

ZigBee Based Advanced Energy Prepaide Meter

Bharat Indorey

*Department of Electronics & Communication Engineering, J.I.T. Boranwa-451228(mp)
Rajiv Gandhi Technical University Bhopal (India)*

M. Lokhande

*Department of Electronics & Communication Engineering, J.I.T. Boranwa-451228(mp)
Rajiv Gandhi Technical University Bhopal (India)*

Abstract -The present system of energy billing in India is error prone and also time and labour consuming. Errors get introduced at every stage of energy billing like errors with electro-mechanical meters, human errors while noting down the meter reading and error while processing the paid bills and the due bills. There are many cases where the bill is paid and then is shown as a due amount in the next bill. There is no proper way to know the consumer's maximum demand, usage details, losses in the lines, and power theft. The remedy for this drawback is overcome by APEMS (Advanced Prepaid Energy Metering System).

The GSM module provides a mode of communication between the user/meter and the EB Station. This will enable the user to recharge his/her electricity account from home. This will also enable the user to carry his/her electricity account with him, eliminating the need to set up a new account every time the user changes homes. The GSM module will also get real time electricity rates and enable the utility to keep a check on electricity theft. This can also be applied in institutions/companies for creating awareness for saving energy among employees.

Keyword-GSM Modem, Optocoupler, Relays, Energy Meter, APE

I. INTRODUCTION

GSM Modem is mainly used to introduce the pre-paid concept in energy meter. GSM which stands for Global System for Mobile Communication is widely used mobile communication architecture used in most of the countries. With the help of GSM modem one can embed a feature of pre-paid through mobile, also one can recharge energy meter through mobile by SMS. The GSM modem loads the recharge amount in one of the register of controller. For each pulses received at interrupt pin, the controller decrement the content of the register which is equivalent to the recharged amount left. If the content of the register falls below the threshold level, the controller activates the GSM to send a message to the user which indicates that amount left in the meter is low. In this paper, we implement the centralized monitoring of energy consumption, while making it prepaid. i.e., consumers can recharge their Energy Meters for an amount of their choice. Recharging is similar to that of a mobile phone. The GSM transmits the exchanged data between the end-users, which are the EB Station and the customer. The use of GSM module provides a feature of pre-paid through SMS. The keypad is used to get banking information from an electricity customer, and the LCD will display the user's account balance and the present electricity rate. PIC controller count the amount of energy consumed and display the remaining amount of energy on the LCD [1]. When the balance goes below the threshold, the GSM module will automatically send a reminder text message to the user to refill the account. Once this amount expires, the connection will be terminated automatically, using the relays within the meter itself.

II. RELATED WORK

Mr. Nazir Bin Abdullah [1], developed an automatic meter reading system (Automation of Residential Electricity Cut off Using Embedded Controller) In 2012 for domestic user. In this project he used GSM modem for transmitting and receiving information, both sides means user side and energy provider side. The heart of this project is a embedded device (microcontroller unit) which control the main power switch and update the data in data base .with help of this project user shows their energy consumption and billing information. Mr. Hung Cheng Chen[2] proposed a wireless automatic meter reading system in 2012. In this project he used zigbee modul on both sides. This technology is chip and low cost. Mr. Alauddin Al – Omary[3] developed an automatic meter reading system using GPRS technology In 2011 .This paper the design of secure low cost AMR system that calculate and transmit the total electrical energy consumption to main server using GSM technology .The AMR system perform the main three function such as taking meter reading ,transmission

facility and billing information. MR.LI Quan Xi[4] design a automatic meter system based on ZigBee and GPRS system In 2010 . Mr. H.G.Rodney Tan[5] Develop an automatic power meter reading system using GSM network.in 2007.In this system GSM digital power meter installed in every consumer unite and electricity ebilling system at the energy provider side. Mr. Mejbauai Haque[6] develop a microcontroller based single phase digital prepaid energy meter for improved meter and billing system .In this paper he present a single phase energy meter IC.This digital prepaid meter does not have any rotating part .The energy is calculated using the output pulse of energy meter and the counter of microcontroller. Amit jain [7],proposed a prepaid meter using mobile communication in2011.In this system he used controller unite,prepaid card and communication module .The prepaid card is the most important addition to the design .The power utility sets the amount in the prepaid card to a measure that the consumer recharges the cards ,called fixed amount.The tariff rates are already programmed and fed into the card. Fawzi Al-Naina and Bahaa Jalil[8],Built a prototyping prepaid electricity meter system based on RFID .This system is divided into two part such as client and server .The client consist of a digital meter based on a microcontroller and an RFID reader and the server consist of a PC with MySQL database server.The client installed in each house and the server installed in local sub station.

III. PROPOSED WORK

In this research, Energy meters have not been replaced which is already installed at our houses, but a small modification on the already installed meters can change the existing meters into prepaid meters, so this meters are very cheaper. The present energy meter can be upgraded to this prepaid version.

IV. INTERFACING ELEMENTS

A.LCD and Keypad interface with Microcontroller The LCD acts as an interface between the user and the Energy meter. The matrix keypad is interfaced with the PIC microcontroller hence the input is given to the PIC microcontroller using the keypad[2]. The LCD displays the character corresponding to the data received from the PIC microcontroller. If the data entered is correct, then the data is transmitted to the EB station by the GSM Modem. If the data entered is incorrect, an Invalid message is displayed on the LCD.

B.MAX 232 and DB9 interfacing,The data will the transmitted to the EB Station through Serial communication. Using MAX232, the data will be received and transmitted from/to the PIC microcontroller using GSM Modem. Once the EB Station receives the transmitted message, it responds by automatically recharging the Energy meter with the specified amount .

