# GSM Module in Remote Electrical Loads Control

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*Abstract* - **Electrical appliances power consumption tends to grow in proportion to the increase in the number of large-sized electric home appliances. These Projects describes the technology associated with the Remote Control of Electrical Loads Using GGSM Module. Using GSM networks, a control system has been projected that will act as an embedded system which can control appliances and other devices locally using built-in input and output peripherals. Also the system allow the user to effectively control house or office appliances and equipment via the mobile phone set by sending commands in the form of SMS messages and receiving the appliances status. The main conception behind this project is receiving a coded SMS to trigger or switch home electrical appliances through communication between GSM module and a microcontroller switching circuit.**
*Keywords:* **SMS, Microcontroller, GSM, Appliances, Switch.**

## I. INTRODUCTION

Electrical appliances power consumption tends to grow in proportion to the increase in the number of large-sized electric home appliances. Remote Control of Electrical Loads Using GSM Module" implements the emerging applications of the GSM technology. Using GSM networks, a control system has been proposed that will act as an embedded system which can control appliances and other devices locally using built-in input and output peripherals. [1] Remotely, the system allows the user to effectively control the house/office appliances and equipment via the mobile phone set by sending commands in the form of SMS messages and receiving the appliances status. The main concept behind the project is receiving the sent SMS and processing it further as required to perform several operations. The type of the operation to be performed depends on the nature of the SMS sent. The principle in which the project is based is fairly simple. First, the sent SMS is stored and polled from the receiver mobile station and then the required control signal is generated and sent to the intermediate hardware that we have designed according to the command received in form of the sent message.

The messages are sent from the mobile set that contain commands in written form which are then processed accordingly to perform the required task. A microcontroller based system has been proposed for our project. There are several terminologies that are used extensively throughout this project report. GSM (Global System for Mobile Communications): It is a cellular communication standard.

SMS (Short Message Service): It is a service available on most digital mobile phones that permit the sending of short messages (also known as text messaging service). To implement home power management, networked electric home/office appliances with control capabilities and home networks without new wiring are indispensable. Together with the construction of access networks, several standards for wired home networks have been proposed and developed. The static function discovers electric home appliances in a network, assign an ID or command to each appliance, and generates an entry for controlling the interface from the home network. However, electric home/office appliances without expansive functions and a conventional power plug which have deteriorated from their interference have made it difficult to build such advanced systems. Setting up a system without new wiring is a major concern in a wide variety of applications such as power consumption monitoring, power control and the management of electric home appliances. Imagine a private house/office equipped with motion, light, temperature and other SMS based control systems for opening the door, switching the light, controlling the heating and so on. These SMS based control system can be used to enhance the individual's lifestyle, e.g. the fan is turned "ON" using SMS when the owner of the house goes out and then light is switched "ON" in points. Existing solutions for home appliances control when no one is available to either switch "ON" or "OFF" the sockets.

Mobile phones have become one of the most popular communication devices among most of the people around the world, and the Short Message Service (SMS) is popular among mobile phone users as a cheap and convenient method of communicating. Therefore, SMS technology is a common feature with all mobile network service providers. Since the use of SMS technology is a cheap, convenient and flexible way of conveying data, researchers are trying to apply this technology in many different areas that are not covered by service providers at present.

## II. THE BACKGROUND

The new age of technology has redefined communication. Most people nowadays have access to mobile phones and thus the world indeed has become a global village. At any given moment, any particular individual can be contacted with the mobile phone. But the application of mobile phone

cannot just be restricted to sending SMS or starting conversations. New innovations and ideas can be generated from it that can further enhance its capabilities. Technologies such as Infra-red, Bluetooth, etc which has developed in recent years goes to show the very fact that improvements are in fact possible and these improvements have eased our life and the way we live. GSM control management of several home and office appliances is a subject of growing interest and in recent years we have seen many systems providing such controls. [2]

These days, apart from supporting voice calls a mobile phone can be used to send text messages as well as multimedia messages (that may contain pictures, graphics, animations, etc). Sending written text messages is very popular among mobile phone users. Instant messaging, as it is also known, allows quick transmission of short messages that allow an individual to share ideas, opinions and other relevant information. We have used the very concept to design a system that acts a platform to receive messages which in fact are commands sent to control different appliances and devices connected to the platform. We have designed a control system which is based on the GSM technology that effectively allows control from a network area to the desired location. The application of our suggested system is immense in the ever changing technological world. It allows a greater degree of freedom to an individual whether it is controlling the household appliances or office equipment. The need to be physically present in order to control appliances of a certain location is eliminated with the use of our system. [3]

