KAKATIYA INSTITUTE OF TECHNOLOGY AND SCIENCE

(An Autonomous Institute under Kakatiya University)

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

roCkSE

A Technical Magazine

VOLUME-VI

March - 2016

KAKATIYA INSTITUTE OF TECHNOLOGY & SCIENCE

WARANGAL - 506015

Estd : 1980

Department of
Computer Science & Engineering

Presents....

roCkSE

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March 2016

KAKATIYA INSTITUTE OF TECHNOLOGY & SCIENCE

(An Autonomous Institute under Kakatiya University, Warangal)

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KAKATIYA INSTITUTE OF TECHNOLOGY & SCIENCE

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Estd : 1980

Department of Computer Science & Engineering

Editorial Board

Student Editorial Board

Chief Editor's Message

This magazine summarizes the current state of Computer Science & Engineering, latest technologies and also information of department. Providing an arena for the student community to showcase their technical talents is a great task. We took up the challenge to bring awareness to everyone in laying their career steps towards latest technologies. Keeping in view of the present era of technological revolution in the field of Engineering, the CSE department of KITSW presents you **roCkSE**

P. Niranjan Reddy
HOD
Department of CSE

Director's Message

I congratulate the team of the faculty members and the students for their brilliant efforts. I wish all the students and faculty a great career ahead. The main focus of the institution is to empower students with sound knowledge, wisdom, experience and training both at the academic level of Engineering and in the highly competitive global industrial market.

We wish the best for all our students, and the members of the institution who reiterate their aims at providing the best in academic and extra-curricular fields.

Y. Manohar
Director

Contents

Estd : 1980

AUGMENTED REALITY

Augmented reality (AR) is a live direct or indirect view of a physical, real-world environment whose elements are "augmented" by computer-generated or extracted real-world sensory input such as sound, video, graphics, haptics or GPS data. It is related to a more general concept called computer-mediated reality, in which a view of reality is modified (possibly even diminished rather than augmented) by a computer. Augmented reality enhances one's current perception of reality, whereas virtual reality replaces the real world with a simulated one. Augmented reality is used in order to enhance the experienced environments or situations and to offer enriched experiences. Originally, the immersive augmented reality experiences were used in entertainment and game businesses, but now other business industries are also getting interested about AR's possibilities for example in knowledge sharing, educating, managing the information flood and organizing distant meetings. Augmented reality has a lot of potential in gathering and sharing tacit knowledge.Augmentation techniques are typically performed in real time and in semantic context with environmental elements, such as overlaying supplemental information like scores over a live video feed of a sporting event.

With the help of advanced AR technology (e.g. adding computer vision and object recognition) the information about the surrounding real world of the user becomes interactive. Information about the environment and its objects is overlaid on the real world. This information can be virtualor real, e.g. seeing other real sensed or measured information such as electromagnetic radio waves overlaid in exact alignment with where they actually are in space.

Augmented reality brings the components of the digital world into a person's perceived real world. One example is an AR helmet for construction workers which display information about the construction sites. The first functional AR systems that provided immersive mixed reality experiences for users were invented in the early 1990s, starting with the Virtual Fixtures system developed at the U.S. Air Force's Armstrong Labs in 1992.Augmented reality is also transforming the world of education, where content may be accessed by scanning or viewing an image with a mobile device.

Modern mobile augmented-reality systems use one or more of the following tracking technologies: digital cameras and/or other optical sensors, accelerometers, GPS, gyroscopes, solid state compasses, RFID and wireless sensors. These technologies offer varying levels of accuracy and precision. Most important is the position and orientation of the user's head. Tracking the user's hand(s) or a handheld input device can provide a 6DOF interaction technique.

FINGER VEIN RECOGNITION

Finger vein recognition is a method of biometric authentication that uses pattern-recognition techniques based on images of human finger vein patterns beneath the skin's surface. Finger vein recognition is one of many forms of biometrics used to identify individuals and verify their identity.

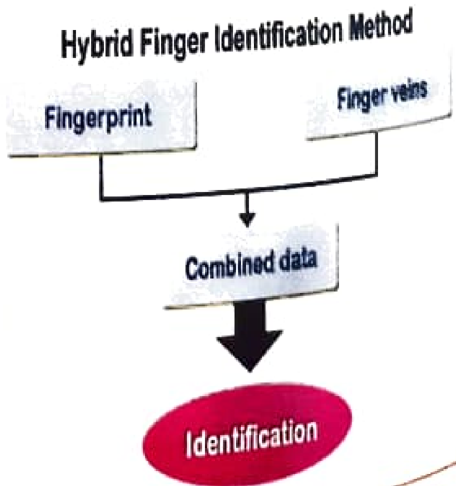
Finger Vein ID is a biometric authentication system that matches the vascular pattern in an individual's finger to previously obtained data. Hitachi developed and patented a finger vein ID system in 2005. The technology is currently in use or development for a wide variety of applications, including credit card authentication, automobile security, employee time and attendance tracking, computer and network authentication, end point security and automated teller machines.

