Power Theft Identification by Using IOT

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Abstract **- In this paper Arduino based power theft detection and protection system is designed. An increase in the demand of electric power for household, commercial and industrial loads lead to management of electric distribution system become more complicated. Lack of information at the bases station regarding status of the distribution network has been identified as the major bottleneck to its effective monitoring and controlling. Electrical power theft detection and protection system is used to detect and protect an unauthorized tapping on distribution line. In this paper ACS712 series current sensor has been used as the interfacing instrument between the power line current and Arduino. To isolate power line from power theft system relay used as switching gear. Arduino control all operations that all devices do. This system would provide a simple way to detect and prevent an electrical power theft without any human interference, maximize the profit margin of power utility company and Prevent fault due to overload. The theft detection of electricity also became possible by using this system through which server received the message when users by passed the meter. This system provides billing activity in addition to detection and protection power theft.**

Index Terms **- IOT, Electric Energy, Energy Meter, Arduino.**

INTRODUCTION

Generation, transmission and distribution of electrical energy involve many operational losses. Whereas losses implicated in generation can be technically defined, but transmission and distribution losses cannot be precisely quantified with the sending end information. This illustrates the involvement of nontechnical parameter in transmission and distribution system. Overall technical losses occur naturally and caused because of power dissipation in transmission lines, transformers, and other power system components was discussed in [1]. Technical losses in transmission and distributions computed with the information about total load and energy billed. On the other hand, nontechnical losses cannot be precisely computed. It can be estimated from the difference between the total energy supplied to the customers and the total energy billed. This kind of loss can be a power theft in the form of meter tampering, stealing or illegal connections billing irregularities, and unpaid bills. power theft, so has become a serious concern for the utility company and the government [2]. It has also different impact like financial and quality of supplied power.

The financial impact of power theft has two-fold manifestations, first there is income lost or not collected after delivery of the service, second the income lost due to not charging customers more. If there is power theft, it also leads to non-efficient utilization of generated power. So, now a day merely generating more power is not enough, controlling the electrical system has become very important. This can improve power quality to a great extent and prevent power theft of different forms. But some forms of electricity are difficulty to measure, and thus to control. For example, theft that involves tampering with meter to distort the billing information or direct information to the power system results in commercial loss, is nearly impossible to measure. Since there is lack of information on both commercial and the legitimate loads in the system, it is difficult to measure commercial loss. This is due to insufficient inputs for any meaningful loss calculation. Despite the best efforts by utility, the current results of commercial losses measurements are often inaccurate, because the figure rely heavily on the records of detected cases, rather than actual measurement of the electrical power system [3]. Even if utility do have some control over the magnitude of commercial losses, they are not able to have full control. This has led to a huge lose for electric utilities.

In the future, electricity supply has to be reliable, quality and secured. In order to do so, utilities need to

have better information about the operation and the state of the distribution networks. For this to materialize, in the future, there will an increasing penetration of distributed generation connected to customer's premises and a shift from the traditional dominant large central power plants electricity generation concept to more complex power delivery [4]. When electricity theft happens getting information is the first step for controlling and taking measure. In this study an electricity theft detection system has been designed. It can be used to detect when the transmission line was taped by unauthorized person through a piece of wire. In system the current sensors are used to sense the total amount of current consumed by the load. If any tapping has had happened in the line during transmission, the two current sensors read different valves, which indicates that electricity theft has been occurred. The theft information is then quickly accessed by the Arduino and sends SMS to the concerned body through the GSM module.
related work

Energy consumption is increasing rapidly in the state of Kerala. As per the survey conducted during the period of November 2016 to December 2016, a total number of 40 houses in the local areas of Manvettam, Mallappaly, Pathanapuram and Puthur. The people are not satisfied with the present existing meter billing system. The meter readers have to visit every home to take the meter readings. Many of the times the door locked and could not get the bill. In the absence of the consumers, they locked the door and gates due to security reasons. So, they did not get the electricity bill properly and also get fined. They are also complaining against the errors caused by the meter readers while writing the reading. A single digit error can entirely change the cost and consumed units. People need to know their consumed units and the corresponding cost at any time. The storage of the electricity bill is also hectic. Most of the people demanded to limit their usage to a particular value. Above that particular value the heavy loads should be tripped off automatically and the alert the users.

