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IOT Based Energy Meter

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Abstract: ***Electricity consumption has continued to go up rapidly at a rate faster than energy consumption. All forms of electricity generation have impact on our environment. Using electricity more efficiently reduces both the amount of fuel needed to generate electricity and the amount of greenhouse gases and other air pollution emitted as a result. This paper proposes smart, integrated power consumption monitoring system that has been implemented with the use of open-source standard technology. Just like commercial energy meter, this system can monitor electrical energy consumption from a remote distance with the technology of Internet of Things (IoT). This energy monitoring system using IoT will read the energy level and the consumer can check the energy consumption and the electric bill via Cloud platform such as ThingSpeak, MQTT and mobile app. The main target of this system is to reduce the high energy consumption. The consumer can reach out his/her energy consumption at anytime and anywhere in the world.***

Keyword: esp module, smart meter,ioT, energy

I. INTRODUCTION

Electricity Energy meter is a well-known device which is installed in every household and other work place to give the accurate data of the measure of energy consumption. As we observe, most of the consumers are always worried about the high electricity bills, it became a necessity to find a solution towards this problem. The possible solution for this is by monitoring the energy consumption real time from anywhere in the world and sending a notification using SMS/e-mail to the consumer when the energy consumption reaches its threshold value. This energy meter monitor will be connected to the internet via WIFI. This energy meter monitor will not only monitor the total energy consumption from anywhere and anytime in the world but will also notify the consumer about its high usage using SMS/e-mail. And compared to the traditional system, this system is much smaller in size, less expensive to implement and much more convenient as it is an IOT based device.

II. FUNCTIONAL BLOCK DIAGRAM

The following figure gives the block diagram of the overall operation of the device. Here we use a current sensor ACS712 to measure the energy consumption.

The ACS712 sensor senses current consumption and gives analog output. The analog output is then calculated abd callibrated and the real-time value of current consumptionn is generaed via Arduino Nano. As we know the mains power supply is 240V AC, so from the equation of Power = Voltage * Current, the power consumption is calculated. The total amount of enectrical energy used is calculted by multiplying the total time with the total power consumed by the appliances. Then the real-time values are uploaed to the cloud at regular intervals of time through ESP8266 Wi-Fi module. From the Cloud, the real-time energy consumption can be seen graphically on Cloud Platform and Mobile app from anywhere in the world.

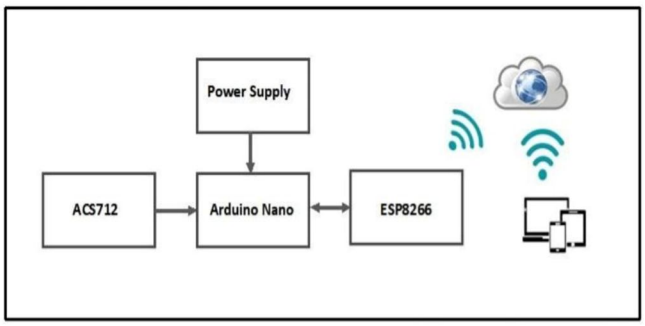


Fig: Functional Block Diagram

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III. METHODOLOGY

This modular system which can not only sends you a SMS/Email of your electricity bill but also you can monitor the energy uses anytime and from anywhere in the world. This system is made up with three modules, i.e.:

- Smart Energy Monitoring System which senses and compute energy consumption.
- User End which lets the users connect with the system via mobile or web platform.
- Cloud Platform which connects the other two modules and stores generated data for further computation.

A. Smart Energy Monitoring System

Here Current Sensor ACS712 is used to measure the energy consumption using the Arduino platform along with Wi-Fi Module ESP8266 to connect this module with cloud.

First it is very important for us to understand the working of the ACS712 Current sensor as it is the key component of the project. Measuring current especially AC current is always a tough task due to the noise coupled with it improper isolation problem etc. But, with the help of this ACS712 module thing have become a lot easier. This module works on the principle of Hall-effect. It uses a hall sensor to measure the magnetic field around a current carrying conductor. This measurement will be in terms of millivolts which we called as the hall-voltage. This measured hall-voltage is proportional to the current that was flowing through the conductor.

B. Cloud Platform

The next crucial module of this system i.e. cloud platfrom is responsible for the connection between User End & Smart Energy Monitoring System. Cloud computing is a promising paradigm for provisioning IoT user end applications in a cost-efficient manner. In this case MQTT broker is used, although it works fine with other broker(i.e. ThingSpeak, MATLAB e.t.c). The MQTT broker will be hosted on AdaFruit IO platform. The important credentials that we will be using on the ESP8266 code are the server, the user, the password and the port. In the ESP8266 side, it will be using an MQTT that supports the ESP8266, called PubSubClient. The library can be installed via Arduino IDE library manager. A feed is needed to be created in AdaFruit IO. Feed stores the data sent by Smart Energy Monitoring System & IFTTT. Next Applet is created in IFTTT for triggering SMS/Email for energy meter. Here user can easily set the limit exceeding which the sytem will send an alert to user via SMS/Email. Furthurmore electricity bill can easily be calculated from the energy consumtion data by multiplying the price of per unit with the KiloWatt Hour equivaent of enargy consumption. This feed containingtotal energy consumption ammount, realtime power consumption, hourly power consumption graph is easily accessible from user end at anywhere in the world.

C. User End

This module is the part where interaction between user and the system occurs. This lets the user monitor the desired data from the system real timeInternet of Things (IoT) enables a myriad of user end applications by interconnecting physical objects. IoT end-user applications are provisioned in cloud settings using PaaS and offered as SaaS. User can access the required data real time from anywhere of the world via website as well as mobile application. In this case as MQTT broker is used, so MQTT Dashboard Android Application is used. This application have the features to monitor real time power sonsumption data, total energy consumtion data and real time bill. Moreover this app also provides higher security, real time troubleshooting feature, management tools etc to make this system more convenient. All the above mentioned features are also available in the website.

