

# Electricity Meter Reading using GSM

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The present system is designed to collect the consumed energy data of a particular energy consumer through wireless communication system (without going to consumer house), the system can be called as automatic meter reading (AMR) system. The Automatic Meter reading system is intended to remotely collect the meter readings of a locality using a communication system, without persons physically going and reading the meters visually.

This system also makes use of a GSM modem for remote monitoring and control of energy meter. The microcontroller based system continuously records the readings and the live meter reading can be sent to the electricity department on request. This system also can be used to disconnect the power supply to the house in case of non-payment of electricity bills. A dedicated GSM modem with SIM card is required for each energy meter. The electricity meter reading system with GSM module takes the advantage of available GSM infrastructure nationwide coverage and the Short Messaging System (SMS) cell broadcasting feature to request and retrieve individual houses and building power consumption reading back to the energy provider wirelessly. The Store and Forwarding feature of SMS allows reliable meter reading delivery when the GSM signal is affected by the poor weather conditions. The stored message is archive in the mobile operator and can be later retrieved for billing purposes.

## II. System Block Diagram and Flowchart

220VAC power supply is sent to the bulb. The bulb is also connected to the current sensor. The current sensor (ACS 712) has 3pins:  $V_{CC}$ , output and GND. LM7805 regulator

## ABSTRACT

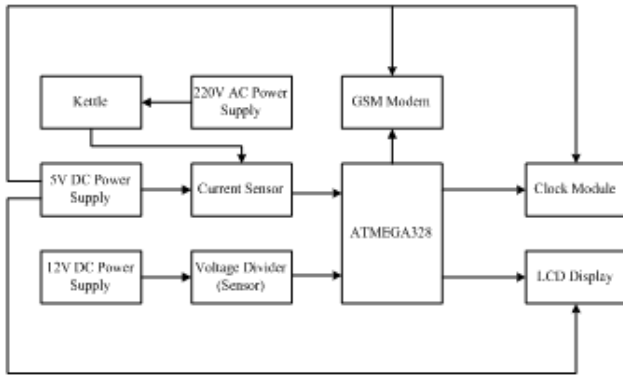
This system is designed for reading electrical energy consumed in units and in kyats to display on an LCD screen to the user. This system becomes necessary for the consumer to know as to how much electricity is consumed to control electricity bill within user budget. In this system, the consumer will get energy consumption data on a real-time basis on an LCD display. The same data is sent through GSM modem to the electricity department via SMS. AT Mega 328P microcontroller is interfaced to the voltage divider and current sensor to get the Watt Hour pulses. The microcontroller then processes these pulses according to the program written in it, to calculate the units consumed and cost involved. Further, it gives the command to the SIM loaded GSM modem for sending the data to the electricity department via SMS. Further, this system can be enhanced by to control the electrical appliances remotely via SMS. Moreover, this system can reduce human efforts needed to record the meter reading which is till now recorded by visiting every home individually.

