# IOT Based Battery Monitoring System in E-Vehicle

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**Abstract - The use of electric vehicles (EVs) has been increasing due to the need for sustainable transportation. However, the main challenge of EVs is the limited range of travel, which depends on the capacity of the battery. In order to ensure reliable and efficient use of EVs, it is necessary to monitor the state of the battery. Therefore, an IoT-based battery monitoring system can be used to track the health of the battery. The proposed IoT-based battery monitoring system for electric vehicles comprises of battery sensors, microcontroller, wireless communication module, and cloud server. The battery sensors measure the voltage, current, and temperature of the battery and send the data to the microcontroller. The microcontroller processes the data and transmits it to the cloud server through the wireless communication module. The cloud server stores the data and analyzes it to generate insights about the battery's health. The IoT-based battery monitoring system provides real-time monitoring of the battery's state, including its voltage, current, and temperature. This information can be used to optimize the performance of the battery and prolong its lifespan. The data generated by the system can also be used to predict the remaining range of the EV, which can help the driver plan the journey more efficiently. Electric vehicles are popular for transportation in the current world and are taking the place of conventional vehicles since they provide a pollutionfree environment. Several battery types, including lithium batteries, leadacid batteries, nickel-metal batteries, and solid-state batteries, are utilized in electric cars. The Lithium battery is the most recommended of these battery kinds. Since it is more efficient than conventional batteries and has a high energy content per unit of mass. It can also be recycled. In this study, an Internet of Things-based battery management system is suggested. This this project, observing the display of the car utilizing IoT approaches is proposed in this study, thus the testing should be apparent. The design and development of an IoT-enabled battery monitoring system. Monitoring entails keeping an eye on critical operating factors like as voltage,Current, Gas, and temperature during charging and discharging. This is a hardware-timed sensor system that monitors and reports different variables such as temperature, voltage, and smoke on IOT so you can see when everything has achieved the correct value. Key Words: Lithium batteries, ESP32 Microcontroller, Sensors, IOT, LCD, Relay, Motor.**

## I. INTRODUCTION

In today's hectic environment, electric vehicles play an important role in mobility. Electric vehicles (EVs) produce no emissions and help to keep our environment clean. To help the global environment grow green, the Indian government has tackled and launched the upgrading and manufacture of electric cars in the country. Electric vehicles improve power efficiency and provide fuel alternatives. EVs are battery electric vehicles that run entirely on energy and are more efficient than others. A hybrid electric vehicle is one that uses both an engine and a battery. A fuel cell electric car is one that operates on electricity generated by chemical energy. Electric vehicles (EVs) have emerged as a promising solution for sustainable transportation. However, one of the major challenges in EVs is the limited range of travel, which is dependent on the capacity and health of the battery. Therefore, it is crucial to monitor the state of the battery to ensure the reliable and efficient use of EVs. In recent years, the Internet of Things (IoT) has gained significant attention in various industries, including automotive, due to its potential to provide real-time monitoring and control of devices remotely. The application of IoT in EVs can improve the performance and efficiency of the battery, as well as enhance the driving experience of the users. This paper proposes an IoT-based battery monitoring system for electric vehicles. The system consists of battery sensors, microcontroller, wireless communication module, and cloud server. The battery sensors measure the voltage, current, and temperature of the battery and send the data to the microcontroller. The microcontroller processes the data and transmits it to the cloud server through the wireless communication module. The cloud server stores the data and analyzes it to generate insights about the battery's health. The proposed system provides real-time monitoring of the battery's state, enabling the optimization of the battery's performance and prolonging its lifespan. Moreover, the data generated by the system can be used to predict the remaining range of the EV, which can help the driver plan the journey more efficiently.

## II. LITERATURE SURVEY:

In this study, an alternative method to the currently used methods for categorizing batteries according to their chemistry is discussed. Brand new and aged batteries are used in experimental setup that is consist of a programmable electronic DC load and a software developed to run the algorithm on it.

[2] The Battery Management System of an Electric Vehicle is a system designed to ensure safe operation of the battery pack, and report its state to other systems. It is a distributed system, and the communication between its sub-modules is performed through wired buses.

