Pre- E-Vehicle Battery Burning Detection and Alert System

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***Abstract*—Electric vehicles (EVS) use lithium-ion batteries, which can be too hot and even catch fire if not managed properly. The purpose of this project is to make EVS safe by creating a system that closely looks at the battery and warns if something is wrong. It uses the sensor to check the voltage, current and temperature of the battery. These sensors send data to a small computer (NodeMCU), which seeks warning signs of problems such as overheating. If something seems wrong, it quickly sends an alert to the owner through a mobile app so that they can take action before it becomes dangerous. System also sends battery data to the cloud using ThingSpeak, where it can be seen anytime on a website. This helps people not only see the current battery position, but also how it behaves with time. In this way, users can better understand the health of their battery and may require maintenance. Overall, the project helps to make electric vehicles safe and more reliable, while showing how smart technology (IOT) can improve transportation. This solution not only enhances immediate safety measures, but also supports the future maintenance. It helps to create confidence in EV technology by ensuring reliable battery performance over time. The integration of the system with cloud services enables the real -time view of continuous data logging and battery parameters. This empowers users to monitor the battery health and promote informed decisions, eventually to promote safe and efficient operation of electric vehicles.**

***Index Terms*---Electric Vehicles (EVs), Lithium-ion Battery, Battery Safety, Battery Fault Detection, Thermal Runaway, Real-time Monitoring, Node MCU, MCP3008, DHT11 Sensor, Internet of Things (IoT), Thing Speak API, Cloud Monitoring, Battery Health Analysis, Fire Prevention, Smart Transportation.**

I. INTRODUCTION

1.1. BACKGROUND

The rise of electric vehicles (EVS) has changed the transport landscape, promoted stability and reduced greenhouse gas emissions. The centre of this innings has a lithium-ion battery, known for its high energy density and long life. However, these batteries also bring safety concerns such as overheating, malfunction and potential fire hazards. Recent events related to battery fire highlight the immediate requirement of reliable systems that can detect battery issues in real time. A pre-vehicle battery can improve EV security by identifying the burn detection and an alert system by identifying the initial signals of the failure of the battery, which can protect the passengers and the public.

Progress in sensors and microcontroller techniques now allows for continuous battery monitoring. Using voltage, current and DHT11 temperature sensors, major parameters can be tracked to predict failures before it becomes dangerous. These sensors enable real -time data processing and cloud transmission through platforms such as Thing Speak, integrated with a Node MCU microcontroller. This allows IOT-based approach to monitor the battery health, imagine trends and take preventive action. Such systems not only reduce the risk of accidents, but also improve battery design and use practices, promoting the consumer trust in electric vehicle technology.

1.2. OBJECTIVES

The main objective of this project is to develop a pre-vehicle battery burning detection and alert system for electric vehicles using voltage, current and temperature sensors. The data collected through these sensors is digitized via MCP3008 ADC and is processed by a NodeMCU, which sends real-time updates to the ThingSpeak Cloud Platform.

The system includes algorithms that analyse data and trigger alerts when the threshold is crossed, which helps predict potential battery failures. It supports distance monitoring, safety, and supports better battery maintenance through historical data analysis and system verification.

1.3. SIGNIFICANCE

Electric vehicles require safe and healthy batteries to function properly, especially because the lithium-ion battery can sometimes hold warm or fire. Using sensors and smart techniques, we can watch the battery closely and catch problems quickly. It helps to protect people and instills confidence in using electric cars. As more city cleaner pushes to air and green transport, having a safe battery system makes it easy for people to choose electric vehicles. Sending battery data on the cloud also helps in future plans and maintenance, not only in cars, but also in gadgets and energy systems that use the same type of battery.

