Iot based Smart Energy Meter and Monitoring Device

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Abstract:
The main objective of this paper is to know the electricity consumers about their usage of power by the means of IoT. The usage of ARDUNIO microcontroller and the help of the Wi-Fi module makes this project based on IoT. To set the limit value of the power and if the limit value exceeds, the whole information about this power usage will get to our mobile via messages, emails, calls, etc. We use the ADA fruit server and IFTTT for this process.

I. INTRODUCTION

The technology today is getting improved day to day life and also the usage of this technology increasing accordingly. Nowadays everything is getting automated for simplicity, security, saving electricity and time. In the present bill system, a man should come to our homes and the bill will be generated by him by seeing it in the meter. And the amount of power we consumed will be not known until he gives the bill. This can be removed and also a proper usage of electricity can be done using this work by placing a smart energy meter near to our meter and we used to track the power we consume using the Internet of Things(IoT) which is connected with an Ardunio. The internet of things (IoT) is like the medium which is used to connect daily used things like smartphones, sensors, and people. They also give the advantage to control the things far away from us by just using this medium and the particular processes to be done to use or control the particular thing. It is the modern way of communication between things like the used materials and the controlling material. The improvement of Internet of Things these days is very fast and the users of these are increasing day by day and the development is

made such that this enables automatic billing system to our registered mobile and also mails and calls to warn the increase of the consumption to specific limit and also avoid a person to visit the homes to print the bill.

In the present system, manpower is used for meter readings of each house and this takes a long time and more manpower to cover the whole area and the system is very complicated. Humans can't know the date of billing and they do not work properly and cause some errors which also increase the number of bills because of the more usage of power by the consumers. So by making everything automatic, we can reduce the manpower and we can also reduce the errors that occurred by them and save the electricity.

II. PROPOSED SYSTEM

In this system, the readings of the energy meter are calculated and it is uploaded to the server using the IoT which is controlled by using an ARDUNIO known as a controller so that the consumer can open the server and know the amount of power consumed and the respective calculated bill for that particular bill can be known. A current sensor is used to read the current flowing through the load from the power

supply. Using this current sensor, the power consumption is identified by using the ARDUINO microcontroller and these data are uploaded to the server or the website through Wi-Fi Module.

Advantages:

- *Manpower is not necessary for taking current readings.*
- *Avoid High or Unwanted usage of electricity.*
- *Can identify the High-Power Consumption in industries easily.*

III. HARDWARE SPECIFICATIONS

A. Current Sensor

This device assumes a significant job in figuring the current. It is noteworthy to gauge the AC flows due to the sound combined with its lopsided protection. Be that as it may, with the assistance of this ACS712 unit which was designed by Allegro things have become much simpler. This module takes a shot at the standard of Hall-impact, which was found by Dr. Edwin Hall. Concurring his guideline, when a current conveying conductor is set into an attractive field, a voltage is created over its edges opposite to the bearings of both the current and the attractive field. We utilize a lobby sensor to gauge the attractive field around a current conveying conductor. This estimation will be as far as millivolts which we called as the corridor voltage. The significant bit of leeway of utilizing ACS712Current Sensor is that is can gauge both AC and DC and it likewise gives disengagement between the Load (AC/DC burden) and Measuring Unit (Microcontroller part).

The 2-pin terminal square is the place the current helping wire ought to be gone through. The module chip away at +5V so the Vcc ought to be fueled by 5V and the ground ought to be associated with Ground of the framework. The Vout pin has a counterbalanced voltage of 2500mV, which means when there is no present moving through the wire then the yield voltage will be 2500mV and when current streaming is sure, the voltage will be more

noteworthy than 2500mV and when the present streaming is negative, the voltage will be under 2500mV.

In this paper, we utilize the Analog pin of Arduino to peruse the yield voltage (Vout) of the module, which will be 512(2500mV) when there is no present coursing through the wire. This worth will decrease as the present streams negative way and will increment as the present streams positive way.

