# Development of a Hybrid System Combining Solar and Vertical Axis Power

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***Abstract-* People have been looking at alternatives to conventional energy sources because of the modulation and utilization of energy resulting from needs based on the post-industrial revolution. Using natural renewable energy sources is advisable because fossil fuels and energy sources like coal, radioactive materials, and petroleum are becoming increasingly scarce. Primarily, due to the paradigm shift, humans have made an impressive transition to solar and wind power development. The energy needs are satisfied through generation and distribution based on those demands, even though new alternative resources and recently growing technology have helped us. The dependability and efficiency of the output are decreased since the technologies depend on a safe, suitable environment for the generation. The scalability of these technologies is still limited since, even if the sources have enough capacity and the limitations have been removed, only a tiny generation has been made to date. For people right now in these situations of constrained operation, the combined operation of two or more models that depend on various energy sources can be beneficial. A hybrid wind turbine is an illustration of it, constructed using a multi-blade wind turbine and another generative model. Scaling up machine production and operation aids in increasing the efficiency coefficient. The torque coefficient and the static torque coefficient are crucial operational and geometrical elements that affect the power coefficient. When coupled with a size of operation that is practical, such as a small-scale operation for residential purposes, the integrated solar panel and turbine in this sort of machine will enhance the machine's operability. Before mass commercialization, there should be additional optimization and adjustment in addition to the application.**

***Keywords-* Photovoltaics (PV), Pulse width modulation (PWM), Horizontal axis wind turbine (HAWT), Vertical Axis wind turbine (VAWT).**

## INTRODUCTION

Global warming is a severe problem that the world is currently facing. As more people rely on fossil fuels to meet their everyday energy needs, their limited supply is running out. A sustainable solution must be discovered to preserve the world's wealth for future generations. Utilizing renewable energy sources can help reduce carbon emissions and promote the adoption of green energy as a result. Growing renewable energy options have enabled us to replace our current carbon-intensive sources and reduce pollution. [1]

Large amounts of wind energy may be used to meet a sizable fraction of the current global demand for electrical energy. The availability of solar energy is limited by the amount of sunlight that is available during the day [2]. Other uncontrollable factors include shadows from nearby solid objects, like trees or birds that are likely to fall on the panel and cause dark interference. Despite their effectiveness, it may be argued that the fact that the technologies are not self-sufficient in generation is a drawback. Using innovative turbine blade designs, we can improve the self-starting capabilities of vertical-axis wind turbines. Axis wind turbine, or HAWT. For scientists and engineers, however, simulating the wake is challenging, particularly in the case of VAWTs, where the aerodynamics are very unpredictable and have significant 3D implications [3].

Wind turbines come in two basic varieties: rotating horizontal axis wind turbines (HAWT) and vertical axis wind turbines (VAWT). [4] The rotor axis of a wind turbine and a HAWT are parallel to the ground when rotating. [5] The vertical axis wind turbine, as opposed to the HAWT, is more suitable for this application since it can simultaneously capture wind from various directions without the need for a YAW mechanism or piloting. [6]. A solar panel needs lots of sunlight to properly use solar energy. So for solar panels to produce power, they must face the sun. In order to achieve this, we must have the best possible angle for capturing sunlight that lasts a long time. This strategy requires less energy. This system helps create the output more effectively. In order to establish a plant in the proper location and position and create the most electricity, the wind turbine's production depends on how fast the air is moving. The secondary is a crucial element of the system that helps produce torque.

Utilizing solar and wind energy PV cells in solar panels are utilized to generate electricity. Since solar energy is easily accessible and the sun provides an unending energy source, its popularity has increased over the past several decades. We use photovoltaic solar cells to transform solar energy into electricity, which we must position correctly to catch the most energy. Electricity is produced based on the position of the sun and the amount of sunlight that reaches the cells. [7]

In contrast to other types of solar panels, the polycrystalline PV panels utilized in this model have an efficiency of more than 13–16%. The requirements of each used panel are 0.64 A, 10 W, and 18 V. Two panels are positioned and turned beneath a pole in this model. This charge controller's electrical circuitry constantly monitors the input voltage from the producing systems and the battery-based voltage. This device controls how the battery unit charges.

