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IOT Based Smart Energy Meter: Energy Theft System

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***Abstract* - IOT Based Smart Energy meter is a proposed system designed to eliminate human involvement in the electricity metering system. IOT (Internet of things) is the network of physical things with electronics software. sensors, and connectivity to enable objects to collect and exchange data. In the traditional method, a person from the electricity board stands in front of our house, whose job it is to rent the energy meter and hand over the bills to the owner of that house every month; this is nothing more than meter reading. The biggest disadvantage of this approach is that a person must go from area to area, reading the meters of each property and handing them the bills. Errors such as an excess bill amount or a notification from the power board even if the bills have been paid are typical. To address this flaw, we've devised a solution that eliminates the middleman between the customer and the service provider. Energy meters that are already installed in our homes are not replaced in this paper, but existing meters can be converted to smart meters with a small modification. The use of Wi-Fi Module enables us to see our energy consumption on website on daily basis. One can easily access the meter working through web page that we have designed.**

Keywords: Traditional method, Smart energy meter, Internet of things, Wi-fi module, Power theft.

I. INTRODUCTION

Today's world is offering us with multiple challenges that we have to deal with, Energy crisis is the main faced by our society. One answer to this problem is a suitable system to manage and monitor power usage and another way to deal with today's energy issue is to reduce residential power consumption. The current billing method makes it difficult for distribution companies to track the maximum amount of energy consumed by each user. Even if bills are paid on time, consumers face issues such as receiving late bills even when they have already been paid. All of these issues can be solved by keeping track of the consumer's load on a regular basis, which will allow for proper billing, tracking maximum demand, and detecting threshold values. All of these aspects must be considered when creating an effective energy billing system. The current project, "Internet of Things-Based Smart Energy Meter," tackles issues that customers and distribution firms face. The project is primarily concerned with the development of a smart energy meter that makes use of embedded system features, such as combination of hardware and software in order to implement desired functionality. This project proposes an integrated hardware and software to solution for wireless monitoring of energy consumption of the end user and also detects a theft in electricity system.

Cloud-based energy monitoring is cost-effective and provides a viable alternative for remote monitoring. The number of consumers is continually increasing, as is the pressure on power distribution divisions. The consumer must be facilitated by giving them an ideal solution that is the concept of IOT (Internet of Things) BASED ENERGY METER. Here the unit reading is uploaded to the website using a WeMo's DI mini based on ESP8266-12e (Wi-Fi Module). The highlight of our project is that it does not include any Arduino or Microcontroller. All the consumption is calculated by ESP8266 Wi-Fi Module. ESP8266 is high integration wireless SOC, designed for space and power constrained mobile platform designers. It provides unsurpassed ability to embed Wi-Fi capabilities within other systems, and to perform as a stand-alone application at the lowest possible cost and with the least amount of space requirement. 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 Wi-Fi Module that continuously monitor and records the energy meter reading in its memory.

II. BLOCK DIAGRAM & DESCRIPTION

The block diagram of an IOT-based smart energy meter includes five key components: an energy meter (Cal led), a current sensor, a led display, a WeMo's d1 mini, and a driver. The block diagram also includes a power supply and a load; the project's input power is 3.3 volts; here, 230 volts AC is converted to 3.3 volts DC.

2.1 Energy meter CAL (LED)

Cal Led is connected to We-MOs DI mini (Wi-Fi Module) through a optocoupler MCT2E. For signal conditioning the output from Cal led this optocoupler is used. This acts as interrupt to Wi-Fi module and Wi-Fi on the basis of interrupt Wi-Fi module increments the units consumed.

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2.2 Current Sensor (ac712)

It used for sensing current for theft detection and this is connected to analog pin of Wi-Fi module through a voltage divider circuit.