**KEYWORDS:** ATmega 328P Microcontroller, GSM Module, ACS 712, DS 1307

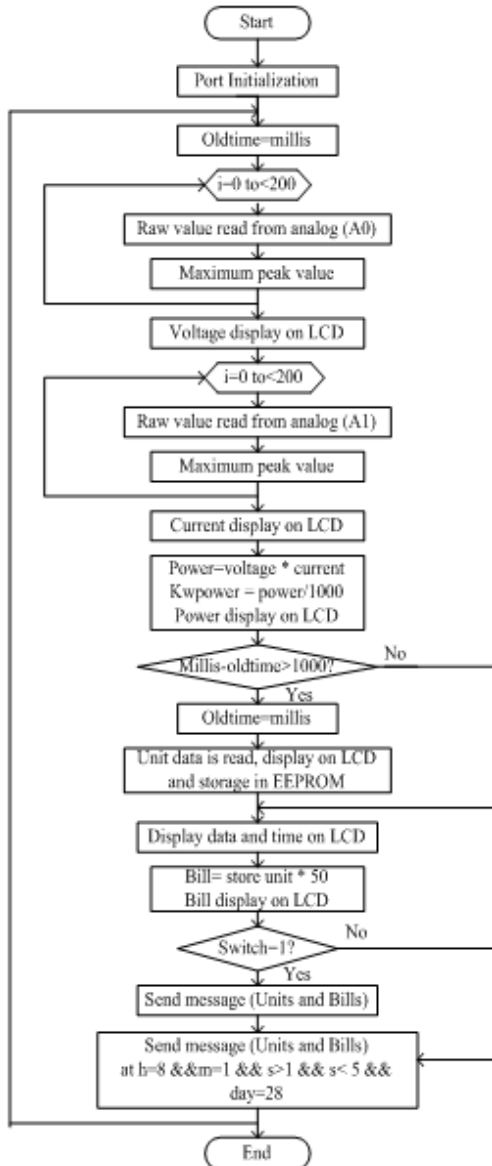
## I. INTRODUCTION

Today the metering instrument technology has grown up significantly, such that the Consumed energy can be calculated mathematically, displayed, data can be stored, data can be transmitted, etc. Presently the microcontrollers are playing a major role in metering instrument technology.

operates into two parts. In the first part, the AC Mains is converted into unregulated DC and in the second part, this unregulated DC is converted into regulated 5VDC. And, 5VDC power supply is used to provide for the current sensor, AT Mega 328P microcontroller clock module and LCD display. After, 12VDC power supply is given to the voltage divider. 1k and 3k resistor are used for the voltage divider. AT Mega 328P microcontroller has 28 pins:14 digital I/O pins,6 analog input pins,2 crystal oscillator pins,  $V_{CC}$  and GND pins provide for power, RESET pin and  $AV_{CC}$ , AREF and GND pins for Analog to Digital Converter(ADC). Moreover, 23 and 24 pins of AT Mega 328P microcontroller are connected to the voltage divider and current sensor. The amount of power is read from the voltage divider and current sensor. C program is embedded into the AT Mega 328P microcontroller which helps it to calculate the units consumed and costs involved. 27 and 28 pins of AT Mega 328P microcontroller are connected to the SDA and SCL pins of (20x4) LCD display. That means the LCD display shows the units consumed and costs for the user. The clock module (DS 1307) has 5 pins: DS, SCL, SDA,  $V_{CC}$  and GND. The clock module provides seconds, minutes, hours, day, date, month, and year information. The clock operates in either the 24-hour or 12-hour format with an AM/PM indicator.27 and 28 pins of AT Mega 328P microcontroller are also connected to the SCL and SDA pins of clock module(DS 1307).SIM 900A GSM module receives 5VDC power supply. GSM module has 4pins:  $V_{CC}$ , GND, TX and RX pins. The switch is put in the electrical department.5VDC power supply is given to the switch. Bypassing switch, the units consumed and costs are also sent to the cell phone of the station by message through GSM modem.



**Fig.1: System Block Diagram of Electricity Meter Reading**



**Fig.2: System Flowchart**

### III. Design of Electricity Meter Reading

This system uses 220VAC and 5VDC power supplies. Thus, a 220V to 12VAC transformer is used to convert 220V to 12VAC.

Transformer input voltage,  $V_{in} = 220V$

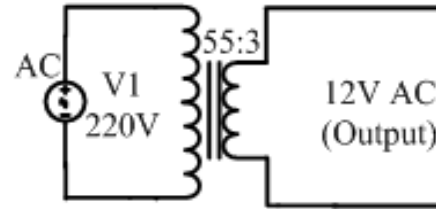
Transformer output voltage,  $V_{out} = 12V$

$$\frac{V_{out}}{V_{in}} = \frac{12V}{220V} = \frac{3}{55} = 0.055$$

Transformer's number of turns =  $\frac{N_{out}}{N_{in}} = ?$

$$\frac{N_{out}}{N_{in}} = \frac{V_{out}}{V_{in}} = \frac{3}{55} = 0.055$$

So, a number of turns for the transformer must be 55:3.



