E-TARANG

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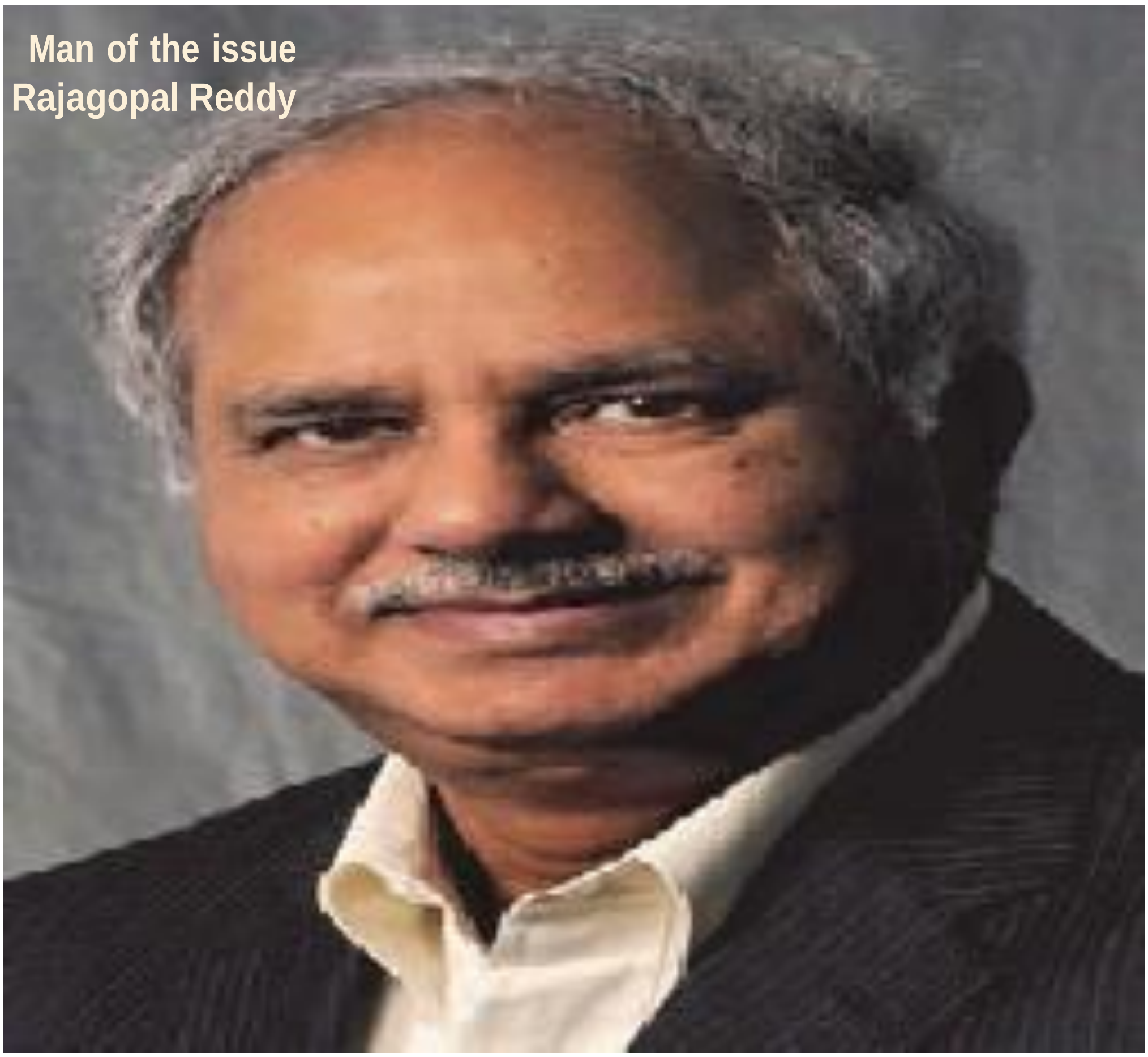

Department of Electronics and Communication Engineering
KIET Group of Institutions, Ghaziabad
(NAAC 'A' Grade, NBA Accredited and ISO 9001-2000)

KIET Group of Institutions, Ghaziabad, U.P.

Department of Electronics & Communication Engineering

VISION AND MISSION OF THE INSTITUTE

Vision statement

To become a leading institution nationally in the area of professional education, research & innovation for serving the global community.

Mission statements

- To impart quality professional education, skills and values through outcome-based innovative teaching learning process in all spheres.
- To undertake collaborative interdisciplinary research as a co-requisite for professional education and simultaneously solve problems faced by society and industry.
- To create an ambience of innovation, entrepreneurship and consultancy for future leaders and innovators.
- To keep faculty members enthusiastic by continuous professional development and positive working environment.

KIET Group of Institutions, Ghaziabad, U.P.
Department of Electronics & Communication Engineering

VISION AND MI SSION OF THE DEPARTMENT

Vision:

To become a leading center of excellence in the technical education of Electronics & Communication Engineering and create competent professionals in thrust areas for the development of society and nation.

Mission:

- To educate the students with the state of the art technologies through innovative teaching-learning process.
- To enable the graduates to develop the skills required to solve complex real time problems using tools and techniques of Electronics & Communication Engineering practice.
- To develop the spirit of innovation and creativity by collaborating with industries and research establishments to fulfill the needs of society.
- To practice high standards of human values, professional ethics and accountability.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs) OF B.TECH. (ELECTRONICS & COMMUNICATION ENGINEERING)

Graduates of the program will:

I. Acquire fundamental knowledge of Electronics & Communication Engineering to become employable and capable of pursuing higher studies.

II. Have sound foundation required to develop hardware & software solutions necessary for analysis, design and implementation of modern Electronics & Communication Engineering systems

III. Develop effective communication skills and interpersonal behavior to become a cooperative team member and able leader.

IV. Provide quality and worthy service towards their profession with societal and ethical values.

V. Inculcate the habit of life -long learning needed for higher studies and research and continue to develop new methodologies and technologies.

KIET Group of Institutions, Ghaziabad, U.P.

Department of Electronics & Communication Engineering

PROGRAMME OUTCOMES (POs) and (PSOs) OF B.TECH. (ELECTRONICS & COMMUNICATION ENGINEERING)

Program Outcomes (POs)

PO1: Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

PO2: Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the

engineering practice.

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

PSO1: Formulate the real-life problems and apply the concepts of semiconductor technology, signal processing and communication systems, VLSI etc., in the design and development of application-oriented engineering systems.

PSO2: Ability to identify, formulate and analyze complex problems in the field of Electronics and Communication Engineering using modern engineering tools, along with analytical and managerial skills either independently or as team.

KIET Group of Institutions, Ghaziabad, U.P.

Department of Electronics & Communication Engineering

GRADUATE ATTRIBUTES

The Graduate Attributes of Engineering Programs as identified by NBA are:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis:** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

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Dr. A Garg

Message

I am delighted to note that the Department of Electronics and Communication Engineering, KIET Group of Institutions, Ghaziabad is publishing (Online) Volume III Issue I, of KIET ECE E-Magazine, "E-TARANG".

I appreciate the efforts on the part of the Editorial Committee in bringing out Volume III Issue I, of E-TARANG on various domains of Electronics & Communication Engineering.

I understand that the articles contributed for publication in the Volume III Issue I, of are on almost all the current aspects of Communication Systems, Electronics systems and several others.

I have great pleasure in congratulating the Editors of KIET ECE E-Magazine, "E-TARANG" for their untiring efforts in bringing out this Volume III Issue I, of E-TARANG which will be a valued treasure for all researchers, students and faculty in Communications, Networking, Microwave and Electronics Engineering areas.

Let me close with warmest regards.

Dr. A Garg

President
KIET ECE E-Magazine, "E-TARANG"

FROM EDITOR'S DESK

It gives me immense pleasure in writing this foreword for the second volume, first issue of the KIET ECE E-Magazine, "E-TARANG" being published by the Department of Electronics and Communication Engineering, KIET Group of Institutions, Ghaziabad.

This magazine is targeted towards researchers, professionals, educators and students to share innovative ideas, issues, recent trends and future directions in the field of Electronics and Communication Engineering. Furthermore, it will enable the students in the various domains to foster the exchange of concepts, prototypes, research ideas and the results of research work which could contribute to the academic arena and also benefit business and industrial community.

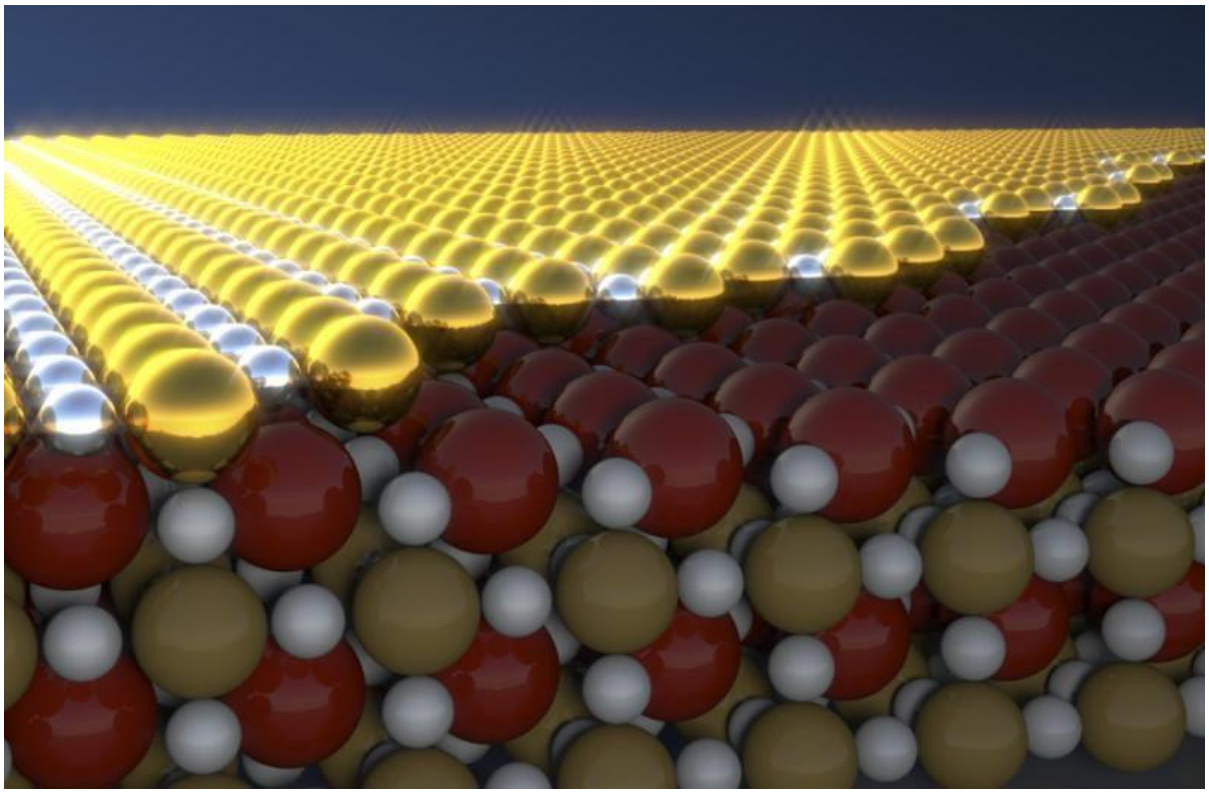
I am sure that this magazine would greatly benefit researchers, students and faculty. Young students and technocrats will find the contents of the magazine helpful to set roadmaps for their future endeavors.

Dr. Sanjay Sharma
Professor & Head, ECE DepartmentKIET Group of Institutions

NEWS

'Exotic' material is like a switch when super thin

Researchers have shown how to switch a particular transition metal oxide, a lanthanum nickelate, from a metal to an insulator by making the material less than a nanometer thick. Ever-shrinking electronic devices could get down to atomic dimensions with the help of transition metal oxides, a class of materials that seems to have it all: superconductivity, magnetoresistance and other exotic properties. These possibilities have scientists excited to understand everything about these materials, and to find new ways to control their properties at the most fundamental levels.



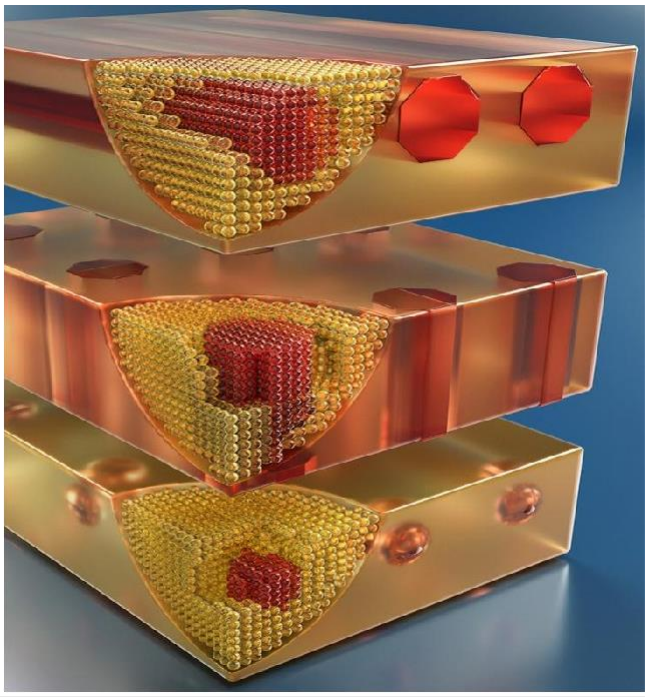
Researchers from Cornell University and Brookhaven National Laboratory have shown how to switch a particular transition metal oxide, a lanthanum nickelate ($LaNiO_3$), from a metal to an insulator by making the material less than a nanometer thick.

Ever-shrinking electronic devices could get down to atomic dimensions with the help of transition metal oxides, a class of materials that seems to have it all: superconductivity, magnetoresistance and other exotic properties. These possibilities have scientists excited to understand everything about these materials, and to find new ways to control their properties at the most fundamental levels.The team of researchers, which published its findings online April 6 in *Nature Nanotechnology* (to appear in the journal's May issue), includes lead researcher Kyle Shen, associate professor of physics; first author Phil King, a recent Kavli postdoctoral fellow at Cornell now on the faculty at the University of St. Andrews; Darrell Schlom, the Herbert Fisk Johnson Professor of Industrial Chemistry; and co- authors Haofei Wei, Yuefeng Nie, Masaki Uchida, Carolina Adamo, and Shabo Zhu, and Xi He and Ivan Božović. Using an extremely precise growth technique called molecular-beam epitaxy (MBE), King synthesized atomically thin samples of the lanthanum nickelate and discovered that the material changes abruptly from a metal to an insulator when its thickness is reduced to below 1 nanometer. When that threshold is crossed, its conductivity -- the ability for electrons to flow through the material -- switches off like a light, a characteristic that could prove useful in nanoscale switches or transistors, Shen said. Using a one-of-a-kind system at Cornell, which integrates MBE film growth with a technique called angle-resolved photoemission spectroscopy (ARPES), King and colleagues mappedout how the motions and interactions of the electrons in the material changed across this threshold, varying the thickness of their oxide films atom by atom. They discovered that when the films were less than 3 nickel atoms thick, the electrons formed an unusual nanoscale order, akin to a checkerboard. The results demonstrate the ability to control the electronic properties of exotic transition metal oxides at the nanometer scale, as well as revealing the striking cooperative interactions that govern the behavior of the electrons in these ultrathin materials. Their discovery paves the way for making advanced new electronic devices from oxides.

