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Development of Hybrid Power Generation System Using Solar and Wind Energy

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Abstract: ***Electricity is one of the most important things for our daily lives in today's technology-driven environment. We are all unaware of the reality that renewable energy sources are exhausting at a breakneck pace. So it's time to switch our attention from conventional to unconventional energy sources in order to generate electricity. When compared to traditional sources, non-conventional sources produce less electricity overall. The environment is not harmed by the use of renewable resources. In essence, a solar-wind hybrid system combines a solar energy plant with a wind energy plant. It will contribute to ensuring a steady supply of power. The hybrid system can be applied to both household and commercial settings. Solar-wind hybrid structures are essentially a combination of wind and sun power flowers. The main rotor shaft of horizontal-axis wind turbines (HAWTs) is a particular design of wind turbine. One benefit of this configuration is that solar panels and generators can both be installed near to the ground, creating a hybrid system. This electricity can be used for a variety of things. At a reasonable price, electricity will be generated. The goal of this project is to generate electricity from two sources simultaneously at a low cost without endangering the delicate balance of nature.***

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

I. INTRODUCTION

The hybrid machine is a combination of many renewable energy sources, including solar and wind power. In hybrid energy generation, the energy produced is initially stored in batteries and then utilised to satisfy user needs. Currently, the wind and solar energy industry is developing quite unexpectedly, and conventional power sources are declining every day and will eventually disappear. We want to learn about new energy sources that are easily accessible without harming the environment. It is powered by solar energy on sunny days and by wind energy in large amounts on cloudy days[1][2].

Thanks to renewable energy sources, there is ample clean energy available on earth. The ground, water, sunlight, plants, and other natural resources are the source of these renewable energy sources. Power generating commonly uses these resources. Solar and wind power generation are appealing sources since they are environmentally friendly. A hybrid machine is a combination of numerous renewable energy sources, such as solar energy, wind energy, and biomass energy [3]. Energy demands are satisfied by storing the electricity produced by hybrid strength generation in batteries initially. Traditional energy sources are declining every day and may disappear in the future, whereas wind and solar power are now growing rapidly [3][4].

We therefore want to discover new energy sources that are clean to use without polluting the environment. It is significantly powered by solar energy on sunny days, and significantly powered by wind force on cloudy days. The horizontal axis windmill has the identical horizontal rotor as the traditional Dutch windmill. Windmills with horizontal axes mostly rely on lift from the wind. According to Bernoulli's precept, "a fluid will exit from a region of extremely high stress to a location of low stress." Also, it states, "A fluid's density decreases as its velocity increases." The horizontal axis windmill blades are primarily based on this principle and are constructed to resemble the wings of an areophane with a curved top. This layout increases the air's spread at the top of the wall, correspondingly reduces its density, and causes an upward rise in the air below the wall. The blades are angled at the axis to use lift inside the rucksack. The blades of conventional wind generators are built for maximum lift and little drag [5][6].

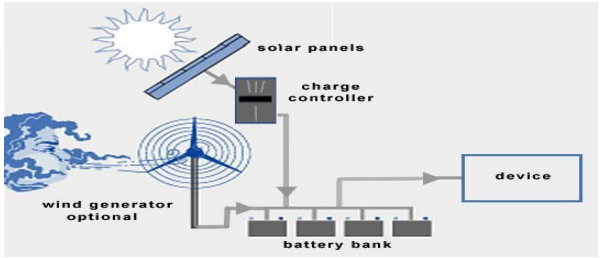


Fig.1. Hybrid Power Generation system [2]

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Now, depending on the environmental conditions, the needed amount of energy may be produced by employing different systems at the same time or by choosing the most effective one, depending on the conditions at that particular time[6].

A. Hybrid Energy System

In order to power the load, a hybrid power tool combines two power sources. In other words, it can be described as "a strength device that is manufactured or constructed to extract energy by the use of two energy sources, commonly known as a hybrid energy system." The hybrid strength device has the necessary dependability, efficiency, low emissions, and low cost [7].

In this proposed device, power is generated using solar and wind strength. In comparison to all other non-conventional energy sources, the strength of the sun and the wind have distinct advantages. Every owner asset is specifically to be held in each area. It asks for a small cost. There is no need to locate a specific area to house this gadget [7].

1) Solar Power

The sun's radiation is where we get our energy from the sun. On this network, solar energy is continuously and abundantly available. Free sun electricity is available. It doesn't produce any fuel, which means that its constituents are quite loose. It has a tremendous value for the money. It has a low maintenance cost. The biggest issue with solar energy is that it cannot generate electricity in unfavourable climatic conditions. Yet, its effectiveness is exceptional when compared to other electricity assets. It calls for the best preliminary finance. It has a projected existence span and coffee emissions [7][8].

