A Project Report

On

MIRA

"Micro-controller Integration by Radio Frequency in Automation System"

Submitted in Fulfillment of the Requirement Of

Project-III (BIT206CO)

Of

Bachelor of Information Technology

PURBANCHAL UNIVERSITY

Biratnagar, Nepal

Submitted by:

John Subba(333645)

Sudeep Khadka(333663)

Kaustuv Baral(333646)

KANTIPUR CITY COLLEGE

Putalisadak, Kathmandu

March 22, 2023

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John Subba

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Project Supervisor

Er. Rabi Shrestha

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Putalisadak, Kathmandu

CERTIFICATE OF TOPIC APPROVAL SHEET

It is here by informed that the topic selected by John Subba, Sudeep Khadka and Kaustuv Baral of BIT Third semester project has been found suitable and as per the credit assigned by Purbanchal University (PU), Biratnagar, Nepal. The Project Committee has approved the following topic and assigned supervisor for the mentioned students. This project has been completed for the prescribed period and the project embodied the result of their investigation conducted during their work as full-time student of this institution.

Topic Approved: M-I-R-A(Micro-controller Integration by Radio frequency in Automation)

Mr. Saroj Pandey	Er. Rabi Shrestha
Deputy HOD, Department of Information Technology	Project Supervisor
Kantipur City College	Kantipur City College

CERTIFICATE FROM SUPERVISOR

This is to certify that the project titled "M-I-R-A" submitted by John Subba, Sudeep Khadka and Kaustuv Baral to the Department of Information Technology, School of Science and Technology at Kantipur City College, Kathmandu, Nepal towards the requirement for Project-III (BIT206CO) is an original work carried out by them under my supervision and guidance.

_____

Er. Rabi Shrestha
Department of Information Technology
Kantipur City College
(Project Supervisor)

ACKNOWLEDGEMENT

We would like to acknowledge all who have encouraged and inspired us directly or indirectly to complete this project. At first, we desire to express our deepest sense of gratitude to Purbanchal University for giving us the opportunity to present ourselves this report within the scheduled time.

We want to thank Kantipur City College for providing this opportunity by approving our project. We are incredibly grateful to our supervisor Er. Rabi Shrestha for continuously supporting and guiding us in our project and providing his valuable time to complete our project.

We also are very thankful to whole IT department for providing us the idea to prepare this project and for continuously motivating us to focus on our project.

We are fortunate enough to get the encouragement and feedback from our teachers and friends. Lastly, many thanks to all the people for their suggestions, feedback and support which was the most in completing our project successfully.

This project has been a wonderful experience where we have learned and experienced many beneficial things.

ABSTRACT

This system is implemented to reduce the manual work and to automate task in the Home. This system provides monitoring capabilities and notify the owner for unwanted invasion.

It is the application used to ease the user life my providing a medium to control electrical appliances from any distance as well as an effective intrusion detection system.

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CHAPTER 1: INTRODUCTION

1.1 Project Introduction

M-I-R-A stands for Micro-controller Integration by Radio Frequency in Automation System. This very system is introduced within us due to its working capability, making our daily lives more convenient by saving our time and effort. For e.g. we are far away from our home and we need to turn our Air Cooler ON, unless we are home at that moment we can't turn on anything, but due to our system we can just sent a simple DTMF tone by calling it and turn that very device on or off from any location from our phone.

Micro-controller Integration by Radio Frequency in Automation System uses DTMF(Dual Tone Multi-frequency) for controlling the appliances attached to the output of 8051/52.

1.2 Problem Statement

The need for such system solely arise due to the advancement of technology and the need to avail the features of such technology.

1.3 Project Objectives

The main objectives:

- To Control electrical home appliances using cell-phones.
- To detect and notify intrusion via SMS.

1.4 Project Features

- Long Range of Control(Limited by the existence of cellular carrier cell towers)
- Giving commands directly by calling to the sim number.
- Receive info through the SMS.

1.5 Assignment of roles and responsibilities

Team Members	Task Performed
John Subba	Coding, Documentation, Debugging & Research, Task Division, Integration of whole team members work.
Sudeep Khadka	Coding, Documentation, Research, Debugging
Kaustuv Baral	Coding, Documentation, Research, Debugging

1.6 Documentation Organization

This documentation is a comprehensive report on the project to create MIRA system. It also includes all background information regarding the project. It also clarifies how the system works and its main features and objectives. Alongside the functions of the system, it also shows how this program is different from other systems. It includes how the system is used in real life fields. It contains all stages of development along with the problems that were faced by members while building this system. It helps to understand the limitations that were seen on this system. Similarly, it includes the detailed information on how the system was made. This documentation includes screenshots and pictures listed in Appendix 1-2 to help readers to visually see the system under operation.

1.7 Literature Review

While visiting websites such as nevonprojects, lastminutes engineers, nevonprojects, etc we come to similar projects that implements such automation system. For communication protocols we tried to study bluetooth module but it was limited by range of 10-15 meters. We also tried to study wifi module, but we found that the creating of web server to switch appliances was more cumbersome as the page might not load properly sometimes and it also need good internet connection. So our final option was to implement the control using cell phones connectivity to give commands for our switch as it has ample range of 30km in a single cell tower block. Finally since the connection is a type of dedicated line once the connection is established. Therefore the choice for GSM become our main target. Hence our idea for MIRA was formed.

CHAPTER 2: SYSTEM ANALYSIS

2.1 Requirement Gathering Process

Requirement No	Requirement Name	Requirement Description	Process of Gathering
1	Working SIM800l module	GSM module should register to network.	Trying to register with NTC/NCELL sim cards.
2	Working IR sensor	To detect objects.	Objects placed near it should reflect light to the IR receiver.
3	Sound Recorded playback IC	It plays the sound as voice menu.	Using ISD 1820 module and tinkering it with various values resistors
4	AT commands testing	Sim800l should be able to respond to AT commands.	Using serial monitor software tools such as PUTTY or Arduino Serial monitor.

2.2 Feasibility study:

Under feasibility study we performed feasibility analysis of the proposed system. There are many types of study that are considered and are categorized under following headings, we performed while developing this project.

2.2.1 Hardware Feasibility

The hardware Feasibility we have studied for development:

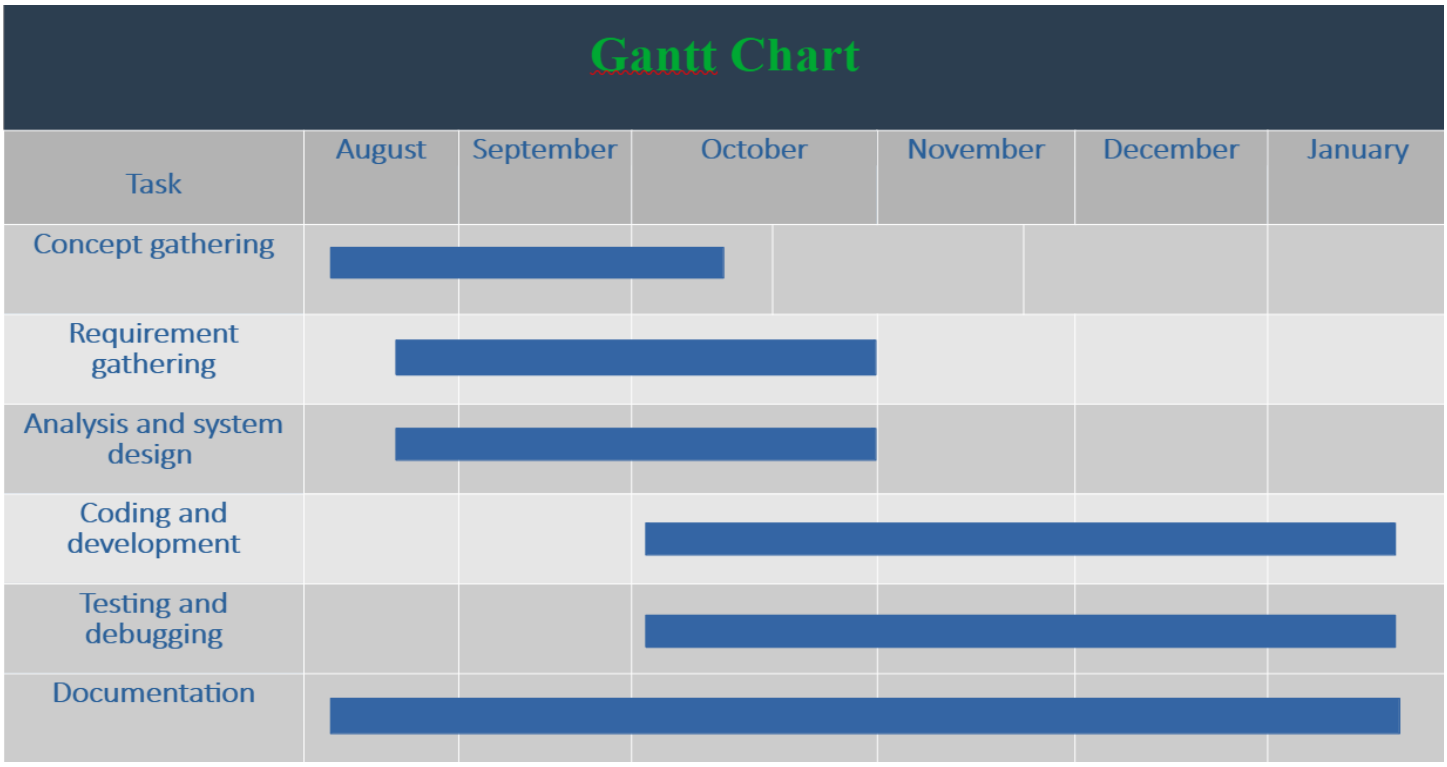
- Micro-controller: Atmel AT89S52/AT89S51
- GSM Module: Sim800l version 1/Sim800l version 2(ROHS)
- Sound IC: ISD 1820 Record and Playback Module
- LCD: 16x2 Alphanumeric LCD display
- IR Sensor: IR Infrared Obstacle Sensor Module and Ultrasonic sensor

2.2.2 Software Feasibility

Computer software feasibility we have studied for development:

