Chapter-1

Introduction

1. INTRODUCTION

The quests for a constant, safe, clean, environmental-friendly fuel is never-ending. Carbon-based fuels, such as fossil fuels are unsustainable and hazardous to our environment. Some of the alternatives are renewable energy sources which include all fuel types and energy carriers, different from the fossil ones, such as the sun, wind, tides, hydropower and biomass. Amongst these elements, solar and wind energy is preferred since it could provide the cleanest sustainable energy for the longest duration of time – the next few billion years. It can arguably be said that the only limitation to wind power as an energy source is our understanding of developing efficient and cost effective technology which can implement it. Nothing on earth is free of cost, but what if we could find a way to implement free rides? Indeed it would be wonderful if our cars could continue to run without us having to spend billions on fossil fuels every year and to deal with natural hazards that their combustion leave behind. If we could drive a wind-powered car, that auto dream would come true. They are noiseless and pollution-free and need minimum maintenance. The electricity thus generated would then fuel the battery that would run the car's motors. Therefore we would obtain an electrically driven vehicle that would travel on “free” energy with no harmful emissions, that can utilize its full power at all speeds, and would have very little maintenance cost.

1.1 HISTORY

According to the Wind Energy Foundation, wind power has been around for quite some time, starting with boats.

“Since early recorded history, people have harnessed the energy of the wind. Wind energy propelled boats along the Nile River as early as 5000 B.C. By 200 B.C., simple windmills in China were pumping water, while vertical-axis windmills with woven reed sails were grinding grain in Persia and the Middle East.

“New ways of using the energy of the wind eventually spread around the world. By the 11th century, people in the Middle East used windmills extensively for food production. Returning merchants and crusaders carried this idea back to Europe. The Dutch refined the windmill and adapted it for draining lakes and marshes in the Rhine River Delta. When settlers took this technology to the New World in the late 19th century, they began using windmills to pump water for farms and ranches and later to generate electricity for homes and industry.

“American colonists used windmills to grind wheat and corn, to pump water and to cut wood at sawmills. With the development of electric power, wind power found new applications in lighting buildings remotely from centrally generated power. Throughout the 20th century, small wind plants, suitable for farms and residences, and larger utility-scale wind farms that could be connected to electricity grids were developed.

1.2 MOTIVATION

1.2.1 POLLUTION

The earth is suffering as a result of the destruction wreaked upon it by humanity. Whether it is the pesticides contaminating the rivers, chemicals from factories polluting the seas or the exhaust fumes from vehicles and industries polluting the air, the systematic destruction of our different ecosystems all over the world has led to a dreadful mess. Our main focus is on the transportation industry which is the second largest source of pollution and health hazards. Dhaka has been named one of the worst polluted cities of the world where the roads congested with vehicles bombard the countless hordes of people streaming past on the pavements with deafening noise and toxic exhaust fumes from burning fuel especially during peak office hours when cars stuck in traffic produce more and more harmful emissions. As a result thousands of people are becoming victims of heart and lung problems, depression, memory loss, asthma and even premature deaths.

1.2.2 GLOBAL WARMING

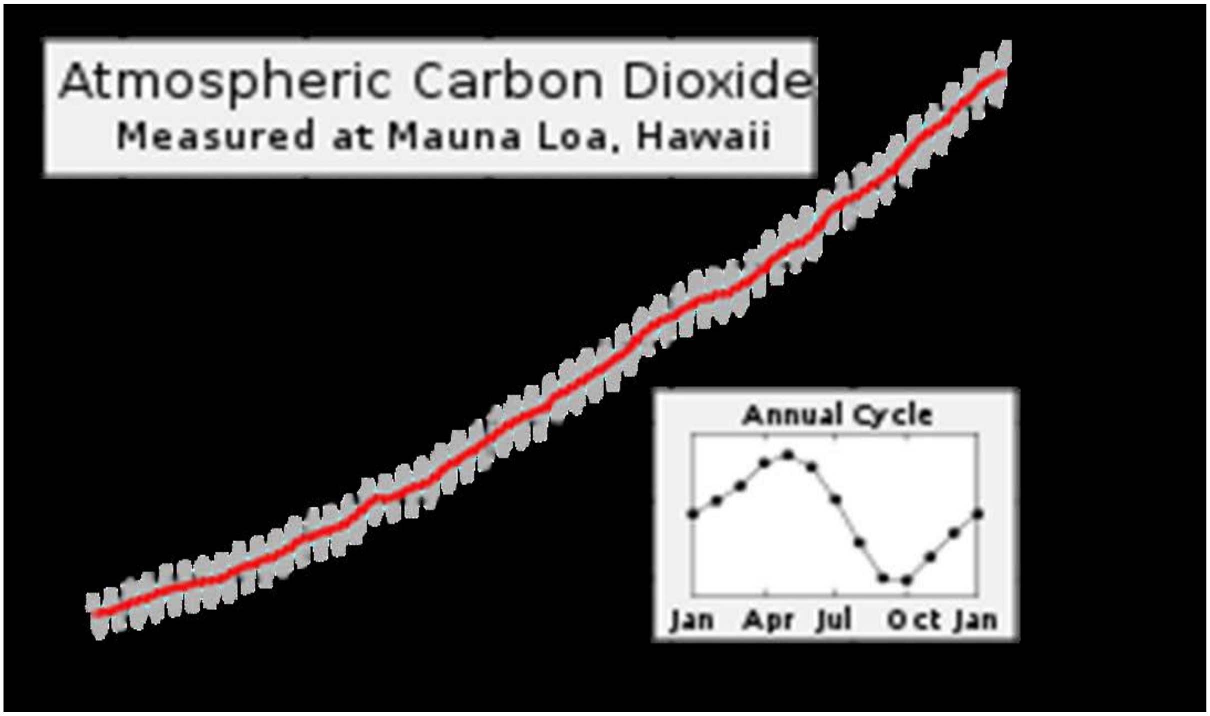


FIGURE 1.1.1: WORLD $C0_2$ emissions

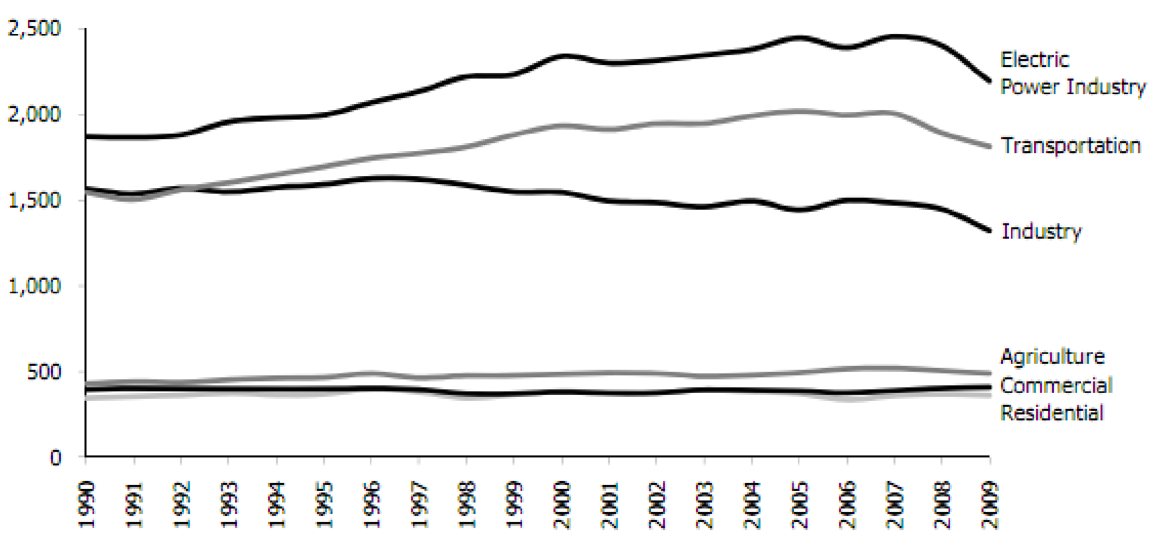


FIGURE 1.2.2: CO_2 Emission by Various Sectors

The CO_2 of the world is rising at an extremely alarming rate. As shown in FIGURE1.2.1

The conventional car's exhaust fumes today are one of the biggest contributors to the atmospheric CO_2 As illustrated in FIGURE 1.2.2. The global warming resulting from this causes global temperatures to increase and consequently raises the sea levels as well.

