CHAPTER 1
INTRODUCTION

1.1 OBJECTIVE

The objective of this project is that wind thrust produced due to the speeding vehicles can provide enough rotation to the turbine to generate electrical power all day and night without stopping. The energy generated can be transported to places or it can be used for maintenance of roadways. This technology can revolutionize the roads.

1.2 AIM OF VERTICAL AXIS WIND TURBINE

The aim of the project is to utilize the maximum amount of wind energy and hence highway is selected as installation site. The wind turbine will be placed so that the tangential acting air flow from both sides of the road due to moving vehicles will help to rotate the turbine. The variation of blade angle is made so that to get maximum output and blades are fixed.

Fig.1.1: Picture of Enlil Vertical Axis Wind Turbine

1.3 DEFINITION OF VERTICAL AXIS WIND TURBINE

Renewable energy options have many people around the world talking as they desire to reduce their costs of energy while also doing their part to protect the world. Rising sea levels and escalating pollution levels has generated worldwide interest and has given rise to new wind turbines designs. Many people are using turbines to help them take these steps.

Wind turbines mainly are of two types: vertical axis(VAWT) and horizontal axis(HAWT). HAWT are the most common type of wind turbines built across the world. VAWT is a type of wind turbine which have two or three blades and in which the main rotor shaft runs vertically. They are however used less frequently as they are not as effective as HAWT.

The Vertical Axis Wind Turbine (VAWT) is the most popular of the turbines that people are adding to make their home a source of renewable energy. While it is not as commonly used as the Horizontal Axis Wind Turbine, they are great for placement at residential locations and more. Here we will take a look at the VAWT, and fill you in on the pros and the cons as well as other important information that will alleviate stress and headache when you simply want to do your part to keep the environment protected.

A vertical-axis wind turbines (VAWT) is a type of wind turbine where the main rotor shaft is set transverse to the wind (but not necessarily vertically) while the main components are located at the base of the turbine. This arrangement allows the generator and gearbox to be located close to the ground, facilitating service and repair. VAWTs do not need to be pointed into the wind, which removes the need for wind-sensing and orientation mechanisms.

Major drawbacks for the early designs (Savonius, Darrieus and giromill) included the significant torque variation or "ripple" during each revolution, and the large bending moments on the blades. Later designs addressed the torque ripple issue by sweeping the blades helically (Gorlov type).
A vertical axis wind turbine has its axis perpendicular to the wind streamlines and vertical to the ground. A more general term that includes this option is "transverse axis wind turbine" or "cross-flow wind turbine”. Drag-type VAWTs such as the Savonius rotor typically operate at lower tip speed ratios than lift-based VAWTs such as Darrieus rotors and cycloturbines.

1.4 HISTORY OF VERTICAL AXIS WIND TURBINE

The wind wheel of Hero of Alexandria (10 AD – 70 AD) marks one of the first recorded instances of wind powering a machine in history. However, the first known practical wind power plants were built in Sistan, an Eastern province of Persia (now Iran), from the 7th century. These "Panemone" were vertical axle windmills, which had long vertical drive shafts with rectangular blades. Made of six to twelve sails covered in reed matting or cloth material, these windmills were used to grind grain or draw up water, and were used in the gristmilling and sugarcane industries.

Wind power first appeared in Europe during the Middle Ages. The first historical records of their use in England date to the 11th or 12th centuries and there are reports of German crusaders taking their windmill-making skills to Syria around 1190. By the 14th century, Dutch windmills were in use to drain areas of the Rhine delta. Advanced wind turbines were described by Croatian inventor Fausto Veranzio. In his book Machinae Novae (1595) he described vertical axis wind turbines with curved or V-shaped blades.

The first electricity-generating wind turbine was a battery charging machine installed in July 1887 by Scottish academic James Blyth to light his holiday home in Marykirk, Scotland. Some months later American inventor Charles F. Brush was able to build the first automatically operated wind turbine after consulting local University professors and colleagues Jacob S. Gibbs and Brinsley Coleberd and successfully getting the blueprints peer-reviewed for electricity production in Cleveland, Ohio. Although Blyth's turbine was considered uneconomical in the United Kingdom, electricity generation by wind turbines was more cost effective in countries with widely scattered populations.

In Denmark by 1900, there were about 2500 windmills for mechanical loads such as pumps and mills, producing an estimated combined peak power of about 30 MW. The largest machines were on 24-meter (79 ft) towers with four-bladed 23-meter (75 ft) diameter rotors. By 1908, there were 72 wind-driven electric generators operating in the United States from 5 kW to 25 kW. Around the time of World War I, American windmill makers were producing 100,000 farm windmills each year, mostly for water-pumping.

By the 1930s, wind generators for electricity were common on farms, mostly in the United States where distribution systems had not yet been installed. In this period, high-tensile steel was cheap, and the generators were placed atop prefabricated open steel lattice towers.

A forerunner of modern horizontal-axis wind generators was in service at Yalta, USSR in 1931. This was a 100 kW generator on a 30-meter (98 ft) tower, connected to the local 6.3 kV distribution system. It was reported to have an annual capacity factor of 32 percent, not much different from current wind machines.

In the autumn of 1941, the first megawatt-class wind turbine was synchronized to a utility grid in Vermont. The Smith–Putnam wind turbineonly ran for 1,100 hours before suffering a critical failure. The unit was not repaired, because of a shortage of materials during the war.

The first utility grid-connected wind turbine to operate in the UK was built by John Brown & Company in 1951 in the Orkney Islands.

Despite these diverse developments, developments in fossil fuel systems almost entirely eliminated any wind turbine systems larger than supermicro size. In the early 1970s, however, anti-nuclear protests in Denmark spurred artisan mechanics to develop microturbines of 22 kW. Organizing owners into associations and co-operatives lead to the lobbying of the government and utilities and provided incentives for larger turbines throughout the 1980s and later. Local activists in Germany, nascent turbine manufacturers in Spain, and large investors in the United States in the early 1990s then lobbied for policies that stimulated the industry in those countries.

European style grain grinding windmills, like the ones attacked by Don Quijote, is what usually comes to mind when thinking of early-age wind power. However, even if these types of horizontal axis windmills was introduced in Europe no later than the 12th century, the first recordings of wind turbines are from the 9th century describing Persian vertical axis windmills.

Actually, vertical axis windmills might have been in use in the Afghan highlands as early as the 7th century BC. These early VAWT's where simple devices based on aerodynamic drag, the wind was simply pushing the blades of the turbine and thus creating torque. Using aerodynamic lift created by pressure difference due to the shape of the blade is far more efficient than using drag and the first lift-based vertical axis wind turbines were invented by Darrieus in 1931. Darrieus patent cover both the troop skein "egg beater" shaped turbine with curved blades mounted directly to the rotating tower/shaft that is supported by guy wires at the top and the so called H-rotor with straight blades and struts connecting them to the shaft placed inside the tower.

During the 1970-80s there were large research programs in North America focusing on the Darrieus concept, for example Sandia National Laboratories 1 tested different configurations and sizes of the Darrieus turbine.

A company called The FloWind Corp utilized much of the Sandia technology to build commercial wind farms using turbines ranging up to 300 kW which initially proved to be quite reliable and efficient. In Quebec, a record-breaking 4.2 MW Darrieus turbine known as Éole C was built in the late 1980s. However, during this period the blades which were designed to flex, were usually made of aluminum which is not very endurable to cyclic stress, so with time problems with fatigue on the blades started to appear which ultimately lead to failures. These problems together with withdrawal of funding finally stalled the development.

