

# **GSM BASEDELECTRICAL DEVICE CONTROL**

**A Project submitted in partial fulfillment of the requirements for the  
Award of Degree of Bachelor of Science in Electrical and Electronic  
Engineering.**

**By**

**Name: Md. Shamim Mollah**

**ID: 151-33-2419**

**Name: Md. Mahadi Hasan**

**ID:151-33-2576**

**Supervised by:**

**Rahnuma Rahman (RR)**

**(Lecturer)**

**Department of EEE**



**DEPARTMENT OF ELECTRICAL AND ELECTRONIC  
ENGINEERING**

**FACULTY OF ENGINEERING**

**DAFFODIL INTERNATIONAL UNIVERSITY**

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# DECLARATION

We hereby declare that, this project has been done by us under the supervision of **Rahnuma Rahman (RR)**, Lecturer, Department of EEE Daffodil International University. We also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma.

## Signature of the candidates

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**Name: Md. Shamim Mollah**  
**ID: 151-33-2419**

---

**Name: Md. Mahadi Hasan**  
**ID: 151-33-2576**

## Countersigned

---

**Rahnuma Rahman (RR)**  
Lecturer  
Department of Electrical and Electronic Engineering  
Faculty of Engineering  
Daffodil International University

The project entitled “GSM Base Electrical Device Control” submitted by Name Md Shamim Mollah, ID No: 151-33-2419, Name Md. Mahadi Hasan, ID No: 151-33-2576, Has been accepted as satisfactory in partial fulfillment of the requirements for the degree of Bachelor of Science in Electrical and Electronic Engineering.

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*Dedicated to...*

**Our Parents**

**&**

**All of my Teachers**

# CONTENTS

<b>List of Figures</b>		viii
<b>List of Tables</b>		ix
<b>List of Abbreviations</b>		ix
<b>List of Symbols</b>		x
<b>Acknowledgment</b>		xi
<b>Abstract</b>		xii
<b>Chapter 1: INTRODUCTION</b>		<b>1-3</b>
1.1	Introduction	1
1.2	Problem Statement	1
1.3	Objectives	2
1.4	Scopes	2
1.5	Methodology	2
1.6	Project Outline	3
<b>Chapter 2: LITERATURE REVIEWS</b>		<b>4-6</b>
2.1	Introduction	4
2.2	Literature Contributions	4
2.3	Literature Survey	5
2.4	Summary	6
<b>Chapter 3: ANALYSIS AND SIMULATION</b>		<b>7-21</b>
3.1	Introduction	7
3.2	Define GSM	7
3.3	Overview	8
3.3.1	Topics	8
3.4	Two Thirds of World's Population Now Connected, According to GSMA Intelligence	8

3.5	The GSM Network	10
3.5.1	The Switching System	10
3.6	The Base Station System (BSS)	11
3.7	The Operation and Support system	11
3.7.1	Additional Functional Elements	12
3.8	GSM Network Areas	12
3.9	GSM Specification	14
3.10	Supplementary Services	15
3.11	Universal Synchronous Asynchronous Receiver Transmitter (USART)	16
3.12	Using Programming System	17
3.13	Softer Analysis	17
3.14	Block Diagram	18
3.15	Flow Chart	19
3.16	Circuit Diagram	20
3.17	Reset	21
<b>Chapter 4:</b>	<b>HARDWARE DEVELOPMENT</b>	<b>22-39</b>
4.1	Introduction	22
4.1.1	The methodology followed in our project is as follows	22
4.2	Different Types of Hardware Equipment list and Costing Sheet	23
4.2.1	Capacity Elements	24
4.3	A6 GSM Module	25
4.3.1	A6 GSM Module Description	25
4.3.2	About the antenna	26
4.3.3	Arduino (UNO )	27
4.3.4	Description	27

4.4	Circuit Diagram of Arduino UNO	29
4.5	Pin Diagram of Arduino (At mega 328)	30
4.5.1	Pin Description of At mega 328	31
4.5.2	Arduino Works	32
4.6	LCD Display (16×2)	33
4.6.1	Pin Configuration	33
4.7	Feature of (16×2) LCD Module	34
4.8	Fixed voltage Regulator	35
4.9	Resistor	36
4.10	Capacitor	37
4.11	Relay	37
4.12	Transformer	38
4.13	Diode	39
<b>Chapter 5:</b>	<b>RESULTS AND DISCUSSIONS</b>	<b>40-44</b>
5.1	Introduction	40
5.2	Hardware Result	40
5.2.1	Command and Feedback SMS	44
5.3	Summary	44
<b>Chapter 6</b>	<b>CONCLUSION AND RECOMMENDATION</b>	<b>45-57</b>
6.1	Conclusion	45
6.2	Limitations of the Work	45
6.3	Future Scopes	45
6.4	Advantages	46
6.5	Disadvantage	47
	References	48

## **LIST OF FIGURES**

<b>Figure No.</b>	<b>Figure Caption</b>	<b>Page No.</b>
3.1	Global System for Mobile Communication(GSM) System Diagram	8
3.2	GSM Network Elements	10
3.3	Network Areas	13
3.4	Location Area	13
3.5	MSC/VLR Service Areas	14
3.6	PLMN Network Areas	14
3.7	Softer Analysis Step	17
3.8.	Block Diagram	18
3.9	Flow Chart	19
3.10	Circuit Diagram	20
4.1	A6 GSM Module	25
4.2	Arduino UNO	27
4.3	Circuit Diagram of Arduino UNO	29
4.4	Pin Diagram of Arduino (At mega 328)	30
4.5	LCD Display 16×2	33
4.6	Voltage Regulator Pin Diagram	35
4.7	Figure of Resistor	36
4.8	Figure of Capacity	37
4.9	Relay Shield	37
4.9.1	Internal Connection	38
4.10	Step-down Transformer	38
4.11	Diode	39
5.1	Starting.....	41
5.2	when all load off	41
5.3	Load-1 ON	42
5.4	Load-1 and Load-3 ON	42
5.5	All Load ON (Auto)	43
5.6	All Load ON (Manual)	43



5.7	Feedback SMS	44
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## **LIST of TABLES**

<b>Table No.</b>	<b>Table Caption</b>	<b>Page No.</b>
3.1	Unique Mobile Subscribers by Global region, into 2017	9
4.1	Equipment List	23
4.1.1	Cost Analysis	23
4.2	Specs	28
4.3	Pin description of At mega 328	31
4.4	Pin Configuration	33

## **List of Abbreviation**

<b>Name</b>	<b>Elaborations</b>
GSM	Global System for Mobile Communication
SIM	Subscriber Identity Module
LCD	Liquid Crystal Display
GPRS	General Packet Radio Service
AC	Alternating Current
LED	Light Emitting Diodes
DC	Direct Current
SIM	Subscriber Identity Module
IC	Integrated Circuit
PCB	Printed Circuit Board

SMS	Short Message service
USART	Universal Synchronous Asynchronous Receiver Transmitter
BPS	Bits Per Second
MXE	Message Center
BSS	Base Station System
AUC	Authentication Center

## List of Symbols

$\lambda$	Wavelength
$\lambda_B$	Bragg wavelength
$n_{eff}$	Effective index
$Z$	Position along the grating
$N$	Mode index
$F$	Fundamental Frequency
$\omega$	Angular frequency
$M$	Modulation Index
$T$	Fundamental Time Period
$V$	Voltage
$I$	Current
$P$	Power
$W$	Watt

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# ABSTRACT

This paper represent the advancement of GSM-based both home and fieldappliancecontrol for remote system. The main goal of the advancement is to reduce electricity wastage. GSM module is used for receiving short message service (SMS) from user's mobile phone that automatically enable the controller to take any other operation such as to switch ON and OFF the home appliances such as light, fan, television, air-conditioner, many others type and field appliance out door system. The system is compact with microcontroller and GSM network interface using C language. Essay EDA software was exploited to accomplish the integration. The system is activated when the sender sends the SMS to controller at house. when receiving the SMS command, the microcontroller unit automatically controls the electrical home appliances by switching ON or OFF the device according to the user direction. In other words, the home appliances are controlled by the home server, which operates according to the user commands.

# CHAPTER– 1

## INTRODUCTION

### **1.1 Introduction:**

Home automation is the control of any electrical device in our home or office, whether we are there or not. The advancement of technology makes our life simpler and easier. Automation presents the outbound applications of the GSM technology. Using the mobile GSM networks, an electrical device and home appliance control has been designed, implemented and turned. Through the project we have tried to show automatic control of a house or industry.

The design of the automation system that can monitor and control system locally using built-in input and output peripherals is presented. The system allows the user or from out land any space monitoring and controlling the house appliances or out from any distance via the smart or cellular phone set by sending commands in the form of SMS messages and receiving the appliances message Total system showing in the LCD such as command L1 for ON, L0 for OFF and step by step each load control. The GSM module provides the communication media between the user and the device by means of SMS messages. The system software is also developed using an interactive C programming language platform.

### **1.2 Problem statement:**

Literature inspection to comprehend the constraints and requirements of our smart an electrical device and automatic control system.

- (a) Attainment of chips and ICs
- (b) Simulation of the microcontroller system using Easy EDA
- (c) Program burning in the microcontroller and hard ware implementation

### **1.3 Objective:**

The followings are the objectives of this Major Project to ensure it meets the goal.

- a) To design a circuit that can expert and self-acting read the position of the different electrical device appliances connected to the control system.
- b) To design a control system for modern home application using GSM network
- c) To design a circuit that can automatically switch ON / OFF the electrical device and outdoor appliances control using GSM module.
- d) To experiment our designed system with a wide range of electrical and electronic equipment and troubleshoot any errors.

### **1.4 Scopes:**

It is an automation of home. Home automation may use control all of the home appliances. Electrical and Electronic environment with favor to this context is any situation which consists of appliances such as motors, television sets, fan, air conditioners, heater, lighting systems, wateringetc. Home automation is such a field where we always want to make easiest and comfortable so, we look forward to a system to install in our home so that we can easily communicate with our daily used device wherever we live. So that this project is getting the opportunity to implement each and every house.

### **1.5 Methodology:**

Electricity is an essential part of our life. We can't think of our modern life without electricity. It is becoming the restrict source now. So, we can't afford to abuse any fraction of it. If we accidentally leave any of the electrical device and irrigation appliances (bulb, microwave oven, TV, fan, pump etc.) switched on, we can access them remotely through our cell phone and switch it off through SMS. It's not always possible to be physically near to the home still sometimes it's very necessary to control the machinery for many purposes So the remote controlling takes the control of the house beyond the house and to the hands of the public. If a simple mobile phone takes the added liability to control the smart system then the control is available from almost everywhere people travels and lives on universe. Nowadays most of the people are using mobile services. So, inventing a system which can control home

weapons from remote places using SMS can benefit a large population which may not be possible using other facility like internet.

## **1.6 Project Outline:**

This Project is organized as follows:

Chapter 1: Introduction, Problem statement, Objectives, Scope, Approach, Project outline.

Chapter 2: Reviews the literature Introduction, Literature contributions, project summary, Mobile telephony system.

Chapter 3: Analyzes and simulates the theoretical model such as introduction, Features of microcontroller, Peripheral features, Special microcontroller, Device overview, Memory organization, USART, A/D module,

Chapter 4: Describes the hardware development part of Introduction, Pin diagram, program, Relay driver, Relay, Oscillator configuration, Circuit diagram, SIM300 module, Product concept, Application interface, Serial interface etc.

Chapter 5: Presents the result and its discussions such as Simulation result & Hardware result.

Chapter 6: Concludes with some recommendations are Limitations of work, Future scopes.

# CHAPTER-2

## LITERATURE REVIEWS

### 2.1 Introduction:

The need for systems that make our life easier and more comfortable has increased within the past few years. The ability to conserve two of the most essential resources of a user. In the scope of industrialization and automation A system that provides this ability to through the use of efficient and reliable way such as wireless networking, GSM, SMS technologies and easily available mobile phone devices is certain to help the user get a better facility and on a larger scale, help the automation and economic growth of the country involves LCD display, GSM. So LCD will be on field display purpose. GSM module will take on a Subscriber Identity Module (SIM) user can communicate with this SIM-Number. When the specific command activated or given by the user, instantly the corresponding GSM system will activates and reads the existent reading and with out delay sends results to the same user mobile and displays in the LCD panel in the field. Instantly user will take the essential action if required. All these devices are linked to the Arduino. GSM is used for communication purpose, with the help of Library (attention)-Commands we can communicate with the equipment's. Wearer using smart phone. This system is designed for controlling device with the help of mobile network

### 2.2 Literature Contributions:

In the literature, there are several contributions mentioned in recent years in mobile to- machine or machine-to-mobile or machine-to-machine, communication. These include: creation prototype integrated mobile telemedicine system interfaced with sensors to a patient's body using GSM simulation[10]; scheming mobile system with wireless LAN [11]; implementing measurement system to supervision the ambient air skill using GPS, GPRS modem and advanced RISC machine [12]; designing remote control of sensors and actuators using GSM module [13]; and designing stand-alone humane warmth and blood pressure system using microcontroller with embedded



software [14]. Meantime, the system developed by [15] is automating the power reading meter to send the energy wasted to e-billing system at approved office. The system works by integrating the GSM module that was attached with digital kWh power meter. It utilizes the GSM network to send power usage reading using SMS to the approved office. The authorized office takes out and operate the received SMS message contains the meter reading to produce the billing cost and send back the cost to the respective consumer through SMS. The work presented by [16] is about the improvement of Integrated Water Billing System with SMS capability. The system is designed to simplify the Water authorized to manage the monthly billing system without the use of human services. The system receives SMS from the meter to central databases. Then the information received is processed to produce current billing. The system again sends a SMS notification to the user concerning the total amount that has been billed. The system was performed using Visual Basic and database in order to perform the prototype and the device works successfully in sending SMS to user for notification. Vehicle Speed Detection using SMS [17], represented the design of the black box for warning system to control the excessive speed of express bus via SMS.

