

# Energy Management System with Programmable Numbers using GSM

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## Abstract:

The communication will consist of data transfer, for which we will employ a GSM module as wireless communications are used in this project for better and longer distance connection. In this project, we will use an ATmega8 embedded microcontroller to implement this strategy in the house or in the workplace. Appliances such as a refrigerator, light bulb, fan, television, and so on. The project's goal is to create a system that allows users to operate household appliances via SMS and receive acknowledgements. The user does not have to manually turn on and off home appliances. Our technology allows users to control these devices by SMS, and the status of whether the device is turned on or off is provided to the user via a return SMS. Domestic and business customers can use this to operate and monitor home and business appliances from anywhere in the world. This is highly helpful for consumers because it allows them to control their house loads at any time and from any location in the world. One example of how this technology might improve our life is when a person is travelling and wishes that the instant he enters his room, it be cool enough to make him feel comfortable. In such a circumstance, he can use this method to turn on the air conditioning while travelling. SMS messages are sent to the GSM modem, which is linked to the microcontroller. The modem receives the message and delivers the command to the microcontroller, which processes it and activates a mechanism that controls the associated household appliance through a relay. We will describe Energy Management System with Programmable Numbers Using GSM in this paper.

**Keywords** — Energy, Management, System, Programmable, Numbers, Communication, Project, Technology, Microcontroller, Meters, Consumer, Control Mechanism, Global System Mobile, Short Messaging Service.

## INTRODUCTION:

An energy management system (EMS) is software that allows you to control and monitor your electric utilities and devices that use electricity. An energy management system, for example, might control your hotel's HVAC systems in each guestroom. The EMS provides insight into energy utilization, allowing you to cut consumption and utility expenses while increasing functionality and comfort.

The thermostat in your home is an example of a very rudimentary EMS. The thermostat has an interface that allows you to programmed a heating or cooling schedule, a sensor that measures the temperature in the room, a controller that instructs the heater when to turn on or off, and the actual heating or cooling element itself.

An energy management system (EMS) is a collection of computer-aided tools used by electric utility grid managers to monitor, control, and optimize the performance of the generation or transmission system. It can also be employed in small-scale systems such as microgrids.

Wireless communication is becoming more popular by the day. This has inspired us to utilize mobile phones to remotely operate domestic appliances and to receive SMS notifications on the house's security and safety. In this study, we describe a remote appliance control system that can manage various household appliances via SMS and monitor the safety and security of the house via SMS. [1]

This controller is highly useful in situations when we need to regulate the ON and OFF switching of devices since it does not require a connected connection between the switch and the home appliances and can be operated from anywhere in the world.

The microcontroller would then manage the home appliances based on the information sent to it and deliver feedback during a security breach, as well as when a gas leak or a fire. The proposed method is simple, secure, and robust, and it can also be controlled via an android application on mobile phones.

Traditional electro-mechanical meters, which tend to drift over temperature and time due to the analogue and mechanical nature of the components in these meters, are still commonly used in many impoverished nations such as India. Meter reading collection is additionally inefficient due to the post-paid billing mechanism, because a meter reader must physically be on-site to take the readings. [2]

When readings are obtained from large, sometimes dispersed rural areas, this method of obtaining meter readings becomes more difficult and costly. Meter readers are hesitant to make the effort to travel to such regions, resulting in inaccurate estimates of the quantity of electricity utilized. Even in regions where traditional meters have been replaced with electronic meters, difficulties exist due to post-paid billing. So, instead of using post-paid billing, prepaid billing eliminates the need to collect payments. The GSM technology is utilized so that the customer receives notifications regarding power usage (in watts), and if it falls below a certain threshold, it instantly alerts the user to recharge. This technology is applicable to all power distribution corporations, private communities, IT parks, and self-contained housing complexes. The execution of this document will aid in better energy management, energy conservation, and the elimination of unneeded problems associated with inaccurate billing. The automatic billing system will track real-time consumption and allow minimal room for argument regarding consumption and billing. [3]

### **Benefits of an Energy Management System:**

The use of an energy management system can provide your hotel with a number of exciting benefits, including reduced energy use, cheaper operating expenses, and more efficient operations.

A system like this can also provide insights that you would not be able to obtain without a system that closely analyses your energy usage. Let's take a closer look at each benefit and how an energy management system might help you accomplish your operational objectives.

- **Lower energy consumption:** To put it simply, an energy management system can assist you in using less energy. Once you've mastered the art of monitoring your energy consumption, you'll be able to see opportunities to turn off certain systems or reduce usage at specific times of day. Using less energy reduces your hotel's environmental imprint, which not only makes you feel good but may also be an excellent point to mention in your marketing materials, since many customers are looking for sustainable solutions when they travel.
- **Lower operating costs:** As your hotel consumes less energy, your running costs will naturally fall. However, you will not only save money on your gas or electric bill; when your systems function more efficiently, they will experience less wear and tear, and you will be able to get more use out of your equipment. You'll save money on replacement and maintenance charges this way.
- **Usability:** While it is feasible to operate your building systems manually, it is not the most efficient way to do it. An energy management system provides a centralized interface for controlling all of your systems. This eliminates the need to switch from your air conditioning system to your external lighting system to the system that controls the kitchen exhaust fans. You can do it all from one location, making day-to-day operations faster and easier. [4]

