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IoT Based Battery Monitoring System for E-Vehicle

V. Ramakrishnan[1], M. Ram kumar[1], D. Sharoun[1]*, A.S. Vigneshwar[2]
[1]Final year students, Department of Electrical and Electronics Engineering, Ramco Institute of Technology, Rajapalayam, Tamil Nadu, India
[2]Assistant Professor, Department of Electrical and Electronics Engineering, Ramco Institute of Technology, Rajapalayam, Tamil Nadu, India

ABSTRACT

In real-time monitoring of lithium ion batteries based on Internet of things is proposed system monitors and stores parameters that provide an indication of the lithium ion battery's acid level, state of charge, voltage, current, and the remaining charge capacity in a real-time scenario. The current state of the battery is sent to the e-vehicle company's cloud and the current location of the nearby charging station is received from the cloud. The proposed IOT based battery monitoring system consists of two major parts 1) Battery monitoring device 2) User Interface based on the experimental results, the system is capable to detect degraded battery performance and sends notification messages to the cloud and retrieves the location of the charging station.

Keywords: Internet of things, Battery monitoring system, Find the location.

I. INTRODUCTION

Since gasoline prices have risen, electric vehicles (EVs) are becoming more common. As a result of these circumstances, many car manufacturers are looking for alternative energy sources to gas. Electrical energy sources may be better for the environment because they produce less emission. Furthermore, electric vehicles provide significant benefits in terms of energy conservation and environmental protection. The lithium ion battery is used in the majority of electric vehicles. When compared to lead acid, it is much smaller. In fact, compared to a lithium ion battery, it has a steady power and a 6 to 10 time's longer life cycle. Overcharging and deep discharges will both shorten the life cycle of lithium ion batteries. On the other hand, due to battery size and body structure, EVs typically have a limited range of travel. Now, one of the major factors limiting EV adoption is the safety of current battery technology [1]. Overcharging a battery, for example, would greatly reduce its life span while still posing a serious safety risk, such as fire [2-4]. To avoid the aforementioned issues, an EV battery monitoring system that can alert the user about battery condition is required. The previous battery monitoring system only monitored and detected the battery's condition and alerted the driver via the vehicle's battery indicator. The internet of things (IOT) technology can be used to alert the manufacturer and customers about the battery status thanks to advancements in notification system design. This would be called one of the manufacturer's maintenance support procedures. IOT takes advantage of internet connectivity in ways that go beyond typical applications, allowing a wide range of devices and everyday objects to be linked to the internet, putting the world at the user's fingertips. The design and development of a battery monitoring system using IOT technology is suggested in this work, which is motivated by the mentioned issues.

II. TECHNOLOGY BASED ON WIRELESS COMMUNICATION

Wireless communication is a type of data transmission that takes place over the air. This is a broad term that encompasses all processes and methods for connecting and communicating between two or more devices using wireless communication technologies and devices using a wireless signal. Several types of technology have been used in the past for wireless battery monitoring systems, including GSM, ZigBee, GPRS, Android, WIFI, and Bluetooth communication. GSM (Global System for Mobile Communication) is a wireless communication system that is widely used in the world. It operates on either the 900MHz or 1800MHz frequency bands. There are some benefits and drawbacks of using the GSM module. GSM has the benefit of not having any issues with overseas roaming. It's still simple to set up, and the worldwide subscribers give GSM handset makers' carriers and customers a much greater network impact.

The Global Positioning System (GPS) uses satellites to communicate data that gives location and time to GPS receivers all over the world. It synchronizes the operation so that all of the repeating signals are sent at the same time. Because some satellites are farther away than others, the signals, which travel at the speed of light, arrive at a GPS receiver at slightly different times. The GPS satellites' distance can be calculated by calculating the time it takes for their signals to reach the receiver. The receiver can compute its position in three dimensions by estimating the distance to at least four GPS satellites. The precision of a GPS position is determined by the type of receiver used. The precision of most consumer GPS units is around +/-10 meters. Differential GPS (DGPS) is a technique used by some kinds of receivers to achieve much greater accuracy [5]. GSM/GPS was used to monitor and manage an EV battery in a study published in [5]. Android is a mobile operating system that runs on phones, tablets, and an increasing number of other devices, ranging from wearable computers to in-car entertainment. Android is a Linux-based operating system that, like Linux, is free and open source. It is open source and can be implemented by anybody since it is based on Linux. The operating system would alert you to new notifications, SMS, emails, or even the most recent articles from an RSS Reader. Unfortunately, it requires an active internet connection or at the very least a GPRS internet connection in order for the device to be willing to go online to meet the needs of the users. Furthermore, the operating system runs several processes in the background, resulting in battery waste.

III. TECHNOLOGY BASED ON WIRELESS BATTERY MONITORING SYSTEM

For safety reasons, reliable battery protection is needed. Battery failure can be caused by a variety of factors, including battery degradation and design flaws. Manual battery monitoring systems are similar to standard battery monitoring systems except that they do not save data to a database. However, only the data obtained in real time will be shown. As a result, using wireless devices to remotely control battery systems is important. Various battery control systems based on wireless connectivity have been developed for the industry, such as uninterruptible power supply (UPS), which is critical for ensuring power supply reliability for domestic and industrial customers during power outages.

