HYBRID POWER GENERATION (SOLAR AND WIND ENERGY)

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ABSTRACT

Today, the world is progressing at quit fast rate with the use of conventional source of energy. Now a day's electricity is most needed facility for the human being. All the conventional energy resources are depleting day by day and having disadvantages of using them are environmental pollution created by its use. So we have to shift from conventional to non-conventional energy resources. Many types of clean and renewable energy sources can be used in production of electrical energy. In this project the combination of two energy resources is takes place i.e. wind and solar energy. This process reviles the sustainable energy resources without damaging the nature. We can give uninterrupted power by using hybrid energy system. Basically this system involves the integration of two energy system that will give continuous power. Solar panels are used for converting solar energy into electricity and wind turbines are used for converting wind energy into electricity. This electrical power can utilize for various purpose. Generation of electricity will be takes place at affordable cost. This project deals with the generation of electricity by using two sources combine which leads to generate electricity with affordable cost without damaging the nature balance.

Keywords: *Electricity, hybrid, solar, power, wind.*

1. INTRODUCTION

There are two ways of electricity generation either by conventional energy resources or by non-conventional energy resources. Now a day's 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. In these project used a VAWT instead of HAWT. Hence these project is based on the combination of two energy source wind and solar.

Hybrid energy system:

Hybrid energy system is the combination of two energy sources for giving power to the load. In other word it can defined as "Combination of two or more renewable energy source used together to provide increased system efficiency well as greater balance in energy system." Hybrid energy system has good reliability, efficiency, less emission, and lower cost.

Project Objectives:

- The main objective of this project is to provide an alternative power solution for remote locations such as research areas and small villages.
- The system can be used as a temporary power solution for locations affected by natural disasters.
- In order to reach these objectives the product must be low cost and easy to manufacture.
- To utilized free energy sources to generate electricity.
- To use VAWT (vertical axis wind turbine) instead of HAWT (horizontal axis wind turbine).
- Construct and manufacture prototype model

Reaching the non-electrified rural population is currently not possible through the extension of the grid, since the connection is neither economically feasible, nor encouraged by the main actors. Further, the increases in oil prices and the unbearable impacts of this energy source on the users and on the environment, are slowly removing conventional energy solutions, such as fuel genets based systems, from the rural development agendas. This problem can overcome by using "HYBRID POWER GENERATION USING SOLAR AND WIND ENERGY". Hybrid systems have proved to be the best option to deliver "high quality" power

2. LITERATURE SUREVEY

For our project we are surveying some reports and references which are helping us to make it easy and simplest and they are as follows

S. Jain, and V. Agarwal, "An Integrated Hybrid Power Supply for Distributed Generation Applications Fed by Nonconventional Energy Sources," in these chapter a review of the literature is suggested about the modern techniques use in a hybrid power generation, its control and monitoring. Also introduce to the equipment's for controlling the hybrid power generation [1].

A. O. Ciuca, I. B. Istrate, and M. Scripcariu, "Hybrid Power-Application for Tourism in Isolated Areas," in these chapter a review of the literature is suggested about the regulatory changes has brought increasing opportunities for distributed power generation at small scale for meeting the requirements of a single house, a community, a commercial activity in an efficient way close to the point of demand than main grid connected to a large centralized power plant [2].

Non-conventional energy sources by smt. C. K. Rai, in these chapter a review of the literature is taken about how the actual hybrid power plant is being constructed in large scale, as it is very easy to set up a hybrid power plant [3].

Ahmed et al., "Power Fluctuations Suppression Of Stand-Alone Hybrid Generation Combining Solar Photovoltaic/Wind Turbine And Fuel Cell Systems, Energy Conversion," in these chapter a review of the literature is taken about a hybrid system model that included fuel cell generation along with wind and solar power. The fuel cell system was used as a backup resource, where as the main energy sources were the solar and wind systems. Results demonstrate that the system is reliable and can supply high-quality power to the load, even in the absence of wind and sun [4].

Deshmukh and Deshmukh, "Modeling of hybrid Renewable Energy Systems", Renewable and Sustainable Energy Reviews, in these chapter a review of the literature is discussed about methods of modeling and designing hybrid renewable energy systems, and also issues involved in increasing the penetration of such systems [5].

Yang et al., "Weather data And probability analysis Of hybrid photovoltaic-wind power generation systems" in these chapter a review of the literature is taken about the development of a hybrid wind/solar system which are used to calculate optimized combinations of PV module, wind turbine design of a hybrid power generation system, with the objective of maximizing power, while minimizing cost [6, 7].

