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Upgradation of UPS System of AVCOE Using Various Sensors

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Abstract - This project focuses on the upgradation of the UPS (Uninterruptible Power Supply) system at Amrutvahini College of Engineering by incorporating various sensors to improve monitoring capabilities and introduce an alert mechanism. The system utilizes two current sensors to measure battery current and load current respectively. Additionally, two voltage sensors and two temperature sensors are employed to monitor the battery and load voltage as well as the temperature of heat sinks within the UPS. The collected data, including temperature, voltage, current, and maximum load information, is transmitted to a web server using SIM900A. This allows for real-time monitoring and analysis of the UPS system's performance and health parameters. To ensure proactive maintenance and mitigate potential risks, the system incorporates an alert mechanism. If the temperature of the heat sinks exceeds the predefined limit, an alert is generated. This alert is sent through SMS to a designated mobile device via the SIM900A module, which is integrated with the PIC18F4520 microcontroller. By integrating various sensors, enabling remote monitoring, and implementing an alert mechanism, this project aims to enhance the reliability and performance of the UPS system while ensuring timely intervention in case of critical events.

Key Words: GSM, IOT, UPS and M2M.

1.INTRODUCTION

In India, the electricity shortage has been a significant issue in rural areas. Power outages cause processes to run less efficiently, which lowers an organization's productivity. We have various systems in large plants and industries that give backup power based on their backup time in order to prevent this. UPS stands for "Uninterruptible Power Supply." Manually monitoring the industrial UPS at a remote area is challenging, though. Additionally, troubleshooting takes a lot of time and money.

The installed UPS systems must function properly or the productivity will suffer. It's possible that the chief engineer and the maintenance worker won't always be in the control room when this happens. We are using M2M communication, also known as machine-to-machine communication, to address this. When the chief engineer or technician is away from the worksite, SMS (Short Messaging Service) can notify him if a UPS fails or if any of its settings change. Within the company, there are numerous UPS that are interconnected. They are all linked to the same gateway.

Every aspect of business now is bigger than it was in the past, and UPS usage has gone up as well. The fundamental issue, which will be resolved as soon as feasible, is how the UPS is distributed. Only during the moment of distribution is the UPS being extensively monitored, and it is being done online. The UPS is primarily utilised in crucial businesses like banks, hospitals, and others. Accidental power outages can harm present operations or possibly result in data loss, which results in financial losses.

In IT contexts, uninterruptible power supplies (UPS) are frequently employed. A UPS provides some power to powerful devices. High-end routers are just one example of a gadget that includes sensors for temperature, current, and fans. numerous sensors of any given type, such as numerous temperature monitors or multiple fans, may be present in external heavy equipment. Additionally, there are several gadgets dedicated to environmental monitoring.

Some devices have a built-in UPS, while others have an external UPS with an integrated SNMP operator and a system that will enable remote monitoring. UPSs are the backup power sources that kick in when the primary supply goes out. Power inputs, outputs, and a backup battery are all present on the UPS. When the power source fails, the UPS will reactivate in about 25 milliseconds. For some network managers, the continuous UPS monitoring fails. The UPS's data can be simply viewed from anywhere.

Based on the utilization area, UPS come in a variety of forms. Certain types of UPS, such as Off-Line, Line Interactive, On-Line, Double Conversion, and Digital On-Line, are heavily focused on addressing marketing requirements as opposed to using technology [1].

The only item that changes the main power supply from main to battery or from battery to main over time is the off line UPS. Although the switchover time may be 500 milliseconds, an offline UPS may only need 3 to 8 milliseconds. Domestic uses for offline UPSs constitute the majority. When the main power supply is switched on, the device continues to operate with the UPS until it is completely discharged. If the main power source is present, the device will operate with the power supply. The UPS's primary function is to protect against various power interruptions. provides safety against gadgets that are malfunctioning, Data loss, computer and device damage If possible, the time and costs involved in getting back to where you were [2].

Based on an Internet of Things (IoT) platform and cloud technologies, UPS improves administration, expands the use of UPS systems, and assists businesses in achieving the lowest possible running costs for their vital power systems. UPS will be offered with a variety of services and agreements and will be available around-the-clock as part of a comprehensive service offering [3].

The UPS may be managed, controlled, and monitored from anywhere in the globe by connecting it to the IOT. The priority software will be obtained by the network manager from UPS manufacturers and management. The UPS's storage capacity and consumption capacity are disclosed by the IOT. A battery is connected when installing UPS, and the loads are given backup power [4].

