Review on Design of IOT Based Energy Monitoring System and Home Automation

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Abstract: In the most of the developing countries, the effort of collecting electricity utility meter reading and detecting illegal usage of electricity is a very difficult and time consuming task which requires a lot of human resources. Energy monitoring system using Internet of Things (IOT) present an efficient and cost-effective way to transfer the information of energy consumed by the consumer wirelessly. Aim of this study is to measure electricity consumption in the household and generate its bill automatically using IOT and telemetric communication techniques. In this paper, the use of GSM module provides a feature of notification through SMS. One can easily access the meter working through web page that we designed. Current reading with cost can be seen on web page. Automatic ON & OFF of meter is possible. In addition to this in this project home automation will also be done using IOT technology.

Keywords **–** IoT (Internet of Things), GSM, Energy Monitoring system, Home Automation.

1. INTRODUCTION

1.1. INTERNET OF THINGS (IOT):

The Internet of Things (IoT) is becoming more widely used technology nowadays. It is often used to refer to the growing network for connected devices, or "things", that are capable of exchange data over on a low bandwidth network. IoT is being used in various areas, such as automotive industry, logistics, healthcare, smart grid and smart cities.

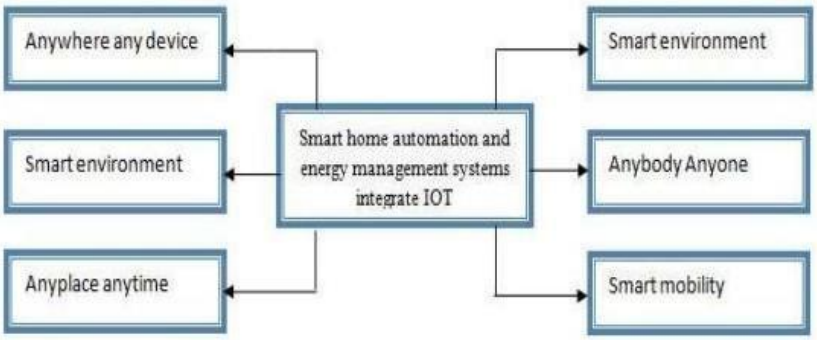

Figure 1.1.1. Relation with various phases

The figure (1.1.1) shows the various advantages of the internet of things like the different methods for connecting our devices and appliance to the internet from any place anywhere in this world and integrating this connectivity with our home and the devices connected. IOT technology is the connection of various networks in embedded devices used in the everyday life integrated into the Internet. It aims to automate the operation of different domains such as home appliances, health care systems, security and surveillance systems, industrial systems, transportation systems, military systems, electrical systems, and many others. In order to achieve a fully automated process, devices in the different domains must be equipped with micro-controllers, transceivers, and protocols to facilitate and standardize their communication with each other and with external entities.

2. LITERATURE REVIEW:

Nowadays, electricity consumption has become one of the basic needs in every sector. Thus to improve the efficiency of all electrical appliances and to reduce wastage of electricity is one of the challenges faced by the world. The objective is to develop load monitoring and controlling system for electric appliances to reduce energy consumption and energy usage in an efficient way.

IOT based energy monitoring system is designed based on three major objectives. They are :-

1. To provide automated load energy reading over an immediate basis.
2. To use the electricity in an optimized manner.
3. Reduce the power wastage.

In the present billing system the distribution companies are unable to keep track of the changing maximum demand of consumers. The consumer is facing problems like receiving due bills for bills that have already been paid as well as poor reliability of electricity

supply and quality even if bills are paid regularly. The remedy for all these problems is to keep track of the consumers load on timely basis, which will held to assure accurate billing, track maximum demand and to detect threshold value. These are all the features to be taken into account for designing an efficient energy billing system. The present project "IoT Based Energy monitoring system" addresses the problems faced by both the consumers and the distribution companies. The paper mainly deals with smart energy meter, which utilizes the features of embedded systems i.e. combination of hardware and software in order to implement desired functionality.

