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# Battery Storage Management System

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**Abstract**

This report details the design and creation of a web application on relays and Raspberry Pi-based online battery monitoring and control system through a web interface. The system enables users to remotely check the battery's voltage level, recharge it and manage the load that is linked to it. Relays are used to control the load in the system, and a web application is used to provide real-time data on battery voltage and load status. The Raspberry Pi serves as the system's central processing unit. The system is suited for both homes and businesses because it is made to be user-friendly and economical. It allows users to turn ON/OFF the load and initiate the charging process remotely. The use of relays ensures safe control of high-power devices, and the Raspberry Pi can be configured to communicate with web application and control the relays.

**Keywords**: Remote monitoring, Web application, Recharging, Raspberry Pi, Relays.

## 1. INTRODUCTION

There is a rising need for remote monitoring and management of various systems, including battery monitoring and control. Significant energy savings and improved efficiency can result from the ability to remotely monitor and adjust battery voltage, recharge the battery, and control the load attached to the battery. By automating the process of tracking the state of a battery and its related load using a web application, the project seeks to provide a trustworthy and effective means to manage and monitor batteries, loads, and charging processes remotely.

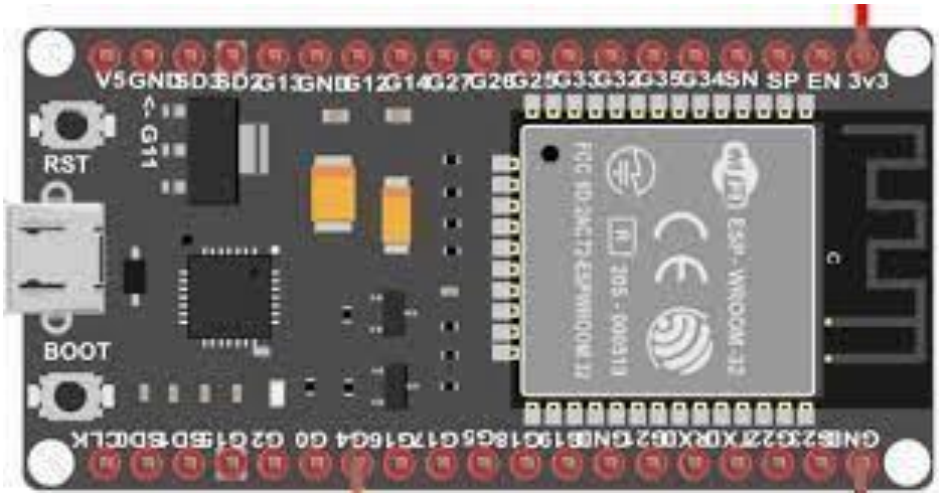
The project uses a Raspberry Pi to monitor the charging process, read the battery voltage, and manage the load. The Raspberry Pi then communicates with relays to turn

on and off the load and control the charging process. Users can access real-time data on the battery voltage, load status, and charging procedure using a web application. With the help of this online application, users can start and monitor the charging process as well as remotely regulate the load.

The initiative is especially helpful in rural areas where it is impractical to personally monitor the battery and its load. This project offers a useful tool for numerous applications thanks to its flexible and economical qualities. By providing a practical means of managing and keeping track of batteries, loads, and charging operations from a distance.

## *2. HARDWARE REQUIREMENTS*

### 2.1 ESP 32

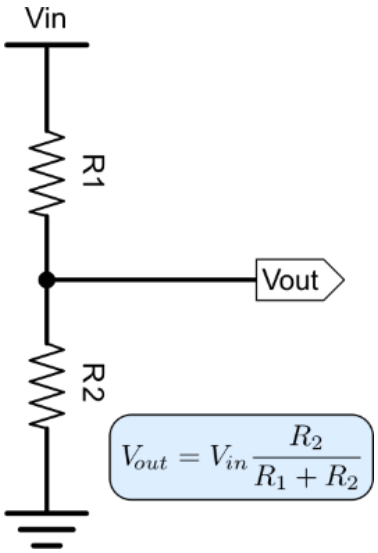



ESP32microcontroller

ESP32 is a versatile and popular microcontroller module widely used in IoT projects. It features a dual-core processor, built-in Wi-Fi and Bluetooth capabilities, and a rich set of peripheral interfaces. The ESP32 supports programming in various languages, including Arduino and MicroPython, making it flexible for different development needs. It enables seamless connectivity and efficient processing for a wide range of IoT applications.