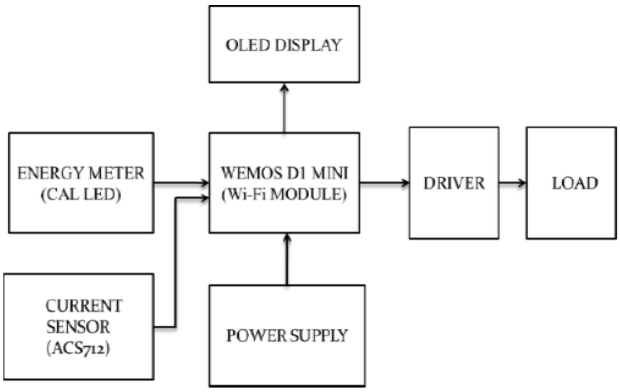

Figure: 1 Block Diagram

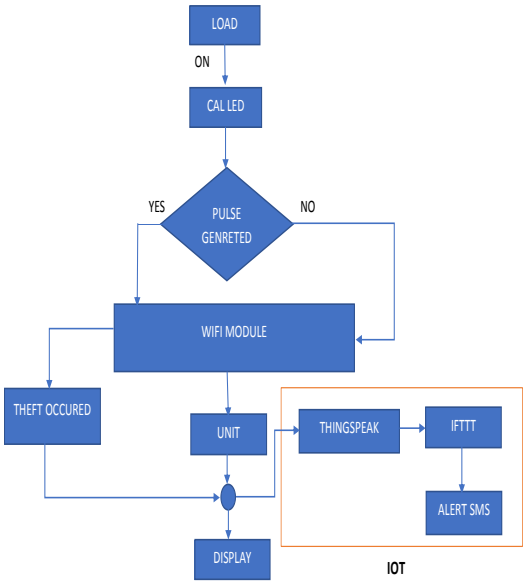

Figure 2: Flow Chart

2.3 We Mos DI mini (Wi-Fi Module)

This is the heart of the project and calculates the units consumed and sends the data to the website as well display it on the OLED display.

2.4 OLED display

It is used to display the units consumed and also display if theft is detected or not.

2.5 Driver

It consists of Triac driver Optocoupler and a triac. This circuit is used to drive the load.

III. FLOW CHART

The IOT-based smart energy meter has an integrated hardware and software part. This project has six stages, including the one that is IoT. It begins with load and concludes with displaying. When the load is turned on, the Cal led generates a pulse, which is transmitted to the Wi-Fi module. It has two consequences.

If a pulse is generated, the unit will be displayed on the Users can track the unit's usage on the OLED display as well as on the Thing Speak website in the form of a graph. If no pulse is formed, the Wi-Fi module will detect power theft and display it on the OLED display as well as the Thing speak website.

IV. SOFTWARE

The software involved in the IOT-based smart energy meter project includes Proteus for schematics, Arduino IDE for writing and uploading programming to Hardware part, and IOT, which includes Thing speak and IFTTT.

4.1 Schematic

The schematic shows a microcontroller with built-in Wi-Fi, or a Wi-Fi module interface, that runs on 3.3 volts and can be programmed through serial port. It is the project's heart, and it calculates the number of units consumed, sends the information to the website, and displays it on the OLED display.

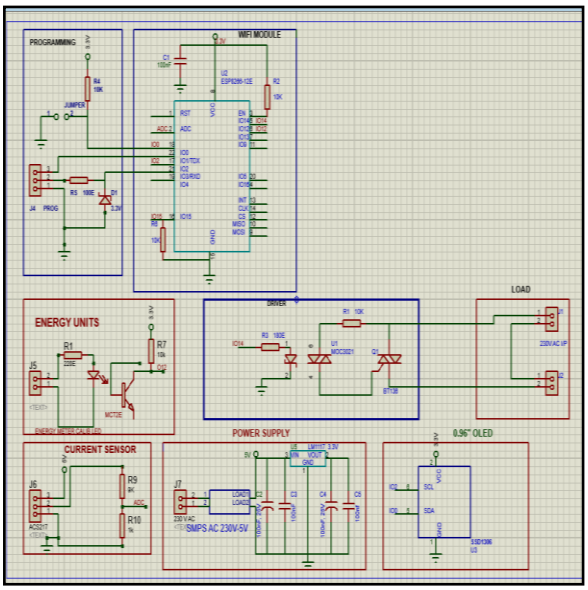

Figure 3: Schematic

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This energy meter shows how much energy is being consumed. It is connected to the controller via an MCT2E optocoupler, which is used to signal condition the output from the Cad Led. This operates as an interrupt to the Wi-Fi-module, and the units consumed are increased as a result of the interrupt. A current sensor is used to detect power theft, and it is connected to an analog pin via a potential divider network because the maximum voltage is low. The organic LED, also known as an OLED, is used to display power and is controlled by the driver. It is made up of a triac driver and a triac. The system's input voltage is 230 volts, which is converted to 5 volts by an SMPS and regulated to 3.3 volts by a regulator.

