AUTOMATIC POWER METER READING SYSTEMUSING GSM NETWORK

Dr.M.Aravind kumar Professor, Department of ECE**,** West Godavari Institute of Science and Engineering,Affliated to Jntuk, Andhra Pradesh, India
L.Sankar Associate Professor, Department of ECE **,**West Godavari Institute of Science and Engineering,Affliated to Jntuk, Andhra Pradesh, India
K.Sudha rani Assistant Professor, Department of ECE **,**West Godavari Institute of Science and Engineering,Affliated to Jntuk, Andhra Pradesh, India
T.Himabindu Assistant Professor, Department of ECE**,** West Godavari Institute of Science and Engineering,Affliated to Jntuk, Andhra Pradesh, India

Abstract:
Electricity is one of the most important requirements for living a comfortable and productive life, and it should be used wisely to ensure its optimal use. Energy Meter Reading system (AEMR) regularly read the energy meter and calculate total amount of bill at the set dead line and sends the message to service provider. From energy meter received data i.e. user name, meter ID, total units with paying amount this message maintained at database server which located at service provider department With the current energy meter reading and billing system, consumers are dissatisfied with the services provided by power companies. The majority of their complaints are about statistical inaccuracies in their monthly bills. Our project's goal is to build and install an automatic energy meter reading system that measures and transmits total energy consumption to the Electricity Provider via the GSM network, as well as remotely disconnecting and reconnecting the meter. This is accomplished with the help of a microcontroller unit that continuously monitors and records energy meter readings in a permanent memory location, as well as a GSM modem that allows remote monitoring and control of the energy meter. The suggested Microcontroller-based system continuously records readings, and on request, the live meter reading can be relayed to the provider using the GSM network's existing short messaging services (SMS). If necessary, this system can also be utilized to disconnect or reconnect the power supply to the customer. Each energy meter requires a dedicated GSM modem with a SIM card connected to the microcontroller's ports. This saves a lot of energy, and the consumer gets the most out of the electrical energy they pay for; as a result, there is an improvement in the quality, stability, and usage of electrical energy, as well as a reduction in human dependency.

Keywords: Digital Energy meter, GSM module, RTC, Microcontroller, MAX-232

Introduction:

Human operators perform a substantial amount of the meter reading for power use, moving from building to building to collect data for bill generation. The human operator must also visit the premises to disconnect the electricity supply in the case of consumers who do not pay their bills. To cover the requisite area of interest, a large number of operators and lengthy working hours are required. This method of meter reading for invoicing is prone to human mistake and takes a long time. Weather conditions may limit or stifle the operation. This billing system is inaccurate, inefficient, and raises the cost of meter reading for the energy provider. . The prepaid electronic energy meter was recently introduced, largely resolving the issue of having to visit the site to take meter readings. However, several issues remain, such as the prepaid card's vulnerability to damage or loss, the inability to provide real-time monitoring, and the inability to prevent theft. With the rapid improvement in wireless communication technology and microelectronics, the number of power consumers and commercial operations in the electrical industry has increased significantly. In order to accomplish efficient meter reading, eliminate billing mistake, and lower operational costs, it became increasingly vital to develop automatic electric energy meters to replace existing manual energy meters. Automatic meter reading is a cost-effective data gathering method that offers increased data accuracy, allows for more frequent readings, enhanced invoicing and customer service, timely energy

Profiles and consumption trend updates, and better human resource use. Several solutions have been proposed and developed based on various technologies such as Wi-Fi, Bluetooth, the internet, embedded Radio frequency modules, and power line connection to give the efficiency, dependability, These methods, on the other hand, either require a complex infrastructure setup, are too expensive to implement and operate, or have a short operating distance and still require human operators in the field [2][3]. The GSM-based Automatic Energy Meter detailed in this project takes advantage of the country's GSM infrastructure's nationwide coverage as well as the SMS feature to fulfill the goal of an efficient, reliable, and effective meter reading system.

2.1 Literature study:

Under the title "Automated wireless meter reading system for monitoring and managing power consumption," Homa Kesav and B. Abdul Rahim have proposed suggestions. The ARM7 LPC2148" microcontroller module receives data from the energy meter and executes essential control activities, such as breaking the circuit via the Relay control unit and sending the appropriate information to the mobile phone via the GSM communication module. The ARM7's MAX-232 is utilized as a serial communication interface for the GSM modem, which is used to transport data from the controller to the mobile phone. A 60W incandescent bulb is utilized as a load in the Load bank section to calculate energy usage.