To obtain the pattern for the database record, an individual inserts a finger into an attester terminal containing a near-infrared LED (light- emitting diode) light and a monochrome CCD (charge-coupled device) camera. The haemoglobin in the blood absorbs near-infrared LED light, which makes the vein system appear as a dark pattern of lines. The camera records the image and the raw data is digitized, certified and sent to a database of registered images. For authentication purposes, the finger is scanned as before and the data is sent to the database of registered images for comparison. The authentication process takes less than two seconds.

Blood vessel patterns are unique to each individual, as are other biometric data such as fingerprints or the patterns of the iris. Unlike some biometric systems, blood vessel patterns are almost impossible to counterfeit because they are located beneath the skin's surface. Biometric systems based on fingerprints can be fooled with a dummy finger fitted with a copied fingerprint; voice and facial characteristic-based systems can be fooled by recordings and high-resolution images. The finger vein ID system is much harder to fool because it can only authenticate the finger of a living person.

Biometric identification systems identify people by personal traits such as the characteristics of their faces, fingerprints, palm prints, veins, eyes or DNA. Since the difficulty and accuracy of biometric identification varies depending on the person and trait, as well as the measuring environment, multi-modal identification that measures more than one trait is becoming popular. If one measurement fails to provide ample information, the other serves as a backup to support proper identification. Multi-modal identification also helps prevent impersonation since faking more than one trait is quite difficult. On the other hand, multi-modal identification tends to be more time-consuming and inconvenient.

Through world-leading biometrics technology and experience, NEC's renowned fingerprint identification algorithm development team created a Hybrid Hybrid Finger Identification system that is both supremely accurate and convenient. In a single step, it simultaneously scans both the fingerprint and the large, branched vein pattern between the first and second finger joint that is ideal for personal identification. It's the ideal solution for today's demanding security needs.



SMART GLASSES

Smart glasses are wearable computer glasses that add information alongside or to what the wearer sees. Alternatively smart glasses are sometimes defined as wearable computer glasses that are able to change their optical properties at runtime. Smart sunglasses which are programmed to change tint by electronic means are an example of the latter type of smart glasses. Superimposing information onto a field of view is achieved through an optical head-mounted display (OHMD) or embedded wireless glasses with transparent heads-up display (HUD) or augmented reality (AR) overlay that has the capability of reflecting projected digital images as well as allowing the user to see through it, or see better with it. While early models can perform basic tasks, such as just serve as a frontend display for a remote system, as in the case of smart glasses utilizing cellular technology or Wi-Fi, modern smart glasses are effectively wearable computers which can run self-contained mobile apps. Some are hands free that can communicate with the Internet via natural language voice commands, while other use touch buttons.

Like other computers, smart glasses may collect information from internal or external sensors. It may control or retrieve data from other instruments or computers. It may support wireless technologies like Bluetooth, Wi-Fi, and GPS. While a smaller number of models run a mobile operating system and function as portable media players to send audio and video files to the user via a Bluetooth or WiFi headset. Some smart glasses models, also feature full lifelogging and activity tracker capability.

Such smart glasses devices may also have all the features of a smartphone.Some also have activity tracker functionality features (also known as "fitness tracker") as seen in some GPS watches.

As with other lifelogging and activity tracking devices, the GPS tracking unit and digital camera of some smartglasses can be used to record historical data. For example, after the completion of a workout, data can be uploaded onto a computer or online to create a log of exercise activities for analysis. Some smart watches can serve as full GPS navigation devices, displaying maps and current coordinates. Users can "mark" their current location and then edit the entry's name and coordinates, which enables navigation to those new coordinates.

Although some smartglasses models manufactured in the 21st century are completely functional as standalone products, most manufacturers recommend or even require that consumers purchase mobile phone handsets that run the same operating system so that the two devices can be synchronized for additional and enhanced functionality. The smartglasses can work as an extension, for head-up display (HUD) or remote control of the phone and alert the user to communication data such as calls, SMS messages, emails, and calendar invites calendar invites.

