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# Hybrid Power Generation By Using Solar & Vertical Axis Wind Turbine

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***Abstract—****A Renewable energy sources are seen as next generation source of energy for meeting rising energy demands and depleting fossil fuels. Solar, biomass, geothermal, hydro-electric and wind are the renewable which can produces a huge amount of power. The power from wind current can be extracted using a vertical axis turbine/horizontal axis turbine. Vertical axis turbine is capable of extracting power form wind regardless of the direction of flow. The solar PV cells absorb the radiation of sun and converting it into the electrical power. The wind mill is capable to extracted energy in day and night time while the solar PV cell is capable to get power only during day time. The combination of this hybrid system will be beneficial in future aspects. The objectives of this paper is „Hybrid power generation by using solar cell /solar energy and wind mill energy, with the help of solar tracking and vertical axis wind turbine". The VAWT (Vertical Axis Wind Turbine) can tap wind energy from any direction and VAWT are more profitable in nature. That why we have used the VAWT with solar tracking hybrid power generation. The vertical axis turbine has much better self- starting characters and better conversion efficiency at lower flaw speed. In this we are used Savonius type vertical axis turbine produce higher torque and have lower cut in speed. This paper deals with the hybrid power generation by using VAWT turbine and solar tracking.***

***Keywords—*** *Wind energy, Solar Energy, Hybrid Energy system, Converter circuit, Operation and Functioning.*

## I. Introduction

The demand of renewable energy sources has been increasing due to the rise in environmental pollution, increase in energy demand and due to depletion of fossil fuels. The concept of on-site renewable energy generation is to extract energy from renewable sources close to the populated area and also in ruler area where energy is required. A hybrid system consisting of wind and solar renewable sources is more beneficial than a system that only depends on one source of energy. Also power supply from a hybrid system is more stable and reliable. In addition, optimization of hybrid renewable energy system is crucial for researchers to maximize the energy output from the system with lowest cost and highest reliability.

The hybrid system has some beneficial advantages that why we have used these systems for power generation some as below:

- Supplying load demand under varying weather conditions.
- Overall costs for self-powered system may be reduced drastically.
- High reliability without backup power source.

Due to the advantages of a hybrid system and to further improve the performance of small wind turbine, this paper presents the urban Eco- Greenery hybrid wind- solar generation system. The design of the system is adopted from the larger building integrated Omni- Direction Guide-Vane (ODGV). The ODGV was originally designed to be installed on top of a high-rise building. Shrouding a Vertical Axis Wind Turbine (VAWT) that covers much of the roof area of the building. Hence, we are introducing a small scale Eco-Greenery hybrid wind-solar system that employs the ODGV integrated with VAWT and solar Photo Voltaic (PV) panel for on – site standalone energy generation. This minimizes the risks posed by the large scale system, and with reduced cost. This is achieved by using the control system have become cheaper and more advanced, new profiles for the rotor blades can extract more power from the win, and new power electronic equipment makes it possible to use variable speed and to optimize the capacity of the turbine.

## II. Solar Energy

Photovoltaic is a combination of two words photo means light and voltaic means electricity which is get by the radiation of the sun solar energy is present on the earth continuously. Solar energy is available freely it does not produce any gases or ash means it is free of pollution. It has low maintenance cost, only problem with solar system it cannot produced energy in bad weather condition, but has better efficiency than other energy source. It only need initial investment; it has long life span.

## III. Type of Solar Panel.

For the production of solar panels, we can distinguish two mainstream technologies:

**1. Monocrystalline Silicon**

The monocrystalline silicon solar cell is made of a large single crystal of pure silicon. This single crystal is mostly fabricated owing to the Czochralski method. It consists of melting high-purity, semiconductor-grade silicon having only a few parts per million of impurities in a crucible at 1425 degree Celsius. During this melting process, dopant impurity atoms such as boron (for p-type semiconductor) or phosphorus (for n-type semiconductor) are added to the molten silicon to dope the silicon; for PV-cells the preferred dopant is boron. The second step consists to dip a rod-mounted seed crystal into the molten silicon. The seed crystal has a well-defined crystal orientation. Next, the crystal's rod is carefully pulled out and rotated simultaneously. The temperature gradients, the pulling-rate and the rotation speed must be controlled precisely. Doing so results in the extraction of a large, single-crystal, cylindrical ingot from the melt. The melting process needs both, an inert atmosphere (e.g. argon) and an inert chamber (e.g. quartz). The disadvantages of the classical melting process are the very low speed and the energy intensive production costs. In addition the ingot must be sawed in order to produce thin solar cell wafer. This process is time-consuming and furthermore results in loss of valuable material. A lot of R&D effort is undertaken by the PV industry to improve the fabrication process.

