DEPARTMENTAL JOURNAL ON ELECTRONICS & TELECOMMUNICATION ENGINEERING

DEPARTMENT OF ELECTRONICS & TELECOMMUNICATION ENGINEERING

TECHNIQUE POLYTECHNIC INSTITUTE
Panchrokhi, Sugandhya
Hooghly, West Bengal, Pin: 712102

TECHNOTRONICS

Volume-5

PUBLISHER:
DEPARTMENT OF ELECTRONICS & TELECOMMUNICATION ENGINEERING
TECHNIQUE POLYTECHNIC INSTITUTE
E-mail: detce@techniqueedu.com

Departmental Journal on Electronics and Telecommunication Engineering

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- *To inculcate critical thinking for solving technological problem, professional skill in engineering practices with the attitude of life-long learning.*

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Technotronics Volume 5 is a departmental magazine to publish significant technical information in all areas of Electronics and Tele-communication Engineering. Published articles in this magazine will address important research topics and new technological advancements in this field. The main aim is to motivate students and faculty members in research works and to increase their knowledge domain. It will give them an opportunity to express their ability of writing technical papers and documentations. The intended audience may submit their research documents yearly in the community of scholars, interested in social impact of new advanced technologies. This Magazine was initiated by the department of Electronics & Tele-communication Engineering. Students and faculty members are cordially supported by the students and faculty members of all other departments.

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Manuscripts are invited from academician and students of this institution for publication in this magazine. Papers are accepted for editorial considerations through e-mail detce@techniqueedu.com with the understanding that they have relevant and logical issues regarding the new trends in technology.

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One volume of this journal will be published yearly.

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Seeing Beyond Darkness with Smart Vision Wallet

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Smart vision wallet is a simple and efficient money counter and a counterfeit detector designed to be used by the visually-impaired and hearing-impaired community. Most machines use an LCD display, and are expensive and difficult to carry. Smart vision wallet is cheaper and comprises lighter and smaller components, reducing it to a size of an ordinary wallet—making it easy to carry.

As money has become extremely important for everyday life, the blind are at a big disadvantage. The visually-impaired community have no security when it comes to cash-related matters, and can be tricked easily. At times, they are even given false or wrong currency notes or the wrong sum total of currency. It is also easy to steal from them.

The Reserve Bank of India (RBI) in consideration for the blind community has introduced symbolic references in newer currency notes, such as Intaglio markings, which can be detected through touch. The main drawback of this feature is that not everyone can easily identify these symbols. The markings are introduced with the belief that everyone who is blind is sensitive to touch and can identify these.

How smart vision wallet helps

The smart vision wallet notifies the user regarding the sum of money counted as a sequence of vibrations and as voice output, which is intended for the hearing-impaired and the visually-impaired, respectively. Having such a device allows them to handle money with utmost confidence and independence.

There are many products available for the visually-impaired. Radio frequency identification (RFID) utilises electromagnetic fields to carefully exchange information. However, someone standing behind a visually-impaired person in a supermarket queue could quietly extract the latter's information using silent technology.

A rechargeable smart wallet available in the market is a smart Bluetooth-powered wallet that shields the wallet from getting lost. Such options are great for the common people, but do not address the problems faced by the visually- and hearing-challenged people of the society.

What is smart vision wallet

Smart vision wallet consists of colour sensors, Bluetooth interface, ultraviolet LEDs, microprocessor and vibrator. The microprocessor analyses the data obtained from colour sensors to identify the denomination of the currency. Ultraviolet LEDs, in conjunction with the sensor and microcontroller (MCU), check the authenticity of the currency. After the processing is complete, the device vibrates in a specific sequence and the smart phone connected to the device via the Bluetooth interface gives the sum as voice output to the user.

The vibration sequence is unique for every different denomination of the currency. The device can be concealed as a wallet never giving off its purpose. This guarantees anonymity and a sense of privacy and security to the user.

The embedded system known as the smart vision wallet has been solely created with the desire to assist the blind community to live alongside others as equals. The device has been fashioned in the shape of a common wallet, and weighs about the same. It works by placing the currency notes inside, after pressing a button on the wallet. The components within the wallet scan the currency for their denomination. These also check whether the currency is original or counterfeit.

Output is given via vibrations—a vibration pattern is assigned for each currency denomination—or through audio output. The wallet connects to Android devices via Bluetooth. An Android app has also been developed that works with the device. It helps in scanning the currency or finding the total currency that has been previously scanned.

This system does not require much effort by the user, who only has to place the currency and press the button on the device or the Android app.

Such a device gives the visually-impaired independence in finding the money. It eliminates the need for another person's help in finding the correct denomination. Information regarding the currency is provided in a discreet manner. Due to the device's portability feature and the ability to differentiate between real and counterfeit money, it is useful for everyone. It could also incorporate existing technologies used in smart wallets that are currently available in the market.

Features of smart vision wallet

Smart vision wallet has the following features:

- Currency differentiation
- Counterfeit detection
- Notification

Currency differentiation

A smart vision wallet must meet two requirements: affordability and portability. The device should also look like an ordinary wallet. Primary difference between the different denominations of Indian currency is colour. Hence, the most effective and simple means to identify the denominations of Indian currency is the ability to detect these unique differences in colour, and to do that, colour sensors having great precision are required.

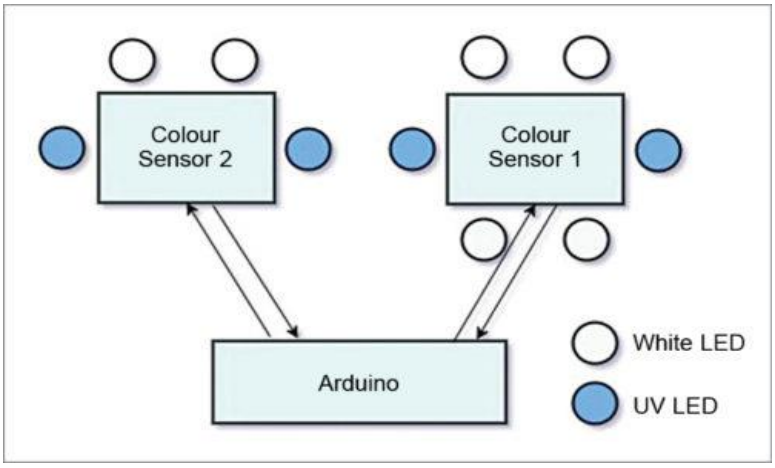

Fig. 1: Currency identification

Counterfeit detection

To check the validity of security features implemented in the Indian currency, the smart vision wallet makes use of colour sensors and programmed ATmega328P MCU.

Notifications

The user needs to be informed of the counted sum or the detected counterfeit. The smart vision wallet is designed to be used by the visually-impaired and the hearing-impaired community. There are two ways in which users can be notified: the announcement by a pattern of tones and generation of sequences of vibration. The sequence is different for different denominations.

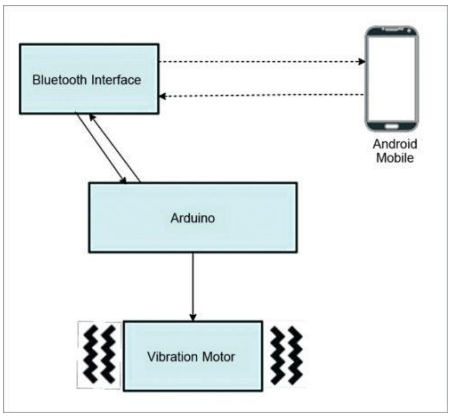

Fig. 2: Notification message

Voice output is designed for the visually-impaired, whereas vibration output is designed for the visually- and hearing-impaired, in addition to being a privacy measure. It is generated using an Android app specifically for the visually-impaired. The user interface of the app used to generate audio output is designed in such a way that it can be used by the blind with great ease. The app consists of four buttons located at four corners of the screen. This design guarantees ease of use by the visually-impaired. The four buttons are Connect, Scan, Total and Clear.

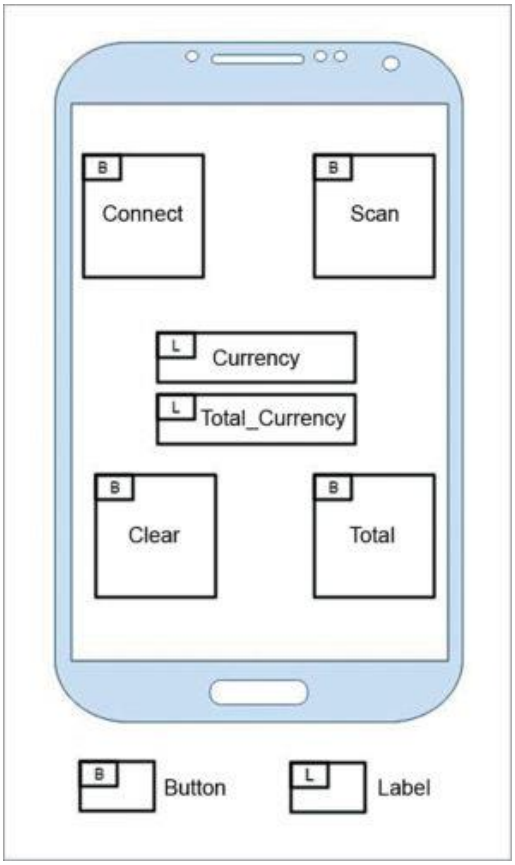

Fig. 3: Mobile app

The Android app consists of four modules: connection, scanning, computing and resetting. Connection module handles the connection of a Smartphone with Arduino. Scanning module sends the scan command to smart vision wallet, retrieves denomination and announces it as voice output.

Face Recognition Technology

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Introduction

The information age is quickly revolutionizing the way transactions are completed. Everyday actions are increasingly being handled electronically, instead of with pencil and paper or face to face. This growth in electronic transactions has resulted in a greater demand for fast and accurate user identification and authentication. Access codes for buildings, banks accounts and computer systems often use PIN's for identification and security clearances.

Using the proper PIN gains access, but the user of the PIN is not verified. When credit and ATM cards are lost or stolen, an unauthorized user can often come up with the correct personal codes. Despite warning, many people continue to choose easily guessed PIN's and passwords: birthdays, phone numbers and social security numbers. Recent cases of identity theft have heightened the nee for methods to prove that someone is truly who he/she claims to be.

Face recognition technology may solve this problem since a face is undeniably connected to its owner expect in the case of identical twins. Its non transferable. The system can then compare scans to records stored in a central or local database or even on a smart card.

FACE RECOGNITION:

THE FACE:

The face is an important part of who you are and how people identify you. Except in the case of identical twins, the face is arguably a person's most unique physical characteristics. While humans have the innate ability to recognize and distinguish different faces for millions of years , computers are just now catching up.

For face recognition there are two types of comparisons .the first is verification. This is where the system compares the given individual with who that individual says they are and gives a yes or no decision. The second is identification. This is where the system compares the given individual to all the other individuals in the database and gives a ranked list of matches. All identification or authentication technologies operate using the following four stages:

•capture: a physical or behavioural sample is captured by the system during enrolment and also in identification or verification process.
•Extraction: unique data is extracted from the sample and a template is created.
•Comparison: the template is then compared with a new sample.
•Match/non match : the system decides if the features extracted from the new sample are a match or a non match.

Face recognition technology analyze the unique shape ,pattern and positioning of the facial features. Face recognition is very complex technology and is largely software based. This Biometric Methodology establishes the analysis framework with tailored algorithms for each type of biometric device. Face recognition starts with a picture, attempting to find a person in the image. This can be accomplished using several methods including movement, skin tones, or blurred human shapes. The face recognition system locates the head and finally the eyes of the individual. A matrix is then developed based on the characteristics of the individual's face. The method of defining the matrix varies according to the algorithm (the mathematical process used by the computer to perform the comparison). This matrix is then compared to matrices that are in a database and a similarity score is generated for each comparison.

Artificial intelligence is used to simulate human interpretation of faces. In order to increase the accuracy and adaptability , some kind of machine learning has to be implemented.

There are essentially two methods of capture. One is video imaging and the other is thermal imaging. Video imaging is more common as standard video cameras can be used. The precise position and the angle of the head and the surrounding lighting conditions may affect the system performance. The complete facial image is usually captured and a number of points on the face can then be mapped, position of the eyes, mouth and the nostrils as a example. More advanced technologies make 3-D map of the face which multiplies the possible measurements that can be made. Thermal imaging has better accuracy as it uses facial temperature variations caused by vein structure as the distinguishing traits. As the heat pattern is emitted from the face itself without source of external radiation these systems can capture images despite the lighting condition, even in the dark. They are more expensive than standard video cameras.

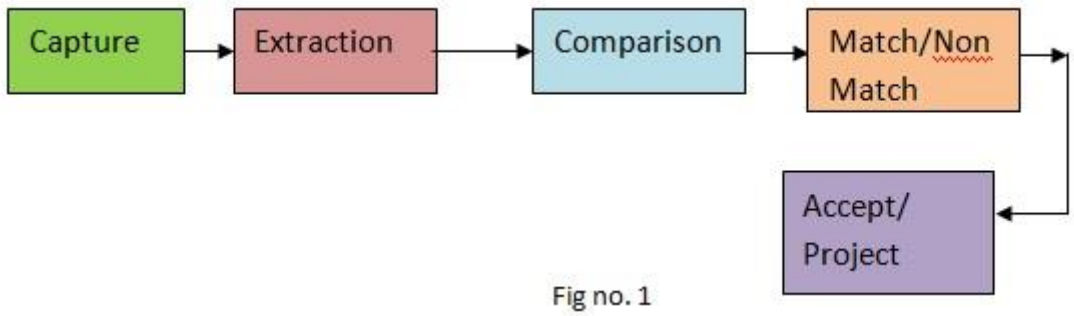

Fig no. 1

COMPONENTS OF FACE RECOGNITION SYSTEMS

•An automated mechanism that scans and captures a digital or an analog image of a living personal characteristics.(enrolment module)
•Another entity which handles compression, processing, storage and compression of the captured data with stored data (database)
•The third interfaces with the application system (identification module)

User interface captures the analog or digital image of the person's face. In the enrolment module the obtained sample is pre processed and analyzed. This analyzed data is stored in the database for the purpose of future comparison.

The database compresses the obtained sample and stores it. It should have retrival property also that is it compares all the stored sample with the newly obtained sample and retrieves the matched sample for the purpose of verification by the user and determine whether the match declared is right or wrong

The verification module also consists of a pre processing system. Verification means the system checks as to who the person says he or she is and gives a yes or no decision. In this module the newly obtained sample is pre processed and compared with the sample stored in the database. The decision is taken depending on the match obtained from the database. Correspondingly the sample is accepted or rejected.

Instead of verification module we can make use of identification module. In this the sample is compared with all the other samples stored in the database. For each comparison made a match score is given. The decision to accept or reject the sample depends on this match score falling above or below a predetermined threshold.

PERFORMANCE

•False acceptance rate (FAR)

The probability that a system will incorrectly identify an individual or will fail to reject an imposter. It is also called as type 2 error rate.

FAR= NFA/NIIA

Where, FAR= false acceptance rate
NFA= number of false acceptance
NIIA= number of imposter identification attempts

•False rejection rates (FRR)

The probability that a system will fail to identify an enrolee. It is also called type 1 error rate

FRR= NFR/NEIA

Where, FRR= false rejection rates
NFR= number of false rejection rates
NEIA= number of enrolee identification attempt

•Response time:

The time period required by a biometric system to return a decision on identification of a sample.

•Threshold/ decision Threshold:

The acceptance or rejection of a data is dependent on the match score falling above or below the threshold. The threshold is adjustable so that the system can be made more or less strict; depending on the requirements of any given application.

•Enrolment time:

The time period a person must spend to have his/her facial reference template successfully created.

•Equal error rate:

When the decision threshold of a system is set so that the proportion of false rejection will be approximately equal to the proportion of false acceptance. This synonym is 'crossover rate'. The facial verification process involves computing the distance between the stored pattern and the live sample. The decision to accept or reject is dependent on a predetermined threshold. (Decision threshold).

IMPLEMENTATION OF FACE RECOGNITION TECHNOLOGY

The implementation of face recognition technology include the following four stages:

•data acquisition
•input processing
•face image classification and decision making

Data acquisition:

The input can be recorded video of the speaker or a still image. A sample of 1 sec duration consists of a 25 frame video sequence. More than one camera can be used to produce a 3D representation of the face and to protect against the usage of photographs to gain unauthorized access.

Input processing:

A pre-processing module locates the eye position and takes care of the surrounding lighting condition and colour variance. First the presence of faces or face in a scene must be detected. Once the face is detected, it must be localized and normalization process may be required to bring the dimensions of the live facial sample in alignment with the one on the template.

Some facial recognition approaches use the whole face while others concentrate on facial components and/ or regions(such as lips, eyes etc). the appearance of the face can change considerably during speech and due to facial expressions. In particular the mouth is subjected to fundamental changes

but is also very important source for discriminating faces. So an approach to persons recognition is developed based on spatio-temporal modelling of features extracted from talking face. Models are trained specific to a persons speech articulate and the way that the person speaks. Person identification is performed by tracking mouth

movements of the talking face and by estimating the likelihoods of each model of having generated the observed sequence of features. The model with the highest likelihoods is chosen as the recognized person.

Block diagram:

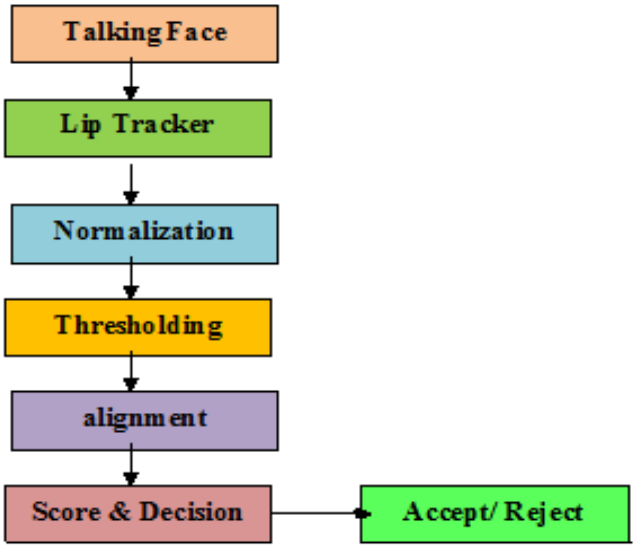

Fig no. 2

Face image classification and decision making:

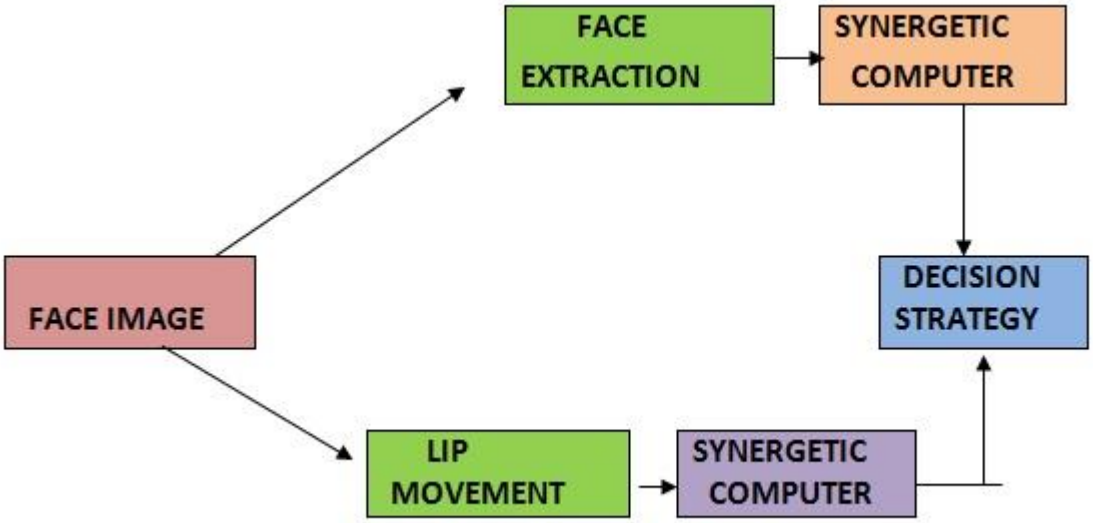

Fig no. 3

Synergetic computer are used to classify optical and audio features, respectively. A synergetic computer is a set of algorithm that simulate synergetic phenomena. In training phase the BIOID creates a prototype called face print for each person. A newly recorded pattern is pre processed and compared with each face print stored in the database. As comparisons are made, the system assigns a value to the comparison using a scale of one to ten. If a score is above a predetermined threshold, a match is declared.

From the image of the face , a particular trait is extracted. It may measure various nodal points of the face like the distance between the eyes ,width of nose etc. it is fed to a synergetic computer which consists of algorithm to capture, process, compare the sample with the one stored in the database. We can also track the lip movements which is also fed to the synergetic computer. Observing the likelihoods each of the sample with the one stored in the database we can accept or reject the sample.