Tina et al., "Hybrid solar/wind power system probabilistic modelling for long-term performance assessment", in these chapter a review of the literature is taken about assessed the long-term performance of a hybrid wind/solar power system for both standalone and grid-dependent applications by using a probabilistic approach to model the uncertain nature of the load and resources [8].

Celik, "Techno-Economic Analysis Of Autonomous PV-Wind Hybrid Energy Systems Using Different Sizing Methods", in these chapter a review of the literature is taken about a novel method of sizing hybrid wind/solar energy systems using battery storage that includes as design parameters both the fraction of time that the system can satisfy the load and the cost of the system [9].

From the above literature review we are getting the ideas about various methods which are usefully o our project and these ideas help us to make our project well.

3. CONSTRUCTION:

For construct of the hybrid energy system we need the following part. Figure 3.1 shows the block diagram of the hybrid power generation system using wind and solar power. This block diagram includes following blocks.
3.1 Solar power system 3.1 Wind power system 3.1 Charge controller 3.1 Battery Bank 3.1 `Grid

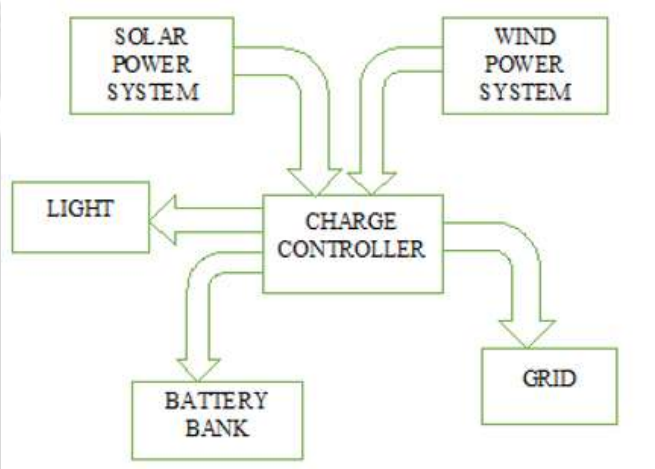

Figure 3.1 Block Diagram of Hybrid Power Generation

3.1 Solar power plant

Solar panel is use to convert solar radiation to the electrical energy. When the PV cell absorbs light, the energy of absorbed photon is transferred to the electron-proton system of the material, creating charge carriers that are separated at the junction. The charge carriers in the junction region create a potential gradient, get accelerated under the electric field, and circulate as current through an external circuit. Solar array or panel is a group of a several modules electrically connected in series parallel combination to generate the required current and voltage. Solar panels are the medium to convert solar power into the electrical power.

Figure 3.2 Solar panel

3.2 Wind power plant

In construction of wind power plant wind turbine, chain and sprocket, gear box, DC generator, shaft take very important role.

3.2.1Wind turbine

Wind turbine is that system which extracts energy from wind by rotation of the blades of the wind turbine. Basically wind turbine has two types one is vertical and another is horizontal. As the wind speed increases power generation is also increases. The power generated from wind is not continuous its fluctuating. For obtain the non-fluctuating power we have to store in battery and then provide it to the load.

Figure 3.3 Actual wind turbine

3.2.2 Chain and sprocket

A sprocket or sprocket-wheel is a profiled wheel with teeth, cogs or even sprockets that mesh with a chain, track or other perforated or indented material. The name 'sprocket' applies generally to any wheel upon which radial projections engage a chain passing over it. It is distinguished from a gear in that sprockets are never meshed together directly, and differs from a pulley in that sprockets have teeth and pulleys are smooth.

Chains have a surprising number of parts. The roller turns freely on the bushing, which is attached on each end to the inner plate. A pin passes through the bushing, and is attached at each end to the outer plate. Chains omit the bushing, instead using the circular ridge formed around the pin hole of the inner plate.

Figure 3.4: Chain and sprocket

3.2.3 Gear box

A gear is a wheel with teeth around its circumference. Gears are usually found in sets of two or more, used to transmit rotation from the axis of one gear to the axis of another. The teeth of a gear one axis mesh with the teeth of a gear on another, thus creating a relationship between the rotations of the two axes. When one axis is spin, the other will too. Two gears of different sizes will make their two axes spin at different speeds, which you'll learn about, along with different types of gears and places they're used.

Spur gears are most common type of gear. They have straight teeth, and are mounted on parallel shaft .Spur gear are regularly used for speed reduction or increase, torque multiplication. They are most useful component of transmission because variation in counter shaft and main shaft torque is depend upon gear ratio.

Figure 3.5 Gear box

3.2.4 DC generator

Dc generator is a electrical machine that converts mechanical energy into an electrical energy. The principle is that whenever flux is cut by conductor, an emf is induced which will cause a current flow if the conductor circuit is closed.

