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Battery Lifetime Optimization in a Solar Microgrid Using IOT

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ABSTRACT:
As electric vehicles become more popular, it's crucial to monitor the health and performance of their batteries to ensure optimal efficiency and longevity. In this paper, we propose an IoT-based battery monitoring system that leverages wireless communication and cloud computing to collect and analyze battery data in real-time. Our system consists of three main components: battery sensors, a gateway device, and a cloud platform. The battery sensors are placed in each battery cell to measure key parameters such as voltage, current, temperature, and state of charge. These sensors transmit data wirelessly to the gateway device, which aggregates and processes the data before sending it to the cloud platform. The paper described the design and development of an IoT-based battery monitoring system for electric vehicle to ensure the battery performance degradation. We are developing the system for battery management in electric vehicle by controlling the crucial parameters such as voltage and temperature. It is very important that the BMS should be well maintained with battery reliability and safety. This present paper focuses on the study of Battery Management System and optimizes the power performances of electric vehicles. Moreover, the target of reducing the greenhouse gases can greatly be achieved by using battery management system.
Key Words: *PIC controller, IOT, relay, Electric vehicles and solar.*

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I. INTRODUCTION

The system consists of a solar panel that charges the battery of the electric vehicle during the day and an IoT-based monitoring system that tracks the battery status in real-time. The monitoring system is equipped with sensors that measure the battery voltage, current, and temperature. These sensors transmit the data to the cloud server through a wireless network, where the data is analyzed and processed. The data is then presented to the user in the form of graphical representations or alerts.

Our system offers several benefits, including improved battery performance, reduced maintenance costs, and enhanced safety. By leveraging IoT and cloud technologies, we can provide real-time monitoring and analysis of battery data, enabling more informed decision-making and proactive maintenance.

At the present time, the resources that we use for electricity are costly and inefficient. That is why we must rely on those that are of in the least harmful to the environment and inexpensive. There are also additional benefits: Photo voltaic panels and photovoltaic plants use the naturals un-light for additional lighting. photovoltaic cells are used in applications that allow the use of taking solar energy and expanding it into electricity most of the solar systems are situated in sparsely populated regions, large-scale agricultural communities, as well as in medium-sized farm sites and smaller, agricultural local agricultural production facilities that have power grids For a machine to function, it must be operated by a human. This is a hardware-timed sensor system that tracks various variables, like temperature, voltage, and fire and battery percentage and reports them on the cloud so you can see exactly when everything has reached the right value.

The solar-based battery monitoring system in an electric vehicle using IoT has several advantages. First, it helps to optimize the charging of the battery, which can extend the life of the battery and improve the performance and range of the vehicle. Second, it reduces the reliance on the grid for charging, which can reduce the carbon footprint of the vehicle. Finally, it provides real-time monitoring of the battery status, which can help to prevent battery failure and improve the safety of the vehicle.

Electric vehicles (EV) are playing a key role because of its zero-emission of harmful gases and use of efficient energy. Electric vehicles are equipped by a large number of battery cells which require an effective battery management system (BMS) while they are providing necessary power. The battery installed in electric vehicle should not only provide long lasting energy but also provide high power. Lead-acid, Lithium-ion, -metal hydride are the most commonly used traction batteries, of all these traction batteries lithium-ion is most commonly used because of its advantages and its performance.

Battery management system (BMS) makes decisions based on the battery charging and cell voltage, temperature, etc. To ensure safe operation of the battery pack, the Battery Management System (BMS) has to make sure the cells remain in this safety window. Electric vehicles are becoming more commonplace as the technology matures and gas prices remain higher than in previous decades. While the internal combustion engine still dominates much of the world's roads, electric vehicles and hybrids (vehicles with both an internal combustion engine and some form of electric motor) are more prevalent in urban areas than previous decades.

The solar-based battery monitoring system in an electric vehicle using IoT is a technology that addresses this need by providing real-time monitoring of the battery's condition and optimizing the charging process. The system uses solar power to charge the battery during the day and an IoT-based monitoring system to track the battery status in real-time.

Electric vehicles do not have any on board power generation and rely solely on stored energy in batteries to power the electric motors during operation. This paper outlines a scalable method of determining the voltage across each battery in an electric vehicle charging and an eventual path for the development of a real-time battery monitoring for use in the Department Electric Vehicle.

The system has several advantages, including optimized charging, reduced reliance on the grid, and real-time monitoring of the battery status, which can help prevent battery failure and improve the safety of the vehicle. With the increasing demand for electric vehicles and the need for sustainable energy solutions, the solar-based battery monitoring system in an electric vehicle using IoT has the potential to play a significant role in the future of transportation.

