TECNO SAVIOR

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Matoshri College of Engineering & Research Centre, Nashik

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"To Establish Omnipotent Learning Centre Meeting the Standards to Evolve as a Lighthouse for the Society."

Mission

- Setting up state-of-the-art infrastructure
- Instilling strong ethical practices and values
- Empowering through quality technical education
- Tuning the faculty to modern technology and establishing strong liaison with industry
- Developing the institute as a prominent center for Research and Development
- Establishing the institute to serve a Lighthouse for the society

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"We, Matoshri College of Engineering & Research Center are committed to practice a system of Quality Assurance that inculcates quality culture, aiming at quality initiation, sustenance and enhancement of quality comprehensively ultimately leading the institute as Center of Excellence."

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Precast geopolymer ferrocement building components – an alternative for reinforced concrete

Mr. H. M. Pawar

This study deals with the study of comparison of flexural strength of precast geopolymer ferrocement beam and slab panels with reinforced concrete beam and slab. Reinforce concrete beam having size 150 x 300 mm and geopolymer ferrocement T beam having size 230 x 300 mm and flange thickness 50 mm of length 800 mm were design as balance section and cast accordingly. Similarly, geopolymer slab of thickness 50 mm having size 500mm x 500mm were cast in mould for flexural test. Both type of beam and slab were test under two-point loads until failure. As per the observation of result load carrying capacity of RC beam is more as compare to geopolymer ferrocement beam, but load carrying capacity of geopolymer ferrocement beam and slab per unit weight is greater than reinforced concrete. Also observed that geopolymer ferrocement slab has more elastic in deflection and thickness of cracks was very thin as compare to reinforced concrete slab. Bending moment at first crack and at failure calculated by WSM and LSM method respectively and also observed that ferrocement beam carried less bending moment both, at first crack and at failure than moment of resistance calculated by WSM and LASM Respectively.

Concrete usage around the world is second only to water. Ordinary Portland cement (OPC) is conventionally used as the primary binder to product concrete. The environment issues associated with the product of OPC are well known. The amount of the carbon dioxide related during the manufacturing of OPC due to the calcination of limestone and combustion ofm fossil fuel is in the order of one ton for every ton of OPC produced. In addition, the extent of energy required to produce OPC is only next to steel and aluminum. On the other hand, the abundant availability of fly ash worldwide creates opportunity to utilize this by – product of burning coals, as a substitute for OPC to manufacture concrete. When used as a partial replacement of OPC, in the presence of water and in ambient temperature. Fly ash react with the calcium hydroxide during the hydration process of OPC to form the calcium silicate hydrate (C-S-H) gel. The development and application of high-volume fly ash concrete, which enabled the replacement of OPC up to 60% by mass (Malhotra 2002; Malhotra and Mehta 2002) is a significant development. In 1978,Davidov its (1999) proposed that binders could be produced by a polymeric reaction of alkaline liquid with the silicon and aluminum in source material of geological origin or by product material such as fly ash and rice husk ash. He termed this binder as geopolymers. Palmate al (1999) suggested that pozzolans such as blast furnace slag might be activate using alkaline liquid to form a binder and hence totally replace the use of OPC in concrete. In this scheme, the main content to be activated are silicon and calcium in the blast furnace slag. The main binder produced in a C-S-H gel as the result of the hydration process.

Geopolymer, X- rays amorphous aluminosilicate gels, are produced by the alkali activation of aluminosilicate present in the source material. These gels can be used to bind aggregate, such as sand or natural rocks, to produce mortars and concrete. In simple words, geopolymer are inorganic binder that function like the better – known Portland cement. French professor,Davidov its found out that the

existence of three dimensional silicate – aluminum product in the ancient pyramids had the same structure as zeolite, and then he designated this man-made rock like product as "Geopolymers" . Industrialization leads to the generation and release of undesirable pollutants into the environment. In order to keep pace with the rapid industrialization, there is a necessity to select an engineering process , which would cause minimum pollution into environment . on the other hand , construction industry is increasingly turning towards the use of environmentally friendly material on order to meet the sustainable aspect required by modern infrastructure . Consequently ,in the last two decades, the expansion of this concept and the increasing global warming have raised concerns on the extensive use of Portland cement due to the high amount of carbon dioxide associated with its production.

The development of geopolymer concrete offers promising signs for a change in the way of producing concrete. However, to seriously consider geopolymer binder as an alternative to ordinary Portlandcement, various strength related factors of this new material should be evaluated in any comparative analysis format . Every year millions of tons of fly ash are generated worldwide by coal-fired power plant satisfying the large demand for industrial and domestic energy. The management of this by – product is always a matter of concrete . Only about 20-30% of the generated fly ash is used , mainly as addictive in cement and concrete , filling material and the rest is disposed of. Therefore, strategies are required to deal with this waste safely . Special attention should be paid not only to prevent environmental pollution , but also to treat fly ash as a valuable resource material. In this regard , the synthesis of geopolymer is foreseen as an interesting approach . Ferrocement is a special form of reinforced concrete, which exhibits a behaviour differing much from conventional reinforced concrete in strength performance and potential application. Therefore, the uniform dispersion of reinforcement in the matrix offers in achieving improvement in many of the engineering properties of the material, such as tensile and flexural strength, toughness, fracture, crack control, fatigue resistance and an impact resistance and in addition it also provides advantages in fabrication. In developing countries, the raw materials for Ferrocement construction are

Easily available, and also it could be constructed in any complicated shape. The skill required is of low level and it has superior strength properties as compared to conventional reinforced concrete. These are the reasons for which the Ferrocement is considered to be an appropriate confinement material in developing countries such as India. The global cement industry contributes around 1.35 billion tons of the greenhouse gas emissions annually, or about 7% of the total man-made greenhouse gas emissions to the earth's atmosphere. The development of geopolymer material is an important step towards the production of environment friendly materials. Geopolymer is an inorganic alumino-silicate compound, synthesized from materials of geological origin or from by- product materials such as fly ash, rice husk ash, etc., that are rich in silicon and aluminium. Fly ash is one of the residues generated in the combustion of coal. Fly ash is generally captured from the chimneys of coal-fired power plants, and is one of two types of ash that jointly are known as coal ash Consumption of fly ash in the manufacture of geopolymers is an important strategy in making materials more environment friendly. For this reason, fly ash has been chosen as a base material for this project in order to better utilise this industrial waste.

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The primary difference between geopolymer between geopolymer concrete and Portland cement concretes the binder . The silicon and aluminium oxides in the low calcium fly ash react with the alkaline liquid to form the geopolymer paste that binds the binds the loose coarse aggregates , fine aggregate , and other un – reacted material together to form the geopolymer concrete. As in the case of Portland cement concrete. The influence of aggregate , such as grading, angularity and strength , are considered to be the same as in the case of Portland cement concrete mixtures can be designed using the tools currently available for Portland,cement concrete. Head – cured low – calcium fly ash based geopolymer concrete offer several economic benefits over Portland cement concrete. The prize of one ton of fly ash is only a small fraction of this prize of one ton of Portland

Cement. Therefore , after allowing for prize of alkaline liquid needs the make the geopolymer concrete, the prize of fly ash based geopolymer concrete is estimated to be about 10 -30 % cheaper than that of Portland cement concrete.

Interlinking of River — *Praful Rane ,S.E. Civil*

India is a diverse country not only in terms of culture and traditions but also in terms o geography, wherein some regions have an excess of river water and others face water scarity. The Rivers play a vital role in the lives of the Indian people Indian agriculture largely depends upon Manson which is always uncertain. The interlinking ofn rivers involving inter basin water transfer has canals, tunnels or water lifts, for water to flow from one river basin to another and making use of excess water. In India rainfall is dependent on the south-west and north-east monsoons or on the shallow cyclonic depression and disturbance and on violent local storms which form regions where cool humid winds of the sea meet the dry winds from the land and occasionally reach cyclonic dimension. Hence some areas are affected by the droughts while other areas are affected by seasonal floods. There is a general perception that with growing human population and rising standards of living, the available supplies of fresh water on the planet are becoming insufficient to meet demand. It will be scarce, expensive to develop and maintain and valuable in use. “Water scarcity is one of most important concerns of the present day in Maharashtra, most of the west flowing rivers meet the sea at end, major quantity of water waste.

Water is one of the principle elements which not only governs life on earth but also influences economics industrial and agricultural growth of mankind. A characteristic of the monsoon climate is variability of rainfall from year to year. India is basically an agricultural country and all its resources depend on agricultural output. In India, 55% of agricultural output is from irrigated lands. The Inter-linking of rivers in India proposal has a long history. During the British colonial rule during 19th century engineer Arthur cotton proposed the plan to interlink major Indian rivers in order to hasten import and export of goods from its colony in south Asia, as well as to address water shortages and droughts in southeastern India. Main aim of interlinking of rivers is to stop the flood problem and wastage of water and at the same time solving the deficiency problem in southern India by divert surplus water of the snow- fed rivers to the rain fed peninsular rivers. India’s National Water Development Agency (NWDA)

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has recommended the interlinkng of rivers of the country. It is jumbo project that engages money, weath engineering, management and human understanding.

The National Perspective Plan comprised, starting 1980s, of two main components,

i. Himalaya Rivers Development and
ii. Penninsular Rivers Development

Need of Study

It is very important to understand. The important of exhausting water quality has degraded as well as river interlinking is one of the ways to solve the issue of the people facing water scarity or shortage. The water from the flood river can be diverted into Dry river or can be stored in reservoir. The purpose of interlinking the river is to join the Indian rivers through reservoir and canals. This will solve the problems of flood and will provide water throughout the year. Farmers will also get benefit as they will not be dependent on monsoon for water etc. Drought, floods and shortage of drinking water. With these vast water resources our agriculture is still struggling to get water for irrigation. This is mainly because of the improper planning, unpredictable policies and failure of the successive governments to implant the policies effectively.

Economical Water Purification system. *Mr. R. S. Mawal*

About one-fifth of people on earth lack the access to safe drinking water, a condition that resulted in the death of 22.2 million people in 2004, as per the records of United Nations. Clean water use being a prime concern in many communities of developing countries. Contaminated water plays significant role in taking numerous lives in these localities, for which a number of efforts are being made for accessing safe purified drinking water. Fortunately, efficient and cheap water purification systems are being utilized and being tried to be accessed worldwide for easy access to clean water. In the following project we had tried to develop a “Low-Cost Water Purification Technique” using the basic ideas of Slow Sand Filter, some locally available filter material like charcoal, bone char, sand, manganese modified sand, clay, rice husk, banana residue ash, anthracite and try to improve the methodology using the UV Filter, RO Filter, and Activated Carbon Filter mechanism. Main focus was removal of iron from surface water by adsorption and oxidation followed by precipitation technique.Among all the adsorption media used, manganese modified sand proved to be a good adsorbent in removal of iron. For oxidation followed by precipitation, the ash produced from banana residue was used which proved to give the best result in removal of iron and also was having the cheapest material cost. A ceramic membrane with locally collected clay and rice husk was prepared which also proved to be effective for removal of turbidity, but may be due to rigorous use of the filter or any manufacturing defect, there were cracks developed on its surface and was discarded for any further use.

Purified water is essential for living a healthy life as such everyone should have access to it. Drinking water conditions have great impacts on people’s everyday life, especially in the rural and

remote areas where access to safe drinking water is very crucial. Surface water often is the only source; thus, water contaminations are difficult to avoid due to rigorous and reckless use of surface water. Unsafe drinking water may result in fatal diseases. Statistics shows that these diseases resulted in ninety percent of all deaths of children under five years old in developing countries, due to low immunization of children to infections. Despite of fulfilment of requirement of drinking water standards, the municipal water in used in developing countries is being improved and cost-efficient water filtration techniques are being developed commonly used to improve taste or to eliminate any undesired matters. Various types of filters have been designed to be more suitable for the rural areas of the countries, but the cost as well as the filter effectiveness is still not satisfactory and further improvement is still required. Drinking water is being the biggest issue nowadays in India. Most of the people in the rural areas are not able enough to use water filters or buy mineral water bottles. To overcome this problem many efforts have been done due to which cleaning water may become an affordable commodity. Every house hold should be able to develop its own drinking water purification system; this should be the aim of development of any low-cost water purification technique.

In this context a number of contributions that has been made where the filter media varies from a layer of simple cotton cloth to composite nano materials. Some of the typically used water filtration methods in India have been discussed here.

In some of the rural areas of Karnataka, women use cotton cloth layers for water filtration. This method is very cheap, cost effective in removal of sediments or any suspended solids, but may be not completely suitable for drinking purpose. Some places people are using simple plastic bottles with open end, inside which a layer of bone char followed by a layer of sand and a layer of pebble on both sides of the bone\ char layer is being used through which water will be passed for filtration. This kind of filtration process is capable of removing sediment and microbes effectively from water. Solar distillation and solar sterilization are the recent but convenient technologies developed as a low-cost water filtration process. In this process water filled clean plastic bottles are left in sun for several mhours so that the UV radiation and the heat generated will be able to kill the microbes present in water causing many waters borne diseases. Now these methods are improvised by using thermal indicators inside the bottle letting the users know when it will be safe to drink the water. But despite of being cheap and effective, this method is a function of availability of solar light. So maybe not abundantly used in mwater purification process. In comparison with solar sterilization, the solar distillation technique is even capable of purifying muddy water or salty water through the process of evaporation and condensation.

