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IoT Based Smart Energy Meter Monitoring and Theft Detection Using ATMEGA

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ABSTRACT: The main objectives of this system are described clearly as follows: theft of electricity increases the costs paid by customers and can have serious safety consequences. Detecting electricity theft has been traditionally addressed by physical checks of tamper-evident seals by field personnel and by using balance meters. Identify the theft by sending alert SMS to the owner. Sent meter readings and rate every month to the owner. Adding with these setup an efficient Internet of Things (IoT) is defined, which portraits the global connection environment to the users and allow them to view the status of meter reading and theft associations globally from anywhere at any time. Theft of electricity has a material impact on customers in terms of cost and safety. We consider that the existing regulatory framework does not adequately encourage suppliers to be proactive in detecting theft. In this document we are requesting views on proposed new supply license obligations to strengthen the arrangements for tackling theft and on the proposed role of Distribution Network Operators (DNOs) in tackling theft when it is not responsibility of suppliers. We are also consulting on additional policy measures and proposals to support suppliers in investigating, detecting and preventing theft. For all the entire system is useful for prevention of thefts and globally connected medium to portrait the meter reading to its customers effectively.

KEYWORDS: Electricity Theft, Meter Reading, Internet of Things, Theft Control, Customer Alert Mechanism.

I. INTRODUCTION

Theft of electricity increases the costs paid by customers and can have serious safety consequences. It leads to misallocation of costs among suppliers that can distort competition and hamper the efficient functioning of the market. The costs faced by an electricity supplier in detecting electricity theft by its customers may be greater than the costs to the industry as a whole. In particular, when it detects electricity theft by one of its customers, the supplier may incur liabilities relating to generation, network and balancing costs associated with the entry to the settlement system of estimates of the volume of electricity stolen by that customer.

On the other hand, this action does not lead to an increase in costs at the level of the industry as a whole. Detecting electricity theft has been traditionally addressed by physical checks of tamper-evident seals by field personnel and by using balance meters. Although these techniques reduce unmeasured and unbilled consumption of electricity, they are insufficient. Indeed, tamper- evident seals can be easily defeated, and although balance meters can detect that some customers are fraudulent, they cannot identify the culprits exactly. Despite the security vulnerabilities of smart meters, the higher-resolution data collected by them is seen as a promising technology that will complement traditional detection tools. They have clear potential to improve metering, billing and collection processes, and the detection of fraud and unmetered connections. Common methods of theft range from compromising the physical security of meters to directly connecting loads to electricity distribution lines. Default of payments has been a major problem, due to suboptimal levels of monitoring and enforcement.

The lack of technology and insufficient distributor incentives were the major contributors to this problem. CT (Current Transformer) Sensor is used to measure the incoming current from the Power meter and shown in LCD Display. If you add load to the Power Meter it consume some power this value is shown in lcd as well as computer via serial communication. Voltage Sensor is used to find the voltage level from main supply and shown in LCD.

This voltage value is sent to computer using TTL-USB convertor. This alert message is received by owner instantly .The message contain Recent Current, Voltage and Usage values. Units are displaying in the 4 digit 7 segment

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Led Display. Once the meter is taken the unit reset to 0. If unauthorized person they are using power it gives instant SMS alert to the owner. In the Internet of Things (IoT) model, many of the living and non-living things that encompass us will be on the internet in one form or another. Driven by the popularity of gadgets empowered by wire-less technological innovation such as Wireless Bluetooth, Radio Frequency Identification, Wireless-Fidelity, embedded sensor, IoT has moved out from its beginning stage and it is actually on the edge of changing the present fixed inter-net into a well featured upcoming Internet. Currently there are almost nine billion inter-connected gadgets and it is estimated to touch almost fifty billion gadgets by 2020.

Today the world is facing such an environment that offers challenges. Energy crisis is the main problem faced by our society. A relevant system to control and monitor the power usage is one of the solutions for this problem. One approach through which today's energy crisis can be addressed is through the reduction of power usage in households. The consumers are increasing rapidly and also burden on electricity offering divisions is sharply increasing. The consumers must be facilitated by giving them an ideal solution: - i.e. the concept of IoT (Internet of Things) meters and on the other hand service provider end can also be informed about electricity thefts using theft detection unit and PLC modem.