### **2.3 Literature Survey:**

The home automation system is the system that permit us to control and operate all the home appliance when we are away from home. The home automation system can connect multiple devices home security, light, Fan, access control system, air conditioner etc. It provides comfort, suitability and security to home owners. There are so many Technologies that are used for home automation. The system is useful for elderly people and to save power. It associate to almost all the device and control remotely. The user will send SMS which is received by GSM module and Microcontroller is identifying the orders from SMS and do action according to command. All the over system have some disadvantage. Some system have instrument connectivity problem or some are costly or some other may have security problem. The paper consists of the popular Technologies of use in home automation and digitalization.

## **2.4 Summary:**

The system consists of three main parts which is microcontroller circuit or Arduino, relay driving circuit and GSM unit. In this project we used Arduino, A6 GSM Module and using Library software for the programming. The intention of this project is to confine the express bus driver from driving over the permitted speed limit as well as to instruct the drive to obey the regulation; therefore the accident can be prevented as well. This project improved Easy EDA software for programming. At the same time the PIC circuit will automatically interface to the mobile phone and send themes sage to the user. In line with these works, we designed a low-cost and simple way to designing intelligent home system using the concept of machine-to-mobile and mobile-to-machine communication. First, we raised a general purpose electronic circuit design that can control and monitor a difference home appliance with interface that can be plugged into GSM modulo unit. The design build of microcontroller, adaptation circuit, power circuit. Then, we tried to improve prototype home appliance control system with devices as an application example of the designed system.

# CHAPTER-3

## ANALYSIS AND SIMULATION

### **3.1 Introduction:**

This paper represents the theoretical information of this project that connects to the particular application and the air interface. All useful components of this project are presented in great detail. This paper can help us quickly understand all device interface conditions, electrical and mechanical details. With the help of this paper and other A6 GSM application notes, user manual, we can use A6 GSM Module to design and set up mobile application swiftly.

### **3.2 Define GSM:**

Global system for mobile communication (GSM) is a wide area wireless communications system that uses digital radio transmission to provide voice, data, and multimedia communication services. A GSM system comprises the communication between a mobile stations, base stations base (cell site) and switching system. GSM was basically named Group Special Mobile. GSM is the name of a standardization group founded in 1982 to create a common European mobile telephone standard that would formulate specifications for a pan-European mobile cellular radio system operating at 900 MHz. It is calculated that many countries beside of Europe will join the GSM partnership.

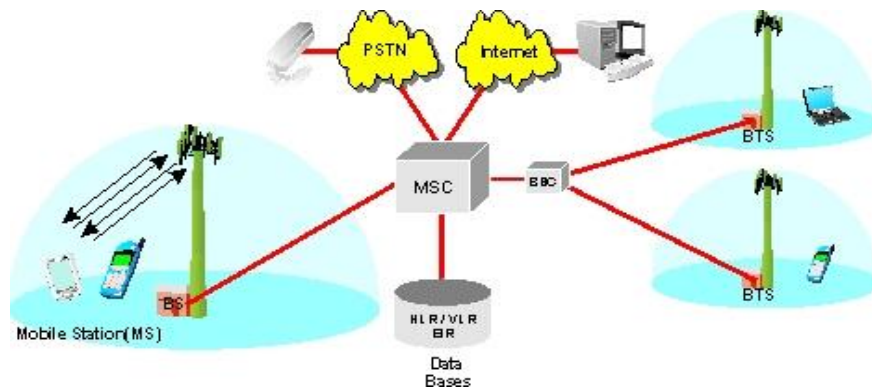


Figure 3.1: Global System for Mobile Communication(GSM) System Diagram.

### 3.3 Overview:

This document provides an introduction to initial GSM concepts, specifications, networks, and services. A short story of network evolution is provided in order set the context for accessing GSM.

#### 3.3.1 Topics:

- \* Introduction: The Evolution of Mobile Telephone Systems
- \* The GSM Network
- \* GSM Network Ares
- \* GSM Specifications

### 3.4 Two-Thirds of World's Nation Now Involved, According to GSMA Intelligence:

The GSMA represents the interests of mobile operators universal, combining nearly 800 operators with almost 300 companies in the wide mobile ecosystem, along handset and device makers, software companies, instrument providers and internet companies, as well as organizations in adjacent industry division. The GSMA also produces industry-guidance events such as Mobile World Congress, Mobile World Congress Shanghai, Mobile World Congress Americas and the Mobile 360 Series of convention. Cellular is one of the fastest, easiest rising and most demanding telecommunications applications. Today, it providing the platform for a new digital

globe as we enter the 5G area currently there are more than 45 million cellular subscribers worldwide, and nearly 50 percent of those subscribers are situated in the United States. It is forecasted that cellular method using a digital technology will become the universal system of telecommunications. Subscriber growth benefits over the upcoming years will be prophecy on connecting mainly rural, low-income nations; operators are growing a range of sustainable solutions to deliver reasonable connectivity to underserved communities,” added Granary. “Meanwhile, in mature markets where subscriber progress is slowing, operators are evolving their business models to acceptance rising value within the expanding mobile ecosystem.

**Table 3.1:** Unique Mobile Subscribers by Global Region, into Q2 2018 [ 7 ]

Region	Unique mobile subscribers (millions)	% of global subscriber base	Subscriber penetration (% of population)
Asia Pacific	2,765	55%	68%
China	1,081	21%	78%
India	730	14%	54%
Europe	465	9%	86%
Latin America	459	9%	71%
Sub-Sahara Africa	436	9%	44%
Middle East & North Africa	391	8%	63%
North America	292	6%	80%
CIS	227	5%	79%
TOTAL:	5,035	100%	67%

### 3.5 The GSM Network:

GSM provides recommendations, not necessity. The GSM specifications identify the functions and interface reasons in detail but do not trace the hardware. The reason for this is to limit the designers as small as feasible but still to make it feasible for the operators to buy materials from different suppliers. The GSM network is divided into three main parts: The switching system(SS), The base station system(BSS), and the operation and support system(OSS).

The basic GSM network elements are shown in Figure:

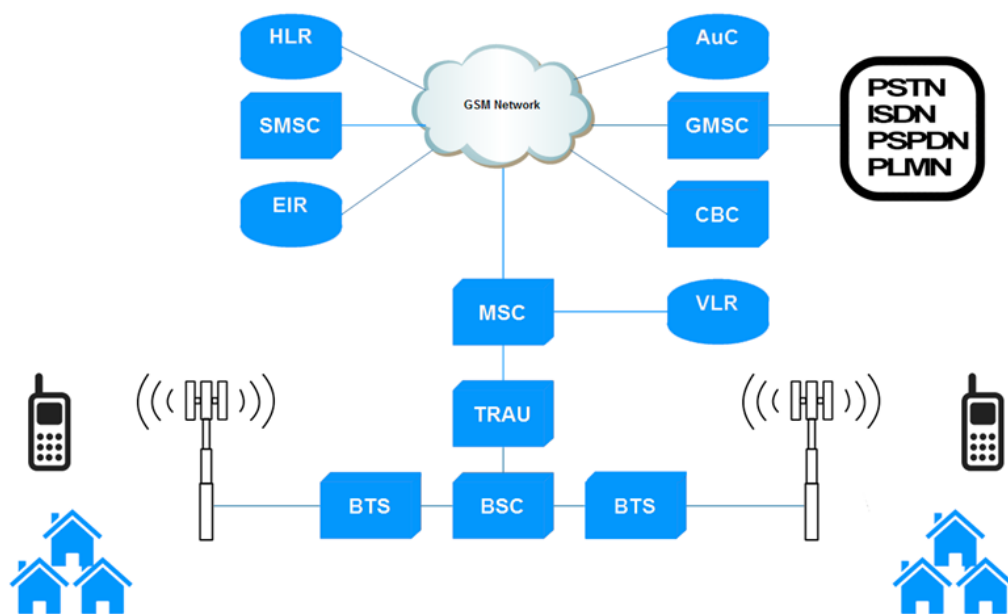


Figure: 3.2 GSM Network Elements

#### 3.5.1 The Switching System:

The switching system (SS) is liable for performing call processing and subscriber-related operations. The switching system involves the following functional units:

- **Home Location Register (HLR).** The HLR is a database used for storage and administration of subscriptions. The HLR is calculated the most important database, as it stores fixed data about subscribers, including a subscriber's service profile, location information, and movement status. When a separate buy a subscription from one of the PCS operators, he or she is affixed in the HLR of that operator.
- **Mobile Services Switching Center (MSC)**—The MSC execute the telephony switching actions of the system. It monitoring calls to and from other telephone and

data systems. It also monitoring such functions as toll ticketing, network interfacing, general channel signaling, and others.

- **Visitor Location Register (VLR)**—The VLR is a database that contains transient information about subscribers that is wanted by the MSC in order to service visiting subscribers. The VLR is always integrated with the MSC. When a mobile station ramble into a new MSC area, the VLR connected to that MSC will request data about the mobile position from the HLR. Later, if the mobile station makes a call, the VLR will have the information needed for call setup without having to examine the HLR each time.
- **Authentication Center (AUC)**—A unit called the AUC provides authentication and encryption parameters that confirm the user's identity and assure the confidentiality of each call. The AUC protects network operators from various types of fraud found in today's cellular world.
- **Equipment Identity Register (EIR)**—The EIR is a database that contains information about the identity of mobile material that confine calls from stolen, unrecognized, or defective mobile stations. The AUC and EIR are accomplished as stand-alone nodes or as attached AUC/EIR node.

### **3.6 The Base Station System (BSS):**

All radio-related functions are accomplished in the (BSS), which contains of base station controllers (BSCs) and the base transceiver stations (BTSs)

- **BSC**—The BSC contribute all the control functions and physical links between the MSC and BTS. It is a high-capacity switch that contribute functions such as handover, cell configuration data, and monitoring of radio frequency (RF) power levels in base transceiver stations. A number of BSCs are enforced by an MSC.
- **BTS**—The BTS controls the radio interface to the mobile station. The BTS is the radio instrument (transceivers and antennas) needed to service each cell in the network. A group of BTSs are conducted by a BSC.

### **3.7 The Operation and Support System:**

The operations and maintenance center (OMC) is connected to all equipment in the switching system and to the BSC. The implementation of OMC is called the operation and support system (OSS). The OSS is the functional entity from which the network

operator monitors and controls the system. The purpose of OSS is to offer the customer cost-effective support for centralized, regional and local operational and maintenance activities that are required for a GSM network. An important function of OSS is to provide a network overview and support the maintenance activities of different operation and maintenance organizations.

### **3.7.1 Additional Functional Elements:**

**Another functional elements shown in Figure 2 are as follows;**

- **Message Center (MXE)**—The MXE is a node that contribute integrated voice, fax, and data messaging. Particularly, the MXE operate short message service, cell broadcasting, voice mail, fax mail, e-mail, and notification.
- **Mobile Service Node (MSN)**—The MSN is the node that operates the mobile intelligent network (IN) services.
- **Gateway Mobile Services Switching Center (GMSC)**—A entrance a node used to interconnect two networks. The entrance is often performed in an MSC. The MSC is then mentioned to as the GMSC.
- **GSM Interworking Unit (GIWU)**—The GIWU contains of both hardware and software that provides an interface to different networks for data communications. By the GIWU, users can alternate between speech and data during the similar call. The GIWU hardware instrument is physically located at the MSC/VLR..

### **3.8 GSM Network Areas:**

The GSM network is made up of geographical areas. As shown in Figure 3, this area cover cells, location areas (LAs), MSC/VLR service areas, and public land mobile network (PLMN) areas.