3. EXISTING SYSTEM METHODOLOGY

The electric meter installed in your home is the device that allows the utility department to charge you monthly on the amount of energy you have consumed. The electric meter measures the current flow through the service entrance and into your personal electrical service panel. As you would already know, electric meters can be mechanical or analogue and digital or smart meters. In the first case, a utility service person would visit your home to read the meter on a monthly basis. With the newer smart meters, the information is directly sent over radio or internet signals.

The consumption of electricity is measured in kilowatt hours. This means we are measuring the watts consumed over a period of time. The power consumption meter does this work i.e. it records the electricity that is consumed in kilowatt-hours.

4. PROPOSED METHODOLOGY

This system enables the electricity department to read the meter readings monthly without a person visiting each house. This can be achieved by the use of ESP32 unit that continuously monitor and records the energy meter reading in its permanent (non-volatile) memory location. This system continuously records the reading and the live meter reading can be displayed on webpage to the consumer on request. This system also can be used to disconnect the power supply of the house when needed.

When the various appliances of the household consume energy the energy meter reads the reading continuously and this consumed load can be seen on meter.

- We can see that the LED on meter continuously blinks which counts the meter reading. Based on
- The blinking, the units are counted. Normally, 3200 blinks is one unit.
- In our project we are trying to develop, a system in which esp32 act as main controller, which continuously monitor energy meter.
- As per the blinking of LED on energy meter the ESP32 will measure the unit consumption.
- The measured reading with the calculation of the cost will be continuously displayed on web page that we have designed.
- Threshold value can be set on webpage with the help of Wi-Fi, as per the consumer's requirement. When the consumers reading will be near about to the set threshold value it will send a notification value to the consumer.
- This threshold value notification will increase the awareness amongst the consumer about the energy.
- When the consumer gets the notification he can visit the webpage and change the threshold value.
- If the consumer is not aware with the threshold notification, then the meter will automatically get off. Then the consumer has to visit the webpage again and increment the threshold value. By the incrementation, the meter will automatically get ON.
- Finally the overall monthly bill with cost will be sent to customer as well as service provider in the form of text at first day of every month.

5. BLOCK DIAGRAM

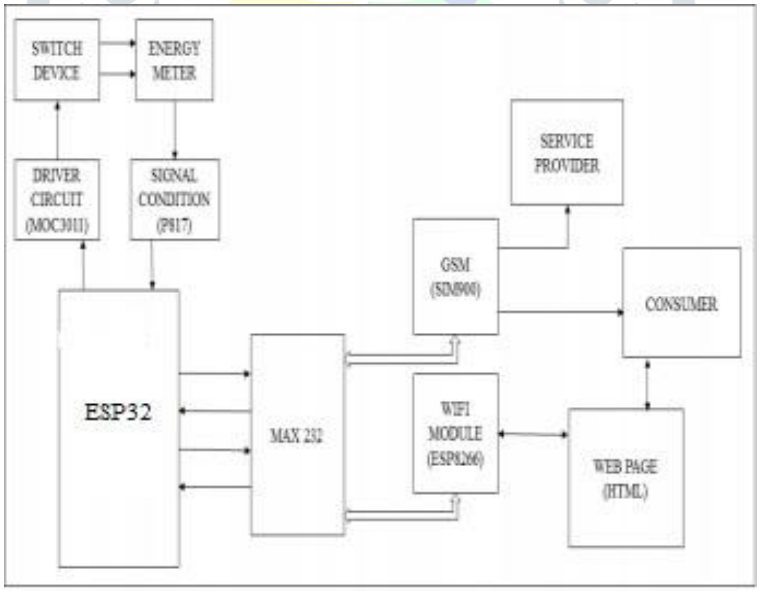

Figure 4.1: Block Diagram Representation

4.1 SIGNAL CONDITIONER (P817)

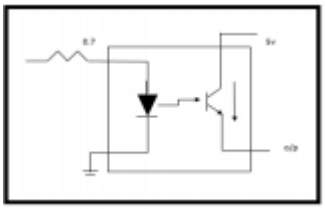

Figure 4.1.1: Signal Conditioning Circuit

Above figure shown is the simple internal working of optocoupler P817 which we are using as signal conditioning block. As we can see on a working meter that one LED continuously blinks, it is nothing but indicates the count of power. The LED whenever blinks it produces only 0.7v which is not suitable for ESP32 board to capture, so to remove this error we are using this block. When the LED blinks the diode will conduct, transistor will get active and it will give 5v at output which we are externally giving to transistor. Whenever LED will blink the 5v supply will be provided to ESP32 board and it will count them. We are using signal conditioning block to increase voltage.

