, which produces a current in the charger's secondary coil by induction for charging the device. So the primary coil is plugged into an AC socket using wires, though called wireless. Wireless charging, when started, was based on a Qi inductive power standard that was produced in 2008 by WPC.

The low-power Qi specification limits the draw of power to just 0W to 5W, which limits the current available to the device for charging. But newer wireless chargers available in the market are much better and can transmit a higher amount of current. A few years ago, Qi began to extend its specification to medium power to deliver up to 120 watts.

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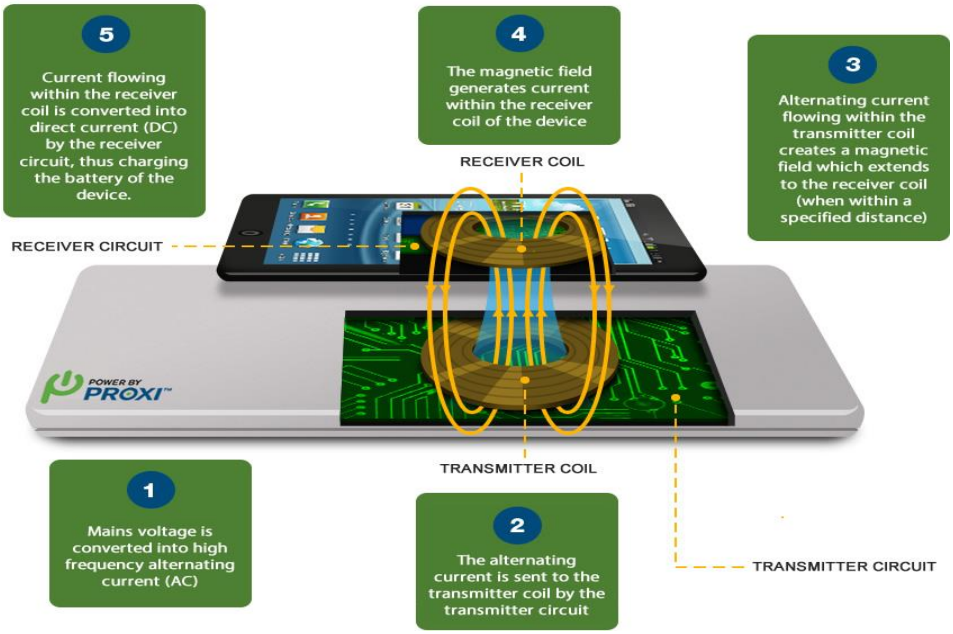


Resonance Charging

The new wireless charging standard A4WP (Alliance for Wireless Power) is changing the concept of inductive charging from magnetic induction to resonance. Magnetic induction requires the two coils to be placed very close, whereas with this technique a large area is covered so the device's position is not very critical. In fact, multiple devices can be charged wirelessly with this technique by placing them all within the wide resonant field. And charging is not affected by the position of the device being charged. No matter how you position the device on the charging pad, the maximum amount of power gets transferred to the device to charge it easily and fast.

The chargers based on A4WP standard transfer power wirelessly at a frequency of.78 MHz, which is internationally available for such applications. The frequency used for control and management is within the 2.4GHz band, which is ideal for use with smartphones and with other electronics devices globally.

Although both inductive and resonant charging are based on the same principle, the main difference between the two is the coupling factor. It defines how the two coils will be aligned to transfer maximum flux. When measured on a scale 0 means less coupling factor and 1.0 means high coupling factor. Devices based on inductive charging technology have a coupling factor of 0.3 to 0.8 whereas devices based on resonance charging can also have a coupling factor below 0.3.

Technical Analysis of Standards

	EPC	PMA	A4WP
Freq	100-205 kHz	250-400 kHz	6.78 MHZ
Range of coupling	K-0.4 to 0.7	K-0.6-0.8	K-0.1 to 0.5
Q of Coils	6-10	6-10	40-100
Communication	In Band (detailed)	In Band (simple)	Out of Band-BLE
Alignment	Magnet on TX (retired)/ Multi Coil	Magnet on TX and RX	No alignment needed
Coil size/cost	Med/Med	Small/high	Small/small
Thickness	0.3-1.0 mm	0.8-1.3 mm	0.2-0.5 mm (Est)
Semiconductors RX	<20V	<20V	40V-60V
Architecture of RX	Rect + Reg + internal COMM	Rect + Reg + internal COMM	Rect + Buck _ BLE
Heating of metal	Med (FOD implemented)	Med (will need FOD in future)	Low
Form factor flexibility	Med	Low	Med-High
Efficiency	70%+	70%+	~50%