Nanostructures with applications in infrared and terahertz ranges

In a feat that may provide a promising array of applications, from energy efficiency to telecommunications to enhanced imaging, researchers at UC Santa Barbara have created a

compound semiconductor of nearly perfect quality with embedded nanostructures containing ordered lines of atoms that can manipulate light energy in the mid-infrared range. More efficient solar cells, less risky and higher resolution biological imaging, and the ability to transmit massive amounts ofdata at higher speeds are only a few applications that this unique semiconductor will be able to support. "This is a new and exciting field," said Hong Lu, researcher in UCSB's Department of Materials and Department of Electrical and Computer Engineering, and lead author of a study that appears as a cover story of the March issue in the journal *Nano Letters*, a publication of the American Chemical Society. Key to this technology is the use of erbium, a



Scientists have created a compound semiconductor of nearly perfect quality with embedded nanostructures containing ordered lines of atoms that can manipulate light energy in the mid-infrared range. More efficient solar cells, less risky and higher resolution biological imaging, and the ability to transmit massive amounts of data at higher speeds are only a few applications that this unique semiconductor will be able to support.

rare earth metal that has the ability to absorb light in the visible as well as infrared wavelength -- which is longer and lower frequency wavelength to which the human eye is accustomed -- and has

been used for years to enhance the performance of silicon in the production of fiber optics. Pairing erbium with the element antimony (Sb), the researchers embedded the resulting compound -- erbium antimonide (ErSb) -- as semimetallic nanostructures within the semiconducting matrix of gallium antimonide (GaSb). ErSb, according to Lu, is an ideal material to match with GaSb because of its structural compatibility with its surrounding material, allowing the researchers to embed the nanostructures without interrupting the atomic lattice structure of the semiconducting matrix. The less flawed the crystal lattice structure of a semiconductor is, the more reliable and better performing the device in which it is used will be. "The nanostructures are coherently embedded, without introducing noticeable defects, through the growth process by molecular beam epitaxy," said Lu. "Secondly, we can control the size, the shape and the orientation of the nanostructures." The term "epitaxy" refers to a process by which layers of material are deposited atom by atom, or molecule by molecule, one on top of the other with a specific orientation.

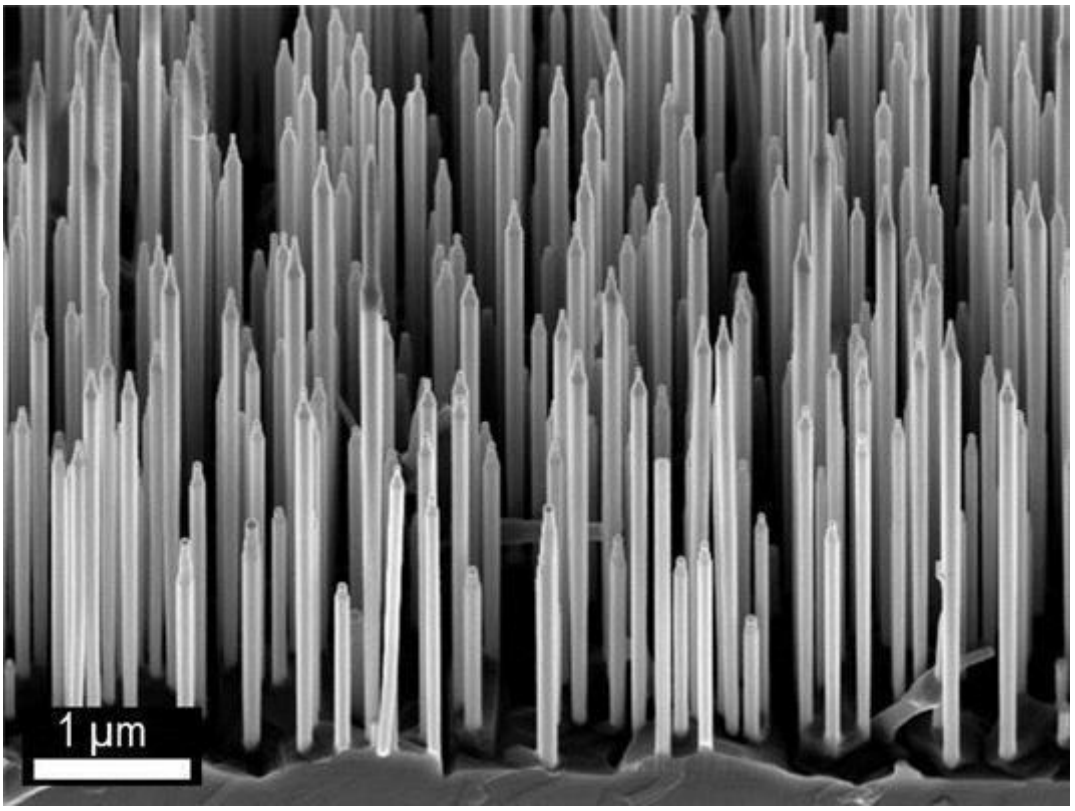
"It's really a new kind of heterostructure," said Arthur Gossard, professor in the Materials Department and also in the Department of Electrical and Computer Engineering. While semiconductors incorporating different materials have been studied for years -- a technology UCSB professor and Nobel laureate Herbert Kroemer pioneered -- a single crystal heterostructured semiconductor/metal is in a class of its own.

The nanostructures allow the compound semiconductor to absorb a wider spectrum of light due to a phenomenon called surface plasmon resonance, said Lu, and that the effect has potential applications in broad research fields, such as solar cells, medical applications to fight cancer, and in the new field of plasmonics. Optics and electronics operate on vastly different scales, with electron confinement being possible in spaces far smaller than light waves. Therefore, it has been an ongoing challenge for engineers to create a circuit that can take advantage of the speed and data capacity of photons andthe compactness of electronics for information processing. The highly sought bridge between optics and electronics may be found with this compound semiconductor using surface plasmons, electron oscillations at the surface of a metal excited by light. When light (in this case, infrared) hits the surface of this semiconductor, electrons in the nanostructures begin to resonate -- that is, move

away from their equilibrium positions and oscillate at the same frequency as the infrared light -- preserving the optical information, but shrinking it to a scale that would be compatible with electronic devices. In the realm of imaging, embedded nanowires of ErSb offer a strong broadband polarization effect, according to Lu, filtering and defining images with infrared and even longer-wavelength terahertz light signatures. This effect can be used to image a variety of materials, including the human body, without the risk posed by the higher energies that emanate from X-rays, for instance. Chemicals such as those found in explosives and some illegal narcotics have unique absorption features in this spectrum region. The researchers have already applied for a patent for these embedded nanowires as a broadband light polarizer. "For infrared imaging, if you can do it with controllable polarizations, there's information there," said Gossard. While infrared and terahertz wavelengths offer much in the way of the kind of information they can provide, the development of instruments that can take full advantage of their range of frequencies is still an emerging field. Lu credits this breakthrough to the collaborative nature of the research on the UCSB campus, which allowed her to merge her materials expertise with the skills of researchers who specialize in infrared and terahertz technology. "It's amazing here," she said. "We basically collaborated and discovered all these interesting features and properties of the material together." "One of the most exciting things about this for me is that this was a 'grassroots' collaboration," said Mark Sherwin, professor of physics, director of the Institute for Terahertz Science and Technology at UCSB, and one of the paper's co-authors. The idea for the direction of the research came from the junior researchers inthe group, he said, grad students and undergrads from different laboratories and research groups working on different aspects of the project, all of whom decided to combine their efforts and their expertise into one study. "I think what's really special about UCSB is that we can have an environment like that." Since the paper was written, most of the researchers have gone into industry: Daniel G. Ouelette and Benjamin Zaks, formerly of the Department of Physics and the Institute for Terahertz Science and Technology at UCSB, now work at Intel and Agilent, respectively. Their colleague Justin Watts, who was an undergraduate participant is now pursuing graduate studies at the University of Minnesota. Peter Burke, formerly of the UCSB Materials Department, now works at Lockheed Martin. Sascha Preu, a former postdoc in the Sherwin Group, is now assistant professor at the Technical

University of Darmstadt. Researchers on campus are also exploring the possibilities of this technology in the field of thermoelectrics, which studies how temperature differences of a material can create electric voltage or how differences in electric voltages in a material can create temperature differences. Renowned UCSB researchers John Bowers (solid state photonics) and Christopher Palmstrom (heteroepitaxial growth of novel materials) are investigating the potential of this new semiconductor.

Better solar cells, better LED light and vast optical possibilities



Electron microscope picture of wurtzite GaA/AIGaAs core-shell nanowires.

Changes at the atom level in nanowires offer vast possibilities for improvement of solar cells and LED light. Researchers have discovered that by tuning a small strain on single nanowires they can become more effective in LEDs and solar cells.

NTNU researchers Dheeraj Dasa and Helge Weman have, in cooperation with IBM, discovered that gallium arsenide can be tuned with a small strain to function efficiently as a single light-emitting diode

or a photodetector. This is facilitated by the special hexagonal crystal structure, referred to as wurtzite, which the NTNU researchers have succeeded in growing in the MBE lab at NTNU. The results were published in *Nature Communications* this week. The last few years have seen significant breakthroughs in nanowire and graphene research at NTNU. In 2010, Professors Helge Weman, Bjørn-Ove Fimland and Ton van Helvoort and their academic group went public with their first groundbreaking discoveries within the field. The researchers, who specialise on growing nanowires, had succeeded in controlling a change in the crystal structure during nanowire growth. By altering the crystal structure in a substance, i.e. changing the positions of the atoms, the substance can gain entirely new properties. The NTNU researchers discovered how to alter the crystal structure in nanowires made of gallium arsenide and other semiconductors. With that, the foundation was laid for more efficient solar cells and LEDs. "Our discovery was that we could manipulate the structure, atomby atom. We were able to manipulate the atoms and alter the crystal structure during the growth of the nanowires. This opened up for vast new possibilities. We were among the first in the world who were able to create a new gallium arsenide material with a different crystal structure," says Helge Weman at the Department of Electronics and Telecommunications.

This process exists in nature as well. For example, diamond and graphite -- the latter is used as the "lead" in pencils -- are composed by the same carbon atoms. But their crystal structures are different. And now, researchers can also change the structure of nanowires at the atom level.

Graphene, the super-material

The next big news came in 2012. At that point, the researchers had managed to make semiconductor nanowires grow on the super-material graphene. Graphene is the thinnest and strongest material ever made. This discovery was described as a revolution in solar cell and LED component development. Over time, graphene can replace silicon as a component in electronic circuits. Today, silicon is used for producing both electronics and solar cells. Graphene conducts electricity 100 times faster than silicon, and is only one atom thick, while a silicon wafer is normally millions of times thicker. Graphene will also likely be cheaper than silicon in just a few years. The research group has

received a lot of international attention for the graphene method. Helge Weman and his NTNU co-founders Bjørn-Ove Fimland and Dong-Chul Kim have established the company CrayoNano AS, working with a patented invention that grows semiconductor nanowires on graphene. The method is called molecular beam epitaxy (MBE), and the hybrid material has good electric and optical properties. "We are showing how to use graphene to make much more effective and flexible electronic products, initially solar cells and white light-emitting diodes (LED). The future holds much more advanced applications," says Weman.

Highly effective solar cells

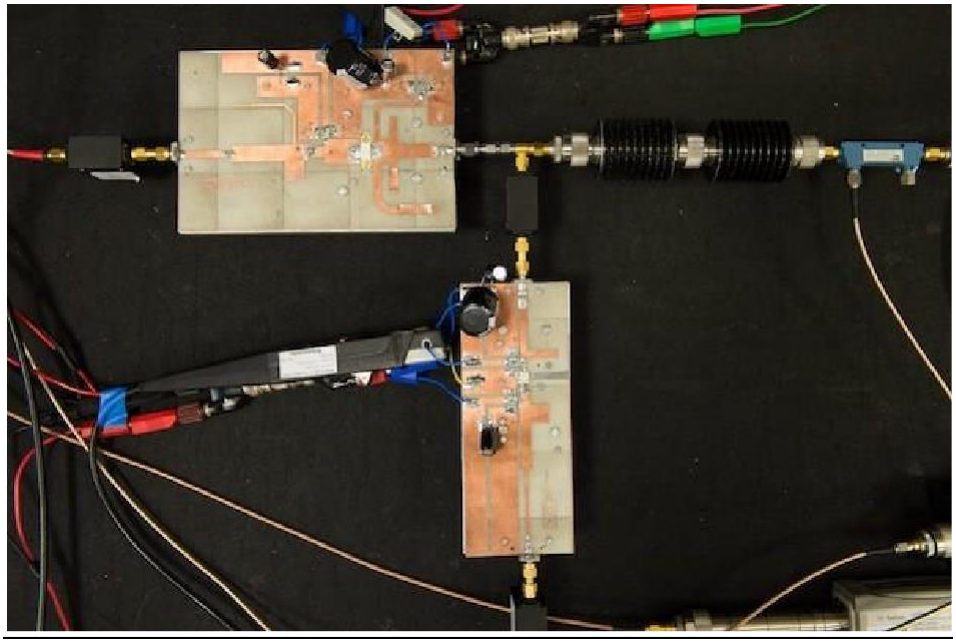
"Our goal is to create solar cells that are more effective than when they are made with thin film technology," Weman emphasises. Thin film technology is a term from the solar cell technology. This technology develops super-thin solar cell panels, where the active layer converting sunlight to electricity has a thickness of no more than three micrometres, i.e. three thousands of a millimetre. The low weight allows easy transportation, installation and maintenance of the solar cells, and theycan in practice be rolled out like roofing felt on most buildings. Now, the combination of nanowires and graphene facilitates much broader and more flexible solar cells. In thin films like gallium arsenide, the atoms are placed cubically in a fixed, predefined structure. When the researchers manipulate the atom structure inside the nanowire, they can grow both cubic and hexagonal crystal structures. The different structures have completely different properties, for example when it comes to optical properties.

New discoveries, new possibilities

The last couple of years the research group has, among other things, studied the unique hexagonal crystal structure in the GaAs nanowires. "In cooperation with IBM, we have now discovered that if we stretch these nanowires, they function quite well as light-emitting diodes. Also, if we press the nanowires, they work quite well as photodetectors. This is facilitated by the hexagonal crystal structure, called wurtzite. It makes it easier for us to change the structure to optimise the optical

effect for different applications. "It also gives us a much better understanding, allowing us to design the nanowires with a built-in compressive stress, for example to make them more effective in a solar cell. This can for instance be used to develop different pressure sensors, or to harvest electric energy when the nanowires are bent," Weman explains. Because of this new ability to manipulate the nanowires' crystal structure, it is possible to create highly effective solar cells that produce a higher electric power. Also, the fact that CrayoNano now can grow nanowires on super-light, strong and flexible graphene, allows production of very flexible and lightweight solar cells. The CrayoNano group will now also start growing gallium nitride nanowires for use in white light-emitting diodes. "One ofour objectives is to create gallium nitride nanowires in a newly installed MBE machine at NTNU to create light-emitting diodes with better optical properties -- and grow them on graphene to make them flexible, lightweight and strong."

New design for mobile phone masts could cut carbon emissions



A signal amplifier: A breakthrough in the design of signal amplifiers for mobile phone masts could deliver a massive 200MW cut in the load on UK power stations, reducing CO_2 emissions by around 0.5 million tonnes a year.

Funded by the Engineering and Physical Sciences Research Council (EPSRC), the Universities of Bristol and Cardiff have designed an amplifier that works at 50 per cent efficiency compared with the 30 per cent now typically achieved. Currently, a 40W transmitter in a phone mast's base station* requiresjust over 130W of power to amplify signals and send them wirelessly to people's mobiles. The new design, however, enables the transmitter to work effectively while using just 80W of power. If 10,000 base stations in the UK were fitted with the new amplifier, it is estimated that the total saving would amount to half the output of a mid-size, 400MW power station. There are currently around 50,000 phone mast base stations in the UK, so the potential energy and carbon-saving benefits could be even greater. The team's development of a less power-hungry amplifier has focused on devising sophisticated new computing algorithms for incorporation into its inbuilt electronic management system, as well as on making a number of adjustments to the amplifier hardware. Dr Kevin Morris, project leader and Reader in Radio Frequency Engineering, Department of Electrical & Electronic Engineering at the University of Bristol, said: "This new amplifier design represents a step change in energy efficiency that could make a really valuable contribution to meeting the UK's carbon reduction targets."The team have also succeeded in simplifying the whole amplifier design process, which is of vital importance to encouraging widespread take-up of the project's findings.

