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IoT Based Auto Control Electricity, Water Management System using Smart Energy Meters

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ABSTRACT

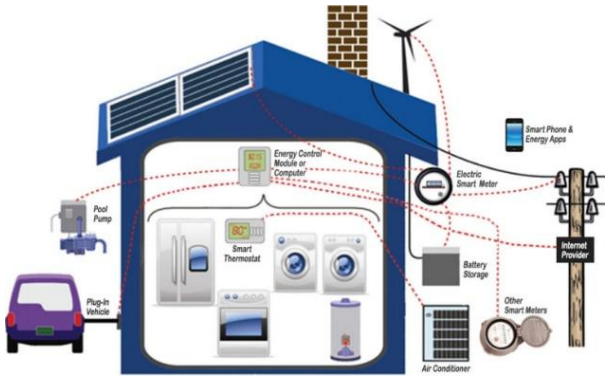
In recent years Smart Energy Meter Industries are realizing the benefits of smart meters to improve the efficiency and accuracy for utilization management. There are near about 15 million smart and advanced meters that are operating across homes and businesses in Great Britain, by large as well as small energy suppliers. It indicates10% increase in operating meters. Asian countries are placing themselves as the leaders in this space: they have a goal that by 2021, 75% of all homes in the region will be connected via smart meters. In this paper implementation of smart energy meter system using ESP, Arduino which can be used for calculate an amount the power utilized by any individual home appliances. These energy meters implemented using IoT devices. Smart Energy meter and in-home devices main intention of the proposed to monitor the power utilization at load, this information sent to the server and establish remote control of any appliance. At some points in a day, especially during peak hours, energy need to be borrowed from neighbouring states or the central pool, to manage the demand; or otherwise, load shedding need to be adopted.

1. Introduction

This high demand can be solved either by generating more power by installing power stations or by controlling the power usage at the consumer side. New power stations are not a feasible and viable solution. Major electrical wastages in house hold appliances can be considerably reduced with proper monitoring and control. Switching off fans, TV, lights etc. when not in use is a simple task which many fail to do[1]. Here an intelligent or smart meter is introducing, which can carefully monitor the usage pattern and reduce the load during peak hours and also saving electricity cost by 25-30%. The energy meter is connected with the GSM module and get updated units of energy consumed by consumer via Arduino and also turn on/off the appliances using IoT via switching mechanisms.

2. Smart Energy Meters

Smart energy meters are IoT based electricity meters[2]. These systems are wide range of smart functions and utilities by enhancing customer satisfaction with quick interaction.



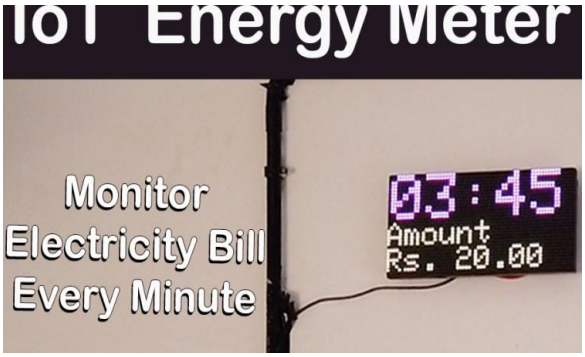


Fig1. Smart IoT based Energy meter

Fig. 1 shows IoT based Smart Energy is used by industries and home automation systems, agriculture systems[3].So many industries have ready to invest more than USD 70 billion for smart meter design. Previous meters are measures only total power consumption, whereas IoT based Energy meter is able to report update information of resources such as water, energy.

3. Hardware working description:

IoT based Smart Energy billing is an important part of energy supply. Previous energy meters it creates a problem, because the manual reading needs manpower, time consuming and may cause an error[4]. IoT based Smart Energy meter there is a lot of facilities of automatic reading of meter and also can detect the current theft by sending the information with the help of IOT technology. It also can detect the fault if occurs in the electric system overloading and warn

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the consumer of overload usage of electricity by sending the message[5].

This paper describes the IoT based Smart Energy system we replace the outdated meter by a metering module which consists low end processors which scans the energy meter automatically after every month and transmit billing to the consumer as shown in fig.2.

