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Mechanical Engineering Department

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SJPN, Trust's

Hirasugar Institute of Technology, Nidasoshi

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INSTITUTE VISION

“To be a preferred institution in Engineering Education by achieving excellence in teaching and research and to remain as a source of pride for its commitment to holistic development of individual and society”

INSTITUTE MISSION

"To continuously strive for the overall development of students, educating them in a state-of-the-art-infrastructure, by retaining the best practices, people and inspire them to imbibe real time problem solving skills, leadership qualities, human values and societal commitments, so that they emerge as competent professionals"

DEPARTMENT OF MECHANICAL ENGINEERING

VISION

“To be the centre of excellence in providing education in the field of Mechanical Engineering to produce technically competent and socially responsible engineering graduates”

MISSION

“Educating students to prepare them for professional competencies in the broader areas of the Mechanical Engineering field by inculcating analytical skills, research abilities and encouraging culture of continuous learning for solving real time problems using modern tools”

Program Educational Objectives (PEOs)

The Graduates of the program will be able to

PEO1: Acquire core competence in Applied Science, Mathematics and Mechanical Engineering fundamentals to excel in professional career and higher study.

PEO2: Design, demonstrate and analyze the mechanical systems which are useful to society.

PEO3: Maintain professional and ethical values, employability skills and multidisciplinary approach to realize engineering issues in broader social context by engaging in life-long learning.

INDEX

1. Spidy Car

Toys have always been an entertaining source to kids from centuries and it will be for the next centuries to come. But the technology doesn't remain the same. Every now and then technology is flourishing at a very high rate. So the effect of technology is quite obvious on all the domains of life. Toys also have been affected with this fever of technology. One of such device/toy is lape controlled toy car.

Arduino Nano and Arduino UNO

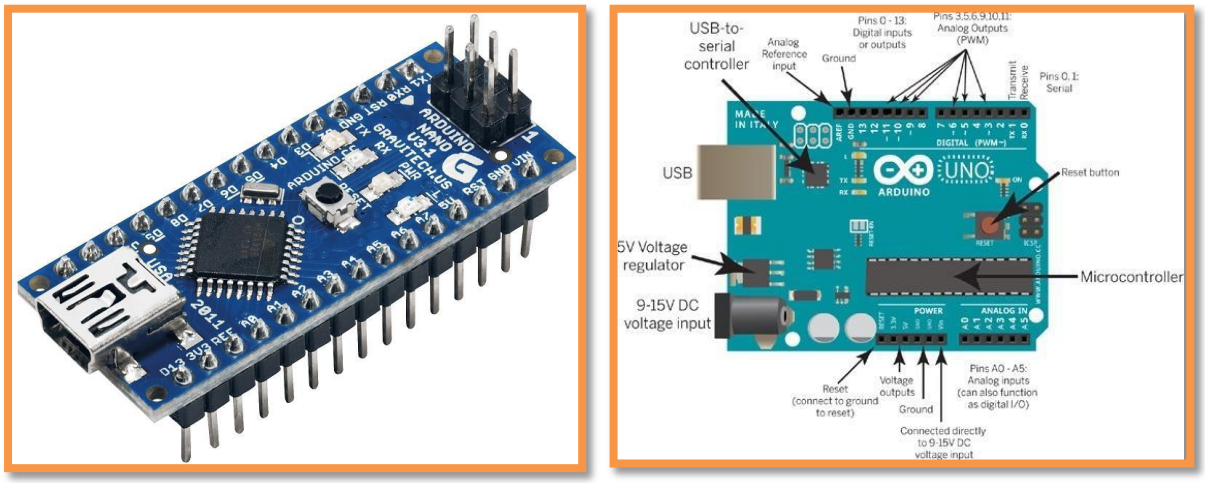

Figure 1.1 Arduino Nano and Arduino UNO

Arduino Nano comes with a **crystal oscillator** of frequency 16 MHz. It is used to produce a clock of precise frequency using constant voltage. There is one limitation using Arduino Nano i.e. it doesn't come with DC power jack, means you cannot supply external power source through a battery. **Arduino Nano** is a small, complete, flexible and breadboard-friendly Microcontroller board, based on **ATmega328p**, developed by Arduino.cc in Italy in 2008 and contains 30 male I/O headers, configured in a **DIP30 style**. Arduino Nano Pinout contains 14 digital pins, 8 analog Pins, 2 Reset Pins & 6 Power Pins. It is programmed using Arduino IDE, which can be downloaded from Arduino Official site. Arduino Nano is simply a smaller version of Arduino UNO, thus both have almost the same functionalities. The Arduino Uno board is a microcontroller based on the ATmega328. It has 14 digital input/output pins in which 6 can be used as PWM outputs, a 16 MHz ceramic resonator, an ICSP header, a USB connection, 6 analog inputs, a power jack and a reset button. This contains all the required support needed for microcontroller. In order to get started, they are simply connected to a computer with a USB cable or with a AC-to-DC adapter or battery. Arduino Uno Board varies from all other boards and they will not use the FTDI USB-to-serial driver chip in them. It is featured by the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter.

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Receiver circuit with ultrasonic sensor

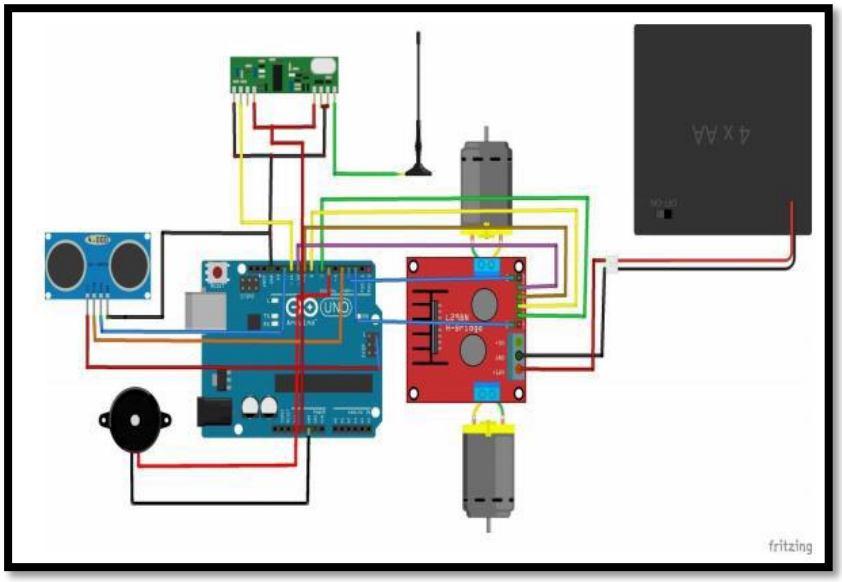

Figure 1.2 Arduino Circuit Diagram

3D-Model of spidy car

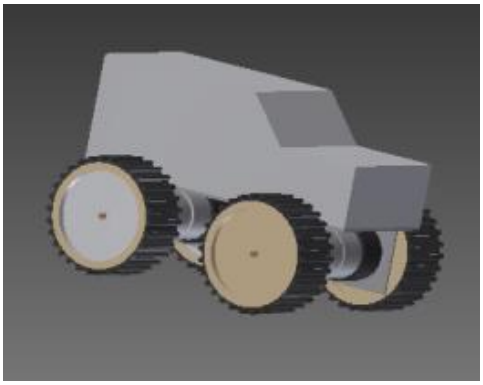

Figure 1.3 3D-Model of Spidy Car

2. Solar Energy Cell

Introduction

The sun is a star made up of hydrogen and helium gas and it radiates an enormous amount of energy every second. Solar cell works on the principle of photovoltaic effect. Sunlight is composed of photons, or "packets" of energy. These photons contain various amounts of energy corresponding to the different wavelengths of light. When a photon is absorbed, the energy of the photon is transferred to an electron in an atom of the cell.

Methodology

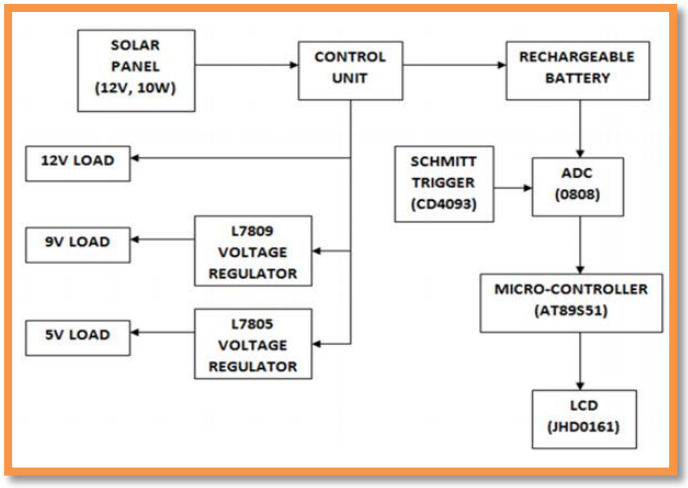

Figure 2.1 System Block Diagram

The block diagram of solar mobile charger consists of solar panel with control unit, fixed voltage regulators, rechargeable battery, ADC, Schmitt trigger, micro-controller and an LCD. The solar panel of 12V, 10W is used, the output of which varies based on the intensity of incident light. This output is regulated through a control unit and is stored in a battery. This battery produces an output of 12V which can be used directly to charge the load. A 9V fixed output can be obtained by regulating the voltage from battery using an L7809 voltage regulator and can be used to charge a 9V load. The battery can be regulated further to obtain 3 a 5V fixed output, using L7805 and charge a 5V load. The 5V output, so obtained, is also used to power-up the micro-controller, ADC, Schmitt trigger and the LCD. The Schmitt trigger is used to trigger the ADC0808 which converts the analog voltage across the battery terminals into digital. Micro-controller AT89S51 is used to display this charge on the LCD JHD0161. The analysis of charge present in the battery is performed by scaling down the output of rechargeable battery (12V) to 4.3V. The LCD displays the percentage of charge in the battery, and critical conditions in the battery (if the battery is full, low, etc.).

