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# Design and Modelling of Power-Shifting Circuit for Hybrid Power Generation in Rural Area

**Sarvesh Saraf, Bhavesh Matre, Tejas Suryawanshi, Aniket Fale**

**B.E. (Electrical Engineering), TSSM BSCOER, Pune**

**Project Guide : Prof. Prajakta S. Wankhade**

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**Abstract -** Any nation's social and economic progress depends on its access to energy. The generation of power is a concern for the entire planet. Fossil fuel resources must be used wisely since they are finite. The greenhouse impact is boosted by the power produced. Utilizing a system that uses both solar and wind energy can have additional advantages and be used all year round. India has grand aspirations to integrate a record amount of renewable energy into its electrical infrastructure. The fundamental motivation behind this programmed is to attain energy security by utilizing strategies that are environmentally friendly and generate clean energy. As part of this project, a Solar Photo-Voltaic (SPV) system has also been installed in a wind farm's buildings where a Wind Energy Convertor (WEC) is already in use. The combination allows for significant cost savings on a variety of fronts, including the sharing of common land and some pieces of equipment, such inverters, transmission networks for power evacuation, and shared auxiliary services. Additionally, the total fluctuation of the output produced has been tempered by combining wind and solar, which are typically complementary in nature, and the combined production is undoubtedly more amenable to integration with the grid.

## 1.INTRODUCTION

We are all aware of the serious threat posed by the world's rapidly declining fossil fuel supply. Fossil and nuclear power facilities supply the majority of the world's energy needs at the moment. Renewable energy methods including wind, solar, biomass, and geothermal provide a small portion of the world's energy needs. We're going to have a serious gasoline shortage at some point soon. Energy cannot be generated or destroyed; instead, it can only be changed from one form to another, according to the rule of conservation of energy. The majority of current research focuses on energy conservation and improved energy use. Both are plentiful sources of clean energy. Solar energy is power that comes from the Sun. It is renewable, limitless, and does not cause environmental degradation. Regardless of inclement weather, solar-charged battery systems provide power supply continuously around-the-clock.

We can harness a significant quantity of electricity from solar radiation by using the right technology for the area in question. Furthermore, solar energy is seen to be the most promising alternative energy source. Supply and demand for power products are becoming increasingly difficult, especially in certain distant places, due to globalization and the rising expense of traditional fossil fuels. The expense of fueling generators, which are frequently utilized as an alternative to traditional power supply systems, is getting more and more challenging if they are to be used for commercial reasons. They are known to only run during specific hours of the day.

The kinetic energy associated with the movement of atmospheric air is known as wind energy. It has been utilized for irrigation, grain milling, and sailing for hundreds of years. This kinetic energy is transformed into more useable kinds of electricity by wind energy systems. Since the dawn of the 20th century, wind energy systems have been employed to generate electricity. Originally, they were used for irrigation and milling. Many nations have constructed windmills for water pumping, especially in rural regions. Wind turbines turn the wind's energy into mechanical power, which may subsequently be used for grinding and other tasks, or they can be further converted to electric power to produce electricity. This article describes the Solar-Wind hybrid power system, which, depending on the requirements at the location where it is utilized, generates and supplies energy to a private residence, farm house, small business, educational institution, or apartment housing.

### *A. Wind Energy Conversion System*

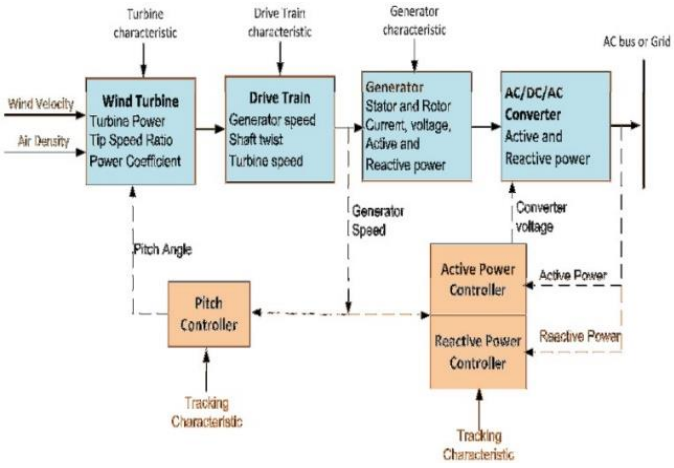


**Fig -2: Wind Energy Conversion System**

The wind energy conversion system (WECS) is made up of a generator to turn mechanical energy into electrical energy, a drive train to accelerate the shaft's rotation, and a turbine to absorb the kinetic energy of the wind (see Fig.

