IoT based smart electricity meter and power theft detection

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Abstract- In today's era, electricity is one of the basic necessities. In the conventional method, a meter reader who is authorized by the Electricity department visits the user's house and notes down the consumed energy units and calculates the usage charge. In this method problems may arise due to errors caused by meter reader, it is also time consuming and requires human labor. Automation of billing system is the solution to this problem. This paper proposes a method to automate the billing system. It can be achieved by incorporating microcontroller with energy meter. A database at the server stores all the details and will be accessible to the officials and users on demand. User can access his daily electricity consumption by using an android application or a website. Data which is sent by the meter to the server is provided with network security. If the user fails to follow the rules and regulations of the electricity board then the server will automatically cut the power supply. Electricity theft is the main problem which needs to be eliminated. This paper suggests a method for effective energy management and power theft detection. If there is any tapering between the distribution post and the user's meter or any human interference occurs within the meter then power theft detection message will be sent to server as well as to the user.

Keywords - GSM Smart billing system, GSM, Tamper notification, Android, Web development

I. INTRODUCTION

Imperativeness organization and watching has a basic part for the right utilize and better essentialness organization. In existing system the meter per user needs to visit each home to take the exhausted units and cost. This charging method may rise a couple of issues, for instance, bungles caused by the meter per user while creating the scrutinizing. A solitary digit mix-up would altogether be able to change the cost of the used units. Next issue is nonattendance of the customer in the house when the meter per user comes to take the scrutinizing. This will bear fine to the purchaser. In light of the dreadful atmosphere conditions this errand is troublesome for per user. This charging procedure will be dreary. Nowadays Maharashtra state faces a lack of energy. To manage this insufficiency government getting energy from various states and this will bear a colossal total as commitment around 200 crores. Illegal control utilize is named as

energy thievery [1] [2]. This paper proposed a methodology to mechanize the charging technique, fruitful imperativeness organization and energy thievery recognizable proof on scattering lines. This system engages MSEB office to assemble the bill and energy theft acknowledgment data normally without utilizing the man control. The data assembled at the customer premises are shared to MSEB office through web likewise, GSM. A Liquid crystal display (LCD) will exhibit the live readings at customer premises. The data is sent to the customer through GSM in addition. Exactly when the essentialness usage outperforms a particular limit the mind-boggling weights will subsequently bumbled off and alert the customers through short message service (SMS) and through pointer. If there is any changing done in the post by then control theft recognized message will send through MSEB office by methods for a GSM. The sharp imperativeness meter contains essentialness meters, GSM modem, micro-controllers besides, an exchange circuit. This proposed structure is exceedingly justified for national use. This paper redesigns and support automated India and therefore making the country painstakingly occupied with the field of development. Whatever remains of the bit of the paper is dealt with as takes after. In section II, it portrays the composition survey. In section III, gives the information about the system designing. In region IV, the gear execution of the proposed system is cleared up. Zone V delineates the reasoning of the system executed. In portion VI the results and talk has been presented. In territory VII gives the complete of the paper.

II. LITERATURE SURVEY

Electro-mechanical[1] meters with motorized nature of the segments utilized in many regions ruin due to long usage . These meters were later substituted by digital energy meters having high precision and accuracy with LCD display. Evolution in this pathway includes AMR using digital energy meters. There are diverse technologies being utilized for AMR[2] using Bluetooth , GSM , GPRS , ZigBee , PLC , RFID and so on. Design of such meters based on BT, GPRS may direct to network uncertainty; with GSM, instantaneous invoice might lead to loss of message, which humiliates performance and accuracy. PLC system makes use of existing power lines to convey info from energy meter to server. The solidity and consistency are the main issues in this method as the carrier wave is readily

troubled by noise; also as these systems are wired AMR systems transmission distance, transmission cost, maintenance and security are critical setback in this technique.

The present system[3] only provides feedback to the customer at the end of the month that how much power is consumed in the form of bill. The consumer has no way to track their energy usage on a more immediate basis. The consumers are growing exponentially fast and load on power providing divisions is rapidly rising. In the existing system meter tampering can be done easily and it's one of the major drawback for an energy crisis.

