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BATTERY MANAGEMENT USING IOT CLOUD

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ABSTRACT :

Electric vehicles (EVs) have gained increasing popularity as a sustainable and eco-friendly mode of transportation. However, efficient battery management and charging infrastructure are critical to their widespread adoption. This report presents a novel Battery Management System (BMS) designed for electric vehicles, with a focus on hybrid charging solutions. The system integrates Arduino IoT Cloud technology to enable real-time monitoring, control, and data analysis. The proposed BMS employs advanced algorithms to optimize battery health and extend its lifespan. It ensures safe and efficient charging while monitoring the battery's state of charge, state of health, and temperature. The hybrid charging approach combines both wired and wireless charging methods, providing flexibility and convenience to EV users. Arduino IoT Cloud facilitates remote monitoring and control, allowing users to access vital information about their vehicle's battery status via a user-friendly interface. It also enables data analytics, helping users make informed decisions regarding charging and maintenance. This report outlines the design and implementation of the Battery Management System and the Arduino IoT Cloud integration. The experimental results demonstrate the system's effectiveness in improving the overall performance and longevity of electric vehicle batteries. Furthermore, it offers a more eco-conscious and user-friendly approach to charging, contributing to the broader adoption of electric vehicles in the automotive industry.

INTRODUCTION :

The electrification of transportation through Electric Vehicles (EVs) has emerged as a pivotal solution to mitigate the environmental impact of traditional internal combustion engine vehicles. Electric vehicles are not only energy-efficient but also contribute significantly to reducing greenhouse gas emissions. However, the widespread adoption of electric vehicles hinges on addressing critical challenges such as efficient battery management and charging infrastructure. This introduction sets the stage for a comprehensive exploration of a Battery Management System (BMS) designed for electric vehicles, emphasizing the integration of hybrid charging solutions and the power of the Arduino IoT Cloud. As the automotive industry undergoes a transformative shift towards sustainability, optimizing the performance and lifespan of EV batteries becomes paramount. The battery in an electric vehicle is its lifeblood, dictating range, efficiency, and overall operational reliability. A well-designed BMS is essential to ensure the safe and efficient operation of the battery, extending its longevity and, in turn, reducing the total cost of ownership for EV owners. The focus of this research lies not only in the efficient management of electric vehicle batteries but also in addressing the charging infrastructure dilemma. Electric vehicle charging, a critical facet of EV ownership, often confronts users with concerns about accessibility, convenience, and speed. Hybrid charging solutions, which combine both wired and wireless charging methods, offer a promising approach to overcome these challenges. This paper explores the integration of such hybrid charging systems into the BMS to offer EV owners a more flexible and user-friendly experience. In an era of rapid technological advancement, the Internet of Things (IoT) has revolutionized the way devices and systems interact and communicate. Arduino, a wellknown open-source hardware and software platform, has ventured into the IoT domain with the Arduino IoT Cloud. This paper leverages the power of Arduino IoT Cloud to enable realtime monitoring, control, and data analysis for the BMS. By seamlessly connecting the BMS to the cloud, EV owners can remotely access critical information about their vehicle's battery, empowering them to make informed decisions regarding charging, maintenance, and overall vehicle operation. This research represents a significant step towards achieving a sustainable and ecoconscious future of transportation. By addressing battery management, charging infrastructure, and IoT integration, the proposed system contributes to the broader adoption of electric vehicles, ultimately reducing carbon emissions and lessening our dependence on fossil fuels. In the pages that follow, we delve into the design, implementation, and experimental results of this innovative Battery Management System for Electric Vehicles with Hybrid Charging Using Arduino IoT Cloud.

LITERATURE SURVEY :

- Battery Management Systems (BMS) for Electric Vehicles: Battery Management Systems have been a critical component of electric vehicles, as they monitor and control the battery's health and performance. Various research studies have focused on the design and implementation of BMS

to ensure safe and efficient battery operation. This literature emphasizes the importance of BMS in electric vehicles and sets the foundation for more advanced BMS designs.[1] • Hybrid Charging for Electric Vehicles: Hybrid charging solutions, combining wired and wireless charging methods, have gained attention in recent years. Studies exploring the advantages and challenges of hybrid charging in electric vehicles have emerged. They discuss the potential for faster and more convenient charging, while also addressing compatibility and standardization issues.[2]