II. LITERATURE SURVEY

Power battery is a critical factor affecting the safety of electric vehicles (EVs). Fault diagnosis and prediction of power batteries are of great significance to ensure the safety of EVs. This paper proposes a voltage fault diagnosis model based on boxplots and Gini impurity. Considering cells voltages are not normal distribution at any time, we use the boxplots to analyze the monitoring voltage data and identify the abnormal cells with coarse granularity. To quantify the abnormality of each cell, the anomaly distance is defined based on boxplots. Considering each time has different degrees of influence on the final result of each cell, we use the Gini impurity weighting method to measure the contribution rate of each time. By this means the goal of further locating the faulty cells accurately can be achieved. And then we can easily identify those faulty cells by utilizing the Z-score method. Different from other previous researches, the validation and contrast experiments in this paper are carried out by using the actual vehicle operation data of the National Monitoring and Management Center for NEVs in Beijing. The results of experiments clearly show that the proposed model has high diagnostic efficiency relatively and the faulty cells in the battery system can be located accurately.[1]

Growing response for Electric Vehicles (EV) across the world is an implication of techno-economical efforts targeted to mitigate the challenges related to fossil fuels. Energy storage powering EVs is a very critical component. A battery pack used as energy storage in EVs uses many battery cells connected in series and parallel. These battery cells need close monitoring and management system during its operation in EVs. Such a system referred to as `Battery Management System' (BMS) ensures a safe operating envelope while increasing battery power delivery capabilities and improving lifetime. The cell voltage balancing along with the State of Charge (SOC) and State of Health (SOH) monitoring are some of the critical functions of BMS. For EVs to become the best techno-commercial alternative for gasoline-based vehicles, BMS and battery packs will play a very crucial role.[2] This paper highlights the state of the art of BMS and illustrates the passive cell balancing network design for Lithium-Iron-Phosphate (LiFePO4) batteries based on Digital Signal Processor (DSP) TMS320F28379D controller. Some key simulation and hardware results are presented to demonstrate the SOC estimation using the Coulombs counting method and battery cell balancing mechanism.

For safe and reliable operation of lithium-ion batteries on electric vehicles (EVs), the online monitoring and states estimation of the batteries is necessary. To make it convenient for every vehicle owner to monitor the battery status of their vehicles anytime and anywhere, we designed a real-time Android-based monitoring system for lithium-ion batteries on EVs, which achieves an integration monitoring system of batteries, phones, computers for owners and repairs. The system is composed of an on-board monitoring device, android phone client, cloud server. Android phone collects and displays the batteries operation parameters through WIFI communication with the on-board monitoring device. Besides, the batteries data is stored in the local database and uploaded to the cloud server, which provides support for battery states estimation. To validate the feasibility of the real-time monitoring system we present, we built the actual test environment. Test results show that the batteries data is transmitted to owner's phone and displayed on it, which could help users monitor the batteries status conveniently.[3]

Electric vehicle batteries are getting more advanced, but they still require careful management to stay safe and work properly for a long time. An important part of it is understanding the behavior of the battery through modeling. This involves checking how much energy the battery has left (charge or SOC), how healthy the battery is over time (health or SOH status), and how it handles the temperature during charging and discharging. Various methods are used to study these behaviors, such as electrochemical models, circuit-based models and computer-operated models. These models help predict when the battery can start problems and allow engineers to plan a better charging system. Since lithium-ion batteries are widely used in electric vehicles, it is particularly important to keep an eye on their condition during use. To help with it, the battery management system (BMS) is used. A BMS examines the battery in real time, ensuring that each cell is balanced, temperature control, and everything is running safely.[4] To fix this, researchers suggest using clever techniques such as artificial intelligence, better sensors and rapid data analysis. These improvements can make the battery safe, more reliable and better favorable for the increasing number of electric vehicles on the road.

Electric vehicles require a safe battery to drive properly, and this system helps to ensure that the battery remains healthy and do not catch fire. It uses sensors to check the voltage, current and temperature of the battery at all times. A microcontroller named STM32 reads this data and shows it on the LCD screen. If the battery becomes too hot or the voltage goes above a safe level, the system will stop charging or discharge to prevent any danger. A buzzer will sound if the temperature goes beyond the range, warning the user of a possible fire risk. The system also balances charge in each battery cell, so no cell overcharges occur. It keeps a

record of all battery data such as how fast it charges, how much electricity is used, and there is any change in temperature. Fire protection is improved with facilities such as automatic shut-off, cooling support and safety alert. Using simple tools such as sensors, a display and cloud-free monitoring, this system helps users to safely charge their batteries and avoid accidents.[5]