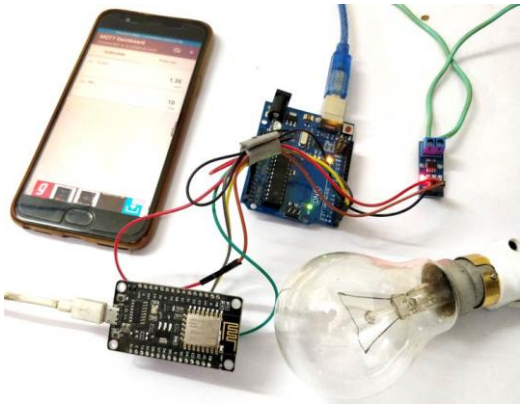


Fig.2. Circuit connection of smart energy system

In this microcontroller unit, LCD, sensors, current sensor and Voltage sensors are present. This stores data sends SMS to the consumer about the billing amount and maybe if any other activities happen in this proposed system such as tempering, overloading, fault etc. latest technology IOT is a source of communication B/W client and Web Server. IOT is the worldwide network for the data transfer over and the always online connection between main location and mobile devices[6]. The cost of transferring data is much lesser than the SMS. controller is interfaced with energy meter and ESP8266 which acts as the main controller. The Power supply is provided to energy meter and GSM, different modules are interfacing with controller. Data transfer to office MODEM using user MODEM. Each and every consumer has unique number provided by the authority[7].The Energy Cite LTD patent portfolio fully covers the system topology discussed above including dependent claims supporting electricity, gas & water, smart thermostats, smart phones, electric vehicle charging units, subscriber side billing, electronic funds transfer, utility billing, and smart meter to home automation & IoT interfacing.

3.1. Wi-Fi MODULE (ESP8266):

Wi-Fi stands for Wireless Fidelity. We are using Wi-Fi which plays important role in the IOT field. By using this Wi-Fi the client can vary in various verge values according to their requirement, also they can automatically ON/OFF using IoT technology smart energy meter. Every time in the last of the month the readings of the units and the cost are displayed on the webpage.

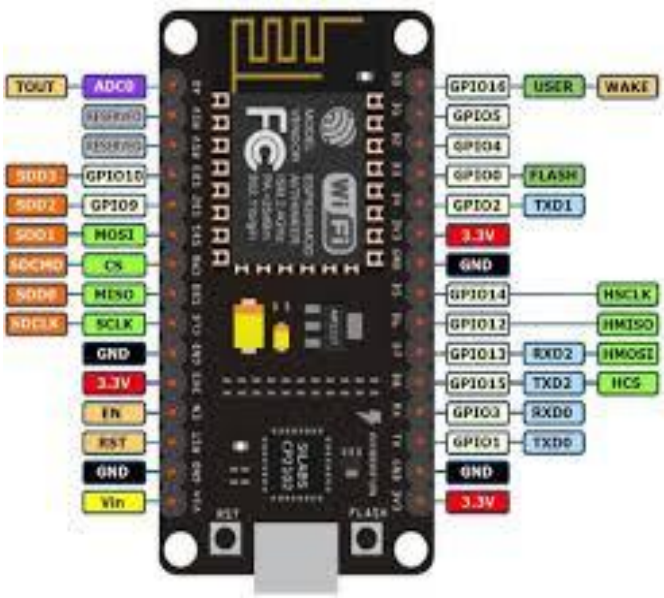


Fig.2.1 ESP8266

We will take help of **IFTTT** platform to link our Wi-Fi to SMS/E-mail notifications[8]. By using advanced light weight **MQTT protocol,** ubdots cloud is used to monitor our Energy uses.

3.2.Arduino Uno:

Fig.2.2 Arduino Uno

The Arduino Uno is a microcontrollerATmega328. It simply connect it to a system with a USB cable or powerDC adapter. It has 14 digital I/O pins 6 can be used as Pulse Width Modulation O/P's, 6 analogI/P's, with 16 MHz ceramic resonator, ICSP header and RESET button[9]. It differs from all other controller boards and not use for FTDI USB-to-serial driver chip.

3.3.Internet of Things:

IoT platform is an important building block for Smart Energy Meter infrastructure. Information is collected via a smart meter and transferred over WiFi. IoT platform information is collected by the individual measuring devices[10]. This information is received and continuously monitored by using ubdots clouds in smart phones. The complete system shows the security of any sensitive customer data.

