AUTOMATIC DISCONNECTION OF ENERGY METER USING GSM & MICROCONTROLLER

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Abstract: The technology of 'Electronic Metering' has been advancing rapidly and there is increased demand for a reliable and efficient Automatic Meter Reading (AMR) system with energy bill recovery. The present invention is related to automatic electricity power cut system which can save manpower needed for collecting the energy meter reading and bill distribution process. This system consists of an electricity permitted device including verification device, processing unit, wireless communication unit & display devices. The purpose of invention is to improve energy meter billing and distribution as well as connecting or disconnecting connections wirelessly. The main purpose of this project is presenting a design of a simple, low cost wireless GSM energy meter and its associated web interface, for automating billing and managing the electricity disconnection, if consumer not paying bill in allotted time. The traditional meter reading method is replaced by this proposed system, enabling remote access of existing energy meter by the energy provider. Also, they can monitor the meter readings regularly without the person visiting every house. A GSM based wireless communication module is integrated with electronic energy meter of each entity to have remote access over the usage of electricity. A PC with a GSM receiver is at the other end, which contains the database acts as the billing point. Live meter reading from the GSM enabled energy meter is sent back to this billing point periodically and these details are updated in a central database. The complete monthly consumption and due bill is messaged back to the customer after processing these data.

Keywords: ATMEGA-16 microcontroller, GSM modem, energy meter Introduction

I. INTRODUCTION

Electricity is now being an important basic need for any country for sustaining development or to be developed. For the electricity department, collecting energy meter readings as well as distribution is an important part. Again, the revenue collection of this energy bills is another teddy task for department. This invention relates to a design of a smart power cut system. Particularly, this invention is relates to the electricity department, which faces trouble of power line disconnection if the costumer/consumer is not pay the electricity bill. This concept gives us more economic, secure and flexible solution for the problem of disconnection. This system consists of a electricity permitted device which includes verification device, processing unit, a wireless commutation unit and display devices. The system unit identifies accurate electricity bill which will feed on main server and customer, as well as verifies its authentication and then allows electricity department to on or off the power line of consumer. If the electricity bill is not payable, after that only power cut system will get activated for a specified time and immediate after completion of meter reading it will send information to processing unit. This unit will forward the detail information of meter reading per month to the authority using wireless commutation unit. If the electricity bill is not pay by customer, the authority will disconnect electricity. By this way the power cut system will work more precisely using minimum resources.

II. LITERATURE REVIEW AND RELATED WORK

The technology of e-metering has gone through rapid technological advancement & there is inversed demand for reliable & efficient AMR system. This proposed system replaced traditional meter reading methods. They can monitor meter reading regularly without person visiting each house. Thus provides automatic billing and managing collected data globally [1]. The smart card system has been designed and implemented has benefit of using secure smart card to login to the network and control amount of money needed to be spent for the required electricity consumption based on the user profile store on the card. But it's quite difficult to alter whole system which ultimately increases installation cost [2]. The proposed system overcomes these problems as we are just extending the system without changing the current one. The automatic cutoff electric meter using Bluetooth displays the corresponding billing information and data is sent to the server through the Bluetooth. The consumer has to pay the bill in time, if couldn't , the power connection may be disconnected automatically from the remote server but the drawbacks of the system is it can only useful up to certain valid area /range[3]. But in this advanced system we can operate the system from anywhere.

III. SYSTEM OVERVIEW

The block diagram of prototype is shown in figure 1. The bridge rectifier is used to convert the 9V supply output of transformer into DC voltage. A voltage regulator IC 7805 is used to obtain fixed output voltage of +5V. Separate supply of same

specification requirement is used for microcontroller and GSM module. Energy meter shows total unit consumed to inform energy meter reading. The microcontroller used is ATMEGA-16 and GSM modem is SIM-800. The TXD pin of microcontroller is connected to the RXD pin of GSM model and vice–versa. The line driver ULN 2003 is used for increase in current. Automatic electricity power cut system consist of microcontroller for controlling all work, power supply is for providing the power to system, LCD display is for displaying the details to customer, wireless communication module connected for sending the voting data to the server, relay work for on and off the system. Signal transmitter and wireless receiver is for intercommunication in between two machines, electricity dept. server is for reading the personal identification information from customer. Power supply is for providing the power to the machines.