Circuit Working

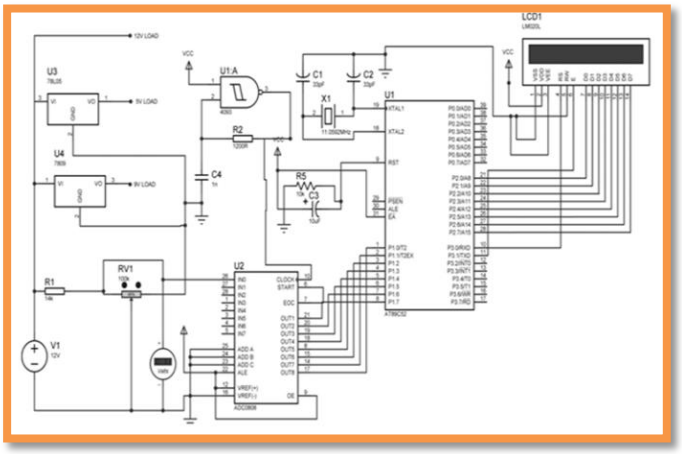

Figure 2.2 Circuit Diagram

The solar panel is used to charge the rechargeable battery. This rechargeable battery is interfaced with the 78L05 and 78L09 voltage regulators to charge 5V, 9V, 12V loads. The 5V output is also used to power-up the analyzer circuit. Analyzer circuit consists of Schmitt trigger, ADC, Micro-controller and LCD. The Schmitt trigger CD4093 acts as the timer to ADC, generating a clock of 550 KHz frequency. The ADC analyzes the voltage across the battery terminals and converts it into digital form. The micro-controller displays the charge in the battery on the LCD. It also displays whether the battery is fully charged and if the battery charge is below 20%, stating "low battery". The Schmitt trigger frequency can be varied by varying the external resistor, capacitor values. The digitized output from the ADC (AD0-AD7) 4 transfers the voltage across the battery terminals in digital form to the port 1 of the microcontroller. The voltage-divider circuit scales-down the battery terminal voltage to a maximum of 5V. Based on this voltage, the micro-controller analyzes the charge in the battery and displays this on the LCD through port 2.

Application

1. For low-power portable electronics, like calculators or small fans, a photovoltaic array may be a reasonable energy source rather than a battery.
2. Solar chargers can charge lead acid or Ni-Cl battery bank up to 48 V and hundreds of ampere-hours (up to 400 Ah) capacity.
3. Small portable models designed to charge a range of different mobile phones, cell phones, iPods or other portable audio equipment.

3. Automatic Lighting Using Arduino and PIR Sensor

Introduction

Technology has become vital and necessary part of our lives. Electrical energy has become an crucial part of human life. In recent years the people are looking forward for the automation in their day to day life, and even now the people are excited to save energy consumed to reduce the expenditures. People are becoming lazy to switch off the lights while leaving the room, so the large amount of energy is wasted if the light is remain ON in the absence of human being. Generally, in public and private sector companies, offices, school and colleges most of the people are not interested to switch OFF the electronic machines like fan, light, etc., while going out of the room.

Working of the System

When there is no human movement, the PIR Sensor doesn't detect any individual and it's OUT pin stays LOW. As the individual enters the room, the change in infrared radiation in the room is identified by the PIR Sensor. As a result, the output of the PIR Sensor becomes HIGH. Since the Data OUT of the PIR sensor is connected to Digital Pin 8 of Arduino, whenever it develops HIGH, Arduino will trigger the relay by making the relay pin LOW (as the relay module is an active LOW module). This will turn the Light ON. The light stays turned ON as long as there is movement in front of the sensor. If the person takes a nap or leaves the room, the IR Radiation will become stable (there will be no change) and hence, the Data OUT of the PIR Sensor will become LOW. This in turn will make the Arduino to turn OFF the relay (make the relay pin HIGH) and the room light will be turned OFF.

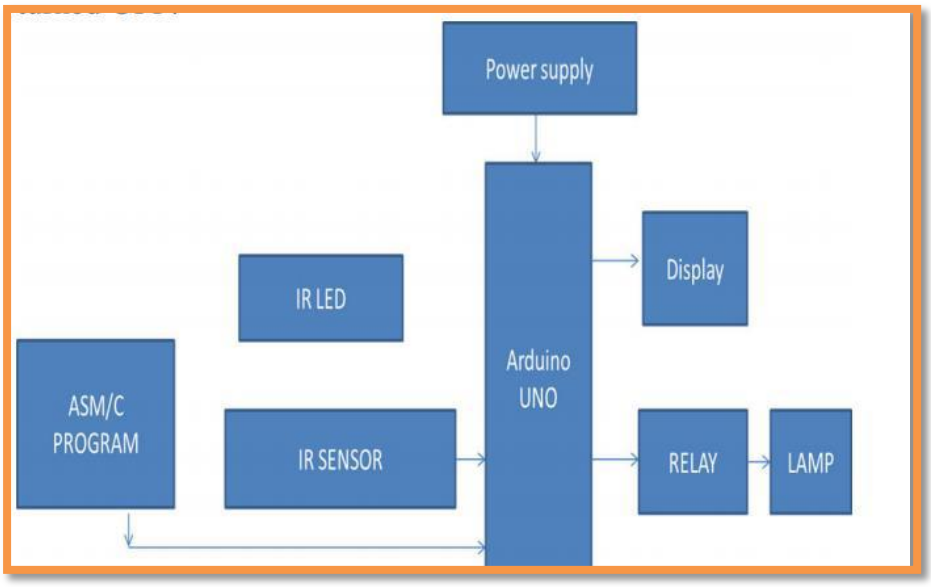

Figure 3.1 Working of the System

Circuit Diagram

Whenever PIR sensor detects any body movement, its OUTPUT pin becomes HIGH, which applies the triggering voltage to the base of the transistor, transistor gets ON, and current started flowing through the coil. Coil in Relay get energies and create electromagnetic field, This permits much larger current (220v AC) to flow, which turns ON the BULB. You can increase or decrease the Bulb ON duration by setting up PIR sensor.

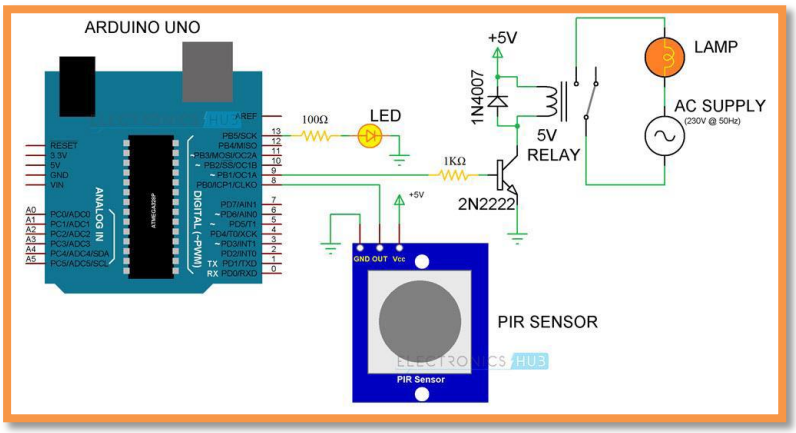

Figure 3.2 Circuit Diagram

Advantages

1. Completely Automatic System.
2. No need human interference.
3. Can work 24*7 without any problem.
4. Low cost and very easy to implement.
5. Most importantly it is a Power Saving.

Applications

1. It can be used in college labs, schools, etc.
2. It can also be used in bathrooms, staircases, etc. in the house.

4. Jute Fiber and Its Applications

Introduction

The composite technology is one of the advanced fast growing technologies in present scenario. No one has more experts to realize which the best material. But we may say some material are stronger by comparing with other materials .Like composite material is continuously developing material because of high strength, less cost, easily availability etc. It is fully advanced and replacing metal by its less weight.

Composite materials are using in various field because of their high tensile strength, impact strength, stiffness, and fatigue characteristics. Because of their good properties comparing to other materials they are widely using in Aerospace industry, Automobile industry, Manufacturing of helmets, bullet proof jackets and also composite materials are using in drive shaft, brakes, Bumpers, Dash board, Engine hood etc.

Jute Fiber

Jute is one of the most important natural fibers. Jute is obtained from jute plant hence jute has one popular name as GOLDEN FIBER because of its high strength it can be used in many applications such as packing materials, door manufacturing, and boat indstry. Sometimes jute is blended individually used in the production of apparel. Two major sources of jute are INDIA and Bangladesh. In jute fiber the fibers are bounded by using special type of sticky material which keeps the fibers bundles tightly. In this soft tissues should be softened, dissolved then washed away then only fiber can be obtained from the steam. This process is known as retting.

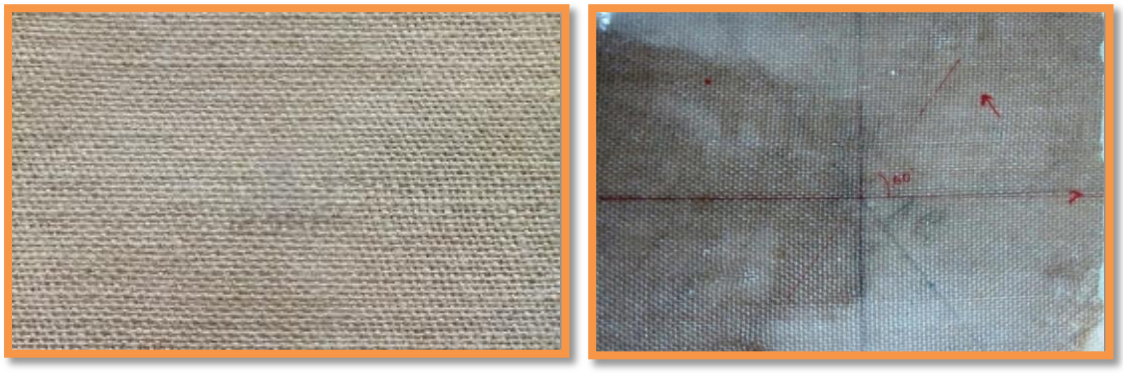

Figure 4.1 Jute Fiber

Jute Composites

Jute composite contains jute fiber it has high strength and has modulus. In jute composite both fibers and matrix plays important rule. The jute composite contains two constituents one is reinforcing phase and another one is matrix phase. In this form both fibers and matrix apply their physical and chemical properties then only we may get properties of jute or else we cannot

achieved properties for jute. Jute fiber has the load carrying member while the matrix keeps them in the suitable location and acts as load transfer media in between them and save it from environmental damage.