"Smart Wireless Electronic Energy Meter Reading Using Embedded Technology" is a project led by Shraddha Male Pallavi Vethekar, Kavita More, and Prof. V. K. Bhusari. In this article, he concluded that the metering IC generates pulses, which are tallied using the PIC microcontroller unit's default timer. The automatic voltage regulator's transition between high and low voltage identifies these pulses. Before applying the created pulse to the counter, a TTL inverter circuit is needed to reverse it. The microcontroller is designed with software interfacing to read data from the metering IC. When the microcontroller reads the energy usage, it saves and updates the information in software. In this case,

Dr. Sidappa Naidu, S. Arun "Design and Implementation of Automatic Meter Reading System Using GSM, ZIGBEE via GPRS" is the title of the project. This paper outlines an approach for implementing a wireless automatic meter reading system (WAMRS) that uses the widely used GSM and Zigbee networks. GSM and GPRS networks are well-known in many countries for their extensive coverage, cost-effectiveness, and competitiveness in an ever-growing market. The WAMRS uses GSM as the medium to provide a cost-effective, wireless, always-connected, two-way data link between the utility company and the WAMRS. The WAMRS sends information about utility usage, power quality, and outage alarm to the utility company, and the WAMRS receives information about utility usage, power quality, and outage alarm from the utility company. Tele communications systems for automatic data transmission to simplify bill production at the server end as well as communication with customers via SMS and email [2]

Salai Thillai Thilagam, E. Moni Silviya, K. Meena Vinodhini J. proposes a "GSM Based Automatic Energy Meter System with Instant Billing" as a proposal .System that uses an infrared sensor to determine the current consumption unit. The IR transmitter is installed in the EB meter's spinning unit. The receiver photo diode is set in a certain location to determine the number of rotations. We can calculate current consumption by multiplying the number of rotations. These systems can be used in a variety of applications, including industrial control, medical systems, and access control. [5]

Under the title "GSM Based Automatic Energy Meter Reading System with Instant Billing," Ashna. k and Sudhish N. George present their ideas. In this system, the two-wire power supply is connected to the energy metering IC via the MCP3905 energy meter evaluation board's analogue front end, which delivers average active power information via a pulse output that can subsequently be processed by a Micro Controller Unit (MCU). A MAX 232 interface connects the GSM unit to the microcontroller. The office modem receives use information from the user's GSM modem. Every house/premise is assigned a unique number (consumer number) by the appropriate authority. [6]

Automatic Meter Reading and Theft Control System Using GSM are invented by P. Rakesh Malhotra and Dr. R. Seethalakshmi. In this article, he found that GSM technology might be utilized to send meter readings to customers and the government at a reasonable cost. Once the transfer between the

consumer and the government has been completed, this process will last for 60 days. The energy theft is then controlled by an IR sensor, a magnetic reed switch, or another high-security mechanism. [8]

2.2 HARDWARE COMPONENTS:

2.2.1 Digital energy meter:

Digital energy meters also called advanced meters or smart meters, are intelligent devices that automatically record the user consumption of water and electricity. After the data is collected, digital meters electronically report all the gathered information to the utility company at regular intervals.

Fig 1: Digital energy meter

2.2.2 GSM:

Global System for Mobile Communications, originally Group Spécial Mobile, is a standard developed by the European Telecommunications Standards Institute (ETSI). A GSM module or a GPRS module is a chip or circuit that will be used to establish communication between a mobile device or a computing machine and a GSM or GPRS system. The modem (modulator-demodulator) is a critical part here.

Fig 2: GSM module

2.2.3 Real Time Clock:

RTC" is an acronym for Real Time Clock, which is an electronic device that measures time.
"RTC module" is a single packaged module which integrated RTC IC, oscillator circuit and master clock. There is no need for oscillator circuit design and frequency adjustment by your selves.

Fig: 3 RTC

2.2.4 Arduino Uno:

The **Arduino Uno** is an open-source microcontroller board based on the micro controller and developed by Arduino.cc and initially released in 2010. The board is equipped with sets of digital and analog (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. The board has 14 digital I/O pins (six capable of output), 6 analog I/O pins, and is programmable with the IDE (Integrated Development Environment), via a type B It can be powered by the USB cable or by an external 9-volt battery though it accepts voltages between 7 and 20 volts. It is similar to the Arduino Nano and Leonardo. The hardware reference design is distributed under a Creative Commons Attribution Share-Alike 2.5 license and is available on the Arduino website. Layout and production files for some versions of the hardware are also available.

Fig 4: Arduino Uno

2.2.5 MAX232:

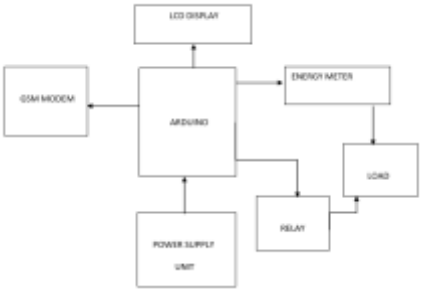
The **MAX232** is an integrated circuit by Maxim Integrated Products now a subsidiary of Analog Devices that converts signals from a TIA-232(RS-232) serial port to signals suitable for use in TTL-compatible digital logic circuits. The MAX232 is a dual transmitter / dual receiver that typically is used to convert the RX, TX, CTS, RTS signals.

The drivers provide TIA-232 voltage level outputs (about ±7.5 volts)from a single 5-volt supply by on-chip charge pumps and external capacitors This makes it useful for implementing TIA-232 in devices that otherwise do not need any other voltages. The receivers translates the TIA-232 input voltages (up to ±25 volts, though MAX232 supports up to ±30 volts) down to standard 5 volt TTL levels. These receivers have a typical threshold of 1.3 volts and a typical hysteresis of 0.5 volts.

