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BATTERY MANAGEMENT SYSTEM FOR ELECTRONIC GADGETS

G.V. Swathi*, Kasturi Ramesh**, Kattapoloju Arunchary***, Bollepally Sai Pranay ****
*(Assistant Professor, Department of Electrical & Electronics Engineering, ACE Engineering College Ghatkesar, Telangana
Email: ace.swathigv@gmail.com)
**(Student, Department of Electrical & Electronics Engineering, ACE Engineering College Ghatkesar, Telangana
Email: kasturi.ramesh.2002@gmail.com)
***(Student, Department of Electrical & Electronics Engineering, ACE Engineering College Ghatkesar, Telangana
Email: kattapolojuarunchary100@gmail.com)
****(Student, Department of Electrical & Electronics Engineering, ACE Engineering College Ghatkesar, Telangana
Email: bollepallypranay7@gmail.com)

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Abstract:
This paper presents the design and practical implementation of a Battery Management System for Electronic Gadgets that leverages ESP8266, ThingSpeak and a battery. This system is used to monitor various parameters of the battery like voltage, temperature, humidity and percentage of charging. Integrating all these parameters in to the ThingSpeak API. The paper covers the system architecture, hardware and software setup, testing, and real-world applications.

***Keywords*—Battery, ESP8266, ThingSpeak, Temperature, Humidity.**

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I. INTRODUCTION

A. BATTERY MANAGEMENT SYSTEM

In our growing digital world, electronic gadgets have become an integral part of our daily lives. These gadgets, ranging from smartphones to wearable devices works on rechargeable Li-ion batteries for power. However, efficient and safe battery management is critical to ensure the longevity and reliability of these devices. This paper explores a Battery Management System (BMS) designed to address these concerns. Leveraging components such as NodeMCU (ESP8266), DHT11 sensor, Li-ion battery, charger module and relay, our BMS offers a robust solution. These, battery management system, to be designed and implemented aims to detect the various parameters of the battery like temperature, humidity, voltage and charging percentage of the battery and to monitor and control all this these parameters remotely.
Its core functionality is simple yet essential when the temperature or battery charge level reaches 100%, the system triggers the relay to disconnect the charging source, effectively safeguarding the battery against overcharging and preventing overheating. This paper crystalise the significance in enhancing the performance and safety of electronic gadgets.

B. SCOPE AND OBJECTIVES

The scope of this paper titled "Battery Management System for Electronic Gadgets" is to design, implement, and evaluate a battery management system (BMS) using NodeMCU ESP8266, DHT11 sensor, Li-ion battery, charger module, and relay. The system's primary objective is to monitor and control the charging process of the Li-ion battery in electronic gadgets.
The objective of this paper is to design and build a Battery Management System (BMS) using NodeMCU ESP8266, DHT11 sensor, Li-ion battery, charging module and relay, and the real-time monitoring system for tracking temperature, humidity, voltage and battery charging levels in the electronic gadgets. So, that the performance and effectiveness of the BMS in preventing overcharging and overheating in the electronic gadgets.

II. SYSTEMDESCRIPTION

The design and implementation of “Battery Management System for Electronic Gadgets" is a comprehensive monitoring system that integrates hardware and software components to safeguard various types of batteries and the different kinds of electronic gadgets which we are using in our daily life. The system employs the monitoring of the various parameters of the batteries during charging of the battery.

The system is used to monitor and control the various parameters of the batteries. In which the battery is connected to node MCU esp8266 which is a wi-fi module, the dht11 sensor is used to read the temperature and humidity values. The charging module is used to charge the battery. A relay module is also used to turn ON or turn OFF the charging

module during the charging state based on the commands and the readings which are assigned in the code and dumped it in the esp8266.