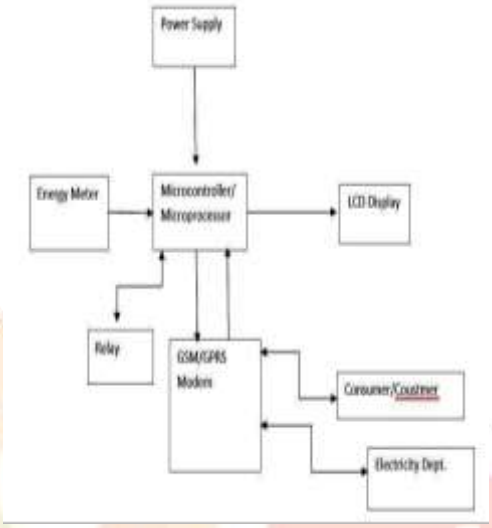


Figure 1**.** Block diagram of System

IV. CIRCUIT DIAGRAM

Figure 2 shows the complete connection diagram of our project. Here the whole project needs constant 5V DC supply to run the project. Optocoupler is connected to energy meter from one side & also to the ATMEGA-16 microcontroller from another side now optocoupler consist of LED & Transistor & energy meter connected to each other via a relation that no. of pulse generated in energy meter is detected by LED of optocoupler and get transmitted to transistor of optocoupler. Optocoupler connected to microcontroller which is connected to LCD & no. of pulses are displayed on LCD in terms of no. of unit's consumption. Now this same message of no. of unit's consumption will be send to the customers as well as to electricity board. Now there are two conditions,

A] If customers will be paid the bill within valid duration.

B] If customers unable to pay the bill within the valid duration.

So, these two conditions are described as,

A] If customers will be paid the bill within varied duration: As a customer get message of amount of unit's consumption and if he paid the bill within valid duration and if he does a message of payment to the system. Now, GSM read these messages and transmit the microcontroller. Our microcontroller has authenticated key which detect about the bill payment and if he paid the bill then system will have continued without any disconnection.

B] If customers unable to paid the bill within the valid duration: But if the customer is unable to pay the bill then the microcontroller has a code of unbilled which is send to both customer as well as electricity board. Now electricity board. send the message of disconnection of supply to the microcontroller and at the same time automatic disconnection of the energy meter takes place.

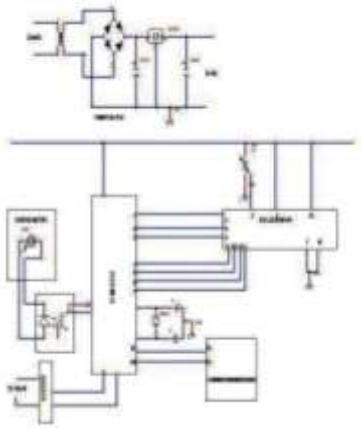


Figure 2. Connection diagram of system

V. HARDWARE REQUIREMENTS

5.1 Power supply : DC 5V Regulated

5.2 Microcontroller: ATMEGA16

5.3 GSM module: SIMCOM800

5.4 LCD display : [16×2] Display

5.5 Energy Meter : 5-30Amp, 50Hz

5.6. Relay : 5V

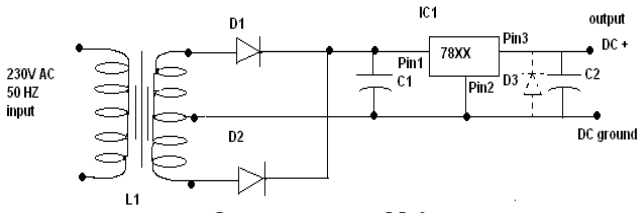
5.7 IC ULN 2003

5.8 Opto-coupler : 5V DC

5.9 Light : 60W

5.1 POWER SUPPLY

The power supply used in this project is shown in figure 3. The step down transformer is used which convert 9-0-9 V. We used bridge rectifier to convert the 9V supply output of transformer into DC voltage. A voltage regulator IC is used to have the fixed output voltage of +5V. For microcontroller and GSM module separate supplier are used of same specification requirement.



5.2 MICROCONTROLLER ATMEGA-16

The ATmega16 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega16 achieves throughputs approaching 1 MIPS per MHz allowing the system designed to optimize power consumption versus processing speed.

5.2.1 PIN CONFIGURATION

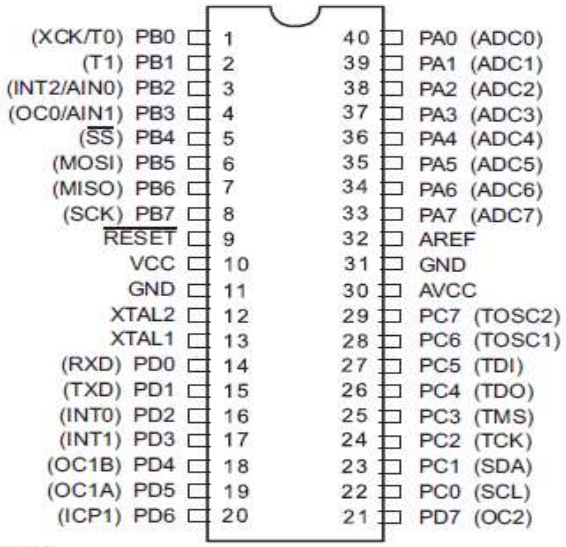


Figure 4. Pin Configuration

5.3 GSM SYSTEM

The global system for mobile communications (GSM**)** originally is the most popular standard for mobile phones in the world. GSM service is used by over 2 billion people across more than 212 countries and territories. As the GSM standard continued to develop, it retained backward compatibility with the original GSM phones; higher speed data transmission has also been introduced with enhance data rates for GSM evolution the release 99 versions of the standard.