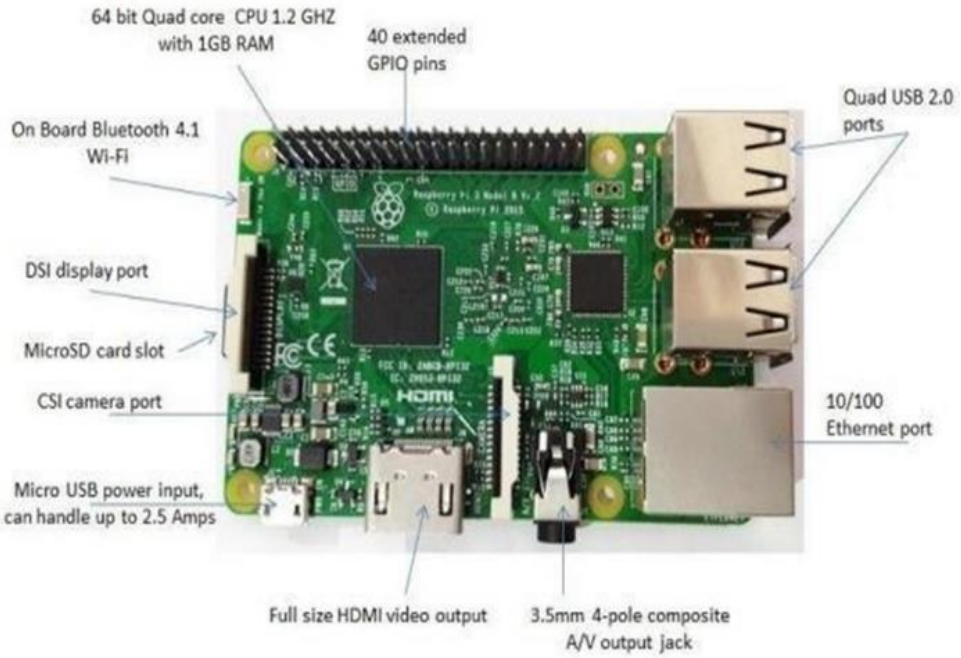
### 2.2 Voltage Divider

A voltage divider is a simple electrical circuit used to divide a voltage into smaller fractions. It consists of two resistors connected in series, with the output voltage taken from the junction between them. The ratio of the resistances determines the output voltage. Voltage dividers are commonly used in electronic circuits for level shifting, signal conditioning, and biasing applications.

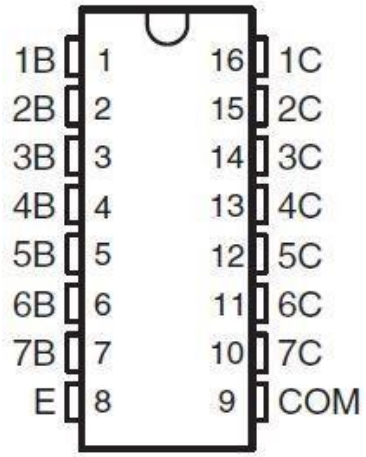



## 2.3 Raspberry Pi

Raspberry Pi is a credit-card-sized single-board computer capable of performing a variety of tasks. It is equipped with a powerful ARM-based processor, ample RAM, and various connectivity options, including USB and Ethernet ports. With its GPIO pins, it enables interfacing with external devices. Raspberry Pi supports various operating systems, including Linux, and can be programmed in multiple languages. It is a versatile and cost-effective solution for educational, prototyping, and DIY projects, offering a wide range of possibilities in robotics, home automation, media centers, and more.