Today most of the VAWT projects regard small scale turbines like Ropatec from Italy, Turby from the Netherlands or the innovative Swedish offshore concept Sea Twirl which features a floating tower and kinetic energy storage using sea water. In recent years there has been a renewed interest in larger VAWTs, not least because of findings within the VAWT research project at the Division for Electricity at Uppsala University which the author of this thesis takes part in.

1.5 TYPES OF VERTICAL AXIS WIND TURBINE

The two types of vertical-axis wind turbines are the Darrieus wind turbine, which turns a shaft using lift forces, and the Savonius wind turbine, whose cups are pushed by direct wind forces.

Because they vary widely in speed, the AC Generator they use do not produce a constant output. Usually, the output goes to an inverter that converts it to standard AC (either single-phase or three-phase). Another option is to use DC as the output.In urban areas, wind speed and directions are frequently changing, and wind speeds tend to be lower because of buildings and other objects that create wind shadows.

1.5.1 DARRIEUS WIND TURBINE

Darrieus Wind Turbine is commonly known as an “Eggbeater” turbine. It was invented by Georges Darrieus in 1931. A Darrieus is a high speed, low torque machine suitable for generating alternating current (AC) electricity. Darrieus generally require manual push therefore some external power source to start turning as the starting torque is very low. Darrieus has two vertically oriented blades revolving around a vertical shaft.The Darrieus wind turbine offers the following features:

- These eggbeater shaped turbines are great at efficiency, however, they are not as reliable.

- In order to use the Darrieus wind turbine you must have an outside source of power in order to start them.

- It is in your best interest to choose a wind turbine that has at least three blades.

- To support such a wind turbine it is necessary that you have a superstructure which will connect it near the top bearing.

Fig.1.2: Darrieus Vertical Axis Wind Turbine

1.5.2 SAVONIUS WIND TURBINE

A Savonius vertical-axis wind turbine is a slow rotating, high torque machine with two or more scoops and are used in high-reliability low-efficiency power turbines.

Most wind turbines use lift generated by airfoil-shaped blades to drive a rotor, the Savonius uses drag and therefore cannot rotate faster than the approaching wind speed. Now let's take a look at the second type, which is also the most popular of the two. The Savonius wind turbine is the most popular of the two types. Let's go ahead and look at some of the features these VAWT offer to the homeowner.

- As a drag type of turbine, these units are less efficient.

- When you live in an area that has strong and gusting winds or when you need a unit that self-starts, this is the best type available to you.

- This unit is larger than the Darrieus model.

Savonius vertical axis wind turbine needs to be manually started. The slow speed of Savonius increases cost and produces less efficiency.

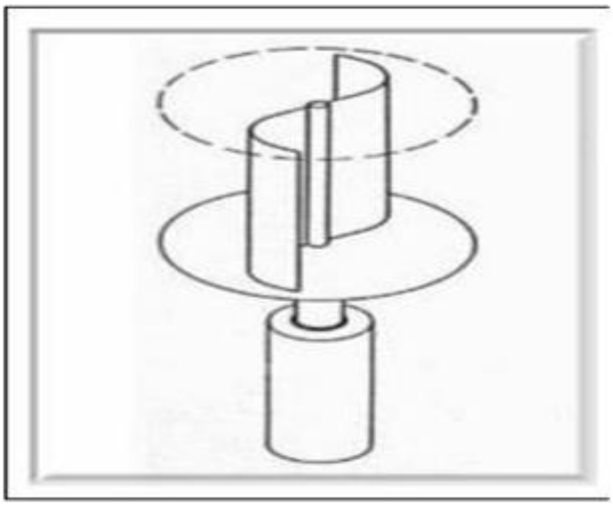

Fig.1.3: Savonius Vertical Axis Wind Turbine

1.6 ADVANTAGES

VAWTs offer a number of advantages over traditional horizontal-axis wind turbines (HAWTs):

1. Being bidirectional, some forms do not need to track the wind. This means they don't require a complex mechanism and motors to yaw the rotor and pitch the blades.
2. VAWTs generally function better than HAWTs in turbulent and gusty winds. HAWTs cannot efficiently harvest such winds, which also cause accelerated fatigue.
3. The gearbox of a VAWT takes much less fatigue than that of a HAWT.
4. In VAWTs, gearbox replacement and maintenance are simpler and more efficient, as the gearbox is accessible at ground level, so that that no cranes or other large equipment are needed on-site. This reduces costs and impact on the environment. Motor and gearbox failures generally are significant considerations in the operation and maintenance of HAWTs both on and offshore.

5. Some designs of VAWTs in suitable situations can use screw pile foundations, which hugely reduces the road transport of concrete and the carbon cost of installation. Screw piles can be fully recycled at the end of their life.
6. Wings of the Darrieus type have a constant chord and so are easier to manufacture than the blades of a HAWT, which have a much more complex shape and structure.
7. VAWTs can be grouped more closely in wind farms, increasing the generated power per unit of land area.
8. VAWTs can be installed on HAWT wind farm below the existing HAWTs, this can supplement the power output of the existing farm.
9. Research at Caltech has also shown that a carefully designed wind farm using VAWTs can have an output power ten times that of a HAWT wind farm of the same size.

Why we would consider using a VAWT instead of a HAWT, there are actually a number of reasons that this decision is made. Let's take a look at some of the advantages that we can enjoy with this type of wind turbine in use at our home.

1. We can build our wind turbine close to the ground so if we do not have a suitable rooftop for placement, or if we live where there are hills, ridges, etc. that prohibit the flow of air, it work wonderfully for our needs.
2. Since VAWT are mounted closer to the ground they make maintenance easier, reduce the construction costs, are more bird friendly and does not destroy the wildlife.
3. We do not need any mechanisms in order to operate the wind turbine
4. Lower wind start up speed
5. The main advantage of VAWT is it does not need to be pointed towards the wind to be effective. In other words, it can be used on the sites with high variable wind direction.
6. We can use the wind turbine where tall structures are not allowed.
7. VAWT's are quiet, efficient, economical and perfect for residential energy production, especially in urban environments.
8. It is cost effective when compare to the HAWTs. It is still best to shop around and check prices before making a purchase, however.
9. Many of the turbines are resistant to many of the different weather elements that we may experience. It is imperative to choose a unit that offers this valuable protection and extra durability when we need it the most.

1.7 APPLICATONS

The Windspire, a small VAWT intended for individual (home or office) use was developed in the early 2000s by US company Mariah Power. The company reported that several units had been installed across the US by June 2008.

Arborwind, an Ann-Arbor (Michigan, US) based company, produces a patented small VAWT which has been installed at several US locations as of 2013.

In 2011, Sandia National Laboratories wind-energy researchers began a five-year study of applying VAWT design technology to offshore wind farms. The researchers stated: "The economics of offshore windpower are different from land-based turbines, due to installation and operational challenges. VAWTs offer three big advantages that could reduce the cost of wind energy: a lower turbine center of gravity; reduced machine complexity; and better scalability to very large sizes. A lower center of gravity means improved stability afloat and lower gravitational fatigue loads. Additionally, the drivetrain on a VAWT is at or near the surface, potentially making maintenance easier and less time-consuming. Fewer parts, lower fatigue loads and simpler maintenance all lead to reduced maintenance costs."

A 24-unit VAWT demonstration plot was installed in southern California in the early 2010s by Caltech aeronautical professor John Dabiri. His design was incorporated in a 10-unit generating farm installed in 2013 in the Alaskan village of Igiugig.

Dulas, Anglesey received permission in March 2014 to install a prototype VAWT on the breakwater at Port Talbot waterside. The turbine is a new design, supplied by Wales-based C-FEC (Swansea),[21] and will be operated for a two-year trial. This VAWT incorporates a wind shield which blocks the wind from the advancing blades, and thus requires a wind-direction sensor and a positioning mechanism, as opposed to the "egg-beater" types of VAWTs discussed above.