HOW FACE RECOGNITION SYSTEMS WORK

An example Visionics, company based in a New Jersey is one of the many developers of facial recognition technology. The twist to its particular software, Face it is that it can pick someone's face from the rest of the scene and compare it to a database full of stored images. In order for this software to work, it has to know what a basic face looks like. Facial recognition software is based on the ability to first recognize faces, which is a technological feat in itself and then measure the various features of each face.

If you look at the mirror, you can see that your face has certain distinguishable landmarks. These are the peaks and valleys that make up the different facial features. Visionics defines these landmarks as nodal points. There are about 80 nodal points on a human face. Here are few nodal points that are measured by the software.

•distance between the eyes
•width of the nose
•depth of the eye socket

•cheekbones
•jaw line
•chin

These nodal points are measured to create a numerical code, a string of numbers that represents a face in the database. This code is called face print. Only 14 to 22 nodal points are needed for face it software to complete the recognition process.

THE SOFTWARE

Facial recognition software falls into a larger group of technologies known as biometrics. Facial recognition methods may vary, but they generally involve a series of steps that serve to capture, analyze and compare your face to a database of stored images. Here is the basic process that is used by the Faceit system to capture and compare images:

Detection
When the system is attached to a video surveillance system, the recognition software searches the field of view of a video camera for faces. If there is a face in the view, it is detected within a fraction of a second. A multi-scale algorithm is used to search for faces in low resolution. (An algorithm is a program that provides a set of instructions to accomplish a specific task). The system switches to a high-resolution search only after a head-like shape is detected.

Alignment
Once a face is detected, the system determines the head's position, size and pose. A face needs to be turned at least 35 degrees toward the camera for the system to register it.

Normalization
The image of the head is scaled and rotated so that it can be registered and mapped into an appropriate size and pose. Normalization is performed regardless of the head's location and distance from the camera. Light does not impact the normalization process.

Representation
The system translates the facial data into a unique code. This coding process allows for easier comparison of the newly acquired facial data to stored facial data.

Matching
The newly acquired facial data is compared to the stored data and (ideally) linked to at least one stored facial representation. The heart of the Face It facial recognition system is the Local Feature Analysis (LFA) algorithm. This is the mathematical technique the system uses to encode faces. The system maps the face and creates a face print, a unique numerical code for that face. Once the system has stored a face print, it can compare it to the thousands or millions of face prints stored in a database. Each face print is stored as an 84-byte file. Using facial recognition software, police can zoom in with cameras and take a snapshot of a face.
The system can match multiple face prints at a rate of 60 million per minute from memory or 15 million per minute from hard disk. As comparisons are made, the system assigns a value to the comparison using a scale of one to 10. If a score is above a predetermined threshold, a match is declared.

The operator then views the two photos that have been declared a match to be certain that the computer is accurate.

ADVANTAGES AND DISADVANTAGES

Advantages:

- There are many benefits to face recognition systems such as its convenience and social acceptability. All you need is your picture taken for it to work.
- Face recognition is easy to use and in many cases it can be performed without a person even knowing.
- Face recognition is also one of the most inexpensive biometric in the market and its prices should continue to go down.

Disadvantage:

- Face recognition systems can't tell the difference between identical twins.

Virtual Reality (VR) & Augmented Reality (AR) technologies for tourism and hospitality industry

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Technique Polytechnic Institute

INTRODUCTION

Virtual Reality (VR) and Augmented Reality (AR) are regarded as the most world-changing technologies of 21st Century. By stimulating our senses with computer generated images, they are able to immerse our minds in the experience which temporarily accepts VR/AR as another real version of reality. VR and AR are used to create powerful 3D interactive visual experiences for all kinds of purposes.

VR is considered to a promising technology for the Hospitality and Tourism industry that has the powerful effect of fooling the senses into believing one is present in a virtual world, by providing interactive 3D surroundings simulated by a computer. These simulations can depict any tourist location or attraction reproduced as 3D imagery, controlled by powerful computers creating a complete Virtual Environment (VE). VE is simply a virtual digital environment generated that makes the user with VR equipment feels as if he/she is present inside it. A complete VR System is regarded as the interface between the real world user and the VE.

According to a report published in May 2017,(Grand View Research, Inc)., the VR industry is expected to reach USD 692 billion by 2025 and the concept can potentially expand from basic gaming to other applications like Education, Medicine and Healthcare, Architecture, Sports, TV Programs, Movies and Music and many more. VR is gaining forefront attention in 2017 as various companies like Google, Microsoft, Face book, HTC and many others have come up with their own designs of VR Head-Mounted Displays (HMDs).

AR is an integration of the real world and the virtual world, with the aim of providing additional information about something in the real world with information displayed in the virtual world. For instance a person could look at a painting or a machine in the real world, hold up their smart phone or tablet in front of the painting or machine, and see on the screen the painting or machine with additional useful information, thus augmenting reality. AR technology is also capable of revolutionizing the tourist experience by making possible the planning, previewing and accessing location-based information of the holiday journey and destinations, in an interactive and simple manner, from various places. Users can preview and book their hotel, access information while they are there, navigate around their destination, translate written, spoken signs or conversations, locating dining and entertainment options. It can all be done simply through an app on a mobile device.

In 2009 the first AR Smartphone apps came out, using AR technology to add a layer of guidance, content and entertainment to physical locations seen through the smart phone's camera view. Tuscany+ was the first app built specifically for tourism - an "interactive, real-time guide" - intending to enhance the visitor experience (Figure 1). The AR technology made it possible to layer the digital enhancements over an existing reality or real-life scenario.

Fig. 1: Tuscany+ the first app built specifically for tourism.

Fig. 2: Pokémon GO mobile multi-player AR

Another, world-famous example is Pokémon GO, an open, mobile multi-player AR based game since its release in July 2016 it has taken the world by storm. It is an application with which players can collect points by walking around in the real world, while holding up their Smartphone, in a quest to find, catch and collect in their phone camera view, virtual characters, called "pocket monsters", which are located near and linked to specific geographical locations (Figure 2). It already had more than 65 million players by April 2017 and is still rapidly increasing user numbers. With these numbers, it has become the most successful game of all-time. It is praised internationally by health experts because it gets people out of their houses and motivates them to walk around outside and connect with others.

Gastronomical providers have already started benefiting from the Pokémon GO craze, and there are more ways in which Pokémon GO can benefit tourism industry. The game makes use of "Poke Stops", strategically placed at sightseeing locations, such as monuments and other public areas of interest; while in the game, these locations are displayed with a photo and a brief description. Tour operators can design new tours according to the location of Poke Stops or the known locations of rare collectable Pokémon's. During the tour, players can expand their knowledge of the world around them in a playful and spontaneous manner, when they encounter Poke Stops that have interesting historic, artistic or cultural value.

Pokémon GO has made AR technology popular among consumers, and many variations on this theme can now be easily envisioned and introduced. This new technology can bring new opportunities to the Hospitality and Tourism industry. According to an article published by Marketwatch.com in July 2017, in 2016 the AR market was valued at USD 2.39 billion and is expected to reach USD 61.39 billion by 2023, growing at a CAGR of 55.71% during the forecasted period. The concepts of VR and AR are also referred to as Mixed Reality (MR) and various levels of integration are possible. The VR, AR and MR concepts will be defined in more detail in the sections below.

Augmented reality

Augmented Reality (AR) is regarded as a variation of VR. For this reason AR is often listed in combination with VR, as "AR/VR" and sometimes "VR/AR", and also "AR/VR/MR" where MR is short for the term Mixed Reality (MR). Mixed Reality is a useful term because it encapsulates the fact that there are various different configurations or hybrid AR/VR systems. The real environment refers to the Real World (RW) with all the objects and interactions that we are used to, AR refers to virtual objects overlaid on real objects. VR refers to an entirely virtual world with virtual objects in it. AR technology is beneficial to various industrial application areas, where there is a requirement for advanced user perception, and can help workers to have quick access to relevant information and instructions, during the manufacturing processes.

Augmented Reality Systems have the following characteristics.

- Mix of real world and virtual objects in real environment.
- Synchronize real and virtual objects with each other.
- Highly interactive and runs in 3D in real time.

In recent times the scope of AR applications has expanded to include innovation for the domains of Research, Science, Medicine, Telecommunications, etc. A software development platform called AR Toolkit is now also available for end-users to create AR applications. AR Toolkit is an open-source computer tracking software development toolkit (SDK) for the creation of AR applications that overlay virtual imagery on the real world, allowing the end-user to create annotations and animations of the virtual image that is overlaying the real-world object or scene.

Some AR systems can be used on a Smartphone and tablet, so AR applications are not necessarily limited to use on display technologies like HMDs. However, many companies are working on developing dedicated AR HMDs. The AR headset market has been steadily developing as the technology matures and is widely expected to reach $4 trillion by 2030 as compared to $1 trillion in 2017. It is also expected to grab almost 28% of M-Commerce market share which is expected to reach about $1.3 trillion by 2025.

This enormous growth of AR/VR technology has motivated us to conduct a study on the current state of art on the technical aspects of this technology.

Technologies for virtual reality and augmented reality

In this section the technologies that enable to user to see and interact with the VR/AR application will be discussed. The technology for VR/AR are still rapidly evolving. The software is becoming more sophisticated, and faster and the graphical imagery more detailed. The hardware is becoming less expensive and less bulky. And last but not least, the user experience is getting better due to these advances in the technologies. AR requires more sophisticated technology compared to VR, but the key components have remained the same since the 1960s, when Ivan Sutherland, who is widely regarded as the "father of computer graphics", and his students invented several foundations of modern computer graphics in the 1960s. The most essential components for AR/VR are Displays, Trackers and Graphics Computers and Software. The following sections give a short overview of the relevant technologies for AR/VR.

Display technologies for virtual reality

With regard to selecting VR devices, the main importance is to select a device that is user-friendly, i.e. comfortable to wear, flexible in operations, and the viewing depth and visual experience has to provide a

good dynamic VE experience for the user. The race is on between the different VR hardware and software developers and technology for VR is so rapidly evolving that reviewing the latest technology specifications at the time of writing this, may very well be out of date by the time of printing this. For this reason, the underlying principles for a good user experience are discussed here. These principles can be used to evaluate any VR display and help ask the right questions when deciding which technology is best. The principles for successful VR display technology are:

Stereoscopic imagery: A binocular HMD can display slightly different viewing angles for each eye, creating binocular overlap, which gives the viewer the illusion of stereoscopic depth and a more or less realistic 3D viewing experience, creating the illusion that some objects are near and others far away. It is important that the binocular overlap is correct, because it is not, the user will experience an unfocused, double-vision image.

Interpupillary distance (IPD): The distance between the two eyes, measured at the pupils. It is important that a head-mounted display has an adjustable IPD, because the effectiveness of the stereoscopic imagery depends on it and every end-user has a slightly different IPD setting at which they will experience a clear focused image.

Field of view (FOV): The natural FOV of human beings is about 180°, but so far HMDs are not capable of creating this. Current HMDs offer a field of view of between 60° to 150°. A bigger field of view results in a more realistic user experience, with a greater sense of immersion, allowing the user to establish greater situational awareness and more effective interaction.

HMD Resolution: For an effective visual experience, a resolution of 1920x1080 (960x1080 per eye) is required. HMDs like for instance Gear VR offer a resolution of 2560x1440 (1280x1440 per eye). HMD specifications are usually described by the total number of pixels or the number of pixels per degree, also called “pixel density”, specified in pixels per degree or in arc minutes per pixel. The human eye, at the fovea (the part of the retina where the visual acuity is the highest), with normal vision can not perceive more than 60 pixels/° (also referred to as 1 arcmin/pixel). This is limit is called “eye limiting resolution”. HMDs typically offer 10 to 20 pixels/°, though advances in micro-displays help increase this number. As display screens technology improves, it will approach eye-limiting resolution in the HMD and achieve photo-realistic experiences.

On-Board Processing and Operating System: Wireless HMDs, also known as “smart goggles”, have on-board operating systems such as Android, allowing applications to run locally on the HMD, and eliminating the need to be tethered to an external device to function. The challenge is to make the HMD construction as light as possible, and early solutions of HMD plus “backpacks” which contain the processing system and battery pack are already available.

Display technologies for augmented reality

AR is enabled by new technical features such as computer vision, object recognition, miniature accelerometers, a Global Positing System (GPS) and the solid state compass. The AR display technologies that are essential to create the AR experience are briefly described below:

- *Marker-Based AR*: the marker based AR relies on the image recognition technique that takes help of a camera and certain types of visual markers like QR/2D code , that gives result only when sensed by a reader. The marker based apps with the use of camera can differentiate between the marker and other real world objects. Markers are generally based on simple patterns, easily recognizable, requiring comparative low processing power for reading. Here the orientation and the position is also

calculated where certain content and/or information is then overlaid on location of marker.

❖ *Marker less AR*: (also known as location-based, position- based, or GPS-based AR) uses miniature versions of a GPS, a digital compass, and a velocity meter, or accelerometer, which are embedded in the device, to provide data based on the exact location and orientation of the device. A strong force behind popularization of the Marker-less AR technology solution is the availability of smart phones everywhere with the location detection features. They are mostly used for mapping directions, finding nearby businesses, or other location-centric mobile applications.

❖ *Projection-Based AR*: Projection-based AR works by projecting artificial light onto real world surfaces. Projection-based AR applications allow for human interaction by sending light onto a real-world surface and then sensing the human interaction (i.e. touch) of that projected light. Detecting the user's interaction is done by differentiating between an expected (or known) projection and the altered projection (caused by the user's interaction). Projection-based AR can utilize laser plasma technology to project a 3D interactive hologram into mid-air, and although early demonstrators have come out in 2014, consumer version applications are still in the early stages of development.

❖ *Superimposition-Based AR*: Superimposition-based AR partially or fully replaces the original view of the object with an augmented view of that object. Computer vision and object recognition play a vital role, because the original view has to be recognized before it can be replaced with the correct augmented version. It is very suitable for the low-end consumer, who can use their Smartphone or tablet to experience an augmented version of their view, in for instance a museum or cultural heritage location.

Tracking sensors

Tracking sensors are essential to allow the user to roam in real environment, in order to move their viewpoint in AR/VR, and be able to continuously update the location of the user in the virtual world. For this reason it is regarded as one of the main components of VR/AR systems. These sensors basically interact with a system processing unit, relaying the orientation of the user's point of view to the system. Using the sensors in combination with VR/AR systems does not only allow the detection of the location of the user, it also helps detect the user's direction of movement and speed of that movement in any direction. The following three concepts are relevant to tracking for VR setups:

1. 6-DOF: Six Degrees of Freedom (DOF) for detection of movement; the freedom of movement (forward/backwards, left/right, up/down, yaw, pitch and roll) of a rigid body in 3D space, (Figure 4).
2. Orientation: It is based on the combination of yaw, roll and pitch of an object in 3D space.
3. Coordinates: Position of the objects on the X-axis, Y-axis and Z-axis known as orientation of objects.

These three concepts are relevant to the design of tracking for HMDs. All tracking systems consist of a device which generates a signal that can be detected by a sensor. The entire VR/AR unit is involved in the processing of this signal generation, and the transmission and sending information to the Central Processing Unit (CPU) and the Graphical Processing Unit (GPU). The signals generated from different sensors can take different shapes including Electromagnetic Signals, Optical Signals, Mechanical Signals and Acoustic Signals. Different tracking systems use these respective types of signals.

VR/AR in hospitality & tourism

VR/AR application areas for Hospitality and Tourism are still under development as the technology becomes more mainstream, both the industry and the consumers are starting to appreciate the possibilities this technology has for their hospitality and tourism interests. As the technology matures, the application areas are rapidly being explored by the early-adopters. This section analyses the immediate application areas for the Hospitality and Tourism industry and highlights the opportunities that lie ahead as the technology evolves.

With the advancements in VR/AR technologies, the implementations of VR/AR technologies continue to impress consumers and investors and as a result, these increasingly sophisticated technologies are being envisioned and implemented for end-user benefits in the Tourism and Hospitality industry. The following analysis highlights the impact and importance of AR/VR technology for the Hospitality and Tourism industry.

Effective Planning and Suitable Management: With the help of AR/VR technologies in tourism, the potential has widened in terms of implementing effective tourism policy and also effective planning. VR devices create almost realistic, easy and detailed navigation of tourist places for tourists in order to plan their trips. With VR technologies, travellers can experience bird's-eye views of their destination, to have detailed look and feel of the place to be visited. It also acts as an important and effective tool for tourist activity planning, as tourists can connect to each other via social media apps to get feedback regarding their previous experience.

Effective Entertainment Tool: Considering the important history of VR devices starting with the introduction of the "Sensorama Simulator" in 1962, which provided people a virtual experience of driving a motorcycle, including realistic movement, sound, scent and airflow, VR technology has evolved to much greater heights since then. It has been implemented in various theme parks like Disneyland and other kids entertainment parks to provide virtual based environments in terms of rides, flight simulators and so on. Nowadays, the concept of 3D and 4D theatres are also on the rise in different parts of the world.

Education Tool: VR has tremendous potential in terms of education and effective research of many years has proved that VR devices and even the latest AR technology can serve as a great tool for entertainment. A VR model can be an efficient means of communication of large amounts of information because it leverages the user's natural spatial perception abilities. VR has great potential to entertain and educate people via games, interactive sessions, Artificial Intelligence based Interactive Systems and many more

.

Virtual Attractions at Effective Cost: New AR and VR travel tourism experiences can be added to existing applications by simply modelling and animating them. These create a perfect digital environment and digital content can just be added or uploaded on demand considering the visitor's requirement and even used for location marketing purposes.

Interactive Dining Experience: Amazing food and entertainment is the primary focus for the travellers planning a trip from home. With the help of augmented reality technology a virtual tour of the restaurant is possible along with that they can even make diving decisions using the virtual menus available. There are other attractive features like accessing mobile, coupons or advance reservation features that may facilitate the visitors to try new dining experience.

Convenient Translation Capabilities: AR technology may help the non-local travellers facing the language barrier as a challenge towards interacting with people. The technology makes the translation simple and effective that increases the experience as well as understanding.

Real Time and Reliable Navigation: the landing of the people in an unfamiliar environment may tend to develop frustration as well as challenging at times. The technology may help in elevating the navigation maps with addition of digital elements like arrows as well as other helpful information to the map. This technology augments the feeling with simplified directions to follow and ensuring a safe and easy travelling to the desired destination.

Booking Rooms: AR technology provides the perspective guests to survey the rooms prior to booking them. The travellers can physically visit the rooms to cross check with size as well as floor plans. These guests may further be approached for upgrading to a suite by looking at additional amenities, mesmerizing view and the comfortable spaciousness around them.

Exploring the property: the visitors need not imagine the hotel using website images and paper brochures, instead they can virtually visit the hotels, restaurant spa or fitness centre. The eco-friendly hotel may also provide users for a virtual tour of its roof top, herb garden, or show-off green building materials that enhances the customer loyalty. The Casa-madrona mansion, uses the printed or augmented brochure.

Experience of Rich luxurious Restaurants: The hotel may also add, AR content to their restaurant menu, that can help non-native guests to be able to read it in their own language. The AR images may also be projected on the restaurant table that may allow the guests to decide and select their choice of table theme.

Local attractions: the locational advantage of a hotel is one of the most attractive feature for a guest to choose or select a hotel. This technology may allow a user to give a glance at the hotel location also give a view of the eminent historical events, cultural experiences of the nearby destinations. Along with beautiful sight seeing the AR may advertise more of its attractive features as long as the guests interact with their apps.

Marketing: The AR tech enhances the guests satisfaction through the process of effective marketing, on billboards placed at airports or high traffic areas, or scanning the clicked images as well as information about the hotel.

Hotel Management: AR has also contributed in the field of business and the back of house operations. The advanced AR technology can create blue prints allowing the investors to look through the end results. And in the areas of staff training , these hotels may provide a real feel that can help the employees to enhance their soft skills while guest interaction.

Though AR technology is at the budding stage in the hotel industry, but it may not be too long to dominate in this field since the recurring of this technology may contribute as a huge impact on its scales.

Conclusion

This paper covered a description of the history of VR/AR enabling technologies, the currently popular VR/AR equipment, and several use cases of VR/AR applications for the Tourism & Hospitality sector. It reviewed the successes, failures and challenges for the development and use of VR/AR applications to improve existing marketing funnel designs, improving client conversion rates and thus providing the required added value and ROI. From the Use Cases many examples can be drawn that showcase a substantial amount of institutions that have made the investment in VR/AR apps to help their potential customers with their pre-purchase decision making, indicating that they consider VR/AR technology particularly suitable for supporting the decision-making process of intangible products such as the holiday or event experience. AI driven chat bots are flagged as a new application area beneficial for the Tourism & Hospitality sector, particularly where it comes to answering the frequently asked questions from pre-purchase customers and helping those in the process of purchasing, thus helping reduce this type of repetitive, time-consuming workload of customer support personnel.