2. LITERATURE SURVEY

The UPS monitoring is crucial for several computations, including those involving battery charging, temperature, and battery discharge. We use an RTU (Real Time Unit) with a built-in UPS to monitor the UPS. We will benefit from the advancement of embedded internet-based technology as we adopt and manage UPS. The web server, hardware, and software of the system are used to implement the Magatec communication protocol for UPS monitoring and control. To enable ups accesses, the TCP/IP protocol layer has undergone some simplification. The integrated web server will be connected through Ethernet, which will be of utmost importance. The protocol is used to extract data regarding the UPS's parameters. Device server wants to use the Magatec protocol to translate user commands into instructions that UPS can comprehend [5].

The controlled battery charger-compatible online UPS Endeavour AC voltage regulating has been proposed. A type LA (Liquid Acid type) battery is one option. With the aid of the relay, which the PIC microcontroller is connected through, the battery may be continuously charged and the battery pin discharge is well known. Shutting off the main switch will supply the AC voltage directly to the load if the UPS is destroyed or the voltage falls below the established threshold values [6].

Utilising cloud computing will enable UPS battery monitoring. When cloud computing is used, it is possible to get battery information and UPS strategy. This can also be accomplished by establishing a prototype battery monitoring system using Hadoop technology [8].

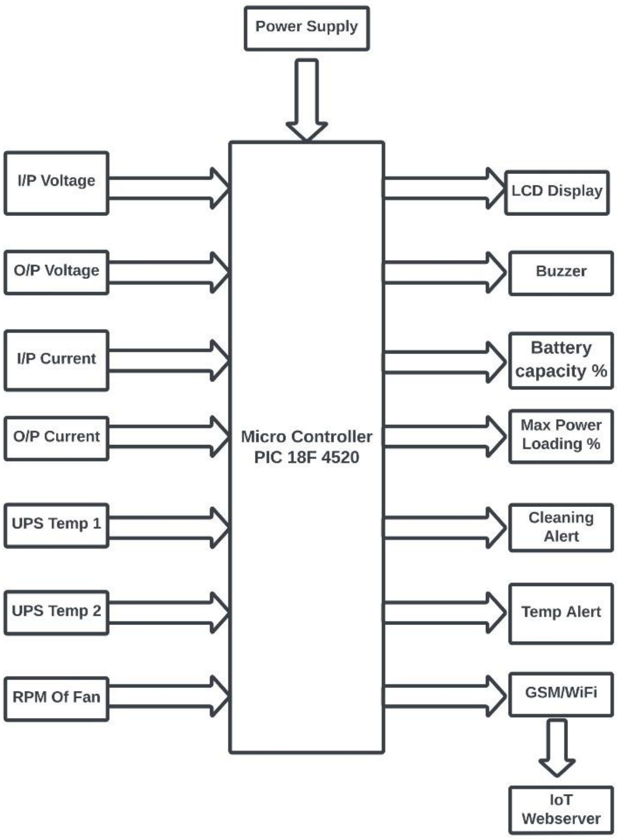
For cost-effective applications, Ming TsungTsai and Chia Hung Liu (2003) developed an improved single-phase passive-standby UPS. A switching inverter and an input charger make up the suggested system. It functions essentially as an offline UPS system. It has performance features that are comparable to line iterative UPS. By connecting the voltage in series with the source voltage in normal mode, it can continually regulate the constant voltage. Compared to the off-line and on-line iterative UPS, the regulatory range is substantially wider [9].

For computer systems, Ghennam et al. (2008) provided hybrid parallel active offline UPS. Here, the inverter functions as an active filter utilising the single-phase PQ theory to reduce harmonics, increase power usage, and charge batteries [10].

IOT simply refers to the process of connecting any gadget to the internet so that users can access their data from anywhere in the world. Everything will only be connected through IOT in the future. This could lead to an increase in the number of IOT devices linked. The data must be adequate and versatile, which is what UPS provides. It must meet the anticipated requirements. The equipment's availability and scalability will be supported by the UPS. Equipment that exposes electric current and produces a signal is a current sensor. Both an analogue and a digital signal can be used. It may also be utilised for data utilisation and control purposes. The GSM modem is a particular kind of modem that only functions as a mobile phone and has a SIM card. The device can communicate with the mobile phone whenever the mobile phone is connected to the device. Both SMS and MMS messages can be sent and received using it. LCD, or liquid crystal display, used for visualisation. These displays are chosen for multi-segment and displays with seven segments. These devices can be simply programmed and will have no display restrictions. These come in many forms, such as 16x2 and 32x2. It will facilitate the device's internet connection. It features strong internal processing that facilitates GPIO-based interfacing and integration of the sensors.

