IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 1, October 2022
Impact Factor: 6.252

Voltage, Current, Power Consumption Monitoring: A IOT Based System

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Abstract: *Electricity is a basic human necessity that is extensively employed for home, industrial, and agricultural purposes. In this way, energy waste leads nations to lose revenue. Solutions based on technology, such as The Internet of Things (IOT) connects the physical and digital worlds, This IOT application ,In this scenario, manages and/or analyze energy consumption.. Furthermore, the advancement of micro and Nano-electronics has made it possible to the creation of connectivity modules like the XBEE that enables the rapid deployment of a wireless sensor network effectively, using the least amount of energy possible employed for responsibilities of monitoring and control. By developing a hardware and software solution, the given prototype takes advantage of the previously indicated features. It uses a scalable and modular platform with XBEE technology and a developed protocol for data exchange between the modules that make up the system to allow remote monitoring of electricity consumption in a home. The prototype's accuracy is shown when compared to readings acquired with a regular electric bill, according to the conclusions.*

Keywords: BMS, BAS, SMACS, XBEE

I. INTRODUCTION

This document is a template. An electronic copy can be downloaded from the website. For questions on paper guidelines, please contact the International Journal committee as indicated on the Journal website. Information about final paper submission is available from the website. This is only possible with the help of controlling devices that are to be installed in a building during construction. This control can be of any type, from simple switching on and off of lights, to water motor control and many more. Therefore the main idea of designing this system is to automate these building operations in the most resourceful manner. Besides controlling, security factor has also been kept as a concern with password protection. Cameras, fire alarms systems, main gate security and main gate barrier automation has been put at priority in this systems (BMS). Another feature which is required in a multiple story building is elevator, which can also be found in building systems.

Building Management System (BMS), otherwise known as Building Automation System (BAS), is a computer-based control system installed in buildings that controls and monitors building's mechanical and electrical equipment such as ventilation, lighting, power systems, fire and security systems. BMS consists of software and hardware; the software program, usually configured in a hierarchical manner, can be proprietary, using such protocols as C-Bus, Profibus, and so on. Vendors are also producing BMS that integrates the use of internet and open standards such as Device Net, SOAP, XML, BAC net, Lon Works and Modbus.

It analyses specific necessities of a particular building by controlling the associated plant installed in it and helps save energy. Devices installed outside the buildings are connected withpanels which can be switch on or off over different sets of instructions. The working of BMS is totally based on the inputin form of information by the devices such as sensors. Oncethe information is collected it can be processed with the helpof controller that will further instruct the system to perform a specific task. In BMS technology, switching on and off of the plant can be controlled in the same manner. Plant can be set to a respective temperature in order to provide heating and cooling with respect to the temperature outside the building.

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BMS serves as a tool for potential increase in economics and energy efficiency, and thus, must be clearly defined and understood before its implementation in both private and commercial buildings, especially in the later where it seems to provide enormous cost savings due to minimized energy consumption it yields when installed in a building. The evolution, benefits, limitations, efficiency, application and adoption of BMS are reviewed.

II. BACKGROUND

Since a home contains a variety of equipment, each of which uses a different amount of energy. With the help of IOT, this model focuses on voltage consumption and analyses current usage. The model aids in identifying and graphically presenting the amount of energy used by each object.

Second, the model is a combination of hardware and software; the software warns the user when voltage fluctuation occurs. The software component displays the consumption and acts as the project's front end, while the hardware component is in charge of voltage monitoring and resistance.

III. LITERATURE SURVEY

1. IEEE Xplore, 01 March 2018- IOT based Electrical Energy Consumption Monitoring System Prototype

Energy monitoring system becomes an important subject to provide information of electricity usage for the users. Moreover, with rapid development in information technology, especially IOT, it is possible to establish better energy monitoring system by providing real-time consumption data. In this paper, IOT based Electrical Energy Consumption Monitoring System Prototype for G4 Building Universities Negeri Malang is developed. Real-time measurement of the energy consumption utilizes current and voltage sensors for each wiring phase of the building electrical panel. For the IOT system, data is processed and displayed in Web-based system using Public Subscribe method. This prototype is implemented during work-hours and achieving 95.5%accuracy based on the electrical data of the G4 Building.

2. IEEE Xplore, 06 December 2018: - An IOT-based Remote Monitoring System for Electrical Power Consumption via Web-Application [2]

Electricity is a fundamental need of the human being that is commonly used for domestic, industrial and agricultural purposes. In this sense, the waste of energy generates millionaire losses for the countries. The presented prototype takes advantage of the previously mentioned advantages by developing a hardware and software solution. It allows remote monitoring of electricity consumption in a home through a scalable and modular platform using XBEE technology and a customized protocol for data communication between the four modules that make up the system. Results are presented that demonstrate the accuracy of the prototype compared to the readings obtained with a conventional electricity meter .