The device will keep track of the battery's voltage, current, and temperature. To detect dead battery cells, created a battery monitoring device for UPS using wireless communication [6]. Several experiments have also been conducted on the implementation of a battery control device for electric vehicles that uses wireless communication. Using a GSM module, we developed an automatic battery charging and engine control system for EVs [7]. When the battery health falls below a certain threshold, an SMS is sent to the recipient. The user will then answer via SMS to have the engine start automatically to charge the battery.

3.1 BENEFITS OF BATTERY MONITORING SYSTEM:

- Automated capturing of data reduces the human errors.
- Notifies users in case of alarms using the advantages of latest technologies.
- Provides the state of readiness of battery at any time.
- Allows for early detection of weak cells before they risk the integrity of the battery.
- Analysing the data provided by the system allows remedial actions for cells to extend their life. Enables procurement of batteries through planned schedules, not emergency replacement. Improves the battery reliability while providing an ongoing return on investment.
- BMS outputs when needed can be used in DC power plants, Rectifiers, Inverter Systems to trigger an equalization charge remotely.
- Suitable to monitor any type of battery i.e. Nickel Cadmium (NiCd), Nickel-Metal Hydride (NiMH), Lithium ion, Lithium ion (Li-ion) etc.

IV. IOT-CLOUD INTEGRATION

The advantages of IOT in the cloud By granting third-party access to the infrastructure, public cloud services can easily assist the IOT space. As a result, the integration will assist IOT data or computational components that are used on IOT devices. To share data for worthwhile purposes, IOT devices need a lot of storage[8]. To communicate and connect with one another, the vast quantities of data provided by IOT devices necessitate extreme performance. IOT in the cloud provides the connectivity required to share data between devices and make sense of it in a timely manner.

Storage capacity: The Internet of Things (IOT) is made up of a vast number of data sources (things) that generate massive quantities of unstructured or semi-structured data. As a result, IOT necessitates large-scale data collection, access, processing, visualization, and sharing[9]. Cloud storage capacity is unrestricted, low-cost, and on-demand, making it the best and most cost-effective solution for dealing with IOT data. Through standard APIs, data stored in the Cloud can be accessed and visualized from anywhere.

Computation power: The processing capabilities of the devices used in IOT are limited. The data collected from different sensors is typically sent to more powerful nodes for aggregation and processing. [10]. The IOT computing needs can be met by utilizing Cloud's unrestricted processing capabilities and on-demand model. IOT systems could use cloud computing to perform real-time data processing, allowing for more responsive applications.

Communication resources:IOT's primary function is to allow IP-enabled devices to communicate with one another via a dedicated set of hardware. Cloud computing allows you to connect, track, and manage devices from anywhere on the internet[11] for a low cost. IOT systems could monitor and control things in real time from remote locations thanks to built-in applications.

Scalability: The cloud offers a scalable approach to IOT. It allows for a dynamic rise or decrease in resources. When cloud integration is available, any number of "things" can be added or removed from the system. [12]. The cloud distributes resources based on the demands of stuff and applications.

V. SYSTEM FLOWCHART

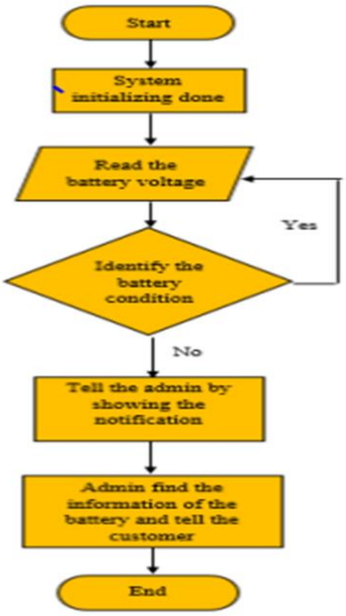

Fig 5.1 Flow chart

5.1 Experiments and Analysis:

Voltage Sensor Experiment:

A multimeter was used to calculate the values of five (5) batteries in this experiment, as seen in Figure. Then, as seen in Figure, these values were compared to the values of the same batteries attached to the voltage sensor circuit. The aim is to demonstrate the variations and percentage of consistency between the two values. The voltage values of the chosen batteries were varying. There were a combination of new and used batteries. These variations would be visible in the calculation performance.

