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A study on development of Smart Electricity Meter based on IoT by using NODEMCU

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Abstract: Internet of things has taken the world to the next level with its principle of internetworking of physical devices. Automation is the key concept behind IoT (Internet of Things). A smart electricity meter designed on the basis of IoT features reduces the involvement of manpower in electricity invoice generation. It primarily increases the accuracy in invoice generation which in-turn boosts country's economy. Smart electricity meter is designed in such a way that it overcomes all the possible miscellaneous techniques of meter tampering. A remote enabled energy consumption indicator will always solve the problem of energy crisis existing in the world. A NODEMCU is used as an interface unit between existing electricity meter and end user to establish connectivity. This paper presents a comprehensive study of smart electricity meter and their utilization focusing on key aspects of metering process, different consumer interests, and the technologies used to satisfy consumer interest. Furthermore this paper highlights the challenges raised due to tampering of electricity meter and a way to resolve them.

Keywords: NODEMCU, MQTT, I.R.SENSOR, Hall Effect Sensor.

I. INTRODUCTION

The IoT allows objects to be sensed or controlled remotely across existing network infrastructure, creating opportunities for more direct integration of the physical world into computer-based systems, and resulting in improved efficiency, accuracy and economic benefit in addition to reduced human intervention. When IoT is augmented with sensors and actuators, the technology becomes an instance of the more general class of cyber-physical system, which also encompasses technologies such as smart grids, virtual power plants, smart homes and smart cities. Each thing is uniquely identified through its embedded computing system but is able to interoperate within the existing internet infrastructure. People also want to communicate with all non-living things through internet such as home appliances, furniture's, stationeries, cloths etc. The people already have a lot of technologies to interact with living things but IoT enables to communicate with non-living things with comfort manner and is a convergence of several technologies like ubiquitous, pervasive computing, Ambient Intelligence, Sensors, Actuators, Communications technologies, Internet Technologies, Embedded systems etc. We have quite seen that in our country, electricity billing system includes a lot of human intervention. In current scenario, meter readers manually take the meter reading by going home-to-home and note down it and electricity bills are generated. This scenario consumes a lot of time and energy. Electricity-stealing is an another major problem, however, each power supply department has made huge investments of manpower and material, but still electricity stealing methods are improved day by day. This improvised model solves these limitations using the concept of IoT and newly developed sensors [1][2].

II. EXISTING MODEL

A. Currently, the electricity meter's reading are being noted from door to door. This has been a time consuming process it has also lead to decrease in efficiency of readings and increase in costs. Though there might be loss in lot of jobs but the accuracy in readings can increase the economy which can in turn create lot of jobs.

B. PROPOSED MODEL

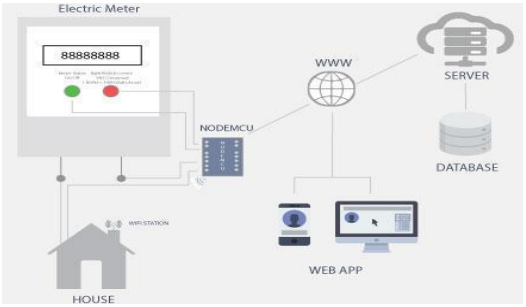

Fig 1- Architecture of Smart Energy meter based on internet of things

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NODEMCU

NODEMCU is a Lua based ESP8266-E12 Wi-Fi SOC (System on Chip) module used commonly for the implementation of internet of things. It has 16 GPIO (General Purpose Input Output) and works on 3.3v. The term "NodeMCU" by default refers to the firmware rather than the dev kits. The firmware uses the Lua scripting language.

Fig 2- NODEMCU

MQTT

MQTT (Message Queue Telemetry Transport) is a binary client-server publish/subscribe messaging transport protocol, standardized by OASIS. It is lightweight, open, simple, and easy to implement. Designed with a minimal protocol overhead, this protocol is a good choice for a variety of Machine-to-Machine (M2M) and Internet of Things applications, especially where a small code footprint is required and/or network bandwidth is at a premium. MQTT utilizes many characteristics of the TCP transport, so the minimum requirement for using MQTT is a working TCP stack, which is now available for even the smallest microcontrollers**.**

I.R SENSOR

An infrared sensor is an electronic device that emits in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. These types of sensors measures only infrared radiation, rather than emitting it which is called as a passive IR sensor . Usually in the infrared spectrum, all the objects radiate some form of thermal radiations. These types of radiations are invisible to our eyes, that can be detected by an infrared sensor. The emitter is simply an IR LED (Light Emitting Diode) and the detector is simply an IR photodiode which is sensitive to IR light of the same wavelength as that emitted by the IR LED. When IR light falls on the photodiode. The resistances and these output voltages, change in proportion to the magnitude of the IR light received.