**2. Multicrystalline Silicon**

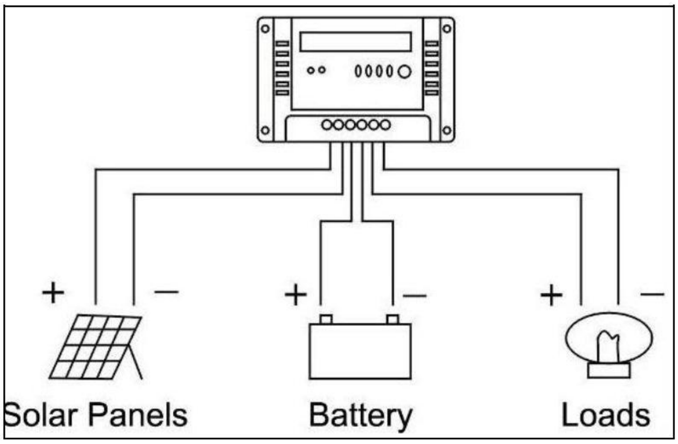
Multicrystalline silicon is also referred to as polycrystalline silicon or more simply poly-Si. Solar cells based on poly-Si are very similar to monocrystalline modules. The same theory applies; the main difference is the fabrication process. Poly-Si cells are fabricated from pure molten Si in a square-like tank; the cooling down is an essential step because it determines the grain size and the distribution of impurities. The obtained ingots are cut in bars with a cross-section of 15.6cm x 15.6cm; finally they are sawn to get thin wafers. This fabrication process gives life to a multi-grain crystal structure. Compared to monocrystalline Si, the structure is less ideal resulting in a loss of efficiency (of about 1% compared to mono-Si), but this drawback is overcome by lower wafer costs. A second advantage is the arrangement of the cell modules which are typically rectangular, rather than “pseudo-square” compared to mono-Si, so they can be packed very closely in the modules. The appearance of the poly-Si is distinctly blue due to the missing absorption of higher energy photons. In fact, these high energy photons from the upper part of the visible spectrum are back-reflected.

**3. Amorphous and thin film materials**

Thin film solar cells are also often called second-generation solar cells [5]. In this category fall amorphous Si-cells, CdTe cells and CIGS cells. CIGS stand for: Copper Indium Gallium Selenide. The huge advantage of these cells lies in the fact that only very little material is needed for their fabrication. The production processes are compatible with large surfaces that can be used with either flexible or rigid substrates; these properties result in a cost-effective solution for PV-cell production. In fact, thin film materials are able to efficiently absorb photons (with a up to 100 times higher absorption coefficient compared to mono- or poly-Si cells). Consequently, they need only a few micron thickness compared to about 200μm thickness required for the mono- or poly-Si to absorb all the photons having energy higher than the gap.

## IV. Solar Charge Controller

Basically the device used to control the voltage and current to charge the battery and protecting battery or cell from overcharging. It provides way to voltage and current from solar panels setting to the battery and load. Generally 12V panels output in the space of 16V to 20V,so if there is no change then the electric cell will damaged from overcharging so there is requirement is near to 14V to 14.5V to complete charge of cell or battery. So there are role and function of charge controller for protection.