3. IEEE Xplore, 10 November 2020: Internet of Things (IOT) based Energy Tracking and Bill Estimation System

Electricity is the most requisite energy in modern times. IOT based energy tracking and bill estimation system discussed in this paper has an objective to build awareness among household and industrial consumers about their usage of this energy. It does so by displaying real-time estimated electricity consumption by each load connected to it and real-time estimated bill of total consumption on a monitor unit. The novel approach used in the proposed system is the integration of a cloud-hosted database and control unit. The hosted database in Google Firebase enabled the simple design of this system, which is without the use of any electric energy measurement chip or current and voltage sensor, and it also gets logged with the final estimated bill of each month. To save energy when unused, users can operate the control unit to transmit switching instructions for loads. The proposed system also uses Node MCU, 4- channel relay module, and Blynk android application current and voltage.

IV. PROPOSED METHODOLOGY

The step-by-step methodology to be followed for Voltage and Current consumption model:

- Research and analyses on various old, voltage and current monitoring techniques.
- Based upon above analysis a Model is developed using XBEE.
- Results achieved after the Completion of Model and are to compared with the earlier Electric Bill.

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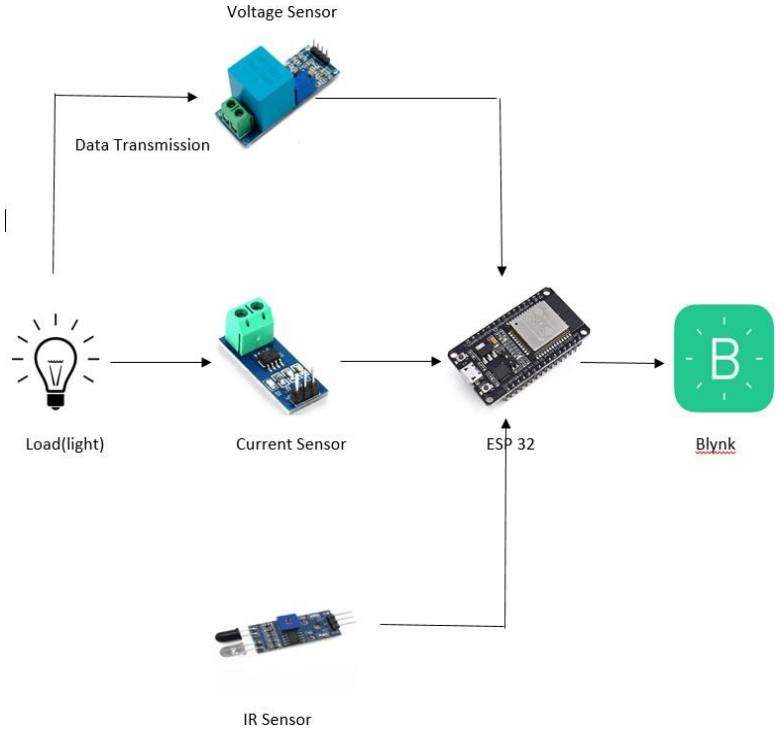

4.1 Voltage Sensor

The Voltage Sensor is a simple module that can used with Arduino (or any other microcontroller with input tolerance of 5V) to measure external voltages that are greater than its maximum acceptable value i.e. 5V in case of Arduino. Following is the image of the Voltage Sensor Module used in this project. In our Project, the Voltage Sensor constantly monitors the Line Voltage of the Battery and sends the Data to the Dashboard.

4.2 Current Sensor

This sensor operates at 5V and produces an Analog voltage output proportional to the measured current. The output of this current sensor is analogy, so to read it, we can directly measure the output voltage using voltmeter or measure it by using a microcontroller like Arduino through Analog Read pin or ADC pin.In our Project, the Current sensor will constantly monitor the Current.