Fig: 5TTL converters that use MAX232

3.1 Block Diagram and description:

An automatic GSM-based energy meter system can overcome this problem. As we mention in our review paper titled Automatic energy meter reading system using GSM technology, an automatic energy reading system can be constructed using a variety of processors. According to the findings of that study, the system can be more efficient if it is implemented utilizing an AVR controller. As a result, in this work, we will use the AVR controller to create the AEMR (automated energy meter reading).A block diagram of a GSM-based automatic energy meter reading system using an AVR microcontroller. This system is made up of various components such as a GSM module, an opto coupler, an RTC, an energy meter, a UART connection, and a computer system.



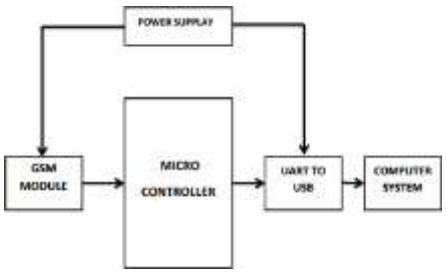


Fig.3.1 block diagram of GSM based energy meter(tx block) **Fig.3.1.2block diagram of GSM base energy meter (rx block)**

3.2 Implementation Study:

Here we give an overview of the various steps taken so far and the steps that would be taken to ensure the successful completion of the project.

3.3 Steps taken so far:

The following steps have been taken so far towards the completion of the project.

- Understanding the project
- Review of existing literature on the project
- Research of various components required
- Research of Automatic Energy Meters
- Typing of project write-up

4.1 Proposed Approach:

The GSM-based autonomous energy meter is meant to allow for meter reading and control from a distance. The following factors went into the creation of the automatic energy meter:

1. Researching the operations and workings of the ATMEGA328 microcontroller, GSM modem, and electronic energy meter in order to obtain a better understanding of how we will coordinate all of the various pieces to produce the ultimate working of the GSM based automatic meter reading system.
2. 2. Using our knowledge of how the microcontroller, electronic energy meter, and GSM module work, we created a flow chart describing how our design should work.
3. 3. The creation of a code. Using Mikro C Pro, a code was developed based on the f low chart.
4. Component selection.

   Following the creation of the code, the components required for the design were carefully chosen, taking into account the following factors:

   - Their operating voltage range.
   - The operational voltage range for the ATMEGA328 18F4550 Microcontroller, the Real Time Clock, and the 16*2 LCD was all 5V.
   - The amount of energy they use.
   - The components chosen were energy efficient.
   - Their compatibility as a couple.

   Because the LCD and Real Time Clock, as well as the Solid State Relay, are microcontroller compatible, a straightforward interface to the microcontroller was available. Through an opto coupler, the energy meter's output pulses are transmitted to the microcontroller.
5. Power supply selection.

   As previously indicated, the components' voltage needs were tyATMEGA328ally 5V, therefore a power source that could supply 5V while also providing enough power to power all of the components at the same time was necessary.

• A 9V battery that would be controlled to supply
5V was taken into consideration.
• A USB power adapter
The latter was chosen because it could offer enough steady, stable power for the entire circuitry, but the battery could only provide power for a short time before running out.

4.2 DESIGN SPECIFICATIONS

We defined our design standards based on the design factors listed in the preceding section. The following were the requirements:

• The quantity of energy utilized will be recorded using an electronic energy meter with pulse output.
• The microcontroller was supposed to be the system's controller.
• The GSM module would be used to send data on energy consumption from the client's outlets

to the energy provider and back to the consumer through SMS.

• Customers with overdue accounts would have their connections disconnected and reconnected using a solid state relay and a contactor.

• A display subsystem (LCD) would also be included to show the amount of energy utilized over the time interval.

The block diagram below depicts the many components that combine to make the GSM-based automatic energy meter reading system.

4.3 Results and Evolution Metrics:

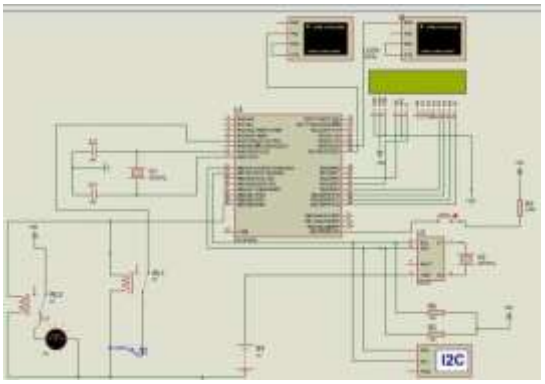


Fig 1: The complete circuit schematic for the GSM based automatic energy meter reading system is shownin the figure

Figure: 2- final output Snapshot of our GSM based Automatic energy meter design

5 Conclusion:

The current work uses a wireless meter reading system to continuously monitor meter readings, avoiding human interaction, providing efficient meter reading, avoiding billing errors, and lowering maintenance costs. It notifies the user by displaying the relevant information on the LCD. Moreover, it is responsible for maintaining the database of meter readings obtained by the consumer energy meter.

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