Solar And Wind Powered Hybrid System for Electric Vehicles using MPPT

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ABSTRACT

As the world's energy demand rises, the search for fossilfuels becomes more urgent. These fuels are not environmentally friendly and harm the environment. Due to a lack of fossil fuel supplies and harmful environmental effects, the usage of Non-conventional sources like solar energy and wind energy has become critical. Solar and wind energy are non- depletable natural resources that are increasingly popular. Solar and wind power have emerged as viable alternative energy sources due to their accessibility and ease of use, the combination of solar and wind energy has led to the development of a renewable energy system known as a Solar-Wind Hybrid Power System (SWHPS). This system harnesses the power generation capabilities of both solar and wind energy technologies. Optimized utilization of these natural resources is required to produce power in order to lessen the power demand on the conventional power producing industry. Solar-wind hybrid systems with MPPT are becoming increasingly popular as a sustainable and efficient solution for generating renewable energy. For maximalpower transfer, the constant voltage approach is used. This approach should include a few critical aspects to improve its stability and efficiency.

Keywords: Wind Energy System, Solar Energy System, MPPT Controller

1 Introduction

As the world faces a looming shortage of fossil fuels, it is crucial to explore alternative sources of energy to replace them. Among the various renewable energy sources available today, solar power stands out as a particularly promising option. Meanwhile, wind energy is another sustainable and eco-friendly resource that has gained popularity in the electricity sector, although it has yet to be widely adopted as a direct power source in the automotive industry. As a result, a hybrid system combining solar panels and wind turbines has been built and installed to generate power. As a result, we are building a new model that is entirely dependent on renewable energy, thereby removing our need on fossil fuels. Generating power from solar and wind energy using moving automobiles is a complex task and requires specialized technology. However, the concept of replacing fossil fuel-powered vehicles with electric vehicles (EVs) charged using Non-conventional sources like wind and solar is already being widely adopted around the world.

As a result, a charging station based on renewable energy has enormous potential and control for charging electric vehicles. For the current scenario, an electric vehicle charging station using solar power and a Battery Energy Storage System is planned. Using an innovative way, additional grid assistance is considered for uninterrupted power in the charging station without being an additional load to the system. Non-conventional sources like photovoltaic and wind energy, have become more efficient, reliable, and cost-

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effective thanks to the advances in power electronics technology. Essentially, solar radiation, wind speed and direction are complimentary profiles. Because the public does not visit their homes, the communities outside of urban centres face installation and wiring challenges. In these instances, these energy sources are a viable option. A hybrid system outperforms an unusual source in terms of performance.

When it comes to these two energy supplies, the output is not guaranteed owing to environmental or day and night conditions. That is the result of Solar-Wind systems are unpredictable; one may produce more electricity, while another may produce less or no power. As a result, this system's output voltage needed to be stabilized due to the effects of global warming, it has become essential to adopt new Non-conventional sources like solar and wind energy. Solar and wind energy are two of the most popular and promising sources of renewable energy. Renewable resources of some kind can be found in every part of the planet. As a result, research into renewable energies is becoming increasingly important. Numerous research studies have investigated the feasibility of utilizing renewable energy sources for power generation. Solar and wind energy systems are known to be inherently unstable because of their unpredictable nature.

2 Literature Review

The concept of using wind and solar energy to power a vehicle is not a new one, but it has yet to be fully implemented on a large scale. However, as the world moves towards a more sustainable future, it is becoming increasingly important to find alternative sources of energy to power our vehicles [1]. The fundamental grasp of Hybrid Vehicle Prototyping can be seen in [2]. It also makes recommendations for wind system design Including a truncated cone in the design of a wind turbine or fan can help to induce more wind in the direction of the device and increase its efficiency in generating electricity. [2]. A Solar Electric Powered Hybrid Vehicle (SEPHV) system that tackles the key fuel and emissions challenges having 1.2HP, 24V Permanent Magnet DC Motor as its engine, a battery set of 12V, 150AH provides power to the motor [3]. The hybrid system, which combines a wind turbine and a solar panel, was built and installed to generate power. This type of system can help conserve energy by using less fuel than traditional gasoline-only vehicles. Renewable energy has enormous potential for power generation. This article clearly shows that vehicles driven by solar and wind energy are more efficient than petroleum vehicles [1]. A smart vehicle that runs on solar and wind energy rather than any form of fossil fuel. It is made up of two generating units first of which is positioned on the front of the vehicle, the second of which is mounted on the top of the vehicle, and the DC gear motor is coupled to the back of the wheels [4]. The use of a speed control switch with multiple tapping and different values of resistance is a common technique to change the motor speed. By changing the resistance in the circuit, the voltage and current supplied to the motor can be varied, which in turn affects its speed in the case of a SEPHV (Solar Electric Personal Hybrid Vehicle), this technique can be particularly useful for reducing running costs and increasing running efficiency. By adjusting the speed of the motor to match the requirements of the vehicle, the battery can be conserved, and the vehicle can run for longer distances on a single charge. This can be especially important for electric vehicles, which often have limited range due to the capacity of their batteries. The solar panel mounted on the vehicle's roof, and the battery is utilised to store electricity. A basic digital metre indicating battery storage percentage and vehicle speed is to be fitted on the device handle side [4]. A step-down transformer reduces the 230V domestic power supply to 48V, converted to DC using a rectifying device for battery charging. The PV panel absorbs power, which is stored in four 150 AH 12 V batteries [3]. The use of a speed control switch with multiple tapping and different values of resistance is a common technique to control the speed of a motor. One of the functions of SEPHV's speed control switch is to improve the vehicle's running efficiency and reduce its operating expenses [3].