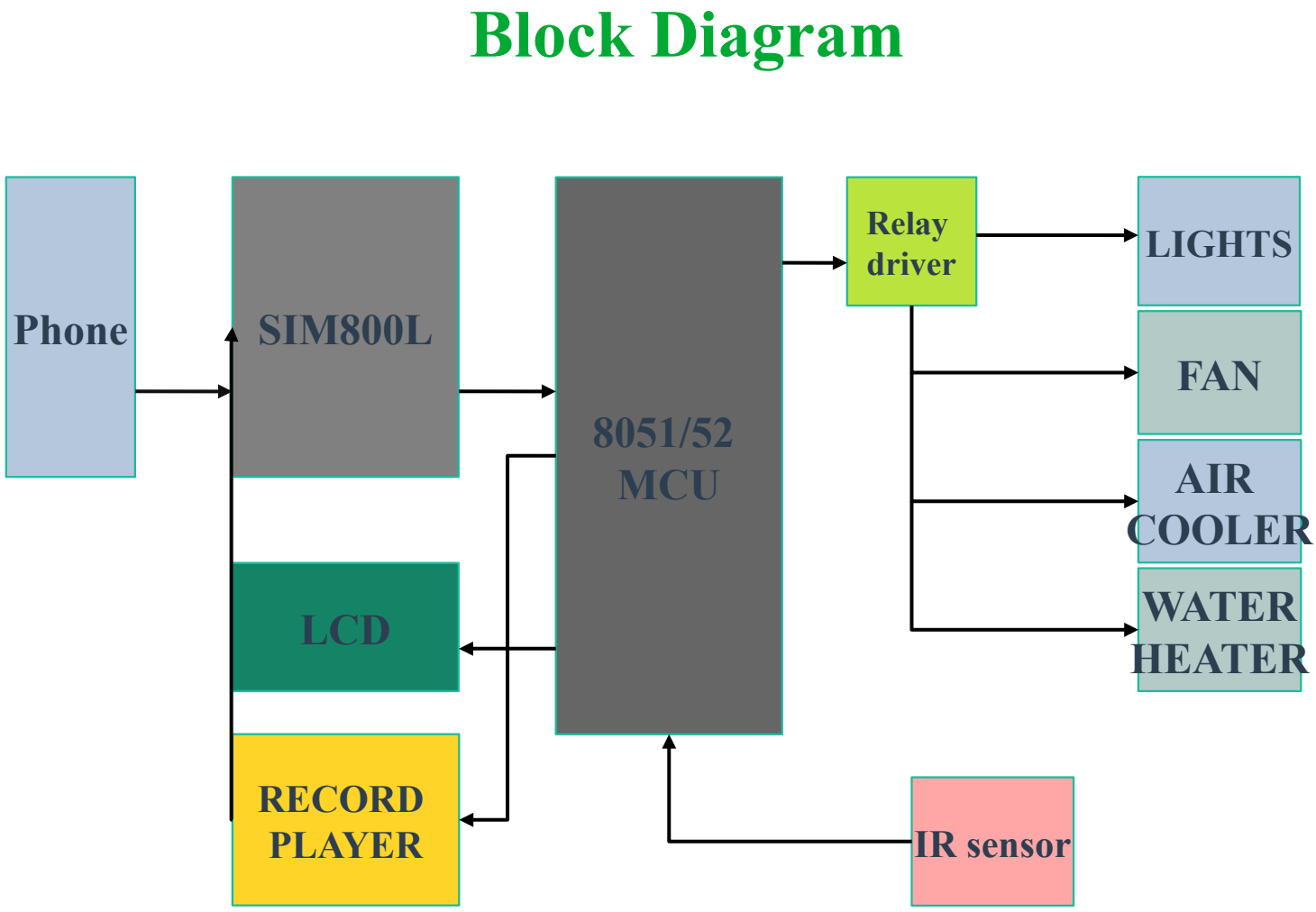
- Operating System: Windows 10 Operating System.
- Simulation Software: Proteus 8, Arduino Serial monitor, PUTTY
- IDE: Keil Uvision Compiler for 805x microcontrollers(C51)
- Programming Language: C/Embedded C, 8051 Assembly

2.3 Gantt chart



CHAPTER 3: SYSTEM DESIGN

3.1 Block Diagram



3.2 System Component

This system contains distinct hardware components as well as software components including functions, header files that helps in running our project.

3.2.1 Hardware components used

These are all the major hardware used along with their brief specifications:

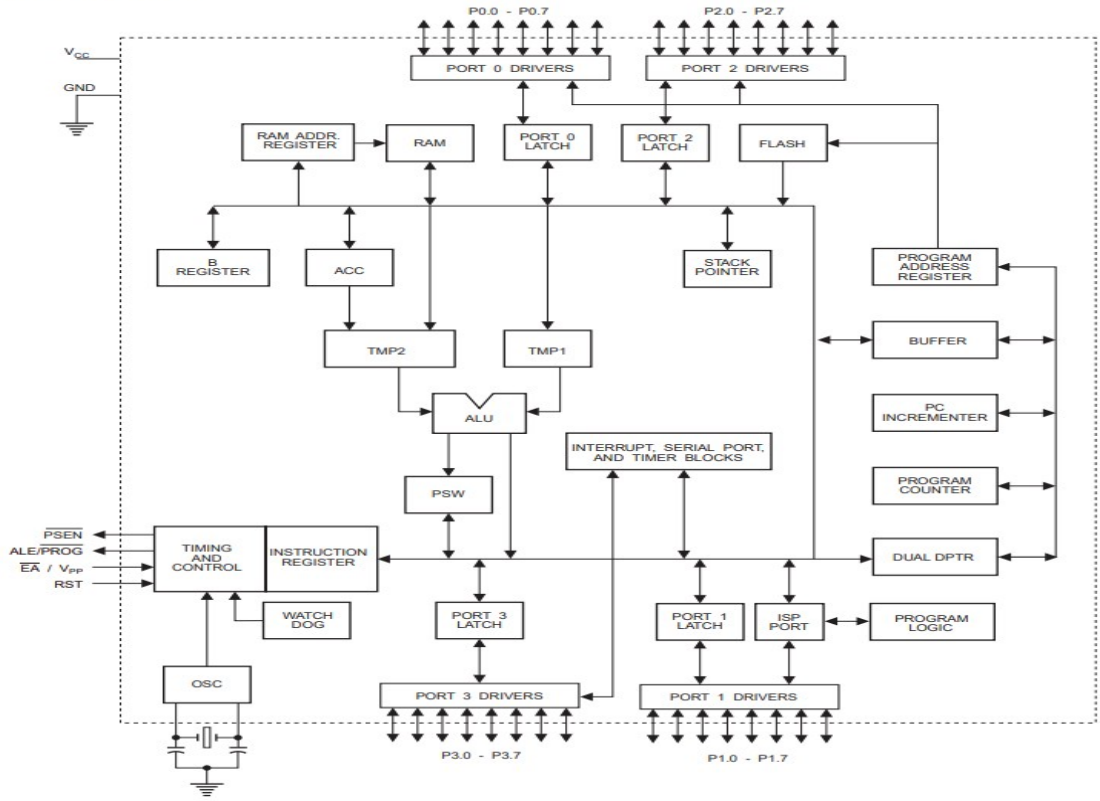
1) AT89S52 micro-controller unit:

Specifications:

- 8K Bytes of In-System Programmable(ISP) Flash Memory
  -Endurance: 1000 Write/Erase Cycles
- 4.0V to 5.5V Operating Range
- 256×8-Bit Internal RAM
- 32 Programmable I/O lines
- Three 16-bit Timers/Counters
- Full Duplex UART Serial Channel
- Watchdog Timer

AT89S52

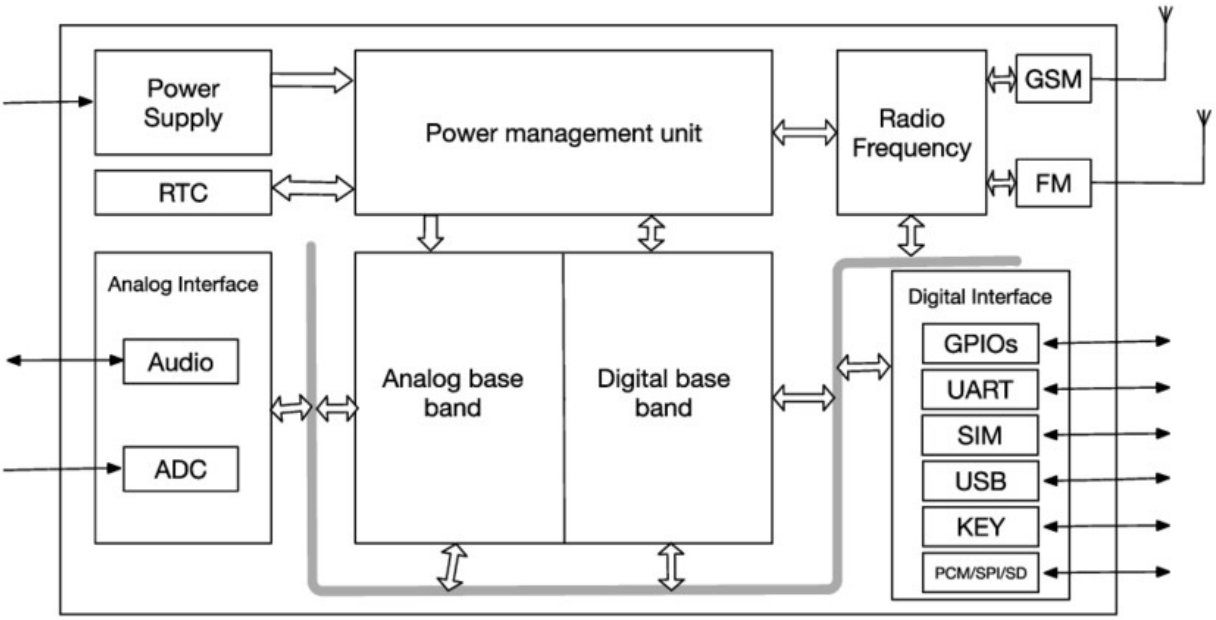
Block Diagram



2) SIM800L GSM/GPRS Module:

Specifications:

- Supply Voltage: 3.8V – 4.2V
- Recommended Supply voltage: 4V
- Power Consumption:
  - sleep mode < 2.0mA
  - idle mode < 7.0mA
  - GSM transmission (avg): 350 mA
  - GSM transmission (peak): 2000mA
- Module Size: 25×23 mm
- Interface: UART (max. 2.8V) and AT commands
- SIM card socket: microSIM (bottom side)
- Supported frequencies: Quad Band (850/950/1800/1900 MHz)
- Antenna connector: IPX
- Status Signaling: LED
- Working temperature range: -40 to +85 C