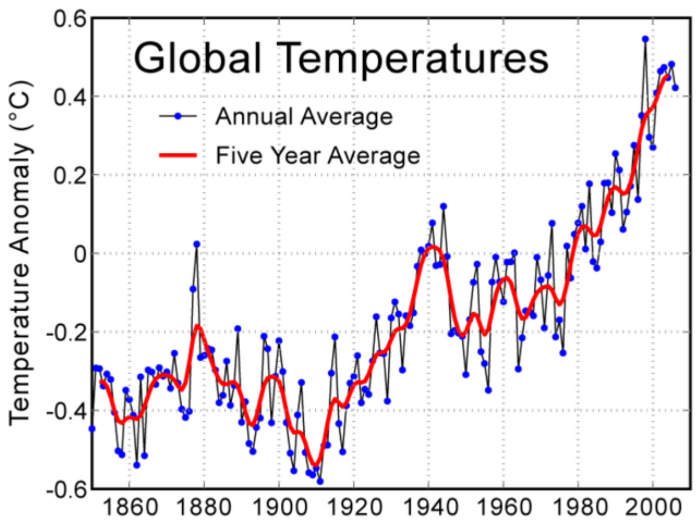


FIGURE 1.1.3: World temperature trend

1.2.3 FUEL PRICES

Fuel-based cars not only threaten the very air we breathe in but also the cost of running and maintaining them are huge and overbearing, and as the fossil fuels are gradually being depleted, the cost of these limited scare resources, the existing fuels' prices are continuously rising.

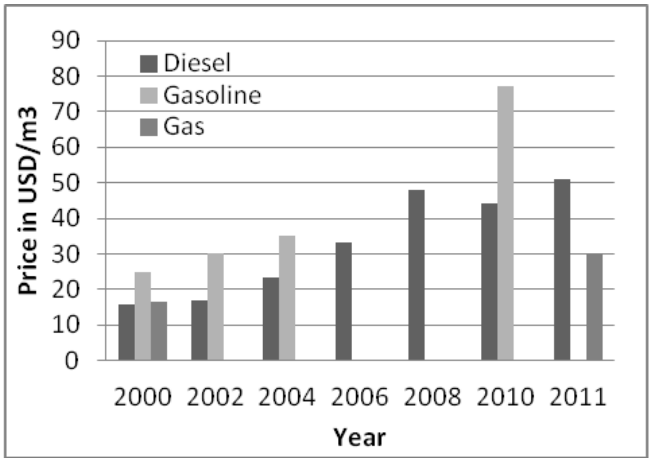


FIGURE 1.1.4: Fuel prices and trends

Clearly, individuals need to become more aware of the consequences of their actions and can help protect the earth by using an alternative method of transport, perhaps the wind powered vehicle, an eco-friendly, clean, inexpensive, compact car, independent of fossil fuels and toxic emissions. This electric vehicle may definitely be a major step in reducing traffic congestion, noise and vehicle emissions on the road.

These vehicles would not contribute to global warming or to the production of CO_2.Thus this will reduce greenhouse gas emissions as CO_2 is the primary greenhouse gas and thereby lower human health risks. They will cost four times less than fuel-based cars since apart from the initial cost of the major components of installation for example the propellers, charge and motor controllers, there would be no more recurring costs as wind energy is absolutely free. If the government and many transportation industries can take the initiative to provide the fund for the research and development of the technology to produce wind power and thus to the production of vehicles at a large scale, the use of this modern vehicle will benefit us all.

CHAPTER - 2

WIND ENERGY BASICS

Wind Energy Basics

Basic information on wind energy and wind power technology, resources, and issues of concern.

Wind Energy and Wind Power

Wind is a form of solar energy. Winds are caused by the uneven heating of the atmosphere by the sun, the irregularities of the earth's surface, and rotation of the earth. Wind flow patterns are modified by the earth's terrain, bodies of water, and vegetative cover. This wind flow, or motion energy, when "harvested" by modern wind turbines, can be used to generate electricity.

How Wind Power Is Generated

The terms "wind energy" or "wind power" describe the process by which the wind is used to generate mechanical power or electricity. Wind turbines convert the kinetic energy in the wind into mechanical power. This mechanical power can be used for specific tasks (such as grinding grain or pumping water) or a generator can convert this mechanical power into electricity to power homes, businesses, schools, and the like.

Equation for Wind Power

$$P = \frac{1}{2}\rho A V^3$$

Where

P = wind power

A = swept area of the blades

V = velocity with which the blades are rotating

Wind speed

The amount of energy in the wind varies with the cube of the wind speed, in other words, if the wind speed doubles, there is eight times more energy in the wind ($2^3 = 2x2x2 = 8$).

Small changes in wind speed have a large impact on the amount of power available in the wind.

Density of the air

The more dense the air, the more energy received by the turbine. Air density varies with elevation and temperature. Air is less dense at higher elevations than at sea level, and warm air is less dense than cold air. *All else being equal*, turbines will produce more power at lower elevations and in locations with cooler average temperatures.

Swept area of the turbine

The larger the swept area (the size of the area through which the rotor spins), the more power the turbine can capture from the wind. Since swept area is $A = pir^2$, where r = radius of the rotor, a small increase in blade length results in a larger increase in the power available to the turbine.

Advantages and Disadvantages of Wind-Generated Electricity

A Renewable Non-Polluting Resource

Wind energy is a **free, renewable resource**, so no matter how much is used today, there will still be the same supply in the future. Wind energy is also a source of **clean, non-polluting, electricity**. Unlike conventional power plants, wind plants emit no air pollutants or greenhouse gases. According to the U.S. Department of Energy, in 1990, California's wind power plants offset the emission of more than 2.5 billion pounds of carbon dioxide, and 15 million pounds of other pollutants that would have otherwise been produced. It would take a forest of 90 million to 175 million trees to provide the same air quality.

Cost Issues

Even though the cost of wind power has decreased dramatically in the past 10 years, the technology requires a **higher initial investment** than fossil-fueled generators. Roughly 80% of the cost is the machinery, with the balance being site preparation and installation. If wind generating systems are compared with fossil-fueled systems on a "life-cycle" cost basis (counting fuel and operating expenses for the life of the generator), however, wind costs are much more competitive with other generating technologies because there is no fuel to purchase and minimal operating expenses.

Environmental Concerns

Although wind power plants have relatively little impact on the environment compared to fossil fuel power plants, there is some concern over the **noise** produced by the rotor blades, **aesthetic (visual) impacts**, and birds and bats having been killed (**avian/bat mortality**) by flying into the rotors. Most of these problems have been resolved or greatly reduced through technological development or by properly sitting wind plants.

Supply and Transport Issues

The major challenge to using wind as a source of power is that it is **intermittent** and does not always blow when electricity is needed. Wind cannot be stored (although wind-generated electricity can be stored, if batteries are used), and not all winds can be harnessed to meet the timing of electricity demands. Further, good wind sites are often located in **remote locations** far from areas of electric power demand (such as cities). Finally, wind resource development may compete with other uses for the land, and those **alternative uses** may be more highly valued than electricity generation. However, wind turbines can be located on land that is also used for grazing or even farming.