III. SYSTEM ARCHITECTURE

The system designing of shrewd imperativeness meter is showed up in figure1. It involves arduinouno, essentialness meter, opt coupler, exchange, LCD show and GSM modem.
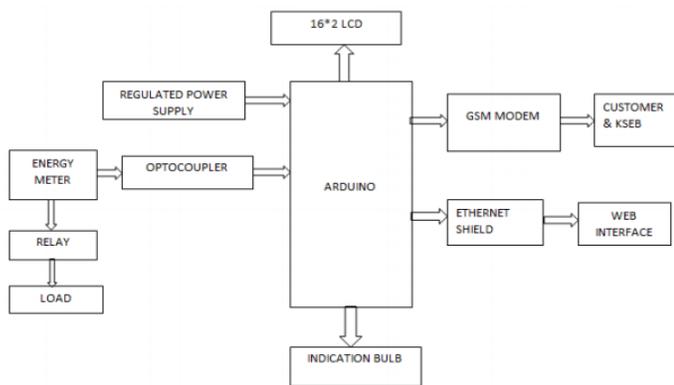

Fig.1: Block diagram of intelligent energy meter

A. Arduino Uno

Arduino is a versatile programmable gear arrange. The arduino programming change condition is successfully available in web. It is a microcontroller board in perspective of the ATmega328P. It has fourteen mechanized information/yield pins, six straightforward wellsprings of data, a sixteen megahertz quartz jewel, a Universal serial bus(USB) affiliation, a energy jack, an In-circuit Serial Programming (ICSP) header and a reset get. Arduino is a physical programmable circuit board (PCB) and a touch of programming called Arduino Integrated Development Environment (IDE) that continues running on PC, used to make and exchange PC code to the board. The Arduino IDE uses an improved type of C, making it less requesting to make sense of how to program. Arduino gives a standard casing factor that breaks out the

components of the littler scale controller into a more open package. The Arduino Uno is a standout amongst the most well-known sheets in the Arduino family what's more, a magnificent choice for novices [2].

B. Imperativeness Meter

An imperativeness meter is a contraption that measures the measure of electrical essentialness gave to or made by a home or building. The most by and large used imperativeness meter is kilowatt hour meter. Provoke control is registered by taking the consequence of the incite current and voltage. This snappy energy is then fused against time to give essentialness used by the buyers. The meters are requested into two essential orders, electromechanical and electronic. The imperativeness use is figured by using the yield beats of essentialness meter. The store is said to eat up 1 unit of energy when within counter of microcontroller checks upto 3200 beats.

C. Optocoupler

It is an electronic device which is proposed to give electrical separation coupling between its data and yield. Optocouplers execute the effects of electrical confusion caused by crosstalk, control irregularities and electrical obstacles. The essential purpose behind an optocoupler is to keep away from rapidly advancing voltages or high voltages on the circuit [4].

D. Hand-off

A hand-off is an electrically worked switch. Exchanges are major parts in a bigger piece of sorts of electrical and electronic device. It is in addition used as a piece of vitality building. An over-trouble hand-off that uses a warming segment to distinguish over-loads. Electro-mechanical exchange is a quick device which is harsh to pulse and high-repeat check and surge voltage. It shows a solid lead in finished weight modes and has a worthy reset extent. [4].

E. LCD Display

A 16*2 LCD demonstrate contains two lines likewise, there are 16 characters for each line. Each character is appeared by 5x7 pixel lattice. This LCD includes two registers, specifically, Order and Data. The charge select extras the charge bearings that are given to the LCD. A charge is a rule given to LCD to do a predefined errand like presenting it, clears its screen, sets the cursor position, controls show et cetera. The data enroll saves the data to be appeared on the LCD [2].

F. GSM Modem

GSM Modem has the ability to send moreover, get SMS to and from the structure. The correspondence with the system occurs through RS232 serial port. It needs AT summons for talking with the microcontroller. This GSM Modem can recognize any GSM sort out chairman SIM card and act simply like a mobile phone with its own particular exceptional phone number. GSM advancement gives the favorable position that the structure is accessible in remote zones [1].

