DESIGN OF HYBRID WIND TREE

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ABSTRACT

Energy from wind is the fastest growing source of electricity in the world. The power from the wind can be extracted using vertical or horizontal axis turbine. Vertical axis turbine is capable of extracting energy from wind in any direction. The solar PV cells absorb radiation from sun and convert in electricity. The wind mill is capable of extracting energy from wind throughout the day and night, While the solar cell is capable of extracting power from sun during day time only. By combining both the solar and wind we are able to produce more electricity from a single system. Here we are making a tree. The branches of the trees are provided with turbine blades. Each turbine is having separate generators to convert the wind energy into electrical energy. Here we are using J type savonius turbine. It is having low starting torque hence it will rotate even with a wind of small velocity. Solar cells are provided on the surface of the turbine. The solar cells rotate along with the turbine and produce electricity. The transition of power from the solar cell is done with help of slip ring. As a result energy produced can be combined together and can be directly used or stored in battery for future use.

Keywords: *savonius turbine, solar cell, vertical axis turbine*

1.INTRODUCTION

Electricity is the most needful of our day today life. There are two ways of electricity generation either by conventional energy resources or by non-conventional energy resources. Electrical energy demand increases in world so to full-fill demand we have to generate electrical energy. Nowadays electrical energy is generated by the conventional energy resources like coal, diesel, and nuclear etc. The main drawback of these sources is that it produces waste like ash in coal power plant, nuclear waste in nuclear power plant and taking care of this wastage is very costly and it also damages the nature. The nuclear waste is very harmful to human being also. The conventional energy resources are depleting day by day. Soon it will be completely vanishes from the earth so we have to find another way to generate electricity. The new source should be reliable, pollution free and economical. The non-conventional energy resources should be good alternative energy resources for the conventional energy resources. There are many non-conventional energy resources like geothermal, tidal, wind; solar etc. the tidal energy has drawbacks like it can only implemented on sea shores. While geothermal energy needs very lager step to extract heat from earth. Solar and wind are easily available in all condition. The non-conventional energy resources like solar, wind can be good alternative source. Solar energy has drawback that it could not produce electrical energy in rainy and cloudy season so we need to overcome this drawback we can use two energy resources so that any one of source fails other source will keep generating the electricity. And in good weather condition we can use both sources combine.

2. LITERATURE REVIEW

Ragunath L et al [1]: The increase in power requirement causes power shut down in rural areas. This is mainly due to large power consumption by the factories and less availability of the non-renewable energy sources. From this it gives a clear picture of the importance of hybrid power generation system. It is more reliable and have higher efficiency when compared with the other systems. In this system a combination of wind energy and solar energy is used for power generation. While using only solar energy the energy can be harvested only during day time. But while combining the solar and wind energy, energy hidden in the solar and wind can be harvested during the day time and during night energy can produced by the wind turbine.

Dr. Shivprakash Bhagwatrao Barve et al [2]: The main objective is to provide electricity to the rural areas. Here vertical axis turbine is opted instead of horizontal axis turbine because vertical axis turbines are easy to make and produce same electricity as that of horizontal axis turbine. It does not produce any noise during its working and the maintenance cost is comparatively less when compared to the horizontal axis turbine. The wind turbine is designed in such a way that it will extract energy even from a small wind. By combining solar and wind a hybrid system can be developed which can be utilised for power generation in rural areas.

Lucas Deisadze et al [3]: A study is conducted on placing a VAWT on the roof top. Different types of VAWT are being designed for maximizing the efficiency of the turbine. In this a detailed study conducted on the wind turbine design and making it suitable mounting in the roof top and reducing the vibration being transferred to roof top. In this project wind analyzing software is used to analyze the existing wind data. Turbine vibration is being measured during wind tunnel test and impact test on scale-model test.

Javier Castillo et al [4]: This thesis focused on the design of small vertical axis turbine which is made of wood. The aerodynamics analysis is done in a momentum based model in a mathematical computer programming. Three turbine blades are chosen for the analysis. It is done considering the efficiency of the turbine.