By keeping above factors, the concept of IoT meters thrived consisting of four different units: Microcontroller unit, Theft detection unit, Meter Analysis and communication unit. The paper describes ATMEGA328P Microcontroller based design and implementation of energy meter using IoT and theft control concept. The user can monitor the energy consumption in units from a web page by providing device. Theft detection unit connected to energy meter will notify company side when meter tampering occurs in energy meter and it will send theft detect information through efficient applications and theft detected will be displayed on the terminal window on the service provider end. Today's Demand actually requires accessing the device characteristics remotely in a reliable way. One of the possible way to accomplish the task is to connect a device (energy meter) to internet by providing efficiency to it.

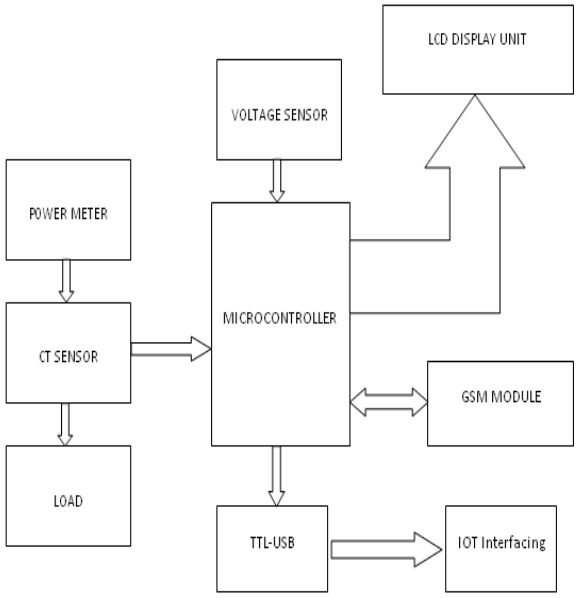

Fig.1. System Block Diagram

Proposed Methodology

- Real Time Messaging System
- Theft Identification
- Energy Monitoring and storing
- Digital Metering
- IOT Based Global Connectivity and Remote Interfacing

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II. WORKING PRINCIPLE

This System consists of Microcontroller unit, LCD Display, Sensors like Voltage and Current Sensor. The PCF8574 has a low current consumption and includes latched outputs with high current drive capability for directly driving LEDs or LCD Display. The I2C-bus is for 2-way, 2-line communication between different ICs or modules. The two lines are a serial data line (SDA) and a serial clock line (SCL). Both lines must be connected to a positive supply via a pull-up resistor when connected to the output stages of a device. Data transfer may be initiated only when the bus is not busy. One data bit is transferred during each clock pulse. The data on the SDA line must remain stable during the HIGH period of the clock pulse as changes in the data line at this time will be interpreted as control signals. The device consists of an 8-bit quasi-bidirectional port and an I2C-bus interface. CT (Current Transformer) Sensor is used to measure the incoming current from the Power meter and shown in LCD Display.

If you add load to the Power Meter it consume some power this value is shown in lcd as well as computer via serial communication. Voltage Sensor is used to find the voltage level from main supply and shown in LCD. This voltage value is sent to computer using TTL-USB convertor. 74HC595 are 8-stage serial shift registers with a storage register and 3-state outputs. The registers have separate clocks. Data is shifted on the positive-going transitions of the shift register clock input (SHCP). The data in each register is transferred to the storage register on a positive-going transition of the storage register clock input (STCP). If both clocks are connected together, the shift register will always be one clock pulse ahead of the storage register .Shift Register which controls the 4 digit 7 Segment Led Display.GSM Module is used to sent SMS to the Owner about billing Details and usage of Units. This alert message is received by owner instantly .The message contain Recent Current, Voltage and Usage values. Units are displaying in the 4 digit 7 segment Led Display. Once the meter is taken the unit reset to 0. If unauthorized person they are using power it gives instant SMS alert to the owner. Along with this we use IOT service to make the global system connectivity to portrait the electricity oriented records to all its respective users via online.

III. LITERATURE SURVEY

In the year of 2011, the authors "Landi, C.; Dipt. di Ing. dell"Inf., Seconda Univ. di Napoli, Aversa, Italy ; Merola, P. ; Ianniello, G" presented a paper titled "ARM-based energy management system using smart meter and Web server", in this paper they described such as a low cost real-time ARM-based energy management system is proposed. It is conceived as part of a distributed system that measures the main power system quantities and give the possibility to manage the whole power plant. An integrated Web Server allow to collect the statistics of power consumptions, power quality and is able to interface devices for load displacement. The device is characterized by easy access to the information and the combination of a smart meter and data communication capability allow local and remote access. In this way it is possible to manage the power consumption of the power system leading to an overall reduction in consumption and costs.

