Industrial Uninterruptible Power Supply using IoT

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Abstract

This paper reports the development of industrial UPS monitoring system integrated with IoT. The parameters such as bus voltage, load voltage, shunt voltage, current, and power of LED were monitored using inverters, board inputs, energy monitoring system and INA219 Current sensor. The remote monitoring of the system to reduce energy consumption and output rate becomes possible during the breakdown situations through an alert message. The notification was displayed in the customer dashboard.

Keywords: *UPS, current sensor, IoT, voltage*

1.0 Introduction

UPS (Uninterruptible Power Supply) system plays a vital role in maintaining the system functioning in industries even when the primary voltage source fails. In enterprises, the UPS transit from either the base voltage [1] source to the power supply when the main power supply is cut off or fails. The UPS system is associated with voltage and sensitive loads and the out-turn of the UPS is the sine wave with the proper frequency [2] with no disturbances in power. During the difficulties of power supply to the industries such as blackout, voltage sags, and voltage surge, the UPS device actually switches to battery backup power [3]. When the receiving power gets low or exceeds acceptable voltage levels, the UPS flips to DC electric power and transforms it to AC energy to operate the appliances. The stand-by power for the industries [4] is higher (> 400V) than that adopted in home appliances.

The deployment of the Industrial UPS monitoring system using IoT consists of three users namely administrator, employee, and customers. The registration of employee and customer is done by administrator who in turn givesaccess to the employee and customer. The administrator then sends a username and password from which the employee and customer can access the application. This application [5] includes a dashboard that displays the parameters of board inputs, inverter specifications, UPS

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specifications, and energy monitoring based on the departments in the organization. The results are presented in a graphical format, and reports are generated accordingly. These reports are shared via email by the admin on the request of customers. The Industrial UPS monitoring system using IoT involves monitoring board inputs, inverter specifications, energy monitoring, and UPS specifications. The application allows the selection of the organization and its departments and displays the parameters of board inputs, inverter specifications, energy monitoring, and UPS specifications. The real-time [6] data is analyzed and represented in the form of graphs and reports.UPS performance is evaluated by its Total Harmonic Distortion (THD), input power factor, output voltage, current, and efficiency. Hence, it is cost-effective, efficient, safe, and consistent than the traditional way of monitoring UPS which needs to be maintained on regular basis. Demand-side management procedures are adopted to decrease the energy consumption [7]. The system is implemented to seek the measurement of battery voltage and the level of current using the IoT. Hence, the integration of IoT helps in increased efficiency, accuracy, and balanced economy. Real time monitoring of industrial electrical equipment [8] can detect of failures in early stages and also the effective current drawn from the equipment.The current sensor ACS-712 was linked to the Node-MCU and users are allowed to set a threshold power limit in the mobile application and the app will notify the users when the electricity consumption reaches certain limits. The battery voltage is sensed by the battery sensor and compared to the DC charging voltage of a UPS.This paper focuses on developing of industrial UPS monitoring system integrated with IoT enabled for remote monitoring of the systems and reduced power consumption.

2.0 Industrial UPS monitoring using IoT

The structure provides a trade-off in terms of remotely monitoring the system to improve energy consumption and production rate. The system monitors the parameters of board inputs, UPS specifications, and inverter specifications. When the parameters, such as voltage and current, deviate from ideal circumstances during drain out or wear-out**,** the unit is tracked and the values are displayed in the application. UPS's failover conditions are communicated to the customer via an alertmessage. The proposed system is built using Arduino UNO R3 (Fig. 1 a), LED and INA219 DC Current Sensor (Fig. 1b).Both current and voltage are measured simultaneously by the INA219 module. The current and voltage data are transferred using I2C connection from this module.