Wind is one of those resources we find all around us in nature. It’s one of the more environmentally-friendly alternative energies around and has been tapped into for thousands of years. It has a wide variety of uses, some you may be familiar with and others not so much. So, let’s take a look at 5 smart uses for wind-powered energy:

Ways of using wind energy

1. Energy-generating wind turbines: Wind turbines are installed to capture the power of the wind and be able to convert it to energy. This can be on a broad scale, such as the wind turbines found on wind farms or can be on a smaller scale, such as individual wind turbines people use to generate power for their home. Companies even want to take advantage of the wind.

2. Wind-powered vehicles: You've probably heard about this one recently. A car, powered primarily by wind (using kites), just completed a 3,100 mile journey across Australia. While it wasn't 100% powered by the wind, it was a good example of how cars can also be powered using alternative energies. It used a combination of wind, kite and batteries. In total, it reportedly used about $10-$15 of energy for the entire 3,100 mile journey. Not too shabby!

3. Wind/Kite-Powered Cargo Ships: Another great example of tapping into the power of the wind, can be found with Cargill. Cargill has stepped up and gone with the innovative idea of installing a large kite on one of its cargo ships in order to tap into the power of the wind and thus reduce fuel consumption and CO2 emissions. Now, of course wind has been used for hundreds and thousands of year to "power" sailing and smaller vessels, but now it is being used to help power larger cargo ships as well.

4. Wind-Powered Sports: For many, many years the wind has been used to power our love of sports, both literally and figuratively. Everything from simple kite-flying to sailing, wind-surfing, kite-surfing, hang-gliding, para-sailing, wind-skiing and more.

5. Wind-Powered Water Pumps: Using the wind to help pump water out of the ground is not something new. It is however a very helpful and sometimes much needed tool when it comes to some communities and countries. Tapping into the power of the wind makes sense, esp when it comes to the work needed to pump water.

CHAPTER – 3

USE OF WIND POWER TO RUN VEHICLE

Wind energy and the electric vehicle

Wind Energy is the most mature and developed renewable energy. It generates electricity through wind, by using the kinetic energy produced by the effect of air currents. It is a source of clean and renewable energy, which reduces the emission of greenhouse effect gases and preserves the environment.

Wind power has been used since antiquity to move boats powered by sails or to operate the machinery of mills to move their blades. Since the early twentieth century, it produces energy through wind turbines. The wind drives a propeller and through a mechanical system, it rotates the rotor of a generator that produces electricity.

Electrification of transportation can be the leap that renewable energies need for the generation of electricity to consolidate and overcome the disadvantages of not being manageable and not being able to guarantee supply. Wind energy is by far the technology with the greatest potential in the short to medium term, but also photo voltaic can provide electricity in isolated or not connected to the grid places with a simple pergola (already patented models) or in garages with photovoltaic roofs. Solar thermal will play an important role in certain regions such as Southern Spain, South Western United States or Israel.

Electrification of transportation in the next two decades may have the driving force for wind power and other renewable energies similar to the one internal combustion engines had in the early twentieth century for the oil industry.

The batteries that operate the vehicles can be recharged when there is surplus of electricity from wind power. In the not too distant future, stored electricity may be discharged into the grid at peak times, acting as a distributed storage system similar to reversible pumping stations, but on a much larger scale and involving thousands or millions of vehicles that, in addition, spend most of the time parked. Bi-directional integration between the grid and electric vehicles creates the conditions to integrate electricity generation and transport, opening a new horizon for wind power and other renewable energies, which can overcome many of its current limitations.

In fact, wind power alone could supply all the electricity needed to electrify the existing vehicle fleet in Spain.

Use of wind power to run vehicles

From time immemorial, wind has been harnessed to move ships and large boats, till the introduction of steam engines. Initially, wind was used to drive sails so that the vehicles move forward. In several countries of the world, using sails and capturing wind energy for moving over water still persists, but is mostly used for leisurely activities such as windsurfing, yachting, sailing ships and boats. However, today with so much pollution and the problem of global warming, scientists have thought of and devised ways of developing a wind-powered car. It hasn't grown to that big an industry like thermal or hydroelectricity generation, but has still been able to create a niche for itself.

Working principle

How does a Wind-powered Car Work?

A wind-powered car converts wind power into electric energy, thereby helping the car to move forward. The concept of harnessing wind energy has been derived from the fact that, whenever we put our hands out from the windows of a fast-moving car, the tremendous force of the wind can be felt. This force can as well be harnessed into electrical energy and be used as a clean source for running cars. There are several wind power pros and cons, so you should try and gather as much information as possible on that.

Vehicles powered by wind energy use wind turbines and valves which are placed in such a position that the turbines can start moving. The valves absorb wind which is needed to power the car. There's an alternator connected to the valves which in turn changes kinetic energy into electric energy. The electric energy so generated is stored in a DC battery, and it's connected to a controller. The controller is responsible for converting DC to AC voltage. The controller is assisted by power diodes in this conversion of DC to AC.

A cable connects the controller and accelerator and it passes through a couple of potentiometers. It's the potentiometers that act to resist and regulate the speed of the car. The efficiency of this is excellent as the number of rotating and revolving parts are very less, thereby helping it to move quite fast. In case the accelerator is put of full speed, the controller gives out the full voltage. On the other hand, whenever pressure is released from the accelerator the controller stops releasing power, thereby slowing the vehicle.

A wind-powered car uses the configuration of motor to wheel, thereby providing the auto an increase of power supply. A number of motors are linked to the wheels so that the braking and propulsion system works efficiently. Similar to the automatic gear system, a wind-powered car has a single gear system. In such a car, a vacuum braking system is introduced and in this kind of system the force of brakes is derived from atmospheric pressure.

It's even possible to maintain and run an air conditioner in such a vehicle. The motors are cooled with the help of wind thereby increasing efficiency, besides preventing overheating. The power generated by wind energy helps in continuously charging the batteries, and this is one of the main features of such a vehicle. Unlike other batteries, which need to be charged for a specified period of time, these batteries have no such condition. Whenever you drive, the battery is continuously and automatically recharged. A volt meter is also fitted, which helps in tracking the current from the battery.

So, a wind-powered car is an excellent vehicle to be used in these days of global warming. However, these cars are still in the developmental phase, and there has been no mass production of such cars

CHAPTER - 4

COMPONENTS

brushless DC motor:

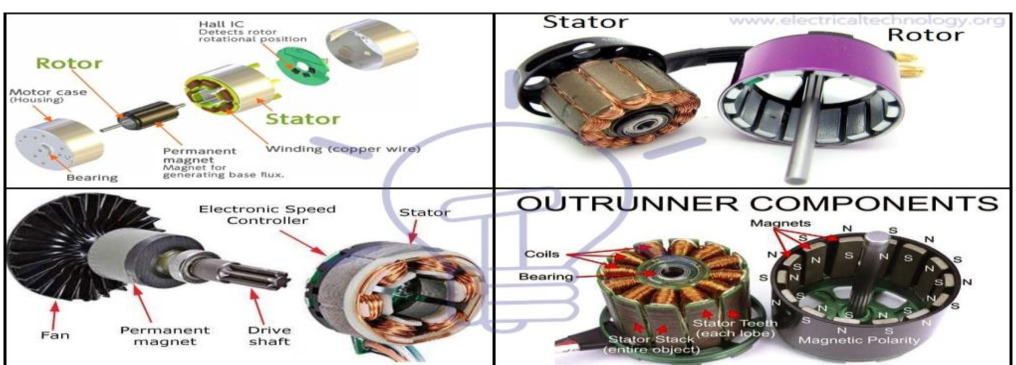
A brushless DC motor (known as BLDC) is a permanent magnet synchronous electric motor which is driven by direct current (DC) electricity and it accomplishes electronically controlled commutation system (commutation is the process of producing rotational torque in the motor by changing phase currents through it at appropriate times) instead of a mechanically commutation system. BLDC motors are also referred as trapezoidal permanent magnet motors.

