Smart Meter Reading and Theft Control System by Using GSM

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Abstract- **this paper introduces a modified management system for smart electrical energy meter. The proposed smart meter has feature to inform the consumer about energy consumption, this feature serves energy consumption reduction by self-awareness of real consumption. The other important feature is to eliminating the difficulties by direct contact by employee and consumer to getting the reading of the conventional meter and also reduction of error in bill. The proposal system consists of two parts: client's side part (the prepaid meters in consumer houses) and server side (electrical sub-station). The client part consists of an RFID reader, credit cards, GSM network, Arduino microcontroller and electronic meter. The system operates with high accuracy which could tell the user the amount of energy consumed at any moment and these results the user will be urged to rationalize energy consumption.**

Index Terms- Energy Meter; Microcontroller; RFID ; GSM.

I. INTRODUCTION

The prepaid energy meter may not be familiar in Iraq though it has been used in numerous countries. This system designed for the customer's to control of the amount of energy consumption and electrical bills. This system also gives to the customer used electricity through his own bill and that advantageous in some cases such as moving house, hotel and flat. This paper aimed to develop the prepaid metering system by using GSM and RFID technologies [1]. The current energy meter that depends on RFID technology have employ (read) types of RFID systems to activate the energy meter and supply power to the consumer [2,3]. Furthermore, several studies about this subject such as S. Ganurkar and P. Gour, in 2014 [4] proposed a prepaid energy meter use two microcontrollers Atmel's AT89S52 family and AT24C02. the prepaid cards are used for a different range (i.e. Rs. 50, Rs. 100, Rs. 20 etc.) and

energy meter used to which the number of charging unit that be loaded. M. Haque, et al., in 2011 [5] proposed a single phase electronic prepaid energy meter by using two microcontrollers and IC energy meter. The consumption of energy is calculated using the output pulses of the energy meter IC and the internal counter of microcontroller (ATmega32). A microcontroller (ATtiny13) is used as a smarts cards and the number of unit recharged by the consumer is written in it. M. Rahman, et al., in 2015 [6] proposed An advanced metering and billing system based on Arduino and GSM with smart energy meter, it can read andEase of Use send data by wireless protocol using GSM technology through GSM modem, also it can manage the meter and the line connection. A Jain and M. Bagree, in 2011 [7] proposed amodel of mobile prepaid meter using mobile communication. In this a prepaid card able to communicate with power utility by using mobile communication is attached to the energy meter. The idea has been implemented in Matlab and results obtained have been presented by the authors. M. W. Raad et al., in 2007 [8] proposed a system that used an IP-based controller in addition to a power meter, providing efficient online control of the amount of electricity consumed by the user. Ch.Sumalatha, A.Viyayamanasa , and others, in 2016 [9] proposed a bank locker security system based on RFID and GSM technology. The system allows authentic person to recover money from bank locker. The system consists of microcontroller AT89C52, RFID reader, GSM modem, keyboard, and LCD, The RFID reader reads the id number from passive tag and send to the microcontroller, if the id number is valid then the person has an access to open the locker.

The main contribution of this paper the system work depends on the number of electrical pulses that directly proportion to the increasing of consumption

in the same microcontroller that interfaces with the GSM and supported with prepaid card represented by RFID card for the wireless collecting of the energy data of the consumers in addition to crystal display (LCD) to monitoring the consumption.

II. RFID SYSTEM

Radio Frequency Identification (RFID) now day is the wildly uses as wireless sensor system. Each RFID tag in the system is assigned a unique ID (UID). The RFID tag with the memory also records the on-demand information. Due to the popularity of RFID, a number of applications based on local or small area are proposed. Based on short-range wireless signals, RFID tag users can be monitored within a specific area. In other words, RFID systems are commonly used for hardware identification in many applications [10]. Some access control systems are also based on RFID systems. An RFID ticket or RFID card is used to identify whether a user is legitimate. In addition, since RFID tags can be used as identification, this means that applications that use software encryption as an identifier to protect the intellectual property of the application or file can also use RFID tags [11] [12].