**Fig(1):** Charge controller

## 1. TYPES OF SOLAR CHARGE CONTROLLER:

In solar power system the most commonly two types of charge controller are used.
A. Pulse Width Modulation (PWM)
B. Maximum power point tracking (MPPT)

### A. Pulse Width Modulation (PWM)

PWM charge controller provides constant voltage by switching the switches (MOSFET) to charging the battery. It adjusting the switching duty ratio of switches for current requirement, for battery charging it provides the current from solar panel tappers according to the battery’s condition and recharging needs. PWM system has the following advantages:

- Higher charging efficiency
- Longer battery life
- Reduced battery over heating
- Minimizes stress on the battery
- Ability to de-sulfate a battery

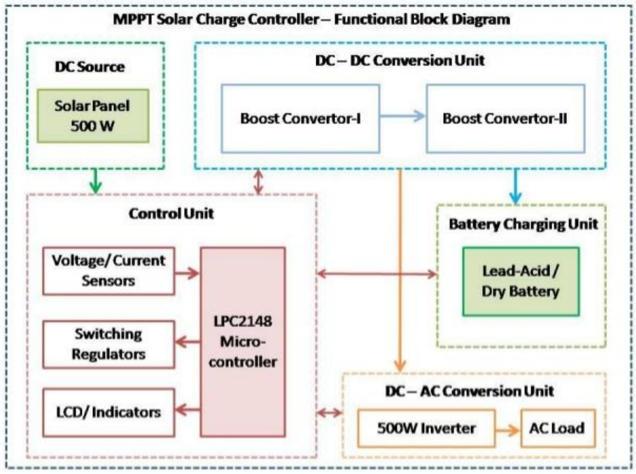
A PWM controller is not a DC to DC transformer. The PWM controller is a switch which connects the solar panel to the battery. When the switch is closed, the panel and the battery will be at nearly the same voltage.Units.

### B. Maximum Power Point Tracking (MPPT)

Nowadays, the most advanced solar charge controller available is the Maximum Power Point Tracking (MPPT). It is more sophisticated and more expensive. It has several advantages over the PWM charge controller. It is 30 to 40% more efficient at low temperature. The MPPT is based around a synchronous buck converter circuit. It steps the higher solar panel voltage down to the charging voltage of the battery.

It will adjust its input voltage to harvest the maximum power from the solar panel and then transform this power to supply the varying voltage requirement of the battery plus load. It is generally accepted that MPPT will outperform PWM in a cold temperature climate, while both controllers will show approximately the same performance in a subtropical to tropical climate.

The MPPT charge controller is a DC to DC transformer that can transform power from a higher voltage to power at a lower voltage. The amount of power does not change, therefore, if the output voltage is lower than the input voltage, the output current will be higher than the input current, so that the product P=VI remains constant. Hence, in order to get the maximum out of a solar panel, a charge controller should be able to choose the optimum current-voltage point on the current-voltage curve: the Maximum Power Point. An MPPT does exactly that. The input voltage of a PWM controller is, in principle, equal to the voltage of the battery connected to its output.
The solar panel, therefore, is not used at its Maximum Power Point, in most cases.




**Fig(2).**MPPT charge controller block dia.

## V. Methodology

Solar charge controller performs 4 major functions:

**1.** Charges the battery.

**2.** Gives an indication when battery is fully charged. Monitors the battery voltage and when it is minimum, cuts off the supply to the load switch to remove the load connection.

**3.** In case of overload, the load switch is in off condition ensuring the load is cut off from the battery supply. A solar panel is a collection of solar cells. The solar panel converts the solar energy into electrical energy. The solar panel uses Ohmic material for interconnections as well as the external terminals.

**4.** So the electrons created in the n-type material passes through the electrode to the wire connected to the battery. Through the battery, the electrons reach the p-type material. Here the electrons combine with the holes.

When the solar panel is connected to the battery, it behaves like other battery, and both the systems are in series just like two batteries connected serially. The solar panel has totally consisted of four process steps overload, under charge, low battery and deep discharge condition.

The out from the solar panel is connected to the switch and from there the output is fed to the battery. And setting from there it goes to the load switch and finally at the output load. This system consists of 4 different parts-over voltage indication and detection, over charge detection, over charge indication, low battery indication and detection. Incase of the over charge, the power from the solar panel is bypassed through a diode to the MOSFET switch. Incase of low charge, the supply to MOSFET switch is cut off to make it in off condition and thus switch off the power supply to the load.