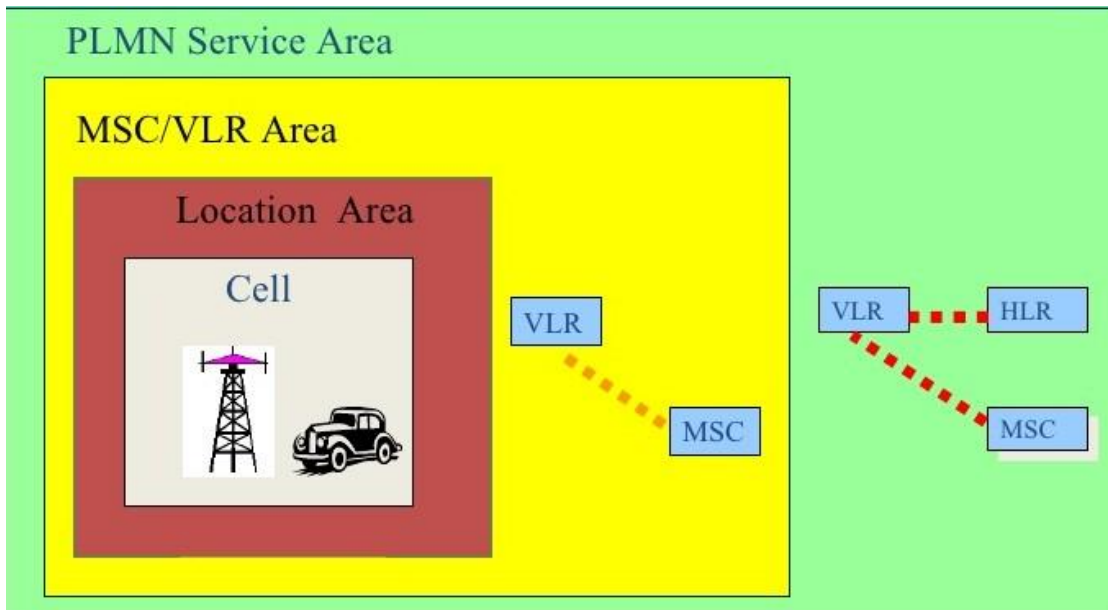


Figure:3.3 Network Areas

The cell is the field given radio coverage by one base transceiver station. The GSM network defines each cell via the cell global identity (CGI) number assigned to each cell. The position area is a group of cells. It is the area in which the contributor paged. Each LA is served by one or more base station controllers, yet only by a single MSC. Each LA is assigned a location area identity (LAI) number

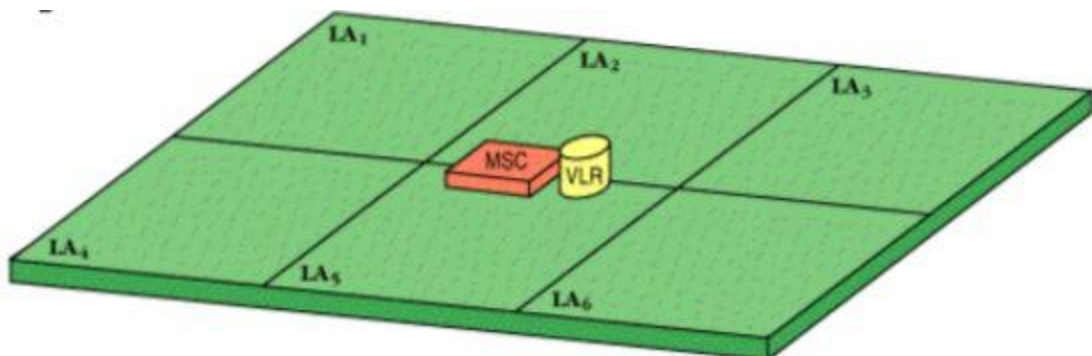


Figure: 3.4 Location Area

An MSC/VLR service area presents the part of the GSM network that is covered with one MSC and which is reachable, as it is registered in the VLR of the MSC (see Figure).

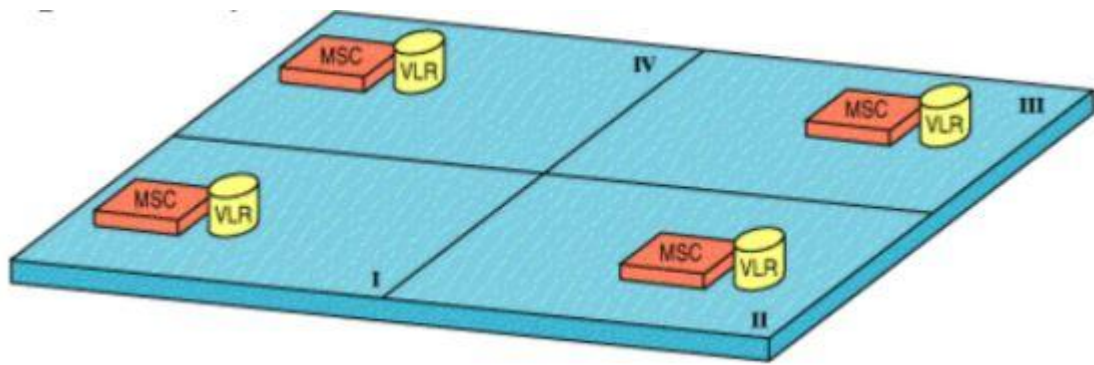


Figure 3.5: MSC/VLR Service Areas

The PLMN service area is an area served by one network operator (see Figure).



Figure:3.6 PLMN Network Areas

### 3.9 GSM Specifications:

Before looking at the GSM specifications, it is necessary to understand the following basic terms:

- **Bandwidth**—The range of a channel's border; the broader the bandwidth, the faster data can be sent.
- **Bits per second (bps)**—A single on-off pulse of data; eight bits are similar to one byte.
- **Frequency**—The number of cycles per unit of time; frequency is measured in hertz (Hz).
- **Kilo (K)**—kilo is the term for 1,000; the abbreviation kbps represents 1k bits per second.
- **Mega Hertz(MHz)**—1,000,000 hertz (cycles per second)

- **Mille Seconds (MS)**—One-thousandth of a second
  - **Watt (W)**—A measure of power of a transmitter
- particular for different personal communication services (PCS) systems vary among the various PCS networks. Listed below is a statement of the specifications and characteristics for GSM.
- **Frequency Band**—The frequency range embarked for GSM is 1,850 to 1,990 MHz (mobile station to base station).
  - **Duplex Distance**—The duplex distance is 80 MHz Duplex distance is the distance among the uplink and downlink frequencies. A channel has two frequencies, 80 MHz apart.
  - **Channel Separation**—The separation among adjacent carrier frequencies. In GSM, this is 200 kHz.
  - **Modulation**—Modulation is the process of sending a signal by switching the characteristics of a carrier frequency. This is done in GSM via Gaussian minimum shift keying(GMSK).
  - **Transmission Rate**—GSM is a digital process with an over-the-air bit rate of 270 kbps.
  - **Access Method**—GSM utilizes the time division multiple access (TDMA) conception. TDMA is a technique in which several variety calls may share the same carrier. Each call is imposed a particular time slot.
  - **Speech Coder**—GSM uses linear predictive coding (LPC). The purpose of LPC is to decrease the bit rate. The LPC delivers parameters for a filter that mimics the vocal tract. The signal takes across this filter, leaving behind a residual signal. Speech is encoded at 13 kbps.

### 3.10 Supplementary Services:

GSM supports an extensive set of supplementary services that can implement and support both telephony and data services. Supplementary services are specified by GSM and are characterized as revenue-generating specialty .Some listing of supplementary services follows.

- **Call Forwarding**—This service gives the subscriber the capability to forward incoming calls to another number if the called mobile unit is not reachable, if it is busy, if there is no reply, or if call forwarding is approved unconditionally.

- **Barring of Outgoing Calls**—this service makes it possible for a mobile subscriber to confine all outgoing calls.
- **Barring of Incoming Calls**—This function allows the subscriber to confine incoming calls. The following two terms for incoming call barring exist: barring of all incoming calls and barring of incoming calls when roaming outside the home PLMN.
- **Advice of Charge (AoC)**—The AoC service provides the mobile subscriber with a calculation of the call charges. There are two types of AoC information: one that provides the subscriber with a calculation of the bill and one that can be used for instantly charging purposes. AoC for data calls is provided on the basis of time assessments.

### **3.11 Universal Synchronous Asynchronous Receiver Transmitter (USART):**

The Universal Synchronous /Asynchronous Receiver Transmitter (USART) module is a type of two serial I/O communications hardware. USART is also known as a Serial Communications Interface (SCI). The USART can be embedded as a full duplex asynchronous system that can communicate with other peripheral devices, such as CRT terminals and personal computers, or it can be configured as a half-duplex synchronous system that can communicate with peripheral devices, such as A/D or D/A integrated circuits (IC), serial EEPROMs, etc. The USART can be configured in the following types:

- Asynchronous (full duplex)
- Synchronous - Master (half duplex)
- Synchronous - Slave (half duplex)

Bit SPEN (RCSTA<7>) and bits TRISC<7:6> have to be set in order to configure pins RC6/TX/CK and RC7/RX/DT as the Universal Synchronous Asynchronous Receiver Transmitter(USART).

### 3.12 Using Program System:

These commands are used to this project (#include "SIM900.h", #include <SoftwareSerial.h>)

A6 GSM Module. (Send SMS) is used to SMS send and (Get SMS) is used to receive SMS. AT commands with a GSM can be used to access following information and services:

1. Information and configuration concerning to mobile device or SIM card.
2. SMS services.

### 3.13 Software Analysis:

Arduino Uno software works with two function setup and loop

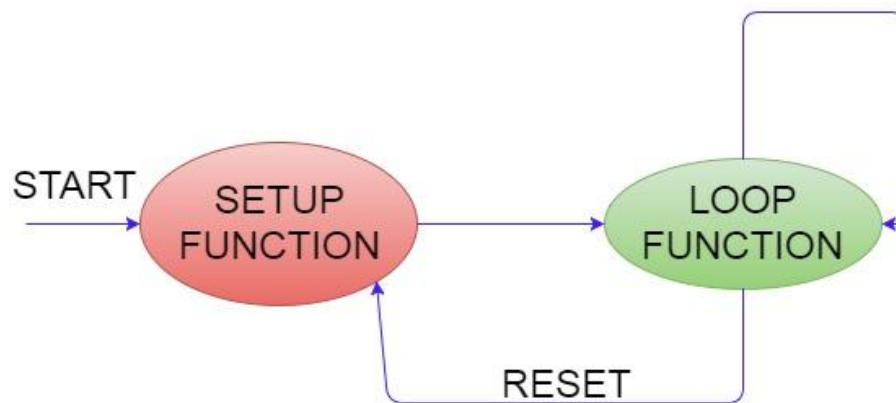


Figure:3.7 Softer Analysis Step

### 3.14 Block Diagram:

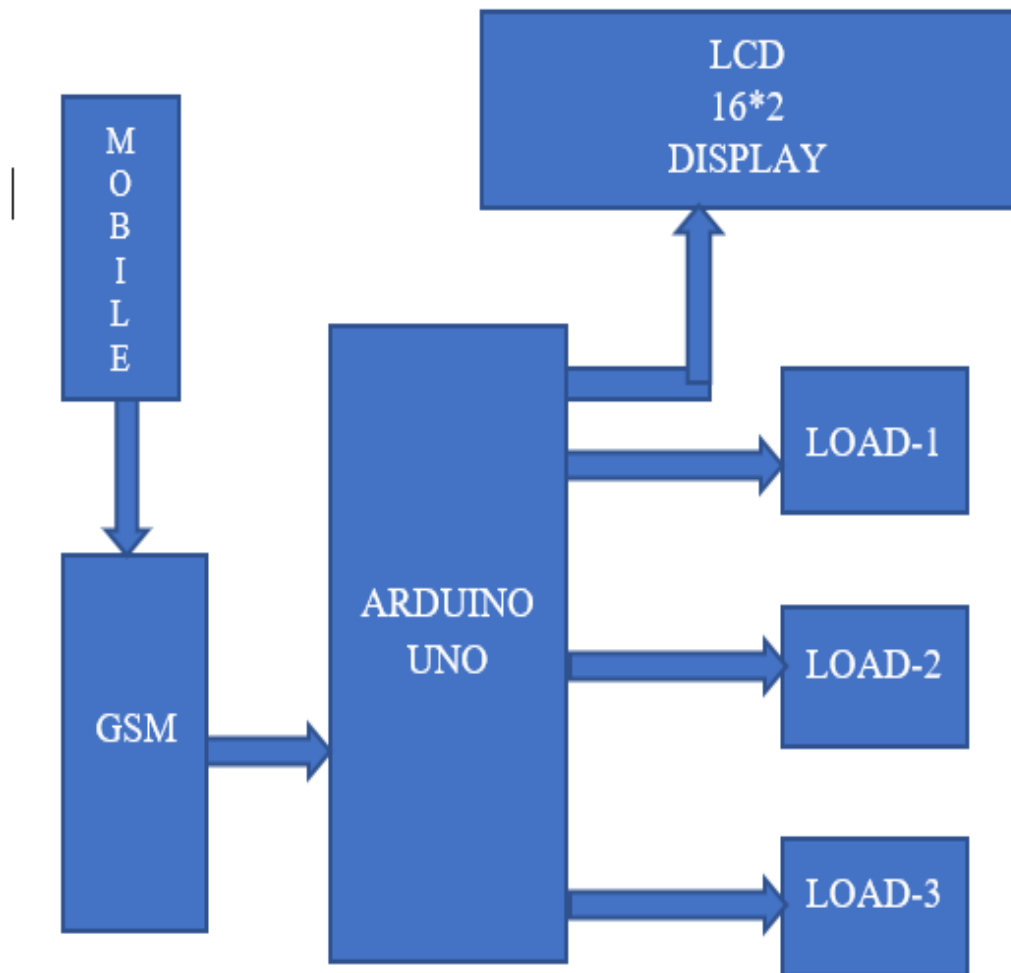


Figure:3.8 Block Diagram

Connect with GSM network, then input signal receive from GSM, if incase, system ready will be shown in LCD. Message is send to return ALLON or ALLOFF and step by step. Message is convert to digital or data binary data. Relay is one kind of switching device, which control the all loads.