We are using a battery, and the battery has a built-in BMS controller to avoid overcharging. The battery's lifespan may be extended using this system. If not, the battery may be harmed, or the required battery backup may not be provided.
In order to charge batteries and prevent overcharging, solar charge controllers generally function as voltage or current controllers. Its ranges vary depending on its intended usage. The appropriate level of battery charge is maintained while charging times are shortened. We can employ a reverse flow controller for each type of fault scenario. These days, a charge controller has several uses.
A hybrid wind turbine and solar energy generating system are suggested in this project, along with a model of the system's prototype. It might be posted along the sides of the roads. Air moves because of the motion of cars, which is used to generate power. A similar concept can be applied to supplying areas with insufficient on-grid connectivity, rough geography, and challenging roadways. A wind turbine is a device that converts mechanical energy into electrical energy. When a turbine rotates with the airflow produced by a DC motor, the power is DC voltage, which can be used in a variety of applications.

## I. CURRENT TECHNOLOGIES

Wind power generation has increased rapidly and steadily during the last few decades, claims N.C. Batista et al. [8]. Because fewer natural resources are available and we installed more plants in 2010 than other energy sources (renewable) in Europe, we need a smart grid system that can handle both the rising demand for energy in urban areas and the integration of thriving decentralized renewable energy sources. Otherwise, we will not be able to power the grid. Because of the straightforward schematic, many are drawn to vertical wind turbines; nonetheless, this design has significant drawbacks, including the fact that it does not self-stare at low airflow. Therefore, we need to work on the black construction to rotate in low air flow and start the wind turbine on its own. The method utilizes a vertical axis and wind turbine blade (VAWT). It is thus more trustworthy and self-staring. Here, a method is also provided that provides an essential means of creating and comparing blade profiles using various airfoils.

Mitchell, S briefly summarize the wind turbine.[10] et al. When the wind turbine blade is positioned at an angle of 0 to 31 degrees, the lift-driven system rotates at high tip speed ratios (TSR), producing the full output power. It also demonstrates the self-starting ability that depends on the wind turbine's angle that we specified. The blade angle and airflow speed affect wind turbine efficiency. The best position to install a wind turbine is at a right angle. Low angle results (less than 90 degrees) are to blame for poor outcomes and results that are up to 30% less powerful, claim simulation studies.
Joaquin Alberto Moleon. He installed a test wind turbine for better results. The two distinct hemispheres of this machine are joined rather intimately by a system of duct valves that modify the airflow to the blades. The findings imply that wind power generation options may be easily sustained in high wind circumstances in topographic locations prone to severe weather. Experimental testing was carried out using the existing model, under demanding circumstances to examine the motion and behavior of the blades.

The initial investigation of the various approaches to judging the viability of energy was done by Elena V. [11]. Platono v and his companions fastened the solar panel before separating. As a result, it will be easier to calculate how much energy the solar panels and other affecting factors will absorb. They aid in our acquisition of a comparative modelling viewpoint as well as the development of useful tools in this area. Here, a solar-powered power system might be created, and the best power systems would optimize the energy produced. The ideal angle for a solar panel can be calculated by placing it at various angles and recording the measurements. The loss of incoming energy is then estimated if the data differ from the ideal value. These evaluations could also include a graphic analysis.

## II. RENEWABLE ENERGY SOURCES

Renewable energy sources can be copied or filled up at a rate equal to their use rate. Although fossil fuels will likely be the main sources of thermal energy for the foreseeable future, there is concern that they will exhaust themselves. As a result, many countries are testing new systems that rely on renewable and non-traditional resources. These include geothermal, wind, sun, ocean, and biomass energy. Although the term "renewable" has gained the most attention, these are also referred to as alternative, natural, or new energy sources. Nonrenewable energy resources are running out day by day. These resources are all renewable and can be used to meet all requirements.