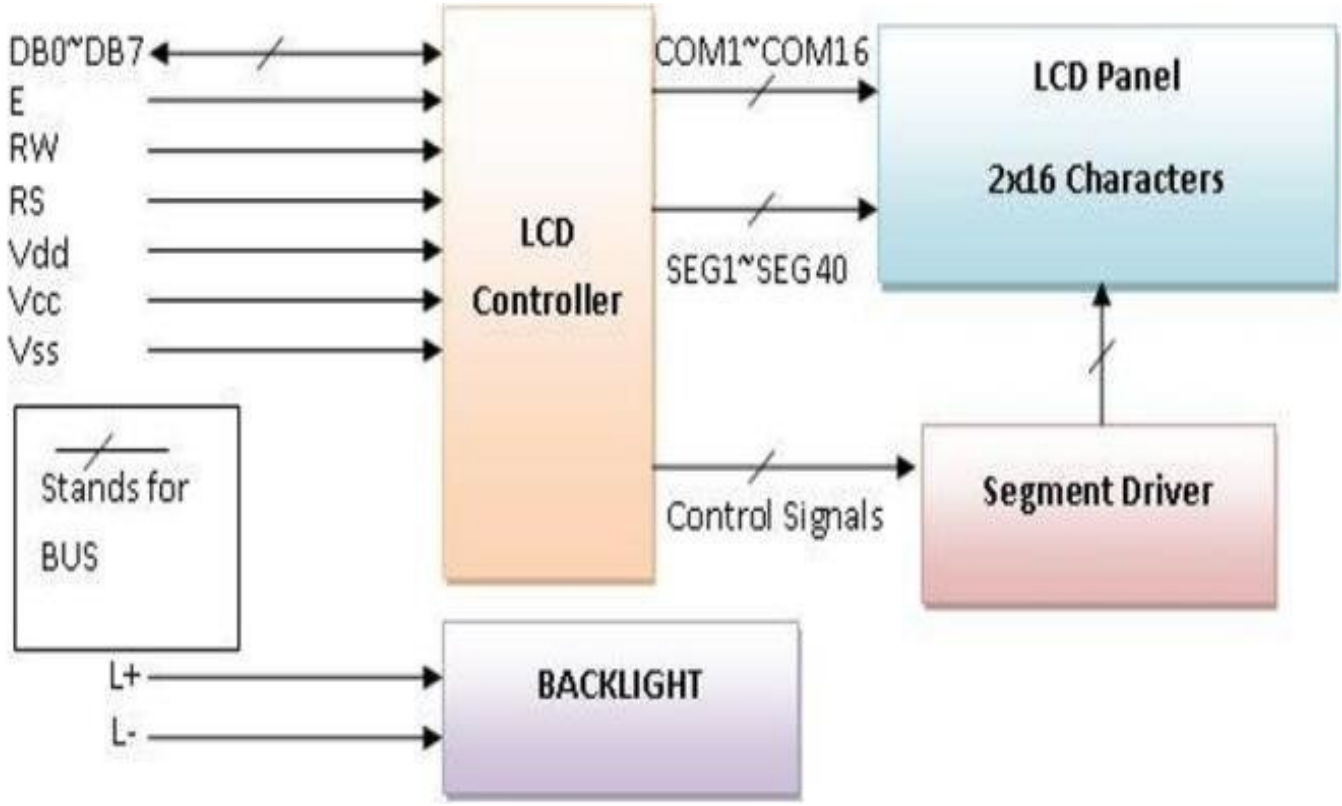


Sim800l Functional Diagram

3) 16×2 Alphanumeric LCD:

Specifications:

- Operating Voltage: 4.7V-5.3V
- 2 Rows with each rows producing 16 characters
- Power Consumption is 1mA with no back-light
- Character can be built with 5×8 pixel box
- Works in 4-bit and 8-bit mode
- Obtainable in blue and green back-light

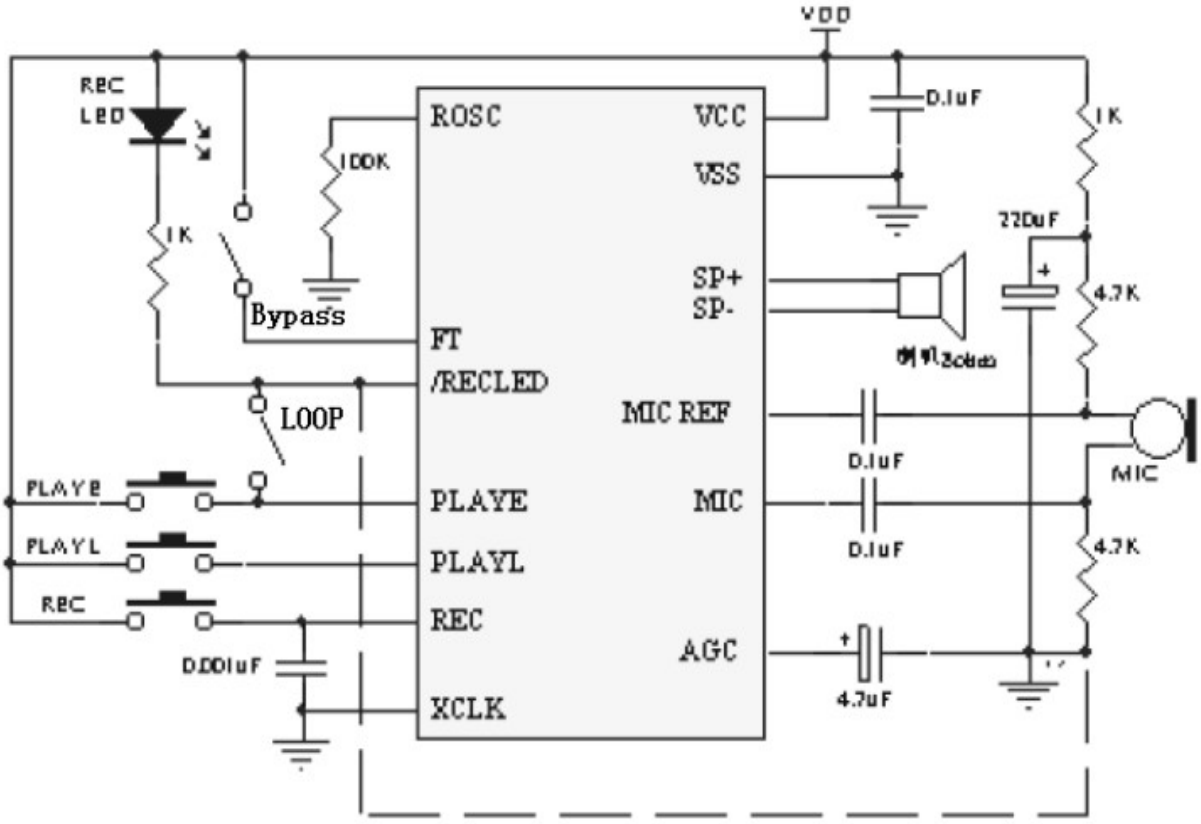


Block Diagram of 16x2 LCD

4) ISD 1820 Record and Playback Module:

Specifications:

- Push-button interface, playback can be edge or level activated
- Automatic power-down mode
- On-chip 8Ω speaker driver
- Signal 3V Power Supply
- Can be controlled both manually or by MCU
- Sample rate and duration changeable by replacing a single resistor
- Record up to 20 seconds of audio
- Dimensions: 37×54 mm

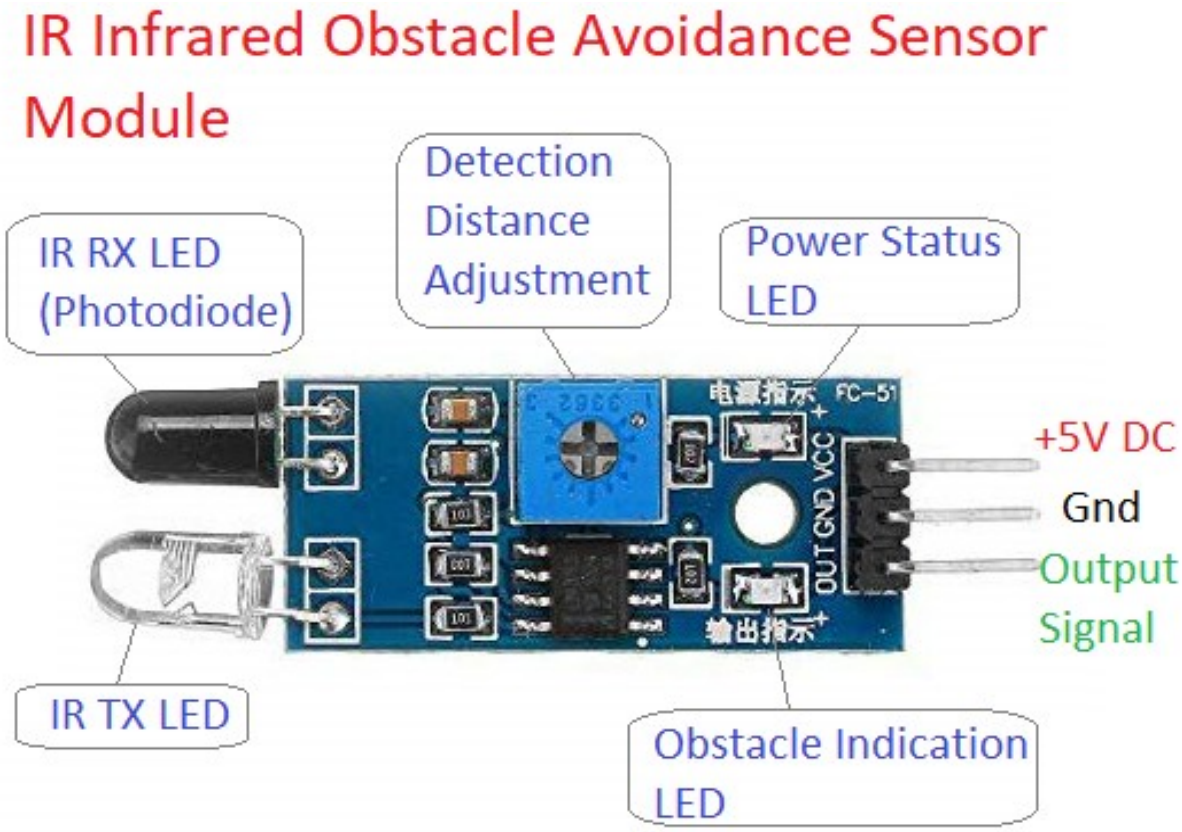


Schematic Diagram of ISD 1820

5) IR Sensor Module:

Specifications:

