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# Design and Implementation of Battery Management System for Electric Vehicles using Random Forest Algorithm

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**ABSTRACT:** Battery Management Systems (BMS) are important to ensure safe, efficient and reliable batteries, especially in electric vehicles. If the temperature exceeds the threshold, the relay is triggered to isolate the charging circuitry and avoid possible damage. Similarly, the charging circuit process is intelligently controlled based on the battery voltage. If the battery voltage is too high or too low, it will only remain off if the battery voltage is active only if it is in a safe central area. This means the battery remains healthy. serial Communication transfers data to your PC, allowing for further analysis. The software module uses algorithms for machine learning, decision trees and logistics for random forests. This is implemented in the SCIKIT Learn Library to predict battery bloat and health.

#### I. INTRODUCTION

The introduction of storage systems for electric vehicles (electric vehicles) and renewable energy, as well as the importance of efficient and intelligent battery management systems (BMSs) is more important than ever. Lithium ion types used in batteries, especially EVs, operate within safe parameters and require constant monitoring and control to prevent problems such as overload, overheating, deep discharge, and heat deposition. In this project, a microcontroller-based system was developed to monitor battery health in real time with different sensors. The system includes temperature sensors, voltage, electrical sensors, and analog-to-digital converters (ADCs) that continuously provide data to Arduino microcontrollers. Based on sensor data, BMS can make intelligent decisions. To improve prediction capabilities, algorithms are implemented for machine learning such as logistics, decision trees, and random forests, with the help of SCIKIT learning.

#### **II. LITERATURE SURVEY**

#### [1]Uwang Yuan Wang is Aurix Multi-Core Architecture, 2020 IEEE4.

We proposed a battery management system based on advanced information technology and electronic equipment and automation control conference (IAEC). The complexity of the control algorithms for these batteries increases with energy density, making the BMS even more stressful. [2]yangxu; Shen Zhang introduces the lithium-ion battery management frame. This happens especially in evikes. Actual monitoring of the processes permitted for operation is the purpose of load and drainage targets. It can monitor many functions such as voltage, electricity, temperature, energy, battery packaging, and send this data to a cloud-based management system. The leasing company has effectively integrated this method into its battery lease scope.[3]Fawadarishah; Shezard Shazad Shah. umer ifikhar me; Syed Owais Athar was proposed to monitor the batteries with commercialized batteries for electric vehicles. Lithium Ion-I-I-I-DiploI: October 28, 2021.

It highlights how important it is for battery modeling to maintain efficiency, security and reliability. First, we focus on the wide range of batteries used in EVs and HEVs, and pay particular attention to the latest developments in Battery Management Technology (BMS).[4]federomartinibanez; Tanbil Ahmed; iilder idrisov; Jose Sebastian Gutierrez evaluated and analyzed in impedance-based modeling to predict the aging of lithium-ion batteries and international conferences in EV Applications and Renewable Energy and Application Research (ICRA). (LifePO4). It is important to



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model the behavior of the LIB under a variety of circumstances, including temperature, load current, and load conditions. A suitable model can explain modifying properties such as capacity, outdoor tension, and impedance. Actual electrical and electronic load profiles were used to age experimentally. VAR9 Test Results [Anti-radioactive Revappaptan test using Ious cycles was tested and tested for selected ECMs

#### **III. EXISTING & PROPOSED SYSTEM**

#### 1. EXISTING SYSTEM

In existing systems, the function of the Battery Management System (BMS) is to check and control the battery status within specified safe operating conditions. Kalman Filter Method. - Battery parameters from experimental results are integrated into the model, and simulation results are verified by experiment.

#### **1.1 DISADVANTAGES**

- Battery Management Systems (BMS) are used in many industrial and commercial systems to make battery operation more efficient and estimate battery status. This is estimated as much as possible due to destructive conditions that extend the service life of the battery.
- This system evaluates and displays the battery temperature, load/discharge current, and load status (SOC) for selected battery models. For microcontrollers, voltage and current sensors are used for real-time monitoring. Battery information and results are displayed via photos and LCD screen.