"Traditionally, designing signal amplifiers for base stations have been a long, complex process involving a trial-and-error approach and producing one-off solutions," Dr Morris explained. "This has fuelled a reluctance to develop new amplifier designs. To get over that barrier, we've made it a priority to ensure our design is easily replicable." The team are now working with a major electronics company to take some of the project's key findings towards commercialisation. Follow-up funding has also been secured through an Impact Acceleration Grant awarded by EPSRC.

Agrit Tiwari

E- PRODUCTS

GOOGLE GLASS

Priya Agarwal, B.Tech. ECE, VI-B

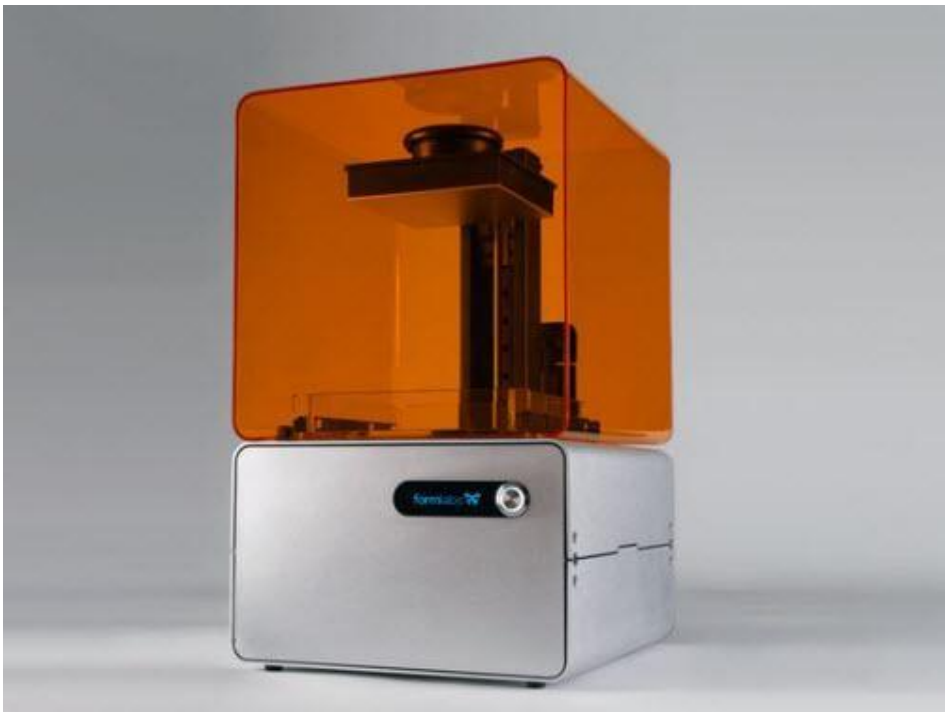
Augmented Reality has already gotten into our life in the forms of simulated experiment and education app, but Google is taking it several steps higher with Google Glass. Theoretically, with Google Glass, you are able to view social media feeds, text, Google Maps, as well as navigate with GPS and take photos. You will also get the latest updates while you are on the ground.

It's truly what we called vision, and it's absolutely possible given the fact that the Google's co-founder, Sergey Brin has demo'ed the glass with skydivers and creatives. Currently the device is only available to some developers with the price tag of $1500, but expects other tech companies trying it out and building an affordable consumer version.

2. FORM 1

Just as the term suggests, 3D printing is the technology that could forge your digital design into a solid real-life product. It's nothing new for the advanced mechanical industry, but a personal 3D printer is definitely a revolutionary idea.

Everybody can create their own physical product based on their custom design, and no approval needed from any giant manufacturer! Even the James Bond's Aston Martin which was crashed in the movie was a 3D printed product!



Form 1 is one such personal 3D printer which can be yours at just $2799. It may sound like a high price but to have the luxury of getting producing your own prototypes, that's a reasonable price. Imagine a future where every individual professional has the capability to mass produce their own creative physical products without limitation. This is the future where personal productivity and creativity are maximized.

3. OCULUS RIFT

Virtual Reality gaming is here in the form of Oculus Rift. This history-defining 3D headset lets you mentally feel that you are actually inside a video game. In the Rift's virtual world, you could turn your head around with ultra-low latency to view the world in high resolution display.

There are premium products in the market that can do the same, but Rift wants you to enjoy the experience at only $300, and the package even comes as a development kit. This is the beginning of the revolution for next-generation gaming.

The timing is perfect as the world is currently bombarded with the virtual reality topic that could also be attributed to Sword Art Online, the anime series featuring the characters playing games in an entirely virtual world. While we're getting there, it could take a few more years to reach that level of realism. Oculus Rift is our first step.

4. LEAP MOTION

Multi-touch desktop is a (miserably) failed product due to the fact that hands could get very tired with prolonged use, but Leap Motion wants to challenge this dark area again with a more advanced idea. It lets you control the desktop with fingers, but without touching the screen.

It's not your typical motion sensor, as Leap Motion allows you to scroll the web page, zoom in the map and photos, sign documents and even play a first person shooter game with only hand and finger movements. The smooth reaction is the most crucial key point here. More importantly, you can own this future with just $70, a price of a premium PS3 game title!

If this device could completely work with Oculus Rift to simulate a real-time gaming experience, gaming is going to get a major make-over.

5. EYE TRIBE

Eye tracking has been actively discussed by technology enthusiasts throughout these years, but it's really challenging to implement. But Eye Tribe actually did this. They successfully created the technology to allow you to control your tablet, play flight simulator, and even slice fruits in Fruit Ninja only with your eye movements.

Priya Shukla

It's basically taking the common eye-tracking technology and combining it with a front-facing camera plus some serious computer-vision algorithm, and voila, fruit slicing done with the eyes! A live demo was done in LeWeb this year and we may actually be able to see it in in action in mobile devices in 2013.

Currently the company is still seeking partnership to bring this sci-fi tech into the consumer market but you and I know that this product is simply too awesome to fail.

6. SMART THINGS

The current problem that most devices have is that they function as a standalone being, and it require effort for tech competitors to actually partner with each other and build products that can truly connect with each other. Smart Things is here to make your every device, digital or non-digital, connect together and benefit you.

With Smart Things you can get your smoke alarms, humidity, pressure and vibration sensors to detect changes in your house and alert you through your smart phone! Imagine the possibilities with this.

You could track who's been inside your house, turn on the lights while you're entering a room, shut windows and doors when you leave the house, all with the help of something that only costs $500! Feel like a tech lord in your castle with this marvel.

7. FIREFOX OS

iOS and Android are great, but they each have their own rules and policies that certainly inhibit the creative efforts of developers. Mozilla has since decided to build a new mobile operating system from scratch, one that will focus on true openness, freedom and user choice. It's Firefox OS.

Firefox OS is built on Gonk, Gecko and Gaia software layers – for the rest of us, it means it is built on open source, and it carries web technologies such as HTML5 and CSS3.

Developers can create and debut web apps without the blockade of requirements set by app stores, and users could even customize the OS based on their needs. Currently the OS has made its debut on Android-compatible phones, and the impression so far, is great.

You can use the OS to do essential tasks you do on iOS or Android: calling friends, browsing web, taking photos, playing games, they are all possible on Firefox OS, set to rock the smart phone market.

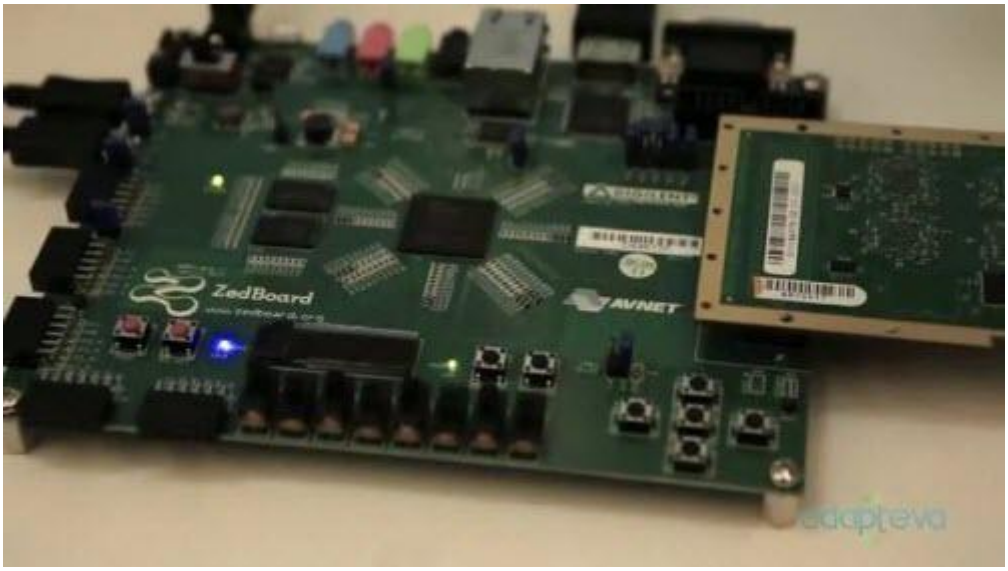
8. PROJECT FIONA

Meet the first generation of the gaming tablet. Razer's Project Fiona is a serious gaming tablet built for hardcore gaming. Once it's out, it will be the frontier for the future tablets, as tech companies might want to build their own tablets, dedicated towards gaming, but for now Fiona is the only possible one that will debut in 2013.

This beast features next generation Intel® Core i7 processor geared to render all your favourite PC games, all at the palm of your hands. Crowned as the best gaming accessories manufacturer, Razer clearly knows how to build user experience straight into the tablet, and that means 3-axis gyro, magnetometer, accelerometer and full-screen user interface supporting multi-touch. My body and soul are ready.

9. PARALLELLA

Parallella is going to change the way that computers are made, and Adapteva offers you chance to join in on this revolution. Simply put, it's a supercomputer for everyone. Basically, an energy-efficient computer built for processing complex software simultaneously and effectively. Real-time object tracking, holographic heads-up display, speech recognition will become even stronger and smarter with Parallella.



The project has been successfully funded so far, with an estimated delivery date of February 2013. For a mini supercomputer, the price seems really promising since it's magically $99! It's not recommended for the non-programmer and non-Linux user, but the kit is loaded with development software to create your personal projects.

I never thought the future of computing could be kick-started with just $99, which is made possible using crowd funding platforms.

10. GOOGLE DRIVERLESS CAR

I could still remember the day I watch the iRobot as a teen, and being skeptical about my brother's statement that one day, the driverless car will become reality. And it's now a reality, made possible by... a search engine company, Google.

While the data source is still a secret recipe, the Google driverless car is powered by artificial intelligence that utilizes the input from the video cameras inside the car, a sensor on the vehicle's top, and some radar and position sensors attached to different positions of the car. Sounds like a lot of effort to mimic the human intelligence in a car, but so far the system has successfully driven 1609 kilometres without human commands!

-You can count on one hand the number of years it will take before ordinary people can experience this.‖ Google co-founder, Sergey Brin said. However, innovation is an achievement; consumerization is the headache, as Google currently face the challenge to forge the system into an affordable gem that every worker with an average salary could benefit from.

FIN

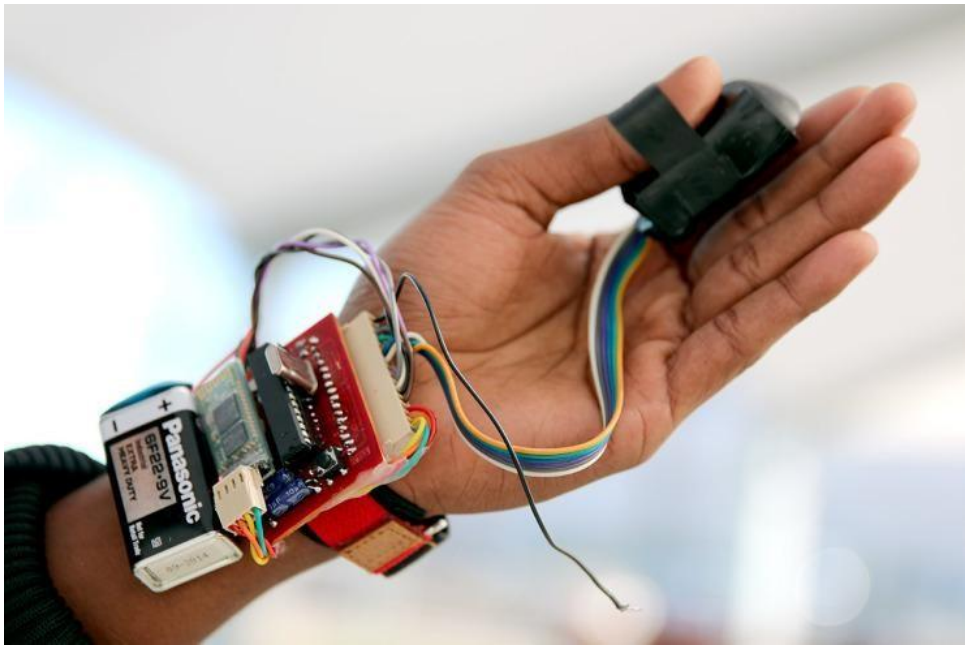
Akash Singh, B.Tech. ECE, IV-A

In a short period of time we have seen a number of wearable devices, be it the google glass, smart watches, samsung's fitness band and more. Well there's an entry from India too, though still in concepts and prototypes the product is already a smashing success.