Chandrayaan-2

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Chandrayaan-2 was India's second mission to the moon, and was a follow-up mission from the Chandrayaan-1 mission that assisted in confirming the presence of water/hydroxyl on the moon in 2009. Chandrayaan-2 consisted of a lunar orbiter, the Vikram lander, and the Pragyan lunar rover, all of which were developed in India. The main scientific objective is to map and study the variations in lunar surface composition, as well as the location and abundance of lunar water.

Chandrayaan-2 was launched from the SatishDhawan Space Centre in Sriharikota, India, aboard a Geosynchronous Satellite Launch Vehicle (GSLV) rocket on July 22, 2019 and reached lunar orbit on Aug. 19. During the Sept. 6 (Sept. 7 IST) moon landing attempt, ISRO officials lost contact with the Vikram moon Lander as the probe was just 1.3 miles (2.1 kilometres) above the lunar surface. Officials have been unable to reach the Lander since losing contact on Sept. 6. If this mission went successful, India will become the fourth country after the US, Russia, and China to conduct a soft landing on the moon and the first country to land close to the lunar south pole on its first attempt.

Despite the apparent crash-landing of the Lander, ISRO has confirmed that all the instruments on board the orbiter are working well. The current orbiter carries eight different instruments — and Indian scientists are already poring over some of the mission's very first science data. On Oct. 4, ISRO released photos the orbiter's High Resolution Camera took on Sept. 5 of a crater called Boguslawsky E, located near the lunar south pole.

Key scientists and engineers involved in the development of Chandrayaan-2 include:

- RituKaridhal – Mission Director
- MuthayyaVanitha – Project Director
- K. Kalpana – Associate Project Director
- G. Narayanan – Associate Project Director
- G. Nagesh – Project Director (former)
- Chandrakanta Kumar – Deputy Project Director (Radio frequency systems)
- Amitabh Singh – Deputy Project Director (Optical Payload Data Processing, SAC)

Why did we go to the Moon?

The Moon is the closest cosmic body at which space discovery can be attempted and documented. It is also a promising test bed to demonstrate technologies required for deep-space missions. Chandrayaan-2 aims for enhancing our understanding of the Moon, stimulate the advancement of technology, promote global alliances and inspire a future generation of explorers and scientists.

What are the scientific objectives of Chandrayaan 2? Why was the Lunar South Pole targeted for exploration?

Moon provides the best linkage to Earth's early history. It offers an undisturbed historical record of the inner Solar system environment. Though there are a few mature models, further explanations were needed to understand the origin of the Moon. Extensive mapping of lunar surface to study variations in lunar surface were essential to trace back the origin and evolution of the Moon. Evidence for water molecules discovered by Chandrayaan-1, required further studies on the extent of water molecule distribution on the surface, below the surface and in the tenuous lunar exosphere to address the origin of water on Moon.
The Lunar South pole is especially interesting because of the lunar surface area that remains in shadow is much larger than that at the North Pole. There could be a possibility of presence of water in permanently shadowed areas around it. In addition, South Pole region has craters that are cold traps and contain a fossil record of the early Solar System.

Launcher and the Spacecraft

- Launcher

The GSLV Mk-III(Geosynchronous Satellite Launch Vehicle Mark-III) is India's most powerful launcher to date, and has been completely designed and fabricated from within the country. The GSLV Mk-III will carry Chandrayaan 2 to its designated orbit. This three-stage vehicle is India's most powerful launcher and is capable of launching 4-ton class of satellites to the Geosynchronous Transfer Orbit (GTO).

Its components are:

- S200 solid rocket boosters
- L110 liquid stage
- C25 upper stage

- Orbiter:
  The Orbiter will observe the lunar surface and relay communication between Earth and Chandrayaan 2's Lander — Vikram.

Chandrayaan 2 Orbiter is capable of communicating with Indian Deep Space Network (IDSN) at Byalalu as well as the Vikram Lander. The precise launch and mission management has ensured a mission life of almost seven years instead of the planned one year.

The orbiter's structure was manufactured by Hindustan Aeronautics Limited and delivered to ISRO Satellite Centre on 22 June 2015.

- Dimensions: 3.2 × 5.8 × 2.2 m
- Gross lift-off mass: 2,379 kg (5,245 lb)
- Propellant mass: 1,697 kg (3,741 lb)
- Dry mass: 682 kg (1,504 lb)
- Power generation capacity: 1000 W
- Mission duration: approximately 7.5 years, extended from the planned 1 year owing to the precise launch and mission management, in lunar orbit.

❖ Lander — Vikram:

The Lander of Chandrayaan-2 was named Vikram after Dr Vikram A Sarabhai, the Father of the Indian Space Programme. It was designed to function for one lunar day, which is equivalent to about 14 Earth days.

The Vikram Lander detached from the orbiter and descended to a low lunar orbit of 30 km × 100 km (19 mi × 62 mi) using its 800 N (180 lbf) liquid main engines. It then performed a comprehensive check of all its on-board systems before attempting a soft landing that would have deployed the rover, and perform scientific activities for approximately 14 Earth days. Vikram spacecraft apparently crash-landed. The approximate combined mass of the Lander and rover is 1,471 kg.

The preliminary configuration study of the Lander was completed in 2013 by the Space Applications Centre (SAC) in Ahmadabad. The Lander's propulsion system consists of eight 50 N thrusters for attitude control and five 800 N liquid main engines derived from ISRO's 440 N (99 lbf) Liquid Apogee Motor. Initially, the Lander design employed four main liquid engines, but a centrally mounted engine was added to handle new requirements of having to orbit the Moon before landing. The additional engine was expected to mitigate upward draft of lunar dust during the soft landing. Vikram was designed to safely land on slopes up to 12°.

Some associated technologies include a high resolution camera, Laser Altimeter (LASA),Lander Hazard Detection Avoidance Camera (LHDAC), Lander Position Detection Camera (LPDC),Lander Horizontal Velocity Camera (LHVC), an 800 N throttle able liquid main engine, attitude thrusters, Ka band radio altimeters (KaRA),Laser Inertial Reference & Accelerometer Package (LIRAP),and the software needed to run these components. Engineering models of the Lander began undergoing ground and aerial tests in late October 2016, in Challakere in the Chitradurga district of Karnataka. ISRO created roughly 10 craters on the surface to help assess the ability of the Lander's sensors to select a landing site.

- Dimensions: 2.54 × 2 × 1.2 m
- Gross lift-off mass: 1,471 kg
- Propellant mass: 845 kg
- Dry mass: 626 kg
- Power generation capability: 650 W
- Mission duration: ≤14 days (one lunar day)

❖ Pragyan Rover:

The rover was a 6-wheeled, AI-powered vehicle named Pragyan, which translates to 'wisdom' in Sanskrit.
The rover was to move on 6 wheels traversing 500 meters on the lunar surface at the rate of 1 cm per second, perform on-site analyses and send the data to the Lander, which would have relayed it to the Mission Control on the Earth.
For navigation, the rover uses:
Stereoscopic camera-based 3D vision: two 1 megapixel, monochromatic NAVCAMs in front of the rover to provide the ground control team a 3D view of the surrounding terrain, and help in path-planning by generating a digital elevation model of the terrain.IIT Kanpur contributed to the development of the subsystems for light-based map generation and motion planning for the rover.
Control and motor dynamics: the rover has a rocker-bogie suspension system and six wheels, each driven by independent brushless DC electric motors. Steering is accomplished by differential speed of the wheels or skid steering.
The expected operating time of Pragyan rover was one lunar day, or around 14 Earth days, as its electronics were not designed to endure the frigid lunar night. However, its power system has a solar-powered sleep/wake-up cycle implemented, which could have resulted in longer service time than planned. Two aft wheels of the rover have the ISRO logo and the State Emblem of India embossed on them to leave behind patterned tracks on the lunar surface, which is used to measure the exact distance travelled, also called visual odometry.

- Dimensions: 0.9 × 0.75 × 0.85 m
- Power: 50 W
- Travel speed: 1 cm/sec.
- Mission duration: ≤14 days (one lunar day)

Loss of Vikram

Vikram began its descent at 20:08:03 UTC, 6 September 2019 and was scheduled to land on the Moon at around 20:23 UTC. The descent and soft-landing were to be done by the on-board computers on Vikram, with mission control unable to make corrections.
The initial descent was considered within mission parameters, passing critical braking procedures as expected, but the Lander's trajectory began to deviate at about 2.1 kilometres (1.3 mi; 6,900 ft) above the surface. The final telemetry readings during ISRO's live-stream show that Vikram's final vertical velocity was 58 m/s (210 km/h) at 330 meters above the surface which, according to some experts, is quite fast for a lunar landing. Initial reports suggesting a crash were confirmed by ISRO chairman K. Sivan, stating that "it must have been a hard landing".
Radio transmissions from the Lander were tracked during descent by analysts using a 25-meter radio telescope owned by the Netherlands Institute for Radio Astronomy. Analysis of the Doppler data suggests that the loss of signal coincided with the Lander impacting the lunar surface at a velocity of nearly 50 m/s (180 km/h) (as opposed to an ideal 2 m/s (7.2 km/h) touchdown velocity).

The powered descent was also observed by NASA's Lunar Reconnaissance Orbiter (LRO) using its Lyman-Alpha Mapping Project (LAMP) instrument to study changes in the lunar exosphere due to exhaust gases from the Lander's engines.

The mission's orbiter was reported to have imaged the location of the Lander. Unconfirmed reports, citing an ISRO official, stated that the Lander was intact, but there has been no official announcement by ISRO on the Lander's actual location or physical condition. ISRO's Chairman, K. Sivan, tasked senior scientist P. S. Goel to head the Failure Analysis Committee to look into the causes of the failure.

Both ISRO and NASA attempted to communicate with the Lander for about two weeks before the lunar night set in, while NASA's Lunar Reconnaissance Orbiter (LRO) flew over on 17 September 2019 and acquired some images of the intended landing zone. However, the region was near dusk, causing poor lighting for optical imaging. NASA's LRO images, showing no sight of the Lander, were released on 26 September. The LRO flew over again on 14 October under more favourable lighting conditions, but was unable to locate it. The LRO performed a third flyover on November 10.

On 16 November 2019, the Failure Analysis Committee released its report to the Space Commission, concluding that the crash was caused by a software glitch. Phase one of descent from an altitude of 30 km to 7.4 km above the moon surface went as intended with velocity being reduced from 1683 m/s to 146 m/s. But velocity reduction during the second phase of descent was more than expected. This deviation from nominal was beyond the designed parameters of on-board software, causing Vikram to hard land potentially within 500 meters of the intended landing site. The complete findings have not been made public.

The orbiter part of the mission, with eight scientific instruments, remains operational, and will continue its seven-year mission to study the Moon.

In November 2019, ISRO officials stated that a new lunar Lander mission is being studied for launch in November 2020; this new proposal is called Chandrayaan-3 and it would be a re-attempt to demonstrate the landing capabilities needed for the Lunar Polar Exploration Mission proposed in partnership with Japan for 2024.If funded, this re-attempt would not include launching an orbiter. The proposed configuration would have a detachable propulsion module, a Lander and a rover. According to VSSC director, S. Somanath, there will be more follow up missions in the Chandrayaan program.

Quantum Communication

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INTRODUCTION:

Quantum communication is the art of transferring a quantum state from one place to another. Traditionally, the sender is named Alice and the receiver Bob. The basic motivation is that quantum states code quantum information - called qubits in the case of 2-dimensional Hilbert spaces - and that quantum information allows one to perform tasks that could only be achieved far less efficiently, if at all, using classical information. The best known example is Quantum Key Distribution (QKD). Actually, there is another motivation, at least equally important to most physicists, namely the close connection between quantum communication and quantum non-locality, as illustrated by the fascinating process of quantum teleportation.

Quantum communication theory is a broad field, including e.g. communication complexity and quantum bit-string commitment. In this review we restrict ourselves to its most promising application, QKD, both point to point and in futuristic networks.

There are several ways to realize quantum communication. We list them below from the simplest to the more involved. Since ”flying qubits” are naturally realized by photons, we often write ”photon” for ”quantum system”, although in principle, any other quantum system could do the job.

- 1 photon: Alice encodes the state she wants to communicate into a quantum system and sends it to Bob.
- 2 photons: Exploit entanglement to prepare the desired quantum state at a distance.
- 3 photons: Teleport the quantum state from Alice to Bob.
- 4 photons: Teleport entanglement, also called entanglement swapping.

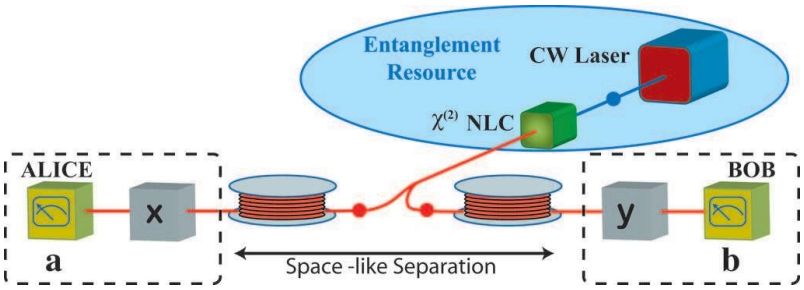

FIG. 1: Revealing non-locality. Alice and Bob independently perform experiments x and y, on an entangled state at space like separated locations, and study the correlations for the results a and b.

ENTANGLEMENT & NON-LOCALITY

Entanglement is the essence of quantum physics. To understand this statement already stressed by Schrödinger in 1935, it is worth presenting it in modern terms inspired by quantum information theory. In Science in general, all experimental evidence takes the form of conditional probabilities: if observer A_i performs the experiment labeled x_i, she observes a_i and in general one writes the probability for all of the possible results $P(a_1 \ldots a_n|x_1 \ldots x_n)$. Such conditional probabilities are often called *correlations*. For simplicity, we restrict the discussion here to the bi-partite case, denoting their correlation $P(a, b|\, x, y)$.

The correlations $P(a, b|x, y)$ carry a lot of structure. Apart from being non-negative and normalized, the local marginal's are independent of the experiment performed by independent observers: $\sum_a P(a, b|\, x, y) = P(b|\, y)$ is independent of the experiment x performed by Alice. As a trivial example of independent observers, imagine two physicists performing different experiments in labs in distant countries, in which case the independence of the marginal's is obvious. There is however another more interesting situation. Suppose the two parties perform similar experiments, but at two space-like separated locations, thus preventing any communication, as is the case in Fig. 1. It is therefore natural to assume that the local probabilities depend only on the *local state of affairs* and, as the local state of affairs may be unknown, one merely denotes them by a generic symbol λ. Note that the local state of affairs at Alice's site and at Bob's site may still be correlated. This is why computer scientists call λ *shared randomness*. Given the local state of affairs, the correlations factorize to *local correlations*, $P(a, b|\, x, y, \lambda) = P(a|\, x, \lambda) \cdot P(b|\, y, \lambda)$, which necessarily satisfy some (infinite) set of inequalities, known as Bell Inequalities. Let us emphasize that there is no need to assume predetermined values to derive Bell Inequalities, it suffices to assume that the probabilities of results of local experiments depend only on local variables.

Almost all correlations between independent observers known in Science are local. The only exceptions are some correlations predicted by quantum physics when the two observers perform measurements on two (or more) entangled systems. This implies that in some cases, a quantum experiment performed at two distant locations can't be completely described by the *local state of affairs*, a very surprising prediction of quantum physics indeed!

Einstein, among others, was so surprised by this that he concluded that it "proves" the incompleteness of quantum mechanics. Following Bohr's reply to the famous EPR paper, the debate became philosophical. John Bell resolved this with the introduction of the experimental question of Bell Inequalities and remarkably, by 1991, it had become applied physics. Indeed, it was realized that the non-existence of a local state of affairs guaranties that Alice and Bob's data have no duplicate anywhere else in the world, in particular not in any adversaries' hands. The intuition is clear: since there is no λ, no one can hold a copy of λ, hence no one can compute the probabilities for Alice and Bob's data, $P(a|\, x, \lambda)$ and $P(b|\, y, \lambda)$. Consequently, Alice and Bob's data have some secrecy. This is the essence of QKD, but clearly, this intuition needs elaboration.

Let us conclude this section with a brief review of the experimental and theoretical status of quantum non- locality. Today, no serious physicist doubts that Nature exhibits quantum non-locality. Despite the depth of such a conclusion (whose revolutionary aspect is often not fully appreciated), it has turned out to be exceedingly difficult to realize an experiment between space-like separated parties with detection efficiencies high enough to avoid the detection loophole. While the detection loophole was closed in an ion trap experiment, the close proximity of the ions ensured that these were not space-like separated. Only a couple of experiments have managed to perform space-like separated tests with entanglement distributed over ten kilometers both in fiber and free space, though without closing the detection

loophole. Also on the theory side, it is surprisingly poorly understood why the most well known Bell inequality, the CHSH-inequality, named after its discoverers, seems the most efficient one despite the existence of infinitely many other Bell inequalities. In particular, we still have no practical way to tell whether a given quantum state is able to exhibit non-locality or not. This limited understanding is especially frustrating once one realizes that the experimental violation of a Bell inequality is the *only* direct evidence for the presence of entanglement. Indeed, all the other entanglement witnesses require that one knows the dimension of the relevant Hilbert space.

QUANTUM KEY DISTRIBUTION: FROM ENTANGLEMENT TO WEAK LASER PULSES

One simple way to think about entanglement for the non specialist is that some composite systems, like pairs of photons, are able to provide the same random answer when asked the same question. Let us emphasize that the answer (measurement result) is random, but it is precisely the same randomness that manifests itself at two distant locations, provided that Alice and Bob perform the same experiment (or experiments related by a simple transformation). It then suffices that Alice and Bob independently choose to perform a series of experiments, drawn from a pre-established list of possible experiments, and, after recording all their data, they post-select those corresponding to the cases in which they happened, by chance, to have chosen to perform the same experiment. In these cases, they asked the same question and thus obtained the same random answer. This provides them with a cryptographic key.

The first choice that the quantum telecom engineer has to face is that of the wavelength. While most quantum optics experiments since the invention of the laser have used silicon-based detectors, limited to wavelengths be- low 1 μm, for long distance quantum communication one should also consider wavelengths suitable for fiber optic communication, 1.3 & 1.5 μm (although space communication to satellites is a serious and fascinating alternative that we can't review here). Nowadays, there are several options for detectors compatible with optical fibers, ranging from detectors based on super conduction transitions to commercially available APDs (Avalanche Photodiodes).

The second choice concerns the degree of freedom in which to encode the qubit. An obvious first choice is the state of polarization, except that polarization is un- stable in standard fibers, especially in aerial fiber cables. In 1989 Jim Franson proposed the use of energy-time entanglement, with the initial objective to test a Bell inequality, though later adapted to quantum communication. Fig. 2 illustrates Franson's idea, consisting of a CW laser that pumps a χ^2 nonlinear crystal, where each photon from the pump laser has a probability of, at best, 10^{-6} to be down-converted into a pair of photons, de- pending on the crystal. Each of the two photons has an uncertain energy (i.e. an uncertain wavelength), where *uncertain* should be understood in the quantum mechanical sense. However, through energy conservation, the sum of the two photon's energy equals the well defined energy of the pump laser photon. Moreover, both photons are created at the same time (again through energy conservation), but this time is "quantum uncertain" within the long coherence-time of the pump laser. We see a nice analogy with the case presented by EPR: the energy and the age of each photon are uncertain, but the sum of the energies and the difference of their ages are both sharply defined. Look now at the two un- balanced interferometers and detectors on both sides of Fig. 2, which have replaced our abstract operations and measurements from Fig. 1, and consider the cases where both photons hit a detector simultaneously. Recalling that the photons were produced simultaneously, this can happen in two ways: both photons propagate through the short arm of their interferometers; or both take the long arms. If the imbalance of both interferometers is alike and much smaller than the pump laser coherence length, then these two paths are indistinguishable. According to quantum physics, one should thus add the probability amplitudes and expect interference effects. These are 2-photon interferences and have been used to violate

the Bell CHSH-inequality. This configuration is thus suitable for QKD, but it is not practical using today's technology, hence let's simplify it.

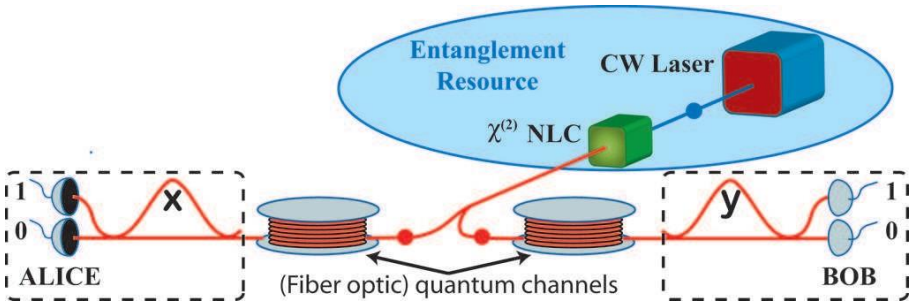

FIG. 2: The Franson interferometer for testing the energy- time entanglement of the entanglement resource (ER). The correlations between each of Alice and Bob's results **{**0,1**}** depends on both the phase measurement settings **{**x,y**}**.