This task shows a simple way to keep the track of the battery of the electric vehicle using IOT (Internet of Things). This battery uses sensors to measure voltage, current, temperature and charge levels. A microcontroller reads this data and sends it to the cloud using Wi-Fi, so users can see it anytime from their mobile phone or computer. The system also shows battery information on LCD screen.[6] If anything goes wrong, such as the battery overheating or loses too much charge, the users can easily see it and take action. The main goal is to make electric vehicles smart, safe, and more efficient using low -cost technology that easily connects to the Internet.

This paper presents a smart system that helps in monitoring the electric vehicle (EV) battery using the Internet of Things (IOT) technology. The system regularly uses sensors to check the voltage, temperature and current of the battery. A microcontroller processes this data and sends it to the cloud, where users can see information on a mobile app such as a mobile app such as Thing View or LCD screen. If any reading goes out of the safe range - such as too much heat or low voltage - the system alerts the user and acts like disconnecting the battery to prevent fire or damage. The project uses components such as Arduino, NodeMCU, DHT11 sensor and a relay module to create a working battery management system (BMS). This system not only warns users about battery problems, but also helps to improve security, battery life and performance. It is also designed to be simple, low cost and useful in remote areas. With real -time alert and control, it supports safe driving and better care of EV batteries.[7]

Electric vehicle batteries can be dangerous if something goes wrong during charging, like too much heat or incorrect current flow. This paper talks about a smart system that uses Artificial Intelligence (AI) to watch the battery while it's charging and detect problems early. It uses a model called Adaptive Deep Belief Network (ADBN), which checks real- time values like voltage and current and compares them to normal patterns using a math method called the Pearson coefficient. If the system finds a big difference between the actual data and the expected data, it gives a warning before anything bad happens, helping to avoid fires or battery damage. To make the system more accurate and faster, the model is trained using an improved method called NAdam, which helps it learn better than older training methods. The system was tested using real battery charging data and showed better results than older models like Back Propagation Neural Network (BPNN) and regular Deep Belief Network (DBN). This smart method can be used in electric vehicles to monitor battery health and alert users in advance, making battery charging safer and more reliable.[8]

III. METHODOLOGY

3.1. EXISTING SYSTEM

Many electric vehicles use battery monitoring systems today, but these systems only check ordinary things such as how much charge is left and how hot the battery is. They do not look closely on how the battery behaves during charging or driving. Because of this, they can recall early warning signs such as the battery is getting very hot or short circuit starts. These problems, if ignored, may cause severe damage or even battery fire. In addition, most of these systems do not send data to clouds, so the user cannot see the status of the battery from the phone or computer. They do not even give real -time alert, which means that the user is too late about a problem. Therefore, we need a better and smart system that sees the battery every moment and warns users before anything is dangerous.

3.2. PROPOSED SYSTEM

The new system we are building can check the voltage, current and temperature of the battery at all times using the sensor. A small tool called NodeMCU, collects this data and sends it to the Internet using Wi-Fi. The data is stored and shown on a website, called ThingSpeak, where the user can see live updates or can see it later. If something is wrong, such as if the battery becomes too hot or if the voltage becomes too much or too low, the system quickly sends an alert. This helps the user to take early action. In the future, we can also make the system smarter using machine learning, before they predict battery problems. This makes the system very reliable for not only auxiliary, but also for people using lifesaving and electric vehicles.

3.3 METHODOLOGIES

To create this system, we use different parts and stages. First, sensors are connected to the battery to check the voltage, current and temperature. These sensors send data to the MCP3008 ADC chip, which converts the sensor data into a digital number. NodeMCU reads these numbers, checks if they are safe, and sends them to the cloud. The DHT11 sensor checks the temperature around the battery and also sends that data. The system takes frequent readings at short time intervals like every few seconds. NodeMCU checks whether any reading is too much or is very low, which can mean danger. This battery also examines health and charge level. If necessary, it uses simple machine learning to find patterns and predict issues. When a problem is found, an alert is sent to the user. All this data is shown on ThingSpeak, so the user can see how the battery is doing. We test everything to ensure that sensors and alerts work well. Over time, we can improve this system with updates.