### 3.15 Flow Chart:

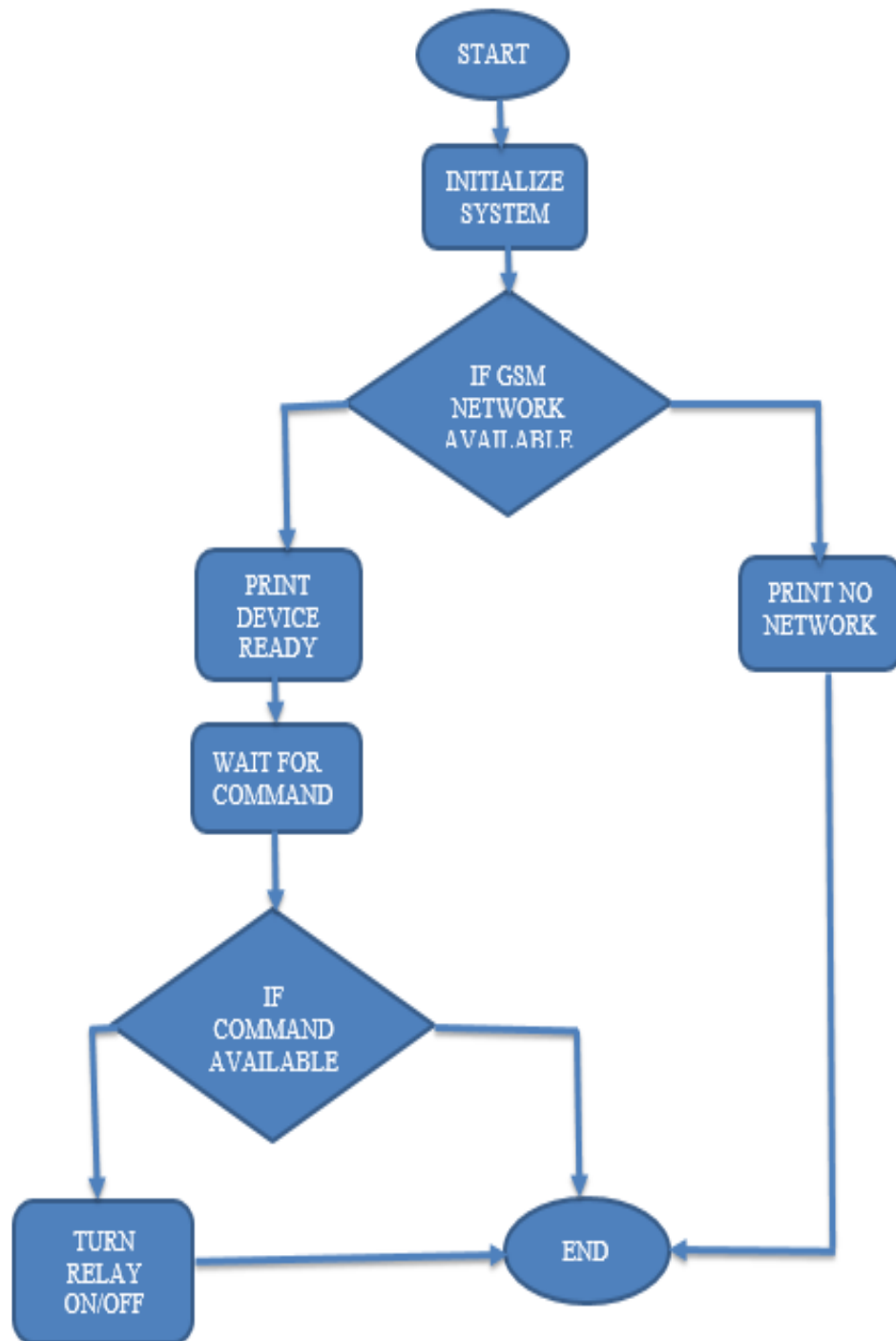


Figure:3.9 Flow Chart

Start the system is become to ready. Initialize the system check the GSM network. Incoming message contain command is load turn ON/OFF relay into end point. The network is not given properly by this system. Directly come into end point, never print no network.

### 3.16 Circuit Diagram:

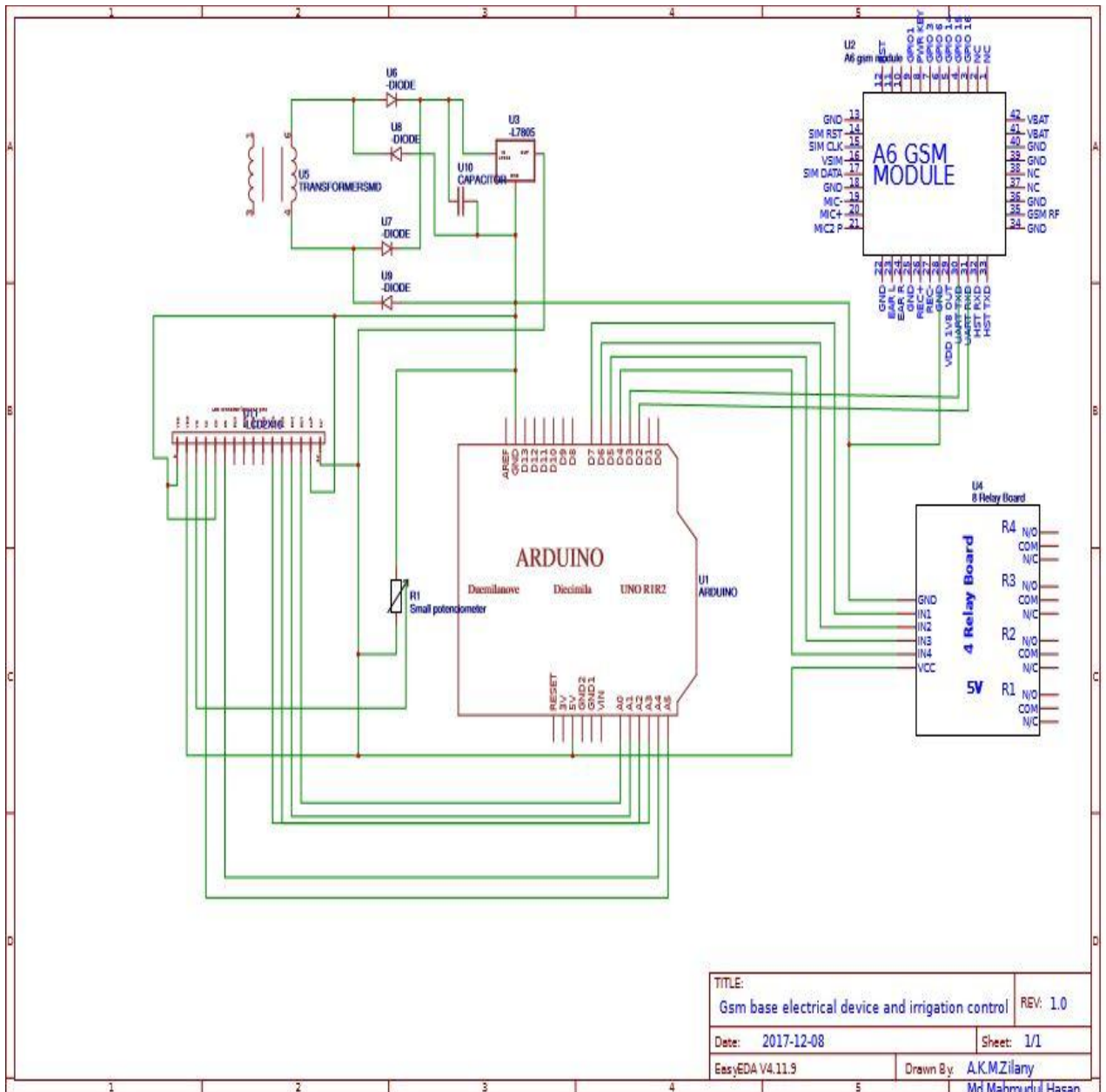


Figure: 3.10 Circuit Diagram



### 3.17 Reset:

The PIC16F7X splits between various kinds of RESET:

- MCLR Reset during normal operation
- MCLR Reset during SLEEP
- Power-on Reset(POR)
- WDT Reset (during normal operation)
- Brown-out Reset (BOR)
- WDT Wake-up (during SLEEP)

Some registers are not affected in any RESET condition. Their status is unfamiliar on POR and unchanged in any other RESET. Most other registers are reset to a —RESET status on Power-on Reset (POR), on the MCLR and WDT Reset, on MCLR Reset

during SLEEP, and Brown-out Reset (BOR). They are not affected by a WDT Wake-up, which is viewed as the restart of normal operation.

# CHAPTER-4

## HARDWARE DEVELOPMENT

### 4.1 Introduction:

In this project a microcontroller or Arduino with UART circuit is connected with Library supporting GSM module sends SMS to the mobile to control the electrical devices. The Arduino decodes the received message and does the required action. The protocol used for the communication between the two Library operator. The microcontroller pulls the SMS received by GSM module and decodes it, recognizes the mobile number and then switches on the relays attached to its port to control the devices. After successful operation, microcontroller sends back the acceptance to the user's mobile through SMS. SMS will be directly ignored if the mobile number is unauthorized.

#### 4.1.1 The methodology followed in our project is as follows:

- a. GSM module tests are run in order to check the hardware support. The process calls GSM modem and it get activated.
- b. After reactive the Modem checks for hardware support. If the hardware is missing or another hardware problem there is error, outcome in communication failure and the application is terminated.
- c. If device responds then the serial port is opened for communication and GSM hardware approve transmission of SMS.
- d. The system is then connected and after connection installation the system is able to switch ON and OFF and similarly the system will update status of apparatus by receiving SMS from the pre-defined cell number.
- e. Automation system is properly control in any outline conditions.

## 4.2 Different Types Equipment List and Cost:

Table: 4.1 Equipment List:

Hardware					Software
Arduino	Adapter	Iron	PVC Board	Resistor	Compiler Arduino
GSM	Transformer	Holder	Reign	Capacitor	
Relay Shield	PCB	Bulb	Soldering lead	Diode	
LCD	Rail Connector	Switch	LM 7805	Connector	

Table: 4.1.1 Cost:

Equipment Name	Costing(TK)
Arduino	450
GSM	600
Transformer	60
LCD	130
Adapter	120
Relay	250
PCB	110
Iron	250
Rail Connector	50
Holder	105
Bulb	90
PVC Board	60
Glue Gun	200
Glue Stick	20
De-soldering Pump	80
Reign	15

Soldering Lead	100
Capacitor	20
Connector	50
Resistor	5
Variable Resistor	5
Diode	4
LM 7805	15
Total Cost	2789 TK

#### 4.2.1 Capacity Elements:

- i. Total Relay 4,  
Relay = 250V, 10A  
 $\text{Relay } P = VI \cos \theta = 250 \times 10 \times 0.8 = 2000W$   
For 3Relay = 250V, 30A  
 $P = 250 \times 30 \times 0.8 = 6000W$   
Total Relay Capacity = 8000W
- ii. Load controller up to 20 devices
- iii. Transformer – 6V, 2A
- iv. IC LM7805
- v. LCD - 16 pin, using 12 pin
- vi. Arduino – 20mA, 5V  
Output Up-gradable

### 4.3 A6 GSM MODULE:

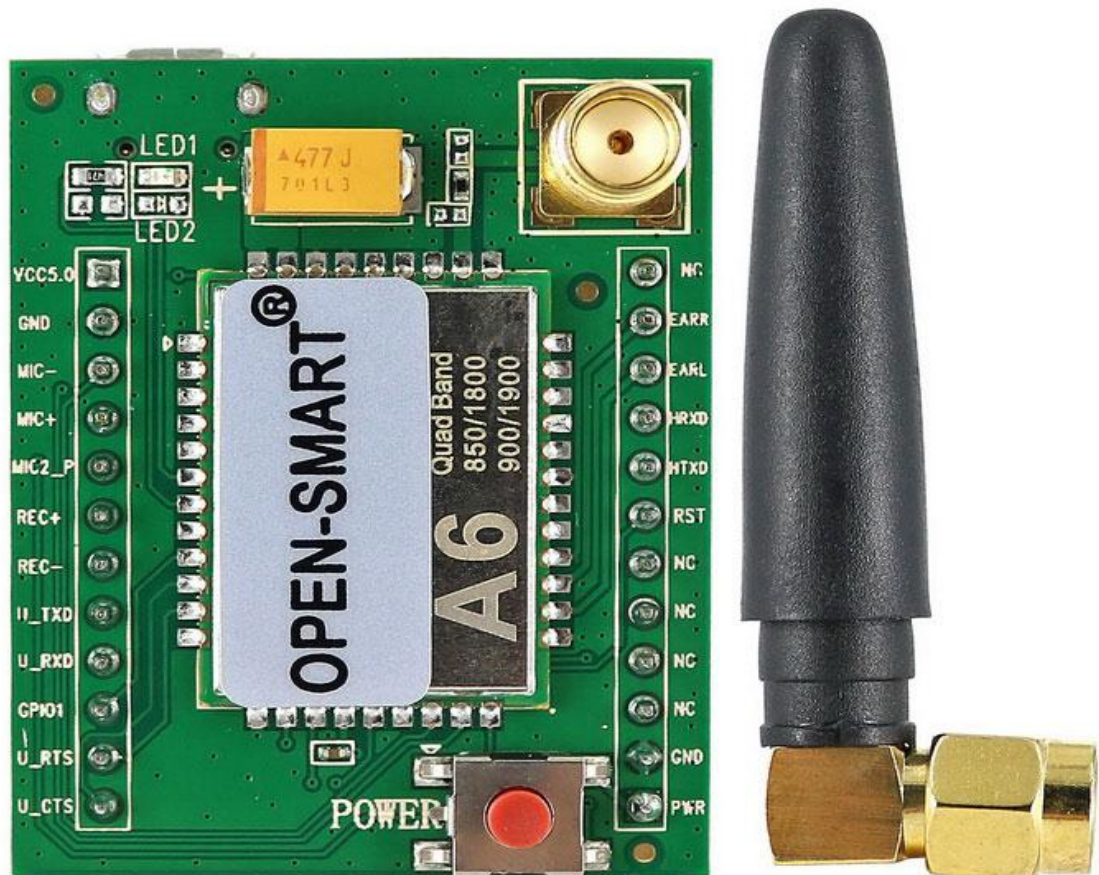


Figure: 4.1 A6 GSM MODULE

#### 4.3.1 A6 GSM Module Description:

This is mini GSM / GPRS core improvement board based on GPRS A6 module. It carrying dual-band GSM/GPRS network, obtainable for GPRS and SMS message data remote transmission. The board characteristics compact size and low current consumption. With power saving techniques, the current cost sari as low as 3mA in sleep mode. It contacts with microcontroller via UART port, supports command including GSM 07.07, GSM 07.05 and Library command.

