Remote Monitoring of UPS by Using IOT

Dr. K. Chandra Sekhar [1] ,Veeramallu Vijay [2], S. Bharat Naik [3], Ch. Pavan Teja [4], T. Suresh [5],

[1]Professor & HOD, Department of Electrical and Electronics Engineering,

R.V.R & J.C College of Engineering, Guntur, Andhra Pradesh, India

[2345]UG Student, Department of Electrical and Electronics Engineering,

R.V.R & J.C College of Engineering, Guntur, Andhra Pradesh, India

Email: vijayveeramallu242004@gmail.com

Abstract -The goal of this paper is to collect battery voltage, temperature and environment conditions near the battery by using IoT. An Uninterrupted Power Supply (UPS) is a critical component in any widely used system. The effectiveness of a UPS depends largely on its battery backup, which must be continuously monitored to ensure that it is working properly. In the past, this monitoring has been done manually or through local monitoring systems, but advances in IoT technology now make it possible to remotely monitor the status of UPS batteries and receive real-time alerts if any issues arise. The proposed system will have several benefits over existing battery monitoring systems. First, it will be fully automated, reducing the need for manual monitoring and minimizing the risk of human error. Second, it will be accessible remotely, allowing system administrators to monitor the status of the battery backup system from anywhere in the world. Finally, the system will be scalable, allowing additional sensors to be added to the network as needed.

Key words: UPS (Uninterrupted Power Supply), IoT (Internet of Things)

1.INTRODUCTION

The smooth functioning of organizations like Banks, Substations, data centers, hospitals, financial institutions, Online Exam Centres and many more. These systems require a continuous power supply, and to achieve that, they depend on uninterrupted power supplies (UPS). A UPS provides power backup during power outages and prevents downtime, which is crucial for above organizations. A UPS is only as effective as its battery backup, which must be continuously monitored to ensure its proper functioning. In the past, UPS battery monitoring was done manually or through local monitoring systems. But advances in IoT technology have made it possible to monitor UPS batteries remotely, enabling real-time monitoring and alerts. The proposed project aims to develop a Remote monitoring system for UPS batteries by using IoT. This system will consist of a network of sensors placed in strategic locations throughout the battery backup system. These sensors will collect data on critical performance indicators, such as voltage, temperature, humidity, H2 level, Flame detection. The collected data will be transmitted wirelessly to Cloud (Google sheets) accessible via the internet. If any issue is detected, the system will generate real-time alerts, allowing system administrators to take prompt action and prevent downtime. The proposed system will have several advantages over existing battery monitoring systems. It will be fully automated, reducing the need for manual monitoring and minimizing the risk of human error. It will be remotely accessible, enabling system administrators to monitor the status of the battery backup system from anywhere in the world.

2.LITERATURE REVIEW

The battery is the key component of the Uninterrupted power supply, so that we have to continuously monitor the battery voltage, temperature, H2 level (based on battery type), and environment conditions. For this we have to collect the battery data by using the sensors and sensor data can be transferred to the cloud because by access remotely. By implementing this project we can reduce the accidents and several breakdowns of the systems.

3.PROPOSED METHODLOGY

3.1 Block Diagram

Proposed Remote monitoring of UPS by using IoT will consist of the following components: Sensors: The system will use a network of sensors placed in strategic locations throughout the battery backup system. These sensors will collect data on critical performance indicators, such as voltage, temperature, H2Level, and environment conditions. IoT Gateway: The sensors will transmit data wirelessly to an IoT gateway, which will collect and analyze the data. Also, the gateway will link the system to the internet, enabling remote access to the surveillance system.

