

GMRIT TECHMAG

Vol : 8

2014



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Phyto-Remediation of Waste Water through Artificial Wetlands

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INTRODUCTION

Phyto-remediation is an emerging technology to stabilize or to reduce the contamination in sewage, sludge, surface water and ground water by using green plants. Phytoremediation combines the Greek word "phyton", (plant), with the Latin word "remediare", (to remedy) to describe a system whereby certain plants, working together with soil organisms, can transform contaminants into harmless and often, valuable forms. This practice is increasingly used to remediate sites contaminated with heavy metals and toxic organic compounds. This paper strives to treat the different contaminants which are present in GMRIT Sewage Water. We are going to make a wet land system by using suitable and available plants to treat the water in a cost effective manner.

A.) Types of Phytoremediation:

Phytoremediation is used to remove different types of contaminants like Hydrocarbons, metals like Cadmium, Zinc, Arsenic and excess nutrients. Hence to remove those contaminants different types of "Phytoremediation techniques" are adopted.

- Phytosequestration- Phytochemical complexation in the root zone, reduce the fraction of the contaminant that is bio-available. Transport protein inhibition on the root membrane- preventing contaminants from entering the plant. Vacuolar storage in the root cells - Contaminants can be sequestered into the vacuoles of root cells,
- Phyto-extraction — uptake and concentration of substances from the environment into the plant biomass.
- Phyto-stabilization - reducing the mobility of substances in the environment, for example, by limiting the leaching of substances from the soil.
- Phyto-transformation - Degradation of complex organic materials into simple molecules and incorporation of these molecules into plant tissues.
- Phyto-stimulation - the stimulation of microbial and fungal degradation by release of exudates/enzymes into the root zone (rhizosphere); This process is also known as *rhizosphere degradation*.
- Phyto-volatilization - Removal of substances from soil or water with release into the air, sometimes as a result of phytotransformation to more volatile and/or less polluting substances.
- Rhizo-filtration - Filtering water through a mass of roots to remove toxic substances or excess nutrients. The pollutants remain absorbed in or adsorbed to the roots.

B.) Why choose Phyto-transformation?

Out of all the mechanisms of phytoremediation, phyto transformation or photodegradation can be considered as the best for removal of contaminants from the sewage water because these pollutants are broken down or degraded into simpler non-toxic particles and used up by the plants during their metabolic activities instead of storing them as it is inside a particular part of the plant body. The other methods pose problem while their disposal because the toxic pollutants and contaminants are recycled back into the environment. Hence the problem

of waste cannot be considered to have been treated rather it would be a relocation of the waste.

C.) Selection of Plant species:

Are selected for use based on the following factors:

- Ability to extract or degrade the contaminants of concern
- Adaptation to local climates,
- High biomass,
- Depth root structure,
- Compatibility with soils,
- Growth rate,
- Ease of planting and maintenance and
- Ability to take up large quantities of water through the roots.

II.PHYTO-TRANSFORMATION

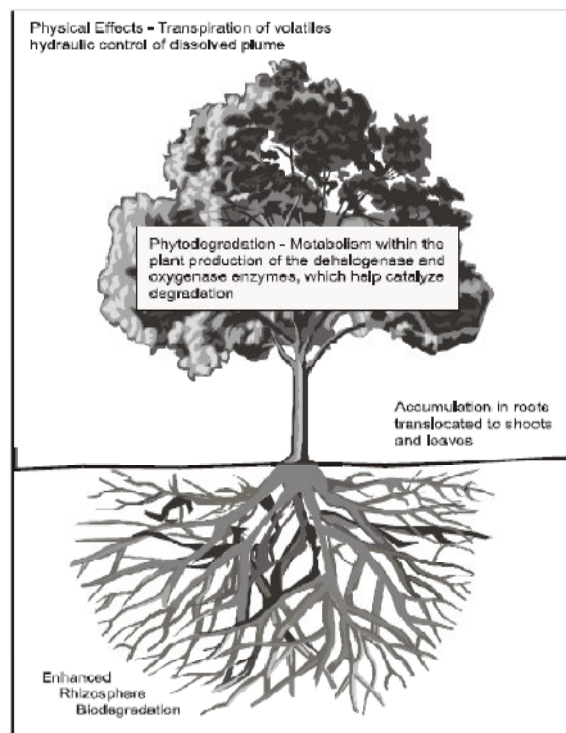
Phytotransformation, also referred to as phytodegradation, is the breakdown of organic contaminants sequestered by plants via:

- (1) metabolic processes within the plant; or
- (2) the effect of compounds, such as enzymes, produced by the plant.

The organic contaminants are degraded into simpler compounds that are integrated with plant tissue, which in turn, foster plant growth . Remediation of site by phyto-transformation is dependent on direct uptake of contaminants from the media and accumulation in the vegetation.

Direct uptake of chemicals into plant tissue via the root system is dependent on uptake efficiency, transpiration rate, and concentration of the chemical in soil water. Uptake efficiency depends on chemical speciation, physical/chemical properties, and plant characteristics, whereas transpiration rate depends on plant type, leaf area, nutrients, soil moisture, temperature, wind conditions, and relative humidity. Two processes of remediation can occur after the organic compound has been translocated by the plant: (1) storage of the chemical and its fragments into the plant via lignification; and (2) complete conversion to carbon dioxide and water .The release of volatile contaminants to the atmosphere via plant transpiration, called phytovolatilization, is a form of phytotransformation. Although transfer of contaminants to the atmosphere may not achieve the goal of complete remediation, phytovolatilization may be desirable in that prolonged soil exposure and the risk of groundwater contamination are reduced.

A.) Advantages of Phyto-transformation:



- This technique is less energy intensive.
- Cost effective
- Contaminant degradation due to enzymes produced by a plant can occur in an environment free of microorganisms
- Plants are able to grow in sterile soil and also in soil that has concentration levels that are toxic to microorganisms
- This technique only requires plants rather than any chemical substances which causes pollution.
- Phytodegradation potentially could occur in soils where biodegradation cannot.
- Minimal land disturbance
- Reduces potential for transport of contaminants by wind, reduces soil erosion.

III. CONVENTIONAL TREATMENT PROCEDURE FOR SEWAGE WATER

1. Primary treatment
2. Secondary treatment
3. Tertiary treatment

Primary treatment:

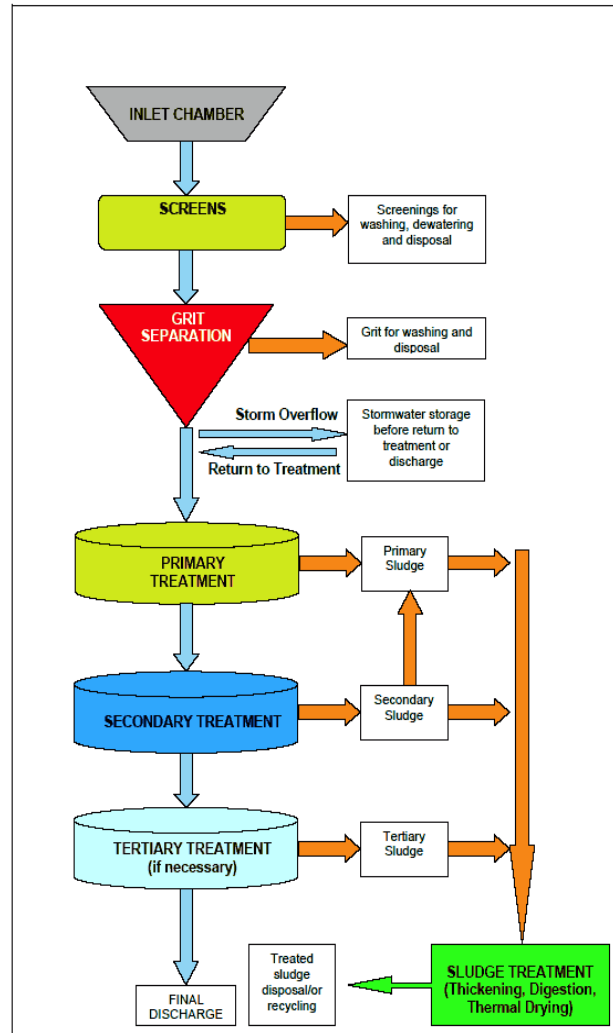
It consists of temporarily holding the sewage in a quiescent basin where heavy solids can settle to the bottom while oil, grease, lighter solids float to the surface. The settled and floating materials are removed and the remaining liquid may be discharged or subjected to secondary treatment.

Secondary treatment:

It removes dissolved and suspended biological matter. Secondary treatment is typically performed by indigenous, water borne micro organisms in a managed habitat. It may require a separation process to remove the micro organisms from the treated water prior to discharge or tertiary treatment.

Tertiary treatment:

Treated water sometimes disinfected chemically or physically before discharging into a stream, river, bay, lagoon or wetland or it can be used for the irrigation and other purposes.



IV. PHYTO-REMEDIATION AS A REPLACEMENT OF SECONDARY TREATMENT STEP

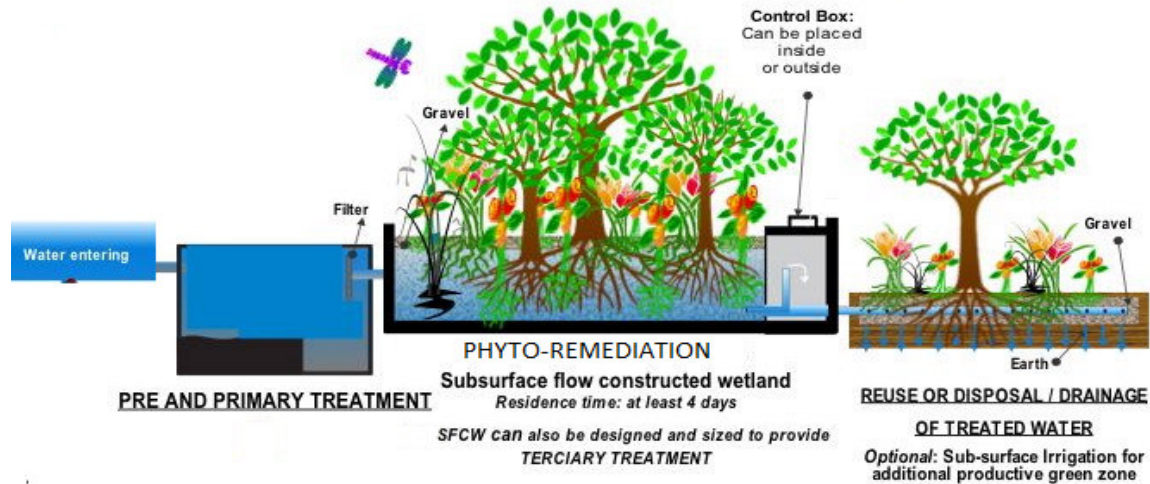
The secondary treatment process in waste water treatment is very costly and energy intensive. The phytoremediation process has such a huge potential that it can entirely replace this secondary treatment step with economic advantage.

PLANTS COMMONLY USED FOR PHYTOREMEDIATION

SPECIES/COMMON NAME	CONTAMINANT	PROCESS	COMMENTS
1. <i>Myriophyllum aquaticum</i> Parrot feather	Any variety of contaminants	Phytotransformation and phytodegradation	—
2. <i>Festuca rubra</i> Red festuca	Hydrocarbons	Rhizodegradation	Enhanced degradation of TPH and PAHs
3. <i>Lolium perenne</i> English ryegrass	Hydrocarbons	Rhizodegradation	Uptake nutrients and enhance significantly TPH and PAH in soils
4. <i>Trifolium repens</i> White clover	Hydrocarbons, PCBs	Rhizodegradation/ Metabolization	Deep rooter, nitrogen fixer, enhances microbial activity and degradation of PAHs
5. <i>Atriplex hortensis</i> Garden Orach	PCBs	Metabolism	Of spinach family, promises transforms PAH and metabolises PCBs
6. <i>Brassica juncea</i> Indian Mustard	metals	Rhizofiltration/ phytotransformation	Various species can be removed from the heavy metals
7. <i>Helianthus annuus</i> Sunflower	Metals and PAHs	Metabolism/ Rhizodegradation	Observed to rhizodegrade crude oil in Kuwait

V. USING INDIAN MUSTARD PLANT AS A MEDIUM OF PHYTO-TRANSFORMATION

Indian mustard also known as *Brassica Juncea* is widely used as an edible product which are rich in vitamin A and K and as food supplement as well as green manure. This plant is used in phytoremediation, mainly to remove heavy metals such as lead from the soil in hazardous waste sites using phyto transformation and by storing the heavy metals in its cells. This method is easier and less expensive and it also prevents erosion of soil.



Source: http://en.wikipedia.org/wiki/Sewage_treatment.

VI. LIMITATIONS OF PHYTO-REMEDICATION

1. Root System

Root contact is a primary limitation on phytoremediation applicability. Remediation with plants requires that the contaminants be in contact with the root zone of the plants. Either the plants must be able to extend the roots to the contaminants, or the contaminated media must be moved to within the range of the plants. this movement can be accomplished by irrigating the plants with contaminated waste water. Because these activities can generate potential risks like fugitive dust volatile organic compounds. The effective root depth of plants varies by species and depends on soil and climate condition.

2. Growth Rate

Phytoremediation is not advisable to be used for sites that require instantaneous clean-up and pose acute risks for human and other ecological receptors ecause it may require more time to phytoremediate a site as compared to other conventional methods.

Fourier Extension Analysis for Multi-component signals

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INTRODUCTION:

Conventional representations in the time or frequency domain are inadequate for non-stationary time varying chirp-type signals and the use of these time varying chirp signals widespread in radar, sonar and seismic technologies. These signals require time-frequency representation. We present a technique which extends the Fourier transform to non-stationary signals. We call this technique as Fourier Extension analysis. We have Short Time Fourier Transform(STFT), Wavelet theory, Wigner-Ville Distribution (WVD) and Pseudo-Wigner-Ville Distribution (PWVD) and other transforms.

Short time Fourier transforms(STFT):

It is a local analysis scheme for a time frequency representation using window functions but long time windows gives high frequency resolution but low time resolution and also it can't analyze chirp signals.

$$STFT_f^u(t', u) = \int_t [f(t) \cdot W(t - t')] \cdot e^{-j2\pi ut} dt$$

Wavelet Analysis:

A wavelet is a waveform of effectively limited duration that has an average value of zero. It gives time-scale representation of a signal but for high frequency components, these are good at time localization and for low frequency components, these are good at frequency localization.

The Wigner-Ville Distribution (WVD) and Pseudo-Wigner-Ville Distribution (PWVD) are very popular and effective methods for detecting Linear Frequency Modulated (LFM) signals in noisy environments. Hough transform is also widely used method for detection and parameter estimation of chirp signals. However, when there are signals with very different strength from each other, it is difficult to simultaneously detect both of them. The paper proposes a method for solving this problem. The algorithm is based on PWVD and Binary Transform in Hough space. Simulations show that the strong and the weak signal can be detected simultaneously and their parameters can be estimated.

PSEUDO-WIGNER-VILLE TRANSFORM:

Wigner-Ville Distribution (WVD) is perfectly suitable and gives excellent results when we deal with only one chirp signal. WVD is given as:

$$W(t, f) = \int_{-\infty}^{\infty} x\left(t + \frac{\tau}{2}\right) \cdot x^*\left(t - \frac{\tau}{2}\right) e^{-j2\pi f\tau} d\tau,$$

where $x(t)$ is the analyzed signal, $x^*(t)$ is its complex conjugate.

However, if we have to process two or more LFM signals, the WVD unavoidably gives cross terms due to its nonlinearity. Pseudo-Wigner-Ville Distribution (PWVD) is a method which uses a time domain window for smoothing in the frequency domain. PWVD is defined as :

$$P(k,f) = \sum x(k+n).x^*(k-n).w(n).w(-n).e^{-j2\pi fn},$$

where $w(n)$ is the real window of $2N$ length.