Proposed Hardware Design:

Fig1. Block Diagram of UPS Monitoring and Controlling.



The microcontroller-based UPS has an integrated 10-bit ADC converter. Here, the UPS signal distortion is measured together with its amplitude and frequency. Additionally measured are the battery level and the signal strength [12].

3. IMPLEMENTATION

To implement the project of upgrading the UPS system of Amrutvahini College of Engineering using various sensors, including current sensors, voltage sensors, temperature sensors, a web server, and an SMS alert system, you can follow these steps:

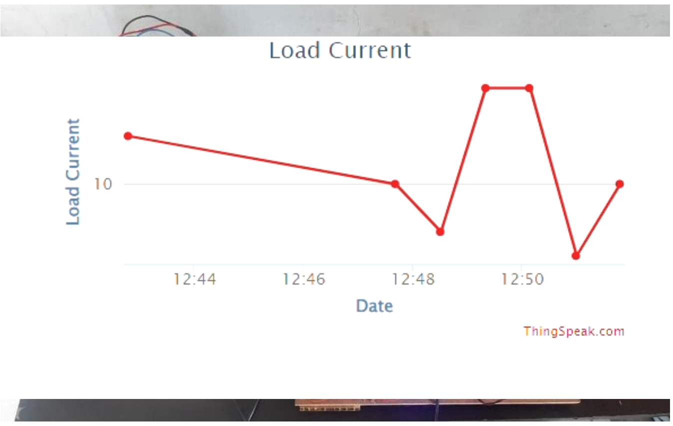


Fig2. The hardware setup of the Implemented System.

Hardware setup:

1. Connect the current sensor for battery current measurement to the appropriate terminals of the UPS system.
2. Connect the current sensor for load current measurement to the relevant load terminals.
3. Connect the voltage sensors to measure the battery and load voltages.
4. Install the temperature sensors on the heat sinks of the UPS system.

Microcontroller integration:

1. Interface the current sensors, voltage sensors, and temperature sensors with the PIC18F4520 microcontroller.
2. Configure the microcontroller to read data from the sensors periodically.

Data acquisition and processing:

1. Read the current measurements from the current sensors and voltage measurements from the voltage sensors using the microcontroller.
2. Read the temperature measurements from the temperature sensors.
3. Process the acquired data to obtain relevant information such as battery current, load current, battery voltage, load voltage, and temperature values.

Communication with Thing Speak:

1. Set up an account on Thing Speak (https://thingspeak.com) to create a web server for data logging and visualization.
2. Configure the microcontroller to send the acquired data to Thing Speak using the appropriate communication protocol (e.g., HTTP, MQTT).
3. Transmit the data (battery current, load current, battery voltage, load voltage, and temperature values) to Thing Speak at regular intervals.

Alert system setup:

1. Connect the SIM900A module to the microcontroller for SMS functionality.
2. Define temperature thresholds for the heat sinks that, when exceeded, trigger an alert.
3. Monitor the temperature readings from the temperature sensors.
4. When the temperature exceeds the defined threshold, send an SMS alert using the SIM900A module.

Deployment and testing:

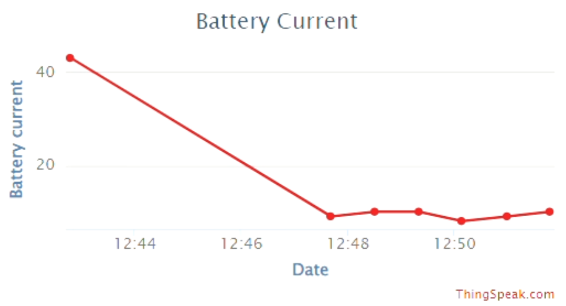
1. Mount the sensors and microcontroller in the UPS system, ensuring proper connections and insulation.
2. Power up the system and verify that the microcontroller is acquiring data correctly from all the sensors.
3. Check if the data is being successfully transmitted to Thing Speak.
4. Test the alert system by simulating high temperatures on the heat sinks and verifying if the SMS alerts are received.

Remember to refer to the datasheets and documentation of the sensors, microcontroller, SIM900A module, and any other components used in the project for detailed pin configurations, communication protocols, and programming instructions.

4. RESULTS

In Fig. 3, the input Battery current (Cin) is shown as being absorbed by the UPS on the X and Y axes, respectively. This graph makes it easier for the user to keep track of the settings.

Fig3. Depicts the input Battery current consumed by UPS.



In Fig. 4, the load's output current is shown as (Cout), and the load's current is shown as (Y-axis) and (X-axis) respectively. This graph makes it easier for the user to keep track of the settings.