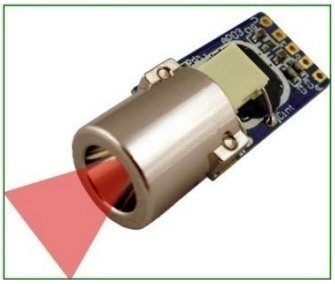

Fig 3- I.R sensor

HALL EFFECT SENSOR

Magnetic sensors are designed to respond to a wide range of positive and negative magnetic fields in a variety of different applications and one type of magnet sensor whose output signal is a function of magnetic field density around it is called the **Hall Effect Sensors.**

Hall Effect Sensors are devices which are activated by an external magnetic field. We know that a magnetic field has two important characteristics flux density, (B) and polarity (North and South Poles). The output signal from a Hall Effect sensor is the function of magnetic field density around the device. When the magnetic flux density around the sensor exceeds a certain pre-set threshold, the sensor detects it and generates an output voltage called the Hall Voltage V_H**.**

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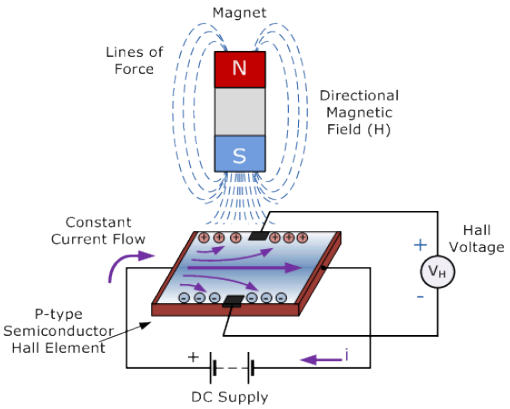

Fig 4- Hall Effect Sensor

III. WORKING PROCEDURE

The working of this model is primarily based on three elements that have been attached to the existing model to improvise its functioning. The two elements used to improvise the existing model are NODEMCU, Hall Effect sensor. This meter will be connected to NODEMCU (A System on Chip Wi-Fi module). This NODEMCU will be connected to local Wi-Fi access point. Every NODEMCU will have a unique identification number, at the time of installation of this device, staff of the electricity provider will assign this device identity to user of the meter. This device will measure the electricity units on the blinking pulse rate of the LED of the meter and only allow the electricity to pass through if balance of that device is not zero. This device will be connected to a server through MQTT protocol (Message Query Telemetry Protocol). NODEMCU will be programmed such that it will send usage hourly to the server. Server will store all the incoming messages in database. This device will be connected to the electric meter via a circuit that will connect a GPIO pin of this device to the kwh pulse LED. Usage of electricity will be calculated on the basis of the KWH PULSE LED blinking. Each 1000 times a LED blinks 1 unit of electricity will be added to the usage and cost of that 1 unit will be deducted from the device, which will be updated onto the server in real time with the help of MQTT protocol. In order to have successfully transition of data working internet connectivity is required via Wi-Fi access point. If no internet connection is available at the time of operation data will be stored locally and will transmit the data whenever internet connection will be available[3][5]. Due to recent development in tampering techniques, a smart meter's design is complemented with Hall Effect sensor. At present an electricity meter can be more vitally tampered in two ways which are:-

1) Physical tampering includes trying to break the case, inserting metal objects to prevent measurement [4].
2) Magnetic interference is the most common and easiest way to tamper with a meter. Typical sources of magnetic interference are powerful magnets and strong ac fields. Magnetic core-based components in meters such as CTs and transformer-based power supplies saturate in such conditions, resulting in a complete shutdown of metering.

Physical tampering can be eliminated by using I.R sensor. It detects the approaching objects and human beings from the thermal radiations that they emit and give an immediate protocol to the corresponding electricity board section.
Magnetic tampering can be eliminated by using Hall Effect sensor connected to NODEMCU which can detect the magnetic field present around it. It is mainly programmed to some threshold level if magnetic field exceeds it, data detailing about tampering will be transmitted to server station.

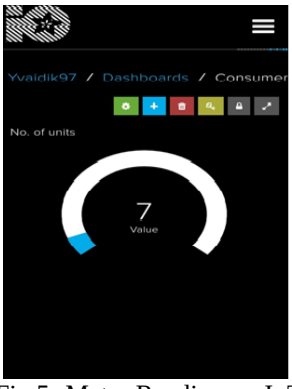

Fig 5- Meter Reading on IoT Application(platform).

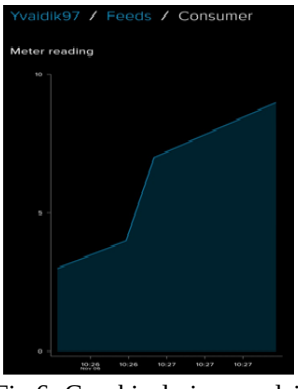

Fig 6- Graphical view on daily Consumption of Electricity.

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IV. CONCLUSION

With the increasing dependencies over electricity and internet, smart energy meter can be developed. This smart energy meters can solve many problems such as over usage of electricity, large amount of manpower transparency of usage and wastage of money and resources, tampering etc. This technology allows verified customers to check status of electricity usage by using Device identification number and password in real time.The smart energy meter is high in accuracy and low in cost. A design aimed to meet the need of a nation which always play a vital role in its development**.**

REFERENCES

1. Praveen Vadda, Sreerama Murthy Seelam.”Smart Metering for Smart Electricity Consumption”. (May 2013)
2. Tufail Azfar, Naeem Hummayoun. "Advance enegy meter for smart metering system: an operational perspective” IOSR journal of Electrical and Electronic Engineering. (June 2016).
3. Mayur rawte, shrishti Sharma, Praveen lalwani “ Smart Prepaid Energy Meter based on Internet of Things” *International Journal of Computer Applications (0975 – 8887) Volume 171 – No.2, August 2017.*
4. Birendrakumar Sahani, Tejashree Ravi, Akibjaved Tamboli , Ranjeet Pisal “ IoT Based Smart Energy Meter” International Research Journal of Engineering and Technology (IRJET) Volume: 04 Issue: 04 , Apr -2017.
5. DamindaAlahakoon and Xinghuo Yu. “Smart Electricity Meter Data Intelligence for Future Energy Systems: A Survey”. (January 2015) in IEEE.