The result from the PWVD is that the cross terms are decreased. Another consequence is that the frequency resolution decreases. The longer the filter, the higher the frequency resolution. In this case, the cross terms rejection is also very good, however, the time resolution is low. Moreover, if the filter is longer than the signal, the cross terms rejection is not so effective. Choosing the appropriate length of the filter, as well as the two thresholds, which will be explained later, is critical for the success of the method.

HOUGH TRANSFORM:

The Hough transform is an image processing technique which can find straight lines. It is also robust to extraneous noise because the integration carried out by the Hough transform increases the SNR. As it can be seen from Fig., each point in the TF plane is mapped to a sinusoid in the Hough domain by :

$$\rho = x \cos \theta + y \sin \theta,$$

where ρ is the length of the shortest line segment between the line (target trajectory) and the origin, and θ is the angle between this line segment and the range axis of the data space. If the points lie on one line in the TF domain, their corresponding sinusoids in the parameter space will intersect in one point. By the line integration, a peak appears in the Hough space and its coordinates are directly related to the parameters of the lines. After performing PWVD, the chirp signal is transformed into a straight line in an image. Moreover, PWVD reduces the influence of the interference terms. After that, Hough transform is employed which also decreases the negative effect of the noise.

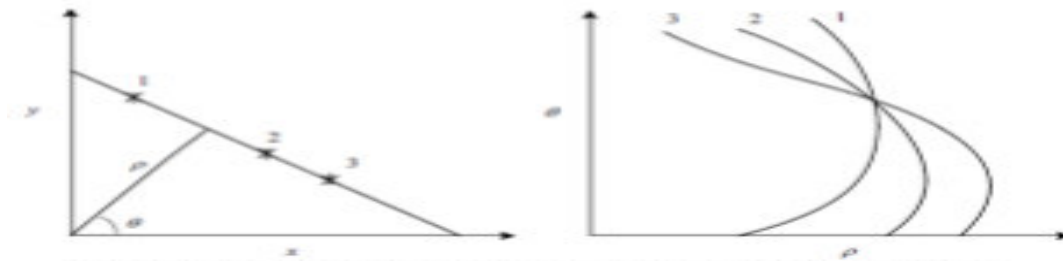
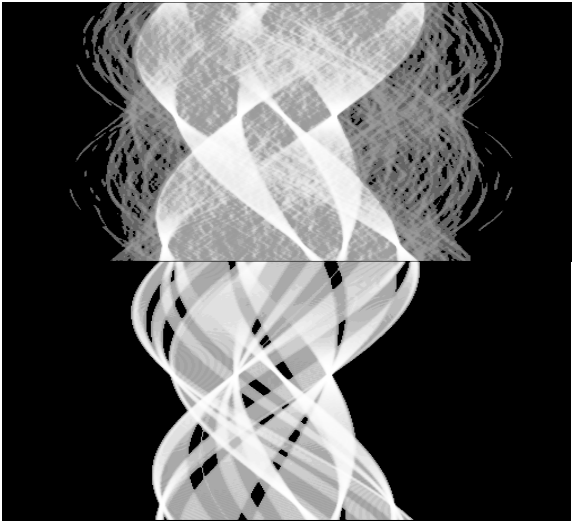


Figure 1. The illustration of coordinate plane and Hough plane.

BINARY INTEGRATION OF HOUGH TRANSFORM:

One way of simultaneously detecting a strong signal (large target) and a weak signal (small target) is to use binary integration in the Hough domain. For this method an “analog” power threshold is set in the TF plane to establish a set of primary detections. Then, only these

points higher than the first threshold are mapped to the parameter space and all of the resulting Hough curves are given unit weight. This step makes small targets and large targets look the same size in Hough space. After that, if the peaks in the parameter domain are higher than a second threshold value, then the peaks are assumed to be targets. The Hough transform subdivides the $\rho\theta$ parameter space into so-called accumulator cells. Instead of summing the signal powers, associated with the sinusoidal curve segments in a given cell, the binary integration simply counts the number of segments in the cell. That is why it shows distinguishable peaks for strong and weak signals. However, in noisy environments there will be interference terms producing as many segments as the weak signal. This means that both the noise and the small target will look the same in the Hough plane which will lead to false alarm detections.



Image

Houghed image

CONCLUSION:

When the SNR is low, it is crucial that the length of the filter used for PWVD sufficiently suppresses the cross terms but simultaneously, does not filter out the weak signal. Simulations prove that by using PWVD and binary integration in Hough space, the small target is much more noticeable in the parameter domain. This means that the weak and the strong signals can be detected simultaneously. However, the success of the method proposed in the paper relies on appropriately choosing the parameters of the filter for PWVD and the two thresholds. The additional filtering is what gives the benefits of PWVD over WVD so in future works, the comparison between WVD and binary integration in parameter domain and the method, proposed here, should be conducted.

Why Playing Sports Are Important?

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IV Year - Chemical Engineering.

I started playing with my dad first by crawling under the roof we lived. So did my journey start which lead me forward with health, discipline and honour. We all play sports but some of them play for happiness, some play for relaxation, some play out of interest, some play for a career but I play as I fell in love with it.

I played many games during my school days where I also happen to serve as Sports Secretary in school cabinet. It so happened I couldn't even attend the investiture ceremony where I were to be honoured to hold my school sports flag and receive cabinet batch of Sports since I was out to play 54th National School Games. Over the years sports have taught me many things which are essential for a sport's professional to lead the legacy of life. I travelled to north, south, east and west of the country playing, learning, teaching and loving every moment. Out of many beautiful jewels it was difficult for me to pick one. I was wise enough to choose one the most beautiful one and that is Taekwondo. This Olympic game nurtured me with teamwork, discipline, strength, concentration, self-defence, agility and health which are of its core values. But it additionally taught me respect to individual, determination, zeal to achieve and work with proper planning to achieve tasks in my life out of sports.

Sports transform us in all the above mentioned ways which enable us to be a good professional. On the other hand while playing sports, we practice few things like engaging ourselves in team for practicing the game. While this goes on we learn to understand people mentally and act accordingly. It is very essential for s sports person to play mind game than just using his physical strength. Agility of our mind increases while playing the game since we are ought to be a step ahead in performing the task to win the game. Also I learn to compete with happiness, as I always play the game smiling in the ring. I smiled when I won and I even smiled when I lost. So it became a practice for me and I even started smiling when I failed in a subject as I understood that this smile would keep me in focus to beat my failure. Also travelling along with the team teaches you to be strategic and also increases your managerial skills and leadership quality. Many leaders thus embrace sports and practice every day because they know, apart from refreshing themselves they also improve their managerial skills. However when we play we meet new people coming into the game, we go to new places and practice techniques and thus we get exposed to new things. It is always good to

engage oneself with new things as it refreshes our thought process. It is as refreshing as wearing the new clothes which my dad gets for me for my birthday.

While practicing games and also while teaching (coaching) others we improve our interpersonal skills and learn to become responsible. Also you know how to keep yourself fit and health. People also start asking health tips and many more physical and medical solutions thus we may pose a busy competition to the doctors around. Thus, we the sportspersons have holistic development and transformation in all areas which are essential to any child, teenager and even to a well grown professional.

Thus to gain all the essentials in a very friendly and joyous environment, playing sports would be the best fit for the professionals.

Play with passion and love playing the sport. When playing is fun so will be a professional's life.

Biodiesel Production from Micro Algae

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Continuous usage of petroleum based fuels is now widely recognized as unsustainable because of depleting supplies and the contribution of these fuels to the accumulation of carbon dioxide in the environment. Renewable, carbon neutral, transport fuels are necessary for environmental and economic sustainability. We have sustainable production of renewable energy which being hotly debated globally since it is increasingly understood that first generation of bio fuel, primarily produced from food crops. Biodiesel derived from oil crops is a potential renewable and carbon neutral alternative to petroleum fuels. Moreover biofuels are abundantly available in all locations which are easily accessible and highly sustainable. Unfortunately, biodiesel from oil crops, waste cooking oil and animal fat cannot realistically satisfy even a small fraction of the existing demand for transport fuels. Here, to meet such challenges that necessitates to be covered in order to make both, micro as well as macro algae a viable option to produce renewable biofuels. It is interesting to note that algae are varied, pervasive and productive and also having less impacts with plants as a food for human and animals. Microalgae appear to be the only source of renewable biodiesel that is capable of meeting the global demand for transport fuels. Like plants, microalgae also use sunlight to produce oils and they do it more efficiently than crop plants and they also act further as photo bioreactors. Oil productivity of many microalgae greatly exceeds the oil productivity of the best producing oil crops. Moreover production of biodiesel from microalgae could be a greater alternative to oil crops due to economical instability, jeopardizing agricultural lands. Approaches for making microalgae biodiesel are economically competitive when compared to petro diesel and is a thought provoke.

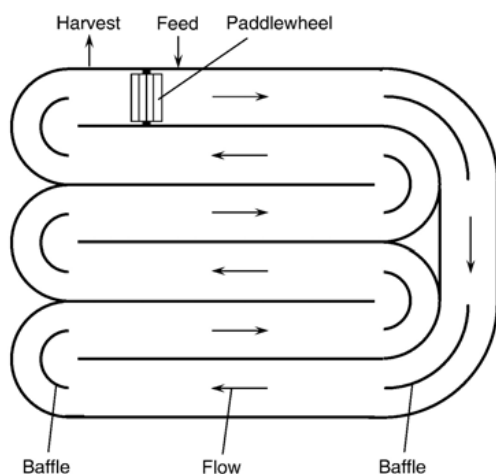
INTRODUCTION:

The production of Bio fuels is expected to offer new opportunities to diversify income and fuel supply sources, to promote employability in rural areas, to develop long term replacement of fossil fuels, and to reduce GHG emissions, boosting the decarbonisation of transportation fuels and increasing the security of energy supply. The most common bio fuels are biodiesel and bio-ethanol, which can replace diesel and gasoline, respectively, in today cars with little or none modifications of vehicle engines. They are mainly produced from biomass or renewable energy sources and contribute to lower combustion emissions than fossil fuels per equivalent power output. They can be produced using existing technologies and be distributed through the available distribution system. For this reason bio fuels are currently pursued as a fuel. Ultimately biofuels are vital in this present world to nurture the nature of future generation. Microalgae biodiesel is also such a type. Microalgae are prokaryotic or eukaryotic photosynthetic microorganisms that can grow rapidly and live in harsh conditions due to their unicellular or simple multicellular structure. Examples of prokaryotic microorganisms are Cyanobacteria (Cyanophyceae)s and eukaryotic microalgae are for example green algae (Chlorophyta) and diatoms (Bacillariophyta).

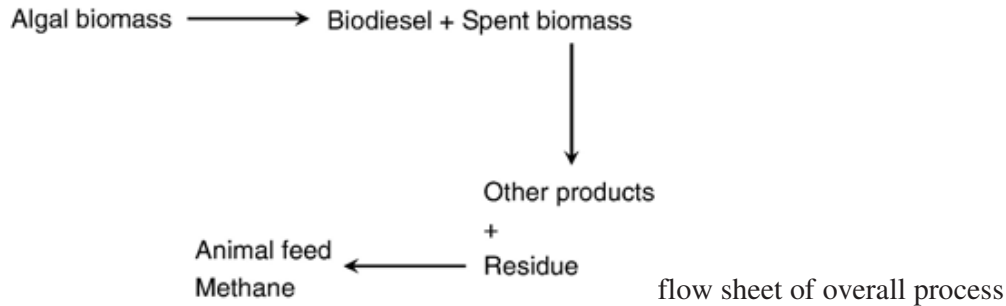
PRODUCTION OF MICROALGAE BIODIESEL:

Producing microalgae biomass is generally very expensive than growing crops. Photosynthetic growth requires light, carbon dioxide, water and inorganic salts. Temperature must remain generally within 20 to 30 °C. To minimize expense, biodiesel production must rely on freely available sunlight, despite daily and seasonal variations in light levels. Growth medium must provide the inorganic elements that constitute the algal cell. Essential elements include nitrogen (N), phosphorus (P), iron and in some cases silicon. Minimal nutritional requirements can be estimated using the approximate molecular formula of the microalgae biomass that is $\text{CO}_{0.48}\text{H}_{1.83}\text{N}_{0.11}\text{P}_{0.01}$. Nutrients such as phosphorus must be supplied in significant excess because the phosphates added complex with metal ions, therefore, not all the added P is bio available. Sea water supplemented with commercial nitrate and phosphate fertilizers and a few other micronutrients is commonly used for growing marine microalgae.

Micro algal biomass contains approximately 50% carbon by dry weight. All of this carbon is typically derived from carbon dioxide. Producing 100 t of algal biomass fixes roughly 183 t of carbon dioxide. Carbon dioxide must be fed continually during daylight hours. Feeding controlled in response to signals from pH sensors minimizes loss of carbon dioxide and pH variations. Biodiesel production can potentially use some of the carbon dioxide that is released in power plants by burning fossil fuels. This carbon dioxide is often available at little or no cost. Ideally, microalgae biodiesel would be carbon neutral, as all the power needed for producing and processing the algae would come from biodiesel itself and from methane produced by anaerobic digestion of biomass residue left behind after the oils has been extracted. Although microalgae biodiesel can be carbon neutral, it will not result in any net reduction in carbon dioxide that is accumulating as a consequence of burning of fossil fuels. Large-scale production of microalgal biomass generally uses continuous culture during daylight. In this method of operation, fresh culture medium is fed at a constant rate and the same quantity of microalgal broth is withdrawn continuously. Feeding ceases during the night, but the mixing of broth must continue to prevent settling of the biomass. As much as 25% of the biomass produced during daylight, may be lost during the night because of respiration. The extent of this loss depends on the light level under which the biomass was grown, the growth temperature, and the temperature at night.



PRODUCTION OF BIODIESEL



CONCLUSION:

Microalgae biodiesel is technically feasible. It is the only renewable biodiesel that can potentially and can completely displace liquid fuels derived from petroleum. Economics of producing microalgae biodiesel need to improve substantially to make it competitive with petrodiesel, but the level of improvement necessarily appears to be attainable. Producing low-cost microalgae biodiesel requires primarily improvements to algal biology through genetic and metabolic engineering. Use of the biorefinery concept and advances in photo bioreactor engineering will further lower the cost of production. In view of their much greater productivity than raceways, tubular photo bioreactors are likely to be used in producing much of the microalgae biomass required for making biodiesel. Photo bioreactors provide a controlled environment that can be tailored to the specific demands of highly productive microalgae to attain a consistently good annual yield of oils.

Artificial Vision-Bionic Eye

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I. Introduction

Belonging to the community of engineers there is no frontier that we cannot conquer. If scientists give birth to ideas, then it is we engineers who put life into those ideas. Today, we talk of artificial intelligence that has created waves of interest in the field of robotics. When this has been possible, then there is a possibility for artificial vision. 'Bionic eye' also called a Bio Electronic eye, is the electronic device that replaces functionality of a part or whole of the eye. It is still at a very early stage in its development, but if successful, it could restore vision to people who have lost sight during their lifetime. This technology can add life to their visionless eyes. A bionic eye works by stimulating nerves, which are activated by electrical impulses. In this case the patient has a small device implanted into the body that can receive radio signals and transmit those signals to brain through nerves and can interpret the image. One of the most dramatic applications of bionics is the creation of artificial eyes. Early efforts used silicon-based photo detectors, but silicon is toxic to the human body and reacts unfavourably with fluids in the eye. Now, scientists at the Space Vacuum epitaxy Centre (SVEC) based at the University of Houston, Texas, are using a new material they have developed, tiny ceramic photocells that could Detect incoming light and so repair malfunctioning human eyes .