4.2 Arduino IDE

The open-source Arduino Software (IDE) simplifies the process of writing code and uploading it to the board. This software is compatible with any Arduino board. The Arduino Integrated Development Environment (IDE), also known as the Arduino Software, includes a text editor for writing code, a message box, a text console, a toolbar with buttons for basic functions, and a series of menus. It communicates with and uploads programmes to the Arduino hardware.

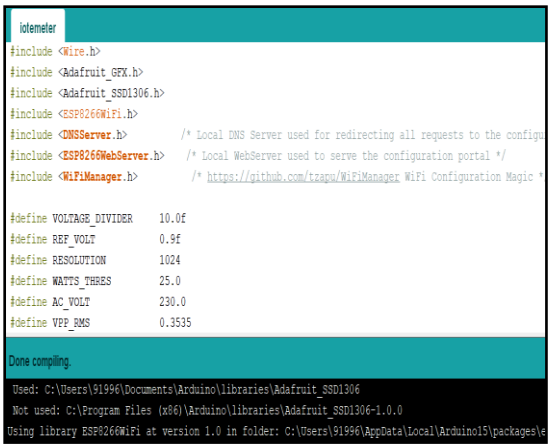

Figure 4: Ardunio IDE

The Arduino IDE is software that runs on your computer and allows you to build sketches (Arduino jargon for programs) for a variety of Arduino boards. The Arduino programming language is built on processing, a very simple hardware programming language that is similar to the C language. The sketch should be uploaded to the Arduino board for execution after it has been written in the Arduino IDE.

4.3 IOT

The Internet of Things (IoT) is a network of physical objects "things" embedded with sensors, software, and other technologies to connect and exchange data with other devices and systems over the internet.

4.3.1 Thingspeak

ThingSpeak is an open-source Ruby application that allows users to communicate with internet-connected devices. By exposing an API to both devices and social network websites, it improves data access, retrieval, and logging. In ThingSpeak, we have established two channels, one of which will show the consumer's unit consumption and the other will reveal the theft data if theft is identified in the energy meter. In addition, we formed a new request for Thing HTTP that is coupled to ifttt to trigger notifications.

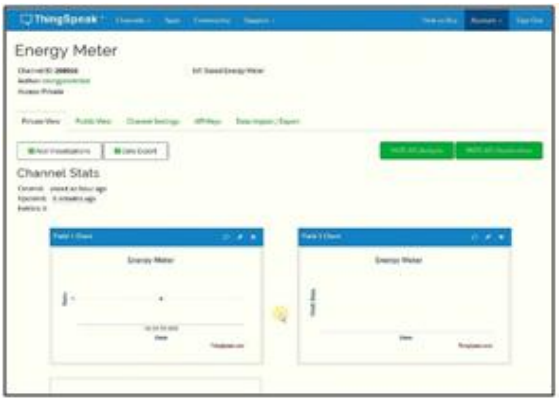

Figure 5: Thingspeak website

4.3.2 IFTTT

IFTTT offers agreements with a variety of service providers who deliver event notifications to IFTTT and run commands to perform the responses. Public APIs are used by some event and command interfaces an applet's triggers are the "this" part. They are the items that cause the activity to occur. An applet's actions are the "that" part of it. They're the things that come out of the trigger's input.

Figure 6: IFTTT

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We designed an IFTTT Applet (if this, then that) for our project. As a webhook, "this" has been inserted. The webhook might include information about the sort of event as well as a shared secret or digital signature to verify the webhook, and the "that" part is made up of SMS. The web service IFTTT makes it simple to send push notifications to any mobile device. This can be used to connect a web request made to a certain URL to a companion app installed on a mobile device.

V. OBSERVATION & RESULT

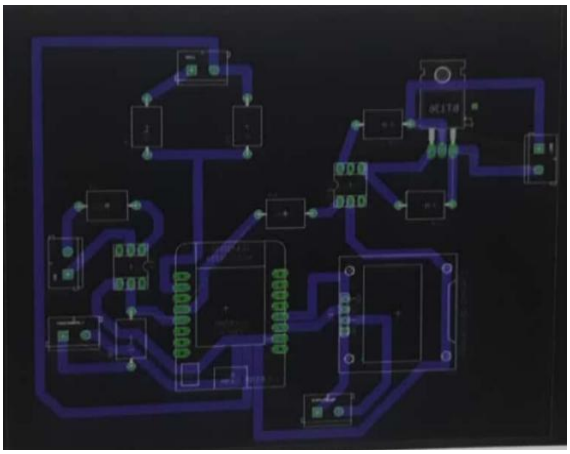

Figure 7: PCB Layout

This is our final layout of PCB designed on Proteus 8 professional.