A student from Kathir College of Engineering, Coimbatore, Tamil Nadu, Rohildev NV a founder/CEO/innovationist as he describes himself has come up with an innovative idea of converting your fingers palm into a touch interface. He names his product *fin*', on *fin* website you find about *fin*

"Fin is a real life buddy for every individual to do their digital interactions as natural as possible. Fin is a trendy gadget you can wear on the thumb and make your whole palm as a digital touch interface. Fin is one of the Top 15 startups in the world at TechCrunch Hardware Battlefield 2014.‖

Rohildev and the company founded by him. RHL vision proposes *fin* as an optical sensor into a small ring placed around your thumb, the *Fin* is able to detect swipes and taps across your hand, now you can understand your finger segments as buttons or/and you can also do gestures on your palm to give commands. Now the PCB has you input commands, and is connected to your device via Bluetooth (at present) it communicates them to your device. Swiping your thumb down your index finger, for example, could turn your phone's volume down. Swiping your thumb down your index finger, for example, could turn your phone's volume down. In future version biometrics would be included to detect segments and biological properties of your hands



1st Prototype

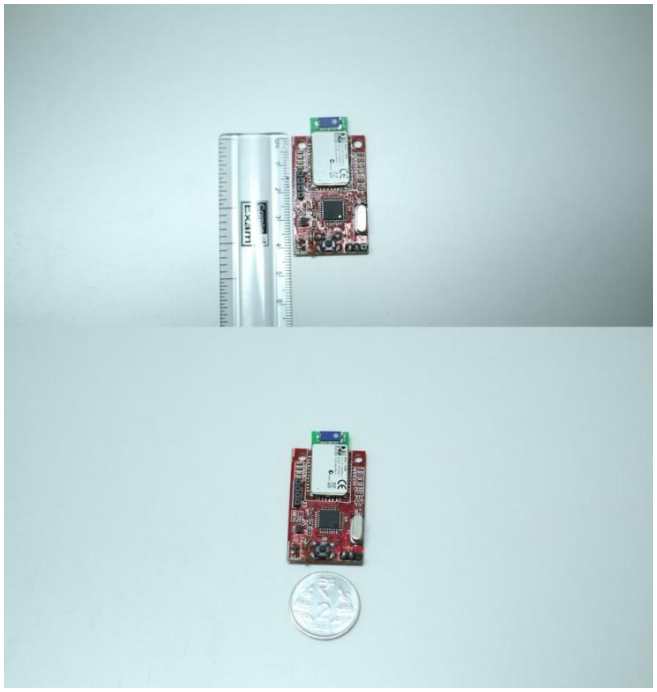
Well the product here won't appeal you but given its functions and the beautiful final product artists rendering would definitely

Artistic rendering of final '*fin*'

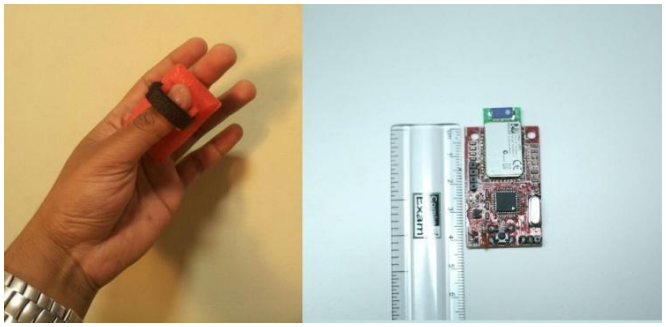
The *fin* can help you a number of ways from controlling your devices without taking out of your pocket or loosing screen assets, in future may be it can serve you for biometric scanners(fingerprint scanners, maybe giving freedom from annoying iphone verification failures), health sensors giving you freedom to roam around without heavy smartwatches and fitness bands. Made out of durable, waterproof and dustproof material, a single *Fin* will be capable of supporting up to three devices at a time. It will come with a custom Lithium ion battery with micro-USB charging dock and last more than one month on full charge. ―One of the most valuable applications of *Fin* will be as a companion for the physically challenged, provided they have a functional thumb,‖ Rohildev told Indian Science Journal. ―The palm can be a touch interface for the visually impaired and *Fin* can be used to control disability aids with the least amount of physical stress.‖ Roll on boy, that's something with values and requirements from India!

The success

The founders knew the product is going to be success so instead of finding financers for the startup and given the harsh conditions for new companies in India they went for crowd funding on indiegogo. Indiegogo is a crowd funding platform which has its own success story. A crowdfunding platform is a place where you like buy a product even before it exists, this helps the startup(campaign to be specific) to collect the capital required to realize your project and the funds can also be used for further product development as is the case with *fin. fin* $99 as listed per piece doesn't sound that appealing as its applications. A campaign is started with some initial target and so was the *fin* with a target of $100,000 USD, seems big but as you would be feeling by now the product has a magnetic appeal and the campaign has so far collected $202,547*USD* (nearly 1.23 crore rupees at time of writing) from 1600 peoples who signed up for campaign, almost double of what projected. As you see the product is already a hit even before it exists. Rohildev's RHLvision was one of the top 15 companies invited to TechCrunch CES Hardware Battlefield in Las Vegas early January; this gave it a exposure and chance for international tieups. The company also plans to (and will eventually) to lower the costs as the mass production begins, until then the developer version will be shipped from India. Now the company is working on faster to bring the *fin* in existence



2nd Prototype



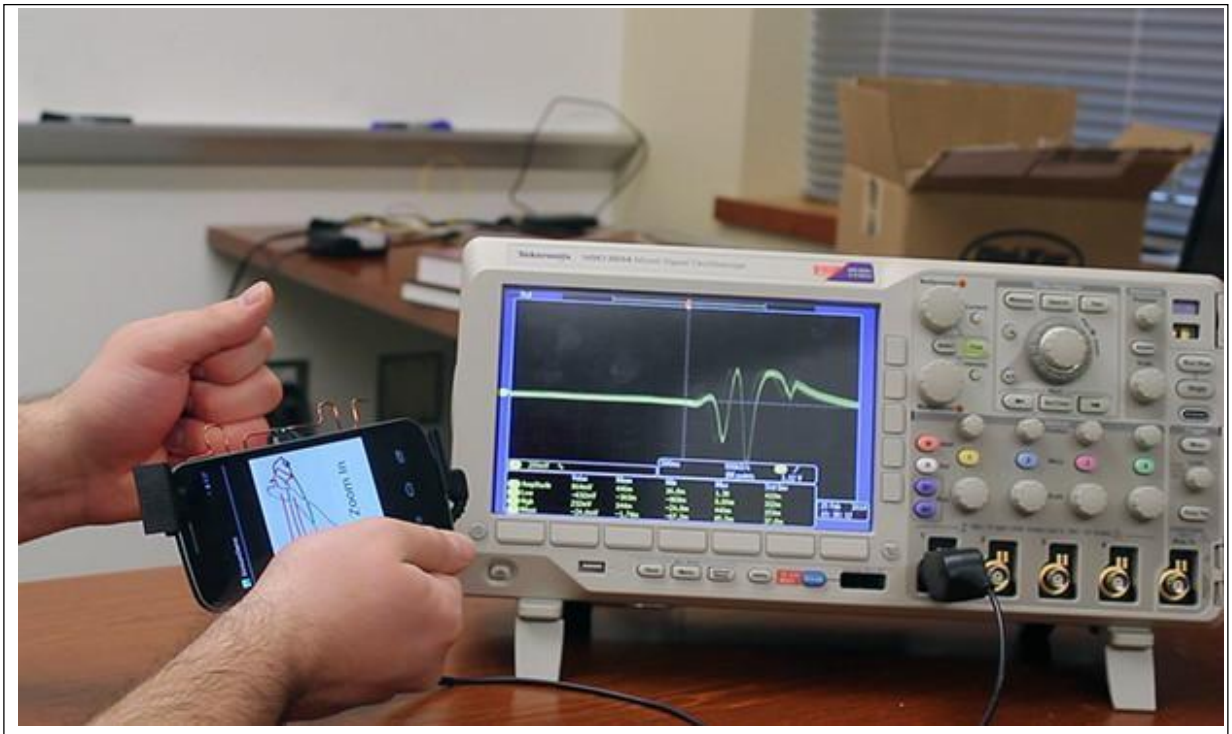
3rd Prototype, 3D printed

Latest 4th prototype

Battery-free technology brings gesture recognition to all devices

Gaurav Chaudhary, B.Tech. ECE IV-A

Mute the song playing on your smartphone in your pocket by flicking your index finger in the air, or pause your "This American Life" podcast with a small wave of the hand. This kind of gesture controlfor electronics could soon become an alternative to touchscreens and sensing technologies that consume a lot of power and only work when users can see their smartphones and tablets.



AllSee detects the unique signal changes (shown on the oscilloscope) and classifies a rich set of hand gestures.

University of Washington computer scientists have built a low-cost gesture recognition system that runs without batteries and lets users control their electronic devices hidden from sight with simple hand movements. The prototype, called "AllSee," uses existing TV signals as both a power source and the means for detecting a user's gesture command.

"This is the first gesture recognition system that can be implemented for less than a dollar and doesn't require a battery," said Shyam Gollakota, a UW assistant professor of computer science and engineering. "You can leverage TV signals both as a source of power and as a source of gesture recognition."

The technology is set to appear April 2-4 at the Symposium on Networked Systems Design and Implementation conference in Seattle.

The researchers built a small sensor that can be placed on an electronic device such as a smartphone. The sensor uses an ultra-low-power receiver to extract and classify gesture information from wireless transmissions around us. When a person gestures with the hand, it changes the

amplitude of the wireless signals in the air. The AllSee sensors then recognize unique amplitude changes created by specific gestures.

Sensors use three to four times less power than existing gesture recognition systems by harvesting power from wireless transmissions. This allows for mobile devices to always have the gesture technology on and enabled.

Gesture recognition already is possible on some mobile devices, including the Samsung Galaxy S4 smartphone. But users have to first manually enable the feature and be able to see the device for the gesture technology to work, and if left on, the gesture system quickly drains the phone's battery. In contrast, AllSee consumes only tens of microwatts of power and can always be left on. The user could gesture at the phone in a pocket or handbag to change the volume or mute the phone without having to touch or see the phone. This technology could allow sensors to be attached to household electronics, making it possible to interact with everyday objects using gestures and also connect them to the Internet and to each other in an "Internet of Things" world.

"Beyond mobile devices, AllSee can enable interaction with Internet of Things devices. These sensing devices are increasingly smaller electronics that can't operate with usual keypads, so gesture-based systems are ideal," said Bryce Kellogg, a UW doctoral student in electrical engineering.

The UW team tested AllSee's capabilities on smartphones and battery-free sensors using eight different hand gestures such as pushing or pulling to zoom in and out. The prototype could correctly identify the gestures more than 90 percent of the time while performed more than 2 feet away fromthe device.

Researchers have tested the technology for response time and whether it can distinguish between other motions and those directed at it. They found that the technology's response time is less than 80 microseconds, which is 1,000 times faster than blinking an eye.

"This enables a seamless and interactive experience for the user," said Vamsi Talla, a UW doctoral student in electrical engineering. The researchers also designed a wake-up gesture that allows the system not to confuse unintentional motions for actual gestures.

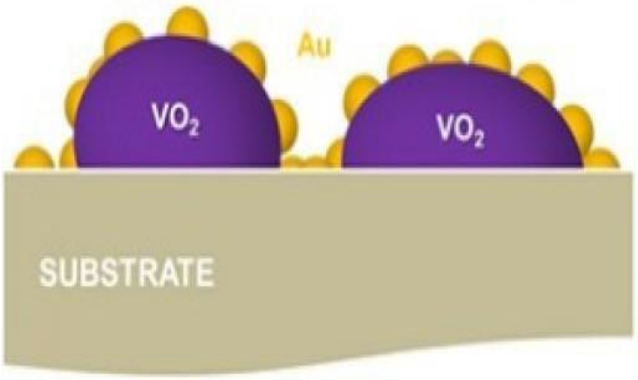
This technology builds on previous work by Gollakota on leveraging Wi-Fi signals around us for gesture recognition around the home. Prior wireless gesture recognition techniques, however, consume tens

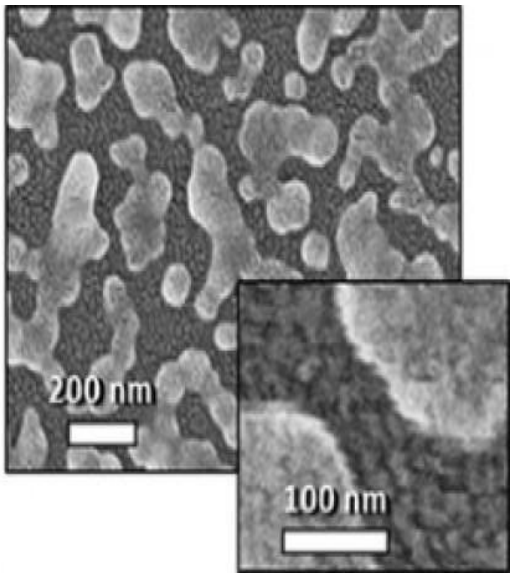
of watts of power and aren't suitable for mobile or Internet of Things devices. The research is funded by a Google Faculty Research Award and the Washington Research Foundation.

Nanoscale optical switch breaks miniaturization barrier

Preetika Tandon B.Tech. ECE VI-A

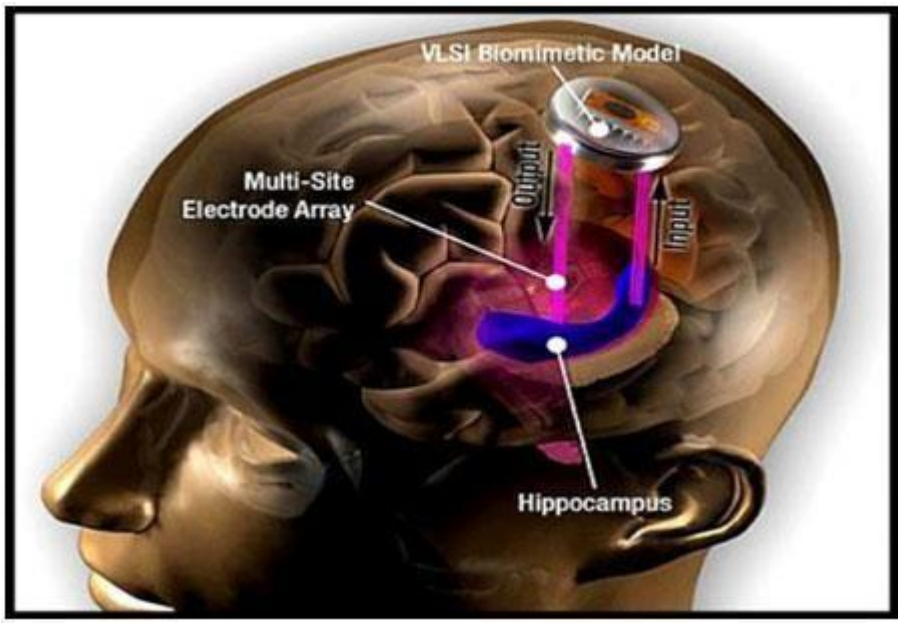
An ultra-fast and ultra-small optical switch has been invented that could advance the day when photons replace electrons in the innards of consumer products ranging from cell phones to automobiles. The new optical device can turn on and off trillions of times per second. It consists of individual switches that are only one five-hundredths the width of a human hair (200 nanometers) in diameter. This size is much smaller than the current generation of optical switches and it easily breaks one of the major technical barriers to the spread of electronic devices that detect and control light: miniaturizing the size of ultrafast optical switches.





WEB PULSE

Brain Memory Implants: Something to Remember



―The goal is to improve the quality of life for somebody who has had a severe memory deficit. If I can give them the ability to form new long term memories for half the conditions that most people live in, I'll be happy as hell, and so will be most patients.‖ – Theodore Berger (Inventor of the Memory Implants)

The field of biomedical engineering has risen to a new level in the past few decades. It combines various fields of engineering to ultimately design and develop artificial body parts which can duplicate its biological counterpart. It absorbs principles from different disciplines including biotechnology, medicine, mechanical engineering, electronics, computer science, etc. and applies it on the biological machine that is our body. Prosthetic limbs, artificial hearts and kidneys, artificial image processing retinas, 3D printed heart valves, synthetic tissues and stem cells are some of the wonders of biomedical engineering which help repair unrepairable damages. The human brain is by far the most complex organ present in the human body, more complex than any supercomputer or microprocessor man has ever made. It consists of millions of neurons inter connected to each other hidden in folds of grey matter producing tiny electric signals (in micro volts) to every data which the brain processes.

From the simple choice you make for breakfast in the morning to the complex cosmological problems, we call upon the unprecedented power of the brain to generate emotions and thoughts and to store them as memories. It is the epitome of the central nervous system of the human body. But, as we age the brain function tends to decrease causing memory loss or even more serious diseases such as Alzheimer's disease and dementia. Biomedical engineer at the University of South California, Theodore Berger hopes to restore this problem by his artificial silicon chips which create memories and help recall them for more than a minute. To know how it functions we must first understand how memory works.

How does Memory Work?

One of the most important functions of the brain is its ability to store data (memory). Therefore once we understand how the brain works to store and recall memory, we can begin to learn to improve our memory. Previously, researchers believed a single part of the brain to coordinate the basic functions of memory. Recent studies have found memory to be much more complex than it was believed to be. The functions of creating, storing and recalling memories consists of the synchronized action of various groups of systems of the brain. It is a web of intricately connected events which lead to the formation of memories. Let us consider an example of you falling in love, your eyes send visual data via the optical nerve to your brain like her physical features, color of her eyes and hair, your nose sends data of how the scent of her perfume smells like, your auditory senses send data of the soundof her voice and the way she laughs.