### A. *Operating Environment*

The control system will include two separate units: the cellular phone, and the control unit. There will therefore be two operating environments. The cellular phone will operate indoors and outdoors whereas the control unit will operate indoors within the temperature and humidity limits for proper operation of the hardware. [4] Assuming that the control unit is powered and operating properly, the process of controlling a device connected to the interface will proceed through the following steps;

a. The remote user sends text messages including commands to the receiver.
b. GSM receiver receives messages sent from the user cell phone.
c. GSM receiver decodes the sent message and sends the commands to the microcontroller.
d. Microcontroller issues commands to the appliances and the devices connected will switch ON / OFF. [5]

### III. THE STUDY

GSM is a global system for mobile communication GSM is an international digital cellular telecommunication. The GSM standard was released by ETSI (European Standard Telecommunication Standard) back in 1989. The first commercial services were launched in 1991 and after its early introduction in Europe; the standard went global in1992. Since then, GSM has become the most widely adopted and fastest-growing digital cellular standard, and it is positioned to become the world's dominant cellular standard. [6] Today's second-generation GSM networks deliver high quality and secure mobile voice and data services (such as SMS/ Text Messaging) with full roaming capabilities across the world. [6]

GSM platform is a hugely successful technology and as unprecedented story of global achievement. In less than ten years since the first GSM network was commercially launched, it become, the world's leading and fastest growing mobile standard, spanning over 173 countries. Today, GSM technology is in use by more than one in ten of the world's population and growth continues to sour with the number of subscriber worldwide expected to surpass one billion by through end of 2003. [6] Today's GSM platform is living, growing and evolving and already offers an expanded and feature-rich 'family' of voice and enabling services.

The Global System for Mobile Communication (GSM) network is a cellular telecommunication network with a versatile architecture complying with the ETSI GSM 900/GSM 1800 standard. Siemen's implementation is the digital cellular mobile communication system D900/1800/1900 that uses the very latest technology to meet every requirement of the standard. [6]

### IV.SCOPE OF WORK

The scope of work for this project will cover the development of home appliances control system. This project will be focused on control system and messaging system. The control system used the system control signal. Then the signal will trigger to system microcontroller, where the SIM will send out a command to the microcontroller. The SIM in the module will give a respond to the microcontroller command by sending an SMS 'ON' to the switches through the programmed command.

### V.THE OBJECTIVE

This project "Remote Control of Electrical Loads Using GSM Module" is aimed constructing a control system that enables the complete control of the interface on which it is based. General objectives of the project are defined as;

1. Continuous process to home appliances control system without any supervisor
2. To provide hands on skills in hardware and software designing
3. Using the PIC programming as a program to control system.
4. Design the circuit using combination SIM Module and circuit control system.

5. To co-ordinate appliances and other devices through Short Message Service

### VI.PROBLEM STATEMENT

This project is an alternative way to overcome and extend the application of existing home control system. Generally, all appliances in our various homes should be switched OFF before embarking on any journey, either short or long distance to avoid electrical damages. This home appliance control system deals with controlling the electrical power point in various homes with a GSM mobile. The major problems faced is the hard purchase of the materials due to the fact that some of the materials used are not produced or hardly seen in or within the country. Due to the power failure in the country, the application of this home appliances control will not be that affective. Not everything that we had planned went smoothly during the project development span.

Also we had a limited amount of time for its completion so we were under a certain amount of pressure as well. We had to start from the research phase at the beginning andneeded to gain knowledge on all the devices and components that we had intended to usefor our project. Other phases of the project included coding, debugging, testing, documentation and implementation and it needed certain time for completion so we really had to manage the limited time

available to us and work accordingly to finish the project within the scheduled time.

*Assumptions*

Certain assumptions have to be made in order to implement our project. The list of assumptions for our project is;

a. The user and control unit will establish communication via GSM.
b. The cell phone and service provider chosen will support text messaging service.
c. The user is familiar with the text messaging program on their cell phone.
d. All service charges (standard messaging rates) from the service provider apply.
e. The controlled appliances can and will have to have an electrical interface in order to be controlled by the microcontroller.