A portion of the highlights are

- 100 mV/A yield affectability
- 5 V, single information supply activity
- 80 kHz transmission capacity
- 1.2mω inward conductor opposition

Counts for current sensor is as per the following:

1) Vout Voltage(mV) = (ADC Value/1023)*5000
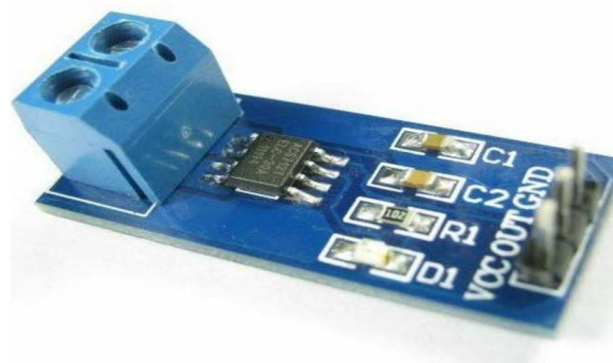2) Current Through the Wire (A) = (Vout(mv)-2500)/185

Figure 1: Current sensor

B. Energy Meter

Energy meter or watt-hour meter is an electrical instrument that measures the energy and displays it on the sled screen. All the input loads will be passed through it and it calculates the number of units. The electric bill will depend on this particular bill. The input of this meter will be the supply from the board of electricity and the output is connected to the load. The usage of this will be different for different

places like industries, home appliances, residential buildings. the power is coordinated over some time and which calculates the energy used about that particular period. This calculated energy will be for the particular periods and after the billing is done for that particular period then these meter is set to be reset and again the new number of units will be started reading for the next certain period.
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C. WiFi Module(Node MCU)

Wi-Fi represents Wireless Fidelity. Wi-Fi is the heart of the IoT. Without this module, we are not able to see the readings on the internet or server. It acts as a medium between the server and the ARDUINO board. We can control the energy usage using this medium and also the control over the meter. The entire details of the power usage, billing can be displayed on the server using this module. Without the W-Fi there is no internet of things. Consumers can access the Arduino board and the smart meter with the help of Wi-Fi.

ESP8266 is a Wi-Fi chip that uses Hub MCU as an open-source LUA based firework.Hub MCU is an open-source LUA based firmware. There are 8 pins for this component which are ground, enable, inputs, outputs, receiver, and transmitters. The main pins used in these are the input supply pin which is used to supply the board and the transmitter board which transmits the data from the board to the server and also the receiver pin receives the commands from the Arduino as well as the server or the internet. In All these pins the transmitter and receiver pin play an important role in transmitting and receiving data and the ground pin is connected to the ground. The maximum input supply that a module can bare is about 3.3 v and about this voltage leads to the damage of the equipment. So particular supply measurements should be taken to connect to the system.

Associations for Module to Ardunio is as per the following
- Connection of receiver pin Rx of ESP12 to the transmitter pin Tx of Arduino.
- Connection of transmitter pin Tx of ESP12 to the receiver Rx of Arduino.

D. Arduino

Arduino is one of the microcontrollers which is open-sourced and can be excellently modified, exterminated and recreated at any particular time whenever it is needed. This helps in developing and controlling of the electronic instruments. This was offered in 2005 and this stage was useful to give the most economical and easy growth for the specialists to understand or study any equipment in the system and to connect or interface with the systems is made easy. Arduino usage can be done and controlled by using some programs which are preferred or written in that particular language in which the Arduino understands the program and runs with the help of that program for the running as well as controlling purpose. It is similar to that of a simple Pc which works for some particular purpose. It is also connected to some of the other modules for transmitting and receiving data and to upload the data in the servers and also this can be controlled using such types of protecting modules. The Arduino will be having two types like UNO and NANO. The space and pins for the Arduino NANO are less when compared to that of the Arduino UNO.

The processor in the Arduino utilizes Harvard design where the code and information of the programs have separate memory. It includes two memories that are the memory for information and the memory for the program. Blasé memory is used to put the program memory in it and the information memory is used to put the program memory in it which works with a clock speed of 16 MHz.