1). In this study, a wind turbine with variable rotational speed that can continuously adapt (i.e. accelerate or decelerate) its rotating speed to the wind speed "v" is employed. According to the kind of generator being utilized, the WECS fitted with doubly fed inductance generators (DFIGs) are the most significant classification of variable-speed wind turbines. Due to the growing concern over the influence of wind power on the electrical network, there is now the possibility of pitch control with an efficient transfer of electricity to the grid through active and reactive power regulation. In the aforementioned types of generators, the rotor power is handled by converters while the stator (Stationery) of the generators is directly linked to the grid.

### *B. SOLAR-WIND HYBRID ENERGY SYSTEM*

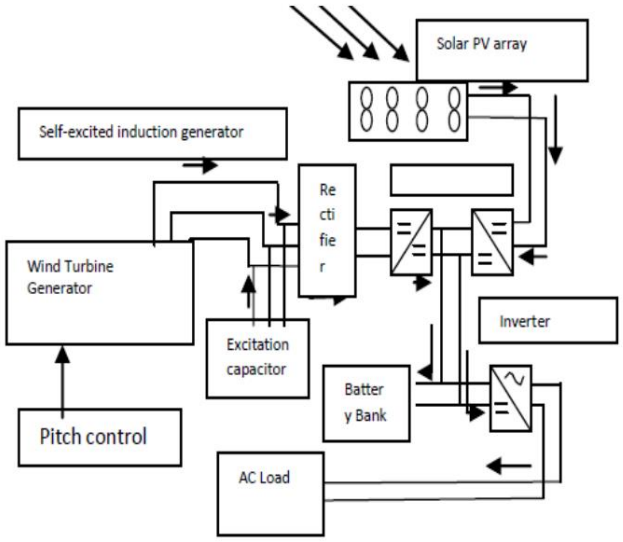


**Fig -2: Functional Block Diagram Of Hybrid Wind Solar Energy System.**

Wind-Solar hybrid Power systems combine solar energy panels and wind turbines to produce electricity. Additionally, it has a battery for storing the energy produced by the two sources. With the help of this system, it is possible to generate electricity using a windmill when a wind source is present and a PV module when light radiation is present. When both sources are accessible, electricity may be generated for both units. When both sources are not in use, an uninterrupted power supply can be achieved by charging the battery.

## 2. IMPLEMENTATIO OF HYBRID ENERGY SYSTEM

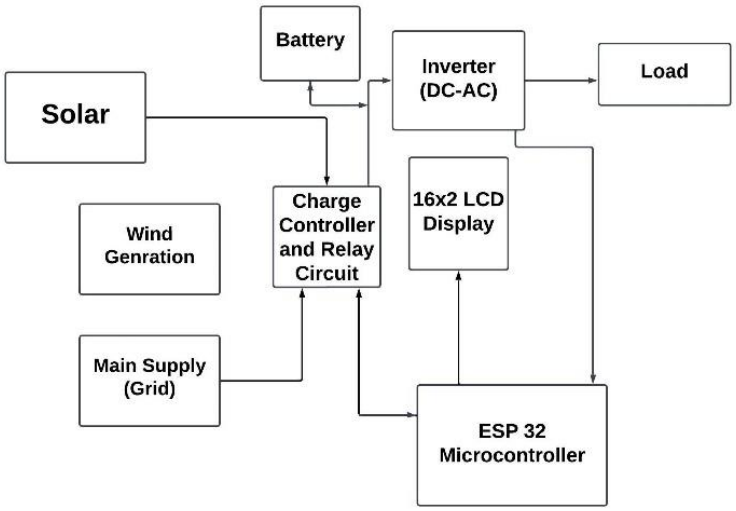


**Fig -1: Block Diagram of Power Shifting Circuit for Hybrid Power Generation**

The two main causes for installing a hybrid energy supply system are intermittent energy supplies and an imbalance in energy resources. The Solar PV wind hybrid system is appropriate for climates with seasonal variations in the sun and wind. Using a single source will not be an appropriate decision because the wind does not blow all day and the sun does not always shine. A much more dependable and practical power source may be a hybrid system that combines energy from the sun and wind and stores it in a battery. Even when there is no wind or sun, the load can still be powered by the batteries' stored energy. Hybrid systems are often created to build systems with the lowest cost and most dependability. Solar PV cells are less suitable for greater capacity designs due to their high cost. This is where wind turbines come into play, with their major benefit being their lower cost as compared to PV cells. To store the solar and wind energy generated throughout the day, a battery system is required. It is more appropriate to employ a hybrid wind solar system during the monsoon seasons since the site's exposure to the sun is reduced. The parts of the system are as follows.