**2.4ULN2003**




The ULN2003 is a popular high-voltage, high-current darlington transistor array commonly used as a driver circuit. It consists of seven darlington pairs, each capable of driving loads up to 500mA. The ULN2003 simplifies interfacing between low-power microcontrollers and high-power devices such as motors, relays, and solenoids. It provides convenient protection features and is commonly utilized in robotics, automation, and industrial control applications.

## 2.5 Battery charging Module

This is a compact electronic device designed to charge rechargeable batteries efficiently and safely. It typically includes features like voltage regulation, current control, and temperature monitoring to prevent overcharging and protect the battery from damage.They offer convenience, reliability, and safety in the charging process, making them essential components in battery-powered applications.

### 2.6 5V Dc Fan


## 3. SOFTWARE REQUIREMENTS

### 3.1 Streamlit

Streamlit is an open-source software framework that allows developers to build interactive web applications and data visualizations with ease. It simplifies the process of creating user-friendly interfaces by providing a simple and intuitive syntax. Streamlit supports Python and enables seamless integration with popular data science libraries like Pandas, Matplotlib, and TensorFlow. With Streamlit, developers can quickly prototype and deploy data-driven applications, making it a valuable tool for data scientists, machine learning engineers, and web developers. Its simplicity and versatility make it an excellent choice for building interactive dashboards and sharing data insights.

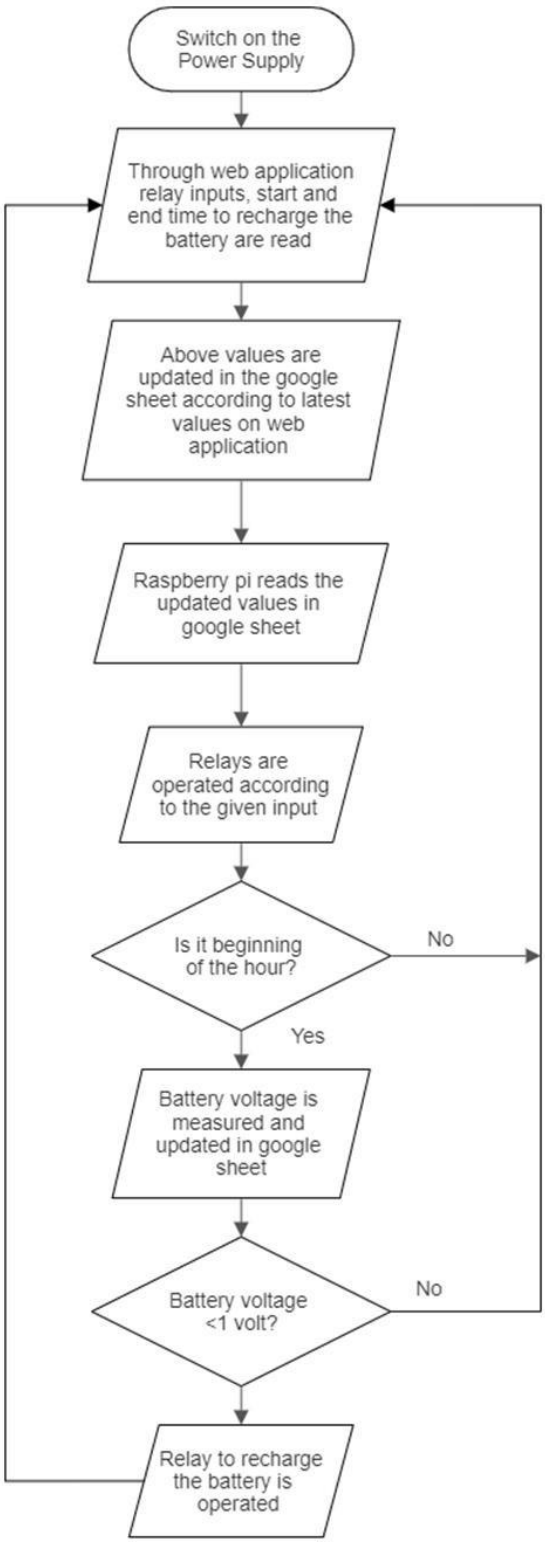
### 3.2 Google Apps Script

Google Apps Script is a scripting language developed by Google for automating tasks and extending the functionality of various Google services like Sheets, Docs, and Gmail. It allows users to create custom scripts to automate repetitive tasks, build add-ons, and create web applications within the Google ecosystem.

