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IoT Based Load Monitoring System

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ABSTRACT: All jobs and human needs are highly dependent on the existence of electrical energy, especially on household needs. Human negligence in the use of electrical energy will cause extravagance which also has an impact on rising electricity consumption costs. An electrical load monitoring system (ELMS) is a system that measures and monitors the electrical load on a building or facility. ELMSs can be used to identify and track energy consumption patterns, identify potential energy savings opportunities, and improve the efficiency of electrical systems.

Key notes: Electrical Load Monitoring System (ELMS), Internet of Things (IOT), Feed Forword Neural Network (FFNN), Long Short-Term Memory (LSTM), Recurrent Neural Network (RNN), Activities of Daily Living (ADL).

I. INTRODUCTION

IoT (Internet of Things) based load monitoring is a smart and efficient approach to monitor and manage electrical loads in various applications. It leverages the power of interconnected devices and sensors to collect, analyze, and communicate data related to electrical consumption. This technology is particularly valuable in industries, smart homes, and commercial spaces where optimizing energy usage is crucial for efficiency and cost savings. IoT-based load monitoring is a system that uses sensors and internet connectivity to collect and transmit data about the electrical load on a device or circuit. This data can be used to improve energy efficiency, identify potential problems, and optimize performance. IoT-based load monitoring is a transformative technology that brings intelligence and efficiency to the management of electrical loads. It plays a crucial role in the era of smart buildings, industries, and cities by providing the tools needed to optimize energy consumption and enhance overall operational performance.

Components of an IoT-based load monitoring system are:

Sensors: Sensors are used to measure the voltage and current of the electrical load. The type of sensor used will depend on the specific application.

Microcontroller: The microcontroller is the brains of the system. It collects data from the sensors, processes it, and transmits it to the cloud.

Communication module: The communication module allows the microcontroller to transmit data to the cloud. This can be done using Wi-Fi, Bluetooth, or cellular networks.

Cloud platform: The cloud platform is where the data is stored and analyzed. It can also be used to provide users with real-time insights into their energy consumption

II. LITERATURE SURVEY

Mubarak [1] has presented a prototype design of an IoT (Internet of Things)-based load monitoring system. The system uses Arduino UNO as the microcontroller, Node MCU as the WIFI module, ZMPT101B as the voltage sensor, ACS712 as the current sensor, and relay as the current limiter. The system can measure and transmit real-time voltage, current, and power consumption data to a cloud-based server. The data can be accessed remotely through a web application. The IoT-based load monitoring system is a viable solution for monitoring and managing energy consumption. The system can be used in a variety of applications, including homes, offices, and industrial facilities.

Franco et al. [2] have presented a novel appliance recognition module that leverages machine learning techniques to identify the specific appliances in the smart home. This module utilizes a feed-forward neural network (FFNN) classifier trained on a dataset of appliance power consumption profiles. The trained FFNN classifier accurately identifies appliances with over 95% accuracy. Furthermore, the paper proposes an activities of daily living (ADL) recognition algorithm that maps appliance usage patterns to specific ADLs. The ADL recognition algorithm utilizes a long short-term memory (LSTM) recurrent neural network (RNN) to capture the temporal dependencies between appliance usage events. The LSTM-RNN-based ADL recognition algorithm achieves an accuracy of over 90% in identifying common household activities.

Munoz et al. [3] have discussed design and development of an IOT smart meter with load control for home energy management systems. The whole practice involved the design and implementation of the electronic instrumentation, the creation of a simple IoT scheme model, a calibration process, the measurement validation, and the demonstration of the system in a space environment. the device proposed in this work could be a useful tool for the areas of smart grids and microgrids, primarily because it allows the opportunity to know exactly how energy is being used in individual appliances, as well as enabling remote control.

Cheeli et al. [4] have presented a novel load disaggregation algorithm that utilizes non-intrusive load monitoring (NILM) techniques to identify the specific appliances in the smart home and their corresponding power consumption patterns. The NILM algorithm employs a combination of machine learning techniques, including k-nearest neighbours (KNN) and support vector machines (SVM), to achieve accurate appliance identification and load disaggregation. Furthermore, authors propose an activities of daily living (ADL) recognition algorithm that maps appliance usage patterns to specific ADLs. The ADL recognition algorithm utilizes a hierarchical temporal memory (HTM) model to capture the complex temporal dependencies between appliance usage events. The HTM-based ADL recognition algorithm achieves an accuracy of over 92% in identifying common household activities.