Unlike conventional brushed type DC motor, wherein the brushes make the mechanical contact with commutator on the rotor so as to form an electric path between a DC electric source and rotor armature windings, BLDC motor employs electrical commutation with permanent magnet rotor and a stator with a sequence of coils. In this motor, permanent magnet (or field poles) rotates and current carrying conductors are fixed.

The armature coils are switched electronically by transistors or silicon controlled rectifiers at the correct rotor position in such a way that armature field is in space quadrature with the rotor field poles. Hence the force acting on the rotor causes it to rotate. Hall sensors or rotary encoders are most commonly used to sense the position of the rotor and are positioned around the stator. The rotor position feedback from the sensor helps to determine when to switch the armature current. This electronic commutation arrangement eliminates the commutator arrangement and brushes in a DC motor and hence more reliable and less noisy operation is achieved. Due to the absence of brushes BLDC motors are capable to run at high speeds. The efficiency of BLDC motors is typically 85 to 90 percent, whereas as brushed type DC motors are 75 to 80 percent efficient. There are wide varieties BLDC motors available ranging from small power range to fractional horsepower, integral horsepower and large power ranges.

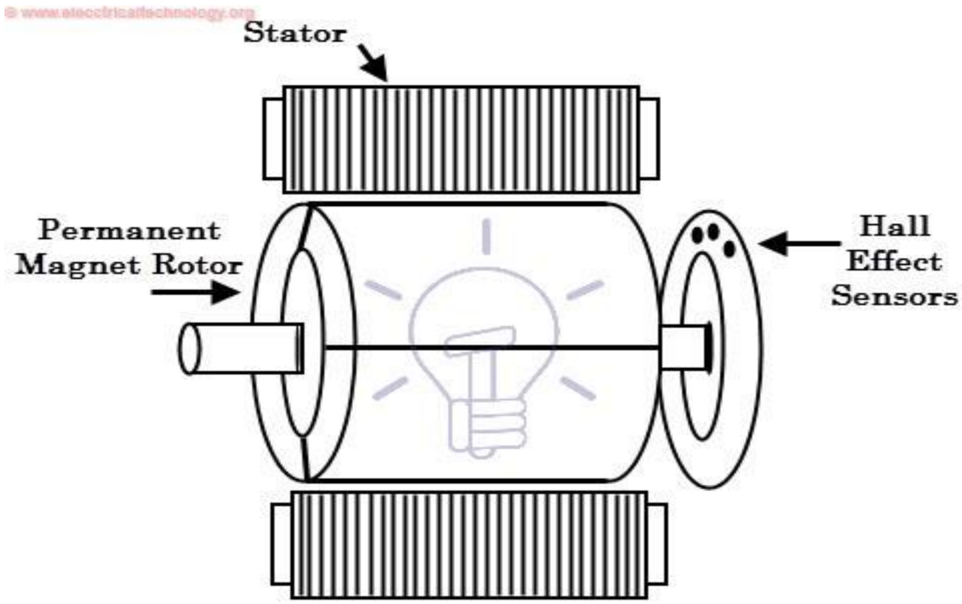
Construction of BLDC Motor

BLDC motors can be constructed in different physical configurations. Depending on the stator windings, these can be configured as single-phase, two-phase, or three-phase motors. However, three-phase BLDC motors with permanent magnet rotor are most commonly used.



Construction of BLDC Motor

The construction of this motor has many similarities of three phase induction motor as well as conventional DC motor. This motor has stator and rotor parts as like all other motors.



Stator of a BLDC motor made up of stacked steel laminations to carry the windings. These windings are placed in slots which are axially cut along the inner periphery of the stator. These windings can be arranged in either star or delta. However, most BLDC motors have three phase star connected stator.

Each winding is constructed with numerous interconnected coils, where one or more coils are placed in each slot. In order to form an even number of poles, each of these windings is distributed over the stator periphery.

The stator must be chosen with the correct rating of the voltage depending on the power supply capability. For robotics, automotive and small actuating applications, 48 V or less voltage BLDC motors are preferred. For industrial applications and automation systems, 100 V or higher rating motors are used.

Rotor:

BLDC motor incorporates a permanent magnet in the rotor. The number of poles in the rotor can vary from 2 to 8 pole pairs with alternate south and north poles depending on the application requirement. In order to achieve maximum torque in the motor, the flux density of the material should be high. A proper magnetic material for the rotor is needed to produce required magnetic field density.

Ferrite magnets are inexpensive, however they have a low flux density for a given volume. Rare earth alloy magnets are commonly used for new designs. Some of these alloys are Samarium Cobalt (SmCo), Neodymium (Nd), and Ferrite and Boron (NdFeB). The rotor can be constructed with different core configurations such as the circular core with permanent magnet on the periphery, circular core with rectangular magnets, etc.

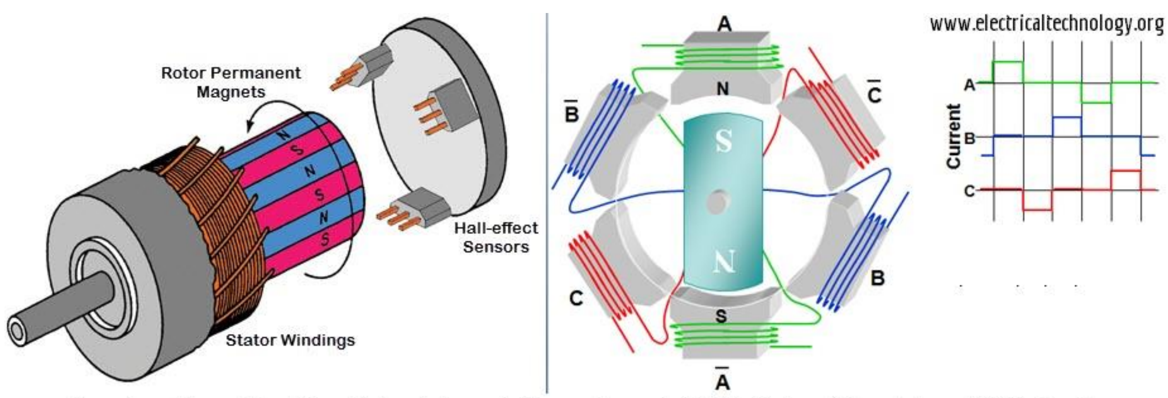
Hall Sensors

Hall sensor provides the information to synchronize stator armature excitation with rotor position. Since the commutation of BLDC motor is controlled electronically, the stator windings should be energized in sequence in order to rotate the motor. Before energizing a particular stator winding, acknowledgment of rotor position is necessary. So the Hall Effect sensor embedded in stator senses the rotor position.

Most BLDC motors incorporate three Hall sensors which are embedded into the stator. Each sensor generates Low and High signals whenever the rotor poles pass near to it. The exact commutation sequence to the stator winding can be determined based on the combination of these three sensor's response.

Working Principle and Operation of BLDC Motor

BLDC motor works on the principle similar to that of a conventional DC motor, i.e., the Lorentz force law which states that whenever a current carrying conductor placed in a magnetic field it experiences a force. As a consequence of reaction force, the magnet will experience an equal and opposite force. In case BLDC motor, the current carrying conductor is stationary while the permanent magnet moves.