Texas Instruments has recently come up with two 5W receivers (bq51020 and bq51021) focused around the Qi 1.1 standard. They offer a programmable yield voltage of about 8V, reducing the power loss and the rise in temperature by 35% compared to other charging solutions. The I²C interface in bq51201 enables designers to implement the pad detection feature, an easy way to align receiver with the charger and the foreign object detection to allow faster and efficient charging of all the Qi-compliant gadgets.

Lesser components

Texas Instruments also came up with bq500412 that allows designers to develop charging stations with half the number of components used in other charging solutions. This transmitter, featured on foreign object detection, though created for 12V charging pad, can also be used with a boost converter to create a 5V USB charging pad with three coils to limit power loss.

Power by Proxi brings a fully integrated receiver circuit that fits easily into a smartphone to charge its battery wirelessly. You can place at least three devices on its pad for simultaneous charging. It charges a device at the speed of a wired charger without overheating its components.

Comforting power

Charging has moved on from what has hitherto been a utility to one that comes with an aura of comfort. Though the modules integrated in furniture are based on Qi technology they can also charge the devices that are not based on Qi technology. To accomplish this they use an adaptor with the module. C+P Furniture Systems is working to bring the whole new Cegano smart table and the Prefino locker system with the wireless charging facility for smartphones.

Leggett & Platt have come up with Helios, an inductive charging system that is available in puck shapes or low-profile designs. It is an intelligent system that communicates with the device to be charged. That is, the primary coil communicates with the secondary to identify

its power requirements and charges it accordingly. Once Helios identifies that the device is fully charged, it cuts off charging and turns on the LED indicating full charge. Although the device is charged wirelessly, Helios has to be plugged into a socket to power the primary coil.

Wireless Charging Solutions for Design Engineers

Manufacturer	Solution	Feature	Advantages
Freescale	MWCT1000CFM	5W single-coil transmitter	• Robust foreign object detection algorithm to meet latest safety requirements • Transfer efficiency exceeding 75%
NXP	NXQ1TXA5	Qi low-power A5/A11 transmitter according to specification version 1.1.2	• Extremely small PCB size • Safe operation with FOD and optional NTC
Active-Semi	EVK-PAC5220WP-Qi-xxA11-V1	Single-IC based wireless power transmitter	• Built-in surge protection • Scalable MCU based solution to enable products with multi-coils, multi-modes, and medium or higher power levels up to 150W
Texas Instruments	bq51020EVM-520	Wireless power receiver evaluation module	• Inductor-less receiver for lowest height profile solution • Adjustable output voltage (4.5V to 8V) for coil and thermal optimisation
Broadcom	BCM59350	A wireless charging PMU	• Up to 88% AC-to-DC efficiency • Ensures acceptable NFC performance

Wireless charging furniture tables, chairs and desks—is not very far. In fact, many of us are already in the design phase of these things. However, these are not out-of-the box solutions either; just being manifestation and augmentation of existing technology with the surroundings. Either way, it will soon be ready to jolt the interior decoration and furniture market.

> "The cost of the product is mainly due to the testing and compliance efforts that go into the product. The semiconductor content does not increase price of the product but the R&D that goes into developing the product increases the price." —Srivasta Raghunath, TI

Verizon and DOCOMO are using Qi standard, AT&T has chosen PMA standard and T-Mobile wants to use A4WP. Power Matters brings various PMA-based wireless charging options like Power snap kit, travel mat, power mat and access kit for high-end mobile devices.

Future: Industrial use

Although the main focus of wireless charging has been small portable devices, it cannot be limited to these devices alone. The main aim of this type of charging technology is to transfer maximum power to the receiver in a wire-free environment.