[3] This paper describes the application of Internet-of-things (IoT) in monitoring the performance of electric vehicle battery. It is clear that an electric vehicle totally depends on the source of energy from a battery. However, the amount of energy supplied to the vehicle is decreasing gradually that leads to the performance degradation. [4] This paper proposes 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 proposed BMS is implemented using sufficient sensing technology, central processor, interfacing devices, and Node-RED environments on the hardware platform. www.ijcrt.org © 2023 IJCRT | Volume 11, Issue 4 April 2023 | ISSN: 2320-2882 IJCRT2304122 International Journal of Creative Research Thoughts (IJCRT).
[5] States estimation of lithium-ion batteries is an essential element of Battery Management Systems (BMS) to meet the safety and performance requirements of electric and hybrid vehicles. Accurate estimations of the battery's State of Charge (SoC), State of Health (SoH), and State of Power (SoP) are essential for safe and effective operation of the vehicle.

## III. PROPOSED METHODOLOGY:

The system would include battery sensors that measure the voltage, current, temperature, and other relevant parameters of the battery. The sensors would transmit the data wirelessly to a central hub. Wireless network: The system would rely on a wireless network, such as Wi-Fi or cellular, to transmit the data from the sensors to the central hub. The central hub would receive and process the data from the battery sensors, using analytics and algorithms to identify any abnormalities or faults in the battery. The hub would also provide a user interface for the driver or user to monitor the battery's state and receive alerts or notifications. The system could also include a cloud-based platform that stores and analyzes the data generated by the battery sensors. The platform could provide additional analytics and insights into the battery's performance, as well as enable remote monitoring and control of the battery. Machine learning and artificial intelligence: The system could also incorporate machine learning and artificial intelligence (AI) algorithms to analyze the data from the battery sensors and identify patterns and anomalies that might indicate potential issues with the battery. The AI algorithms could also be used to predict the battery's remaining lifespan and optimize its performance. Mobile application: The system could also include a mobile application that provides a user interface for the driver or user to access the battery's data and receive alerts or notifications on their smartphone. The suggested IOT-based battery management solution for electric vehicles. This system includes a voltage sensor that detects voltage and updates the IOT. The temperature sensor is used to detect the temperature of the battery; if the temperature rises, a buzzer alarm is sent and shown on the LCD. To ensure safety, the system is linked to a smoke sensor, which detects smoke in the battery and sounds an alert. When the voltage surpasses a specific level, www.ijcrt.org © 2023 IJCRT | Volume 11, Issue 4 April 2023 | ISSN: 2320-2882 IJCRT2304122 International Journal of Creative Research Thoughts (IJCRT) www.ijcrt.org a971 the overvoltage button illuminates. The measured parameters are updated in the IOT and shown on the LCD display.

3. System Architechture:

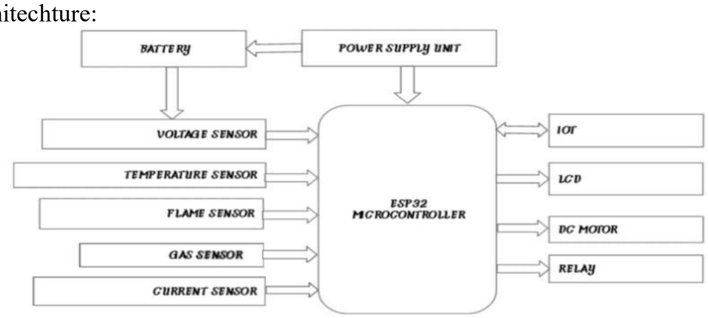


Figure 1:System Architecture of IOT Based Battery Monitoring System In EV

## IV. REQUIREMENTS:

Software Requirements:
* IoT
* Arduino IDE / Embedded C Hardware Requirements:
* ESP32 Microcontroller
* 12V Battery
* Voltage Sensor
* Current sensor
* Temperature Sensor
* Flame Sensor

* Gas Sensor
* LCD Display
* Relay
* DC Motor

5.1 ESP32 Microcontroller:

ESP32 is a low-cost System on Chip (SoC) Microcontroller from Espressif Systems, the developers of the famous ESP8266 SoC. It is a successor to ESP8266 SoC and comes in both single-core and dual-core variations of the Tensilica’s 32-bit Xtensa LX6 Microprocessor with integrated Wi-Fi and Bluetooth.The good thing about ESP32, like ESP8266 is its integrated RF components like Power Amplifier, Low-Noise Receive Amplifier, Antenna Switch, Filters and RF Balun. This makes designing hardware around ESP32 very easy as you require very few external components.