Reid A. Berdainer et al [5]: In this paper it discuss about a new sustainable method for the power generation by combing vertical axis turbine and photovoltaic cell. This fully-integrated design improves upon existing designs which already address the combination of these efficient energy-producing technologies. Currently existing devices are characterized by an additive combination and the assembly of readily available system parts. The introduction of a VAWT provides the ability for wind energy to be harnessed from any wind direction. This omni-directionality of the VAWT is further increased by the introduction of multiple, phase-offset rotor stages. Moreover, this design incorporates a unique feature enabling the amplification of wind velocities through a converging housing section, allowing for an increase in rotor power coefficient and a low cut-in wind speed. This wind funneling effect is implemented via synergistic integration of the three main product components of the lighting system: wind turbine, solar panel, and light-emitting diode (LED) lighting. Computational fluid dynamics results were incorporated to assist in the development of the rotor sizing parameters and the turbine housing. An LED light product was selected to reduce the amount of power required from the energy production systems.

Abderrahmane Belghachi et al[6]: In recent years there has been intense research work into the development of high efficiency solar cells relying on emerging novel materials and structures. All this has lead to a continuous record breaking of highest achievable efficiencies using different technologies. Since the first photovoltaic devices were developed the most prevalent concern is to hem in all sorts of efficiency losses preventing from reaching the physical limits. To overcome this impediment, thorough investigations have been carried out to control and unearth their origins in order to identify potential efficiency advantages. Numerous thermodynamic approaches were employed to calculate solar cell efficiency limit, starting from the ideal Carnot engine to the latest detailed balance with its improved approach.

3.COMPONENTS

1.Frame

This is made of mild steel material. The whole part of the structure is mounted on this frame structure with suitable arrangement. It is having a tree like structure with branches. Each branch is strong enough to hold the turbine arrangement. Provisions are provided on the branches for the safe fixing of the turbine blades.

2.Turbine Blades

J type wind turbines are basically a drag type wind turbine. It is capable of producing electricity at low cost. The turbines that basically lift type are expensive and they are complex in construction. The turbine rotor consists of airfoil-shaped blades with constant chord length attached to a rotating vertical shaft. Unlike the more common savonious VAWT, darriues wind turbine uses lit forces generated by aerofoils to wind energy into rotational mechanical energy. Although this turbines have high efficiency they are having lower starting torque.

3.PV Solar Cells

PV cells are those which convert sunlight into electrical energy. When sunrays falls on the surface of the PV cells electrons and hole pairs are generated, this creates electricity. Here 9 pieces of mono solar cells are being used, with dimension 125x125mm. It is having an efficiency of 17.6%. It is a grade A monocrystalline silicon PV wafer.

4.Slip Rings

A slip ring is an electromechanical device that allows the transmission of power and electrical signals from a stationary to a rotating structure. A slip ring can be used in any electromechanical system that requires rotation while transmitting power or signal. It can improve mechanical performance, simplify system operation and eliminate damage-prone wires dangling from movable joints. Here slip rings are used to transmit power from the rotating solar cells. Electrical slip rings work by holding a sliding contact (brush) against a ring (conductor ring). One part, typically the brush, is stationary while the other, typically the conductor ring rotates.

5.Booster

A booster was a motor-generator set used voltage regulation in DC electrical power circuits. The development of AC and solid state devices has rendered it obsolete. Boosters were made in various configurations to suit different applications. Here we use 2 booster which can convert 12V to 14V. And also we use a booster of 14V to 35V.

Fig 1: Booster

6.Diode

A diode is a two-terminal electronic component that conducts current primarily in one direction. It has low resistance in the other. Here we are taking 1N4007 diode. A rectifier diode is used as a one-way check valve. Since these diodes allow electrical current to flow in one direction. They are used to convert AC power into DC power. When constructing a rectifier, it is important to choose the correct diode for the job. Otherwise circuit may become damaged.

Fig 3:Diode

7.Generator

A permanent magnet synchronous generator is a generator where the excitation field is provided by a permanent magnet instead of a coil. The term synchronous refers here to the fact that the rotor and magnetic field rotates with the same speed, because the magnetic field is generated through a shaft mounted permanent magnet mechanism and current is induced into the stationary armature. Synchronous generators are the majority source of commercial electrical energy. They are commonly used to convert the mechanical power output of steam turbines, gas turbines, reciprocating engines and hydro turbines into electrical power for the grid. Some design if wind turbines also use this generator.