Healthcare applications Several proofs of concept for Google Glasses have been proposed in healthcare. In July 2013, Lucien Engelen started research on the usability and impact of Google Glass in health care. As of August 2013, Engelen, who is based at Singularity University and in Europe at Radboud University Medical Center, is the first healthcare professional in Europe to participate in the Glass Explorer program. His research on Google Glass (starting August 9, 2013) was conducted in operating rooms, ambulances, a trauma helicopter, general practice, and home care as well as the use in public transportation for visually or physically impaired. His research consisted of taking pictures, streaming videos to other locations, dictating operative log, and tele-consultation through Hangout. Engelen documented his findings in blogs, videos, pictures, on Twitter, and on Google+ and is still ongoing. Key findings of Engelen's research included:

1. The quality of pictures and video are usable for healthcare education, reference, and remote consultation.The camera needs to be tilted to different anglefor most of the operative procedures
2. Tele-consultation is possible depending on the available bandwidth during operative procedures.
3. A stabilizer should be added to the video function to prevent choppy transmission when a surgeon looks to screens or colleagues.
4. Battery life can be easily extended with the use of an external battery.
5. Controlling the device and/or programs from another device is needed for some features because of sterile environment.
6. Text-to-speech ("Take a Note" to Evernote) exhibited a correction rate of 60 percent, without the addition of a medical thesaurus.
7. A protocol or checklist displayed on the screen of Google Glass can be helpful during procedures.

Dr. Phil Haslam and Dr. Sebastian Mafeld demonstrated the first concept for Google Glass in the field of interventional radiology. They demonstrated the manner in which the concept of Google Glass could assist a liver biopsy and fistulaplasty, and the pair stated that Google Glass has the potential to improve patient safety, operator comfort, and procedure efficiency in the field of interventional radiology. In June 2013, surgeon Dr. Rafael Grossmann was the first person to integrate Google Glass into the operating theater, when he wore the device during a PEG (percutaneous endoscopic gastrostomy) procedure. In August 2013, Google Glass was also used at Wexner Medical Center at Ohio State University. Surgeon Dr. Christopher Kaeding used Google Glass to consult with a colleague in a distant part of Columbus, Ohio. A group of students at The Ohio State University College of Medicine also observed the operation on their laptop computers. Following the procedure, Kaeding stated, "To be honest, once we got into the surgery, I often forgot the device was there. It just seemed very intuitive and fit seamlessly."on their laptop computers. Following the procedure, Kaeding stated, "To be honest, once we got into the surgery, I often forgot the device was there. It just seemed very intuitive and fit seamlessly."

The November 16, 2013, in Santiago de Chile, the maxillofacial team led by Dr.gn Antonio Marino conducted the first orthognathic surgery assisted with Google Glass in Latin America, interacting with them and working with simultaneous three-dimensional navigation. The surgical team was interviewed by the ADN radio medium and the LUN newspaper. In January 2014, Indian Orthopedic Surgeon Selene G. Parekh conducted the foot and ankle surgery using Google Glass in Jaipur, which was broadcast live on Google website via the internet. The surgery was held during a three-day annual Indo-US conference attended by a team of experts from the US, and co-organized by Dr Ashish Sharma. Sharma said Google Glass allows looking at an X-Ray or MRI without taking the eye off of the patient, and allows a doctor to communicate with a patient's family or friends during a procedure. "The image which the doctor sees through Google Glass will be broadcast on the internet. It's an amazing technology. Earlier, during surgeries, to show something to another doctor, we had to keep moving and the cameraman had to move as well to take different angles. During this, there are chances of infection. So in this technology, the image seen by the doctor using Google Glass will be seen by everyone throughout the world," he said.

FERROELECTRIC RAM

Ferroelectric RAM (FeRAM, F-RAM or FRAM) is a random-access memory similar in construction to DRAM but using a ferroelectric layer instead of a dielectric layer to achieve non-volatility. FeRAM is one of a growing number of alternative non-volatile random-access memory technologies that offer the same functionality as flash memory.

FeRAM's advantages over flash include: lower power usage, faster write performance and much greater maximum read/write endurance. FeRAMs have data retention times of more than 10 years at +85 °C (up to many decades at lower temperatures). Market disadvantages of FeRAM are much lower storage densities than flash devices, storage capacity limitations, and higher cost. FeRAM also has the unusual technical disadvantage of a destructive read process, necessitating a write-after-read architecture.