Nowadays, the state Kerala is facing an electricity shortage crisis. So, the conservation of energy is inevitable. According to the discussion with the KSEB officials of Pallom and Kaduthuruthy subdivisions, they arise the problem of power theft on distribution lines. Illegal power usage in customers, namely electricity theft is classified as a non-technical loss of power distribution systems. There is no method to find the power theft in the present system. About 2.8 crores of revenue is wasting every year due to power theft. (Newspaper report "power theft cases on the rise", The Hindu news on 24 May 2016) Based on these survey results, the proposed method is trying to optimize the problems faced by the consumers and KSEB officials. This paper proposed a method to automate the billing process, better energy management and power theft on distribution lines. This system enables KSEB to collect the billing and theft detection data without utilizing manpower. When the energy consumption exceeds the threshold value the heavy loads will be automatically disconnected. The paper is concerned with the automation of the electric billing system. The electricity bill sends to KSEB office through GSM module. An LCD display is connected with microcontroller to show the consumed units and cost. Bill records are digitized. When the energy consumption is more than the threshold value the heavy loads in the home circuit will automatically tripped off using relays. This method provides an indication system to aware the user about the over energy consumption than the threshold value and sends a SMS to consumers.

SYSTEM ARCHITECTURE

The system architecture of intelligent energy meter is shown in figure1. It consists of arduino uno, energy meter, optocoupler, relay, LCD display and IOT modem.

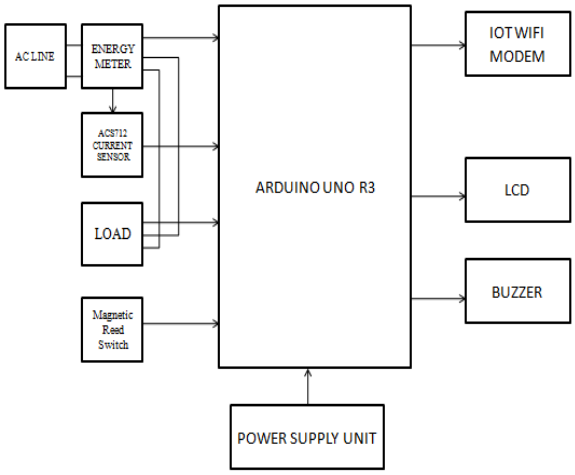

Fig 1:Meter Unit

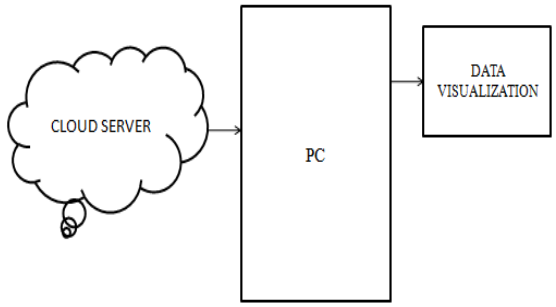

Fig 2: Monitoring Unit

Hardware Requirements

- Arduino Uno R3
- Voltage Sensor
- Current Sensor
- Load
- Ac Supply Connection
- Iot Wifi Modem
- Power Supply Unit
- Lcd

Software Requirement

- ARDUINO IDE
- Embedded C

HARDWARE IMPLEMENTATION

Arduino UNO

The Arduino UNO is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by arduino. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. The board has 14 Digital pins, 6 Analog pins, and programmable with the Arduino IDE (Integrated Development Environment) via a type B USB cable. It can be powered by a USB cable or by an external 9-volt battery, though it accepts voltages between 7 and 20 volts. It is also similar to the Arduino Nano and Leonardo. The hardware reference design is distributed under Common Creative Attribution Share-Alike 2.5 license and is available on the arduino website. Layout and production files for some versions of the hardware are also available. "UNO" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0. The UNO board and version 1.0 of arduino Software (IDE) were the reference versions of arduino, now evolved to newer releases. The UNO board is the first in a series of USB arduino boards, and the reference model for the arduino platform. The ATmega328P on the arduino UNO comes preprogrammed with a boot loader that allows uploading new code to it without the use of an external hardware programmer. It communicates using the original STK500 protocol. The UNO also differs from all preceding boards in that it does not use the FTDI USB-to serial driver chip. Instead, it uses the Atmega16U (Atmega8U2 up to version R2) programmed as a USB-to-serial converter.

Fig -2: Arduino Board

LCD

Liquid Crystal Display (LCD) is used to display the output to the user in the form of GUI (Graphic User Interface) and a mono chromatic display. LCD used in this project is JHD162A series. There are 16 pins in all. They are numbered from left to right 1 to 16 (if you are reading from the backside). Generating custom charcters on LCD is not very hard. It requires the knowledge about custom generated random-access memory (CG-RAM) of LCD and the LCD chip controller. Most LCDs contain Hitachi HD4478 controller. CG-RAM is the main component in making custom characters. It stores the custom characters once declared in the code. CG-RAM size is 64 byte providing the option of creating eight characters at a time. Each character is eight byte in size.