### VII. THE TECHNOLOGY

This work embraces the literature review of the project which includes the concept, theory, perspective and the method of the project that is used in order to solve the problem occurs and any hypothesis that related with the research of methodology. The methodology are briefly discussed which purposely to provide the reader an understanding of the project introduction.

*A.System Flow Diagram*

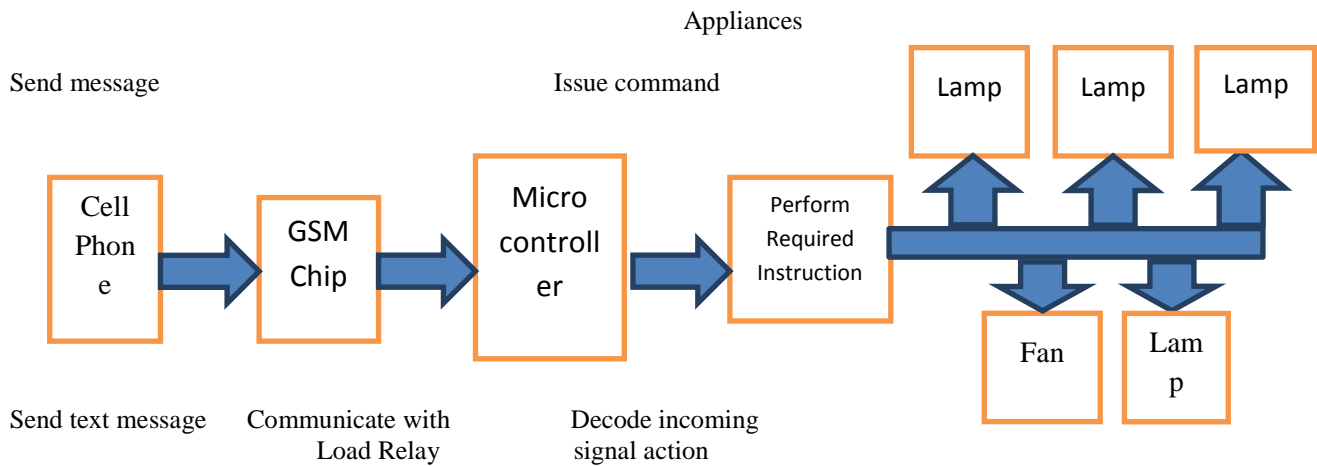The system block diagram and Circuits diagram are as shown in Fig.1and 2 respectively.
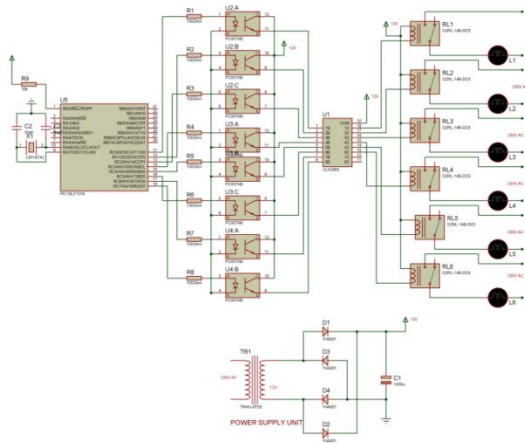


Fig.1 The system block diagram

Fig.2 The system circuit diagram

## B.The System Software Design

### Algorithm

1. Start
2. Microcontroller configuration
3. Interrupt Configuration
4. GSM module configuration
   a. UART initialization
   b. Baud rate negotiation
   c. Issue Disable command echo
   d. Set message type as TXT
   e. Delete all messages(if any)
5. Blink the LED for 5 times
   a. Read EEPROM for any saved number
6. Copy the saved number to microcontroller RAM
7. Begin infinity loop
8. Read if any message Received from GSM module
9. If "Pwd" received as message
   a. Blink led for 7 times
   b. Copy the phone number that sent the "Pwd" message to RAM of the microcontroller
   c. Also saved the number to the EEPROM of the microcontroller.
   d. Send Acknowledge msg to the phone number.
10. If motion detected
    a. LED off
    b. SECURITY LIGHT is ON
    c. If the last message is over 30 seconds or thereabout send SMS message
    d. Delay 10 seconds
    e. LED is ON
    f. SECURITY LIGHT is OFF
11. End an Infinity loop
12. End