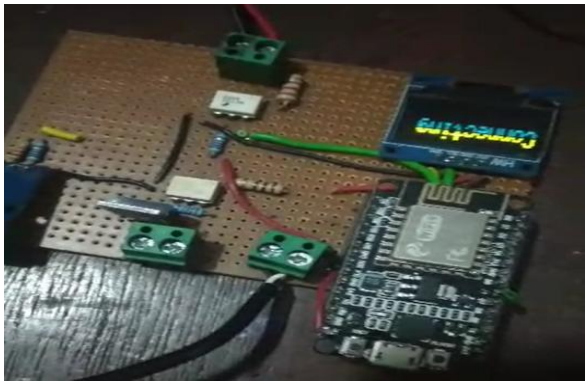

Figure 8: Design of the hardware

We have showed the design of the hardware part in this paper. We have soldered the pcb and have connected wifi module to the oled display along with other components. When we provide power supply to the wifi module at that time it gets connected to the OLED display and hence the display of connectivity is shown. The routers present in our houses are connected to the Wifi module for easy working of the smart energy meter. And this overall process is displayed on the OLED display.

Figure 9: Energy consumed by meter display on OLED

When the load is turn on then the energy consumed is directly shown on the energy meter leading to generation of pulses due to which CAL LED starts to blink continuously.

Whereas, 1 blink of CAL LED= 1KW hrs.
Hence, The overall data is displayed on OLED display. And the above image shows the overall energy/units consumption.

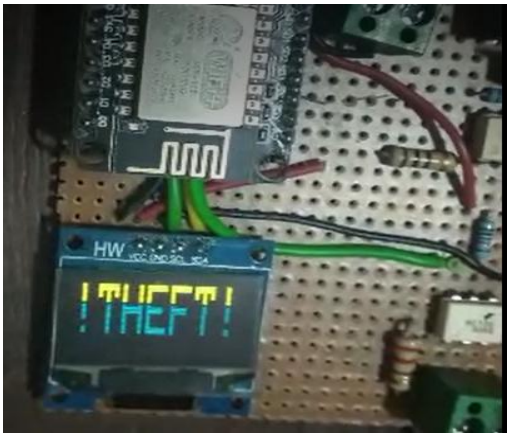

Figure 10:Theft Detected on system

When we turn on the theft mode at that time energy is consumed yet is not shown on the energy meter by not generating the pulses which are helped to track the units after threshold time theft is detected.

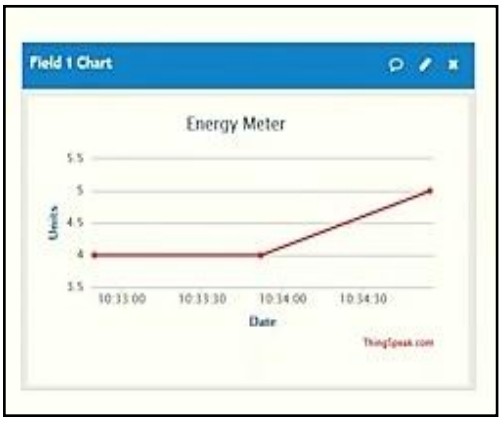

Figure 11: Display Units on cloud

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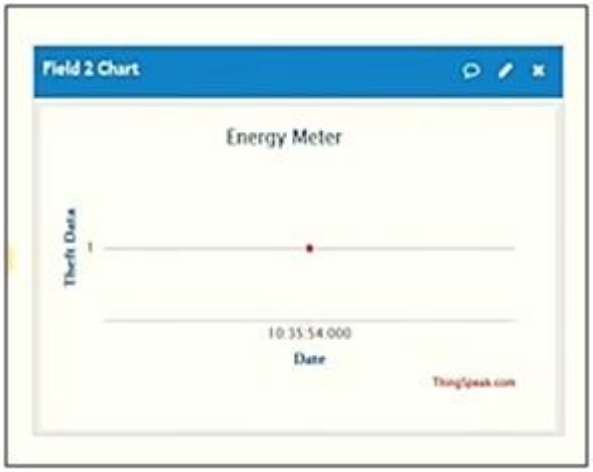

Figure 12: Display theft data on cloud

This is an overview of the specific output that is expected from the Thingspeak website. When the application is open, it will display two channels, one of which causes a disruption in the graph if any theft is detected, and the other which continuously monitors the units consumed by the consumer.

