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# Battery Status Monitoring System Using Esp8266 & ThingSpeak

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**ABSTRACT**: The Battery Status Monitoring System (BSMS) presented in this project offers a robust solution for real time monitoring of battery health and status using the ESP8266 microcontroller and ThingSpeak platform. With the increasing demand for reliable power sources in various applications such as IoT devices, remote sensors, and portable electronics, efficient monitoring of battery parameters has become imperative. The proposed system utilizes the ESP8266 microcontroller, known for its low power consumption and Wi-Fi connectivity capabilities, enabling seamless integration with the Arduino IoT Cloud platform. The system employs voltage and current sensors to accurately measure the parameters crucial for assessing battery status, including voltage levels, charging/discharging currents, and temperature.

**KEYWORDS:** Battery Status Monitoring System, ESP8266 microcontroller, Arduino, Battery parameters, Voltage and current sensors.

## I. INTRODUCTION

The integration of Internet of Things (IoT) technology with battery monitoring systems has become increasingly crucial in various industries and applications. Efficient management of battery health and performance is essential for ensuring uninterrupted operation, prolonging battery lifespan, and optimizing resource utilization. In response to this need, this paper presents a comprehensive Battery Status Monitoring System (BSMS) utilizing ESP8266 and Arduino IoT Cloud. The convergence of Internet of Things (IoT) technology with battery monitoring systems has emerged as a critical necessity across various industries and applications. Efficient management of battery health and performance is imperative for ensuring uninterrupted operation, extending battery lifespan, and maximizing resource utilization. In light of this demand, this paper introduces a comprehensive Battery Status Monitoring System (BSMS) that leverages the capabilities of ESP8266 and Arduino IoT Cloud. This system aims to address the shortcomings of traditional battery monitoring approaches by offering real-time monitoring, remote accessibility, and proactive maintenance capabilities. At the core of the proposed system are the ESP8266 module and Arduino IoT Cloud platform. The ESP8266 module, renowned for its affordability, low-power consumption, and integrated Wi-Fi connectivity, provides the foundation for wireless communication and data processing.

Complementing this, Arduino IoT Cloud offers a robust cloud-based infrastructure for managing IoT devices, collecting sensor data, and visualizing insights through customizable dashboards. Together, these technologies form a powerful framework for developing scalable and accessible battery monitoring solutions, catering to a diverse range of IoT applications. The significance of the BSMS lies in its ability to provide real-time insights into battery health and performance, thereby enabling proactive maintenance and efficient resource management. By seamlessly integrating hardware components, firmware, and cloud-based infrastructure, the system achieves scalability, reliability, and accessibility. This innovative approach not only addresses the limitations of existing battery monitoring methods but also sets a new standard for comprehensive battery monitoring solutions in the IoT ecosystem.

The significance of the proposed BSMS lies in its ability to offer real-time insights into battery health and performance, enabling proactive maintenance, and optimizing resource utilization. By leveraging ESP8266 and Arduino IoT Cloud, the system achieves scalability, reliability, and accessibility, making it suitable for a wide range of IoT applications.

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## II. PROBLEM STATEMENT

Despite the widespread use of battery-powered systems in various applications, there exists a significant challenge in efficiently monitoring and managing the health and status of batteries in real-time. Traditional methods of battery monitoring often lack accuracy, accessibility, and scalability, leading to potential issues such as undetected battery degradation, premature failure, and compromised system reliability.

1. Inadequate Monitoring: Existing battery monitoring methods lack accuracy and real-time capabilities, making it challenging to detect and address battery issues promptly Traditional battery monitoring methods often rely on simplistic techniques such as periodic voltage checks or simple threshold alarms. These methods may fail to detect subtle changes in battery health or performance, leading to undetected battery degradation or premature failure. As a result, system reliability may be compromised, leading to unexpected downtimes or failures, especially in critical applications.
2. Limited Accessibility: Current monitoring systems often lack remote accessibility, hindering the ability to monitor battery status from anywhere with internet connectivity. Many existing battery monitoring systems lack remote accessibility, requiring physical access to the devices for monitoring and management. This limitation poses challenges in scenarios where IoT devices are deployed in remote or inaccessible locations. Without the ability to monitor battery status remotely, maintenance and troubleshooting become more difficult and costly.
3. Lack of Scalability: Many battery monitoring solutions are not scalable and may not be compatible with different battery types, sizes, and applications. Battery monitoring solutions often lack scalability and may not be easily adaptable to different battery types, sizes, and applications. This limitation restricts the applicability of monitoring systems across diverse IoT deployments, requiring customized solutions for each scenario. Additionally, incompatible monitoring systems may result in interoperability issues and increased complexity in managing heterogeneous IoT environments.