- IoT in Electric Vehicle Management: The Internet of Things (IoT) has played a significant role in revolutionizing various industries. Several research articles delve into the integration of IoT technologies in electric vehicles. They highlight the potential for real-time monitoring, data analytics, and remote control, contributing to enhanced user experience and better decisionmaking regarding vehicle operation.[3]

- Arduino and IoT Cloud Integration: Arduino, as an open-source hardware and software platform, has gained prominence in IoT applications. Research on Arduino's IoT Cloud platform showcases its ease of use and versatility in connecting and controlling various devices. Its integration into electric vehicle systems offers a new dimension for remote monitoring and control.[4]

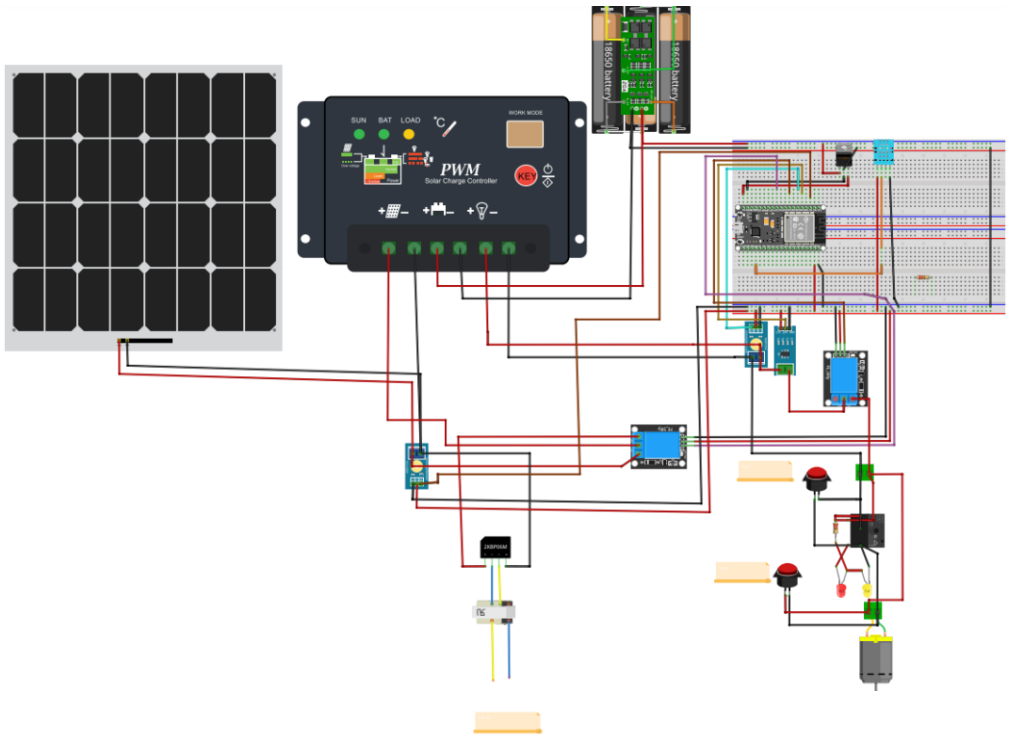
- Battery Health and Management Algorithms: Battery management involves advanced algorithms that determine the state of charge, state of health, and temperature of the battery. Various studies have explored different algorithms and methodologies to optimize battery performance, enhance safety, and prolong battery lifespan in electric vehicles.[5]

- Charging Infrastructure for Electric Vehicles: The development of charging infrastructure is essential for the widespread adoption of electric vehicles. Literature on this topic discusses the challenges in creating a comprehensive and accessible charging network and emphasizes the importance of providing a convenient and reliable charging experience to EV users.[6]

- Energy Efficiency and Sustainability in Transportation: With the growing concern over environmental issues and climate change, there is a strong emphasis on sustainable transportation. Research highlights the significance of electric vehicles in reducing carbon emissions and achieving a more sustainable and eco-friendly mode of transportation.[7] 6

- User Experience and Adoption of Electric Vehicles: Studies examining user perspectives and experiences with electric vehicles provide insights into the factors influencing EV adoption. An improved charging and battery management system can address some of the concerns and challenges that affect consumer decisions to switch to electric vehicles.[8] The literature reviewed highlights the existing knowledge and developments in the fields of battery management systems, hybrid charging solutions, IoT integration, and the broader context of electric vehicle adoption and sustainability. This information serves as a foundation for the development and evaluation of the Battery Management System for Electric Vehicles with Hybrid Charging Using Arduino IoT Cloud discussed in this research.