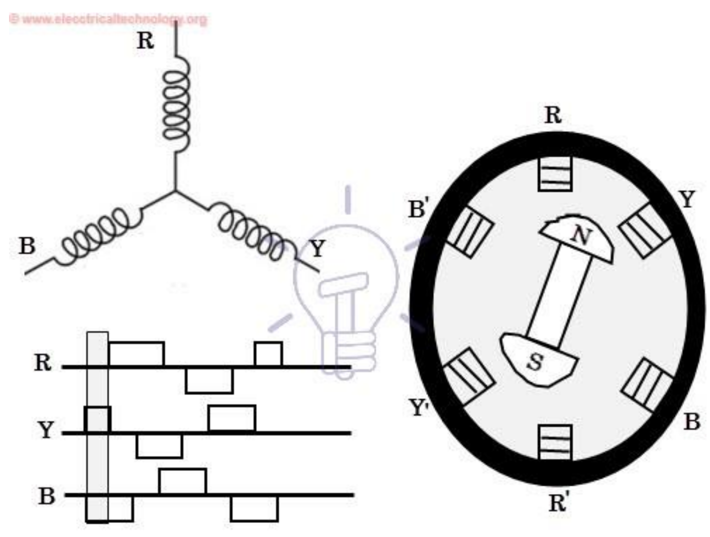
Construction, Working Principle and Operation of BLDC Motor (Brushless DC Motor)

When the stator coils are electrically switched by a supply source, it becomes electromagnet and starts producing the uniform field in the air gap. Though the source of supply is DC, switching makes to generate an AC voltage waveform with trapezoidal shape. Due to the force of interaction between electromagnet stator and permanent magnet rotor, the rotor continues to rotate.

Consider the figure below in which motor stator is excited based on different switching states. With the switching of windings as High and Low signals, corresponding winding energized as North and South poles. The permanent magnet rotor with North and South poles align with stator poles causing motor to rotate.

Observe that motor produces torque because of the development of attraction forces (when North-South or South-North alignment) and repulsion force (when North-North or South-South alignment). By this way motor moves in a clockwise direction. Here, one might get a question that how we know which stator coil should be energized and when to do. This is because; the motor continuous rotation depends on the switching sequence around the coils. As discussed above that Hall sensors give shaft position feedback to the electronic controller unit.

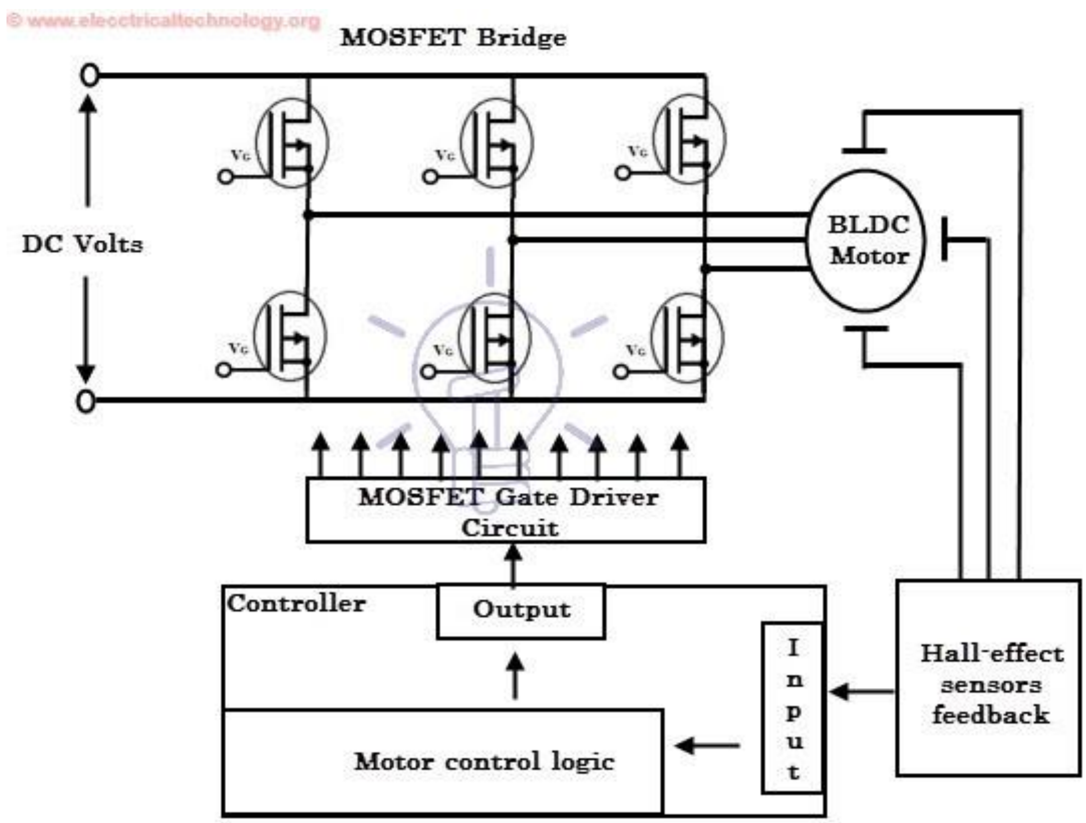
Based on this signal from sensor, the controller decides particular coils to energize. Hall-effect sensors generate Low and High level signals whenever rotor poles pass near to it. These signals determine the position of the shaft.



Switching Sequence BLDC Motor

As described above that the electronic controller circuit energizes appropriate motor winding by turning transistor or other solid state switches to rotate the motor continuously. The figure below shows the simple BLDC motor drive circuit which consists of MOSFET bridge (also called as inverter bridge), electronic controller, hall effect sensor and BLDC motor.

Here, Hall-effect sensors are used for position and speed feedback. The electronic controller can be a microcontroller unit or microprocessor or DSP processor or FPGA unit or any other controller. This controller receives these signals, processes them and sends the control signals to the MOSFET driver circuit.



In addition to the switching for a rated speed of the motor, additional electronic circuitry changes the motor speed based on required application. These speed control units are generally implemented with PID controllers to have precise control. It is also possible to produce four-quadrant operation from the motor whilst maintaining good efficiency throughout the speed variations using modern drives.

Advantages of BLDC Motor:

1. BLDC motor has several advantages over conventional DC motors and some of these are
2. It has no mechanical commutator and associated problems
3. High efficiency due to the use of permanent magnet rotor
4. High speed of operation even in loaded and unloaded conditions due to the absence of brushes that limits the speed
5. Smaller motor geometry and lighter in weight than both brushed type DC and induction AC motors
6. Long life as no inspection and maintenance is required for commutator system
7. Higher dynamic response due to low inertia and carrying windings in the stator
8. Less electromagnetic interference
9. Quite operation (or low noise) due to absence of brushes

Disadvantages of BLDC Motor:

1. These motors are costly
2. Electronic controller required control this motor is expensive
3. Not much availability of many integrated electronic control solutions, especially for tiny BLDC motors
4. Requires complex drive circuitry
5. Need of additional sensors

Applications of BLDC Motors:

