

# GSM Based Smart Power Monitoring System

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**Abstract**—The automation of smart metering has gone to the quick high-tech advancements and also there is a high expanded demand for an authentic and flexible smart meter reading system. This project represents the proposed design of GSM based smart power monitoring system. An Arduino UNO & ACS712 Current sensor is integrated with GSM based smart power monitoring system for monitoring the power. As electrical energy has become indispensable to human survival and progress that's why GSM based power monitoring system is a major step towards smart metering process. This paper focus on to create an automatic power monitoring meter. This system monitored the energy at anywhere without any person visiting the device. This system also assists us to identifying the losses of power to the electricity provider company.

**Index Terms**—Energy Meter, Automatic-Meter-Reading (AMR), GSM, Arduino Uno, Current sensor.

## I. INTRODUCTION

It is laborious or sometimes it is not possible to compute Current and Watt with standard Multimeters. To hold out such a measurement dependable and precise, a wattmeter is needed. As these types meters are very costly, a less costly method is presented here based on an Arduino Uno board. This project represents the proposed design of a low-cost simple wireless GSM Based smart power monitor and its related mobile interface, for calculating and managing the metering data globally. With this method conventional meter reading can be altered and authorize the remote access of energy meter. Also, the meter readings can be calculated and monitored in regular basis without the person visiting each device [1]. To have

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remotely approach over the electricity usage a GSM based communication module is connected with an electronic meter.

This feature (remote monitoring) is formed available if it will be made up of a GSM communication modem which send all details related to the meter reading via an SMS. This proposed smart metering system cannot require the GSM module. The procedure has been proposed and tested in this project assist the GSM infrastructure. It's nationwide range and SMS cell transmitting feature is wirelessly broadcast the individual device energy consumption readings [2]. This system is really pleasant to the Electricity provider company as it authorizes them to get the meter readings on a regular basis.

## II. LITERATURE REVIEW

Power Monitoring system is being used from the ancient times; in that time this system is mainly used to monitor the total power using GSM Module. There are many types of definitions where the parameter powers, energy defined. If the voltage and current are not sinusoidal then how we measured the power [2]. In the year 2011 in article “Wireless Automated Digital Energy Meter” We studied about a digital energy meter which is fully automatic control. By this article we know how a digital energy meter working wirelessly. [3]

Many research and ideas are implemented on power monitoring system. According to these studies the power monitoring system. The first electricity consumption meter for accurate reading DC meter which was invented by Dr. Hermann Aron, who patented it in 1883. A power monitoring system is a device which monitored the total energy consumed by any field [4].

## III. METHODOLOGY

The basic concept of serial communication of microcontrollers can be used in this system. The controller takes the meter reading and forwards it to the GSM module. GSM module is authorized by a SIM card which is used to transmit to the end user.



IV. COMPONENTS

A. Arduino Uno ATmega-328 Pu

14 digital input/output pins are available in an Arduino board which is built with ATmega328 microcontroller board. Out of these input/output pins (For PWM outputs purpose 6 pins can be used), 6 pins can be used as analog inputs, a Universal Serial Bus (USB) connection, a ceramic resonator(16MHZ), an ICSP header, a power jack and a reset button. It is a single chip microcontroller which is formed with Atmel inside the megaAVR family.