Fig. 1: Human Eye

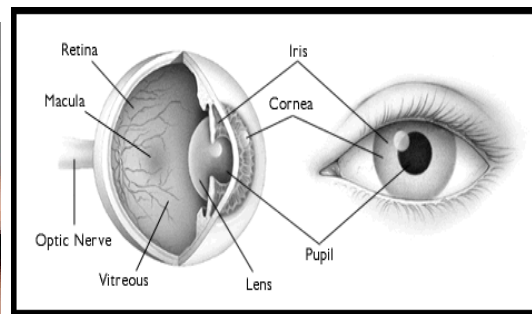


Fig. 2: Internal Structure of Human Eye

We are able to see because light from an object can move through space and reach our eyes. Once light reaches our eyes, signals are sent to our brain, and our brain deciphers the information in order to detect the appearance, location and movement of the objects we are sighting at. The internal working of eye is as follows [3], Scattered light from the object enters through the cornea.

1. The light is projected onto the retina.
2. The retina sends messages to the brain through the optic nerve.
3. The brain interprets what the object is

The eyeball is set in a protective cone-shaped cavity in the skull called the orbit or socket and measures approximately one inch in diameter. The orbit is surrounded by layers of soft, fatty tissue which protect the eye and enable it to turn easily. The important part of an eye

that is responsible for vision is retina. The retina is complex in itself. This thin membrane at the back of the eye is a vital part of your ability to see. Its main function is to receive and transmit images to the brain. In humans there are three main types of light sensitive cells in the retina. They are

- Rod Cells
- Cone Cells
- Ganglion Cells

There are about 125 million rods and cones within the retina that act as the eye's photoreceptors. Rods are able to function in low light and can create black and white images without much light. Once enough light is available, cones give us the ability to see colour and detail of objects. The information received by the rods and cones are then transmitted to the nearly 1 million ganglion cells in the retina. These ganglion cells interpret the messages from the rods and cones and send the information on to the brain by way of the optic nerve [2].

B. Vision Impairment

Damage or degeneration of the optic nerve, the brain, or any part of the visual pathway between them, can impair vision.

C. CAUSES OF BLINDNESS

There are a number of retinal diseases that attack these cells, which can lead to blindness. The most notable of these diseases are:

1. Retinitis pigmentosa
2. Age-related macular degeneration

Retinitis Pigmentosa (RP) is the name given to a group of hereditary diseases of the retina of the eye.

In macular degeneration, a layer beneath the retina, called the Retinal Pigment Epithelium (RPE), gradually wears out from its lifelong duties of disposing of retinal waste products [4]. Both of these diseases attack the retina, rendering the rods and cones inoperative, causing either loss of peripheral vision or total blindness. However, it's been found that neither of these retinal diseases affects the ganglion cells or the optic nerve. This means that if scientists can develop artificial cones and rods, information could still be sent to the brain for interpretation.

D. Corneal Transplants

Surgical removal of opaque or deteriorating corneas and replacement with donor transplants is a common medical practice. Corneal tissue is avascular; that is, the cornea is free of blood vessels. Therefore corneal tissue is seldom rejected by the body's immune system. Antibodies carried in the blood have no way to reach the transplanted tissue, and therefore long-term success following implant surgery is excellent [5].

E. The Surgery

This concept of Artificial Vision is also interesting to engineers, because there are a number of technicalities involved in this surgery apart from the anatomical part. The microsurgery starts with three incisions smaller than the diameter of a needle in the white part of the eye. Through the incisions, surgeons introduce a vacuuming device that removes the gel in the middle of the eye and replaces it with saline solution. Surgeons then make a pinpoint opening in the retina to inject fluid in order to lift a portion of the retina from the back of the eye, creating a pocket to accommodate the chip. The retina is resealed over the chip, and doctors inject air into the middle of the eye to force the retina back over the device and close the incisions. During the entire surgery, a biomedical engineer takes part actively to ensure that

there is no problem with the chip to be implanted. Artificial retinas constructed at SVEC consist of 100,000 tiny ceramic detectors, each 1/20 the size of a human hair. The assemblage is so small that surgeons can't safely handle it. So, the arrays are attached to a polymer film one millimetre by one millimetre in size. A couple of weeks after insertion into an eyeball, the polymer film will simply dissolve leaving only the array behind.

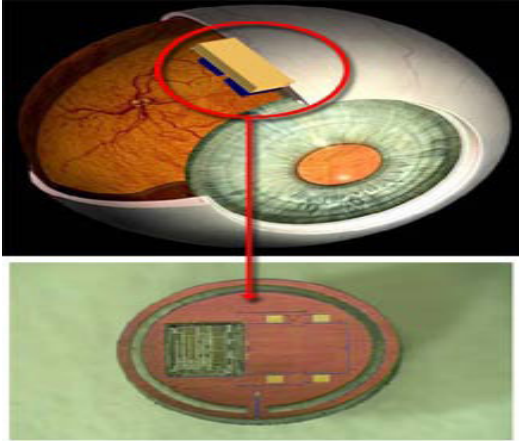


Fig. 3: Implanted Chip



Fig. 4: Magnified Image of ASR

III. System Features

A. Artificial Silicon Retina

The brothers Alan Chow and Vincent Chow have developed a microchip containing 3500 photo diodes, which detect light and convert it into electrical impulses, which stimulate healthy retinal ganglion cells. The ASR requires no externally-worn devices. The ASR is a silicon chip 2 mm in diameter and 1/1000 inch in thickness. It contains approximately 3,500 microscopic solar cells called “microphotodiodes,” each having its own stimulating electrode. These microphotodiodes are designed to convert the light energy from images into thousands of tiny electrical impulses to stimulate the remaining functional cells of the retina in patients suffering with AMD and RP types of conditions. The ASR is powered solely by incident light and does not require the use of external wires or batteries.

When surgically implanted under the retina, in a location known as the sub retinal space, the ASR is designed to produce visual signals similar to those produced by the photoreceptor layer. From their sub retinal location these artificial “photoelectric” signals from the ASR are in a position to induce biological visual signals in the remaining functional retinal cells which may be processed and sent via the optic nerve to the brain. The original Optobionics Corp. stopped operations, but Dr. Chow acquired the Optobionics name, the ASR implants and will be reorganizing a new company under the same name. The ASR microchip is a 2mm in diameter silicon chip (same concept as computer chips) containing ~5,000 microscopic solar cells called “Microphotodiodes” that each have their own stimulating electrode.

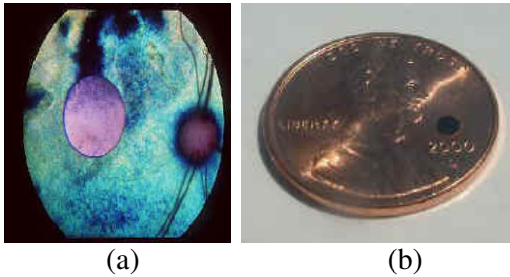


Fig. 5: (a) ASR Implant in Eye (b) Fig. 6: The Dot Above the Date on this Penny is the Full Size of the ASR

As you can see in the picture at the top of this page, the ASR is an extremely tiny device, smaller than the surface of a pencil eraser. It has a diameter of just 2 mm (.078 inch) and is thinner than a human hair. There is good reason for its microscopic size. In order for an artificial retina to work it has to be small enough so that doctors can transplant it in the eye without damaging the other structures within the eye.

B. MARC System

The intermediary device is the MARC system. The schematic of the components of the MARC to be implanted consists of a secondary receiving coil mounted in close proximity to the cornea, a power and signal transceiver and processing chip, a stimulation-current driver, and a proposed electrode array fabricated on a material such as silicone rubber, thin silicon, or polyimide with ribbon cables connecting the devices. The biocompatibility of polyimide is being studied, and its thin, lightweight consistency suggests its possible use as a non-intrusive material for an electrode array. Titanium tacks or cyanoacrylate glue may be used to hold the electrode array in place [9]. The MARC system will operate in the following manner. An external camera will acquire an image, whereupon it will be encoded into data stream which will be transmitted via RF telemetry to an intraocular

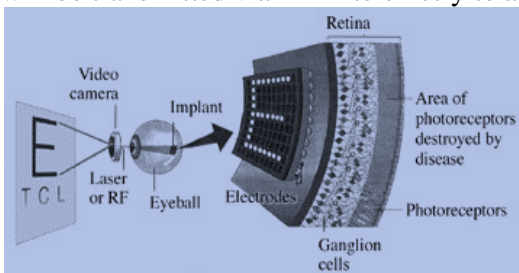


Fig. 6: The MARC System

transceiver. A data signal will be transmitted by modulating the amplitude of a higher frequency carrier signal. The signal will be rectified and filtered, and the MARC will be capable of extracting power, data, and a clock signal. The subsequently derived image will then be stimulated upon the patient's retina [10].

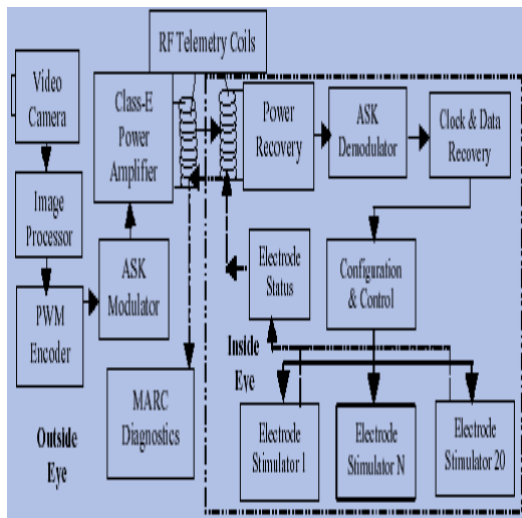


Fig. 7: Circuit of MARC System

The MARC system would consist of two parts which separately reside exterior and interior to the eyeball. Each part is equipped with both a transmitter and a receiver. The primary coil can be driven with a 0.5-10 MHz carrier signal, accompanied by a 10 kHz amplitude modulated (AM/ASK) signal which provides data for setting the configuration of the stimulating electrodes. A DC power supply is obtained by the rectification of the incoming RF signal. The receiver on the secondary side extracts four bits of data for each pixel from the incoming RF signal and provides filtering, demodulation, and amplification. The extracted data is interpreted by the electrode signal driver which finally generates appropriate currents for the stimulating electrodes in terms of magnitude, pulse width, and frequency [11].

C. Engineering Details

First, for visually impaired people to derive the greatest benefit from an enhanced-vision system, the image must be adapted to their particular blind areas and areas of poor acuity or contrast sensitivity. Then the information arriving instantaneously at the eye must be shifted around those areas. The thrust of all prosthetic vision devices is to use an electrode array to give the user perceptions of points of light (phosphenes) that are correlated with the outside world. Thus, to achieve the expected shift of the image across the stimulating electrode array, the camera capturing the image must follow the wearer's eye or pupil movements by monitoring the front of the eye under Infrared (IR) illumination. The eye-position monitor controls the image camera's orientation. If the main image-acquisition camera is not mounted on the head, compensation for head movement will be needed, as well. Finally, if a retinal prosthesis is to receive power and signal input from outside the eye via an IR beam entering the pupil, the transmitter must be aligned with the intraocular chip. The beam has two roles: it sends power, and it is pulse or amplitude-modulated to transmit image data. Under the control of eye movement, the main imaging camera for each eye can swivel in any direction. Each of these cameras--located just outside the users' field of view to avoid blocking whatever peripheral vision they might have--captures the image of the outside world and transmits the information through an optical fiber to a signal-processing computer worn on the body. The chip which is inserted on the retina is coded using the computer programmatic languages. After the implantation, the working of the bionic eye is compared with the normal view through necessary algorithms so that measures are taken that can rectify the abnormalities.

IV. Working Procedure

An artificial eye provokes visual sensations in the brain by directly stimulating different parts of the optic nerve. A bionic eye works by stimulating nerves, which are activated by electrical impulses. In this case the patient has a small device implanted into the body that can receive radio signals and transmit those signals to nerves. The Argus II implant consists of an array of electrodes that are attached to the retina and used in conjunction with an external camera and video processing system to provide a rudimentary form of sight to implanted subjects. The Argus II Retinal Prosthesis System can provide sight, the detection of light, to people who have gone blind from degenerative eye diseases. Diseases damage the eyes' photoreceptors, the cells at the back of the retina that perceive light patterns and pass them on to the brain in the form of nerve impulses, where the

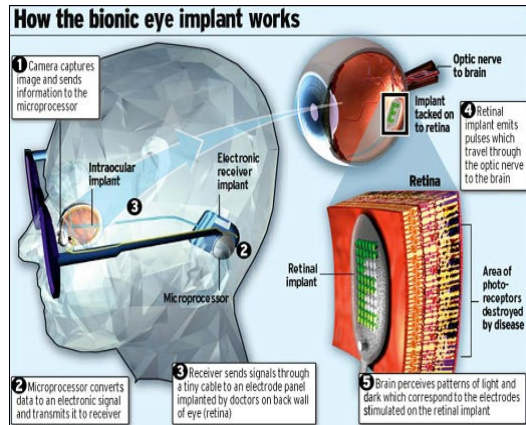


Fig. 8: Working of Bionic Eye

impulse patterns are then interpreted as images. The Argus II system takes the place of these photoreceptors. The second incarnation of Second Sight's retinal prosthesis consists of five main parts:

- Digital Camera - built into a pair of glasses, captures images in real-time sends images to microchip.
- Video processing microchip - built into a handheld unit, processes images into electrical pulses representing patterns of light and dark; sends pulses to radio transmitter in glasses
- Radio transmitter - wirelessly transmits pulses to receiver implanted above the ear or under the eye
- Radio receiver - receiver sends pulses to the retinal implant by a hair-thin, implanted wire
- Retinal implant - array of 60 electrodes on a chip measuring 1 mm by 1 mm

The entire system runs on a battery pack that is housed with the video processing unit. When the camera captures an image of, say, a tree the image is in the form of light and dark pixels. It sends this image to the video processor, which converts the tree-shaped pattern of pixels into a series of electrical pulses that represent "light" and "dark." The processor sends these pulses to a radio transmitter on the glasses, which then transmits the pulses in radio form to a receiver implanted underneath the subject's skin. The receiver is directly connected via a wire to the electrode array implanted at the back of the eye, and it sends the pulses down the wire. When the pulses reach the retinal implant, they excite the electrode array. The array acts as the artificial equivalent of the retina's photoreceptors. The electrodes are stimulated in accordance with the encoded pattern of light and dark that represents the tree, as the retina's

photoreceptors would be if they were working (except that the pattern wouldn't be digitally encoded). The electrical signals generated by the stimulated electrodes then travel as neural signals to the visual centre of the brain by way of the normal pathways used by healthy eyes - the optic nerves. In macular degeneration and retinitis pigmentosa, the optical neural pathways aren't damaged. The brain, in turn, interprets these signals as a tree, and tells the subject, "You're seeing a tree" [12].

All of this takes some training for subjects to actually see a tree. At first, they see mostly light and dark spots. But after a while, they learn to interpret what the brain is showing them, and eventually perceive that pattern of light and dark as a tree. Thus bionic eye helps a blind people to see the objects and recognize them.

A. Structure of the Micro Detectors

The ceramic micro detectors resemble the ultra-thin films found in modern computer chips. The arrays are stacked in a hexagonal structure, which mimics the arrangement of the rods and cones it has been designed to replace.

B. The Prototype Implant

The first implant had just 16 electrodes on the retinal pad and, as a result, visual information was limited. The new device has 60 electrodes and the receiver is shrunk to one-quarter of the original's size. It is now small enough to be inserted into the eye socket itself. The operation to fit the implant will also last just 1.5 hours, down from 7.5 hours.

C. Implantation

An incision is made in the white portion of the eye and the retina is elevated by injecting fluid underneath, comparing the space to a blister forming on the skin after a burn. Within that little blister, we place the artificial retina.

A light-sensitive layer covers 65% of the interior surface of the eye. Scientists hope to replace damaged rods and cones in the retina with ceramic micro detector arrays.

D. Some Facts about Bionic Eyes

Scientists at the Space Vacuum Epitaxy Centre (SVEC) based at the University of Houston, Texas, are using a new material, comprising tiny ceramic photocells that could detect incoming light and repair malfunctioning human eyes. Scientists at SVEC are conducting preliminary tests on the biocompatibility of this ceramic detector.



