



e-ISSN: 2319-8753 | p-ISSN: 2320-6710

IJRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 10, Issue 5, May 2021

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 7.512

9940 572 462

6381 907 438

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A Review on Design and Fabrication of Solar Wind Hybrid Power Generation System

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ABSTRACT: In today's technology driven world electricity is one of the foremost things for our day to day life activities. As we all are oblivious of the fact that the renewable sources of energy are depleting at a lightning fast rate. So it's time for us to shift the focus from conventional to non-conventional sources of energy to produce electricity. The output of the electricity produced by non-conventional sources is less than their counterparts. Renewable sources do not have any detrimental effect on the environment. Solar-wind hybrid system is basically an integration of solar plant and a wind energy plant. It will help in providing the uninterrupted power supply. As during bad weather conditions the production can be shifted from one plant to other with the help of a microcontroller. A microcontroller ensures the optimum utilization of resources and it also increases the efficiency of the combined system as compared to the individual mode of generation.

KEYWORDS: Solar Energy, Wind Energy, PV Cell, Renewable Energy, Hybrid Power System, Electricity.

I. INTRODUCTION

We require electricity for operating almost all the appliances we use in our day to day life. So it has become an indispensable part of our life. Now there are two ways to produce electricity first by using non-renewable sources of energy and second by renewable sources of energy. With increase in population and advancement of technology, consumption of electricity is also increasing exponentially. Simultaneously, we have to increase the production of electricity also in order to meet the demands of growing population. The biggest disadvantage with the usage of conventional resources is that their usage causes pollution due to the production of various pollutants like ash in case of a coal power plant, smoke in case of diesel power plant, radioactive material in case of nuclear power plant. Maintaining these pollutants is not an easy task and it also requires a lot of money. So we have to find some other methods to produce electricity. The best possible way is by using non-conventional sources of energy. Out of all the possible options available in non-conventional sources of energy, solar and wind are the best methods. As tidal energy can be used only on the sea shores, ocean thermal energy can be used in the middle of the sea and its setup is also very difficult. While solar and wind are available in all the areas of the world and setting up their power plant is also a cumbersome task. The availability of solar energy is a major concern, as it is available for around 8 hours in a day; on the other hand wind is available almost for 24 hours. But we can do one thing to make up for that problem by integrating these two together. During foul weather conditions one of them can be used while during normal weather both can be operated together.

Renewable energy sources provide clean energy which is present in a sufficient amount on the earth. These renewable sources are obtained from earth, water, sun, plants etc. These sources are widely used for power generation. Solar and wind power generation is an attractive source because they are eco-friendly. Hybrid system is a mixture of different renewable energy sources like solar energy, biomass power, wind etc. In the Hybrid power generation the generated power is firstly stored in the battery and then it is used to fulfil the demand of energy. Nowadays wind and solar energy systems are growing with a great speed and conventional energy sources are depleting day by day and it is going to vanish in coming years. So we have to search a new energy source which is pollution free, easily available. Sunny days the energy is provided by the sun while on cloudy days the power is supplied by the wind system.



II. RELATED WORK

By using solar arrays, a series of solar cells electrically connected, a DC voltage is generated which can be physically used on a load. Solar arrays or panels are being used increasingly as efficiencies reach higher levels, and are especially popular in remote areas where placement of electricity lines is not economically viable. This alternative power source is continuously achieving greater popularity especially since the realisation of fossil fuels shortcomings. Renewable energy in the form of electricity has been in use to some degree as long as 75 or 100 years ago. Sources such as Solar, Wind, Hydro and Geothermal have all been utilised with varying levels of success. The most widely used are hydro and wind power, with solar power being moderately used worldwide. This can be attributed to the relatively high cost of solar cells and their low conversion efficiency. Solar power is being heavily researched, and solar energy costs have now reached within a few cents per kW/h of other forms of electricity generation, and will drop further with new technologies such as titanium oxide cells. With a peak laboratory efficiency of 32% and average efficiency of 15- 20%, it is necessary to recover as much energy as possible from a solar power system. This includes reducing inverter losses, storage losses, and light gathering losses. Light gathering is dependent on the angle of incidence of the light source providing power (i.e. the sun) to the solar cell’s surface, and the closer to perpendicular, the greater the power.