III. PROPOSED SYSTEM DESIGN

The designed system uses the GSM technology and prepaid card represented by RFID card for the wireless collecting of the energy data of the consumers. This requires use special type of the energy meters to compatible with the proposed system. The system work depends on the number of electrical pulses that directly proportion to the increasing of consumption. The calculated number of pulses consumed is transferred to Arduino microcontroller, which is provided with liquid crystal display (LCD) to show consumption and EEPROM to keep consumer data when the power is shutdown. The server part consists of GSM and Arduino compatible. The database has a table of three fields: identity, authenticity and credit. The RFID reader reads the cards ID and sends it to the server through the GSM. The server checks the validation of that ID in the database and updates its information if necessary then sends back that information. The microcontroller receives the information and takes an action based on it. The credit will be decreased when the consumer uses power. If the credit is equal to zero the relay will open and electricity will be off, and while the credit is greater than zero the relay will be on close state and electricity will be on. Fig.(1) shows the block diagram of the main parts of the system which are:
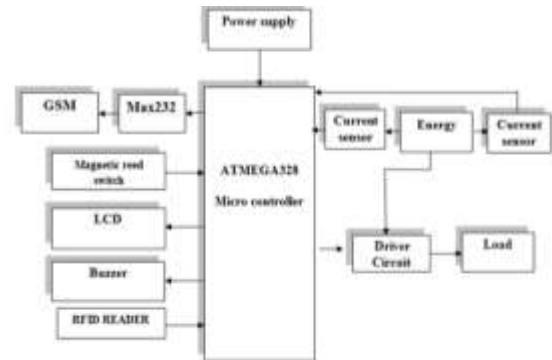

Figure 1: Block Diagram

A. Electronic Energy Meter

The energy meter used in proposed system is LUNA single phase electronic meter standard compliant active energy measuring with meter constant 1000 imp/KW. Shockproof and high temperature resistant elegant design is suitable for all installation housings. Upper and lower cover tamper monitoring system registers lawful openings of both covers and saves data in internal memory for retrieval. Built in optical read-out port for a handheld terminal is standard. Optional RS485 and RS-232 output ports allow LUNA Meters to be used in any Automated Meter Reading (AMR) system [13]. This Meter allows to the user obtain data stored in the electricity meter via the optical data port on all types of electricity meters. All registered data inside the meters can be read and easily exported to a computer file to help analyze data using other programs.

B. Seal Tempering Circuit

If the person theft the power in energy meter like, if he remove the seal which on energy meter then IR sensor will send the signal to PIC microcontroller then it will send the message to substation controller mobile through GSM modem

C. Bypass detection unit

If the person use a the power without connecting to energy meter, that means if he is bypassing the connection in energy meter without any reading in energy meter the person use power in houses at time

our circuit send a message to substation controller through GSM with help of PIC controller and cut the power supply automatically by using relay

D. Power Measurement Unit

In the power measurement unit, the one CT is used to measure total current used and measuring voltage, we use bridge of diode for converting AC to DC and then voltage divider circuit reduce voltage level at measurable scale.

E. GSM Modem &MAX232 IC

GSM Modem-Max 232 is built with dual band GSM engine-SIM 900A. As mentioned in the above sensing circuit there is power theft then it will send message to microcontroller as per our program and it will send message to GSM through Max 232. Also if mobile received SMS from authorized mobile phone to cut the supply, then supply is off by using relay.

F. LCD Display

The commonly used 16x2 LCD display custom made characters, numbers, alphabets, and special characters. When there is no theft occur in energy meter then the LCD will display voltage current and power. If theft is occurs then it display THEFT IS DETECTED

G. Arduino Board

The Arduino board (Mega) that has been used and its better features than the first version from a project issued by (Interaction Design Institute Ivrea) in Italy (Arduino UNO). The purpose was to simplify implementation of microcontroller projects in terms of hardware and software. And it is open source whereas the board offers the operating requirements for the microcontroller like the operating power, the oscillation circuit, and the connection pins to the external circuits by connecting them to other pins to make it easier to deal with them. One of the most important features of the Arduino microcontroller is that it does not require external programmer whereas it contains a Universal Serial Port (USB) for connection to the computer for the purpose of programming or data exchange and that reduces the cost and time [14].