Figure 3: IoT Technology

Fig.3 shows IoT Technology permits objects to be controlled remotely and direct integration of the physical world into computer-based systems. In this way we can improve accuracy, efficiency and financial benefit[11]. There is an main advantage is reduced human intervention. Each thing is uniquely identified through its embedded computing system but is able to interoperate within the existing internet infrastructure.

3.4. IoT core service

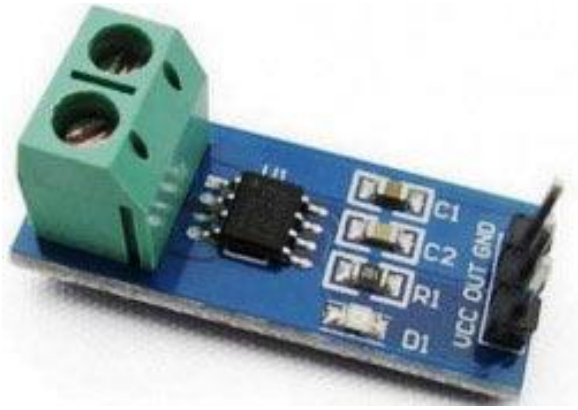
- Configuration of IoT core service
- On boarding of things in IoT core service
- Monitoring of communication between things and IoT core
- Creation of certificates for secured communication
- Define Rules and actions

3.5. ACS712 Current Sensor:

According **Hall-effect** principle, when a current carrying conductor is placed into a magnetic field, a voltage is generated across its edges perpendicular to the directions of both the current and the magnetic field. Let us not get too deep into the concept but, simply put we use 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[12]. This measured hall-voltage is proportional to the current that was flowing through the conductor.

The major advantage of using ACS712 Current Sensor is that is can measure both AC and DC current and it also provides isolation between the Load (AC/DC load) and Measuring Unit (Microcontroller part). As shown in the picture we have three pins on the module which are Vcc, Vout and Ground respectively.



Current Sensor Module ACS712-5A

We will be using the Analog pin of Arduino to read the output voltage (Vout) of the module, which will be 512(2500mV) when there is no current flowing through the wire[13]. This value will reduce as the current flows in negative direction and will increase as the current flows in positive direction. The below table will help you understand how the output voltage and ADC value varies based on the current flowing through the wire.

Analog Value	Vout(mV)	Current Thorugh the Wires (A)
1023	5000	13.51351351
800	3910.068426	7.621991493
700	3421.309873	4.980053367
512	2502.443793	0.013209691
300	1466.27566	-5.587699136
301	1471.163245	-5.561279755
0	0	-13.51351351

Directing a fault in distributing system can be done by communicating between the distribution system and consumer energy meter. If there is a supply in the transformer and no supply in the consumer's end it means that there is a fault between consumer and distribution transformer.

If the consumer is not aware of threshold notification, then meter gets off automatically after that consumer can increment the threshold value and meter will automatically turn on.

These values were calculated based on the information given in the Datasheet of ACS712. You can also calculate them using the below formulae:

Vout Voltage(mV) = (ADC Value/ 1023)*5000

Finally, the overall monthly bill with amount will be sent to the consumer as well as a service provider of text at first day of every month.

Current Through the Wire (A) = (Vout(mv)-2500)/185

4. Web Page (HTML):

By the use of HTML designing we can operate controller and smart Energy Meter. HTML basically stands for Hypertext Markup Language. It is a standard markup language which is used for creating web pages and web applications using Cascading Style Sheets (CSS) and JAVA scripts[14]. The web browser receives HTML documents from the corresponding Webserver or from local storage and renders them into the multimedia web pages. HTML describes the structure of web page originally and semantically and includes cues for the appearance of the documents and files.

Fig.4 shows **monitor our** *energy uses* **over the internet**, we have to use MQTT broker. Create Applet in IFTTT for Triggering SMS/Email for Energy Meter. Codes for Arduino and ESP12 Wi-Fi module.