- This data is sent to the part of the brain which is called the hippocampus which along with the frontal cortex (front brain) decide whether a sense is worth remembering or not.

- After approval of which is stored in the long term memory by a process of firing electrical pulses between synapses (connection between the roots of neurons) causing the release of chemical carriers called Neurotransmitters (ex: a neurotransmitter called ‗dopamine' is released which triggers the emotion of happiness) which gives a memory its own signature of stimulus.

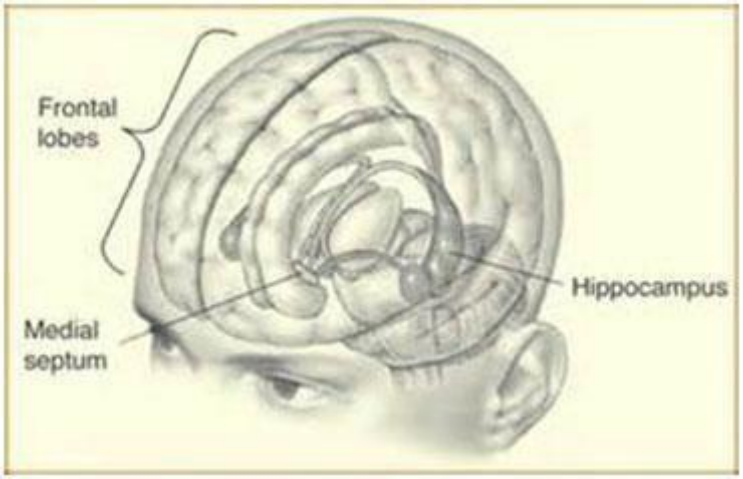
· These can occur in a trillion ways which allows flexibility and rewiring of the neuronal circuits. This process is the memory encoding.

· While retrieving a memory the signature electric pulse pattern is re-fired to release the similar neurotransmitters. It depends on how good you register and retain the memory. One or both of the above (registry and retention) may fail when you tend to ‗forget'.

· Applying this to the same example taken in the first case, suppose that you cannot recall the date of your anniversary. The possible failures are, your brain did not value the data to be important avoiding registry, or you might not have given much attention to the date leading to the failure of retention, or simply the failure to retrieve information due to mismatch between the chemical triggers of retrieving the information and the encoded memory.

· So then what hampers memory loss during old age? Research has found that this is accounted for the decay of brain cells in the hippocampus region at the rate of 5% every decade decreasing the neurotransmitter ‗Acetylcholine' while promotes learning and memory.

· Even neuronal diseases such as Alzheimer's, strokes, injuries or in fact anything which disruptsthe neuronal network can inhabit the formation of new memories.



But why should we let age and disabilities diminish our ability to cherish the beauty life? Would you be willing to forget how you felt during your first love, graduation day, your wedding day, your child's

birth, your first promotion, retirement day or even simple things you need to remember to carry out everyday tasks like the way to your house or where you left your keys?

The Memory 'Chips'

Note that the controlling factor of memory is the controlled firing of electrical pulses at the synapses which trigger the release of the chemical neurotransmitters. So if microcontrollers or microprocessors could be used to mimic the electronic pulse generation of the neurons, memory creation can be achieved artificially. Although it sounds doable the human brain consists of a 100 trillion synapses which fire in a signature pattern different from all other patterns, so to find a particular response would be much like finding a needle in a forest. Such complication goes into the invention of the silicon chips by Theodore Berger (no wonder it took him 35 years to study the behavior of the neurons in the hippocampus). Although human tests of neural prosthesis are yet to be conducted, Theodore and his team have reported successful reports of being able to create memories by his implants in rats and monkeys connected externally to their brains via electrodes. The primary purpose of the memory implant is to create memories.

The difficulties faced in this problem are:

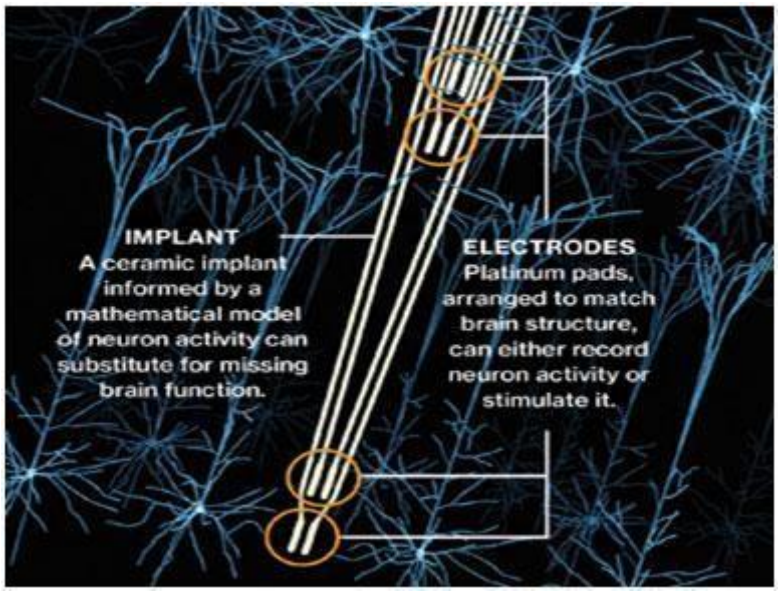
1. Filtering out the brain activity to study only memory related processes so as to mimic not the entire function of the brain but a fraction of it.

2. Next, the conversion of the physical principles into mathematical equations (mathematical modelling) and applying this model to a device.

3. This device must be compatible to the environment inside the cranium of not only one brain but brains of different people.

So how exactly do neuroscientists track the brain activity? They do this by monitoring the -action potentials‖ (microvolt changes in the electrical activity) on the surface of neurons. They monitor these responses with respect to an external stimulus. While studying the brain, it is inadequate to

concentrate only on the neuron undergoing the change, but also the effect it has on the neighboring neurons. Berger and his colleague Vasilis Marmarelis, studied these signals from the hippocampal slices from the brains of rats. After, obtaining the patterns of signals, they modelled it into a mathematical form of transformation programming it onto a computer chip. Next they researched whether they could bypass the generally received signals to an externally placed chip through electrodes and send back the processed signal back to the brain in the damaged hippocampal region through a central pathway (back again through electrodes).



Experimental Results: Theodore and his team after applying pre-evaluative tests on live rats moved to monkeys. They attached electrodes to a monkey's brain and connected the external chip which recorded an image which was showed to the monkey on full brain functionality. Later they doped the monkey with cocaine which in the calculated amounts inhabits that part of the brain and studied the image identification capability of the primate. Results concluded the increased performance of such memory based activities.

Berger is hopeful of moving into human trials by moving into talks with clinicians in his university who are hoping to cure certain patients with severe epilepsy by attaching electrodes on either side the hippocampus. He hopes to use this opportunity to encode memories on these trials. This will opengates to a new era of where science can be used to cure the unrepairable neuronal diseases. This concept of Berger's would sound to a regular person like a scene taken straight out of a science fiction film. But, recent successes of electronic implants in humans include the success of ‗cochlear implants' which help deaf people by converting sound to electrical signals which is collected by the auditory nerve. Also, prosthetic limbs (robotic) controlled by thoughts have cured cases of paralysis. So why not allow new developments to help improve the quality of life of numerous lives?

Virgin Galactic – Commercial Space Flight

Whoever said -*sky is the limit*ll, was clearly not dreaming big enough as proved by this tremendous pillar of space tourism. The idea was planted in man's mind when the historic **Apollo 11** rocket took **Neil Armstrong** and **Buzz Aldrin** and to the moon in**June, 1969**. He immediately grew an obsession to explore space up to a depth which was previously thought inexistent. He then sent the satellite, —*voyager*ll which has now already crossed the boundary of our solar system (entered the oort cloud) late last year, after 35 years of journey. Since then, few people have gone into space to attain the

privilege of being called -*Astronaut*ll. To become an astronaut, one has to have outstanding credentials, tons of experienceand rigorous training to adapt to extreme conditions in space. Odysee

When we watch videos of space shuttle launches and the astonishing views of the earth from space, we always dream of ourselves beingin such a place, a place where we feel bigger than the earth, and all the extravagant images that the deep dark space has to offer us. Each and every one of us has at least once in our childhood dreamed of being an astronaut. This dream was first out of reach for purposes of tourism. Later space tourism was given a price of $25 million which was made by a former Microsoft executive, Charles Simonyi to go along with two other astronauts.**Sir Richard Branson**, self-made billionaire and **CEO of the Virgin group of companies**, saw a business opportunity in making that dream affordable.

Sir Richard Branson and Burt Rutan have partnered to form the company, Virgin Galactic which aimsto commercialize space travel, booking for which started at a price of *200,000$* in 2004 and is currently 250,000$ (around Rs.1.5crore). Clearly, it is not cheap, but it is much more economical than the $25 million (today around Rs.150crores) which was paid earlier by space tourists. Co-Founder, Burt Rutan is the brains behind the design of concept of the operating spacecraft of Virgin Galactic. His design, Spaceship One (SS1) won the Ansari X prize in 2004 and also the founder of the company, Scaled Composites. Virgin Galactic and Scaled Composites combined to form ―The Spaceship Company‖ (TSC).

The Journey

Virgin Galactic, after acquiring the design of the spaceship one, licensed to develop the integral parts of the space flight named, **White Knight 2** and the **SpaceShip 2**. The *White Knight 2* is a large dual body carrier plane built to fly at high altitudes which carries the actual spacecraft, spaceship 2 to a certain altitude and releases it giving it lower power requirements than what it would require it to take off from the ground. The White Knight 2 will carry the Spaceship 2 from the ***New Mexico Spaceport***.The journey will consist of a *two and half hour flight* taking **6 passengers** and **2 pilots** 110kms above earth well above passing the standard distance to become an astronaut (80kms).

Passengers will experience a six minute period of weightlessness floating around the spaceship which has windows all around it so that no sight is missed. During the descent the spaceship reenters the earth‘s atmosphere with its wings folded up (sort of a free fall). The spaceship 2 will land back on to the New Mexico spaceport returning back to where it started from. For now, the Spaceport America at New Mexico is the only commercially opened spaceport opened for space travel.Plans for future spaceports in cities like Abu Dhabi, etc. are being screened to turn space travel into a global business.

The White Knight Two

The white knight 2 is the mothership carrier for the payload spaceship 2 developed by ―The Spaceship Company‖ using Burt Rutan‘s Ansari X prize winning concept white knight 1. The first whiteknight 2 was unveiled in 2008 and named the Virgin Mothership Eve (named after Richard Branson‘s mother). The white knight 2 will disengage the space ship near about the ceiling of the earth‘s atmosphere. So, the problems it might have to face are:

Problem 1: An equal mass distribution so that the fuselage (aircraft‘s main body section which carries the crew and passengers) of the white knight 2 and the space ship 2 in such a way that too much mass is not concentrated on a small area.

Solution: A **twin fuselage**, one on either side of the mid-section wherethe spaceship 2 is to be carried provides uniform mass distribution on the top loaded wings. Further, a **W-shaped wing section** which raised at the center section provides mass distribution as well a good ground clearance required for the mounting of the spaceship 2.

Problem 2: The pressure at such a high altitudes is extremely low (almost vacuum) that the pressure difference with cabin pressure (1 atm.) will create a high deformation force on the body and the engines. Therefore the material used must be strong to withstand the pressure as well as lightweight (low density) so that the engines can thrust it upwards against the gravitational pull of the earth.

Solution: The solution involves an optimum balance of weight with strength in the material selection process. Regular commercial and military aircrafts use aluminum alloys allowing it a ceiling of about 35,000 – 40, 000 feet, but when it came to designing the whiteknight 2, Burt Rutan left all convention behind. As a result, the white knight 2 is the **world's largest allCarbon Composite aircraft**. Carbon composites are not naturally found on earth but has to besynthesized artificially using just the right fractions making it a metallurgical wonder.

As a result, the *white knight 2 can fly up to* ***50,000feet*** above the earth and the carbon composite makes it so strong that it can fly zero-g parabolic paths duplicating the flight plan of the spaceship 2(a parabolic path will allow the crew to experience weightlessness which is also known as Zero G i.e., zero gravity), and on the other hand it can also perform 6G turns (six times the gravitational force). The Whiteknight 2 is powered by four ***Pratt and Whitney PW308A turbojet engines***. It is designed tocarry the 60 feet long by 27 feet wide spaceship 2, having a room of 50 feet in between the twin fuselage along with the W shaped wing, it makes the payload section easily available from the ground.It can also carry the Launcher One payload which is capable of sending small satellites into low earth orbit.

Spaceship Two

The spaceship two will take eight people (6 passengers and 2 pilots) to an altitude of 110kms above the earth. The whiteknight two will disengage the spaceship 2 at an altitude of 15km (50,000 feet), after which the single hybrid rocket motor (the **RocketMotor 2**) will thrust the spaceship to supersonic

speeds in just eight seconds (4200kmph). After 70 seconds, the rocket motor turns off as it reaches its peak altitude. It was first unveiled in 2009 and its first glide flight was conducted on 10th October, 2010, first powered flight on 29th April, 2013. Recently the SS2 had conducted its third rocket powered flight on January 10th of 2014.

Dimensions:

Cabin Length:	3.66m (12feet)
Cabin Diameter:	2.28m (7.5feet)
Wing Span:	8.23m (27feet)
Total length:	18.29m (60feet)
Tail Height:	4.57m (15feet)

The important features of the spaceship two are

i. **Carbon composite double hull**, which are like a sandwich structure having a **honeycomb** layer in between making it stronger and lighter.

ii. The **Hybrid Rocket Motor (RocketMotor Two)**, fueled by part solid and part liquid. **Nitrous oxide** is used as an oxidizer to burn the fuel, is contained in a pressurized tank behind the cabin. This nitrous oxide flows out of a **CTN** (case, throat and nozzle) which made out solid fuel (**tire rubber fuel**) after being lighted by an ignition system. The CTN system eventually burns out and must be replaced for the next flight.

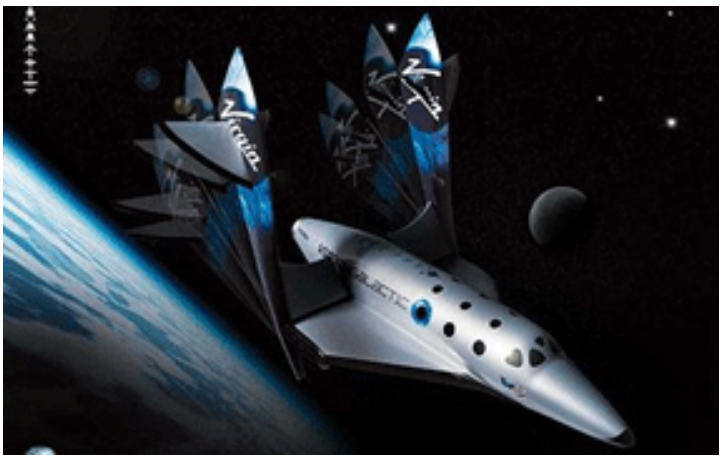
iii. **Thrusters**, which help the SS2 to perform roll, pitch and yaw. They are pressurized containers of air which provide thrust in the direction opposite to the movement needed.

iv. **Double Pane Windows (43cm and 47cm diameter)**, which surround the cabin providing numerous views of the earth. They are made to withstand the pressure difference by making them into a glass fiber structure instead of a direct glass mold.

v. **Rudders and Elevons**, while gliding back to earth these help in maneuvering the spacecraft to make course corrections. They alter the flow of air over the flight surface to adjust the pitch and angle.

vi. **Two hatches**, one of which is used for entry and exit and the other for emergency.

vii. **Feather Mechanism**, with*pneumatic* (air pressure actuators) controllers to rotate the wings. During reentry they wings rotate to a vertical position increasing the surface area in the flow direction to increase the drag force. This will reduce the drop velocity, which may reach up to 25,000kmph. The space craft will shift to a gliding position at about 24km to land back on to the New Mexico Spaceport. (You can observe this at 1:46 min on the video posted.)