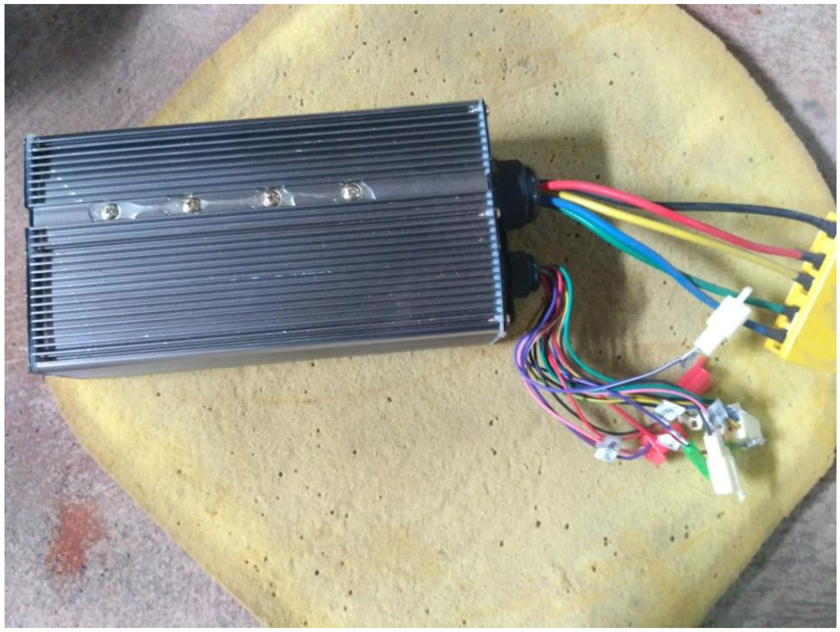
Brushless DC motors (BLDC) are used for a wide variety of application requirements such as varying loads, constant loads and positioning applications in the fields of industrial control, automotive, aviation, automation systems, health care equipments, etc.

Some specific applications of BLDC motors are

1. Computer hard drives and DVD/CD players
2. Electric vehicles, hybrid vehicles, and electric bicycles
3. Industrial robots, CNC machine tools, and simple belt driven systems
4. Washing machines, compressors and dryers

SPEED CONTROLLER:

Generation 1	Generation 2	Generation 3
----------------Main features--------------	----------------Main features--------------	----------------Main features--------------
working voltage: DC 24V-120V	working voltage: DC 24V-120V	working voltage: DC 24V-120V
constant current: 17A-250A	constant current: 40A-120A	constant current: 50A-100A
MOSfet quantity: 6/9/12/18/24/30/36 pcs	MOSfet quantity: 18/24/36 pcs	MOSfet quantity: 24 pcs
rated power: 350W-10KW	rated power: 800W - 4KW	rated power: 1KW - 3KW
Bluetooth programing is available	Bluetooth programing is available	Bluetooth programing is available



ELECTRONIC DIFFERENTIAL

In automotive engineering the electronic differential is a form of differential, which provides the required torque for each driving wheel and allows different wheel speeds. It is used in place of the mechanical differential in multi-drive systems. When cornering, the inner and outer wheels rotate at different speeds, because the inner wheels describe a smaller turning radius. The electronic differential uses the steering wheel command signal and the motor speed signals to control the power to each wheel so that all wheels are supplied with the torque they need.

Functional description

The classical automobile drive train is composed by a single motor providing torque to one or more driving wheels. The most common solution is to use a mechanical device to distribute torque to the wheels. This mechanical differential allows different wheel speeds when cornering. With the emergence of electric vehicles new drive train configurations are possible. Multi-drive systems become easy to implement due to the large power density of electric motors. These systems, usually with one motor per driving wheel, need an additional top level controller which performs the same task as a mechanical differential.

The ED scheme has several advantages over a mechanical differential:[1]

Simplicity - it avoids additional mechanical parts such as a gearbox or clutch;

Independent torque for each wheel allows additional capabilities (e.g., traction control, stability control);

Reconfigurable - it is reprogrammable in order to include new features or tuned according to the driver's preferences;

Allows distributed regenerative braking;

The torque is not limited by the wheel with least traction, as it is with a mechanical differential.

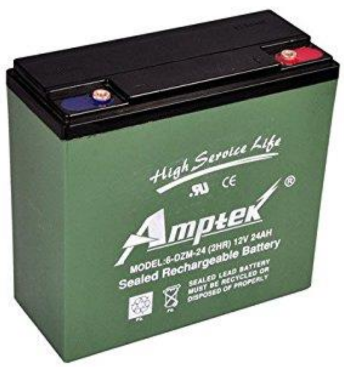
Faster response times;

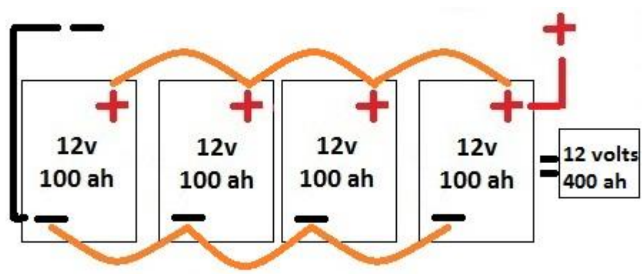
Accurate knowledge of traction torque per wheel.

Batteries:

The most commonly used for batteries type was in the past, the lead- acid battery. For its use of low price per storable energy quantity, the achievable maintenance, the low self discharge and the relatively high efficiency of about 80% spoke. The losses in lead-acid batteries can be explained in part by the out gassing of hydrogen –oxygen during charging. With maintenance-free lead-acid batteries the gas emissions are reduced. They are optimized for a particularly long service life, cycle stability and behaviour at low discharge. Typical are numbers of cycles of 1200 {with a depth of discharge of about 80%} residual capacity of 80%, since then a battery is considered defective from, maintenance-free lead acid batteries have the advantage that there are no or only forms a minimum stratification she sure but allow only a much smaller number of cycles from 400 to 600. An additional circulation of acid prevents completely stratification and the lead-acid batteries. This is especially important in stationary operation.

Lithium-ion batteries are also used recently as a solar battery, which is due to sharp fall in prices of lithium-ion batteries in addition, lithium ion batteries have some very high cycle stability of more than 10,000 charge and discharge cycles and a long service life of up to 20 years. In particular, lithium iron phosphate batteries are used which, and by a high cycle stability, high security small price excel and come as traction batteries for use. Partly also used batteries are used, which no longer have enough capacity for other applications for example, pedelec or electric cars, as solar battery, but still suffice.





DYNAMO:-

A dynamo is an electrical generator that produces direct current with the use of a commutator. Dynamos were the first electrical generators capable of delivering power for industry, and the foundation upon which many other later electric-power conversion devices were based, including the electric motor, the alternating-current alternator, and the rotary converter. Today, the simpler alternator dominates large scale power generation, for efficiency, reliability and cost reasons. A dynamo has the disadvantages of a mechanical commutator. Also, converting alternating to direct current using power rectification devices (vacuum tube or more recently solid state) is effective and usually economical.

The electric dynamo uses rotating coils of wire and magnetic fields to convert mechanical rotation into a pulsing direct electric current through Faraday's law of induction. A dynamo machine consists of a stationary structure, called the stator, which provides a constant magnetic field, and a set of rotating windings called the armature which turn within that field. Due to Faraday's law of induction the motion of the wire within the magnetic field creates an electromotive force which pushes on the electrons in the metal, creating an electric current in the wire. On small machines the constant magnetic field may be provided by one or more **permanent magnets**; larger machines have the constant magnetic field provided by one or more electromagnets, which are usually called **field coils.**

Historical uses

Electric power generation

Dynamos, usually driven by steam engines, were widely used in power stations to generate electricity for industrial and domestic purposes. They have since been replaced by alternators.

Large industrial dynamos with series and parallel (shunt) windings can be difficult to use together in a power plant, unless either the rotor or field wiring or the mechanical drive systems are coupled together in certain special combinations. It seems theoretically possible to run dynamos in parallel to create induction and self sustaining system for electrical power. [19]

Transport

Dynamos were used in motor vehicles to generate electricity for battery charging. An early type was the third-brush dynamo. They have, again, been replaced by alternators.