Among widely used naturally occurring adsorption media, bamboo charcoal provided with base gravel layer also is very effective in purifying water with the advantages of being low coat, environment friendly and requires minimum maintenance. Activated carbon, silver beds, charcoal, sand is being widely used in portable filters for disinfection and filtration of water. Bone char is proved to be very efficient in removing heavy metal ion s from water, the excess amount of which can cause many fatal renal and cardiac diseases and high blood pressure. Ceramic filters provided with saw dust or rice husk in the shape of pots are very much efficient in microfiltration which removes suspended solids and

microbes to great extents. The main disadvantage is for small house hold purpose where pressure filtration is not an option; it has to be used for gravity filtration and thus the rate of filtration will be very much less and the filter requires continuous maintenance. Recently IIT M has developed an effective low-cost water filtration model specifically meant for rural areas which uses a cheap plastic mesh which is capable of removing 98 percent of impurities from water including pathogens. The cost of the filter is somewhat Rs 700 to 800 and very easy for reuse. Another recent development of IIT M is development of composite nano material used as a filter media which capable of removing toxic metal ions as well as killing the pathogens. The filter is worth rupees Rs 500 excluding the cartridge. Another attractive feature of this filter media is that the cartridge can be reused by simply boiling in water or rubbing with lemon juice which is easily available in common households. India's largest company Tata Group has developed a very cheap water filter known as "Swaach", cost of which is less than Rs1000. It uses nano-technology for filtration and silver particles for eradicating bacterial contamination.

Ultimately the aim of development of any low-cost water filtration model should be to operate with minimum energy, minimum maintenance, cost effective, environment friendly, implementable with ease and can be developed from local artisans. This will subsequently inspire the people to put hygiene in to habit and of course will help in the social and economic growth of the country.

Durability of slag sand concrete — *Pravin Kolhe, T. E. Civil*

In construction materials, concrete is the largest production of all other materials. Aggregates are the important constituents in concrete. The increase in demand for the ingredients of concrete is meeting by partial replacement of materials by the waste materials which is obtained by means of various industries. Steel slag is a waste product generated during the production of steel. These wastes are disposed in the form of landfills causes an enormous amount of land pollution. So, for the increasing demand to protect the normal environment, especially in build-up areas, the needs to use these wastes are very important. Therefore, replacing all or some portion of natural aggregates with steel slag would lead to considerable environmental benefits. The utilization of waste materials from the industries has been continuously emphasized in the research work.

Replacement of Sand by Slag Sand The durability of concrete subjected to chemical attacks such as acids and sulphates are still the aspects of concern. The acids and sulphates usually attack the products of hydration of cement. Preliminary attempt is made to study the effect of partial replacement of coarse aggregate and fine aggregate by slag sand in the properties of concrete. The properties involve the compressive strength, tensile strength, flexural strength and durability. Not much work has been reported on the use of Slag Sand in concrete related to durability. So, in this work, Slag Sand is used as a partial replacement material for fine aggregate and for coarse aggregate, while manufacturing concrete, to investigate the effect of Slag Sand on the strength and durability properties. The acids and sulphates usually attack the products of hydration of cement to form products such asgypsum and ettringite along with changes in the C-S-H structure. The formation of the additional products leads to internal expansive

stress which leads to the deterioration of the concrete. In that project, we perform various durability test of concrete, like sulphate resistance, chloride penetration, water absorption (Sorptivity) slag sand replacing the aggregate in concrete is suitable for Nasik atmosphere.

In construction industry sand, aggregate and gravel crushed stone. Sand is obtained from bottom of river and aggregate and stone is available from blasting of mountain. its non-renewable sources so we used slag sand to replace the percentage of fine and coarse aggregate. Slag sand are the waste from mining industry such as copper, aluminium, steel, iron, ferrochrome, welding slag, IFC. It's waste and present in huge amount. So, to reduce the adverse effect slag sand is a best possible solution for the replaced material. Slag sand is an eco-friendly material. this help to damage ecology balanced due to excess sand lifting from river bed affecting ground water table preventing deflection of natural resource. In the world, near about 780Mt of crude steel produce and average of about 400 kg of solid product are generate. Initially the optimal percentage slag sand to be replaced is found out by conducting 28 days' compressive strength on cubes of standard size with 20%, 40%, 60%, 80% replacement of aggregate by slag sand and check the durability of the cube.

Durability test of concrete is including three type of test

1. Resistance to sulphate attack.
2. Chloride penetration test.
3. Sorptivity test of concrete.

Turbidity removal by using natural coagulant

Bhushan Pavale,Student, B. E. Civil

Turbidity in water is caused by the presence of clays, silt, fine divided inorganic and organiparticles. Turbidity is one of the important steps in water treatment process and is achieved by using coagulation process. The effectiveness of chemical coagulant are well noted yet the drawbacks associated with it can't be ruled out such as its high cost, detrimental effects on human health, large sludge production. Thus there is need to replace the chemical coagulant with effective natural coagulants. In present study, application of natural coagulants in removal of turbidity is carry out in laboratory. Carica papaya, Jackfruit, Ocimum basilicum, Banana Pith, Roselle seeds, Rice and Corn starch, Moringa Oleifera, Tamarind seeds, has the ability to remove maximum turbidity as the dosage is increased. The study indicates that with the application of above mentioned natural coagulants the turbidity of water could be reduced with aim of providing safe drinking water. Turbidity imparts a great problem in the water treatment. Carica papaya, Jackfruit, Ocimum basilicum, Banana Pith, Roselle seeds, Rice and Corn starch, Moringa Oleifera, and tamarind seeds are use as locally available natural coagulants in this study to reduce turbidity of water. Using locally available natural coagulants, suitable, easier, and environmental friendly options for water treatment. Coagulation is a primary and cost effective process

in water treatment plants. Under optimum conditions not only it effectively removes turbidity but also results in reduce sludge volume and subsequently minimize sludge management costs.

Water is the driving force of all nature. Water is vital to life and development in all parts of the world. The availability of a water supply adequate in terms of both quantity and quality is essential to human existence. Civilization developed around water bodies that could support agriculture and transportation as well as provide drinking water. Recognition of the importance of water quality developed more slowly. Early humans could judge water quality through physical senses of taste and smell. Not until the biological, chemical and medical sciences developed were methods available to measure water quality and determine its effects on human health and well-being. Water pollution is the presence of some inorganic, organic, biological, radiological or physical foreign substance in the water that tends to degrade its quality. In many developing countries, access to clean and safe water is a crucial issue. More than six million people die because of diarrhea which is caused by polluted water.

Developing countries pay a high cost to import chemicals for water treatment. About more than 80% of people lack clean, safe water. The water condition of the surface water has become highly polluted due to indiscriminate discharge from tannery, textile, and other industries, municipal into water bodies, poor drainage system, population increasing and urban encroachment, and river bank erosion. Water from all sources must have some form of purification before consumption. Various methods are used to make water safe and attractive to the consumer. The method employed depends on the character of the raw water. One of the problems with treatment of surface water is the large seasonal variation in turbidity.

For the treatment of surface water, some traditional chemicals are used during the treatment of surface water at its various steps. Commonly used chemicals for various treatment units are synthetic organic and inorganic substances. In most of the cases, these are expensive since they are required in higher dose and does not show cost effectiveness. Many of the chemicals are also associated with human health and environmental problems. So, there raised a voice to develop cost-effective, easier, and environmental friendly process of water clarification. The history of the use of natural coagulants is long. Natural organic polymers have been used for more than 2000 years in India, Africa, and China as effective coagulants and coagulant aids at high water turbidities. They may be manufactured from plant seeds, leaves, and roots. These natural organic polymers are interesting because, comparative to the use of synthetic organic polymers

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How to use Transparency in Graphic Design . *Swati Bhavsar*

There are a number of principles that make up the building blocks of great design. Some of them, like balance or alignment, are fairly basic—and well-known to anyone who's even tangentially familiar with the design world. But other principles can be a bit more of a question mark for people who don't consider themselves to be design experts—and one of those principles? Transparency.

Transparency might not be as widely known as some of the more basic design principles—but that doesn't mean it's any less important!

Let's take a deep dive into transparency—what it is, why it's important, and how to use transparency in graphic design: What is transperancy?

Graphic created in Canva.

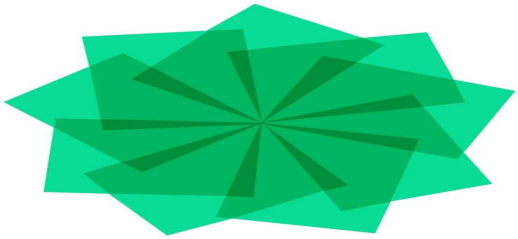
Before we jump into how to use transparency in graphic design, let's quickly cover what, exactly, transparency in graphic design is.

Transparency is also sometimes referred to as opacity. Opacity has to do with how much light passes through an object. The lower the opacity—or the more light that can pass through an object—the lighter and more see-through it is. The higher the opacity—or the less light that can pass through said object—the more solid it is.

So, in other words, the lower the opacity, the more transparent an object.

Sound confusing? Here's a simpler way to think about it: transparency is just a measure of how "see-through" an object is. The more see-through the object, the higher the transparency.

Why is transparency so important in graphic design?



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Transparent films, like this one for sale at Amazon, works as color filters for various uses.

Transparent film So transparency is about how "see-through" any particular element is in your design. But why, exactly, is that so important?

Transparency creates a sense of depth in design. Instead of keeping design elements (like typography, photos, and shapes) separate, you can layer them. This adds depth and makes for a more visually interesting design.

For example, let's say you were designing an event poster. You could create depth by using a more transparent photo as the background for your poster. Then, you can layer different design elements with different levels of transparency on top of that photo to create a sense of depth and visual interest.

Transparency can also allow your design elements to interact in new and interesting ways. For example, let's say you layered a number of transparent circles on top of each other, like a Venn diagram. The area where they intersect would create a completely different, more opaque shade—which, again, makes for a visually interesting design.

Principles of transparency in graphic design:

Now that you know what transparency is, and why it's important, let's cover the basic principles of how to use transparency in graphic design.

Use Varying levels of transparency in your design:

When it comes to transparency, if you want to add the most visual interest, you should plan to incorporate elements of varying levels of transparency.

For example, if you're rating a design element's transparency on a level between 1 and 10, you don't want every element in your design to be a transparency level 6 or a transparency level 2. Instead, you want a mix of transparency levels.

That variety in transparency is what lends a sense of depth to design—and will make all of your designs feel more visually interesting.

Mix transparent and opaque elements:

Contrast is another basic principle of design. It applies to color—but it also applies to transparency. For transparent elements to have the most impact, they need opaque elements to provide a sense of contrast.

For example, if you add a transparent box of color to your design, layer solid text on top. Or if you have a solid box of color, try a transparent font. The point is, the contrast between solid and see-through adds visual interest—and will maximize the impact of using transparency in your designs.

Machine Learning – Making Machines Smart

Komal Gaikwad ,TE Computer

"If we do it right, we might be able to evolve a form of work that taps into our uniquely human capabilities and restores our humanity. The ultimate paradox is that this technology may become a powerful catalyst that we need to reclaim our humanity."

-John Hagel, Business Management Consultant

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Machine Learning is cardinally an area of **Artificial Intelligence** which has been a featuring component of digitalization solutions that has caught an eye in the digital arena. As **John Hagel** has said, if used in the right way, artificial intelligence could prove to be a boost to unique human capabilities.

There are so many ways in which the term 'Machine Learning' could be defined and described. The simplest of all is 'the technology that helps the machine to act, learn, gain experience, gather the data and then act while predicting the possible outcomes.' In Machine Learning a computer program is assigned to perform some tasks and it is said that the machine has learnt from its experience if its measurable performance in these tasks improves as it gains more and more experience in executing these tasks. So, the machine takes decisions and does predictions / forecasting based on data.

Machine Learning has a wide variety of fields where it can be applied, such as: robotics, computer games, virtual personal assistants (like Google assistant, Siri, Alexa), natural language processing, pattern recognition, online transportation network (example: predicting the risen prices in the peak hours for cab services like Ola, Uber, etc.), traffic prediction (roadblocks, congestion, jams, etc.), medical diagnosis, data mining, agriculture advisory, BoTs (chatbots to serve as online customer support), search engine result filtering (showing the results of users' interest on top), social media services, share market prediction (market trends and fluctuations), online fraud predictions, E-mail spam filtering, crime prediction through video surveillance system.

Though a reliable technology, machine learning is still prone to ethical threats. As the machine learning completely depends on the datasets that are fed to it or collected by the machine itself, it is a threat if the datasets are biased and may exhibit these biases upon use, thus compromising the ethical base of the result generated or the predictions made by the machine. The evolution of AI systems gives rise to many questions in the terms of ethics and morality. Other forms of ethical challenges, not related to personal biases, are more seen in fields like health care. There are concerns among health care professionals that these systems might not be designed in the public's interest but as income-generating machines. This is seen in regions where there is a long-standing ethical dilemma of improving health care, but also increasing profits.

The goal of machine learning technology is to optimize performance of a system when handling new instances of data through user defined programming logic for a given environment. To accomplish this goal effectively and efficiently, machine learning depends heavily on statistics and computer science. Overcoming the challenges in order to reach the optimal goal is going to be a huge task for the industry. Machine learning has been evolving since the beginning of its development and experts make a conclusion that it is going to be a huge market trend in the upcoming future. It has shown great potential and has much more to offer. Machine learning is the future of AI.

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jQuery - Introduction — *Ms. Harshala Antapurkar*

jQuery is an open source JavaScript library that simplifies the interactions between an HTML/CSS document, or more precisely the Document Object Model (DOM), and JavaScript.
Elaborating the terms, jQuery simplifies HTML document traversing and manipulation, browser event handling, DOM animations, Ajax interactions, and cross-browser JavaScript development.
jQuery is widely famous with its philosophy of **"Write less, do more."** This philosophy can be further elaborated as three concepts:

- Finding some elements (via CSS selectors) and doing something with them (via jQuery methods) i.e. locate a set of elements in the DOM, and then do something with that set of elements.
- Chaining multiple jQuery methods on a set of elements
- Using the jQuery wrapper and implicit iteration

Using jQuery (JS) library on HTML page

There are several ways to start using jQuery on your web site.