The current fleet at TSC (The Spaceship Company) two WhiteKnight Two Mother ships and more than five SpaceShip Two spacecrafts (Virgin Mother Ships and Virgin Space Ships)

1. **VMS Eve**

2. **VMS Spirit of Steve Fossett**

3. **VSS Enterprise**

4. **VSS Voyager (Named after the popular space crafts from the movie Star Trek)**

Launcher One

With advancement in nanotechnology and electronics, devices are growing smaller and more accurate. Same is the case of Satellites. They are growing smaller in size, smarter in brains and cheaper in cost. The only thing faltering this rapid advance is the way that they are sent into space. Conventional rockets costs millions of dollars and a tremendous waste of fuel and material to send a small satellite. The launcher one was built to address this flaw. It can be attached as payload to the WhiteKnight two. The launcher one can carry a small satellite payload (100kgs) of its own. After being disengaged the rocket motor ignites sending it into the desired suborbital region. The primary burners disengage from the satellite payload sending the satellite into orbit with the secondary thrusters. Operations of Launcher One is expected to begin in 2016. It will open doors to various research organizations and universities to further their scope to send satellites of their own into space.

Spaceport America

In 2005, Virgin Galactic and the state of New Mexico, USA announced plans of building the world's first commercial spaceport in the New Mexico desert in state funded deal costing **$200million**. It will consist of a two mile long (3.2km) runway. The design of the spaceport by the UK based Foster and partners. Its curvy shape and futuristic interiors provide to the enthrallment of the aspiring astronauts to add to the excitement of going to space. It is designed to have minimalistic impact on the environment and provide an aesthetic view. It is powered by solar panels and consist of environmentally friendly heating, cooling and ventilation systems.

Virgin Galactic will be heading its operations at Spaceport America for the foreseeable future. The Spaceport America is divided into three zones.

i. **Western**: Administrative offices for the Virgin Galactic and New Mexico Space Authorities.

ii. **Central**: Hangars, Flight maintenance and operations

iii. **Eastern**: Departure Lounge, Astronaut dressing rooms, clubhouse, canteen and training center.

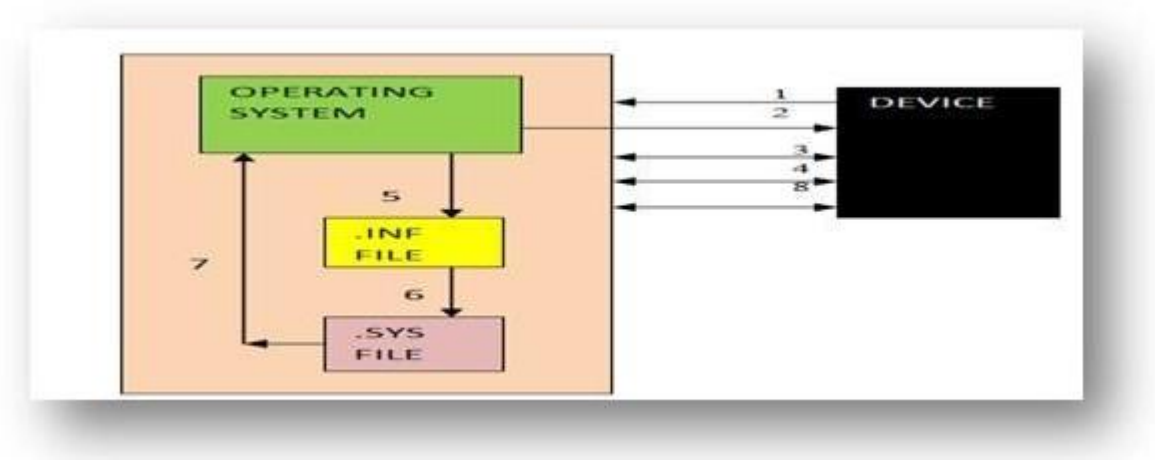
Safety and Future Scope

Space exploration has seen its share of fatal disasters and catastrophes, from the Apollo 13 in 1960 to the Space shuttle Columbia in 2003. These programs were funded by government organizations. Space tourism on the other hand will be conducted by private firms worldwide. The major concern for any prospective customer would be the safety of space travel. When a person pays such large sums of money the least he would expect is a firewall to his safety. Virgin Galactic is no less concerned in providing safety than the passengers themselves. The technology they use is selected primarily for economy and safety, for example the hybrid rocket motor is very less prone to mishaps and its propulsion is less violent and more controlled than the liquid fuelled rockets.

Virgin Galactic and Scaled Composites are sure that they will be the first to enter into this newly created market sectors after facing rumours of competitions from various other private firms working on **commercial passenger suborbital spaceflight.**

USB (Universal Serial Bus): An Overview

Communication in USB



While Communication in USB we consider three parts-

{C}{C}{C}{C}1. a) {C}{C}{C}{C}Host which can be a Computer / PC/ laptops

{C}{C}{C}{C}2. b) {C}{C}{C}{C}USB cable and connector

{C}{C}{C}{C}3. c) {C}{C}{C}{C}Peripheral devices eg. Keyboards, mouse, audio player etc

USB systems consist of a personal computer (PC) known as host and multiple peripheral devices like mouse, keyboard, and audio system. The host itself contains two components, the host controller and the root hub. A host controller is a hardware component that is contained in a host computer. The

Host controller converts the data in the language understandable to the **OPERATING SYSTEM** and also manages communication on the bus. The USB host controller has an embedded hub called the **root hub**. A hub is a common connection point that allows multiple devices to connect in the network. A hub contains multiple ports. The root hub connects the host controller(s) to the peripheral device and acts as the first interface layer to the USB in a system. The ports that are visible at the system's back panel are the ports of the root hub. These ports are part of the root hub and in turncan be connected to external hub thereby increasing the number of USB devices which can be connected to host. An external hub can be used to extend the connections to the maximum of 127 devices.

Whenever a **USB device** is connected or disconnected it is first detected at the root hub which in turns passes information to the host controller. USB is a half duplex protocol where all data is passed via a two wire interface called D+ (D plus) and D- (D minus).

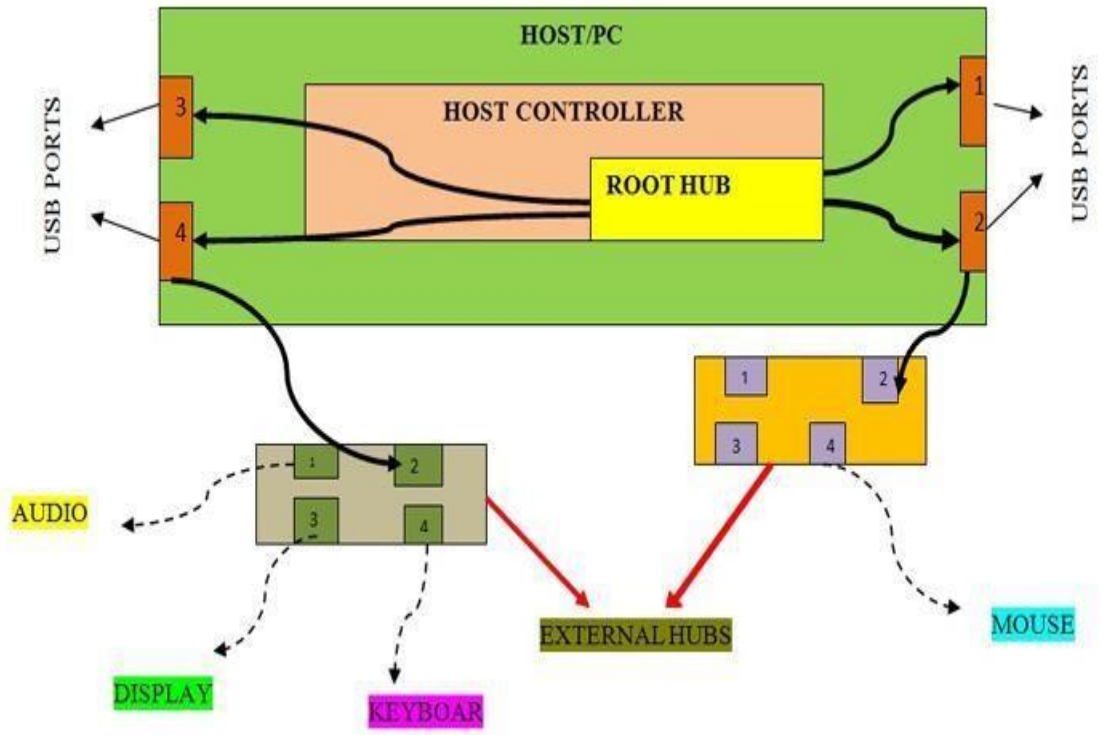
The host is responsible for the following tasks:

{C}{C}{C}{C}1. 1.Detect attachment and removal of USB devices

{C}{C}{C}{C}2. 2.{C}{C}{C}{C}Provide and manage power to attached devices

{C}{C}{C}{C}3. 3.{C}{C}{C}{C}Monitor activity on the bus and initiate the process of enumeration

{C}{C}{C}{C}4. 4.{C}{C}{C}{C}Manage data flow between host and devices.



When we discuss data transfer across the USB we always use the vantage point of the host for reference. For example, if there is an IN transfer that means the host is going to receive the data. An OUT transfer means the host is going to transmit data.

CONCEPT OF PIPES & END POINT

The ports are used to connect the peripheral devices like mouse, keyboards, or audio devices to them. Each device is given a specific address used during the communication process by the host. These devices are connected to the root hub and in turn to the host by pipes. A pipe is a logical connection between the host and end point and is used by client software to transfer data. It sets various parameters such as direction of data flow, length of bandwidth allocated to the device and what kind of transfer will take place. There are two types of pipes in USB one is stream pipe and other is message pipe.

{C}{C}{C}{C}· **Stream Pipes**- It is unidirectional communication pipes used for most of the data transfers. These pipes have no defined USB format. We can send any type of data from one end and

retrieve it from another end. Data flows sequentially and has a pre-defined direction either IN or OUT. Stream pipes support bulk, isochronous and interrupt type of transfers and controlled by either host or device.

{C}{C}{C}{C}· **Message Pipes**- It is bi-directional communication pipes and only used for sending/receiving short messages. These pipes have defined USB format. They are host controlled initiated by request sent from the host. Data is transferred in the desired direction as per the request. They support only control transfers.

Once we have understood the pipes we learn about various types of data transfers. Depending on the type of data we need to decide which type of pipe to use.

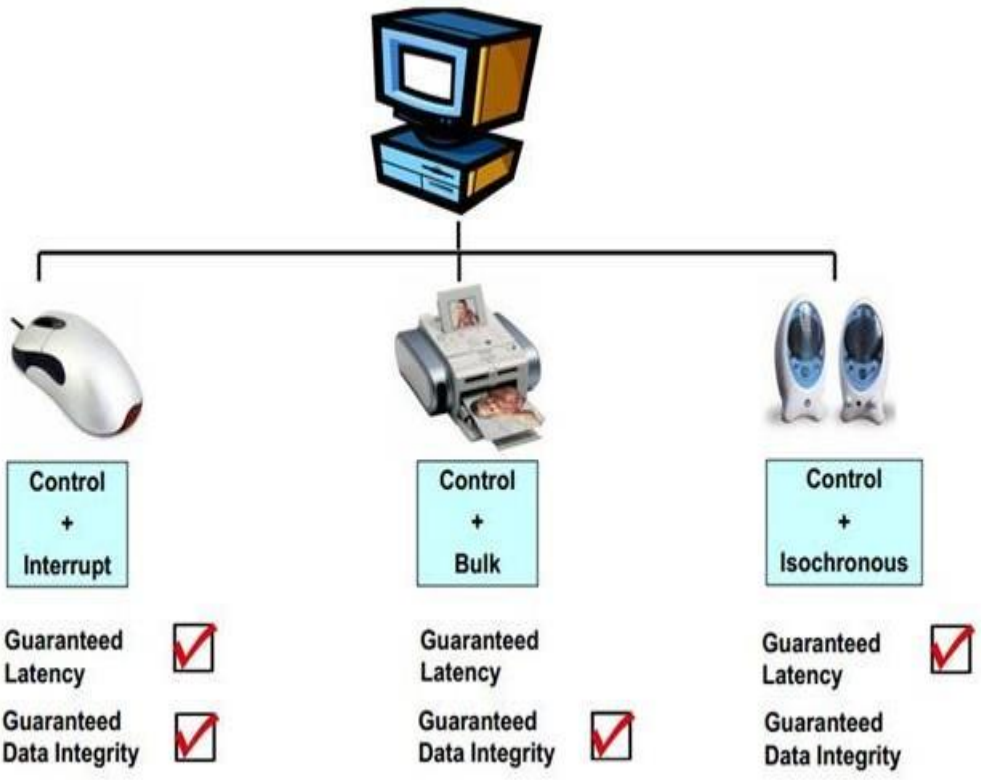
There are four different types of data transfer in USB.

{C}{C}{C}{C}1. 1.**Control Transfer**- It is used to send commands to the devices for making enquiries. This transfer uses Message pipes.

{C}{C}{C}{C}2. 2.{C}{C}{C}{C}**Interrupt Transfers**- It is used to send small amount of data that requires a guaranteed minimum time delay. It uses Stream pipes.