4.Design Parameter

1.Kinetic energy

The kinetic energy of an object is the energy that it possesses due to its motion. It is defined as the work needed to accelerate a body of a given mass from rest to its started velocity.

K E = ½ρAV^3 ρ = Air density (1.225 Kg/m^3), A = Turbine swept area, V = Air velocity
For P = 10 watt, Efficiency of turbine = 0.25, Efficiency of generator = 0.85
P = 10/(0.25*O.85) = 47 watt
P = ½ρAV^3
A = 2P/(ρV^3) = 2*47/(1.225*6^3) = 0.36 m^2

2.Turbine Height
A = D*H
H = A/D =0.36/0.5 = 0.70m

3.Design of Turbine Blade
Wing width= diameter*0.14 = 0.5*0.14 = 0.07m
Wing chord = circumference*.09 = 3.14*0.5*0.09 = 0.14m

4.The Tip Speed Ratio
TSR = λ = (ω*D)/V
For savonius λ = 1
1 = (ω*0.5)/6 ω = 12 rad/sec

5.Speed Of Rotor
ω = (2*3.14*N)/60
N = 145Rpm

6.Solar cells
Area of one solar cell = 15.6$m^{,2}$
Total area (9 cells) = 140.4$m^{,2}$
Efficiency of solar cell= 17.6%

5.Working

In hybrid wind tree, power is generated by the wind turbine and the solar panel. The turbine attached to a generator. So when the wind rotates the turbine the generator attached to it also starts rotating. As soon as the generator starts rotating electricity is produced. The amount of electricity produced depends upon the intensity of the wind. The electricity produced is directed towards the booster where the voltage is stabilized by converting 12V DC into 14V DC. Then the current is then directed towards the diode (1N 4007 diode). The diode is provided in order to prevent the current entering back into the generator.

When sunrays falls on the surface of PV cell electrons and holes are generated at the PN junction as a result electricity is produced. These solar cells are placed on the outer surface of the turbine and hence they rotate along with the turbine. Since the solar cells are rotating the transmission of power generated is difficult. So in order to transmit the power generated we have introduced slip ring in to the system. The output of the solar cells is connected to the input of the slip ring. Slip ring is the stationary part. A slip ring is a method of making an electrical connection through a rotating assembly. And hence the transmission of power takes place. The power generated is directed towards the booster where it gets stabilized and amplified into 14 DC. This current is directed towards the diode which prevents the reverse flow of current back to the slip ring.

Both the current generated by the turbine and the solar is combined at a booster. In this booster 14V DC is converted 35V DC. This produced current can be directly used or can be stored in battery.