IV. RFID BASED SMART METER

Radio-frequency identification (RFID) is a programmed recognizable proof strategy, depending on putting away and remotely recovering information utilizing gadgets called RFID tags or also known as transponders. The development requires some level of the coordinated effort of a RFID reader and the tag. A RFID tag is associated with or melded into a thing, animal, or a person with the true objective of recognizable proof and following using radio waves. A few tags can be read from a few meters away and past the line of sight (LOS) of the reader [5].

Following this strategy, the individuals utilize the RFID cards issued by the power providers. The energy could be purchased by recharging the novel RFID cards while utilizing the code in the card. At the point, when the buyer needs to utilize the electricity, he needs to demonstrate the card to the reader, at that point the one of a kind code inside the card is perceived by the reader, and begins deducting the RFID card amount according to the quantized unit charge. After utilization of whole amount, the consumer needs to recharge the RFID card again [5].

V. METHODOLOGY

The entire Circuit diagram has been shown below in Fig. 2. The power is measured by the energy meter with respect to time and is calculated by multiplication of voltage and current signals. The IC of energy meter generates pulses according to real power utilization. This energy meter calculates 1KWh for 3200 impulses, so rated as 3200imp/KWh, and there will be blinking of an LED for its every pulse. An Optocoupler has been connected to this LED so Optocoupler will be switched whenever LED blinks. We cannot directly connect energy meter's LED with Arduino because LED possesses analogue signals while we are feeding Arduino on the digital side. The pin number(D8) of Arduino is attached to the switching side of an Optocoupler for detecting pulses coming from energy meter. When a pulse occurs from energy meter, optocoupler is switched, pin D8 of Arduino detects a digital 0, otherwise it is not active and is in undefined state. There will be a count 1 to a data when there will be change on the state of the pin from digital 1 to 0. We have interfaced GSM module with Arduino UNO. The data communication pins are RX and TX, Arduino's RX pin is connected with GSM module's TX pin and