1. Use the Google-hosted/ Microsoft-hosted content delivery network (CDN) to include a version of jQuery.
2. Download own version of jQuery from jQuery.com and host it on own server or local file system.

Basic syntax for any jQuery function is:

- A $(selector).action()
- A $ sign is to define/access jQuery
- A (selector) is to "query (or find)" HTML elements in html page
- A jQuery action() is the action to be performed on the selected element(s)

Why jQuery?

Some of the key points which support the answer for why to use jQuery:

- It is incredibly popular, which is to say it has a large community of users and a healthy amount of contributors who participate as developers and evangelists.
- It normalizes the differences between web browsers so that you don't have to.
- It is intentionally a lightweight footprint with a simple yet clever plug-in architecture.
- Its repository of plugins is vast and has seen steady growth since jQuery's release.
- Its API is fully documented, including inline code examples, which in the world of JavaScript
- libraries is a luxury. Heck, any documentation at all was a luxury for years.
- It is friendly, which is to say it provides helpful ways to avoid conflicts with other JavaScript libraries.

Advantages:

- Wide range of plug-ins. jQuery allows developers to create plug-ins on top of the JavaScript library.
- Large development community
- It has a good and comprehensive documentation
- It is a lot more easy to use compared to standard javascript and other javascript libraries.

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- JQuery lets users develop Ajax templates with ease; Ajax enables a sleeker interface where actions can be performed on pages without requiring the entire page to be reloaded.
- Being Light weight and powerful chaining capabilities makes jQuery stronger.

Disadvantages:

- While JQuery has an impressive library in terms of quantity, depending on how much customization you require on your website, the functionality may be limited thus using raw javascript may be inevitable in some cases.
- The JQuery javascript file is required to run JQuery commands, while the size of this file is relatively small (25-100KB depending on the server), it is still a strain on the client computer and maybe your web server as well if you intend to host the JQuery script on your own web server.

How to tackle CyberCrime? — *Ms. Surabhi Pagar*

To tackle cybercrime effectively, establish multidimensional public-private collaborations between law enforcement agencies, the information technology industry, information security organizations, internet companies, and financial institutions. Unlike the real world, Cybercriminals do not fight one another for supremacy or control. Instead, they work together to improve their skills and even help out each other with new opportunities. Hence, the usual methods of fighting crime cannot be used against cybercriminals.

The best way to go about is by using the solutions provided by Cross-Domain Solutions. This allows organizations to use a unified system comprising of software and hardware that authenticates both manual and automatic transfer and access to information when it takes place between different security classification levels. This allows seamless sharing and access of information within a specific security classification, but cannot be intercepted by or advertently revealed to the user who is not part of the security classification. This helps to keep the network and the systems using the network safe.

- **Use Strong Passwords:** Maintain different password and username combinations for each account and resist the temptation to write them down. Weak passwords can be easily cracked using certain attacking methods like Brute force attack, Rainbow table attack etc. The following precautions can be taken to avoid your password getting hacked.
  - Using keyboard patterns for passwords. e.g. – qwertyui
  - Using easy combinations. e.g. – Raju1990, Feb1990
  - Using Default passwords. e.g. – Welcome123, Ravi123
  - Keeping the password the same as the username. e.g. – Raju/Raju
- **Be social media savvy:** Be sure to keep your social networking profiles (Facebook, Twitter, YouTube, etc.) are set to private. Be sure to check your security settings. Be careful of what information you post online. Once it is on the Internet it is there forever.

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- **Secure your Mobile Devices:** Many people are not aware that their mobile devices are also vulnerable to malicious software, such as computer viruses and hackers. Be sure to download applications only from trusted sources. It is also crucial that you keep your operating system up-to-date. Be sure to install anti-virus software and to use a secure lock screen as well. Otherwise, anyone can access all your personal information on your phone if you misplace it or even set it down for a few moments. Someone could even install malicious software that could track your every movement through your GPS.
- **Protect your data:** Protect your data by using encryption for your most sensitive files such as financial records and tax returns. A person can stay one step ahead of the hacker by getting information about the scams and hacking styles on the Internet. Fishing is a famous hacking method, but a person can get rid of all the frauds by taking information from the Internet about the latest fishing attacks. So, stay safe and tell your neighbors about these scams and make them aware.
- **Protect your identity online:** When it comes to protecting your identity online it is better to be too cautious than not cautious enough. It is critical that you be cautious when giving out personal ID such as your name, address, phone number, and/or financial information on the Internet. Be certain to make sure websites are secure when making online purchases, etc. This includes enabling your privacy settings when using/accessing social networking sites.
- **Keep your computer current with the latest patches and updates:** One of the best ways to keep attackers away from your computer is to apply patches and other software fixes when they become available. By regularly updating your computer, you block attackers from being able to take advantage of software flaws (vulnerabilities) that they could otherwise use to break into your system.
- **Protect your computer with security software:** Several types of security software are necessary for basic online security. Security software essentials include firewalls and antivirus programs. A firewall is usually your computer's first line of defense. It controls who and what can communicate with your computer online. You could think of a firewall as a sort of "policeman" that watches all the data attempting to flow in and out of your computer on the Internet, allowing communications that it knows are safe and blocking "bad" traffic such as attacks from ever reaching your computer.
- **Parental Control:** In the era of online technology, parents should monitor all the activities of their children online. Giving adequate privacy to children would be problematic. Parents need to be cautious and should keep an eye on browser history and email accounts regularly. A better way of handling this is by enabling parental control in mobile apps, browsers, and at the router level so that they will be able to access only the secured sites. This will keep the children safe from online fraud. Many apps like Netflix, Amazon Prime, youtube offer kids-only personalized content to protect children from wrongdoings.

Techno savior

- **Call the right person for help:** Try not to panic if you are a victim. If you encounter illegal online content, such as child exploitation, or if you suspect a cybercrime, identity theft, or a commercial scam, just like any other crime report this to your local police. There are many websites to get help on cybercrime. To name a few https://staysafeonline.org, https://digitalpolice.gov.in, www.usa.gov, https://cybercrime.gov.in

Conclusion:

Today hackers are spread across the world in large quantities. Many government and private agencies like FBI, CIA, state police are working to detect these hackers, but we also have some duty to protect ourselves and our private data from online frauds. Apart from this, people who are illiterate should be given information about debit cards, credit cards, the internet, and computer. We know it is a bit difficult to catch these hackers because they sit in one country and hack the computer from another country, so the best way to avoid these things is that we have to be careful and alert and all IDs and Passwords on the Internet should always be unique and strong. Finally, I would like to say that if you use the internet properly and use the secure websites, then it will be difficult for hackers to hack your data.

A Hybrid Intrusion Detection System — Priyanka Ishwar Patil TE Computer

With the rapid expansion of computer usage and computer network the security of the computer system has become very important. Every day new kind of attacks are being faced by industries. As the threat becomes a serious matter year by year, intrusion detection technologies are indispensable for network and computer security. A variety of intrusion detection approaches be present to resolve this severe issue but the main problem is performance. It is important to increase the detection rates and reduce false alarm rates in the area of intrusion detection. In order to detect the intrusion, various approaches have been developed and proposed over the last decade. In this article, a detailed survey of intrusion detection based various techniques has been presented.

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Intrusion is some time also called as hacker or cracker attempting to break into or misuse your system. While introducing the concept of intrusion detection in 1980, defined an intrusion attempt or a threat to be the potential possibility of a deliberate unauthorized attempt to

- access information,
- manipulate information, or
- Render a system unreliable or unusable.

Intrusion detection systems do exactly as the name suggests: they detect possible intrusions. More specifically, IDS tools aim to detect computer attacks and/or computer misuse, and to alert the proper individuals upon detection.

An intrusion detection system (IDS) inspects all inbound and outbound network activity and identifies suspicious patterns that may indicate a network or system attack from someone attempting to break into or compromise a system. An IDS installed on a network provides much the same purpose as a burglar alarm system installed in a house. Through various methods, both detect when an intruder/attacker/burglar is present, and both subsequently issue some type of warning or alert.

Intrusion detection systems serve three essential security functions: they monitor, detect, and respond to unauthorized activity by company insiders and outsider intrusion. Intrusion detection systems use policies to define certain events that, if detected will issue an alert. In other words, if a particular event is considered to constitute a security incident, an alert will be issued if that event is detected. Certain intrusion detection systems have the capability of sending out alerts, so that the administrator of the IDS will receive a notification of a possible security incident in the form of a page, email, or SNMP trap. Many intrusion detection systems not only recognize a particular incident and issue an appropriate alert, they also respond automatically to the event. Such a response might include logging off a user, disabling a user account, and launching of scripts.

Basically IDS are of two type's i.e.

--NIDS (Network Intrusion Detection Systems)

--HIDS (Host Intrusion Detection Systems)

Both of them have their own prone and cons. The two types of intrusion detection systems differ significantly from each other, but complement one another well. The best IDS tools combine both approaches under one management console. That way, the user gets comprehensive coverage, making sure to guard against as many threats as possible.

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Techno savior

Laser Diodes Enable Motion Sensing and Light-Based Distance Measurements (LiDAR)

M.N.Navale

Source :https://www.allaboutcircuits.com/industry-articles/laser-diodes-enable-motion-sensing-and-light-based-distance-measurements-lidar/

White light comprises every color of the visible spectrum, with multiple colors having different frequencies and wavelengths. As a result, it's very challenging to beam this type of light onto a single point. LEDs commonly utilized for visual indication in electronic devices and equipment generate light containing electromagnetic waves of varying frequencies.

Laser diodes (LDs), on the other hand, produce "coherent light," which consists of a focused light beam of a specific frequency and wavelength. Their unique properties make them highly useful in today's fast-changing world.

There are two seemingly at-odds needs for LDs that many designers have to seemingly choose between: most people need both improved sensing accuracy and longer detection distance from their LDs. The improvement of accuracy has been traditionally achieved by reducing the size of a laser beam's spot; increased detection distance has been traditionally achieved by increasing the optical output of the laser. It is not easy, however, to realize these two competing needs at the same time.

What's the Role of Laser Diodes in LiDAR?

LDs are semiconductor devices similar in function to LEDs, but capable of producing coherent laser light. LEDs generate light via electroluminescence — the process of passing an electric current through the device to create photons by creating excess electron and hole pairs. LDs, on the other hand, amplify visible light via stimulated emission of radiation.

Laser light has the following distinct properties:

- **Coherence:** Laser light can be termed coherent since the wavelength of the light waves emitted is in phase.
- **High-power and Intensity:** Laser is incredibly bright since it is emitted by continuous emissions with more power per unit surface area.
- **Monochromaticity:** Laser comprises light waves of a single wavelength.
- **Directionality:** Light emitted from laser diodes is highly directional, as it shows minimal divergence.

Laser diodes are designed by doping semiconductor materials like aluminum gallium arsenide to create n-type and p-type layers. Doping is the process of adding small amounts of impurities to pure semiconductors to improve conductivity.

LDs give off light when electric current applied to the device causes the holes and electrons in a semiconductor material to interact at the p-n junction, also known as stimulated emission. They can also accurately measure an object's shape and distance by taking advantage of the laser beam's linearity. This technology is known as Light Detection and Ranging (LiDAR).

The time of flight (ToF) method is the most used distance measurement method in LiDAR. In the ToF method as depicted in the image below, distance is calculated by measuring the time it takes for the light emitted from the light source to be reflected by the object and returned to the detector (flight time).

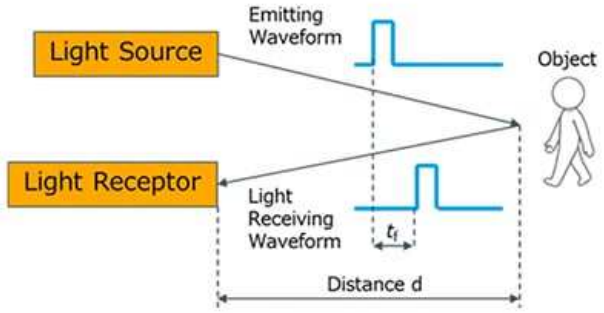


Figure 1. Conceptual diagram of the time of flight (ToF) method. Image from ROHM

A Broad Range of Applications for High Power Laser Diodes

Due to their linearity, coherence, pulse response characteristics, and monochromaticity, LDs are highly useful in a wide range of electronic devices for sensing and distance measurement. Key applications encompass industrial, consumer, and automotive, ranging from robotic vacuum cleaners and autonomous vehicles to automated control systems.

In many of these applications, as the need for both accuracy and distance increase, high-power laser diodes are a natural choice to suit the otherwise competing needs of the designer.

Automated Control

High-power laser diodes provide motion sensing and LiDAR capabilities for non-contact control of equipment, including HVAC systems used in commercial, industrial, and residential facilities.

Security and Surveillance

LDs can help detect the presence of intruders at factories, private facilities, construction sites, and more. They enable security and surveillance systems to capture images and video footage even in poor lighting conditions.

Transport

In commercial transport facilities, such as train stations, laser diodes utilize LiDAR to detect human presence at train platform doors, enabling automatic operation. Similarly, LDs can be used in advanced

driver-assistance systems (ADAS) in modern cars for detecting variations in a driver's eyelids and facial features.

VR/AR and Gaming Systems

Laser diodes enable motion sensing in virtual reality/augmented reality systems and gaming consoles.

Robotic Vacuum Cleaners

LDs are used in robotic vacuum cleaners to deliver a laser beam for measuring the entire room's shape before the operation to find an optimal cleaning path.