Figure 4.2 Harvests of Jute Plant

Applications of Jute Composite

Jute mat: Jute mat is good example of a non woven jute fiber. This is composition of jute fiber, resin, and little amount of synthetic fiber. This mat used is the car door panel.

Composite Doors & Door Frames: Composites doors and door frames are made up of jute fiber, resin and rigid polyurethane foam and little amount of pystyrene. This type of matt used in many applications such as Residential buildings, Offices, Schools, Hospitals. The doors made of FRP and Jute mat sandwich composites material has special advantages compare to natural fibers.FRP + JUTE door has some features they are water proof, Fire resistances, Corrosion resistances, Flexibility.

Building & Construction: Composite material plays important role in the application of building and construction because of prominent position jute fibers are widely used in building and constructions technology. Compare to the metal composites have attractive position and other important properties such as impact resistances, corrosion resistances, thermal and acoustic insulations

Fishing Boats: At Tamil-Nadu because of Tsunami around 7000 mechanized diesel power fishing boats were lost and 30,000 manual and motorized boats were lost in calamity. In those maximum boats were made of wood and steel due to high impact resistances, Flexural strength and corrosion resistances composites boats are used.

5. Hydraulic Robotic Arm

Introduction

Hydraulic drive system is a drive or transmission system that uses pressurized hydraulic fluid to power hydraulic machinery. The term hydrostatic refers to the transfer of energy from flow and pressure, not from the kinetic energy of the flow. A hydraulic drive system consists of three parts: the generator (e.g. A hydraulic pump), driven by an electric motor, a combustion engine, valves, filters, piping etc. (to guide and control the system); and the actuator (e.g. A hydraulic motor or hydraulic cylinder) to drive the machinery. A robot is a machine that can be programmed to perform a task. It increases production capability, improves quality and lower production costs. A robotic arm which is hydraulically operated and controlled by syringes filled with some fluid. It consists of various parts connected to each other in a pre-designed manner which are guided in a constrained way to obtain required output.

Hydraulic actuation

All the movements above are controlled hydraulically by syringes attached to each one. The hydraulic supply acts like the arm's heart and muscles. It provides the energy for pushing, pulling, turning and lifting

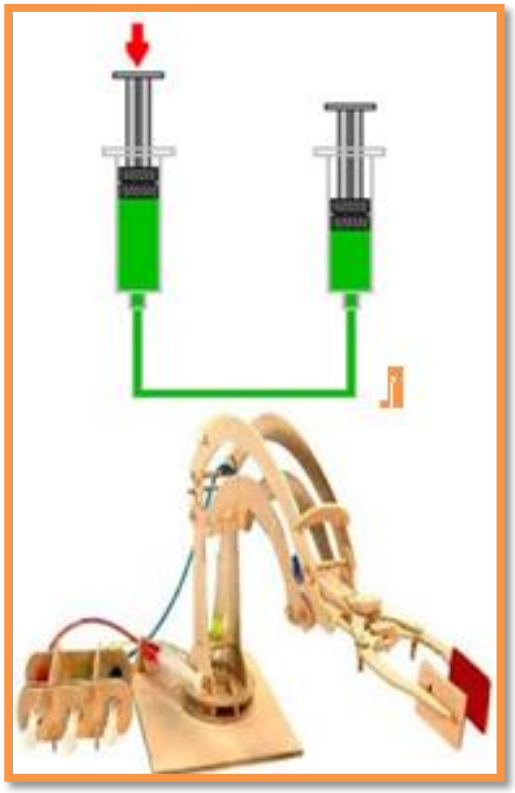

Figure 5. A Typical Model of Syringe Actuating Mechanical Arm

Principle of a hydraulic robotic

Pascal's law is the basis of hydraulic drive systems. As the pressure in the system is the same, the force that the fluid gives to the surroundings is therefore equal to pressure x area. In such a way, a small piston feels a small force and a large piston feels a large force. The same principle applies for a hydraulic pump with a small swept volume that asks for a small torque, combined with a hydraulic motor with a large swept volume that gives a large torque. In such a way a transmission with a certain ratio can be built. Most hydraulic drive systems make use of hydraulic cylinders. Here the same principle is used a small torque can be transmitted into a large force. By throttling the fluid between the generator part and the motor part, or by using hydraulic pumps and/or motors with adjustable swept volume, the ratio of the transmission can be changed easily. In case throttling is used, the efficiency of the transmission is limited. In case adjustable pumps and motors are used, the efficiency, however, is very large. In fact, up to around 1980, a hydraulic drive system had hardly any competition from other adjustable drive systems.

Nowadays, electric drive systems using electric servo-motors can be controlled in an excellent way and can easily compete with rotating hydraulic drive systems. Hydraulic cylinders are, in fact, without competition for linear forces. For these cylinders, hydraulic systems will remain of interest and if such a system is available, it is easy and logical to use this system for the rotating drives of the cooling systems, also. An important advantage of a hydraulic drive is its high power density: the mass of a hydraulic drive is several times smaller than the mass of an electric drive of the same power.

Application

1. These arms are used in assembly lines of mega factories to assemble various parts of a product and also to paint vehicles.
2. They are also used in earth movers to pick up heavy weight and keep them where required. Same principle is being used in JCB's, automobile lifters, etc.

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6. Water Level Indicator

Introduction

Nowadays everybody has overhead tank at their homes, but the one who has a water tank above knows the kind of problems that they face. Water tank overflow is a common problem which leads to the wastage of water. Being electronics enthusiastic made a simple and handy circuit which will detect the water level and will raise an alarm upon getting the water tank full or a preset level. This simple transistor-based water level indicator circuit is very useful to indicate the water levels in a tank. Whenever tank gets filled, we get alerts on particular levels.Here we have created levels by alarms & we have added LEDs to indicate the level of water and one buzzer to indicate full level. When tanks get filled completely we get beep sound from buzzer. The wires with colours Blue, Red, Green & Yellow are adjusted to check Level 1, Level 2, Level 3 and Level 4 respectively wires are connected to the amplifier. In this project we have designed the sensor to measure water up to four levels. Four segments of insulated conducting wires are used and the naked ends within water are connected with carbon rods. The length of the wire segments are adjusted according to the water levels within the reservoir

Working of automatic water tank level controller

As shown in figure, in the beginning when without water on a bucket transistor will not works, because the base of the transistors is not triggered from the common point.

There are four parts in this project:

(i) The Sensor Part: It is generally a fixed support inside the tank having some nuts and bolt with wires coming out.

(ii) The Circuit Part: It comprises the brain of the module; where in all the various inputs from the sensors are fed. It is the unit from where you will get all the information of how much of water is in the tank.

(iii) The Power Supply: It is the part where in you will be converting the A/C voltage to a regulated voltage of 5V to the Circuit.

(iv) The Buzzer Part: It is responsible for bringing up the sound when the water level fills up in the tank. It will also be having a speaker or a buzzer to alert. The connections and arrangements are made as shown in the figure above. The +9V is supplied to water using a metal contact. In this circuit all the transistors are working as a switch. When the water touches the metal contact in which base of each transistor is connected, small current flows and turns on the transistor. When a transistor turns on, LED connected to it glows. Thus LEDs will be turned on depending up on the level of water. And finally when it reaches to its top most level, there will be a visual display as well as a sound from the unit indicating that the water has filled in the tank and one can be alerted that

the tank has been filled up and the water pump has to be switched off saving the electricity bill as well as over flow of water from the tank

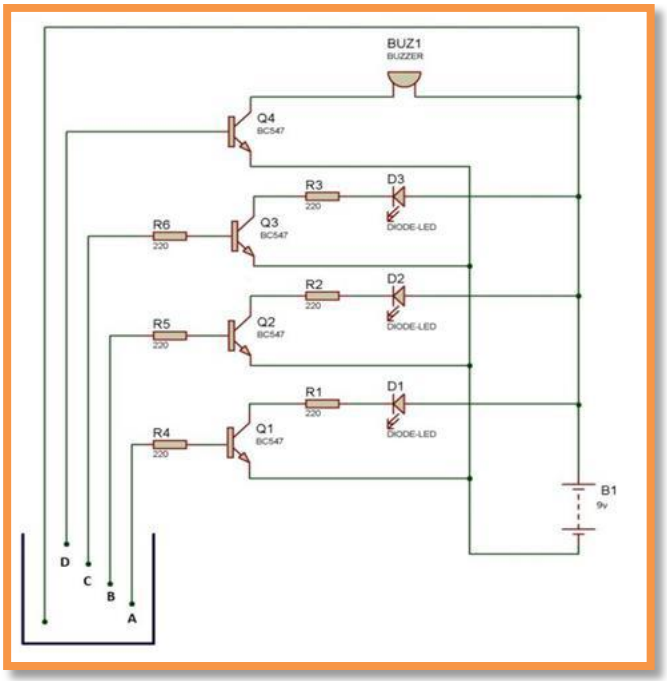

Figure 6.Circuit Diagram

Advantage

1. Easy to operate & Fast response.
2. Smaller in size.
3. Efficient design eliminates man's work.
4. Low power consumption and reduces wastage.

Disadvantages

1. Required a dedicated controller (Human).
2. There is a need of automatic system to increase the accuracy.

Application

1. Water level indicator is used in application like storage tanks, boiler etc to indicate level of inside water.
2. Easily indicate when water level is full in the tank with beep sound.