Subramanian et al. [5] have presented novel IOT based domestic automation system for load monitoring and efficient control. Authors have proposed a modified smart monitoring and management system with the function of manipulating data at high speed by Profibus technology and digital meter current era. The customized system proposed is designed as an automatic system for demand tracking and load control with exact management of different load during peak period based on system requirements and actual time control of system output.

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III. BLOCK DIAGRAM

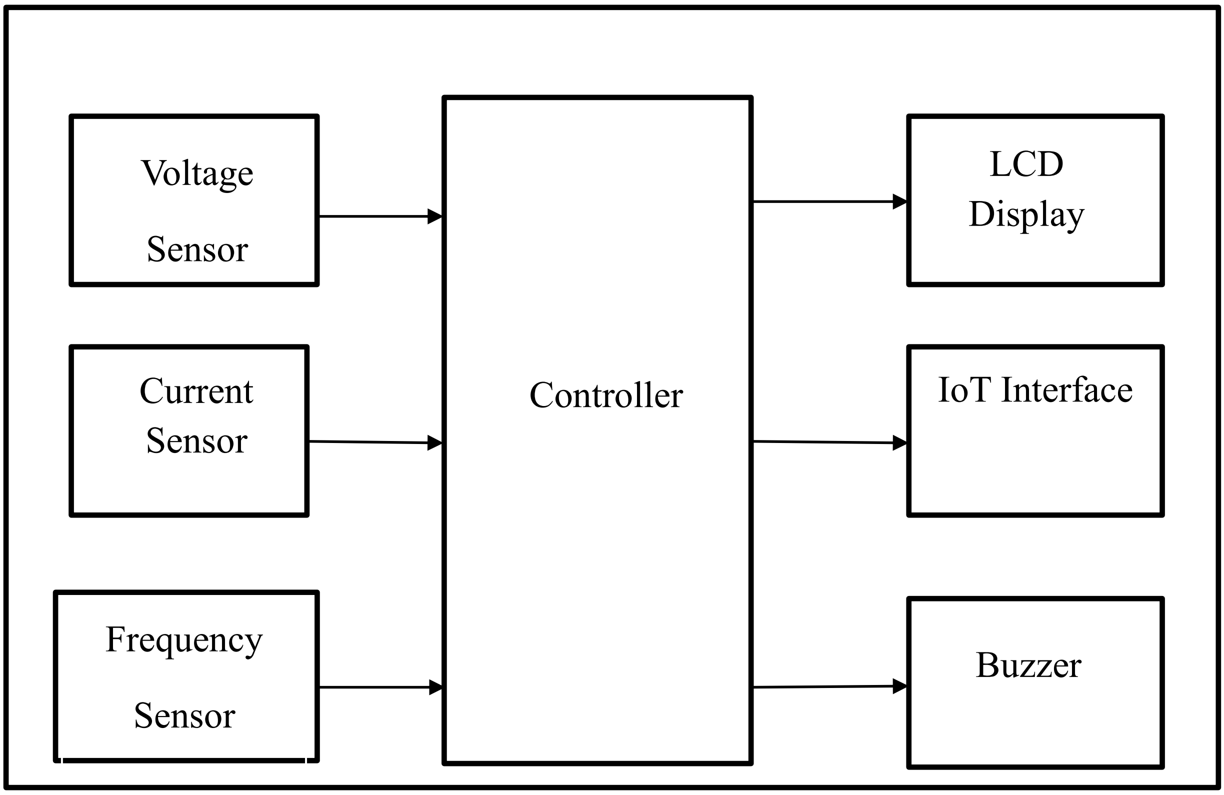

Fig. 1: Block diagram.

The above block diagram is of IOT based Load monitoring system. It consists of voltage sensor, current sensor, frequency sensor, LCD display, IoT interfacer, buzzer and controller are used in this system. Voltage sensor, current sensor, frequency sensor is connected to input of the controller and LCD display, IoT interfacer, Buzzer is connected to output of the controller. The block diagram of proposed load monitoring system is shown in figure 1. The system uses three voltage and three currents sensors to measure the three phase voltages and currents. The control measures these voltages and currents and calculates active power, reactive power, power factor and frequency. The readings of all the parameters are displayed on a local LCD display as well as on IOT platform through Thing Speak platform. In case any of the measured parameter exceeds the threshold limit, an alarm will be raised by the controller.