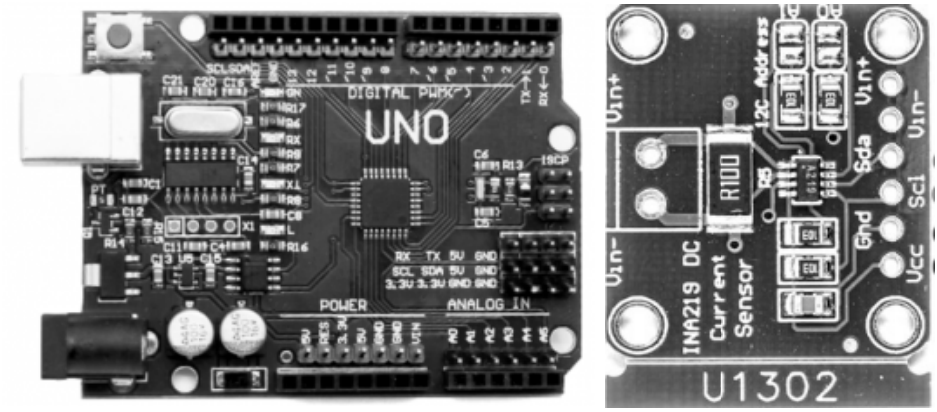


Fig. 1. (a) Arduino UNO R3 and (b) INA219 DC Current

The source terminal pin was connected to the current sensor which in turn was connected to Arduino of 3.3v, Also load terminal pin was connected to LED, Vcc of current sensor was connected to 5v of Arduino, the ground connection of Arduino and current sensor. I2C clock was connected to A5 pin of Arduino and SDA I2C Data to A4 pin of Arduino board. The current sensor displays the values of bus voltage, shunt voltage, load voltage, power, and current passing through the LED. The data was stored in MySQL database. The real time values are displayed in web application and can be downloaded in the various formats such as pdf, .xls and jpeg. The block diagram as shown in Fig. 2a depicts the overall view of the system. The industrial UPS monitoring using IoT work flow is as shown in Fig. 2b.

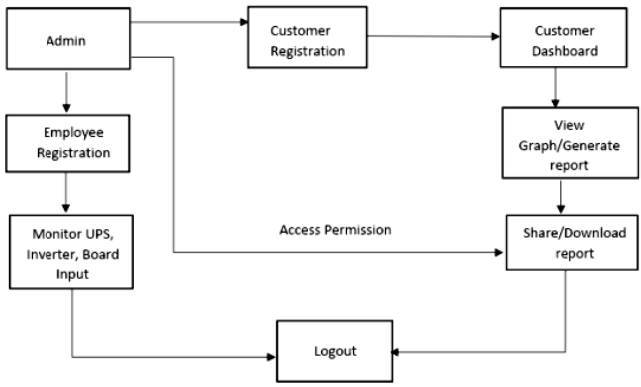


Fig. 2. (a) Block diagram of industrial UPS monitoring using IoT

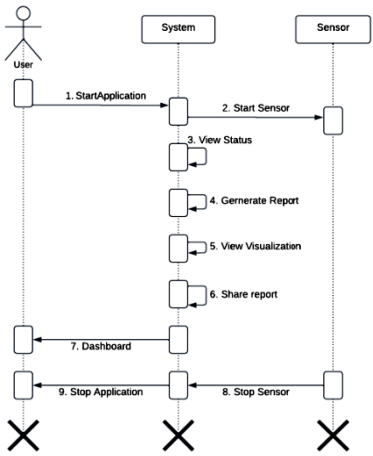
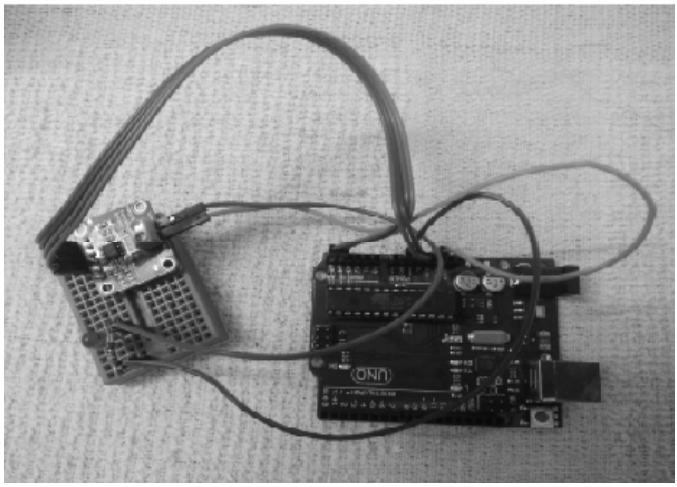