The existing system for an IoT-based battery monitoring system in an electric vehicle would typically describe the limitations and drawbacks of current battery monitoring systems and highlight the need for a more advanced and comprehensive solution. Here's a possible section on the existing system

Nowadays, electric vehicle (EV) is becoming popular since the fuel prices becoming more expensive. Due to these scenario, many vehicle manufacturer looking for alternatives of energy sources other than gas.

A real-time Battery Monitoring System (BMS) using the coulomb counting method for SOC estimation and messaging-based MQTT as the communication protocol, based on ease of implementation and less overall complexity. The BMS is implemented using sufficient sensing technology, central processor, interfacing devices, and Node-RED environments on the hardware platform. In the Existing system work, there is no implementation of IoT platform with application development.

II. WORKFLOW OF THE PROPOSED APPROACH

In this proposed solar-based battery monitoring system in an electric vehicle using IoT includes several components that work together to optimize the charging process and ensure the battery's optimal performance and lifespan as illustrated in Fig.1. The system also includes safety features such as the fire sensor to prevent any potential hazards during charging. With these features, the system has the potential to provide a reliable and safe charging solution for electric vehicle owners.

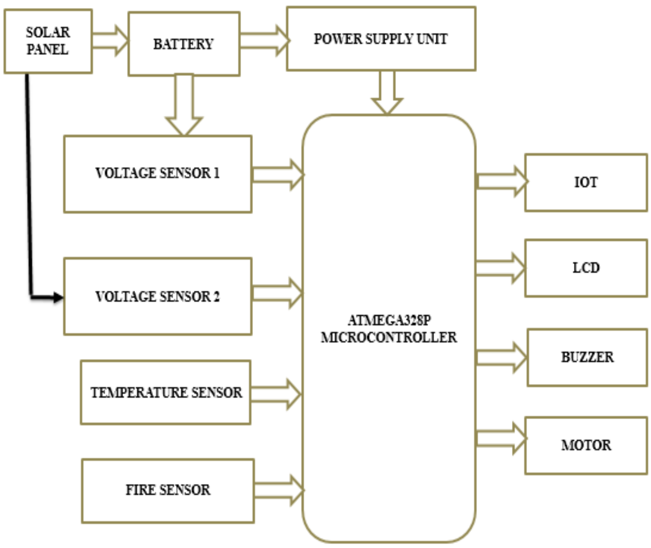

Fig.1.Block Diagram.

ADVANTAGES
•Maintain the safety and the reliability of the battery
•Battery state monitoring and evaluation
•It improves the battery performance
•It enhances the life span of battery
•It controls the charging, discharging and temperature ranges and keeps them with in their range.
•It predicts the batteries capabilities in near future.

III.OPERATING INSTRUCTIONS

A liquid crystal display (LCD) is a flat panel display, electronic visual display, or video display that uses the light modulating properties of liquid crystals. Liquid crystals do not emit light directly. LCDs are available to display arbitrary images (as in a general-purpose computer display) or fixed images which can be displayed or hidden, such as preset words, digits, and 7-segment displays as in a digital clock. They use the same basic technology, except that arbitrary images are made up of a large number of small pixels, while other displays have larger elements. An LCD is a small low cost display. It is easy to interface with a micro-controller because of an embedded controller (the black blob on the back of the board). This controller is standard across many displays (HD 44780) which means many micro-controllers (including the Arduino) have libraries that make displaying messages as easy as a single line of code.

Fig. 2 LCD display unit

LCDs are used in a wide range of applications including computer monitors, televisions, instrument panels, aircraft cockpit displays, and signage. They are common in consumer devices such as video players, gaming devices, clocks, watches, calculators, and telephones, and have replaced cathode ray tube (CRT) displays in most applications. They are available in a wider range of screen sizes than CRT and plasma displays, and since they do not use phosphors, they do not suffer image burn-in. LCDs are, however, susceptible to image persistence.

The components of the proposed system, including the solar panel, voltage sensor, current sensor, temperature sensor, fire sensor, LCD, and buzzer motor, work together to create a reliable and efficient charging solution for electric vehicle owners as shown in Fig.3.

