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Smart Energy Metering based on IoT and Pocket Picking using Arduino and GSM

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Abstract - *Here the idea of smart energy meter using IoT and Arduino have been introduced. In this method we are using Arduino because it is energy efficient i.e. it consume less power, it is fastest and has two UARTS. Energy meter which is already installed at our houses are not replaced, but a small modification on the already installed meters can change the existing meters into smart meters. The use of GSM module provides a feature of notification through SMS. One can easily access the meter working through web page that we designed. Current reading with cost can be seen on web page. Automatic ON & OFF of meter is possible. Threshold value setting and sending of notification is the additional task that we are performing.*

Energy theft is a very common problem in countries like India where consumers of energy are increasing consistently as the population increases. Utilities in electricity system are destroying the amounts of revenue each year due to energy theft.

Key Words: *Smart Energy Meter, Pocket Picking, Electric board, UARTS, IoT, GSM, Wi-Fi, webpage.*

1. INTRODUCTION

"IoT Based Smart Energy Meter and Pocket Picking using Arduino" addresses the problems faced by both the consumers and the distribution companies. It deals with smart energy meter, which utilizes the features of embedded systems i.e. combination of hardware and software in order to implement desired functionality. With the use of GSM modem the consumer as well as service provider will get the used energy reading with the respective amount, Consumers will even get notification in the form text through GSM when they are about to reach their threshold value, that they have set. Also with the help of Wi-Fi modem the consumer can monitor his consumed reading and can set the threshold value through webpage.

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 Arduino unit that continuously monitor and records the energy meter reading in its permanent (non-volatile) memory location. This system continuously records the reading and the live meter reading can be displayed on webpage to the consumer on request. This system also can be used to disconnect the power supply of the house when needed.

The electric energy used by unauthorized person cause losses to utility and also pollutes the environment. Losses in electricity energy sector can come under two sets: technical and managerial. Technical losses of electrical energy are caused due to the functional tendency of the equipment used from generating station to the distributing station. Non-Technical losses are due to lack of utility labor interference periodically.

2. ARCHITECTURAL MODEL

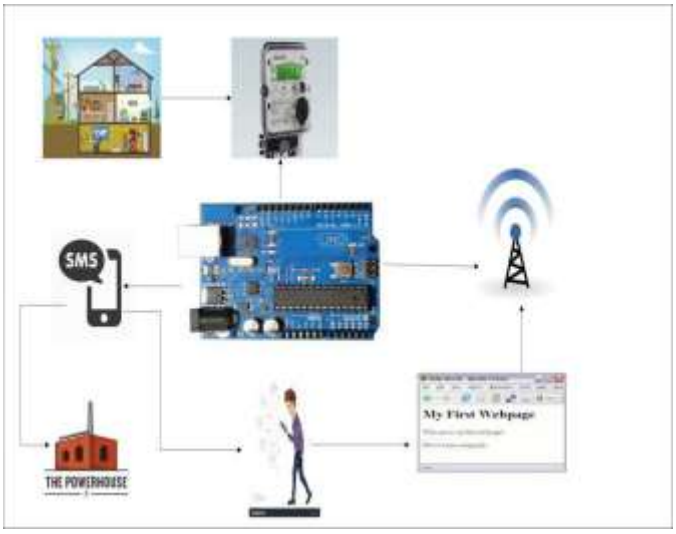

Fig-1: Architectural model

The explanation of the above architectural model is as

Follows:

- When the various appliances of the household consume energy the energy meter reads the reading continuously and this consumed load can be seen on meter.
- Based on the blinking, the units are counted. Normally, 3200 blinks is one unit.

- In this we are trying to develop, a system in which Arduino Uno act as main controller, which continuously monitor energy meter.
- As per the blinking of LED on energy meter the Arduino will measure the unit consumption.
- The measured reading with the calculation of the cost will be continuously displayed on web page that we have designed.
- Threshold value can be set on webpage with the help of Wi-Fi, as per the consumer's requirement. When the consumers reading will be near about to the set threshold value it will send a notification value to the consumer.
- This threshold value notification will increase the awareness amongst the consumer about the energy.
- When the consumer gets the notification he can visit the webpage and change the threshold value.
- If the consumer is not aware with the threshold notification, then the meter will automatically get off. Then the consumer has to visit the webpage again and increment the threshold value. By the incrementation, the meter will automatically get ON.
- Finally the overall monthly bill with cost will be sent to customer as well as service provider in the form of text at first day of every month.

3. EASE OF USE

The above block diagram represents our proposed 'SMART ENERGY METER BASED ON IOT' system:

3.1 ENERGY METER

Energy meter or watt-hour meter is an electrical instrument that measures the amount of electrical energy used by the consumers. Utilities is one of the electrical departments, which install these instruments at every place like homes, industries, organizations, commercial buildings to charge for the electricity consumption by loads such as lights, fans, refrigerators and other home appliances. Energy meter measures the rapid voltage and currents, calculate their product and give instantaneous power. This power is integrated over a time interval, which gives the energy utilized over that time period.