Fig. 10: What the Person Can See?

The artificial retinas constructed at SVEC consist of 100,000 tiny ceramic detectors, each 1/20th the size of a human hair. The assemblage is so small that surgeons can't safely handle it. So, the arrays are attached to a polymer film one millimetre in size. After insertion into an eyeball, the polymer film will simply dissolve leaving only the array behind after a couple of weeks.

V. Prototyping Devices

Researchers at Bionic Vision Australia (BVA) have produced a prototype version of a bionic eye implant that could be ready to start restoring rudimentary vision to blind people as soon as 2013. The system consists of a pair of glasses with a camera built in, a processor that fits in your pocket, and an ocular implant that sits against the retina at the back of the eye and electronically stimulates the retinal neurons that send visual information to the brain. The resulting visual picture is blocky and low-res at this point, but the technology is bound to improve, and even in its current form it's going to be a major life-changer for those with no vision at all. And the future potential - even for sighted people - is fascinating. There are two prototypes being developed to suit the needs of different patient groups.

A. Wide-View Device

The first prototype bionic eye, known as the wide-view device, will use around 100 electrodes to stimulate the nerve cells in the back of the eye. This will allow people with severe vision loss to see the contrast between light and dark shapes regain mobility and independence. This device may be most suitable for retinitis pigmentosa patients.

B. High-Acuity Device

The second prototype, known as the high-acuity device, will use 1000 electrodes to stimulate the retina and will provide patients with more detailed information about the visual field, helping them recognize faces and even read large print. The high-acuity device may be most suitable for patients with age-related macular degeneration; however, it is still some years before the first patient tests will commence.

C. Diamond Device

Melbourne researchers working to restore sight to the vision impaired believe diamond is the best material with which to build a bionic eye and hope to have a prototype in testing within the next few years. Kumar Ganesan, a physicist helping to design a bionic eye for Bionic Vision Australia at the University of Melbourne, says metals such as platinum and iridium are currently used for implants. He says even the hardest metals deteriorate within five to 10 years, which is why researchers have turned their focus to diamonds. "We made a diamond device so the implant inside the eye will not deteriorate or will not be damaged by any other means," he said .



Fig. 11: How the Bionic Person Looks?

VI. Conclusion

Bionic devices are being developed to do more than replace defective parts. Researchers are also using them to fight illnesses. If this system is fully developed it will change the lives of millions of people around the world. We may not restore the vision fully, but we can help them at least to find their way, recognize faces, read books, distinguish between objects such as cups and plates, above all lead an independent life. Though there are a number of

challenges to be faced before this technology reach the common man, the path has been laid. It has enabled a formerly blind patient to see. But with only 16 electrodes, the device does not allow the patient to see a clear picture. For that, thousands of electrodes are needed on the same size of chip. The bionic eye has changed the world of the visually challenged people. We are sure that higher quality, better resolution, and even colours are possible in the future. Restoration of sight for the blind is no more a dream today. Bionic Eyes have made this true.



Fig. 13: The Bionic Eye

VII. Future Scope

Researchers are already planning a third version that has 1,000 electrodes on the retinal implant, which they believe could allow for facial-recognition capabilities and hope to allow the user to see colourful images. Scientists believe the immediate goal after achieving above is to develop a functioning artificial retina with resolution that mimics human sensors. Once this step has been achieved, they say, then attention can be brought to bear on colour vision, followed by the replacement of some of the interconnecting neural cells that lead to the optic nerve. So, let us hope to reach all these goals as soon as possible.

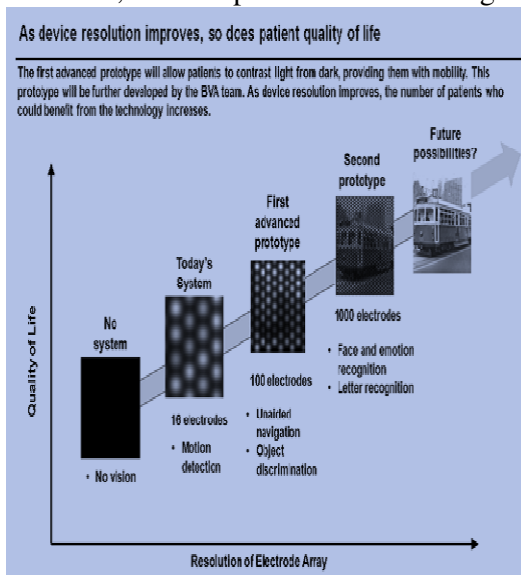


Fig. 14: The Resolution Challenge

The researchers note the device has some limitations, and it will not restore perfect vision. However, they are sure it will give people the advantage of having a general sense of their surroundings. Hopefully, the technology may enable people to recognize faces and facial expressions. "The thing is to significantly improve the quality of life for blind patients".

GPR Signal Processing using sliding-Window Space-Frequency Matrices

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1. INTRODUCTION

Ground penetrating radar is a geo physical method that uses radar process to image the sub surface this non-destructive method uses electromagnetic radiations in the microwave band of the radio-spectrum and detects reflected signals from the subsurface GPR uses high frequency radio waves in the range of 10MHz to 1GHz. A GPR transmitter push electromagnetic energy into the ground when the energy encounters a buried target are boundary between materials having different dielectric constants, it may be reflected or scattered back to the surface. It is extensively used in various fields such as geophysical exploration, civil engineering and archaeology [1]. In many applications, GPR data is often hampered by clutter which is mainly composed of (rough) surface reflections, scattering from third party objects and cross stop between antennas. Also, particular for shallow buried objects, temporal responses of the Surfaces and the targets can overlap and interfere each other thereby eliminating the option of time-gating for improved GPR responses. Additionally, in case of lossy sub surfaces and dielectric targets(e. g., plastic mines), scattered energy from the targets can be very low thus , GPR performance highly depends on ability to successfully differentiate the target from the clutter one of the main topic of interest in GPR signal processing is therefore geared towards the reduction of clutter. Various studies have been conducted on this front, among them of filtering algorithms [3-5], parametric system identification[5], statistical signal processing[6], subspace methods [8-10], entropy-base approaches[10] and techniques employing parametric and non-parametric modeling[11]. A neural networks approach has been introduce in the marine radar application for sea clutter reduction and other approaches have been successfully used in the automatic radar detection in ground clutter[11,12] while each method tackles different aspects of the problem, there is still room for further improvement. Ground penetrating radar performance is primarily governed by the material being surveyed as radio decreased exponentially and soon become and detectable in energy absorbing materials such as wet clay. In this study we present the features GPR and their impact on the system performance. Those are

1. Dynamic range
2. System internal clutter profile

A. Dynamic range

This is a common evaluation parameter for specific GPR system. It represents the maximum total attenuation loss during two-way transit of the electromagnetic wave which will still allow reception, greater losses will not be recorded for instance, in a soil with a two-way attenuation of 40dB/m, a GPR system with 100dB of dynamic range will collect a useful signal up to a depth of 2.5m, beyond such a depth echoes from targets will

become undetectable given that the GPR user has no control over the soil attenuation, it is obvious that the dynamic range directly influences the exploration depth of the GPR, as larger the dynamic range the greater the GPR penetration the dynamic can also be defined the ratio the maximum receivable signal and the minimum detectable signal great care is therefore needed in GPR design to reduce sources of internal noise and to shield the antenna against external noise as Doppler targets may become undetectable if the noise level is too high.

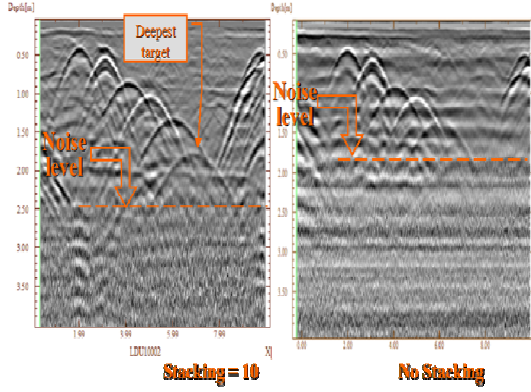


Fig.a: Improvement of exploration depth due to stacking. The target marked with an arrow in the picture on the left is hidden by noise in the picture on the right

B. System internal clutter profile

Another crucial parameter to be evaluated is the system's clutter profile. Clutter is the term used for returns identified by the system has the targets that do not correspond to intended targets or to noise. In fact when a GPR control until it is connected to practical antennas internal system reflections, ground returns and transmitter to receiver antenna leakage generate time dependent clutter that may hide signals backscattered by the targets. In this respect, although a large dynamic range is an obvious requirement for an effective GPR it is not necessarily the major performance limiter. In this study we present a singular value decomposition (SVD) based method for improved detection of shallow dielectric targets (plastic landmines). The method was first applied on a time reversal based algorithm utilizing space frequency matrices. Here we adapt the SF-TR matrices proposed in [13] for its potential application to GPR detection of shallowly buried targets. Time reversal (TR) based imaging can achieve both temporal and spatial focusing around the original target locations. It's ability to positively exploit the multipath in the medium yields to super resolution and statistical stability [14].

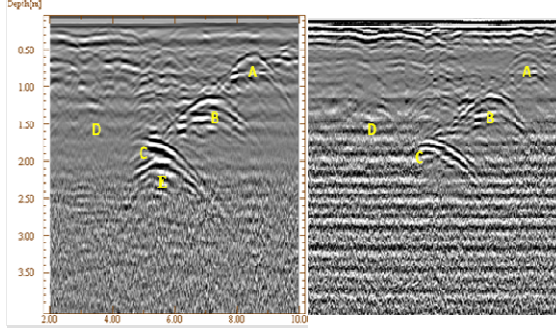


Fig.b: Comparison in terms of system clutter between the GPR system's running a 500MHz antenna (right) and a 600MHz antenna (left). The horizontal stripes in the right are fully hide target E.

II. SPACE-FREQUENCY DATA MATRIX GENERATION AND UTILIZATION

Basically when GPR is away from the target of interest, the radargram mainly carries the (rough) surface information and when the GPR is in the vicinity of target the radargram contains both surface and target responses. In our attempt to extract the target signature in the presence of strong clutter, we develop a method based on spatially sliding windows and synthesizing singular vector distributions corresponding to different scattering mechanisms we apply SVD to the appropriately selected subsets of radargrams (B-scan) obtained during a given GPR survey. A radargram is obtained by the collection individual A-scans each of which correspond to the recorded GPR response at a single location. We consider a pulse radar GPR system with single transmitter receiver to illustrate the method (fig.1). For better articulation, alongside with the fundamentals of the method, we provide results obtain from numerical simulations based on the finite difference time domain method [13]. The utilized GPR antenna located at 10cm above the ground transmits a short pulse of 900MHz and the scattered signals are recorded back at the same location at a given spatial location above the ground, the time domain response recorded by the GPR unit an A-scan and denoted by $A(\vec{r}_i, t)$. Each A-scan signal can be modeled as follows $A(\vec{r}_i, t) = s_i(t) + b_i(t) + n_i(t)$ Where $s_i(t)$ is the desired target signal, $b_i(t)$ is the background return and $n_i(t)$ is the remaining clutter and noise [1]. An ensemble A-scans obtained at various spatial locations forms the so called B-scan which is represented in terms of individual A-scans as $B(R_1^N, t) = [A(\vec{r}_1, t), \dots, A(\vec{r}_N, t)]$

Where N is the total number of A-scans and $R_i^j = [\vec{r}_i \dots \vec{r}_j]$ with $j \geq i$. B-scans obtained for a dielectric target of 5cm radius and $\epsilon_r = 3$ embedded 5cm below the uniform and randomly fluctuating surface profiles of $\epsilon_r = 9$ (dry clay) are shown in Fig.1. As the target shallowly buried and the target-soil dielectric contrast is smaller compared to air-subsurface contrast, this constitutes a difficult detection problem with a low signal to noise ratio. If the individual A-scans forming the B-scan are Fourier transform in time, the frequency domain B-scan $B(R_1^N, \omega)$ is obtained which is essentially similar in form to the space-frequency (SF) TR matrix of [13]. However, while the SF matrix of [13] utilizes an

array of $N > 1$ static antennas, $B(R_1^N, \omega)$ is obtained using a single transceiver at different survey locations mimicking synthetic aperture behavior. Owing to this similarity, space-frequency TR algorithm can in principle be applied to the full B-scan.

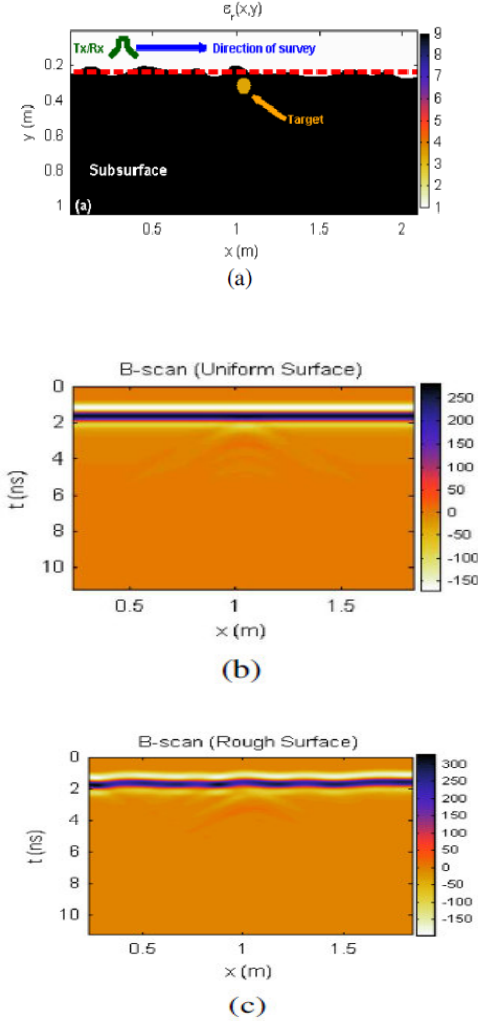


Fig.1. (a) A GPR surveying scenario where a dielectric target $\epsilon_r = 3$ is embedded below a rough surface profile with $\epsilon_r = 9$ (dry clay). The dashed line represents the corresponding uniform surface interface. (b) Full B-scan obtained with uniform and (c) Rough surface [1].

In the SF-TR algorithm, SVD is applied to chosen data matrix to obtain the coherent time-domain singular vectors that can be later used for back propagation [13] or extracting target signatures. In the GPR problem, with the spatial range of B-scan is relatively large such that the individual A-scans have both target and surface signatures with different direction of arrivals, delays and amplitudes, then the obtained time-domain singular vectors do not necessarily represent scattering centers accurately. However with a shorter spatial range, it might be possible to extract the signatures due to different scattering components more effectively. Hence, in an effort to adapt the technique for its successful application to the GPR scenario, several modifications are introduced. First, instead using the global data

through the whole B-scan matrix, sub-matrices having localized information are utilized. For this purpose, a sliding window of predetermined number of A-scans is swept through full B-scan to obtain sub matrices as shown in fig.2. Each sub matrix corresponds to $M_f \times L$ sub B-scan denoted here as follows

$$B_i^{sub} = B_i^{sub}(R_i^{L+i-1}, \omega) = \begin{pmatrix} \vec{A}(r_i, \omega) & \dots & \vec{A}(r_{L+i-1}, \omega) \\ \vdots & \ddots & \vdots \\ \vec{A}(r_i, \omega_{M_f}) & \dots & \vec{A}(r_{L+i-1}, \omega_{M_f}) \end{pmatrix} \text{ where } i=1, \dots, N-L+1, L \leq N-i+1 \text{ is the number}$$

of A-scans considered in a single sub B-scan and M_f is the number of frequency samples considered in the bandwidth.