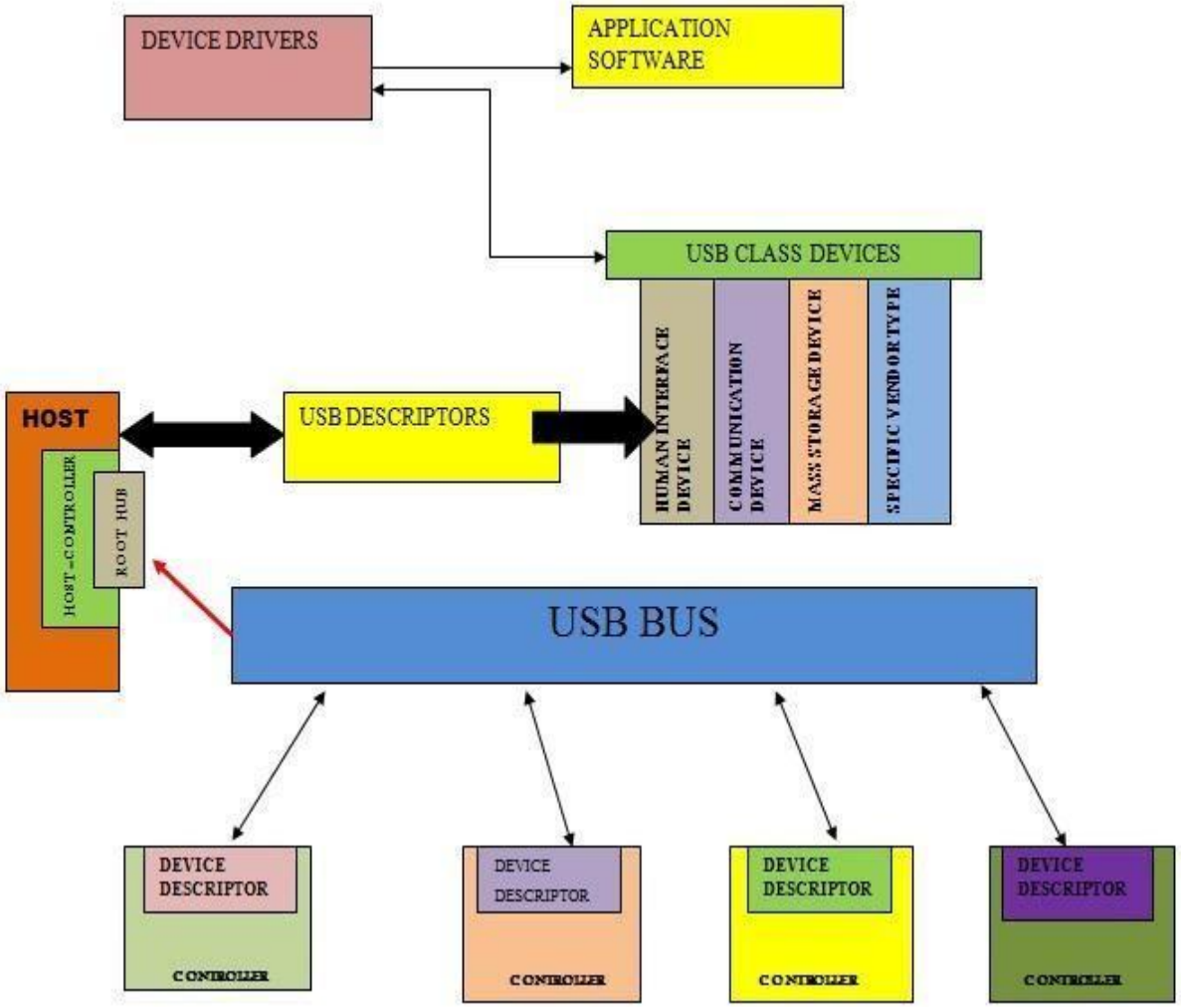
{C}{C}{C}{C}3. 3.{C}{C}{C}{C}**Bulk Transfer**- It is used for transferring large amount of data with no time guarantee and uses Stream pipes

{C}{C}{C}{C}4. 4.{C}{C}{C}{C}**Isochronous Transfers**- it is used for transferring data that requires a fixed delivery rate as they are capable of fixed bus bandwidth and lack of error correction. Since there is no error correction there is no delay in transfer of data. These transfers use Stream pipes.



In between the device and host there is addressable buffer which is known as endpoint. An endpoint is an electrical terminal usually consists of a set of memory registers that stores the data temporarily in USB peripheral devices on their way in or out. An endpoint stores received data from the host and holds the data to be transmitted to the host. A USB device can have multiple endpoints and each endpoint has a pipe associated with it. Each endpoint is accessed with a device address assigned by the host and an endpoint number that is assigned by the device. Endpoints usually come in pairs, e.g. Endpoint 1 In and Endpoint 1 Out. One set of Endpoints, **Endpoint 0 In** and **Endpoint 0 Out** is always turned on which is used for basic commands to all USB devices.

This next figure shows the entire USB system. Let's try to understand what exactly happens when a peripheral device is connected to the **USB port** and what are the processes going on between the host and the peripheral device.



3-D Printing – 'Modern Manufacturing & Rapid Prototyping'

–Scientists investigate that which already is; Engineers create that which has never been‖- Albert Einstein

Have you ever had an idea of a design lingering in your head, but couldn't possibly bring it into reality considering the manufacturing or economic limitations? Have you ever lost or damaged a part of a product which is no longer available in the market? Are you an inventor looking to produce working models to test functionality? Well, these are some of the questions now a days, to which the **utilization of a 3D-Printer** would be the recommended solution. So **what exactly is 3D Printing**, **how does it work?**

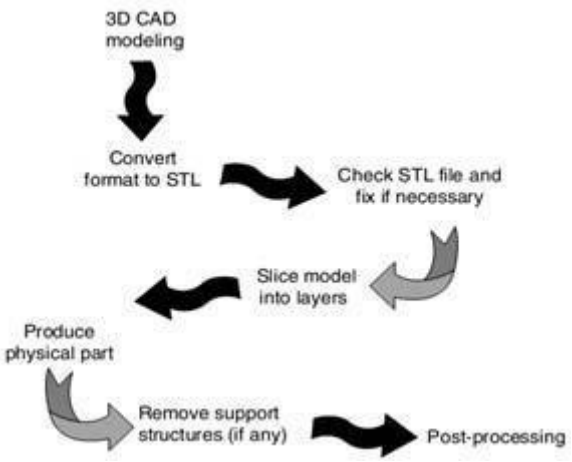
What is 3D Printing?

Intense global competition has pushed manufacturing firms to apply new technologies which allowed them to push out products faster, more accurately and with lower labor dependence into the markets which not only satisfies customer requirements faster, but also at a cheaper prices.

3D printing is a computer aided, additive manufacturing process in which a solid part is created from its CAD (Computer Aided Design) model. Sometimes this process is referred to as a ‗freedom manufacturing' process thanks to its dynamic and flexible classes of applications. The CAD model

produced by 3D modelling software applications such as CATIA, Solid works, Pro-Engineer, UG, etc. is first sliced into layers by various other software applications. The **3D printer** then produces the cross section of the part and stacks it layer by layer to produce the finished real world replica of the intended CAD model. 3D printing has been known to maintain a cycle time reduction between 30%- 90% depending on the technology used and the complexity of the part.

The 3D Printing Process



The figure above represents a basic data flow of the processes involved in 3d printing

The 3d model can be obtained by two ways, one is generated by any CAD system as either a surface model or a solid model. The other way is by obtaining 3d models from an existing physical part using scanners such as CMMs (Co-ordinate Measurement Machines), by a process called **Reverse Engineering.**

The standard format of input to the printing hardware is the **STL** (**ST**ereo**L**ithographic) format file which converts the 3d model into a shell consisting of a mesh of triangles joined by common sides and vertices. These triangles describe the X, Y and Z co-ordinates of the surface giving a path to the hardware.

Closely spaced 2D cross sections are created from the 3D STL filewith predefined thicknesses depending upon the fineness required (typically about 0.006 inches). This leads to a staircase formation and affects the final surface finish.

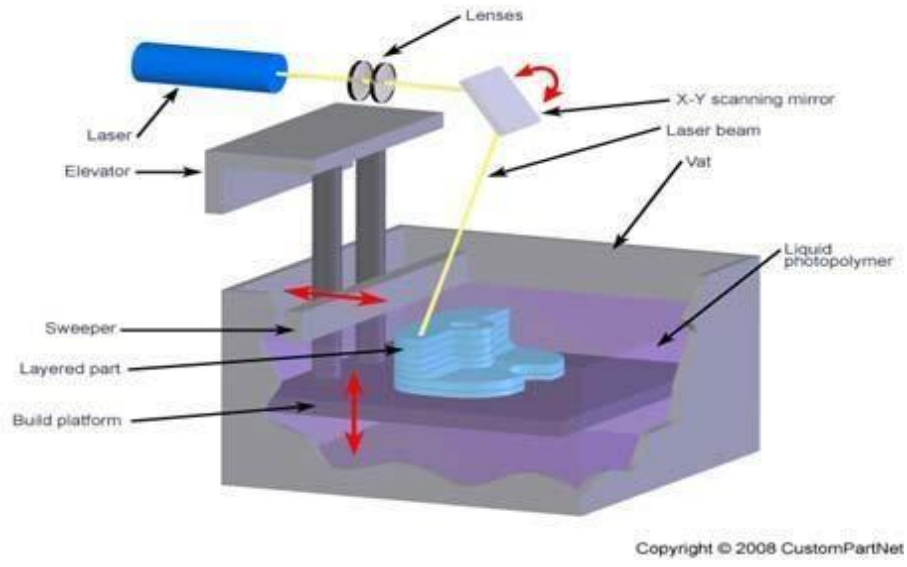
Support structures are added to hold the part together after the part is completed. Post completion, the support structures are melted off or dissolved in solvents.

Methods of 3D Printing

Based on the initial state of the material, the **types of 3d printing** may be broadly classified as liquid based, solid based and powder based.

Liquid based 3d printers consists of its initial material in the liquid state. Liquid based processes contain the advantage of having a good surface finish since the liquid initially has a smooth surface. Usually liquid based 3d printers use a heat source such as UV laser to solidify the liquids, which are mostly photo sensitive epoxy resins. This process of phase change occurring in the resins is called ‗curing'. The UV laser is concentrated on each point to control the curing process. The point location is coordinated with the point data received from the sliced STL file. The most common liquid based process (also called photo polymerization printing) is the Stereo Lithography process (SLA)

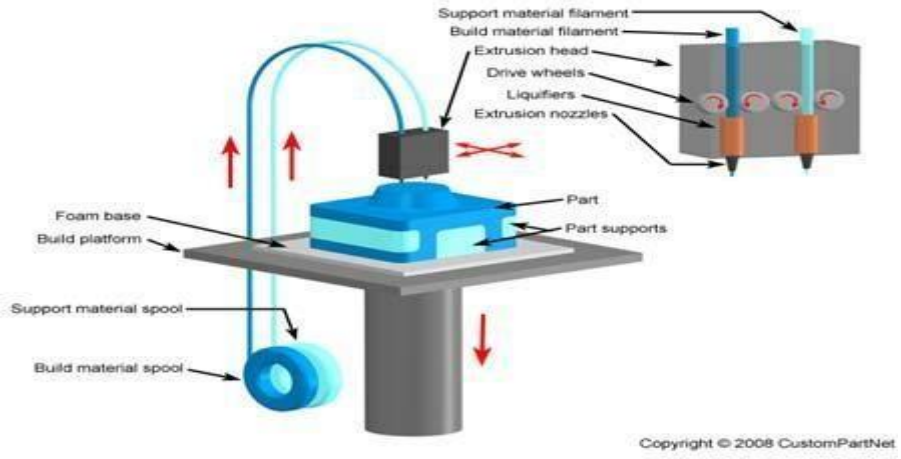
i. Stereo Lithography Apparatus (SLA)



This is one of the earliest technologies to be used as a prototyping technique and was patented by scientist and engineer Chuck Hull in 1986. It consists of a vat of photopolymer resin on a movable platform which moves in the Z-direction (up and down). The UV laser cures the 2D layer producing the cross section. After one layer is completed, the platform moves down by the Z-thickness value to fabricate the next layer. Therefore the X-Y coordinates actuate the UV laser whereas the Z coordinateis controlled by the platform. The UV light causes the photopolymer to harden exactly at the point where the light contacts the surface. The photopolymers can be epoxies, vinyl ethers or acrylates. The finished part is rinsed and support parts removed either manually or by heating. The resolution and accuracy of the finished part is very close to the CAD model and the engineering drawings guaranteeing companies to supply their best product in the least time possible. Industrial applications include the sectors of aerospace, automotive, armaments, consumer electronics, medical and surgical equipment, toys and many other large scale production sectors. The limitations of this process is the inability to form hollow or enclosed features which may cause liquid to be trapped inside.

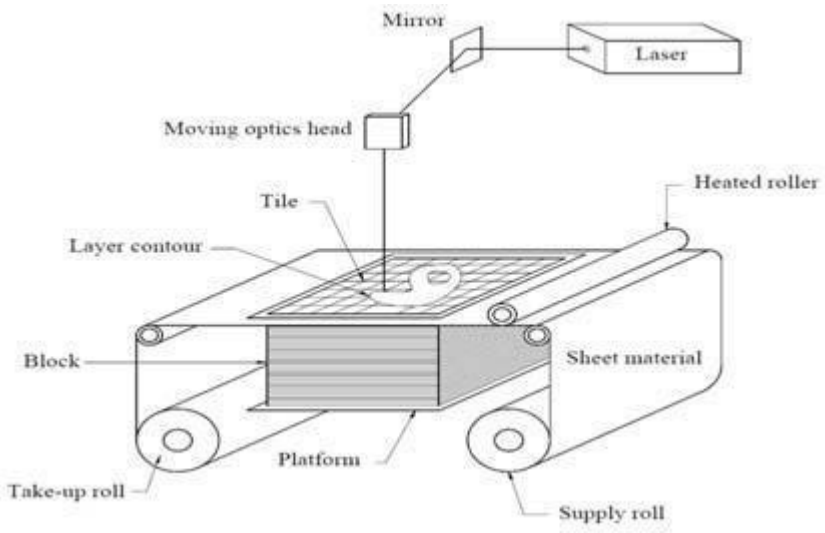
The SLA process although it being a success in mass production and large scale industries, are very expensive for the small scale and personal home based applications. A more commercialized method of the liquid based 3D printing process is the **Inject based liquid process** (*Objet Polyjet* by **Objet Geometries ltd**.) which combines the SLA with material jet printing. A thin layer of photopolymer resin is sprayed onto a tray which is simultaneously exposed to a UV laser curing source. Sometimes instead of a heating source, a cooling source can cause the solidification (water cooled to ice), which is the case of the **Rapid Freeze Prototyping Process**.

ii. Extrusion Based Processes (Solid Phase)



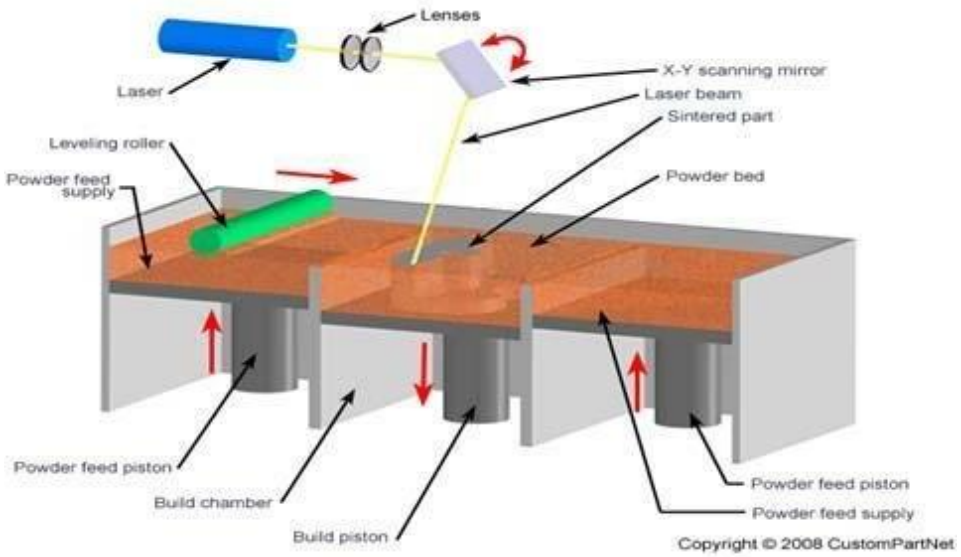
In the solid based printing process, a solid wire is fed which is melted into a shape to form a shape. A specific process called **Fused Deposition Modelling (FDM)** was developed by the Advanced Ceramics Research (ACR) in Tucson, Arizona, USA and developed further by a leading 3D modelling industry, ***Stratasys Inc***., of Minneapolis, Minnesota. The FDM process uses engineering grade thermoplastics such as ABS (Acrylonitrile Butadiene Styrene). The wire filament is pre heated and extruded out finely to build the layer from the bottom up. The extrusion head is shown in the figure below. The drive wheels force the wire from the spool through the nozzle which is surrounded by heating coils. Similar to the SLA it has a moving platform which is at a lower temperature to ensure rapid hardening of the solid from liquid phase. The nozzle controls the X-Y axes movement while the platform in the Z-axis. Multiple nozzles maybe present so that support materials can be simultaneously added to the part. The obvious advantages include the production of non-delicate and tough parts with low wastage of material. The support material used is water soluble and can be removed easily. The accuracy may not be up to the standard of the SLA due to shrinkage on cooling.

iii. Laminated Object Manufacturing (LOM)