Ferroelectric RAM was proposed by MIT graduate student Dudley Allen Buck in his master's thesis, Ferroelectrics for Digital Information Storage and Switching, published in 1952. In 1955 Bell Telephone Laboratories was experimenting with ferroelectric-crystal memories. Development of FeRAM began in the late 1980s. Work was done in 1991 at NASA's Jet Propulsion Laboratory on improving methods of read out, including a novel method of non-destructive readout using pulses of UV radiation. Much of the current FeRAM technology was developed by Ramtron, a fabless semiconductor company.

One major licensee is Fujitsu, who operates what is probably the largest semiconductor foundry production line with FeRAM capability. Since 1999 they have been using this line to produce standalone FeRAMs, as well as specialized chips (e.g. chips for smart cards) with embedded FeRAMs. Fujitsu produced devices for Ramtron until 2010. Since 2010 Ramtron's fabricators have been TI (Texas Instruments) and IBM. Since at least 2001 Texas Instruments has collaborated with Ramtron to develop FeRAM test chips in a modified 130 nm process.

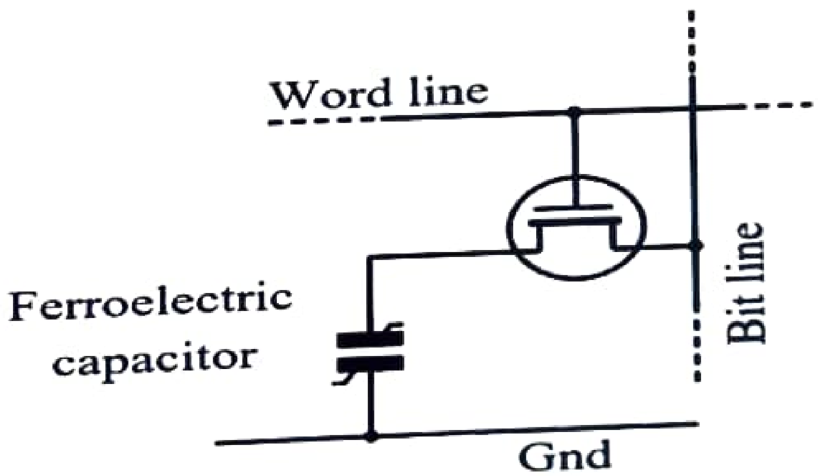
In the fall of 2005, Ramtron reported that they were evaluating prototype samples of an 8-megabit FeRAM manufactured using Texas Instruments' FeRAM process. Fujitsu and Seiko-Epson were in 2005 collaborating in the development of a 180 nm FeRAM process. In 2012 Ramtron was acquired by Cypress Semiconductor. FeRAM research projects have also been reported at Samsung, Matsushita, Oki, Toshiba, Infineon, Hynix, Symetrix, Cambridge University, University of Toronto, and the Interuniversity Microelectronics Centre (IMEC, Belgium). A ferroelectric material has a nonlinear relationship between the applied electric field and the apparent stored charge. Specifically, the ferroelectric characteristic has the form of a hysteresis loop, which is very similar in shape to the hysteresis loop of ferromagnetic materials.

FeRAM remains a relatively small part of the overall semiconductor market. In 2005, worldwide semiconductor sales were US $235 billion, with the flash memory market accounting for US $18.6 billion. The 2005 annual sales of Ramtron, perhaps the largest FeRAM vendor, were reported to be US $32.7 million. The much larger sales of flash memory compared to the alternative NVRAMs support a much larger research and development effort. Flash memory is produced using semiconductor linewidths of 30 nm at Samsung (2007) while FeRAMs are produced in linewidths of 350 nm at Fujitsu and 130 nm at

Texas Instruments (2007). Flash memory cells can store multiple bits per cell, and the number of bits per flash cell is projected to increase to 4 or even to 8 as a result of innovations in flash cell design. As a consequence, the areal bit densities of flash memory are much higher than those of FeRAM, and thus the cost per bit of flash memory is orders of magnitude lower than that of FeRAM.

The density of FeRAM arrays might be increased by improvements in FeRAM foundry process technology and cell structures, such as the development of vertical capacitor structures (in the same way as DRAM) to reduce the area of the cell footprint. However, reducing the cell size may cause the data signal to become too weak to be detectable. In 2005, Ramtron reported significant sales of its FeRAM products in a variety of sectors including electricity meters, automotive, business machines, instrumentation, medical equipment, industrial microcontrollers, and radio frequency identification tags. The other emerging NVRAMs, such as MRAM, may seek to enter similar niche markets in competition with FeRAM.