3D Scanners

In 3D scanners for industrial and retail applications, laser diodes utilize LiDAR to obtain the coordinate data from the shapes of different objects.

Ranging Machines

Laser diodes deliver a narrow beam for precise measurements in laser rangefinders. These devices measure distance by calculating the phase difference between light emitted and reflected from an object, also known as the TOF method. Without the high-coherence light characteristics of semiconductor lasers, this application is not feasible.

Drones and UAVs

Laser diodes provide long-range LiDAR capabilities in military/commercial drones and UAVs for measuring the distance to the ground, 3D mapping, and automatic landing.

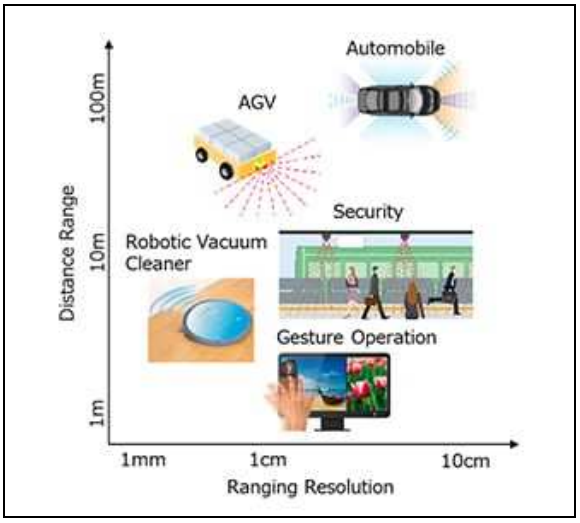


Figure 2. Applications of LiDAR technology using the TOF method. Image from ROHM

Techno savior

Automated Guided Vehicles

Laser diodes enable highly reliable sensory functions for navigation of automated guided vehicles (AGVs) utilized in a wide range of industries. Examples include portable robots used for transporting materials in factories, assembly plants, and warehouses.

Supply Chain

Laser diodes help to enhance the efficiency of logistics by employing LiDAR to detect the shape and condition of objects in warehouses, allowing for more accurate inventory.

Autonomous Vehicles

Laser diodes in self-driving vehicles utilize LiDAR for 3D representation of the surroundings and obstacle detection. LDs rated up to 125W can meet the high-power requirements of automotive applications with stable performance over a wide range of operating temperatures.

Limitations of Laser Diodes

The majority of laser diodes available today are manufactured using semiconductor materials and manufacturing processes that achieve typical lifetimes anywhere from 25,000 to 50,000 hours. However, designers note that reliability is highly dependent on operating temperature conditions. The long-term performance of laser diodes tends to degrade significantly when used at high temperatures. Nonetheless, today's industrial applications require components that can perform reliably in high-temperature and pressure environments.

Introduction to Photodiodes: The Nature of Light and pn Junctions

Vishwas Wadekar

Source: https://www.allaboutcircuits.com/technical-articles/introduction-to-photodiodes-the-nature-of-light-and-pn-junctions/

Learn about how semiconductor devices interact with electromagnetic radiation to enable electronic detection of light, UV, and infrared.

Photodiodes are measurement devices that produce electrical signals in response to various types of high-frequency electromagnetic radiation—ambient light, light focused by a camera lens, laser signals used in communication systems, thermal emissions, and so forth.

This introduction to photodiodes will serve as preparation for further study of light-sensitive circuits, applications, and techniques. The introduction is organized as five separate articles:

1. **The Nature of Light and pn Junctions**
2. Physical Operation of Light-Sensitive pn Junctions
3. Understanding Photovoltaic and Photoconductive Modes of Photodiode Operation

4. Characteristics of Different Photodiode Technologies
5. Understanding the Photodiode Equivalent Circuit

What Is Light?

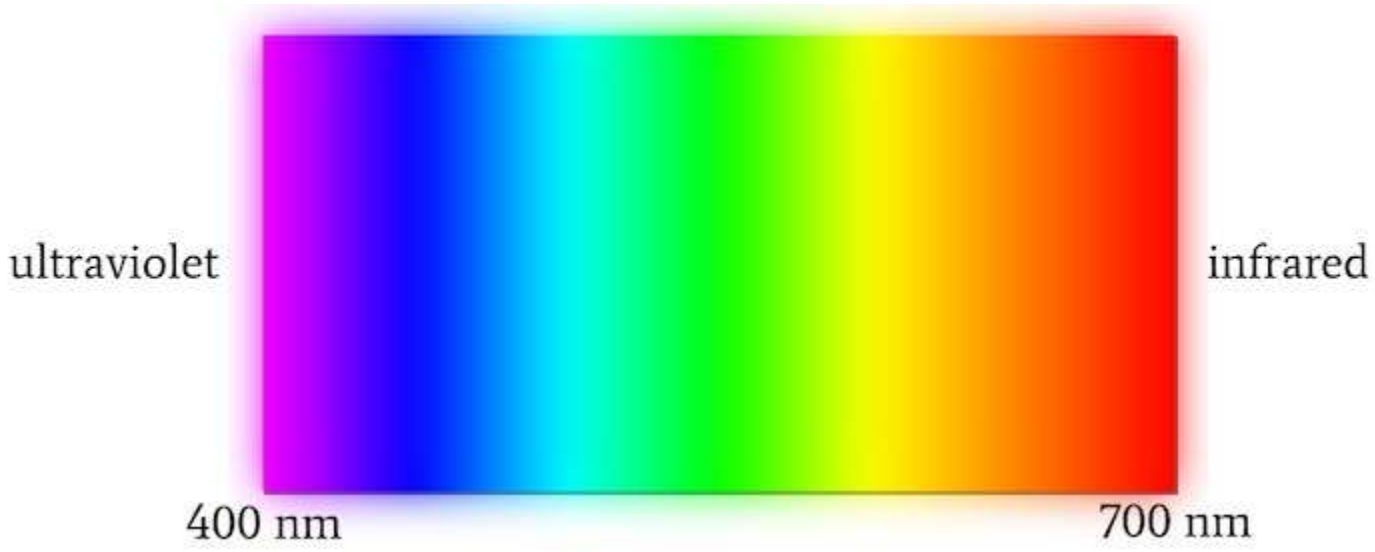
If you've studied quantum mechanics, you know that this question is not as straightforward as it seems. Fortunately, we don't need to unravel the mysteries of the universe in order to successfully incorporate photodiodes into our electronic systems. We do, however, need to have a basic scientific understanding of light.

Electromagnetic Radiation and Wavelengths

Electromagnetic radiation (EMR) propagates as a wave and also consists of massless particles called photons. We categorize electromagnetic waves according to their wavelength. Light is simply EMR that falls within a specific range of wavelengths.

If we adopt a strict interpretation of the word "light," we would associate this word only with optical wavelengths, i.e., wavelengths of light to which the human eye is sensitive. The optical wavelengths extend from 400 nm to 700 nm, with different wavelengths corresponding to different colors.

As you can see in the diagram, the colors start at violet (which has the shortest wavelengths) and move through the rainbow toward red (which has the longest wavelengths).



We can also apply the word "light" to electromagnetic radiation that is near but not actually within the optical range. Infrared light extends from 700 nm to 1 mm, and ultraviolet light extends from 400 nm to 10 nm. When "light" is interpreted in this broader sense, we can use the term "visible light" to distinguish optical EMR from infrared and ultraviolet.

Techno savior

Electromagnetic Radiation and Photons

Electrical engineers often emphasize the quantum nature of light, because photons play an important role in the interaction between light and electronic circuitry. Photons transfer energy, and the energy associated with an individual photon is determined by wavelength.

EMR with higher frequency (or shorter wavelength) has higher-energy photons, and EMR with lower frequency (or longer wavelength) has lower-energy photons.

The pn Junction and the Diode

Get some semiconductor-grade silicon (the **really** pure stuff). Dope a section of it with a pentavalent element to make n-type silicon, and dope an adjacent section of it with a trivalent element to make p-type silicon. You've got a pn junction—one of the pillars of postmodern civilization.

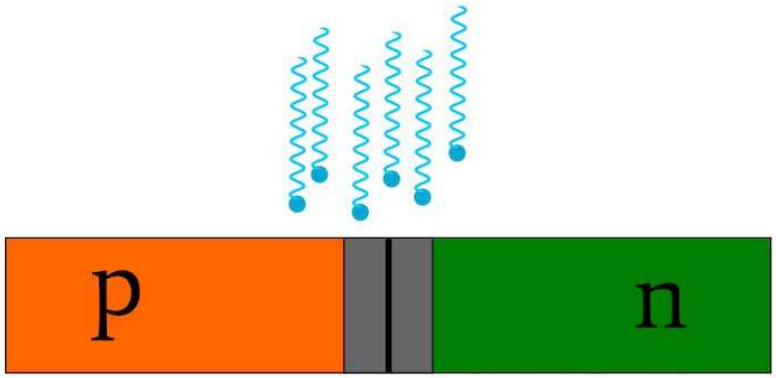
When a silicon pn junction is packaged and used in a circuit, we call it a diode (or a silicon junction diode if you want to be more precise). When we implement ordinary diodes, we're usually thinking in terms of forward-bias operation: the diode blocks current when its forward-bias voltage is less than about 0.6 V, and it freely conducts current when its forward-bias voltage is greater than 0.6 V. (This is a major simplification, but a useful one. For a more in-depth discussion, consider reading my article on simplified circuit-analysis techniques for forward-conducting diode circuits.)

With photodiodes, however, we're interested in zero-bias operation or reverse-bias operation. This principle of photodiode implementation is crucial, so let's discuss it a bit more before we finish up.

The pn Junction as an Optical Detector

The purpose of a photodiode is to generate current that is proportional to the intensity of visible, infrared, or ultraviolet light. The technical term for light intensity as measured by a photodiode is illuminance.

A photodiode has transparent packaging that allows light to reach the pn junction, and in a properly designed photodiode circuit, incident light will create precise variations in the amount of current flowing through the photodiode.



If we forward bias a photodiode to the point of conduction, we no longer have an optical detector. Detection occurs when the energy transferred by incident photons significantly influences the total diode current. Current flows freely through a forward-conducting diode, regardless of the incident light. Thus, photodiode circuits are designed such that the photodiode has zero bias or reverse bias.

A photodiode implemented with zero bias operates in photovoltaic mode, and a photodiode implemented with reverse bias operates in photoconductive mode. These two modes are explored in detail later in this introduction.

Measuring Light, Infrared Radiation, and Ultraviolet Radiation

Photodiodes are semiconductor devices that can be used to measure visible light, infrared radiation, or ultraviolet radiation. A silicon photodiode is not fundamentally different from a typical silicon rectifier diode, but photodiodes take advantage of the zero-bias or reverse-bias characteristics of a pn junction.

Intro to Fiber-Optic Communication Systems — *Mayuri Hire*

Source:https://www.allaboutcircuits.com/technical-articles/transmitter-and-receiver-circuits-for-fiber-optic-communication-systems/

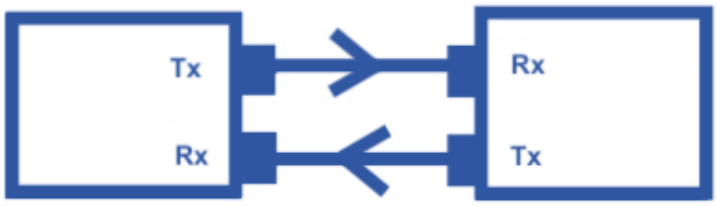
What Is an Optical Communication System?

For decades, electronic signals have been sent effectively via normal 'hard-wired' connections or by the use of different kinds of radio links which had their own downfalls. On the contrary, optic fiber links, whether utilized for video or audio links over long or short ranges, offer some unique advantages as compared to the standard wired cables. This article delves to discuss the optical transmitters and receiver circuits for fiber-optic communication systems.

Presently, the growth in information technology has had increased use of the current telecommunication systems. Often, optical fiber communication plays a significant role in the development of telecommunication systems with high quality and speed. Nowadays, optical fiber applications majorly involve telecommunication systems with an inclusion of internet and local area networks (LAN) to achieve high signaling rates.

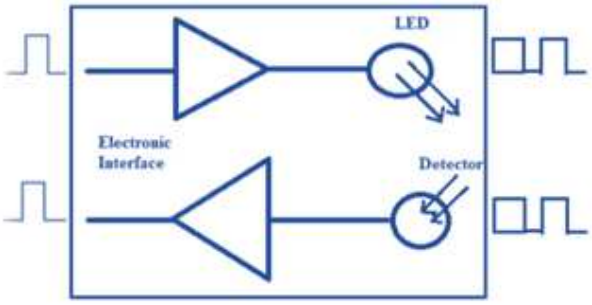
How Fiber Optics Work

In optical fiber technology, an optical fiber link is utilized to transfer analog or digital data in light frequency form via a cable with a highly reflective central core. The role of the highly reflective central core is to act as a light guide for the transfer of light through it through continuous reflections across its characteristic reflective walls. As is illustrated in the block diagram below, the optical fiber communication module mainly comprises a transmitter (Tx) circuit and a receiver (Rx) module.



A simple receiver-transmitter block diagram

As shown in the fiber-optic data link above, the transmitter is located on one end of the fiber cable while the receiver is located on the other sides. As is common, a transceiver- a module that includes a transmitter and receiver- is employed in most systems. The input to the transmitter comprises an electrical signal which converts into an optical signal from either a light-emitting diode (LED) or laser diode. As required, the light signal from the transmitter is linked to the fiber cable with the use of a connector and broadcasted via the cable. Subsequently, the light signal from the fiber terminal can be linked to a receiver, anywhere a detector converts the light to an electrical signal, after which it is suitably conditioned for use by the receiving equipment. The figure below depicts a block diagram for a typical optical transmitter and receivers.