IV. METHODOLOGY

A. Shrewd essentialness meter Insightful imperativeness meter is worried about the robotization of the electric charging structure. Correct examining is possible by using redid microcontroller. The imperativeness meter is interfaced with the microcontroller using an interfacing contraption/Opto-coupler. The beats from the imperativeness meter are recognized by an Optocoupler and it changes over the beats to electrical signs going about as clock beats for the microcontroller. In bona fide system 1unit =3200 beats yet here in this paper considering 1 unit= 10pulses for comfort. In light of these heartbeats ardunio will subsequently make ate up unit and cost. A LCD indicate is related with microcontroller to show the used units and cost. Around the complete of consistently the data containing the ate up units and cost is shared to a database gave by the expert association, which is kept at MSEB office through web and to the customer through GSM. The interfacing of the essentialness meter with web and GSM can be expert by using Ethernet shield on arduino board [1] [4]. All the web interfaced data are escaped in a database at the premises of pro association, which can be made by MySQL. Right when the essentialness use is more than the point of confinement regard the significant loads in the client server plan. MySQL is definitely not hard to tune additionally, progress for the most asking for applications. MySQL ended up being comprehensively notable because of its speed and straightforwardness. It is a high performance however for the most part fundamental database structure and is much confounding to set up and control than greater systems [5].

B. Energy theft acknowledgment

Two separate electronic essentialness meters can be used for control theft acknowledgment, one meter is presented at customer side and the other is presented at a pole based structure. Customer side imperativeness meter measures the energy ate up by stack over a period. Shaft based meter is talented to gage the energy movement over each line related with that pole. Directly the microcontroller in the

pole based meter has two readings: one is signify control circled by the post itself and another is control eaten up by the customer. In normal case these two readings will be same and which appears there is no energy theft. In case there is tapping done by any unapproved individual on hold over a particular period there will be a complexity between the more than two meter readings. Microcontroller put in the pole meter will take a gander at these two regards got from the two meters and if the think control on post is more than the energy send by customer side meter by then control thievery happened in question. This theft signal delivered on post structure can be transmitted to substation/MSEB office by control line correspondence methodology or by remote strategy whichever is suitable and preservationist. Remote correspondence is done by using a Bluetooth module. HM-10 is a Bluetooth V4.0 Bluetooth low imperativeness (BLE) interpretation. It has a working repeat of 2.4GHz ISM band. Transmission frame can be used to transmit data between two Bluetooth devices. Protection should be given to disasters of line. Figure 2 shows the energy theft area game-plan [3] [4] [5].
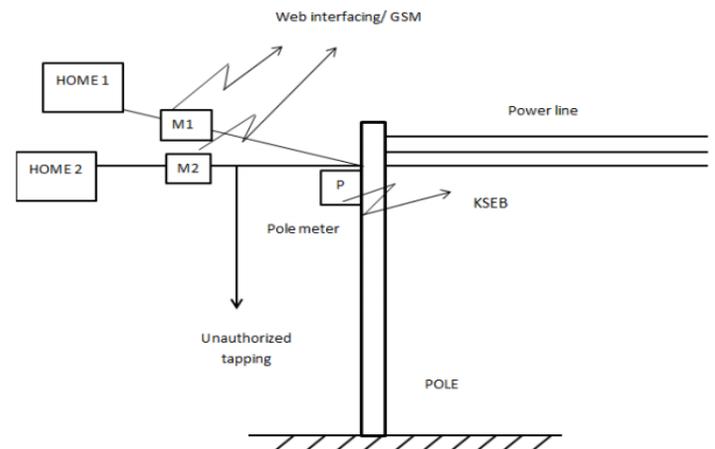

Fig.2: Method for power theft detection

V. HARDWARE IMPLEMENTATION

The energy supply is the fundamental unit in each electrical and equipment wanders circuit, which is used for giving the normal vitality to the microcontroller and diverse parts in the circuit. Generally, this energy supply square contains wander down transformer, center tapped rectifier, and IC 7805 voltage controller. Microcontroller in the Arduino requires 5V control supply. The microcontroller piece can be considered as the standard square of the entire circuit. It is altered to control each one of the parts to play out the pined for operation. Here, in this proposed structure Arduino uno is used and altered using Arduino programming. The imperativeness meter is

