INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH IN ENGINEERING AND MANAGEMENT (IJSREM)
VOLUME: 08 ISSUE: 03 | MARCH - 2024 SJIF RATING: 8.448 ISSN: 2582-3930

Power Generation of Solar and Wind Hybrid Energy System

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***Abstract*—** In today's technology driven world electricity is one of the foremost thing 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 structures are basically the combination of sun and wind power flowers. This allows to ensure uninterruptible power supply. Hybrid systems may be used for each industrial and domestic use.The benefit of this association is that the generator may be located next to the sun modules, making it a hybrid system. This challenge is set strength manufacturing the use of a mixture of sources to supply electricity at an low priced charge with out worrying the natural stability.

Keywords— Solar Energy, Wind Energy, PV Cell, Renewable Energy, Hybrid Power System, Electricity etc.

I. INTRODUCTION

The hybrid machine combines many renewable energy sources, including solar and wind power. In hybrid energy generation, the generated strength is first stored in batteries and then used to satisfy power requirements. Currently, the wind and solar energy enterprise is developing unexpectedly, and conventional power sources are decreasing every day and will disappear in the future. We want to discover new energy resources that are easily accessible and do not pollute the environment. On bright days, it is powered by solar energy, while on cloudy days, it is powered by wind energy.

Renewable power sources provide clean energy in adequate quantities on Earth. These renewable sources come from earth, water, sunlight, plants, and so on. These sources are frequently employed for power generation. Solar and wind power generation are appealing sources since they are environmentally friendly. A hybrid machine is a combination of several renewable energy sources, such as solar energy, biomass energy, wind energy, and so on. The electricity generated by hybrid strength generation is first stored in batteries before being used to meet energy demands. Wind and solar power are rapidly expanding, whereas traditional energy sources are declining and may disappear in the future. As a result, we want to identify new energy resources that are clean enough to utilise without polluting the surroundings. On bright days, it's far powered by solar energy, whereas on cloudy days, it's miles powered by wind power. The horizontal axis windmill uses the same horizontal rotor as the classic Dutch windmill. Horizontal axis windmills mostly rely on wind lift. According to Bernoulli's principle, "Fluid will move from an area of high stress to a place of low stress." Additionally, it states that when a fluid's velocity increases, its density decreases. Primarily based on this principle, the horizontal axis windmill blades are designed to resemble the wings of a plane with a curved top. This layout increases the spread of the air at the top of the blade, reduces its density, and leads to an upward rise in the air underneath the blade. The blades are angled at the axis to employ raise within the rocker. Contemporary wind generators' blades are engineered for maximum rise and least drag.

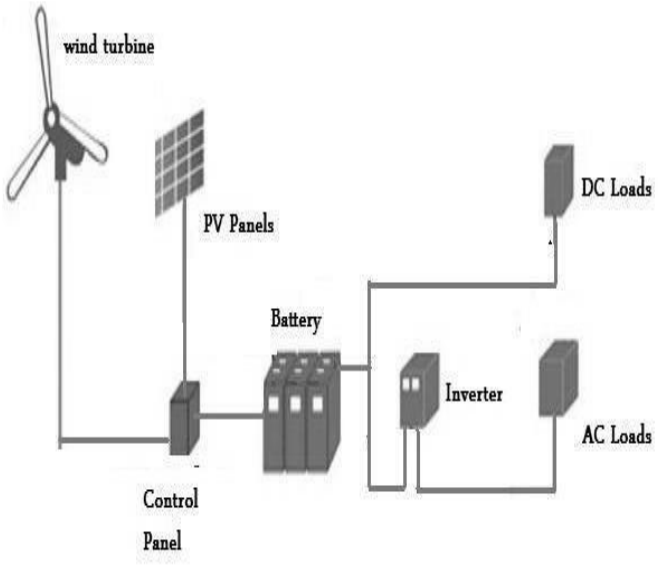

Fig.1. Hybrid Power Generation system

The necessary quantity of energy may now be produced based on environmental conditions, by utilising the same systems at the same time, or by employing the most efficient one, depending on the conditions at that moment.

II. METHODOLOGY

Hybrid Power :

A hybrid power tool is a combination of two power sources used to power the load. Under other circumstances it may be summed up as "an strength device which is fabricated or developed to extract electricity by teh usage of two electricity sources, t's far called hybrid power system." The hybrid strength gadget has enough reliability, efficiency, low emissions, and low cost.