Navitas (Blackpool) have been operating two prototype VAWTs since June 2013, powered by a Siemens Power Train, they are due to enter the market in January 2015, with a free technology share to interested parties. 4 Navitas are now in the process of scaling their prototype to 1 MW, (working with PERA Technology) and then floating the turbine on an offshore pontoon. This will reduce the cost of offshore wind energy.

The Dynasphere, is Michael Reynolds' (known for his Earthship house designs) 4th generation vertical axis windmill. These windmills have two 1.5 KW generators and can produce electricity at very low speeds.

It can be installed near park, sea-shore, rooftops household. These are mainly designed to be located at the roadside and beside railway tracks so that it can generate the maximum amount of electricity by the wind energy getting from the moving vehicles.

The big vehicles like buses, trucks can provide a lot of wind energy, the speeding vehicles on the highway can provide enough energy to drive these turbines in a high-speed the generated energy can be used to power the street lights or it can be transported to some other places also. The Enlil wind turbine is still under development phase and the researches on it are going on to improve the design and make it more efficient and durable.

CHAPTER 2
LITERATURE REVIEW

Wind turbine is the most potent alternative which can convert wind energy into electric power. This source is found to be economical and effective means to cut down electrical cost. IN olden days wind turbines were not developed for power generation, they were used to produce repetitive mechanical task for pumping water or to grind grain. These were called as wind mills. Charles F Brush developed the first power producing wind turbine in 1888 in United States.

Eventually wind turbines became popular due to development in steel. Lehman compiled the data of modern horizontal-axis wind turbine. The first megawatt-class wind turbine was synchronized in 1941 to a utility grid in Vermont. John Brown and Company operated the first utility grid-connected wind turbine in 1954 in the Orkney Islands. Rotor diameter of the turbine was 18-11 huge, they require large space, high installation cost, high maintenance cost, which makes them unaffordable for generation of power for domestic purpose.

Vertical Axis Wind Turbines have the capability of operating in turbulent wind because of which they can be installed at lower heights. As the gear box mechanism is located at ground level, their maintenance is not cumbersome. No pitch and yaw mechanism is required for vertical axis wind turbine.

1922, **Finnish Engineer S J Savonius** developed Savonius turbine which was simple structure with two cups or half drums fixed to the rotating shaft in opposite directions.

Each cup or half drum intercepts the wind and rotates the shaft, which brings the opposite part of the drum or cup in the wind flow. The cup or drum repeats the process so as the shaft rotates and completes the rotation.

In 1927 the first aerodynamic vertical axis wind turbine was developed by Darrius in France. The turbine was based on the principle that its blade speed was multiple of wind speed. The apparent wind throughout the whole revolution coming in as head wind with only limited variation in angle.

In 1975, **P J Musgroves** put endeavors in straightening the Darrius blades which led to straight blade vertical axis wind turbine known as H-rotor vertical axis wind turbine.

In 1986, **Sir Robert Mc Alpine and Northern Engineering** developed an arrow head blade of 25 m large and 130 KW rated capacity located in Carmarthen bay in South Wales.

In between 1970-80 lot of research has been carried out on Darrius vertical axis wind turbine. Few researchers used symmetrical airfoil blade profile. The principle behind using symmetrical airfoil was that it would generate lift force from both the side for 360◦ path of the blades rotation. Researchers from 12 Italy developed Ropatec type of turbines which are Hybrid Darrius and Savonius wind turbines. To reduce the noise level in Darrius turbine, researchers from New Zealand developed Vertical Axis wind turbine, Solwind model.

These turbines are quite operated turbines, by virtue of their design, the blades do not make the conning noise which occurs in conventional horizontal axis wind turbine when the blade passes close through the mast. The blades of this turbine are always at the equidistant from turbine mast. The Wind Side Wind Turbine of Finland has developed a vertical axis wind turbine working on sailing engineering principle. This turbine is rotated in two spiral formed vanes. This turbine is known as Helical wind turbines.

Study of vertical axis wind turbine requires a literature review of several different areas. The literature in these areas can be classified mainly 13 Initial analytic work includes power calculations, blade element momentum theory, power generation and structural analysis has been focused on improving the performance of turbine by improving the aerodynamics of blades. Gundtoft book elaborates about the energy obtained from the wind in an idealized wind turbine (Proof of Betz law) and the design process for the rotor.

Further, this book elaborates optimal design guidelines for rotor pitch angle and chord length and other characteristic of the rotor blades viz. coefficients of lift and drag. This book also covers the the step wise procedure for calculation of the power of a given rotor using the BEM theory and efficiency of a wind turbine. A book by Muyeen gave detailed analysis of a Wind Power Generation System using various analytical expressions. Power generation analysis also includes various turbine system components viz. synchronous generator with permanent magnets, active rectifier and voltage source inverter.

Deglaire et.al. developed a model for two dimensional flow around a moving profile. The model was suitable for fast aerodynamic and aero elastic coupling calculation. This developed methodology which was used to represent any profile, pitching motion and blade attachment position. The method was based on conformal mapping technique and Laurent’s series decomposition and is faster and more accurate than standard panel methods.

Tescione et al. investigated development of the near wake of VAWT using stereoscopic 15 particle image velocimetry. The experiments demonstrated the evolution of the vortices shed by the blade and it organizes in large scale vertical structures at the edges of the wake resulting into asymmetric induction field in the wake.

Coxa and Echtermeyer used Finite Element Analysis (FEA) approach for wind turbine blade made of hybrid composite material yielding low weight and high strength.

Hameed and Kamran studied the performance of blade at extreme wind conditions. The maximum stress and deflection values were estimated. Chou and Tu study provides significant insights into post-disaster inspection of tower failure during typhoon.

Greenblatt et al. assessed turbine performance enhancement resulting from the control of dynamic flow separation and project the validity of upscaling the turbine. They have used plasma actuator at the tip of the blade to impart smooth separation of the dynamic flow. It was found that overall performance improvement up to 30% may be possible. The testing on a small wind turbine was carried in low speed wind tunnel. It was found that pitch angle, turbine radius and chord length has a significant effect on turbine power co-efficient. Vertical axis wind turbine (VAWT) performance improvement studies include modifications in blade design, orientations of blades and attachments to change wind pattern.

Li et al. worked on the problem of VAWT in cold climate, icing, and snow. Due to above climatic condition the performance of the VAWT is affected. They simulated the condition of rime type icing on the leading edge of the blade surface by clay. The effects on the rotation and power performance of VAWT were measured in wind tunnel.

Bhuyan and Biswas compared the self-starting characteristics of H-rotor and Hybrid Savonius rotor VAWT and found that hybrid design fully exhibits self-starting capability at all azimuthal positions, signified by the positive static torque coefficients values. Attempts were made to improve the self- starting speed of Darrius hydrokinetic wind turbine by studying the forces acting on the straight blades and varying the pitch angle. Novel vertical axis sail rotor was used and force analysis for one complete rotation was made for enhancement of self-starting speed.

Evaluation of different wind turbine configurations of VAWT has been done from the most important aspects including coefficient of power, tip speed ratio, blade design, aero foils.