### **REVIEW OF LITERATURE:**

Since the last decade, Austin, TX has been an isolated example of smart grid growth and integration. Power networks are complex systems that require an EMS to operate and manage them efficiently and safely. The management systems will play an essential part in the evolution of smart

grids, as well as the integration of renewable energy. Most solutions, which supervise, control, optimize, and manage generation and transmission systems, are referred to as SCADA, EMS, GMS (Generation Management System), or DMS (Distribution Management System). These systems allow utilities to collect, store, and analyses data from hundreds of thousands of data points in national or regional networks, as well as execute network modelling and power simulation operations, detect defects, predict outages, and engage in energy trading markets. EMS are critical for modernizing power networks and enabling the development of smart grids, the highly automated energy systems of the future. Smart grids will have to handle enormous amounts of renewable energy generated by both large and small-scale generators. [5]

The history and evolution of the energy meter began in the 1880s. More efficient varieties of bulbs were introduced as a result of the discovery and high use of electricity. New ways of assessing consumption had to be developed. Over time, various meters were introduced. For the advanced billing and metering billing system, the proposed energy meter with microcontroller and GSM modem to transmit information such as electricity used in kWh, security services (line Cut/On) over GSM mobile network like data are frequently fed and integrated into existing energy management systems located at power companies or organizations to supply services among purchasers without man-power. [6]

Researchers, engineers in the electrical and financial departments are interested in developments in building smart and intelligent control mechanisms for switching on and off-street lighting. Because this not only cuts energy usage but also lowers system costs. In, a survey of several energy management systems used in India is offered. A case study of the JK Lakshmi Cement Plant is being discussed. The paper presents an efficient energy management system based on LDR and piezoelectric transducer (PZT). [7]

#### **OBJECTIVES:**

- Smart Energy management system.
- GSM technology is convenient and having fast communication.
- To Study Energy Management System with Programmable Numbers using GSM.

#### **RESEARCH METHODOLOGY:**

This study's overall design was exploratory. The proposed methodology employs current and voltage sensors to continuously monitor the amount of power supplied to the consumer, as well as a microcontroller in charge of activating the relay in the event of over-consumption and the Global System for Mobile (GSM) network to warn the consumer and notify the authority. This study work eliminates the need for manual and arduous meter readings while also protecting electrical devices. Furthermore, this effort can enable online invoicing, pre-paid billing, and energy savings, as well as serve as a foundation for power theft detection. [8]

#### **RESULT AND DISCUSSION:**

##### **Circuit Diagram:**

We discuss a simple remote home appliance control, security, and safety system using GSM SMS (Short Messaging Service) in this work. The system is divided into two parts: hardware and software. The hardware design consists of a stand-alone embedded system based on an 8-bit microcontroller (ATMega8), a GSM smartphone with GSM Modem (SIM900), a relay module, and software programming in Arduino that runs on an Android phone. The GSM modem serves as a communication medium between the house owner and the system via SMS. [9]

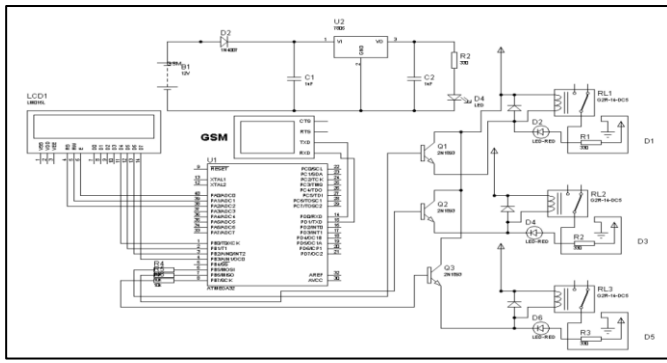


Figure 1: Circuit Diagram

The SMS is made up of commands that must be carried out. The message format is predefined. The SMS message is sent to the GSM modem as a text message with a specific predetermined format over the GSM public networks. When the transmission is received by the GSM modem, the commands sent are extracted and performed by the microcontroller.

The system will read the commands and use the switching module to turn the appliances on and off as needed. In the instance of a security breach, fire, or gas leakage, the microcontroller will sound the alarm and send a feedback message to the GSM handset via the GSM modem. [10]

A LDR is used to count the number of units consumed by capturing the flickering LED pulses from the meter. A set of buttons is used to set the price and so recharge the system. A relay is used to automatically turn on and off the power supply. When the E-Meter is connected to the load, the LED in the meter blinks in response to the energy usage. The LDR put over the LED will detect its blinking. The LDR output will be used as an input to the microcontroller. [11]

The blinking of the LED increases the blinking count in the Micro-controller, and therefore the amount in the recharge balance is subtracted. The remaining quantity will be displayed on the LCD module in real time. When the balance approaches zero, the user will receive a notification on the registered cellphone number, requesting that the client recharge in order to continue using the services. [12]

This paper presents application of GSM-SMS technology for real time data acquisition. The application is based on a field data collection prototype system that is composed of field monitoring and host side control platforms. This monitoring system consist of a new energy calculation algorithm, offering electricity packages with an intelligent monitoring system for daily power consumption connected to base-station via GSM network. The proposed energy meter system when incorporated with embedded controller and GSM modem can be used to transmit the data like consumed energy in kWh, generated bill, security services (line Cut/On) over GSM mobile network. Such a data can be then fed and integrated into existing energy management systems located at power companies or organizations to provide the services among the customers without man-power.