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07. Motion detection using PIR sensor

Introduction

Motion detection using a PIR sensor circuit can be used for providing security to home, shopping malls etc, as the PIR sensor used in this system detects the motion of human around this circuit. With the help of buzzer, we can identify the motion of human which was detected by the sensor. This system can be used at any place where security is needed. Security is needed by everyone in the society now-a-days to protect their property or confidential information from others which is sensor sense a human motion and then transmit the signal wirelessly. However, this project will relate to auto power ON light and fan system. When the sensor senses a human motion in the sensor's detection area, sensor will be triggered and then the room's light will automatically switch ON. It is useful for us when we cannot find the switch in the dark condition. For the fan's function, it is depends on the room temperature, when the temperature is higher, fan will run when the PIR had detect motion in the detection area. When the room temperature is low, fan will not run. Degree of temperature is measure by the temperature sensor and temperature will show on a LCD display (2x16). Light and fan will automatically OFF when the user was going out from the room. As long as PIR sensor does not detect motion in the detection area, light and fans are not function and the fan is depends on the room temperature. Once the sensor is triggered, system will have around 2 minutes to run the function. After 2 minutes and sensor does not detect any motion, light and fans will be switched OFF automatically.

Working

Since there are many projects using PIR with Arduino and also a lot of tutorials, I will introduce some of the easier yet interesting ones for you to get your hands on!
At Seeed, we offer six PIR motion sensors! However, I'll take Grove – PIR Motion Sensor as an example and compare it with other PIR sensors to illustrate how PIRs work with Arduino.
The way it senses movement is by sensing the change in temperature between the background and a warm body. PIRs have a pyroelectric sensor that detects levels of infrared radiation – everything emits some low-level radiation, but a human body emits a good amount of heat. The most common type of active motion detector uses ultrasonic sensor technology; these motion sensors emit sound waves to detect the presence of objects. There are also microwave sensors (which emit microwave radiation), and tomographic sensors (which transmit and receive radio waves).

System design

Circuit Description In our project, we used microcontroller from ATMEL which plays an important role having configured to work with a crystal oscillator of A Passive Infrared Sensor (PIR sensor) is used in this project to detect the human presence, which is connected to port 2.0 of the microcontroller. It gives an interrupt to the microcontroller when it detects the human presence at its field of view. To indicate this, a buzzer is connected to same port 2.0 pin of the microcontroller.

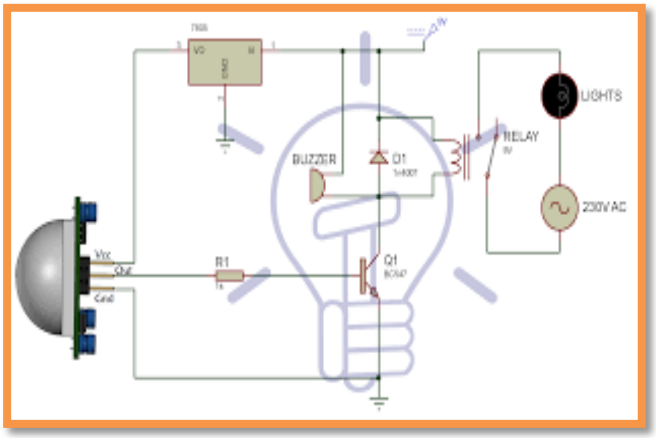

Figure 7.System Design

Advantages

1. Improved home security
2. Enhanced safety
3. Energy savings
4. Cost savings

Disadvantages

1. Radio frequency at high power is harmful for humans (active type).
2. Radio frequency in microwave range does not penetrate metal objects (active type).
3. Passive motion sensors do not operate above temperature of 35℃.

APPLICATIONS

1. Offices, banks, shopping malls and in intruder alarm in homes.
2. Automatic light control and counting machines.
3. Many systems like home-automation systems, energy-efficient systems and control systems and automatic door opening systems

8. Moisture Detection in Soil

Introduction

Capable and efficient use of water resources for irrigation is of high importance in agricultural nations. The environmental change criteria affect the farming area, farmers are forced to change and adapt practices to account for environmental changes and pressure from governments and other interested parties. The Internet of Things (IoT) is an innovation that is connected to numerous fields it centers on associating every related gadget (Things) to the Internet. Utilizing low essential resources that is installed with sensors, the pattern of Internet and communication network has been as of recently adapted as the improvement of a keen agriculture framework.

Methodology

The complete system design with its logical components is more easily presented by utilizing the block diagram. The block diagram is able to take what could possibly be a complicated project and break it down to an easy to follow format. Having a recognizable format such as this enables the designer to best focus their efforts on what is needed in the final product. The block diagram developed by the team is shown below. There are two functional components in this project. They are the moisture sensors module and the motor driver for motor pump. Thus the Arduino Board is programmed using the Arduino IDE software. The function of the moisture sensor is to sense the temperature content present in the soil, and also it measure moisture level in the soil. The motor driver interrupts the signal to, water pump supplies water to the plants. This project uses microcontroller Arduino Uno board to controls the motor and monitor soil moisture

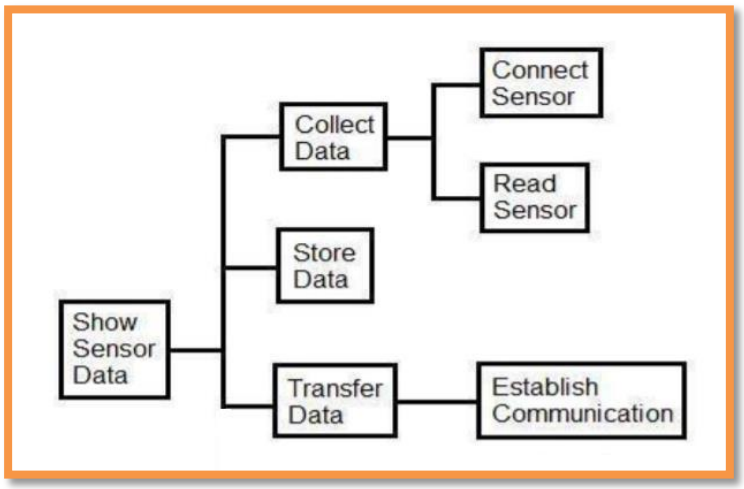

Figure 8.1 Block Diagram

Test result of this project

This project has three various testing that included with low, medium and high water content in the soil. The soil moisture detector detects the soil moisture content if the soil moisture content is very low then the motor is automatically on and water supplies to the soil. If the soil has a sufficient amount then the motor turn off automatically. That are shown in below diagram as different conditions and different water levels and there output

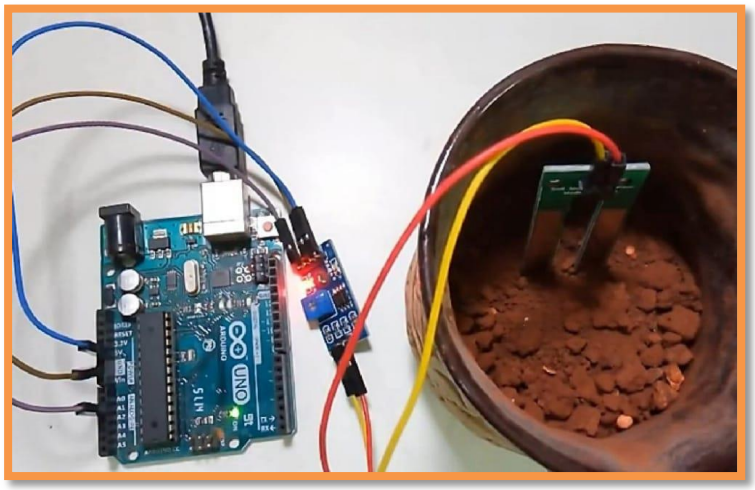

Figure 8.2 Working Model

Step1: When the water content is very low in the soil the pump will be automatically on and give some water to plant

Step2: After giving some water to the plant .moisture sensor will detect the moisture.So, pump will automatically off and stops the watering to the plant

Step 3: When we give to much amount of water than the result will be like this (i.e the plant reaches the minimum amount of water it needs), further watering the plant may hurts the plant. So the motor off automatically

Advantages

1. Irrigation and watering play a substantial role in determining the quality and yields of farming. More appropriate is the process of watering of the fields, more favorable are the end results.
2. No need Extra work Hard.
3. Save Water, Accordingly our Requirement of water, depends upon water level quantity soil and crops. Money Saving (Electricity bile + Water)

09. Six Mechanical Engineering Innovations that could Change the Industrial Game

1. An absorber design using a natural hyperbolic material for harvesting solar energy

Researchers led by Professor Ping Cheng, from Shanghai Jiao Tong University, in collaboration with Professor Zhuomin M. Zhang, from Georgia Institute of Technology, developed a perfect light absorption structure that utilizes an array of pyramidal nanostructures made of bismuth telluride (a natural hyperbolic material) over a thin substrate to absorb incident solar radiation.

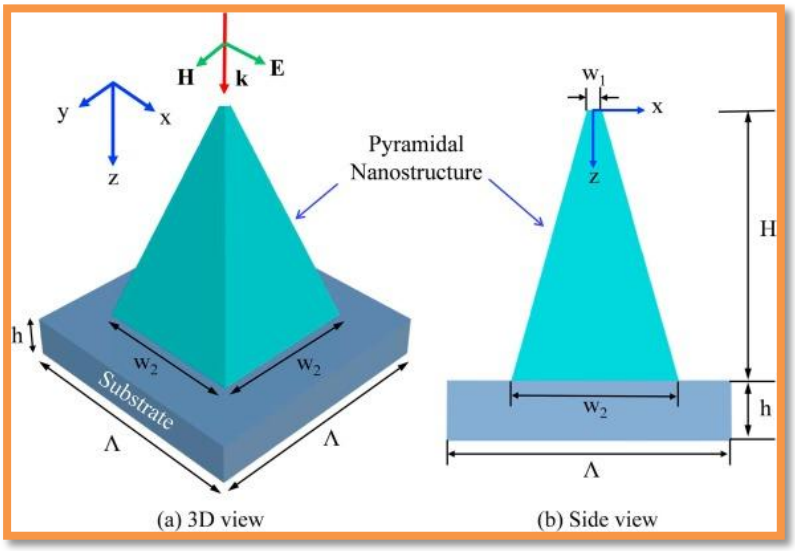

Figure 9.1 3-D and Side Views

The study successfully presented a perfect absorber design that manipulates a periodic array of pyramidal nanostructures that are made of a natural hyperbolic material bismuth telluride on a metallic substrate. The results from the experimental procedure undertaken in this study have shown that the proposed structure can achieve absorptance values of almost 100% in the wavelength range of 300–2400 nm, upon which most of the solar radiation spectrum fall into. Altogether, the proposed meta material has great potential application and can lead to the effective harvesting of solar energy during photo thermal conversion processes in water or aqueous solutions.

