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Smart EV Charging Station Using Hybrid Power Generation System

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ABSTRACT: The Smart EV Hybrid Charging Station project presents a sustainable and efficient solution for electric vehicle (EV) charging by integrating renewable energy sources with grid power. The station utilizes wind and solar power to charge EV batteries, with a relay system and IoT application (Blynk) managing the power sources based on availability and demand. The project aims to reduce reliance on non-renewable energy sources and minimize the carbon footprint of EV charging infrastructure. The system architecture includes a wind turbine, solar panels, grid connection, relay system, IoT application, and battery management system. The wind turbine and solar panels generate power, which is managed by the relay system to charge EV batteries. The IoT application enables remote monitoring and control of the charging station, providing real-time data on energy consumption and power source selection. The implementation of the Smart EV Hybrid Charging Station involves the installation of renewable energy sources, connection to the grid, integration of the relay system, development of the IoT application, and testing and optimization of the system. Data on charging status, energy consumption, and power source selection are collected and analyzed to evaluate the performance of the station. The Smart EV Hybrid Charging Station project demonstrates the feasibility and benefits of integrating renewable energy sources into EV charging infrastructure. By combining wind and solar power with grid power, the station offers a sustainable and efficient charging solution for EV owners. The project contributes to the advancement of sustainable transportation infrastructure and highlights the potential of renewable energy integration in addressing environmental challenges. The results show that the renewable charging mechanism is suitable for charging electric cars and creates a pollution-free environment.

KEYWORDS: Electric Vehicles, Solar Energy, Wind Energy.

I. INTRODUCTION

The Smart EV Hybrid Charging Station project is a pioneering initiative aimed at revolutionizing the way electric vehicles (EVs) are charged. With the growing emphasis on sustainability and the need to reduce greenhouse gas emissions, the transportation sector is undergoing a significant transformation. EVs have emerged as a promising alternative to traditional gasoline-powered vehicles, offering lower emissions and reduced environmental impact. However, the widespread adoption of EVs is dependent on the availability of efficient and sustainable charging infrastructure. The Smart EV Hybrid Charging Station addresses this need by integrating renewable energy sources – wind and solar power – with the conventional grid power supply. This hybrid approach ensures that EVs can be charged using clean energy whenever possible, while also providing the reliability and accessibility of grid power. The station's intelligent power management system dynamically adjusts the power source based on factors such as weather conditions, energy demand, and battery status, optimizing the charging process for efficiency and sustainability. Furthermore, the Smart EV Hybrid Charging Station serves as a demonstration of the feasibility and benefits of integrating renewable energy sources into EV charging infrastructure. By showcasing the environmental and economic advantages of this approach, the project aims to encourage the adoption of similar solutions in other locations and sectors. Additionally, the station's modular design and scalable architecture make it adaptable to different environments and energy requirements, further enhancing its versatility and applicability. The charging system integrates these renewable energy sources with EV charging infrastructure, including charging stations and associated electronics. Solar and wind energy generated onsite can be stored in batteries or directly fed into EVs to charge their batteries. These systems can also be connected to the grid, allowing excess energy to be exported when production exceeds demand and imported when additional energy is needed.

Overall, solar and wind electric vehicle chargers offer a sustainable and environmentally friendly way to power EVs,



reducing reliance on fossil fuels and lowering carbon emissions associated with transportation. In conclusion, the Smart EV Hybrid Charging Station represents a significant advancement in sustainable transportation infrastructure. By combining renewable energy sources with innovative technology, the station offers a glimpse into the future of EV charging, where sustainability, efficiency, and reliability are paramount. As the world transitions towards a cleaner and greener future, initiatives like the Smart EV Hybrid Charging Station will play a crucial role in shaping the future of transportation.