CHAPTER 3
DESIGN AND IMPLEMENTATION

3.1 BLOCK DIAGRAM

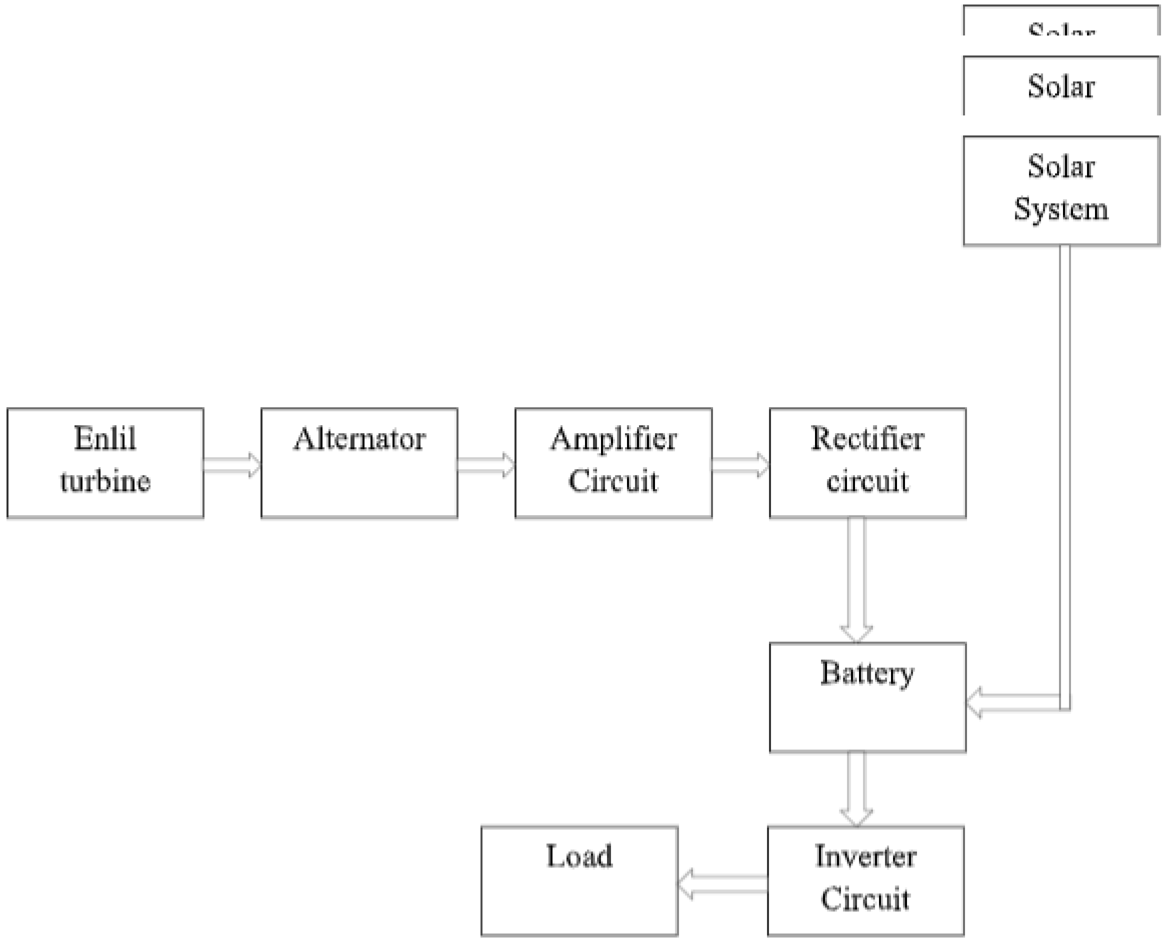

Fig.3.1: Block Diagram

In this project, we create electrical energy using traffic. ENLIL is a vertical axis wind turbine that generates electricity from wind power. It was designed to capture the energy created by modern cities, like wind created from passing vehicles. It also has solar panels to capture extra energy from sunlight. The ENLIL turbine is being tested on the streets of Istanbul, in Turkey. Deveci Tech. claims that ENLIL can generate 50W of energy per hour, enough to handle the power of street light.

With the global populating rapidly rising, the demand for energy is increasing day by day. Non-renewable sources of energy are running out, so continuing to rely on them is not a viable, long-term strategy. The benefit of the ENLIL wind turbine is that it offers a pollution-free alternative to the burning of gas, oil, and coal for the production of electricity.

Many people are using wind turbines in order to simultaneously reduce their energy costs and their impact on the climate. There are a number of reasons why homeowners could benefit from using VAHWs instead of HAWTs. Conserve Energy Future highlight:

- We can build our wind turbine close to the ground so if we do not have a suitable rooftop for placement, or if we live where there are hills, ridges, etc. that prohibit the flow of air, it work wonderfully for our needs.
- Since VAWT are mounted closer to the ground it make maintenance easier, reduce the construction costs, are more bird friendly and does not destroy the wildlife.
- We do not need any mechanisms in order to operate the wind turbine
- Lower wind startup speed.
- The main advantage of VAWT is it does not need to be pointed towards the wind to be effective. In other words, it can be used on the sites with high variable wind direction.
- We can use the wind turbine where tall structures are not allowed.
- VAWT’s are quiet, efficient, economical and perfect for residential energy production, especially in urban environments.
- It is cost effective when compared to the HAWTs. It is still best to shop around and check prices before making a purchase, however.
- Many of the turbines are resistant to many of the different weather elements that we may experience. It is imperative to choose a unit that offers this valuable Protection and extra durability when we need it the most.

Nevertheless, there are some disadvantages to VAWTs, as Conserve Energy Future points out:

- Decreased level of efficiency when compared to the HAWT. The reason for the reduced amount of efficiency is usually due to the drag that occurs within the blades as they rotate.
- We are unable to take advantage of the wind speeds that occur at higher levels.

- VAWT's are very difficult to erect on towers, which means they are installed on base, such as ground or building.

3.2 PROJECT DISCRIPTION

In this project, wind thrust produced due to the speeding vehicles can provide enough rotation to the turbine to generate electrical power all day and night without stopping. The energy generated can be transported to places or it can be used for maintenance of roadways. The aim of the project is to utilize the maximum amount of wind energy and hence highway is selected as installation site. The wind turbine will be placed so that the tangential acting air flow from both sides of the road due to moving vehicles will help to rotate the turbine. The variation of blade angle is made so that to get maximum output and blades are fixed.

In this, we have three sources which are used to charge batteries and produce electrical energy. Which are as follows:-

1. Turbine .
2. Solar Pannel.
3. Auxiliary source.

Firstly, the power is generated from turbine due to speeding vehicles which provide wind thrust. The produced wind thrust is enough to rotate the turbine blades. Now, the energy produced is in form of mechanical energy. This mechanical energy is converted into electrical energy with the help of dymo.

The converted electrical energy is again converted to DC by using rectifier circuit. Also, with this circuit two LED's are also placed which shows the direction of rotation of turbine. Such as, when turbine rotates in clockwise direction then first LED will glow. Similarly, when turbine rotates in anticlockwise direction then second LED will glow. Now, the rectified energy is stored in battery (it's capacity is 12V and gives 1.2A current).

Second source of this project is solar panel. With the help of solar panel we can generate power to store in battery and for utilization purpose. When, the sun's rays fall on solar plate it generates energy. The solar panel generate approx. 21V of electricity when the intensity is very high. Now, the energy produced by solar panel is step down by transformer, so that it can be easily stored in battery. Also with the solar panel circuit voltage regulation circuit is also there which regulates the energy produced by solar panel so that it can be easily stored in battery.

Third source which is used to produce power is an auxiliary power source. It is used when, there is no availability of sun's rays due to weather conditions or any other reason, in that case, solar panel is not able to generate energy. Other condition arises due to wind turbine, when vehicles are not able to produce that amount of wind thrust that the turbine requires and and during night time there is no vehicles on the road so that turbine rotate. So, when energy is not generated from solar panel and turbine then auxiliary supply is used to charge the battery. The transformer is used with the auxiliary power circuit to step down the voltage from 220V to 12V and it is stored in battery.