### 1.The GSM Module

The GSM Module is specifically designed to connect to the Essential Control Module thus allowing calls to be made using the GSM cellular mobile phone network. Because the GSM Module is supplied SIM Card-free by the service provider the user can use the network of his choice. The GSMModule provides a remote GSM mobile to control the system using the SMS. The complete circuit diagram of the GSM Module with microcontroller is shown in Figure 3.
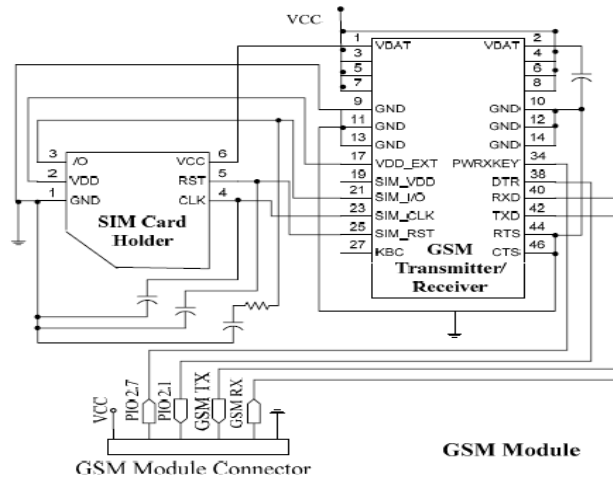


Fig.3 Complete circuit diagram of the GSM Module with microcontroller

### 2.Short Message Service

SMS stands for Short Message Service. It is a technology that enables the sending and receiving of message between mobile phones. SMS first appeared in Europe in 1992. It was included in the GSM (Global System for Mobile Communication) standards right at the beginning. Later it was ported to wireless technologies like CDMA and TDMA. The GSM and SMS standards were originally developed by ETSI. ETSI is the abbreviation for European Telecommunication Standard Institute. Now the 3GPP (Third Generation Partnership Project) is responsible for the development and maintenance of the GSM and SMS standards. [7] [8] One SMS message can contain at most 140 bytes (1120 bits) of data, so one SMS message can contain up to: [8] 160 characters if 7-bit character encoding is used. (7-bit character encoding is suitable for encoding Latin characters like English alphabets.). 70 characters if 16-bit Unicode UCS2 character encoding is used. (SMS text messages containing non-Latin characters like Chinese character should use 16- 32bit character encoding.) [8] Once the message is sent the message is received by SMSC, which must then get it to the appropriate mobile device. To do this the SMSC sends a SMS request to Home Location Register (HLR) to find the roaming customer. Once HLR receives the request, it responds to the SMSC with the subscriber's status:

1. Inactive or active
2. Where subscriber is roaming.

If the response is "inactive", then the SMSC will hold onto the message for a period of time. When the subscriber access his device, the HLR sends a SMS notification to the SMSC and the SMSC will attempt delivery. [8] The SMSC transfer the message in a Short Message Delivery Point to

Point format to the serving system. The system pages the device, and if it responds, the message gets delivered. The SMSC receives verification that the message was received by the end user, then categorizes the message as "sent" and will not attempt to send again. [8] SMS provides a mechanism for transmitting short message to and from wireless devices. [8] The service makes use of an SMSC, which acts as a store and forward system for short messages. [8] One major advantage of SMS is that it is supported by 100% GSM mobile phones. Almost all subscription plans provided by wireless carriers include inexpensive SMS messaging service. [8]

### 3.What makes SMS messaging so successful worldwide?

SMS is so successful all over the world. SMS messaging is now one of the most important revenue sources of wireless carriers. Some of the reasons are discussed below.

1. SMS Messages can be sent and read at any time
2. SMS Message can be sent to an offline Mobile Phone.
3. SMS Messaging is less disturbing while you can still stay in touch.
4. SMS are supported by 100% GSM Mobile Phones and they can be exchanged between different wireless carriers

### 4.Microcontroller

An embedded microcontroller is a chip, which has a computer processor with all itssupport function (clocking and reset), memory (both program storage and RAM), and I/O (including bus interfaces) built into the device. These built in function minimize the need for external circuits and devices to the designed in the final applications. [9] The improvements in micro-controller technology has meant that it is often more cost-effective, faster and more efficient to develop an application using a micro-controller rather than discrete logic. Creating applications for micro-controllers is completely different than any other development job in computing and electronics. In most other applications, number of subsystems and interfaces are available but this is not the case for the micro-controller where the following responsibilities have to be taken. [9]