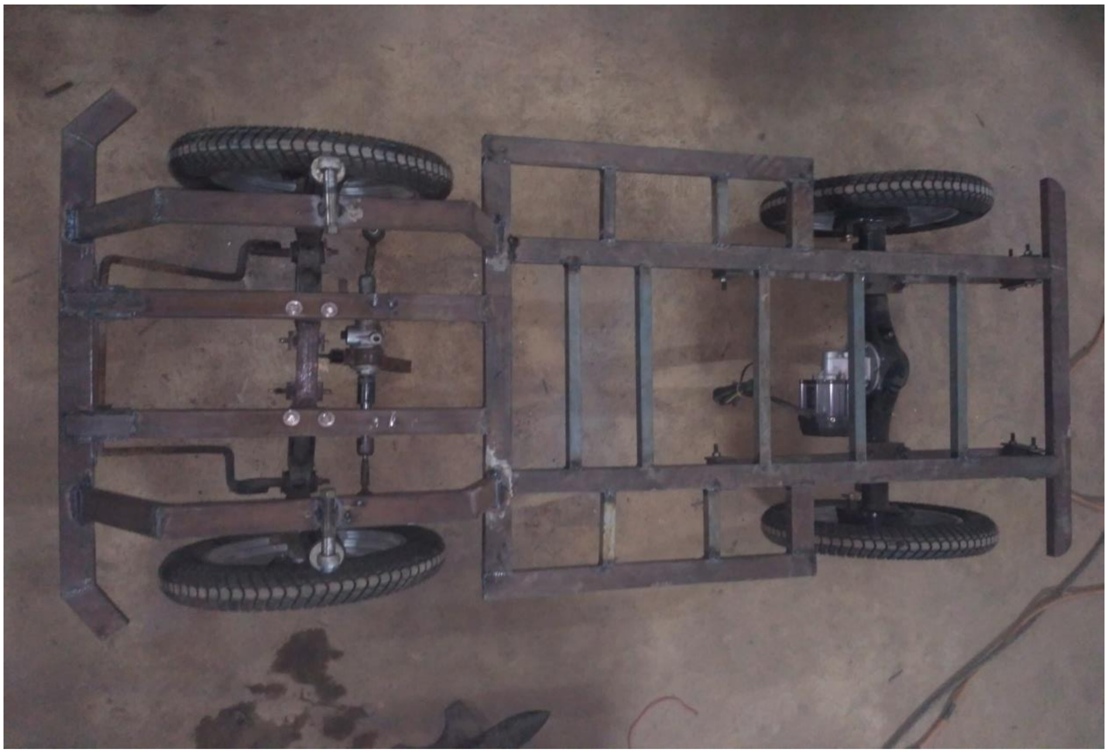
Modern uses

Dynamos still have some uses in low power applications, particularly where low voltage DC is required, since an alternator with a semiconductor rectifier can be inefficient in these applications.

Hand cranked dynamos are used in clockwork radios, hand powered flashlights, mobile phone rechargers, and other human powered equipment to recharge batteries.

CHASSIS:-

Chassis is the under part of a motor vehicle, consisting of the frame (on which the body is mounted). If the running gear such as wheels and transmission, and sometimes even the driver's seat, are included, then the assembly is described as a rolling chassis.



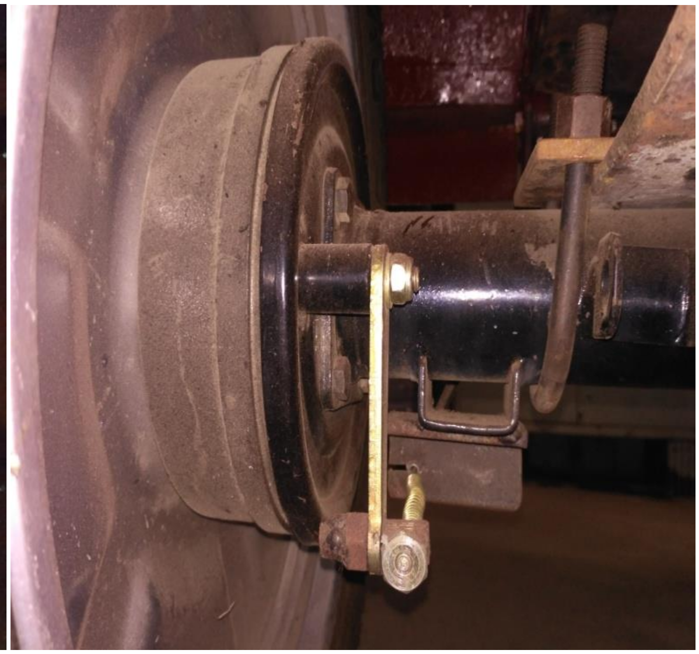
STEERING:-

The basic aim of steering is to ensure that the wheels are pointing in the desired directions. This is typically achieved by a series of linkages, rods, pivots and gears. One of the fundamental concepts is that of caster angle – each wheel is steered with a pivot point ahead of the wheel; this makes the steering tend to be self-centring towards the direction of travel.

The steering linkages connecting the steering box and the wheels usually conform to a variation of Ackermann steering geometry, to account for the fact that in a turn, the inner wheel is actually travelling a path of smaller radius than the outer wheel, so that the degree of toe suitable for driving in a straight path is not suitable for turns. The angle the wheels make with the vertical plane also influences steering dynamics (see camber angle) as do the tires.

BRAKES:-

Frictional brakes are most common and can be divided broadly into "shoe" or "pad" brakes, using an explicit wear surface, and hydrodynamic brakes, such as parachutes, which use friction in a working fluid and do not explicitly wear. Typically the term "friction brake" is used to mean pad/shoe brakes and excludes hydrodynamic brakes, even though hydrodynamic brakes use friction. Friction (pad/shoe) brakes are often rotating devices with a stationary pad and a rotating wear surface. Common configurations include shoes that contract to rub on the outside of a rotating drum, such as a band brake; a rotating drum with shoes that expand to rub the inside of a drum, commonly called a "drum brake", although other drum configurations are possible; and pads that pinch a rotating disc, commonly called a "disc brake". Other brake configurations are used, but less often. For example, PCC trolley brakes include a flat shoe which is clamped to the rail with an electromagnet; the Murphy brake pinches a rotating drum, and the Ausco Lambert disc brake uses a hollow disc (two parallel discs with a structural bridge) with shoes that sit between the disc surfaces and expand laterally.

A drum brake is a vehicle brake in which the friction is caused by a set of brake shoes that press against the inner surface of a rotating drum. The drum is connected to the rotating road wheel hub.

TYRES:-

Tyres are mounted onto wheels that most often have integral rims on their outer edges to hold tire. Automotive wheels are typically made from pressed and welded steel, or a composite of light weight metal alloys, such as aluminium or magnesium. These alloy wheels may be either cast or forged. The mounted tire and wheel assembly is then bolted to the vehicle’s hub. A decorative hubcap and trim may be placed over the wheel.

SUSPENSIONS:-

Suspension is the system of tires, tire air, springs, shock absorbers and linkages that connects a vehicle to its wheels and allows relative motion between the two. Suspension systems must support both road holding/handling and ride quality, which are at odds with each other. The tuning of suspensions involves finding the right compromise. It is important for the suspension to keep the road wheel in contact with the road surface as much as possible, because all the road or ground forces acting on the vehicle do so through the contact patches of the tires. The suspension also protects the vehicle itself and any cargo or luggage from damage and wear. The design of front and rear suspension of a car is different.

Front suspension:- shock absorbers are used as suspension units at the front.

Rear suspension:- leaf springs are used for rear suspension units.

