International Journal of Research Publication and Reviews

Prepaid Energy Meter using GSM Technology

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ABSTRACT :

The aim of the paper is to minimize the queue at the energy meter billing counters and to restrict the usage of energy meter automatically, if the bill is not paid. The project also aims at proposing a system that will reduce the loss of power and revenue due to power thefts and other illegal activities. This technology holds good for all electricity distribution companies, private communities, IT parks and self-containing housing projects. The implementation of this paper will help in better energy management, conservation of energy and also in doing away with the unnecessary hassles over incorrect billing. The prepaid card communicates with the power utility using GSM communication network. Once the prepaid card is out of balance, the consumer load is disconnected from the utility supply by the latching Relay (contactor). This paper demonstrates the use of prepaid energy meter system. If we use this system it will be beneficial for the consumer to manage power. It is easy to operate and cost effective. Another advantage of the prepaid system is that the human errors in taking meter readings and processing bills can be reduced to a large extent.

Keywords: Prepaid,Energymeter, GSMmodule

1.Introduction

The electric metering instrument era has come an extended manner from what it became extra than one hundred years in the past. From the authentic bulky meters with heavy magnets and coils, there have been many inventions that have ended in size & weight loss further to improvement in features and specifications. Decision and accuracy of the meter have seen tremendous improvements over time. Introduction of the digital meter in the later part of remaining century has completely changed the manner electrical parameters are measured. Beginning with voltmeters & ammeters, the digital meter has conquered the complete spectrum of measuring units due to their benefits like ease of reading, higher decision and rugged production. Of specific importance is the advent of the electronic power meter inside the mid-Nineteen Eighties. Now a days, the power consumption and strength distribution has grow to be a huge difficulty for dialogue due to large difference in electricity manufacturing and intake. On this regard, electricity purchasers are facing such a lot of troubles due to the common electricity failures; every other crucial purpose for power cuts is because of the un-limited power consumption of rich human beings. In this aspect, to reduce the power cuts and to distribute the electricity similarly to all regions, some restrict have to have over the energy consumption of every and each power customer, and in step with that the authorities have to enforce a policy, with the aid of introducing self reliant strength meters anywhere in home area. As a result, the want has come to think in this line and a solution must be emerged out

.2.Literature review:

His paper praposesa initiative design to develop a system based on Prepaid Energy meter using GSM. To define revenue management as the application of information systems and pricing strategies to allocate the right capacity to the right customer at the right price at the right time. [1]

Revenue management is an important tool for matching supply and demand by segmenting customers into different segments based on their willingness to pay and allocate limited capacity to the different segments in a way that maximizes company's revenues.[2]

Bluetooth based home automation system. (a) Host and client modules in a Bluetooth piconet. (b) An individual client module. N. Sriskanthan et al. Semantic Scholar extracted view of "Bluetooth based home automation system" by N. Sriskanthan et al.[3]

3. Methodology

The electrical metering device generation has come a long way from what it turned into more than one hundred years ago. From the authentic bulky meters with heavy magnets and coils, there had been many innovations which have led to size & weight loss in addition to development in functions and specs. Decision and accuracy of the meter have seen giant enhancements over the years. Advent of the virtual meter in the later a part of final century has completely changed the way electrical parameters are measured. Beginning with voltmeters & ammeters, the virtual meter has conquered the entire spectrum of measuring contraptions due to their blessings like ease of analyzing, higher decision and rugged production. Of specific importance is the creation of the electronic energy meter inside the mid-Eighties. Now a days, the electricity consumption and energy distribution has come to be a big problem for dialogue because of huge distinction in power manufacturing and intake. Fig(1) shows the old version of self reliant strength meter, power clients are dealing with so many issues due to the common electricity disasters; every other crucial motive for power cuts is due to the un-restrained power intake of rich humans. In this component, to reduce the power cuts and to distribute the strength similarly to all regions, some limit have to have over the electricity intake of each and each electricity customer, and according to that the government should put in force a policy, with the aid of introducing autonomous power meters anywhere in home quarter. Consequently, the want has come to assume on this line and an answer must be emerged out.