First, let's move the source from the center to the emit- ter, as in Fig. 3a, thus limiting the number of sites to two. Now the photons don't arrive simultaneously at their detectors but, for an appropriate difference of arrival times, the same reasoning as above applies: one still has interferences between the short-short and the long- long 2-photon paths. The second simplification consists of moving the source to the left of Alice's interferometers, Fig. 3b. Now the two interfering paths are the short-long and long-short paths. As before, they are indistinguishable and thus lead to interferences, though now one of the two photons is not really used (except possibly as a herald). This leads to the third and major simplification: replace this 2-photon source with a simple weak laser pulse, Fig. 3c. The story about the interfering paths remains the same, but the source is now very simple and reliable: a standard telecom laser-diode with enough attenuation. The 60 to 100 dB attenuation (requiring a well calibrated attenuator) assures that only a very small fraction of the laser pulses contain more than one pho- ton. It is essential to understand that, provided this fraction of multi-photon pulses is known, the security of such weak laser pulse QKD system is in no way compromised. Moreover, using the recent idea of decoy states, weak laser pulse QKD obeys the same scaling law as ideal single-photon QKD.

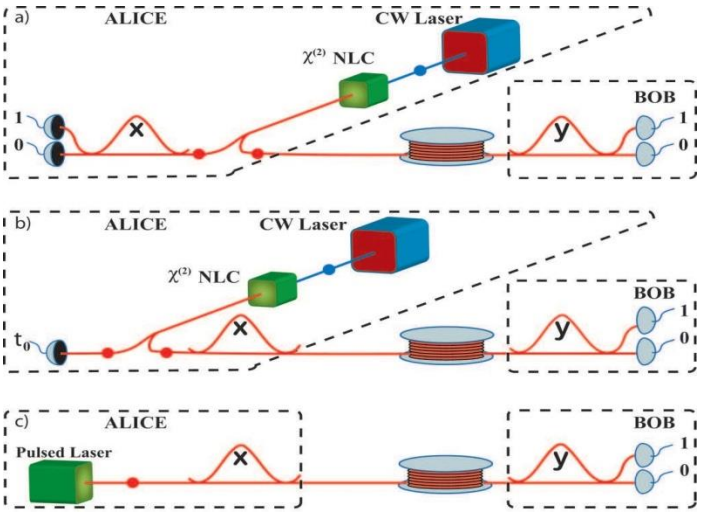

FIG. 3: Simplifying the Franson scheme: a) The ER from Fig. 2 is moved to Alice's side; b) The ER is placed before Alice's interferometer - the interfering paths are different but we don't need the extra photon except as a herald; c) Remove ER and replace single heralded photon with attenuated pulsed diode laser.

Today, all practical QKD systems use this simplification and the major challenge for QKD is the secret bit rate. Given that the source is not an issue, there remain two ways to improve this. First, we can make technical improvements, for example to the detectors whose maximal count rates are severely limited by dark counts and after-pulses, by using better In- GaAs APDs, up-conversion detection schemes or superconducting detectors. Second, the historical protocols, like BB84 and Ekert91, were invented for the sake of presenting a beautifully simple idea, but today's many new protocols have been designed with the aim of optimizing their implementation using weak laser or mesoscopic systems. It is likely that more efficient protocols are yet to be discovered by teams combining telecom engineers and quantum physicists.

SECURITY OF QKD

The intuition as to why QKD provides perfectly secret bits is quite straightforward (section II). However, the details of the proofs are very involved and many questions remain open, especially concerning optimality.

We would, however, like to highlight just a few key concepts. We can characterize bounds on the security by comparing Shannon's mutual information for Alice and Bob $I(A : B)$ and for Alice and an adversary, traditionally called Eve, $I(A : E)$. It is intuitive that if Bob has more information than Eve on Alice's data, $I(A : B) > I(A : E)$, then Alice and Bob can *distill* a secret key out of their data. This first intuition is, however, incomplete. Eve's information should, in full generality, be treated as quantum information: there is no way to know whether she per- formed measurements on her quantum systems (resulting in classical information) before the key is used. As our goal is to provide a secret key whose security does not rely on assumptions about Eve's technology, whether classical computer power or quantum technology, this remark has to be taken seriously. Fortunately, the quantum analog of Shannon's mutual information and its consequences have recently been resolved .

A second limitation to the above intuitive idea is the so called man-in-the-middle attack: how can Alice and Bob be sure they really talk to each other? The answer is known and requires that they start from an initial short common secret, so as to be able to recognize each other. It has been shown that QKD provides much more secret key than it consumes. In this sense, QKD should be called *Quantum key expansion*.

A third, less studied difficulty are side-channels: how can Alice be sure she doesn't inadvertently code more than one degree of freedom? For example, it might be that her phase modulator introduces a measurable distortion of the pulse envelope, in which case Eve could mea- sure the encoded bit indirectly and remain undetected. A related danger is Trojan horse attacks, in which Eve actively profits from the quantum channel (i.e. the optical fiber) to probe inside Alice and/or Bob's systems. Not too much is known to counter such attacks, except by emphasizing that real systems should be well characterized.

Before we end here, let us briefly elaborate on the widely used terminology *unconditionally secure*. Note that there is nothing like this: security proofs rely on assumptions and some assumptions are difficult to check in realistic systems. The historical reason for that terminology comes from classical cryptography where computer scientists use it to mean not conditioned on assumptions about the adversary's classical computation power", a meaning quite foreign to quantum physics.

QUANTUM TELEPORTATION

Quantum teleportation is the most fascinating manifestation of quantum non-locality: an "object" dissolves here and reappears at a distance! Well, not the entire object, "only" its quantum state, that is its ultimate structure, is transferred from here to there without ever existing at any intermediate location. The energy-matter must already be present at the receiver side and must be entangled with the transceiver. Quantum teleportation attracts a lot of attention from physicists and journalists, and rightly so. Mathematically, quantum teleportation is very simple, but understanding requires clarifying some often confused concepts concerning quantum non- locality.

The entire process requires 3 steps. Consider Fig. 4 where one first has the distribution of entanglement, usually photon pairs sent through optical fibers. The "quantum teleportation channel" is then established and in principle, one could remove the fibers. Next, the sender performs a so called Bell-State-Measurement (BSM) between his photon from the entangled pair and the qubit photon that carries the quantum state to be teleported. Technically, this is the most difficult step and usually only a partial BSM is realized. The BSM provides no information at all about the teleported state, but tells us something about the relationship between the two photons.

This ability to acquire information only about the relationship between two quantum systems is typical of quantum physics: it is another manifestation of entanglement, but in this case not present between the incoming photons to be measured. The entanglement lies in the eigenvectors of the operator representing the BSM. Hence, entanglement plays a dual role in teleportation. Finally, the third step consists of Alice informing Bob of the result of her BSM and Bob performing a result- dependent unitary rotation on his system. Only after this operation is the teleportation process finished. Note that the size of the classical information sent by Alice to Bob is infinitely smaller than the information required to give a classical description of the teleported quantum state, but it is the need for this message that ensures that teleportation is a sub-luminal process.

The BSM provides a fundamental limit to these experiments. It has been proven that no BSM with efficiency greater than 50% is achievable with linear optics. To perform these partial BSMs, the two photons should arrive on a beam-splitter simultaneously within their coherence time. Since single-photon detectors have a large timing jitter, the timing has so far always been set by bulky and expensive femto-second lasers. Moreover, the length of the optical fibers should be stabilized within a coherence length of the photons, typically a few tens of microns, an unrealistic requirement over tens of kilometers. Consequently, some of the next steps will require detectors with improved jitter as well as compact sources of entangled photons with significantly increased single-photon coherence. Alternatively, this limitation has been overcome in some experiments by using continuous variables or hyper entanglement, while others have used generalized quantum measurements to probabilistically distinguish 3 out of the 4 Bell states (it is an open question whether all 4 could be distinguished using passive linear optics). The intense interest in BSMs is due to the key role it plays not only in teleportation, but more importantly its role in long distance quantum communication and specifically entanglement swapping.

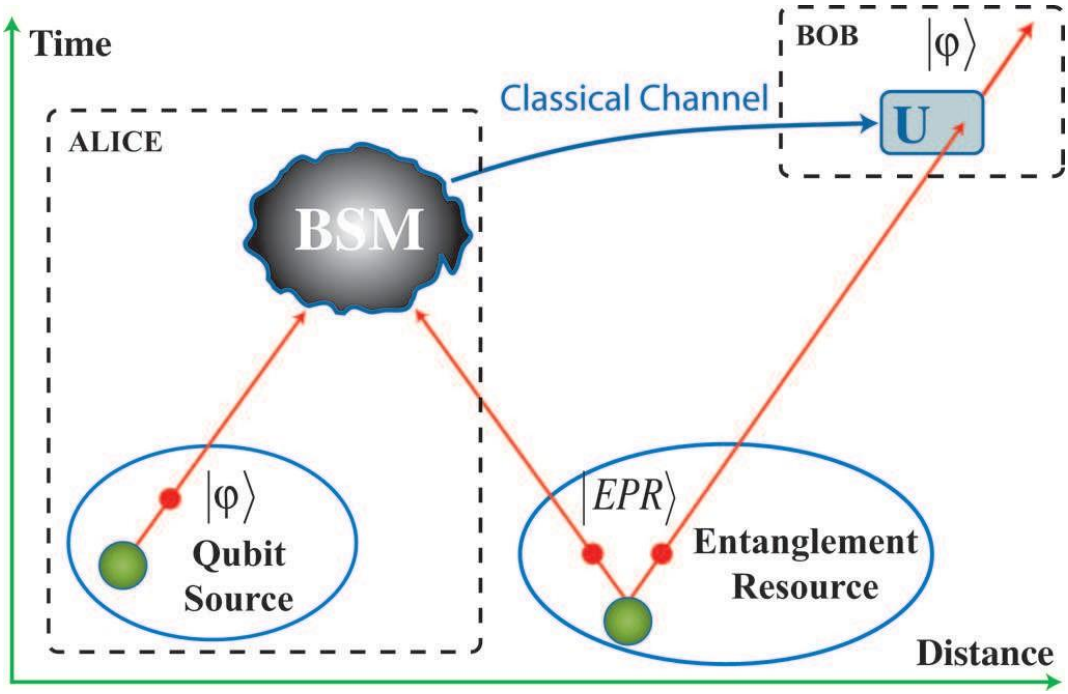

Fig4: Quantum teleportation. Alice performs a BSM, a joint measurement, on the unknown qubit $|\varphi\rangle$ and one photon from the entangled state $|EPR\rangle$. The result does not reveal the state of the qubit but is sent to Bob who performs a result-dependent operation U to complete the teleportation.

Cell Level Observation Using Wireless Sensor Device

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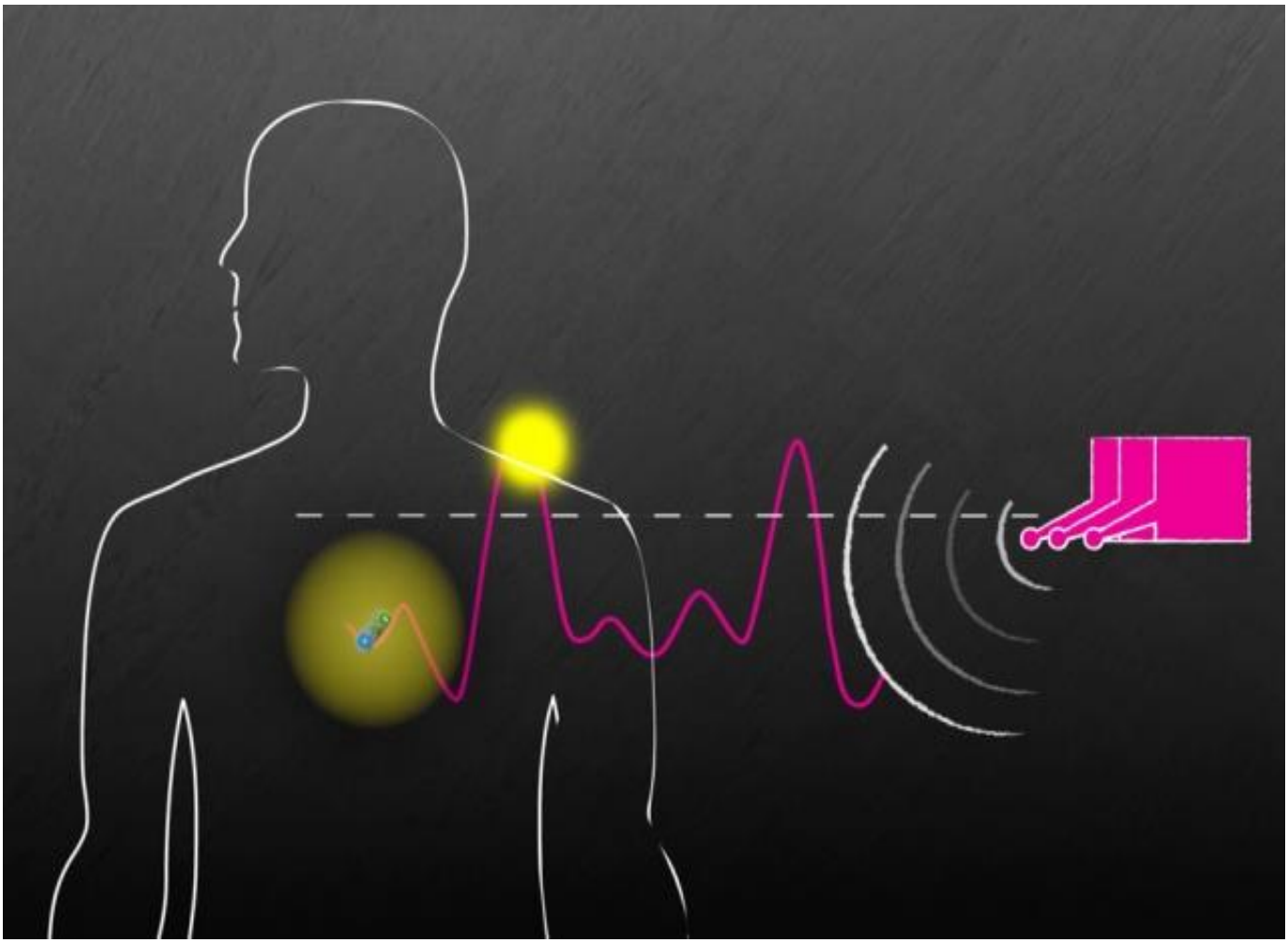
General Overview:

The smallest unit of human body is cell. Observe the activities of cells in a continuous way using wireless body sensor devices is that if any abnormality is found it can easily detect.

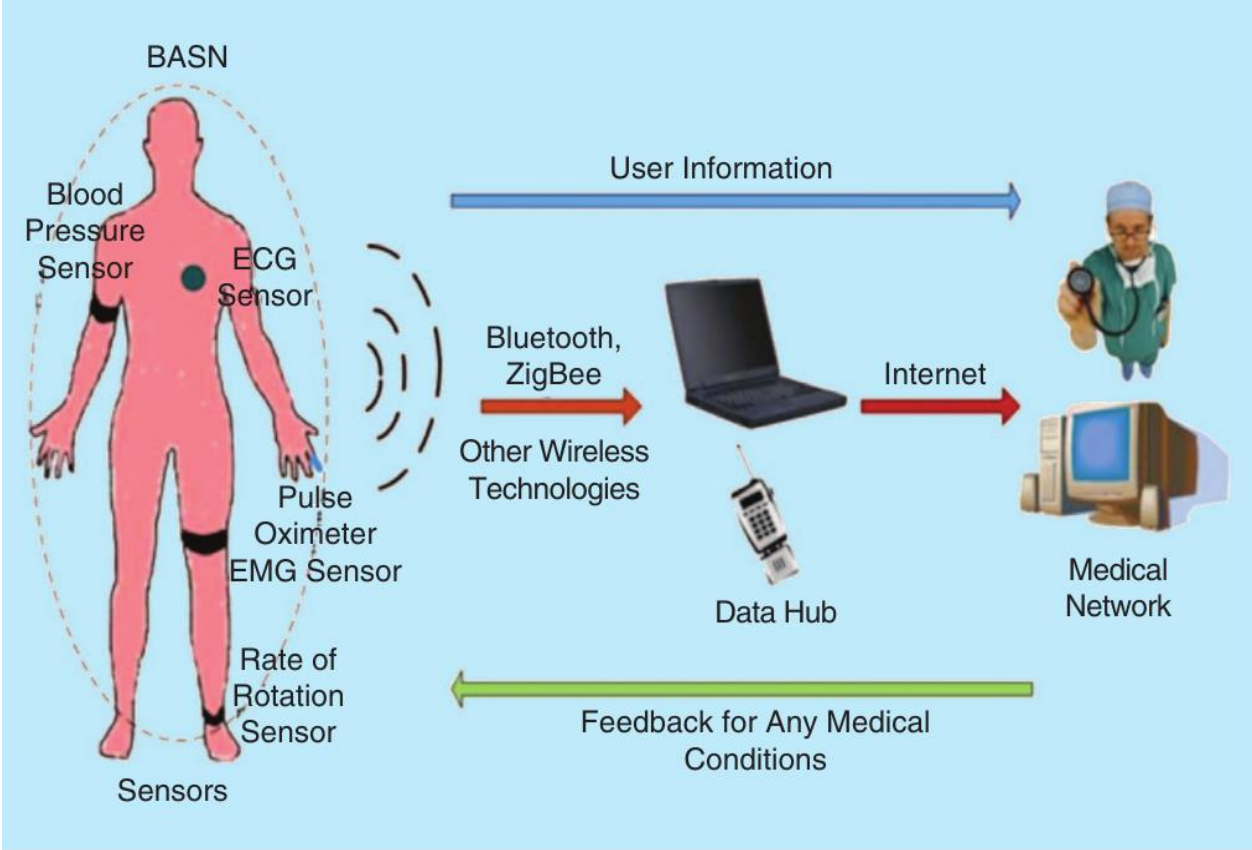
Wireless sensor network is one of the most important fields of study. In healthcare field, it is used to improve the quality of life. Wearable, epidermal and implantable body sensor devices are prominent application tools for continuous monitoring of a human body. In context of cancer biology, it is a complex paradigm to identify the causes and regular monitoring is required.



Functions of cells:

A cell is composed of various types of organelles that perform different functions such as metabolism, transportation and secretion of substances. Cells never stop growing and dividing but uncontrolled cell growth results in the formation of a tumour. If we consider cancer, cells have more genetic changes compared to normal cells.

Wireless sensor Technology:



Analysis: Monitoring of human body is necessary in a regular basis. If any abnormality is found, whether physical or chemical changes in a cell, immediate action is required to stop the further growth.

Wireless Sensor Network:

Wireless sensor network (WSN) refers to a group of spatially dispersed and dedicated sensors for monitoring and recording the physical conditions of the environment and organizing the collected data at a central location. WSNs measure environmental conditions like temperature, sound, pollution levels, humidity, wind, and so on. These are similar to wireless ad hoc networks in the sense that they rely on wireless connectivity and spontaneous formation of networks so that sensor data can be transported wirelessly.

WSNs are spatially distributed autonomous sensors to *monitor* physical or environmental conditions, such as temperature, sound, pressure, etc. and to cooperatively pass their data through the network to a main location. The more modern networks are bi-directional, also enabling *control* of sensor activity. The development of wireless sensor networks was motivated by military applications such as battlefield surveillance; today such networks are used in many industrial and consumer applications, such as industrial process monitoring and control, machine health monitoring, and so on.

The WSN is built of "nodes" – from a few to several hundreds or even thousands, where each node is connected to one (or sometimes several) sensors. Each such sensor network node has typically several parts: a radio transceiver with an internal antenna or connection to an external antenna, a microcontroller, an electronic circuit for interfacing with the sensors and an energy source, usually a battery or an embedded form of energy harvesting. A sensor node might vary in size from that of a shoebox down to the size of a grain of dust, although functioning "motes" of genuine microscopic dimensions have yet to be created. The cost of sensor nodes is similarly variable, ranging from a few to hundreds of dollars, depending on the complexity of the individual sensor nodes. Size and cost constraints on sensor nodes result in corresponding constraints on resources such as energy, memory, computational speed and communications bandwidth. The topology of the WSNs can vary from a simple star network to an advanced multi-hop wireless mesh network. The propagation technique between the hops of the network can be routing or flooding.

In computer science and Telecommunication fields wireless sensor networks are an active research area with numerous workshops and conferences arranged each year, for example IPSN, SenSys, and EWSN. As of 2010, wireless sensor networks have reached approximately 120 million remote units worldwide.