Texas Instruments proved it to be possible to embed FeRAM cells using two additional masking steps during conventional CMOS semiconductor manufacture. Flash typically requires nine masks. This makes possible for example, the integration of FeRAM onto microcontrollers, where a simplified process would reduce costs. However, the materials used to make FeRAMs are not commonly used in CMOS integrated circuit manufacturing. Both the PZT ferroelectric layer and the noble metals used for electrodes raise CMOS process compatibility and contamination issues. Texas Instruments has incorporated an amount of FRAM memory into its MSP430 microcontrollers in its new FRAM series.



PAPER BATTERY

A paper battery is an electric battery engineered to use a spacer formed largely of cellulose (the major constituent of paper). It incorporates nano scale structures to act as high surface-area electrodes to improve conductivity.

In addition to being unusually thin, paper batteries are flexible and environmentally-friendly, allowing integration into a wide range of products. Their functioning is similar to conventional chemical batteries with the important difference that they are non-corrosive and do not require extensive housing.

The composition of these batteries is what sets them apart from traditional batteries. Paper is abundant and self-sustaining, which makes paper cheap. Disposing of paper is also inexpensive since paper is combustible as well as biodegradable. Using paper gives the battery a great degree of flexibility. The battery can be bent or wrapped around objects instead of requiring a fixed casing. Also, being a thin, flat sheet, the paper battery can easily fit into tight places, reducing the size and weight of the device it powers. The use of paper increases the electron flow which is well suited for high performance applications. Paper allows for capillary action so fluids in batteries, such as electrolytes, can be moved without the use of an external pump. Using paper in batteries increases the surface area that can be used integrate reagents. The paper used in paper batteries can be supplemented to improve its performance characteristics. Patterning techniques such as photolithography, wax printing, and laser micromachining are used to create hydrophobic and hydrophilic sections on the paper to create a pathway to direct the capillary action of the fluids used in batteries. Similar techniques can be used to create electrical pathways on paper to create paper electrical devices and can integrate paper energy storage.

The paper-like quality of the battery combined with the structure of the nanotubes embedded within gives them light weight and low cost, offering potential for portable electronics, aircraft, automobiles and toys.

The batteries employ nano tubes, potentially slowing commercial adoption due to excessive cost. Commercial adoption also requires larger devices.

Paper can be integrated into several different forms of batteries, such as electrochemical batteries, biofuel cells, lithium-ion batteries, super capacitors, and nano generators.

Electrochemical Batteries

Electrochemical batteries can be modified to integrate the use of paper. An electrochemical battery typically uses two metals, separated into two chambers and connected by a bridge or a membrane which permits the exchange of electrons between the two metals, thereby producing energy. Paper can be integrated into electrochemical batteries by depositing the electrode onto the paper and by using paper to contain the fluid used to activate the battery. Paper that has been patterned can also be used in electrochemical batteries. This is done to make the battery more compatible with paper electronics. These batteries tend to produce low voltage and operate for short periods of time, but they can be connected in series to increase their output and capacity. Paper batteries of this type can be activated with bodily fluids which makes them very useful in the healthcare field such as single-use medical devices or tests for specific diseases. A battery of this type has been developed with a longer life to power point of care devices for the healthcare industry. The device used a paper battery made using a magnesium foil anode and a silver cathode has been used to detect diseases in patients such as kidney cancer, liver cancer, and osteoblastic bone cancer. The paper was patterned using wax printing and is able to be easily disposed of.

Lithium-ion Batteries

Paper can be used in lithium-ion batteries as regular, commercial paper, or paper enhanced with single-walled carbon nanotubes. Enhanced paper is used as the electrode and as the separator which results in a sturdy, flexible battery that have great performance capabilities such as good cycling, great efficiency, and good reversibility. Using paper as a separator is more effective than using plastic. The process of enhancing the paper, however, can be complicated and costly, depending on the materials used. A carbon nanotube and silver nanowire film can be used to coat regular paper to create a simpler and less expensive separator and battery support. The conductive paper can also be used to replace traditionally used metallic chemicals. The resulting battery performs well, while simplifying the manufacturing process and reducing the cost. Lithium-ion paper batteries are flexible, durable, rechargeable, and produce significantly more power than electrochemical batteries. In spite of these advantages, there are still some drawbacks. In order for paper to be integrated with the Li-ion battery, complex layering and insulating techniques are required for the battery to function as desired. One reason these complex techniques are used is to strengthen the paper used so that it does not tear as easily. This contributes to the overall strength and flexibility of the battery. These techniques require time, training, and costly materials.