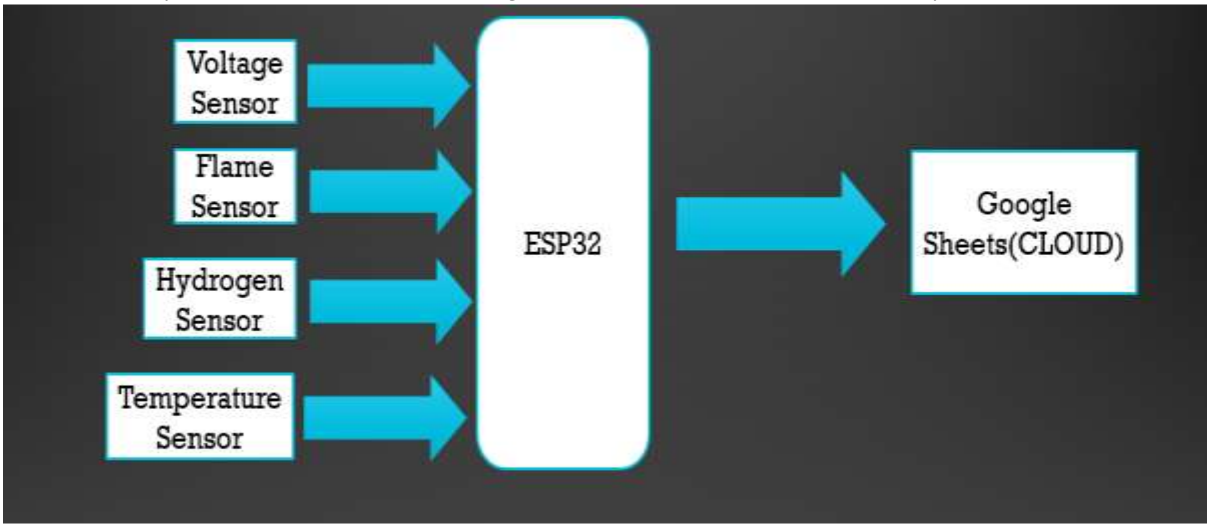

Fig-1: Block Diagram

3.2 Components Description

1.ESP32

Fig-2: ESP32

ESP 32 is heart of this project. Specifications of ESP32 related to this project as follows. ADC (Analog to digital Converter): Total Channels: 18, ADC1: 8 channels, attached to GPIOs 32-39, ADC2: 10 channels, attached to GPIOs 0,2,4,12-15 and 25-27, Resolution: 12 bit that is the analog values varies from 0-4096, Voltage Range: 0 to 3.3V, Wi-Fi Module: The function of Wi-Fi module is to send and receive data over Wi-Fi. Range:1KM, Power Supply: By Micro USB port, which provides 5V Supply. A 3.3 V regulated power supply can be connected to 3.3V and GND pins

2.Voltage Sensor

Fig -3: Voltage sensor

The Voltage Sensor is used to measure the UPS Connected Battery voltage continuously. Pins Description: VCC: Connects to the positive terminal of the battery. GND: Connects to the negative terminal of the battery. S(Sense): Connects to an analog input pin on the ESP32. (Ground): Connects to the ESP32 GND pin. Here we use Potential Divider type Voltage sensor: The Resistor Values are R1= 30k and R2=7.5k. The input Voltage = Vout /(R2/R1+R2), Where Vout= (Sensingvalue*3.3)/4096

3.Flame Sensor

Fig -4: Flame Sensor

Flame Sensors typically utilize infrared sensors to detect the unique radiation emitted by flames. When a flame is present, the sensor detects the infrared radiation and generates an electrical signal. Pins Description: VCC: This pins receives positive supply for Sensor Module (3.3V to 5V), GND, DO (Digital Output): This provides output as HIGH or LOW corresponding to flame detection, AO (Analog Output): This provides continuous analog values corresponding to flame intensity.

4.DHT11 Sensor

Fig -5: DHT11 Sensor

The DHT11 Sensor measures temperature and humidity. It has a temperature range of 0°C to 50°C with an accuracy of ±2°C. It has a humidity range of 20% to 90% RH with an accuracy of ±5% RH. It operates on a 3.3V to 5V DC power supply. Sampling rate is 1Hz (one reading per second). The cost of DHT11 is low as compared to DHT22 sensor. So that here we use DHT11.