Application of Wireless Sensor Networks in Health Care System

Recent, advances in wireless networks and electronics have led to the emergence of Wireless Sensor networks (WSNs). WSNs have been considered as one of the most important technologies that can change the future. These networks consist of small battery–powered motes with limited computation and radio communication capabilities. Each sensor in a sensor network consists of three subsystems: the sensor subsystem which senses the environment, the processing subsystem which performs local computations on the sensed data, and the communication subsystem which is responsible for message exchanges with neighbouring sensors. WSNs comprise tiny wireless computers that sense, process, and communicate environmental stimuli, including temperature, light, and vibration. WSNs have been under rapid development and has become essential in such domains as industrial operations (factory, production, supply chains), health care (home monitoring, biomedical, food safety), environmental (agriculture, habitat preservation), infrastructure (energy, traffic and transportation, flood gauges, bridge stress, power grids, water distribution), and military, as well as for research and development. Advances in wireless sensor networking have opened up new opportunities in healthcare systems. Sensor-based technology has invaded medical devices to replace thousands of wires connected to these devices found in hospitals. This technology has the capability of providing reliability in addition to enhanced mobility. In the future, we will see the integration of a vast array of wireless networks into existing specialized medical technology.

"WSNs are composed of individual embedded systems that are capable of

1. interacting with their environment through various sensors,

2. processing information locally, and

3. communicating this information wirelessly with their neighbours.

"A sensor node (embedded system) usually consists of three components which are :

• Wireless modules or motes – key components of the network which consists of a microcontroller, transceiver, power source, memory unit, and may contain few sensors. Examples: Mica2, Cricket, MicaZ, Iris, TELUS, Sunspot, and Imote2.

• A sensor board which is mounted on the mote and is embedded with multiple types of sensors. Examples: MTS300/400 and MDA100/300.

• A programming board (gateway board) – provides multiple interfaces including Ethernet, WiFi, USB, or serial ports for connecting different motes to an enterprise or industrial network or locally to a PC/laptop. These boards are used to program the motes or gather data from them. Example: M1B510, M1B520, and M1B600.

In a wireless sensor network, tens, hundreds, or even thousands of sensor nodes are scattered throughout a physical environment. Each device is capable of monitoring- sensing-and/or displaying-actuating-information. A sensor node is capable of gathering sensory information, processing it in some manner, and communicating with other nodes in the network . When wireless sensor networks are designed for medical applications they are often referred to as wireless medical sensor networks (WMSNs). Wireless medical sensor networks have delivered significant improvements to the healthcare industry in the 21st century . Wireless medical sensors are arranged on a patient's body and can be used to closely monitor the physiological condition of patients. These medical sensors monitor the patient's vital body signs (e.g temperature, heart rate, blood pressure, oxygen saturation, etc.) and transmit the data in a timely fashion to some remote location without human intervention. A doctor can interpret these sensor readings to assess a patient's condition. Thus patients could benefit from continuous long-term monitoring after being discharged from the hospital . WMSNs will continue to play a central role in the future of modern healthcare as continuous and ubiquitous monitoring becomes increasingly important in order to shorten the amount of interaction needed between physicians and their patients to facilitate reduction of costs. The term wireless medical sensor networks was recently coined to unite researchers to form interdisciplinary teams with expertise in bioengineering, electronics, computer science and engineering, medicine, among others. Wireless medical sensor networks differ from traditional wireless sensor networks (WSNs). Traditional WSNs are independent and automatic, utilized in a large scale in either a fixed or distributed manner. Their data rates are limited by the applications. WMSNs, however, involve direct human involvement (i.e., patient, doctor, nurse, other providers, etc.), are utilized in a small scale (i.e., depending on usability), must support mobility in order for the patient to be able to carry the device, and demand high data rates, with reliable communication and multiple recipients. WMSNs carry the promise of quality-of-care across wide variety of healthcare applications as they can be wearable, implantable, portable, and integrated on many types of wireless communication motes . Wireless sensor networks have emerged as a feasible technology for a myriad of applications, including many different health care applications. WSN technology can be adapted for the design of practical Health Care WSNs (HCWSNs) that support the key system architecture requirements of reliable communication, node mobility support, multicast technology, energy efficiency, and the timely delivery of data .

The application of the Wireless Sensor Networks in healthcare systems can be divided into three categories:

1. Monitoring of patients in clinical settings
2. Home & elderly care centre monitoring for chronic and elderly patients
3. Collection of long-term databases of clinical data.

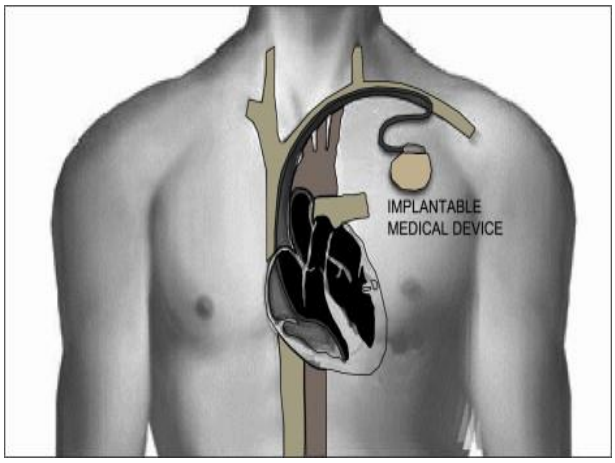
Various types of wireless sensor devices and their applications:

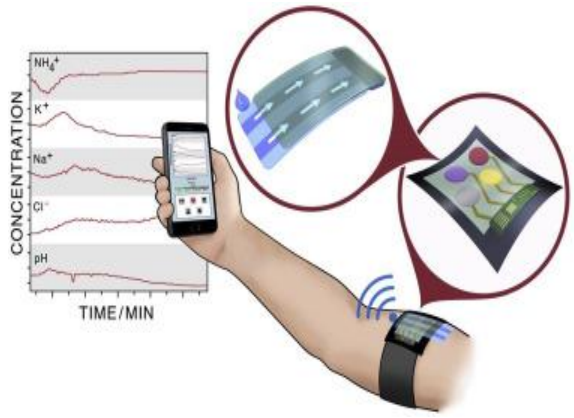
There are several types of sensor networks for medical applications: implanted, wearable, and environment-embedded. Implantable medical devices are those that are inserted inside the human body. Wearable devices are used on the body surface of a human or just at close proximity of the user. Environment-embedded systems employ sensors contained in the environment. Possible applications include body position measurement, location of persons, overall monitoring of ill patients in hospitals and at home. Devices embedded in the environment track the physical state of a person for continuous health diagnosis, using as input the data from a network of depth cameras, a sensing floor, or other similar devices. Body-area networks can collect information about an individual's health, fitness, and energy expenditure. In health care applications the privacy and authenticity of user data has prime importance. Especially due to the integration of sensor networks, with IoT, the user authentication becomes more challenging; however, a solution is presented in recent work.

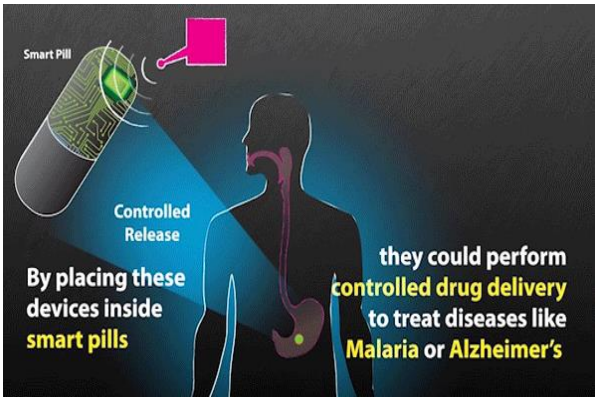
In order to provide optimal health status wireless body area networks (WBANs) are introduced. Heartbeat and respiration rate recording was implemented in using a wearable device .It is now commercially available.

While wearable and textile biomedical sensors are placed on the body using clothes, epidermal wireless sensor devices are placed on skin directly like tattoos. Functions of epidermal sensor devices span a wide range with temperature monitoring.

In case of implantable wireless devices are made of biocompatible materials which are placed in human body for continuous medical observations. They generate signals from the deep tissue level.







Methodology:

A wireless sensor device should be made that must be implemented in deep tissue level which can generate signals according to chemical activities of cells. These chemical activities are stored into database and compare these with normal cell activities.

Benefits:

The stored information will help doctors to easily detect the abnormality and take necessary steps to stop the further growth.

NON-CONVENTIONAL ENERGY

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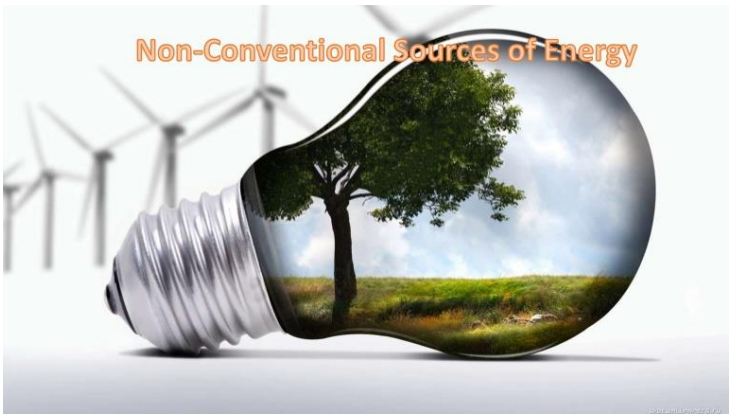
Technique Polytechnic Institute

INTRODUCTION:

Energy is the primary and most universal measure of all kinds work by human beings and nature. Everything what happens the world is the expression of flow of energy in one of its forms. Energy is the major input to drive the life cycle and improve it. Energy consumption is closely related to the progress of the mankind. In future, improvement in the living standard of the mankind, industrialization of the developing countries and the global demand for energy will increase with the every growing population. The development of infrastructure plays a significant role to sustain economic growth. The power sector is one of the major significant constituents of infrastructure. In general, India is dependent on conventional sources of energy like thermal, hydro and nuclear.

Non-conventional sources of Energy



Natural resources like wind, tides, solar, biomass, etc generate energy which is known as **"Non-conventional resources**". These are pollution free and hence we can use these to produce a clean form of energy without any wastage.

Need of non-conventional energy resources

As the consumption of energy grows, the population depends more and more on fossil fuels such as coal, oil and gas day by day. There is a need to secure the energy supply for future since the prices of gas and oil keep rising by each passing day. So we need to use more and more renewable sources of energy. For the effective exploitation of non-conventional sources, there has been an establishment of a separate

department namely "Department of non-conventional sources of energy" by the government of India. Renewable resources provide energy in four important areas like :

- Electricity generation
- Water heating or cooling
- Transporting
- Rural
- Types of Non-convention sources
- Solar Energy
- Wind Energy
- Tidal Energy
- Geothermal Energy
- Biomass

Solar energy

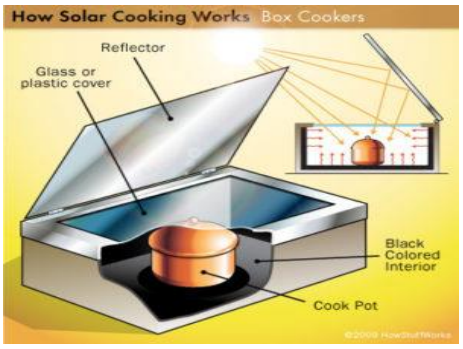
Solar energy is the most readily available and free source of energy since prehistoric times. It is estimated that solar energy equivalent to over 15,000 times the world's annual commercial energy consumption reaches the earth every year. Solar energy can be utilized through two different routes, as solar thermal route and solar electric (solar photovoltaic) routes. Solar thermal route uses the sun's heat to produce hot water or air, cook food, drying materials etc. Solar photovoltaic uses sun's heat to produce electricity for lighting home and building, running motors, pumps, electric appliances, and lighting. In solar thermal route, solar energy can be converted into thermal energy with the help of solar collectors and receivers known as solar thermal devices.

Uses of Solar energy

A solar cooker directs the solar heat into secondary reflector inside the kitchen, which focuses the heat to the bottom of the cooking vessel. It has a covering of a glass plate. They are applicable widely in areas of the developing world where deforestation is an issue, and financial resources to purchase fuel are not much

Solar heaters also use solar energy to heat water instead of using gas or electricity.

Solar cells also use solar power to generate electricity from the sun.

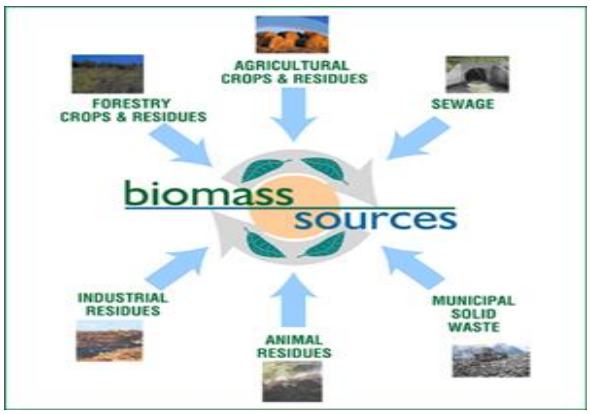


Wind energy

Wind energy is basically harnessing of wind power to produce electricity. The kinetic energy of the wind is converted to electrical energy. When solar radiation enters the earth's atmosphere, different regions of the atmosphere are heated to different degrees because of earth curvature. This heating is higher at the equator and lowest at the poles. Since air tends to flow from warmer to cooler regions, this causes what we call winds, and it is these airflows that are harnessed in windmills and wind turbines to produce power. Now wind power is harnessed to generate electricity in a larger scale with better technology.

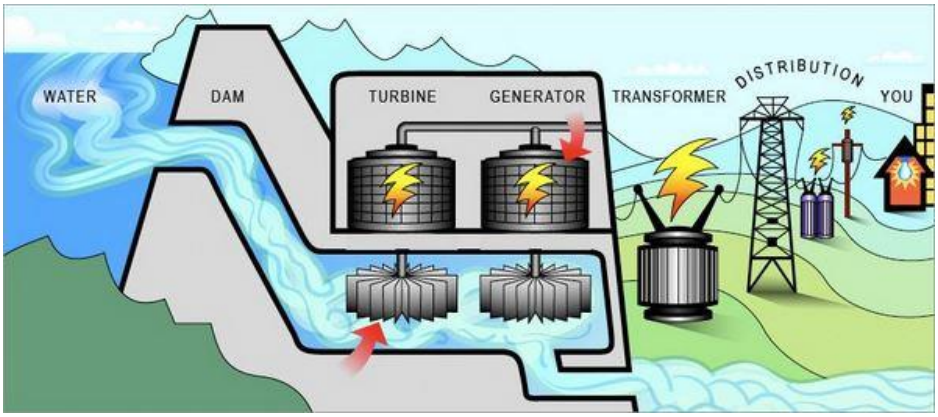
Bio energy

Bio-energy, in the form of biogas, which is derived from biomass, is expected to become one of the key energy resources for global sustainable development. Biomass is a renewable energy resource derived from the carbonaceous waste of various human and natural activities. Biomass does not add carbon dioxide to the atmosphere as it absorbs the same amount of carbon in growing as it releases when consumed as a fuel. Its advantage is that it can be used to generate electricity with the same equipment that is now being used for burning fossil fuels. Bio energy is being used for cooking, mechanical applications, pumping, power generation etc.



Hydro energy

The potential energy of falling water, captured and converted to mechanical energy by waterwheels, powered the start of the industrial revolution. Wherever sufficient head, or change in elevation, could be found, rivers and streams were dammed and mills were built. Water under pressure flows through a turbine and causes it to spin. The Turbine is connected to a generator, which produces electricity.



PRESENT STATUS OF NON-CONVENTIONAL ENERGY

In India, the Department of Non-Conventional Energy Sources (DNES) was created in the Ministry of Energy in the year of 1982 to look after all the aspects relating to new and renewable energy. The Department was upgraded into a separate Ministry of Non-Conventional Energy Sources (MNES) in 1992 and was rechristened as Ministry of New and Renewable Energy (MNRE) in October, 2006. As per the information furnished by MNRE, starting with the 9th Plan, there has been consistent increase in pace of renewable energy development. Reportedly, India's renewable energy installed capacity has grown at an

annual rate of 23%, rising from about 3900 MW in 2002-03 to about 24000 MW in 2011-12. Energy generated by using wind, solar, small hydro, tides, geothermal heat and biomass is known a non-

conventional energy. All these sources are renewable process of energy generation and do not cause environmental pollution. Our country has been endowed with adequate natural resource.

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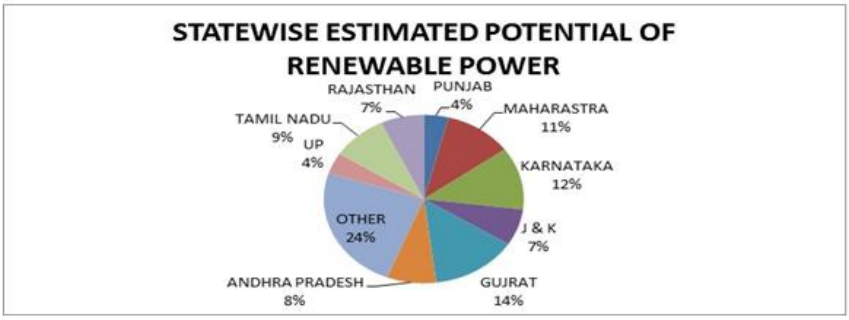

ADVANTAGES OF NON-CONVENTIONAL ENERGY TECHNOLOGIES

Non-conventional/renewable energy is an indigenous source available in considerable quantities to all developing nations and capable, in principle of having a significant local, regional or national economic impact.

There is a great scope of research and development in non-conventional/renewable energy sectors regarding its future development and scientific utilization.

The power plants based on renewable do not have any fuel cost and hence negligible running cost.

Renewable have low energy density and more or less there is no pollution or ecological balance problem. Provide energy in environmentally benign manner.

The use of non-conventional/renewable energy could help to conserve foreign exchange and generate local employment if conservation technologies are designed, manufactured, assembled and installed locally.

Short gestation period and low investment.

CONCLUSIONS

The sustainable economic development and growth of any country are closely related to the development and security of its energy sectors. Concerning the finite and limited reserves of conventional energy sources and their impact on environment, a great emphasis should be given to the development of non-conventional energy sectors and their proper utilization for the benefit and betterment of mankind. Such initiatives would also be helpful to create many employment opportunities at all levels, especially in rural areas. Thus, mainstreaming of non-conventional and renewable energy technologies is becoming very essential for the developing countries. In India, there is great scope for the development of non-conventional and renewable energy sectors. India is the only country that has an exclusive Ministry for New and Non-Conventional Energy Sources. India possesses the largest decentralized solar energy programme, the second largest biogas and improved stove programmes, and the fifth largest wind power programme in the world.

3D PRINTING TECHNOLOGY

Subham Das, Student of 2nd Year Electronics & Telecommunication Engineering
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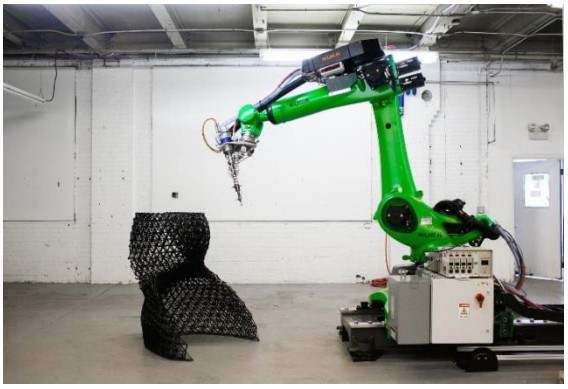
Introduction:

3D printing or additive manufacturing is a process of making three dimensional solid objects from a digital file.
The creation of a 3D printed object is achieved using additive processes. In an additive process an object is created by laying down successive layers of material until the object is created. Each of these layers can be seen as a thinly sliced horizontal cross-section of the eventual object.
3D printing is the opposite of subtractive manufacturing which is cutting out/hollowing out a piece of metal or plastic with for instance a milling machine.
3D printing enables you to produce complex shapes using less material than traditional manufacturing methods.

How does 3D Printing work?

It all starts with a 3D model. You create one yourself or download it from a 3D repository. When creating it yourself you can choose to use a 3D scanner, app, hap tic device, code or 3D modelling software.

3D Modelling Software



There are many different type 3D modelling software tools available. Industrial grade software can easily cost thousands a year per license, but there's also open source software you can get for free.
I often recommended beginners to start with Tinker cad. Tinker cad is free and works in your browser, you don't have to install it on your computer. Tinker cad offers beginner lessons and has a built-in feature to get your 3D model printed via a 3D print service.
Now that you have a 3D model, the next step is to prepare the file for your 3D printer. This is called slicing.
Slicing: From 3D Model to 3D Printer Slicing is dividing a 3D model into hundreds or thousands of horizontal layers and is done with slicing software.

Some 3D printers have a built-in slicer and let you feed the raw .stl, .obj or even CAD file.

When your file is sliced, it's ready to be fed to your 3D printer. This can be done via USB, SD or internet. Your sliced 3D model is now ready to be 3D printed layer by layer.