## III. OBJECTIVES

Efficient monitoring and management of battery health are critical for various applications, yet traditional methods often lack accuracy and accessibility. This paper presents the development of a Battery Status Monitoring System (BSMS) using the ESP8266 microcontroller and Arduino IoT Cloud platform. The BSMS aims to provide accurate sensor-based monitoring, remote accessibility, minimized power consumption, and an intuitive user interface.

These objectives address key challenges in battery monitoring, offering a comprehensive solution for improved reliability and performance.

1. Develop a Battery Status Monitoring System (BSMS) using ESP8266 and Arduino IoT Cloud platform.
2. Implement accurate sensor-based monitoring of battery parameters including voltage, current, and temperature in real-time.
3. Enable remote accessibility to battery status data via web or mobile interfaces, facilitating monitoring from anywhere with internet connectivity.
4. Design the system to minimize power consumption, ensuring prolonged battery life and suitability for batterypowered applications.
5. Develop an intuitive and user-friendly interface for configuring, monitoring, and managing the battery status monitoring system, catering to users with varying levels of technical expertise.

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## IV. LITERATURE REVIEW

The development of IoT-based battery monitoring systems has gained significant attention in recent years due to the increasing demand for efficient battery management in various applications. This section reviews existing literature on IoT-based battery monitoring systems, focusing on the use of ESP8266 microcontroller and related technologies.

In the paper [1] "Webserver Based Smart Monitoring System Using ESP8266 Node MCU Module" introduced by the Author Dlnya Abdulahad Aziz. The paper demonstrates a cost-effective, user-friendly control system design suitable for IoT applications, particularly in weather monitoring, navigation, transportation, and agricultural fields, showcasing its versatility and practicality. But the shortcoming of the project is costly and limit range of data transmission. The Authors Tole Sutikno1, Hendril Satrian Purnama2, Anggit Pamungkas3, Abdul Fadlil4, Ibrahim Mohd Alsofyani5, Mohd Hatta Jopri6 developed "Internet of things-based photovoltaics parameter monitoring system using NodeMCU ESP8266" research paper[2] which explain an IoT-based PV parameter monitoring system utilizing low-cost components, including NodeMCU V3 ESP8266, to measure and wirelessly transmit solar irradiance, ambient temperature, PV output voltage, current, and power to ThingSpeak cloud server, demonstrating accurate results and suggesting further testing under various environmental conditions for future validation. But the output of system may change according to the weather conditions and solar panel is more important. If the sun light is not capable to charge the battery and one more thing that find during the research studying that is complex circuit design.

In the paper [3], Authors Manushri Gowda, Jnanavi Gowda, Sahil Iyer, Manaswi Pawar, Vishal Gaikwad develop the system on "Power Consumption Optimization in IoT based Wireless Sensor Node Using ESP8266". during the study weather monitoring using solar. But Over time, solar panel degradation necessitates replacement, particularly in cloudy weather, higher-efficiency panels are essential; maintenance of sensors and optimization of deep sleep mode duration are crucial for preserving solar energy while obtaining accurate weather readings. "Development of Power Consumption Models for ESP8266-Enabled Low-Cost IoT Monitoring Nodes" in this research paper[4] Author Olubiyi O. Akintade, Thomas K. Yesufu, Lawrence O. Kehinde explain the setup of a temperature and humidity monitoring node utilizing specific components and sleep mode optimization results in a battery life of approximately 6 months before replacement is needed, with significant reductions in current consumption achieved through sleep duration adjustments, demonstrating the effectiveness of energy-saving measures in prolonging battery longevity. But complexity of project is more than the other papers so that this is main shortcoming of the research.