### 3.3 Arduino IDE

The Arduino IDE (Integrated Development Environment) is a robust software platform specifically designed for programming Arduino microcontrollers. It offers a comprehensive set of tools and features to simplify the development process. The IDE is built on the avr-gcc compiler, allowing developers to write code in a variant of the C/C++ programming language. The IDE also includes a powerful compiler that translates the code into machine language for the Arduino board. Additionally, it offers a serial monitor for debugging and serial communication. With its extensive library support and user-friendly interface, the Arduino IDE empowers developers to create a wide range of embedded systems projects efficiently and effectively.

## 4. FLOWCHART

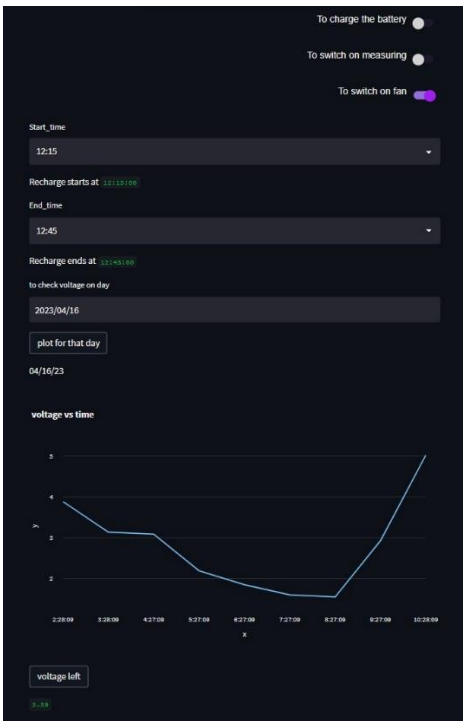

Switch on the Power Supply
Through web application relay inputs, start and end time to recharge the battery are read
Above values are updated in the google sheet according to latest values on web application
Raspberry pi reads the updated values in google sheet
Relays are operated according to the given input
Is it beginning of the hour?
No
Yes
Battery voltage is measured and updated in google sheet
Battery voltage <1 volt?
No
Relay to recharge the battery is operated

## 5.WORKING

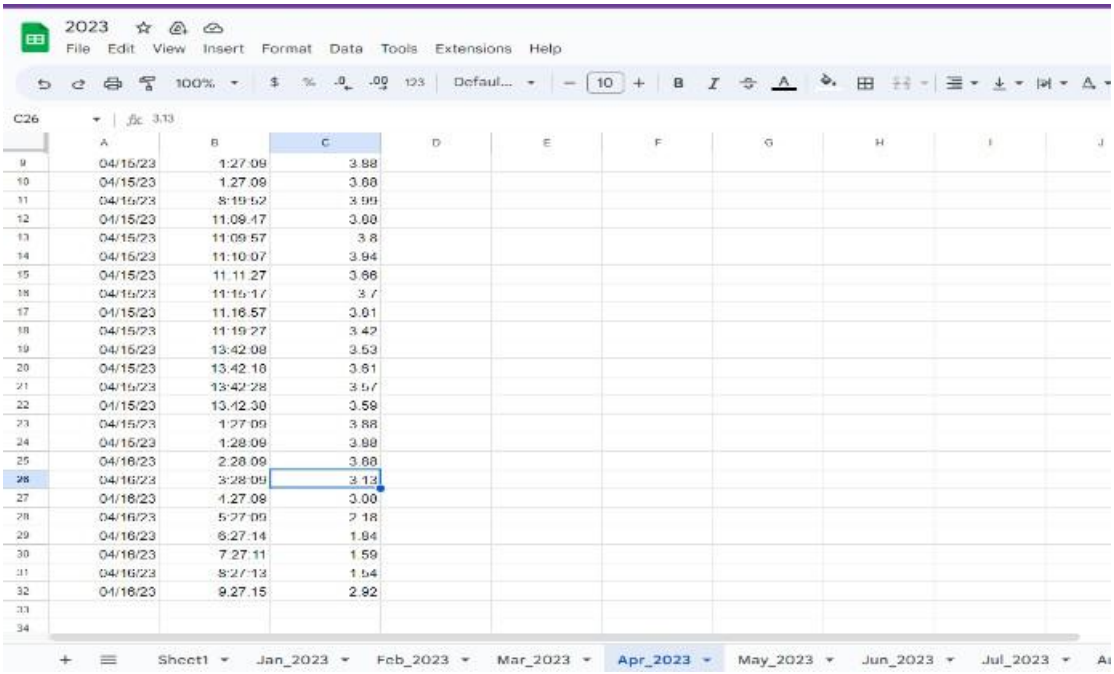
Utilising web apps created on the Streamlit platform, the system is intended to allow the user to adjust the load, gauge the battery's remaining voltage, and recharge the battery.The ESP32 microcontroller requires an additional power source in order to run the relay circuit because its operating voltage of 3.3 volts is insufficient to power the relay. The relay is driven with 5 volts by the ULN2003 driver circuit, and the chip itself performs the switching.

