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Iot Based Solar Charged Electric Vehicle Battery Monitoring And Protecting System

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Abstract:
In recent years the need for battery vehicles has become the need of the automobile industry. The heart of the Electric vehicle system is the Battery. The performance, range, and safety of an electric vehicle (EV) depend heavily on the battery is ability to operate properly. The proposed system can precisely and consistently track the status of charge level of the battery along with the measurement of battery temperature, output voltage and current values. In this project, a voltage-current sensor and temperature sensor are used with Arduino Mega as microcontroller. The sensors are used to measure the battery parameters and the values are sent to the Arduino Mega micro controller. Controller checks the safe level of the battery parameters and issues alert signal if the battery is operating with unsafe values. To prevent damage to the battery and fire, the battery will be promptly withdrawn from operation when the safe levels are exceeded. Fan is activated when the temperature of the battery rises and exceeds the threshold value. The sensor data is sent to IOT Cloud Blynk Web through ESP8266 for checking the sensor data externally.

Key Word: *Arduino Mega, voltage-current sensor, temperature sensor, ESP8266 and IOT Blynk Web*

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I. Introduction

The need for battery monitoring systems that can precisely and consistently track the status of charge and health of the battery is rising as electric cars (EVs) gain in popularity. The performance, range, and safety of an electric vehicle (EV) depend heavily on the battery's ability to operate properly. In this project, a voltage sensor, current sensor, and Arduino mega microcontroller are proposed as components of a system for monitoring an EV battery. In order to prevent overheating, the system also has a temperature sensor that can determine when the battery temperature rises to a safe level. At that time, a cooling system is activated. To prevent damage to the battery and fire, the battery will be promptly withdrawn from operation when the temperature exceeds the safe level.

The brain of this project is Arduino mega which works as micro controller. Voltage sensor, current sensor and temperature sensor are used as input to Arduino. Th sensed values will be compared in Arduino mega with the safe threshold. If the value exceeds the safe threshold, the battery automatically will disconnect from operation. A cooling system is applied for the battery. Additionally, a battery level indicator shows the level of battery.

II. Material And Methods

A.Review Paper 1

A study by Zhang et al. (2021) proposed a battery management system for an electric vehicle that includes voltage and current sensors, a temperature sensor, and a microcontroller for data acquisition and analysis. The system was designed to monitor the state of charge and temperature of the battery and to activate a cooling system when the battery temperature exceeded a safe threshold. The study found that the proposed system was effective in managing the battery temperature and improving the overall performance of the battery [1].

B.Review Paper 2

In another study, Liu et al. (2020) proposed a battery management system for electric vehicles that incorporated an Arduino microcontroller, voltage, and current sensors, and a wireless communication module for data transmission. The system was designed to monitor the state of charge, health, and temperature of the battery, and to provide real-time data to the driver or fleet operator via a mobile application. The study found that the proposed system was effective in improving the efficiency and safety of the battery [2].

C.Review Paper 3

A paper by Saha et al. (2020) discussed the development of a battery management system for an electric rickshaw that included voltage and current sensors, a microcontroller, and a temperature sensor. The system was designed to monitor the state of charge, temperature, and health of the battery, and to activate a cooling system when the battery temperature exceeded a safe threshold. The study found that the proposed system was effective in improving the overall performance and reliability of the battery [3].

G. Problem Identification

Existing methods are built up for manned vehicle system where the measurement and the display are built in the same vehicle Proposed system aims to implement the battery monitoring and protecting system in unmanned vehicle systems such as drones, industry vehicles etc using solar charged battery The proposed system uses cost effective and efficient Arduino compatible sensors for measuring voltage, current and temperature.

This project aims to improve the reliability, safety, and performance of electric vehicle battery monitoring and protection systems using IOT System It will implement advanced algorithms for IOT based monitoring and control, introduce intelligent protective measures, and optimize communication protocols for seamless data exchange, ultimately contributing to the efficiency and longevity of electric vehicle power sources.

III. Circuit Diagram And Operation

A Circuit Diagram

This project uses the Arduino mega module which works as microcontroller. All the required parts and circuits are connected to it. The Arduino program will enable the different connected circuits to operate in the designated intervals.

