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Intelligent Hybrid EV Charging Framework

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Abstract-

Nowadays, EV vehicles are increasing day by day. In the present day, charging stations rely on grid electricity, which results in increased carbon emissions and higher energy costs. To overcome this problem, this paper introduces an EcoPulse EV charging system using IoT, BMS, and an automatic surplus energy system. This framework integrates solar, wind, and the grid to ensure continuous and optimized EV charging. The IoT-based monitoring system will monitor the charging status. The BMS will protect the battery from overcharging, overheating, and voltage imbalance, improving battery life and safety. The GSM will provide instant notifications regarding the charging process. Once the EV battery is fully charged, the remaining charge will be transferred to a nearby home instead of that electricity being wasted. This framework will improve renewable energy utilization and reduce dependence on the grid, keeping electricity costs low. It is eco-friendly and reliable for future electric vehicle charging.

Keywords – electric vehicles, IoT, BMS, GSM, surplus energy.

INTRODUCTION

The rapid growth of EV vehicles will help us provide a clean and more sustainable environment. Instead of using fuel-powered vehicles, use EV charging vehicles. The government promotes EV vehicle adoption to reduce greenhouse gas emissions and to achieve global environmental sustainability across the world. currently, existing EV charging stations depend only on grid electricity, which costs more money to run and prevents us from using clean power from the sun and wind.

Renewable energy sources such as solar and wind are ecofriendly; it is a solution for EV charging. By using solar energy in a day time and wind energy generate electricity under suitable weather conditions. If solar and wind is unavailable the grid will be useful. By integrating solar, wind and grid a charging system can provide continuous and efficient power for electric vehicle. Solar and wind power changes all the time based on the weather.

By using Internet of things (IoT) that enables real time monitoring and control of energy system. This IoT technology allows users and operators to monitor charging status, battery condition, power consumption, renewable energy generation. Here battery management system (BMS) plays a vital role in ensuring battery safety by measuring voltage, current, temperature and state of charge. It protects the battery from deep discharge, overcharging, overheating and cell imbalance. It improves battery life, charge efficiency and operational safety. Global system for mobile communication (GSM) will provide a instant notification to user's mobile phone regarding charging status, system faults and energy availability. Surplus renewable energy efficiently to minimize energy waste. The proposed system is cost efficiency, reliable, scalable and environmentally sustainable.

It will be helpful for future smart cities.

RELATED WORK

Many researchers have looked into hybrid renewable energy-based EV charging systems to reduce dependence on grid electricity and improve charging efficiency.

[1] For continuous EV charging and to minimize the charging cost the system integrated Solar photovoltaic (PV), Battery energy storage (BES), Diesel generator (DG) and utility grid. It uses a smart power control plan to make sure charging never stop, even when the power sources change. But the system did not include Internet of things (IoT), Battery management system (BMS), Global system for mobile communication (GSM) and energy utilization of surplus energy. [2] Used both photovoltaic solar panel and wind turbine the main objective was to increase EV vehicles and reduce fuel-powered vehicles. Although system demonstrated successfully, it lacked live internet tracking, IoT real time monitoring, battery health monitoring and instant notifications from GSM. [3] system proposed automatically selects currently available source such as solar photovoltaic, wind power, battery energy storage system (BESS) and grid electricity to charge EV vehicle. It mainly focused on power electronics and control algorithms but the system did not provide real IoT monitoring and instant GSM and advanced BMS and surplus energy. [4] Researchers also proposed solar photovoltaic, battery storage and grid electricity in which the system will select which ever best source available automatically to avoid unnecessary charging and discharging to protect battery and to use energy efficiently, to reduce cost. But system used only solar photovoltaic and grid electricity not wind power and system did not implement Internet of Things (IoT) real-time monitoring, automatic surplus energy utilization and Global System for Mobile Communication (GSM). [5] Another important contribution, the authors introduced charging system that uses wind energy and grid electricity to charge EV vehicles. This reduces fluctuations in grid power and improves. System did not include solar energy, surplus energy GSM alerts and Battery management.

The fact that many models only focused on one modality is a big worry. These above research papers do not combine all features in one system. To overcome all these limitations, intelligent hybrid EV charging framework integrates solar, wind, grid and it includes battery management system (BMS), global system for mobile communication (GSM) and automatic surplus energy to nearby homes.