Biofuel Cells

Biofuel cells operate similarly to electrochemical batteries, except that they utilize components such as sugar, ethanol, pyruvate, and lactate, instead of metals to facilitate redox reactions to produce electrical energy. Enhanced paper is used to contain and separate the positive and negative components of the biofuel cell. This paper biofuel cell started up much more quickly than a conventional biofuel cell since the porous paper was able to absorb the positive biofuel and promote the attachment of bacteria to the positive biofuel. This battery capable of producing a significant amount of power after being activated by a wide range of liquids and then be disposed of. Some development must take place, since some components are toxic and expensive.

Naturally occurring electrolytes might allow biocompatible batteries for use on or within living bodies. Paper batteries were described by a researcher as "a way to power a small device such as a pacemaker without introducing any harsh chemicals - such as the kind that are typically found in batteries - into the body."

Supercapacitors

Paper battery technology can be used in supercapacitors. Supercapacitors operate and are manufactured similarly to electrochemical batteries, but are generally capable of greater performance and are able to be recharged. Paper, or enhanced paper can be used to develop thin, flexible supercapacitors that are lightweight less expensive. Paper that has been enhanced with carbon nanotubes is generally preferred over regular paper because it has increased strength and allows for easier transfer of electrons between the two metals. The electrolyte and the electrode are embedded into the paper which produces a flexible paper supercapacitor that can compete with some commercial supercapacitors produced today. A paper supercapacitor would be well suited for a high power application.

Nano generators

Nano generators are a more recent device that convert mechanical energy to electrical energy. Paper is desirable as a component of nanogenerators for the same reasons discussed above. Such devices are able to capture movement, such as body movement, and convert that energy into electrical energy that could power LED lights, for example.

WEARABLE COMPUTERS

Wearable computers, also known as body-borne computers or wearables, are miniature electronic devices that are worn under, with, or on top of clothing. This class of wearable technology has been developed for general or special purpose information technologies. It is also used in media development. Wearable computers are especially useful for applications that require more complex computational support, such as accelerometers or gyroscopes, than just hardware coded logic strained by the physical hardware of the system. Merchandiser often use the broadest definition, as any computing device worn on the body. This article page will use the broadest definition.

Smartwatches and the Fitbit system are the most common form, worn on the wrist. Google Glass is an optical head-mounted displays supplying augmented reality perspective, controlled by novel gestural movements. One common feature of wearable computers is their persistence of activity. Many issues are common to wearables as with mobile computing, ambient intelligence and ubiquitous computing research communities. These include power management and heat dissipation, software architectures, wireless and personal area networks, and data management,all of which are essential for overall data quality and trust in the device.

Next generation wearables most probably would repeat the trend of mobile phones market - they would come down to one single device combining all daily required functions. Many companies are considering the smart necklace to become the solution form-factor due to its relatively big size that could host extensive amount of hardware, ears (as audio player and for communication through build-in voice controlled communicator or through external smartphone as remote headset with earphones) and mouth (a wide microphones for fashion and appearance issues and over belt-attachable devices for minimizing wires utilization.

Many technologies for wearable computers derive their ideas from science fiction. There are many examples of ideas from popular movies that have become technologies or are technologies currently being developed.

3D User Interface: Devices that display usable, tactile interfaces that can be manipulated in front of the user. Examples include the glove-operated hologram computer featured at the Pre-Crime headquarters in the beginning of Minority Report and the computers used by the gate workers at Zion in The Matrix trilogy.

Intelligent Textiles: Clothing that can relay and collect information. Examples include Tron and its sequel, and also many sci-fi military films.

Threat Glasses: Scan others in vicinity and assess threat-to-self level. Examples include Terminator 2, and 'Threep' Technology in Lock-In.

Contat lenses: A special contact lenses that is used to confirm one's identity. Used in Mission Impossible 4.

Combat Suit Armor: A wearable exoskeleton that provides protection to its wearer and is typically equipped with powerful weapons and a computer system. Examples include numerous Iron Man suits, along with Samus Aran's Power Suit and Fusion Suit in the Metroid video game series.

Brain Nano-Bots to Store Memories in the Cloud: Used in Total Recall.

Infrared Headsets: Can help identify suspects and see through walls. Examples include Robocop's special eye system, as well as some more advanced visors that Samus Aran uses in the Metroid Prime trilogy.

Wrist-Worn Computers: Provide various abilities and information, such as data about the wearer, a vicinity map, a flashlight, a communicator, a poison detector or an enemy-tracking device. Examples include the Pip-Boy 3000 from the Fallout games and Leela's Wrist Device from the Futurama TV sitcom.