Driving wireless charging technology forward

A4WP is accepting the inductive charging solution pioneered by PMA, leaving behind no working groups to develop another inductive charging standard. While on the other hand, PMA is accepting the resonant charging solution pioneered by A4WP (called Rezence) as the industry standard for resonant charging. This way even A4WP is no longer going to have working groups that would develop another resonant charging solution. Itay says, "The whole point of this is to harmonise the various recognised industry standards that enable consumers to power up wirelessly." They have developed a common certification to accelerate the use of wireless charging in more devices and have collaborated on their API (application programming interface) for network service management. Qualcomm joined this group two weeks after joining WPC, leading the roles of three different bodies for wireless charging.

A technology can never improve with just one merger or collaboration. There has to be continuous improvements along with partnerships and investments to make the technology widely known and acceptable. Samsung's Electro-Mechanical division recently partnered with PowerbyProxi to develop new charging devices. Samsung, being a member of the A4WP consortium, is looking forward to promote the Qualcomm's WiPower standard based on resonance.

With Toyota deciding to license intellectual property from WiTricity to offer wireless charging on both hybrid-electric and fully-electric vehicles, "We envision a world in which wireless charging would accelerate the adoption of clean, green electrified vehicles".

In future we will not only see the extensive use of wireless charging technology, but also see some enhancements in the standards enabling this technology. Although Qi is typically an inductive charging technology, WPC is developing a resonance extension to its specifications. Resonant extension to Qi is expected to be backward compatible with more than 40 million products and devices globally, including the 60 models of Qi-compatible devices. Qi is constantly enhancing to give away the best wireless charging experience.

One vision is to have NFC RFID in the phone that provides the local power company with billing information so that they can charge your credit card for power purchased as you walk by the public outdoor wireless charging infrastructure. With the development of extended distance wireless charging, it even becomes possible to charge the devices by walking outside on the street in proximity to public portable power infrastructure.

FACIAL RECONGNITION

-Yahswanth Kolla

Earlier days, facial recognition was done using a software that could only compare a 2-D image of a person. The software was very weak in technicality as correct results were difficult to obtain if the photo was not taken in the correct lighting and with good facial expressions. As these types of photos were taken instantly there would be changes in orientation of face of the person and click angles would be different. When these photos were compared there will be no result as the orientation or click angle may be different.
Facial recognition, the software used for this purpose mainly recognizes a number of distinguished features of the face. All of them adding together make 80 nodal points. The software used for facial recognition recognizes and distinguishes the face from its background by some of the common nodal points.

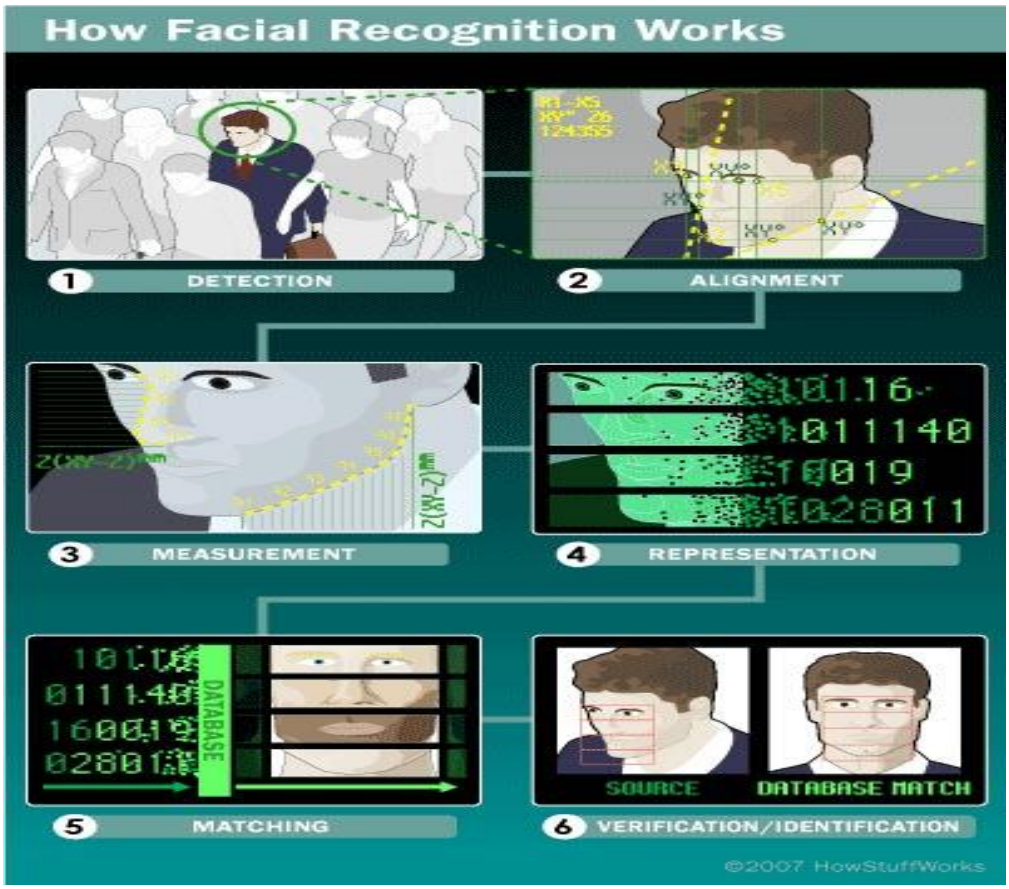
- Distance between the eyes
- Nose width
- Depth of the eye sockets
- Cheekbone shape
- Length of jaw-line

