IoT Based Smart Electricity Management System for Industry to Monitor Power Consumption of Individual Appliances

By

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Abstract – Energy is the most important source for all industries, domestic, commercial building, farming, restaurant and so on. Vitality utilization is straightforwardly influenced with various parameters, for example, Coal, oil and diesel towards the power generation. So, for conserving the energy lots of research have been administered for the smart energy management system.

As indicated by the assessment, it is found that none of the researchers have worked towards calculating the power consumption of the household, industry, commercial building, agriculture etc., individual devices.

This investigation focuses on a structure which can convey a reasonable energy/power management system conferring to the device"s specification i.e. Power wattage of a device. All energy meter energy reading correctly managed by node MCU. An Apache server is created to monitor the energy utilization of every gadget. This information will be transferred to the Apache server at the observing end so as to record the data and access it whenever required. Moreover, this developed system will protect the device, as when the device consume more power than specified on appliances excluding some surplus 10% power usage, then this system just cut off the power supply, to protect the appliances from getting damage.

Key Words: IoT, Apache, Smart electricity management, MySql, web Server.

1.INTRODUCTION

In current era of latest technology everyone wants more power to run their devices/gadgets. This increases the energy / power requirement, but the energy / power cannot be used for long because of limited resources. Thus everyone should carefully utilize energy/power. They must save energy/power by monitoring their devices. In the event that gadgets expends more energy/power they should be fixed or changed. This required smart electricity management. Thus researcher must think on it.

IoT:- The Internet of Things (IoT) concept enables us to connect ordinary everyday devices to the Internet. The devices connected via IoT conception can be observed remotely. The IoT idea gives the fundamental chances to frame an association between the physical and computer world. This idea is becoming more and more important as more and more wireless devices grow rapidly in the market. Devices connected to each other via the Internet.

Management System : Fuel management involves planning and managing fuel use and production plants. The goals are to save resources, get climate protection and cost savings while having continued connection with energy. This venture will assist with checking the force utilization of every apparatus to take the necessary action for power consuming equipment. In industry nobody can monitor the machine power thus electric bill get increases. So due to this project a consumer can identify which machine is consuming extra power to take its maintenance. To find out the data on the server all data is forwarded to the monitoring end and the analysis can be done for the exact usage of energy consumption of every device and to reduce the power utilization of the device/gadget. These observing reports would assist consumers with taking the necessary activity so as to improvise the energy usage.

So this system is used to solve these problems. The proposed framework configuration expels the contribution of human intercession in power conservation. Users can monitor power consumption on XAMPP server, energy consumption table for the different load.

1.1 Literature Review

In one of the examination revealed, "IoT Based Automated Temperature and Humidity Monitoring and Control" framework created [1][2] with the help of raspberry pi. Pi receives the observed temperature and humidity values and sends them to the Internet. Though, this effort provided additional control to the temperature and humidity.

Investigation also been carried out near Smart Home Control and Monitor System with the help of IoT [3] where a User Friendly GUI been created which can be gotten to comprehensively from any gadget that has internet connectivity.

Work is also underway to set up an automated lighting and class control system for efficient energy use of classroom[4]. They provided mobility and remote access to the system using the Android mobile app via Bluetooth to control lighting based on voice commands.

2.Proposed-System

This system has the following blocks.

- ➢ Power Supply.
- ➢ Node MCU.
- ➢ Current Sensor.
- ➢ MCP3008(A/D converter).
- ➢ Relay.
- ➢ Voltage circuit.

Node MCU is the core of this system and provides wireless assembly to the system. Where MCP3008 is an Analogue-to-Digital converter use to convert the analogue values of voltage circuit into digital form. The relay is use to control the AC supply connected to the appliances and is operated at 5V.
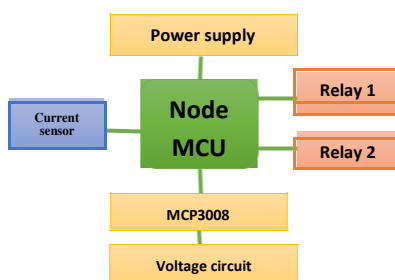

Fig 1: Block Diagram of System

2.1 Hardware and Software Requirement

i)Hardware:

A)ESP8266-module:

The ESP8266 is a Wi-Fi unit and offers a wireless network between a machine and the host. It requires a current of 3.3 to 5 V. It is communicated by 3.3V serial supply and cannot handle on 5V input and hence it need level conversion.