3.4. ALGORITHM

The core algorithm to facilitate this battery monitoring and alert system can be broadly out lined as foll ws :

1. Start the System: The NodeMCU turns on and checks if all the sensors are connected and working.
2. Read Sensor Data: The system reads voltage, current, and temperature again and again at fixed time intervals.
3. Check Data Values: It checks if the sensor values are in the safe range. If they are too high or too low, something might be wrong.
4. Calculate Battery Status: It calculates how much charge is left (SoC) and how healthy the battery is (SoH).
5. Find Problems Early: The system can also use past data to find patterns and guess future problems using simple learning methods.
6. Send Alert if Needed: If a danger is found, like overheating, the system sends an alert to the user.
7. Send Data to Cloud: The data is sent to the ThingSpeak cloud so it can be seen live through a web app.
8. Repeat: The process keeps repeating to make sure the battery is always being watched.

3.5. WORKFLOW

1. Power On: The NodeMCU and all sensors turn on.
2. Sensor Check: The system checks if the sensors are working properly.
3. Read Data: Voltage, current, and temperature are measured at regular time gaps.
4. Send to Cloud: The measured data is sent to the ThingSpeak cloud for storage.
5. Analyze Data: The cloud system looks at the data to find any sudden or dangerous changes.
6. Check Limits: The system compares the data with safe values to see if anything is wrong.
7. Alert the User: If something is wrong, an alert is sent to the user right away.
8. Save the Data: All readings and alerts are saved in the cloud for future use.

9. Repeat Cycle: The system keeps running and checking the battery all the time.

IV. HARDWARE

The hardware used in pre-e-vehicle battery burning detection and alert systems is carefully chosen to correctly monitor the battery status and work smoothly together. This system uses a combination of sensors and electronic components to collect, process and transmit important battery data such as voltage, current and temperature. The main goal of the hardware is to ensure that the battery is healthy and safe by detecting the initial signals of overheating or other defects and warning the user on time.

The system includes voltage and current sensors that are connected to the battery. These sensors measure how much the voltage is present and how much current is flowing through the battery. The voltage sensor works by reducing the voltage of the battery to a safe level that can be controlled by the system. The current sensor works using the hall effect, which helps to detect the current without directly touching the electric current. Both these sensors send analog signals, which are not directly readable by the microcontroller.

To solve this, a MCP3008 analog is used for a digital converter (ADC). This chip converts analog signal from sensor to digital values so that NodeMCU microcontroller can read and understand them. MCP3008 uses SPI (serial peripheral interface) communication to connect with NodeMCU. It has 8 input channels, meaning that it can handle signals from multiple sensors at the same time, ensure accuracy and efficiency in data reading.

Nodemcu acts as the brain of the microcontroller system. It receives digital data from MCP3008, processes it, examines for any unusual reading, and sends this information to the cloud using its built-in Wi-Fi feature. It is programmed using Arduino Ide, where the sensor is included to work and connect with the ThingSpeak Cloud platform. Nodemcu is responsible for running all arguments, making decisions and sending alerts if needed.

The system also uses DHT11 sensor to monitor temperature and humidity around the battery. Since temperature is a very important factor in battery safety, it helps the sensor NodeMCU find out if the battery is getting very hot. If the temperature crosses a certain level, the system may trigger an alert to inform the user of a possible overheating position. DHT11 sends its data in digital form, making it easier to read NodeMCU.

To ensure that the users can access this data from anywhere, NodeMCU sends it to ThingSpeak Cloud. This cloud platform allows real-time storage, display and analysis of the platform battery data. Users can log in from their phone or computer how the battery is performing. If any value goes beyond the safe range, the system sends an alert through the platform.

All hardware components are carefully assembled on the breadboard or printed circuit board (PCB). Good wiring, soldering and clean -cruel connections are important to ensure that everything works properly and safely. A strong external case is used to protect the system from dust, heat or moisture, which can affect performance or damage components.