- Operating Voltage: 3.0V to 6.0V
- LM393 Comparater chip
- Detection angle: 35◦
- Detection range: 2cm – 30cm(Adjustable using potentiometer)
- Active Output Signal: Outputs low logic level when obstacle is detected
- In-Active Output Signal: Outputs high logic level when obstacle is not detected
- Current Consumption: 3.3V(23mA) / 5.0V(43mA)
- Size: 4.5cm x 1.4cm x 0.7cm

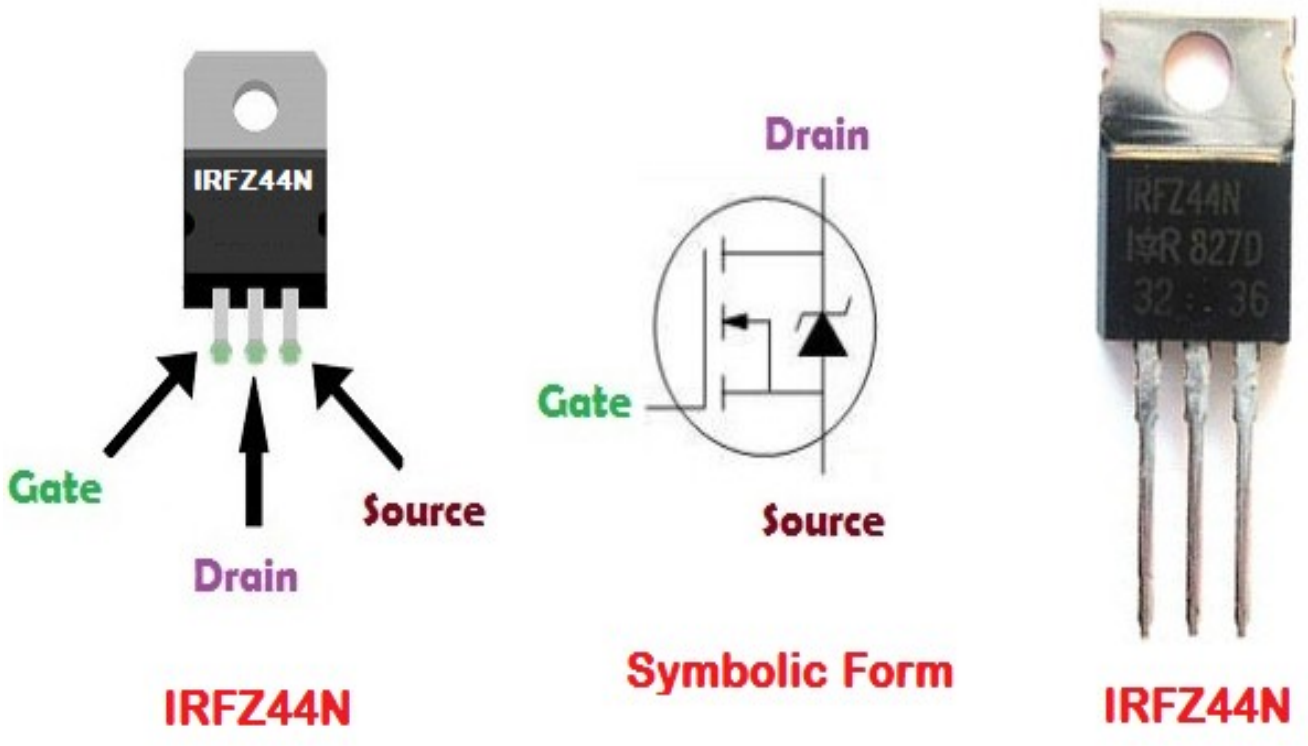


Label Diagram for IR Sensor

6) IRFZ44N Transistor:

Specifications:

- Transistor Type: MOSFET
- Control Channel: N – Channel
- Maximum Power Dissipation: 150W
- Maximum Drain Source Voltage: 60V
- Maximum Drain Current: 35A
- Maximum Junction Temperature: 150° C
- Operating Temperature: 175° C

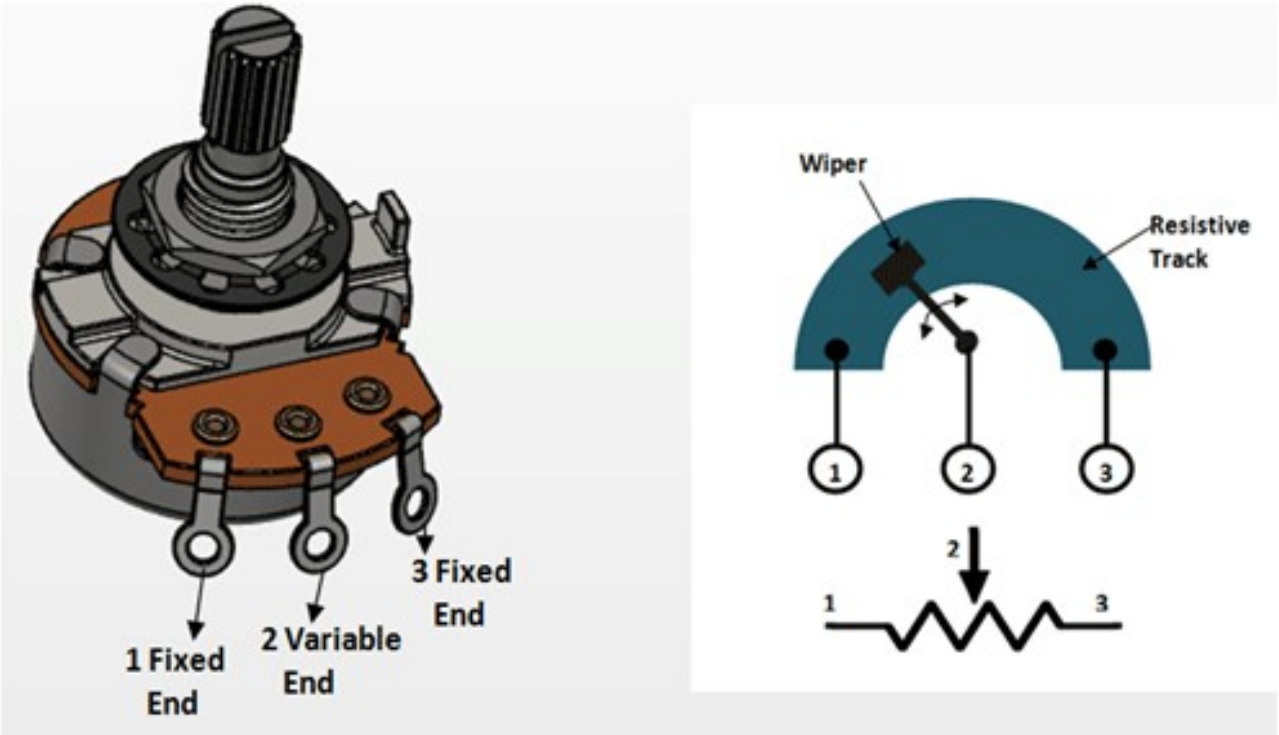


Label Diagram of IRFZ44N

7) 10k Potentiometer:

Specifications:

- Value: 10K
- Potential: 500Ohms – 1M Ohms(+-20%)
- Rotational life of Potentiometer: 10000 cycles
- Rotational life for Joystick: 100000 cycles min
- Rated Power: 1A at AC/DC 125V
- Rotational Travel: 300°
- Withstand Voltage: 1 minute at AC 500V
- Sliding noise: Less than 100 milli volts



10K Potentiometer Diagram

The above are all the major hardware's used in our project. Other common or minor hardware's such as Led's, buzzer, jumper wires, resistors, breadboard and programmer board are not included in the detailed specifications list for brevity.

Note: For Hardware data-sheet, refer to the relevant appendix(data-sheet source:- manufacture website)

All the header files and functions under software components, used in our project are given below along with their characteristics and descriptions:

3.2.2 Software library and functions in C

Header file	Description
#include<reg52.h>	All the special functions registers address mapped to predefined variable names.
#include<string.h>	Standard functions for handling all string operations.
#include<sim800.h>	Custom created header file with several required functions for serial communication to SIM800l module.
#include<lcd.h>	Custom created header file for functions for initialization and displaying in the 16x2 LCD.

Some of the user defined function are listed below with their functionality:

Function No.	Function	Characteristics
1	void delay_ms(int ms)	This function is used to create software delay of the required milliseconds.
3	void my_isr()	This function is used to perform the instructions after the object is detected by IR_Sensor.
4	void configure_Interrupts()	This function is for configuring interrupts for falling edge triggered and for timer0 interrupt.
5	void init_Serial()	This function is for configuring respective values in TMOD, SCON, TH1, etc.
6	void sendChar(char c_send)	This function is for sending single character via TX pin.
7	void sendMessage(char *Str)	This function is for sending message via TX pin.
8	void Serial_ISR()	This function is for handling serial interrupts and processing respectively.
9	void sendString(char *str_Send)	This function is for sending strings while serial communication during active serial interrupts.
10	void dtmf_response_init()	This function will reset the response for receiving the new dtmf response frequently.
11	void init_LCD(void)	This fucntion will initialize the LCD with necessary commands.

12	void send_LCD_Command(unsigned char cmd)	This function will send commands to the LCD.
13	void send_LCD_Data(unsigned char data1);	This function will send data to the LCD via the respective port.
14	void displayString(unsigned char row, unsigned char column, unsigned char *str);	This function will able to take string values, row index as well as column index and send it to LCD to be displayed by utilizing the send_LCD_DATA function.
15	Void Timer0_ISR(void) interrupt 1	This function is tailored with hardware delay value with timer0 to meet the delay needs of the LCD timings signals.

3.3 Algorithm

Step 1: Start

Step 2: Power the Sim800l before the system till it successfully register to network.

Step 3: Power MIRA system and start/initialize it.

Step4: Display “Welcome to Mira” in LCD.

Step 5: Monitor for incoming call as well as interrupt from IR. Interrupt generated at anytime will goto step 6.

If call received, activate sound IC, Auto answer after 1 ring and listen for DTMF tones.

If tone 1 : Turn lights ON and display it on LCD.

If tone 2: Turn lights Off and display it on LCD.

If tone 3 : Turn Fan ON and display it on LCD.

If tone 4: Turn Fan Off and display it on LCD.

If tone 5 : Turn Air Cooler ON and display it on LCD.

If tone 6: Turn Air Cooler Off and display it on LCD.

If tone 7 : Turn Water Heater ON and display it on LCD.

If tone 8: Turn Water Heater Off and display it on LCD.

If tone 9 : Turn Alarm ON and display it on LCD.