Figure 2: Arduino

E. AC Appliances

Here the AC appliances come under what we use in our homes under the energy meter like bulbs, television, fridge, washing machine, electric rice cooker, fans, air conditioner.

IV. SOFTWARE REQUIREMENTS

Arduino IDE 1.8.1

\Steps for getting to the thing are

Stage 1: Download the Arduino Software (IDE).

Stage 2: Install the ideas referenced in the www.arduinocc.com for your working framework.
Stage 3: This IDE urges you to make Arduino code according to your needs.

Stage 4: Open the propensities window from the ARDUINO IDE. Go to Tools then Board. Inboards we have "Arduino UNO, in that select Arduino.

To screen our hugeness utilizes over the web, we need to utilize the MQTT merchant.

We resolve to utilize MQTT administrator as AdaFruit IO stage and look for after the underneath system to do this smart internet of things Energy Meter

1)To set up an AdaFruit account that deals in the energy or power meter readings.

2)Creating an Applet in IFTTT (If This Then That) for getting text messages, emails, calls of the meter readings.

3)Writing Codes for both ESP12 WI-FI module and Arduino.

V. INTERFACING

A. Interfacing between Ac Appliance and Current Sensor

- Connect one terminal of AC supply to input positive terminal of Current sensor
- Connect the second terminal of AC supply to phase terminal of the bulb
- Connect input negative of Current sensor to the neutral terminal of the bulb

B. Interfacing between Current Sensor and Arduino

- Connect Vout of Current device to the A0 pin of the Arduino
- Connect Vcc of Current device to the 5v of the Arduino
- Connect Ground of Current sensor to Ground of Arduino.

1. Sweeping the Application and clicking on the "+" symbol present on the screen. Fill the information regarding the Client Id of our wish. As shown in the screenshot below the server and the port will be the same. The Username and the password (Active key) will be given by the Adafruit dashboard.
NOTE: The password is your active key

2. Select the Electricity Meter then select the Subscribe. In the subscription, give a friendly name and the topic. The format of the topic is 'your username'/feeds/deadname' and by clicking the create icon it will be created.

VI. WORKING

1. When the load is switched ON which is connected current sensor, the current sensor senses the value of current and converts it into a voltage value. This voltage value is given to the A0 pin in the Ardunio.

2. Here these analog values is converted into power by using a program in the Ardunio and this is given to the Node MCU from the Tx pin in Ardunio.

3. Now the power value from the Tx pin is received by Node MCU by the Rx pin and from the power, the value bill is calculated by using a program in Node MCU. This program is also linked with the Adafruit server which is connected to the MQTT dashboard application where the values of power and bill are updated on the internet.

4. This Adafruit is also linked to IFTTT from where we get notifications via messages, email calls when the value of power and bill exceeds the set value on a daily or monthly basis according to our requirement.

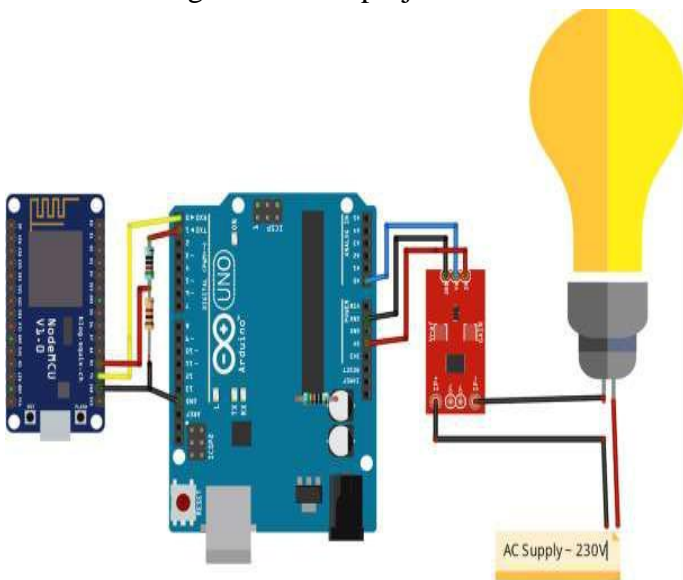The circuit diagram for this project is as follows