The Python programme installed on the Streamlit platform may update the relay status, configure the start and end times for automatic battery recharging, and display the battery voltage. The programme interacts with Google Sheets to modify the cell values, which are then read by the Raspberry Pi and used to control the relays and battery charging module. Every hour, the Raspberry Pi sends the battery voltage to Google Sheets and constantly pings the URL to retrieve the most recent cell values. Three circuits make up the system: a voltage divider circuit, a battery charging circuit, and a fan circuit. Depending on whether the relay is turned on or off, the fan is operated by the fan circuit. A power supply is used in the battery charging circuit to power the battery charging module, which is linked to the battery by a relay. The ESP32 microcontroller is coupled to the voltage divider circuit to measure the battery voltage. Through the Raspberry Pi, the measured voltage is transferred to Google Sheets together with the current date and time.

## 6. RESULTS




Streamlit web application




Appending battery voltage with date and time to the google sheets.

## *7. ADVANTAGES AND DISADVANTAGES*

### 7.1 Advantages

- Use of the battery charging module will ensure that the battery has Over-discharge protection, Overcharge protection, Overcurrent and short-circuit protection.
- Can check battery voltage from a remote location.
- Battery voltage is monitored regularly.
- Extends the battery's life expectancy.
- It can be monitored and controlled online using a web app.
- Battery can be charged at intervals specified in the web app as per our requirement.
- Data collected can be used to plot and analyse voltage vs time every day.
- It is secure and reliable.
- We can customize the way we want to collect data and update in google sheets.

### 7.2 Disadvantages

- **High upfront costs:** The initial cost of installing a battery storage system can be significant, making it a less affordable option for some homeowners.
- **Limited lifespan:** Batteries have a limited lifespan, and they eventually need to be replaced. This replacement can be expensive and may require additional installation costs.
- **Safety concerns:** Batteries can be dangerous if not handled properly. They can overheat, catch fire, or explode in extreme cases, causing potential safety hazards.

## 8. FUTURE SCOPE

- **Integration with renewable energy sources**: The system can be integrated with renewable energy sources like solar panels or wind turbines to enable efficient charging and monitoring of the battery.
- **Mobile application development**: The development of a mobile application can allow users to control and monitor the battery and load connected to it from their smartphones, making it more convenient and user-friendly.
- **Integration with other IoT devices:** The system can be integrated with other IoT devices in the home or office environment to create a smart home or smart office environment.

## 9. CONCLUSION

A dependable and effective way to control and monitor batteries, loads, and charging processes remotely is through the use of a Raspberry Pi, relays, and a web application. The solution is perfect for remote locations where physical monitoring is not possible due to the automation of managing and monitoring the state of the battery and the load attached to it through the web application. The hardware, which includes a Raspberry Pi and relays, functions flawlessly to read the battery voltage, manage the load, and keep an eye on the charging procedure. By allowing users to remotely control the load and monitor the charging process, the web application offers real-time information about the battery voltage, load status, and charging process. This results in significant energy savings and improved efficiency.

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