5.MQ-8 Sensor

Fig -6: MQ-8 Sensor

The MQ-8 sensor is a hydrogen(H2) gas sensor module that detects concentrations between 100 to 1000 ppm. It operates on a 5V power supply, consumes 150mA of current, and has both analog output and digital output. The sensor resistance changes when exposed to hydrogen gas, with higher concentrations leading to a decrease in resistance. This sensor mainly used in this project most of the UPS batteries are Secondary batteries (Lead-acid battery). In lead acid cell battery we have liberation of H2 during charging, discharging and overcharging. The monitoring of H2 level are necessary to avoid unwanted incidents.

3.3 CIRCUIT DIAGRAM

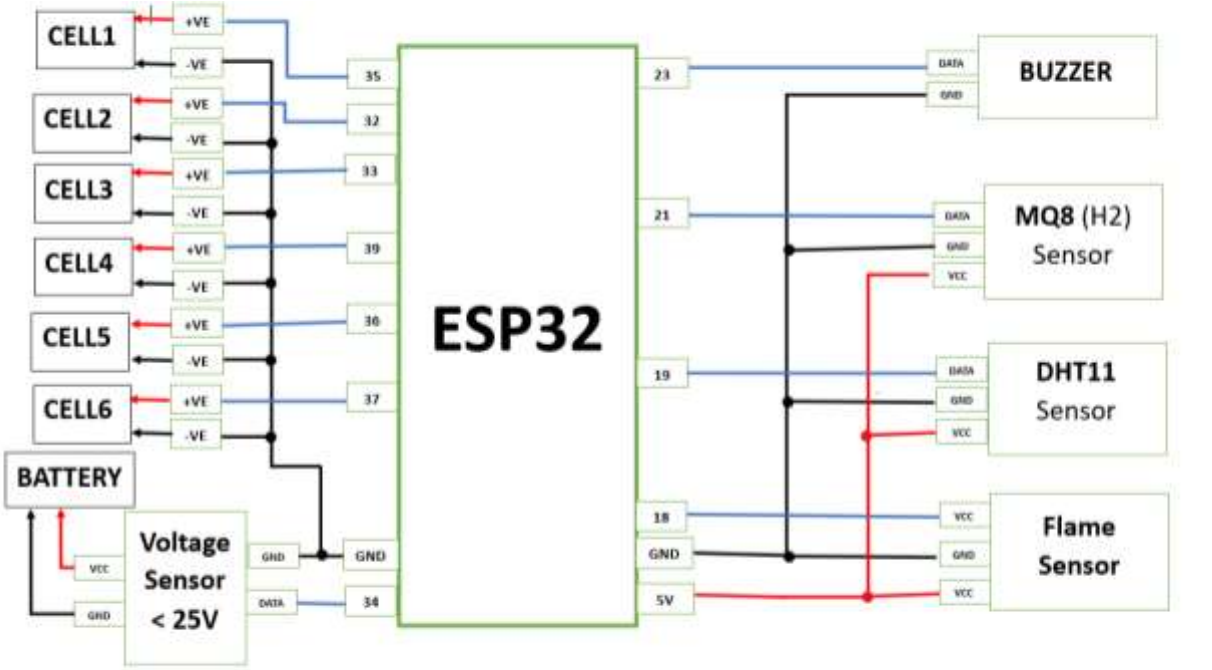

Fig7: Circuit Diagram

The above figure shows the circuit diagram of the prototype. As shown in the circuit diagram the general purpose pins of ESP32 connected to voltage sensor, DHT11 sensor, flame sensor and MQ-8 sensor. Here the buzzer is used to give alerts (beep sound) when the flame sensor detected the falme and MQ-8 sensor detects the H2 level above threshold. In this methodology we have provision to monitor the individual cells voltage in the battery bank connected to UPS in high systems.

3.4 IMPLEMENTATION OF PROTOTYPE

The below pictures show the different angles of the prototype. The all components are integrated on the board and corresponding connections are made by using wires. The integrated board installed on the UPS battery and external connections are made by using wires. After that we have to given power supply to the board then the ESP32 connected to Wi-Fi and sensing values can be store in the cloud (Google sheets). The status of battery can be seen remotely.