The Authors Hicham Ouldzira1, Ahmed Mouhsen2, Hajar Lagraini3, Mostafa Chhiba4, Abdelmoumen Tabyaoui5, Said Amrane6 developed the system on "Remote monitoring of an object using a wireless sensor network based on NODEMCU ESP8266". The paper [5] proposes a system utilizing the RSSI method to enable real-time remote monitoring of objects via NodeMcu interconnection, activating GSM and buzzer modules when objects move outside the designated area, with future considerations for controlling and locating objects regardless of ground displacement, including the potential integration of GPS modules. The aim of this research is to develop an low cost and simple and reliable system to overcome all the problems in the research. [6] The integration of Internet of Things (IoT) technologies with battery management systems (BMS) has emerged as a promising approach to enhance the monitoring, control, and optimization of battery performance across various applications. These sensors facilitate data acquisition from individual battery cells or packs, allowing for comprehensive monitoring of battery health, performance, and usage patterns. By leveraging IoT connectivity, this data can be transmitted to centralized monitoring systems for analysis and decision-making. However, the widespread adoption of IoT-based BMS faces several challenges, including concerns related to data security, privacy, and interoperability.

[7] Renewable energy sources like solar and wind power are gaining traction as sustainable alternatives to traditional fossil fuels. However, their intermittent nature necessitates efficient energy storage solutions for reliable power supply. A critical component in such systems is the Battery Management System (BMS), which ensures the optimal performance and longevity of energy storage batteries. This research presents a study focusing on the design and implementation of a BMS tailored for renewable energy applications, shedding light on key advancements and challenges in this domain. The literature highlights the importance of BMS in maximizing the efficiency and reliability of battery storage systems deployed in Renewable energy applications. It also discusses various aspects of BMS design, including cell balancing, state-of-charge (SoC) estimation, thermal management, and fault detection. [8] Battery

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monitoring systems (BMS) play a critical role in ensuring the reliable operation of batteries, particularly in remote or off-grid applications where continuous monitoring is essential.

This research presents a study focused on the development of a low-cost BMS tailored for remote applications using Arduino microcontrollers and GSM (Global System for Mobile Communications) technology. This paper sheds light on key advancements, challenges, and practical considerations associated with the design and implementation of such systems. The literature underscores the importance of cost-effective BMS solutions for remote applications, where access to reliable power and communication infrastructure may be limited. [9] The adoption of electric vehicles (EVs) is on the rise worldwide, driven by concerns over environmental sustainability and energy security. Central to the performance and safety of EVs is the battery system, making effective battery monitoring systems (BMS) critical for ensuring optimal operation and longevity. This research presents a review focusing on BMS designed specifically for electric vehicle applications, highlighting key advancements, challenges, and future directions in this field. The literature underscores the importance of BMS in electric vehicles, where battery performance directly impacts driving range, charging time, and overall vehicle efficiency. It also discusses various functions of BMS, including state of charge (SoC) estimation, cell balancing, thermal management, and fault detection.

## V. WORKING

Working on a Battery Status Monitoring System using ESP8266 and ThingSpeak platform involves integrating the ESP8266 module for data acquisition and wireless communication, along with Arduino IoT Cloud for device management and data visualization. The system typically includes sensors to measure battery parameters such as voltage and current, which are then transmitted to the cloud for monitoring. Development involves programming the ESP8266 to collect sensor data, establish Wi-Fi connectivity, and communicate with the Arduino IoT Cloud platform. Additionally, configuring the Arduino IoT Cloud dashboard allows users to visualize and analyze battery status remotely. Testing and optimization are essential to ensure reliable operation and accurate monitoring of battery health and performance.

1. **System Design**: Define the requirements and functionalities of the monitoring system. Determine which battery parameters to monitor (e.g., voltage, percentage, current, temperature) and how frequently to collect data.