BLOCK DIAGRAM

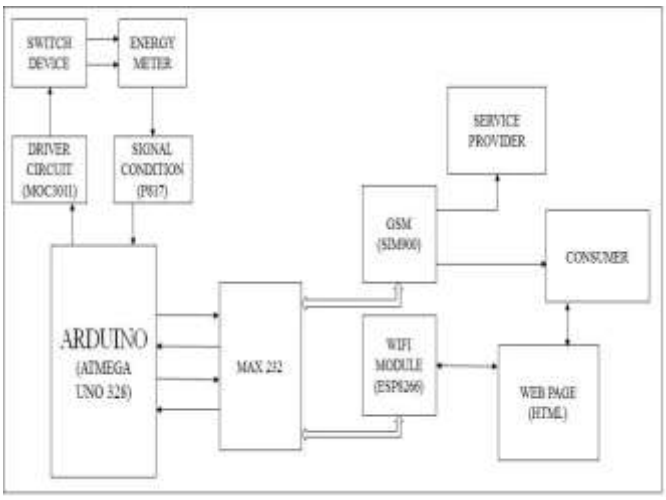

Fig -2: Block Diagram Representation

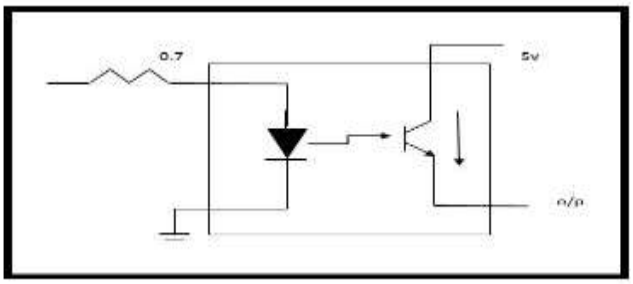

Fig-3: Signal Conditioning Circuit

Above figure shown is the simple internal working of opto-coupler P817 which we are using as signal conditioning block. As we can see on a working meter that one LED continuously blinks, it is nothing but indicates the count of power. The LED whenever blinks it produces only 0.7v which is not suitable for Arduino board to capture, so to remove this error we are using this block. When the LED blinks the diode will conduct, transistor will get active and it will give 5v at output which we are externally giving to transistor. Whenever LED will blink the 5v supply will be provided to Arduino board and it will count them. We are using signal conditioning block to increase voltage.

3.2 ARDUINO UNO(ATMEGA 328)

Arduino board is the heart of our system. Entire functioning of system depends on this board. Arduino reacts to the 5v supply given by opto-coupler and keeps on counting the supply and then calculates the power consumed and also the cost. This data, it continuously stores on webpage, so that users can visit any time and check their consumption. It even reacts accordingly as per programed, to the situations like message sending during threshold value etc.

3.3 MAX 232

We are using MAX 232 for serial communication with the components that are GSM module and Wi-Fi module MAX232 is used to provide TTL to the components as per the requirement. GSM needs TTL so it is connected to Arduino through MAX232. Some Wi-Fi module doesn't require TTL because it's already build in it and some may require based on its working.

3.4 GSM MODULE (SIM900)

GSM stands for Global System for Mobile communication. It is widely used mobile communication modem system in the world. GSM is an open and digital cellular technology used for transmitting mobile voice and data services operates at the 850MHZ, 900MHZ, 1800MHZ, 1900MHZ.

3.5 Wi-Fi MODULE (ESP8266)

Wi-Fi stands for Wireless Fidelity. We are using Wi-Fi which acts as heart for IoT. Through Wi-Fi the consumer can set changes in threshold value, he can ON and OFF the energy meter. Time to time the readings of units and cost are displayed on webpage. Consumer can accesses the Arduino board and meter with help of Wi-Fi.

3.6 WEBPAGE (HTML)

We designed webpage for operating Arduino and Energy Meter with the help of HTML. HTML stands for Hypertext Markup Language. It is a standard markup language for creating web pages and web applications with Cascading Style Sheets (CSS) and JAVA scripts it forms a triad of cornerstone technologies for World Wide Web. Web browser receives HTML documents from a Webserver or from local storage and render them into multimedia web pages.

HTML describes the structure of web page semantically and originally included cues for the appearance of the document. HTML elements are the building blocks of HTML pages. In our system GSM is used to send the notification of threshold reaching to consumer and for sending message of total consumption of unit with cost to the service provider and consumer, frequency bands. It has ability to carry 64kbps to 120Mbps of data rates.