vice-versa. Before connecting GSM module with Arduino, a valid SIM card must be installed in SIM card port of GSM module. All ground pins GND are connected together. For switching purpose (ON/OFF) to supply a relay is being used. We cannot connect Arduino directly with relay because as Arduino has ATMEGA328P processor and its pins can supply roughly 25mA, Processor pins have large effective resistance and a high voltage will "drop" as increasing current is drawn and a low voltage will rise as load increases. Pins may be specific with a maximum short circuit current but at that point a high pin will be pulled low and a low pin will be pulled high so short circuit current has limited applicability. So, relay is connected with Arduino through ULN2003 IC or relay driver, ON/OFF instructions are sent over to relay driver by Arduino and it can turn ON/OFF relay. LCD is also interfaced with Arduino digital pins (7, 6, 5, 4, 3, 2) on which we can see how much units are purchased, remaining units and balance, etc. [7]. Fig. 3 shows the flow diagram of processes involved in prepaid energy meter scheme.
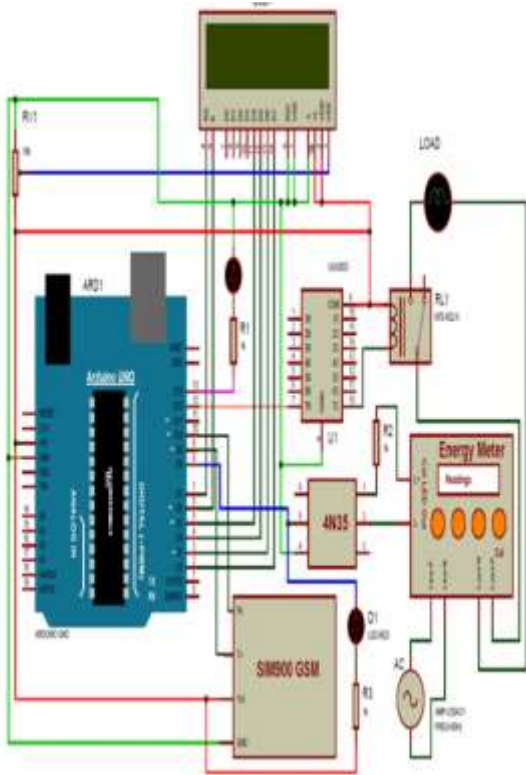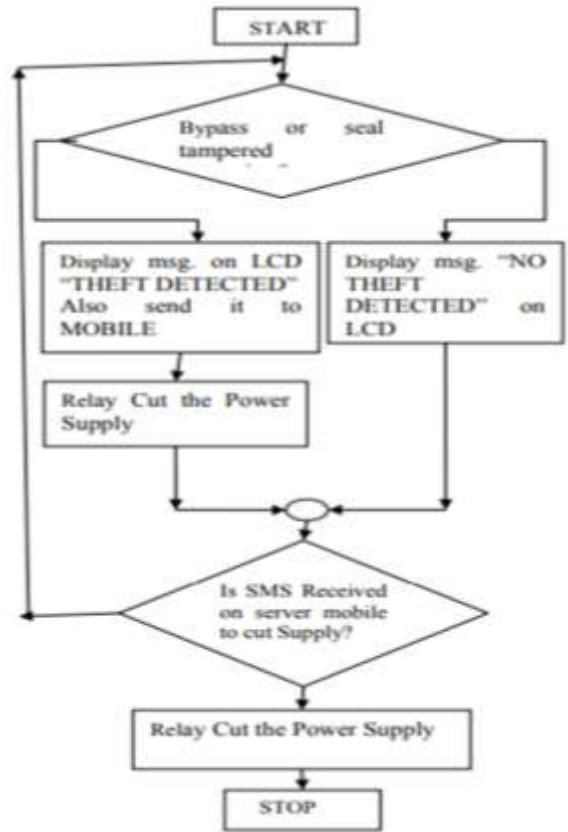

Figure:Circuit diagram of prepaid energy meter

VI. FLOW CHART

The hardware of the automatic meter reading and theft control system by using GSM module our project at designing such a system which will automatically collect the reading and also detect the theft. Current transformer is used to measure the total power consumption for house or industrial purpose. This recorded reading is transmitted to the electricity board as per his demand for transmitting the reading of energy meter GSM module is used. The energy theft is control by IR sensor, IR is placed in the screw portion of energy meter seal. If the screw is removed from the meter message is send to the electricity board. The measuring of energy meter and monitoring of IR sensor is done with a PIC microcontroller. Then bypass of meter is detected by using to CT. One is in energy meter another is placed on electricity pole.

VII. CONCLUSION

The advancement in power distribution system is non-stop process and new technology is always in progress. In this paper, an Arduino and a GSM based smart prepaid energy meter has been proposed. Units

are purchased by using GSM technology and those units are deduced according to electricity usage. This project presents a single-phase energy meter for domestic consumers with prepayment billing method. The significant preferred standpoint is the capacity of this system to update the current conventional meters into smart prepaid meters with a connection of Arduino and GSM (Prepaid Module). This kills the need of totally supplant the energy meters. Cost is the main important factor of this work which is quite high but will reduce from 3 to 4 times after implementation of this project. Nowadays as power supply companies need labour for meter reading after implementing this, there will be no need of so many meter readers and lots of money will be saved. The idea of prepayment electricity bill prior its usage is being gradually accepted around the world, and that's why the market for prepaid energy metering is growing. After having many advantages, this project still needs more safety check and modification especially the GSM module for the network coverage of SIM which is being used, should be strong so that the GSM can work properly.

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