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Solar and Wind Power Based Electrical Vehicles

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Abstract

The Solar-Wind Electric Vehicle (SWEV) is a forward-thinking innovation in sustainable transportation that combines solar and wind energy harvesting systems with electric vehicle (EV) technology to improve energy efficiency, extend operational range, and reduce environmental impact. By integrating two renewable energy sources, the SWEV addresses key limitations of traditional EVs, such as limited range and dependence on external charging infrastructure. The design features high-efficiency photovoltaic panels mounted on the roof, hood, and other surfaces to maximize sunlight capture, converting solar energy into electricity that is stored in an onboard battery system. At the same time, a lightweight wind turbine is strategically positioned to harness airflow during vehicle motion, generating additional power and supplementing the energy provided by the solar panels. This dual energy collection system allows the vehicle to generate power both while in motion and when stationary, ensuring continuous energy accumulation and minimizing the need for frequent recharging from external power sources. The onboard battery, typically a lithium-ion or solid-state system, stores the harvested energy and powers the electric motor, while a smart power management system optimizes the distribution of energy between the motor, battery, and auxiliary systems, enhancing overall performance and efficiency. The combination of solar and wind energy significantly reduces the vehicle's carbon footprint by eliminating greenhouse gas emissions, contributing to cleaner air and supporting global efforts to combat climate change. The SWEV's simple yet effective design also promotes energy independence by reducing reliance on fossil fuels and electricity grids, aligning with the broader shift toward renewable energy adoption and sustainable development. While challenges such as limited surface area for solar panels, weather dependency, and the need for further advancements in photovoltaic efficiency and battery storage remain, ongoing technological progress is steadily addressing these obstacles.

Introduction

The Solar-Wind Electric Vehicle (SWEV) represents a significant leap forward in the pursuit of sustainable and eco-friendly transportation. As the global community grapples with the dual challenges of energy security and environmental degradation, the integration of renewable energy sources into the automotive industry has become a focal point of innovation. The SWEV is a pioneering concept that combines solar and wind energy harvesting systems with electric vehicle (EV) technology to create a more efficient, self-sustaining mode of transport. This approach not only reduces reliance on fossil fuels but also contributes to the reduction of greenhouse gas

emissions, aligning with global efforts to combat climate change and promote greener mobility solutions.

At the heart of the SWEV's design are high-efficiency photovoltaic panels and a compact wind turbine, strategically integrated to maximize energy capture. The solar panels, mounted on the vehicle's roof and hood, convert sunlight into electrical energy, which is stored in an onboard battery system. Simultaneously, the wind turbine harnesses airflow during vehicle motion, generating additional power to further enhance the vehicle's energy efficiency. This dual energy system ensures that power generation occurs both while the vehicle is stationary and in motion, thereby extending the operational range and minimizing the need for frequent external

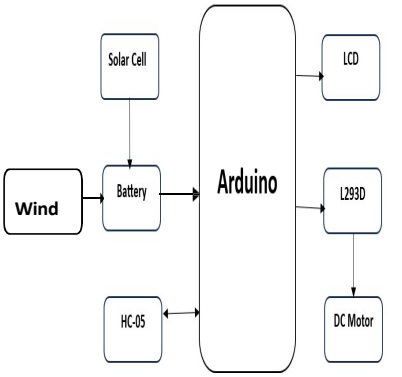

Figure 1.1: Block Diagram of Solar and Wind Power Electric Vehicles

The primary objective of the SWEV project is to demonstrate the feasibility of utilizing renewable energy to power electric vehicles, thereby reducing the consumption of fossil fuels

and decreasing carbon emissions. By leveraging readily available solar and wind energy, the project aims to provide a cost-effective, environmentally friendly alternative to traditional gasoline-powered vehicles. The SWEV not only lowers operational costs by utilizing free energy from natural sources but also addresses the growing demand for energy independence and sustainable transportation solutions.

Despite its numerous advantages, the development of SWEV technology is not without challenges. Limitations in surface area for solar panels, dependency on weather conditions, and the current state of battery storage technology pose significant hurdles. However, ongoing advancements in photovoltaic efficiency, battery capacity, and lightweight materials are gradually addressing these limitations, enhancing the practicality and scalability of the SWEV concept.