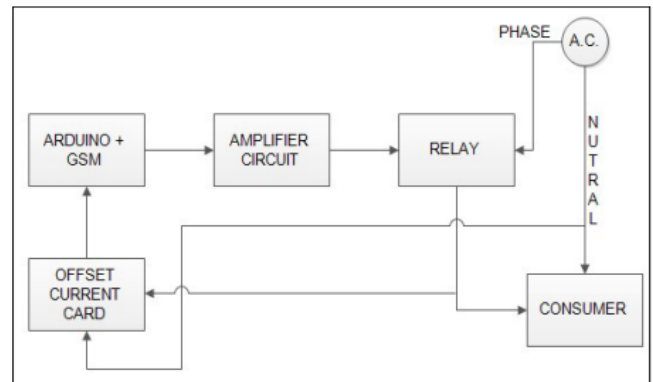


Figure 2: Block Diagram of Proposed System [13]

Energy Management System leads to savings in the overall cost. These savings may be come from better utilization of manpower, servicing cost, savings in the energy consumption, and non-breakdowns in the system. An Energy Management Controller (EMC), is used which checks electricity consumption and generation and remotely manages the load. Whenever utility company sends a command for load shedding, low priority appliances are cut off from power supply so as to reduce peak demand. The priority of the appliances can be set by the user through an easy interface to the EMC. The EMC contains a smart energy meter, a GSM modem, a microcontroller and a relay circuit

(GSM), which is connected between the energy meter and the load.

Nowadays, energy usage is a growing crisis. In most cases, a lack of awareness or information about their utilization results in electricity waste. People are unaware of their usage patterns and the need to consume energy responsibly, which leads to higher billing amounts, load shedding, underproduction of electricity, and so on. Our project addresses all of the major concerns confronting both the utility and the consumers.

The IoT Enabled Energy Management Meter promotes sustainable energy use by alerting consumers to their usage through alert messages.

The alarm messages are sent using the MQTT platform, which also allows for remote control of appliances. In the current environment the real time monitoring of the appliances helps to recognize items left unnoticed or of no use, so that can be regulated i.e., switched ON or OFF. The alert messages are sent for both Post-paid and prepaid plans.

It is for the 50%, 90%, and 100% of the pre-set level for Postpaid. Prepaid warnings, on the other hand, are issued at 50%, 90%, and 100% of the recharged energy. Bills are processed every two months and delivered to customers through text message. If the payment is not received by the deadline, the supply is disconnected and will not be reconnected until the payment is received. [14]



**Figure 3: Starting up of meter**



**Figure 4: Mode Selection**

#### **GSM/GPRS Power Supply Design Requirements:**

The GSM/GPRS module's input voltage supply ranges from 3.2 V to 4.5 V, with an average power supply current need of 400 mA to 1 A. The power supply must also be able to handle transmission pulses of 2 A to 3 A, therefore great load management and minimum ripple must be considered while guaranteeing a highly efficient design. The average current consumption is determined by the class that the module supports.

Class 8, Class 10, and Class 12 are the most frequent GPRS classes. The higher the GPRS class, the faster the data transfer rates, and the bigger the number of timeslots required for transmission. Class 8 has four Rx and one Tx slots; Class 10 has three Rx and two Tx slots; and Class 12 has one Rx and four Tx spaces. Thus, a GSM/GPRS Module sends 1/2/3 time slot(s) of 577us during a 4.6ms period, and receives or is idle for the remaining 4.0ms/3.4ms/2.3ms, depending on whether it is a GSM/GPRS Class 8, Class 10, or Class 12 module. Using 3 A as the amplitude of gearbox bursts, this results in an average current consumption of 400mA in Class 8 to 1 A in Class 12. A GSM/GPRS module power supply should be able to deliver this average current as well as tolerate periodic transmission bursts with high current usage. [15]

## CONCLUSION:

In the present research, a proposed system of energy management for the home appliances has been designed, and implemented using SMS services of the GSM network. By this system the home appliances have remotely been controlled using mobile phones and the statuses of these appliances have been monitored. Developed programs with a simple algorithm have been implemented. The proposed system has been tested and it has seemed to work successfully. An Energy Management Controller (EMC), is used which checks electricity consumption and generation and remotely manages the load. Whenever utility company sends a command for load shedding, low priority appliances are cut off from power supply so as to reduce peak demand. The priority of the appliances can be set by the user through an easy interface to the EMC. The EMC contains a smart energy meter, a GSM modem, a microcontroller and a relay circuit (GSM), which is connected between the energy meter and the load.

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