On-chest device or smart necklace form-factor of wearable computer was shown in many sci-fi movies, including Prometheus and Iron Man, however such location of the most precious individual's possession comes from history of wearing amulets and charms.

The wearable computer was introduced to the US Army in 1989, as a small computer that was meant to assist soldiers in battle. Since then, the concept has grown to include the Land Warrior program and proposal for future systems. The most extensive military program in the wearables arena is the US Army's Land Warrior system, which will eventually be merged into the Future Force Warrior system. F-INSAS is an Indian Military Project, designed largely with wearable computing.

BRAIN COMPUTRE INTERFACE

A brain-computer interface (BCI), sometimes called a Neural-control Interface (NCI), mind-machine interface (MMI), direct neural interface(DNI), or brain-machine interface (BMI), is a direct communication pathway between an enhanced or wired brain and an external device. BCI differs from neuromodulation in that it allows for bidirectional information flow. BCIs are often directed at researching, mapping, assisting, augmenting, or repairing human cognitive or sensory-motor functions.

Research on BCIs began in the 1970s at the University of California, Los Angeles (UCLA) under a grant from the National Science Foundation, followed by a contract from DARPA. The papers published after this research also mark the first appearance of the expression brain-computer interface in scientific literature.

The field of BCI research and development has since focused primarily on neuroprosthetics applications that aim at restoring damaged hearing, sight and movement. Thanks to the remarkable cortical plasticity of the brain, signals from implanted prostheses can, after adaptation, be handled by the brain like natural sensor or effector channels.Following years of animal experimentation; the first neuroprosthetic devices implanted in humans appeared in the mid-1990s.Neuroprosthetics is an area of neuroscience concerned with neural prostheses, that is, using artificial devices to replace the function of impaired nervous systems and brain related problems, or of sensory organs. The most widely used neuroprosthetic device is the cochlear implant which, as of December 2010, had been implanted in approximately 220,000 people worldwide. There are also several neuroprosthetic devices that aim to restore vision, including retinal implants.

The difference between BCIs and neuroprosthetics is mostly in how the terms are used: neuroprosthetics typically connect the nervous system to a device, whereas BCIs usually connect the brain (or nervous system) with a computer system. Practical neuroprosthetics can be linked to any part of the nervous system-for example, peripheral nerves-while the term "BCI" usually designates a narrower class of systems which interface with the central nervous system.

The terms are sometimes, however, used interchangeably. Neuroprosthetics and BCIs seek to achieve the same aims, such as restoring sight, hearing, movement, ability to communicate, and even cognitive function. Both use similar experimental methods and surgical techniques.

Several laboratories have managed to record signals from monkey and rat cerebral cortices to operate BCIs to produce movement. Monkeys have navigated computer cursors on screen and commanded robotic arms to perform simple tasks simply by thinking about the task and seeing the visual feedback, but without any motor output. In May 2008 photographs that showed a monkey at the University of Pittsburgh Medical Center operating a robotic arm by thinking were published in a number of well-known science journals and magazines. Other research on cats has decoded their neural visual signals. Researchers have built devices to interface with neural cells and entire neural networks in cultures outside animals. As well as furthering research on animal implantable devices, experiments on cultured neural tissue have focused on building problem-solving networks, constructing basic computers and manipulating robotic devices. Research into techniques for stimulating and recording from individual neurons grown on semiconductor chips is sometimes referred to as neuroelectronics or neurochips.

Development of the first working neurochip was claimed by a Caltech team led by Jerome Pine and Michael Maher in 1997. The Caltech chip had room for 16 neurons.

In 2003 a team led by Theodore Berger, at the University of Southern California, started work on a neurochip designed to function as an artificial or prosthetic hippocampus. The neurochip was designed to function in rat brains and was intended as a prototype for the eventual development of higher-brain prosthesis. The hippocampus was chosen because it is thought to be the most ordered and structured part of the brain and is the most studied area. Its function is to encode experiences for storage as long-term memories elsewhere in the brain.

In 2004 Thomas DeMarse at the University of Florida used a culture of 25,000 neurons taken from a rat's brain to fly a F-22 fighter jet aircraft simulator. After collection, the cortical neurons were cultured in a petri dish and rapidly began to reconnect themselves to form a living neural network. The cells were arranged over a grid of 60 electrodes and used to control the pitch and yaw functions of the simulator. The study's focus was on understanding how the human brain performs and learns computational tasks at a cellular level.

FLEXIBLE DISPLAY

A flexible display is an electronic visual display which is flexible in nature; as opposed to the more prevalent traditional flat screen displays used in most electronics devices. In recent years there has been a growing interest from numerous consumer electronics manufacturers to apply this display technology in e-readers, mobile phones and other consumer electronics.