Features of ESP8266:-

- • Supports 802.11 b / g / n.
- • Built-in TCP / IP protocol stack.
- • Supports a variety of antennas.
- • The current leak filter is <10uA.
- • Power consumption is <1.0 mW.

Fig 2.2:ESP8266

B)ACS712(Current-Sensor)

It is a current sensor that can measure AC / DC up to 30 A. The sensor can even gauge high AC mains current and stays quarantined from the estimating part because of integrated hall sensor. The board is controled on 5V. The ACS712 Current Sensor is a result of Allegro Micro Systems that can be utilized for exact estimation of both AC and DC currents. This sensor is predicated on Hall Effect .
"The damping effect is the product of the voltage difference between the conductor and conductor current to the end of the conductor and the applied magnetic field." [4]. It was founded by Edwin Hall(1879).

Features of ACS712:-

- • It has 80 kHz BW.
- • Has a sensitivity of 66 to 185 mV / output.
- • Low-noise signal path.
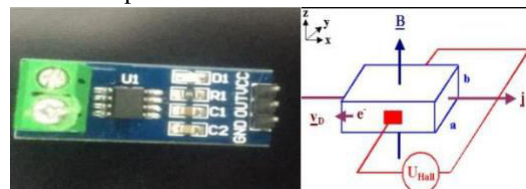- • Total output error is of 1.5%.

Fig 2: ACS712 current sensor & Hall effect

C) MCP3008:- 8-channel 10-bit analog-to-digital converter (ADC). No add-ons are needed for a cheap and easy interface. It follows the SPI bus protocol .

Features of MCP3008:-
• 8 channels of 10-bit ADC ICs.
• Communication protocol: serial SPI interface.
• Operating voltage 2.7V to 5V.
• ADC method: sequential approach (SAR)

Fig 2.3: MCP3008

D)Relay:-
A relay is a elecrical device acts as switch(5V). Numerous transfers (relays) utilize an electromagnet to precisely work as switch, however other working standards are additionally utilized, like solid- state relays. Relays are use when the line is operated by a separate power source or in a line controlled manner. As soon as voltage crosses its maximum limit for respective machine, relay cuts the power supply of that machine.

Fig 2.1 : Relay

Programming-languages:

The programming languages used in this project are XAMPP, PHP, Mysql, HTML Server. The database was created by XAMPP, a MySQL database used to store different uses of energy data from personal devices such as SR.NO. , Current, voltage, power, date and time. The website was designed with C, HTML, PHP and embedded jquery. The functionality of this unit allows customers to control the power consumption of personal equipment. This data is stored and can be accessed by the customer at any time.

XAMPP server :- The XAMPP server is free and open source. Developed by Apache Friends. Its meaning is,

Letter	Meaning
X	As an ideographic letter referring to cross-platform.
A	Apache or its expanded form, Apache HTTP Server.
M	MariaDB (formerly: MySQL)
P	PHP
P	PERL

 PHP :- PHP represents Personal Home Page, it is a well-known universally useful scripting language. It is mainly fit to web development. It was first developed by Rasmus Lerdorf in 1994. It is normally controlled on web server by PHP, translator represented as a module, a daemon or as a Common Gateway Interface (CGI) executable. The PHP mediator, organized by the Zend Engine.

HTML:- Hypertext markup language is the standard language for documents that appear in the browser. It is supported by technologies such as Cascading style sheets (CSS) and scripts like JavaScript. Web browsers accept HTML documents from any Internet or local storage server and convert them to multimedia documents. Interactive forms such as HTML constructions, images and other objects can be displayed on the page. HTML provides a way to create structured documents by identifying structural semantic words for texts such as titles, paragraphs, lists, links, quotes, and more.

2.2 Design and System Architecture

In IoT based smart electricity management system the ESP 8266 is connected with current sensor (ACS712), analog to digital converter (MCP3008), voltage circuit and loads. In this system we calculate the total energy consumption of a machine by calculating its current and voltage and output is sent to the server.