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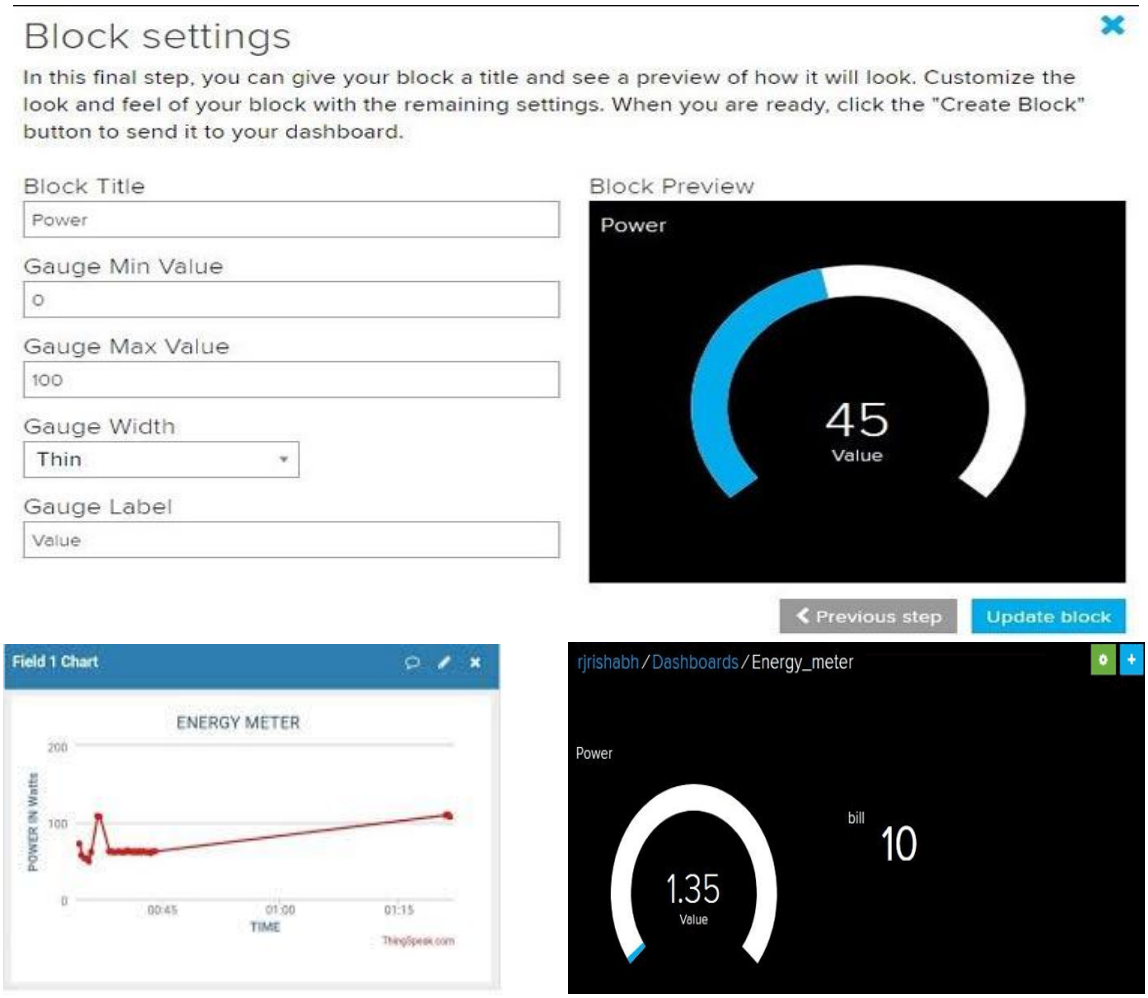

Fig.4. IoT based cloud information of Energy utilization

Advantages of end-to-end IoT solution for Metering:

- IoT based Smart Energy meters maintenance costs are reduced it gives a real-time information according utilization on energy consumption. This information is remotely monitoring through ubdots clouds. It notice malfunctions, leakages and alerts electrical failure. Limited data consumption and also secure the grid.

5. Features of Smart Energy Meter

By using IoT based Smart Energy meter we can monitor load consumption of consumer remotely through ubdots clouds. We can control the load remotely using web application. Also power Theft detects easily.

6. Conclusions

This IoT Based Smart Energy Meter is used to calculate the energy utilization of the household, and even make the energy unit reading to be easy and accurate. Hence it reduces the wastage of energy and brings awareness among all. Even it will deduct the manual intervention. IoT Based Smart Energy Meter is a propagated model, and is used to calculate the energy consumption of the household. Hence it reduces the wastage of energy and bring awareness among all. Even it will deduct the manual intervention.

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