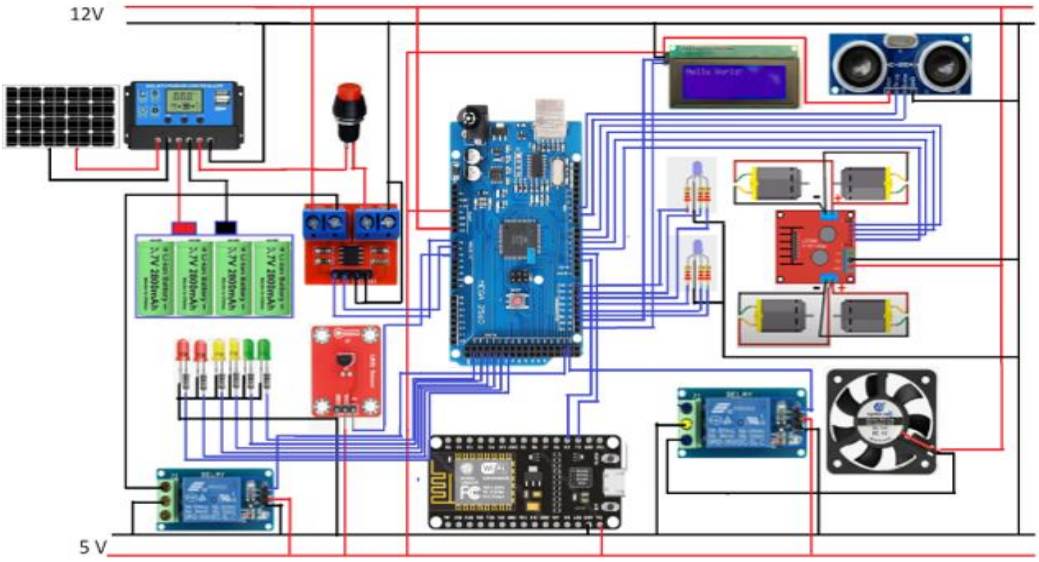

Fig 1. Circuit diagram

B. Circuit diagram explanation

The circuit diagram operation is divided into four different modules.

- Power supply operation
- Sensor operation
- Microcontroller operation
- Output device operation
- IOT Operation

C. Power Supply Operation

When sunlight hits the solar panels, they generate electricity, which is then directed to the battery through the charge controller. The charge controller manages the charging process, ensuring that the battery receives the appropriate amount of power. Once the battery is fully charged or the sunlight diminishes, the charge controller may stop the charging process to prevent overcharging.

The proposed system used 12V Lithium-Ion battery. Microcontroller Arduino Mega is connected with Vin pin from 12V battery supply. 5V required for the voltage sensor, current sensor, temperature sensor, relay for motors and battery level indicator LEDs are received from the Arduino Mega 5V pin. Four motors used to drive

the car are connected to 12V supply through the relay system with programmed on/off control. ESP8266 receives supply from this 5V output of the Arduino Mega.

D. Sensor Modules

The output voltage of Lithium-Ion battery is given as the input for the voltage-current sensor MAX741. The output voltage from this sensor is given to the common bus of 12V. Also, the sensing pin of MAX741 measures the current and voltage value of the battery using A0 and A1 pins of the Arduino Mega. If the current measured by the sensor is more than 1 Amps, then the battery is disconnected using the relay operating system. Also, REG led is used to indicate the safe current working of the battery using RED and GREEN glows.

Six LEDs are connected to the digital pins of the Arduino Mega. These LEDs are switched ON/OFF using the Arduino mega program based on the battery voltage measured using the MAX741 sensor. With the use of these LEDs it is easy to verify the battery levels from any distance without seeing the display.
LM35 Temperature sensor is attached with the battery for measuring the battery heating.

When the temperature of the battery is more than 30 degrees, the fan is switched on using a relay operating system. The relay operation is controlled using the Arduino mega program. Sensor LM35 is connected to A12 pin of Arduino Mega. On measuring the temperature, if the value becomes more than 30 then relay is switched on to connected fan to the 12V supply. If the temperature is less than 30 degrees, then relay remains normally open disconnecting the fan from the battery. A RGB Led is used to indicate the safe battery operation using its RED and GREEN glowing.

Ultrasonic sensor is used to control the movement of the vehicle for temporary operation of the motors connected to the battery vehicle. The vehicle is free to move when there is no object in front of the vehicle for 30 cm and above. If any object is detected within 30cm, then relay is activated to stop the supply for the battery.
Geared motors are used, and they are operated using the motor driver circuit for its safe and easier control.

E. Microcontroller Module

In this project Arduino Mega is used as the micro controller which is the main component of the project. Arduino receives data read from different sensors. The analog values are then sent to the program and converted to actual original values. The original converted values are checked against the standard threshold values. The Arduino issues output signal for display, LED, and motor for their further operation.

G.Display Modules

TFT displays utilize thin-film transistor technology, where each pixel is controlled by its own transistor. This allows for improved color accuracy, contrast, and refresh rates compared to traditional LCD displays. The display has a resolution of 240 pixels in width and 320 pixels in height. This resolution provides a reasonably high level of detail, suitable for displaying graphics, text, and images. The values measured by the sensor like voltage, temperature and current are displayed in the TFT display unit.

H .IOT Module

ESP8266 is used as the Wi-Fi interface. RST and TXT pins of Arduino mega are cross interfaced with the ESP8233 to receive the data from Arduino Mega. These data are then transferred wirelessly to be accessible in cloud.