2. Windows Double as Solar Panels: fully transparent solar-power-generating windows

These windows have solar cells installed in the edges at a specific angle, which allows the incoming solar light to be efficiently transformed into electricity. The windows could generate 8 to 10 watts of power, according to Grapperhaus."Right now, we are looking for iconic projects all over the world to show that a large glass building can be made energy neutral in an aesthetic way.

Figure 9.2 Jasper Juinen

3. Experimental investigation on the performance of non-metallic flexible fire-resistance materials in flameproof diesel engine locomotive

Three kinds of flexible refractory fiber materials were used to verify the performance of fire resistance, according to explosion-proof principle and test methods of flame arrests. Then, a comparison of transmission efficiency between flexible refractory fiber arresters and general arresters was given. The aim of this is to verify the properties of non-metallic flexible fiber materials in fire resistance and transmission efficiency so that we can apply it to the flameproof diesel engine locomotive.

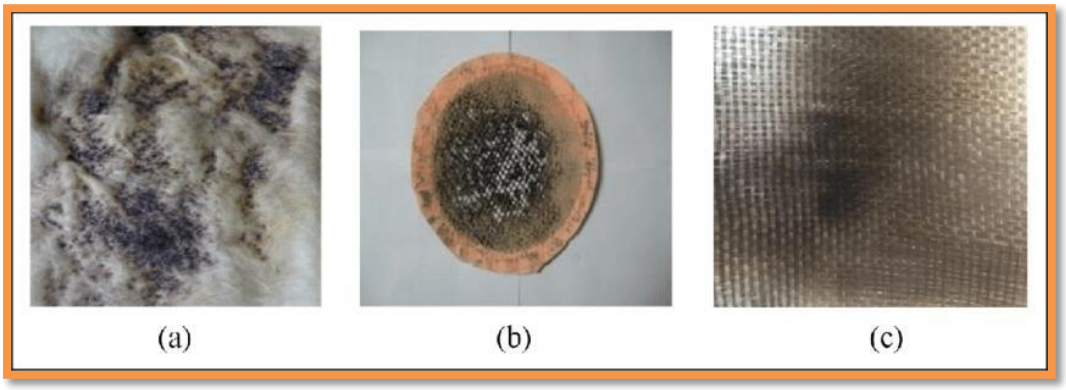

Figure 9.3 Various Flexible Refractory Fiber Materials

Theoretically, refractory fibers have good performances of air permeability and complex internal space, so it can provide with absorption area. First, irregular porous structure increases the cooling area. The temperature of the flame can decrease under the ignition point and quench after the heat exchange. Tiny pores of the porous materials, moreover, increases the probability of absorbing free radicals during chain reaction so as to prevent the combination of free radicals and premixed gas. Then, the chain reaction will slow down and even terminate.

The investigation was aimed at testing the performances in fire-resistance and transmission efficiency of non-metallic flexible materials in flameproof diesel engine locomotive which may replace traditional metal flame arresters with low gas transmission efficiency. On the basis of the chain reaction mechanism, the mixed gas was burnt in the experiment, and the free radical which can be absorbed by tiny pores of flexible fiber materials and quenched was released (1School of Mechanical and Electrical Engineering, China University of Mining and Technology, Xuzhou, China2Jiangsu Collaborative Innovation Center of Intelligent Mining Equipment, Xuzhou, China-Kedi Chen, Baolin Li).

4. Biodiesel Production from Waste Cooking Oil by Using an Ultrasonic Tubular Reactor

The aim of this research is to find an optimum synthesis biodiesel from waste cooking oil (WCO) using an ultrasonic tubular reactor. The experimental studies explored the variations in reaction time, molar ratio WCO to methanol (MeOH), amount of catalyst, the frequency of ultrasonic and output power ultrasonic on the ester contents. Comparisons of type ultrasonic and also the mechanical stirring method based on time reaction were investigated.

Figure 9.4 Biodiesel Plant

The optimum results of the biodiesel process is the reaction time of 5 minute, NaOH catalyst 1%wt of WCO, molar ratio WCO to MeOH of 1:6, frequency ultrasonic of 20 kHz and output power ultrasonic of 650 W. The reaction time reduced 12-24 times compared to both of method and the yield of ester contents was obtained at 96.54%wt.

5. Acoustic Wave Separation

FloDesign Sonics, with funding from the National Science Foundation, has developed a uniquely effective patented technology called Acoustic Wave Separation (AWS) that separates or cleans water or other liquids from other contaminants. Acoustic waves were the secret behind this breakthrough technology that divorced all foreign substances such as radioactive material,

hydrocarbons, bacteria, chemical additives, salt, and more, without the use of chemicals or filters.

Figure 9.5 Acoustic Wave Separation Technology

Their immediate goal was to be able to process 100,000 gallons a day for the gas and oil industry. This same technology could also be used to cleanse blood during surgery, to reclaim proteins from the cells of mammals, as well as many uses in gene and cell therapies. This groundbreaking AWS technology will have innumerable potential uses in the future.

6. Hybrid simulation of thunderstorm outflows and wind excited response of structures

Structural components such as buildings, bridges, and tunnels are often affected by actions of winds and thunderstorms outflows. The need to control their effects on structures has resulted in numerous researchers in the wind engineering field. The study by Professor Giovanni Solari and his team will help in gathering different data involving such structures which will thus be analyzed to produce robust results that may be further used in understanding other effects such as those resulting from aerodynamic damping.

The authors successfully investigated wind-excited responses through modal analysis and time-domain approaches. In the simulation analysis, some parameters such as aerodynamic damping and transient aerodynamic effects were neglected. The obtained results also helped in getting the information about classic analysis. This was done about synoptic stationary cyclones. It was however observed that thunderstorms outflows often induce a major structural response as compared to synoptic stationary cyclones. However, both synoptic and thunderstorms events experience similar qualitative responses as far as the dynamic response and wind loading on the structures are concerned.

10. Effect of Saline Water on Adhesive Bondin

Introduction

A composite is combination of two materials in which one of the materials, called the reinforcing phase, is in the form of fibers, sheets, or particles, and is embedded in the other materials called the matrix phase. The reinforcing material and the matrix material can be metal, ceramic, or polymer. Composites typically have a fiber or particle phase that is stiffer and stronger than the continuous matrix phase and serve as the principal load carrying members. The matrix acts as a load transfer medium between fiber and in less ideal cases where the loads are complex, the matrix may even have to bear loads transverse to the fiber axis. The matrix is more ductile than the fiber and thus acts as a source of composite toughness. The matrix also serves to protect the fiber from environmental damage before, during and after composite processing. When designed properly, the new combined material exhibits better strength than would each individual material.

Advantages of composite materials

Composites can be very strong and stiff, yet very light in weight, so ratios of strength-to weight and stiffness-to-weight are several times greater than steel and aluminum.

- High specific strength.
- High specific stiffness long fatigue life.
- High creep resistance
- Low coefficient of thermal expansion.
- Low density.
- Low thermal conductivity.
- Improved corrosion resistance
- Better temperature dependant behaviour.
- Strong lightweight composites can solve many product design problems.
- Most composites won’t standup to welding, and holds to accommodate traditional fasteners will also weaken them.
- Manufacturer can choose adhesives to seal joints.

- The oil and gas industries are also using adhesives so that it can benefit from light weighting as well. In this case weight reduction increase the amount of oil a platform can pump and store.

Application

The following are the various application areas of adhesive for composites.

- Launch vehicles
- Racing cars and automobiles engines-block flanges and body shell.
- Orthopedic devices
- Aerospace components
- Fishing rods
- Bicycles
- Storage tanks
- Metal to metal sand witch structure