4.3 IR Sensor

The connections for the IR sensor with the Arduino are as follows: Connect the negative wire on the IR sensor to GND on the Arduino. Connect the middle of. The IR sensor which is the VCC to 5V on the Arduino. Connect the signal pin on the IR sensor to pin 8 on the Arduino. In our Project, the Proximity sensor will constantly monitor the presence of people

V. IMPLEMENTATION

We developed a system to keep track of the Voltage and Current using IOT based technology. The Sensor we used Transmit the Data Received to them by the Load(light) to the ESP 32 Module. The module Classify the data as per Code Mentioned and transfer the Data Through WIFI to the UI (Blynk).We have Displayed 2 Progress bar and one Toggle bar for the Output Working Process

The first step of this Project work is system design. A flowchart is constructed to visualize the project flow, and the process is clearer and more understandable. When the system is powered up, the sensors will read the data and all the processes will be executed. The data will be transmitted and received through the WiFi module and then stored on the Blynk. The data will be visualized in web servers. As far as SMACS is concerned, it is a system that monitors the current, voltage, and power consumption usage of the appliances that can be monitored on Application or UI Module

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and also based on the Internet of Things by using Thing-speak.

The WiFi module ESP 32 is used as a medium to transmit and receive data using WiFi. SMACS for household appliances is divided into 2 parts: one major part for the monitoring system and one minor part for the control system. This system is supplied using 12 Vdc or 240 Vac with an AC to DC converter. The current sensor module is used to measure the current, and the value of the current is used to calculate the power consumption. Relay is used in the control system part where it acts as protection, and it cuts off and delays the current when overcurrent occurs.The flowchart shows the monitoring system and control system, respectively. The design of SMACS consists of Arduino UNO, an ACS712 current sensor module, relays, and AC sources. The components can be selected from the library of the software so that the simulation result will be the same as the prototype.

Internet of Things open-source application. It stores data and retrieves it via HTTP protocol over the Internet or Local Area Network (LAN) . Thing-speak is compatible with the ESP 32 WiFi module, and it is also used to show, analyze, and calculate the data and store it publicly or privately in the Blynk. In this project, Thing-speak is used to analyze and store data from the sensor based on IoT. It was analyzed through both laptops and mobile phones anywhere and in any place as long as WiFi is connected. To integrate Thing- speak with Arduino and the ESP8266 WiFi module, some prerequisites need to be done. The most crucial process is the command. Before the command is done, the Blynk account was created.

The SMACS monitoring system, where it first reads the current status then calculates the current, voltage, and total power consumption. These estimations can be monitored in the apps using the Thing-speak IoT module. The flowchart of the proposed SMACS control system, enabling the appliances to read the current and check its limit

A low voltage side is selected for this system where a single- phase housing of the scope of SMACS is a 240 Vac from the power supply. The crucial part of the household appliances is not on the voltage side but on the current side. Current is an electrical charge that carries flow. A simple way of defining this is that current is a charge over time. Current can be categorized into 2 parts: direct current (DC) and alternating current (AC). DC flows only in one direction, whereas AC periodically changes in direction. The root mean square (RMS) current is used in the calculation since AC is constantly changing its value. The RMS current is calculated as follows

$$I_{r.m.s} = \frac{\mathrm{I}_{max}}{\sqrt{2}}$$

where Ir:m:s: is the root mean square of the current in A, Imax is the maximum value of current in A. Other than that, the other important parameter in SMACS is power consumption. Power is an electrical energy flow for the unit time. It can also be defined as the multiplication of voltage, current, and power factors.

$$P = VI\cos\theta$$

$$Z = \frac{V}{I}\cos\theta$$

where P = power in W, I = current in A, cos θ = power factor, Z is the impedance of the system. Voltage and power factors are assumed in SMACS, where it is fixed to 240 Vac and 90%, respectively. It is the nominal value for residential areas, where all the values are based on active power.

This paper presents the comparative analysis and study of different classifiers mainly used in EEG data analysis. Generated a LSTM (RNN) based model to classify and predict human emotion in Neutral, Negative and Positive classes.