These nodal points are measured altogether to provide a common numerical code known as face print.
The 2-D image comparison is not so fruitful because if the orientation of the photo is different or if the brightness of the photo is not sufficient or the photo is not with good facial expressions, then it would not be recognized. To overcome all these problems we use the latest technology that is 3-D Facial Recognition Technology.

3-D Facial Recognition Technology

Problems that we would be facing with 2-D were all resolved with the evolution of 3-D Facial Recognition Technology. As a 3-D image of a person helps to point out clearly the different nodal points, this method is more accurate. All the ups and downs of the face are more apparent and this helps a lot in comparing. The 3-D method also removes the disadvantage of correct lighting aspects. Thus the photo of the person can be taken even in improper lighting and that too in any angle. The range of the photo can be almost 90 degrees.

Different steps in identification of a person:



Detecting the person:
Take a look at the above image to know the proper working of this process. The image that is to be compared with the database is obtained either as a photo (2-D) or (3-D).

Alignment of image:
For a 2-D image, the system can be accurate only if the angular position of the face towards the camera is at least 35 degrees. But for a 3-D image, the system can be accurate even if the angular position of the face towards the camera is at 90 degrees. The size and pose can also affect accuracy.

Measurement of face:
The face recognition software makes templates on the different curves of the face. The face will be measured in micrometer scales.
Transfer of measurement:
The measurement taken is transferred into a unique code. This code makes each template unique and thus represents the different features of the face.
Matching with the database:

The comparison of the image to the database can occur in two ways. If both the image taken and the image in the database are 3-D, then there is no problem in the matching process. But, as the database in most government offices and other places are present in the 2-D form, the comparison becomes more complex. The 3-D image has to be converted to a 2-D image before comparison. A 3-D image will be live and moving when compared to a still and stable 2-D image. So, when a 3-D image is taken, it is converted to a 2-D by taking measurements from some distinguished points from the face. These measurements will then be converted to an algorithmic form and thus will be converted to a 2-D image.

Comparison:

The comparison can be classified into two according to its purpose. One of them is verification and the other is identification.

If a person is to be identified as one who claims to be an employee of a particular office or student of a particular college, it is called verification. This type of comparison will with the database will only take place in a 1:1 ratio. That is, for the identification of a thief or a culprit, the image received will be compared to all the images in the database in a 1: N ratio. Take a look at the comparison process shown in the image below.

The comparison process is usually done in three different templates. They are-

Vector template – This template is used for quick search with the database in both the 1:1 and 1: N ratio.

Local feature analysis [LFA] – This template mostly follows the vector template. This search is little more complex.

Surface texture analysis [STA] – This search is based on the skin features of the image, which contains the most detailed information.

When these templates are combined in the facial recognition software, the system is able to recognize and identify the person even if there are changes in his expression like smiling,

blinking and also frowning. Even a moustache growth or beard will not affect the accuracy of the software. But, there are disadvantages as well. A glare from the person wearing eyeglasses can cause problems. If the person is disguised as one with long hair in such a way that it covers the front part of the face, it will be difficult to identify him. Very poor lighting during the time of photography may cause the face to be underexposed. This can also be a problem.

Uses of facial recognition system:

This technology was first used by a law enforcement agency so as to identify people from huge crowds. This system was also adopted to catch people trying to fraud while voting. The system was also used in airports to check the foreigners visiting the country had any resemblance to criminals or suspects.