METHODOLOGY

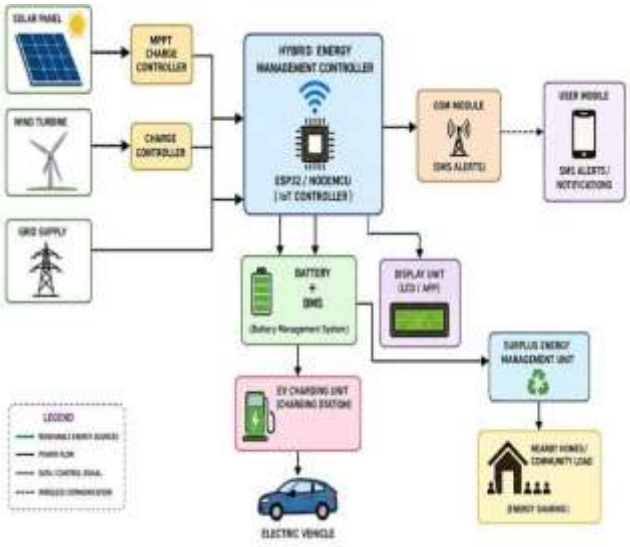

Fig: 1 Block diagram

The main methodology is integrating solar PV and wind turbine as a primary source and grid supply as backup for eco-friendly environment. Battery Management System (BMS) will help to protect the battery, Global System for Mobile Communication (GSM) will send instant notification to mobile phone. Internet of Things (IoT) will monitor the system in real-time, all the data will be stored in cloud platform. Surplus energy will provide excess power to nearby electronic devices.

The Intelligent hybrid EV charging framework is to provide a reliable and sustainable charging system by integrating solar energy, wind energy and grid power and using the latest technology IoT for real-time monitoring, battery management system (BMS), global system for mobile communication (GMS) and automatic surplus energy supply. The main aim of the system is to use of renewable energy and without interruption charging.

The solar photovoltaic panel and wind turbine will generate the energy from sun and wind. Due to environmental conditions the special circuits clean and fix this power and store in battery whenever excess energy is available.

This algorithm continuously checks which source is available. The controller gives the highest priority to renewable sources, because to make our environment ecofriendly. If solar and wind is available the EV will get charge directly using renewable energy, if solar and wind are

insufficient then the battery utilizes its stored energy. Later if both renewable energy and battery storage is unavailable, the system will automatically shift to grid power.

Battery Management System (BMS) monitors voltage, current, temperature and state of charge (SoC). This BMS will protect the battery from deep charging, over charging, short circuit and overheating and it improves battery life and charging efficiency.

The Internet of Things (IoT) module continuously monitors complete charging system. It monitors charging status, battery condition, power consumption and grid usage. Later information will be transmitted to cloud platform. Cloud platform collects the data and displays to users mobile phones, in which users can monitor all information in mobile phones. So that users can check from any location.

Global System for Mobile Communication (GSM) module sends SMS notification regarding charging status. If vehicle gets charge, immediately the user will get the notification to mobile.

In addition, the system includes an automatic surplus energy utilization. When solar panel and wind turbine generates more electricity than required EV charging, the extra charge will be stored in battery, if battery gets full. Then, power is used for electrical devices instead of wasting. By this we can reduce the dependency of the grid.

EXPERIMENTS AND RESULT

The proposed intelligent hybrid EV charging framework is tested under different conditions, to analyze performance, reliability and energy utilization and to check whether is working properly or not.

The intelligent energy system managed the power flow without any interrupting the charging process. The system keeps charging vehicles smoothly when renewable energy is available. When renewable energy drops then it automatically switches to grid. By using voltage and current sensors the output of solar and wind turbines is measured.

The EV charging performance is evaluated by measuring the input power supplied and energy consumed during charging. During this experiment, the values recorded by BMS is compared with the safe operating limits of the battery to verify proper functioning of battery protection system.

The system will check real-time by IoT module, by comparing sensor reading will be displayed in cloud platform. GSM module is tested by generating charging completion and fault conditions, regarding that SMS notification will be received to user's mobile phone.

When renewable energy generation is greater than the EV charging requirement, that excess energy will be transferred to nearby homes. This test verified that excess energy can be utilized instead of getting wasted.

CONCLUSION

The project gives a clear view of solar and wind charging system, and this is an easy technique to replace grid with available renewable source to charging system. The main aim of this project is to provide continuous and reliable charging for electric vehicles, can reduce dependency on grid and improve the utilization of available renewable energy and can lead to environmental eco-friendly EV charging infrastructure. Can enhance the battery safety and provide convenient real-time monitoring.

Now the system is implemented in small scale. In future, large scale real-world implementation and can improve this by including AI-based energy prediction, advanced charging optimization.

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