In this proposed gadget, solar and wind power are employed to generate electricity. Sun and wind strength have distinct advantages as compared to all other unconventional electricity sources. Each power asset is required in all areas. It desires a low fee. There is no need to identify a specific area to put in this gadget.

Solar Power :

Solar energy is power generated by the sun's radiation, which is constantly and readily available on the earth. It is freely accessible, does not emit pollutants, has minimal upkeep expenses, and is cost-effective. However, it has difficulty producing power in bad weather conditions. Solar energy is more efficient than conventional sources, requiring an upfront investment but having a longer lifespan and lower emissions.

Wind Power :

Wind power is generated from the wind utilising a windmill, which is a sustainable energy source with minimal production and maintenance costs. Wind energy is accessible virtually 24 hours a day and produces little emissions. The starting cost is cheaper than for solar energy, and the amount of power produced is determined by the direction of the air flow.

The recommended Hybrid Energy System mixes solar and wind power to solve the short-term nature of individual renewable energy sources. This provides continuous power generation, increases dependability, and overcomes the limitations of individual sources. The system may be deployed in remote places, lowering gearbox costs while providing a dependable, low-emission, and cost-effective option providing continuous power delivery.

III. OBJECTIVES

- Create a hybrid power system that combines solar, wind, and traditional power sources to create electricity.
- To create a solar system capable of absorbing maximum sunlight.
- To improve power efficiency using hybrid sources.
- To reduce installation and operational costs while increasing dependability.
- Hybrid power generation can optimise energy for every sector or location.

IV. LITERATURE SURVEY

- ***Bharat Raj Singh, et. January 2018,*** Hybrid system development is one of the most practical and efficient solutions for electricity generation when compared to non-renewable energy sources. It's not just less expensive, but it's also less environmentally damaging. Another benefit is that it may be used to generate electricity in areas where conventional methods are difficult to transmit. The setup may be determined based on the requirements. All people in the world should be motivated to employ unconventional resources to produce electricity in order to make them self-reliable to some level. Some of its key advantages are a long lifespan and low maintenance requirements. It merely demands some substantial initial investment.
- ***Sasan Moghaddam, et. al. 2019*** This paper proposes designing a hybrid renewable energy PV/wind/battery system to improve load supply reliability over a study horizon while minimising Net Present Value (N V). The NPC includes costs for hybrid system investment, replacement, operation, and maintenance. The considered reliability index is the probability of an interruption of load demand. Variables include the number of PV panels, wind turbines and batteries, inverter capacity, single PV panel, and wind turbine height. To solve the optimisation problem, a new algorithm called the improved crop finding algorithm (ICF) is proposed. The system was designed for the city of Zanjan, Iran, based on current data on solar radiation and wind speed in this area. The performance of the proposed I¡S• is compared with the Crowd Search Algorithm (CSA) and particle swarm optimization methods in different system combinations. This comparison shows that the proposed algorithm has greater performance than other methods.
- ***Abdali Layth Mohammed Abdali1 and. In 2019***, The paper proposes a grid-connected photovoltaic and wind power hybrid system. This system discusses the characteristics of its main components (WE¡S, V, battery, and F¡) and proposes an overall coordinated control strategy for a mixed power system. The primary power generation devices are hydroelectric and wind turbines, while the battery storage acts as a means of storing excess electricity. When the SOC is < 25%, the FC device creates redundancy and supplies power to the system. The hybrid system simulation model is developed with Power Factory. Simulation studies were performed to validate the system's performance.
- ***Udit Mittal, Gunjan Varshney et.al. Sep 2020***, In this paper, a power generation system is constructed utilising a solar and wind system, with the goal of providing continuous power generation during the day and night. Solar and wind power both have unique advantages and disadvantages. The combination of both techniques in a common format will assure advantages for both techniques while also reducing their own limitations. This poster attempts to present a hybrid energy. model has taken these two prominent renewable energy sources into account for an increase in the reliability and continuity of the resulting system. This paper proposes a model with a broad scope

for future research in the area of hybrid energy. This model may be expanded to include a grid-connected version that uses microcontrollers and power factor correction devices. Our country has been suffering from power failure and irregularities, especially in remote areas, and the implementation of this framework at any given location can be of great use as our country has.