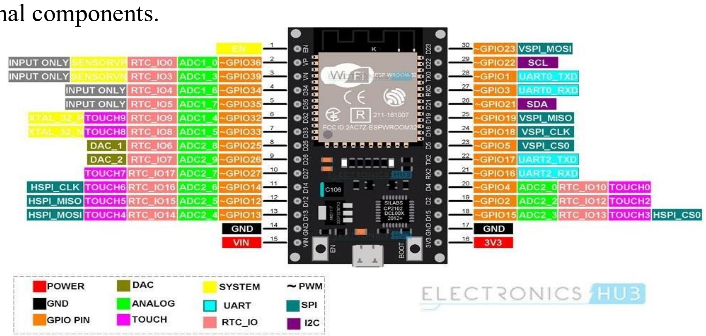


Figure 2:ESP32 Microcontroller

5.2 Battery:

A battery is an electronic device that turns chemical energy into electrical energy. The chemical processes of a battery include the transfer of electrons from one substance (electrode) to another via an external circuit. The movement of electrons produces an electric current, which may be employed to do work. To balance the flow of electrons, charged ions pass through an electrolyte solution in contact with both electrodes. Various electrodes and electrolytes induce different chemical reactions, which influence how the battery operates, how much energy it can store, and how much voltage it can produce. A battery is defined as a collection of one or more electrochemical cells that are capable of turning stored chemical energy into electrical energy.

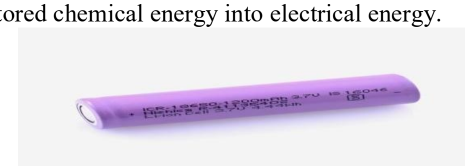

Figure 3: Lithium-ion-Battery

Voltage Sensor:

This sensor measures, calculates, and determines the voltage supply. This sensor can detect the amount of AC or DC voltage. This sensor's input can be voltage, and its output can be switches, analog voltage signals, current signals, audio signals, and so on. Some sensors produce sine waveforms or pulse waveforms, while others can produce AM (Amplitude Modulation), PWM (Pulse Width Modulation), or FM waveforms (Frequency Modulation). The voltage divider can affect the measurement of these sensors. This sensor has both input and output. The input side consists mostly of two pins, positive and negative. The device's two pins can be linked to the sensor's positive and negative pins.

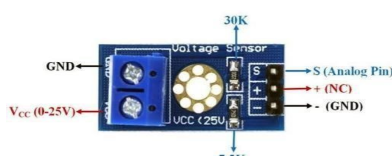


Figure 4: Voltage Sensor

Current Sensor:

A current sensor detects and measures the electric current passing through a conductor. It turns the current into a quantifiable output, such as a voltage, current, or digital signal, which may be utilised in a variety of applications for monitoring, control, or protection.

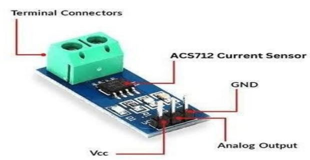


Figure 5: Current Sensor

5.5 Temperature Sensor:

The DS18B20 is a small temperature sensor with a built in 12bit ADC. It can be easily connected to an Arduino digital input. The sensor communicates over a one-wire bus and requires little in the way of additional components. The sensors have a quoted accuracy of +/-0.5 deg C in the range -10 deg C to +85 deg C.


Figure 6: Temperature Sensor

5.6 Flame Sensor:

The sensors in the flame detector will detect the radiation that is sent by the flame, the photoelectric converts the radiant intensity signal of the flame to a relevant voltage signal and this signal would be processed in a single chip microcomputer and converted into a desired output.


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Figure 7: Flame Sensor

5.7 Gas Sensor:

Gas sensors work on the principle of transforming the gas adsorption effects on the surface of the active material into a detectable signal in terms of its changed electrical, optical, thermal, mechanical, magnetic (magnetization and spin), and piezoelectric properties.