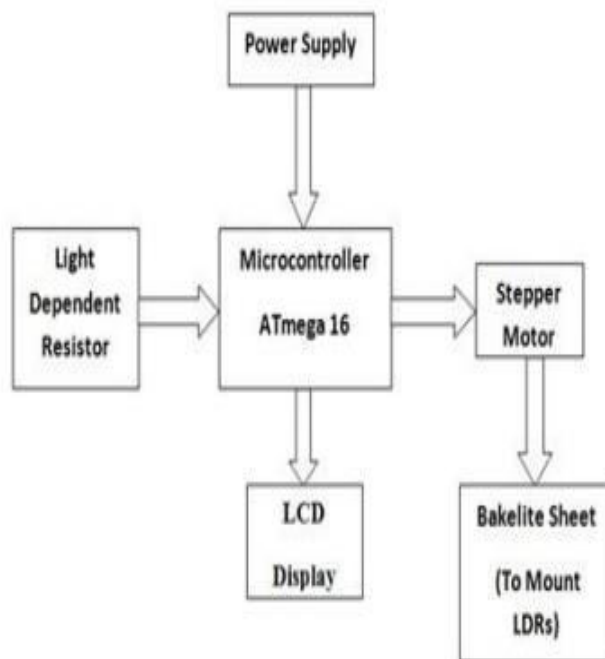


Fig: Block Diagram of Solar Tracking System

Methods of Tracker Mount

- Single axis solar trackers :

Single axis solar trackers can either have a horizontal or a vertical axle. The horizontal type is used in tropical regions where the sun gets very high at noon, but the days are short. The vertical type is used in high latitudes where the sun does not get very high, but summer days can be very long. The single axis tracking system is the simplest solution and the most common one used.

- Double axis solar trackers:

Double axis solar trackers have both a horizontal and a vertical axle and so can track the Sun's apparent motion exactly anywhere in the World. This type of system is used to control astronomical telescopes, and so there is plenty of software available to automatically predict and track the motion of the sun across the sky. By tracking the sun, the

efficiency of the solar panels can be increased by 30-40%. The dual axis tracking system is also used for concentrating a solar reflector toward the concentrator on heliostat systems.

III. METHODOLOGY

The global need to conserve the planet, energy and satisfy the continuous demand for electrical energy generation has led us to explore new sources of sustainable energy such as solar and wind as well as other sustainable energy sources.

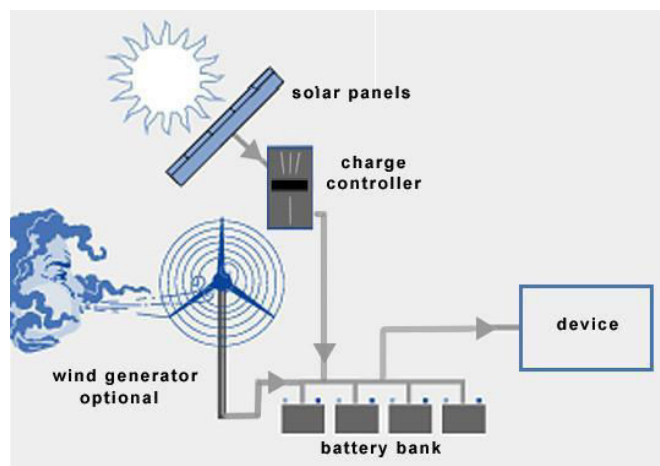


Fig: Schematic of a photovoltaic Hybrid System.

The photovoltaic wind hybrid system as shown in Figure 1, is a system that can be integrated into two or more renewable sources of energy (solar-thermal, geothermal, biomass, hydro etc.). Those systems are integrated to provide electricity or heat, or both, to supply the demand, and taking advantage of the availability of solar and wind energy, in places where these two sources of renewable energies are complementing to each other. Interested readers are advised to consult reference on the subject. The wind energy depends on the conditions of the wind and ambient conditions, the wind turbine is recommended where average annual wind speeds are higher than 6.5m/s at a height of 50m. On the other hand, photovoltaic energy has been one of the renewable energy sources with rapid technological growth. It has been reported that its annual production of solar panels grew tenfold from 1990 to 2003 (50 MW to 500 MW), and is in constant growth. The function of the photovoltaic solar panel is simple; solar panels receive solar radiation form of light and thus generate a potential difference at its ends in the form of continuous current. These panels are normally connected in parallel or series depending on the power and load requirements.