Blynk IOT app is used as the Wi-Fi cloud monitoring interface. By installing Blynk app in mobile and enabling gauges it is possible to display the values measured from the sensors from any remote locations using this app.

IV. Results And Discussions

The proposed system for Electrical vehicle battery monitoring using a voltage sensor, current sensor Arduino if temperature high the LED lamp will glow. The voltage and current sensors were used to collect data continuously. The temperature sensor was used to collect temperature data at regular intervals. The data was stored in Arduino’s memory.

The collected data was analyzed to determine the battery state of charge, temperature, and health. The data analysis module used algorithms to monitor the battery's performance and provided valuable insights into the battery's performance and health. If the battery's state of charge or temperature reached a critical level, the alert system was activated. the LED lamp will glow. The results of the implementation show that the proposed system can effectively monitor the battery's performance, maintain the battery's temperature within a safe operating range, if the battery's state of charge or temperature reaches a critical level. The system is able to detect and alert the operator or fleet manager about any abnormalities in the battery's performance, thereby reducing downtime and maintenance costs. Moreover, the user interface of the system displayed the battery's state of charge, temperature, and health, allowing vehicle operators or fleet managers to monitor the battery's performance

in real time. The system's effectiveness in maintaining the battery's performance and lifespan while reducing downtime and maintenance costs makes it a valuable addition to any fleet of electric vehicles.

Table no 1 Results of the proposed model

Sno	Parameter	Threshold value	Output device operation
1	Voltage	Greater than 12V	Battery level indicator LED ON for maximum value. Battery disconnected from charging using solar charge controller
		Less than 6 V	Battery level indicator LED ON for maximum value. Alarm ON Battery disconnected using solar charge controller
2	Current	More than 1 A	LED RED Battery disconnected using relay
3	Temperature	Greater than 30 degrees Celsius	LED RED, FAN on Battery disconnected using relay

V. Conculsion

In conclusion, the IOT based Electric Vehicle Battery Monitoring and Alerting System developed using Arduino Mega has proven to be an effective and efficient solution for ensuring the optimal performance and safety of electric vehicle batteries. Through the integration of Arduino microcontrollers and relevant sensors, the system successfully monitored crucial parameters such as battery voltage, temperature, and state of charge. One of the significant achievements of this project is the real-time monitoring capability, providing users with instant feedback on the health and status of the EV battery. The use of Arduino Mega as the central processing unit allowed for a cost-effective and customizable solution that can be easily adapted to different electric vehicle models. The implementation of a robust alerting mechanism ensures that users are promptly notified of any potential issues or abnormalities in the battery system. This proactive approach not only enhances the safety of the electric vehicle but also contributes to the overall longevity of the battery, optimizing its performance over time. Moreover, the system's data logging features enable users to analyze historical performance data, allowing for informed decision-making and predictive maintenance. This is crucial for preventing unexpected failures and minimizing downtime for electric vehicle owners. While the prototype has demonstrated successful functionality in a controlled environment. Integration of wireless communication protocols for remote monitoring and control enables IR4 technology implementation and ease of data access from any remote location. Additionally, exploring more advanced machine learning algorithms could further improve the accuracy of predictive maintenance and anomaly detection.

References

[1]. J. Chen, H. Wang, H. Yin, Y. Luo, And H. Zhang, "A Real-Time Monitoring System For Lithium-Ion Battery Based On Arduino Platform," 2017 Ieee 3rd International Conference On Energy Engineering And Information Management (Eeim), 2017, Pp. 105-108.

[2]. M. Z. Rahman And A. I. Al-Odienat, "Real-Time Monitoring System For Electric Vehicle Battery Management Using Internet Of Things (Iot)," 2019 Ieee 5th International Conference On Control, Automation And Robotics (Iccar), 2019, Pp. 853-858.

[3]. Raza And M. H. Zafar, "Design And Development Of An Intelligent Battery Management System For Electric Vehicles Using Arduino," 2019 2nd International Conference On Electrical, Communication, Electronics, Instrumentation And Computing (Iceceic), 2019, Pp. 1-6.

[4]. R. Kumar And S. K. Sharma, "Iot Based Real-Time Monitoring System For Electric Vehicle Battery Management Using Arduino," 2020 2nd International Conference On Inventive Research In Computing Applications (Icirca), 2020, Pp. 1035-1041.

[5]. K. Balan, V. Subramaniyaswamy, And M. Muthukumar, "Design And Implementation Of Electric Vehicle Battery Monitoring And Management System Using Arduino," 2019 Ieee International Conference On Innovative Research And Development (Icird), 2019, Pp. 1-5.

[6]. N. I. Badruddin, N. J. Nawawi, M. Y. Yusof, M. A. H. Aziz, And A. Ahmad, "Design Of Battery Monitoring System For Electric Vehicle Using Arduino Uno," 2017 Ieee Conference On Energy Conversion (Cencon), 2017, Pp. 260-263.