So, the power which is stored in the battery is sufficient to glow the LED's and bulbs and road lights.

It can be installed near park, sea-shore, rooftops household. These are mainly designed to be located at the roadside and beside railway tracks so that it can generate the maximum amount of electricity by the wind energy getting from the moving vehicles.

The big vehicles like buses, trucks can provide a lot of wind energy, the speeding vehicles on the highway can provide enough energy to drive these turbines in a high-speed the generated energy can be used to power the street lights or it can be transported to some other places also.

With this project we can also install other sensor devices like earthquake sensors,weather condition sensing devices, also instead of solar panel we can use solar tracking system, etc. Then all the sensors readings will be send to control room where specialist can check the data of the weather condition and other sources.

Also, with this project we can also install display LED's at top of this project which consume low amount of energy and can display any kind of information or news to the peoples like about change in weather, about earthquake etc so that people will get alert and take safety measures.

The Enlil Vertical Axis Wind Turbine is still under development phase and the researches on it are going on to improve the design and make it more efficient and durable.

3.3 WORKING PRINCIPLE

The moving vehicle on highway may be all types such as small or heavy vehicles. Whenever vehicle moves on both side of the highway divider then some pressurized air is produced due to the speed of vehicle. This pressurized air is strike on the blade of vertical axis wind turbine and turbine makes a rotation. The shaft of the vertical axis wind turbine is connected to generator with the help of gear mechanism. The generated electricity is an alternating quantity; the output of the generator is rectified by rectifier and stored in the battery. The solar panel is also installed in this project for the generation of extra power (auxiliary power generation source).

A solar cell or photovoltaic cell is an electrical device that converts the energy of light directly into electricity by the photovoltaic effect, which is the physical and chemical phenomenon. It is photoelectric cell, defined as a device whose electrical parameter such as current, voltage or resistance varies when exposed light. Solar cells are the building blocks of photovoltaic modules. The generated electricity is stored in the battery. The stored energy used as a street lighting and domestic purpose

3.4 HARDWARE COMPONENTS

1. Turbine Blades
2. Shaft
3. Pulley
4. Bearing
5. Alternator
6. Inverter
7. Solar Panel
8. Dynamo
9. Transformer
10. LED
11. Batteries

3.5 HARDWARE DISCRIPTION

3.5.1 DESIGN OF BLADES

The vertical axis wind turbine is used to convert the kinetic energy into mechanical energy. The light weight blade materials (mica sheet) are used for making the vertical axis wind turbine. The blade is designed in semicircular shape so as one blade passes another blade comes in the position of blades are used so as to use of maximum utilization of wind from air and moving vehicle.

A=d*h

h=height of the blades (m)

d= diameter of the rotor (m)

So, area= (0.61*0.102)

=0.062 sq. m

.**Fig.3.2: Blade**

Wind turbine blades have on aero foil- types cross section and a variable pitch. In the project and a variable pitch. In the project eight blades with vertical shaft are used, it has a height and width of 609.6mm and 101.6mm respectively. The angle between two blades is 45. The material used for the blade is PVC pipe. This material is taken because it is low-cost and weigt of these pipes is also less, due to this the rotational speed also increase so as output, the weight of each blade is 200gm therefore the weight of 6 blades is 1.2 k

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3.5.2 DESIGN OF SHAFT

While designing the shaft it should be properly fitted to blade. The shaft has diameter of 101.6mm so as to easily fixed in the disc and at the top and bottom ends mild steel plates are attached of thickness 2mm.

Fig.3.3: Shaft

3.5.3 DESIGN OF PULLEY

There are 2 pulley used one big pulley and one short. Big pulley is attached to the shaft and lower pulley is attached to the diameter dynamo. Big pulley is made up of aluminium alloy so as to decrease its weight so it can rotate freely. Both the pulley are attached with the help of a belt. This pulley increases the rotation speed of the turbine.

Types of pulleys

- **Static A static or class 1 pulley has an axle that is "staticed" or is stationary,** meaning that it cannot be moved. A fixed pulley is used to redirect the force in a rope (called a belt when it goes in a full circle). A fixed pulley has a mechanical advantage of 1. The static pulley has a wheel and an axle.
- **Movable A movable or class 2 pulley has an axle that is "free" to move in space.** A movable pulley is used to transform forces. A movable pulley has a mechanical advantage of 2. That is, if one end of the rope is anchored, pulling on the other end of the rope will apply a doubled force to the object attached to the pulley.

- Compound A compound pulley is a combination fixed and movable pulley system.
- **Block and tackle** - A block and tackle is a compound pulley where several pulleys are mounted on each axle, further increasing the mechanical advantage. Plutarch reported that Archimedes moved an entire warship, laden with men, using compound pulleys and his own strength.

Fig.3.4: Pulley

3.5.4 BEARING

A bearing is a machine element that constrains relative motion to only the desired motion, and reduces friction between moving parts. The design of the bearing may, for example, provide for free linear movement of the moving part or for free rotation around a fixed axis; or, it may prevent a motion by controlling the vectors of normal forces that bear on the moving parts. Most bearings facilitate the desired motion by minimizing friction. Bearings are classified broadly according to the type of operation, the motions allowed, or to the directions of the loads (forces) applied to the parts.

Rotary bearings hold rotating components such as shafts or axles within mechanical systems, and transfer axial and radial loads from the source of the load to the structure supporting it. The simplest form of bearing, the plain bearing, consists of a shaft rotating in a hole. Lubrication is often used to reduce friction. In the ball bearing and roller bearing, to prevent sliding friction, rolling elements such as rollers or balls with a circular cross-section are located between the races or journals of the bearing assembly. A wide variety of bearing designs exists to allow the demands of the application to be correctly met for maximum

efficiency, reliability, durability and performance.

Fig.3.5: Bearing

Types of bearing:-

Plain Bearings

Plain bearings are the simplest type of bearing and are composed of just the bearing surface with no rolling elements. They have a high load-carrying capacity, are generally the least expensive and, depending on the materials, have much longer lives than other types.

Rolling Element Bearings

Rolling element bearings place balls or rollers between two rings – or "races" – that allows motion with little rolling resistance and sliding. These bearings include ball bearings and roller bearings.

Ball bearings are the most common type of rolling element bearing. These bearings can handle both radial and thrust loads but are usually used where the load is relatively small. Because of its structure, there is not a lot of contact with the balls on the inner and outer races. If the bearing is overloaded the balls would deform and ruin the bearing. Roller bearings are able to handle a much heavier, radial load, like conveyor belts, because they don't use balls. Instead, they have cylinders allowing more contact between the races, spreading the load out over a larger area. However this type of bearing is not designed to handle much thrust loading.

Jewel Bearings

Jewel bearings are plain bearings with a metal spindle that turns in a jewel-lined pivot hole.

They carry loads by rolling the axle slightly off-center and are usually used in mechanical watches or clocks. This is due to their low and predictable friction that improves watch accuracy.

Fluid Bearings

Fluid bearings support their load using a thin layer of gas or liquid and can be classified into two types: fluid-dynamic bearings and hydrostatic bearings. Fluid-dynamic bearings use rotation to form the liquid into a lubricating wedge against the inner surface. In hydrostatic bearings, the fluids – usually oil, water, or air – rely on an external pump.

Fluid bearings are used in high load, high speed or high precision applications that ordinary ball bearings either couldn't handle or would suffer from increased vibration and noise.