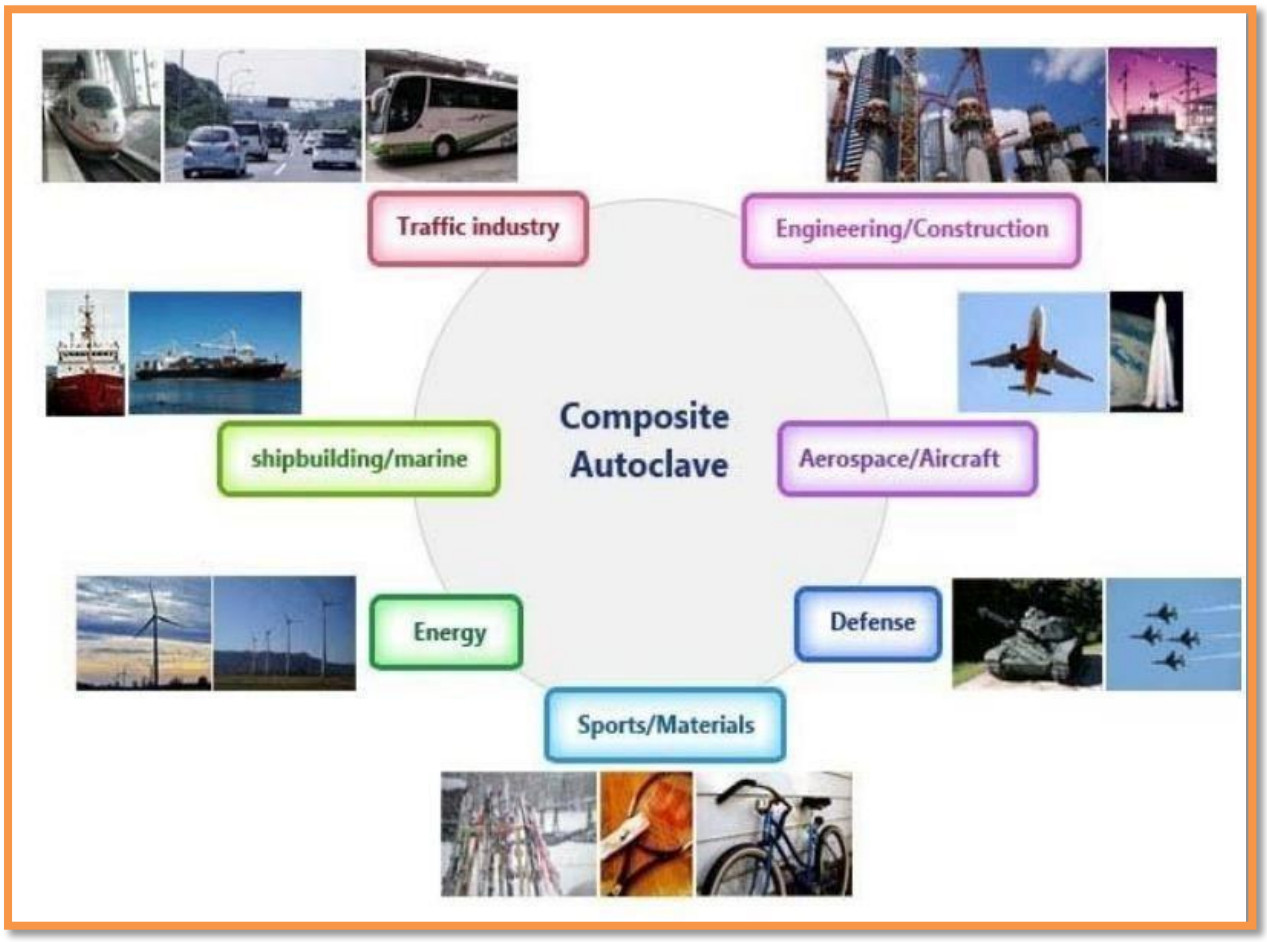

Figure 10. Application of Composite Materials

11. A New Technique of Generating Process Maps for Laser Powder-Bed

Laser powder-bed combination (LPBF) is an added substance fabricating process intertwining metal powder layer-by-layer to shape complex 3D segments. LPBF is viewed as a fast development of machine structure (more and higher force lasers, improved laser control and assemble planning programming) giving expanded thickness of fabricated parts better between and intra-construct repeatability, all prompting better mechanical properties. The customary technique to make process maps by means of after death assessment of cemented single line tracks intends to see how the laser interfaces with the powder to shape single line tracks legitimately onto a base plate Control of procedure boundaries, for example, speed, force and pillar measurement are indispensable to picking ideal laser entrance while maintaining a strategic distance from vanishing keyhole liquefying or balling deserts. This technique is constrained as the substrate might be of a comparative however micro structurally disparate and controlling extra boundaries, for example, the powder layer thickness is troublesome. Another pot strategy is portrayed and contrasted with the customary technique utilizing Ti-6Al-4V and 316L with focal points, which include:

i) High-throughput, high quality geographical and cross-sectional metallography to be effortlessly acquired.

ii) A track to be worked in-situ on a formerly kept substrate is more delegate of the procedure at all layers.

iii) Tight control on the powder profundity and extra boundaries.

The cauldron strategy anticipated a substantially less extreme progress among conductive and keyhole methods of liquefying than direct statement of single tracks onto a base plate, with shallower re-dissolving of lower layers. The cauldron technique likewise anticipated an all the more sympathetic change among persistent and intermittent tracks. Cauldron process, procedure for delivering fine or device steel.

The soonest known utilization of the strategy happened in India and focal Asia in the mid first thousand years. The steel was delivered by warming created iron with materials wealthy in carbon, for example, charcoal in shut vessels. The pot ought to basically be made of materials with an a lot higher softening point than that of the materials to be liquefied. The pot materials ought to likewise have great quality in any event, when amazingly hot. Heater pots arrive in an assortment of metal developments, for example, earth graphite, silicon- carbide, and the sky is the limit from there. Pots are utilized in the research facility to contain synthetic mixes when

warmed to amazingly high temperatures. Cauldrons are accessible in a few sizes and ordinarily accompany a correspondingly-sized top. The pots ought to be "tempered" before use.

Warmth the vacant Cauldron to a temperature of around 500 deg F.This procedure removes any dampness in the pot. Cauldrons ought to appropriately be tried for splits before every application. Particular laser softening, otherwise called direct metal laser liquefying or laser powder bed combination, is a fast prototyping, 3D printing, or added substance fabricating strategy intended to utilize a powerful thickness laser to dissolve and circuit metallic powders together.

Powder bed combination (PBF) is an added substance producing procedure and chips away at a similar essential rule in that parts are shaped through including material as opposed to deducting it through ordinary framing tasks, for example, processing. The PBF procedure starts with the production of a 3D CAD model, which is numerically 'cut' into a few discrete layers. For each layer, a warmth source filter way is determined which characterizes both the limit shape and some type of fill grouping, frequently a raster design since the warmth source is normally a vitality bar arrangement.

Mr. DEEPAK TALWAR
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12. Plasma Engine

A plasma propulsion engine is a type of electric propulsion that generates thrust from a quasi-neutral plasma. This is in contrast with ion thruster engines, which generate thrust through extracting an ion current from the plasma source, which is then accelerated to high velocities using grids/anodes. These exist in many forms. Plasma thrusters do not typically use high voltage grids or anodes/cathodes to accelerate the charged particles in the plasma, but rather use currents and potentials that are generated internally to accelerate the ions, resulting in a lower exhaust velocity given the lack of high accelerating voltages. The lack of high voltage grids of anodes removes a possible limiting element as a result of grid ion erosion. The plasma exhaust is 'quasi-neutral', which means that positive ions and electrons exist in equal number, which allows simple ion-electron recombination in the exhaust to neutralize the exhaust plume, removing the need for an electron gun (hollow cathode). Such a thruster often generates the source plasma using radio frequency or microwave energy, using an external antenna. This fact, combined with the absence of hollow cathodes, allows the possibility of using this thruster on a variety of propellants, from argon to co air mixtures to astronaut urine.

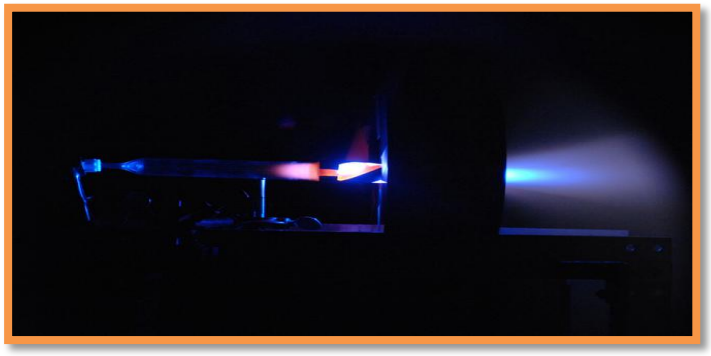

Figure 12 Plasma Engine

Plasma engines have a much higher specific impulse value than most other types of rocket technology. The VASIMR thruster can be throttled for an impulse greater than 12000 s, and hall thrusters have attained ~2000 s. This is a significant improvement over the bipropellant fuels of conventional chemical rockets, which feature specific impulses ~450. With high impulse, plasma thrusters are capable of reaching relatively high speeds over extended periods of acceleration. while reaching a maximum velocity of 34 miles per second (55 km/s).Certain plasma thrusters, such as the mini-helicon, are hailed for their simplicity and efficiency. Their theory of operation is relatively simple and can use a variety of gases, or combinations. These qualities suggest that plasma thrusters have value for many mission profiles.

Mr. SOHAIL YARGATTI
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13. Robotics and Its Applications in Aerospace and Aeronautical Engineering

Airline industries are fully consolidated with robots, which help in performing multi tasks in a given span of time. To withstand the environment of the industry, such robots are implemented with, fire and also electrical proof bodies. The robots which are in production sectors are integrated with smart programming. Since the aeronautical sector is a huge industry which involves difficult tasks, these robots are solved by developing new algorithmic programs for planning and control.

Figure13.1Assembling of Aircraft Done by Robot

Rise of airport robots

Human guided robots are popularly developing and in research, field of airports. Such as robots, which are able to guide the passengers who are trapped and unguided in the airport? The smart materials which are implemented in these robots are ultrasonic sensors, which is the key element to transmit and receive the presence of human.

Figure13.2 Human Guided Robots at the Airport

This device detects the presence of human and guides them to the designation. These robots are also helping the civilians by carrying their baggages. And also there are robots, which are used to serve food and entertain the passengers. These types of robots are being used in Japan Airlines, Dubai by introducing this hybrid robots, the airlines are able to make an imitated constrain of time and passengers.

Mr. Siddharth V. Patil
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14. Duel Fuel Engine

The dual-fuel engine works on diesel cycle. The gaseous fuel is added to the air inducted by the engine or supplied by the supercharger at a pressure slightly above the atmospheric pressure. This mixture of air and gaseous fuel is compressed in the compression stroke near top dead center, a small charge of liquid fuel called pilot fuel is injected through a convention diesel fuel system. This pilot acts as a source of ignition the gas-air mixture in the vicinity of the injected spray ignites at a number of flame-fronts. Thus combustion stars smoothly and rapidly.

