A REVIEW ON IOT BASED SMART ELECTRICITY ENERGY METER

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Abstract: ***This Review focus on the design and implementation of IoT based smart electricity energy meter. This design can be eliminate the man power involvement to maintain the electricity. The consumers of electricity need to pay as per the utilization of electricity on schedule, somehow consumers fail to pay, the transmission of electricity can be turned off from the distant server automatically. Energy meter provides provision to the consumers that they can monitor the energy consumption in units by using web page providing device IP address. Energy meter consists theft detection unit will notify company side in the event of meter tempering or theft practice occur in energy meter and also it will send information regarding theft detection by using PLC modem and the theft detected will be displayed on the terminal screen or window of the company side. IoT operation can be performed by Wi-Fi device which sending energy meter data to the web page through the IP address. This smart electricity energy meter consists Microcontroller, LCD display, theft detection unit, MAX232, Triac switch circuit, temperature sensor, PLC modem and Wi-Fi module.***
Keywords : IoT(Internet of Things), Microcontroller, LCD display, theft detection unit, MAX232, Triac switch circuit, temperature sensor, PLC modem and Wi-Fi module.

I. INTRODUCTION

In the current scenario, the world facing crisis of energy. The effective solution of this burning problem is to monitor and control the usage of the power. One effort is to fight against this energy or power crisis is to save the power or reduction of the power usage in home appliances. On the power system the numbers of consumers are increasing rapidly day by day indirectly we can say the burden on the power system in increasing. The solution of this problem is provide ideal solution at consumer end. Now a days we have concept regarding this is IoT (Internet of Things) based smart energy meter which works smartly in the sense that it can provide other services like information about electricity theft by employing theft detection unit and PLC modem. In this paper author tried to give the idea regarding the IoT based smart energy meter, construction, circuit diagram, and implementation of smart energy meter with the help of PLC modem and IoT. Here we used word smart energy meter the reason is that the energy meter not only measure the consumption of the energy by consumer but also provide some smart function such as consumer can see or monitor the energy consumption in MWh on its display window. This display from a webpage providing device IP address.The authorized fellow of the supplier company get information when tampering occurring in the energy meter, for this facility there is theft detection unit or module connected with energy meter. To transfer the information regarding theft and tempering of energy meter used PLC modem and the indication theft will be displayed on the window on the supplier end.

II. CONCEPT AND DESIGN

The concept of Internet of Things (IoT) from it initial stage changing the current Internet into well featured upcoming internet. At present there are billions of gadgets (approximately nine billions) interconnected gadgets and one prediction is that it will reach upto fifty billions gadgets in 2020.

The IoT based smart energy meter comprises mainly 4 modules (units).

1. Micro controller unit
2. Theft detection unit
3. PLC modem unit
4. Wi-Fi unit

In the design of this smart electricity energy meter we have used three microcontrollers, two microcontrollers are deploy at the consumer end for the purpose of theft detection and IoT and one microcontroller is installed at the supplier end for the PLC modem communication. In the current scenario the need is to access the characteristic of device remotely but in a reliable manner. To achieve the characteristic of device remotely we need to connect a device (here energy meter) to internet by providing IP address to it. In this paper we have concentrated on the theft detection, optimum utilization of power and convey the energy consumption information to the use end. We can see in the block diagram as shown in figure-1, the IoT based smart electricity energy meter at consumer end consist the AC power line (single phase 2 wire) , PLC communication modem, theft detection unit and Wi-Fi unit. We can see in the block diagram as shown in figure-2, the supplier end consists the AC power line (single phase 2 wire), PLC communication modem, microcontroller, and personal computer.

III. PROCESS AT CONSUMER END

At the consumer end, power supply unit supply the power to all those component which requires power. Microcontroller acquire the relevant information from the electricity energy meter and also perform the control process and sends the required information such as number of units consumed with the help of Wi-Fi unit. The purpose of LCD module is to get visual information about the number of units, temperature and Wi-Fi configuration.

IV. PROCESS AT SUPPLIER END

At the supplier end, if any theft is detected the PLC acts as a modem and it sends the necessary command. If consumer fails to pay the electricity bill amount within the time limit mentioned by the supplier the disconnection and reconnection can also done by sending the appropriate command to the controller. Indirectly we can say that it eliminates the need of physically disconnection and reconnection of power line.

V. COMPARISON BETWEEN EXISTING ELECTRICITY ENERGY METERING METHOD AND SMART ELECTRICITY ENERGY METERING METHOD

(a) Existing Electricity Energy Metering Method :-

As we know in our country the electricity energy billing duration is either end of one month or end of two months. During the month electricity consumer cannot how much power consumed, they can know at the end of one or two months when the bill issue. The major drawback of this method is use cannot manage the power consumption. Another disadvantage of this system is tempering with energy meter can be done easily and such practices are happening and increasing rapidly which is one of the major cause of power crises.

(b) Smart Electricity Energy Metering Method :-

In this method we tries to eliminate the drawback and limitations of existing electricity energy metering method. In this method there is a provision for the consumer that they can see their power consumption time to time so they have an opportunity to manage the power consumption as they desire. This method is not only provide the facility to consumer end but also it is more helpful to supplier end also. If the consumer fails to pay their electricity billed amount within the time period mentioned by the supplier, the supplier can be disconnect the power automatically from the distant end. This system eliminate the physical disconnection procedure at consumer site so it will be helpful to avoid conflict between consumer and supplier at the time of disconnection. This system can also provide the facility of the reconnection of the power from the distant end. Another major advantage of this system is that it provides the information at the event meter tempering and power theft. Such information will be very useful to control the practices of power theft and reduce the power crises.