In conclusion, the Solar-Wind Electric Vehicle stands as a testament to the potential of renewable energy integration in the automotive sector. This project not only contributes to the reduction of environmental pollution but also paves the way for a future where transportation is driven by clean, sustainable energy. As technology continues to evolve, the SWEV is poised to become a cornerstone in the shift towards a greener, more resilient transportation ecosystem.

Literature Survey

Electric vehicle are seen as a means of reducing carbon emissions for transport operations. The first mass produced fully electric vehicle was the Nissan leaf. The number of leafs sold passed 50,000 on the 14th feb, 2013 and the total mileage covered by leafs has exceeded 161millions miles.

The sales of battery electric vehicles such as the leaf are exceeding those of the Toyota prius, the first mass produced hybrid vehicle, at an equivalent stage of its market life. e-ISSN: 2582-5208 International Research Journal of

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Vehicle to grid technology, allowing electric vehicles to act as a powersources, is seen as major selling point for electric vehicle technology. The use of vehicle batteries in this way means that overnight charging the vehicles can be used as localized buffers to smooth the load on the power supply grid. This project not only contributes to the reduction of environmental pollution but also paves the way for a future where transportation is driven by clean, sustainable energy.

The US Department of defense is investing $20million to demonstrate the concept using a fleet of electric vehicles and it is believed that the use of the vehicles in this way will offset the increased purchase costs of the electric vehicles.

A further advantage offered by battery electric vehicles is the removal of emissions from the point of operations, offering improved air quality in congested cities.

Despite the sales achieved, EV uptake has so far fallen short of expectations. The main reasons are related to perceptions of poor performance and range along with cost.

Most of the vehicles are running on the gasoline fuels. These vehicles exhaust hazards gases. This increases the environmental pollution in the world. In recent years to reduce the pollution researchers have given the solution of EV's or hybrid vehicles and many countries adopted this as one of the best solutions to reduce pollution. The popularity is due to battery and silent operations. The present challenge is the optimization of best battery and charging. This project not only contributes to the reduction of environmental pollution but also paves the way for a future where transportation is driven by clean, sustainable energy.

Existing System

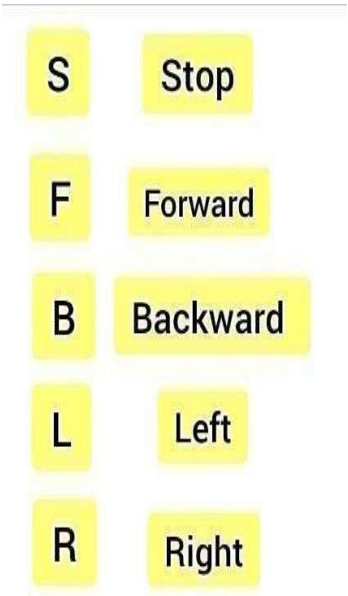
One prominent alternative is Battery Electric Vehicles (BEVs), which operate solely on electricity stored in batteries. These vehicles are charged from the grid or renewable energy sources, making them a clean option with zero tailpipe emissions. Recent advancements in battery technology have significantly improved the range and efficiency of BEVs, making them increasingly viable for everyday use. As the infrastructure for charging stations expands, BEVs are becoming more accessible to consumers, contributing to a shift towards greener transportation.

Another noteworthy option is Plug-in Hybrid Electric Vehicles (PHEVs). These vehicles combine a conventional internal combustion engine with an electric motor and a rechargeable battery. PHEVs can be charged from the grid, allowing for electric-only driving over shorter distances while still having the flexibility to use gasoline or diesel for longer trips. This dual capability addresses range anxiety, making PHEVs an attractive choice for drivers who may not have consistent access to charging facilities.

Hydrogen Fuel Cell Vehicles (FCVs) represent another innovative approach. These vehicles utilize hydrogen gas to generate electricity through a fuel cell, producing only water vapor as a byproduct. FCVs offer the advantage of quick refueling times and longer ranges compared to Another noteworthy option is Plug-in Hybrid Electric Vehicles (PHEVs). These vehicles combine a conventional internal combustion engine with an electric motor and a rechargeable battery. These vehicles are charged from the grid or renewable energy.