Magnetic Bearing

Magnetic bearings support moving parts without physical contact, instead relying on magnetic fields to carry the loads. They require continuous power input to keep the load stable, thus requiring a back-up bearing in the case of power or control system failure.

Magnetic bearings have very low and predictable friction and the ability to run without lubrication or in a vacuum. They are increasingly used in industrial machines like turbines, motors, and generators.

Flexure Bearing

A typical flexure bearing is one part joining two others, like a hinge, in which motion is supported by a load element that bends. These bearings require repeated bending, so material selection is key. Some materials fail after repeated bending, even at low loads, but with the right materials and bearing design the flexure bearing can have an indefinite life. Another notable characteristic of this bearing is its resistance to fatigue. Many other bearings that rely on balls or rollers can fatigue as the rolling elements flatten against each other.

3.5.5 ALTERNATOR

An alternator is an electrical generator that converts mechanical energy to electrical energy in the form of alternating current. For reasons of cost and simplicity, most alternators use a rotating magnetic field with a stationary armature. Occasionally, a linear alternator or a rotating armature with a stationary magnetic field is used. In principle, any AC electrical generator can be called an alternator, but usually the term refers to small rotating machines driven by automotive and other internal combustion engines. An alternator that uses a permanent magnet for its magnetic field is called a magneto. Alternators in power stations driven by steam turbines are called turbo-alternators. Large 50 or 60 Hz three-phase

alternators in power plants generate most of the world's electric power, which is distributed by electric power grids.

Use of Alternator

The power for the electrical system of a modern vehicle gets produced from an alternator. In previous days, we used DC generators or dynamos for this purpose, but after the development of alternator, we replaced the DC dynamos by more robust and lightweight alternator. Although the electrical system of motor vehicles requires direct current, still an alternator along with diode rectifier instead of a DC generator is a better choice as the complicated commutation is absent in alternator. This particular type of generator used in the vehicle is known as an automotive alternator (learn how an alternator is constructed).

Another **use of alternators** is in diesel-electric locomotive. The engine of this locomotive is nothing but an alternator, driven by a diesel engine. The alternating current produced by this generator is converted to DC by integrated silicon diode rectifiers to feed all the DC traction motors. These DC traction motors drive the wheel of the locomotive.

Types of Alternators

Alternators or **synchronous generators** can be classified in many ways depending upon their applications and designs.

The **five different types of alternators** include:

- **Automotive alternators** – used in modern automobiles.
- **Diesel-electric locomotive alternators** – used in diesel electric multiple units.
- **Marine alternators** – used in marine applications.
- **Brushless alternators** – used in electrical power generation plants as the main source of power.
- **Radio alternators** – used for low band radio frequency transmission.

We can categorize these AC generators (alternators) in many ways, but the two main categories depending on their design are:

1. Salient Pole Type
2. Smooth Cylindrical Type

Salient Pole Type

We use it as low and medium speed alternator. It has a large number of projecting poles having their cores bolted or dovetailed onto a heavy magnetic wheel of cast iron or steel of good magnetic quality.

Such generators get characterized by their large diameters and short axial lengths. These generators look like a big wheel. These are mainly used for low-speed turbine such as in hydel power plant.

Smooth Cylindrical Type

We use it for a steam turbine driven alternator. The rotor of this generator rotates at very high speed. The rotor consists of a smooth solid forged steel cylinder having certain numbers of slots milled out at intervals along the outer periphery for accommodating field coils.

These rotors are designed mostly for 2 poles or 4 poles turbo generator running at 36000 rpm or 1800 rpm respectively.

3.5.6 INVERTER

Inverter is an electronic device that changes direct current(DC) to alternating current(AC). The input voltage output voltage and frequency, and overall power handling depand on the design of the specific device. The dc inverter does not produce any power, the power is provided by DC source. DC sources such as batteries or fuel cell. Wind inverters may have the output of a small wind turbine with a AC voltage that changes the value of frequency and voltage depending on the speed of the wind.

There are different types of inverters based on the shape of the switching waveform. These have varying circuit configurations, efficiencies, advantages and disadvantages. An inverter provides an ac voltage from dc power sources and is useful in powering electronics and electrical equipment rated at the ac mains voltage. In addition they are widely used in the switched mode power supplies inverting stages. The circuits are classified according the switching technology and switch type, the waveform, the frequency and output waveform.

3.5.7 SOLAR PANEL

Solar panel are installed in this project for the generation of extra power. Solar panel are the auxiliary power generation source. These are connected at the top of turbine to generate extra power. Photo voltaic solar panels absorb sunlight as a source of energy to generate electricity. A solar panels is a collection of solar cell. Lots of small solar cell spreads over a large area can work together to provide enough power to be useful.

Solar cells are also known as photovoltaic (PV) cells. Solar cells are devices that transform light energy directly into electrical energy.

How do solar cells work?

The general principles by which all solar cells work are:

- Light consists of little 'parcels' or 'packets' of energy called photons.
- When photons shine on a solar cell, they are absorbed by the cell.
- If the photons have enough energy they cause the cell to release electrons.
- If the photons do not have enough energy, their energy is transformed into heat energy.
- The released electrons enter wires and travel around an electrical circuit.
- The resulting electrical current is in the form of a direct current (DC). This is a current that flows in one direction only.
- If the light is more intense (brighter light) more electrons will be released each second and the electrical current will be bigger. The voltage of the cell will stay the same.

Types of solar cell

A solar cell actually works depends on whether it is a silicon-based solar cell or another type of solar cell, such as an organic solar cell (which is made up of plastics), or a dye-sensitised solar cell (also known as a Grätzel cell).

Fig.3.6: Solar Panel

Solar panels and solar arrays

A solar panel consists of a set of solar cells connected in series and/or in parallel to produce a desired voltage and current. The solar cells are set into a frame.

A single solar cell has an output voltage of about 0.6 V DC. In a solar panel there are modules of 60 – 72 solar cells connected in series. This gives a **nominal** output voltage of 24 V DC. The maximum voltage could be greater than 36 V.

A solar array (also known as a PV cell array) is set of solar panels connected in a grid . Solar

arrays are used on the rooftops of buildings, including homes and schools, to help meet their energy requirements.

Sometimes solar arrays can generate more electricity than is required. The excess electrical energy produced can be sold back into the electricity grid

The various operations involved in fabrication process:-

The following were the fabrication techniques involved:

1. Primary shaping process
2. Machine process
3. Gas cutting
4. Arc welding
5. Surface finishing

3.5.8 DYNAMO

A dynamo is an electrical generator that creates direct current using 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 (such as vacuum tubes or more recently via solid state technology) is effective and usually economical.

Fig. 3.7: Dynamo

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.

3.5.9 TRANSFORMER

A transformer is static electrical equipment which transforms electrical energy (from primary side windings) to the magnetic energy (in transformer magnetic core) and again to the electrical energy (on the secondary transformer side). The operating frequency and nominal power are approximately equal on primary and secondary transformer side because the transformer is a very efficient piece of equipment – while the voltage and current values are usually different. Essentially, that is the main task of the transformer, converting high voltage (HV) and low current from the primary side to the low voltage (LV) and high current on the secondary side and vice versa. The transformer can transfer energy in both directions, from HV to LV side as well as inversely. That is the reason why it can work as a voltage step-up or step-down_transformer. Both transformer types have the same design and construction. Theoretically, we can operate any transformer as step-up as well as step-down type. It only depends on the energy flowing direction.