VI. DESCRIPTION OF DIFFERENT CIRCUITS AND UNITS

The IoT based electricity energy meter used the following circuits at consumer end and at supplier end as per their requirements.

1.Triac Switch Circuit for Load
2.Theft Detection Circuit
3.PLC modem unit
4.Wi-Fi unit

In this paper we tried to give brief idea and implementation of the above circuits and units.

1.Triac Switch Circuit for Load :-

TtheTriac Switch Circuit for load which consists zero crossing detector to turn on and turn off the triac switch. As shown in figure this triac switch is connected in parallel to snubber circuit. Snubber circuit which comprises R and C (RC) to protect the triac by avoiding the inrush current and by limiting the rate of rise of dv/dt.Snubber circuit also prevent the transient voltage appear as a consequence of alternating current line noises. In the snubber circuit one should be kept in mind that we need to keep the value of resistance R is minimum which will be helpful to limit the stress experience by triac and also increase the ability of triac to sustain against the fast voltage transients.

2.Theft Detection Circuit :-

Figure-1 shows the meter configuration for theft detection. We can see it consists two circuits one is for theft unit and the other is for normal unit. The theft detection circuit used PN junction diode, opto coupler, transistor and relay. Diode is connected to opto coupler. R9 and R10 are current limiting resistors. Freewheeling diodes (D5 and D6) are used for avoiding the inrush current and capacitor is connected in parallel to freewheeling diode to block the AC. To identify the event of theft relay output is connected to the microcontroller.

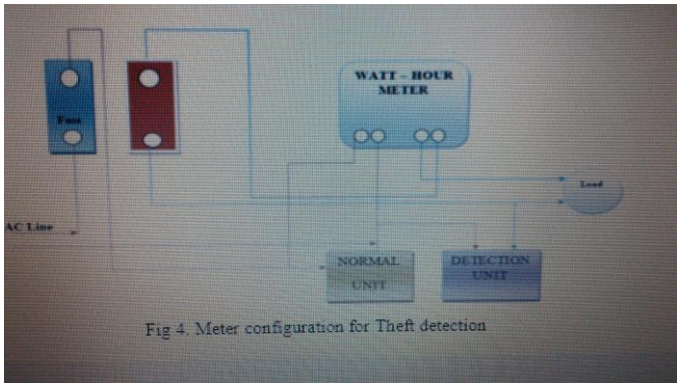

Figure-1 (Meter Configuration for Theft Detection)

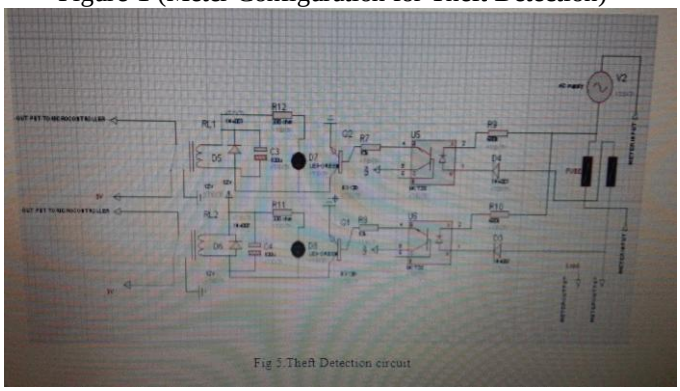

Figure-2 (Theft Detection Circuit)

Theft detection can be done easily by using the following truth table:-

Truth table for theft detection

Theft detection unit	Normal Unit	Status
OFF	OFF	NORMAL
ON	ON	NORMAL
OFF	ON	NORMAL

ON	OFF	THEFT DETECT

3. PLC(Power Line Communication) modem unit :-
In this system the function of power line communication (PLC) modem unit is to sending and receiving serial data through AC power line which is already existed. Here AC power line used because it is already existed and it can withstand in bad weather condition also. It consists certain advantages like this PLC module is available for ready to use, in built error checking ability, small in size, easily interface with microcontroller, remarkable sending and receiving serial data baud rate.

4. Wi-Fi unit :-
Microcontroller perform the control operation and whatever necessary data collected by microcontroller from the energy meter such as number of units are send through Wi-Fi unit.

VII. EXECUTION OF SYSTEM

1.Execution at consumer's end :-
In this proposed system consists three three 8 bits micro controllers. Two micro controllers are installed at consumer's end for the theft detection, PLC communication and IoT operations. This proposed system are basically used for theft detection, power optimization and energy consumption informations to the users. Users can monitor the energy consumption by using web page provided by device IP address. Theft detection unit connected to energy meter give notice to supplier's authorized person whenever meter tempering or electricity theft occurs. This is done by PLC modem and theft detection will be displayed on the terminal screen.

2. Execution at supplier's end :-
The configuration at supplier's end execution of system which consists micro controller, PLC modem for communication between user and supplier.

VIII. ADVANTAGES OF SMART ELECTRICITY ENERGY METER

- It provides telemetering service and eliminate the man power requirement for metering.
- It can reduce revenue loss to supplier company by controlling theft detection.
- It makes easy to access information of energy consumption from energy meter through IoT.
- It provides disconnection of service to consumers from remote.
- It provides LCD display energy consumption.

IX. CONCLUSION

In this proposed system smart energy meter is designed to get telemetering , theft detection and supplier can disconnect service to the consumers in the event of meter tempering or un authorized use of electricity. It eliminates the man power required for meter reading. It saves time for meter reading and prevent mistakes upto some extent.

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