Figure 5.GSM Module

For sending message, a GSM Module named SIMCOM 800 with RS232, power supply are used. This can be connected to PC by using a USB to Serial Adaptor. Terminal programs such as Real term are used to send & receive data. The interface between GSM Module and microcontroller can also be done directly with the help of wires. In this system GSM is used to send messages from customer to electricity board and vice-versa.

5.4 LCD DISPLAY

The display used here is 16x2 LCD (Liquid Crystal Display) that displays 16 characters per line by 2 lines. A very popular standard exists which allows us to communicate with the vast majority of LCDs regardless of their manufacturer. The standard is referred to as HD44780U, which refers to the controller chip which receives data from an external source (in this case, the Atmega16) and communicates directly with the LCD. Below fig shows the interfacing of LCD display with microcontroller ATMEGA 16.

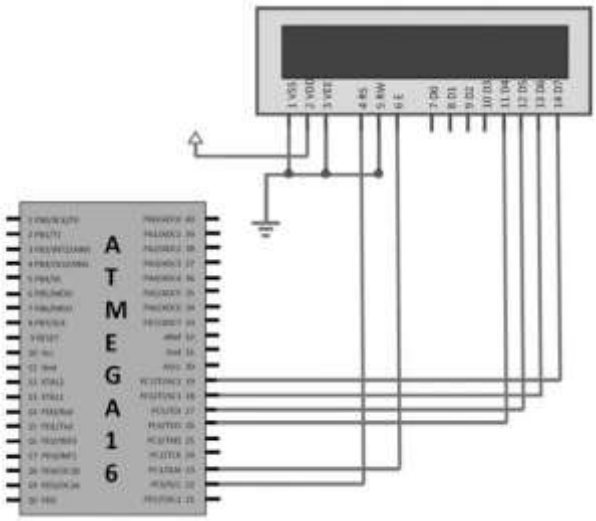


Figure 6.AT MEGA-16 interface with LCD display

5.5 ENERGY METER

An electricity meter, electric meter, electrical meter, or energy meter is a device that measures the amount of electric energy consumed by a residence, a business, or an electrically powered device. Electric utilities use electric meters installed at customers' premises to measure electric energy delivered to their customers for billing purposes. They are typically calibrated in billing units, the most common one being the kilowatt hour [*kWh*]. They are usually read once each billing period.

Figure 7. Energy Meter

5.6 RELAY

Relay is one of the most important electromechanical devices highly used in industrial applications specifically in automation. A relay is used for electronic to electrical interfacing i.e. it is used to switch on or off electrical circuits operating at high AC voltage using a low DC control voltage. A relay generally has two parts, a coil which operates at the rated DC voltage and a mechanically movable switch. The electronic and electrical circuits are electrically isolated but magnetically connected to each other; hence any fault on either side does not affect the other side.

Figure 8. Relay

Relays have the exact working of a switch. So, the same concept is also applied. A relay is said to switch one or more poles. Each pole has contacts that can be thrown in mainly three ways. They are

- **Normally Open Contact (NO)** – NO contact is also called a make contact. It closes the circuit when the relay is activated. It disconnects the circuit when the relay is inactive.

- **Normally Closed Contact (NC)** – NC contact is also known as break contact. This is opposite to the NO contact. When the relay is activated, the circuit disconnects. When the relay is deactivated, the circuit connects.

- **Change-over (CO) / Double-throw (DT) Contacts** – This type of contacts are used to control two types of circuits. They are used to control a NO contact and also a NC contact with a common terminal. According to their type they are called by the names break before make and make before break contacts.

5.7 IC ULN 2003

ULN2003 is a high voltage and high current Darlington array IC. It contains seven open collector darlington pairs with common emitters. A darlington pair is an arrangement of two bipolar transistors. ULN2003 belongs to the family of ULN200X series of ICs. Different versions of this family interface to different logic families. ULN2003 is for 5V TTL, CMOS logic devices. These ICs are used when driving a wide range of loads and are used as relay drivers, display drivers, line drivers etc. ULN2003 is also commonly used while driving Stepper Motors. Refer Stepper Motor interfacing using ULN2003.Each channel or darlington pair in ULN2003 is rated at 500mA and can withstand peak current of 600mA. The inputs and outputs are provided opposite to each other in the pin layout.