Fig.(1). Autonomous Energy Meter

GSM/GPRS module is used to establish communication between a computer and aGSM-GPRS system. Fig (2) Global System for Mobile communication (GSM) is an architecture used for mobile communication in most of the countries. Global Packet Radio Service (GPRS) is an extension of GSM that enables higher data transmission rate. GSM/GPRS module consists of a GSM/GPRS modem assembled together with power supply circuit and communication interfaces (like RS-232, USB, etc) for computer. The MODEM is the soul of such modules
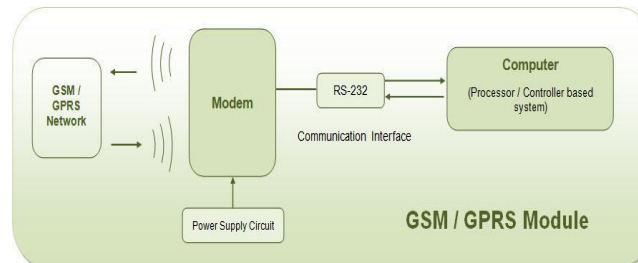
Fig(2). GSM/GRPS Module

3.a. Wireless MODEMs

Wi-fi modems are the modem gadgets that generate, transmit or decode information from a cellular community, for organising verbal exchange among the mobile network and the pc. These are manufactured for specific cellular community (gsm/umts/cdma) or unique cellular statistics preferred (gsm/umts/gprs/area/hsdpa) or technology (gps/sim). Wi-fi modems like other modem gadgets use serial communicationto interface with and want hayes well matched at instructions for communique with the computer (any microprocessor or microcontroller machine).

1.   Acquire, send or delete sms messages in a sim.

2.   Study, upload, seek phonebook entries of the sim.

Three.   Make, acquire, or reject a voice name.

The modem wishes at commands, for interacting with processor or controller, that are communicated via serial communication. Those instructions are sent by way of the controller/processor. The modem sends again a end result after it receives a command. Exclusive at instructions supported with the aid of the modem can be sent by using the processor/controller/pc to interact with the gsm and gprs cell community..

3.b.GSM/GPRS Module

A GSM/GPRS module assembles a

GSM/GPRS modem with standard communication interfaces like RS-232 (Serial Port), USB etc., so that it can be easily interfaced with a computer or a microprocessor / microcontroller based system. The power supply circuit is also built in the module that can be activated by using a suitable adaptor.

Mobile Station (Cell phones and SIM)

A mobile phone and Subscriber Identity Module (SIM) together form a mobile station. It is the user equipment that communicates with the mobile network. A mobile phone comprises of Mobile Termination, Terminal Equipment and Terminal Adapter.
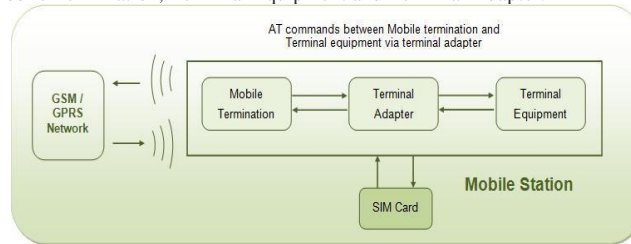
Fig(3). Mobile Station

3.c.Mobile Termination

Mobile transmission is interfaced with the GSM mobile network and is controlled by a baseband processor. It handles access to SIM, speech encoding and decoding, signaling and other network related tasks. The **Terminal Equipment** is an application processor that deals with handling operations related to keypad, screen, phone memory and other hardware and software services embedded into the handset.

3.d.Applications of GSM/GPRS module

The GSM/GPRS module demonstrates the use of AT commands. They can feature all the jfunctionalities of a mobile phone through computer like making and receiving calls, SMS, MMS etc.

AT Commands

AT commands are used to control MODEMs. AT is the abbreviation for Attention. These commands come from Hayes commands that were used by the Hayes smart modems. (devices that involve machine to machine communication) need AT commands to interact with a computer. These include the Hayes command set as a subset, along with other extended AT commands.