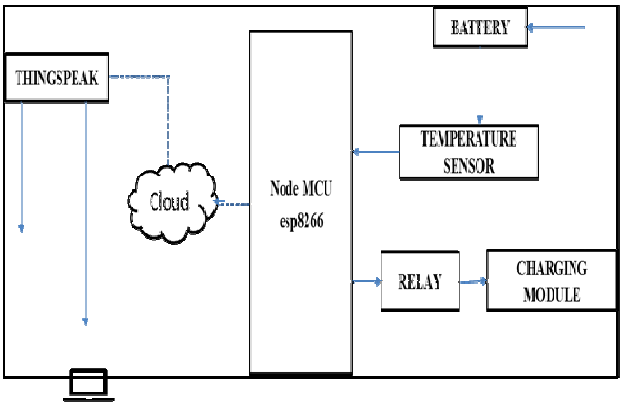

Fig no. 1. Block Diagram of proposed system

Node MCU esp8266 is connected to the dht11 sensor, relay. This relay is connected to charging module which is connected to the battery which helps the battery to charge. The esp8266 is connected to the cloud of the ThingSpeakAPI, from that API we can connect our mobile and laptops, where we can see the various parameters of the battery like charging of the battery, temperature, humidity and voltage. While charging of the battery we can observe that the various parameters such as temperature, humidity, voltage and the percentage of the battery are variable. Based on the type of battery which we are using the temperature, humidity and voltage parameters may vary. When there is rise in the temperature reading beyond the expected readings the esp8266 sends the command to the relay which immediately turn OFF the charging of the battery, in the same way when the charging percentage of the battery reaches to 100% it turns OFF the battery from the charging. So, that accordingly we can monitor all the parameters from our mobile applications from anywhere by switching to internet.

III. SOFTWARE IMPLEMENTATION

To accomplish the proto type and working of the proposed system, we need to write a program accordingly, which plays a major role in working of this system. The system requires Arduino IDE software platforms to write and upload program code.

The Arduino IDE(Integrated Development Environment) is an open-source software platform used for programming Arduino microcontrollers. It is a user-friendly interface for writing, compiling, and uploading code to various types of Arduino boards. The IDE supports the C/C++ programming languages and simplifies hardware interaction for makers and developers. We have used some of its libraries like *esp8266WiFi.h, WiFiClient.h, ESP8266WebServer.h and DHT.h* in Arduino UNO. And there are some special keywords like *digitalwrite low(), digitalwrite high()* related to triggering relay.

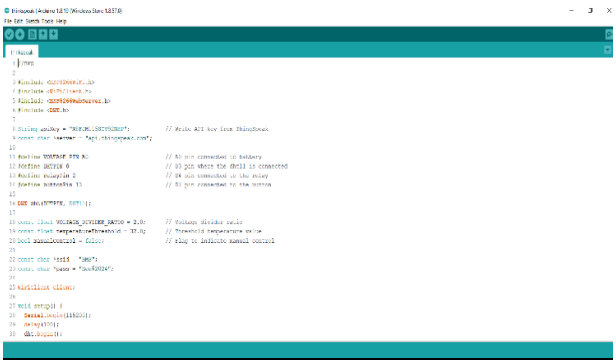

Fig no. 2. Overview of Arduino IDE platform

In ESP32s program code, *HTTPClient.h* provides an ability to make a connection to the API website (ThingSpeak) and after the connection is made successfully, whenever esp8266 gets the readings from the dht11 sensor more the required values it sends the command to the esp8266 which interns sends the command to the relay module, so that it will turn OFF the batteries form the charging process.

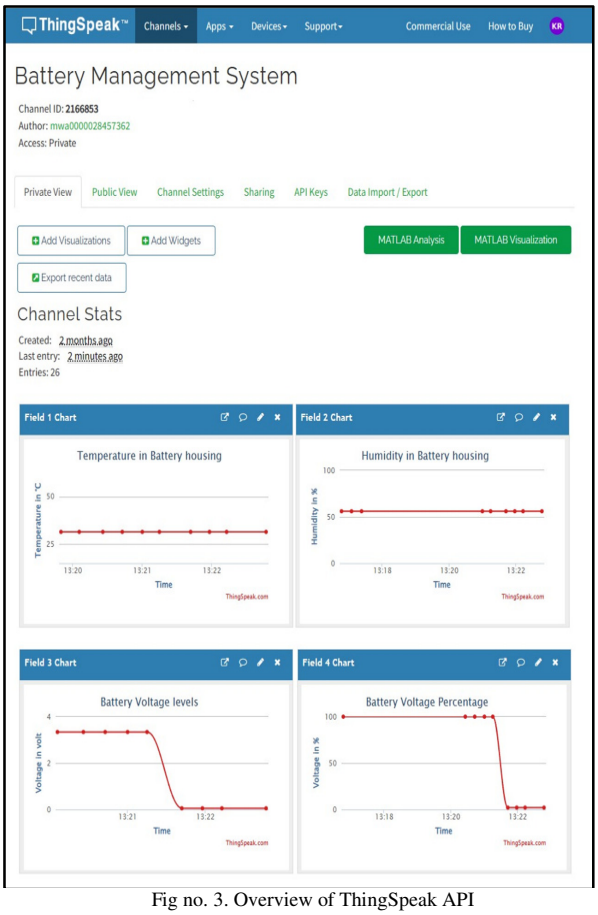

Fig no. 3. Overview of ThingSpeak API

The above figure shows the various parameters like temperature, humidity, voltage and charging percentage of the

battery looks like. We can observe all these parameters in the graphical format in the ThingSpeak API.

```
client.print("POST /update HTTP/1.1\n");
client.print("Host: api.thingspeak.com\n");
client.print("Connection: close\n");
client.print("X-THINGSPEAKAPIKEY: " + apiKey + "\n");
client.print("Content-Type: application/x-www-form-urlencoded\n");
client.print("Content-Length: ");
client.print(postStr.length());
client.print("\n\n");
client.print(postStr);
```

Fig no. 4. Response Code of ThingSpeak API

The above figure is the response code of a URL Post request made through HTTPClient of ESP8266.