2. **Hardware Setup**: Obtain an ESP8266 development board (such as NodeMCU or Wemos D1 Mini). Connect battery voltage and current sensors to the ESP8266 board. And Ensure proper power supply for the ESP8266 board and sensors.

3. **Software Development**: Set up the Arduino development environment and install necessary libraries, Write code for the ESP8266 to read sensor data and establish Wi-Fi connection with the Arduino IoT Cloud. Implement error handling and data formatting to ensure reliable communication.

4. **Arduino IoT Cloud Setup**: Create an account on the Arduino IoT Cloud platform. Set up a new "thing" to represent the battery monitoring system. Define properties for the battery parameters to be monitored (e.g., voltage, current).

5. **Integration**: Connect the ESP8266 to the Arduino IoT Cloud using the provided libraries and APIs. Configure the ESP8266 to publish sensor data to the cloud at regular intervals.

6. **Testing and Optimization**: Conduct thorough testing to ensure the system functions as expected. Optimize power consumption and data transmission to maximize battery life. Fine-tune alert thresholds and dashboard layouts for usability.

7. **Deployment**: Deploy the Battery Status Monitoring System in the desired environment. Monitor system performance and make any necessary adjustments or improvements.

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## VI. RESULT

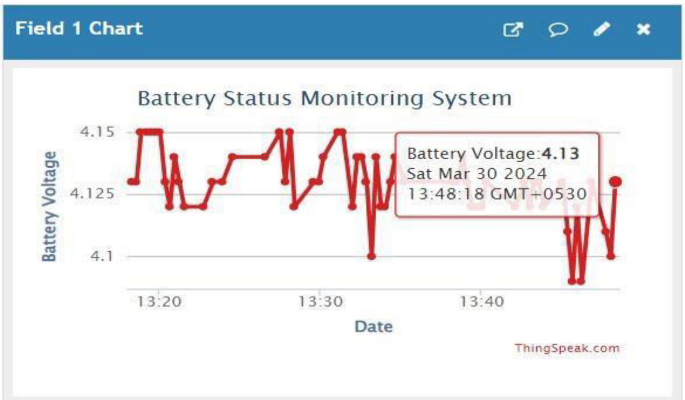


Fig. 1 Battery Voltage

The voltage result from the ESP8266 is sent to the ThingSpeak platform for analysis. The Cloud then processes this data to determine the battery's status (low, medium, high), which is displayed on the user interface for monitoring purposes.

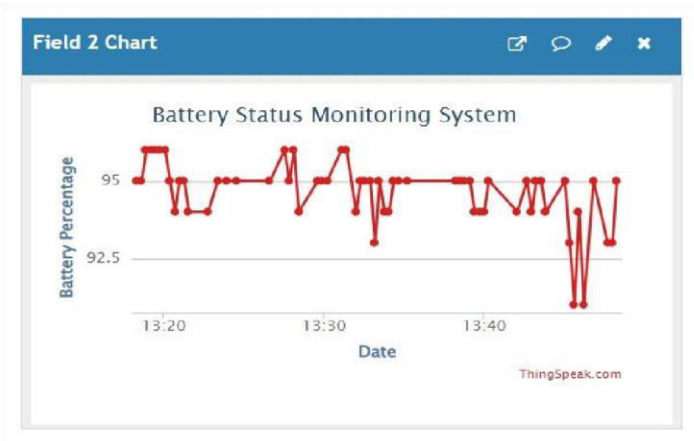


Fig. 2 Battery Percentage

The battery status monitoring system using ESP8266 and ThingSpeak platform calculates the battery percentage based on voltage readings. The resulting battery percentage is then displayed on the IoT Cloud platform for monitoring purposes

## VII.CONCLUSION

By studying the various research papers on IoT and ESP based for understand both the concepts in various systems and working in various system under the various applications. Purpose of this paper is to study and develop such which monitoring battery status by using ESP and Arduino with IoT cloud like think speak. This is capable to overcome the problems related mentioned in the literature review section. The most common shortcomings from the research papers that is complex system, bulky circuits, wrong outputs in harsh or unnecessary conditions which may be effect on the predictions. After studying all related research paper and methods. The expected output of this system is to develop a system to analyse battery life in the percentages to know the user about the battery life on the cloud.