**Fig. 3: 220VAC to 12VAC Transformer**

A voltage divider circuit is a very common circuit that takes a higher voltage and converts it to a lower one by using a pair of resistors. The formula for calculating the output voltage is shown below.

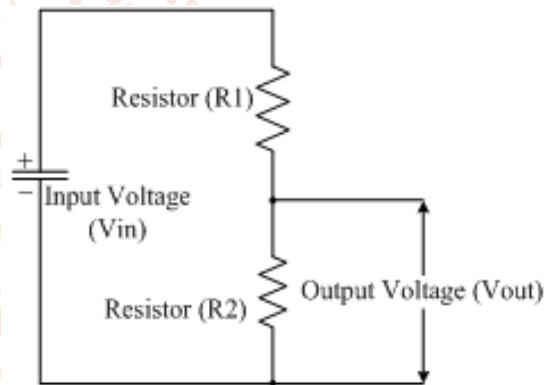
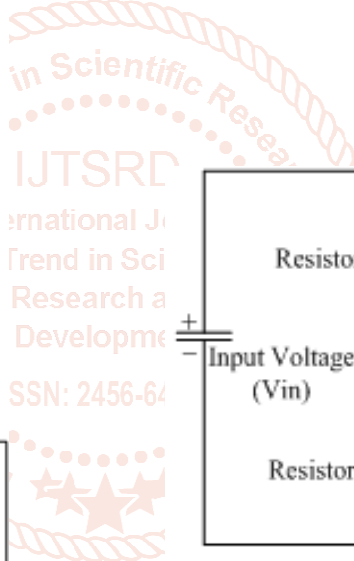
The input voltage,  $V_{in} = 12V$

The resistance of the 1<sup>st</sup> resistor,  $R_1 = 3k$

The Resistance of the 2<sup>nd</sup> resistor,  $R_2 = 1k\Omega$

Output voltage =  $V_{out} = ?$

$$\begin{aligned} V_{out} &= V_{in} \frac{R_2}{(R_1 + R_2)} \\ &= (12\sqrt{2}) \frac{1k}{1k + 3k} \\ &= 4.242V \end{aligned}$$



**Fig. 4: Voltage Divider Circuit**

### IV. System components

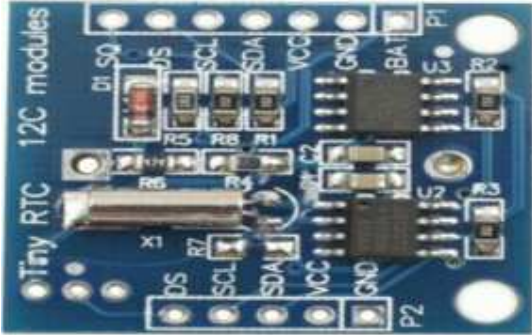
#### 1. AT Mega 328P Microcontroller



The ATmega328P is a single-chip microcontroller created by Atmel in the mega AVR family. ATmega328P is basically an Advanced Virtual RISC (AVR) microcontroller. It supports the data up to eight (8) bits. AT mega 328P has 32kB internal built-in memory. This microcontroller has a lot of other characteristics. ATmega328P is an AVR Microcontroller having twenty-eight (28) pins in total. Functions associated with the pins must be known in order to use the device appropriately. Port A consists of the pins from PA 0 to PA 7. These pins serve as an analog input to analog to digital converters. If analog to digital converters is not used, port A

acts an eight (8) bit bidirectional at input/output port. Port B consists of the pins from PB 0 to PB 7. This port is an 8-bit bidirectional port having an internal pull-up resistor.