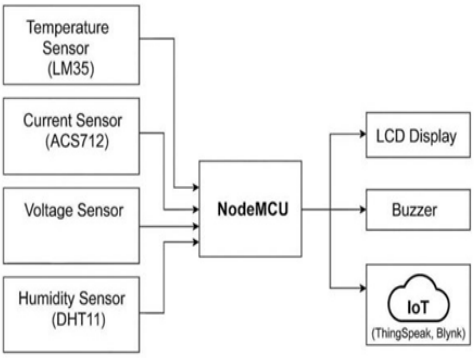
Power management is also an important part of hardware. Since the system runs continuously, it uses low-power components to save energy. NodeMCU can go into sleep mode when it is not collecting data or sending data, helps reduce electricity use. Voltage regulators are used to ensure that each component receives a stable power supply, avoiding any damage due to power changes.

After the construction of hardware, all parts are tested to ensure that they work correctly. The sensor is calibrated to ensure that they give the right reading. The entire system is tested during battery charging and discharging, how it performs in real situations. The data shown on the ThingSpeak Cloud is tested to confirm that it matches the actual reading.

In conclusion, the hardware design of this system includes all the necessary equipment for monitoring and safety of the electric vehicle. Each part - from sensor to cloud connection - plays an important role in keeping the battery safe and reliable. With proper setup, power management and test, it creates a strong base for hardware software systems that will handle alert and data analysis in the next stage.

V. ARCHITECTURE DESCRIPTION AND WORKING

This chapter explains how pre-vehicle battery burning detection and alert system is created and how it works. The system uses various sensors and smart devices to monitor the battery situation at all times. This battery helps to see the initial signs of problems such as overheating or burning. The main parts of the system include sensors (for voltage, current and temperature), an ADC (analog for digital converter), a microcontroller and a cloud platform to store and show data.



5.1. ARCHITECTURE OVERVIEW

Pre-E-Vehicle battery burning detection and alert system architecture is designed to monitor and alert users about potential battery overheating or burning. The system begins with an power supply that activates battery modules and connected sensors such as temperature and gas sensors. These sensors constantly monitor the battery position and send data to a microcontroller (Arduino), which acts as the brain of the system. If abnormal readings are detected, the microcontroller triggers a buzzer for immediate alert, displays information on an LCD/OLED screen, and communicates with the GSM or Bluetooth module to send a warning to a mobile application. This real time alert mechanisms helps users to take quick action and prevent batteries related hazards.

The system sensor is made up of a microcontroller and cloud support. Voltage and current sensors measure the electrical performance of the battery, and a DHT11 sensor checks the temperature. These sensor values are converted from analog to digital using MCP3008 ADC.
NodeMCU reads microcontroller data, checks for any issue, and sends it to ThingSpeak Cloud via Wi-Fi. Users can see the status of the battery in real time using a simple web app that shows the data in the graph that is easily read.

5.2. SYSTEM WORKFLOW

The sensors collect voltage, current and temperature data from the battery. NodeMCU reads these values, checks if they are within a safe range, and send them to the cloud. If something is wrong - such as high temperature or voltage - it sends an alert. ThingSpeak stores the platform and shows data on the graph so that users can track the battery health and work quickly if there is any problem. This helps to protect electric vehicles and prevents accidents.

VI. SOFTWARE DESCRIPTION

The software part of the system helps watch the battery all the time using sensors and a microcontroller. It checks the data, sends warnings if needed, and shows the battery status live on a website.

6.1. TOOLS AND TECHNOLOGIES

This system uses both hardware and software to monitor the battery. Important parts include NodeMCU board, MCP3008 chip, and sensors for voltage, current and temperature. NodeMCU reads data and sends it to the Internet using Wi-Fi. Since it can only read an analog input, the MCP3008 chip helps it read more signs at once. The DHT11 sensor checks the temperature of the battery, while the voltage and current sensors show how the battery is working.