- ***Monik M. Dholariya1, et. al. June 2020***, This paper introduces the Solar-Wind hybrid power system, which harnesses renewable energy such as the sun and wind to generate electricity. Power. Solar panels are used to convert solar energy, whereas wind turbines are used to convert wind energy into electricity. This electrical power source can be used for a variety of purposes. Electricity generation will take place at an affordable cost system. This hybrid solar-wind power generation system is suitable for industries as well as domestic areas. Solar panels are mounted on the surfaces of a wind turbine, such that the combined energy from the wind turbine and the solar panels is provided as an output. Electric DC energy is produced by a solar panel and wind turbine system. The effects of environmental conditions on V cells, modules, and arrays were examined using mathematical modelling and simulation. We investigated the various inverter topologies and their operation. We prepared the Hardware model of hybrid power generation and observed that theoretical findings are similar to those of the Hardware model.

V. BLOCK DIAGRAM

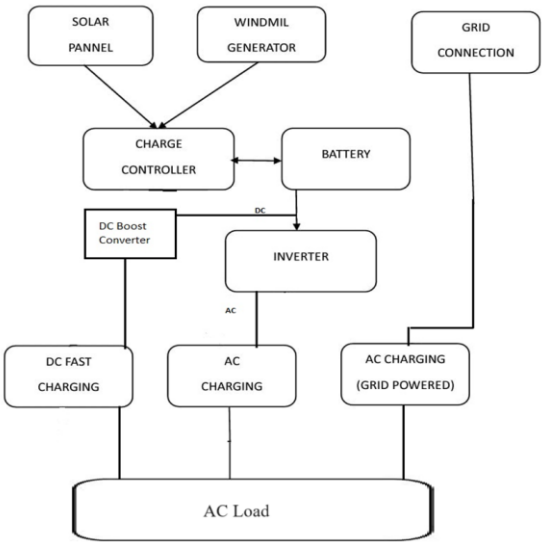

Fig.1. Block Diagram of system

VI. WORKING

Hybrid systems are essentially made up of solar panels with wind turbines; the output of this pair of devices is utilised to charge batteries, which may subsequently be sent to local power stations.

In this setup, a wind turbine may be used to generate power when there is wind, and rooftop solar panels can be utilised when there is sunlight. Both portions may generate power simultaneously.

The purpose of batteries is to offer an uninterrupted power supply. This technique demands a large initial expenditure. However, the durability, extended lifespan, and minimal upkeep make up for this drawback. The wind turbine's power output is DC, and is converted into AC using an inverter.

The needed quantity of power may now be produced based on environmental conditions, either by utilising both systems at the same moment or by using only one, depending on the circumstances at the moment.

Components:

- Wind Generator
- Solar Panel
- Solar Charge Controller
- DC Boost Converter
- Battery
- LCD Display
- Inverter Module
- AC Load
- Charging Socket
- LED Indicator
- Others.

VII. COMPONENTS SPECIFICATION

- ***Solar Panel*** **(12v25w)**

Solar energy is the energy that we receive from the sun in the form of radiation. It does not pollute and is infinitely renewable. It is accessible for free. A solar cell, sometimes called a photovoltaic cell, is a device that converts solar energy into electricity.

- **DC Genrator (12v)**

A direct current generator, or DC generator, is a device whose principal job is converting mechanical power to electricity.

- **DC to DC boost Converter (Regulated 12v)**

A boost converter (or step-up converter) is a power converter from DC to DC that increases voltage while decreasing current from the input (supply) to the output (load). It is a type of switched-mode power supplies (SMPS) that has a minimum of two semiconductor components (a diode and a transistor) along with at least a single energy storage element: a capacitor, an inductor, or both in combination.

- **Inverter (12v DC to 220v AC)**

As we all know, most electrical devices require AC power, thus the direct current (DC) power of the batteries is transformed into AC voltage using an inverter before being transmitted to the loads. The inverter has to be having excess voltage protection, the opposite polarity, as well as short circuit protection.

- **Battery (12V 5Ah)**

Batteries are used to store the power generated by piezoelectric and solar energy. The capacity of the battery might vary based on the dimension of the input power produced.

VIII. PROPOSED CALCULATIONS

Total energy generated by the system is the total energy generated by the solar PV panel and the power generated by the wind turbine. According to statistics, it can be represented by,

PT = NW * Pw + Ns * PS

There,
Total energy generated = PT
Power generated by wind turbines = PW
Energy produced by solar panels = PS
Wind turbine number = NW
Number of solar panels used = NS

A. Calculations for wind energy:

The energy produced by wind power is provided by,
Energy = (air density * swept area * cubed velocity) / 2
PW = ½. ρ (AW) (V) 3
There,
P is the power in watts (W)
ρ air pressure per kilogram per cubic meter (kg / m³) AW area of air per square meter (m²) V wind speed per meter (m / s).