Features: - Working frequency: Quad-band network, 850 / 900 / 1800 / 1900MHz

- i. Working voltage: 4.5~5.5V DC (On-board voltage regulator circuit supply power for A6 module)
- ii. Working current: Maximum of 2A
- iii. Sleep current: 5mA
- iv. Onboard Micro SIM card holder, you can install Micro SIM card
- v. Onboard Micro USB interface for external power supply
- vi. Communication Interface: TTL serial port
- vii. Baud rate: 115200bps and it can also be set by AT command
- viii. Interface logic voltage: 3.3V
- ix. Make and answer phone calls using a headset and electrets microphone.
- x. Send and receive SMS messages
- xi. Send and receive GSM data module
- xii. Be used to test the Ai-Thinker A6 GSM module
- xiii. Pin pitch: 2.54mm, it can be soldered directly to the PCB experimental Pin pitch: 2.54mm, it can be soldered directly to the PCB experimental.

#### **4.3.2 About the antenna:**

- i. Suitable for SIM800L GSM modules / Arduino SIM900 GPRS Shield.
- ii. Frequency: 780MHz ~ 960MHz, 1710MHz ~ 2170MHz
- iii. Antenna gain:  $+2.0 \pm 0.7$  dBi @ 880 MHz,  $+2.0 \pm 0.7$  dBi @ 1800 MHz
- iv. - S.W.R  $\leq 2.0$  @ 2100 MHz ~ 2500 MHz
- v. - Output impedance: 50 Ohm
- vi. Antenna interface: SMA

### 4.3.3 Arduino UNO:



Figure: 4.2 Arduino UNO

### 4.3.4 Description:

The Arduino Uno R3 is the latest version after the Duemilanove with an elevated USB interface chip. Like the Duemilanove, it not only has an increased shield header with a 3.3V reference and a RESET pin (which solves the problem of how to get to the RESET pin in a shield) AND a 500mA fuse to save your computer's USB port, but ALSO a self-acting circuit to select USB or DC power without a jumper! The Arduino Uno is pin and code-compatible with the Duemilanove, Diecimilla and older Arduinos so all yours defends, libraries, code will still work. The R3 (3rd revision) of the Arduino UNO has a bit of updates, with an upgrade to the USB interface chip and excessive breakouts for the i2c pins and an IOR ef pin. For more information about the UNO, the R3 and what the updates mean, please check our UNO FAQ!

Each Arduino ordered from Adafruit still comes with 4 rubber bumpers that will help protect the board when you want to place it on a table. (Also keeps the Arduino from sliding around.)

Arduino is an open-source electronics prototyping position based on flexible, easy-to-use hardware and software. It's intended for artificer, designers, hobbyists, and anyone interested in creating interactive objects or situations.

Arduino can sense the situations by receiving input from a variety of sensors and can affect its surroundings by controlling lights, motors, and other devices. The microcontroller on the board is programmed using the Arduino programming language (based on Wiring) and the Arduino improvement environment (based on Processing). Arduino projects can be stand-alone or they can communicate with software running on a computer (e.g. Flash, Processing, Max/MSP).

**Table 4.2:Specs**

Microcontroller	ATmega328
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limits)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
Analog Input Pins	6
DC Current per I/O Pin	40 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega328) of which 0.5 KB used by boot loader
SRAM	2 KB (ATmega328)
EEPROM	1 KB (ATmega328)
Clock Speed	



## 4.4 Circuit Diagram of Arduino UNO:

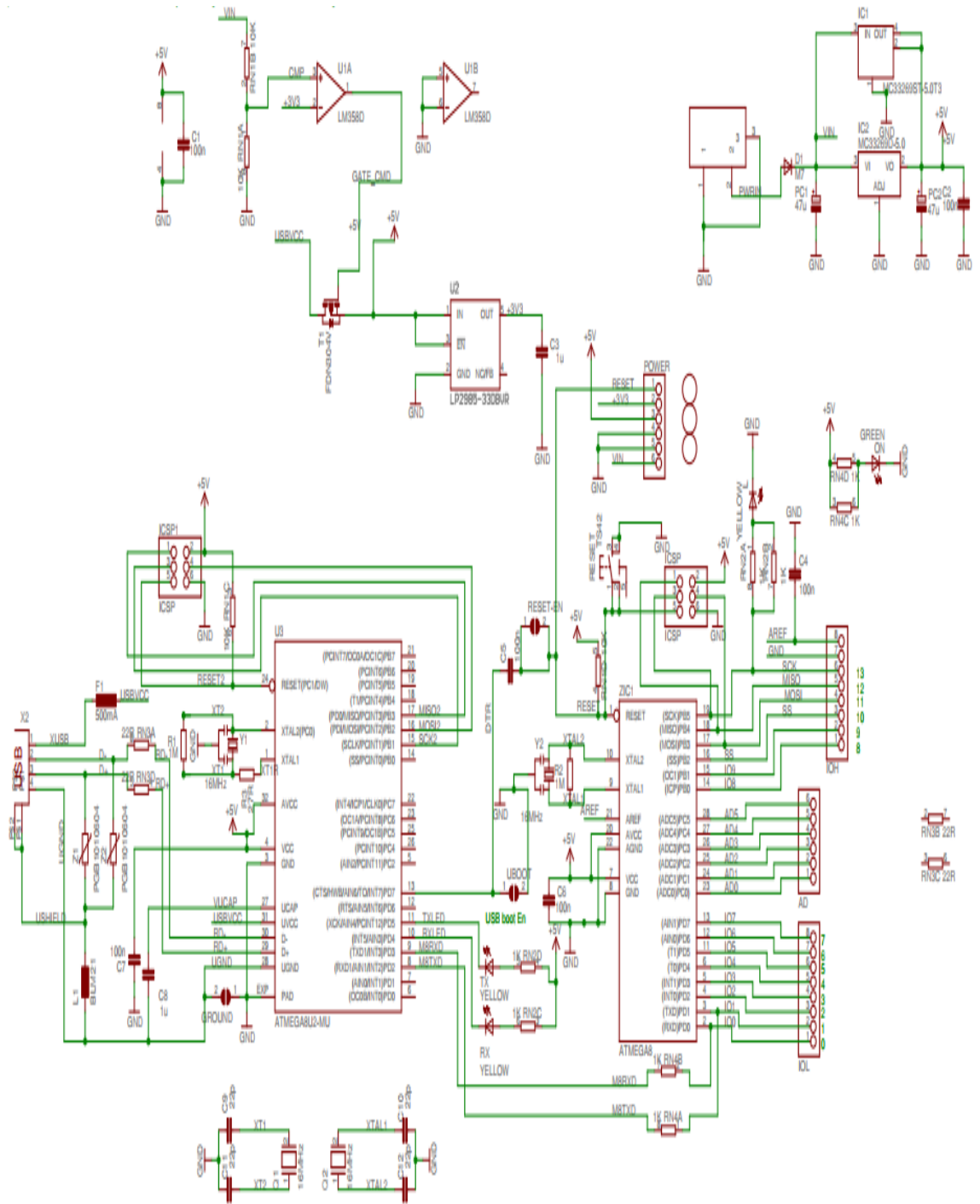


Fig: 4.3 Circuit Diagram of Arduino UNO

## 4.5 Pin Diagram of Arduino (At mega 328)

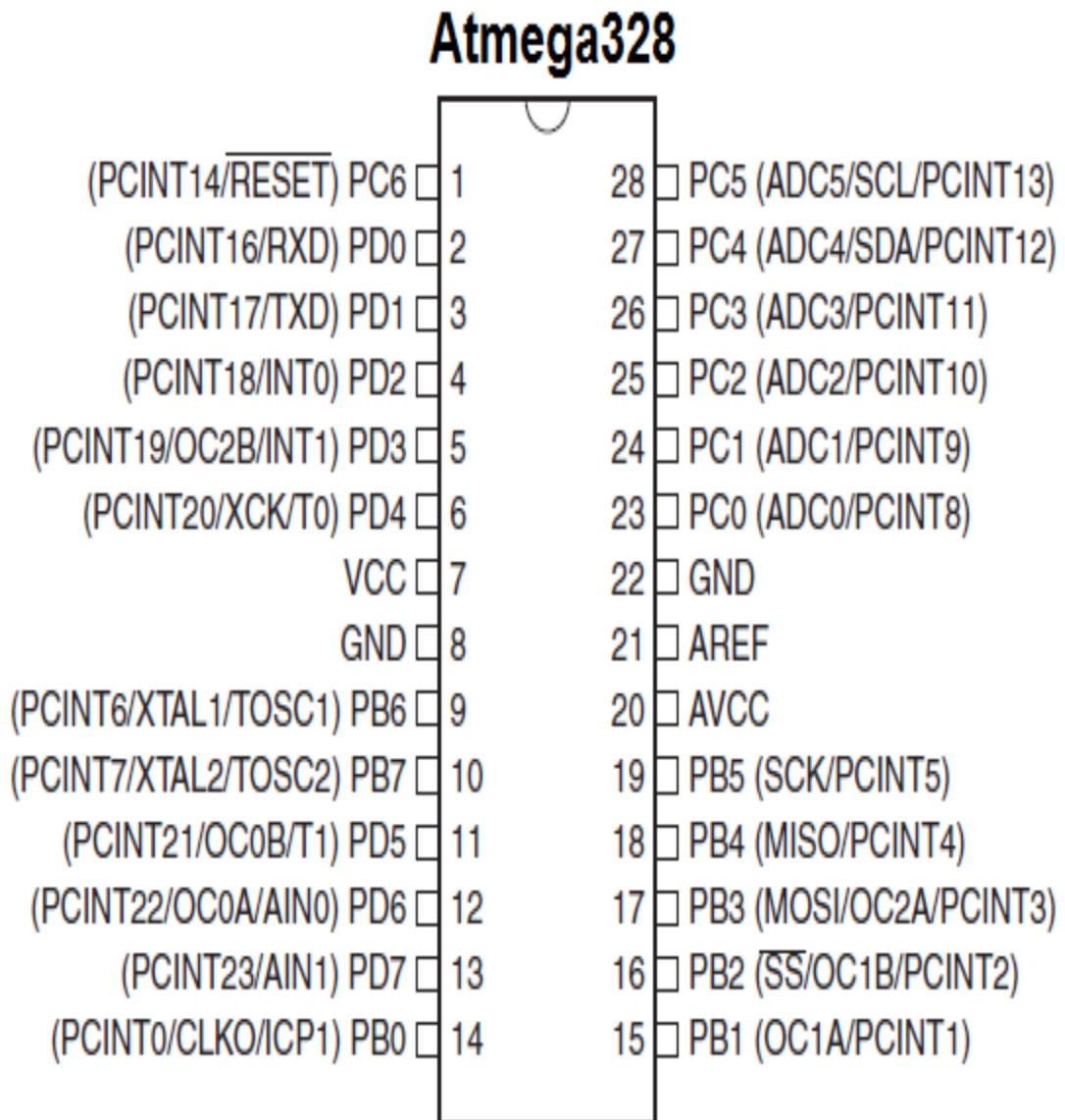


Figure: 4.4 Pin Diagram of Arduino (At mega 328)

#### 4.5.1 Pin description of at mega 328:

Table:4.3

Pin Number	Description	Function
1	PC6	Reset
2	PD0	Digital Pin (RX)
3	PD1	Digital Pin (TX)
4	PD2	Digital Pin
5	PD3	Digital Pin (PWM)
6	PD4	Digital Pin
7	Vcc	Positive Voltage (Power)
8	GND	Ground
9	XTAL 1	Crystal Oscillator
10	XTAL 2	Crystal Oscillator
11	PD5	Digital Pin (PWM)
12	PD6	Digital Pin (PWM)
13	PD7	Digital Pin
14	PB0	Digital Pin
15	PB1	Digital Pin (PWM)
16	PB2	Digital Pin (PWM)
17	PB3	Digital Pin (PWM)
18	PB4	Digital Pin
19	PB5	Digital Pin
20	AVCC	Positive voltage for ADC (power)
21	AREF	Reference Voltage
22	GND	Ground

23	PC0	Analog Input
24	PC1	Analog Input
25	PC2	Analog Input
26	PC3	Analog Input
27	PC4	Analog Input
28	PC5	Analog Input

#### **4.5.2 Arduino Works:**

- i. Arduino Motion Control Rig
- ii. Arduino Phone a do-it-yourself cell phone
- iii. Low cost data glove for virtual reality applications
- iv. Water quality testing platform
- v. DC motor control using Arduino and H-Bridge
- vi. Automatic titration system based on Arduino and stepper motor

## 4.6 LCD Display (16×2):

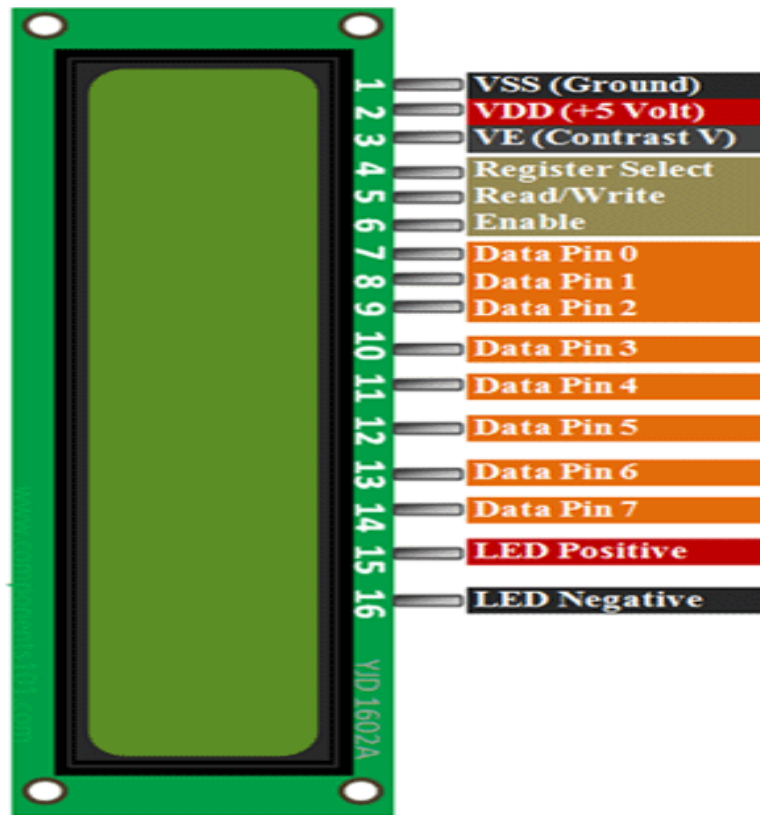


Figure: 4.5 LCD Display 16×2

### 4.6.1 Pin Configuration:

Table 4.4:

Pin No:	Pin Name:	Description
1	Vss (Ground)	Ground pin connected to system ground
2	Vdd (+5 Volt)	Powers the LCD with +5V (4.7V – 5.3V)
3	VE (Contrast V)	Decides the contrast level of display. Grounded to get maximum contrast.