• Power = voltage(V) x current (I) x cosΦ

Connection between Node-MCU and MCP3008:-

D8 of Node-MCU $\longrightarrow$ pin no.10 of MCP3008

D7 of Node-MCU ⟶ pin no.11 of MCP3008

D6 of Node-MCU ⟶ pin no.12 of MCP3008

D5 of Node-MCU ⟶ pin no.13 of MCP3008

MCP3008 connection

Pin no.9 & pin no.14 connected to the GND.

Pin no.15 & pin no.16 are connected to VCC(3.3v).

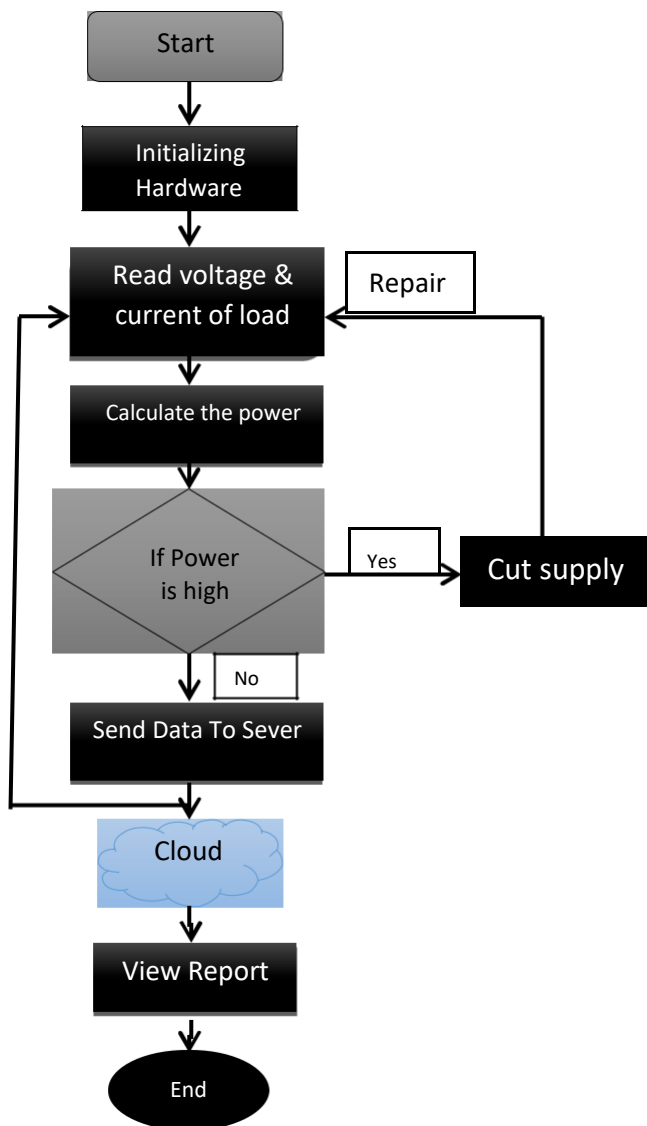Pin no.1 to 8=channel 0 to 7.The figure 3 shows the flow of the system.

Fig 3.**Flow of system**

2.3 EXPERIMENTAL RESULTS:-

The following (fig 4.) is a model used to gauge power, with values in watts. And so, it needs voltage and current from the power supply. Therefore, voltage and current of a particular machine is required to calculate power. Depending on the data received by the system, energy consumption data is displayed on the site via the XAMPP server, as shown in Figure 5. The front end of the web is scripted using Hypertext markup language (HTML) and back end is scripted using XAMP server. The database is connected using the PHP language. The Node-MCU sends the information to a basic PHP content which is having name as insertDB.php, It associates with a MySQL database and stores the information in the database. If consumer had to see the information on a computer/mobile, then consumer had to visit the browser to see the table. Reports are sent to consumer on the website and analyzed to inform consumer to find out which device is consuming more power.

Fig 4 : Hardware Setup

Fig 5: Table representation on server.

3.CONCLUSION:-

The final goal of the document was to design an IoT-based power management system. So, it helps industrial person feel safe about their appliances. This project is manufactured to remove human involvement in computing power consumption and also to prevent appliances from `getting damaged as this system cuts down the power supply of individual appliance as soon as the power uses value crosses its limits. The Languages used in wireless devices and communications in this service are Embedded C, PHP, Mysql, HTML. The general expense is low and might be handily worked. Even industry will undergo its own transformation towards the smart management, this project is implemented for better energy management and full remote control. In future system can be modified as per requirement.

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