2) Wind Power

Wind power is strength that has been extracted from the wind. We employ a wind turbine in mining. It is a sustainable energy source. For wind power to be generated, low value is required. The costs associated with wind machine protection are very low. Wind energy emits very little energy and can be used for at least 24 hours every day. Also less expensive than the device is the first cost. The production of electricity from the wind depends on the air current's spread [8]. The primary disadvantage of adopting unrestricted renewable energy sources is the permanent lack of strength. We employ the combined strength of the sun and wind to overcome this. such that if one source of energy fails, the alternative will handle the technology. On this proposed machine, we'll employ an aggregate of all the assets. Any other way is that we can use one supply and keep the backup supply on hand as a stand-alone item. This may guarantee the continuity of the generation. This can make the machine dependent. The main disadvantage of this device is that it requires an extremely high penalty fee. Despite being reliable, it emits very little pollution. The cost of renovation is low. This device has a longer lifespan. Performance is preferable. One of the significant advantages of this device is that it provides continuous energy supply. This hybrid system is intended to provide the necessary energy. The usage of a hybrid machine lowers the value of transmission in remote areas because it can be set up there to provide power [7][8].

II. OBJECTIVES

This assignment's goal is to create a horizontal axis wind turbine (HWT) with a solar strength device that can generate electricity from incredibly low wind speeds. To achieve this, the goals are to generate power of 10 days or more:

- To analyse the effects that unique wind turbine geometries will have on the output power of wind turbines.
- Vibration analysis is done by examining how the rotation of wind turbines affects the structural integrity of many different components of the building structure.
- A diagram of a solar energy system that produces steady voltage
- To examine how well a turbine performs with a wide variety of barriers in place.

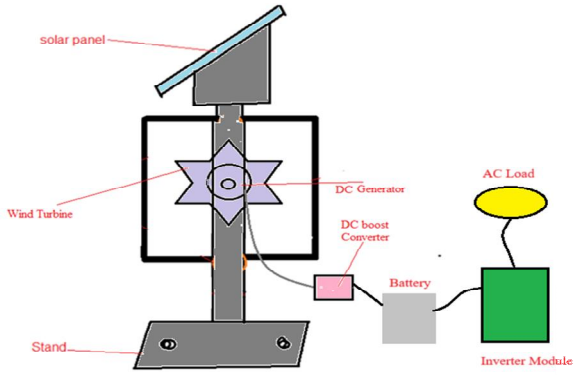
III.LITERATURE REVIEW

- *A. Adejumobi, et. al. 2011* Compared to non-renewable energy sources, the development of hybrid systems is one of the most practical and effective solutions for the generation of electricity. It is not only less expensive, but it also doesn't harm the environment. Another benefit is that it can be used to generate electricity in mountainous regions where conventional methods have difficulty transmitting it. On the basis of the necessity, its setup may be chosen. All people in this world should be encouraged to employ non-inventive resources to generate electricity in order to make them somewhat self-reliant. Long lifespan and little maintenance are some of its key qualities. Simply said, a significant initial expenditure is necessary.