PROPELLER BLADES:-

Propeller blades are fixed to the dynamo for power generation. These blades are of light weight and pave the way for efficient generation of power.

They take the energy from wind flowing in the opposite direction and rotate accordingly. This rotation of the blades in turn results in the rotation of shaft of the dynamo. As the shaft rotates, internally the mechanism starts working and generates the electric energy. This energy is allowed to be stored in the batteries provided.

BODY:-

The term uni body or unit body is short for unitized body, or alternatively unitary construction design. This engineering approach of a vehicle describes of a vehicle, one piece frame and body structure A "type of boy/frame construction in which the body of the vehicle, its floor plan and chassis from a single structure. Such a design is generally and more traditional body on frame architectures has shifted to the lighter unitized body structure that is now used on most cars.

Integral frame and body construction requires more than simply welding an unstressed body to a conventional frame. In a fully integrated body structure, the entire car is a load carrying unit that handles all the loads experienced by the vehicle forces from driving as well as cargo loads.

Integral type bodies for wheeled vehicles forces for driving as well as cargo loads. Integral type bodies for wheeled vehicles are typically manufactured by welding preformed metal panels' and other components together, by forming or casting whole sections as one piece, or by a combination of these techniques. Although this is sometimes also referred to as a monocoque structure, because the cars outer skin and panels are made load bearing there are also still ribs, bulk heads and box sections to reinforce the body, making the description semi monocoque more appropriate.

CHAPTER – 5

DESIGN AND ASSEMBLY

ASSEMBLING OF VEHICLE

Vehicle assembly is made in several stages following the step by step process starting from the base . These stages involve various considerations regarding the dimensions, safety factors and the factors that contribute to the ease of driving the vehicle.

Chassis construction

Chassis of this vehicle is made with mild steel rods of width 2 inches and height 1 inch. The main consideration in the design and manufacture of this chassis is its load bearing capacity and stability. Therefore the MS rods are made into pieces with require dimensions and are welded together with the help of arc welding.

Wheels Arrangement

The electronic differential is fixed between the rear wheels. These wheels are bolted to the drum brake set on either side of the differential. Front wheels are meant for steering the vehicle, so the steering set is arranged between the front wheels with the help of knuckles and the wheel hubs.

Chassis mounting

The chassis that is made to mount on these four wheels as per the design considerations. Rear suspension units i.e. leaf springs are arranged on lower side of the chassis and then placed on the differential. These leaf springs are fixed and held in position with the help of U bends. The front portion of the chassis is mounted on front wheels including the front suspension i.e. shock absorbers. The entire unit is welded together for safety purpose.


Body construction

Body of the vehicle is made as per the dimensions and the design, taking the model of jeep as primary consideration. The skeleton of the body is made with 1 inch square rods and are covered with metal sheets. These sheets are cut into required dimensions and shapes and are welded together with arc welding.

The front part of the body and the side parts are made separately and are mounted on the chassis to give the vehicle a clear shape. Front grill is made to suit the design and mounted to the frame.

Mounting propeller blades and dynamo

Propeller blades are fixed to the shaft of the dynamo, with the help of bushes. These are arranged or mounted on the front portion of the vehicle by taking supports from side of the vehicle.

These blades are placed so that they grab the wind and rotates simultaneously, so that its kinetic energy is converted into electrical energy in the dynamo.

Painting the vehicle

The entire vehicle is coloured accordingly to support the design considerations and for the uniform look of the vehicle.

Wind powered vehicle

CHAPTER - 6

SPECIFICATIONS AND CALCULATIONS

Specifications :

BLDC Motor

Power : 1000W

Voltage Rating : 48V

Peak current : 150A

Power range : 800W - 1000W

Phase : three phase

Speed : 3000 rpm

Splash Resistant Hall effect sensor feedback

Brushless dc electric motor 48v

Electronic differential

Model no. XYG1000 rear axle kit

Differential : one speed differential

Ratio : 8:1 or 10:1

Rear axle : length 33 inch with drum brakes

Motor controller : 48v 50A

Dynamo:

model no : 70 4G CA 40

power : 40 watt

voltage : 24V DC

current : 1.66 amps

speed : 1500 rpm

charge controller:

Model	PRIP-D2410	PRIP-D2415	PRIP-D2420
Rated Current	10A	15A	20A
System Voltage	12 Volt or 12/24 Volt auto work		
Equalisation voltage	14.7Volt		
High voltage disconnect(HVD)	14.4Volt		
Float voltage	13.9Volt		
Low voltage disconnect(LVD)	11.1Volt		
Low voltage reconnect(LVR)	12.6Volt		
Self-consumption	6mA maximum		
Temperature compensation	-30mV / °C/12V		
Terminals	for wire sizes to 6mm		
Temperature	-35 °C to +55°C industrial		

Battery:

Battery rating	HEAVY DUTY	EXTRA HEAVY DUTY	PREMIUM
Nationwide warranty period	1 Year	2 Year	3 Year
Star rating	★★★	★★★★	★★★★★
Capacity	This is the minimum specification battery to suit the vehicle	Higher capacity battery to suit vehicles with extra accessories	Highest capacity battery that will ensure premium performance and service life
Eg. Holden Commodore	1 Year – 1171 (380 CCA) (suits only pre 1985 Commodores)	2 Year – 2176 (450 CCA)	3 Year – 2544 (600 CCA)
Benefit to the Member	1 year warranty	2 year warranty Higher starting power	3 year warranty Maximum starting performance

ADVANTAGES

1. Wind powered vehicles are eco friendly as they do not release any pollutants that harm the environment.
2. Ease of usage and is highly responsive.
3. Minimum maintenance cost
4. No shortage of power to run the vehicle as it generates and stores the energy while the vehicle is in motion.
5. As wind is the renewable source and readily available, no shortage of resources occurs.

DISADVANTAGES

1. The main drawback for this type of vehicle is its high initial and installation costs.
2. Performance issues have to be checked frequently within short periods.

FUTURE SCOPE

Are they in our future?

Wind powered cars are certainly a possibility in our future, even if they are hybrids and use electric power as a second source. Large steps in renewable energy are being made more and more frequently, and with electric cars already well established, there is no reason why we cannot have cars that implement, or even run completely on, wind power. When it comes to transportation running on renewable energy, the future is looking incredibly bright.

It will further push the demand of electricity in almost all the sectors i.e. household, agriculture, commercial, institutional and industrial sector.′ It is expected to grow at faster pace in the times to come as Government of India is stressing upon “Make in India”, “Ease of Doing Business” and “Digital India” predominantly besides land and labour reforms. ′ Indian economy is reviving (7.4% in 2014) after sluggish growth in the last three years (6.6%, 5.1% and 6.9% for 2011, 2012 and 2013 respectively) (The World Bank, 2015). ′Demand for energy is bound to increase with the increased economic development in the country.

WHY RENEWABLE ENERGY?

It tries to estimate the total production of wind energy by 2050 in India.′ Present paper tries to find out the role wind energy can play in the generation mix of power sector in India. ′ As Solar and wind energy can play a vital role in supplying clean and green energy; ′ The International Renewable Energy Agency (Irena) revealed that increasing Wind and Solar power sources to 36 percent would bring the goal of reducing greenhouse gases significantly closer(Gifford, 2016).

CONCLUSION

Though wind energy has its own negatives like noise and loss of birds life yet concentrating on off-shore potentials development and development of bladeless windmills that are having no visibly moving parts and reduced noise will solve these problems in coming decades.′ Wind energy has bright future and we can expect 30% contribution of wind energy in the total generation mix of electricity in India by 2050.

Therefore these type of vehicles are very much helpful to the environment in very near future. As these do not pollute the atmosphere, they are much preferable for the present day travels.

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