## III. PROBLEM DEFINITION

Every day, there is a greater need for energy, but the supply cannot keep up with this demand at a reasonable price. We must use energy in the modern world to suit our demands. We have clean energy options, with solar and wind power having the most potential. Each country must use resources to produce the energy required to meet its needs.
Installing a solar farm or a windmill is very expensive. Solar energy is not usable on days with minimal sunlight or at night. It discourages the typical person from putting up solar farms. The windmill cannot continuously produce power due to seasonal winds, requiring a continual flow of wind breeze. It thus produces sporadic outputs. It makes people less likely to put up wind turbines.

## IV.OBJECTIVES

The goals of this project are:
1. The project's main objective is to enhance the usage of renewable energy sources.
2. To consume less fossil fuel.

3. To improve the standard of living for people.
4. To avoid environmental contamination.
5. To use resources and land as efficiently as possible.

**V. THE PURPOSE OF DEVELOPING A HYBRID SYSTEM COMBINING SOLAR AND VERTICAL POWER.**

The block diagram of the system, which is seen in Figure 1, briefly describes how it functions. Electrical energy is first created from solar energy, according to Figure 2. As shown in the block diagram, energy is produced using both solar and wind turbines. Solar energy is produced using sunlight, while wind turbines produce energy from airflow. Thus, a wind turbine converts mechanical energy into electrical energy as it rotates. The output from the solar panel and the wind turbine is then fed via a DC-DC converter so that the supply may charge the battery. In order to control voltage regulation and prevent overcharging, batteries also require a BMS or battery management system. We use batteries to store energy, which we may use for various purposes. We must maintain solar at the right angle and location for optimal results. A graphical analysis may also be included in these evaluations.