Figure 8: Gas Sensor

5.8 LCD Display:

A liquid-crystal display (LCD) is a flat-panel display or other electronic visual display that makes advantage of liquid crystals' light-modulating characteristics. Liquid crystals do not directly emit light. The command register holds the LCD's command instructions. A command is an order issued to an LCD to do a specific action such as initializing it, clearing its screen, setting the cursor location, managing the display, and so on. The data register saves the information that will be presented on the LCD.Computer monitors, TVs, instrument panels, aircraft cockpit displays, and signs are all examples of electronic displays. They are widespread in consumer gadgets such as DVD players, gaming devices, clocks, watches, calculators, and telephones, and have virtually completely replaced cathode ray tube (CRT) displays.

Figure 9: LCD Display

5.9 Relay:

A relay is an electromagnetic switch that can turn on or off a substantially greater electric current using a very tiny electric current. An electromagnet is at the core of a relay (a coil of wire that becomes a temporary magnet when electricity flows through it). Consider a relay to be an electric lever: turn it on with a little current, and it turns on (or "levers") another device with a much larger current. A relay, on the other hand, utilizes an electrical signal to drive an electromagnet, which in turn connects or disconnects another circuit, rather than a manual process. Several types of relays exist, such as electromechanical and solid state. Electromechanical relays are commonly employed. Let us first examine the internal components of this relay before learning how it works. Despite the presence of several types of relays, their operation is the same.Every electromechanical relay is made International Journal of Creative Research Thoughts (IJCRT) www.ijcrt.org a978 up of an electromagnet. Contact that can be moved mechanically spring and switching points an electromagnet is made by winding a copper coil around a metal core.

Figure 10: Relay

5.10 DC Motor:

Continuous actuators that transform electrical energy into mechanical energy are known as direct current motors. The DC motor does this by providing a constant angular rotation, which may be used to rotate pumps, fans, compressors, wheels, and other similar devices. In addition to traditional rotary DC motors, linear motors capable of providing continuous liner movement are provided. A direct current motor is made up of two parts: a "Stator," which is stationary, and a "Rotor," which rotates. As a result, there are three primary types of DC motors available. Motor with a brushed finish the brushless motor the servo motor the gear motor.

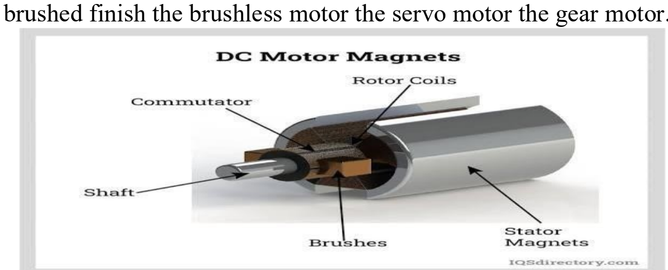


Figure 11: DC Motor

6. IOT Connectivity:

Blynk is a comprehensive software suite that enables the prototyping, deployment, and remote management of connected electronic devices at any scale. Whether it's personal IoT projects or commercial connected products in the millions, Blynk empowers users to connect their hardware to the cloud and create iOS, Android, and web applications, analyze real-time and historical data from devices, remotely control them from anywhere, receive important notifications, and much more.

## V. CONCLUSION

An IoT-based battery monitoring system in electric vehicles can provide numerous benefits, such as real-time monitoring, predictive maintenance, improved battery performance and longevity, enhanced user experience, and optimized charging patterns. The system can also enable remote monitoring and control of the battery, which is especially beneficial for fleet management. However, there are also potential demerits to consider, such as cost, data privacy and security, connectivity issues, false alerts, and integration with existing systems. It is important to carefully evaluate the feasibility and effectiveness of the system, and to implement appropriate security measures to protect the data transmitted wirelessly. The study detailed the design and development of an IoT-based battery monitoring system for electric vehicles in order to monitor battery performance deterioration online. The goal is to demonstrate that the notion of the idea can be implemented. The system's development includes the creation of hardware for the battery monitoring device as well as a web-based battery monitoring user interface. A hardware event for the battery monitor and a web-based battery monitoring interface comprise the system's event. The system is capable of communicating information such as position, battery condition, and time through the internet by integrating an IOT system to identify the coordinate and display it on the mobile application.

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