4	Register Select	Connected to Microcontroller to shift between command/data register
5	Read/Write	Used to read or write data. Normally grounded to write data to LCD
6	Enable	Connected to Microcontroller Pin and toggled between 1 and 0 for data acknowledgement
7	Data Pin 0	Data pins 0 to 7 forms a 8-bit data line. They can be connected to Microcontroller to send 8-bit data. These LCD's can also operate on 4-bit mode in such case Data pin 4,5,6 and 7 will be left free.
8	Data Pin 1	
9	Data Pin 2	
10	Data Pin 3	
11	Data Pin 4	
12	Data Pin 5	
13	Data Pin 6	
14	Data Pin 7	
15	LED Positive	Backlight LED pin positive terminal
16	LED Negative	Backlight LED pin negative terminal

#### 4.7 Features of 16×2 LCD Module:

- Operating Voltage is 4.7V to 5.3V
- Current consumption is 1mA without backlight
- Alphanumeric LCD display module, meaning can display alphabets and numbers
- Consists of two rows and each row can print 16 characters.
- Each character is build by a 5×8 pixel box
- Can work on both 8-bit and 4-bit mode
- It can also display any custom generated characters
- Available in Green and Blue Backlight

### 16x2 Display Equivalents:

Dot Matrix LED Display, 7-Segment LED Display, OLED Display, TFT LCD Screen Display

## 4.8 Fixed Voltage Regulator:

A LM7805 Voltage Regulator is a voltage regulator that outputs +5 volts. An easy way to remember the voltage output by a LM78XX series of voltage regulators is the last two digits of the number. A LM7805 ends with "05"; thus, it outputs 5 volts. The "78" part is just the convention that the chip makers use to denote the series of regulators that output positive voltage. The other series of regulators, the LM79XX, is the series that outputs negative voltage. So:

**LM78XX:** Voltage regulators that output positive voltage, "XX"=voltage output.

**LM79XX:** Voltage regulators that output negative voltage, "XX"=voltage output. The LM7805, like most other regulators, is a three-pin IC.

**Pin 1 (Input Pin):** The Input pin is the pin that accepts the incoming DC voltage, which the voltage regulator will eventually regulate down to 5 volts. **Pin 2 (Ground):** Ground pin establishes the ground for the regulator.

**Pin 3 (Output Pin):** The Output pin is the regulated 5 volts DC.

### LM7805 PINOUT DIAGRAM

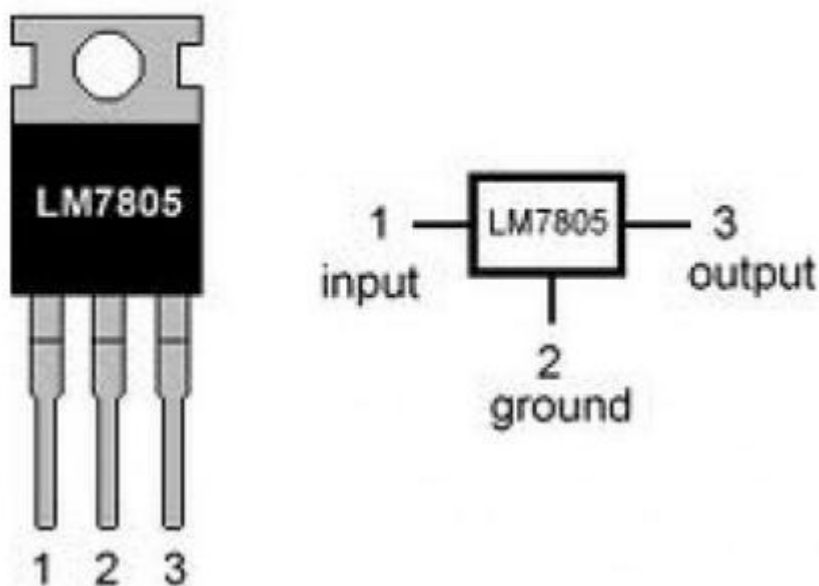


Figure: 4.6 Voltage Regulator Pin Diagram

This series of fixed-voltage integrated-circuit voltage regulators is designed for a wide range of applications. These applications include on-card regulation for elimination of noise and distribution problems associated with single-point regulation. Each of these regulators can deliver up to 1.5 A of output current. The inner current-limiting and thermal-shutdown features of these regulators basically make them immune to overload. In addition to use as fixed-voltage regulators, these devices can be used with external components to obtain adjustable output voltages and currents, and also can be used as the power-pass instrument in precision regulators.

#### 4.9 Resistor:

A resistor contains a given amount of resistance in a circuit. Resistance is a measure of how the flow of electric power is adverse or "resisted." It is defined by Ohm's law which says the resistance coequals the voltage divided by the current.

Resistance = voltage/current or  $R = V/I$  .

Resistance is measured in Ohms. The Ohm is often presented by the omega symbol  $\Omega$ .

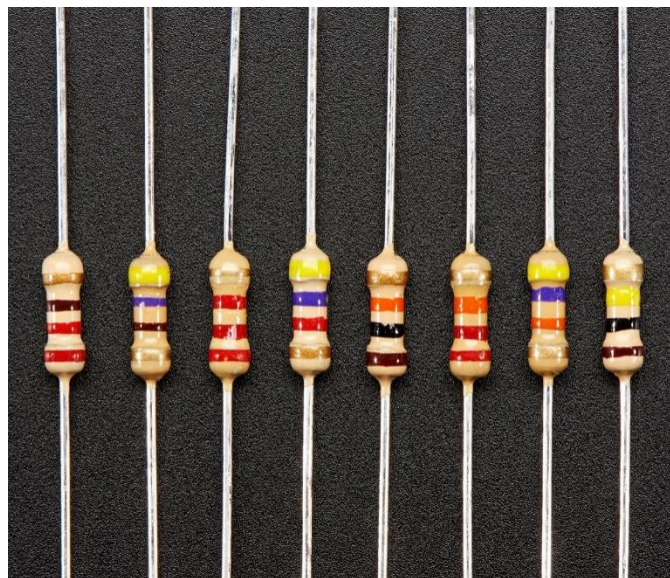


Figure: 4.7 Figure of Resistor

The symbol for resistance is a sinuous line as shown below. The "R" characters are used in equation.



## 4.10 Capacitor:

A capacitor shows up the amount of capacitance in a circuit. The capacitance is the ability of a material to store an electrical charge. It is the "capacity" to store a charge.

The capacitance represents by the equation  $C = q/V$

Where the charge of coulombs and V is is the voltage.

In a DC circuit a capacitor becomes an open circuit obstacle any DC current from moving the capacitor. Only AC current will pass through a capacitor. Capacitance is measured in Farads. The sign for capacitance is two parallel lines. Sometimes one of the lines is curved as shown figure. The letter "C" is used for equations.

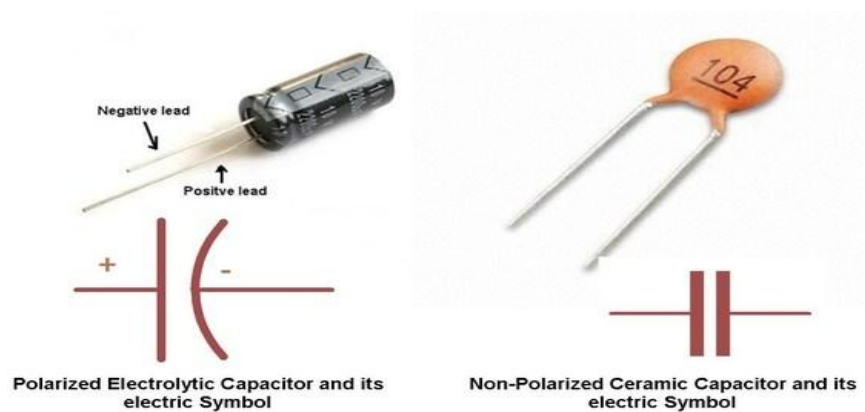


Figure: 4.8 Figure of Capacitor

## 4.11 Relay:

A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Here used in three relay 5v, 12v, 12v.



Figure: 4.9 Relay Shield

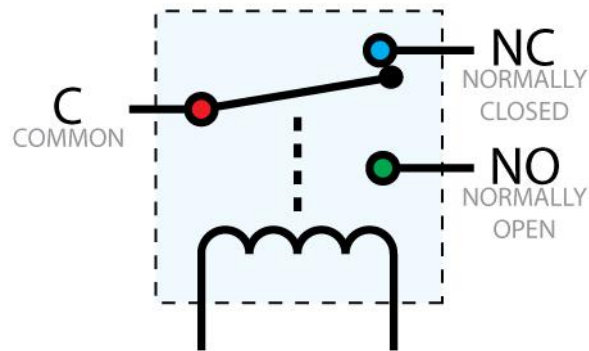


Figure: 4.9.1 Internal Connection

### 4.12 Transformer:

Electrical power transformer is a static device which transforms electrical energy from one circuit to another without any direct electrical connection and with the help of mutual induction between two windings. It transfers power from one circuit to another without changing its frequency but may be in different voltage level.

Great transformer power supplies for a wide range of venture & circuit sheets. Venture down 230V AC to 6V with a greatest of 2000mA current. This is step-down transformer.



Figure: 4.10 Step-down Transformer

### 4.13 DIODE:

A diode contains two electrodes that act in much the same behavior as semiconductors. The positive or p-type is usually the anode and the negative or n-type is the cathode. In other hands, the cathode is negatively charged as compared to the anode. If the cathode is charged at the same or very similar voltage to the anode, current will not flow.

In electronics, a diode acts similarly to charge carriers. Diodes can also be compared to check valves or switches. If liquid or water were connected instead of current, it would essentially be similar to water flowing upstream or downstream. Put simply, a diode supervised to allow for upstream to downstream flow but not the other way around.

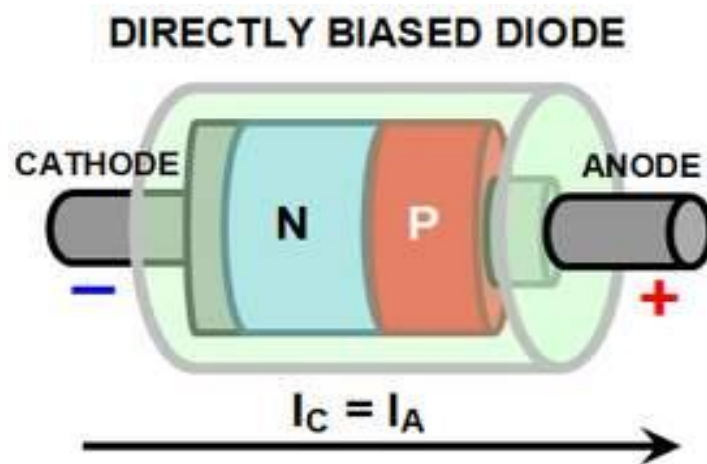


Figure:4.11 Diode

To alter the direction of the flow, the cathode must be charged at a greater voltage than the anode. This is known as avalanche voltage, but despite the name, it does not always require a large number of volts to change the direction. It can in fact be a difference of only a few voltages.

# CHAPTER-5

## RESULTS AND DISCUSSIONS

### **5.1 Introduction:**

The applications of **GSM Based Electrical Device Control** are quite diverse. There are many real-life situations that require control of different devices remotely and to provide security. There will be instances where a wired connection between a remote appliance/device and the control unit might not be feasible due to structural problems. In such cases a wireless connection is a better option. Home appliance has been a major issue where crime is increasing and everybody wants to take proper measures to prevent intrusion. In addition, there is need to automate home so that the user can take the advantage of technological advancement. This project presents a model that will provide control to their home, office or cabin or outline in firm work, via SMS using GSM technology.

### **5.2 Hardware Result:**

All the components were connected as per the circuit diagram. The figures below show the hardware connection and the output obtained.

Step 1: Power supply into the device and showing Starting....