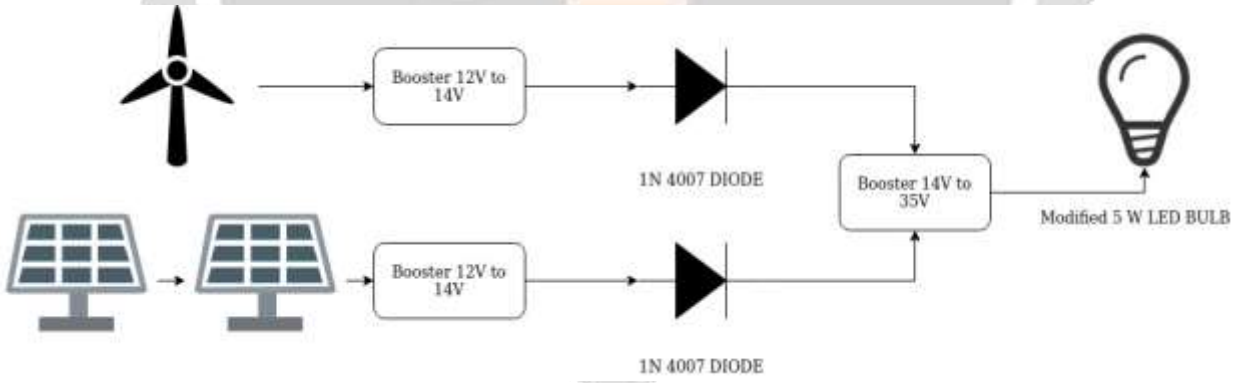

Fig 4: Schematic Diagram

6.Advantages And Disadvantages

1.Advantages

- Seasonal variations are offset.
- Less sound is produced during the rotation of the turbine.
- Increased power output than the ordinary system.
- Less maintenance.
- Energy is produced from solar and the wind at the same time.
- Wind turbine has low starting torque, hence it can rotate even with low wind speed.

- Pollution free

2.Disadvantages

- High initial cost
- Lesser efficiency than conventional power plant.
- Powers from the PV cells are not obtained during night time.