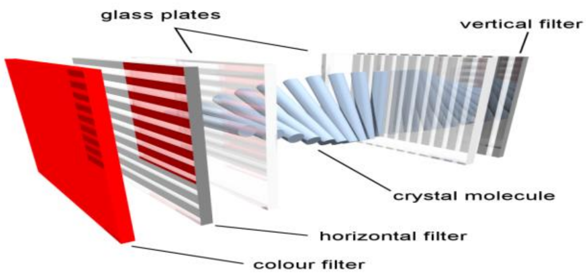

Fig. 3.Internal working of LCD unit

IV.RESULTS AND DISCUSSION

Once the connection instructions have been followed, plug-in AC power cord, the “POWER” Red (LED) will be on, the charger will begin charging automatically and the “CHARGING” Yellow (LED) will be on during charging. When the battery is fully charged the “CHARGING” Yellow (LED) will be off and the “FULL/FLOAT” Green (LED) will be on. Float Mode allows the charger to effectively be left connected to your batteries, over the course of a season, without overcharging your batteries and maintains your battery's full charge.

Specifications:

9.1 Input voltage: 120Vac 50/60Hz 0.4A Max. 9.2 Charging starting conditions: Battery not less than 5.5V 9.3 Rating output: 12Vdc 1.5A 9.4 Battery type: Lead-acid battery 9.5 Maximum charging voltage: 14.4V 9.6 Maintenance charging voltage: 13.2V~14.0V 9.7 Operating Environmental: -10~40℃, 90% RH Maximum 9.8 Weight: 0.62Lbs (0.28kg) approx. 9.9 Dimensions: L4.65” x W1.18” x H2.83” (L118 x W30 x H72mm)

REVERSE BATTERY / OUTPUT PROTECT CONDITION. The charger has reverse battery and output short circuit protection. If a reverse battery charger condition exists ("FAULT" Red L.E.D.) solid, while output leads are connected backwards), simply unplug charger from AC power and properly remake the connections as described in this manual.

a) Mounting the charger to vehicle:

The battery charger is mounted directly to the fender well of your vehicle as shown in figure -1. If using the nuts and bolts provided, drill two 1/8'' holes in diameter. If the backside of the mounting surface is hard to reach, you may consider using two 1/2'' long sheet-metal screws (not supplied) instead of the nuts and bolts provided.

b) Mounting the charger alongside the battery:

If more convenient to do so, as the following figure-2, using the mounting bracket (supplied) to mount the battery charger alongside of the battery. If possible, mount the charger to the side of the battery away from the engine and fan blades. Mount the bracket to the charger as shown, using the nuts and bolts provided. Loosen the battery retaining hardware enough that you can insert the bracket between the bottom of the battery and the battery mounting tray as shown. Position the charger so that it will not rub against the battery or any other part of the vehicle, and then tighten the battery retaining hardware.

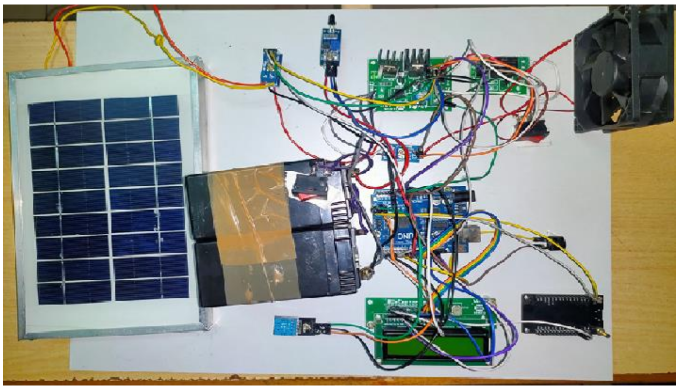

Fig.4.hardware Implementation of battery lifetime optimization.

V.CONCLUSION

In this paper, we have proposed an IoT-based battery monitoring system for electric vehicles that leverages wireless communication and cloud computing to collect and analyze battery data in real-time. Our system offers granular and accurate insights into battery health and performance, real-time monitoring and analysis capabilities, cloud-based analysis, and enhanced safety.Through our experiments and evaluations, we have demonstrated the effectiveness and reliability of our system in detecting potential issues and providing actionable insights to users. We have also shown that our system can be easily integrated into existing electric vehicle infrastructure and can scale to accommodate large fleets of vehicles.

The system provides several benefits, including optimized charging, reduced reliance on the grid, and real-time monitoring of the battery status. These features can help prevent battery failure, improve the safety of the vehicle, and extend the battery's lifespan.

In conclusion, the IOT based battery monitoring system in an electric vehicle is a promising technology that has the potential to improve the performance, safety, and lifespan of electric vehicle batteries. As the demand for sustainable transportation solutions continues to grow, this technology will undoubtedly become more prevalent in the market.

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