Block diagram for a typical optical transmitter and receivers

Pros and Cons of Fiber Optics

A most important aspect of the fiber optic circuit links is the perfect immunity to the electrical interference and stray picks ups. While the problem of electrical interferences and stray pick-ups may be reduced by designing the standard cable links, it may be increasingly difficult to entirely eliminate the issue. In contrast, the non-electrical attributes of the optical fiber cables aids in making the electrical interference inconsequential with an exception of the possible disturbance at the receiver terminal, which may be eradicated via effective shielding of the receiver circuit.

Techno savior

Systems that incorporate optic fiber cables working together have close to no complication or issues associated with cross-talks. This is so given the encapsulation of the fiber optic cables preventing any light leakage. As such, links done by fiber optic guarantee a reasonably safe and reliable transfer of data. Besides, through suitable transmitting and receiving circuits, it is increasingly suitable for the fiber optic links to have the capacity of handling substantial bandwidth ranges, especially due to the improved electrical isolation in the entire like making sure no complications with earth loops develop. Notably, optic cables are typically slim and lightweight with immunity to climatic conditions and various other chemical substances. As a consequence, they are frequently used with ease in inhospitable environments where electrical cables, particularly coaxial cables would otherwise be very ineffective.

Like any system, although fiber optic circuits boast various advantages, it has its shortcomings. For instance, a shortcoming that is quite apparent is the impossibility of having the electrical signals transferred directly into the fiber optic cable. The problems and cost associated with the crucial encoder and decoder circuits are contradictory. Besides, bending optical fibers is often undesirable as twisting them with a sharp curve exposes them to physical damage making them functionally useless since propagation of light signals will be hindered resulting in drastic losses.

JTAG Implementation in Arm Core Devices Revati Rathi

www.google.com

This article will teach you about the intersection between JTAG and Arm core devices, with special attention paid to the Arm Debug Interface or ADI.

What Is Arm?

Arm refers to a processor architecture, along with a large amount of intellectual property relating to microprocessor and microcontroller interfaces. Where consumer PCs tend to use x86-derived processors, or PowerPC, or MIPS, embedded electronics are most often implemented with Arm-core processors.

The “core” of the processors are distributed to manufacturers such as ST Microelectronics or NXP, and these manufacturers then add additional peripheral features, such as I2C and SPI interfaces, ADCs and DACs, USB interfaces, and so on.

Arm architectures are versioned as ARMv, examples being ARMv2 (dating from 1987), ARMv6 (processors produced 2002-2005) and so on, and the processor cores which utilize those architectures are branded as ARMx series (ARM1, ARM6, ARM7), and more recently as ARM Cortex-A/R/M series for high-performance (Cortex-A), real-time (Cortex-R), and microcontroller (Cortex-M) applications. The architecture versioning follows the Cortex suffix naming, becoming such versions as ARMv6-M, ARMv7-R, ARMv7-A.

Arm’s debugging interface falls under the name of the Arm CoreSight Architecture; this includes the debug interface (Arm Debug Interface, ADI), embedded trace macrocells (ETM), high-speed serial trace ports (HSSTP), and CoreSight program flow trace architecture. The ADI forms the base for debugging

operations with Arm-core processors, and part of this standard includes a JTAG interface as well as the Serial Wire Debug (SWD) alternative. The topic of this article is the ADI, and particularly the hardware interface layers.

Introduction to the Arm Debug Interface (ADI)

The Arm Debug Interface (ADI) is a specification of both the hardware interface and the logical interface for debugging between a host and one or more devices. Currently, most processors are implementing ADIv5 (specified in Arm IHI0031E), while the newer ADIv6 (see Arm IHI0074C) is being slowly phased in. Because it is more popular, we'll be focusing here on the ADIv5 standard.

The ADI defines a debug access port (DAP), made up of a debug port (DP) and access ports (APs). The DAP is the primary "unit" of the debug interface. A given device will have one debug port, which handles the physical connection with a debugger, as well as a number of access ports that provide access to system resources such as debug registers, trace port registers, a ROM table, or system memory. Thus the DP includes the physical connection (JTAG, SWD) as well as some built-in registers, and each AP has its connections to the system, and a number of its own registers.

In ADIv5, there are two types of debug ports, and (broadly speaking) three types of access ports. The DPs can be either JTAG-DPs, or SWD-DPs, named for the interface used in connecting to the DAP from outside the device. The APs can be MEM-APs, providing access to resources by addressing (analogous to memory mapping, hence the name), JTAG-APs, allowing JTAG scan chains to be connected to the whole debug unit (the DAP), and vendor-specific APs, which are not specified by Arm. MEM-APs are by far the most common and useful, so we won't be covering the other types here.

JTAG (named after the Joint Test Action Group which codified it) is an industry standard for verifying designs and testing printed circuit boards after manufacture. ... The Joint Test Action Group formed in 1985 to develop a method of verifying designs and testing printed circuit boards after manufacture. **JTAG** is not JUST a technology for programming FPGAs/CPLDs. The debug and programming tools commonly associated with **JTAG** only make use of one aspect of the underlying technology – the four-wire **JTAG** communications **protocol**. These four signals, collectively known as the Test Access Port or TAP, are part of IEEE Std.

In the context of JTAG, we would expect the Debug Interface to provide JTAG instruction codes, as well as vendor-specific JTAG features. In fact, the ADIv5 standard provides the following instructions:

- EXTEST (0b00000000)
- SAMPLE (0b00000001)
- PRELOAD (0b00000010)
- INTEST (0b00000100)
- CLAMP (0b00000101)
- HIGHZ (0b00000110)
- ABORT (0b11111000)
- DPACC (0b11111010)

- APACC (0b11111011)
- IDCODE (0b11111110)
- BYPASS (0b11111111)

As well, the JTAG data registers include:

- ABORT (35 bits), register to force an Access Port abort
- DPACC (35 bits), Debug Port read/write access register
- APACC (35 bits), Access Port read/write access register
- IDCODE (32 bits)
- BYPASS (1 bit)

What should stand out here are the instructions DPACC and APACC, and the associated data registers. DPACC (Debug Port Access) and APACC (Access Port Access) are the instructions/registers used to pass commands through to the associated DP and APs of a device. By setting different values in the DPACC or APACC data registers, the debugger can execute different operations, generally interacting with the registers of the DP and APs themselves. Note the difference between these DPACC and APACC registers (JTAG registers) and the registers built into the DPs and APs.

The general methodology here is that the debugger uses the JTAG or SWD interface to execute instructions by going through the TAP state machine, then the instructions take the data and load it into the DP or an AP, and depending on the data, different registers within the DP or AP are accessed, providing the desired link to the system.

So, what are the DP and AP registers? The DP registers available include:

- CTRL/STAT, used to control and obtain status information about the DP
- DLCR, Data Link Control register, controls the operating mode of the Data Link
- DLPIDR, Data Link Protocol Identification register, protocol version information
- DPIDR, Debug Port Identification register, Debug Port information
- EVENTSTAT, Event Status register, used by the system to signal an event to the external debugger
- RDBUFF, Read Buffer register, provides a read operation; dependent on DP (JTAG or SWD)
- SELECT, AP Select register, selects an Access Port and the active register banks with that AP; selects the DP address bank
- TARGETID, provides information about the target when the host is connected to a single device

While MEM-AP registers are:

- Control/Status Word register (CSW, 0x00), holds control and status information
- Transfer Address Register (TAR, 0x04), holds the address for the next access to the memory system or system resource
- Data Read/Write register (DRW, 0x0C), sets reading or writing of the address in TAR – if you read DRW, the access is set to read; if you write to DRW, the access is set to write
- Banked Data registers (BD0 to BD3, 0x10, 0x14, 0x18, 0x1C), provide direct read or write access to four 32-bit blocks of memory, starting at the address in TAR

- Configuration register (CFG, 0xF4), information about MEM-AP configuration
- Debase Base Address register (BASE, 0xF8), pointer to memory system, either the start of a set of debug registers or the start of a ROM table
- Identification Register (IDR, 0xFC), identifies the MEM-AP.

The connections are shown schematically in Figure 1, below.

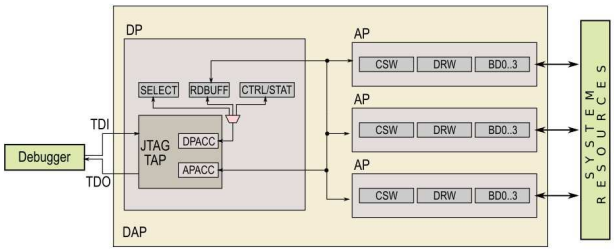


Figure 1. Arm Debug Interface diagram, summarizing connections. Note: not all registers are shown for DPs and APs.

Details of the DP/AP registers and the memory mapping can be found in the specification, IHI 0031E. Instead of going further into the details, I would like to focus on the other type of debug port, the SWD-DP, and how it implements JTAG using only two wires.

Serial Wire Debug (SWD)

While the JTAG-DP is a common and familiar example of a debugging interface, most relevant to our discussion is the JTAG alternative defined for Arm devices, the Arm Serial Wire Debug (SWD). Serial Wire Debug (**SWD**) is a two-wire **protocol** for accessing the ARM debug interface. It is part of. the ARM Debug Interface Specification v5 and is an alternative to JTAG. SWD was developed as a two-wire interface for Arm-core devices with limited pin counts. As microcontrollers tend to be quite dense in peripherals, most Cortex-M devices will implement SWD in place of full JTAG to save pin real-estate. So how does this protocol work?

SWD is specified in the ADIv5 specification (chapter B4). The TDI and TDO pins from JTAG are replaced by a single bidirectional pin called SWDIO; the test mode select (TMS) pin is removed entirely; and the clock (TCK) remains the same (relabeled CLK or SWCLK). Thus SWD uses only two pins compared to the four pins used in JTAG. To make this work, SWD relies on the repetitive nature of JTAG operations: the state machine is manipulated, data is shifted in or out, and the process repeats. The difference with SWD is there is no state machine. Instead, commands are issued serially over SWDIO, and then that same pin is used for reading or writing data.

There are three phases to SWD communication: packet request, acknowledgment, and data transfer. During packet request, the host platform issues a request to the DP, and this must be followed by an acknowledge response. If the packet request was a data read or data write request, and there was a valid acknowledgement, the system enters the data transfer phase, where data is clocked in (write) or clocked out (read) through SWDIO. After a data transfer, the host is responsible for either starting a packet

request, or driving the SWD interface with idle cycles (clocking SWDIO LOW). A parity check is applied to packet requests and data transfer phases.

The particulars of SWD are best understood by seeing a timing diagram, shown in Figure 2.

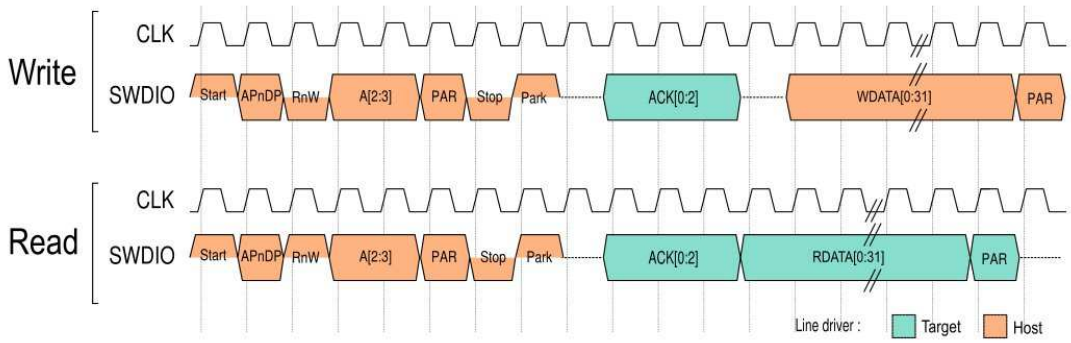


Figure 2. Timing diagrams showing read and write operations for Serial Wire Debug.

The read and write operations both begin the same, starting with the host driving the SWDIO line to a Start bit, which is a HIGH signal. This is followed by the configuration, including the AP or DP access bit (APnDP), the read or write bit (RnW), the address (A[2:3]), a parity bit (PAR), and a Stop bit (a LOW signal), followed finally by a Park bit, which is when the host drives the line HIGH before the line goes into turnaround. During turnaround, neither the target nor the host is allowed to drive the line.

Depending on the value of RnW, a read or write operation is selected. If writing, the target provides a 3-bit ACK signal, then there is another turnaround period, followed by the 32-bit data to be written (WDATA), and a parity bit. If reading, the target provides an ACK, and then continues to drive the line with the 32-bit read data (RDATA), followed by a parity bit. If an error has occurred, the ACK bits will indicate the fault, and the host can attempt to restart the operation. Observe that WDATA and RDATA are transmitted least-significant bit (LSb) first, indicated in Figure 2 by writing WDATA[0:31] instead of WDATA[31:0].

The Arm IHI0031E document provides further timing diagrams to clarify various cases in communication, but the above are the primary use-cases. It is worth noting that there are (as of the time of writing) two versions of SWD; SWDv1 supports only one connection between a host and a target (point-to-point), while SWDv2 implements single-host multiple-target communication (multidrop). Version 2 is nearly backwards compatible with version 1, apart from a few edge cases.

Other Variants of JTAG

SWD is not the only two-wire variant of the JTAG IEEE 1149.1 standard. Notably, the IEEE 1149.7 standard provides a reduced-pin-count (2-wire) JTAG interface. Other 1149.x standards such as IEEE 1149.4 (Standard for Mixed-Signal Test Bus), and IEEE 1149.6 (Boundary-Scan Standard of Advanced Digital Networks) have been developed in the last two decades, and provide additional functionality for more involved applications. This includes things like analog boundary-scan testing and improved capabilities for differential and AC-coupled lines.