Circuit Diagram



PROBLEM DEFINATION :

Problem Statement: The electrification of transportation through Electric Vehicles (EVs) has garnered significant attention as a solution to reduce carbon emissions and dependence on fossil fuels. However, several critical challenges must be addressed to facilitate the widespread adoption of electric vehicles. One of the most pressing issues is the effective management of electric vehicle batteries and the development of a robust charging infrastructure. As the demand for EVs continues to rise, the following key problems have emerged.

- Battery Management and Longevity: Electric vehicle batteries are among the most expensive and critical components. Maximizing the battery's lifespan, optimizing performance, and ensuring its safety are of utmost importance. Existing Battery Management Systems (BMS) often lack the sophistication required to address these concerns comprehensively.
- Charging Infrastructure and Convenience: The success of electric vehicles depends on convenient and widespread access to charging stations. Current charging infrastructure is fragmented, and users often face challenges in locating and accessing charging points. A seamless, user-friendly, and standardized charging experience is vital for EV adoption.
- Hybrid Charging Solutions: While both wired and wireless charging methods offer advantages, they also present compatibility and standardization issues. Hybrid charging solutions that combine these methods have not been widely explored and standardized, creating uncertainty for users.
- IoT Integration for Real-Time Monitoring and Control: Leveraging the potential of the Internet of Things (IoT) to monitor battery status, control charging processes, and analyze data in real time offers numerous benefits. However, the integration of IoT technologies into electric vehicles remains a developing field.
- User Experience and Adoption Barriers: Electric vehicle adoption rates are influenced by factors such as range anxiety, charging inconvenience, and a lack of real-time information about the battery's status. Addressing these concerns is vital to encouraging more consumers to embrace electric vehicles. Given these challenges, there is a compelling need for a comprehensive Battery Management System that not only ensures battery health and longevity but also integrates hybrid charging methods and leverages IoT technologies to enhance user experience. Such a system could provide a more sustainable and user-friendly solution, potentially accelerating the adoption electric vehicles and contributing to the reduction of carbon emissions in the transportation sector. This research aims to develop and evaluate a Battery Management System for Electric Vehicles with Hybrid Charging Using Arduino IoT Cloud, which addresses the identified problems and provides a holistic solution to these pressing challenges in the electric vehicle industry. 8 PROPOSED

METHODOLOGY :

Designing a Battery Management System (BMS) for an Electric Vehicle (EV) with hybrid charging using the Arduino IoT Cloud involves several key components and steps. Here's a proposed methodology to achieve this:

1. Project Overview: Start with a clear project overview. Define the goals and objectives of Battery Management System (BMS). Consider what aspects of the battery to monitor and control. This could include state of charge (SoC), state of health (SoH), temperature, voltage, and current.
2. System Components: List the components needed. For an Arduino-based BMS, require Arduino-compatible microcontrollers, battery monitoring ICs, sensors, relays, and communication modules. Ensure that these components are compatible with the Arduino IoT Cloud.
3. Battery Selection: Choose an appropriate battery for your EV, and understand its characteristics, such as chemistry and nominal voltage.
4. Circuit Design: Design the circuitry for monitoring and controlling the battery. This involves connecting sensors for voltage, current, temperature, and voltage balancing (if needed). Use the Arduino IoT board for data acquisition and control.
5. Data Acquisition: Set up the Arduino to acquire data from the battery. Use analog-to-digital converters (ADCs) to read voltage and current sensors. Temperature sensors can be interfaced via I2C or other suitable communication protocols.
6. Communication Setup: Establish a connection between your Arduino-based BMS and the Arduino IoT Cloud. Ensure that the IoT cloud is properly configured to receive and display data from the BMS. The cloud can be used to store and analyze data, as well as provide remote access for monitoring and control.
7. Battery State Monitoring: Implement algorithms to monitor the state of charge (SoC) and state of health (SoH) of the battery. This may involve tracking voltage, current, and temperature data, as well as using mathematical models or algorithms to estimate SoC and SoH. 9
8. Battery Protection and Control: Implement safety features like overvoltage and undervoltage protection, overcurrent protection, and thermal management. These features can be controlled through the Arduino, ensuring the battery operates within safe limits.
9. Hybrid Charging Control: Develop a charging control system that can handle hybrid charging sources, such as grid power and regenerative braking. This involves creating a charging algorithm that optimizes charging based on the power source and battery state.
10. Data Visualization and Remote Control: Configure the Arduino IoT Cloud for data visualization and remote control. Users should be able to monitor the battery's performance and control charging remotely through a web interface or a mobile app.
11. Testing and Validation: Rigorously test the BMS system under different conditions to ensure its reliability and safety. Verify that the hybrid charging system works as intended and that the battery remains within safe operating limits.
12. Documentation: Document your BMS design, including schematics, code, and usage instructions. This documentation is essential for troubleshooting and future development.
13. Compliance and Safety: Ensure that your BMS complies with relevant safety and regulatory standards for EVs. Safety should be a top