1. Power distribution
2. System clocking
3. Interface design and wiring
4. System Programming
5. Application programming
6. Device programming

There are two types of micro-controller commonly in use. Embedded micro-controller is the micro-controller, which has the entire hardware requirement to run the application, provided on the chip. External memory micro-controller is the micro-controller that allows the connection of external memory when the program memory is insufficient for an

application or during the work a separate ROM (or even RAM) will make the work easier. [10]

### 5.Relay

The relay driver is used to isolate both the controlling and the controlled device. The relay is an electromagnetic device, which consists of solenoid, moving contacts (switch) and restoring spring and consumes comparatively large amount of power. Hence it is possible for the interface IC to drive the relay satisfactorily. To enable this, a driver circuitry, which will act as a buffer circuit, is to be incorporated between them. The driver circuitry senses the presence of a "high" level at the input and drives the relay from another voltage source. Hence the relay is used to switch the electrical supply to the appliances. [10] From the figure when we connect the rated voltage across the coil the back e.m.f opposes the current flow but after the short time the supplied voltage will overcome the back e.m.f and the current flow through the coil increase. When the current is equal to the activating current of relay the core is magnetized and it attracts the moving contacts. Now the moving contact leaves from its initial position denoted "(N/C)" normally closed terminal which is a fixed terminal. The common contact or moving contact establishes theconnection with a new terminal which is indicated as a normally open terminal "(N/O)". Whenever, the supply coil is withdrawn the magnetizing force is vanished. Now, the spring pulls the moving contact back to initial position, where it makes a connection makes with N/C terminal. However, it is also to be noted that at this time also a back e.m.f is produced. The withdrawal time may be in microsecond, the back e.m.f may be in the range of few kilovolts and in opposite polarity with the supplied terminals the voltage is known as surge voltage. It must be neutralized or else it may damage the system.

## VIII. TESTING AND RESULT

The stages involved in the construction of the proposed system are: design validation, casing in implementation, testing and packaging. Design validation: the best workable circuit was devised taken in to consideration the speed of the dc motor, the size of the cable, cost and the availability of the components After the coupling of both

### A.Testing and Result

It is paramount important to establish a highly efficient testing techniques in other to minimize cost. Testing involve troubleshooting system to detect, isolate and correct internal or external fault such as malfunction in the internal circuitry, input or output shorted to ground or input or output open circuited.

1. Each of the component was first tested using multimeter in order to check the state of their performance and accurate value

2. In the connection of each component to the alternator was then tested. This was done in other to carry out the continuity, which is meant for proper connection of the circuit and to detect any wrong connection.

3. After the proper testing, as shown in the Figure 4 (a to f), of the peripherals and found to be working perfectly.
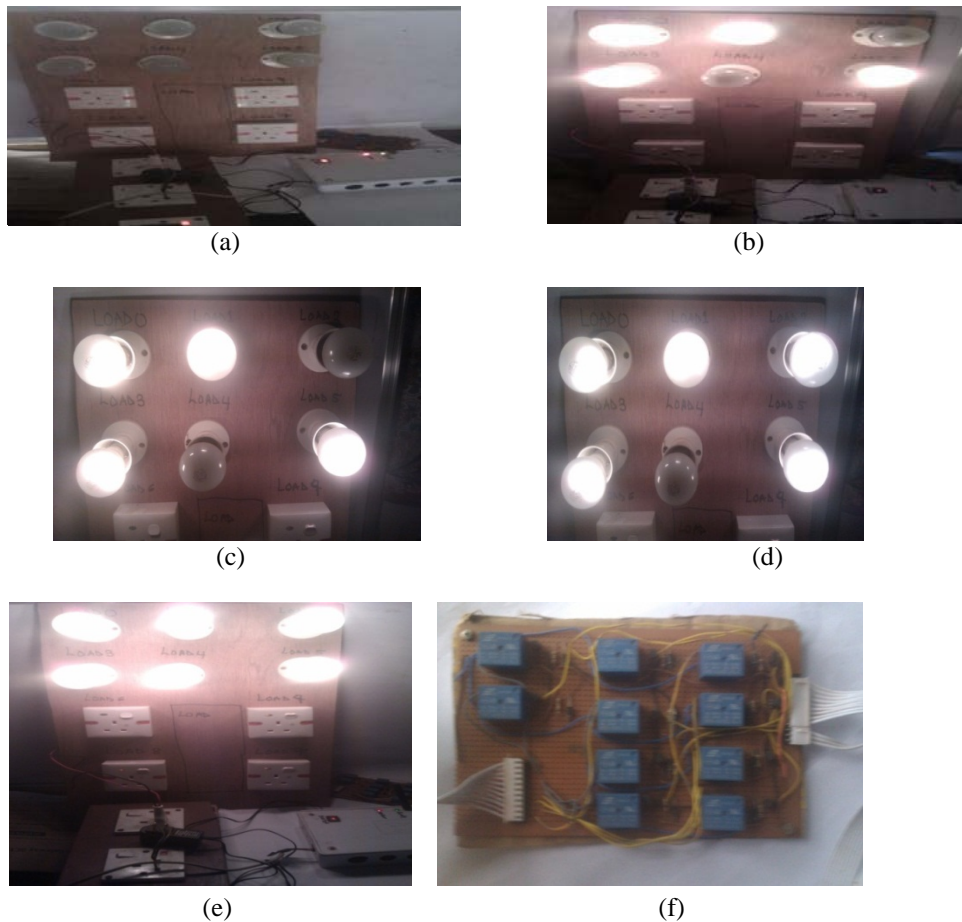