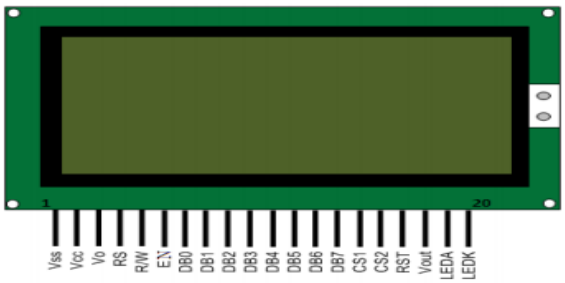

Fig 3: LCD

Energy Meter

An energy meter is a device that measures the amount of electrical energy supplied to or produced by a home or building. The most commonly used energy meter is kilowatt hour meter. Instantaneous power is calculated by taking the product of the instantaneous current and voltage. This instantaneous power is then integrated against time to give energy used by the consumers. The meters are classified into two basic categories, electromechanical and electronic. The energy consumption is calculated by using the output pulses of energy meter. The load is said to consume 1 unit of electricity when the internal counter of microcontroller counts upto 3200 pulses.

Optocoupler

It is an electronic device which is designed to provide electrical isolation coupling between its input and output. Optocouplers eliminate the effects of electrical noise caused by crosstalk, power irregularities and electrical interferences. The main purpose of an optocoupler is to prevent rapidly changing voltages or high voltages on the circuit. A relay is an electrically operated switch. Relays are basic components in a majority of types of electrical and electronic device. It is also used in power engineering. An overload relay that uses a heating element to detect overloads. Electro-mechanical relay is a high-speed device which is insensitive to pulse and high-frequency interference and surge voltage. It exhibits a robust behaviour in overload modes and has a satisfactory reset ratio.

Current Sensor

For measuring current in a circuit, a sensor is required. ACS712 Current Sensor is the sensor that can be used to measure and calculate the amount of current applied to the conductor without affecting the performance of the system. ACS712 Current Sensor is a fully integrated, Hall-effect based linear sensor IC. This IC has a 2.1kV RMS voltage isolation along with a low resistance current conductor.

Energy Tampering Unit

It consists of a basic LDR and LED connection separated by a barrier between the two which is directly attached to meter. Initially the circuit remains closed as of the barrier, but when the meter is open the connection becomes closed as LED will send signal to the LDR and signal is generated in the LDR as resistance changes and is connected to GPIO pin of Raspberry Pi and send message to EB that “meter is opened.

IoT Webpage

It is web analytical IoT service used specialized in connected hardware and software solutions to remotely monitor, control, and automate processes through Arduino or Raspberry pi. By giving the necessary command lines in python data can be collected from sensors and transmitted over the internet and control of devices can also be established.

System implementation

The flowchart gives a diagram representation of the program algorithm. The system flowchart is as shown in Figure 4. The software design plays a vital role in the working of the entire system; the system doesn’t operate without the software. An algorithm was developed to enable Arduino controllers read the input and respond accordingly. The programming language selected for this project C. The C compiler enable communication between the current sensor, Arduino and PC with other different interfaces in the system. Within software programed into it, Arduino acts as brain of the whole system to protect and transmit its parameter for system needs to be take action. It interfaces the power line information through PC via the RS232 serial port as well as display on the LCD.

The main program is divided into multiple of parts, these parts are initialization of ports and pins, initialization of ADC, configuration of the serial communication protocol ports and finally configuration of LCD display. Arduino acts as the brain of the entire system. It monitors the voltage, current of the line, display the parameters on LCD and PC through RS232 serial port. Whenever a theft occurs, it automatically sends a trip signal to the relay and thereby protecting the distribution power line from theft. An algorithm has been developed which makes the Arduino reads the input analogue signals and responds consequently. The algorithms have been represented by the flowchart shown in Figure 2, and now the flowchart has been interpreted into c language and complied using the Arduino for integrated kit.

RESULTS AND DISCUSSION

Simulation results are presented and discussed to show the effectiveness of the proposed drive system based on Arduino based automatic power theft detection and prevention from distribution line. For studying the performances of proposed system, a series of simulations and measurements have been carried out. in this respect, the dynamic response of the propose current estimation algorithm is studied under different condition. As shown in Figure 3 Arduino based automatic power theft detection technique for electricity is proposed. In electricity metering system, tampering is done basically for the purpose of electricity theft. To protect the electricity energy meter from this theft, attempt a relay is used at the opening of the meter. The relay is connected to interrupt pin of the driver. Hence closed switch applies 12V to the interrupt pin and opened relay drives the voltage to zero. The relay normally closed when the meter chassis is closed. If someone tries to open or tamper with electricity energy meter, that switch gets opened, and the interrupt pin gets triggered as 0V is sensed by it. The Arduino immediately sends to GSM module for sending SMS. Upon receiving SMS, the authority can take further legal action against it and penalize the theft person as shown in Figure 4 Thus simulation result shown in Figures 3 and 4 indicate that sensing value of current, voltage and amount of power that customer used and payment /revenue/ of the consumed power. In thus simulation there is no theft which exist on the distribution line due to that green LED indicator is become bright and there is no need power interruption on the line.