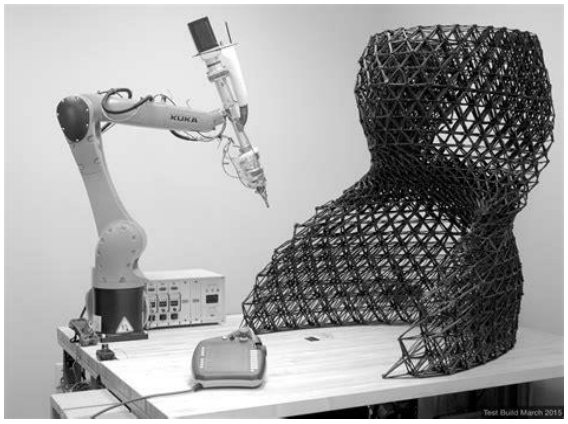
3D Printing Technology Industry

Adoption of 3D printing has reached critical mass as those who have yet to integrate additive manufacturing somewhere in their supply chain are now part of an ever-shrinking minority. Where 3D printing was only suitable for prototyping and one-off manufacturing in the early stages, it is now rapidly transforming into a production technology.

Most of the current demand for 3D printing is industrial in nature. Acumen Research and Consulting forecasts the global 3D printing market to reach $41 billion by 2026.

As it evolves, 3D printing technology is destined to transform almost every major industry and change the way we live, work, and play in the future.

Examples of 3D Printing



3D printing encompasses many forms of technologies and materials as 3D printing is being used in almost all industries you could think of. It's important to see it as a cluster of diverse industries with a myriad of different applications.

A few examples:

1) Dental Products
2) Eyewear
3) Architectural scale models & maquettes
4) Prosthetics
5) Movie Props
6) Design (lamps, furniture etc)
7) Reconstructing bones and body parts in forensic pathology
8) Reconstructing heavily damaged evidence retrieved from a crime scene

Future of 3D Printing Technology

In the current scenario, 3D printing or Additive Manufacturing has been used in manufacturing, medical, industry and socio cultural sectors which facilitate 3D printing or Additive Manufacturing to become successful commercial technology.

NANOTECHNOLOGY

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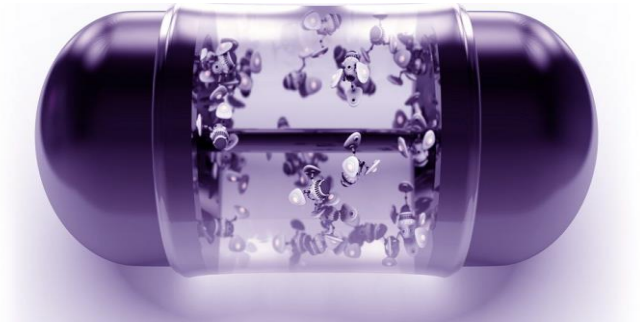
Definition of nanotechnology

so what exactly is *nanotechnology*? One of the problems facing this technology is the confusion about how to define nano technology . Most revolve around the study and control of phenomena and materials at length scales below 100 nm and quite often they make a comparison with a human hair, which is about 80,000 nm wide.

Nanotechnology is science, engineering, and technology conducted at the nanoscale, which is about 1 to 100 nano meter. Nanoscience and nanotechnology are the study and application of extremely small things and can be used across all the other science fields, such as chemistry, biology, physics, materials science, and engineering.

How it started

The ideas and concepts behind nanoscience and nanotechnology started with a talk entitled" There's plenty of room at the bottom " by physicist Richard Feynman at an American Physical Society meeting at the California Institute of Technology on December 29, 1959, long before the term nanotechnology was used. In his talk, Feynman described a process in which scientists would be able to manipulate and control individual atoms and molecules. Over a decade later, in his explorations of ultra precision machining, Professor Norio Taniguchi coined the term nanotechnology. It wasn't until 1981, with the development of the scanning tunnelling microscope that could "see" individual atoms, that modern nanotechnology began.



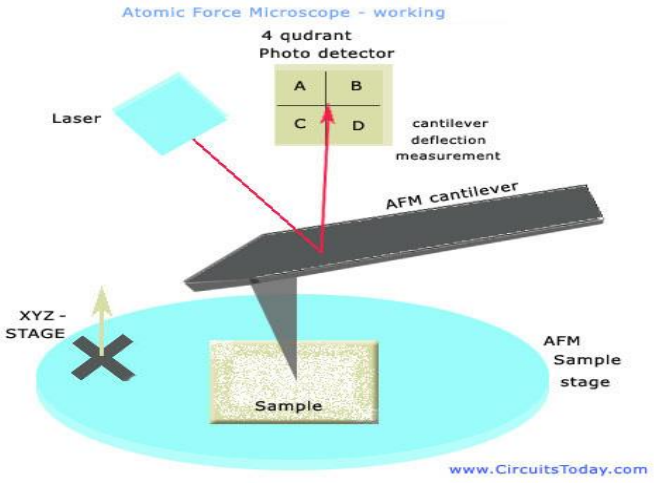
Fundamental concepts in nanotechnology and nanoscience

It's hard to imagine just how small nanotechnology is. One nanometre is a billionth of a meter, or 10-9 of a meter. Here are a few illustrative examples:
There are 25,400,000 nanometres in an inch
A sheet of newspaper is about 100,000 nanometres thick
On a comparative scale, if a marble were a nanometre, then one meter would be the size of the Earth
Nanoscience and nanotechnology involve the ability to see and to control individual atoms and molecules.

Everything on Earth is made up of atoms—the food we eat, the clothes we wear, the buildings and houses we live in, and our own bodies.
But something as small as an atom is impossible to see with the naked eye. In fact, it's impossible to see with the microscopes typically used in a high school science classes. The microscopes needed to see things at the nanoscale were invented relatively recently—about 30 years ago.
Once scientists had the right tools, such as the scanning tunnelling microscope (STM) and the atomic force microscope (AFM), the age of nanotechnology was born.
Although modern nanoscience and nanotechnology are quite new, nanoscale materials were used for centuries. Alternate-sized gold and silver particles created colors in the stained glass windows of medieval churches hundreds of years ago. The artists back then just didn't know that the process they used to create these beautiful works of art actually led to changes in the composition of the materials they were working with.
Today's scientists and engineers are finding a wide variety of ways to deliberately make materials at the nanoscale to take advantage of their enhanced properties such as higher strength, lighter weight, increased control of light spectrum, and greater chemical reactivity thantheir larger-scale counterparts.

Tools used in nanotechnology

There are several important modern developments. The ATOMIC FORCE MICROSCOPE (AFM) and the SCANNING TUNNELING MICEOSCOPE (STM) are two early versions of scanning probes that launched nanotechnology. There are other types of scanning probe microscopy. Although conceptually similar to the scanning confocal microscope developed by Marvin Minsky in 1961 and the scanning acoustic microscope (SAM) developed by Calvin Quate and co-workers in the 1970s, newer scanning probe microscopes have much higher resolution, since they are not limited by the wavelength of sound or light.



Applications

As of August 21, 2008, the Project on Emerging Nanotechnology estimates that over 800 manufacturer-identified nanotech products are publicly available, with new ones hitting the market at a pace of 3–4 per week. The project lists all of the products in a publicly accessible online database. Most applications are limited to the use of "first generation" passive nano materials which includes titanium dioxide in sunscreen, cosmetics, surface coatings, and some food products; Carbon allotropes used to produce gecko tape; silver in food packaging, clothing, disinfectants and household appliances; zinc oxide in sunscreens and cosmetics, surface coatings, paints and outdoor furniture varnishes; and cerium oxide as a fuel catalyst.

Further applications allow tennis balls to last longer, golf balls to fly straighter, and even bowling balls to become more durable and have a harder surface. trousers and socks have been infused with nanotechnology so that they will last longer and keep people cool in the summer. Bandeges are being infused with silver nanoparticles to heal cuts faster. video games and personals computers may become cheaper, faster, and contain more memory thanks to nanotechnology. Also, to build structures for on chip computing with light, for example on chip optical quantum information processing, and picoseconds transmission of information.

DIGITAL IMAGE PROCESSING

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Digital image processing means – processing digital image by means of a digital computer. We can also say that is use of a computer algorithms, in order to get enhanced image either to extract some useful information.

Image processing mainly including the following steps:

1. Importing the image via image acquisition tools;
2. Analyze and manipulating the image;
3. Output in which result can be altered image or a report which is based or a report which is based on analyzing that that image;

Image:

An image is defined as a two dimensional function, F(x, y), where x and y are spatial coordinates , and is called amplitude of F at any pair of coordinates (x, y) is called the intensity of that point. When x, y and amplitude values of F are finite , we call it a digital image.

In other words an image can be defined as a two dimensional array specially arranged in rows and columns. Digital image is composed of a finite number of elements, each and which elements have a particular location. These elements are referred to as picture elements, image elements and pixel elements. A pixel is most widely used to denote the elements of a digital image.

Types of an image:

1. Binary image- The binary image as its more suggests , contains only two digits pixel elements i.e. 0-stands for white and 1 stands for black. This is also called “monochrome”.
2. Black and white image- The image consists only black and white color.
3. 8 bit color format- It is the most famous format. It has 256 different shades of color in it and commonly known as Grayscale Image. Here 0 stands for black 255 stands for white and 127 stands for gray.
4. 16 bit color image format- It is a color image format It has 65536 different colors in it. It is also known as high color for format . A 16 bit format is divided into three further format which is red, green ,blue. It is called famous RGB format.

Image as a matrix:

$$f(x,y)=\begin{matrix} f(0,0)\ f(0,1)\ f(0,2)\ldots\ldots\ldots\ldots..f(0,n-1) \\ f(1,0)\ f(1,1)\ f(1,2)\ldots\ldots\ldots\ldots..f(1,n-1) \\ . \quad . \quad . \quad . \\ . \quad . \quad . \quad . \\ f(M-1,0)\ f(M-1,1)\ldots\ldots\ldots\ldots..f(M-1,n-1) \end{matrix}$$

Digital image representation in MATLAB:

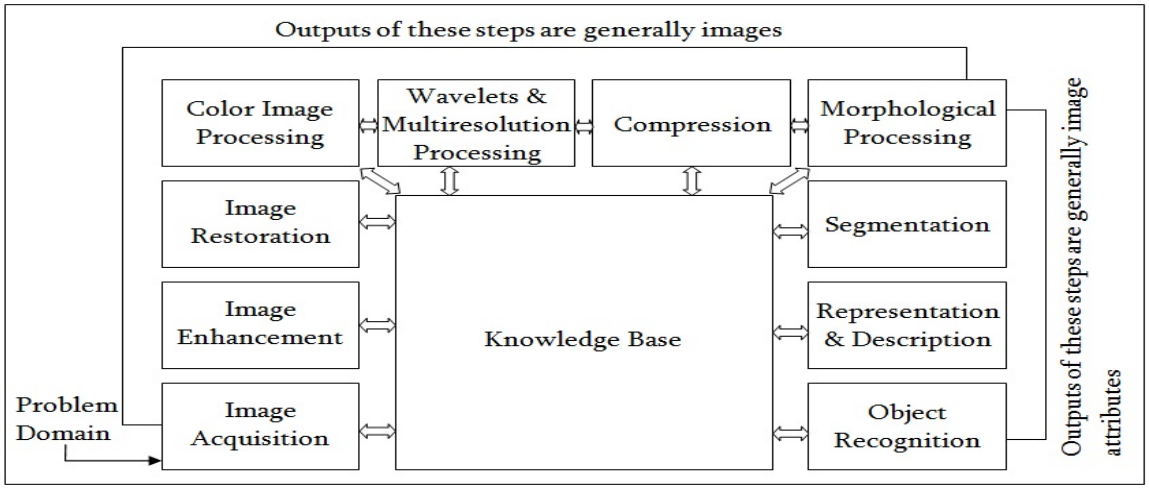
In MATLAB the start index is from 1 instead of 0. Therefore f(1,1)=f(0,0), hence the two representation of image are identical except for the shift in origin.

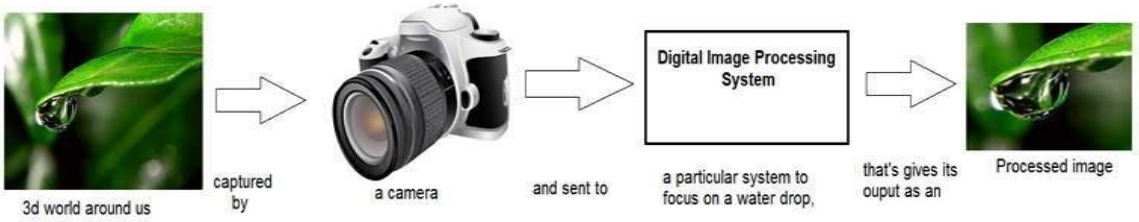
In MATLAB matrices are stored in a variable i.e. X, x input image and so on . The variables must be a letter as same as other programming language.

Phases of Image processing:

1. Acquisition- It could be as simple as being given an image which is in digital form. The main work involves – (a) scaling, (b) color conversion (RGB to gray or vice versa).
2. Image enhancement- It is the simplest and most appearing in areas of image processing it is also used to extract some hidden detail from an image and subject.
3. Image restoration- It also deals with appealing of an image but it is objective restoration based on mathematical or probabilistic model or image degradation.
4. Color image processing- It deals with pseudo color and full color image processing color models are applicable to digital image processing.
5. Wavelets and multicolor resolution processing- It is foundation of representing images in various degrees.
6. Image compression-It involves in developing some function to perform this operation. It mainly deals with image size or resolution.
7. Morphological processing – It deals with tools for extracting image components that are useful in the representation and description of shape.
8. Segmentation procedure- It deals with an includes partitioning an image into its constituent parts or objects. Autonomous segmentation is the most difficult task in image processing.
9. Representation and description- It follows output of segmentation stage, choosing a representation is only the part of solution for transforming raw data into process data.
10. Object detection and recognition- It is a process that assigns a label to an objects based on its descriptor.

Chart of Digital image processing:





SPEECH RECOGNITION AND SPEECH RECOGNITION SYSTEM

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INTRODUCTION

Speech recognition is the ability of a machine or program to identify words and phrases in spoken language and convert them to a machine-readable format. Rudimentary *speech recognition* software has a limited vocabulary of words and phrases, and it may only identify these if they are spoken very clearly.

Speech recognition is the capability of an electronic device to understand spoken words. A microphone records a person's voice and the hardware converts the signal from analog sound waves to digital audio. The audio data is then processed by software, which interprets the sound as individual words.

History

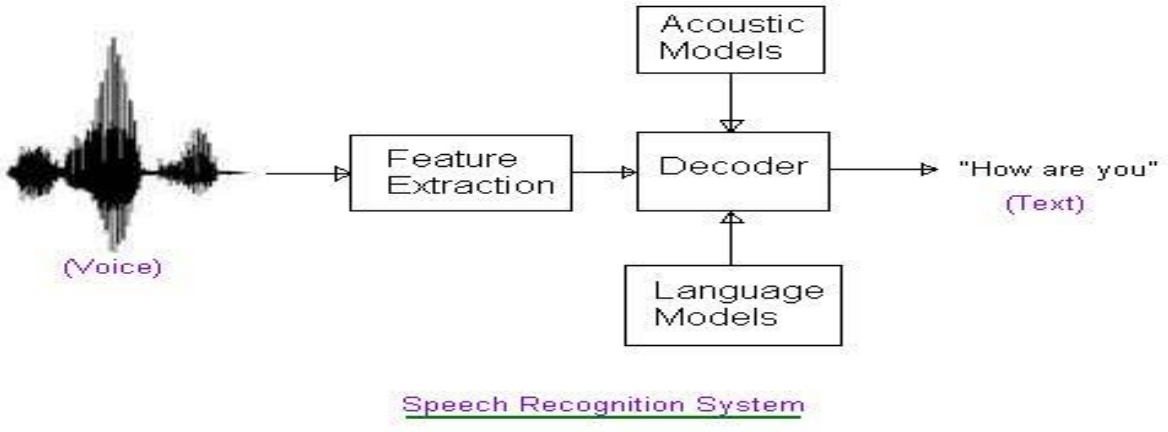
The first speech recognition systems were focused on numbers, not words. In 1952, Bell Laboratories designed the "Audrey" system which could recognize a single voice speaking digits aloud. Ten years later, IBM introduced "Shoebox" which understood and responded to 16 words in English. Speech recognition made several meaningful advancements in this decade. This was mostly due to the US Department of Defence and DARPA. The Speech Understanding Research (SUR) program they ran was one of the largest of its kind in the history of speech recognition. Carnegie Mellon's "Harpy' speech system came from this program and was capable of understanding over 1,000 words which is about the same as a three-year-Olds vocabulary. The '80s saw speech recognition vocabulary go from a few hundred words to several thousand words Speech recognition was propelled forward in the 90s in large part because of the personal computer. Faster processors made it possible for software like Dragon Dictate to become more widely used. In 2011 Apple launched Siri which was similar to Google's Voice Search. The early part of this decade saw an explosion of other voice recognition apps. And with Amazon's Alexa, Google Home we've seen consumers becoming more and more comfortable talking to machines. The technology to support voice applications is now both relatively inexpensive and powerful. With the advancements in artificial intelligence and the increasing amounts of speech data that can be easily mined, it is very possible that voice becomes the next dominant interface.

If we want to make a speech recognition system then we need some hardware that is Arduino board, voice recognition module, USB to TTL module, servo motor, LED, jump wires and we need some software access point for windows user, cool term for MAC user.

Some speech recognizer apps for smart phones is Google mobile apps (for android, BlackBerry, iOS),Bing (for android, iOS), Vlingo(for android, blackberry, iOS, Nokia, windows),Siri Assistant (for iOS)

The top five uses of speech recognition technology

- Playing back simple information
- Call steering
- Automated identification
- Removing IVR menus
- Dealing with spikes in call volumes



Speech Recognition System

1. Playing back simple information

If you have customers who need fast access to information.

In many circumstances customers do not actually need or want to speak to a live operator. For example, if they have little time or they only require basic information then speech recognition can be used to cut waiting times and provide customers with the information they want.

By deploying an intelligent speech recognition system, Dublin Airport was able to cope with a 30 per cent rise in passenger numbers without the need to increase staff levels.

Incoming customer calls are filtered according to requirements and those wanting basic information, say on ‘departures’ or ‘arrivals’, are automatically directed to the speech recognition system that quickly evaluates the nature of the enquiry through a series of prompts. At all times there is an option to speak with a live operator, if necessary. The system has been fine-tuned to pick up the vagaries of the Irish accent.

The average call time has been reduced to just 53 seconds, freeing up skilled agents for more complex calls.

2. Call steering

Putting callers through to the right department.

Waiting in a queue to get through to an operator or, worse still, finally being put through to the wrong operator can be very frustrating to your customer, resulting in dissatisfaction. By applying speech recognition, you can allow callers to choose a 'self-service' route or alternatively 'say' what they want and be directed to the correct department or individual.

Standard Life is using speech recognition for its Life and Pensions business. The solution helps in three ways: it ascertains what the call is about, if necessary it takes the customer through security checks and then transfers the customer to the appropriate member of staff. The details that the customer has already provided appear on the screen so that they do not have to repeat the information.

Using this technology Standard Life increased its overall call handling capacity by over 25 per cent and reduced their misdirected calls by 66 per cent. The system also gives them a better understanding of why customers are calling, because it allows the customer to 'voice' their request rather than forcing them to conform to an organisation's preconceptions on what the customer wants.

3. Automated identification

Where you need to authenticate someone's identity on the phone without using 'risky' personal data.

Identity fraud is now one of the biggest concerns facing UK organisations and research by the UK's fraud prevention service (CIFAS) estimates that it is costing the UK £1.7bn a year. Some advanced speech recognition systems provide an answer to this problem using voice biometrics. This technology is now accepted as a major tool in combating telephone-based crime.

On average it takes less than two minutes to create a 'voiceprint' based on specific text such as 'Name' and 'Account Number'. This is then stored against the individual's record, so when they next call, they can simply say their name and if the voiceprint matches what they have stored, then the person is put straight through to a customer service representative. This takes less than 30 seconds and also bypasses the need for the individual to have to run through a series of tedious ID checks such as passwords, address details and so on.

Australia's 8th largest insurers, ahm Health Management is successfully using voice biometrics to allow existing account holders to speak to customer service representatives quickly and securely. The company has enrolled more than 20,000 customers' voiceprints.

4. Removing IVR menus

Replacing complicated and often frustrating 'push button' IVR.

Due to poorly implemented systems, IVR and automated call handling systems are often unpopular with customers. However, there is a way to improve this scenario. Termed 'intelligent call steering' (ICS), it

does not involve any 'button pushing'. The system simply asks the customer what they want (in their words, not yours) and then transfers them to the most suitable resource to handle their call.

Callers dial one number and are greeted by the message "Welcome to XYZ Company, how can I help you?" The caller is routed to the right agent within 20 to 30 seconds of the call being answered with misdirected calls reduced to as low as 3-5 per cent.