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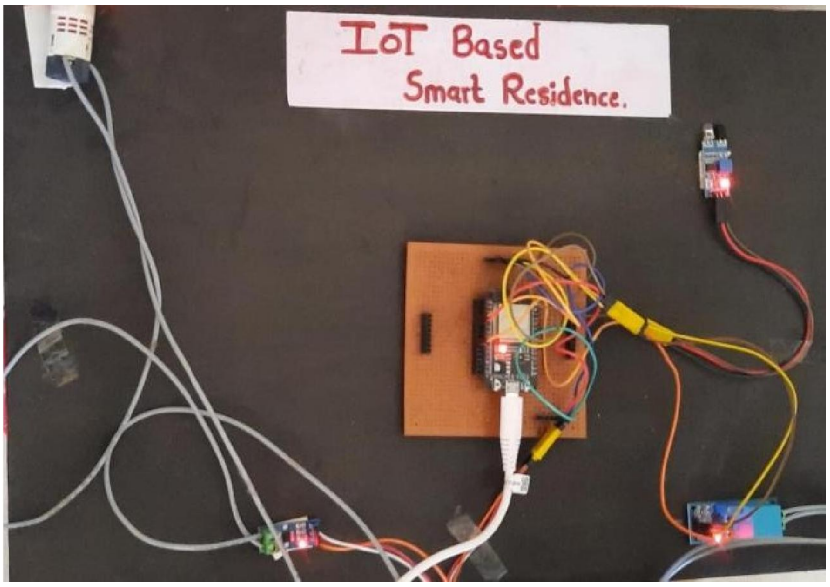
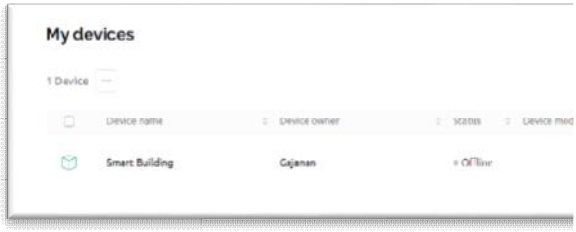
VI. Result Analysis

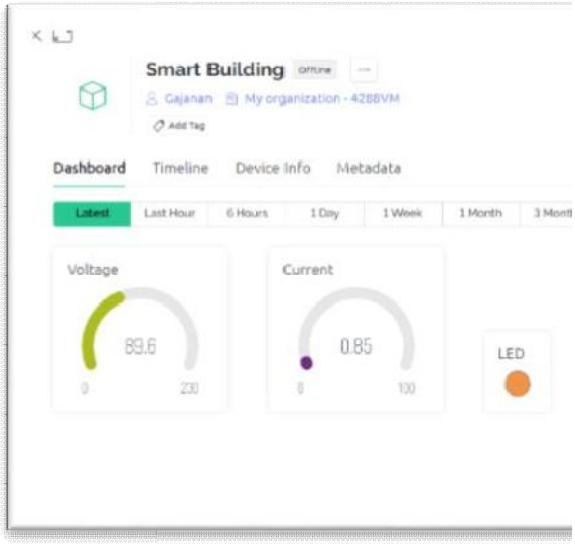
Above shows the implementation of the proposed system in which the channel relay module is connected to NodeMCU with support of jumper wires and is powered up using a 3V pin of NodeMCU while the mobile charger supplies 5V to NodeMCU using a USB cable. The unique digital pin of NodeMCU is connected, while the connection of one load is assumed to each relay of the channel relay module.



Device Info (Interface-first)



Result when Switch not Connected



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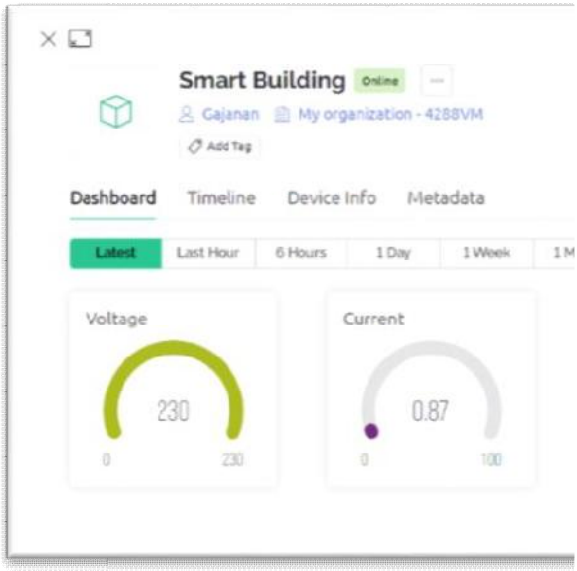

VII. CONCLUSION

This System has proposed and developed an IOT -based smart monitoring and control system for household appliances. The methodology and processes are designed and created to provide a useful and crucial solution in a monitoring and control system. The proposed system performed better in measuring and monitoring the current, voltage, and power consumption. This is because the proposed SMACS considered the system process design with the hardware selection of the ESP8266 WIFI module, ACS712 current sensors, and 5 V relays.

The entire communication has been done through the WIFI module to display the data on webservers, Blynk. The data are also monitored in real time and historically. The monitoring system makes the system more accessible for customers to view consumption rates clearly in real time. The control system of SMACS can fulfill the requirement of safety, can monitor appliances in the household individually or collectively, and can create awareness on electricity consumption. The voltage and current will be monitored in a wider scale in the smart house environment in future work.

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