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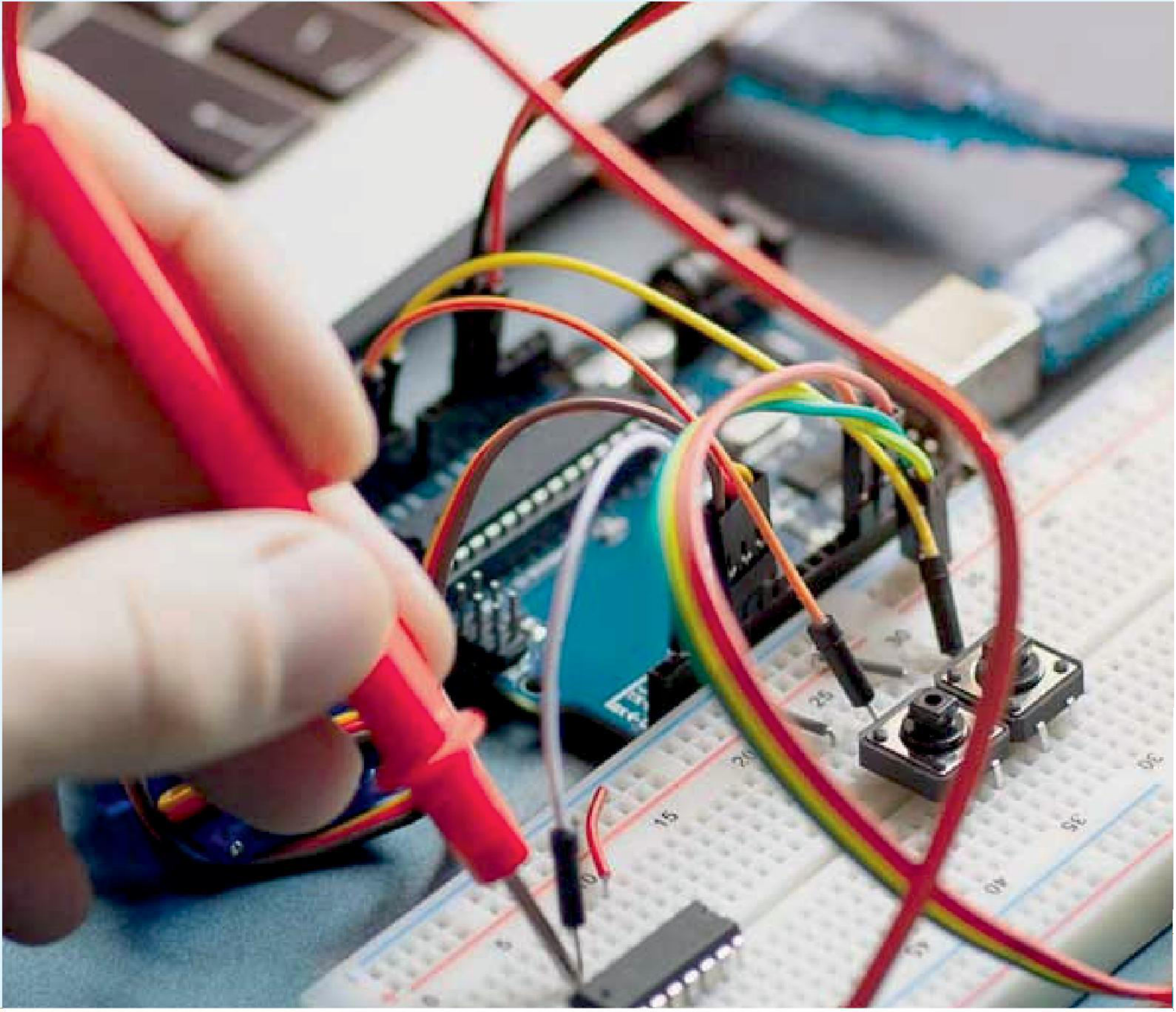


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