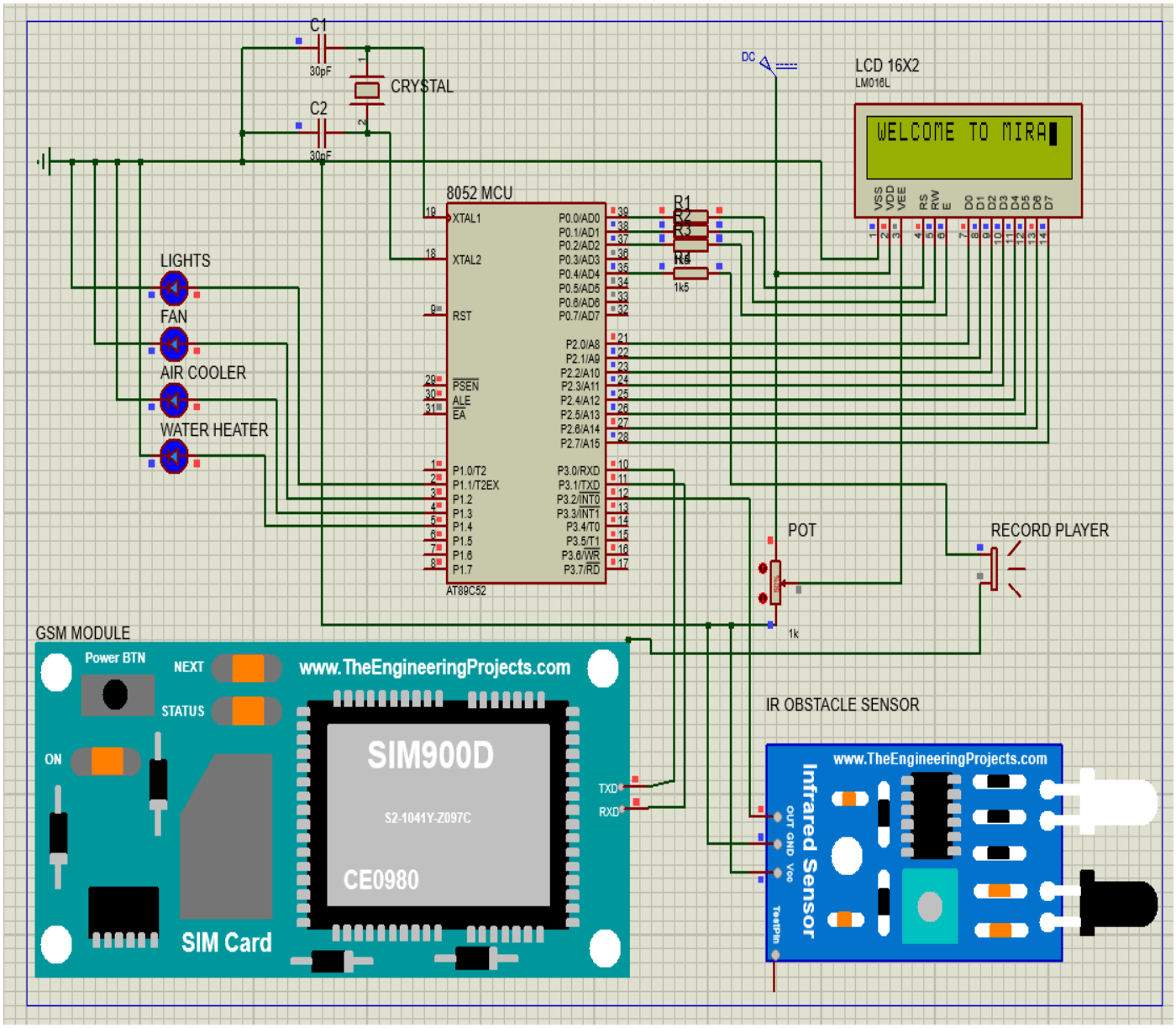
If tone 0: Turn All Devices Off and display it on LCD.

Else called disconnected, turn off Sound IC and goto step 5.

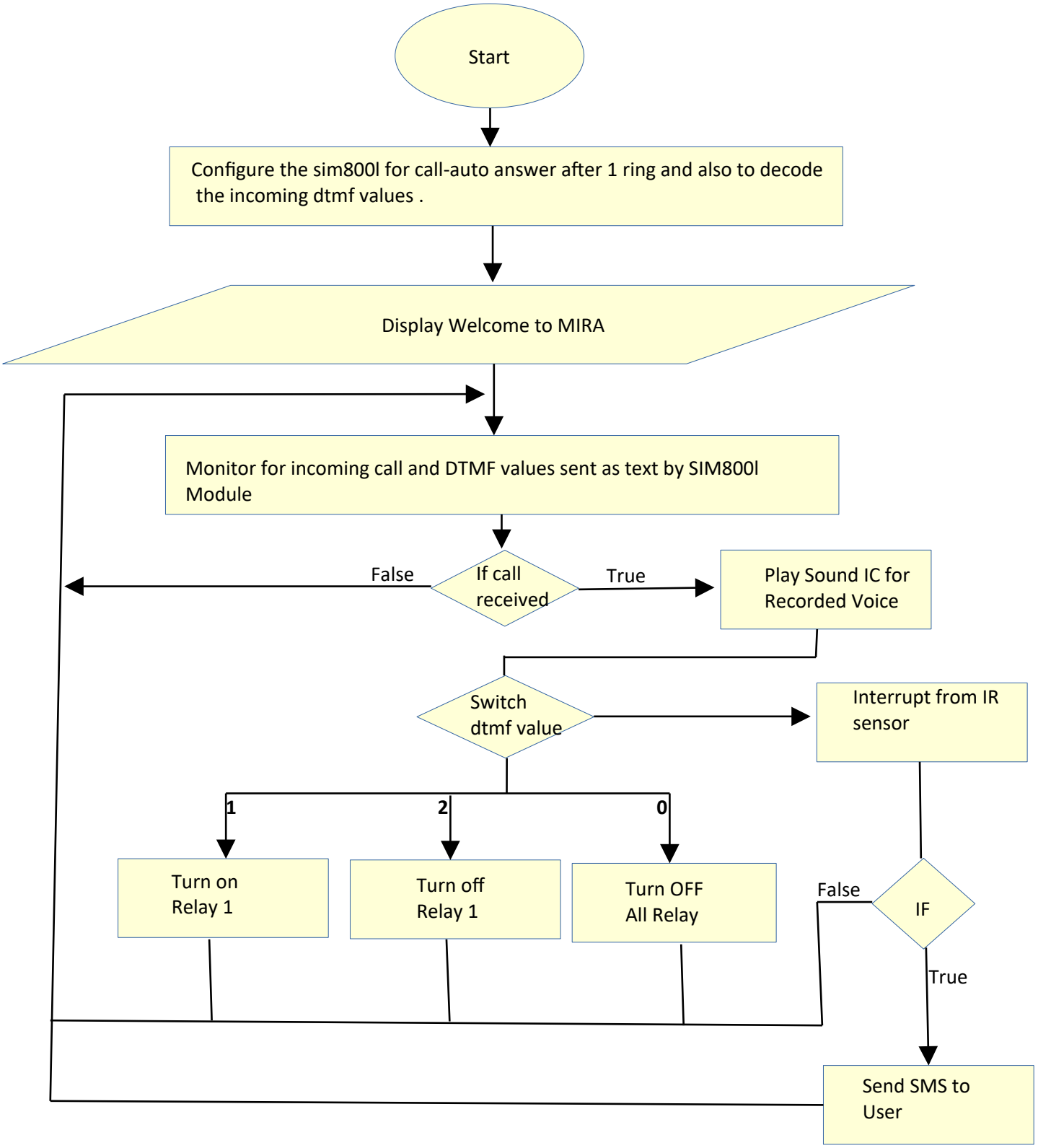
Step 6: Handle the Interrupt Service Routine(send SMS) and goto step 5.

Step 7: Stop.

3.4 Circuit Diagram



3.5 Flowchart:



Chapter 4: System Development and Implementation

4.1 Programming platform (Tools and technologies used)

This System uses hex file created by Keil C compiler, and is directly flashed/burned into the 8051/52 micro-controller using progISP1.7.

4.2 Test Case

While development, there were many tests. Some gave expected results. However, some gave errors and unexpected output.

Some Successful test cases were:

- Sending SMS: Test was successful as it sends the SMS to the given number.
- Receiving DTMF Tone: Test was successful as the sim module sent dtmf response.
- Decoding Tone and Outputs: Test was successful as the assigned tone give correct/expected/programmed outputs.
- Interrupt Check: Interrupt was given on INT0 and it worked perfectly as per the routine.
- Sound IC integration with Sim800l: Call triggering sound IC and the playback given to sim800l mic pins worked perfectly.

Some unexpected output cases:

- Due to CPU speed limit, certain times while handling serial input (i.e. call connected) the display couldn't get required CPU time and does not show characters properly.
- While generating DTMF tone, key must be pressed for more than 500ms to identify the correct tone.
- Improper connection/loose connection to 8052 Micro-controller caused strange behaviour.

CHAPTER 5: CONCLUSION AND FUTURE ENHANCEMENT

5.1 Conclusion

In this documentation we have tried to explain every topic related to our project as clearly as possible. All in all this system is a compact system made from scratch using bare-bones micro-controller to automate/assist our daily chores in house related to electrical appliances.

MIRA needs to have valid sim card in its sim800l and one can expect to get control over the devices it is connected to it without any problem.

5.2 Limitation

As we know that no program can be 100% reliable and efficient. So, there are also some drawbacks from our system like it cannot take other interrupts apart from what is already in the system as the MCU clock capacity is fully reached. In some rare cases while receiving call (baudrate is 9600) and if the LCD delay is utilizing CPU cycles as software delay then there will be latency, which can be seen as random garbage values in LCD.

Similarly it cannot tell which appliances are ON or OFF. So the best way is to turn OFF all devices at the beginning and turn ON the required devices as per the need. This is because the keil compiler free version limits the code capacity that can be compiled as we cannot create more routines for it.

5.3 Future enhancement

For future enchantments of this System, we can optimize to handle interrupt in a better way. We can include GPRS capabilities of the sim800l for transferring of data(small size) as well as the GPS coordinates system by attaching a GPS module. We could even create nodes of such system that could interpret SMS for input and can perform task in several locations all at the same time by giving command to master system(node).