Conclusion

This concludes our coverage of JTAG and SWD. Throughout this series, we have learned where JTAG comes from, how it works, and how it's used to debug and program devices. We've taken a look at the physical connections for JTAG, including the connectors and interfaces available, both commercial and open-source. Finally, we concluded with an overview of the JTAG implementation for the popular Arm processor core technologies, including the SWD two-wire interface.

Automatic Room Light Controller Using Microcontroller And Visitor Counter

D.D.Ahire

www.google.com

The article 'Automatic Room Light Controller Using microcontroller ATMEGA16A and bidirectional visitor counter' controls a room light as well as count the number of individuals entering and leaving a room. When an individual enters into a room then one counter is incremented by one and one light in a room will be switched ON and when the individuals leaves a room then the counter is decremented by one. When the number of individuals in a room is greater than 5 then 2 lights will be switched ON. When the individuals in a room are more than 10 then 3 lights will be switched ON. Similarly on increase of every 5 individuals one more light will switched ON. Lights will turn OFF when all the individuals go out of a room. The total number of individuals present inside a room is also displayed on the LCD display. IR sensors and microcontroller does above job. IR sensors sense the obstruction and microcontroller receives the signals produced by the obstruction from the sensors. The received signal is operated via program stored in ROM of Microcontroller.

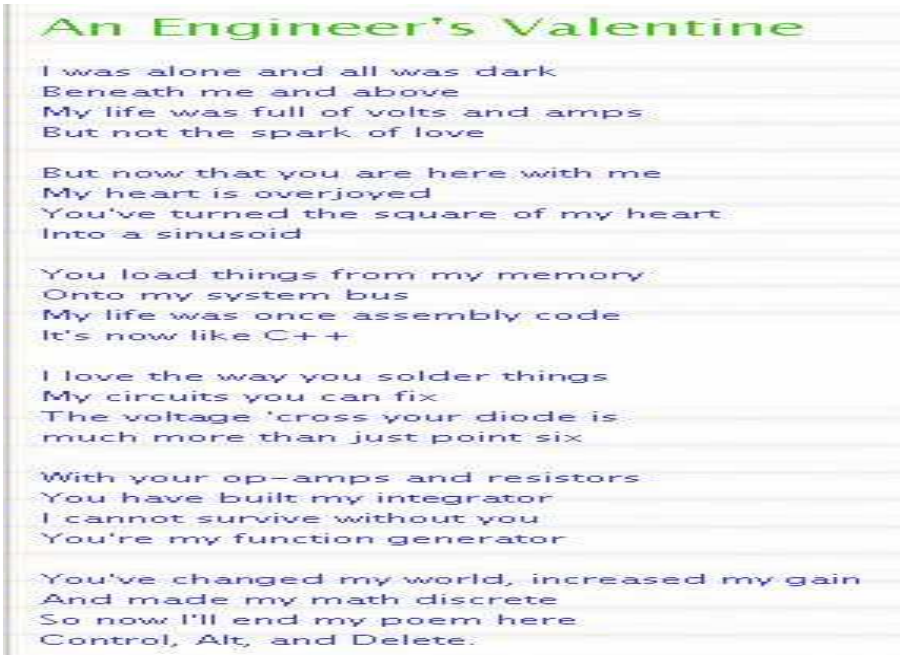
In this digital word we need every possible thing around us to be automatic which reduces human efforts. There are increasing electronic circuits that make today"s life easier and simple. Nowadays Energy Crisis is the big problem faced by everyone. So there is a need to conserve energy. This project is very useful for such problems as one generally forgets to turn off lights and fans while leaving a room. The aim of this is to make an automatic controller based prototype to count the number of individuals entering in the particular room and accordingly light up a room. This project has two parts. One is "Individual count" and other is "Automatic room light Controller" We use IR sensors to detect number of individuals entering in a room. This circuit counts the number of individuals and displays the count on the seven segment LCD display to avoid congestion. This project is very helpful in schools and colleges for their Auditorium. "AUTOMATIC ROOM LIGHT CONTROLLER USING MICROCONTROLLER AND VISITOR COUNTER" as the name specifies that it controls the task of counting the number of individuals and lights of a room with accuracy. When an individual enters into a room then one counter is incremented by one and one light in a room will be switched ON and when the individuals leaves a room then the counter is decremented by one. When there is no individual in a room then lights will be switched off automatically

Techno savior

In this setup IR sensors transmit 40 kHz IR signal to receiver. The µController continuously monitors the signal transmitted by IR sensors.IR1 is connected to PortC.6 and IR2 is connected to PortC.7 of µC . Initially we kept PC6=1 and PC7=1.When any object passes from entry sensor a signal is generated and output of IR sensor gives low trigger to µC pin PC6 then the counter on display will be incremented by one. When any object passes from exit sensor a signal is generated and output of IR sensor gives low trigger to µC pin PC7 then the counter on display will be decremented by one. When there is nobody in a room counter displays „00" then relays are OFF & lights are OFF. In this project, no. of lights in a room will glow according to the individuals entering in a room. If the count is 1 or <6 only one light will glow. If the count is 6 or <11 two lights will glow. If the count is 11 or <16 three lights will glow. If the count is 16 or <256 four lights will glow.

In this digital world Technology is very advanced and we prefer things to be done automatically without any human efforts. This project also helps to reduce human efforts. Also it is very useful to conserve resources. It is very useful in Schools, hospitals, malls, offices, auditoriums etc. In any big hall if we want to count number of individuals it is very difficult as it results in congestion and disturbance to the whole Class. This project becomes helping hand in such situation because it gives the count on LCD display. Also it controls the lighting system automatically according to how many individuals are there in a room.

- Turning ON of lights will increase with increasing the individuals in a room.
- Turning ON of lights will decrease with decreasing the individuals in a room.



An Engineer's Valentine

I was alone and all was dark
Beneath me and above
My life was full of volts and amps
But not the spark of love

But now that you are here with me
My heart is overjoyed
You've turned the square of my heart
Into a sinusoid

You load things from my memory
Onto my system bus
My life was once assembly code
It's now like C++

I love the way you solder things
My circuits you can fix
The voltage 'cross your diode is
much more than just point six

With your op-amps and resistors
You have built my integrator
I cannot survive without you
You're my function generator

You've changed my world, increased my gain
And made my math discrete
So now I'll end my poem here
Control, Alt, and Delete.

Techno savior

Dictionary Based English to Marathi speech Translation - Monika Tarle (TE I.T)

Machine translation, is a Heart of Natural Language Processing, is important for dividing and separating the language obstacles and facilitating for bi-lingual translation. Natural language processing is a subfield of linguistics, computer science, and artificial intelligence concerned with the interactions between computers and human language, in particular how to program computers to process and analyze large amounts of natural language data. People of different linguistic background could not able to interact with each other. This concept of translation will help people to communicate comfortably. Also it will help to fill communication gap between two linguistically different backgrounds. It will help to the people in the villages, who have taken education of English. Majority of the Indian population is not familiar with English while most of the information available on web or electronic information is in English. Many Time government documents and forms are been presented in English Language where a lay man from Marathi language background finds difficulty to understand information and even avoid such procedures therefore it highly urges for need of automated Software based Translation system which would assist in cross Domain information Retrieval. Machine Translation assist to translate Information presented in one language to other language. Information can be present in form of text, speech and image translating this information helps for sharing of information and ultimately information gain. So, to reach out to the common man across various sections and field, an automatic language translator is important. So the main objective of Machine Translation (MT) is to break the language barrier in a multilingual nation like India.MT gives several approaches to translate source language to target language. In this proposed work we are translating English to Marathi sentences for kids based on dictionary.

Considering multiple regional languages of country like India, If we could successfully develop such system then it is truly applicable and useful for all the learners in different languages. Such tools can also be considered in ICT tool in education system

Market Basket Analysis Using FP growth : Vinay Pillai (BE I.T)

Market basket analysis is an important component of analytical system in retail organizations to determine the placement of goods, designing sales promotions for different segments of customers to improve customer satisfaction and hence the profit of the supermarket. These issues for a leading supermarket are addressed here using frequent itemset mining. The frequent item-sets are mined from the market basket database using the efficient K-Apriori algorithm and then the association rules are generated. Data mining is commonly seen as a single step of a whole process called Knowledge Discovery in Databases (KDD). In Market Basket Analysis we can analyze, which type of person wants

Matoshri College of Engineering and Research Centre, Nashik
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which type of product and this will be helpful for both retailer as well as manufacturing company in order to maintain the inventory. A store could use this analyzed information to place products frequently sold together into the same area, so that store product selling gets increased. This information will enable the retailer to understand the buyer's needs and rewrite the store's layout accordingly. Suppose a manger of an electronics store wants to learn about the buying habits of their customers so that one can determine which groups or sets of items are customers likely to purchase on a given trip to the store? To do this, market basket analysis may be performed on the retail data of customer transactions. This will help to plan marketing, designing new catalog so that sale of the store increases. The strategy for designing is that, items that are frequently purchased together are placed into the same area. If a customer who is purchasing a computer gets an antivirus within the same vicinity, then there is high probability that hell buy the antivirus and such planning's tend to increase the sales. Market basket analysis can also help retailers plan which items to put on sale at reduced prices.

Online Training and Placement Systems Toolkit : Rohit Dhumale (BE IT)

Placement web automates activities of training and placement cell provides opportunities to the student community to use collective intelligence to extend choice magnitude relation and eases out method of Creation of management data mechanically. Placement Support focuses on the automation of the position cell. Authorizing the resumes, human action regarding the varied job openings to the scholar community, managing the corporate relationship for tantalizing them for the placements furthermore alternative activities, making the position metrics, monitoring the progress of the choice web provides the module like Student, Administrator, Company and Forum. It's the options like Integrated Toolkit for Reach-out to corporations Track. It manages Placement method of every Job posting one by one. Manage Company Profiles, Manage Job Postings, evidence and activate the scholar profiles, Send Notifications to students, produce list of scholars as per company unit of time Manager Job Request, provides the list of shortlisted student with resume to company unit of time Manager, Export knowledge of shortlisted students to surpass file supported Search Criteria, Manage student profile, Set preferences for student eligibility criteria for placement, Time and Role based mostly Secured Access to users.

Crime Analysis and Pattern Identification - Apurva Khatale (BE IT)

Crime is one of the most important problems of our Indian society which creates a barrier for our citizens to carry out their daily activities. The ability to analysis crimes based on the location, pattern and time can serve as a valuable source of knowledge for them either from strategic or tactical perspectives. The crime records are usually recorded manually and therefore determining the accurate crime trends and rates of reported crimes have proved to be a major hurdle in crime prevention. Though this problem has been identified long before, no visible remedy or action can be seen to overcome or

combat this crime in most of the populated mega-cities of the world. In this project, we propose a Crime Analysis and Pattern Identification model that exploits the historical crime data to identify the pattern of a crime in a particular region at a specific time. Our model captures both space and time proximity of past crimes while predicting future crime. The process starts with the data collection phase and performing data mining, then performing processing on that data like Analysis, Classification, Pattern Identification. Also when proper results have obtained that need to be visualized properly using usability aspects in it and easy to understand. To validate experimental results, we visualize potential crime hotspots on a map and observe whether the models can identify true hotspots. The adoption of mobile technology in crime prevention has substantially grown across the world.

Subjective answer evaluation system - Rushikesh waychale (BE IT)

The current way of checking subjective paper is adverse. Evaluating the Subjective Answers is a critical task to perform. When human being evaluates anything, the quality of evaluation may vary along with the emotions of Person. In Machine Learning, all result is only based on the input data provided by the user. This system uses machine learning and NLP to solve this problem. Algorithm performs a task like Tokenizing words and sentences, Part of Speech tagging, Chunking, Lemmatizing words and Wordnetting to evaluate the subjective answer. Along with it, proposed algorithm provides the semantic meaning of the context. Automated Essay Grading is a very important research area in educational technology.General Latent Semantic Analysis is an information retrieval technique used for automated essay grading. General Latent Semantic Analysis forms a word by document matrix and then the matrix is decomposed using Singular Value Decomposition (SVD) technique. Existing systems based on LSA cannot achieve higher level of performance to be a replica of human grader. Proposed work is develop system using Generalized Latent Semantic Analysis(GLSA) which makes n-gram by document matrix instead of word by document matrix. Praposed work suggestto devolope using details representation and showed the performance of the system. Experimental results show that our system outperforms the existing system.

Techno savior

What are Six-Axis Robots?

Mr. Satvik Handore, -SE Mechanical

Cartesian robots move on the x, y, and z-axis. It has three degrees of freedom for movement. The disadvantage of Cartesian or linear robots is that they cannot tilt or turn, but only can move along the three linear axes. When there are more degrees of freedom (also commonly referred to as the axis of movement) more versatile and precise movements can be executed by the robots. Humanoid robots like Honda ASIMO have more than 30 degrees of freedom/axis.

Having such a large number of axes is not required for most industrial operations. A large portion can be done with just three axes of Cartesian robots. SCARA provides a turning function in addition to the three-axis of Cartesian robots, for a total of four degrees of freedom. Six-axis robots have six degrees of freedom.

These six degrees of freedom are facilitated by the servomotors present in each section. The motion control is aided by the PLCs or ICs of the robots in conjunction with compatible software. Unlike Cartesian robots that work based on only linear motion, six-axis robots have to be designed with various types of rotary motion in three-dimensional space. This makes programming the motion of these robot's complex.

What Does Each Axis Do?