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- *Kavita Sharma, et. al. 2012* , In this paper, a hybrid renewable energy system that combines solar, wind, and batteries is proposed for improving load supply reliability over a study horizon with the goal of minimising the Net Present Value (N). The N includes costs associated with the purchase, replacement, operation, and maintenance of the hybrid system. The load demand's deficient probability of overnight interruption is the considered reliability index. The decision variables include the number of V panels, wind turbines, and batteries, as well as the capacity of power that can be transferred by inverters, the number of V panels, and the height of the wind tower. The improved crowd finding algorithm (IS) is a novel algorithm proposed to address the optimization problem. The system's design was created specifically for the city of Zanjan, Iran, and was based on current data on the region's solar radiation and wind patterns. The performance of the proposed IIS is compared to the broad search algorithm (S) and the component-based warm-optimization methods in various system combinations. This comparison demonstrates that the proposed IS algorithm performs better than other methods.
- *Sandeep Kumar, et. al. 2013*, A grid-connected hybrid PV and wind power generation system is proposed in the paper. This system is discussed; the characteristics of the four main system components—WES, V, battery, and F—are provided; and the proposed overall coordinated control strategy for mixed-power systems is demonstrated. The primary power generating devices are solar and wind-powered systems, and the battery storage acts as a means of storing any excess electricity that may be available. The F device is a device that creates redundancy and supplies power to the system when the S value is less than 25%. Using lower theory, the hybrid system simulation model is created. Simulator experiments were conducted to confirm the system's performance.
- *Arjun A. K. et. al. 2013,* This paper describes a power generation system that uses solar and wind energy and is intended to provide continuous power generation throughout the day and night. Both solar and wind power have specific advantages and disadvantages of their own. The advantages of both techniques will be ensured by combining them in a common framework, while at the same time reducing each technique's unique limitations. This author has attempted to present a hybrid energy model that takes into account these two important renewable energy sources in order to increase the dependability and continuity of the final system. This paper proposes a design with a broad scope for future research in the field of hybrid energy. With micro-controllers and power factor correction devices, this design can also be made into a grid-connected version. Our nation has been suffering from power outages and irregularities, particularly in remote areas, and the implementation of this framework in any given location might be quite useful given that our country has been gifted with geographical and demographic advantages for both resources.
- *Vaibhav J. Babrekar, et. al. 2017*, This article describes the hybrid solar-wind power system, which harnesses the renewable energy of the sun and wind to produce electricity. Power. Solar panels are used to convert solar energy, whereas wind turbines are used to convert wind energy into electricity. This electric power source can be used for a variety of purposes. Electricity generation will take place under an affordable cost system. This hybrid solar-wind power generation system is suitable for both industrial and domestic settings. 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 output as output. Electricity is produced here from a solar panel and a wind turbine system. V cells, modules, and arrays were mathematically modelled and simulated, and the impact of environmental conditions on their V and IV characteristics was investigated. We researched the various inverter methodologies and how they function. We prepared a Hardware model for hybrid power generation and discovered that theoretical findings are comparable to Hardware model results.

IV. PROPOSED SYSTEM



1) A hybrid device essentially combines a wind turbine and solar panel array. The output of this combination is used to charge the battery, and the saved energy can subsequently be supplied to production facilities. Neighborhood fortitude. In this device, solar panels are employed when there is solar radiation and wind generators may be used to generate power when there is a windy day. Both sections could also be created at the same time.
2) The use of batteries is for continuous electrical delivery. This system requires significant financial support. Nonetheless, dependability, long lifespans, and significantly less upkeep account for this shortcoming. The wind turbine's output power is direct current, which is converted into switching current with the use of an inverter.
3) At the moment, the amount of strength needed may be produced depending on the environmental conditions, using two structures at once, or using just one, depending on the circumstances at the moment.

V. COMPONENTS

- Solar panel
- Wind Turbine
- DC Generator
- Gear
- Inverter Module
- Battery
- Frame (mild steel)
- Others

1) *Solar Panel*

Solar panels use the energy from the sun to generate heat or electricity. A bundled, connected assembly of typically 6x10 photovoltaic solar cells is known as a photovoltaic (PV) module. The photovoltaic array of a photovoltaic system, which produces and supplies solar electricity for commercial and residential uses, is made up of photovoltaic modules.



Fig..3. Solar Panel

2) *Wind Turbine*

A renewable energy source is wind. The kinetic energy of the wind is transformed into electric energy by a wind turbine. The blades' shaft-connected generator transforms mechanical energy into electrical energy. Depending on the axis on which the blades rotate, there are two different types of wind turbines.



Fig..4. wind turbine

3) *Battery*

In order to store the electricity generated by solar and wind energy, batteries are employed. The size of the solar or wind power plant may have an impact on the battery's capacity. Low charge leakage and low maintenance should be characteristics of the battery.



Fig..5. Battery

4) Inverter

With the use of the proper transformers, switching, and control circuits, an inverter is an electrical device that transforms direct current (DC) into alternating current (AC). The converted AC can be produced at any desired voltage and frequency.



Fig..6. Inverter Module

VI. ADVANTAGES

1) Due to the fact that during this season, energy is provided by way of the wind device, there isn't enough solar radiation even during the rainy and icy seasons.
2) Strength is provided by solar panels because of the changing climatic conditions when wind power is unavailable.
3) Low labour and renovation costs make it the least expensive.
4) Is used everywhere, whether of not the area is remote, far away, or densely populated.
5) Very green strength generation
6) Solar and wind-powered sites are environmentally friendly since they can reduce carbon emissions and other harmful materials in the environment by around 90%.

VII. APPLICATIONS

1) Generated energy that is dispersed
2) Hospitals, motels, lodges, and so on.
3) Electrification of remote and rural regions.
4) Public illumination.
5) Better programmes and transmission towers for communication

VIII. CONCLUSIONS

Comparing hybrid systems to non-renewable energy sources, hybrid systems are one of the most practical and efficient ways to generate power. It is not only less expensive, but it also has no negative environmental effects. In steep places, where it is challenging to distribute electricity using traditional means, it can also be utilised to create electricity. Its setup can be chosen based on the requirements. To a certain extent, all individuals on the planet should be encouraged to manufacture their own electricity from unconventional resources. Some of its advantages include a long lifespan and minimal maintenance. Simply said, a sizable upfront expenditure is necessary.