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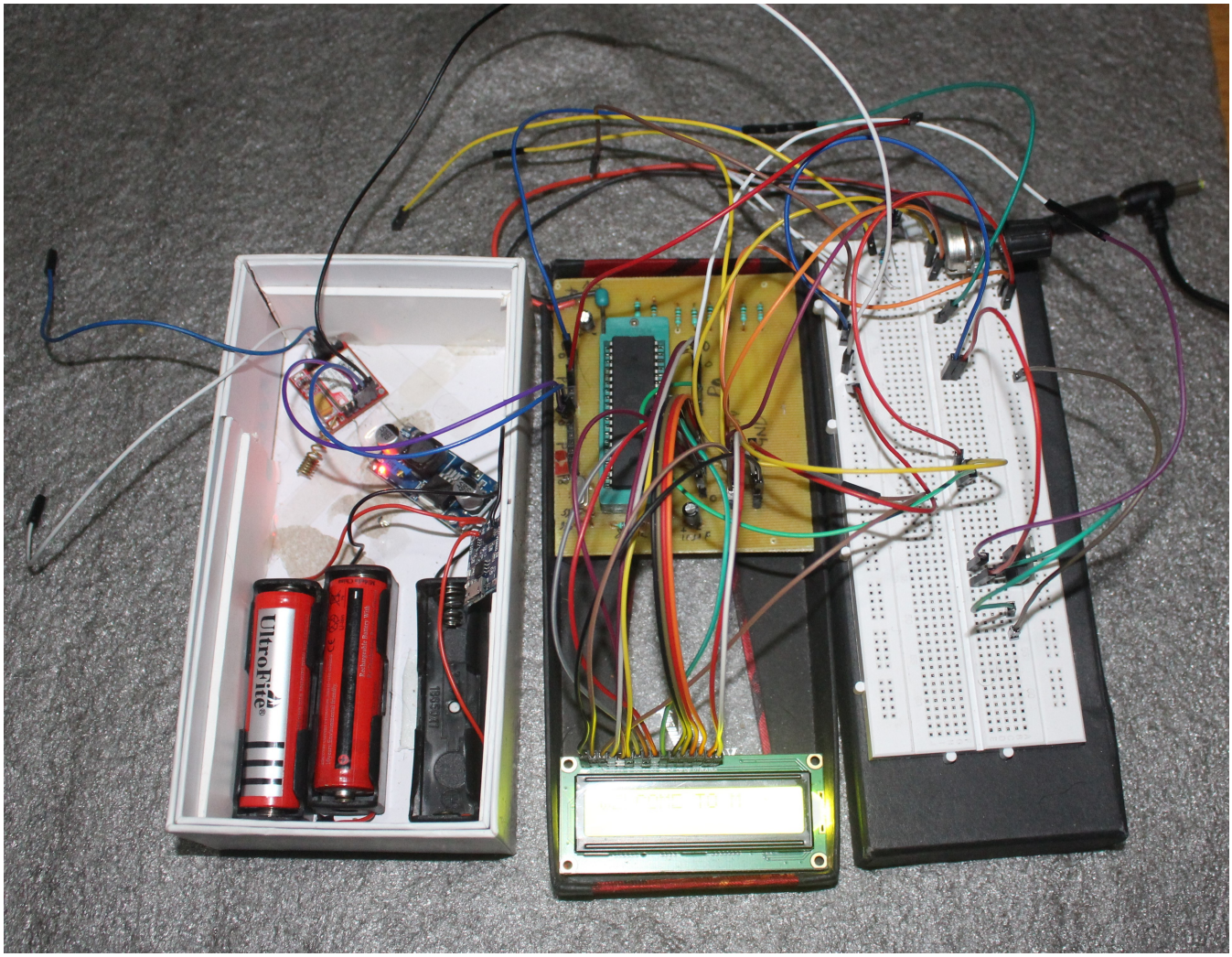
Appendices

Appendix-1 (Photo 1 of MIRA under operation)

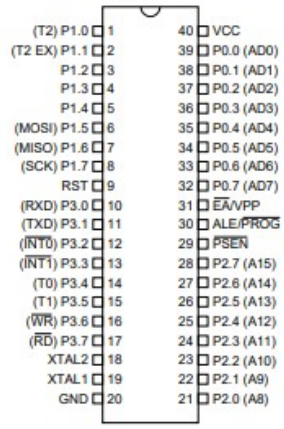


Appendix-2 (Photo 2 of MIRA under operation)

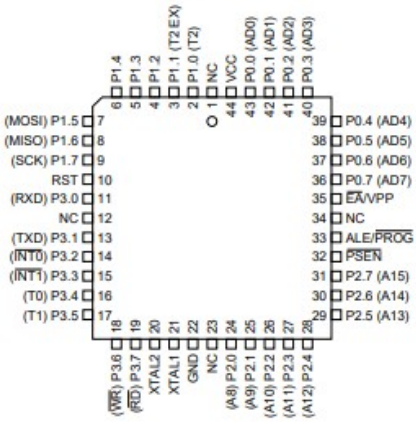
Appendix-3 (Data Sheet of AT89S52)

Pin Configurations

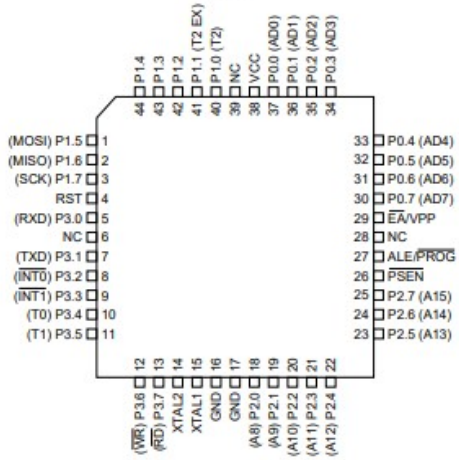
PDIP



PLCC



TQFP



Pin Description

VCC
Supply voltage.

GND
Ground.

Port 0
Port 0 is an 8-bit open drain bidirectional I/O port. As an output port, each pin can sink eight TTL inputs. When 1s are written to port 0 pins, the pins can be used as high-impedance inputs.

Port 0 can also be configured to be the multiplexed low-order address/data bus during accesses to external program and data memory. In this mode, P0 has internal pullups.

Port 0 also receives the code bytes during Flash programming and outputs the code bytes during program verification. External pullups are required during program verification.

Port 1
Port 1 is an 8-bit bidirectional I/O port with internal pullups. The Port 1 output buffers can sink/source four TTL inputs. When 1s are written to Port 1 pins, they are pulled high by the internal pullups and can be used as inputs. As inputs, Port 1 pins that are externally being pulled low will source current (I_{IL}) because of the internal pullups.

In addition, P1.0 and P1.1 can be configured to be the timer/counter 2 external count input (P1.0/T2) and the timer/counter 2 trigger input (P1.1/T2EX), respectively, as shown in the following table.

Port 1 also receives the low-order address bytes during Flash programming and verification.

Port Pin	Alternate Functions
P1.0	T2 (external count input to Timer/Counter 2), clock-out
P1.1	T2EX (Timer/Counter 2 capture/reload trigger and direction control)
P1.5	MOSI (used for In-System Programming)
P1.6	MISO (used for In-System Programming)
P1.7	SCK (used for In-System Programming)

Port 2
Port 2 is an 8-bit bidirectional I/O port with internal pullups. The Port 2 output buffers can sink/source four TTL inputs. When 1s are written to Port 2 pins, they are pulled high by the internal pullups and can be used as inputs. As inputs, Port 2 pins that are externally being pulled low will source current (I_{IL}) because of the internal pullups.

Port 2 emits the high-order address byte during fetches from external program memory and during accesses to external data memory that use 16-bit addresses (MOVX @ DPTR). In this application, Port 2 uses strong internal pullups when emitting 1s. During accesses to external data memory that use 8-bit addresses (MOVX @ RI), Port 2 emits the contents of the P2 Special Function Register.

Port 2 also receives the high-order address bits and some control signals during Flash programming and verification.

Port 3
Port 3 is an 8-bit bidirectional I/O port with internal pullups. The Port 3 output buffers can sink/source four TTL inputs. When 1s are written to Port 3 pins, they are pulled high by the internal pullups and can be used as inputs. As inputs, Port 3 pins that are externally being pulled low will source current (I_{IL}) because of the pullups.

Port 3 also serves the functions of various special features of the AT89S52, as shown in the following table.

Port 3 also receives some control signals for Flash programming and verification.

Port Pin	Alternate Functions
P3.0	RXD (serial input port)
P3.1	TXD (serial output port)
P3.2	$\overline{\text{INT0}}$ (external interrupt 0)
P3.3	$\overline{\text{INT1}}$ (external interrupt 1)
P3.4	T0 (timer 0 external input)
P3.5	T1 (timer 1 external input)
P3.6	$\overline{\text{WR}}$ (external data memory write strobe)
P3.7	$\overline{\text{RD}}$ (external data memory read strobe)

RST
Reset input. A high on this pin for two machine cycles while the oscillator is running resets the device. This pin drives High for 96 oscillator periods after the Watchdog times out. The DISRTO bit in SFR AUXR (address 8EH) can be used to disable this feature. In the default state of bit DISRTO, the RESET HIGH out feature is enabled.

ALE/$\overline{\text{PROG}}$
Address Latch Enable (ALE) is an output pulse for latching the low byte of the address during accesses to external memory. This pin is also the program pulse input ($\overline{\text{PROG}}$) during Flash programming.

In normal operation, ALE is emitted at a constant rate of 1/6 the oscillator frequency and may be used for external timing or clocking purposes. Note, however, that one ALE pulse is skipped during each access to external data memory.

If desired, ALE operation can be disabled by setting bit 0 of SFR location 8EH. With the bit set, ALE is active only during a MOVX or MOVC instruction. Otherwise, the pin is

weakly pulled high. Setting the ALE-disable bit has no effect if the microcontroller is in external execution mode.

$\overline{\text{PSEN}}$

Program Store Enable ($\overline{\text{PSEN}}$) is the read strobe to external program memory.

When the AT89S52 is executing code from external program memory, $\overline{\text{PSEN}}$ is activated twice each machine cycle, except that two $\overline{\text{PSEN}}$ activations are skipped during each access to external data memory.

$\overline{\text{EA}}$/VPP

External Access Enable. $\overline{\text{EA}}$ must be strapped to GND in order to enable the device to fetch code from external program memory locations starting at 0000H up to FFFFH. Note, however, that if lock bit 1 is programmed, $\overline{\text{EA}}$ will be internally latched on reset.

$\overline{\text{EA}}$ should be strapped to V_{CC} for internal program executions.

This pin also receives the 12-volt programming enable voltage (V_{PP}) during Flash programming.

XTAL1

Input to the inverting oscillator amplifier and input to the internal clock operating circuit.

XTAL2

Output from the inverting oscillator amplifier.