Another important application of this technology is in ATM's and check –cashing security. Before transacting the money, a photograph of the person is taken and is verified with the database to see whether the customer is valid. Thus identify theft and fraudulent transactions can be avoided. This system is very useful as there will be no need of personal identification number for any person. But this type of transaction process is yet to come up in many places.

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QUANTUM COMPUTING: IS IT TIME YET FOR THE FUTURE?

-Arvind Rameshwar

It is impossible to not marvel at the sheer brilliance of our computers – the machines that churn away lines of code much faster than we can process. But all the time, we are faced with a problem that may seem trivial, but actually presents a complex issue that is solved quite elegantly by Nature – the worries of increasing memory and power usage. The electrical machines that are used at present, employ very classical techniques of generating discrete signals and still rely on physical methods of providing power. Digital signals are produced by standard voltage levels, and though we can make the gap between these levels as small as our noise margins allow, we still need to solve the problem of powering our systems to shoot these pulses of voltage. Moreover, we can have only a finite number of such levels, since our energy resources are limited.

But there is a way out. We are aware of the fact that the electrons in the atoms around us behave as though their state (position and momentum) were defined by a probability wave function Ψ. It is also known that this wave function is a complex exponential that gives us the odds, so to speak, of gauging an electron's position. It must be noted, however, than any act of measuring the electron's position or velocity will disturb its natural wave function, forcing it to take up a specific state.

The field of Quantum Computing makes use of this wonderful phenomenon of the electron existing in any of multiple possible states, (with a distinct probability of existence in each state), to construct new pieces of information, called qubits. The bits that are used for computing nowadays, are restricted to two possible states: a '0' and a '1'. The qubit, on the other hand, has the advantage of being able to exist in as many states as there are discrete quantized levels in the atom.

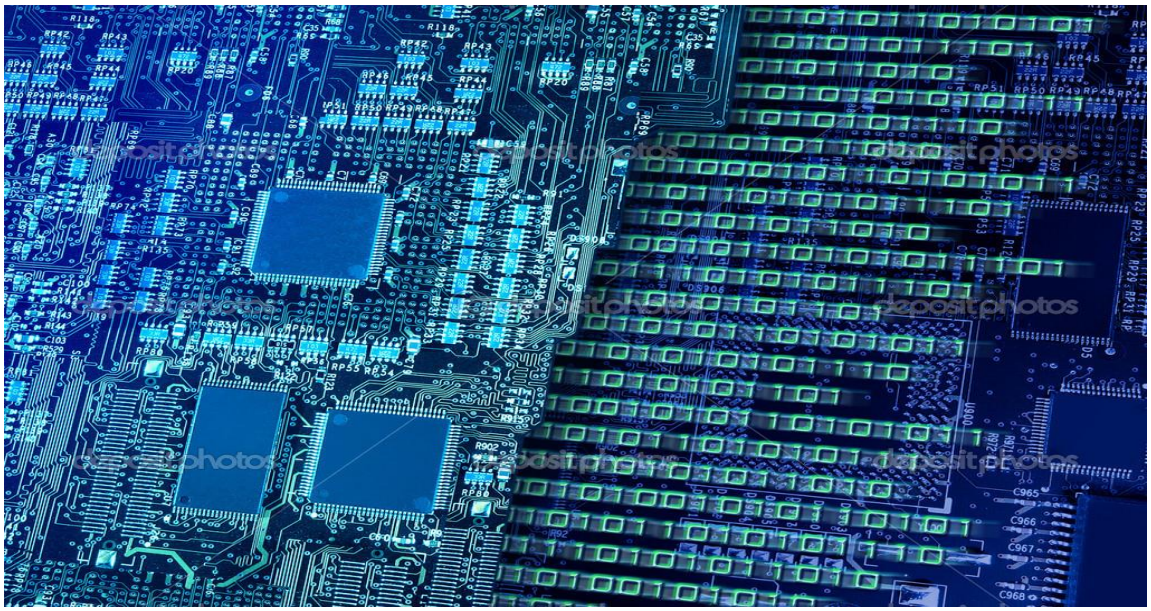
Now, much in the same way as in the famed double slit experiment where there absolutely no chance of being certain on which slit the electron went through, an electron in an atom too can exist in either the ground state or in any of its excited states with a certain probability.