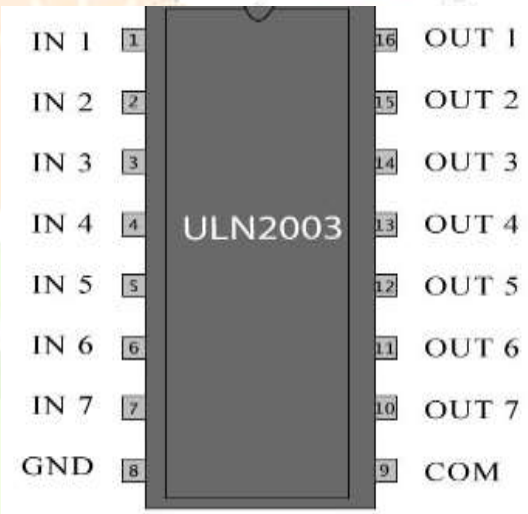


Figure 9. ULN2003

VI. FLOW CHART

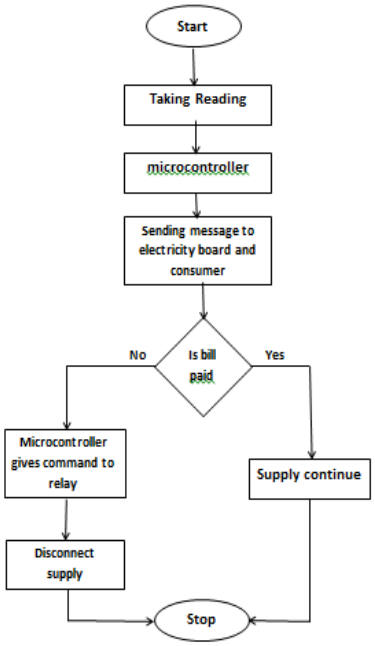


Figure10. Flow Chart

VII. ADVANTAGES

1. It provides automatic electricity power cut system.
2. It saves Manpower which must appoint.
3. It can disconnect power wirelessly.
4. It increases the recovery of bill percentage.
5. It reduces the total time required for energy bill distribution process.
6. It reduces the transportation cost process.
7. The system is compact and more economical and secure.
8. No standing in long queues.

VIII. DISADVANTAGES

1. System cannot operate satisfactorily in bad network areas
2. System failed to operate when the battery discharges

IX. RESULT

Figure11. Message Received By Consumer

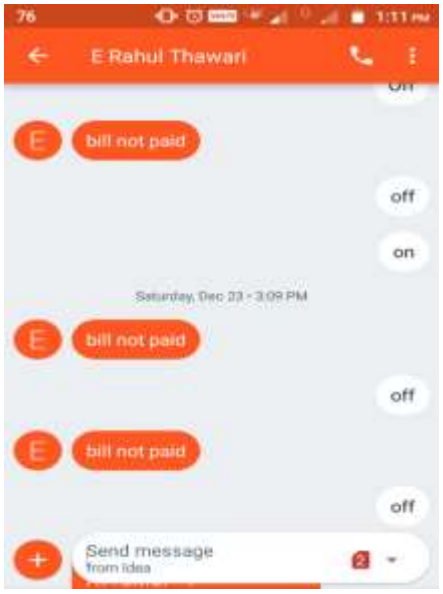


Figure 12. Message Received By Electricity Board

At the end of the month, the message of unit consumed and bill amount of consumer meter send on their own cell phones (shown in fig. no. 11) & also to Electricity department (shown in figure 12). They are allocated valid time for paying the bill amount After Payment consumer responsibility is to make message ' Payment ' (shown in figure 11) to the system and then their supply is continued. If they failed to do payment in valid duration system with the help of GSM sends the message to the electricity department as 'bill not paid ' (shown in figure 12) and then authority has right to disconnect the supply with simply messaging as 'off' (shown in figure 12) and supply will be disconnect automatically. Further after disconnecting of supply consumer will pay the bill for continuation of supply. When payment is done electricity department makes their supply on with messaging 'on' to the system automatically.

X. CONCLUSION

In this concept various electronic meters have been developed and are still being developed. However the use of GSM in this particular system provides numerous advantages over methods that have been currently used. Data transmission is charged at standard SMS rates, thus the charges are not based on the duration of data transmission. The cost efficient transmission of readings ensures that power consumption values can be transmitted more frequently to a remote consumer. The Implications of being able to transmit readings more often are that energy utilities will be able to generate timely bills, better understand energy demand patterns, manage meter failures more efficiently and manage fraud in better way.

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