II. LITERATURE REVIEW

[1] K. Chellaswamy et al. 2012, Currently, electric vehicle batteries are charged at parking lots, roadsides and ordinary household sockets. Electric vehicle storage systems require a long time to charge the battery, which depends on its capacity. Chellaswamy et al. introduced a new charging method. To charge an electric car. The control system of this mechanism automatically charges the battery without the participation of the driver. Perform a performance analysis and compare the results.

[2] Majid Pahlevaninezhad et al. 2014. A camera equipped with a high sampling rate sensor is used to estimate EV slip measurement. The performance of this model is based on an estimate. It uses multilevel Kalman filtering. Rechargeable electric cars are used to reduce greenhouse gas emissions. A high-frequency AC/DC converter is used to charge the conductive battery, and an electromagnetic interference (EMI) filter is connected to the high-frequency converter to suppress the EMI interference studied.

[3] Praveen Kumar et al. (2013) This paper discusses about the potential need for electric vehicles (EV), charging station based on an estimate (CS) infrastructure and its challenges for the Indian scenario. Up to now the BEV's bottleneck is in the range of 100 km per charge due to limited on-board energy which can be optimized by introduction of plug-in hybrid vehicles along with real-time road traffic management. With increase in liberalization, privatization and expansion of distributed and renewable power generation of Indian electricity market, transmission and distribution, as well as market processes related to the allocation of energy and energy mix are undergoing an evolutionary development with improved efficiency.

III. OBJECTIVES

Following are the Main objective of Smart EV Charging Station Using Hybrid Power Generation System.

- Design a hybrid power generation system using solar –wind-piezo generator
- Making model for charging electric vehicles with 3 different hybrid sources with Main power supply.
- To increase the power efficiency through hybrid source
- To test the output results after implementing prototype model
- To write research paper and thesis as per result and analyses from given model.

IV. RESEARCH METHODOLOGY

Fast charging as an indoor electric vehicle board is hindered by the cost of the electronic components needed to convert the electricity, which increases the overall cost of the electric car. However, built-in chargers cannot ensure fast EV charging due to the high cost of EV-related electronics and increasing the charging capacity of the car. To ensure faster charging of electric vehicles, external chargers are used that provide high direct current. It is worth noting that in external chargers, the entire conversion from AC/DC is done by an independent inverter. That is why it is important to increase the power of the converters to ensure faster charging of the car. The results of several published studies have been used in the design and development of efficient and reliable electric vehicle charging systems at electric vehicle charging stations.