By introducing Natural Language Speech Recognition (NLSR), general insurance company Suncorp replaced its original push button IVR, enabling the customer to simply say what they wanted.

Using a financial services' statistical language model of over 100,000 phrases, the system can more accurately assess the nature of the call and transfer it first time to the appropriate department or advisor. The company reduced its call waiting times to around 30 seconds and misdirected calls to virtually nil.

5. Dealing with spikes in call volumes

You need to handle high volumes of customer service enquiries from repeat customers.

The betting industry is an example of a business that has very high volumes of calls from regular 'punters', most of which occur in irregular peaks and troughs. During a normal day, races occur every ten minutes with 80 per cent of calls occurring minutes before each race. To overcome this problem Ladbrokes was able to divert the calls depending simply on their nature, e.g. placing a bet, asking for odds, which were both handled automatically, or for more complex 'customised' bets they could speak directly to an operator. The system is effective on all race days, but on big race days such as The Grand National or The Cheltenham Gold Cup it enables the company to increase the capacity of its call centres without the need to add additional staff. A large database of over 40,000 registered horses and 6,000 football players are part of an extensive database that is updated in real time.

Job done by SRS

Speech recognition applications include voice user interfaces such as voice dialling (e.g. "call home"), call routing (e.g. "I would like to make a collect call"), domestic appliance control, search key words (e.g. find a podcast where particular words were spoken), simple data entry (e.g., entering a credit card number) etc.

BIG DATA

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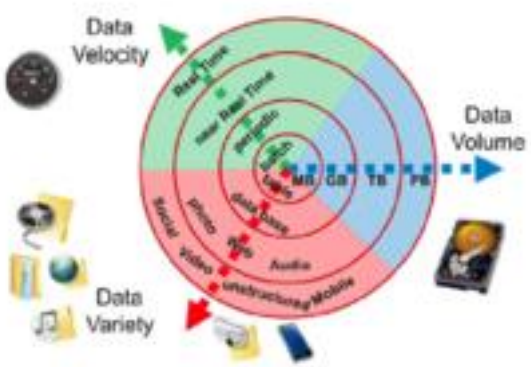
Definition

The term has been in use since the 1990s, with some giving credit to John Mashey for popularizing the term. Big data usually includes data sets with sizes beyond the ability of commonly used software tools to capture, curate, manage, and process data within a tolerable elapsed time. Big data philosophy encompasses unstructured, semi-structured and structured data, however the main focus is on unstructured data. Big data "size" is a constantly moving target, as of 2012 ranging from a few dozen terabytes to many zettabytes of data. Big data requires a set of techniques and technologies with new forms of integration to reveal insights from data-sets that are diverse, complex, and of a massive scale.

Characteristics



Shows the growth of big data's primary characteristics of volume, velocity, and variety
Big data can be described by the following characteristics:

Volume:

The quantity of generated and stored data. The size of the data determines the value and potential insight, and whether it can be considered big data or not.

Variety:

The type and nature of the data. This helps people who analyze it to effectively use the resulting insight. Big data draws from text, images, audio, video; plus it completes missing pieces through data fusion.

Velocity:

The speed at which the data is generated and processed to meet the demands and challenges that lie in the path of growth and development. Big data is often available in real-time. Compared to

small data, big data are produced more continually. Two kinds of velocity related to big data are the frequency of generation and the frequency of handling, recording, and publishing.

Veracity:

It is the extended definition for big data, which refers to the data quality and the data value. The data quality of captured data can vary greatly, affecting the accurate analysis.

Technologies

A 2011 McKinsey Global Institute report characterizes the main components and ecosystem of big data as follows:

- Techniques for analyzing data, such as A/B testing, machine learning and natural language processing
- Big data technologies, like business intelligence, cloud computing and databases
- Visualization, such as charts, graphs and other displays of the data

Multidimensional big data can also be represented as data cubes or, mathematically, tensors. Array Database Systems have set out to provide storage and high-level query support on this data type. Additional technologies being applied to big data include efficient tensor-based computation, such as multilinear subspace learning., massively parallel-processing (MPP) databases, search-based applications, data mining, distributed file systems, distributed cache (e.g., burst buffer and Memcached), distributed databases, cloud and HPC-based infrastructure (applications, storage and computing resources) and the Internet. Although, many approaches and technologies have been developed, it still remains difficult to carry out machine learning with big data.

Some MPP relational databases have the ability to store and manage petabytes of data. Implicit is the ability to load, monitor, back up, and optimize the use of the large data tables in the RDBMS.

Applications

Bus wrapped with SAP Big data parked outside IDF13

Big data has increased the demand of information management specialists so much so that Software AG, Oracle Corporation, IBM, Microsoft, SAP, EMC, HP and Dell have spent more than $15 billion on software firms specializing in data management and analytics. In 2010, this industry was worth more than

$100 billion and was growing at almost 10 percent a year: about twice as fast as the software business as a whole.

Developed economies increasingly use data-intensive technologies. There are 4.6 billion mobile-phone subscriptions worldwide, and between 1 billion and 2 billion people accessing the internet. Between 1990 and 2005, more than 1 billion people worldwide entered the middle class, which means more people became more literate, which in turn led to information growth. The world's effective capacity to exchange information through telecommunication networks was 281 petabytes in 1986, 471 petabytes in 1993, 2.2 Exabyte's in 2000, 65 Exabyte's in 2007 and predictions put the amount of internet traffic at 667 Exabyte's annually by 2014. According to one estimate, one-third of the globally stored information is in the form of alphanumeric text and still image data, which is the format most useful for most big data applications. This also shows the potential of yet unused data (i.e. in the form of video and audio content).

RASPBERRY PI

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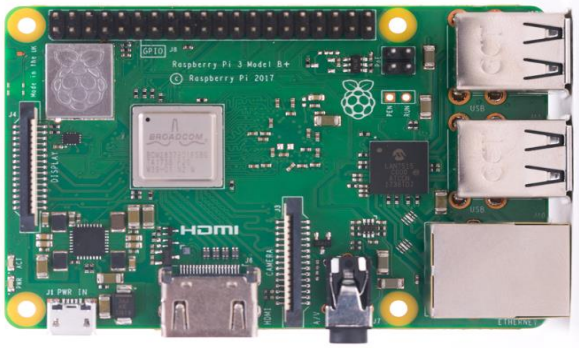
INTRODUCTION:

The Raspberry Pi is a low cost, credit-card sized computer that plugs into a computer monitor or TV, and uses a standard keyboard and mouse. It is a capable little device that enables people of all ages to explore computing, and to learn how to program in languages like Scratch and Python.



WORKING OF RASPBERRY PI

The allure of the Raspberry Pi comes from a combination of the computer's small size and affordable price. Enthusiasts envision using the small form-factor PC as a cheap home theatre PC (HTPC), or secondary low-power desktop. Institutions, like schools and businesses, could benefit from deploying a fleet of computers for a fraction of the cost of traditional desktop towers. The small size makes for an easy-to-hide computer that sips power and can be mounted behind the display with an appropriate case. It could also be used in niche applications, like digital signage. While it will not blow away any recent hardware in performance, it does make for a cheap secondary computer which could be useful for troubleshooting and researching solutions and boot as well.

GENERATIONS OF RASPBERRY PI

Several generations of Raspberry Pi have been released. All models feature a unit (CPU) and on chip graphics processing unit (GPU).Processor speed ranges from 700 MHz to 1.4 GHz for the Pi 3 Model B+ or 1.5 GHz for the Pi 4; on-board memory ranges Broadcom on a chip (SoC) with an integrated ARM compatible central processing from 256 MB to 1 GB random access memory (RAM), with up to 4 GB available on the Pi 4

The first generation (**Raspberry Pi 1 Model B**) was released in February 2012, followed by the simpler

and cheaper **Model A**. In 2014, the Foundation released a board with an improved design, **Raspberry Pi 1 Model B+**. These boards are approximately credit-card sized and represent the standard *mainline* form-factor. Improved A+ and B+ models were released a year later. A compute model was released in April 2014 for embedded applications. The **Raspberry Pi 2**, which added more RAM, was released in February 2015.

A **Raspberry Pi Zero** with smaller size and reduced input/output (I/O) and general purpose input/output (GPIO) capabilities was released in November 2015. By 2017, it became the newest mainline Raspberry Pi. On 28 February 2017, the **Raspberry Pi Zero W** was launched, a version of the Zero with Wi-Fi and Bluetooth capabilities, On 12 January 2018, the **Raspberry Pi Zero WH** was launched, a version of the Zero W with pre-soldered GPIO headers. **Raspberry Pi 3 Model B** was released in February 2016 with a 1.2 GHz 64-bit guard core processor, Bluetooth and USB boot capabilities. On 2018 the **Raspberry Pi 3 Model B+** was launched with a faster 1.4 GHz processor and a three-times faster gigabyte Ethernet.

Raspberry Pi 4 Model B was released in June 2019 with a 1.5 GHz 64-bit quad core ARM coretex A72 processor, on-board 802.11ac WIFI, Bluetooth, full gigabyte Ethernet. The Pi 4 is also powered via a USB C port, enabling additional power to be provided to downstream peripherals, when used with an appropriate PSU. Three sizes of onboard RAM are available: 1 GB ,2 GB, 4 GB.

THE RASPBERRY PI COMPONENTS

- ARM CPU/GPU -- This is a Broadcom BCM2835 System on a Chip (SoC) that's made up of an ARM central processing unit (CPU) and aVideocore 4 graphics processing unit (GPU). ...
- GPIO -- These are exposed general-purpose input/output connection points that will allow the real hardware hobbyists the opportunity to tinker

ADVANTAGES OF RASPBERRY PI

Because, it keeps its operating system, documents and programs. If your **raspberry pi** did not come with an SD card, then the min size you should get is 4GB. **Advantages** of the **raspberry pi** is, it is small in size, and it works as a normal computer at low cost server to handle web traffic

DISADVANTAGES OF RASPBERRY PI

It does not replace your computer, since the Ethernet is only a 10/100 and the processor is not as fast, it is time consuming to download and install software and is unable to do any complex multitasking.

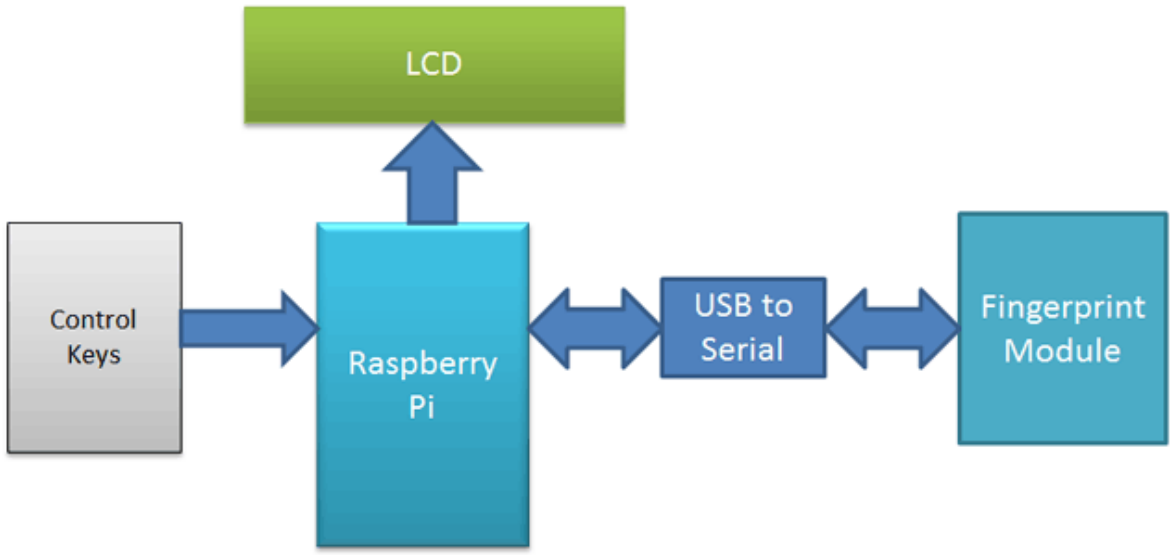
OPERATING SYSTEMS USED IN RASPBERRY PI

Raspbian. Raspbian is a Debian-based engineered especially for the Raspberry Pi and it is the perfect general-purpose OS for Raspberry users. ...
OSMC.
Open ELEC.
RISC OS.
Windows IoT Core.
Lakka. ...
Rasp BSD.
Retro Pie.

APPLICATIONS

The **raspberry pi** boards are used in many **applications** like Media streamer, Arcade machine, Tablet computer, Home automation, Carputer, Internet radio, Controlling, robots, Cosmic Computer, hunting for meteorites, and also in **raspberry pi** based projects.

BLOCK DIAGRAM OF RASPBERRY PI



VOLTE

Anubhab Chowdhury, Student of 3rd Year Electronics & Telecommunication Engineering
Technique Polytechnic Institute

What is volte?

Volte, an acronym for "**Video over** LTE", is a conversational (i.e. person to person) video service based on the IP Multimedia Subsystem (IMS) core network like Volte. It has specific profiles for the control and Volte of the video service and uses LTE as the radio access medium. The service as a whole is governed by the GSM Association in PRD IR.94.

How it works?

ViLTE uses the same control plane protocol as Voice over LTE (Volte), namely the Session Initiation Protocol (SIP). The IMS core network along with the applicable Application Server (AS) performs the call control. ViLTE uses the H.264 codec to encode and decode the video stream. The H.264 codec delivers superior quality as compared to the low bit rate 3G-324M codec that is used in 3G conversational video calls.

It is vital that ViLTE video calls are allocated appropriate quality of service (QoS) to differentiate and prioritize this delay and jitter sensitive conversational traffic from other streaming video traffic that is not as delay or jitter sensitive. The mechanism used is called QoS Class Identifier (QCI). The ViLTE bearer traffic is typically allocated QCI=2, and the SIP-based IMS signalling QCI=5.

As of February 2019 the Global Mobile Suppliers Association had identified 257 devices, virtually all of them phones, supporting ViLTE technology. By August, continued momentum had seen the number of identified devices increase to 390.

Many of the world's largest handset vendors now have ViLTE capable devices on the market. As of August 2019, ViLTE devices were offered by 46 vendors/brands including Askey, BBK Electronics, Blackberry, Casper, Celkon, CENTRiC, Comio, Foxconn, General Mobile, GiONEE, HMD, HTC, Huaquin Telecom Technology, Huawei, Infinix, Infocus, Intex, Intel, Karbonn, Kult, Lanix, Lava, Lenovo, LG, LYF (Reliance Digital), Micromax, Mobiistar, Motorola, Panasonic, Reach, Samsung, Sonim, Sony Mobile, Spice Devices, Swipe Technologies, TCL, Tecno, Vestel, Xiaomi, YU (Micromax), Yulong Computer, Ziox, and ZTE. iPhones TM don't support ViLTE.

Application of volte:-

Voice over LTE (Volte) is an emerging standard which uses IMS to carry voice as a packet-based service on the 4G data network. Volte promises a better service experience for mobile subscribers while reducing load on an operator's legacy network.

WHAT IS LTE?

LTE (stands for Long-Term Evolution and frequently known as 4G LTE) is now current common and most used network technology in India, and it is considered the evolutionary step from the both CDMA and GSM standards. LTE is also widely considered 4th generation of networking technology, which stands for the "4G" designation. LTE is protocol over where data is being transferred, and at the now it is the fastest and most available data transfer platform for all customers. It's also the fast becoming and the most dominant technology.

What is the difference between 4g LTE &Volte?

LTE(Long Term Evolution) is a mobile Internet technology standard. Since we hold a tradition of representing mobile technology in generations, we call it as 4th generation Mobile technology. 4G is just a common name given to LTE. This is primarily designed only for data .

Theoretically, LTE supports download speed of 100 Mbps and upload speed of 50 Mbps. One more variant of LTE is LTE-Advanced, which supports download speed of 1 Gbps and upload speed of 500Mbps.

LTE is considered a technological evolution on both GSM and CDMA protocols which we are using from several years. Nowadays, LTE is fast becoming available across the globe and mobile Internet Service Providers are upgrading their networks from 3G to 4G. LTE is at present the fastest data transfer technology and soon it may become the most dominant among all the mobile Internet technologies which are being used.

Volte (Voice over LTE) Volte is a technology where simultaneously you can send voice and data over the network. So, we can say this is designed for both voice and data traffic. In LTE, if you make a voice call and you also keep your data connection on, the quality of voice will reduce. So, in order to make a good quality voice call, you will have to switch off data. In 3G, while you are making phone call, to preserve voice quality some phones will automatically stop data services.

But in case of Volte, the voice quality will not reduce even if your data connection is on. With Volte it is very easy to transmit telephone conversation over the data network. Compared to LTE ,Volte has better advantages.

WEAPON DETECTING

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For defence purposes, the military has an ongoing interest in reliably detecting the firing of small arms weapons and the launching of larger weapons such as rocket propelled grenades (RPGs), mortars, tanks, artillery, rockets, and missiles. Optical, Infrared (IR), and acoustic sensors exist today that can detect these weapons. However, these detection methods have not always proven reliable and do not work as well during obscured environmental conditions caused clouds, fog, dust, and rain. Passive Radio Frequency (RF) detection of these weapons could provide a benefit over other methods by providing fast detection through obscured environments over extended ranges. Since 2003, we have developed and deployed sensors capable of recording and analyzing RF emissions acquired during small arms gunfire and during the launching of the larger weapons. The basic phenomenology depends on the type of weapon, but we have shown that RF detection of these events is possible.

In the increasingly digitized world, security is more and more of a pervasive threat to both private and public safety. In response, many companies are leveraging artificial intelligence technology to keep threats in check via surveillance monitoring and weapons detection. A report from **Markets and Markets for** instance, finds that global AI in the security market is projected to grow from $2.99 billion in 2016 to $34.81 billion in 2025 with a compound annual growth rate (CAGR) of 31.38 percent in the forecast period.

A recent article from **Zacks.com**, looking at AI in defence and police surveillance, outlined how global tech leader Google employed AI technology in its Maven drone project, established in 2017. Maven analyzes the copious amount of footage gathered by US drones by utilizing Google's Tensor Flow AI technology and machine learning APIs.

VSBLTY Group Technologies Corp. (**CSE:VSBY**) (Frankfurt 5VS) is a company that uses machine learning and computer vision to provide facial recognition and weapon detection capabilities. Recently **joining** the tech company portfolio of security firm Muller Group International (MGI), VSBLTY has extended its range to untapped markets. VSBLTY Co-Founder and CEO Jay Hutton said:

"With more and more so-called soft targets being attacked around the world, heightened security is needed virtually everywhere. In most instances, our face-on cameras provide better facial recognition than overhead CCTV cameras to enable faster, professional security responses to threats. With this partnership with MGI we are advancing the increasingly important ability to provide security where it has never been available before."

Patriot One Technologies Inc. (**TSXV:PAT**) (**OTCQX: PTOTF**), developer of the award-winning PATSCAN covert weapon detection system, last year acquired AI-powered safety and surveillance company EhEye's Inc. Regarding the **acquisition**, Patriot One CEO and President, Martin Cronin explained how EhEye's video threat recognition software was a perfect fit for the company.

"Their award-winning threat recognition software will integrate into our client's existing video camera networks offering a first line of defence to detect active shooters or terrorists approaching a venue with weapons drawn. It will also offer an additional layer of detection inside buildings to track threats and even identify irregular disturbances or physical altercations between individuals."

An **ACM** (Association for Computing Machinery) article from earlier this year indicates how Patriot One addresses the problem of weapon detection through "a microwave radar scanner driven by artificial intelligence (AI) that can detect hidden weapons, along with a video surveillance component." An excerpt from the article explains the technology:

"The Patriot One system works by beaming radio waves at individuals, which bounce off any guns concealed beneath their clothing or stashed in backpacks or other luggage. The system processes the radio waves that bounce back from an individual with AI software trained to recognize what a radio wave bouncing off a hidden gun. The system also incorporates AI video surveillance software component, which has been trained to identify guns in plain sight of video cameras."

Elsewhere, precision-policing solutions provider Shot Spotter, Inc. (**NasdaqCM:SSTI**) **detected** over 107,000 gunfire incidents across the US in 2018. The company's machine learning based classification system leverages the world's largest audio database of gunshots and sounds that are similar to gunshots. Ralph Clark, president and CEO of Shot Spotter explains:

"Shot Spotter is in a unique position to track, analyze and share this comprehensive gunfire incident data to help cities across the country in their efforts to prevent and deter gun violence."

In late 2018, Shot Spotter **acquired** Hunch Lab Technology, equipping its Shot Spotter Missions platform with AI-driven analysis capabilities that enhance predictive policing. William J. Bratton, former NYPD and LAPD Commissioner and current Shot Spotter Board Member commented:

"Precision-policing products represent a new era in law enforcement that will provide more specific and objective data to help prevent crime. I've seen the evolution of intelligence-based tools over the years and I think the combination of Hunch Lab with Shot Spotter will accelerate the maturation of the category and result in even greater value to police departments."