interfaced with the arduino using an interfacing device called Optocoupler [3]. The 230V AC control supply is given to work the loads. Fundamentally, we need to enroll the endorsed convenient number with the remote energy use meter. This, enrolled versatile number can screen the remote essentialness meter system. In this remote imperativeness meter, SIM in the GSM modem sent the message showing up the cost of the ate up essentialness units to MSEB office toward the complete of reliably. A LCD module is used to demonstrate the present utilize and units consumed. After utilization of each unit the entirety and total units will be enlarged. This gives the customer to consider his an opportunity to amend control units used and cost particularly from the imperativeness meter so that there is zero possibility of bill changing. The remote imperativeness meter decreases the work for control charging to each and each home or office. Right when the imperativeness use outperforms a cutoff regard, the mind-boggling weights will be normally isolated using exchange. A similar will caution the customers by exhibiting a sign globule and a message will be sent to the customers. If there is any tapping done on the flow lines, expeditiously a message which includes the purposes of enthusiasm of region is sent to the energy office [3].
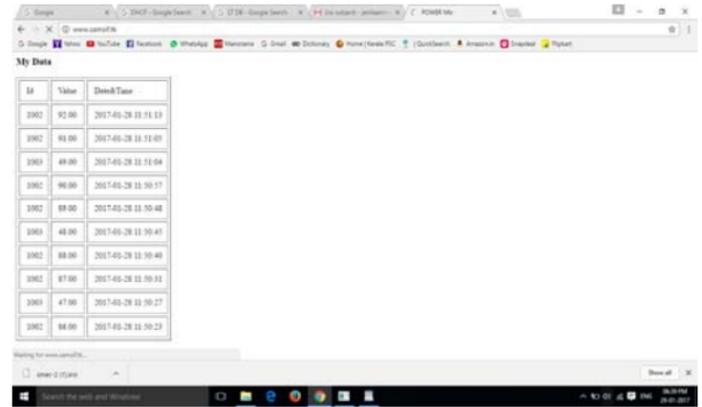
VI. RESULTS AND DISCUSSIONS

Around the complete of consistently the energy charge sent to the MSEB and customer through GSM module. An enlisted SIM number is given in the GSM module. The figure 3 and figure 4 exhibits the modified energy charge as SMS to the MSEB and customer separately with the trial set up.

Fig.3: Automatic electricity bill to KSEB

A database is made in the MSEB office which records the bill purposes of enthusiasm of each home. All the web interfaced data are escaped in a database at the premises of authority association, which can be made by MySQL. Figure 5 shows up the database made in the trial set up of the procedure proposed.

Fig.5: Database creation of Bill

Exactly when the imperativeness use is more than the farthest point regard the staggering weights in the home circuit will thusly faltered off using exchanges. A message sent to the customer to careful about the over imperativeness usage than the edge regard. Figure 6 exhibits the message of over essentialness use with exploratory set up.

In the event that there is any tapping done on the appropriation lines, instantly a message sent to the energy office. Figure 7 demonstrates the theft distinguished message with exploratory set up.
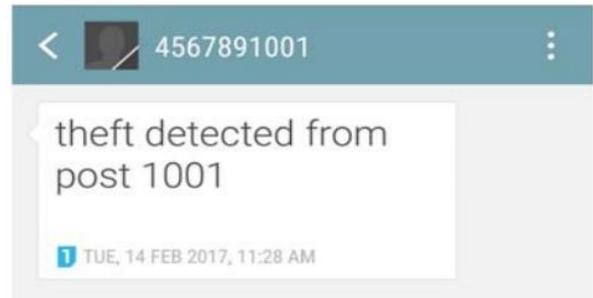

Fig.7: Theft detection message

VII. CONCLUSION

Brilliant essentialness meter is definitely not hard to present and beneficial for both imperativeness provider and client. Using this meter can decrease the manual undertakings to take the readings from the imperativeness meter which is reasonable. This system also urges the customers to think about their essentialness use. The information is transmitted to the energy board office using GSM modem on GSM sort out and through web generation of data base. It can moreover bind the imperativeness use by demonstrating the over essentialness use. The

proposed system keeps up a vital separation from control theft to broad degree and impacts the essentialness to meter precisely planned. This meter extends the pay of the Government by perceiving the unapproved changing in the electrical links. The proposed technique can be stretched out for customized control cutting if the bill isn't paid.

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