Using Arduino and IOT, the illegal usage of power can be solved electronically without any human intervention and wirelessly. The simple working principle of this method is the comparison of the current passed through the current sensor value and the total algebraic sum of current sensor values the consumers connected to that line. A current sensor and relay with IOT module is placed at each of the consumer terminal. It measures the total current consumed by the consumers and it transfers to the utility using the IOT module shown in Figure 4. It compared with the current sensors reading value. If both the values are equivalent, then there is no theft (Transmission and distribution losses are neglected). However, if the value of the pole line current sensor reading is greater than the consumer's current sensor reading, then the theft is acquired. By the help of this mismatching error readings, we can detect the power theft as shown in Figure.

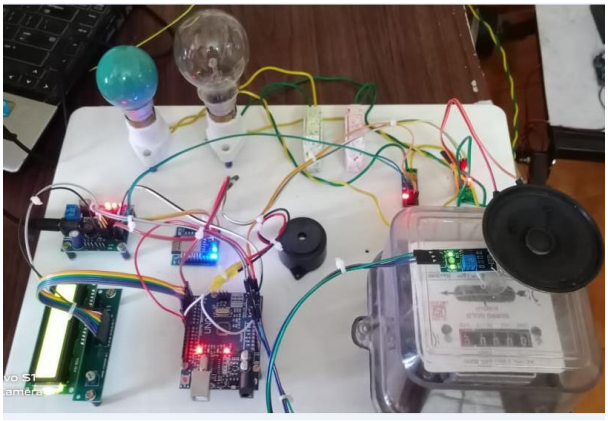

Fig 4: Experimental setup

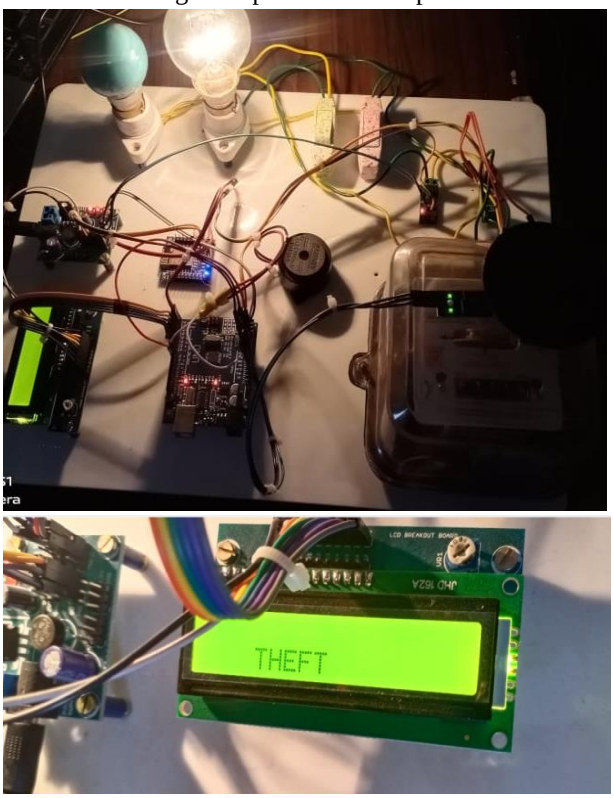

Fig 5: Theft Identification

CONCLUSION

A Wireless Electricity Theft Detection and monitoring system has been designed and developed with proper integration of both the hardware and the software. Without any human interface this system provides an effective and easy way to detect electrical theft. The use of IoT helps in achieving the numerous advantages of wireless network communications. Power theft is

actually bypassing the energy meter but in our project we have indicated the theft by increasing the load also and this method is cost efficient. The design, simulation and construction of a IOT-based power theft have been achieved. It has covered various forms of electricity theft which include unaccountability of servicemen, irregularities of billing leading to a reduction of funds by the utility companies has also been achieved as this work prevents one on one contact between the end user and the workers. With remote monitoring of the meter reading and sending SMS, whenever there are abnormal readings, in the customer electricity meter, the developed system may able to help Utilities to reduce the incidences of household electricity theft. An automatic circuit breaker can be integrated into the unit so as to remotely cut off the power supply to the house or consumer who tries to indulge in power theft. This system design mainly concentrates on single phase electrical distribution system. Automation of the customer billing system has been achieved as the meter keeps track of the consumer's load on a timely basis. This design, therefore, removes the manual reading of meters with its attached consequences of time-consuming system and bill manipulation which affects the company while adding higher bills to the consumer.

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