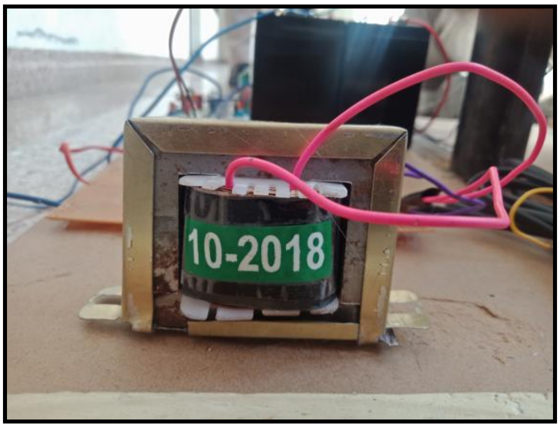

Fig.3.8: Transformer

Types of Transformer

Transformers can be categorized in different ways, depending upon their purpose, use, construction etc. The **types of transformer** are as follows,

Step Up Transformer and Step Down Transformer – Generally used for stepping up and down the voltage level of power in transmission and distribution power system network.

Three Phase Transformer and Single Phase Transformer – Former is generally used in three phase power system as it is cost effective than later. But when size matters, it is preferable to use a bank of three single phase transformer as it is easier to transport than one single three phase transformer unit.

Electrical Power Transformer, Distribution Transformer and Instrument Transformer – Power transformers are generally used in transmission network for stepping up or down the voltage level. It operates mainly during high or peak loads and has maximum efficiency at or near full load. Distribution transformer steps down the voltage for distribution purpose to domestic or commercial users. It has good voltage regulation and operates 24 hrs a day with maximum efficiency at 50% of full load. Instrument transformers include C.T and P.T which are used to reduce high voltages and current to lesser values which can be measured by conventional instruments.

Two Winding Transformer and Auto Transformer – Former is generally used where ratio between high voltage and low voltage is greater than 2. It is cost effective to use later where the ratio between high voltage and low voltage is less than 2.

Outdoor Transformer and Indoor Transformer – Transformers that are designed for installing at outdoor are outdoor transformers and transformers designed for installing at indoor are indoor transformers.

Oil Cooled and Dry Type Transformer – In oil cooled transformer the cooling medium is transformer oil whereas the dry type transformer is air cooled.

Core type, Shell type and Berry type transformer – In core type transformer it has two vertical legs or limbs with two horizontal sections named yoke. Core is rectangular in shape with a common magnetic circuit. Cylindrical coils (HV and LV) are placed on both the limbs.
Shell type transformer: It has a central limb and two outer limbs. Both HV, LV coils are placed on the central limb. The double magnetic circuit is present.
Berry type transformer: The core looks like spokes of wheels. Tightly fitted metal sheet tanks are used for housing this type of transformer with transformer oil filled inside.

3.5.10 LED

A light-emitting diode (LED) is a semiconductor light source that emits light when current flows through it. Electrons in the semiconductor recombine with electron holes, releasing energy in the form of photons. This effect is called electroluminescence. The color of the light (corresponding to the energy of the photons) is determined by the energy required for electrons to cross the band gap of the semiconductor. White light is obtained by using multiple semiconductors or a layer of light-emitting phosphor on the semiconductor device.

Since light is generated within the solid semiconductor material, LEDs are described as solid-state devices. The term solid-state lighting, which also encompasses organic LEDs (OLEDs), distinguishes this lighting technology from other sources that use heated filaments (incandescent and tungsten halogen lamps) or gas discharge (fluorescent lamps).

Different colors

Inside the semiconductor material of the LED, the electrons and holes are contained within energy bands. The separation of the bands (i.e. the bandgap) determines the energy of the photons (light particles) that are emitted by the LED.

The photon energy determines the wavelength of the emitted light, and hence its color. Different semiconductor materials with different bandgaps produce different colors of light. The precise wavelength (color) can be tuned by altering the composition of the light-emitting, or active, region.

LEDs are comprised of compound semiconductor materials, which are made up of elements from group III and group V of the periodic table (these are known as III-V materials). Examples of III-V materials commonly used to make LEDs are gallium arsenide (GaAs) and gallium phosphide (GaP).

Until the mid-90s LEDs had a limited range of colors, and in particular commercial blue and white LEDs did not exist. The development of LEDs based on the gallium nitride (GaN) material system completed the palette of colors and opened up many new applications.

Main LED materials

The main semiconductor materials used to manufacture LEDs are:

- **Indium gallium nitride (InGaN):** blue, green and ultraviolet high-brightness LEDs
- **Aluminum gallium indium phosphide (AlGaInP):** yellow, orange and red high-brightness LEDs
- **Aluminum gallium arsenide (AlGaAs):** red and infrared LEDs
- **Gallium phosphide (GaP):** yellow and green LEDs

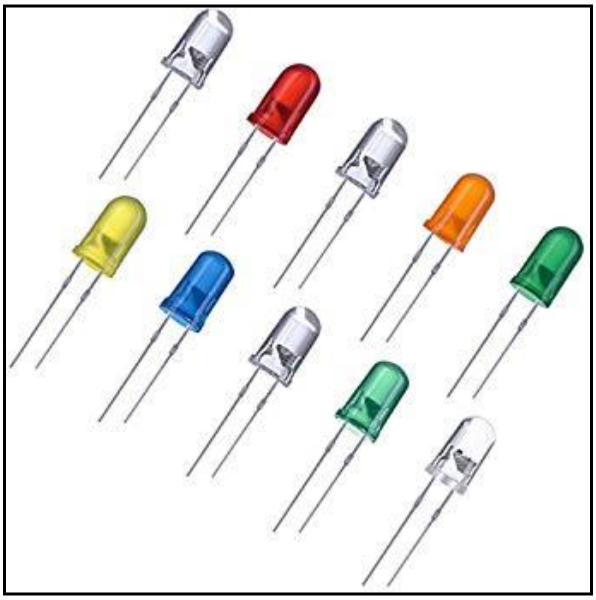

Fig.3.9: LED

An **LED lamp** or **LED light bulb** is an electric light for use in light fixtures that produces light using one or more light-emitting diodes (LEDs). LED lamps have a lifespan many times longer than equivalent incandescent lamps, and are significantly more efficient than most fluorescent lamps, with some LED chips able to emit up to 303 lumens per watt (as claimed by Cree and some other LED manufacturers).] However, LED lamps require an electronic LED driver circuit when operated from mains power lines, and losses from this circuit mean the efficiency of the lamp is lower than the efficiency of the LED chips it uses. The most efficient commercially available LED lamps have efficiencies of 200 lumens per watt (Lm/W). Commercially available LED chips have efficiencies of over 220 Lm/W.

Fig.3.10: LED LAMP

3.5.11 BATTERY

Battery is a criminal offense involving the unlawful physical acting upon a threat, distinct from assault which is the act of creating apprehension of such contact.

Battery is a specific common law misdemeanor, although the term is used more generally to refer to any unlawful offensive physical contact with another person, and may be a misdemeanor or a felony, depending on the circumstances. Battery was defined at common law as "any unlawful and or unwanted touching of the person of another by the aggressor, or by a substance put in motion by him." In most cases, battery is now governed by statutes, and its severity is determined by the law of the specific jurisdiction.

Fig: 3.11: Battery

A battery is a device consisting of one or more electrochemical cells with external connections provided to power electrical devices such as flashlights, smartphones, and electric cars.[1] When a battery is supplying electric power, its positive terminal is the cathode and its negative terminal is the anode.[2] The terminal marked negative is the source of electrons that will flow through an external electric circuit to the positive terminal. When a battery is connected to an external electric load, a redox reaction converts high-energy reactants to lower-energy products, and the free-energy difference is delivered to the external circuit as electrical energy.[3] Historically the term "battery" specifically referred to a device composed of multiple cells, however the usage has evolved to include devices composed of a single cell.[4]

Primary (single-use or "disposable") batteries are used once and discarded; the electrode materials are irreversibly changed during discharge. Common examples are the alkaline battery used for flashlights and a multitude of portable electronic devices.