(a)


(b)


(c)


(d)


(e)


(f)

Fig.4 Appliances switching sequential test

The diagram above shows how the micro controller mode of operation. The processes of controlling home electrical appliances are tested as in Fig. 4. The system control proceeds through the following steps;

1. The remote user sends text messages including commands to the receiver.
2. GSM receiver receives messages sent from the user cell phone.
3. GSM receiver decodes the sent message and sends the commands to the microcontroller.
4. Microcontroller issues commands to the appliances and the devices connected will switch ON/OFF.

### B.Merits of the System

a. GSM covers virtually all parts of the world, this makes the device more universally beneficial
b. It brings about flexibility in controlling home devices even when one forgets to switch off appliances.

### C.Precincts of the System

Weak signal or lack of GSM network signal coverage is of notable limitation to this controlling system. GSM has a fixed maximum cell site range of 35Km, which is imposed by tactical limitation.

TABLE 1 LOAD SWITCHING SEQUENCE TEST

| S / N | | L1 | L2 | L3 | L4 | L5 | L6 | S1 | S2 | S2 | S3 | S4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| | | | | | | | | | | | | |
| 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | O | 1 |
| 3 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 44 | 11 | 11 | 11` | 11 | 11 | 11 | 11 | 11 | 11 | 00 | 11 | 11 |
| 15 | 11 | 11 | 00 | 11 | 11 | 11 | 11 | 00 | 11 | 11 | 11` | 11 |
| 66 | 1 … | | | | | | | | | | | |

'1' implies ON
'0' implies OFF

The loads can be switch 'ON' and 'OFF' in 1024 sequences. However the sequences were tested working except for the delay in response that was due to telecommunication network. No signal and week

TABLE 2 THE DELAY TIME TABLES

| Operation sequence | Response time (sec) |
|---|---|
| 1 | 6 |
| 2 | 10 s |

## IX. CONCLUSION

The objectives of this work have been achieved. Remote Control of Electrical Loads Using GSM has been constructed and tested (as illustrated in section four of this paper) working. This can be improved further for commercial purpose and mass produced for people to use.

## REFERENCES

[1] Chia-Hung Lien, Department of Computer science and Information Engineering, Lee-Ming Institute of Technology, Taipei, Taiwan, 243, R.O.C. Hsien-Chung Chen ; Ying-Wen ai ; Ming-Bo Lin

[2] Retrieved from: iet-journals.org/archive/2013/april_vol_3_no_4/4227991359579551.pdf

[3] yourprojectlibrary.com/cmexxx.php

[4] www.slideshare.net/electronicsbaazar/ gsm-based-control-system

[5] IJCSMS International Journal of Computer Science and Management Studies, Vol. 11, Issue 02, Aug 2011ISSN (Online): 2231-5268 www.ijcsms.com

[6] International Journal of Engineering Trends and Technology July to Aug Issue 2011

[7] www.developershome.com/sms/sms Intro.asp

[8] https://books.google.com.ng/books?isbn=9380578091

[9] www.scf.usc.edu/~yashdosh/projects/ monitor.pdf

[10] https://de.scribd.com/document/43478507/GSM-Based-Control-System-NEW