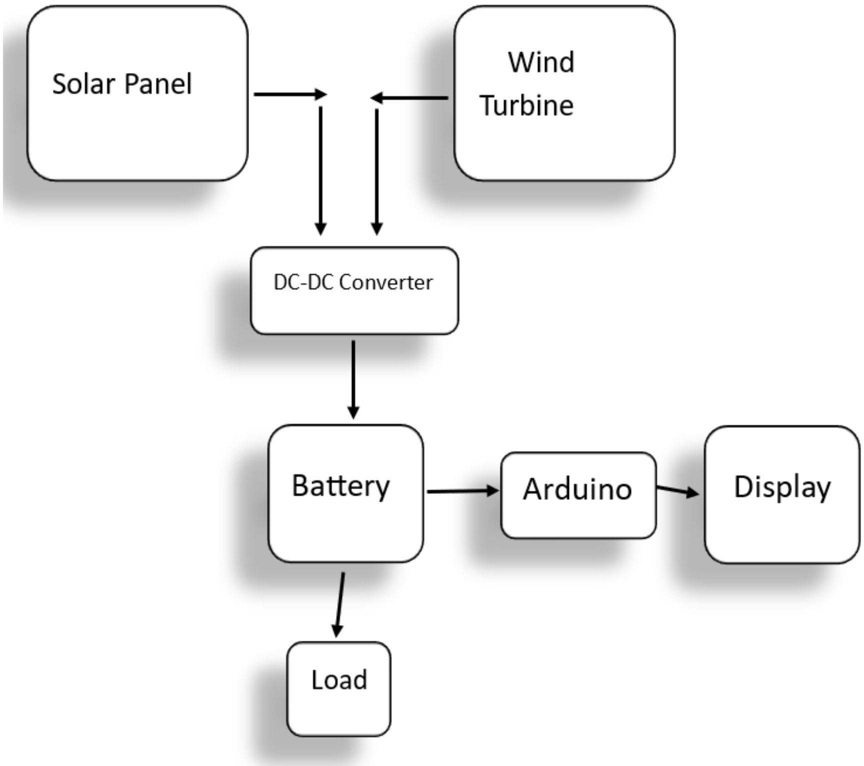


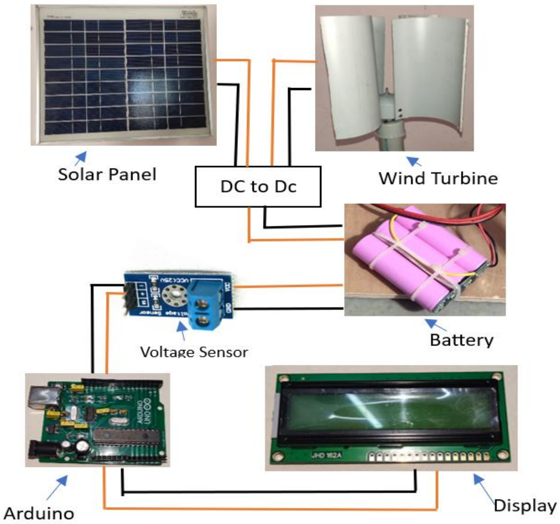

Fig1. A proposed hybrid system diagram using a vertical wind turbine

Fig2. Vertical Wind Turbine and Solar Hybrid System Experimental Setup

A. *Principal Elements in Use*

| Sr | Components | Ratings |
|---|---|---|
| 1 | Solar Panel | 18V, 10W |
| 2 | Arduino | - |
| 3 | Voltage Sensor | - |
| 4 | Wind Turbine | 12V |
| 5 | Display | - |
| 6 | Battery | 12V |

B. *Circuit Diagram*




C. *Experimental Result*

I. Solar Output

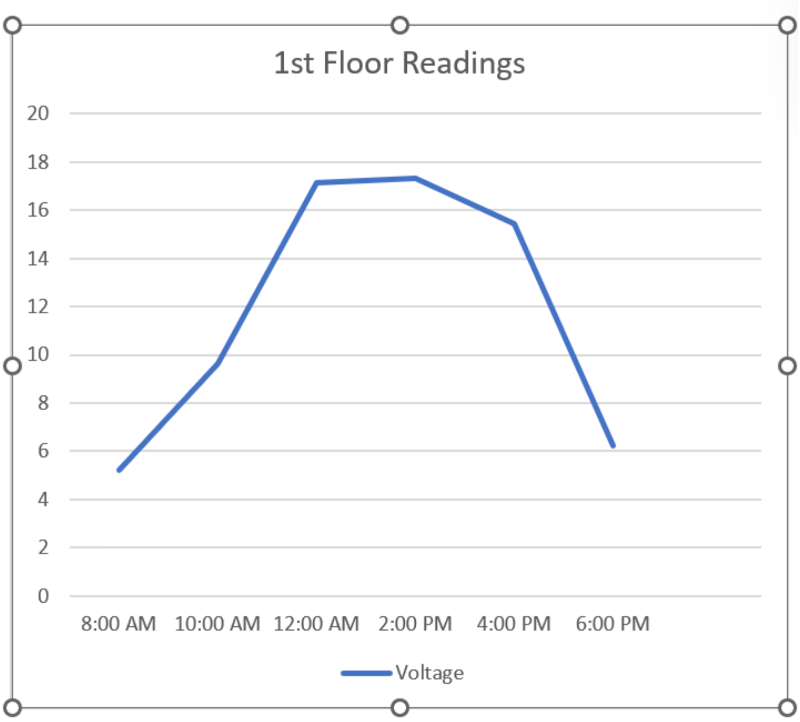



Fig3. It is the output for solar voltage generation. This output starts at 8 AM and updates every two hours.