### *1. PHOTOVOLTAIC SOLAR CELLS:*

The method for converting solar energy into electrical energy is solar panels. Solar panels may either convert energy directly or use induced energy to heat water.
With the help of this substance, sunlight is absorbed and electrons are released from the atoms. A current is initiated by this emission. The process between radiation absorption and electricity induction is referred to as photovoltaic. By using a widely used concept known as the photoelectric effect, solar energy is transformed into

electric power. According to the needed current and voltage, the right number of solar cell modules are linked in series or parallel to create the solar cell array or panel.

### *2. WIND POWER:*

A renewable energy source is wind power. Wind power is transformed into electric power using wind turbines. The turbine's internal electric generator transforms mechanical energy into electrical energy. There are wind turbine systems ranging from 50W to 3–4 MW. In rural locations, wind power can meet both the supply and the demand for electricity. It is used to power a windmill, which in turn powers an electricity-generating wind generator or wind turbine.

### *3. BATTERIES:*

The batteries in the system allow for the storage of the electricity produced by solar or wind energy. Any necessary capacity can be acquired by serial or battery connections that are parallel. The battery that offers the best performance in solar and wind power systems is dry type, maintenance-free, and uses specialized electrolytes. These batteries function well for prolonged discharges.

### *4. INVERTER:*

Electrical loads get power from the battery through the inverter, which transforms DC power into AC power. Short-circuit, Reverse Polarity, Low Battery Voltage, and Over Load safety are integrated into the inverter.

### *4. ESP32 MICROCONTROLLER:*

The Espressif Systems-created ESP32 microcontroller is a feature-rich and potent embedded module that is frequently employed in IoT (Internet of Things) applications. It has a wide variety of characteristics that make it extremely adaptable and appropriate for various application Additionally, it has Wi-Fi and Bluetooth connection built in, allowing for smooth wireless contact with other devices. It also has internal SRAM for data storage and external SPI flash memory for program storage. Because of its low power consumption, the ESP32 is appropriate for battery-powered or energy-saving applications. The ESP32 microcontroller has gained popularity for IoT applications, home automation systems, robotics, and wearable technology thanks to its cost, performance, and wide range of features. It offers a stable foundation for developing connected and intelligent products with wireless connection.

### *5. BLYNKCLOUD:*

The Blynk mobile app and Blynk Cloud are cloud-based platforms that make it simple to design and deploy IoT (Internet of Things) applications. It offers a quick and easy method for remotely connecting to and controlling different hardware devices using a smartphone or tablet. The popular hardware platforms and microcontrollers supported by Blynk Cloud include Arduino, Raspberry Pi, ESP8266, ESP32, and many more. Users may quickly monitor sensor data, operate actuators, get notifications, and create intricate automation logic for their IoT projects by utilizing the Blynk Cloud platform. It makes the process of developing IoT applications simpler, enabling even individuals without in-depth hardware or programming experience to use it.

## 3. CONCLUSIONS

A solar PV wind hybrid energy system was used in the current work. Depending on the needs at the place where it is utilized, some of the energy requirements for a private home, farm house, small business, educational institution, or apartment housing have been met with the electricity produced by wind and solar power. It has boosted dependability and decreased reliance on a single source. As a result, we could increase the system's efficiency in comparison to each generator's unique mode of operation.

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## BIOGRAPHIES

Sarvesh Sandeep Saraf
University Roll No.: 72172804K
B.E.(Electrical Engineering)
TSSM's BSCOER, Pune-41

Bhavesh Manoj Matre
University Roll No.: 72172759L
B.E.(Electrical Engineering)
TSSM's BSCOER, Pune-41

Tejas Vijay Suryawanshi
University Roll No.: 72172810D
B.E.(Electrical Engineering)
TSSM's BSCOER, Pune-41

Aniket Kailas Fale
University Roll No.: 72172771K
B.E.(Electrical Engineering)
TSSM's BSCOER, Pune-41