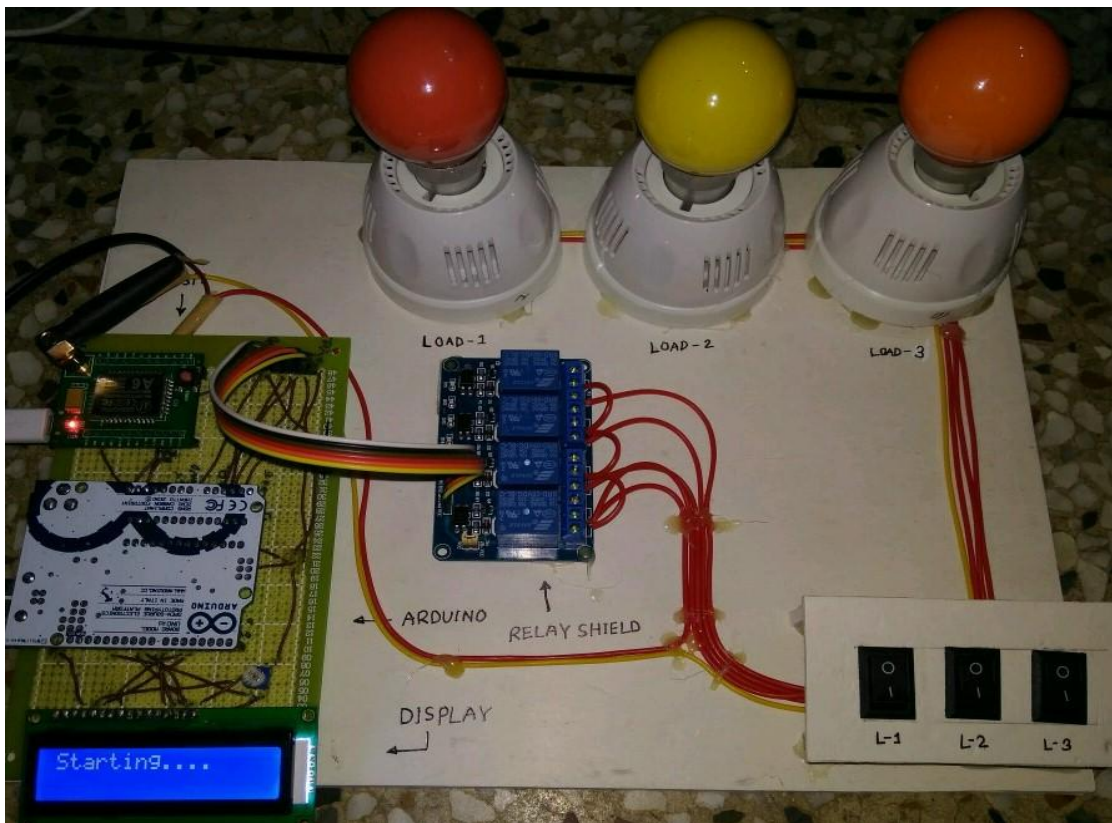


Figure: 5.1 Starting...

Step 2: Device is ready to take command

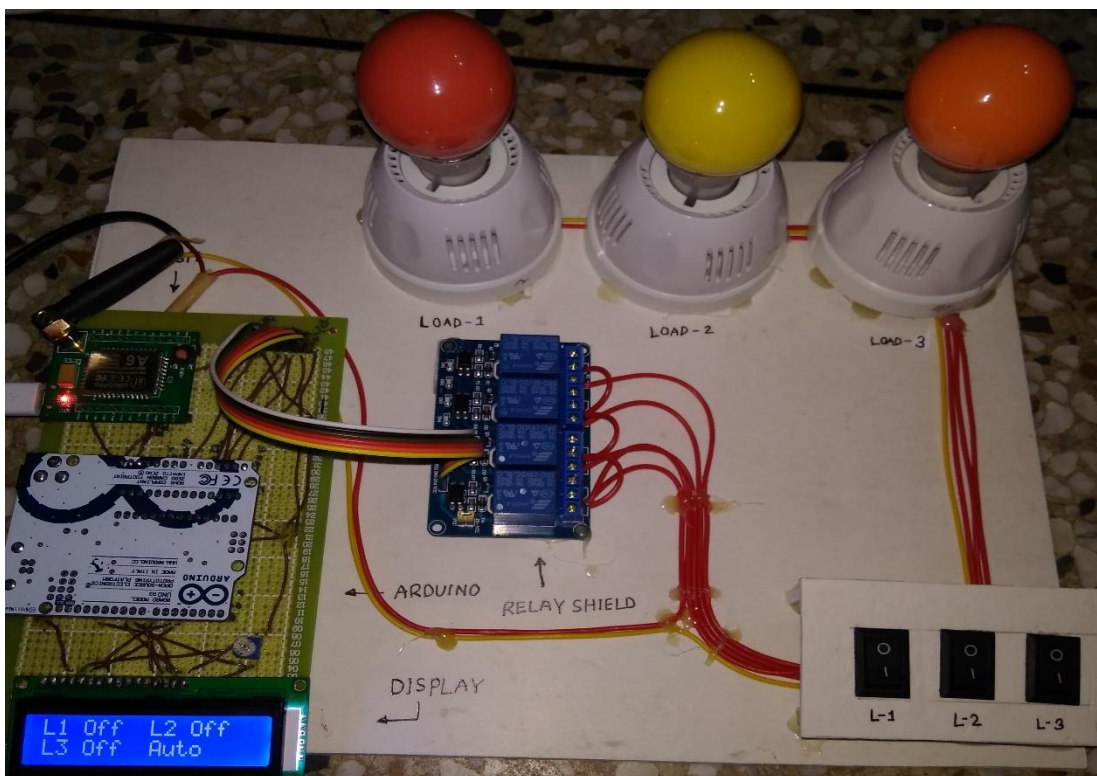


Figure: 5.2 when all load off



Step 3: Load-1 ON and Load-2, Load-3 OFF

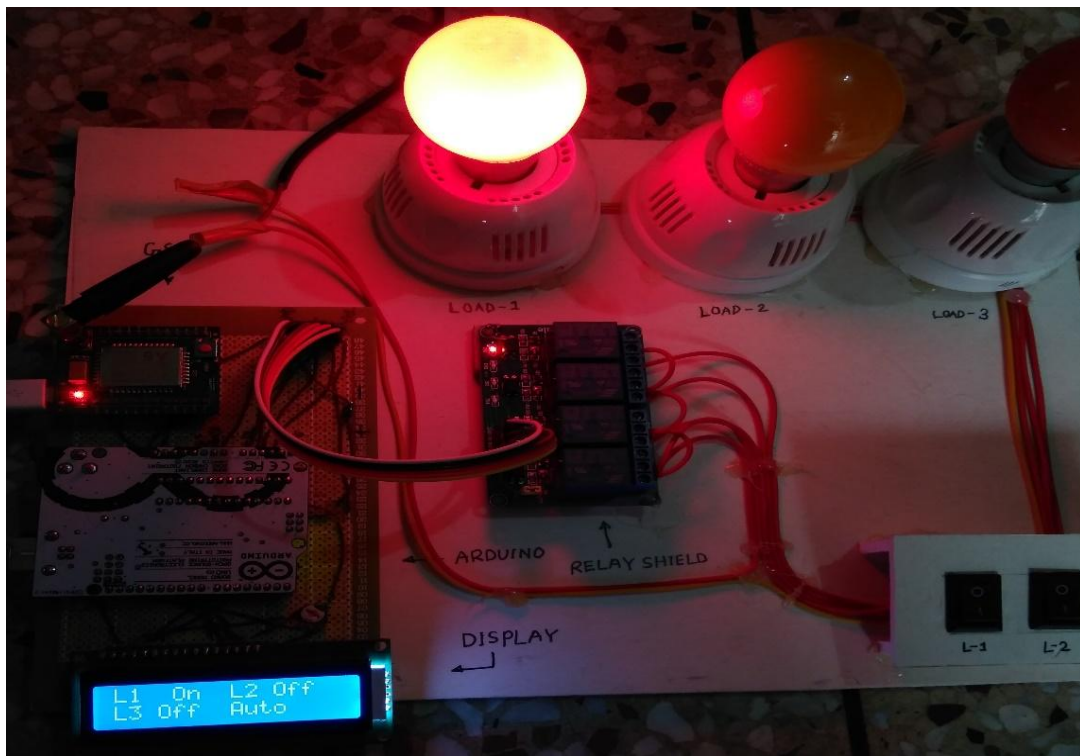


Figure: 5.3 Load-1 ON

Step 4: Load-1 and Load-3 ON, Load-2 OFF

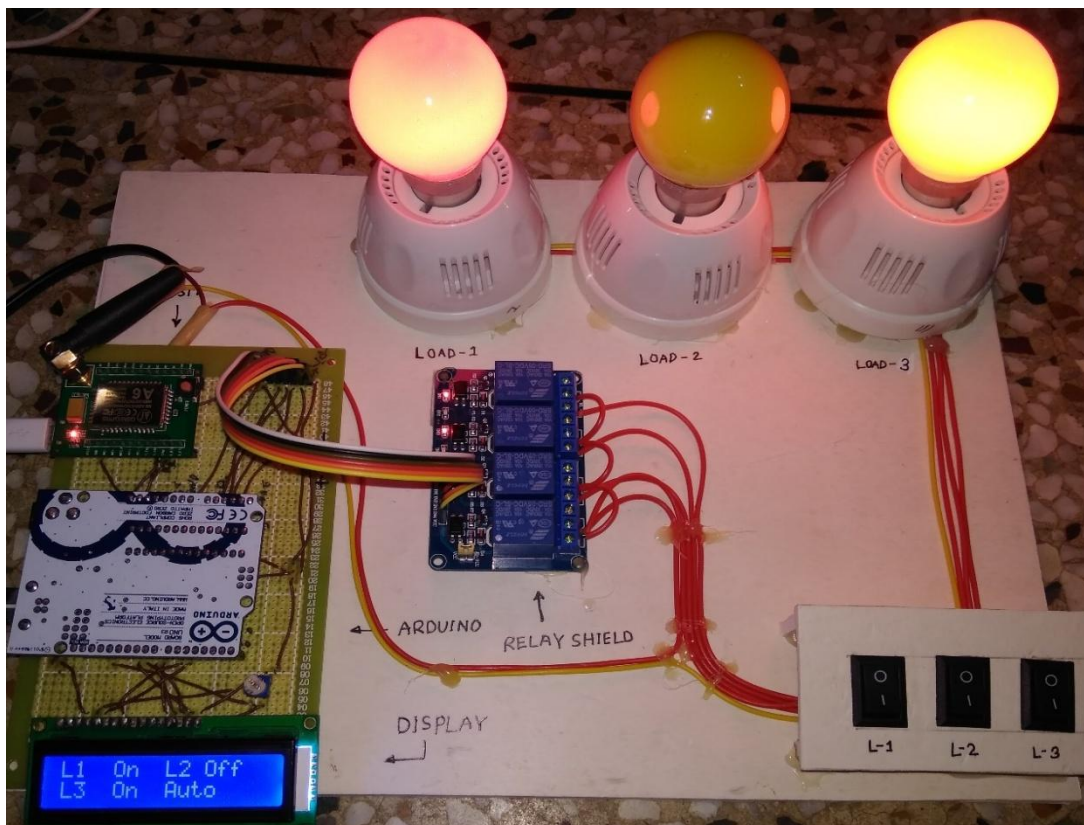


Figure: 5.4 Load-1 and Load-3 ON

Step 5: Load-1, Load-2 and Load-3 ON

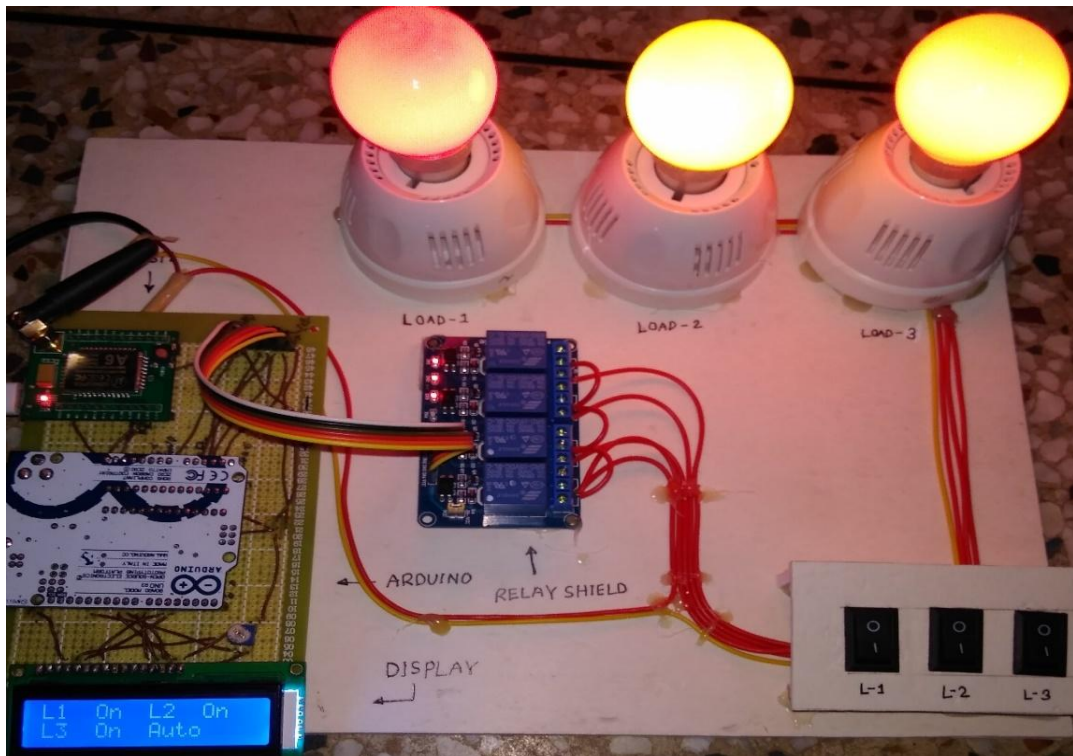


Figure: 5.5 All Load ON (Auto)