In the year of 2012, the authors "Garrab, A.; Bouallegue, A.; Ben Abdallah" presented a paper titled "A new AMR approach for energy saving in Smart Grids using Smart Meter and partial Power Line Communication", in this paper they described such as the growing demand of energy, the capacity limitations of energy management, one-way communication, the need of an interoperability of the different standards, the security of the communication and the greenhouse gas emissions, leads to emerge a new infrastructure grid: Smart Grid. Smart Meters are one of the proposed solutions for the Smart Grid. In this paper, an AMR solution which provides enhanced end-to-end application. It is based on an energy meter with low-power microcontroller MSP430FE423A and the Power Line Communication standards. The microcontroller includes an energy metering module ESP430CEl. The aim of this work is to realize a real time pricing thanks to the proposed communication infrastructure. This solution is with great interest in economical and low carbon society point of view.

In the year of 2012, the authors "B. S. Koay, S. S. Cheah, Y. H. Sng, P. H. Chong, P. Shum, Y. C. Tong, X. Y. Wang, Y. X. Zuo and H. W. Kuek" presented a paper titled "Design and implementation of Bluetooth energy meter", in this paper they described such as Presently electronics energy measurement is continuously replacing existing technology of electro-mechanical meters especially in China and India. By the year 2004, digital meter has start replacing electromechanical meters in Singapore. A wireless digital energy meter would definitely offer greater convenience to the meter reading task. Bluetooth technology is chosen as a possible wireless solution to this issue. In this paper, we present the design and implementation issues of a Bluetooth-enabled energy meter. The energy reader can collect the energy consumption reading from the energy meter wirelessly based on Bluetooth. Two methods, which

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can retrieve the meter reading with little human intervention, are proposed and implemented in the targeted applications. They are AMR (automatic meter reading) and the APM (automatic polling mechanism). Few commercial applications are suggested to apply for the Bluetooth-enabled energy meter. We have successfully implemented the Bluetooth-enabled energy meter for these suggested commercial applications to demonstrate the advantage of reading the electricity consumption wirelessly via Bluetooth technology.

IV. EXPERIMENTAL RESULTS

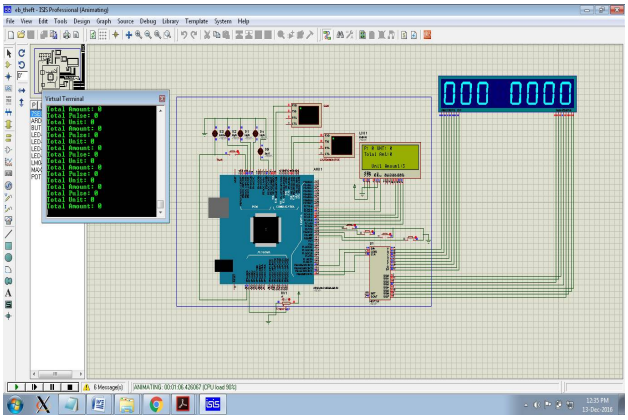

Fig.2 Overall Simulation Design

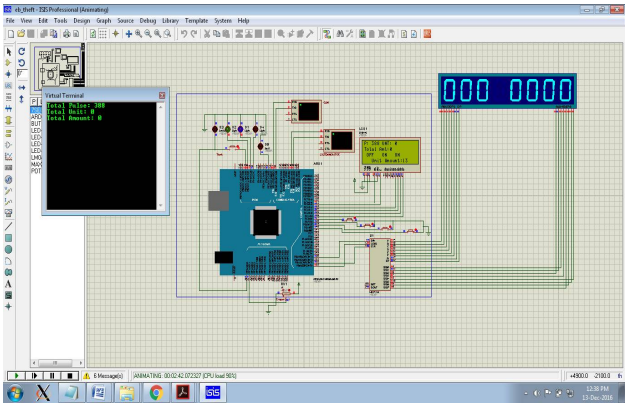

Fig.3 Pulse based Amount Estimations

V. CONCLUSION

In the era of smart city advancement, this project is concentrated on the connectivity and networking factor of the IoT .In this system, an energy consumption calculation based on the counting of calibration pulses is designed and implemented using ATMEGA328P Microcontroller unit in embedded system domain. In the proposed work, IoT and MC based meter reading system is designed to continuously monitor the meter reading and service provider can disconnect the power source whenever the customer does not pay the monthly bill and also it eliminates the human involvement, delivers effective meter reading, prevent the billing mistake.

- The Project has achieved following objectives:
- Ease of accessing information for consumer from energy meter through IoT.
- Theft detection at consumer end in real time.
- LCD displays energy consumption units and temperature.
- Disconnection of service from remote server.

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