B. Calculations for solar energy

To determine the size of the PV modules, the required power consumption should be measured. Therefore, power is calculated as
PS = Ins (t) * AS * Eff (pv)

There,
Ins (t) = separation at t (kw / m2)
AS = one PV panel area (m2)
Effpv = full efficiency of PV panels and dc / dc converters.

The overall efficiency is provided by,
Eff (pv) = H * PR

There,
H = Annual rate of solar radiation on oblique panels.
PR = Performance rate, loss coefficient.

C. Cost

The total cost of a solar-wind energy system depends on the total number of wind turbines used and the total number of solar panels used. The total cost is therefore provided as follows
Total Cost = (Wind Turbine Number * Cost of One Wind Turbine) + (Solar Panel Number * Cost of One Solar Panel) + (Number of Batteries Used in Battery Bank * Cost of One Battery)
CT = (NW * CWT) + (NS * CSP) + (NB * CB)
There,
CT is the total cost per Rs
CWT is the cost of a single wind turbine
CSP costs one day panel per Rs
CB One Battery Cost Rs
NW is the amount of wind turbine used
NS is the number of solar panels used
NB is the number of batteries used in the Battery Bank.

IX. ADVANTAGES

- In rainy and winter season the amount of solar radiation is not sufficient than in this season energy is fulfilled by wind energy system.
- Due to variation in weather condition when there is lack of wind energy than the power is supplied by the solar panels.
- Low operating cost and maintenance cost makes it economical.
- Used in any location whether it is remote area or populated area.
- Highly efficient power generation
- Solar- and wind-powered sites benefits the environment as it will reduce the carbon and other harmful emission is about 90% in environments.

X. APPLICATION

- Distributed power generation
- Hospital, Hotels, Guesthouse etc..
- Remote and Rural area Electrification.
- Street lighting.
- Transmission and communication Tower and many more application.

XI. SCOPE OF PROJECT

- It is the design method for maximum conversion efficiency of a turbine for delivering the maximum power to a load, battery in the case of a standalone solar-wind system.
- Saves space.
- It doesn't require fuel.

XII. RESULT AND DISCUSSION

This is a model of the solar-wind hybrid system, the system-developed power is transferred to the load as shown in the picture. The output voltage and power of the solar panel, wind turbine, batteries and load are measured more accurately and the final results are calculated. The amount of energy produced and used is measured.

Aerodynamically, it is a drag-type device, consisting of two or three scoops. If you look down at the rotor from the top, the two scoop machine will look like an "S" shape in the cross section. Due to the bend, the scoops face less drag when opposed to the wind than moving with the wind.

Differential suction causes the wind turbine to rotate Because they are gravity type tools, wind turbines emit much less wind energy than other lifting turbines of the same size. A large swept area of the air rotor may be close to the ground, if it has a small ladder without extended transmission, making the total power output inefficient due to the low wind speed found at high altitudes.

• ***Solar-PV Wind Power hybrid power is provided below.***

PV Array Power = 20 watts
Air / generator engine = 3W
Electrical power of the system = 48V
Battery = 12V
Inverter Rate (VA) 25
The outgoing AC Wave makes a Sine-wave
Output AC Voltage (Vnom), +/- 10% = 230 V / AC Output Ac frequency, Hertz, +/- 0.5% = 50 Hz.

XIII. CONCLUSION

Developing hybrid systems is one of the simplest and most efficient solutions for generating electricity compared to non-renewable energy resources. Not only is it expensive but it also does not cause environmental damage. Also, it can be used to generate electricity in hilly areas, where it is difficult to transfer electricity in normal ways. Depending on the need the setting can be determined. All the people in the world should be encouraged to use extraordinary resources to generate electricity so that they can be relatively reliable. Longevity, minimal care is one of your best places. It just needs a higher initial investment.

As we know the mixed system has additional production costs per unit but uses the resources available effectively. This Hybrid program is also capable of recovering from any accidental or unwanted situation. And the hybrid system is able to harness power in remote and rural areas. So it is clear that the Hybrid system is the best choice.

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