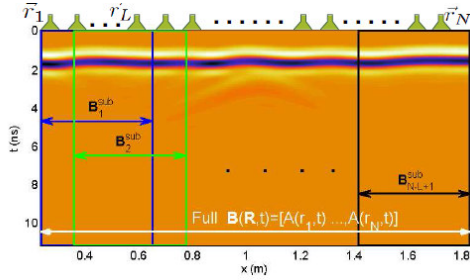


Fig.2. Sliding windows and corresponding sub matrices for the full B-scan of GPR survey obtained for the shallowly buried dielectric target under the rough surface, each sub-radargram is associated with a specific synthetic aperture determined by the recorded A-scan locations [1].

Note that there are a total of $N-L+1$ sub B-scans. Applying SVD to B_i^{sub} yield $B_i^{sub} = U_i^{sub} A_i^{sub} (V_i^{sub})^*$ where U_i^{sub} is the unitary $M_f \times M_f$ matrix of left singular vectors, V_i^{sub} is the unitary $L \times L$ matrix of right singular vectors and A_i^{sub} is the $M_f \times L$ matrix of singular values and $*$ represents the conjugate transpose operator. Here, B_i^{sub} maps the local spatial information to the received frequency data via

$$B_i^{sub} V_{i,n}^{sub} = \lambda_{i,n}^{sub} u_{i,n}^{sub} \quad \text{where } \lambda_{i,n}^{sub} \text{ is the } n^{\text{th}} \text{ singular}$$

value, $V_{i,n}^{sub}$ is the $n^{\text{th}} L \times 1$ right singular vector that represents the spatial (position) content of received signals and $u_{i,n}^{sub}$ is the $n^{\text{th}} M_f \times 1$ left singular vector containing frequency information[15]. The left singular vectors, $u_{i,n}^{sub}$ for $n = 1, \dots, M_f$ are orthonormal and span the frequency space and they are the eigenvectors of the time-reversal operator (TRO) matrix $B_i^{sub} (B_i^{sub})^*$. Similarly, the right singular vectors ($V_{i,n}^{sub}$ for $n = 1, \dots, L$) are also orthonormal and span the GPR location space. Assuming $M_f \geq L$ and utilizing the singular vectors, B_i^{sub} can be rewritten in the following form:

$$B_i^{sub} = \sum_{n=1}^L \lambda_{i,n}^{sub} u_{i,n}^{sub} (V_{i,n}^{sub})^*$$

Using the left singular vectors of each sub-B-scan, time-domain singular vectors can be constructed through inverse Fourier transform via $u_{i,n}^{sub}(t) = F^{-1}\{u_{i,n}^{sub}\}$. Depending on the scenario, each time-domain signal might correspond to different signatures of the scattering mechanisms in the GPR scenario. For illustration, several dominant time-domain singular vectors of the leftmost sub-B-scan $u_{1,n}^{sub}(t)$ for $n=1 \dots 3$) are compared with those of the full B-scan in Fig. 3.

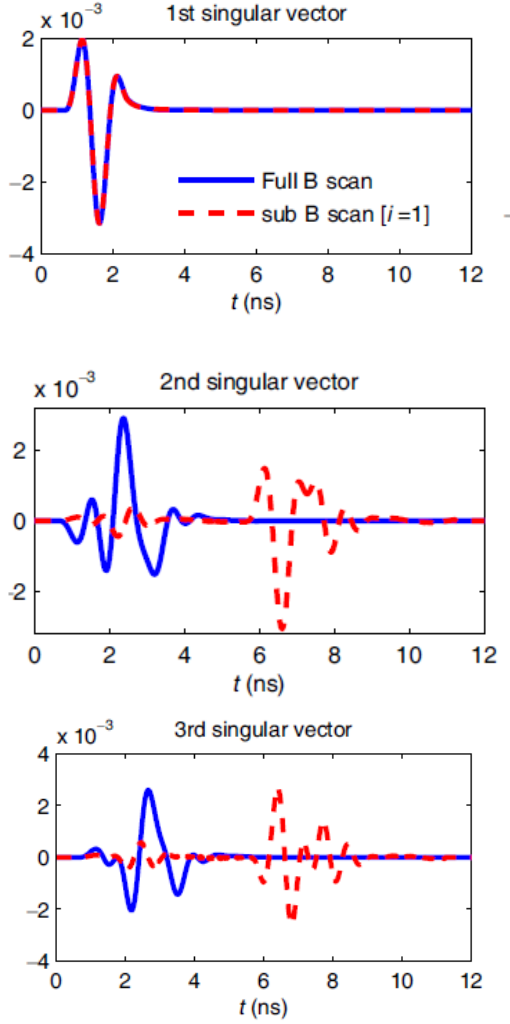


Fig.3. Time domain singular vectors of the 1st sub B-scan $u_{1,n}^{sub}(t)$ are compared with those of the full B-scan for a dielectric target under a uniform surface profile [1].

In this example, the full B-scan utilizes $N = 112$ A-scans whereas the sub B-scan has only $L = 5$ A-scans. Since surface scattering is dominant for both cases, the first singular vectors correspond to the surface reflection. However, the remaining singular vectors show big differences: Those of the full B-scan mainly lie between 1-4 ns and correspond to an effective response from all $N = 112$ A-scans whereas those of the sub-B-scan are around 6-9 ns and correspond to localized target response at the particular GPR antenna distance. This shows the advantage of using sub-radargrams over the full B-scan as it can extract more localized information. The locality of information also applies for the first singular vectors. Under a rough surface profile, the first singular vector of the full B-scan provides a surface

response similar to the ensemble average subtraction [1] which is effective only if the ground is uniform. But with the use of sub-B-scan, relatively local surface roughness is included with different time delays and amplitudes allowing better surface clutter reduction. It may be argued that for localized scatters under uniform surface conditions, the full B-scan can give the same first singular vector (see Fig. 3), hence removes the surface scattering as effectively as sub-B-scan matrices. While this statement is absolutely valid, it should be kept in mind that for elongated scatters under uniform surface, full B-scan cannot provide the same localized information as sub-B-scans. This constitutes yet another advantage of sub-B-scans over full B-scan. Once the time-domain singular vectors of sub-B-scans are obtained, they can be combined to generate *synthetic* singular vector distributions given as follows:

$$c_n(R_1^{N-L+1}, t) = [u_{1,n}^{sub}(t), \dots, u_{N-L+1,n}^{sub}(t)].$$

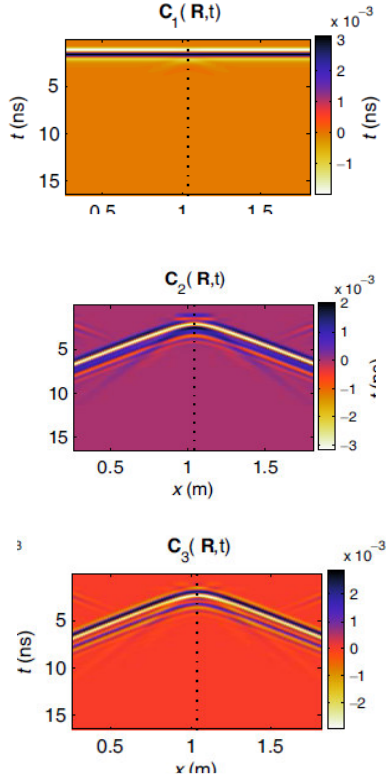


Fig.4. The first three dominant singular vector distributions for $L = 5$ and corresponding singular values for a dielectric target under a uniform surface profile when $L = 5$ and $L = 15$ the vertical dashed lines represent the lateral target location [1].

Each of these distributions provides a global snapshot of distinct mechanisms of the scattering scenario as illustrated in Fig. 4 for the single dielectric target case of Fig. 3. From these figures, it is observed that, the first singular vector distribution is mostly dominated by the surface scattering. Thus, it can be later used to eliminate the surface clutter. The remaining distributions mostly correspond to the embedded target and exhibit somewhat close to the so-called *hyperbola* curve which is typical for isolated scatters (Here, we have limited our study to pulse shaped radar waveforms and similar study can be performed for other waveforms as well). The peak of the hyperbola represents the lateral position of the target. In certain circumstances, the corresponding singular value distributions can also be used for change detection as they tend to peak or dip above the isolated targets [21]. The singular values and vectors can be combined together to obtain the following weighted singular vector distribution:

$$D_n(R_1^{N-L+1}, t) = [\lambda_{1,n}^{sub} u_{1,n}^{sub}(t), \dots, \lambda_{N-L+1,n}^{sub} u_{N-L+1,n}^{sub}(t)]$$

This distribution can then be subtracted from the full B-scan to eliminate the surface clutter and thereby enhancing the target signatures where possible. The resulting matrices (distributions) can be denoted as *synthetic* residual B-scans and are represented by

$$S_p(R_1^{N-L+1}, t) = B(R_1^{N-L+1}, t) - \sum_{n=1}^p D_n(R_1^{N-L+1}, t)$$

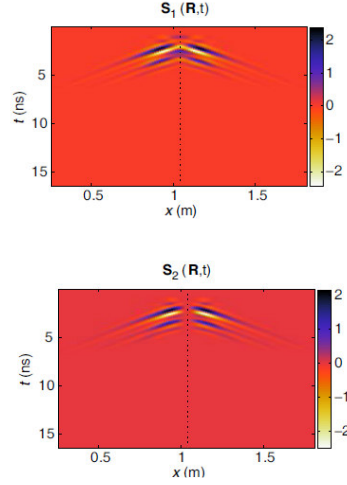


Figure 5. The first two residual distributions, i.e., synthetic B-scans ($S_i(R_1^{N-L+1}, t)$ for $i=1, 2$) once singular vectors are subtracted from the full B-scan for uniform surface case [1].

Where P is the number of individual weighted singular vector distributions. Fig. 5 shows two such synthetic B-scans obtained for the dielectric target under uniform surface profile for $P = 1$ and $P = 2$. Once compared with the full B-scan of Fig. 1, it is observed that the surface scattering from the full B-scan is eliminated and the target response (hyperbola) from the embedded dielectric scattered is distinguishable. For this particular case, S_1 is already enough for detecting the hyperbola curve. Another point to note is the criteria to choose the radargram subsets which are highly scenario dependent. The number of total B-scans, the interval between each B-scan, central wavelength of operation, scattered size and other factors affect the choice of subsets. As a rule of thumb, smaller subsets provide more localized information than the larger subsets. But if the subset is very small (e.g., $L = 1$), then singular vectors can't be necessarily utilized as described in the method. To our experience, depending on the scenario, subsets should be chosen encompassing a range of 1 to 2 wavelengths of interest. In some of the figures throughout the paper, we have provided the singular vector distributions for both $L = 5$ and $L = 15$ for comparison. This can be extended for the case of multiple targets and dielectric, metallic targets under rough surface profile.

Digital Smell

CH.PRADEEP KUMARI IIIT, GMRIT.

Introduction:

In this modern age, computers have verified the cause of their existence. It provides a very good facility of fast processing, sound and picture. The virtual reality concept has provided very good features to the computer systems. The concept of virtual reality is introduced by the computer programmers to provide more attachments to the user. There are several concepts of the virtual reality that are available such as digital smell, virtual theatre, electronics hand gloves, multipoint surround sound system, 3D goggles.

Evolution of Digital Smell:

How it was invented?

As we know that many scientists have started for the virtual reality from the last 5 to 6 years. As a virtual reality they have got a full concept as virtual theater. These theaters consist of an electronic hand gloves, digital smell, multipoint surroundsound system, movement controllable seats, 3d goggles. From this idea the multipoint surround sound system, 3dgoggles, movement controllable seats were completed. For example if we are watching a movie and we see burning of tier then we will fill that smell in the ater or pc or television. The basic idea for this was given by the perfume making companies for the advertisements of their perfumes.

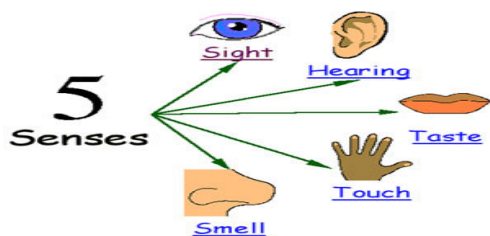
Founders:

Founders Dexster Smith and Joel Lloyd Bellenson, experts in bioinformatics and genomics, started from the following idea: "If we can find the essence of a biological smell and build a profile, we can digitalize and broadcast it."

DIGITAL AROMA

Traditionally one has said that we have five senses, recent studies indicate that we have at least eleven and some specialists still consider more. Of the main ones (Vista, ear, tact, taste and sense of smell), our nose is possibly the one that has more relegated in our sensitive surroundings, since all the technology and the world that surrounds to us attacks the Vista and the ear, but rare time we found some attempt to approach the sense of smell.

So far, computers work with only 3 out of 5 senses. **SIGHT, SOUND, TOUCH, SMELL, and TASTE.**



Our use of scent in the environment has currently become quite an issue in society. It has become such an issue in different regions of the world; those companies are required to carefully plan the use of scent in their direct marketing campaigns. In today's advertising frenzy more companies are realizing that the major advantage of direct

marketing is the ability to be a three-dimensional advertising medium, appealing to all five of the senses. Sense of smell is the ability to detect odours. As humans, we are limited to the sensation of seven basic odours and their combinations. Although not as highly developed as in various other mammals, this perceptual sense can have a significant impact on how we perceive different objects and messages.

DIGITAL SCENT TECHNOLOGY

Imagine being able to smell things using a device that connects to your computer. Like a new language, this technology is a new set of tools for self-expression, communication, and commerce. It includes software components and a peripheral device called the Personal Scent Synthesizer. Digiscents do not plan on designing the games and other platforms themselves. As well as the synthesizers, they have been creating the soft and hardware that game producers will need to mix and incorporate scents into their latest offerings. Part of that is "Reminiscent", a database of standard smells. These odours will be licensed to developers for integration into games, websites and advertisements and so on.

ISMELL:



The iSmell is a peripheral device, about the size of a PC speaker that connects to a PC via a serial or USB port. It uses consumable cartridges which are used and replaced similar to the way ink jet printers use ink cartridges. It emits natural-based vapors into the user's personal space. iSmell is triggered either on demand by the user (via a keyboard or mouse action) or via a timed or programmed response (as is the case with a DVD Scent Track).

The company's technology turns smells into digital codes that can be stored on laser discs or as computer files, and can even be e-mailed. The iSmell device reads a digital scent file, creates a smell from a "palette" of 128 chemicals stored in a cartridge, and then wafts into the air with a small fan.

SPECIFICATIONS:

1. It has cartridge of 128 chemicals which is able to produce 10,000 smells.
2. To active this device for computer it will require a driver program called as Scent Stream.

CARTRIDGE:

The cartridge will contain chemicals-either natural oils or synthetic fragrances -that will be activated by either heat or air pressure, when you send a signal from your computer. The digital smell device could add another sensory dimension to the sights and sounds of a computer game. Currently 128 chemicals are stored in a cartridge. Similar to an ink jet printer, those oils form the core of a replaceable cartridge, which is inserted in the company's iSmell device. The oils are electrically stimulated in different combinations to create specific smells in response to software prompts programmed into applications such as Web site features, computer games, digital music, and movies.

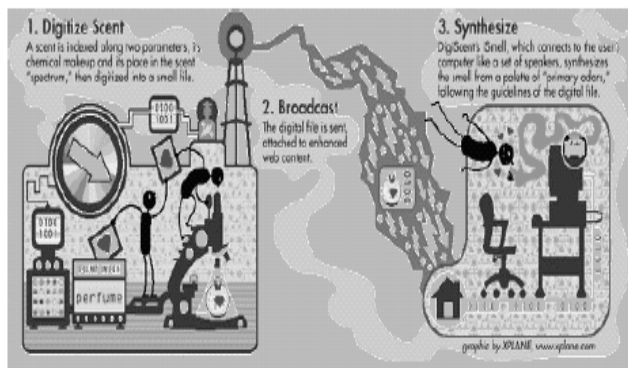


Figure 2. Principle of DigiScent's iSmell system

E-mail Alive with smell:

Of all the uses for scent ware, this one has the most ability to send emails with smells anybody can design. Sure, it'll add a fun new dimension to birthday when you can send an electronic postcard with nice music and a dozen roses that smell. There are, however, more creative uses of scent ware in bringing to life the stories we tell through more traditional mediums.

