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Hybrid Power Generation by Solar & Vertical Axis Wind Turbine: A Review

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Abstract: 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. 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.

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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.

1. 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.

1.1. Darrieus Type of VAWT: Darrieus VAWT are generally known as an “Eggbeater” turbine due its shape looks like egg. It was invented by “Georges Darrieus” in 1931. It is a high speed low torque turbine. It consists vertically oriented two blades rotates around a vertical shaft. Due to shape and area it has high efficiency. But required external push for starting. So external arrangement is required for starting this turbine machine. Shape of turbine is shown in fig.1.

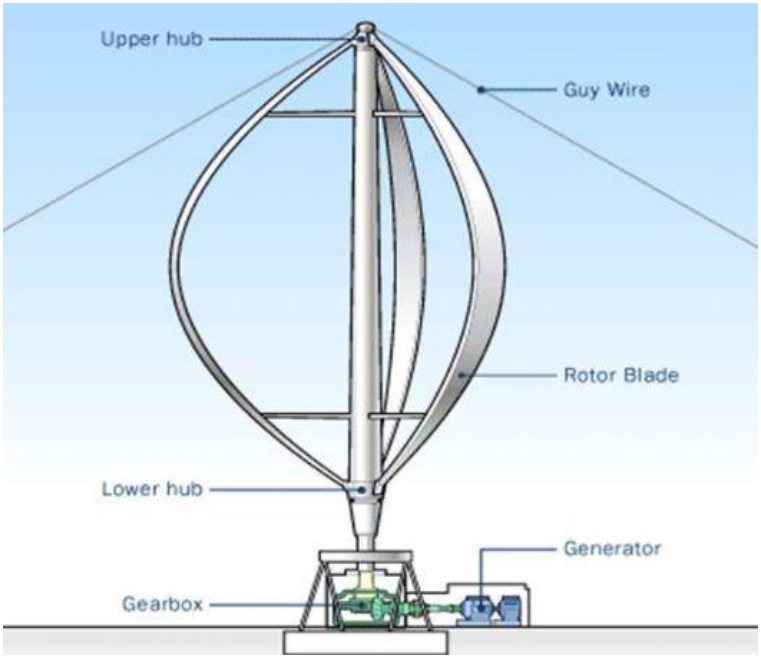

Fig .1 Darrieus type of VAWT

1.2 Savonius type of VAWT: Savonius turbine was invented by Finnish engineer S.J. Savonius in 1922. Its main advantage for selection are slow rotating and high torque turbine. It starts at low wind speed because it required very low starting torque. Another advantage is it work in both directions. Its construction is simplest in form of two cups or half drums fixed to a central shaft in opposition direction as per shown in fig.2. In operation process of this turbine the flow of wind strike on the cups of turbine it competing its rotation, this happen repeat manner and turbine start rotating. The direction of the wind flow doesn’t effect on operation of turbine. This rotating process we applied to drive generator for generation energy. In modern Savonius turbine generally use fluted blade devices, which have highly reliable and highly efficient with less jerk or vibration than twin cup or half drum turbine blade.

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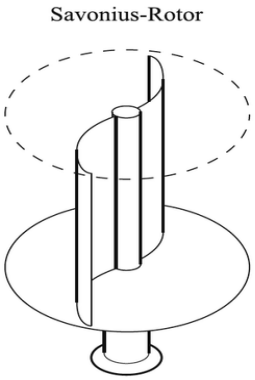

Fig.2 Savonius type of VAWT.

III. SOLAR ENERGY

Photovoltaic is a marriage 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 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.

Fig.3 Solar panel

- **Current Status:** In India a fast growing phenomenon of solar power as of 6 April, 2017. The country's solar grid has a cumulative capacity of 12.28 GW. Compared to 6.76 GW at the end of March 2016. India has a poor electrification rate in rural area. In 2015 only 55% of all rural area household has access to electricity an 85% of rural household depend on solid fuel for cooling. India is one of the countries with the higher solar electricity production per watt installed, with an installation of 1700 to 1900 kilowatt hours per kilowatt peak. With above 300 clear sunny days in year the theoretically calculated solar energy incidence in India's land area is about 6000 trillion kilowatt hours per year. The daily average solar power plant generation capacity over India is 0.20 KWH per $M^2$of used land area. Which is equivalent to about 1400-1800 peak capacity operating hours in a year with the available commercially proven technology.

IV. HYBRID ENERGY SYSTEM

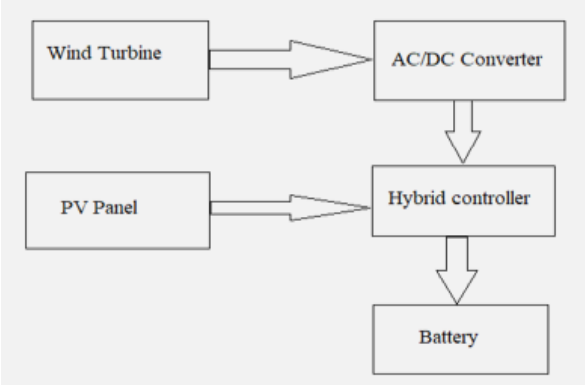

Fig.4 Block Diagram of Only Hybrid System

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Hybrid energy system is the combination of two or more sources for giving power to the load in other word it can define as energy system which is fabricated or designed to extract power by using two energy sources is called as the hybrid energy system. This system is good reliability, efficiency, less emission and low power cost. In our system or proposed system solar and wind power are used for generation of power. Solar and Wind has many advantages of other than non-conventional energy source both the solar wind energy sources have greater availability in all areas.

- **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.

- **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-

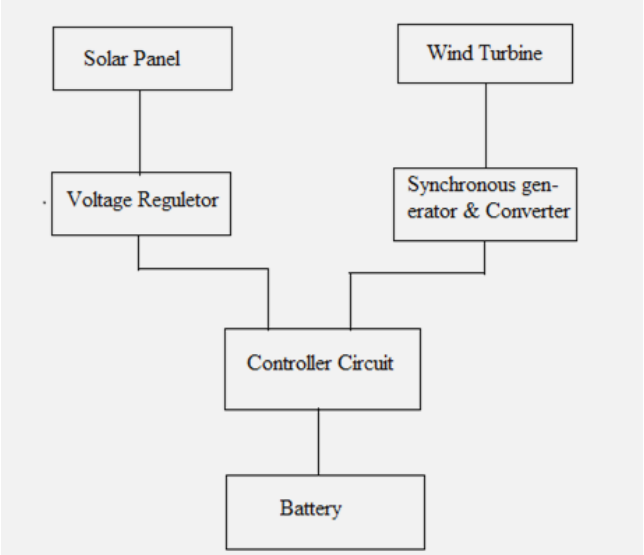

Fig.5 Flow chart of working of hybrid power system.

V. OBSERVATION TABLE

Table. 1 Readings of Wind Speed & Temp for 11th to 20th September 2018

Date	Wind Speed(M/sec)	UV Index	Temperature (^{0}C)
11 Sept 2018	2.2	10	29.00
12 Sept 2018	2.9	07	27.00
13 Sept 2018	2.3	08	28.00
14 Sept 2018	2.4	07	26.00
15 Sept2018	1.2	09	33.00
16 Sept 2018	1.8	07	30.00

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17 Sept 2018	1.5	10	28.00
18 Sept 2018	2.7	08	31.00
19 Sept 2018	2.0	09	33.00
20 Sept 2018	0.8	07	34.00

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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