We must all be encouraged to employ precise resources to generate electricity in order to put strength to use globally. give them confidence in a specific quantity. Longer lifespans tend to spread, and one of its primary causes is less protection. It only needs a few significant upfront investments.

As we realise that the hybrid vehicle uses the available resources in a sustainable manner while still having a higher unit manufacturing cost. This hybrid device is also capable of escaping any unforeseen or undesirable circumstances. Moreover, hybrid machines are able to satisfy the need for rural and motorway areas. Thus, it is obvious that the hybrid device is the top pick.

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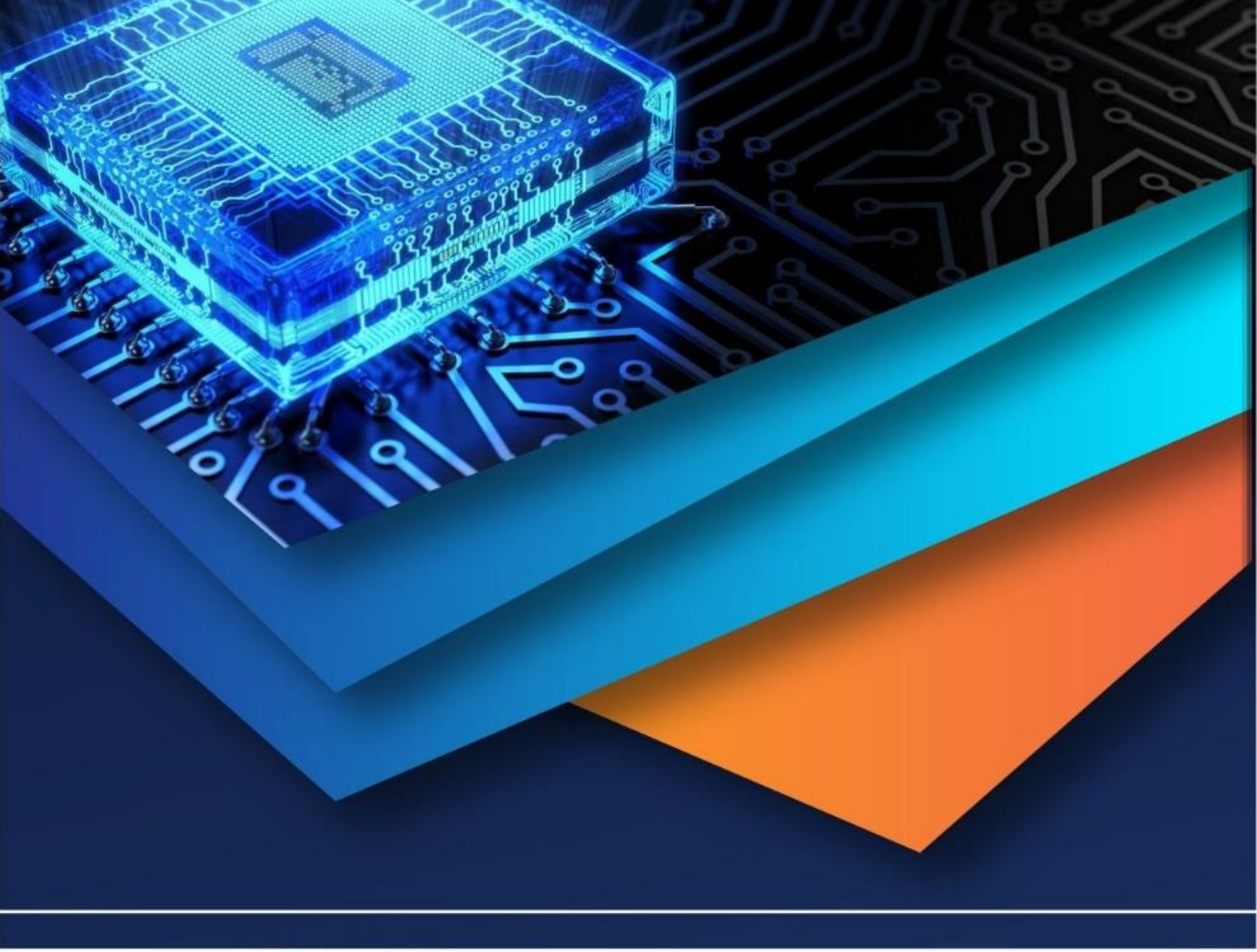
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