A new Tool for Catching Degenerative Neurological Diseases Early Aromatherapy will perhaps be one of the big drivers of home computer scent waresales.

FACILITIES AND LIMITATIONS

Facilities:

1. As we now that user can send any type of smell so the ismell is designed in such a way that it will give protection against that smell.
2. The scent cartridges contain mostly natural materials commonly found in the cosmetics, foods and beverages you use every day.
3. There might be possibility that user has allergy from any smell so for this problem the ismell provides locking facility. So that user can lock that particular smell which he doesn't like.

Limitations:

The obvious one is the price. Most home computer users won't be willing to pay the \$250-500+ price tag for the luxury of scratch-and-sniff websites.

Some diehard game fans may find the olfactory add-on a worthwhile boost to their multimedia experience, but chances are this technology will find its first strong market in small kiosks and other specialty shops.

CONCLUSION:

A Scent has a strange power over human beings. It can create a mood, such as foreshadowing or ambiance. It can intensify emotions such as fear or love. It can also give the sensation of virtual reality and suspension of disbelief. "The Sense of smell is closely tied to memory and emotion, making scent a powerful way to reinforce ideas". This device will become our need in future.

Agile Software Development

K.Akhil, III-B.Tech Information Technology

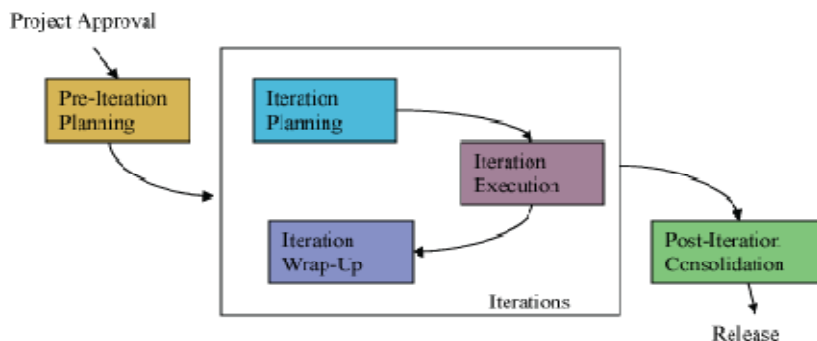
Email.id:akhilkorlam@gmail.com

What is Agile?

"Agile" in general way referred as "swift". Agile software development definition varies from one resource to another; some resources define Agile development as: "An iterative and incremental (evolutionary) approach to software development which is performed in a highly collaborative manner by self-organizing teams .

Why to use Agile?

Agile software development is a relatively new approach for software development. This is an alternative to the traditional approaches like "WaterFall model" and many more. This approach has attracted the attention of development companies in the recent few years. Now a days many leading organizations have adopted Agile in all or some of their projects such as Yahoo!, Google, Microsoft, TCS, and many more MNCs.



A generic Agile Development Process features an initial approval and iterations and release.

Life Cycle of Agile s/w Development:

Developing a software by using Agile Methodologies involves three stages. First stage is an Initiate project and define the requirements. Second stage is an integrate and testing .This can be done by several times in several ways. Third stage is a release. If it is acceptable, then release it in the market. If not then again record the incorporated changes first, then adjust the track and re-prioritise the features.

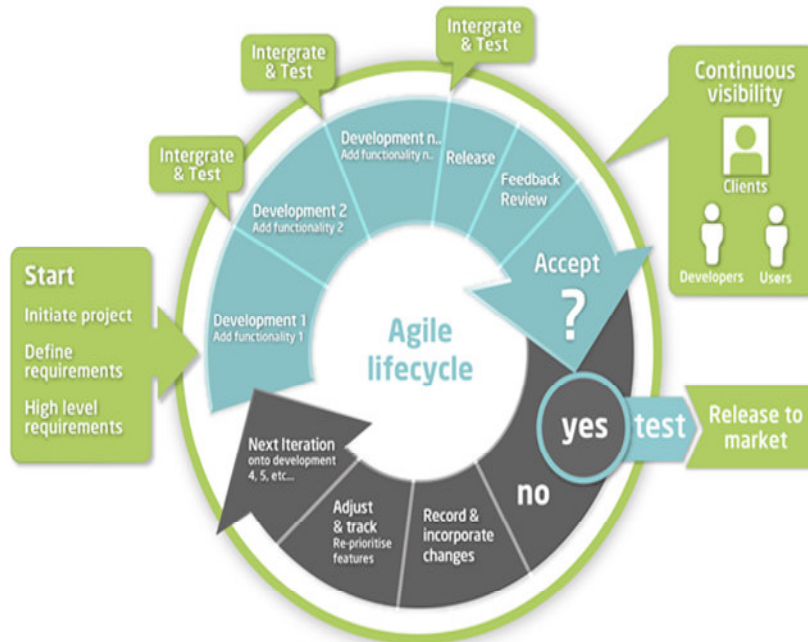


Fig:Life cycle of Agile Software Development

Methods to adopt Agility:

To adopt an Agility in developing a project, we have to follow the methods like "Scrum", "Extreme Programming", "crystal", "DSDM", "FDD".

Extreme Programming:

Extreme Programming is a new approach to software management in which it takes a code-centric view of the activity. XP offers several compelling features like Comprehensive unit tests, short release cycles, adding only what's needed for the current task, collective code ownership, continual improvement, and adding features in the order of importance.

Scrum:

Scrum is an agile, lightweight process to manage and control development work. It is a wrapper for existing engineering practices. Scrum is a team-based approach to iteratively, incrementally develop systems and products when requirements are rapidly changing. Scrum is a way to maximize productivity.

Crystal:

Crystal is a family of human-powered and adaptive, ultra light, "shrink-to fit" software Management & development methodologies.

DSDM:

The Dynamic Systems Development Method (DSDM) is a lightweight software methodology. Like other agile methods, they too use short time boxed cycles of between two and six weeks. There's an emphasis on high quality and adaptivity towards changing requirements

Feature driven development:

FDD is also an agile approach for software development systems. It provides enough structure for large items, emphasis on quality and working software, delivers frequent , tangible results.

Advantages:

1. Shortened development cycle-time of 75%
2. Higher stability of work-loads
3. Higher utilization of work-load, that's developing large-scale, software systems with a fixed number of developers.
4. Higher flexibility to change of Management & development plans,
5. Higher quality by earlier feedback from the customers.

How To Secure Consumable Components of Medical Devices and other Embedded Systems

K.INDRA SENA REDDY

BRANCH: IT

3rd year

INTRODUCTION:

A number of embedded systems, such as medical devices and printers, feature replaceable components are designed to be installed new, consumed through one or more cycles of product use, and ultimately disposed. Security is an important issue for designers of such systems. Whether to ensure against the spread of infectious diseases, guarantee a certain level of product reliability, or generate a steady stream of revenues (or some combination), a common security goal is to ensure that third parties and end users cannot clone or recondition consumables. This article describes the security challenges associated with the design of such consumable (a.k.a., disposable) components as well as practical ways to meet these challenges.

One key aspect of the architecture of a system with consumable components is the design of a secure communications protocol between the terminal or “base station” and the consumable. Another important consideration is that a would-be attacker typically has physical possession and control of at least one terminal station and potentially an unlimited supply of consumables with which to experiment and perform reverse engineering activities. Finally, designers must recognize that security is never perfect and always an arms race; upgradeable security should thus be considered so that additional security can be retrofitted in if/when attackers find the “weakest link”. Of course, all of these aspects of security must be addressed in the context of the limited processing power and memory of embedded systems, particularly within a necessarily low-cost disposable component ultimately destined for a landfill.

Authentication Protocols

At a minimum, a secure communications protocol must provide the ability of the base unit to distinguish an authorized consumable from a clone, a mechanism to limit usage time and/or count uses of the consumable, and allow the base unit to reject spent consumables. So that we may keep the following discussion concrete, consider the design of a medical device, such as that shown in Figure 1, which consists of a terminal with which a doctor interacts through a touchscreen GUI and a single-use disposable probe that interfaces with the patient.



Figure 1 - Medical device terminal with consumable probe

First, it is critical that the design of secure consumables provide for a mechanism whereby the terminal can identify the consumable as authentic. For example, one aspect of authentication might be that each consumable contains secret information known only to engineers working for the manufacturer of the system. Furthermore, each consumable might contain a serial number or encryption key that is unique.

A terminal, which verifies that the attached consumable knows certain facts, may conclude that the consumable is authentic. Importantly, however, secrets must be carefully protected if they are sent over a communications channel and even if they are merely at rest in memory. A determined (and well-funded) attacker, such as a competitor, can generally observe real-time communications over cables between the terminal and consumable, examine the contents of read-only memory areas, and disassemble executable code.

In addition, once the medical procedure has been completed the attached consumable must be somehow “marked” as used. This could be completed either automatically within the consumable as the medical procedure is performed or via a command from the terminal following the procedure. The first approach is generally more secure, but both approaches have tradeoffs, as, for example, one common scenario with a medical consumable is that the limitation of “single use” may be defined as one successful test on a single patient—which requires a level of involvement of the device operator in the marking process and also might involve several runs of the medical procedure using the same consumable.

Finally, the number of uses (or, in more general terms, the degree to which the consumable has been spent) must be ascertainable from the consumable so that the terminal is able to reject an authentic product that should be disposed based on its level of use.

The designer of a protocol, which supports authentication, marking, and use count detection of consumables, must prevent the possibility of certain well-known protocol attacks. For example, in a classic “replay attack” the designer of a clone device could simply record the responses of an authentic and unspent consumable to the various commands from the terminal and replay those same messages from the clone. Alternatively, a third party might attach a spent consumable to the base unit by way of a “man-in-the-middle” device that would intercept and sometimes alter otherwise genuine communications between the two endpoints—as illustrated in Figure 2.

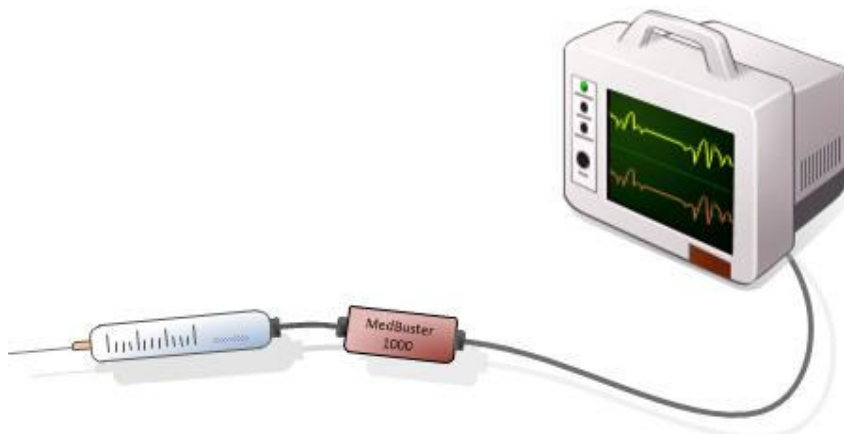


Figure 2 - Man-in-the-middle device

The use of an off-the-shelf Authentication chip can be placed on the consumable to provide a tamper-proof private key management solution. These types of devices typically offer multiple security models, such as a random challenge/response, that are based on open standards and can eliminate the need for a processor on the consumable.

Some manufacturers offer implementations that use a single line for communication and power along with a ground reference, which can be a real advantage when pins or size is at a premium on the consumable connection. Application specific data storage is also available and can be configured for “one time programming” mode to track usage. This specific feature can be employed to prevent attackers from resetting the usage count on a spent consumable. Other methods of authentication could include monitoring the power consumption profile of the consumable and looking for uniquely identifiable behaviors.

Reverse Engineering

Attackers can employ a number of proven techniques to gain insight into the inner workings of a system with the goal of discovering an exploit. One of these techniques is known as a “chip rip”, whereby they physically remove the top of a chip and analyze its internal structure for data, such as a private security key. Some chip vendors offer “tamper proof” solutions for their products while contract manufacturers can use epoxy and other mechanical defenses against this type of attack. A process called “chip sanding” can also be employed to eliminate any identifiable markings, which would complicate the identification of the specific devices that were used in the system.

Another effective method used by attackers is to connect a debugger to the system processor and step through code execution in order to determine a variety of vulnerabilities. This threat can be reduced by disabling the JTAG port, which can be completed by either burning fuses or writing specific values to locations during device programming, or configuring the appropriate debug registers early in the boot process. It is also important to remove all debug connectors/pads along with any related test points. A method to counter this type of attack is detection using case interlocks, destructive enclosures, clock speed and/or voltage level monitoring, and validating the code image by the use of a digital signature. When an

intrusion is detected, the system could potentially log and/or report the attack and optionally cease to operate.

Certain standalone “system on a chip” processors can offer a distinct advantage by not exposing any external memory busses that could be probed with a logic analyzer. If the attacker actually removes an external memory chip by de-soldering it from the circuit board and dumps the contents, data and address lines can be scrambled to further complicate the attacker’s interpretation of information. This can be performed by developing a simple software tool that scrambles the binary code image to match the data and address line assignments on the hardware. It should be noted however that scrambling the address and data lines would not be effective if the attacker is actually able to probe the external bus with a logic analyzer.

Given the level of attacker sophistication, designers must avoid using simple methods like recording serial numbers of each consumable in a text file on internal or removable storage. This type of approach to security is easily exploited by less-sophisticated attackers. Other methods that involve security by obscurity are also generally easy to circumvent by experienced attackers. In contrast, by carefully applying multiple levels of effective security measures, designers can slow down attackers and protect against a single point of entry if a specific tactic is weakened or broken.

Upgradeable Security

Consumables are now becoming more and more profitable, increasing the economic incentive for reverse engineering them. If there is sufficient economic incentive, a determined (and well-funded) attacker will find the weakest link. To limit the manufacturer’s risk, it is critical to quickly retrofit additional security. If the exploit can be prevented by modifying only the consumables going forward, that is ideal. If the exploit only can be prevented by upgrading the terminal then this must be planned for. Ideally, this could be accomplished through a software update, but this is not foolproof, as the updates may not be applied by the end-user in a timely fashion.

Securing a software update requires authenticating the new firmware before it is installed as well as validating it after it has been programmed into flash. Another key component of upgrading the firmware is a secure boot strategy. This is a feature of the processor along with immutable and often multistage authenticated boot images that prevent unauthorized code from executing. Regardless of the software update delivery mechanisms (Internet, USB, SD Card, serial) and whether the end user or field technician performs the upgrade; authentication, validation, and secure boot is critically important to preventing an attack.

The use of code image hashes, public key signatures, and signature authority certificates are common and proven methods to ensure authenticity. There are many providers of tools, processes, and hardware that take full advantage of this standards-based approach. In addition, researchers are constantly developing new and innovative ways to increase the level of security in a variety of settings while leveraging existing standards where possible. An example of this would be the creation of SHA-2, which increases the number of output bits in SHA-1 from 160 to 256 bits in a variant based on roughly the same underlying mathematical concepts.

Secure Consumable Example

One method of authenticating a consumable as described in the previous section is to use an off-the-shelf 1-Wire authentication chip. This approach keeps the complexity and cost down on the consumable side and shifts the burden to the terminal side in terms of implementing a random challenge/response protocol. A high-level block diagram shows the primary functional blocks as illustrated in Figure 3.