To design and manipulate the six-axis robots, it is important to know the roles of each axis (as well as an optional seventh). Each axis is referred to by a different name by various manufacturers. Here I'm including the names for each axis for the FANUC R - 2000iB.

Although the axes may be referred to differently, the movements they perform are consistent. Let's look at each one now.

- **1st Axis:** This axis is the base of the robot that can be rotated. This enables the robot arm to have a sweeping motion from left to right or right to left up to a full 180° from the central location. This axis is referred to as J1 for FANUC R-2000iB.
- **2nd Axis:** This axis enables the rotation of lower robot arms to extend the rest of the arm above it forward or backward. This axis is referred to as J2 for FANUC R-2000iB.
- **3rd Axis:** The 3rd axis moderates the vertical reach of the six-axis robot. The upper arm is raised or lowered with the servomotor located at this axis. Depending on the model, the upper arm can only move in the area in front of it or it can reach all the way behind the robot body. This axis is referred to as J3 for FANUC R-2000iB.
- **4th Axis:** This axis works in synchronization with the fifth axis to manipulate the position of the end effector. This axis actuates a circular motion of the upper arm and the motion is commonly referred to as Wrist roll. This axis is referred to as J4 for FANUC R-2000iB.
- **5th Axis:** The 5th axis performs the tilting function for the robot. Pitch and yaw motion are performed by the servomotors connected to this axis. Pitch motion is moving up and down fixed on a hinge, like opening and closing the lid of a laptop. Yaw motion is moving left and right fixed on a hinge, like opening and closing of a door. Pitch and yaw motion are the bridge between vertical and horizontal movements. This axis is referred to as J5 for FANUC R-2000iB.

- **6th Axis:** Twisting motion is performed by this action. This axis is the closest one to the end effector and is responsible for its direct manipulation. This is capable of rotating more than 360° in both clockwise and anticlockwise directions. This axis is referred to as J5 for FANUC R-2000iB.
- **Optional 7th Axis:** This axis moves the six-axis robot linearly where it is installed. It is an optional axis that provides more functionality to the already versatile robot.

Using a Teach Pendant

A teach pendant is a remote that can control the different axes of the six-axis robot. A human operator can use the teach pendant to move and manipulate the end of arm tooling (EoAT) for the desired operation. The robot is capable of replicating the operations the operator accomplishes with the teach pendant. If the robot needs to be repurposed, the previous operation can be erased and new operations can be taught.

Characteristics and Applications

With the six degrees of freedom in movement the six-axis robots have, they can accomplish a wide range of complex movements that Cartesian robots cannot accomplish with only linear movement. Six-axis robots can closely replicate the movement and function of the human arm making it very versatile. With this capability, it can reach under and over objects and work on surfaces linear robots cannot.

The major deficiencies of six-axis robots with respect to linear/gantry robots are precision, range, and payload capacity. While linear robots can have tolerances in the range of micrometers (μm), six-axis robots can only have tolerances in the range of millimeters (mm).

The range of gantry robots can be extended with additional scaffolding, but the range cannot be extended easily for six-axis robots. It can be done to a brief range with the addition of an extra axis of movement for the robot. This is a costly modification to robots that are already costlier than most linear robots. Six-axis robots generally have a payload-carrying capacity of 50kg. Gantry robots can have a much larger capacity at well over 100kg.

The versatility and the range of complex operations that can be accomplished by six-axis robots help it secure a spot in many modern assembly lines. Some of its applications are:

- Part picking and part handling automation
- Insert loading automation
- Stacking and sorting automation
- Packaging and palletizing automation
- Assembly cell automation
- Auxiliary operations automation
- In-mold decorating (IMD) / In-mold labeling (IML) automation
- Overmolding (press to press transfer) automation

Techno savior

Drones and their Autonomous Applications

Mr. Darshan Kolhe, Student-SE Mechanical

After decades-old R&D efforts, drones have become more reliable and industries are building their platforms to put drones to more commercial use. Today, drones are faster, more accurate, and more stable. Building autonomous capabilities for drones opens a plethora of opportunities for rescue, emergency supplies, and combat operations.

This article explains how drones operate, the physics behind their functioning, the onboard hardware, considerations for commercial applications, and the bottlenecks that hinder their commercial viability.

What is Drone Technology?

A drone is a flying robot that can be moved manually using conventional teleoperation or sensor-based computational driven autonomous navigation. Drones are able to fly using the thrust generated by its four rotors. In this article, a quadcopter design is referred to as drones. They usually have four high-speed brushless motors (hence the name quadcopter) with propellers attached to the rotor shafts.

The rotors rotate at very high speeds, generating thrust against Earth's gravitational force. If the thrust equals the gravitational pull due to the drone weight, it hovers in position. If the thrust is higher or lower than the gravitational force, the drone climbs up or down respectively in air.

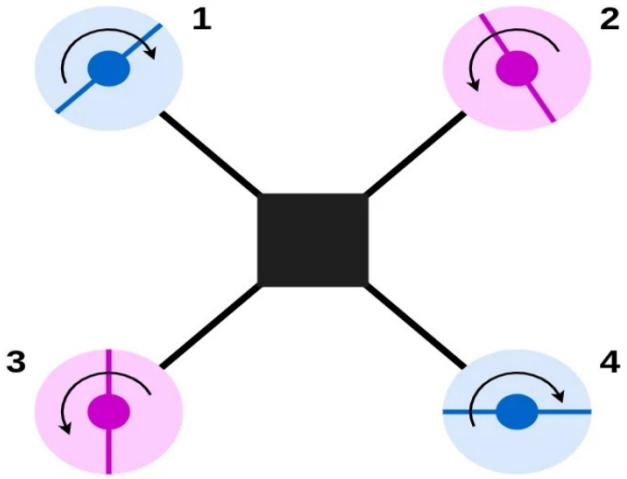


Fig.1 A drone with directions of rotation of the rotors for motion in the vertical direction. The drone may hover/climb up/climb down depending on the force of gravity.

The thrust generated by the propellers is given by:

$$T = \frac{\pi}{4} D^2 \rho v \Delta v$$

Where,

T(N) is the thrust generated, D (m) is the diameter of the propeller

$\rho(kg/m^3)$

is the density of air (1.225 kg/m3), v(m/s) is the velocity of air at the propeller.

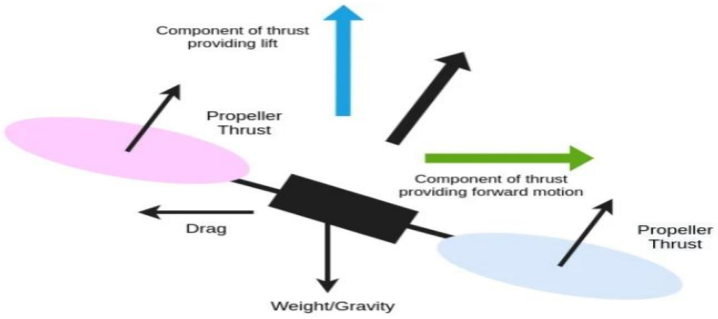
Δv

is the velocity of air accelerated by the propeller.

The thrust generated is vertically opposite to the direction of gravity and thus, the drone's height can only ascend or descend in place unless it has a component of generated thrust in other directions as well. One set of diametrically opposite rotors rotates clockwise, while the other set rotates counter-clockwise. If they have the same rotational speeds, both sets cancel out the reactive yaw generated, and thus, the drone can only translate. By varying the speed of rotation of the propellers, the drone's pitch and roll can be controlled.

Note: To move ahead in a particular direction, the drone needs to have its nose down such that the thrust has a component in the horizontal plane.

Fig 2.Drone forward motion configuration



Physics Behind Drone Motion

A drone's motion is governed by the intensity of the rotation of its propellers and how the components of their generated thrust act against gravity as well as in the horizontal plane.

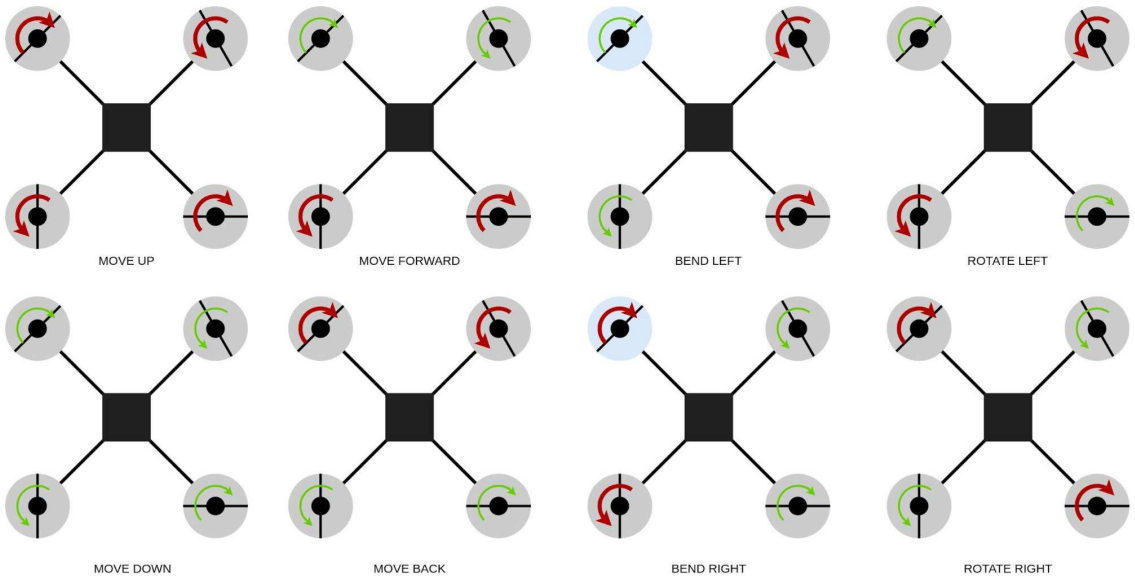


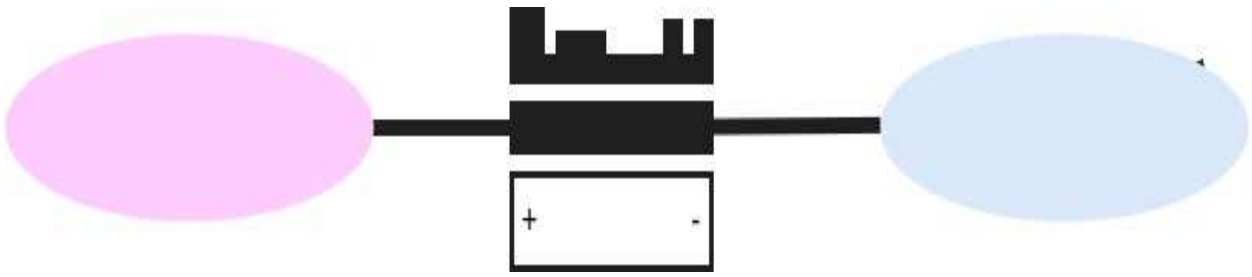
Fig 3. Motion characteristics defined by propeller rotation intensity. Red denotes high speed and green denotes low.

The scenarios for drone motion are:

- If all propellers rotate fast, the drone rises up against the gravity and vice versa
- If the rear propellers rotate faster, the nose pitches down and the drone generates a component of thrust in the forward direction for the forward motion of the drone and vice-versa
- If the right side propellers rotate faster, they generate thrust for roll control, allowing the drone to move to the left and vice-versa
- If the right diagonal propellers rotate faster, they generate yaw force due to a reactive force that obtains yaw control, allowing the drone to rotate left and vice-versa.

The Drone's Build

Since drones generate a lot of thrust to battle strong winds, air resistance, and particles in the air, they need a strong body. They also need to absorb vibrations while being lightweight to reduce the load the



drone body needs to lift against the gravitational force. Lightweight drones are also more agile and can react faster due to less inertia.

Most commercial drones have a lightweight carbon fiber body with a honeycomb design for the limbs that hold the rotors. The brushless motors on these drones can rotate at more than 10000 RPM and generate enough thrust to lift up the body weight. The embedded control unit, usually a microcontroller with multiple sensors, is mounted on top of the drone while the battery is placed below the controller. The battery is usually the drone's heaviest component.

What Electronics Are in a Drone?

The most important components on a drone include a microcontroller board that runs the computations for the control of the motors, the motor speed control components, sensors for various measurements, and the drone's lifeline, the battery.

A flight controller for a drone is a common microcontroller, but usually with high processing speed and a bare minimum of sensors onboard, needed for stabilizations. The most common commercially available flight controllers for drones are PixHawk 4, Navio2, and Beaglebone Blue capable of running the ArduPilot and PX4 autopilot software.

A 3D gyroscope is usually needed to at least have the ability to automatically stabilize the drone on a horizontal plane.

The sensor suite of a drone can include:

- **Gyroscope**: provides the angular velocity of the drone and thus its orientation in the 3D world
- **Accelerometer**: measures the linear acceleration but mainly used to know the direction of gravity
- **Magnetometer**: detects the Earth's magnetic field and obtains the drone's compass direction
- **Barometer**: detects the pressure and indirectly computes the height of the drone
- **GPS**: obtains the coordinates (latitude and longitude) of the drone using multiple satellites

A drone also needs communication with the ground station, satellites, and networking. These components include:

- Radio control transceiver, usually with four channels for height, pitch, roll, and yaw.
- Bluetooth for local debugging and controller access
- Wi-Fi/Internet for onboard connectivity with the ground station to relay real-time sensing information

The most critical component, the battery, is usually a high current source with different voltage ratings from 7.4V to ~22V depending on the type of motor used.

Algorithms Used with Drones

Drones can move around in the 3D world using four propellers and the motion characteristics defined above are used to control their motions. The most important algorithms running on drones include control and perception algorithms.