7.CAD Design

1.Frame

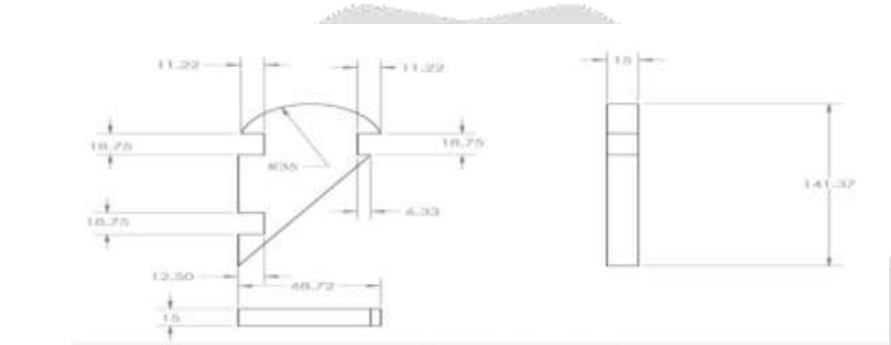

Fig 5

2.Turbine Blade

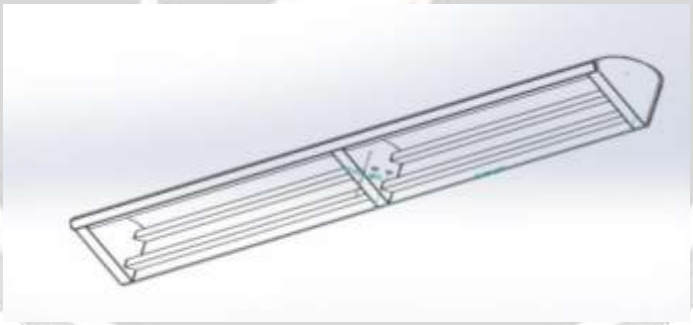

Fig 6

3.Hub design

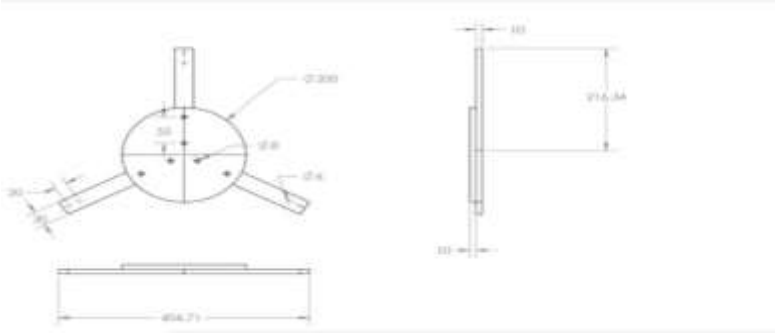

Fig 7

4.Shaft Coupling

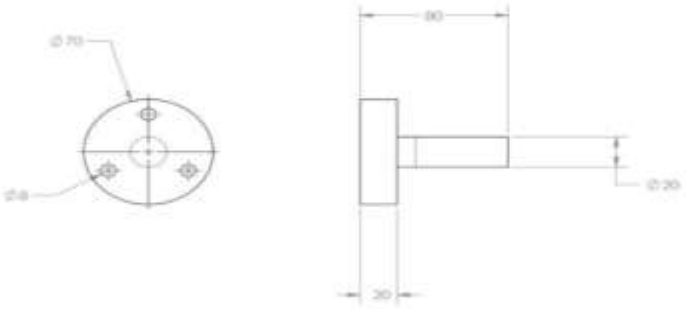

Fig 8

5Assembly

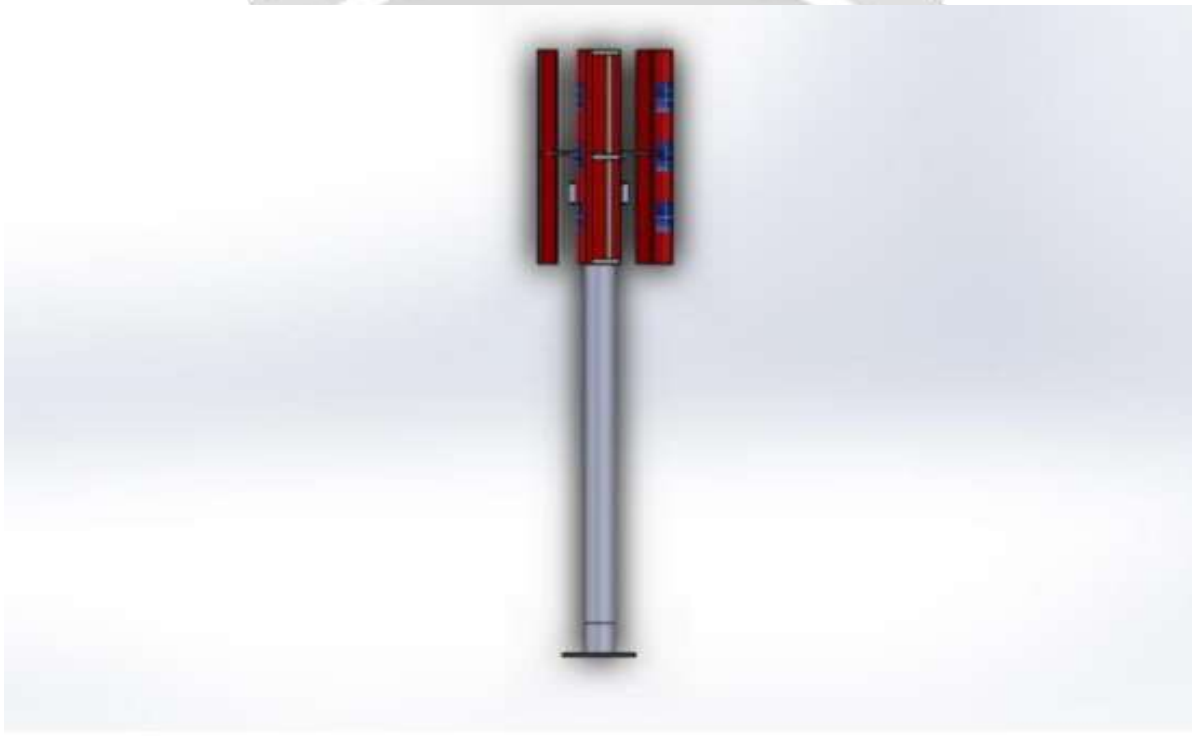

Fig 9

8.Conclusion

A strong multi discipline team with a good engineering base is necessary for the development and refinement of advanced computer programming, editing, techniques, diagnostic software, algorithms, for the dynamic exchange of informational different levels of hierarchy.

This project work has provided us an excellent opportunity and experience, to use our limited knowledge. We gained a lot of practical knowledge regarding, planning, purchasing, assembling and machining while doing this project work.

We are proud that we have completed the work with the limited time successfully. The "DESIGN OF HYBRID WIND TREEE" is working satisfactory condition. We are able to understand the difficulties in maintaining the tolerances and also quality.

We have done to our ability and skill making maximum use of available facilities. In conclusion remark of our project work. Thus we have developed a "DESIGN OF HYBRID WIND TREE". By using more techniques, they can be modified and developed according to the application.

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