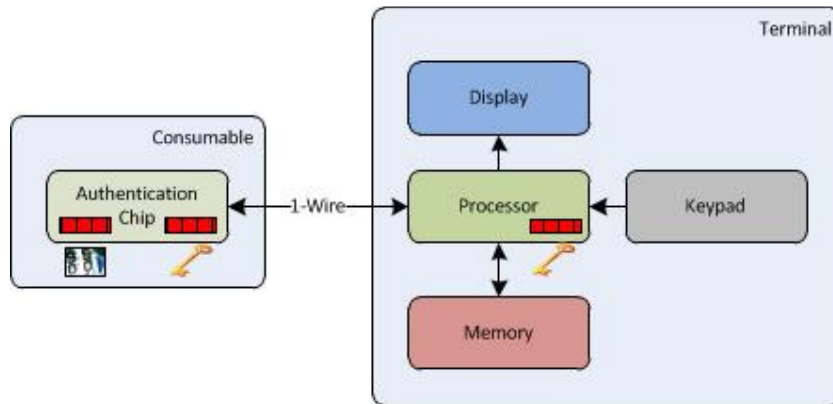


Figure 3 - High-level block diagram

In this example, a private key is permanently stored in the authentication chip during manufacturing and is unreadable from the 1-Wire interface or through physical tampering. A random challenge is generated by the processor on the terminal side and is submitted to the authentication chip over the 1-Wire interface. The consumable provides a response back to the terminal based on the private key. The response is then compared to an expected value that was computed by the terminal's processor using its protected copy of the same private key, which a concept commonly is referred to as "symmetric keys". If the response matches the expected value, then the consumable is authenticated as genuine and normal system operation can continue. The terminal may also repeat this authentication process randomly to make sure that the device has not been swapped out with an unauthorized consumable during the course of a given treatment session.

If the selected processor does not provide any inherent security features, then a second authentication chip can be co-located on the terminal to provide the required functionality. Aside from a secure key storage solution, all of the needed features can alternatively be leveraged from off-the-shelf software libraries; however, this will have an impact on processor performance and memory footprint.

Once the device has been authenticated and before a treatment session begins, the processor checks that the current usage count on the authentication chip data store is below a defined threshold. If the threshold is exceeded, the terminal will not begin the treatment session and consequently inform the operator that a spent consumable has been attached. Otherwise, the terminal will increase the usage count on the consumable by using the "one time programmable" feature (bits can only be set to '0' once, so successive bits are used to implement a count) of the authentication chip and the treatment session will begin. On some systems, the threshold may be determined by using a timestamp with a duration limit as opposed to or in addition to a session counter.

In this example, it also may be important to encrypt patient and general communication data to/from the consumable. Either this can be accomplished with the same private key, or a

different key stored on the authentication chip. Depending on the type of data and rate of communications with the terminal, the consumable would likely require a dedicated local processor and/or custom hardware to implement the encryption and decryption algorithms. Conversely, the terminal would have to have sufficient resources to process the encrypted data in real time.

Conclusion

A consumable must be authenticated as genuine through a secure communications protocol in order to prevent unauthorized cloning. In addition, the consumable must have a method for checking and updating its usage count and/or time-stamps so that it cannot be placed in service beyond its intended life, which for most medical devices is a single “valid” use.

The use of counter-measures like removing debug connectors, tamper detection, and using tamper-proof components and/or other mechanical defenses can dramatically increase the level of difficulty for physical attacks.

Windows Holographic

M.Dhanush Kumar

IT Department

Windows Holographic is an augmented reality computing platform created by Microsoft that is set to be introduced in the Windows 10 operating system upon its release in 2015. With Windows Holographic APIs, which are enabled in all versions of Windows 10 (including Windows 10 for phones and small tablets), augmented reality features can be readily implemented on any Windows universal app, across a wide range of Windows 10 devices. Microsoft announced Windows Holographic at its "Windows 10: The Next Chapter" press event on January 21, 2015.

Microsoft HoloLens:

The device for Windows Holographic, Microsoft HoloLens is a smart glasses unit that is a cordless, self contained Windows 10 computer. It uses advanced sensors, high definition 3D optical head mounted display, and spatial sound to allow for augmented reality applications, with a natural user interface that the user interacts with through gaze, voice, and hand gestures. Code named "Project Baraboo," HoloLens had been in development for five years before its announcement in 2015, but was conceived earlier as the original pitch made in late 2007 for what would become the Kinect technology platform.



Applications showcased for Microsoft HoloLens include HoloStudio, a 3D modelling application which can produce output for 3D printers; Holobuilder, a demonstration inspired by the video game Minecraft; an implementation of the Skype telecommunications application; and OnSight, a software tool developed in collaboration with NASA's Jet Propulsion Laboratory (JPL). OnSight integrates data from the *Curiosity* rover into a 3D simulation of the Martian environment, which scientists around the world can visualize, interact with, and collaborate in together using HoloLens devices. OnSight can be used in mission planning, with users able to program rover activities by looking at a target within the simulation, and using gestures to pull up and select menu commands. JPL plans to deploy OnSight in *Curiosity* mission operations, using it to control rover activities by July 2015.

Microsoft HoloLens puts you at the center of a world that blends holograms with reality. With the ability to design and shape holograms, you'll have a new medium to express your creativity, a more efficient way to teach and learn, and a more effective way to visualize your work and share ideas. Your digital content and creations will be more relevant when they come to life in the world around you. As holograms, your digital content will be as real as physical objects in the room. For the first time, holograms will become practical tools of

daily life. Shape holograms to fine-tune a design. Interact with them to learn something new. When you share your ideas, show and tell from multiple perspectives. Microsoft HoloLens enables you to make decisions more confidently, work more effectively, and bring your ideas to life right before your eyes.



Image of Microsoft HoloLens

Microsoft HoloLens vs Google Glass: Design

Microsoft HoloLens	Google Glass
1) Microsoft HoloLens isn't aiming for that at all. It is a computer of sorts, designed to be used in a relatively fixed location for more intensive set tasks. It is the laptop to Google Glass's smartphone. 2) Microsoft HoloLens, meanwhile, has a deeply tinted eyepiece, revealing that the detailed holographic worlds it creates are to be the centre of attention for however long you're wearing it.	1) Google Glass was designed to be as unobtrusive as a pair of regular glasses. The idea was that you would be comfortable wearing the headset all day. 2) Google Glass is designed to have a clear or prescription lens slotted in - your real world view is the most important factor here, with a small amount of light information layered on top when necessary.

Microsoft HoloLens vs Google Glass: Function

Microsoft HoloLens	Google Glass
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1) Microsoft HoloLens, conversely, is about complex and immersive computing tasks, like having someone show you how to fix a light switch over Skype, playing an immersive table-top game (literally) of Minecraft, or exploring a virtual approximation of Mars. 2) Microsoft HoloLens adds finger tap and head motion tracking inputs to the roster, granting way finer control.	1) Google Glass is all about simple daily tasks and notifications, the likes of which you might usually deal with on your smartphone - incoming messages, weather alerts, and the like. 2) Google Glass has a simple touchpad for manually scrolling through a simple timeline-like interface.
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Microsoft HoloLens vs Google Glass: Software

Holograms are the next evolution in computing. With this vision in mind, hardware, software, and user design engineers came together to create a new canvas for creators and developers.

Microsoft HoloLens	Google Glass
1) Microsoft HoloLens will be based on straight-up Windows 10. 2) HoloLens could just as easily see the kind of engrossing gaming experiences and applications that are being targeted at Oculus Rift.	1) Google Glass could run a number of lightweight apps using its own custom OS. 2) It is essentially a head-mounted computer, complete with screen - which should give to some idea of the kind of in-depth apps it will be able to run. While it could conceivably run the kind of simple apps that have been created for Google Glass.

Microsoft HoloLens, together with Windows 10, introduces a powerful new holographic platform. The era of holographic computing is here.

Advantages of Microsoft HoloLens:

- 1) No cords, no phones, no wires, no tethers.

- 2) Transparent lens and advanced sensors allow you to see your world and move confidently in it.
- 3) Lightweight and adjustable to fit any adult head size. Work and play comfortably.
- 4) Built-in spatial sound lets you hear holograms wherever they are in the room with pinpoint precision.
- 5) Next-generation technology enabled by Windows 10.
- 6) Augmented reality made useful and engaging.
- 7) Windows 10 means it will be easy for developers to write HoloLens apps.

An Overview Of Machine Translation

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GMRIT

INTRODUCTION

Language is an effective medium of communication. It represents the ideas and expressions of human mind. Several thousands of languages exist in the world that reflects linguistic diversity. It is difficult for an individual to know and understand all the languages of the world. Hence the methodology of translation were adopted to communicate the messages from one language into another. Today, in the era of Information and communication technology there is a revolution in the field of machine translation. Several tools free as well as proprietary are now available which supports translation of text into one or more languages.

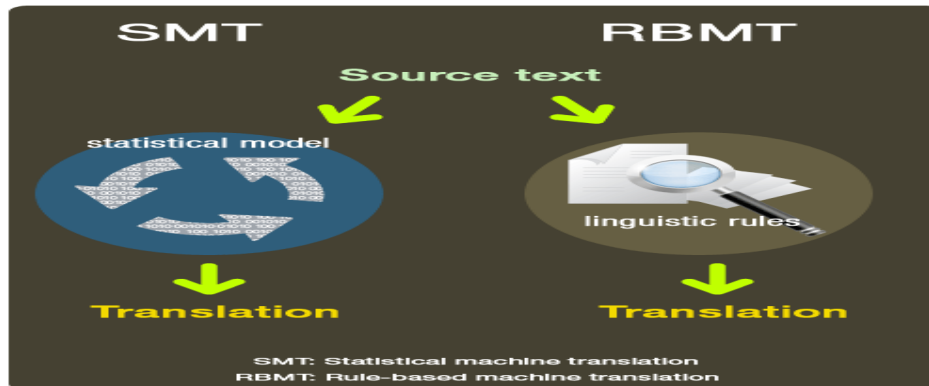
Machine Translation (MT) also known as Computer Aided Translation, is basically the use of software programs which have been specifically designed to translate both verbal as well as written texts from one language into another. It comes under the area of Natural language processing. On the basic level MT perform word for word translation. Translation depends on morphology of the language. Morphology is the identification , analysis, and description of the structure of a given language's morphemes and other linguistic units such as root words, affixes and parts of speech. Languages rich in morphology are Dravidian, Hungarian, and Turkish and languages poor in morphology are English and Chinese. Language with rich in morphology has the advantage of easier processing at higher stage of translation.

TECHNIQUES

There are mainly three types of Machine Translation namely EBMT, RBMT and SMT. EBMT stands for Example Based Machine Translation which translates sentences from one language into another using bilingual corpus. The basic units of EBMT are sequence of words and the basic techniques are matching of words against words in the corpus. In EBMT, the input sentence is decomposed into set of tokens known as fragmental phrases. These fragmental phrases are translated into the target language phrases by the analogy translation principle by referring proper examples in the corpus. Corpus can be supervised, semi-supervised or

unsupervised. Supervised sentence corpus provides tagged sentences, generally tagged using Hidden Markov Model. Unsupervised corpus contains plain sentences. Semi-supervised corpus contains a mixture of the two, can be tagged using predefined set of rules and Viterbi algorithm. The ambiguity arise during word to-word translation from source to target language can be disambiguate using word sense disambiguation algorithms such as Selection Restrictions algorithm, Lesk's algorithm, conceptual density algorithm or Random Walk algorithm. The accuracy of EBMT depends on the number of samples in the corpus. Corpus reduces the human cost. The major drawback of EBMT is search cost is expensive as corpus grows exponentially and knowledge acquisition is still problematic. RBMT stands for Rule Based Machine Translation. It is a machine translation systems based on linguistic information about source and target languages basically retrieved from (unilingual, bilingual or multilingual) dictionaries and grammars covering the main semantic, morphological, and syntactic regularities of each language respectively. It uses a set of predefined rules and sample corpus as part of translation. RBMT can be classified into three categories namely: direct, transfer and Interlingua. Direct RBMT system maps input into output using basic translation rules. It adopted a word for word translation from the source language to the target language. Transfer RBMT System employs morphological and syntactical analysis. In this the transformation process is decomposed into three steps namely: Analysis, Transfer, and Synthesis. Analysis of source text is done based on linguistic information such as morphology, parts of speech, syntax, and semantics. The syntactic or semantic structure of source language is then transferred into the syntactic or semantic structure of the target language. This approach has dependency on the language pair involved. Interlingua RBMT System is considered as the third generation of machine translation. It aims to create linguistic homogeneity across the globe. In this system source language is transformed into an intermediate language which is independent of any of the languages involved in the translation. This intermediate representation is known as Interlingua, which can be transformed into multiple languages. Advantages of RBMT are effective for core phenomena based on linguistic theory. It is easy to build an initial system. The main drawbacks are rules are formulated by experts. So it is difficult to maintain and extend and is ineffective for marginal phenomena. SMT stands for statistical Machine Translation. It is a machine translation paradigm where translations are generated on the basis of statistical models whose parameters are derived from the analysis of bilingual text corpora. The idea behind statistical machine translation comes from information theory. Advantages of SMT are Numerical

knowledge extracts knowledge from corpus reduces the human cost. This model is mathematically grounded. The drawbacks of SMT are it doesn't have any linguistic background. Search cost is expensive. .Hard to capture long distance phenomena.



All of these MT systems involve the following general steps:

- Morphological Analysis: performs word formation rules.
- Lexical analysis: Dictionary representation of words.
- Syntactic analysis: Parsing of sentences.
- Semantic analysis: Meaning representation.
- Pragmatics: determines how a sentence is used
- Discourse: Processing of connected sentences.

All these system requires a corpus for implementation, which contains sample sentences, can be tagged using parts of speech tagger. Parts of speech (POS) Tagging is the process of assigning a unique tag for each word in a Sentence. It is the lowest level of syntactic analysis. POS tagging is mainly used in Information retrieval, text to speech conversion, and word sense disambiguation. It sits between Morphology and Parsing. It requires a standard set of tags known as Tag Set for representation as well as implementation. We can simply assign a tag to each word in the sentence with the help of a Tag Set and a Stochastic HMM Tagger with Bigram assumption. Bigram taggers assign tags on the basis of sequences of two words.

Translation Tools Some of the tools developed for machine translation are :

Anusaaraka project(1995) built to transfer sentences from Telugu, Kannada, Bengali, Punjabi and Marati to Hindi. Mantra(1999) is a translation tool devised for English to Hindi

in a precise domain such as administration, office orders and office memorandum. Matra system (2004) used for English to Hindi for news stories. Anglabharati and Anubharati is used for translating sentences in English into any other languages. Anuvaadak is an English to Hindi translation tool used in domain such as official, formal, agriculture and linguistic.

RECENT TRENDS

The recent trend in machine translation is to combine Machine translation systems with data mining techniques to build corpus independent systems which can be used for extracting information from multi databases. Machine Translation combined with Image processing is useful to extract sentences from images and translate it into the intended Target language. Speech to Text, Image to Text and Speech to Speech translations are some of the research area in this field.

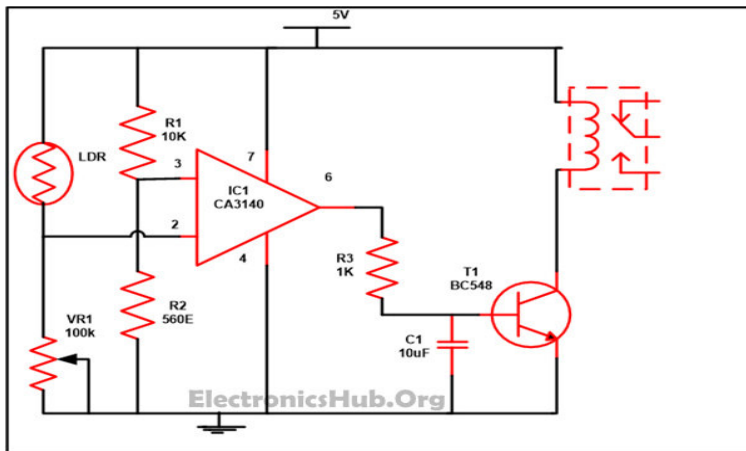
Thaumaturgy with Trivial Electronic Components

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One day when I was reading newspaper early in the morning I saw a headline 'ROBBERY LAST NIGHT'. We generally hear about robberies so that didn't affect me so much but I was constantly thinking why robberies take place only in the night mostly....!! It suddenly struck my mind that yeah, it's dark everywhere and people can't see the thieves so they can do their work easily using a small torch or small light source.