#### **IV. PROPOSED SYSTEM**

This requires monitoring, analyzing, analyzing and controlling the load and mitigation behavior of batteries used in electric vehicles. The core of the system is an Arduino microcontroller that collects real-time data from integrated sensors such as voltage, electricity and temperature sensors. These sensors continuously pursue key battery parameters to ensure safe operation. The temperature sensor monitors the battery's heat level and, if predefined thresholds exceed, the system automatically triggers the relay to isolate the charging circuitry to prevent overheating. Turn off charge when the voltage is too high or too low, and enable load only if the voltage is within the optimum range.

#### ADVANTAGES

- Make sure the battery is in good condition.
- Battery health is continuously monitored to avoid explosion.

#### **BLOCK DIAGRAM**



Fig No : 1 Block Diagram



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#### Fig no: 2 Architecture Design Of Proposed System

#### V. HARDWARE REQUIREMENTS

#### 1.DHT11 Sensor

The DHT11 sensor is used in battery management systems (BMS) to monitor temperature. Provides real-time temperature data to recognize overheating conditions. If the temperature exceeds the safety threshold, the system triggers the relay to isolate the charging circuitry. This protects the battery from damage and increases security. Temperature data is also sent to PCs for analysis and health prediction.



#### Fig No:1 DHT11 sensor

#### 2.ARDUINO MICROCONTROLLER

Fingers on the screen, sensor lights, etc. The Arduinoboard consists of a USB connection and includes a connection that cuts the computer. Therefore, Arduino boards are available in shops and can be purchased by providers. You can also create your own board on request. Using the official H. Head Diagram, you can purchase all components according to the design specifications and create your own board using all components.



Fig no: 2 Arduino Digital

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#### 2. BATTERY

If there were more products in this world than anything else, that's true. After offering a large amount of Hiwatt and Hiwatt, we were able to get the original for our customers. It is a highly reliable, affordable, dedicated solution that provides low application performance. Ideally, it will be used in circuits with low power consumption, so it should work for a long time.



#### Fig no:5 Battery

#### 3. LCD DISPLAY

It can often be found in consumer devices such as video modes, play equipment, watches, watches, pocket computers, and phones, and most applications replace cathode beam pipes (CRTs). They are available in many screen sizes larger than CRTs and plasma displays, and do not use phosphorus to prevent burnout in photos. However, LCDs receive periods more frequently. It is suitable for battery operated electronic devices due to its low power consumption source (backlight) or reflector. The LCD was first discovered in 1888



#### Fig no: 7 Liquid crystal display

#### 4. RELAY

We found that industrial application devices for the highest quality relays have effective work. A relay is a simple switch that operates both electrically and mechanically. The switching mechanism is carried out with an electromagnet. His work also has other operating principles. However, they vary from application to application. Most devices use relays



Fig no:8 Relay Construction



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VI. RESULT

The Battery Management System (BMS) for Electric Vehicles (EVS) successfully monitors and evaluates critical battery parameters, including temperature, load/emission flow, and load status (SOC). When voltage and current sensors are used with a microcontroller, real-time data is processed and displayed on the LCD screen. The system ensures battery safety by automatically shutting down using a relay mechanism. Logistic Regression, Decision Making - Manufacturing Trees, Random Forests have been implemented to predict battery health and optimize management.



Fig No: 9 Temperature Monitor

Fig No:10 Battery Voltage Monitor



Fig No: 10 Battery High Voltage

Fig No:11 Battery Temperature High



Fig No:12 Overall Kit



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Fig No: 13 Welcome Page

Fig No:14 Login Page



#### Fig No:15 Predict The Battery Efficiency

#### VII.CONCLUSION

Monitoring helps to avoid costly downtime and protects your company from losses. Prolongs battery life. Reduces replacement costs for maintenance. This device is designed so that battery conditions such as temperature, air humidity, voltage, electricity, SOC, and SOH are implemented for improved battery management.

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