The control algorithms determine the rotational speed of the propellers that guide the drone to a particular position in a 3D space. A commonly used PID controller is a linear, model-free algorithm with

reference thrust equal to the desired thrust for throttle, roll, pitch, and yaw. Adaptive control handles unprecedented winds and atmospheric objects that can potentially trouble the drone's motion.

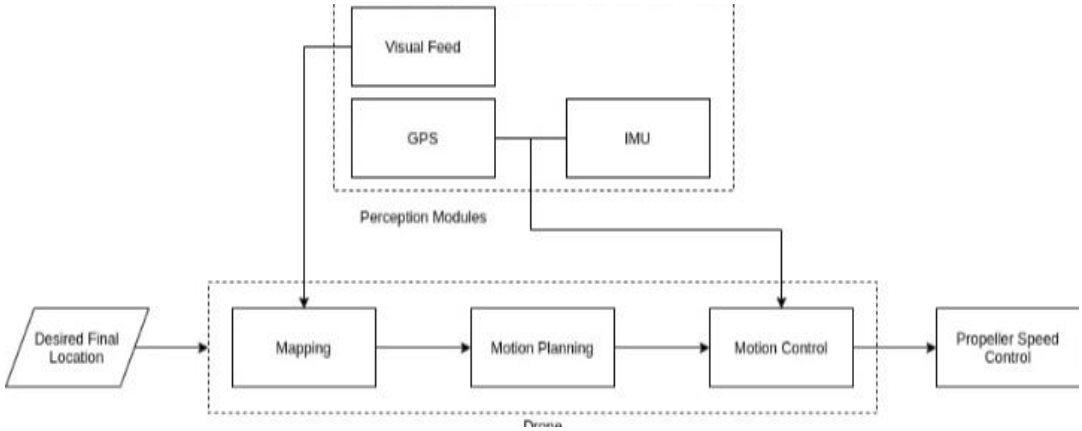
The perception algorithms process the sensors, the accelerometer, gyroscope, and magnetometer to determine the motion characteristics for the drone. Kalman filter and its variants are used to filter these sensor readings for stable results. A few image processing algorithms may also be running on the live camera feed for real time analysis, either onboard the drone or via cloud computing.

Autonomous Drone Navigation

A drone is similar to a terrestrial mobile robot but with more degrees of freedom such that motion is possible anywhere in the 3D space. Autonomous drone navigation is an emerging technological advancement that many companies are working on in an effort to eradicate the need for teleoperation of the drone from one point to another.

Similar to commercial airplanes, autonomous drones flying in 3D space face less stringent challenges because, at heights above 1000 feet, space is not usually occupied with dynamic objects and can be assumed to be free for motion. However, they still need intelligent sensing near the ground level because more obstacles and dynamic objects are expected in the air at low altitudes. Autonomous drones run localization, motion planning, mapping, and control algorithms similar to a mobile robot, as discussed in the previous article on mapping and localization.

Fig 5. Autonomous drone operation pipeline



However, 3D navigation introduces its own variables in the system. For drones, 3D localization has more tolerance for inaccuracies due to noise in onboard sensors, consumer GPS's lower accuracy, and air turbulence. Occupancy grids are ideal for 3D mapping but drones navigating autonomously don't need a large occupancy grid. They only need a 3D environmental map in the proximity of humans or anthropomorphic elements rather than a high compute resource onboard. Motion planning for drones needs simple search algorithms like A* or Djikstra that can navigate along the streets or, even simpler, fly directly from one GPS coordinate to another following a projectile path.

Drone Applications

Techno savior

Autonomous drone navigation has applications for package delivery, visual surveying, landmass mapping, fires/power line inspection, and even disinfectant spraying in the times of COVID-19. Visual surveying and landmass mapping can be programmed tasks that drones can complete autonomously without needing human monitoring or intervention.

Package delivery for medicine, lifesaving drugs, and blood payloads is ideal for autonomous operation. Similarly, spraying of insecticides, pesticides, and fertilizers in farms is being automated with drones.

Challenges for Autonomous Drones

Airplanes can operate on auto-pilot because they have amazingly robust and efficient systems. Replicating the same capabilities for drones is both difficult to implement and extremely expensive from a commercial perspective. More challenges like these limit the feasibility of autonomous drone operation:

- The range of drones is still substantially limited by the battery power and it is impossible to recharge them in the middle of an autonomous flight without having dedicated stations
- The payload they can carry does not promise very quick ROI
- Without manual intervention or active weather perception, handling dynamic situations is still difficult due to unknown behavior of the air at different altitudes
- Not enough robust control mechanisms exist to invoke recovery mechanisms in near-fatal situations
- Remote communication with cloud infrastructure is difficult as mobile networks are weaker at higher altitudes while satellite communication is cumbersome and has high latency.

Do Autonomous Drones Have A Future in Industrial Applications?

While autonomous drones are exciting and potential lifesavers for many critical situations, like the emergency package delivery that Zip line provides, limitations in the operational range and lack of robustness are critical bottlenecks limiting the commercial scalability and revenue generation. With enhancements in edge computing and control algorithms, robust control of autonomous drones is very possible.

Even if the technology matures with time, a lot of regulations and infrastructure needs to be developed to ensure large scale commercial viability of autonomous drones.

Source:-

https://control.com/technical-articles/a-technical-overview-of-drones-and-their-autonomous-applications/

Techno savior

Career opportunities in MES (Maharashtra Engineering Services) for Mechanical Engineers

Mr. Tushar T. Kapade

Maharashtra Engineering Service exam is a paper-pen based state engineering entrance examination directed by the Maharashtra Public Service Commission (MPSC) for recruitment of Assistant Civil Engineer in Water Resource Department, Construction Department Water Supply and Health Department of the Government of Maharashtra. Engineering Services in Maharashtra is broadly classified into two categories namely

Maharashtra Engineering Services, Gr-A

Maharashtra Engineering Services, Gr-B

Aspirants aged between 19 and 38 years of age with degree in Mechanical Engineering or its equivalent from a recognized university are eligible to apply for engineering services examination in Maharashtra 2020.

Maharashtra Engineering Services Selection:- Selection of Assistant Engineers in Maharashtra Engineering Services is based on written test conducted by the Maharashtra Public Services Commission (MPSC). Engineering aspirants are shortlisted for interview based on performance in the written test.

Maharashtra Engineering Services Exam Pattern:- Maharashtra Engineering Services shall consist of two examinations namely

a) Maharashtra Engineering Services Prelim Exam

b) Maharashtra Engineering Services Main Exam

Eligibility for Maharashtra Engineering Services 2020:-

- Age: Aspirants aged between 19 and 38 years of age are eligible to apply.
- Upper Age Limit Relaxation: as per government rules.
- Educational Qualification: Civil Engineering Degree from recognized university or its equivalent.
- Essential: Knowledge of Marathi.

Exam pattern

a) Maharashtra Engineering Services Prelim Exam

Name Of the Subject	**Number Of Questions/ Number Of Marks**	**Duration Of Time**
General English	10 (Each one Mark) – 10 Marks	1 Hour 30 Minutes
Marathi Language	10 (Each one Mark) – 10 Marks	
General Studies	20 (Each one Mark) – 20 Marks	
General Aptitude	60 (Each one Mark) – 60 Marks	
Total	**100 Questions – 100 Marks**	**90 Minutes**
Exam Type: Online Objective Examination (MCQs)		

b) Maharashtra Engineering Services Main Exam

Name Of the Subject	Number Of Questions	Number Of Marks
Papers – I Technical Subject Related Questions	100	200
Papers – II Technical Subject Related Questions	100	200
Total	**200**	**400**

Challenges in Installation, Testing and Commissioning of HVAC systems
Author: Mr. Amol Shinde, Student-BE Mechanical

Dear All, in my opinion, Indian HVAC industry except specialized jobs is still evolving as far as proper installation, testing and commissioning is concerned. Plan to share current scenario in HVAC industry in general and bring out how known challenges still persist .Most of us are aware ofthese challenges, and they are clearly specified in tenders, but their implementation is not handled with the same seriousness. It is important to realize that HVAC system needs to be installed, commissioned and tested properly to achieve intended results for which investments have been made. Undoubtedly, awareness about it is improving but still a lot more is required to see all users get what has been promised /anticipated.

Challenges in Installation Attitude: Biggest challenge, you would agree is "chaltahei "attitude. This is what leads to number of issues related to installation. While we know, what all is needed for proper installation, effort required for doing it is avoided. We feel, installation can be managed by labour since it is a labor oriented job and hence is left to labor or their supervisors. This many time's lead to improper installation and then compromises (Jugad) are made to improve the same to the extent possible. Labour/supervisors are doing it based on their experience and whatever tools and tackles are available at that point of time. We shouldn't expect labour/supervisors to understand the latest recommendations for installation of HVAC systems. We are capable of doing anything but we don't apply ourselves. So one of the challenge isto change mind set and get involved for proper installation techniques, not leaving entirely on labour supervisors/foremen. One should understand how it is to be done and then monitor/supervise the same being done through labour at site.

Proactive Planning: We are aware but rarely document it. Proactive planning involving work method statements for each activity modified to suit site conditions is very important and should be implemented to avoid last minute surprises. To avoid any miss outs these work methods should be prepared by team involving project engineers, supervisors and concerned foremen and not just by project manager/project head so that the entire team is clear and execute the same. These work methods should specify sequence of operations with other agencies, if more than one discipline is involved to perform particular activity. Documentation should be deliberated/submitted and evaluated well in time. All tools/tackles required

for particular activity are arranged beforehand. Kindly note, proper installation only will achieve intended results in testing and commissioning. One should prepare list of activities to be performed before actual installation so that nothing is missed out and cross check everything is there to ensure smooth hassle free installation. Construction team should not leave anything to the last minute.

Switch over to pre-fabricated items: Till date, we had been struggling to get everything done at site through labour (skilled/unskilled). If one gets skilled labour, he is lucky otherwise whole project schedule depend son available type and number of labour. Overall project schedules go haywire since they are largely dependent on availability of dedicated labour. Construction team understands nightmare they have to go through in almost all projects whenever desired number of labour is not available. Here suggestion is to start switching over to prefabricated items as far as possible and hence reduce labour work at site as is being done internationally. Out of box thinking is needed to get most of the site work reduced to assembling prefabricated items at site. Yes initially, it shall involve lot of time in thinking / planning but it shall improve quality and project schedules would be under better control. Wherever it has-been tried out, results are magnificent. Engineers involved in construction/installation have to apply their mind for proper installation and learn what all is already available but not being implemented. We get bogged down by the problems one would face and don't try out anything new which shall help to improve upon project installation. Of course, this all may seem to be more expensive at the beginning, but believe me, end result shall be wonderful and satisfying.

Material Handling: Material handling at projects is another area where alot of rethinking is needed. Unloading/lifting or shifting material to its designated place should be carried out in such a manner that there is not even a scratch over the material. I can only vouch that if material is handled like a paper, one can be sure of getting much better results in terms of installation, testing and commissioning. As far as possible, mechanization should be applied ensuring safety as well as hassle free operations. Similarly, storage of material is equally important otherwise lot of material gets damaged and then the same material is tried out, since wastage of this size had not been accounted for. This leads to imperfect installation which in turn gets noticed during testing and commissioning.

Designers to provide actual working space: One more important point is designers doing design/shop drawings, showing layout schemes should keep in mind actual working space required to Performa particular activity e.g. pipes very close to slab and other pipes beside need to be welded all-round. Proper alignment of pipes for welding etc.when these are very close to slab or other services, similarly duct joints ontop side, while duct is very close to slab or other services. For a proper installation, designers play a major role. If during initial planning these aspects are not addressed, one can't expect good installation, and otherwise drawings need to be modified/revised as per construction team's requirements.

Guidance and clarity: While there is no doubt that we can perform better than anyone and personally, we could demonstrate this when challenge was given that no Indian construction team is capable of understanding and doing it. Results were amazing, when cross checked by foreign consultants. We showed them our leakage results after proper installation were 30% of permissible values, creating lot of

confidence and ultimately changing their mind set. What it needs is guidance andclarity on what needs to be done. So a proper training to all young engineers is must. They should feel proud of their installation. Today they are focusing on their earnings mainly and there is no passion for doing agood installation. A proper grooming is essential and this is possible only if seniors/companies get involved and start doing it religiously for consistent performances.

Training: Training teams should be formed in every company, who keep updating themselves with the latest installation re-commendation, addressing site installation issues and suggesting design modifications from proper installation point of view and grooming/training their candidates regularly for best and consistent performances on all their jobs. Trainee engineer should not be put straight on to the job without intensive training otherwise they try to do their best as per contractor or their foremen's experiences. At times they try to economies which are not always in projects interest.

Safety: Another important aspect is Safety, we all understand its importance but don't implement with a mindset that it slows down the progress. This should not be acceptable and no activity should be allowed without safety practices being implemented. It has to be Safety-first motto and planning should be done considering safety practices in mind. This shall ensure continuous availability of work force and timely completion of projects also avoiding un-necessary issues related to accidents and other legal hassles.

Quality: Another challenge is regular quality checks. We prepare and submit list of quality checks to be carried out during execution. However these are not implemented on regular basis. Many of the projects startwith lot of enthusiasm on quality, which slowly fades away with passage of time and ultimately many of the defects remain till these get noticed during testing and commissioning if they are affecting results.

Budget: The cost involved for above activities, if not budgeted can lead to compromises only. We have to consider their importance and implement corrective steps irrespective of their cost. For small savingsi.e. without proper installation, testing and commissioning, we keep losing throughout life span of the systems. Sufficient budget/cost must be allocated to perform all the above activities and run the system most efficiently.

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