Yes being a student of Electronics I thought to provide a simple solution to this which can be very economical. I was continuously thinking about only these two antonyms light-dark. Then a very small but useful component came into my mind LDR(Light Detecting Resistor).Then I along with some of my friends planned to work on it, we thought for some time and worked out to draw a circuit and collected the components like IC CA3140, resistors, capacitors, LDR , relays and BC548 transistor.



LDR is a device whose sensitivity depends upon the intensity of light falling on it. When the strength of the light falling on LDR increases the LDR resistance decreases, while if the strength of the light falls on LDR is decreased resistance increased. In the time of darkness or when there is no light, the resistance of LDR is in the range of mega ohms, while in the presence of light or brightness it decrease by few hundred ohms. But the problem is these electronic components are not always trustworthy so it is better to check them before working. So, I will now describe the testing of LDR:For testing LDR set the range of multimeter in resistance measurement and connect it. Measure the resistance of LDR in the light, resistance must be low. Now cover LDR properly so that no light beam should fall on it, again measure the resistance now it must be high. So now our LDR is working.

Now coming to resistor it is a passive component having two terminals that are used to manage the current flow in the circuit. A current that flows via a resistor is directly proportional to the voltage that appeared into the resistor.

Resistors are of two types -i) Fixed Resistor – having a fixed value of resistanceii) Variable Resistor – whose value of resistance can be changed for example if we have a resistor of 5K then the value of resistance will vary from 0 to 5 k.Value of resistance can be calculated with the help of multimeter or with the color code that is visible on the resistor. After these two we

will now discuss about the capacitor which is also a passive component with two terminals and used to store charges. Capacitors are made up of two conductors which are separated by the dielectric medium flows in between. It works when potential difference applied across the conductors polarizes the dipole ions to store the charge in the dielectric medium.

There are two types of capacitors -i) polarized –having polarities marked on it. It is mainly used to store the charges. Before troubleshooting the circuit capacitors must be fully discharged as they have charges store in it.ii) Non-polarized – They don't have a polarity and can be mounted in any of the way. They are generally used to remove the noises present during the conversion of AC into DC.

And now the component to be discussed is Relay which provides isolation between the controller and the device because as we know devices may work on AC as well as on DC but they receive signals from microcontroller which works on DC hence we require a relay to bridge the gap. The relay is extremely useful when you need to control a large amount of current or voltage with the small electrical signal. After getting clear idea on all the components it will now be easy to discuss about the working of the designed circuit. The working of circuit is very much easy to understand. Here we used IC CA3140 which is basically an operational amplifier. Pins 2 and 3 of these IC are used to compare the voltage and give us the output in return i.e., it works as a potential divider in its inverting and non-inverting inputs (pins 2 and 3). In this LDR and VR1 form one potential divider which is used to provide a variable voltage at the inverting input (that is 2) and the second potential divider is built around non-inverting input (pin 3) with the help of R1 and R2 which will grant half of the supply voltage to inverting pin.

As we know property of LDR that during the time when our thieves open the locker and focus some light source to see the object, resistance is low therefore voltage at the non-inverting input (IE pin 2) is higher than the voltage at the inverting input (pin3) hence the output at the pin6 is high so the transistor conducts which means LED or bulb will start simmering.

But in dimness or when the locker is closed we know that resistance of LDR is high hence voltage at inverting input pin 2 of the IC CA3140 decreases than the inverting input pin 3 as a result output pin 6 moves to low state which makes the transistor to be in cut-off state and the LED or bulb associated to it stops glowing. So hence our purpose of protecting the locker is served. For experimental purpose we have used a bulb but when we are using it actually we can replace it with a buzzer of high voltage the purpose of relay is that it can support high voltages also.

While working on it we found another thing happening with the circuit. That is when the inverting and non inverting pins are actually interchanged the operation of the circuit is totally reversed. So, it glows during dim light and stops during the day light. So when we were thinking about the practical applications of our inverted circuit we thought this can be used for automating the street lights. Because consuming power is a vital task due to depleting natural resources and we see power being wasted when people forget to off the street lights during the day time.

So electronics is a platform where small changes create magic's and small operations create wonders and this small experiment by us to protect the bank systems helped us create the automated street light system which itself is an example for the game being played by electronics.

Make a tour on “ARDUINO”

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Arduino is an open-source computer software and hardware company, and a community that manufactures microcontrollers and microprocessors for electronic kits to do interactive projects for real life applications. They mainly develop microcontroller boards as hardware and these boards are preassembled for purchase or we can assemble these boards from scratch as the project is open-source hardware. The company is also working on the development of the Arduino software. The project is based on a family of microcontroller board designs manufactured primarily by Smart-Projects in Italy.

Getting started and connected with Arduino:

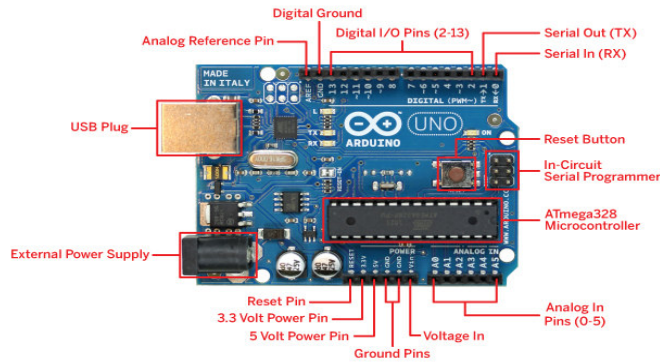
We can simply start with Arduino by buying the Arduino starter kits which provide us an Arduino board, voltage separator, software CD, chassis and the other basic things. Or else we can buy a separate Arduino board and can download software from this link <http://arduino.cc/en/Main/Software>. We simply start programming by an example of LED blinking and can learn the basics and an outlay of the software. There are libraries provided in this software so that one can refer to it and create one's own program. One can also refer to the tutorials downloaded from the following link for more detailed analysis https://www.youtube.com/watch?v=kLd_JyvKV4Y.

Arduino family

Arduino makes several different boards, each with different capabilities. In addition, part of being open source hardware means that others can modify and produce brothers and sisters of Arduino boards that provide even more form factors and functionality. Arduino Uno rev 3 is a good option to start with.

Arduino Uno Rev 3

Arduino Uno rev 3 is a great tool for people of all skill levels. However, we have a much better time learning alongside our Arduino if we understand some basic fundamental electronics beforehand. It is recommended that one should have at least a decent understanding of these concepts before one dives into the wonderful world of Arduino.



The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

"Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno and version 1.0 will be the reference versions of Arduino, moving forward. The Uno is the latest in a series of USB Arduino boards, and the reference model for the Arduino platform.

Summary

Microcontroller	ATmega328
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limits)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
Analog Input Pins	6
DC Current per I/O Pin	40 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega328) of which 0.5 KB used by boot loader
SRAM	2 KB (ATmega328)
EEPROM	1 KB (ATmega328)
Clock Speed	16 MHz
Length	68.6 mm
Width	53.4 mm
Weight	25 g

Analysis of usage of a heat exchanger in CI engine

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WHAT HAPPENS IN A CI ENGINE?

The combustion process in a CI engine starts when the air-fuel mixture self-ignites due to high temperature in the combustion chamber caused by high compression.

The actual combustion process takes place in three phases.

1. Delay period ,
2. Period of uncontrolled combustion,
3. Period of controlled combustion

DELAY PERIOD: The delay period is the time between the start of injection and start of combustion.

USAGE OF A HEAT EXCHANGER ...

If we use a heat exchanger to absorb heat from the exhaust gases and transfer it to the inlet air, then we are able to increase the temperature of the in air which in turn gives an increased temperature to charge at the moment of injection and results in decrease of delay period.

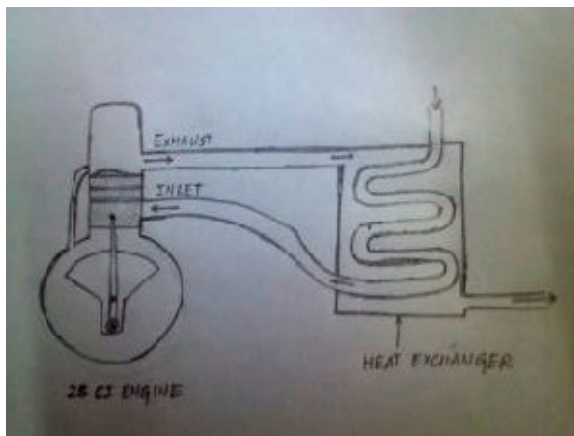


Figure : Simple representation using a heat exchanger with 2S CI engine.

ADVANTAGES :

Due to use of heat exchanger we are able to decrease the delay period in return we may get,

- Smoother engine performance

- Increased power output
- Increased efficiency
- Knocking decreases

DISADVANTAGES :

Probable disadvantages are,

- Design problem
- Increased weight ,economy decreases
- If more temperature is gained by inlet air incomplete combustion takes place due to less delay period

CONCLUSION:

With proper design and choosing a better heat exchanging material and providing sufficient time for heat exchanging, we may be able to increase the efficiency of C.I.engine.

Solar Light Bulb

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Some facts

- In India, one of world's largest, most populated countries, over 74 million rural households live without power. Children study in harmful smoke, average people spends 5% of their income on lighting fuel, people burns wood for lighting.
- A single kerosene wick burns an estimated 80 liters of fuel, producing more than 250 kilograms of carbon dioxide per year. Multiply that across the developing world and kerosene lamps emit 270,000 tons of black carbon annually – equivalent to 240 million metric tons of CO₂.

How a solar light bulb can help

- To help people living in villages, we can make a solar light bulb for providing a low cost solution by replacing their harmful kerosene lamps. This will empower the world's poor to replace kerosene with clean solar-powered light.
- We can prefer to make something from used things to recycle it. This solar light bulb can be made by using used stuffs and few electronics components. The components can be collected from used solar garden lights.

Features

1. One day sun light charge can give light up to 20-22 lumens (about three times the brightness of a kerosene lamp) for the whole night.
2. Can be charged fully in two days bright sun light. You can use the hanger as well as the multipurpose stand for charging. Just hang it on a wire outside or place it at your window.
3. Uses high quality AA NiMh battery which can work at least for 5 years.
4. Uses a high quality solar panel to charge the battery.
5. Automatically switches off in bright light to save charge.
6. The multi -purpose stand is useful for using it as desk lamp as well as for charging.

Uses

- 1.Night Lamp
- 2.Reading Lamp
3. Emergency Light
- 4.Camping Light
- 5.Garden Light

Electrical Discharge Machine

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Electrical Discharge Machining (EDM) is a well-known machining technique since more than fifty years. Nowadays it is the most widely-used non-traditional machining process, mainly to produce injection molds and dies, for mass production of very common objects.. EDM is the thermal erosion process in which metal is removed by a series of recurring electrical discharges between a cutting tool acting as an electrode and a conductive work piece, in the presence of a dielectric fluid. This discharge occurs in a voltage gap between the electrode and work piece. Heat from the discharge vaporizes minute particles of work piece material, which are then washed from the gap by the continuously flushing dielectric fluid. There are two main types of EDMs;

- 1) The ram
- 2) Wire-cut

Each are used to produce very small and accurate parts as well as large items like automotive stamping dies and aircraft body components. The largest single use of EDM is in die making. Materials worked with EDM include hardened and heat-treated steels, carbide, polycrystalline diamond, titanium, hot and cold rolled steels, copper, brass, and high temperature alloys. However, any material to be machined with the EDM process must be conductive.

ADVANTAGES:

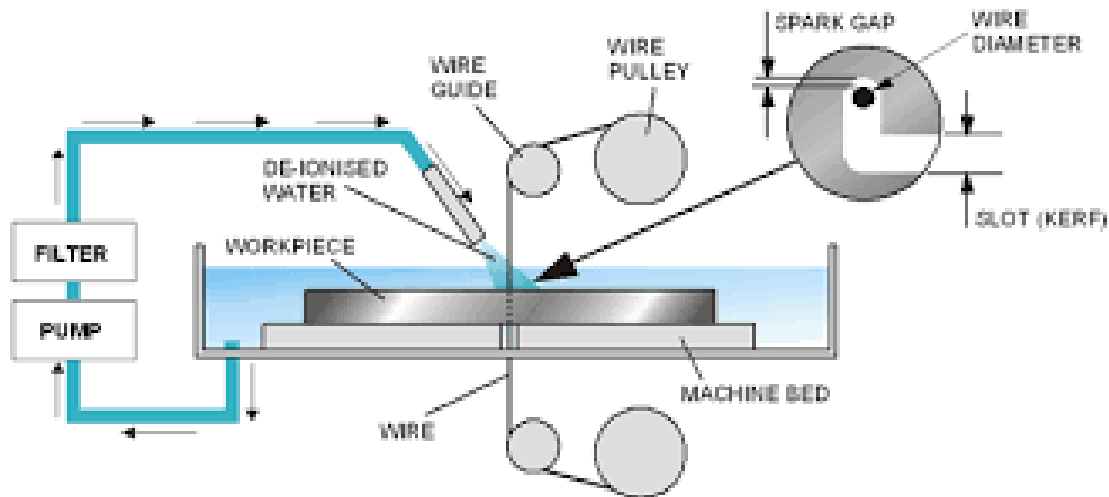
1. EDM is a non-contact process that generates no cutting forces, permitting the production of small and fragile pieces
2. Superior finishing is possible.
3. EDM machines can be used with little human intervention i.e. they can be automated.
4. Material of any hardness can be cut
5. High accuracy is possible
6. Intricate-shaped cavities can be cut with modest tooling costs
7. Holes completed in one “pass”

LIMITATIONS:

1. Low metal removal rates compared to chip machining

2. Lead time is needed to produce specific, consumable electrode shapes i.e. pre preparations are to be required.
3. Limited to electrically conductive materials
4. Slow process, particularly if good surface finish and high accuracy are required
5. Dielectric vapour can be dangerous
6. Heat Affected Zone (HAZ) near cutting edges
7. Die sinking tool life is limited.

EXPERIMENTAL SET UP :



PRINCIPLE

Principles of EDM Electrical Discharge Machining (EDM) are a controlled metal-removal process that is used to remove metal by means of electric spark erosion. In this process, an electric spark is used as the cutting tool to cut (erode) the work piece to produce the finished part to the desired shape. The metal-removal process is performed by applying a pulsating (ON/OFF) electrical charge of high-frequency current through the electrode to the work piece. This removes (erodes) very tiny pieces of metal from the work piece at a controlled rate. EDM Process EDM spark erosion is the same as having an electrical short that burns a small hole in a piece of metal it contacts. With the EDM process both the work piece material and the electrode material must be conductors of electricity. Conventional EDM in the EDM process an electric spark is used to cut the work piece, which takes the shape opposite to that of the cutting tool or electrode. The electrode and the work piece are both to be submerged in a dielectric fluid, which is generally light lubricating oil. A servomechanism maintains a space of about the thickness of a human hair between the electrode and the work, preventing

them from contacting each other. In EDM ram or sinker machining, a relatively soft graphite or metallic electrode can be used to cut hardened steel, or even carbide. The EDM process produces a cavity slightly larger than the electrode because of the overcut.

APPLICATIONS:

EDM is versatile, which allows manufacturers to use wire cut EDM functions for an extensive range of applications. Because the process can cut very small pieces, it is often an ideal choice for the production of small, highly detailed items that would normally be too delicate for other machining options. The process is cost effective for low quantity projects.

It is important to remember that the wire in the process is constantly moving, and not to be reused. As a result, the copper, brass or other metallic wire can be kilometers long, adding to the cost. And, while the process uses no force and thus does not cause burrs and can be used on delicate items, the possibility of thermal stress is certainly present.