AT commands with a GSM/GPRS MODEM or mobile phone can be used to access following information and services:

- Information and configuration pertaining to mobile device or MODEM and SIM card.
- SMS services.
- MMS service
- Fax services.
- Data and Voice link over mobile network.

The Hayes subset commands are called the basic commands and the commands specific to a GSM network are called extended AT commands.

Using a Single AT Command

Prepaid Electricity Energy Meter is a good concept in which you can recharge its balance, like we do in our mobile phones. In this project we are building a automated system by **using Arduino and GSM module**. You can recharge the electricity balance through this system, just by sending a SMS. It can also disconnect the home power supply connection, if there is low or zero balance in the system. And this system will **reads the energy meter readingsand automatically send some updates** to user's mobile phone like low balance alert, cut off alert, resume alert and recharge alert.

3.e.Working Explanation

Here we have **interfaced electricity energy meter with Arduino** using the pulse LED (Calibration or Cal) of electricity Energy meter. We only need to connect tis CAL LED to Arduino through an **Optocoupler IC**.

Components used:

- Arduino
- GSM Module
- 16x2 LCD
- Analogue Electricity Energy Meter

- Optocoupler 4n35
- Resistors
- POT
- Connecting wires
- Bulb and holder
- SIM card
- Power supply
- Mobile Phone

When we power up the system then it reads previous values of rupees stored in EEPROM and restores them into the variables then checks the available balance with the predefined value and take action according to them, like if available balance is greater than 15 rupees then Arduino turns On the electricity of home or office by using relay. And if balance is less than 15 rupees then Arduino sends a SMS to user phone regarding low balance alert and requesting to recharge soon. And if balance is less than 5 rupees then Arudino turns Off the electricity connection of home and sends a SMS to user's phone for 'Light Cut' alert and requesting to recharge soon. GSM module has been used to send and receive messages, you can check about the GSM Module

GSM Module is used in many communication devices which are based on GSM (Global System for Mobile Communications) technology. It is used to interact with GSM network using a computer. GSM module only understands *AT commands*, and can respond accordingly. The most basic command is "AT", if GSM respond OK then it is working good otherwise it respond with "ERROR". There are various AT commands like ATA for answer a call, ATD to dial a call, AT+CMGR to read the message, AT+CMGS to send the sms etc. AT commands should be followed by Carriage return i.e. \r (0D in hex), like "AT+CMGS\r". We can use GSM module using these commands:

ATE0 For echo off

AT+CNMI=2,2,0,0,0 <ENTER>   Auto opened message Receiving. (No need to open message)

ATD<Mobile Number>; <ENTER>   making a call (ATD+919610126059;\r\n)

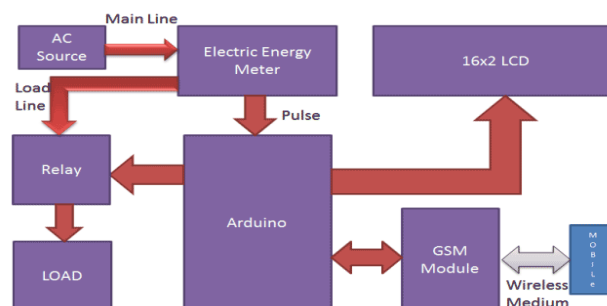AT+CMGF=1 <ENTER>   Selecting Text mode

AT+CMGS="Mobile Number" <ENTER> Assigning recipient's mobile number

>>Now we can write our message

>>After writing message

Ctrl+Z send message command (26 in decimal).

ENTER=0x0d in HEX

Fig(4). Block Diagram based on Prepaid Energy Meter

Now when we need to recharge our system, we can recharge it simply by sending a SMS to the system, through our Cellphone. Like if we want to recharge by 45 bucks then we will send #45*, here # and * are prefix and suffix to the recharge amount. System receives this message and extract recharge amount and update the balance of system. And system again turns On the electricity of the house or office. lThis flow of working can be understood through the video at the end.