V. BLOCK DIAGRAM & WORKING

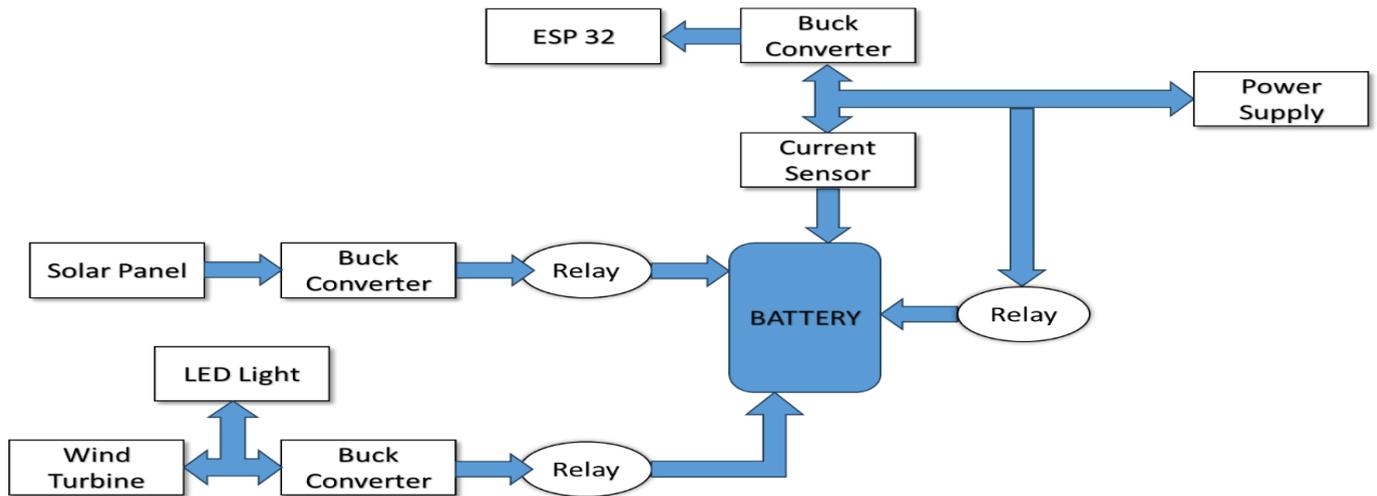


Fig.1 Block Diagram

This project gives a clear picture of a solar wind piezoelectric charging system. And constant electrical charging makes it easy to replace the battery during repairs. This was done keeping in mind the charging points that will appear in the near future. The effectiveness of the proposed centralized energy management strategy with intermediate conversion steps is investigated and tested using different real-time scenarios. This scenario consists of different weather profiles over a 2-hour period and different alternating EV load conditions. Simulations and similar tests of the entire system are carried out. Arduino 328p controller is used to control all charging functions. The LCD display shows the real-time power monitoring system. It also uses solar, wind and piezoelectric generators and DC boost converters to store energy in batteries. Finally, the Inverter module is used to convert direct current to alternating current for direct charging of electric vehicles. To investigate the effectiveness of the proposed strategy, different real-time solar energy profiles are considered, which include sunny, partly sunny and cloudy conditions. For all scenarios, conclusions are drawn about the fixed, analytical and energy balance of source and EM loads. The system also maintains a constant regulated DC bus voltage due to the proposed power control and monitoring architecture.

VI. COMPONENTS SPECIFICATION



Fig 2. Solar Panel (12v25w)

Solar energy is that energy which we get from the sun in form of radiation. It does not cause any kind of pollution, it is inexhaustible. It is available free of cost. A solar cell is used to convert solar energy into electric energy, it is also known as photovoltaic cell.



Fig 3. Buck Converter

A boost converter (step-up converter) is a DC-to-DC power converter that steps up voltage (while stepping down current) from its input (supply) to its output (load). It is a class of switched-mode power supply (SMPS) containing at least two semiconductors (a diode and a transistor) and at least one energy storage element: a capacitor, inductor, or the two in combination.



Fig 4. ESP 32

The ESP32 is a versatile microcontroller developed by Express if Systems. It features a dual-core processor, Wi-Fi and Bluetooth connectivity, and a wide range of GPIO pins, making it suitable for a variety of IoT applications. Here are some key details about the ESP32 Processor: Dual-core Tensilica LX6 microprocessor, clocked at up to 240 MHz. Memory: 520 KB SRAM for data and 448 KB ROM for program storage. Connectivity: Built-in Wi-Fi (802.11 b/g/n) and Bluetooth (v4.2 and BLE) for wireless communication. GPIO Pins: 34 GPIO pins with support for PWM, I2C, SPI, UART, and other common communication protocols. Analog Inputs: 18 analog inputs with 12-bit resolution. Operating Voltage: 3.3V, but some pins are 5V tolerant. Programming: Can be programmed using the Arduino IDE, ESP-IDF (Express if IoT Development Framework), or other compatible development environments. Power Consumption: Can be optimized for low power applications, with sleep currents as low as 5 μ A. Overall, the ESP32 is a powerful and cost-effective microcontroller that is widely used in IoT projects due to its rich feature set and ease of use.

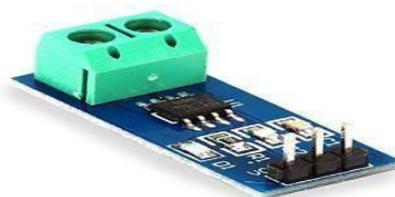


Fig 5. Current Sensor

A current sensor is a device that detects and converts current to an easily measurable output voltage, which is proportional to the current through the measured path. There are a wide variety of sensors, and each sensor is suitable for a specific current range and environmental condition.