6.2. SYSTEM ARCHITECTURE

The software works in four parts. First, it collects data from the sensor. Voltage, current and temperature values are converted from analog to digital using MCP3008 so that NodeMCU can read them. Then, NodeMCU checks whether the data is within a safe range. If the battery becomes too hot or the voltage becomes too high or low, the system detects a problem. After that, NodeMCU sends the data to ThingSpeak Cloud using Wi-Fi. On the ThingSpeak website, users can see this data as a live graph. It helps people understand how the battery is doing, even if they are far away.

6.1. DEVELOPMENT ENVIRONMENT

The code for NodeMCU is written using Arduino Ide, which is a simple and easy tool to write and upload programs. On the cloud side, the python is used for data testing and additional analysis. The python is written using the Jupiter notebook in the anaconda environment, making it easier to work with data. The ThingSpeak platform is opened in a web browser and is used to set the sensor data channel and show the battery information on the dashboard.

6.2. ALGORITHMS AND METHODS

The software uses simple arguments to check battery safety. It always compares battery values with set safe boundaries. If the temperature is too high or is outside the voltage or current allowed, it sees it as a problem. These boundaries are based on the security levels known for lithium-ion batteries. When a problem is found, the system quickly sends alert to the user. These alerts can be shown on the ThingSpeak website or sent to the user's device. This helps the user to take action quickly and avoid any damage. In the future, the system can also be improved to send an alert via mobile app or email.

6.3. USER INTERFACE

The user can see the battery information through a simple online dashboard provided by ThingSpeak. This shows the live graph of temperature, voltage and current, making it easier to know if the battery is working properly. Even without technical knowledge, people can understand these graphs. Older data is also saved so that the user can see how the battery is done over time. Later, a mobile-friendly version can be added to make it easier to use on smartphones.

6.4. SECURITY MEASURES

While sending information to the cloud, the system preserves all the data using encryption. This prevents anyone from changing data during uploads. Only the person who owns ThingSpeak account can look or manage the data by logging in with a user name and password. It keeps the battery information private and safe.

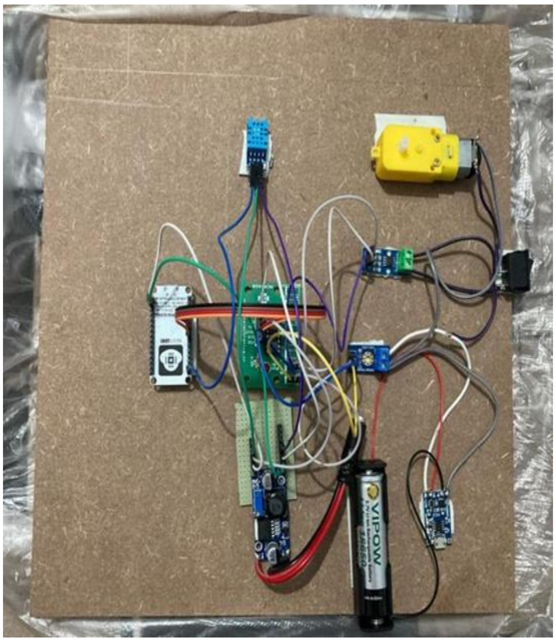
VII. CONCLUSION

The software share of this system is simple but very helpful. It collects battery data, examines for problems, and shows everything clearly on the web dashboard. Tools such as Arduino IDE and Python make it easy to create and run software. The software can also send an alert to the user if something goes wrong. By doing this, the system helps people to protect their electric vehicle batteries and avoid dangerous situations.

RESULTS

7.1. ARDUINO UNO CODE

7.2. HARDWARE SETUP



7.3. FINAL OUTPUT

The displayed output represents real-time battery parameters monitored by the Pre-E-Vehicle Battery Burning Detection and Alert System. It shows a very low voltage of 0.02444V and current of 0.00311A, which are significantly below the normal operating levels for electric vehicle batteries. Although the temperature is 32°C — which is within a safe range — the system has still flagged a battery fault status. This decision is likely based on the abnormal voltage and current values, which may indicate a deeply discharged battery, sensor failure, or possible early signs of internal damage. The state of charge (SOC) value is approximately 58%, suggesting that the battery should have sufficient charge, further supporting the suspicion of a fault or inconsistency. The system's fault detection logic likely prioritizes safety by recognizing any critical deviations in power values, regardless of temperature. By doing so, it can alert the user in advance, helping prevent hazards such as overheating, leakage, or potential fire, thus demonstrating the system's proactive safety mechanism.