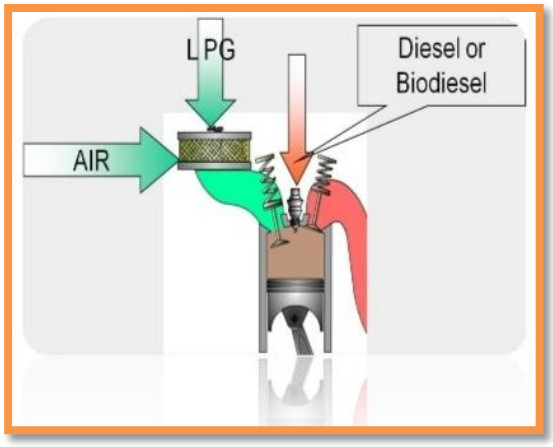

Figure14. Schematic Diagram of Dual fuel Engine

Operation

- Mixes the natural gas with intake air
- Diesel provides ignition source-No spark plugs
- Diesel stars-up , power density and transient performance
- Gas replaces diesel with 50-70% substitution rate

Advantages

- Reduces diesel consumption
- Use of carbon neutral fuel
- Variations in fuel source
- Reduction of NO_x & CO_2

Disadvantages

- Cannot operate without pilot fuel
- Lower engine output
- Higher CO emission

Mr. Dhananjayakumar Magadum
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15. Non Pneumatic Tires

Introduction

The tweel airless tire was first developed in 2005 by Michelin. The name is a combination of the words tire and wheel. The Tweel`s hub connects to flexible polyurethane spokes which are used to support an outer rim.

Working

Airless tires or non-pneumatic tires (NPT) are TIREs that are not supported by air pressure. The flexible tread and shear bands deform temporarily as the spokes bend, then quickly go back to the initial shape.

Figure15. Schematic Diagram of Non Pneumatic Tires

Advantages

- No maintenance required.
- Facilitate recycling.
- Durability & long life.

Disadvantages

- Lack of adjustability.
- Vibration.
- Different manufacturing technique.

Application

- ✓ In backhoe or bulldozers.
- ✓ For military vehicles
- ✓ All terrine vehicles (ATV)

Mr Ramesh S Adin
2HN19ME009

16. Magnetic Refrigeration

Introduction

Refrigeration is the process of removing heat from matter which may be a solid, a liquid, or a gas. Removing heat from the matter cools it, or lowers its temperature.

Magnetic Refrigeration

Magnetic refrigeration is based on a fundamental thermodynamic property of magnetic materials, magnetic caloric effect, which causes a temperature change if the material is subject to an applied magnetic field under adiabatic conditions. Magnetic refrigeration has been recognised as being an alternative technology to the conventional vapour compression technology, it is an environmentally friendly cooling technique used avoiding ozone depleting or global warming gases.Essentially material with the large MCE and high magnetic field created by magnetic field sources, it does not use chlorofluorocarbons that can negatively influence ozone layer depletion.

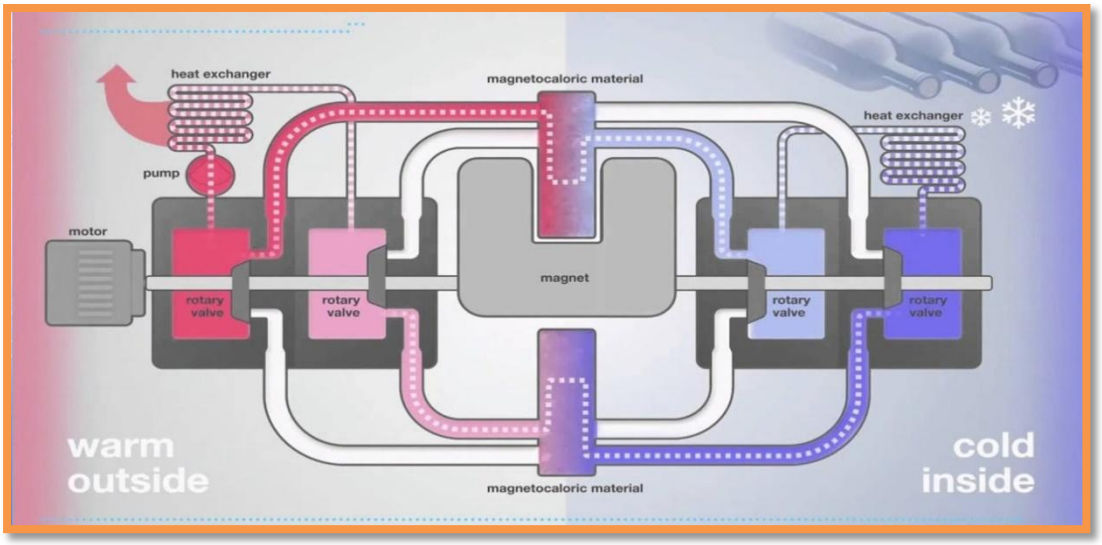

Figure16. Schematic Diagram of Magnetic Refrigeration

Advantages

- No compression is required.
- No refrigerant gas.
- Low pressure operation.

Disadvantages

- High cost.
- Ineffectiveness in subset.
- Requires refrigeration and use of needles.

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17. MEMS

MEMS, an acronym that originated in the United States, is also referred to as Microsystems Technology (MST) in Europe and Micro machines in Japan. Regardless of terminology, the uniting factor of a MEMS device is in the way it is made. While the device electronics are fabricated using 'computer chip' InTechnology, the micromechanical components are fabricated by sophisticated manipulations of silicon and other substrates using micromachining processes. Processes such as bulk and surface micromachining, as well as high-aspect-ratio micromachining (HARM) selectively remove parts of the silicon or add additional structural layers to form the mechanical and electromechanical components. While integrated circuits are designed to exploit the electrical properties of silicon, MEMS takes advantage of either silicon's mechanical properties or both its electrical and mechanical properties.

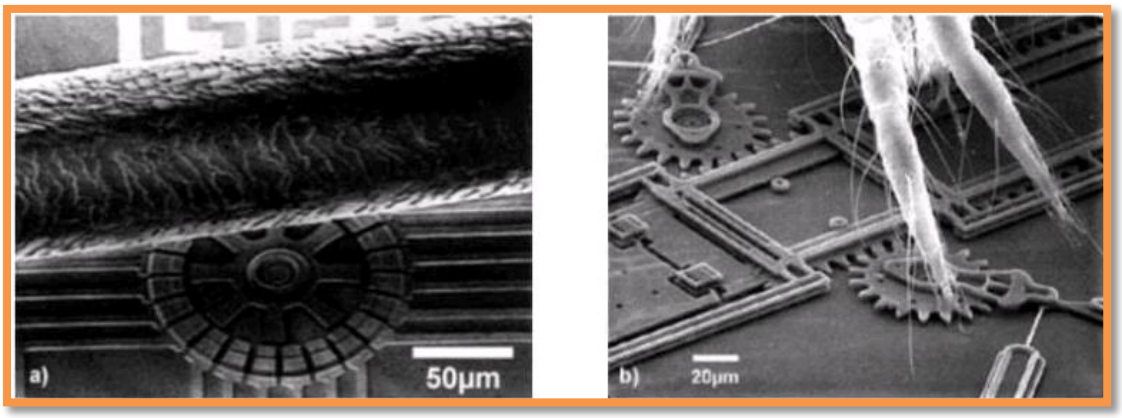

Figure 17. MEMS Components

MEMS devices are very small; their components are usually microscopic. Levers, gears, pistons, as well as motors and even steam engines have all been fabricated by MEMS. However, MEMS is not just about the miniaturization of mechanical components or making things out of silicon. MEMS is a manufacturing technology; a paradigm for designing and creating complex mechanical devices and systems as well as their integrated electronics using batch fabrication techniques.

In the most general form, MEMS consist of mechanical microstructures, micro sensors, micro actuators and microelectronics, all integrated onto the same silicon chip. Micro sensors detect changes in the system's environment by measuring mechanical, thermal, magnetic, chemical or electromagnetic information or phenomena. Microelectronics processes this information and signals the micro actuators to react and create some form of changes to the environment.

Miss. Archana Gulli
USN - 2HN19ME003

18. Common-Rail Direct Injection

The CRDi technology works in tandem with the engine EGU, which get inputs from various sensors. It then calculates the precise quantity of fuel and timing of injection. The fuel system features components that are more intelligent in nature and controls them electrically or electronically. Additionally, the conventional injectors are replaced with more advanced, electrically operated solenoid injectors. They are opened by an ECU signal, depending upon the variables such as engine speed, load, engine temperature, etc.

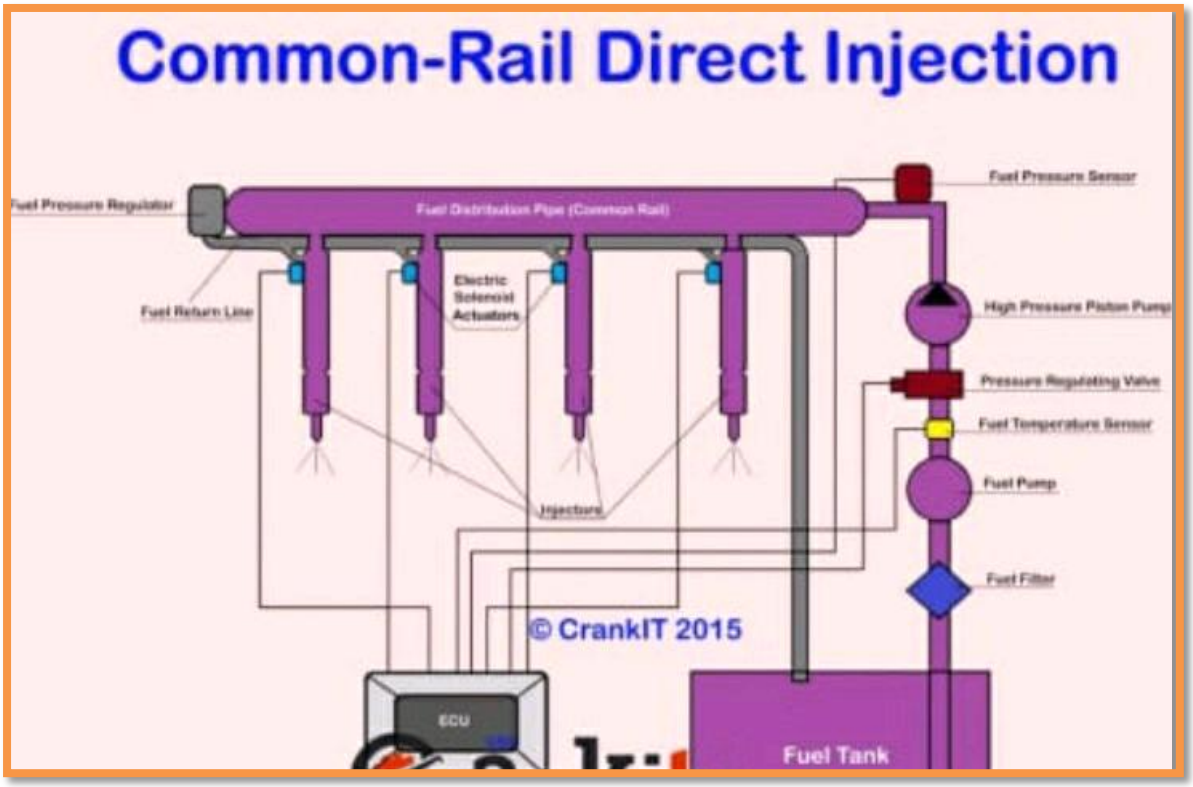

Figure18. Schematic Diagram of CRDi System

Furthermore, a Common Rail system uses a fuel- rail or, in simple words, a ‘fuel distribution pipe' that is common for all cylinders. It maintains optimum residual fuel pressure and also acts as a shared fuel reservoir for all the injectors. In the CRDi system, the fuel-rail constantly stores and supplies the fuel to the solenoid valve injectors at the required pressure. This is quite opposite to the fuel injection pump supplying diesel thru' independent fuel lines to injectors in case of earlier generation.

