

IoT Based Battery Condition Monitoring System for Electric Trolley

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Abstract

Electric trolleys are widely used for short-distance transportation in industries, hospitals, airports and warehouses due to their eco-friendly operation and low operating cost. The battery is the primary energy source and its performance directly affects the reliability, safety and efficiency of the trolley system. Lack of proper monitoring can lead to issues such as overcharging, deep discharge, overheating and unexpected battery failures. To overcome these challenges, this project presents an IoT Based Battery Condition Monitoring System for Electric Trolley that enables continuous real time monitoring of critical battery parameters including voltage, current (INA219), and temperature (DS18B20). Sensors integrated with a microcontroller (ESP8266) collect battery data and transmit it to an IoT platform for remote access, data logging and alert generation. This system allows users to track battery performance, detect abnormal conditions early and schedule predictive maintenance, thereby extending battery life and enhancing operational safety. The proposed solution improves reliability, reduces maintenance costs and ensures efficient operation of electric trolleys.

Keywords: ESP8266 Microcontroller, INA219 Current Sensor, DS18B20 Temperature Sensor, 24v Lead Acid Battery, Buck Converter, Voltage Divider, Blynk App.

1. Introduction

Battery voltage and condition are checked manually using basic instruments such as voltmeters or multimeters. This process takes time and depends on human effort and accuracy. In the existing system, battery parameters such as voltage, current, and temperature are not continuously monitored. Measurements occur only during manual checks, so sudden faults or fluctuations may go unnoticed. Because of this limitation, sudden fluctuations, overheating, or abnormal voltage drops may not be detected immediately. This lack of continuous monitoring can reduce battery efficiency, shorten battery lifespan, and affect the reliability and overall performance of the system.

1.1. Proposed System

IoT-based battery condition monitoring system that continuously measures battery voltage, current, and temperature for real-time health assessment. Sensor modules (voltage, temperature, and the INA219

Current Sensor Module) collect data to evaluate battery performance and operational safety, Data processing is done by a microcontroller, enabling smart analysis of battery parameters and condition monitoring [1-4]. Real-time data transmission to cloud platform allows remote monitoring and visualization of battery health shown in Figure 1-3.

1.2. Block Diagram

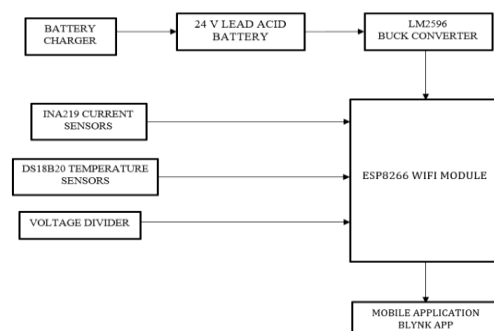


Figure 1 Blockage Diagram

1.3. Description of The Hardware Components

- LM2596 Buck Converter
- INA219 Current Sensor
- DS18B20 Temperature Sensor
- Voltage Divider
- ESP8266 WIFI Module
- 24 V Lead Acid Battery
- LCD Display

1.4. Flow Chart

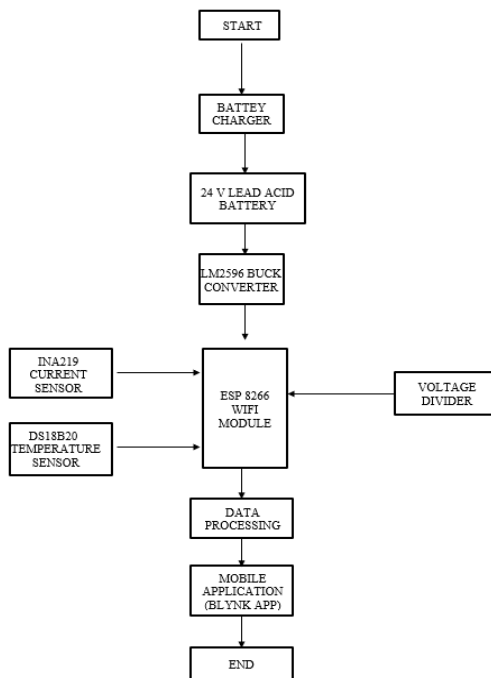


Figure 2 Flow Chart

1.5. Figures

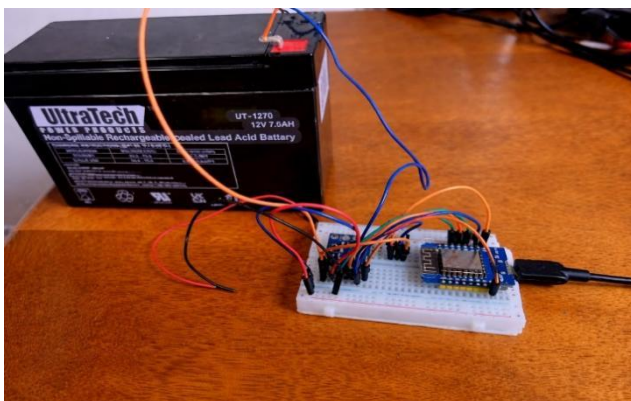


Figure 3 Hardware Components

1.6. Results and Discussion

1.6.1. Results

The IoT-based battery monitoring system was successfully implemented for a 24V electric trolley. The system accurately measured voltage, current, and temperature in real time using sensors and the ESP8266 module. Battery voltage ranged from 25.2V to 28.8V during charging and dropped below 21V during low conditions. Temperature was maintained within 25°C to 40°C under normal operation and alerts were triggered above 50°C. The system also detected overcurrent conditions effectively. Overall, the system provided reliable monitoring and timely alerts, improving battery safety and performance.

1.6.2. Discussion

The test results of the proposed IoT-based Battery Health Monitoring System demonstrate its effectiveness in accurately measuring and displaying key battery parameters such as voltage, current, and temperature in real time. During testing, the battery voltage was monitored using a voltage divider circuit, ensuring that higher voltages were safely scaled down for measurement. The current was measured using the INA219, which provided precise readings of current flow and power consumption. The battery temperature was continuously monitored using the DS18B20, ensuring that thermal conditions remained within safe operating limits. All sensor data was collected and processed by the ESP8266, which transmitted the information to an IoT platform through Wi-Fi [5-9]. The platform displayed real-time values in a clear and user-friendly interface, allowing continuous monitoring of battery performance.

Conclusion

The proposed IoT-based Battery Condition Monitoring System provides an efficient solution for real-time monitoring of electric trolley batteries. It measures key parameters such as voltage, current, and temperature to assess battery condition accurately. Using the ESP8266, the system transmits data to an IoT platform for remote monitoring and alert generation. It helps to support predictive maintenance, and reduces unexpected failures. The system improves battery performance, enhances safety, and extends battery life.

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