## 2. Clock Module (DS 1307)



A real-time clock (RTC) is a computer clock (most often in the form of an integrated circuit that keeps track of the current time). Although the term often refers to the devices in personal computers, servers and embedded systems, RTCs are present in almost any electronic device which needs to keep accurate time. A common RTC used in single-board computers is the DS1307. The DS1307 serial real-time clock (RTC) is a low power, full binary-coded decimal (BCD) clock plus 56 bytes of NVSRAM. Address and data are transferred serially through an I<sup>2</sup>C, bidirectional bus. The clock provides seconds, minutes, hours, day, date, month and year information. The end of the month date is automatically adjusted for months with fewer than 31 days, including corrections for leap year. The clock operates in either the 24 hours or 12-hour format with AM /PM indicator. The DS1307 has a built-in power-sense circuit that detects power failures and automatically switches to the back-up supply. Timekeeping operation continues while the part operates from the backup supply.

## 3. GSM Modem



This GSM Modem can accept any GSM network operator SIM card and act just like a mobile phone with its own unique phone number. Like a GSM mobile phone, a GSM modem requires a SIM card from a wireless carrier in order to operate. A GSM modem can be an external unit or a PCMCIA card (also called PC Card). An external GSM modem is connected to a PC through a serial cable, a USB cable, Bluetooth or Infrared. Like a GSM mobile phone, a GSM modem requires a SIM card from a wireless carrier in order to operate. Advantage of using a modem is that it can use its RS232 port to communicate and develop embedded applications. Applications like SMS Control, data transfer, remote control and logging can be developed easily.

## 4. Current Sensor (ACS 712)



A current sensor is a device that detects electric current in a wire and generates a signal proportional to that current. The generated signal could be analog voltage or current or even a digital output. The generated signal can be then used to display the measured current in an ammeter or can be stored for further analysis in a data acquisition system or can be used for the purpose of control. ACS712 30A current sensor is a current sensing board based on Allegro's ACS712 magnetic linear current sensor IC. ACS712 can sense current up to bidirectional 30A with lower than 5% error. The sensor's output is an analog voltage (66mV/A). The filter pins on the board can be used to adjust the bandwidth (80 kHz default) by connecting a capacitor.

## V. Results



Fig. 5: Electricity Meter Reading System with GSM Module



Fig. 6: Displaying the Units and Bills on LCD

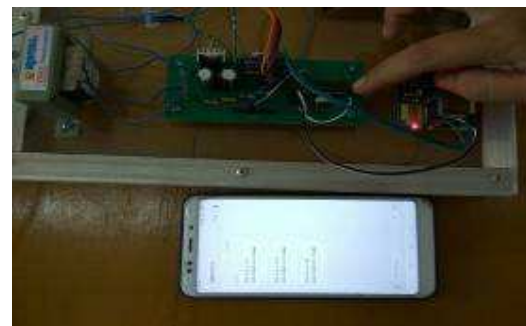


Fig. 7: Units and Bills received by the Mobile Phone when the switch is pressed



## VI. Discussion

The work of this system emphasizes on design and construction of Electricity Meter Reading System with GSM Module. In this system, ACS 712 is a current sensing device and can be used for the purpose of control. The voltage divider is a simple circuit and is also a fraction of the input. This system is used by GSM technology in order to send an SMS message to the mobile phone. As the GSM system is very user-friendly, it is used in most energy control projects due to its high capacity. In this system, the SIM 900A modem is used to send SMS commands. AT Mega 328P is also a high-capacity microcontroller. Thus, this controller can be used for other projects with more flexibility and capability. The DS 1307 is a trickle-charge timekeeping chip. This real-time clock can be used to show 24-hour or 12-hour format with an AM/PM indicator. This electricity meter reading system with a GSM module is a need for anyone who is using electrical appliances and it will be a great help for the electrical department.

## VII. Further Extension

Technology in the electronic field is developing and developing. Although design for this system is simple, its technology and performance are reliable and acceptable for the further extend. This is done electricity meter reading system based on GSM and transmission is constructed with GSM technology between the customer and energy provider. This electricity meter reading system can be advanced by using other languages such as Java and C#. This system can be advanced by using Zigbee method and RFID card-based system. And also, instead of GSM based technology, it can be extended using internet-based for billing purposes. This system can be added to an integrated energy management

system. Moreover, this system can be extended to the system which can read energy consumption annually.

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