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19. Nano Batteries

Nanobatteries are fabricated batteries employing technology at the nanoscale, particles that measure less than 100 nanometers or 10−7 meters. These batteries may be nano in size or may use nanotechnology in a macro scale battery. Nanoscale batteries can be combined to function as a macro battery such as within a nanopore battery.

Traditional lithium-ion-battery technology uses active materials, such as cobalt-oxide or manganese oxide, with particles that range in size between 5 and 20 micrometers (5000 and 20000 nanometers – over 100 times nanoscale). It is hoped that nano-engineering will improve many of the shortcomings of present battery technology, such as volume expansion and power density.

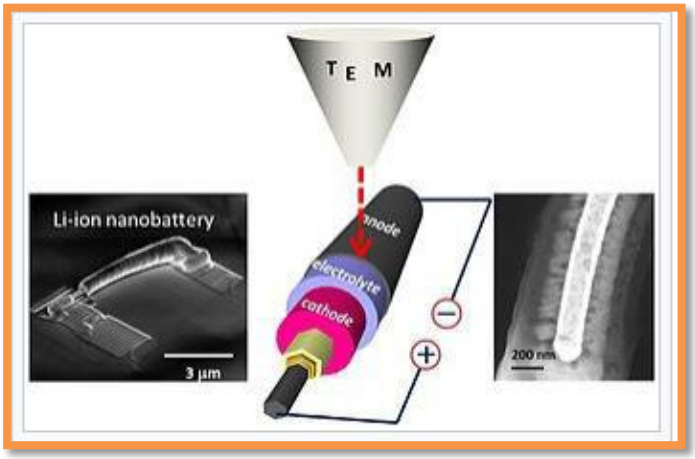

Figure19. Nano Batteries

A battery converts chemical energy to electrical energy and is composed of three general parts:

1. Anode (positive electrode) 2. Cathode (negative electrode) 3. Electrolyte

The anode and cathode have two different chemical potentials, which depend on the reactions that occur at either terminus. The electrolyte can be a solid or a liquid, referring to a dry cell or wet cell respectively and is ionically conductive. The boundary between the electrode and electrolyte is called the solid-electrolyte interphase (SEI). An applied voltage across the electrodes causes the chemical energy stored in the battery to be converted to electrical energy

Limitations of current battery technology

A battery's ability to store charge is dependent on its energy density and Power density. It is important that charges can remain stored and that a maximum amount of charge can be stored within a battery. Cycling and volume expansion are also important considerations as well. While many other types of batteries exist, current battery technology is based on lithium-ion intercalation technology for its high power and energy densities, long cycle life and no memory effects. These characteristics have led lithium-ion batteries to be preferred over other battery

types. To improve a battery technology, cycling ability and energy and power density must be maximized and volume expansion must be minimized.

During lithium intercalation, the volume of the electrode expands, causing mechanical strain. The mechanical strain compromises the structural integrity of the electrode, causing it to crack. nanoparticles can decrease the amount of strain placed on a material when the battery undergoes cycling, as the volume expansion associated with nanoparticles is less than the volume expansion associated with microparticles. The little volume expansion associated with nanoparticles also improves the reversibility capability of the battery: the ability of the battery to undergo many cycles without losing charge.

In current lithium-ion battery technology, lithium diffusion rates are slow. Through nanotechnology, faster diffusion rates can be achieved. Nanoparticles require shorter distances for the transport of electrons, which leads to faster diffusion rates and a higher conductivity, which ultimately leads to a greater power density.

Advantages of nanotechnology

Using nanotechnology to manufacture of batteries offers the following benefits:

- Increasing the available power from a battery and decreasing the time required to recharge a battery. These benefits are achieved by coating the surface of an electrode with nanoparticles, increasing the surface area of the electrode thereby allowing more current to flow between the electrode and the chemicals inside the battery.
- Nanomaterials can be used as a coating to separate the electrodes from any liquids in the battery, when the battery is not in use. In the current battery technology, the liquids and solids interact, causing a low level discharge. This decreases the shelf life of a battery.

Disadvantages of nanotechnology

Nanotechnology provides its own challenges in batteries:

- Nanoparticles have low density and high surface area. The greater the surface area, the more likely reactions are to occur at the surface with the air. This serves to destabilize the materials in the battery.
- Owing to nanoparticle's low density, a higher inter particle resistance exists, decreasing the electrical conductivity of the material.
- Nanomaterials can be difficult to manufacture, increasing their cost.

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20. Advanced Wind Turbine Drivetrain Trends

The drivetrain is the "powerhouse" of a wind turbine, containing the generator and gearbox which converts the torque—or rotation of the blades—into electricity. Most wind turbine drivetrains currently use generators that are connected to gearboxes, which speed up the rotation from the relatively slow speed of the turbine's blades (typically 5–15 rotations per minute for a modern machine), to the high speeds (1,000–1,800 rotations per minute) needed to generate electricity using a high-speed induction generator. Having all of those moving parts makes the gearbox one of the highest-maintenance parts of a wind turbine.

One alternative is to use a "direct drive" generator that can generate electricity at much lower speeds. Direct drive systems do not require a gearbox and therefore have fewer moving parts. However, they usually use permanent magnets, which require expensive, heavy, rare earth materials such as neodymium and dysprosium, and they typically require heavier generators than geared machines for a given turbine capacity.

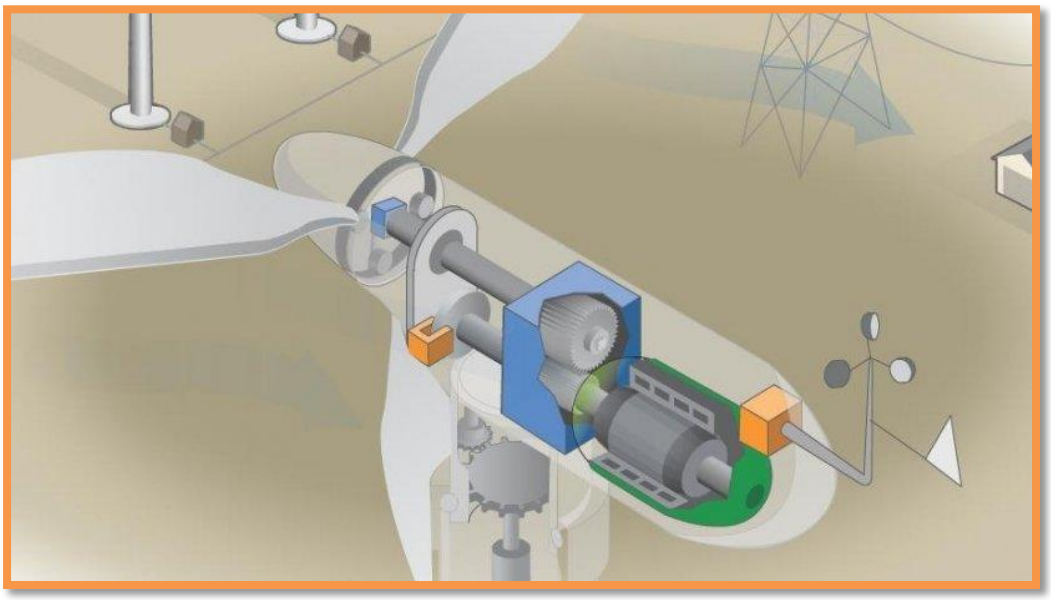

Figure20. Schematic diagram of Drivetrain Wind Turbine

Regardless of whether it's direct drive or geared, these components are massive (200–320 tons for a 10-megawatt (MW) turbine generator system), and as they are positioned on the top of the wind turbine's tower, this also increases the weight and cost of the tower and foundation. They also require large, expensive cranes for installation, and have transportation constraints due to their weight.

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Program Educational Objectives (PEOs)

The Graduates will be able to

PEO1: Acquire core competence in Applied Science, Mathematics and Mechanical Engineering fundamentals to excel in professional career and higher study

PEO2: Design, demonstrate and analyze the mechanical systems which are useful to society.

PEO3: Maintain professional & ethical values, employability skills, multidisciplinary approach & an ability to realize engineering issues to broader social context by engaging in lifelong learning.

Program Specific Outcomes (PSOs)

PSO1: Able to apply the basic principles of Mechanical Engineering in various practical fields to solve societal problems by engaging themselves in many state/national level projects.

PSO2: Able to analyze and design basic mechanical system using relevant tools and techniques.

PSO3: Able to resolve contemporary issues of industries through industry institute interaction and alumni social networks

Program Outcomes (POs)

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

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

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

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

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

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

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

PO8: **Ethics-** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

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

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

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

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

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Mechanical Engineering Department