3.3 Charge controller

Charge controller has basic function is that it control the source which is to be active or inactive. It simultaneously charge battery and also gives power to the load. The controller has over-charge protection, short-circuit protection, pole confusion protection and automatic dump load function. It also the function is that it should vary the power as per the load demand. It add the both the power so that the load demand can fulfill. And when power is not generating it should extract power from battery and give it to the load.

3.4 Battery Bank

We have to choose battery bank size per the load requirement so that it should fulfill the requirement of load.

4. WORKING

To better understand the solar wind hybrid system, we must know the working of solar energy system and wind energy system.

4.1 Solar power system

Solar energy is one of the major renewable energy source that can consist of three major block namely solar panel, solar photovoltaic cell, battery. The electrical energy generated using solar panel can be stored in battery or directly used for equipment.

Solar panel works by allowing photons, or particles of light, to knock electron free from atoms, generating a flow of electricity. Solar panels actually comprises many, smaller units called photovoltaic cells. Many cells linked together make up a solar panel. Each photovoltaic cell is basically a sandwich made up of two slices of semi conducting

material, usually silicon. To work photovoltaic cell need to establish an electric field. Much like a magnetic field, which occur due to the opposite poles, an electric field occurs when opposite charges are separated. To get this field, manufacturers dope silicon with other materials, giving each slice of the sandwich a positive or negative electrical charge. Specifically, they seed phosphorous into the top layer of charges silicon, which add extra electron, a negative charge, to that layer. Meanwhile, the bottom layer gets a dose of boron, which result in fewer electron, or a positive charges. This all adds up to an electric field at the junction between the silicon layers. Then, when photons sunlight knocks an electron free, the electric field will push that electron out of the silicon junction. A couple of other component of the cell turn these electron into usable power. Metal conductive plates on the side of the cell collect the electron and transfer them to wires.

4.2 Wind power system

Wind energy is also one of the renewable energy source that can used for generating electrical energy with wind turbine coupled with generator. These system mainly consist of wind turbine, gear box and dc generator. Overall, when the wind is blowing, turbine are rotate, emf is induced which will cause a current flow. When shaft is rotate mechanism is rotate because mechanism is fixed on shaft. These rotary motion is converted into maximum rpm of the gear box, the generator is directly connected to the gear box, which is directly converted into electrical energy or give the output.

5. PROCEDURE/FABRICATION/SETUP

In the procedure of project fabrication we work as following ways:

5.1 Shaft making

VAWT are set up on the main shaft which is set vertically. This arrangement allows the generator and gear box to locate closed to the ground. Shaft is mechanical component for transmitting torque and rotation, usually used to the connect other component that cannot be connected directly because of distance or the need to allow for relative movement between them. As torque carriers, drives shaft are subject to torsion and shear stress, equivalent the difference between the input torque and the load. They must therefore be strong enough to bear the stress, whilst avoiding too much additional weight as that would in turn increase their inertia**.**

5.2 Wind Blades Setup

When selecting the blades for a wind turbine there are some important factors that must be considered in order to ensure durability safety and performance. The first important factor is the material of the blade. That several types of materials used in small wind blades such as aluminum, carbon fiber, plastic and even PVC. PVC is not considered a good choice for blades since they can fracture and even explode at high wind speeds. Iron is considered a good material, however, most of the Iron plates available in the market have a large pitch.

5.3 Wind Blades Size Setup

Mainly two types of wind turbine VAWT(vertical axis wind turbine) and HAWT(horizontal axis wind turbine) but in these project we decided to use vertical axis wind turbine. Some advantages of vertical axis wind turbine over the horizontal axis wind turbine are:

- They are Omni directional and do not need to tract the wind. This means they do not required a complex mechanism.
- The gear box of VAWT takes much less fatigue than that of HAWT.
- VAWT can be grouped more closely in wind farms, increasing the generated power per unit of land area.
- VAWT can be installed on a wind farm below the existing HAWT; this will improve the efficiency of the existing farm.
- Low production cost as compared to the HAWT.
- 6. Easy installation and easy to transport from one place to other.

5.4 Gear box

The gearbox and the lead screw can be considered to be the system's tower heart. The combination of these two components make it possible for energy to be transduced from rotational to linear. The gearbox and lead screw which was used in the Wind and Hybrid Power System was sourced from a German company called Keterrer Gears. The gearbox chosen (Bevel Gear 4808) has a 1:4 gear ratio, meaning that for every 1 input rotation there are 4 output rotations. This is of advantage as it will would take less time to crank the tower to full extension in a smaller amount of time. According to the manufacturers, the gearbox has max static traction load and max static pressure load of 800 N and 10000 N, respectively.