The image above shows how the theft detection and unit consumed by consumers would be displayed after the implementation in the Thingspeak website.

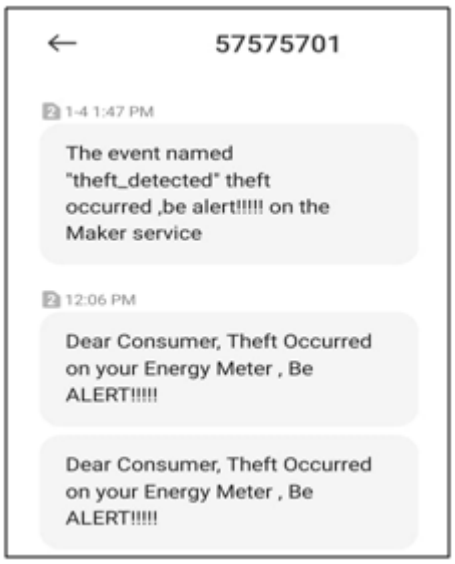

Figure 13: output of an IFTTT

Figure 13 shows the Snapshot of the output of an IFTTT applet that sent an SMS alert to a phone when theft has been detected in an energy meter.

VI. CONCLUSION

An IoT-based smart energy meter is a cutting-edge internet of things application that allows you to operate your home appliances from anywhere in the globe via the cloud. The proposed project employs a current sensor to detect theft and display it on the internet via IOT. The system uses the public cloud THINGSPEAK to update the information on the internet every one to two seconds. In the current system, WiFi assists with energy load consumption, allowing consumers to avoid unnecessary electricity use. It is possible to create an IOT system that allows users to monitor their energy consumption and pay their bills online. A system where a user can receive SMS when a theft is detected is also available. We can also forecast future energy consumption using cloud analytics. Smart technology will be utilised to simplify billing rather than replace existing energy metres.

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REFERENCES

[1] R. Pereira, J. Figueredo, R. Melicio, V.M.F. Mendes,J. Martins and J. C. Quadrado, "Consumer energy management system with integration of smart Meters", Energy Reports, vol. 1, pp. 22-29, 2015.

[2] J. Jose K, L. Mohan, U K Nijeesh and T. C. Benny, "Smart energy meter", International Journal of Engineering Trends and Technology (IJETT), vol. 22, no. 4, pp. 179-182, 2015.Kurde and V. S.

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[3] A.Kulkarni, "IOT Based Smart Power Metering", International Journal of Scientific and Research Publications, vol. 6, no. 9, pp. 411-415, 2016
[4] Al-Sakib Khan Pathan, The State of the Art in Intrusion Prevention and Detection, USA:CRC Press, Taylor & Francis, 2016.
[5] M. Rawte, S. Sharma and P. Lalwani, "Smart Prepaid Energy Meter based on Internet of Things", International Journal of Computer Applications, vol. 171, no. 2, pp. 23-26, 2017.
[6] B. K. Sahani, T. Ravi, A. Tamboli and R. Pisal, "IoT Based Smart Energy Meter", International Research Journal of Engineering and Technology (IRJET), vol. 04, no. 04, pp. 96-102, 2017.
[7] B. K. Sahani, T. Ravi, A. Tamboli and R. Pisal, "IoT Based Smart Energy Meter", International Research Journal of Engineering and Technology (IRJET), vol. 04, no. 04, pp. 96-102, 2017.
[8] J. Every, L. Li and D. G. Dorrell, "Leveraging smart meter data for economic optimization of residential photovoltaics under existing tariff structures and incentive schemes", Appl. Energy, vol. 201, pp. 158-173, 2017.
[9] H. March, A.-F. Morote, A.-M. Rico and D. Saui, "Household smart water metering in Spain: Insights from the experience of remote meter reading in alicante", Sustainability, vol. 9, pp. 1-18, 2017.
[10] Hao-wei Yao, Xiao-wei Wang, Lu-sen Wu, Dan Jiang, Teng Luo and Dong Liang, "Prediction method for Smart Meter Life Based on Big Data", Procedia Engineering, vol. 211, pp. 1111-1114, 2018.

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