Secondary battery can be discharged and recharged multiple times using an applied electric current; the original composition of the electrodes can be restored by reverse current. Examples include the lead-acid batteries used in vehicles and lithium-ion batteries used for portable electronics such as laptops and smartphones.

Batteries come in many shapes and sizes, from miniature cells used to power hearing aids and wristwatches to small, thin cells used in smartphones, to large lead acid batteries or lithium-ion batteries in vehicles, and at the largest extreme, huge battery banks the size of rooms that provide standby or emergency power for telephone exchanges and computer data centers.

A valve regulated lead acid battery sometimes called sealed lead-acid (SLA), gel cell, or maintenance free battery. Due to their construction, the Gel and Absorbent Glass Mat types of VRLA can be mounted in any orientation, and do not require constant maintenance. They are widely used in large electrical devices, off-grid power systems and similar roles, where large amounts of storage are needed at a lower cost than other low-maintenance technologies like lithium-ion.

Specification of Battery

Voltage Range= 12 Volt.
Current Range= 12 Ah.
Valve regulated sealed lead acid rechargeable battery

CHAPTER 4
RESULTS

Hence, we have observed that we have three sources which are used to charge batteries and produce electrical energy. Here we have three sources namely-

1. Enlil Vertical Wind Turbine is connected to the dynamo and it convert mechanical energy to electrical energy. This electrical energy is converted into DC by rectifier circuit.

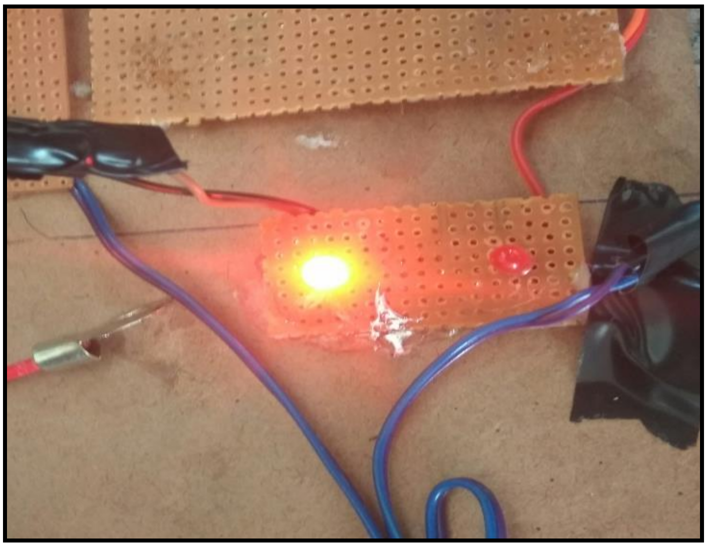

Fig.4.1: LED Glowing

2. Due to rotation of turbine the LED glow. If turbine rotates in clockwise direction then first LED will glow and if it rotates in anticlockwise direction then second LED will glow.
3. Here we have observed that the solar panel is producing electricity up 21V when the intensity is high. This voltage is stepped down by a voltage regulator and dropped to 13V.
4. An auxiliary transformer is also used. In case, if energy is not generated from solar panel and turbine then auxiliary supply is used to charge the battery. The transformer step down the voltage from 220V to 12V and it is stored in battery.

5. Power from solar panel will stored in battery and also power from auxiliary source is stored in battery.
6. This stored power is sufficient to glow the LED and also used for the street light.

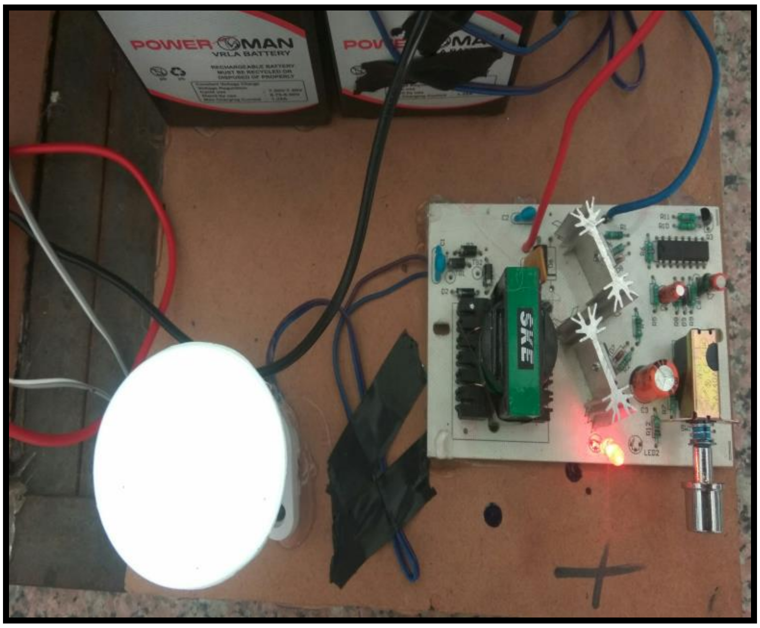

Fig.4.2: Bulb Glowing

CHAPTER 5
CONCLUSION & FUTURE SCOPE

5.1 CONCLUSION

If any conclusion can be drawn is that the VAWT technology undoubtedly will be with us in the future, and can be seen all around us, as has happened with other renewable technologies for electricity production, such as HAWT and PV, thus becoming part of the future renewable energy range and the business network, contributing to the reduction of CO2 production and economic growth. Even after being a subject to which many studies have been devoted, however we still have a long road ahead and certainly there continue to be many areas to experience. That is why, after doing this article, the Department of Energy and Marine Propulsion of University of A Coruña, have determined a preliminary geometry for the development of a new model of VAWT, in which is working out, doing various tests using computational methods in order to obtain optimal morphology and even making a preliminary model prototype, thus doing their bit to the development of this technology.

This system is environmental friendly. The working model of our project is combined energy source with solar system and vertical axis wind turbine system which is a good and effective solution for power generation, basically this system involves the combination of two energy system, suppose anyone source fails to generate another source will keep generating the electricity and will give the continuous power to the load. The renewable energy sources such as solar and wind energy are used to generate the electricity.

5.2 FUTURE SCOPE

Instead of iron, if Fiber Reinforce Plastic(FRP) is used it will yield to more output.

- The word hybrid means a thing which is made by the combination of more than one element. In energy system, electricity can be produced by more than one source at a time. Like, wind, solar, biomass, etc. There are various methods to generate hybrid energy like, wind-solar, solar-diesel, wind-hydro, wind-diesel. The hybridization in India has large prospect because over 75% of Indian household face the problem like power cut especially in summer. So solar panel can be installed on the top of the turbine so that the efficiency.

- Development of effective alternator and dynamo can be used to wind energy from relatively small wind.
- By setting different angles and different speed of turbine can also be turbine done as future work or scope.

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APPINDEX (A)

COMPONENT COST

S.NO	Component	Price(approx)	Quantity
1.	Turbine	2000	1
2. B	Shaft	1500	1
3.	Transformer	150	1
4.	Dynamo	350	1
5.	Pulley & Belt	200	1
6.	Solar panel System	1800	1
7.	Alternator	800	1
8.	Inverter Circuit	1200	1
9.	Battery	600	1
10.	Rectifier Circuit	200	2
	Total	8,800	

APPINDEX (B)

SNAPSHOT OF PROJECT