IV. SIMULATION DESIGN

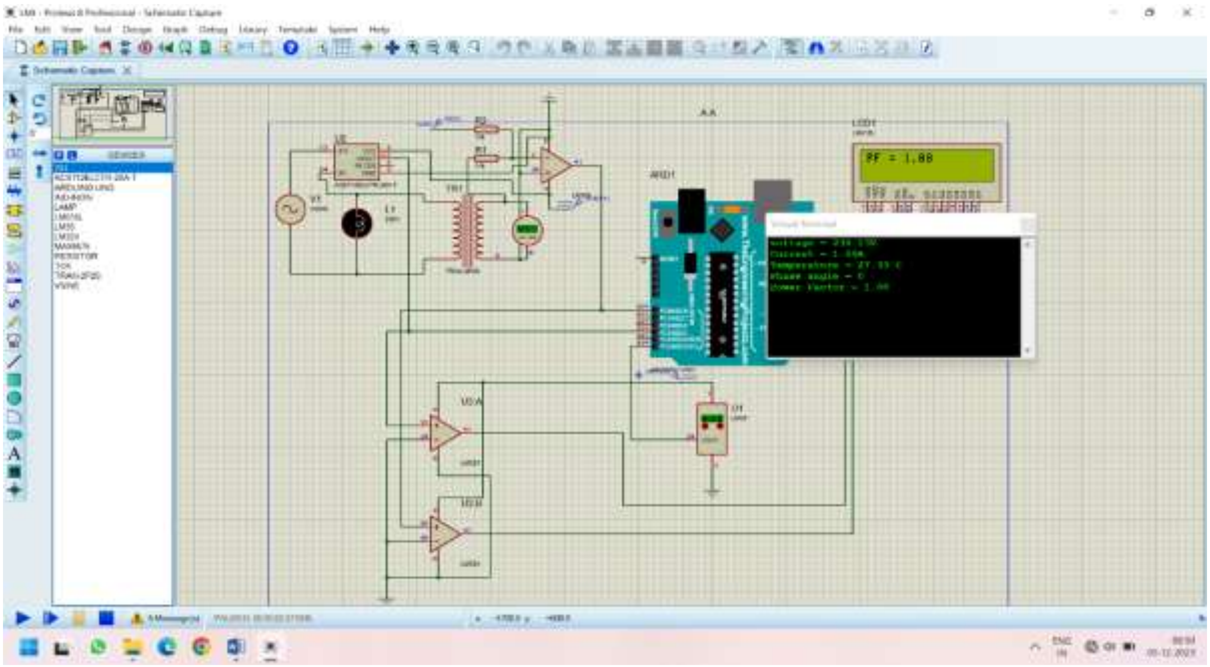

Fig. 2: Simulation diagram.

In this simulation the model of used IOT based Load Monitoring System. We can calculate the load parameters. The parameters are Voltage, Current, Frequency, Temperature, Power factor, Active power, Reactive power. We can used to measure this parameter the components are Voltage sensor, Current sensor, Temperature sensor, Display, Relay, Controller, Node MCU. We can these parameters are connected to load and measure the value of load. The simulation output is displayed these values are Volage, Current, Temperature, Frequency, Power factor, Active power, Reactive power.

V. SIMULATION RESULT

Fig. 3: Temperature.

Fig. 4: Frequency.

Fig. 5: Voltage.

Fig. 6: Current.

Fig. 7: Active Power.

Fig. 8: Power Factor.

In this simulation output is Fig. 3 Measure the temperature of load monitoring system and displayed the value. Fig. 4 Measure the frequency of load monitoring system and displayed the value. Fig. 5 Measure the voltage of load monitoring system and displayed the value. Fig. 6 Measure the current of load monitoring system and displayed the value. Fig. 7 Measure the Active power of load monitoring system and displayed the value. Fig.8 Measure the power factor of load monitoring system and displayed the value.

Table 1: Simulation Result Table.

Sr.No.	**Parameters**	**Parameters value**
1	Voltage	230 V
2	Current	1.09 A
3	Frequency	50 Hz
4	Temperature	27.33 C
5	Power factor	1
6	Active power	252.65 VA

VI. CONCLUSION

The load monitoring system stands as a basis in the quest for efficiency, reliability, and sustainability across diverse industries. By observing and managing energy consumption patterns, load monitoring systems empower organizations to make informed decisions, optimize resource utilization, and proactively address potential challenges. The outcomes extend beyond mere cost savings, reaching into the realms of preventive maintenance, improved system performance, and adherence to environmental and safety standards. As technology continues to advance, the integration of smart grid solutions and data-driven insights enhances the adaptability and responsiveness of these systems, ushering in an era where load monitoring becomes synonymous with intelligent and sustainable resource management. The load monitoring systems promises not only economic benefits but also a substantial contribution to the broader goals of customer satisfaction.

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