Let's consider 'k' possible states for the electron: 1(ground) to k.

Let's say $|A\rangle = A_1|1\rangle + A_2|2\rangle + A_3|3\rangle$. where $|A\rangle$ represents a given state of the electron (in ket notation) and A1, A2, represent probabilities that the electron is present in each of the specified energy levels.

Now, these different quantized states can be represented on a 'Hilbert Space' in a manner such that we can compare operations on them to those on complex rotating vectors. Hence, there is always the possibility of superposition, whereby the electron can exist in a combination of states, giving rise to whole new states.

This is the story of just ONE qubit. When we consider two and more such qubits, quantum entanglement takes place; again, to our advantage.



But what future does this hold for electronics?

It has been theoretically proven that it is possible to build quantum circuits that operate to superpose wavefunctions, similar to the job accomplished by the gates we use today. In 2009, researchers at Yale University created the first solid-state quantum processor. This two-qubit superconducting chip had artificial atom qubits, enabling the scientists to perform operations, without disturbing the qubits' superposition. Now, just as we have the P and NP sets of problems, there has arisen a new class called BQP (Bounded Error, Quantum, and Polynomial Time) that allows quantum computers to efficiently solve higher polynomial-time problems faster, and with greater probabilistic accuracy.

However, one main hitch holds: it is primal that these quantum computers are isolated, lest our process of measurement destroy the whole probabilistic view of the quantum states, pushing the electron to choose one.

It has been said that the world's first quantum computer is just five years away. But who wants to wait till then?

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SOLAR POWER

-Rachit Ajitsaria

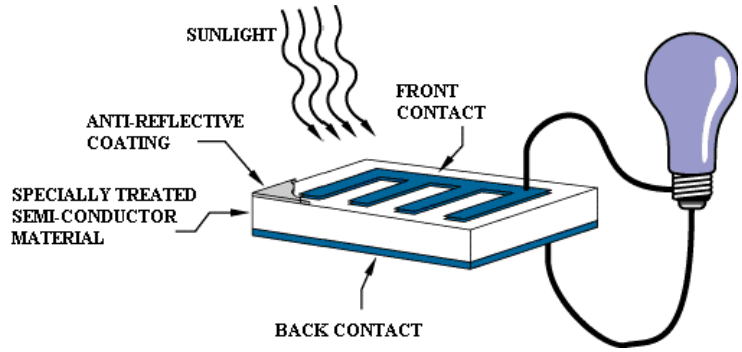
With the global drive against adverse climate change and towards sustainable development, the attention has shifted to renewable sources of energy. India too, has started its shift towards alternative sources and solar energy has emerged as the favorite. Experts today forecast an increased demand of electrical and electronic engineers with the necessary skills and increased funding for the research and development of such sources of energy.

Projects and Plans announced:

The Indian Government has set a target of 100,000MW capacity of solar power in contrast to the present 2600 MW capacity. Also, in accordance with the Prime Minister's "Make in India" programme, it has been declared mandatory that all the photovoltaic cells and modules used in these power plants be manufactured in the country. Additionally, a 70% subsidy for photovoltaic power plant in the North East region and 30% subsidy in the rest of India is already in place.

With the increased funding, and with the growing necessity to shift to renewable energy sources, the states are eager to adopt solar energy as their chief source of power. Gujarat has set an aim of converting its capital to a solar city and has even commissioned a solar power park. Rajasthan has begun the construction of the world's largest solar power plant with a capacity of 4000 MW. In Delhi, the incumbent party has promised to commit to solar energy to eliminate power outages. With these developments in place, it is essential to work out ways to implement the ideas that are at present only on paper.

Working:



Source: science.nasa.gov

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The diagram above illustrates the operation of a basic photovoltaic cell, also referred to as a solar cell. Solar cells are made of the same kind of semiconductor material as that used in the microelectronics industry. Thin semiconductor wafer in the photovoltaic cell is specially treated to form an electric field, positive on one side and negative on the other. When light energy strikes the solar cell, electrons are knocked loose from the atoms in the semiconductor material. With electrical conductors attached to the positive and negative terminals, forming an electrical circuit, the electrons are captured in the form of an electric current, which can be used to power a load.