Proposed System

The proposed system aims to develop a hybrid electric vehicle powered by both solar and wind energy, providing an innovative solution to reduce the harmful environmental impacts caused by fossil fuel-based transportation. The central concept revolves around utilizing freely available and renewable energy sources solar radiation and wind flow to generate electricity on the go. A



high-efficiency solar panel is mounted on the vehicle to capture sunlight and convert it into electrical energy, while a compact wind turbine is strategically placed to harness wind energy generated by the vehicle's motion or natural airflow. The combined power from these sources is regulated through a smart charge controller and stored in a rechargeable battery pack, which supplies energy to a lightweight brushless DC motor integrated into the wheel mechanism. This motor delivers smooth and efficient propulsion, enabling the vehicle to move without emitting any pollutants. The system may also include a monitoring module to display real-time data such as battery voltage, power input from solar and wind sources, and motor status. The primary aim of this project is to build a functional hardware model of a hybrid electric vehicle that demonstrates the potential of renewable energy integration in transportation. By focusing on sustainability, innovation, and energy efficiency, the project aspires to contribute toward reducing carbon emissions and promoting a greener future through clean mobility solutions.

The proposed system not only addresses environmental concerns but also emphasizes practicality and adaptability. The hybrid approach ensures a continuous power supply even in less favorable weather conditions—solar energy during sunny periods and wind energy during vehicle motion or breezy conditions. This dual-source energy model improves the vehicle's reliability and range compared to conventional solar-only systems. Additionally, the use of lightweight materials and energy-efficient components helps in reducing the overall energy consumption, making the vehicle more viable for real-world applications.

Result

Solar and Wind Power-Based Electrical Vehicles, successfully integrates renewable energy sources solar panels and wind turbines to power an electric vehicle. The 140 Wp solar panel generates up to 25V DC during optimal sunlight hours, while the wind turbine complements this by harnessing airflow during motion. Energy is efficiently stored in a battery system, protected from overcharging and deep discharge by a charge controller.

The Arduino microcontroller manages energy flow and system components, while an LCD display provides real-time monitoring. This setup powers a DC motor for eco-friendly vehicle

operation, showcasing reduced reliance on fossil fuels and a significant step towards sustainable transportation.

Figure 8.1: Command window

Figure 8.2: Commands

Figure 8.3: Front view of SWEV

Solar and Wind Power Based Electric Vehicle (SWEV) utilizes both solar panels and a small wind turbine to generate renewable energy, which is stored in a battery and used to power the vehicle's electric motor. This dual-source energy system ensures efficient charging even during low sunlight conditions, improves overall energy availability, and reduces dependence on sources.

Figure 8.4: Side view of SWEV

By combining two natural energy sources, the system ensures better energy reliability in varying weather conditions, making the vehicle more sustainable, environmentally friendly, and suitable for long-term use in clean transportation solution.

Conclusion and Future Scope

Conclusion:

This project focuses on researching, designing, building, and testing a working prototype of a solar and wind-powered electric bus aimed at promoting sustainable and eco-friendly transportation. By integrating solar and wind energy systems, the hybrid setup reduces dependence on fossil fuels, achieves zero emissions, and optimizes energy efficiency for consistent operation. The project emphasizes innovative design, construction, and renewable energy utilization, offering a cost-effective

solution with lower maintenance compared to traditional fuel-based vehicles. Features like regenerative braking, advanced battery management, and real-time monitoring enhance energy storage efficiency, safety, and system performance. Ideal for remote areas with limited infrastructure, this prototype not only demonstrates the practical application of clean energy in public transit but also supports climate change mitigation and the shift toward greener, smarter cities.

This solar and wind-powered electric bus prototype highlights energy resilience by generating its own power, reducing reliance on external charging. Ideal for remote areas, it uses real- time monitoring for efficient energy management and safety. The project supports sustainability and drives innovation in clean, self-sustaining public transport.

Future Scope:

To enhance EV charging efficiency and user experience, key improvements include better internet connectivity for real-time updates, advanced software for locating nearby stations with GPS and online payments, stronger server security, regular system updates, and smart charging features like automatic payments and invoicing.

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