IV. CAUSES OF ELECTRICITY BILL HIKE

1) Letting vampire appliances bleed you dry. One of the main reasons for high electricity bill may be due to leaving appliances or electronics plugged whether they are in use or not.
2) Big appliance, like washing machines, dishwashers have insatiable appetites for electricity consumption.
3) Misuse of lights and ceiling fans, that is not turning them off when not in use.
4) Using old appliances is probably one of the bigger reasons for high bills.
5) Device-charging frenzy is the new source distributing towards high electricity bills.

V. BENEFITS AFTER IMPLEMENTATION OF THE SYSTEM

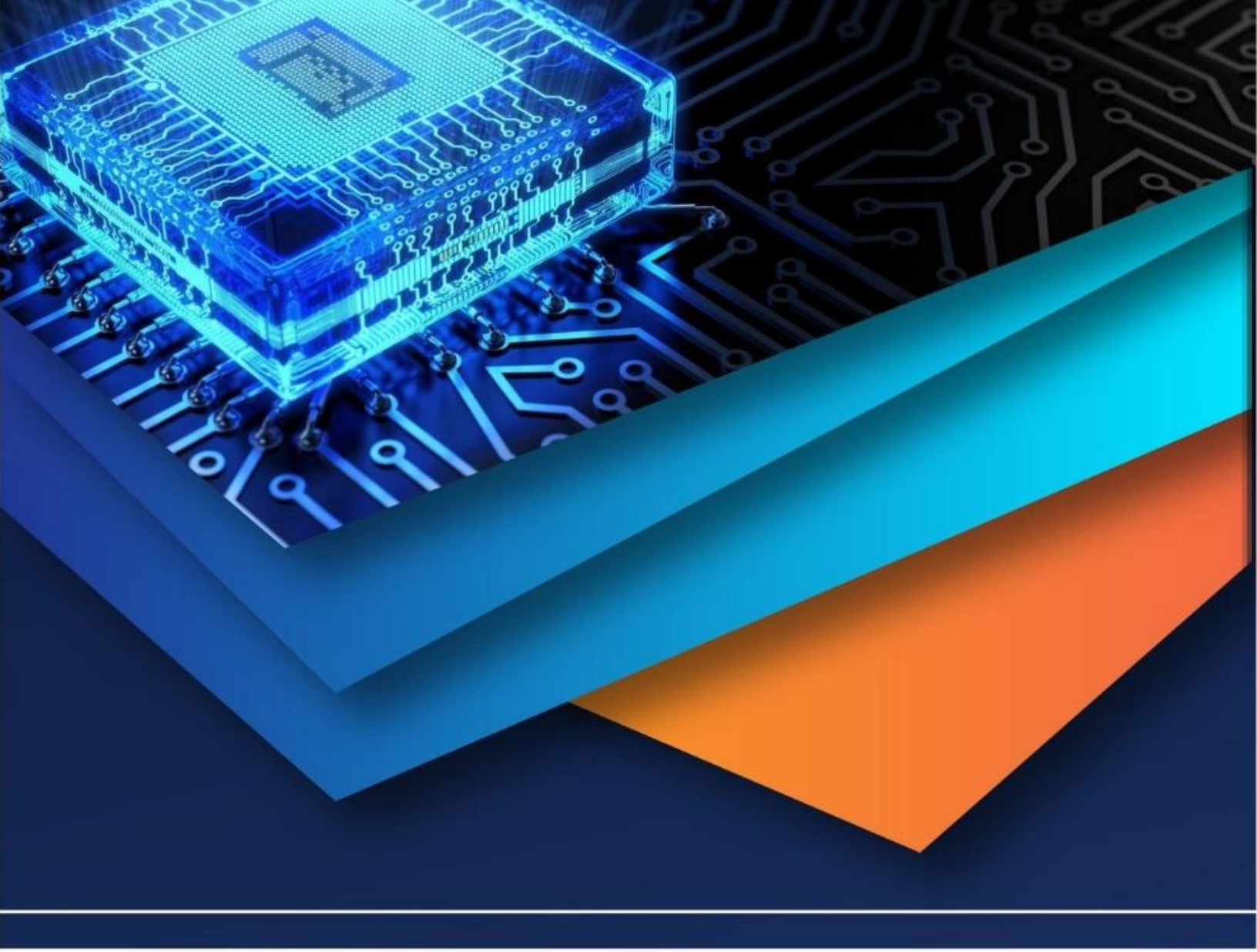
1) The IoT Based Energy Meter can record and measure the total energy consumption in small amount of time. By recording total energy at a small interval, this allows the utility to easily calculate the electricity bill.
2) The user will be able to set the limits for consumption. Beyond the limit of user will generate a warning to the user.

3) With the information in mobile, user can see immediately and adjust according to his/her need.
4) By making energy usage more easily understood, the consumer can make smarter decision to save energy and money.
5) The user can calculate his/her own bill according to their total energy consumption. So more accurate bill can be paid and no misunderstanding will be created between the consummer and electric supplier.
6) This system is much smaller than traditional system and also cost efficient to build.
7) With some further modification in the code of the Arduino, user can also obtain scientific data of the power supply like phase angle, power factor e.t.c.
8) This system can be easily modified by simply adding a relay in the system. Some additional code will allow the user to automate the system and have full control over the appliences so that they can turn OFF the applience if it left ON and vice versa from anywhere in the world.

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