Table 1. AT89S52 SFR Map and Reset Values

0F8H									0FFH
0F0H	B 00000000								0F7H
0E8H									0EFH
0E0H	ACC 00000000								0E7H
0D8H									0DFH
0D0H	PSW 00000000								0D7H
0C8H	T2CON 00000000	T2MOD XXXXXX00	RCAP2L 00000000	RCAP2H 00000000	TL2 00000000	TH2 00000000			0CFH
0C0H									0C7H
0B8H	IP XX000000								0BFH
0B0H	P3 11111111								0B7H
0A8H	IE 0X000000								0AFH
0A0H	P2 11111111		AUXR1 XXXXXXX0				WDTRST XXXXXXXX		0A7H
98H	SCON 00000000	SBUF XXXXXXXX							9FH
90H	P1 11111111								97H
88H	TCON 00000000	TMOD 00000000	TL0 00000000	TL1 00000000	TH0 00000000	TH1 00000000	AUXR XXX00XX0		8FH
80H	P0 11111111	SP 00000111	DP0L 00000000	DP0H 00000000	DP1L 00000000	DP1H 00000000		PCON 0XXX0000	87H

Appendix-4 (Data Sheet of SIM800L)

3. Package Information

3.1. Pin Out Diagram

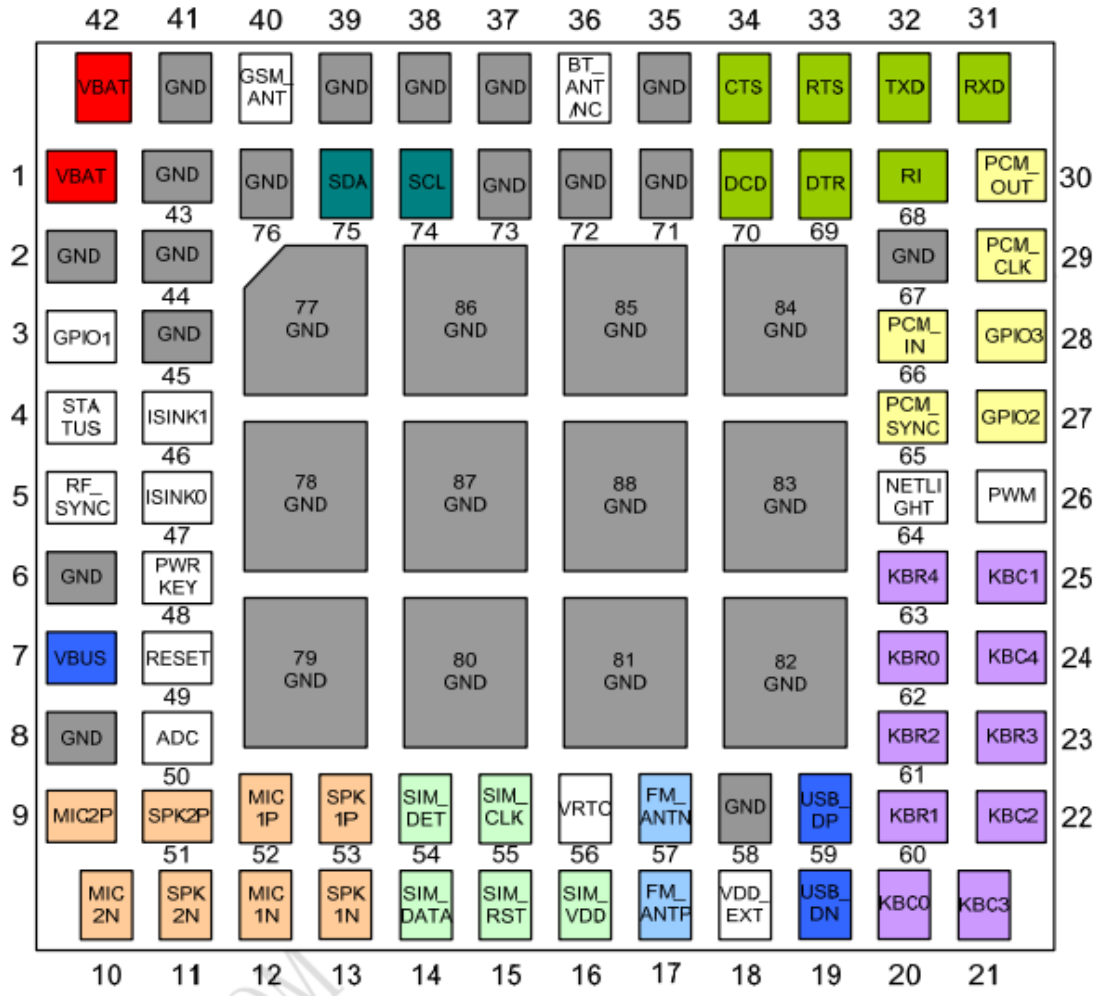


Figure 2: Pin assignment (Top view)

3.2. Pin Description

Table 5: Pin description

Pin name	Pin number	I/O	Description	Comment
Power supply				
VBAT	1,42	I	Power supply	
VRTC	56	I/O	Power supply for RTC	It is recommended to connect with a battery or a capacitor (e.g. 4.7uF).
VDD_EXT	18	O	2.8V power output	If these pins are unused, keep open.
GND	2,6,8,35,37,38,39, 41,43,44,45,58,67 ,71,72,73,76,77,7 8,79,80,81,82,83, 84,85,86,87,88		Ground	GND for VBAT recommend to use 2,43,44,45pin
Power on/down				
PWRKEY	48	I	PWRKEY should be pulled low at least 1 second and then released to power on/down the module.	Internally pulled up to VBAT.
Audio interfaces				
MIC1P	52	I	Differential audio input	If these pins are unused, keep open.
MIC1N	12			
SPK1P	53	O	Differential audio output	
SPK1N	13			
MIC2P	9	I	Differential audio input	
MIC2N	10			
SPK2P	51	O	Differential audio output	
SPK2N	11			
PCM interface				
PCM_CLK	29	O	PCM interface for digital audio	If these pins are unused, keep open.
PCM_OUT	30	O		
PCM_SYNC	65	O		
PCM_IN	66	I		
Keypads interface				
KBC4	24	I	Support up to 50 buttons (5*5*2)	If these pins are unused, keep open.（Please make sure pin20 at high level when power on）
KBC3	21	I		
KBC2	22	I		
KBC1	25	I		
KBC0	20	I		
KBR4	63	O		
KBR3	23	O		

KBR2	61	O		
KBR1	60	O		
KBR0	62	O		
GPIO				
GPIO1	3	I/O	Programmable general purpose input and output	
GPIO2	27	I/O		
GPIO3	28	I/O		
NETLIGHT	64	O	Network status	
STATUS	4	O	Power on status	
Serial port				
DTR	69	I	Data terminal ready	If these pins are unused, keep open.
RI	68	O	Ring indicator	
DCD	70	O	Data carrier detect	
CTS	34	O	Request to send	
RTS	33	I	Clear to send	
TXD	32	O	Transmit data	
RXD	31	I	Receive data	
Debug interface				
VBUS	7	I	Debug and download	If these pins are unused, keep open.
USB_DP	59	I/O		
USB_DN	19	I/O		
ADC				
ADC	50	I	10bit general analog to digital converter	If these pins are unused, keep open.
PWM				
PWM	26	O	Pulse-width modulation	If these pins are unused, keep open.
I2C				
SDA	75	I/O	Open drain output	If these pins are unused, keep open.
SCL	74	O	Open drain output	
SIM card interface				
SIM_VDD	16	O	Voltage supply for SIM card. Support 1.8V or 3V SIM card	All signals of SIM interface should be protected against ESD with a TVS diode array.
SIM_DATA	14	I/O	SIM data input/output	
SIM_CLK	55	O	SIM clock	
SIM_RST	15	O	SIM reset	
SIM_DET	54	I	SIM card detection	If these pins are unused, keep open.
Antenna interface				
GSM_ANT	40	I/O	Connect GSM antenna	
BT_ANT	36	I/O	Connect Bluetooth antenna	Only SIM800H
FM_ANTP	17	I	Differential antenna for FM	

FM_ANTN	57	I		
Synchronizing signal of RF				
RF_SYNC	5	O	Synchronizing signal of RF	
Other				
RESET	49	I	Reset input(Active low)	
ISINK1	46	I	Drive keypad backlight	
ISINK0	47	I	Drive LCD backlight	