Step 6: Load-1, Load-2 and Load-3 ON



Figure: 5.6 All Load ON (Manual)



## 5.2.1: Command and Feedback SMS

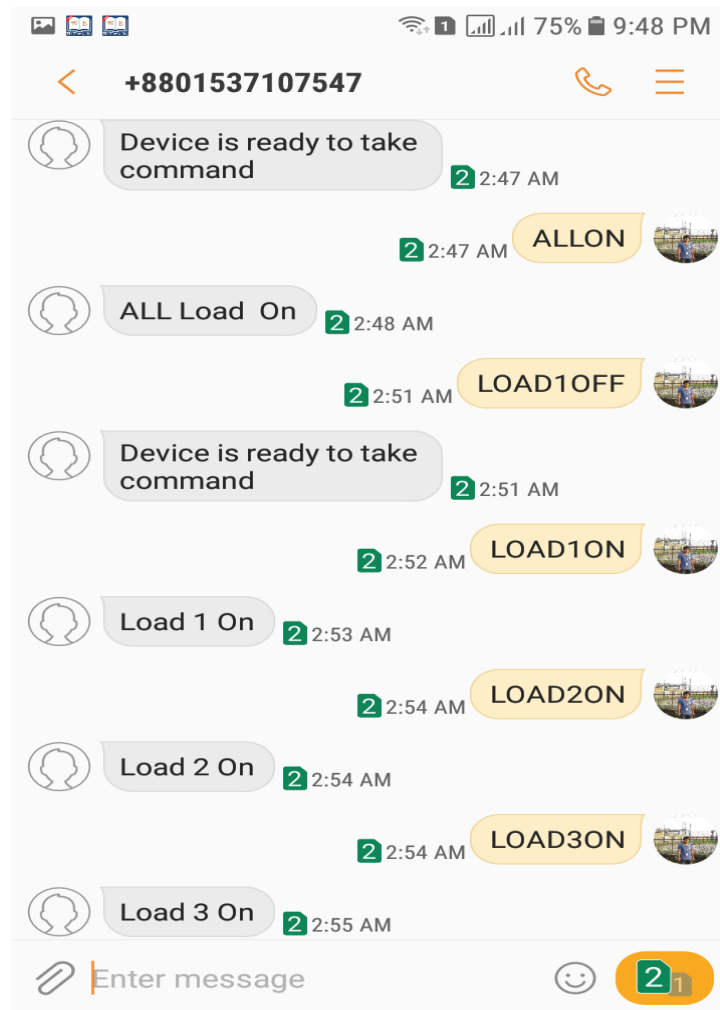


Figure: 5.7 Feedback SMS

## 5.3 Summary:

SMS based electrical device control system is capacity of controlling of the appliances from any place on earth where GSM service is available. The coupling of the hardware gives the final design. The Easy EDA provides the stage for simulating the program on the hardware already designed and troubleshooting of the whole design. There were some problems encountered in our project improvement which can be stated as under:

- i. A6 GSM module is used this project
- ii. Problem with device improvement in laptops with 64-bit Operating System
- iii. Unavailability of components in the local market.
- iv. Coding issues relating to efficient memory usage



# CHAPTER- 6

## CONCLUSIONS

### AND RECOMMENDATIONS

#### **6.1 Conclusion:**

In this project a low-cost and simple approach to design an intelligent load control system and using the concept of mobile-to-machine and machine-to-mobile communication is designed. We improve a general purpose electronic circuit design that can control and monitor a variety of load control system and outline firm work with interface that can be plugged into A6 GSM module. The project is successfully improved and met the stated objectives. The system can automatically switch ON and OFF the devices using SMS and manually. In addition, the system is very practical when the user is away from home or out of home; through it the user can monitoring and controlling the electrical home appliances remotely as long as the mobile phone gets the coverage.

#### **6.2 Limitations of the Work:**

The working process of this project is very easy but we are facing some restriction to doing this project. Such as coding problem, program writing, connecting to PCB board, command, network problem do for ON or OFF following etc.

#### **6.3 Future Scopes:**

The system specification shows the description of the function and the performance of system and the user. The opportunity of our project Design & construction of GSM based electrical device and industrial load control system is immense. The future implementations of the project are very large considering the amount of time and resources it saves. The project we have undertaken can be used as a reference or as a

base for realizing a scheme to be implemented in other project of greater level such as weather forecasting, temperature update, device synchronization, etc. The project itself can be develop to achieve a complete device control home or outline firm work which will then create a platform for the user to interface between himself and household.

## **6.4 Advantages:**

The benefits of this system are it has an ability to control the user home appliances through SMS, can simulate live in situations when the house is leave unattended during holidays, and in control of home condition by SMS.

The main effective advantage of Home Automation is:

Device can be controlled for long distance. It is made economic design.

The system can be easily implemented in homes. Can be used by everyone with just the knowledge of sending text SMS.

1. Convenience: An automated system provides unparalleled convenience to the owner. by having a living place that is self-sufficient to automatically perform routine functions throw a simple access panel or without you click of buttons a lot of convenience to the family members. you can switch on your water heater, ac, even put off the lights, which are you still on when you came out. you can also close the window curtains, bring your coffee in the coffee maker or turn on the smart home theatre, or even feel your bathtub even before reaching your home.
2. Save energy bills. with the use of Advanced Home Automation, you can also cut down on your cost for electricity. this is very much possible as you don't need to keep your refrigerator on, AC running at home to make you feel at comfort. with use of Such Home Automation solution, you can manage many function of your home and operate them to run on optimum energy requirements. this way, not only you save your precious household equipment's, but also help to reduce your energy cost and save the national interest as well.
3. But use of home automation system is Highly Effective and could be beneficial in term of planning for a modern house. with is the use of automated system, Duke and Shirley having a great performance of your electricity consumption as well as save dollars on that. Starting from the home theatre installation to the management of your washing machine water heater floor tab air conditioner you can manage your audio

and lighting system through such smart solution. This offers you flexibility of uses as well as convenience of operation as you no longer need to rush to any particular device to switch that of.

4. Improve life quality and keeping ourselves away from any electrical hazards.

### **6.5 Disadvantages:**

1. It depends on power if any power schedule of hours then the system will collapse.

2. The system is network dependent.

3. Network sometimes fails due to GSM shield.

4. System has some delay due to receiving SMS.

# REFERENCES

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# Appendix-A

```
#include <LiquidCrystal.h>
#include "SIM900.h"
#include <SoftwareSerial.h>
#include "sms.h"
MSGSMS sms;
int numdata;
boolean started=false;
char smsbuffer[160];
char n[20],number[20]="01515213864";
int i;
const int rs = 6, en = 7, d4 = 8, d5 = 9, d6 = 10, d7 = 11;
LiquidCrystal lcd(rs, en, d4, d5, d6, d7);
int mod=0;
#define load1 A0
#define load2 A1
#define load3 A2
#define load4 A3
int L1,L2,L3,L4,LA;
void setup()
{
  L1=0;
  L2=0;
  L3=0;
  L4=0;
  LA=0;
  Serial.begin(9600);
  lcd.begin(16, 2);
  lcd.setCursor(0, 0);
  lcd.print("Starting....");
  delay(1000);
  pinMode(load1, OUTPUT);
```

```

pinMode(load2, OUTPUT);
pinMode(load3, OUTPUT);
pinMode(load4, OUTPUT);
digitalWrite(load1,1);
digitalWrite(load2,1);
    digitalWrite(load3,1);
    digitalWrite(load4,1);
Serial.println(" GSM Shield testing.");
if (gsm.begin(4800)) {
    Serial.println("\nstatus=READY");
    started=true;
} else Serial.println("\nstatus=IDLE");
if(started) {
    if (sms.SendSMS(number, "Device is ready to take command")){
        Serial.println("\nSMS sent OK");
    }
    for (i = 1; i <= 20; i++)
    {
        sms.DeleteSMS(i);
    }
}
lcd.setCursor(0, 0);
lcd.print("Starting....");
delay(3000);
lcd.clear();
lcd.setCursor(0, 0);
lcd.print("L1 Off");
lcd.setCursor(8, 0);
lcd.print("L2 Off");
lcd.setCursor(0, 1);
lcd.print("L3 Off");
lcd.setCursor(8, 1);
lcd.print("Auto");

```

```

}

void lod1(int a) {
    digitalWrite(load1, a);
    if (a == 0) {
        Serial.println("LOAD 1 ON");
        if (sms.SendSMS(number, "Load 1 On")) {
            Serial.println("\nSMS sent OK");
        }
        lcd.setCursor(0, 0);
        lcd.print("L1 On");
    }
    if (a == 1) {
        Serial.println("LOAD 1 off");
        if (sms.SendSMS(number, "Load 1 Off")) {
            Serial.println("\nSMS sent OK");
        }
        lcd.setCursor(0, 0);
        lcd.print("L1 Off");
    }
}

void lod2(int a) {
    digitalWrite(load2, a);
    if (a == 0) {
        if (sms.SendSMS(number, "Load 2 On")) {
            Serial.println("\nSMS sent OK");
        }
        lcd.setCursor(8, 0);
        lcd.print("L2 On");
    }
    if (a == 1) {
        if (sms.SendSMS(number, "Load 2 Off")) {
            Serial.println("\nSMS sent OK");
        }
    }
}

```

```

    lcd.setCursor(8, 0);
    lcd.print("L2 Off");
}
}
void lod3(int a) {
    digitalWrite(load3, a);
    if (a == 0) {
        if (sms.SendSMS(number, "Load 3 On")) {
            Serial.println("\nSMS sent OK");
        }
        lcd.setCursor(0, 1);
        lcd.print("L3 On");
    }
    if (a == 1) {
        if (sms.SendSMS(number, "Load 3 Off")) {
            Serial.println("\nSMS sent OK");
        }
        lcd.setCursor(0, 1);
        lcd.print("L3 Off");
    }
}
void lod4(int a) {
    digitalWrite(load4, a);
    if (a == 1) {
        if (sms.SendSMS(number, "Auto ")) {
            Serial.println("\nSMS sent OK");
        }
        lcd.setCursor(8, 1);
        lcd.print("Auto ");
    } if (a == 0) {
        if (sms.SendSMS(number, "Manual")) {
            Serial.println("\nSMS sent OK");
        }
    }
}

```



```

    lcd.setCursor(8, 1);
    lcd.print("Manual");
}
}
void all(int a) {
    digitalWrite(load1, a);
    digitalWrite(load2, a);
    digitalWrite(load3, a);
    if (a == 0) {
        if (sms.SendSMS(number, "ALL Load On")) {
            Serial.println("\nSMS sent OK");
        }
        lcd.setCursor(0, 0);
        lcd.print("L1 On");
        lcd.setCursor(8, 0);
        lcd.print("L2 On");
        lcd.setCursor(0, 1);
        lcd.print("L3 On");
    } if (a == 1) {
        if (sms.SendSMS(number, "ALL Load Off")) {
            Serial.println("\nSMS sent OK");
        }
        lcd.setCursor(0, 0);
        lcd.print("L1 Off");
        lcd.setCursor(8, 0);
        lcd.print("L2 Off");
        lcd.setCursor(0, 1);
        lcd.print("L3 Off");
    }
}
void del(){
    for (i = 1; i <= 20; i++)
        {

```

```

        sms.DeleteSMS(i);
    }
}
void loop()
{
    String sms_text;
    if(started) {
        //Read if there are messages on SIM card and print them.
        if(gsm.readSMS(smsbuffer, 160, n, 20)) {
            Serial.println(n);
            Serial.println(smsbuffer);
        }
        //get 1st sms
        sms.GetSMS(1,n,20,smsbuffer,160);
        Serial.println(n);
        Serial.println(smsbuffer);
        sms_text=smsbuffer;
        String re=sms_text;
        Serial.print(re);
        if(mod==0)
        {
            if (re=="LOAD1ON"&&L1==0) {
                //Serial.print("Load 1");
                del();
                lod1(0);
                L1=1;
            }
            if (re=="LOAD1OFF"&&L1==1) {
                //Serial.print("Load f");
                del();
                lod1(1);
                L1=0;
            }
        }
    }
}

```

```

if (re=="LOAD2ON" &&L2==0) {
    // Serial.print("Load 1");
    del();
    lod2(0);
    L2=1;
}
if (re=="LOAD2OFF" &&L2==1) {
    // Serial.print("Load f");
    del();
    lod2(1);
    L2=0;
}
if (re=="LOAD3ON" &&L3==0) {
    //Serial.print("Load 1");
    del();
    lod3(0);
    L3=1;
}
if (re=="LOAD3OFF" &&L3==1) {
    //Serial.print("Load f");
    del();
    lod3(1);
    L3=0;
}
if (re=="ALLON" &&LA==0) {
    // Serial.print("Load f");
    del();
    all(0);
    L1=1;
    L2=1;
    L3=1;
    LA=1;
}

```

```

if (re=="ALLOFF" &&LA==1) {
    // Serial.print("Load f");
    del();
    all(1);
    L1=0;
    L2=0;
    L3=0;
    LA=0;
}
}
if (re=="AUTO"&&L4==1) {
    Serial.print("Auto");
    del();
    lod4(1);
    L4=0;
    mod=0;
}
if (re=="MANUAL" &&L4==0) {
    Serial.print("Manual");
    del();
    lod4(0);
    L4=1;
    mod=1;
}
}
else
{
    Serial.println("NO NEW SMS,WAITTING");
}
delay(500);
}

```