## VI. Wind Energy

Wind is the simple are in motion. Today wind energy is mainly used to generate electricity. Wind energy is called a renewable energy source because the wind will blow as long as the sun shines. When the efficiency of wind turbine is increased the more power can be generated thus decreasing the need for expensive power generator that caused pollution This wind is free of cost power can be generated and stored by a wind turbine without pollution. If the efficiency of common wind turbine is improved and widespread. There are two type of wind turbine first is the horizontal axis wind turbine and second is the vertical axis wind turbine. The vertical axis wind turbine is purely operates based on the drag force, but in horizontal axis wind turbine, lift and drag force play the role to operate the wind turbine. The vertical axis wind turbine has less efficiency compare to the horizontal axis wind turbine, but it has high maintenance cost and investment cost to overcome this issues, become vertical axis wind turbine are the best choice for wind generation.

**Type of Wind Turbine**

Collecting wind energy in surrounding environment due to its advantages such ecofriendly, renewable nature and unlimited availability of wind source; for generation of electrical energy. The basic need for generating electrical energy from wind energy is that to rotate the turbine which coupled to generator with shaft with flow of wind. Turbine is the device which play vital role in wind mill generator. Turbine is the device which convert mechanical energy in the wind flow into electrical energy with generator. There are two types turbine configuration used in wind mill which is

1. Horizontal Axis Wind Turbine (HAWT),

2. Vertical Axis Wind Turbine (VAWT),
   - 2.1. Darrieus type of VAWT,
   - 2.2 Savonius type of VAWT.

## VII. Operation And Functioning

In this proposed solar and wind energy hybrid system is made the hybrid power obtained from the source are connected to a dc and stored in battery. Both output is uneven the rotation of the wind turbine may vary, it is depending on speed of air. The wind energy generation system is placed at middle of the straight light pole. Use of the light weight blades, can produced rotational motion at low wind. The solar output also depends on the intensity of the light. Flow chart of working of hybrid power system is shows below-

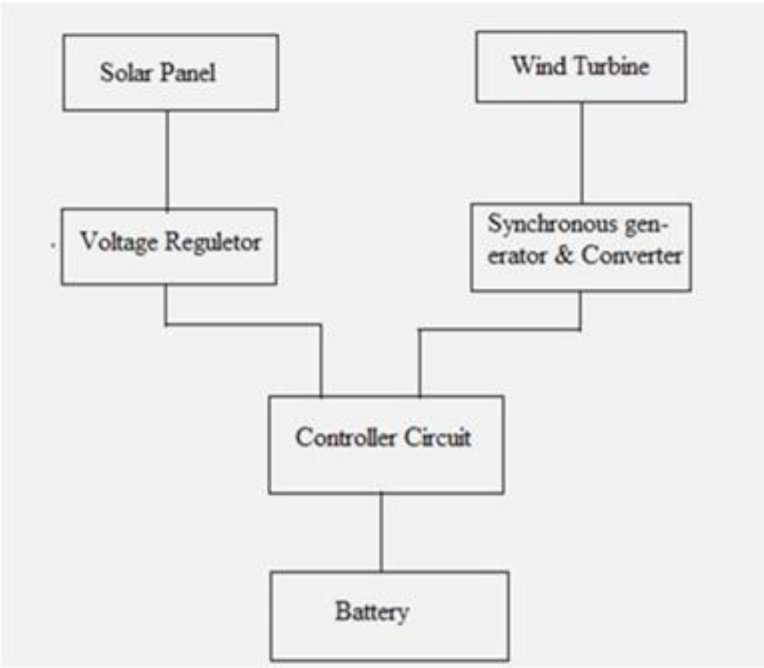



**Fig.(3)** Flow chart of working of hybrid power system.

## VIII. Objective And Scope Of The Project

- Social benefit: wind-solar hybrid streetlight is a high-tech environmentally friendly product. Installing the wind-solar hybrid streetlight is done, not only in conformity with the government's environmental protection concept, but also it reminds people to protect the environment.

- Economic benefit: It uses and produces power by itself. After the construction of a one-time investment, we can get a long-lasting benefit. Changing the traditional streetlight system laid on the underground cable power supply way saves a lot of manpower and financial resources.

## IX. Conclusions

Because of the somewhat complementary nature of the seasonal profile, the combination of wind and solar is better than each individually. It will get higher efficiency than individual systems. Vertical axis wind energy conversion systems are practical and potentially very contributive to the production of clean renewable electricity from the wind even under less than ideal sitting conditions. It is hoped that they may be constructed used high-strength, low- weight materials for deployment in more developed nations and settings or with very low tech local materials and local skills in less developed countries.

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