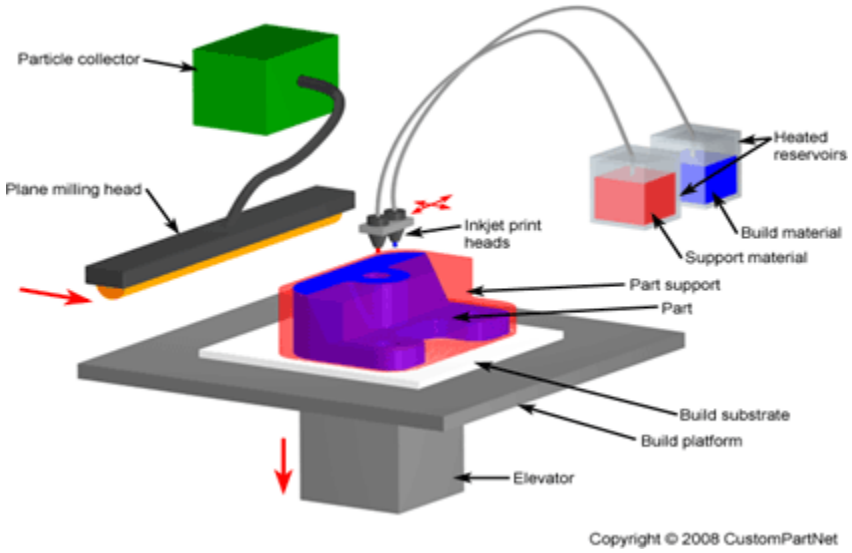
Some of the other solid based processes include contour cutting where layers of material are added onto a platform where they are cut by a laser as per the profile. This process is commercially knownas Laminated Object Manufacturing (LOM) which was developed by Helisys Inc. in 1985. In this process a Ribbon of sheet metal or plastics with thickness equal to that of the layers of the sliced STL file,rolls out to a laser beam which cuts out the cross section on the sheetvia a heated roller. The waste material is separated and rolled out from the part. Since LOM does not involve any phase change,there are no shrinkages and heat defects.

iv. Selective Laser Sintering (SLS – Powder Based Printing)



Selective laser sintering is a powder based printing process which was patented in 1989. In SLS, a laser is used to bond powdered material into a solid object (a process known as sintering). A fine grained powder is used in this process which can be a mixture of different materials or a single material having thermoplastic properties. The main advantage of this process includes the fact that the mechanical properties can be altered as per our liking by mixing different powders of fixed compositions. A laser sinters the powders one layer after the other with the layers being leveled after each layer is completed. This process is very much similar to the stereolithography in the sense that the liquid in SLA is replaced by powder in the SLS but using a similar laser based heating source.

v. 3D Inject Printing Process



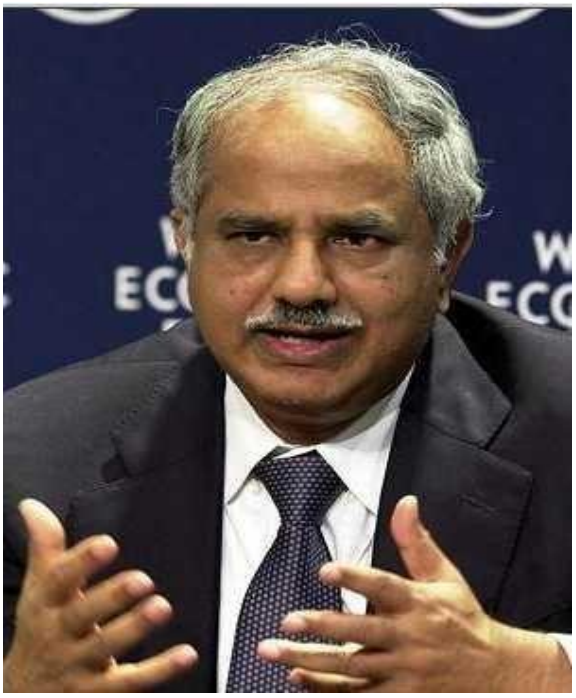
The 3D inject printing process is the most affordable technologies in the present market. It was developed by the Massachusetts Institute of Technology, USA (MIT) in 1993. It is an inexpensive process which solidifies powders by the use of a liquid binder. It replaces the laser in the SLS with liquid binders and the standard inkjet printing technology. Its working can be compared to a standard 2D printer which we use in our homes. Instead of printing on a sheet of paper, the liquid binder is sprayed onto a thin layer of powder according to the 3D CAD data from the STL file. The powder needs to be distributed accurately and evenly on the platform. This is done by a roller and a feed piston as

shown in the picture. Due to the absence of costly optical equipment like lasers and mirrors, and heating sources, Inject printing is a much cheaper and faster alternative to 3D printing.

There are a few other powder based processes such as Electron Beam Melting (EBM), Direct Laser Deposition (DLD) and Direct Metal Laser Sintering (DMLS) which can be used to 3D print metals directly by use of high power energy sources. Usually it is more economical to use cheaper printing processes to produce moulds for casting metal parts.

MAN OF THE ISSUE

Professor Dabbala Rajagopal Reddy



Meet Professor Dabbala Rajagopal Reddy, the A.M. Turing Award-winning computer scientist, best known for his work related to large scale artificial intelligence systems.

Reddy is the Moza Bint Nasser University Professor of Computer Science and Robotics in the School of Computer Science at Carnegie Mellon University. From 1960, Reddy worked for IBM in Australia. He was an Assistant Professor of Computer Science at Stanford University from 1966–69. He joined the Carnegie Mellon faculty as an Associate Professor of Computer Science in 1969. He became a Full Professor in 1973, and a University Professor in 1984.

He was the founding Director of the Robotics Institute from 1979 to 1991 and the Dean of School of Computer Science from 1991 to 1999. As a Dean of SCS, he helped create the Language Technologies Institute, Human Computer Interaction Institute, Centre for Automated Learning and Discovery (since renamed as Machine Learning Department), and the Institute for Software Research. He is the Chairman of Governing Council of IIIT Hyderabad and he is the Chancellor and the Chairman of the Governing Council of the Rajiv Gandhi University of Knowledge Technologies, India.

Reddy was a co-chair of the President's Information Technology Advisory Committee (PITAC) from 1999 to 2001. He was one of the founders of the American Association for Artificial Intelligence and was its President from 1987 to 1989. He serves on the International Board of Governors of Peres Centre for Peace in Israel. He is a member of the governing councils of EMRI and HMRI which use technology-enabled solutions to provide cost-effective health care coverage to rural population in India.

Reddy's early research was conducted at the AI labs at Stanford, first as a graduate student and later as an Assistant Professor, and at CMU since 1969. His AI research concentrated on perceptual and motor aspect of intelligence such as speech, language, vision and robotics. Over a span of three decades, Reddy and his colleagues created several historic demonstrations of spoken language systems, e.g., voice control of a robot, large vocabulary connected speech recognition, speaker independent speech recognition, and unrestricted vocabulary dictation. Reddy and his colleagues have also made seminal contributions to Task Oriented Computer Architectures, Analysis of Natural Scenes, Universal Access to Information, and Autonomous Robotic Systems. Hearsay I is one of the first systems capable of continuous speech recognition. Subsequent systems like Hearsay II, Dragon, Harpy, and Sphinx I/II developed many of the ideas underlying modern commercial speech recognition technology as summarized in his recent historical speech recognition review with Xuedong Huang and James K. Baker.

Some of these ideas—most notably the "blackboard model" for coordinating multiple knowledge sources—have been adopted across the spectrum of applied artificial intelligence. His other major research interest has been in exploring the role of —Technology in Service of Society". An early attempt in this area was the establishment, in 1981, of -Centre Mondial Informatique et Ressource Humaines‖ in France by Jean-Jacques Servan-Schreiber and a technical team of Nicholas Negroponte, Alan Kay, Seymour Papert and Terry Winograd. Reddy served as the Chief Scientist forthe centre. One of Reddy's current research interests is the "Universal Digital Library Project". The project includes efforts to archive 1,000 newspapers for the next 1,000 years and provide online access to UNESCO heritage sites.

In 1984, Reddy was awarded the French Legion of Honour by French President François Mitterrand for his contributions as Chief Scientist at "Centre Mondial Informatique" in Paris in the use of "Technology in Service of Society". In 1994 he and Edward Feigenbaum received the ACM Turing Award "For pioneering the design and construction of large scale artificial intelligence systems, demonstrating the practical importance and potential commercial impact of artificial intelligence technology". In 2001, Reddy was awarded Padma Bhushan, an award given by the Indian Government that recognizes distinguished service of a high order to the nation.

Professor Raj Reddy with Scientist Dr. APJ Abdul Kalam

In 2004, Reddy received the Okawa Prize for pioneering researches of large scale artificial intelligence system, human-computer interaction and Internet, and outstanding contributions to information and telecommunications policy and nurture of many human resources. In 2005, Reddy received the Honda Prize for his pioneering role in robotics and computer science which are expected to be used in the future society for a broad range of applications including education, medicine, healthcare, and disaster relief. In 2006 he received the Vannevar Bush Award, the highest Award of National Science Foundation in United States, for his lifetime contribution to science and long-standing statesmanship in science and behalf of the nation. In 2008, Reddy received the IEEE James L. Flanagan Speech and Audio Processing Award, "for leadership and pioneering contributions to speech recognition, natural language understanding, and machine intelligence". In 2011, Reddy was inducted into IEEE Intelligent Systems' AI's Hall of Fame for the "significant contributions to the field of AI and intelligent systems".

Reddy is a member of the United States National Academy of Engineering, American Academy of Arts and Sciences, Chinese Academy of Engineering, Indian National Science Academy, and Indian National Academy of Engineering. He has been awarded honorary doctorates (Doctor Honoris Causa) from SV University, Universite Henri-Poincare, University of New South Wales, Jawaharlal Nehru Technological University, University of Massachusetts, University of Warwick, Anna University, Indian Institute for Information Technology (Allahabad), Andhra University, IIT Kharagpur and Hong Kong University of Science and Technology.

Life of Raj Reddy:

Dabbala Rajagopal Reddy was born on June 13, 1937, in Katur, Andhra Pradesh, India. His father Sreenivasulu Reddy was an agricultural landlord and his mother, Pitchamma, was a homemaker. He received his bachelor's degree in civil engineering from Guindy Engineering College of the University, Madras (now Anna University, Chennai), India, in 1958. After that Reddy moved to Australia, and there he received his master's degree in technology from the University of New South Wales, Australia, in 1960. He also received a doctor's degree in computer science from Stanford University in 1966.

On the same year he started his academic career as an Assistant Professor in the same University. After that he joined as a member of Carnegie Mellon University faculty in 1969. He was the Founding Director of the Robotics Institute at the University from 1979 to 1991.

Raj Reddy, dean of the School of Computer Science at Carnegie Mellon University.

Now, he lives in Pittsburgh with his wife of 40 years and they have two daughters. His daughters live on the West Coast, in Silicon Valley, California. He visits his native country once a year, his seven brothers and sisters live in Bangalore.

He was awarded the Padma Bhushan by India in 2001 and the Legion of Honor by President François Mitterrand of France in 1984. He is also a fellow of the Acoustical Society of America, IEEE and AAAI, Fellow. He received the 2005 IJCAI Donald E. Walker Distinguished Service Award For, ―His outstanding service to the AI community as President of AAAI, Conference Chair of IJCAI-79, and his leadership and promotion of AI internationally‖. He also received the IBM Research Ralph Gomory Visiting Scholar Award in 1991.

Recently, Reddy received the Honda prize for his, ―Contributions to eco-technology, the concept that technology should not pursue efficiency and profits alone but should be geared toward harmony with the environment surrounding human activities.‖

COMPANY OF THE ISSUE

Intel

Intel Corporation, incorporated in 1968, designs and manufactures integrated digital technology platforms. A platform consists of a microprocessor and chipset. The Company sells these platforms primarily to original equipment manufacturers (OEMs), original design manufacturers (ODMs), and industrial and communications equipment manufacturers in the computing and communications industries. The Company's platforms are used in a range of applications, such as personal computers (PCs) (including Ultrabook systems), data centers, tablets, smartphones, automobiles, automated factory systems and medical devices. The Company also develops and sells software and services primarily focused on security and technology integration.

In February 2013, it acquired ProFUSION-Comercio e Prestacao de Servicos em Tecnologia da Informacao Ltda. In May 2013, Intel Corp acquired Aepona Ltd. Effective July 16, 2013, Intel Corp acquired Omek Interactive Ltd. Effective August 15, 2013, Intel Corp acquired Fujitsu Semiconductor Wireless Products Inc, from Fujitsu Semiconductor Ltd, a wholly owned subsidiary of Fujitsu Ltd. In February 2014, M/A-COM Technology Solutions Holdings Inc announced that its subsidiary Mindspeed Technologies Inc completed the sale of assets of its wireless infrastructure business unit to Intel Corporation.

On January 31, 2011, the Company acquired Wireless Solutions (WLS) business of Infineon Technologies AG. On February 28, 2011, the Company acquired McAfee, Inc. In August 2011, the Company formed a wholly owned subsidiary, Intel Federal LLC. During the year ended December 31, 2011, it sold the remaining interest in Micron. On February 2012, QLogic Corp. sold the product lines and certain assets associated with its InfiniBand business to the Company. In May 2012, Cray Inc. completed the sale ofits interconnect hardware development program and related intellectual property to the Company. In September 2012, InterDigital, Inc.'s subsidiaries sold around 1,700 patents and patent applications to the Company.

The Company offers platforms that incorporate various components and technologies, including a microprocessor and chipset. A microprocessor-the central processing unit (CPU) of a computer system-processes system data and controls other devices in the system. It offers microprocessors with one or multiple processor cores. Its second and third generation Intel Core processor families integrate graphics functionality onto the processor die. In contrast, some of its previous-generation processors incorporated a separate graphics chip inside the processor package. The Company also offers graphics functionality as part of a separate chipset outside the processor package. Processor packages may also integrate the memory controller.

A chipset sends data between the microprocessor and input, display, and storage devices, such as the keyboard, mouse, monitor, hard drive or solid-state drive, and compact disc (CD), digital versatile disc (DVD) or Blu-ray drive. The Company offers and develops System-on-Chip (SoC) products that

integrate its core processing functions with other system components, such as graphics, audio, and video, onto a single chip. The Company offers Intel vPro technology, a computer hardware-based security technology for the notebook and desktop market segments. During 2011, it introduced the second generation Intel Core vPro processor family.

The Company offers components and platforms for mobile phones and connected devices. Key mobile phone components include baseband processors, radio frequency transceivers and power management integrated circuits. It also offers mobile phone platforms, including Bluetooth wireless technology and global positioning system (GPS) receivers, software solutions, customization, and essential interoperability tests. McAfee offers software products that provide security solutions for consumer, mobile, and corporate environments designed to protect systems from malicious virus attacks, as well as loss of data. McAfee's products include endpoint security, network and content security, risk and compliance, and consumer and mobile security.

The Wind River Software Group develops and licenses embedded and mobile device software products, including operating systems, virtualization technologies, middleware, and development tools. The Company offers NAND flash memory products primarily used in solid-state drives (SSDs), portable memory storage devices, digital camera memory cards, and other devices. It offers SSDs in densities ranging from 32 gigabytes (GB) to 600 GB. Its NAND flash memory products are manufactured by IM Flash Technologies, LLC (IMFT) and IM Flash Singapore, LLP (IMFS).

The Company competes with Taiwan Semiconductor Manufacturing Company, Ltd., GlobalFoundries Inc., Advanced Micro Devices, Inc., International Business Machines Corporation, Oracle Corporation, ARM Limited, NVIDIA Corporation, MIPS Technologies, Inc., QUALCOMM Incorporated, Texas Instruments Incorporated and Symantec Corporation.