A cluster of solar cells electrically connected to each other and mounted in a support structure or frame is called a photovoltaic module. The current produced is directly dependent on the amount of light striking the module.

Applications:

In India solar power is presently utilized in four ways:

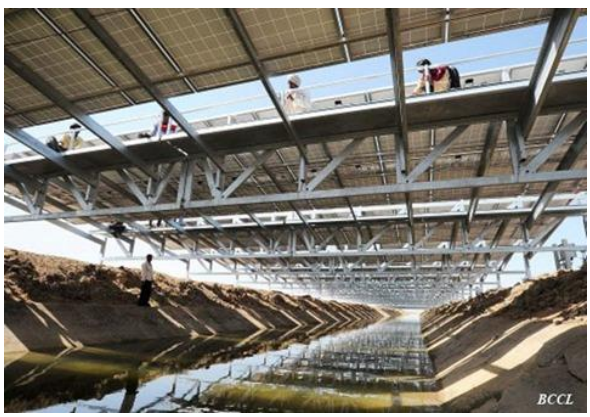
Rural Electrification: About 80,000 villages in India do not have access to electricity. Close to 18,000 of these cannot be covered by the conventional power grid. Developments in cheap solar technology are considered a potential alternative that allow an electricity infrastructure consisting of a network of local-grid clusters with distributed electricity generation instead of the traditional centralised grid.

Solar lamps and lighting: The Ministry of New and Renewable energy is now providing subsidy for the cost of home lights, lanterns and small residential systems.

Agriculture: Solar watering pumps are being extensively used to pump water for irrigation and domestic purposes.

Solar water heaters: These are increasingly getting popular in the urban landscape with Bangalore making such systems mandatory for all high rises. Pune, Gandhinagar and Surat are moving in the same direction.

Canal Top Solar Plants



Solar Trees

Source: indiangeek.com

In a totally awesome *jugaad*, India combined ingenuity, innovation and engineering to deliver its first canal top solar power plant. It provides three benefits: prevention of water evaporation, renewable energy production and reduction of land usage. India is expected to create 100 megawatts (MW) of capacity from grid-connected solar photovoltaic (PV) power plants built on top of canals and on their banks by the end of 2017, in accordance with the government's latest Five Year Plan.

In a conscious amalgamation of art, awareness and engineering, the solar tree was born. Working on the rather simple principle of solar lightning systems, it charges through the day and lights up in the night, besides proving shade during the hours of sunshine. The original manufacturer, Artemide defines the Solar Tree as "The successful marriage of the most advanced technology and the aesthetic requirements of the urban environment by way of renewable energy."

With these developments in place and with the resources that the government has made available, it is inevitable that India will switch to solar power as its chief source of energy, bringing along the betterment of society.

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DID YOU KNOW?

- **The word engineer comes from a Latin word meaning 'cleverness'.**
- **The largest wind turbine in the world is in Denmark. It is 720 feet tall, has 260-foot long blades and can generate energy up to 8 Megawatts.**
- **160 billion emails are sent daily, 97% of which are spam.**
- **Spam generates 33billion Kilo-Watt-hour of energy every year, enough to power 2.4 million homes, producing 17 million tonnes of CO_2.**
- **One Google search produces about 0.2g of CO_2. But since you hardly get an answer from one search, a typical search session produces about the same amount of CO_2 as does boiling a tea kettle. Google handles about a billion search queries per day, releasing some 200 tonnes of CO_2 per day.**
- **Google, uses an estimated 15 billion kWh of electricity per year, more than most countries. However, Google generates a lot of their own power with their solar panels.**
- **Optical fibre was invented in 1966 by two British scientists called Charles Kao and George Hockham working for the British company Standard Telecommunication.**
- **Traffic lights were used before the advent of the motorcar.**
- **The first public cell phone call was made on April 3, 1973 by Martin Cooper.**
- **Happy Birthday (the song) is copyrighted.**
- **One hour before Alexander Graham Bell registered his patent for the telephone in 1876 Elisha Grey patented his design. After years of litigation, the patent went to Bell.**
- **The first fax process was patented in 1843.**
- **Nissan has developed a 'self-healing' iPhone case that erases scratches.**
- **A Russian scientist got hit in the head by the proton beam in a particle accelerator and survived to tell the tale.**
- **Before 1929, most scientists, including Einstein thought the universe just 'was there' from the start.**

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