priority.

14. Deployment and Maintenance: Once BMS is functional and validated, deploy it in your electric vehicle. Regular maintenance and updates to the BMS software may be required. Remember that building a BMS for an EV is a complex task that involves both hardware and software development. It's important to prioritize safety and adhere to industry standards and best practices throughout the development process. Additionally, consider consulting experts in battery management and IoT if you're not experienced in these areas. 10 PROJECT BLOCK DIAGRAM Circuit Diagram 11 SIMULATION OF PROPOSED WORK Program Code of Project: /* Sketch generated by the Arduino IoT Cloud Thing "Ev Battery Management System " https://create.arduino.cc/cloud/things/343bf8ed-f25c-46d7-89ff-ff6be0995e21 Arduino IoT Cloud Variables description The following variables are automatically generated and updated when changes are made to the Thing String message; Cloud Electric Current current ; Cloud Electric Potential voltage; Cloud Temperature Sensor temperature; Cloud Percentage battery percentage; Variables which are marked as READ/WRITE in the Cloud Thing will also have functions which are called when their values are changed from the Dashboard.

These functions are generated with the Thing and added at the end of this sketch.

```
*/ #include "thing Properties .h"
//voltage sensor
 #define ANALOG_IN_PIN 35 float a dc_ voltage = 0.0;
float in_ voltage = 0.0;
float R1 = 30000.0;
float R2 = 7500.0;
float ref _voltage = 3.3;
in  a dc_ value = 0;12
 //voltage sensor 2
#define ANALOG_IN 36
float adc _voltage _A = 0.0;
float in_ voltage _B = 0.0;
float R12 = 10000.0;
//30k 30 000 float R22 = 1000.0;
//7.5k 75 00 float ref_voltage_C = 3.3;
int adc_value_D = 0;
// Current Sensor constant   sensor In = 34;
int m VperAmp = 100;
// use 185 for 5A, 100 for 20A Module and 66 for 30A Module 197 int Watt = 0;
double Voltage = 0;
double VRMS = 0;
double AmpsRMS = 0;
//dht temp #include "DHT.h" #define DHTPIN 15 #define DHTTYPE DHT11 DHT dht(DHTPIN, DHTTYPE);
float t; //relay int relay1 = 33;
int relay2 = 27;
int LED_BUILTIN = 2;
```

APPLICATIONS :

Remote Monitoring

- Energy Optimization
- Energy Consumption Tracking
- Battery Management.
- Monitoring battery parameters. This is the primary function of a BMS.
- Managing thermal temperatures. Temperature is the biggest factor affecting a battery.
- Making key calculations.
- Facilitating internal and external communication.
- Off-Grid Applications

CONCLUSION :

In conclusion, the Battery Management & Monitoring System of an Electrical Vehicle with Hybrid Charging using Arduino IoT Cloud is a remarkable solution that not only improves the performance and longevity of electric vehicle batteries but also promotes sustainability and user convenience. As electric vehicles become increasingly prevalent, such systems will play a crucial role in shaping the future of transportation by reducing environmental impact and operating costs while providing a seamless user experience.

FUTURE SCOPE :

1. Advanced Battery Technologies.
2. Smart Grid Integration
3. Predictive Maintenance
4. 5G Integration
5. Energy-Efficient Charging Algorithms
6. Enhanced Security Measures
7. User-Friendly Interfaces
8. Collaboration with Automotive Industry

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