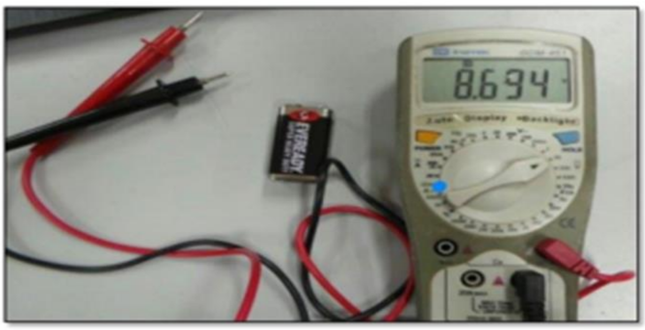

Fig 5.2 Battery voltage measurement using multimeter

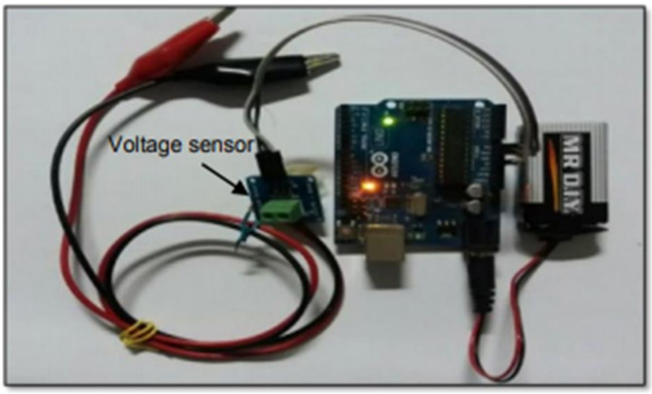

Fig 5.3 Battery voltage measurement using voltage Sensor circuit

Battery	Voltage measurement results		Accuracy percentage (%)
	Voltage sensor	Multimeter	
1	3.81	3.79	99.47
2	9.98	9.91	99.29
3	8.70	8.55	98.27
4	1.25	1.23	98.40
5	3.81	3.79	99.48

Since the batteries is a combination of used and new batteries, the values vary from one another, as seen in the table. According to the findings, the accuracy of voltage measurements taken with a voltage sensor is very close to that of measurements taken with a multimeter. Many of the tested batteries have an accuracy rate of more than 99 percent. As a consequence, it can be inferred that the voltage sensor has correct battery calculation values.

VI. IMPLEMENTATION & WORKING

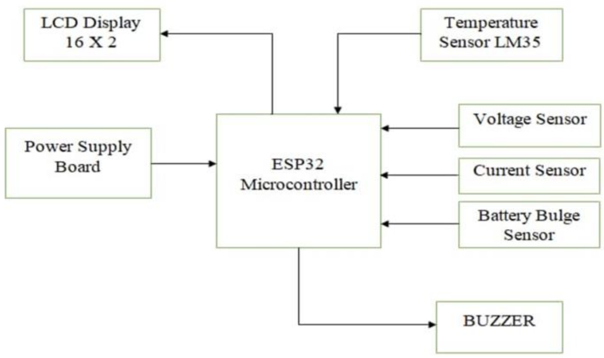

Fig 6.1 Block diagram

Step 1 : Switch ON the battery

Step 2 : Install the Blynkapplication on your mobile device.

Step 3 : With the help of the mobile app get the voltage, current, temperature and bulge data from the ESP32 Microcontroller.

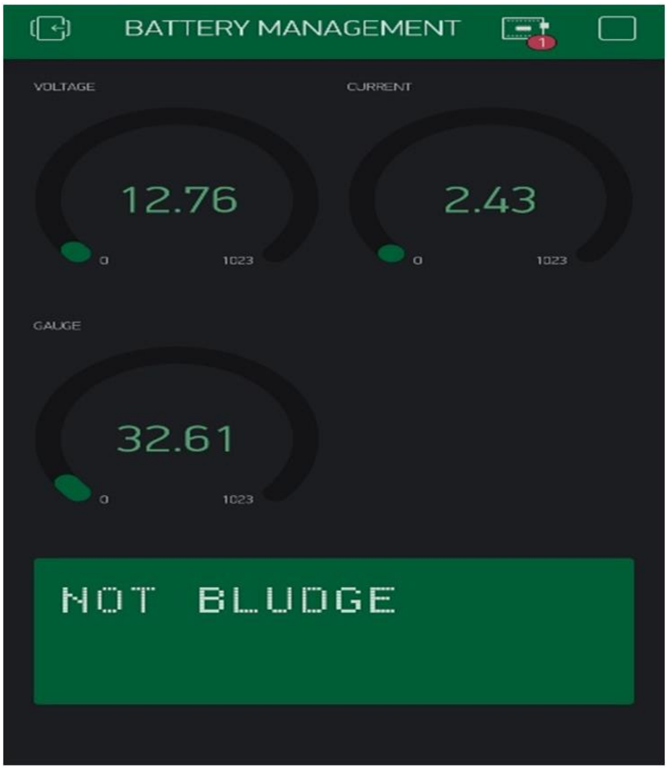

Fig 6.2Obtained output from Blynk software

VII. CONCLUSION

The paper represented the design and implementation of an IOT-based battery management system for electric vehicles, which allows for online monitoring of battery efficiency deterioration. The aim is to show that the idea's definition can be achieved. The system's implementation includes the creation of hardware for the battery monitoring platform as well as a web-based battery monitoring user interface. By adding a GPS device to detect the coordinate and display it on the Google Maps application, the device is capable of showing information such as position, battery status, and time via the internet. Many features may be added to the machine to boost it much more. The framework can be implemented in smart phones by the development of a mobile application that can assist users in battery monitoring and serve as a battery depletion reminder. If you want to improve your internet access, Ethernet is a safer option than GPRS.

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