In Fig. 5, the UPS Heat Sink Temperature is shown as (Heatsink Temp1), and the Heat Sink Temperature is shown as (Y-axis) and (X-axis) respectively. This graph makes it easier for the user to keep track of the settings.

In Fig. 6, the UPS Heat Sink Temperature is shown as (Heatsink Temp2), and the Heat Sink Temperature is shown as (Y-axis) and (X-axis) respectively. This graph makes it easier for the user to keep track of the settings.

Fig4. Depicts the output Load current consumed by UPS.

Fig5. Depicts the Heat Sink 1 Temperature UPS.

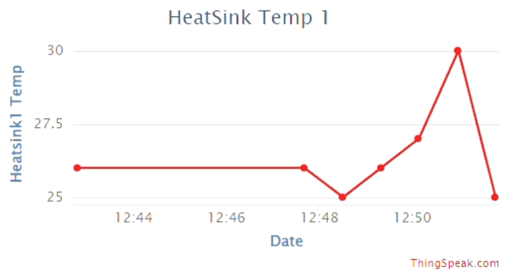
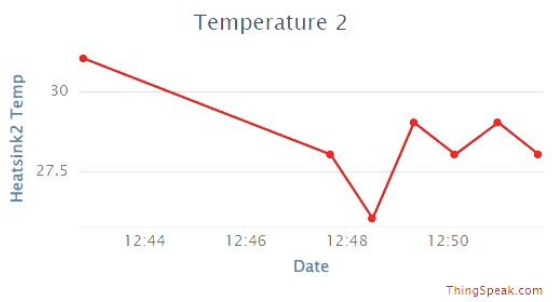


Fig6. Depicts the Heat Sink 2 Temperature UPS.



In Fig. 7, the input Battery voltage is shown as (Battery Voltage), and the Battery Voltage is shown as (Y-axis) and (X-axis) respectively. This graph makes it easier for the user to keep track of the settings.

In Fig. 8, the output Load voltage is shown as (Load Voltage), and the Load Voltage is shown as (Y-axis) and (X-axis) respectively. This graph makes it easier for the user to keep track of the settings.

In Fig. 9, the RPM of the Cooling Fan is shown as (RPM), and the RPM is shown as (Y-axis) and (X-axis) respectively. This graph makes it easier for the user to keep track of the settings.

Fig7. Depicts the Battery Voltage of UPS.

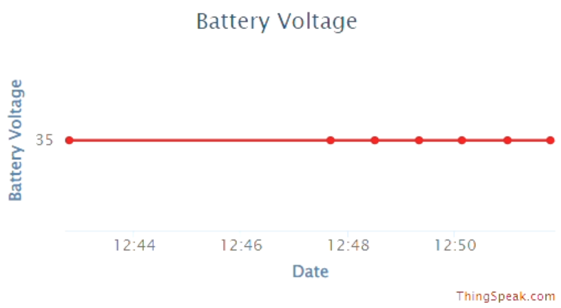


Fig8. Depicts the Load Voltage of UPS.

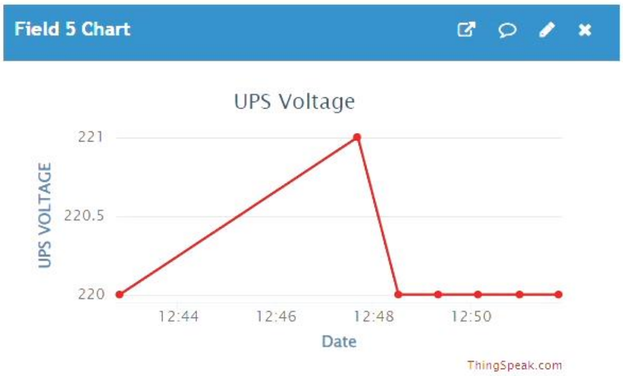


Fig9. Depicts the RPM of Colling Fan of UPS.

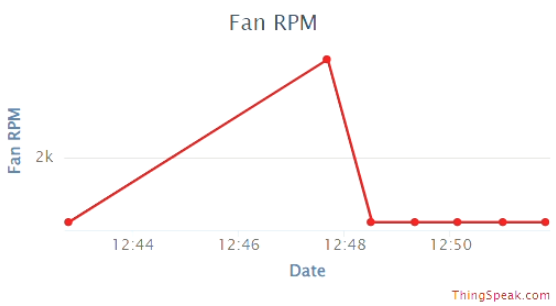


Fig. 10, represents the alert message ALERT: Temperature Limit Exceed System Shutdown received to the mobile n the form of SMS whenever the UPS temperature of any heat sink will exceed the limit which is set to 60 degrees Celsius.