Fig -8: Prototype

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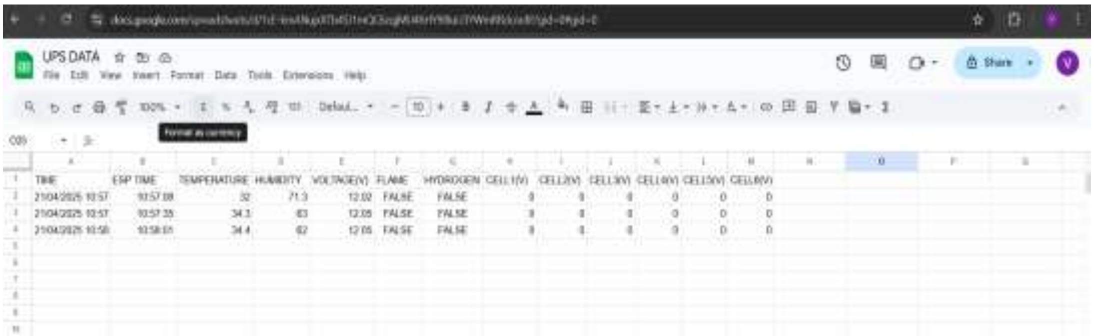
4.RESULTS

The hardware connections are successfully made, the status of the battery as shown below in google sheets (cloud) as shown in fig-9. The observations are voltage, Temperature, Humidity, Flame , H2 level and individual cells voltages (in case of battery bank).



TIME	ESP TIME	TEMPERATURE	HUMIDITY	VOLTAGE(V)	FLAME	HYDROGEN	CELL1(V)	CELL2(V)	CELL3(V)	CELL4(V)	CELL5(V)	CELL6(V)
21/04/2025 10:57	10:57:08	32	71.3	12.02	FALSE	FALSE	0	0	0	0	0	0
21/04/2025 10:57	10:57:35	34.3	63	12.05	FALSE	FALSE	0	0	0	0	0	0
21/04/2025 10:58	10:58:01	34.4	62	12.05	FALSE	FALSE	0	0	0	0	0	0

Fig -9: Monitoring page

The fig-10 shows the graphical representation for better analyse. As shown in the figure the graph shows a constant line across 12V so that the battery in working condition and UPS can run smoothly. Any disturbance in the line graph shows the battery condition.

Fig -10 Voltage vs Time

The fig-11 shows the graphical representation of temperature variations. The maximum temperature across the battery is 45°C. Above 45°C the signal can be given to the buzzer for alert then corresponding action can be taken.

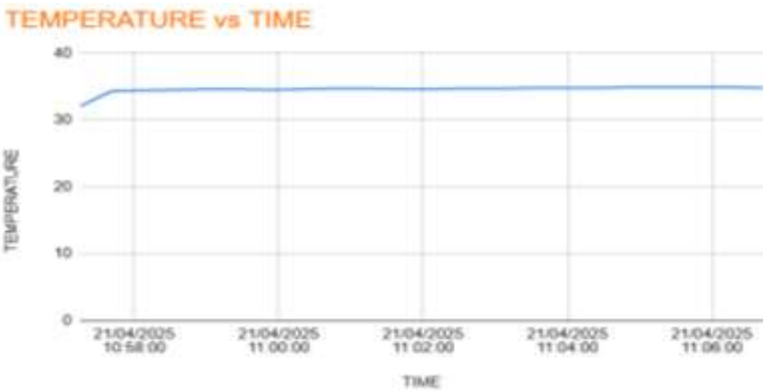


Fig -11: Temperature vs Time

Thus Remote monitoring of UPS can be implemented by using the ESP32 microcontroller and sensors and google sheets.

5. CONCLUSION

Implementing a Remote monitoring system of UPS for high availability systems can bring Several benefits. By continuously monitoring the UPS battery status and sending alerts, this system can help prevent unexpected downtime and minimize the risk of data loss or damage to critical systems. The use of IoT technology allows for remote monitoring and management, making it easier for IT administrators to access critical information and take necessary actions. This can save time and reduce the need for on-site maintenance, which can be especially important in large-scale data centers. By regulating critical factors like voltage and temperature, thus improve the battery reliability and safety. The advantages are Real-time monitoring, Remote management, Improve efficiency. The applications are Data centres, Healthcare, Banking.

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