BATTERY STATUS MONITORING

VOLTAGE	CURRENT	SOC	TEMPERATURE	STATUS
0.02444	0.00311	0.58186	32.00000	BATTERY_FAULT

VIII. CONCLUSION AND FUTURE WORK

Pre-E-Vehicle Battery improves electric vehicle safety by offering real-time monitoring of the burning detection and alert system lithium-ion battery health. It uses cloud platforms such as the sensor, a NodeMCU microcontroller, and the initial signals of battery defects to detect ThingSpeak It helps prevent dangerous events such as overheating or battery fire.

The alert system immediately informs users when the unprotected situation is detected, they will allow quick action to be taken. The system is also designed to be flexible, so future updates and additional features can be easily included.

In the future, the system can be increased by adding machine learning to predict defects based on patterns in data. Monitoring additional factors such as humidity or battery cycle can give a complete picture of battery health. Connecting the system with the vehicle onboard diagnostics (OBDII) can lead to automatic safety activities. Adding to Bluetooth or mobile app can improve user alert and interaction. These will help update system to be useful as electric vehicles and battery techniques develop.

REFERENCES

[1] H. Yin, Z. Wang, P. Liu, Z. Zhang, and Y. Li, "Voltage Fault Diagnosis of Power Batteries based on Boxplots and Gini Impurity for Electric Vehicles," in *2019 Electric Vehicles International Conference (EV)*, Bucharest, Romania: IEEE, Oct. 2019, pp. 1–5. doi: 10.1109/EV.2019.8892849.

[2] Prof. P. S. Mali, Patil Arti S, Gavade Pratibha S, Mane Mrunal A, and Patil Aniket A, "IoT Based Battery Monitoring System for Electric Vehicle," *IJARSCT*, pp. 37–43, Jun. 2022, doi: 10.48175/IJARSCT-4767.

[3] Y. Mastanamma, B. Laxman, A. Archana, andK. P. Reddy, "EV BMS With Charge Monitor and Fire Detection," *E3S Web Conf.*, vol. 472, p. 03006, 2024, doi: 10.1051/e3sconf/202447203006.

[4] S. Dalvi and S. Thale, "Design of DSP Controlled Passive Cell Balancing Network based Battery Management System for EV Application," in *2020 IEEE India Council International Subsections Conference (INDISCON)*, Visakhapatnam, India: IEEE, Oct. 2020, pp. 84–89. doi: 10.1109/INDISCON50162.2020.00029.

[5] R. A. Naik, A. L. Divya, B. Sathvik, and M. Lalitha, "BATTERY MANAGEMENT SYSTEM IN ELECTRIC VEHICLE WITH CHARGE MONITORING AND FIRE PROTECTION USING IOT," vol. 9, no. 4, 2024.

[6] R. R. Kumar, C. Bharatiraja, K. Udhayakumar,S. Devakirubakaran, K. S. Sekar, and L. Mihet-Popa, "Advances in Batteries, Battery Modeling, Battery Management System, Battery Thermal Management, SOC, SOH, and Charge/Discharge Characteristics in EV Applications," *IEEE Access*, vol. 11, pp.105761–105809, 2023, doi:10.1109/ACCESS.2023.3318121.

[7] W. Menghua and X. Bing, "A Real-Time Android-Based Monitoring System for the Power Lithium-Ion Battery Used on EVs," in *2017 10th International Conference on Intelligent Computation Technology and Automation (ICICTA)*, Changsha: IEEE, Oct. 2017, pp. 245–249. doi:10.1109/ICICTA.2017.62.

[8] D. Gao, Y. Wang, X. Zheng, and Q. Yang, "A Fault Warning Method for Electric Vehicle Charging Process Based on Adaptive Deep Belief Network," *WEVJ*, vol. 12, no. 4, p. 265, Dec. 2021, doi: 10.3390/wevj12040265.