Fig10. Depicts the message received by the mobile.

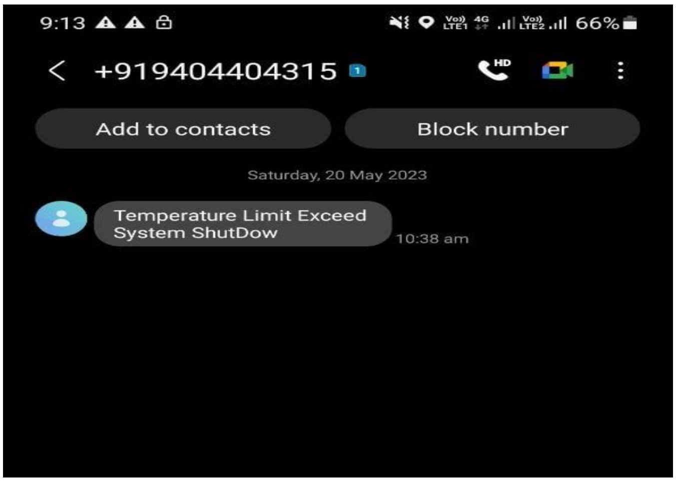


Fig. 11 and Fig. 12, shows the parameter like input battery current, output load current, battery voltage, load voltage, heat sink temp 1, heat sink temp 2, and the rpm of the cooling fan on the 16*2 LCD which is mounting is the prototype. In that, the current is denoted as CT1, CT2. Voltage is denoted as BV and UPSV. Temperature is denoted as T1, T2. The speed of the cooling fan is denoted as RPM.

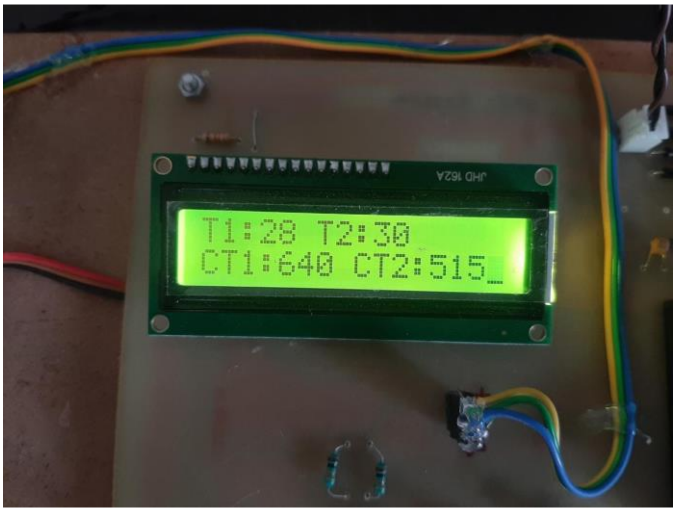


Fig11. Depicts the Temperature and Current in LCD.

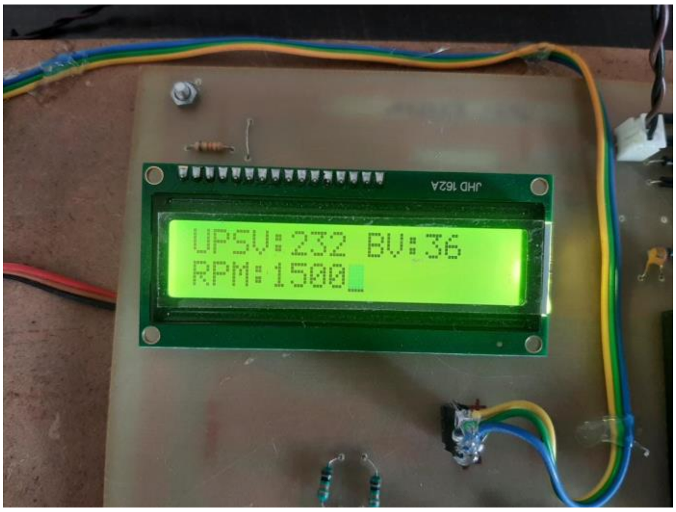


Fig12. Depicts the Voltage and RPM of the Colling Fan in LCD.

5. CONCLUSION

The designed system keeps track of how much power the load and UPS use. When the UPS is operating at a higher temperature it sends a text message alert to the phone and may be managed online. The system that has been put into place is inexpensive, effective, and accessible to businesses of all sizes. The designed system immediately delivers the parameters. With little adjustments, this system can be enhanced and adjusted.

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