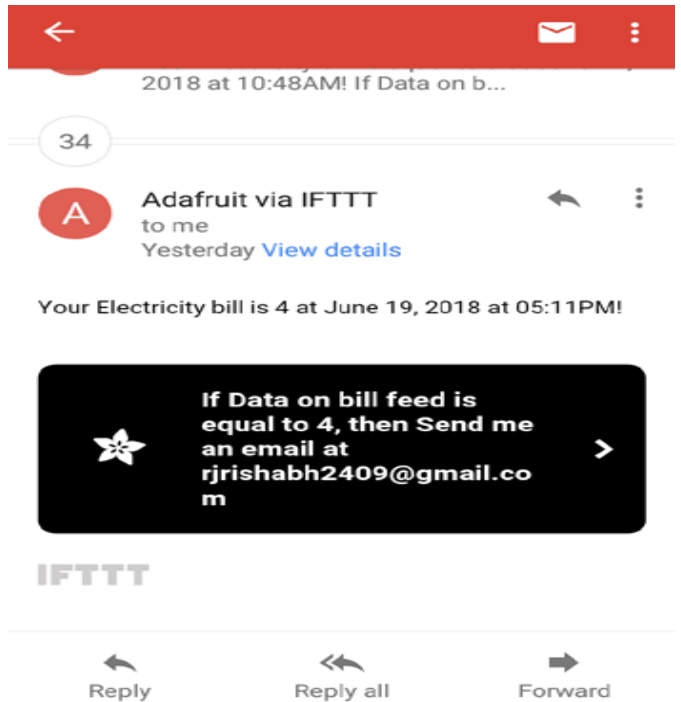Figure 3: Circuit diagram

VII. RESULTS
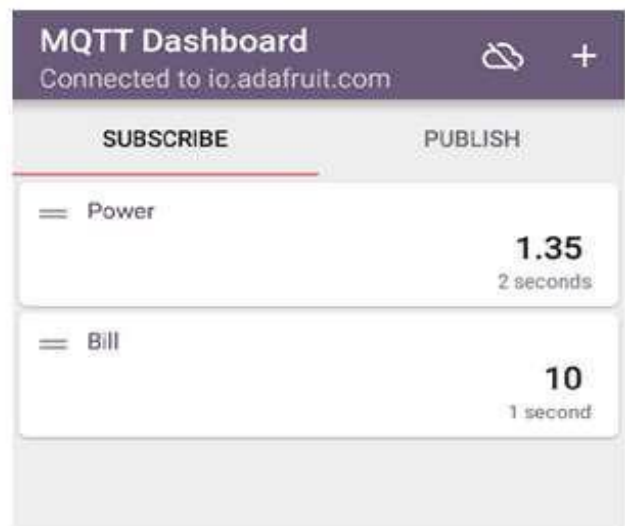

Figure 4:Email of Threshold Bill

Figure 2: Output showing in Application

Figure 3: Power and Bill in an online application

VIII. PROS AND CONS

1. Advantages

- Manual meter readings are eliminated
- Electric systems are monitored more quickly

- Power resources are more possible to use more efficiently
- Helping to optimize income with existing resources

2. Disadvantages

- Managing public reaction and customer acceptance of the new meters
- Ensuring the security of metering data

IX. CONCLUSION AND FUTURE SCOPE

This system helps to know the power consumed by the consumers and also he can analyze the usage of power. The wastage of both power and money can be done using this system. This system is based on the Arduino and implementation of energy meter using the IoT concept. This is an innovative application of the internet of things to know the usage of electrical power and to warn if the excess of power used beyond the set value for the period based on daily or monthly based on consumers' interest. In the proposed project current sensor is used to sense the inflowing current through the load and display it on the server within 2 seconds on the internet using public cloud Adafruit using IoT. Hence it reduces the energy wastage and gets to know the information about our users everywhere in the world.

The main improvement for the future is going on in the Wi-Fi modules, instead of using one to one module for every meter we can use one module of large capacity and used for 5 to 6 houses so that the capital invested on it will be decreased.

X. REFERENCES

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