Circuit connections for this **Wireless Electricity Meter Reading Project**, are shown in the fig (4) we have used a <u>Arduino UNO</u> for processing all

the things used in project. A liquid crystal display is used for displaying the status of Units and remaining balance. Data pins of LCD namely RS, EN, D4, D5, D6, D7 are connected to Arduino digital pin number 7, 6, 5, 4, 3, 2. And Rx and Tx pins of GSM module are directly connected to the Tx and Rx pins of Arduino respectively. And GSM module is powered by using a 12 volt adaptor. A relay is used for switching electricity connection which is connected at pin 12 of Arduino though ULN2003 relay driver.
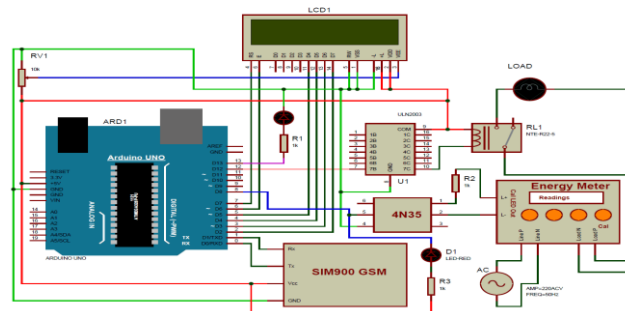

Fig.(5) Circuit Diagram of Prepaid Energy meter

How to Connect Energy Meter with Arduino:First user need to buy an Analogue Electricity Energy Meter. After it user needs to open it and find the Pulse LED or Cal LED's terminals (cathode and Anode). Now solder two wires at both the terminals and take it out from the energy meter and then close energy meter and tight the screws.

Calculation of Pulses and Units: Before proceeding for the calculations, first we have to keep in mind the pulse rate of energy meter. There are two pulse rates of energy meter first is 1600 imp/kwh and second is 3200

So first we need to calculate the Pulses for 100watt, **means how many times Pulse LED will blink in a minute**, for the load of 100 watts.

Pulse= (Pluse_rate*watt*time)/ (1000*3600)

So pulses for 100 watt bulb in 60 seconds, with energy meter of 3200 imp/kwh pulse rate can be calculated as below:

Pulses=3200*100*60/1000*3600

Pulses = ~5.33 pulse per minute

Now we need to calculate Power factor of a single pulse, means how much **electricity will be consumed in one pulse**:

PF= watt/(hour*Pulse)

PF=100/60*5.33

PF=0.3125 watt in a single pulse

Units= PF*Total pulse/1000

Total pulses in an hour is around 5.33*60=320

Units = 0.3125*320/1000

Units = 0.1 per hour

If a 100 watt bulb is lighting for a day then it will consume

Units =0.1*24

Units = 2.4 Units

And suppose unit rate is at your region is 5 rupees per unit then

You have to pay for 2.4 Units Rs:

Rupees= 2.4*5 = 12 rupees

4.Advantages

You may nevertheless switch provider. Gives you control over your energy spend. Gives you manipulate over your strength spend. Your meter is loaded with "emergency credit score" in case you run out of credit score. You may get a clever prepayment meter mounted, allowing you to pinnacle up out of your cellphone or pc.

5. Disadvantages

The unit quotes have a tendency to be more highly-priced. You need to hold an eye at the balance. Confined amount of tariffs to pick out from. In case you run out of emergency credit, you'll burst off deliver. The inconvenience of getting to pinnacle-up. When you have an older meter it will want to be manually updated after fee adjustments, that means you can be overpaying or underpaying for a while.

4.Future Scope

This method will reduce the energy wastage and save a lot of energy for future **use** Measurement of parameters like power line current and power line voltage has not been available in a satisfactory way to optimize power network management.

5.Result

The advancement in a 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 kills the need of totally supplant the energy meters. 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). 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.

6.Conclusion

In conclusion,we had found that the majority of people who are using the prepaid electricity meter are satisfied with the system as they are more alert and well informed of their electric usage; thus encourage them to be more preserved in their energy as well as financial practise. They would also encourage other people to adopt the prepaid electric meter into their homes as it may prevent outstanding debts to the government.

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