Fig. 2. (b) Industrial UPS monitoring using IoT work flow

The user starts the application, wherein the sensors read values to display them in a dashboard. Sublime Text 3 was used to develop the system, which is known for its simplicity and convenience of being used. It aids in the enhancement of the functionality by utilizing package control and customizing settings. Sublime Text 3 adopts the MVC pattern of model, view, and controller. The 'model' saves the information logic, 'view'can display the information to users, and 'controller' is adopted to control the flow of information from the Model to the View mode. The phpMyAdmin is a tool for MySQL. It supports MySQL features of creating databases, dropping databases, creating, editing table fields and indexes, and also executing queries. Arduino IDE to write code and upload it to the Arduino board. Any Arduino board can be used with the software. Python 3.10V is a coding tool that has features such as Error detection, Automatic text encoding, and asynchronous iteration.

3.0 Results and Discussion

The connection of the INA219 current sensor that displays the values of bus voltage, shunt voltage, power, current, and load voltage is as shown in Fig. 3a. The dashboard with UPS specification, inverter, board input, and energy monitoring system is as shown in Fig.3b.



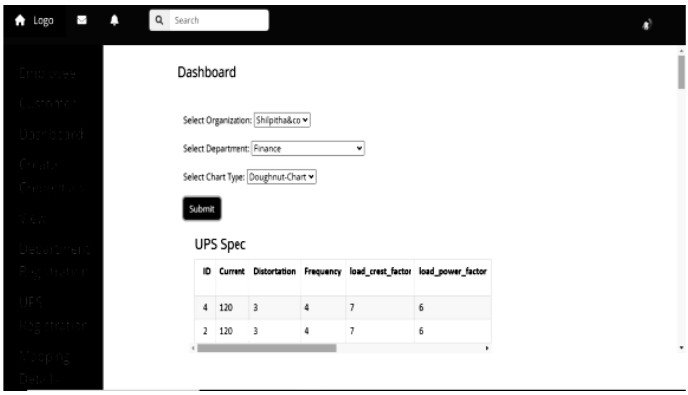


Fig. 3. Dashboard of Industrial UPS Monitoring Using IoT

4.0 Conclusion

The industrial UPS monitoring system was designed to display the real-time parameters of UPS, Inverter, Board input, and energy monitoring systems. The UPS monitoring system using IoT adopts INA219 Current sensor to display voltage, power, and current. The system was implemented with administrator, employee, and customers. The failure of ups is sent to the customer through an alert message. The notification is displayed in the customer dashboard.

References

1. M Aftab, A N Hameed, A Samiq, M B Shah, M A Pasha, IoT-enabled Smart Energy Metering Solution with Soft-UPS for Developing Countries, *International Conference on Intelligent Data Acquisition and Advanced Computing Systems: Technology and Applications (IDAACS)*, 2022.
2. M Nithya, N R Karthik, K Meenakshi, EB-Charge Monitoring System Using IoT, *International Conference on Power, Energy, Control and Transmission Systems (ICPECTS)*99, 2021.
3. S Truitt, T D Gage, B E Vincent, S Chun, Low-cost Remote Monitoring System for Small-Scale UPS Installations in Developing Countries, *IEEE Global Humanitarian Technology Conference (GHTC)*, 2020.
4. M A Fabrício, F H Behrens, D Bianchini, Monitoring of Industrial Electrical Equipment using IoT, *IEEE Latin America Transactions*, 99,2020.
5. S Kazadi, M Thokozile, K A Ogudo, Design and Monitoring of a Voltage battery sensor of an Uninterruptible Power Supply (UPS) by means of an Arduino, *IEEE PES/IAS Power Africa*, 2, 2020.
6. P Alqinsi, I J M Edward, N Ismail, W Darmalaksana, IoT-Based UPS Monitoring System Using MQTT Protocols, *International Conference on Wireless and Telematics (ICWT)*, 2018.
7. D Alulema, M Zapata, M A Zapata, An IoT-Based Remote Monitoring System for Electrical Power Consumption via Web-Application, *International Conference on Information Systems and Computer Science (INCISCOS)*, 597–60, 2018.
8. K V Manasa, A V Prabu, M S Prathyusha, S Varakumari, Performance monitoring of UPS battery using IoT, *International Journal of Engineering & Technology*, l (7), 352-355, 2017.