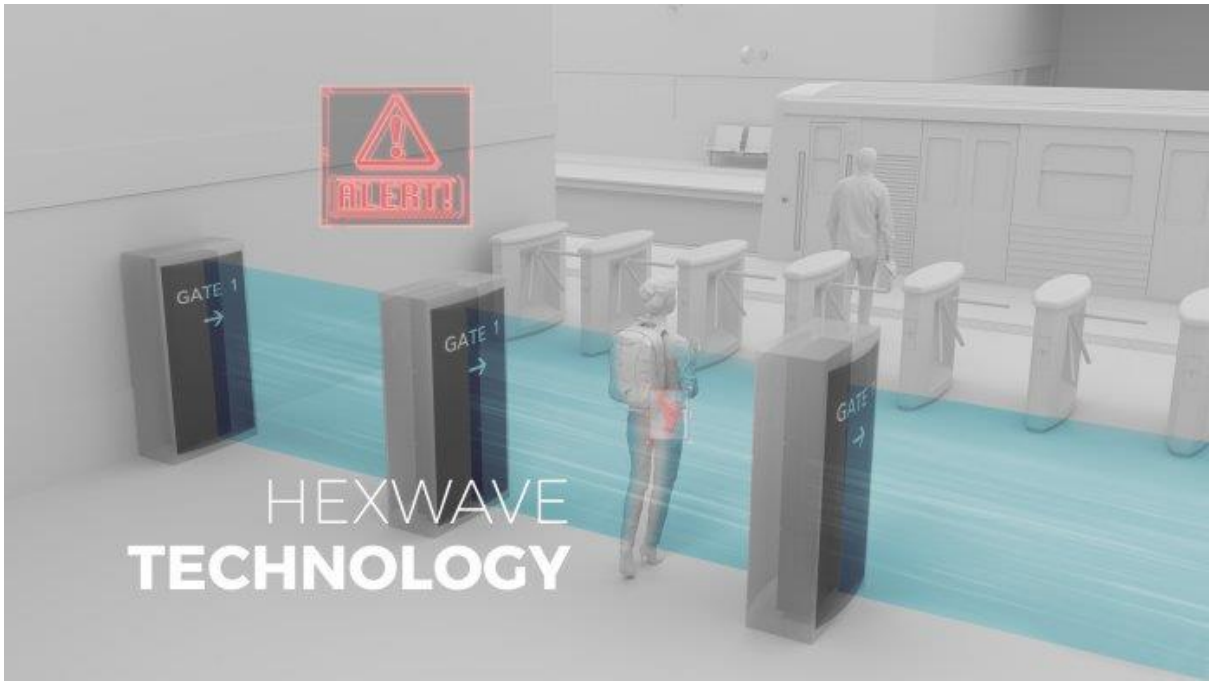
So, with the ongoing threat of global terrorism or instances of simple armed robbery, weapons-based threats remain a constant risk for security systems and public safety around the world. And as with its penetration of many other industry verticals, AI is being leveraged in a variety of ways to keep those threats in check.

REAL-TIME WEAPON DETECTION

The instant a knife, gun or automatic weapon threat is seen by your security cameras we relay and coordinate an alert to your officers for immediate response.

SAMSON is currently tested in Israel. Using already installed standard security cameras our state of the art and easy to use software provides real-time weapon detection and enables teams to quickly respond and neutralize threats in real-time. SAMSON provides real-time situation awareness in the most critical environments such as border control and safe cities.

Capitol Police plan to test AI-powered weapon detection scanners



Under rules set by lawmakers, anyone with a concealed carry permit can bring a gun into the state Capitol. And lots of people do, as anyone who was around for last week's special session on gun legislation undoubtedly noticed.

That makes the Capitol Square complex a prime location to test a radio-wave powered scanner developed by MIT that relies on artificial intelligence developed to detect concealed weapons, according to Capitol Police and the company developing the technology.

"We'll have targets of opportunity," said Bill Riker, CEO of Liberty Defence, though he added that the decision to approach Virginia had more to do with relationships with Capitol Police and the state's business friendly reputation.

The company's scanners look a bit like the theft detection devices stationed by the doors of retail outlets. They use radio waves to develop a 3D image of everyone entering and exiting. AI-powered software then analyzes those images in an attempt to detect whether the person is carrying a weapon, be it metallic, plastic, a bomb or a suicide vest.

The test, which will take place early next year and last about a week, comes as companies rush an array of security devices to market in response to growing concern over mass shootings and government officials weigh whether the specialized technology is worth the cost.

Lawmakers have rejected legislation in past years that required all new school buildings be constructed with integrated gun-shot detection systems, citing the cost.

Del. Jason Miyares, R-Virginia Beach, introduced similar legislation as part of the special session on gun control. His bill goes further, also requiring technology with an "artificial intelligence platform that detects exposed guns or knives at main building access points" be installed in all new or renovated schools and government buildings.

Like all the other legislation submitted, it's been referred to the State Crime Commission for study.

Scanners on trial at London train station to detect weapons on body

A UK government funded trial of a specialised technology that can detect weapons on the body of individuals has been deployed in London as part of a crackdown on knife crime in the UK capital.

The technology, made by British company Thru vision and backed by the UK Home Office, can detect weapons including guns, knives and explosive devices concealed under clothing at distances of up to 30 feet. It works by revealing objects concealed in clothing that block a person's body heat.

A five-day trial of the tech opened at Stratford in east London from Monday to help police officers identify objects that could be used as a weapon, without needing to stop and physically search suspects.

Wimax

Avinanda Mondal, Student of 3rd Year Electronics & Telecommunication Engineering
Technique Polytechnic Institute

INTRODUCTION:

New and increasingly advanced data services are driving up wireless traffic, which is being further boosted by growth in voice applications in advanced market segments as the migration from fixed to mobile voice continues. This is already putting pressure on some networks and may be leading to difficulties in maintaining acceptable levels of service to subscribers.
For the past few decades the lower band width applications are growing but the growth of broad band data applications is slow. Hence we require technology which helps in the growth of the broad band data applications. Wimax is such a technology which helps in point-to-multipoint broadband wireless access with out the need of direct line of sight connectivity with base station.
This paper explains about the Wimax technology, its additional features in physical layer and MAC layer and the benefits of each feature.

This paper focuses on the major technical comparisons (like QOS and coverage) between Wimax and other technologies. It also explains about the ability of the Wimax to provide efficient service in multipath environment.

II. Introduction:

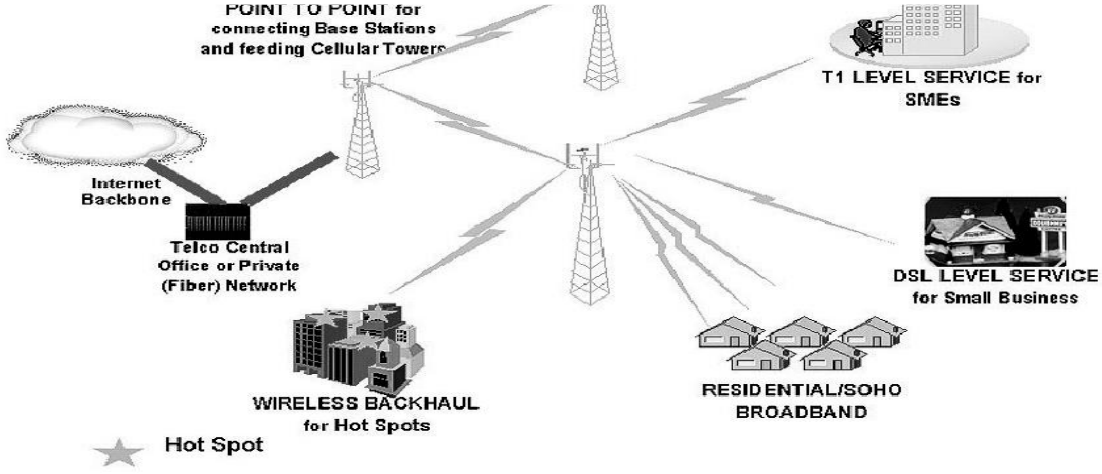
For the past couple decades, low-bandwidth applications such as downloading ring tones and SMS are experiencing sharp growth, but the growth of broadband data applications such as email and downloading/ uploading files with a laptop computer or PDA has been slow. The demand for broadband access continues to escalate worldwide and lower-bandwidth wire line methods have failed to satisfy the need for higher bandwidth integrated data and voice services. Wimax is radio technology that promises two-way Internet access at several megabits per second with ranges of several miles. It is believed that the technology can challenge DSL (Digital Subscriber Line) and cable broadband services because it offers similar speeds but is less expensive to set up. The intention for Wimax is to provide fixed, nomadic, portable and, eventually, Mobile wireless broadband connectivity without the need for Direct line-of-sight with a base station.

III. What the Wimax actually means.

Wimax is an acronym that stands for “Worldwide Interoperability for Microwave Access”. IEEE 802.16 is working group number 16 of IEEE 802, specializing in point-to-multipoint broadband wireless access. It also is known as Wimax. There are at least four 802.16 standards: 802.16, 802.16a, 802.16-2004 (802.16), and 802.16e.
Wimax does not conflict with WiFi but actually complements it. Wimax is a wireless metropolitan area network (MAN) technology that will connect IEEE 802.11 (WiFi) hotspots to the Internet and

provide a wireless extension to cable and DSL for last km broadband access. IEEE 802.16 provides up to 50 km of linear service area range and allows

User's connectivity without a direct line of sight to a base station. The technology also provides shared data rates up to 70 Mbit/s.
The portable version of Wimax, IEEE 802.16 utilizes Orthogonal Frequency Division Multiplexing Access (OFDM/OFDMA) where the spectrum is divided into many sub-carriers. Each sub-carrier then uses QPSK or QAM for modulation. Wimax standard relies mainly on spectrum in the 2 to 11 GHz range. The Wimax specification improves upon many of the limitations of the WiFi standard by providing increased bandwidth and stronger encryption
For years, the wildly successful 802.11 x or WiFi wireless LAN technology has been used in BWA applications. When the WLAN technology was examined closely, it was evident that the overall design and feature set available was not well suited for outdoor Broadband wireless access (BWA) applications. Wimax is suited for both indoor and outdoor BWA; hence it solves the major problem.



BWA (IEEE 802.16) Everywhere

In reviewing the standard, the technical details and features that differentiate Wimax certified equipment from WiFi or other technologies can best be illustrated by focusing on the two layers addressed in the standard, the physical (PHY) and the media access control (MAC) layer design.

IV. a) WIMAX PHY Layer

The first version of the 802.16 standard released addressed Line-of-Sight (LOS) environments at high frequency bands operating in the 10-66 GHz range, whereas the recently adopted amendment, the 802.16a standard, is designed for systems operating in bands between 2 GHz and 11 GHz. The significant difference between these two frequency bands lies in the ability to support Non-Line -of-Sight (NLOS) operation in the lower frequencies, something that is not possible in higher bands. Consequently, the 802.16a

Amendment to the standard opened up the opportunity for major changes to the PHY layer specifications specifically to address the needs of the 2-11 GHz bands. This is achieved through the introduction of three new PHY-layer specifications (a new Single Carrier PHY, a 256 point FFT OFDM PHY, and a 2048 point FFT OFDMA PHY);
Some of the other PHY layer features of 802.16a that are instrumental in giving this technology the power to deliver robust performance in a broad range of channel environments are; flexible channel widths, adaptive burst profiles, forward error correction with concatenated Reed-Solomon and convolution encoding, optional AAS (advanced antenna systems) to improve range/capacity, DFS (dynamic frequency selection)-which helps in minimizing interference, and STC (space-time coding) to enhance performance in fading environments through spatial diversity. Table 1 gives a high level overview of some of the PHY layer features of the IEEE 802.16a standard.

FEATURES	BENEFITS
256 point FFT OFDM waveform.	Built in support for addressing multipath in outdoor LOS and NLOS environments.
Adaptive Modulation and variable error correction encoding per RF burst.	Ensures a roubust RF link while maximizing the number of bits/sec for each subscriber unit
TDD and FDD duplexing support.	Adress varying worldwide regulations where one or both may be allowed.
Flexible Channel sizes(e.g 3.5MHz,5MHz,10MHz etc).	Provides the flexibility necessary to operate in many different frequency bands with varying channel requirements around the world.
Designed to support smart antenna systems.	Smart antennas are fast becoming more affordable and these costs come down their ability to suppress interference and increase system gain will become important to BWA deployments.

b) IEEE 802.16a MAC Layer

The 802.16a standard uses a slotted TDMA protocol scheduled by the base Station to allocate capacity to subscribers in a point-to-multipoint network Topology. By tarting with a TDMA approach with intelligent scheduling, Wimax systems will be able to deliver not only high speed data with SLAs, but latency sensitive services such as voice and video or database access are also supported. The standard delivers QoS beyond mere prioritization, a technique that is very limited in effectiveness as traffic load and the number of subscriber's increases. The MAC layer in Wimax certified systems has also been designed to address the harsh physical layer environment where interference, fast fading and other phenomena are prevalent in outdoor operation.
requirement low power consumption limiting the range. OFDM in the WLAN was created with the vision of the systems covering tens and maybe a few hundreds of meters versus 802.16 which is designed for higher power and an OFDM approach that supports deployments in the tens of kilometers.

a) Quality of service:

The 802.16a MAC relies on a Grant/Request protocol for access to the medium and it supports differentiated service The protocol employs TDM data streams on the DL (downlink) and TDMA on the UL (uplink), with the hooks for a centralized scheduler to support delay-sensitive services like voice and video. By assuring collision-free data access to the channel, the 16a MAC improves total system throughput and bandwidth efficiency, in comparison with contention-based access techniques like the CSMA-CA protocol used in WLANs. The 16a MAC also assures bounded delay on the data. The TDM/TDMA access technique also ensures easier support for multicast and broadcast services. With a CSMA/CA approach at its core, WLANs in their current implementation will never be able to deliver the QoS of a BWA, 802.16 systems.

VI.TECHNICAL ADVANTAGES OVER WIFI

Because IEEE 802.16 networks use the same Logical Link Controller (standardized by IEEE 802.2) as other LANs and WANs, it can be both bridged and routed to them. An important aspect of the IEEE 802.16 is that it defines a MAC layer that supports multiple physical layer (PHY) specifications. This is crucial to allow equipment makers to differentiate their offerings. This is also an important aspect of why Wimax can be described as a "framework for the evolution of wireless broadband" rather than a static Implementation of wireless technologies. Enhancements to current and new technologies and potentially new basic technologies incorporated into the PHY (physical layer) can be used. A converging trend is the use of multi-mode and multi-radio SoCs and system designs that are harmonized through the use of common MAC, system management, roaming, IMS and other levels of the system. Wimax may be described as a bold attempt at forging many technologies to serve many needs across many spectrums. The MAC is significantly different from that of Wi-Fi (and Ethernet from which Wi-Fi is derived). In Wi-Fi, the Ethernet uses contention access—all subscriber stations wishing to pass data through an access point are competing for the AP's attention on a random basis. This can cause distant nodes from the AP to be repeatedly interrupted by less sensitive, closer nodes, greatly reducing their throughput. By contrast, the 802.16 MAC is a scheduling MAC where the subscriber station only has to compete once (for initial entry into the network). After that it is allocated a time slot by the base station. The time slot can enlarge and constrict, but it remains assigned to the subscriber station meaning that other subscribers are not supposed to use it but take their turn. This scheduling algorithm is stable under overload and oversubscription (unlike 802.11). It is also much more bandwidth efficient. The scheduling algorithm also allows the base station to control Quality of Service by balancing the assignments among the needs of the subscriber stations.

FEATURES	BENEFITS
TDM/TDMA Scheduled uplink/downlink frames.	Efficient bandwidth usage.
Scalable from 1 to 100's of subscribers.	Allows cost effective deployments by supporting enough subs to deliver robust business case.
Connection oriented.	Per connection QoS. Faster packet routing and forwarding.
Automatic retransmission request(ARQ).	Improves end to end performance by hiding RF layer induced errors from upper layer protocols.
Support for adaptive modulation.	Enable highest data rates allowed by channel conditions, improving system capacity
Security and encryption.	Protects user privacy.
Automatic power control.	Enables cellular deployments by minimizing self interference.

V. Wimax Scalability:

At the PHY layer the standard supports flexible RF channel bandwidths and reuse of these channels (frequency reuse) as a way to increase cell capacity as the network grows. The standard also specifies support for automatic transmit power control and channel quality measurements as additional PHY layer tools to support cell planning/deployment and efficient spectrum use. Operators can re-allocate spectrum through sectorization and cell splitting as the number of subscribers grows.
In the MAC layer, the CSMA/CA foundation of 802.11, basically a wireless Ethernet protocol, scales about as well as does Ethernet. That is to say - poorly. Just as in an Ethernet LAN, more users results in a geometric reduction of throughput, so does the CSMA/CA MAC for WLANs. In contrast the MAC layer in the 802.16 standard has been designed to scale from one up to 100's of users within one RF channel, a feat the 802.11 MAC was never designed for and is incapable of supporting.

a) Coverage:

The BWA standard is designed for optimal performance in all types of propagation environments, including LOS, near LOS and NLOS environments, and delivers reliable robust performance even in cases where extreme link pathologies have been introduced. The robust OFDM waveform supports high spectral efficiency over ranges from 2 to 40 kilometers with up to 70 Mbps in a single RF channel. Advanced topologies (mesh networks) and antenna techniques (beam-forming, STC, antenna diversity) can be employed to improve coverage even further. These advanced techniques can also be used to increase spectral efficiency capacity, reuse, and average and peak throughput per RF channel. In addition, not all OFDM is the same. The OFDM designed for BWA has in it the ability to support longer range transmissions and the multi-path or reflections encountered. In contrast, WLANs and 802.11 systems have at their core either a basic CDMA approach or use OFDM with a much different design, and have as a requirement low power consumption limiting the range. OFDM in the WLAN was created with the

vision of the systems covering tens and maybe a few hundreds of meters versus 802.16 which is designed for higher power and an OFDM approach that supports deployments in the tens of kilometers.

Quality of service:

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A recent addition to the Wimax standard is underway which will add full mesh networking capability by enabling Wimax nodes to simultaneously operate in "subscriber station" and "base station" mode. This will blur that initial distinction and allow for widespread adoption of Wimax based mesh networks and promises widespread Wimax adoption. The original Wimax standard, IEEE 802.16, specifies Wimax

in the 10 to 66 GHz range. 802.16a added support for the 2 to 11 GHz range, of which most parts are already
Unlicensed internationally and only very few still require domestic licenses. Most business interest will probably be in the 802.16a standard, as opposed to licensed frequencies. The Wimax specification improves upon many of the limitations of the Wi-Fi standard by providing increased bandwidth and stronger encryption. It also aims to provide connectivity between network endpoints without direct line of sight in some circumstances. The details of performance under non-line of sight (NLOS) circumstances are unclear as they have yet to be demonstrated. It is commonly considered that spectrum
under 5-6 GHz is needed to provide reasonable NLOS performance and cost
7 effectiveness for PtM (point to multi-point) deployments. Wimax makes clever use of multi-path signals but does not defy the laws of physics.

VII. The Future with Wimax

The technology has been a long time coming but advancements combined with international standards such as 802.11.16 has made it feasible. Add to this the slice of
Licensed spectrum that will become available in 2007 when the broadcasting companies have to give up these frequencies due to a FCC mandate to digitize TV transmissions.
The decisive factor here will be for the FCC to enforce the mandate rather than succumbing to political pressures to extend the deadline.
There are already a few pioneers offering High Speed Broadband via Wimax.
One example is Tower Stream. The company currently offers up to 1000MB broadband service in seven major markets that include New York City, Chicago, and Los Angeles.
AT&T has recently announced plans to test the waters in this market, and Bell South has deployed this technology in Athens GA, a university town just northeast of Atlanta.

VIII.APPLICATIONS

The Wimax will provide solutions to the following multiple broadband segments:
Cellular backhaul:
The robust bandwidth of technology makes it an excellent choice for the backhaul for commercial enterprises, such as those providing „hotspots", as well as for point to point backhaul applications.
Broadband to undeserved and remote areas:
Wimax is a natural choice for under serviced rural and outlying areas with a low population density.
Broadband on-demand:
It can help to accelerate the deployment of Wi-Fi hotspots and SOHO wireless
LANs, especially in those areas not served by cable, DSL or in areas where the local telephone company may have a long lead time for providing a broadband service.
Broadband Residential:
This fills the gaps is cable and DSL coverage.
Best-connected wireless service:
Wimax has monadic capabilities, which allow users to connect to a WISP
(WirelessISP) Even when they roam outside their home or business, or go to another city that also has a WISP

IX. CONCLUSION:

Thus Wimax systems for portable/nomadic use will have better performance, interference rejection, multipath tolerance, high data quality of service support (data oriented MAC, symmetric link) and lower future equipment costs i.e., low chipset complexity, high spectral efficiencies. And hence Wimax can complement existing and emerging 3G mobile and wire line networks, and play a significant role in helping service provides deliver converged service offerings.