C.Opto-coupler interfacing,When one unit of Electricity is consumed, an interrupt is given to the PIC microcontroller using Opto-coupler [4]. When one interrupt is received by the controller, it decrements the recharged amount equals to one unit of electricity.

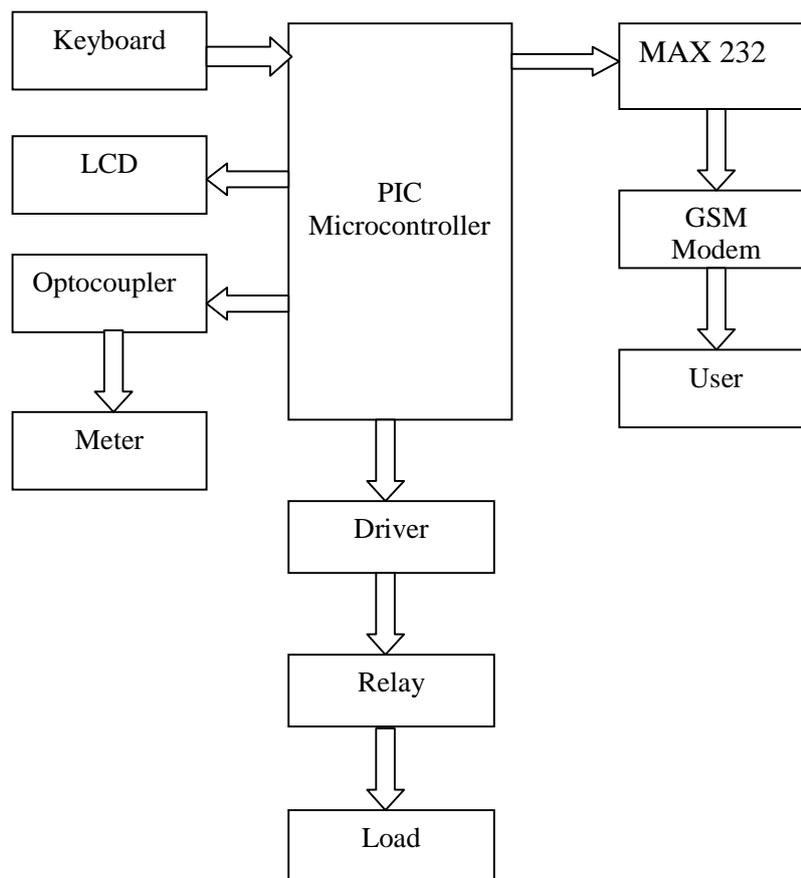
D.Interfacing of Relay and Relay driver,A Relay is an electrically operated switch. When the recharged amount reaches 80% by consuming the electricity, the user will get a warning message to recharge the Energy Meter[7].When the recharged amount gets over, the household power supply will be cut off using the relay. The relay driver is used to drive the relay at 12V and also it is used to prevent the back current from the relay to PIC microcontroller.

V. PROJECT DESCRIPTION

The power supply is given to the Energy Meter. The unit readings from the energy meter are calculated using the sensor and the value can be stored in the PIC microcontroller. The code can be given using the Matrix Keypad to the PIC microcontroller and it is displayed in the LCD. The data can be transmitted and received from PIC to the MAX232 through UART. The serial communication can be achieved through the DB9 to the GSM modem. The code is sent to the EB station and acknowledge is received by the GSM Modem. The recharge amount can be stored in the PIC microcontroller[8] and it can be viewed through the LCD. When the recharged amount reaches 80% by consuming the electricity, the user will get a warning message to recharge the Energy Meter. When the recharged amount gets over, the household power supply will be cut off using the relay .When household again recharge their account , then further microcontroller send a message via SMS to the user. In this project Energy meter connected to microcontroller through the optocoupler. This system is low cost and highly reliable. With help of this system we can improve the system capability and reduced operation cost and theft activity of electricity.

VI. BLOCK DIAGRAM

Shows the block diagram of advanced electronic prepaid meter. In this project we use the PIC microcontroller which developed by microchip. It is available in 28,40 and 44 pin package. These microcontroller has some important feature such as 35 single word instruction, 20MHz clock input, 8K x 14 word of flash memory, 368 x 8 byte of data memory, two 8 bit timer and one 16 bit timer and two comparator and 10 bit, upto 8 channel ADC. Energy meter is interfaced with the help of optocoupler. The load is connected to the relay which is driven by a driver by microcontroller. The LCD module display real time information of the system. By keypad we can edit the program of the system. The GSM modem connected to the microcontroller by the MAX 232 voltage level converter.



Block Diagram of GSM Based Energy Prepaid Meter

VII. PROPOSED ALGORITHM

The Pic Microcontroller is programmed using Embedded C Language using MikroC Pro Software. The algorithm of the program is given below.

Step 1: Start the program.

Step 2: Interface the LCD and the Keypad to the PIC Microcontroller.

Step 3: Initializing the LCD and the UART.

Step 4: Enter the card number.

Step 5: Configure the GSM and send number to the EB station.

Step 6: If the number is valid then receive the recharged amount from the EB station.

Step 7: If the number is invalid then enter the correct number.

Step 8: When the electricity is consumed, then the recharged amount will get decremented.

Step 9: When 80% of the recharged is consumed, then the user will get a warning message to recharge the Energy Meter.

Step 10: When the recharged money gets over, the relay cut-off the household power supply.

Step 11: Stop the program.

VIII.CONCLUSION

Advancement in Energy meters enables the customers to see the energy consumed and to manage the energy efficiently. To save money, the consumed energy corresponding price is displayed for the consumer benefits. This paper work exposes the purpose of energy monitoring and controlling by implementing prepaid system. It is hoped that this work helps the consumers for better energy management and its utility in the distribution system for economic liability of the Electrical Boards.

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