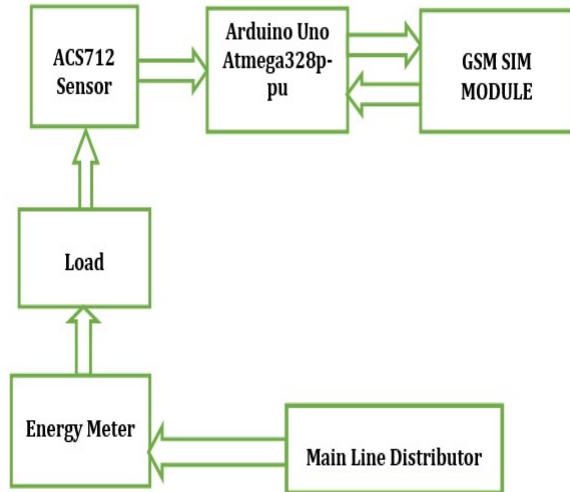


Fig. 1. Block Diagram of proposed system

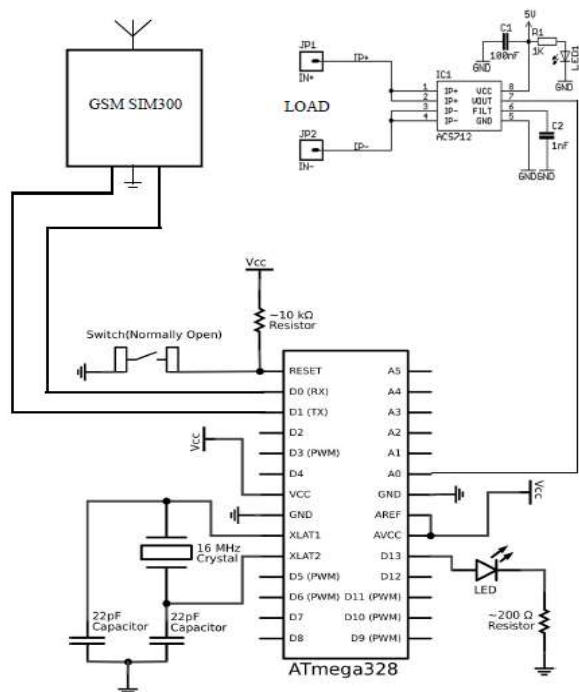


Fig. 2. Circuit Diagram of Smart Power Monitoring system

To support the microcontroller, it carries everything that is needed. To get connection of Arduino uno simply connect the Arduino uno with a laptop/computer or it can be powered with an AC-to-DC adapter/ battery.

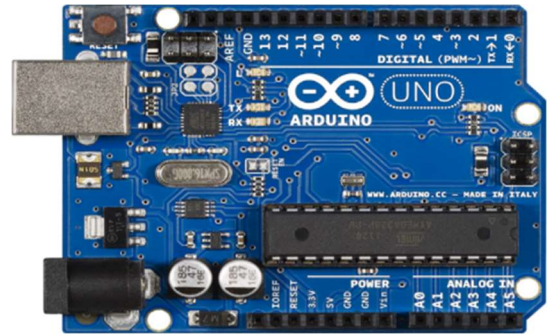


Fig. 3. Arduino Uno Atmega-328 Pu

TABLE I  
Specifications of components

Name	Specifications
Microcontroller	AT-mega328-pu
Working Voltage	5v
Input Voltage (I/O)	7-12V
Digital Input Pins	14 pins (out of which 6 provide PWM output)
Input Pins (Analog)	6
DC Current in every input Pin	40 mA
DC Current (3.3V Pin):	50mA
Flash Memory	32 KB of which 0.5 KB used
Static Random Access Memory (SRAM)	2 KB
EEPROM	1 KB
Clock Speed	16 MHz

Some of the main characteristics of Arduino-Uno:

- The main advantages of an Arduino Uno are it is an open source and a large circle of people using it and also troubleshooting it.
- A portable Universal Serial Bus interfaces. The chip on the Arduino uno board linearly plugs into the USB port and it record on the desktop as virtual serial port. It permits us



to combine with it as this was a serial device. Serial communication is a very much easy and time-tested protocol is the main advantage of this kind of setup, and modern computers makes really convenient by connecting USB.

- In Arduino Uno the built-in voltage regulation and power management system is very much appropriate. A 12v power source can be connected externally and it can modulate it to both 5v and 3.3v.
- For reserving code flash memory (32KB) available.
- In an Arduino Uno 13 digital pins are available and also 6 analog pins are there. These digital and analog pins assist us to attach between external hardware and Arduino. With these pins increasing the computing ability of the Arduino-Uno into the existent world.
- An LED attached to digital pin 13, For an easy rectification of code,
- At last, to reset an Arduino program a button in there.

*B. GSM Modem*

GSM implies Global System for Mobile Communications system. This is a high-level set which was implemented by the ETSI [European Telecommunications Standards Institute]. It is used to mobile phones for elaborating the protocols of 2G digital cellular networks. The Modem is an electronic device which regulates and demodulates signals as required to meet the communication requirements. It adjusts an analog carrier signal to digital signal by encoding, and also pull out this signal such a signal to the communicated information by decoding. A Global System for Mobile Communications Module is a device which regulates and extracts the GSM signals and in 2G signals. Naturally SIMCOM SIM900a modems are used in this proposed system. It is a GSM/GPRS Modem, which can be operated at three different frequencies (EGSM 900 MHz, DCS 1800 MHz and PCS1900 MHz). Basic working frequencies are EGSM 900MHz and DCS 1800MHz.



Fig. 4. GSM Modem

Use of GSM Module –

The technology usage of GSM module is increasing day by day, that exactly there is no place on earth where GSM signal is not there. In this situation GSM technology gives us scope with our finger tips to managing things remotely from any places. Also, this technology gives ease to easily convey in a stronger way.