3.3. Package Dimensions

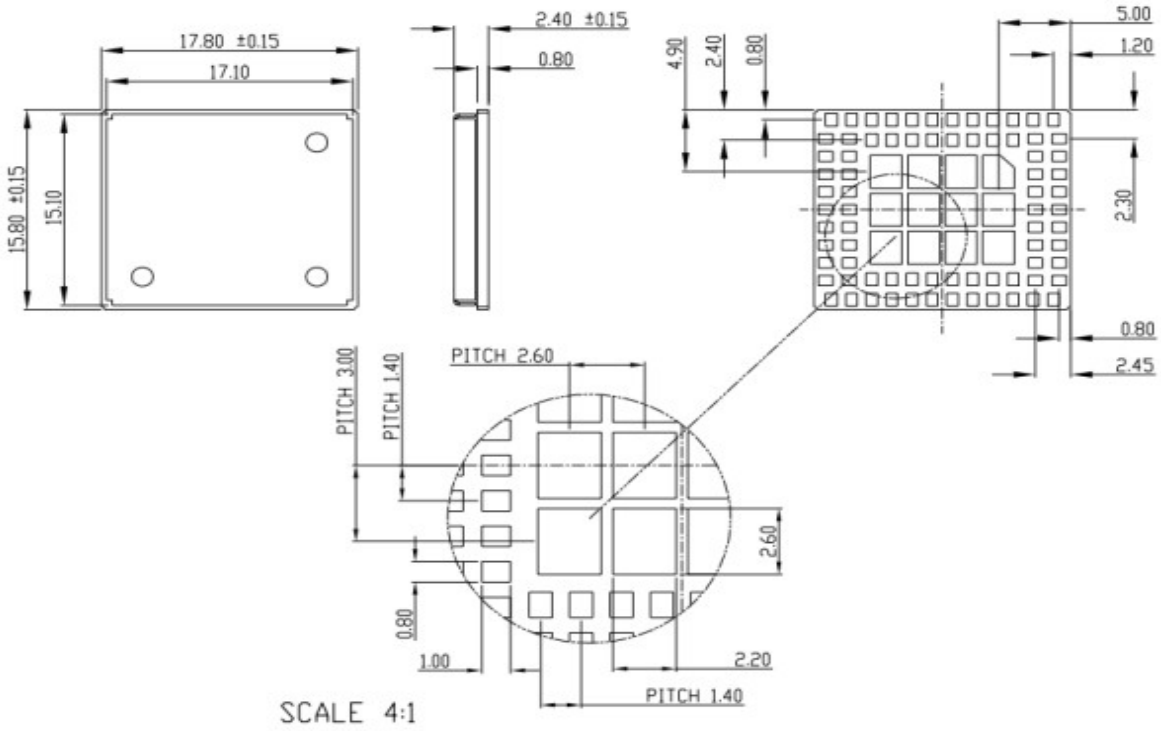


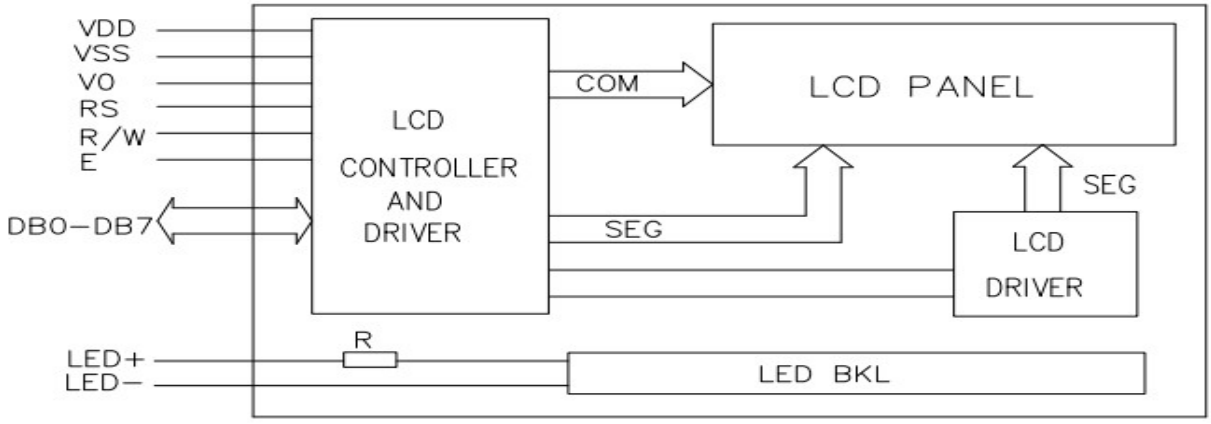
Figure 3: Dimensions of SIM800H&SIM800L (Unit: mm)

Appendix-5 (Data Sheet of 16×2 LCD)

4. Absolute maximum ratings

Item	Symbol	Standard			Unit
Power voltage	V_{DD}-V_{SS}	0	-	7.0	V
Input voltage	V_{IN}	VSS	-	VDD	
Operating temperature range	V_{OP}	0	-	+50	℃
Storage temperature range	V_{ST}	-10	-	+60	

5. Block diagram



6. Interface pin description

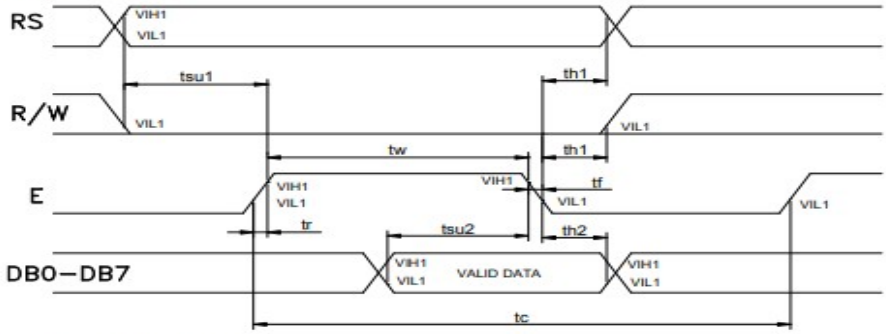
Pin no.	Symbol	External connection	Function
1	Vss	Power supply	Signal ground for LCM
2	V_{DD}		Power supply for logic for LCM
3	V_0		Contrast adjust
4	RS	MPU	Register select signal
5	R/W	MPU	Read/write select signal
6	E	MPU	Operation (data read/write) enable signal
7~10	DB0~DB3	MPU	Four low order bi-directional three-state data bus lines. Used for data transfer between the MPU and the LCM. These four are not used during 4-bit operation.
11~14	DB4~DB7	MPU	Four high order bi-directional three-state data bus lines. Used for data transfer between the MPU
15	LED+	LED BKL power supply	Power supply for BKL
16	LED-		Power supply for BKL

10. Timing Characteristics

Write cycle (Ta=25℃, VDD=3.3V)

Parameter	Symbol	Test pin	Min.	Typ.	Max.	Unit
Enable cycle time	t_c	E	500	-	-	ns
Enable pulse width	t_w		300	-	-	
Enable rise/fall time	t_r, t_f		-	-	25	
RS; R/W setup time	t_{su1}	RS; R/W	100	-	-	
RS; R/W address hold time	t_{h1}	RS; R/W	10	-	-	
Read data output delay	t_{su2}	DB0~DB7	60	-	-	
Read data hold time	t_{h2}		10	-	-	

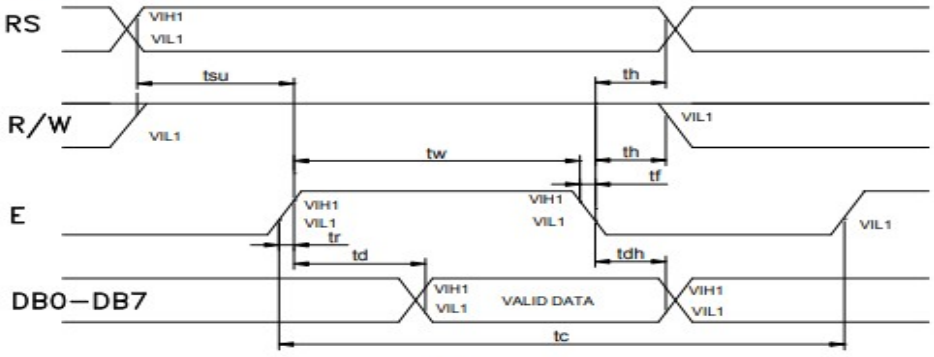
Write mode timing diagram



Read cycle (Ta=25℃, VDD=3.3V)

Parameter	Symbol	Test pin	Min.	Typ.	Max.	Unit
Enable cycle time	t_c	E	500	-	-	ns
Enable pulse width	t_w		300	-	-	
Enable rise/fall time	t_r, t_f		-	-	25	
RS; R/W setup time	t_{su}	RS; R/W	100	-	-	
RS; R/W address hold time	t_h	RS; R/W	10	-	-	
Read data output delay	t_d	DB0~DB7	60	-	90	
Read data hold time	t_{dh}		20	-	-	

Read mode timing diagram



11.9 Instruction Table

Instruction	Instruction code										Description	Execution time (fosc= 270 KHZ
	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0		
Clear Display	0	0	0	0	0	0	0	0	0	1	Write "20H" to DDRA and set DDRAM address to "00H" from AC	1.53ms
Return Home	0	0	0	0	0	0	0	0	1	-	Set DDRAM address to "00H" From AC and return cursor to Its original position if shifted. The contents of DDRAM are not changed.	1.53ms
Entry mode Set	0	0	0	0	0	0	0	1	I/D	SH	Assign cursor moving direction And blinking of entire display	39us
Display ON/ OFF control	0	0	0	0	0	0	1	D	C	B	Set display (D), cursor (C), and Blinking of cursor (B) on/off Control bit.	
Cursor or Display shift	0	0	0	0	0	1	S/C	R/L	-	-	Set cursor moving and display Shift control bit, and the Direction, without changing of DDRAM data.	39us
Function set	0	0	0	0	1	DL	N	F	-	-	Set interface data length (DL: 8-Bit/4-bit), numbers of display Line (N: =2-line/1-line) and, Display font type (F: 5x11/5x8)	39us
Set CGRAM Address	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0	Set CGRAM address in address Counter.	39us
Set DDRAM Address	0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Set DDRAM address in address Counter.	39us
Read busy Flag and Address	0	1	BF	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Whether during internal Operation or not can be known By reading BF. The contents of Address counter can also be read.	0us
Write data to Address	1	0	D7	D6	D5	D4	D3	D2	D1	D0	Write data into internal RAM (DDRAM/CGRAM).	43us
Read data From RAM	1	1	D7	D6	D5	D4	D3	D2	D1	D0	Read data from internal RAM (DDRAM/CGRAM).	43us

NOTE:

When an MPU program with checking the busy flag (DB7) is made, it must be necessary 1/2fosc is necessary for executing the next instruction by the falling edge of the "E" signal after the busy flag (DB7) goes to "Low".

11.3Contents

1) Clear display

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	0	0	0	0	1

Clear all the display data by writing "20H" (space code) to all DDRAM address, and set DDRAM address to "00H" into AC (address counter).

Return cursor to the original status, namely, bring the cursor to the left edge on the fist line of the display.

Make the entry mode increment (I/D="High").

2) Return home

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	0	0	0	1	-

Return home is cursor return home instruction.

Appendix-6 (Data Sheet of ISD 1820)

1. **VCC**– 3.3V power supply
2. **GND**– Power ground
3. **REC** – The REC input is an active-HIGH record signal. The module starts recording whenever REC is HIGH. This pin must remain HIGH for the duration of the recording. REC takes precedence over either playback(PLAYL or PLAYE) signal.
4. **PLAYE** – Playback, Edge-activated: When a HIGH-going transition is detected on continues until an End-of-Message (EOM) marker is encountered or the end of the memory space is reached.
5. **PLAYL** – Playback, Level-activated, when this input pin level transits for LOW to HIGH, a playback cycle is initiated.
6. **Speaker Outputs** – The SP+ and SP- pins provide direct drive for loudspeakers with impedances as low as 8Ω.
7. **MIC** – Microphone Input, the microphone input transfers its signals to the on-chip preamplifier.
8. **FT** – Feed Through: This mode enable the Microphone to drive the speaker directly.
9. **P-E** – Play the records endlessly.

Record Operate Guide

1. Push REC button then the RECLED will light and keep push until record end.
2. Release the REC button
3. Select Playback mode: PLAYE, just need push one time, and will playback all of the record or power down ; PLAYL, you need always push this button until you want to stop playback record or end ; When short P-E jumper the record will playback time a time until jumper off or power down
4. FT mode, when short FT jumper, that means all of you speak to MIC will direct playback to Speaker.