It should be noted that a hybrid system such as solar/wind hybrid must have load/charge controller which controls the wind turbine and solar panel at the same time and allows the conversion and transformation of wind and solar energies into electrical energy and consequently, stores this electrical energy in the batteries bank. It should be also noted that the driver of the hybrid Wind/Solar is the most important part in the out-of-network system, due to the control that allows the operation of all the hybrid system. This paper is intended to discuss the construction and implementation of a system for the measurement of electrical power parameters such as amperage and voltage of the hybrid system; photovoltaic solar-wind, to evaluate and analyze the system performance.

With the rapid increase in population and economic development, the problems of the energy crisis and global warming effects are today a cause for increasing concern. The utilization of renewable energy resources is the key solution to these problems. Solar energy is one of the primary sources of clean, abundant and inexhaustible energy that not only provides alternative energy resources, but also improves environmental pollution.

Solar tracking is the most appropriate technology to enhance the electricity production of a PV system. To achieve a high degree of tracking accuracy, several approaches have been widely investigated. Generally, they can be classified as either open-loop tracking types based on solar movement mathematical models or closed-loop tracking types using sensor-based feedback controllers. In the open-loop tracking approach, a tracking formula or control algorithm is used. Referring to the literature, the azimuth and the elevation angles of the Sun were determined by solar movement models or algorithms at the given date, time and geographical information.

The control algorithms were executed in a microprocessor controller. In the closed-loop tracking approach, various active sensor devices, such as charge couple devices (CCDs) or light dependent resistors (LDRs) were utilized to sense the Sun's position and a feedback error signal was then generated to the control system to continuously receive the maximum solar radiation on the PV panel. Solar tracking approaches can be implemented by using single-axis schemes, and vertical axis structures for higher accuracy systems. In general, the single-axis tracker with one degree of freedom follows the Sun's movement from the east to west during a day while a single-axis tracker also follows the elevation angle of the Sun. In recent years, there has been a growing Volume of research concerned with vertical axis solar tracking systems.

Furthermore, such systems always involve complex tracking strategies using microprocessor chips as a control platform. In this work, employing a vertical axis with only single tracking motor, an attempt has been made to develop and implement a simple and efficient control scheme. The two axes of the Sun tracker were allowed to move simultaneously within their respective ranges. Utilizing conventional electronic circuits, no programming or computer interface was needed. Moreover, the proposed system used a stand-alone PV inverter to drive motor and provide power supply. The system was self-contained and autonomous. Experiment results have demonstrated the feasibility of the tracking PV system and verified the advantages of the proposed control implementation.



Fig: wind turbine

Electricity has helped in reducing physical efforts to a very large extent, but, the way in which it is produced is quite a matter of concern. Even today, most of the electricity that we use is produced through conventional methods. These conventional methods commonly use fossil fuels to produce electricity. Not only are these methods expensive, but also cause grave damage to the environment. The use of fuels for the generation of electricity results in increased costs and emissions of hazardous pollutants. The only alternative is a new method that is not only cheap and efficient, but also eco-friendly.

The Solar Tracking - Vertical Axis Wind Turbine System is capable of satisfying both these requirements. In addition to being eco-friendly, it is also relatively cheaper when compared to the conventional methods of electricity generation. This turbine uses both Solar and Wind Energies to generate electricity. So, we have two efficient and inexhaustible sources for uninterrupted generation of electricity. The system has two basic components – one for generation of electricity through Solar Energy and another one for generation from Wind Energy. Even in the case of absence of either of the two sources, the other remaining source could be used to supplement the absence of the former. Due to all these features, the Solar-Vertical Axis Wind Turbines could be considered suitable for replacing the existing old means of electricity generation.



Because, not only are they cheaper, but also economic and highly efficient. These turbines are gaining ground day by day and hopefully will be helpful in making us achieve the long sought-after goal of green and clean energy.