4.2 ESP32:

ESP32 is a series of low cost, low power system on a chip microcontrollers with integrated Wi-Fi and dual-mode Bluetooth. ESP32 is created and developed by Espressif Systems, a Shanghai-based Chinese company, and is manufactured by TSMC using their 40 nm process. ESP32is the heart of our system. Entire functioning of system depends on this board. ESP32 reacts to the 5v supply given by opto-coupler and keeps on counting the supply and then calculates the power consumed and also the cost. This data, it continuously stores on webpage, so that users can visit any time and check their consumption. It even reacts accordingly as per programed, to the situations like message sending during threshold value etc.

4.3 MAX 232:

We are using MAX 232 for serial communication with the components that are GSM module and Wi-Fi module MAX232 is used to provide TTL to the components as per the requirement. GSM needs TTL so it is connected to ESP32 through MAX232. Some Wi-Fi module doesn't require TTL because it's already build in it and some may require based on its working.

4.4 GSM MODULE (SIM900):

GSM stands for Global System for Mobile communication. It is widely used mobile communication modem system in the world. GSM is an open and digital cellular technology used for transmitting mobile voice and data services operates at the 850MHZ, 900MHZ, 1800MHZ, 1900MHZ frequency bands. It has ability to carry 64kbps to 120Mbps of data rates. In our system GSM is used to send the notification of threshold reaching to consumer and for sending message of total consumption of unit with cost to the service provider and consumer.

4.5 WI-FI MODULE (ESP8266):

Wi-Fi stands for Wireless Fidelity. We are using Wi-Fi which acts as heart for IoT. Through Wi-Fi the consumer can set changes in threshold value, he can ON and OFF the energy meter. Time to time the readings of units and cost are displayed on webpage. Consumer can accesses the ESP32 board and meter with help of Wi-Fi.

4.6 DRIVER CIRCUIT (MOC3071):

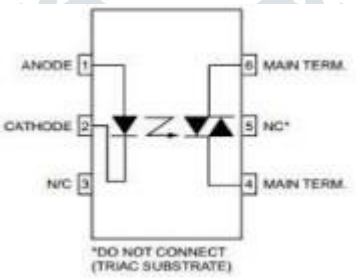

Figure 4.6.1: Driver Circuit

It is a 6 pin device known as opto coupler or opto isolator. In our project we are using this opto coupler to cut off the AC load. It is connected to the SSR to cut off the AC load.

4.7 SWITCHING DEVICE (RELAY):

Relay acts like a switch and it is used to control the high power devices. As the operating voltage of ESP32 is 5v it can't control higher voltage devices directly, so a 5v relay can be used to switch the 230v current and then ESP32 is used to control the relay. The relay work by controlling one electrical circuit by switching contact in another circuit either electrically or mechanically. A relay is said to be in open contact when it is normally open (NO) i.e. NC pin connected to COM and connected when INT1 is set high and thereby relay is not energized. A relay contact is a closed contact when it is normally closed (NC) i.e. disconnected when INT1 is high, and hence there will be no supply to relay.

6. CONCLUSION

A smart power monitoring and control system has been designed and developed towards the implementation of an intelligent building. This system monitors and controls the power consumption of home appliances remotely by using wireless network. And also protect the load from High voltages. The entire system is designed on an embedded platform which is easy to design and consume less power, and provides at low cost with portable size. Thus, the continuous monitoring of the electrical appliances can be observed through a website as well as android app.

Further, this work can be extended for power consumption of whole building and electricity bill can be determined. This project can be installed at the transformer to determine the illegal connections for households and by verifying the power in each transmission line, the load at the end of line from transformer can be regulated.

7. REFERENCES

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