II. Wind Turbine

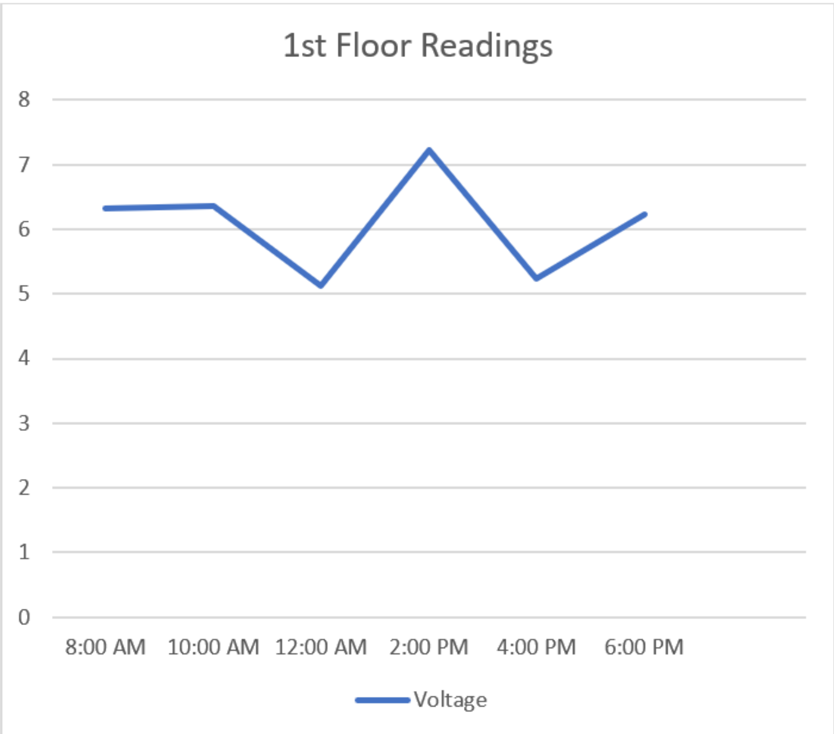



Fig4. This graph depicts the voltage generated by a wind turbine. As a result, the average air flow rate is 25 km/h (based on online data). According to this figure, the wind turbine produces 5 to 7 volts at a moderate airflow of 25 km/h.

III. Both Wind and Solar voltage Generated Chart

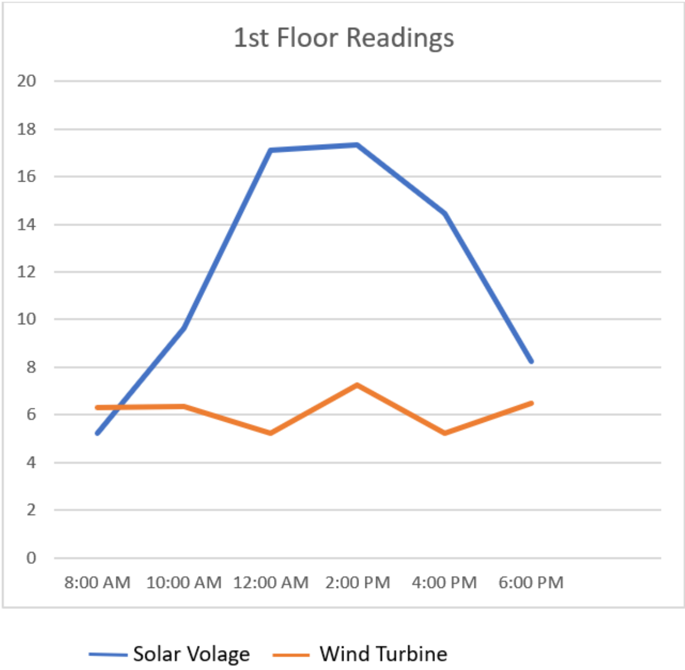



Fig5. Overall comparison of wind turbine and solar power generated. With modest air movement, this is the overall result.

## VI. CONCLUSION

This technology is used in the basic hardware prototype of the hybrid vertical axis wind turbine concept. It is the underlying notion of combining wind and solar electricity. We have created a model in which we have built a system incorporating inputs from several energy-harvesting sources. Some of the project's primary uses are in areas where electricity is still unavailable; with the help of this project, we can power up the fundamental needs of the home. It can be useful in locations where "motor roads" have not yet been constructed but where the population still requires basic electricity that can be supplied on a minimal scale. If we need extra supply for other reasons, the size of this system can still be optimized. It might also be used for highway illumination or in tiny residences, businesses, and filling stations with enough small-scale electricity, and off-grid connectivity is feasible.

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