Merits of Solar Energy

- It is a Non-Conventional Fuel energy source.
- The Sun is a universal source and it cannot diminish.
- Free from Pollution.
- Cost of fuel is free.
- It is a reliable one

Now-a-days in India the central part is found to have generation of electricity by using renewable energy resources such as coal, gas, oil, water or nuclear as fuel in primary order. The usage of coal and nuclear substrate in primary manner produces risk and creates the dangerous impact over environment. Hence use of hybrid combination of solar and wind combination gives the account of better environment and reduce the usage of existing fossil fuels. Again the standalone system such as wind or solar system can't produce the energy all the time. Hence energy should be generated with the help of combination of renewable energy resources.

The hunger of electricity developed by various areas across the world has been simulated by using renewable way thereby great variety of grid power supply. About 30,000 wind turbines and 1, 00,000 off-grid solar PV panels are installed all over the world. The technical feasibility of PV wind hybrid system in given range of load demand was evaluated and economical evaluation of standalone PV, standalone wind and PV wind hybrid system have been developed using the model. It offers generation of power in rural areas. Hybrid model with proper assembly is keen interest for recent years.

To generate the electricity with the help of VAWT (Vertical axis wind turbine). The VAWT is use for generate the 10watt D.C. power & LED is turn on. A VAWT does not need to be oriented into the wind, the power transition mechanisms can be mounted at ground level for easy access. For generating the power it is depend on the velocity of the wind. But we assured that VAWT is generating the fixed D.C. output which is depending on the velocity of the wind.

IV. EXPERIMENTAL RESULTS

The aim of our topic is to present a solar energy collection technology by a photovoltaic cell. To present this efficient solar distributed generation system, a dual-axis solar tracker is designed. The tracker actively tracks the sun and changes its position accordingly to maximize the power output. The designed tracking system consists of sensors, microcontroller operated control circuits to drive DC motors and gear- bearing arrangements with supports and mountings. Two geared dc motors are used to move the solar panel so that sun's beam is able to remain aligned with the solar panel.

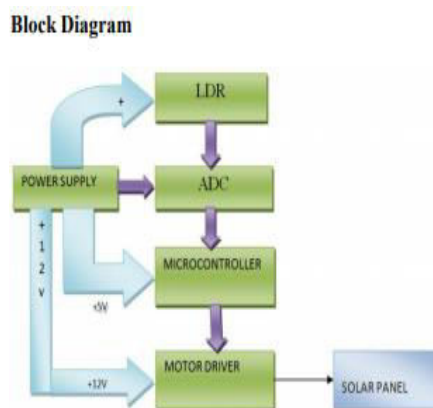


Fig: Automatic dual axis solar tracking system



Why we go for Solar Energy :

Generally we can generate power in two ways

- Conventional Fuels.
- Non Conventional Fuels.

Due to the excessive usage of conventional fuels there has been depletion in our natural resources. According to the scales, fuels like coal will last approximately for about 100 years and petrol and diesel for about 15 years. Therefore the future power depends entirely on Non Conventional Fuels. Under the category of Non-Conventional Fuels we have are Solar, Wind, Ocean, Tidal, and Geothermal energy sources. The reason as to why we are choosing only solar energy in our project is because of its merits when compared to the other energy sources. 1) In India, the speed of the wind is only 15 to 20 km/hr. and also this is possible only at hilly and vast areas (remote areas) but still the conversion of wind energy to useful energy is economical. 2) For Tidal energy we require full moon and half-moon days. Also we can extract more amount of energy at full moon days because there are more tides on this day. This is because the Sun, the Moon, and the Earth come in a straight line on full moon day, while they are perpendicular on half-moon days. Moreover, we have 702 tides per year according to the scales. 3) For the Geothermal energy hot temperatures and rocky areas are needed. Even though it extracts huge amount of energy of about 88% compared to the other energy sources but the conversion efficiency is low of about 15%. 4) Keeping in view all these factors we consider solar energy to be the best option for power generation

V. CONCLUSION

Developing hybrid systems is one of the most convenient and effective solution for producing electricity as compared to non-renewable energy resources. It is not only less costly but also it does not cause any harm to the environment. Another thing is that it can be used to generate electricity in hilly areas, where it is quite difficult to transmit electricity by conventional methods. Depending on the requirement its setup can be decided. All the people in this world should be motivated to use non-conventional resources to produce electricity in order to make them self-reliable to some extent. Long life span, less maintenance is some of its plus point. It just requires some high initial investment.

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