Flexible electronic paper (e-paper) based displays were the first flexible displays conceptualized and prototyped. Though this form of flexible displays has a long history and were attempted by many companies, it is only recently that this technology began to see commercial implementations slated for mass production to be used in consumer electronic devices. Flexible displays using electronic paper technology commonly use Electro phonetic or Electro wetting technologies. However, each type of flexible electronic paper varies in specification due to different implementation techniques by different companies.

In May 2011, Human Media Lab at Queen's University in Canada introduced Paper Phone, the first flexible smartphone, in partnership with the Arizona State University Flexible Display Centre. Paper Phone used 5 bend sensors to implement navigation of the user interface through bend gestures of corners and sides of the display.

In January 2013, the Human Media Lab introduced the first flexible tablet PC, Paper Tab, in collaboration with Plastic Logic and Intel Labs, at CES. Paper Tab is a multi-display environment in which each display represents a window, app or computer document. Displays are tracked in 3D to allow multi display operations, such as collate to enlarge the display space, or pointing with one display onto another to pull open a document file.

In April 2013 in Paris, the Human Media Lab, in collaboration with Plastic Logic, unveiled the world's first actuated flexible smart phone prototype, More Phone. More Phones actuates its body to notify users upon receiving a phone call or message.

Nokia introduced the Kinetic concept phone at Nokia World 2011 in London. The flexible OLED display allows users to interact with the phone by twisting, bending, squeezing and folding in different manners across both the vertical and horizontal planes.

The technology journalist website Engadget described interactions such as "bend the screen towards yourself, [the device] acts as a selection function, or zooms in on any pictures you're viewing." Nokia envisioned this type of device to be available to consumers in "as little as three years", and claimed to already possess "the technology to produce it."

SMART RING

A smart ring is a wearable electronics device with advanced mobile components that combine features of mobile devices with innovative features useful for mobile or handheld use. Smart rings, which are typically the size of traditional rings or larger, combine the features of a mobile device, such as the ability to make payments and mitigate access control, with popular innovative uses such as gesture control and activity tracking.

Smart rings can communicate directly with smart phones or personal computers through a variety of applications and websites, and operate without the need to carry a smart phone, such as when interacting with back-end systems on the cloud through or performing standalone functions such as activity tracking. They typically do not have a display and operate by contextual relevance, such as by making a payment when near a payment terminal, unlocking an electronic lock when near the lock, or controlling home appliances when making gestures in the home. Some smart rings have physical or capacitive buttons to use as an activation mechanism, such as to initiate a gesture.

In 2013, the English firm McLear released the first smart ring in the marketplace and remains the leader in the space. The market is currently around $25 million and is expected to grow to a $15 billion industry by 2020.

The main feature of the smart ring is to serve as a near-field communication device, effectively eliminating the need to carry credit cards, door keys, car keys, and potentially even ID cards or driver`s licenses. Other features include connection to a smartphone in order to notify the user of incoming calls, text, emails, and more; use as gesture-based controller, allowing the user to perform a variety of actions with a simple motion of the hand; and measure steps, distance, sleep, heart rate, and track how many calories the user consumes.

Secure access control such as for company entry and exit, home access, cars, and electronic devices was the first use of smart rings. Smart rings change the status quo for secure access control by increasing ease of use, decreasing physical security flaws such as by ease of losing the device, and by adding two-factor authentication mechanisms including biometrics and key code entry.

Smart rings can perform payments and metro ticketing similar to contactless cards, smart cards, and mobile phones. Security of the transaction is equal to or greater than contactless cards. The first smart ring to be created with contactless payments was the NFC Payment Ring, which was mass produced and unveiled at the Olympics Summer Games at Rio de Janeiro in August 2016. Smart rings provide social feedback to users and can be used to engage in the user's environment in a way that other wearables and mobile devices do not permit. Ringly produces a women's fashion smart ring which lights to notify the user when the user receives a text message, phone call, or other notification. This enables the user to be aware of the notification without having to constantly check her or his smart phone.Replicating smartwatches, smart rings provide features including activity tracking (i.e. step tracking), heart beat tracking, and sleep tracking (through measuring heart beats and movements). The smart ring form factor contains enough space to contain the same components as smart watches. Due to size constraints, smaller components are typically used in current smart ring products in market, such as smaller and less accurate accelerometers, and smaller batteries leading to lower battery life than smart watches.

COMPUTER SCIENCE