*C. ACS712 Current Sensor*

Current flows need to be observed and controlled in a vast variation of applications which includes battery chargers, protection circuit for over current, SMPS (Switching Mode Power Supplies), wattmeter (digital) etc. To observe the consumed power, placement of Shunt resistor is one of the easiest methods. A minimum value of resistance is coupled with the load and the ground to evaluate the voltage drop across it. As there is a variation between temperature and shunt resistor, in fact because of Joule heating this is not constant. Due to variation in temperature and resistance value, this procedure is at all efficient to execute. In high voltage application, the load and sensing unit is lacking proper insulation in the said method. Based on the principle of Hall-effect Allergo, ACS712 device can be designed in which within a magnetic field a current fetching conductor is placed. ACS712 is a current sensor device which is sensing currents for both AC and DC. Voltage is created beyond its boundaries which is perpendicular to both the present and also the field. A hall element made of a skinny Semiconductor sheet, a current carrying material is placed into a field (B) which is perpendicular to the current flow direction. The potential difference is called Hall voltage within few microvolts.

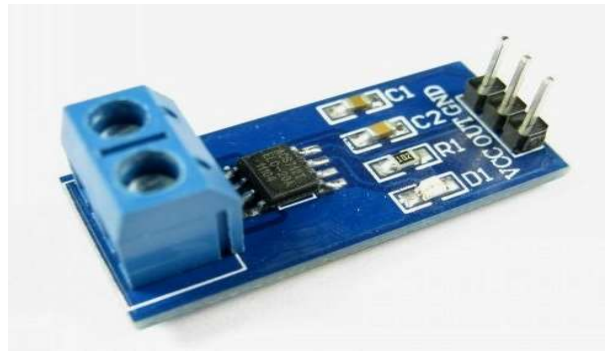


Fig. 5. ACS712 Current Sensor

V. RESULT & ANALYSIS

The components of this system arranged in the order of circuit diagram. The picture of working model is given below –



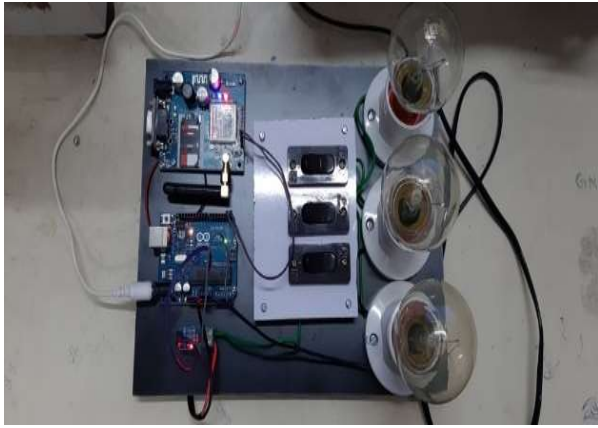


Fig. 6. Working Model of proposed System

#### Some actions of AT Commands against GSM Module -

Sim900a GSM Module can be utilized for sending and receiving SMS when the module connecting it to a computer. In this system this communication GSM module used to send commands to send/receive SMS from a computer with a port which is either a serial port or an USB. Basically, these types of commands are known as AT commands. With these types of commands many types of activities can be performed. With these commands sending or receiving SMS, and MMS, can be done. Sim300 module has an RS232 interface which can be utilized to be in the communication with the computer. Sim900a module generally works at 9600 baud rates, with 8 stop bits and 8 data bits. Some AT Commands which are needed to send or receive SMS are given below-

- For testing the condition of modem 'AT' Command can be used. This command is common prefix command for every command which is sent to the modem.
- For checking a sim is inserted or not we use 'AT+CREG' Command.
- To switch on the Echo, we use 'ATE1' Command. With this command GSM module continuously echo back to bite of data until a sense will get from carriage return character.
- To fix the communication to text mode 'AT=CMGF=1' command can be used.
- For deleting a SMS at index 1 'AT+CMGD=1' command can be used.
- To sending a SMS from GSM module 'AT+CMGS' command can be used.

#### VI. CONCLUSION

A wireless GSM communication based smart power monitoring system is very simple to install and important for Customer as well as energy Provider. Main advantages of this

system are very lower physical cost and also make reduces the inaccuracy. This system also minimizes the problems like meter over running, over load of the meter, and also decreases thefts. This system specifies to the customer when any type of guilt occurs. When any types of faults occur customer can contact with the energy provider company and inform them about the fault. Then the energy provider Company can slash the power easily by sending a SMS to the ID number which is connected to that SIM card number. The analytical load can be utilized and this profile help the customer to control their energy consumption. This helps them to scale back their previous dues. This procedure is used even within the remote areas by changing the sort of the modem, and its range of frequency for communication. This system creates less problems to the country and supports us to boost our usage. This system also can be built up to control the electrical devices by remote operation via SMS. The electricity division can send the quarterly/monthly bill amount over SMS to the collected unit for information to the consumers.

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