3.7 DRIVER CIRCUIT (moc3071)

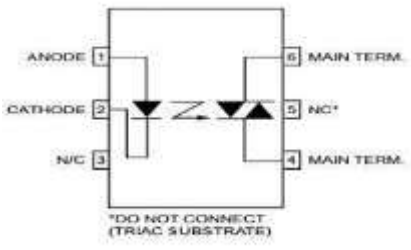

Fig-4: Driver Circuit

- It is a 6 pin device known as opto coupler or opto isolator.
- In our project we are using this opto coupler to cut off the AC load.
- It is connected to the SSR to cut off the ACload.

6. OVERVIEW OF INTERNET OF THINGS

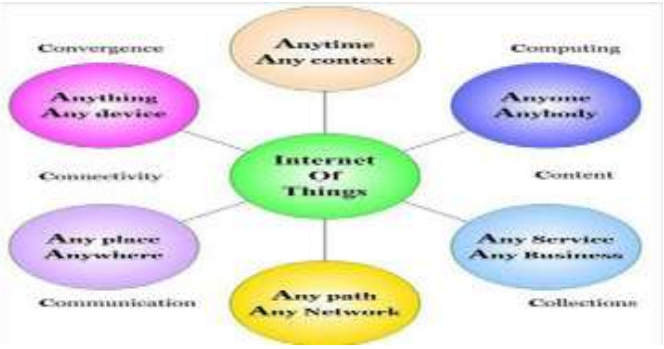

Fig-5: IoT Representation

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.

IoT Working

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. IoT is a convergence of several technologies like ubiquitous, pervasive computing, Ambient Intelligence, Sensors, Actuators, Communications technologies, Internet Technologies, Embedded systems etc.

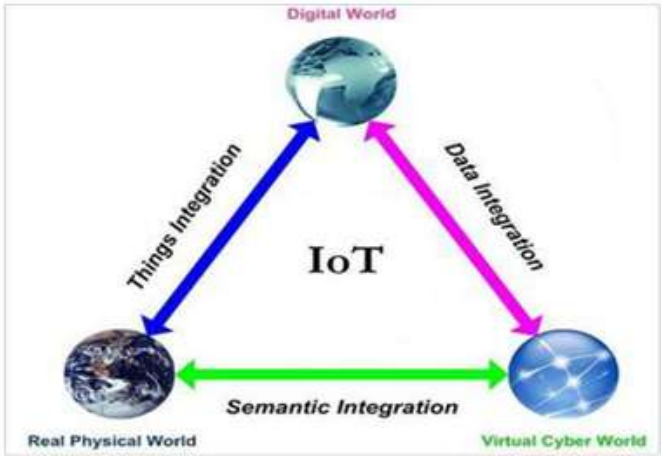

Figure 6: IoT Working

7. SYSTEM ARCHITECTURE OF POCKET PICKING

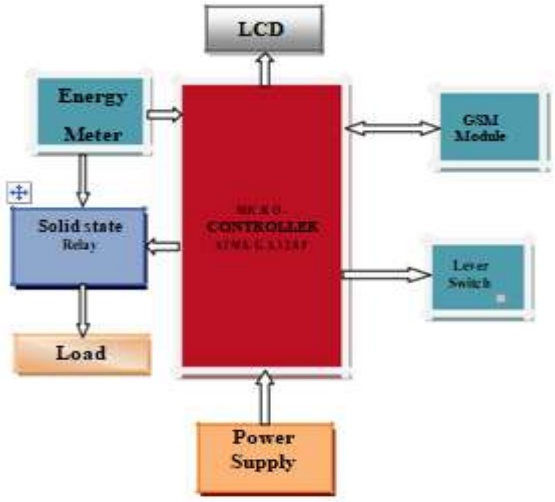

Fig-7: Architecture Diagram

The system architecture of Arduino and GSM based smart energy meter is shown in the Fig. 7. The energy consumption is being calculated using the energy meter IC and Arduino.

In order to prevent pocket picking, detection program is present in the Arduino. Arduino and GSM based smart energy meter can be divided into several parts as Energy Meter IC, LCD, Arduino, GSM modem, Relay, Optocoupler, Lever switch, Display Unit and Power Supply Unit etc.

8. RESULT

1] Current unit with cost will be displayed.

2] When threshold is about to over the following message will be sent to consumer.

3] Monthly consumption of power will be send as message to the consumer with total bill of electricity.

4] The monthly bill with unit consumption and user Id will be sent to service provider.

9. CONCLUSIONS

Smart energy meter based on IoT is used to calculate the energy consumption of the household, and even make the energy unit reading to be handy.Hence it reduces the wastage of energy and bring awareness among all. Even it will deduct the manual intervention.

In the case of pocket picking, defaulter meter line cutting/joining labor system is reduced.

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