RESULTS AND DISCUSSIONS

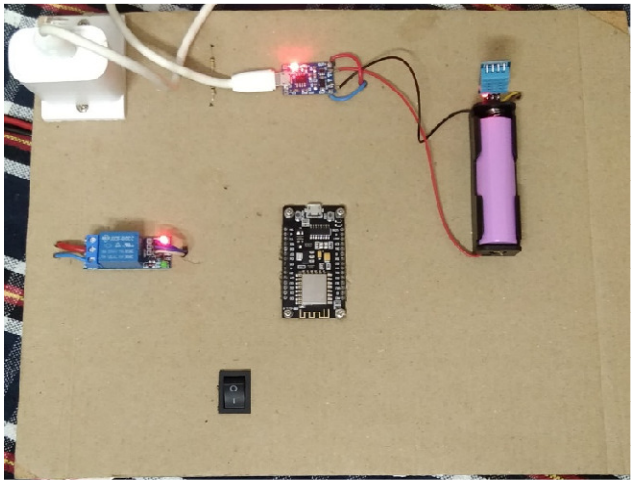

Fig no. 5. Proposed model of Battery Management System for Electronic Gadgets– Final Stage

The above figure shows the exact proposed system containing DHT11 Sensors, relay (to turn ON/OFF the charging module), switch (to take supply from the battery), node MCU (esp8266) and a battery.

CONCLUSION

In conclusion, the proposed system represents a significant step towards enhancing the safety access control in various environments. The system successfully combines hardware components and IoT technology to monitor and control the various parameters of the batteries, user-friendly access control, and remote monitoring capabilities. This system can help us in the foundation for further development, with future prospects including mobile accessibility, cloud-based data storage and analysis and storage expanded compatibility of the various electronic devices. Finally, this paper showcases the possibilities of controlling and monitoring of the various parameters of the battery while charging process. It also improving safety and access control, making it a valuable contribution to the electronic gadgets. This battery management system framework can used in different applications like laptops, electrical vehicles, industrial appliances etc.

REFERENCES

[1] G Prakasha, S Santosh Kumar, K N Sunil Kumar, A B Darshan, Venkatesha G, "Electric Vehicle Battery Power Management System Analysis", *2022 International Interdisciplinary Humanitarian Conference for Sustainability (IIHC), pp.1179-1183, 2022.*

[2] J. Tharun, J. Vishnupriyan, S. Muthumanickam, K. Chidambarathanu, "Intelligent Battery Management System", *2021 International Conference on System, Computation, Automation and Networking (ICSCAN), pp.1-5, 2021.*

[3] Ahmed T. Elsayed, Christopher R. Lashway, Osama A. Mohammed, "Advanced Battery Management and Diagnostic System for Smart Grid Infrastructure", *IEEE Transactions on Smart Grid, vol.7, no.2, pp.897-905, 2016*

[4] Pınar, M. Ç., & Vural. "A review of battery management systems for Li-ion battery packs in hybrid and electric vehicles". Journal of Power Sources, 367, 243-266, 2017.

[5] Valerio, J., Cheong, J. H., & Sivaraman, G.,"Battery management systems: Accurate state-of-charge indication for lead-acid batteries". IEEE Control Systems, 35(1), 58-70, 2015.

[6] Wang, J., Li, J., & Lai, Y."A review of charging algorithms for lithium-ion batteries in battery management system". Energies, 9(9), 607, 2016.

[7] C. Bibin, M. Vijayaram, V. Suriya, R. Sai Ganesh, and S. Soundarraj, "A review on thermal issues in Li-ion battery and recent advancements in battery thermal management system", Mater. Proc., Apr. 2020, DOI: 10.1016/j.matpr.2020.03.317.

[8] M. Lu, X. Zhang, J. Ji, X. Xu, and Y. Zhang, 'Research progress on power battery cooling technology for electric vehicles', J. Energy Storage, 2020, DOI: 10.1016/j.est.2019.101155

[9] https://batteryuniversity.com/learn/article/charging_the_lead_acid_battery

[10] https://www.sciencedirect.com/topics/engineering/charge-controller