Gears are a very useful type of transmission mechanism used to transmit rotation from one axis to another. As mentioned previously, you can use gears to change the output speed of a shaft. . Say you have a motor that spins at 100 rotations per minute, and you only want it to spin at 50 rotations per minute. You can use a system of gears to reduce the speed (and likewise increase the torque) so that the output shaft spins at half the speed of the motor. Gears are commonly used in high load situations because the teeth of a gear allow for finer, discrete control over movement of a shaft, which is one advantage gears have over most pulley systems. Gears can be used to transmit rotation from one axis to another, and special types of gears can allow for the transfer of motion to non-parallel axes.

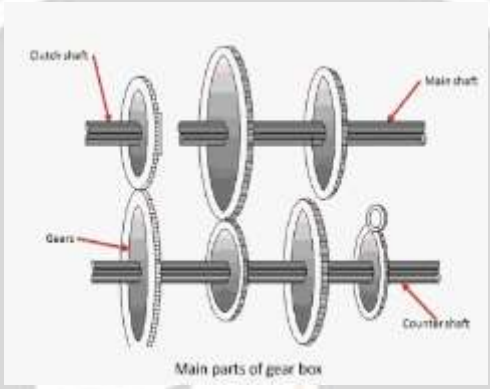

Figure 5.1 Internal structure of gear box

Figure 5.2 Actual overview of the project

6. CALCULATIONS

6.1 Calculation for wind power plant:

When wind turbine start to rotate,
Number of revolutions obtained = 1
Average output Voltage = 12 V
Average output current = 0.15 Amp
Total power generation
When wind turbine start to rotate,
Number of revolutions obtained = 1
For 1 revolution, electricity generated = 12 V, 0.15 Amp
∴ For 1 revolution = 12 V x 0.15 Amp = 1.8 W
Consider, in one minute 5 times wind turbines are rotated = 1.8 x 5 = 9 Watt
∴ In 1 hour = 9x 60 = 540 watt
Consider that in a day, door is operated for 16 hours
∴ Power generated in a day = 540x 16 = 5760 watt = 5.76 KW.

6.2Calculation for solar power plant:

Maximum power of the solar panel is = 3W
Rated voltages=8.95 V
Rated current=0.34A
Therefore, generation can be obtained from solar power plant is 3.043W/min.
We are getting the following result:

1. 1.5 to 2.5 KW generation can be obtained from wind turbine power plant.
2. 6W/Min, 11.2V generation can be obtained from the solar power plant.

Overall, output obtained from these project is 7.8W

7. ADVANTAGES AND DISADVANTAGES

7.1 Advantages:

1. It is reliable, pollutant free process because use of wind power electricity and solar power electricity can cut our carbon footprint (the total amount of greenhouse gases used to support human activity) because it doesn't release any harmful gases or pollutants in the process of generating electricity.
2. The use of wind energy and solar energy can cut our electricity bills because wind and solar energy is free, and thus, after the payment for the initial installation, electricity costs will be reduced. These process is easy to installation, longer life.
3. We can store energy even on a calm day. If our houses are not connected to the National Power Grid, we can store the excess electricity produced from the hybrid power plant in batteries and use it when there is no wind or sunlight.
4. Since wind energy production in West Texas tends to be higher in winter and spring, and solar is highest in summer months, seasonal fluctuations in energy supply tend to even out when the two sources are combined in an integrated system.
5. As compared to the HAWT, VAWT required low altitudes and low velocity air flow.
6. In these project we used vertical axis wind turbine, accept the wind from any angle.
7. Low maintenance cost.

7.2 Disadvantages :

1. Initial investment is more
2. Periodic maintenance.

8. CONCLUSION

From these Project we conclude that, vertical wind turbine have a large base of application in power production. Hybrid power generation system is good and effective solution for power generation than conventional energy resources. It can provide to remote places where government is unable to reach. So that the power can be utilize where it generated so that it will reduce the transmission losses and cost. Cost reduction can be done by increasing the production of the equipment. People should motivate to use the non-conventional energy resources. It is highly safe for the environment as it doesn't produce any emission and harmful waste product like conventional energy resources. It is cost effective solution for generation. It only need initial investment. It has also long life span. Overall it good, reliable and affordable solution for electricity generation.

9. FUTURE SCOPE

This hybrid power generation at small level that help to construct hybrid generation plant with a minimum cost with highest generating capacity. In past days vertical axis wind turbine had to be start by giving the excitation, our project aspect is to make self-starting wind turbine and another is that to reduce the power fluctuation due to the uneven wind. So that we get constant power supply.

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