Fig 6. Battery

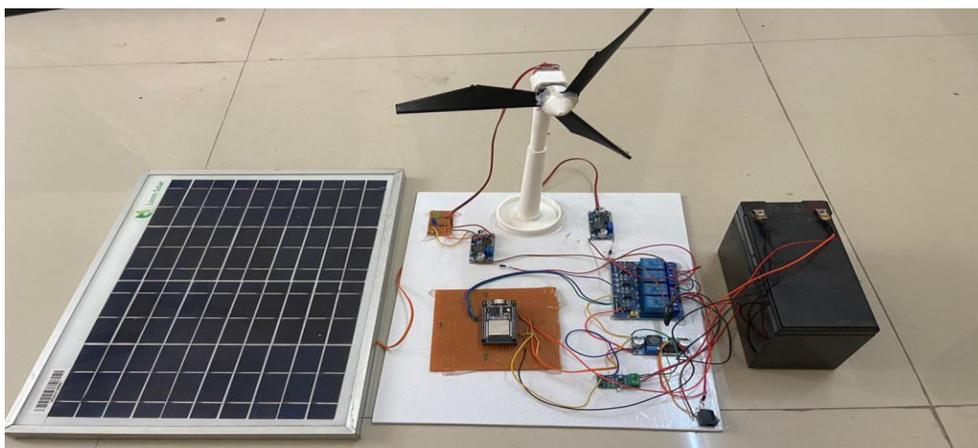
The batteries are used in order to store the electricity that is produced from Piezo and solar energy. The capacity of battery may vary depending on the size of input power produce.



Fig 7. Motor

The generator in a wind turbine converts mechanical energy from the rotating blades into electrical energy. Common types of generators used in wind turbines include asynchronous (induction) generators and permanent magnet synchronous generators (PMSGs). PMSGs are often preferred for their higher efficiency and better performance at variable wind speeds.

HARDWARE





ADVANTAGES

1. A microcontroller, a smart chip, is introduced. Therefore, the system can be modified according to the needs of the application.
2. Use a microcontroller to ensure system reliability.
3. The system is user friendly and easy to use.
4. The system becomes compact and convenient.
5. Eco-friendly and cost-efficient system.
6. The system must be designed for a high current rating in amperes.

VII. CONCLUSION

The project gives a clear view of solar-wind charging system. And it is an easier technique to replace the battery with continuous power supply to charging station, in case of any repair. This work is done considering the charging stations that are going to come in near future. The performance of the proposed centralized energy management strategy together with interleaves conversion stages is studied and validated with different real-time scenarios. These scenarios consist of different weather profiles covering the 24h horizon and various intermittent EVs loading conditions. The modeling of the whole system and the corresponding experiment are performed. In order to examine the performance of proposed strategy, different real-time PV profiles covering sunny, partially sunny and cloudy conditions are considered. During all the scenarios, it is recorded, analyzed and concluded that energy balance between sources and the EVs load retains. At EV stations, some electric vehicles have on-board converters that can plug into a standard electrical outlet or a high-capacity appliance outlet. Others either require or can use a charging station that provides electrical conversion, monitoring or safety functionality. These systems are becoming more common and suitable for the development of fast charging stations. Solar energy system and battery technologies are also important to increase the adoption of this type of system. For further research, new systems allow energy flow between electric cars. Therefore, minimizing the dimensions of charging stations can be considered as an alternative. This is the supposed reason for fast charging stations. To control and minimize the negative effects of this new load potential on the grid, the use of local energy resources is inevitable. Electric vehicles should benefit effectively from these sources. This study investigates a hybrid fast charging system powered by local renewable energy sources instead of the grid.

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