3 Components

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3.1 Solar Panel - Monocrystalline

Monocrystalline solar panels are made from monocrystalline silicon, which is a highly-purity form of silicon that is grown from a single crystal. The process involves melting the silicon and then slowly cooling it in a controlled environment to form a single crystal, this crystal is then into thin wafers, which are used to make the solar cells that forms the basis of the monocrystalline solar panel.

3.2 DC-DC Converter

DC-to-DC converters are devices that store electrical energy momentarily in order to convert direct current (DC) from one voltage level to another. They are a vital mediator between systems with varying voltage levels throughout the car in automotive applications.

4 System Description

The mechanism comprises of a wind turbine linked to a gear box as shown in figure 1, designed to vary the speed as needed. Consequently, the torque produced will be inversely proportional to the speed. The MPPT controller continuously monitors the PV module's output and compares it with the battery voltage to identify the maximum power point (MPP) at which the module can provide optimal charging power to the battery. Based on this information, the controller adjusts the PV module's voltage to match the battery voltage, allowing maximum current to flow into the battery. The DC-DC chopper converts the DC supply, and the resulting output is then fed into the motor driver, which is responsible for driving the DC motor.

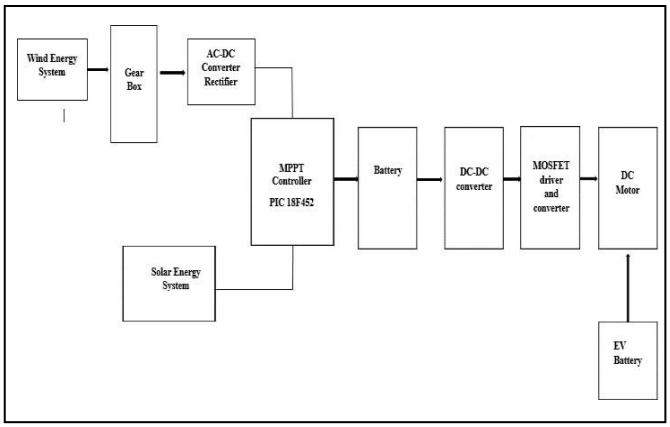

Figure 1: *Block diagram of solar and wind hybrid energy System using MPPT Controller*

Note. MPPT stands for Maximum Power Point Tracking, which is a technique used in solar power systems to maximize the power output of photovoltaic panels by continuously tracking and adjusting the voltage and current levels to match the optimal operating point of the panels.

The system consists of the following components:

- Solar Panel- Monocrystalline
- Rotary fans for wind power
- Generator for wind power
- DC-DC Converter
- Li-ion Battery (Depends on overall cost)
- LCD Display for voltage and speed measurement
- DC motor
- Object detecting sensor (Optional Renewable energy sources are crucial for sustainable development, and among them, solar energy plays a significant role. The types of solar technologies are

passive and active. Passive solar approaches involve designing buildings to maximize the benefits of natural sunlight and heat. One way to design a building for energy efficiency is to consider factors such as the orientation of the building in relation to the sun, the use of materials that can store and distribute heat effectively, and the creation of rooms that encourage natural air circulation for cooling purposes and there are long-term benefits to developing solar energy production methods that are both economically viable and environmentally friendly.

Wind energy is an eco-friendly and sustainable energy source that is gaining significance as nations seek alternatives to decrease their dependence on non-renewable energy sources. The wind turbines in wind energy systems convert the kinetic energy in the wind into mechanical energy, which is then converted into electrical energy by a generator. One of the advantages of wind energy is that it is widely available and can be controlled in many different locations, both onshore and the offshore. Another advantage is that it will not emit harmful gases or pollutants, which makes it a very clean source of energy.

Hybrid power systems that combine solar and wind energy have several advantages over standalone systems. The combination of solar and wind power can help to smooth out fluctuations in power generation, since wind speeds are often higher in the winter when solar production is lower, and vice versa. In remote locations or areas without access to a power grid, hybrid power systems that integrate both wind and solar power have gained popularity as a means of generating electricity. These systems are designed to work together to produce power when it is needed, with wind turbines providing energy during periods of high wind and solar panels generating electricity during peak sunlight hours.

When the charge in our existing electric vehicles runs low, there is no backup system. There is a scarcity of charging stations. Fixed wind-based electricity generation systems have traditionally been dependent on the direction and strength of the wind, which is not consistently available in all locations throughout the year. To address this issue, there is a growing demand for a system that can harness wind energy from moving vehicles, providing a year-round source of power in various locations and wind conditions.

A true hybrid vehicle combines two or more power sources to provide improved fuel efficiency and lower emissions. A solar-powered electric vehicle charging system, on the other hand, simply provides an alternative way to charge the vehicle's batteries using renewable energy.

5 Advantages

- Zero Carbon emission
- Use of brushed motor
- Vehicle speed has been increased
- Environment Friendly
- Self-Generation of power.
- Reduce cost of charging
- Less Reliant on charging stations.

6 Conclusion

There are certainly many benefits to using a solar and wind powered hybrid vehicle. One of the most significant advantages is that it can help reduce pollution and greenhouse gas emissions. Unlike traditional vehicles that rely on fossil fuels, these vehicles can generate their own electricity from renewable sources like solar and wind power. Another advantage of using a solar and wind powered hybrid vehicle is that it can be cost- effective in the long run. MPPT stands for Maximum Power Point Tracking, which is a technique used in solar power systems to maximize the power output of photovoltaic panels by continuously tracking and adjusting the voltage and current levels to match the optimal operating point of

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the panels. In hybrid system that combines multiple non-conventional energy sources like wind, solar and battery storage, MPPT can play a crucial role in improving the efficiency and reliability of the system. By continuously monitoring and adjusting the power output of each energy source, MPPT can ensure that the system is operating at its maximum capacity and generating the maximum amount of energy possible.

7 Publisher's Note

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