GSM LANDLINE SWITCH

By

NC Muhammad Salman

Capt Muhammad Abbas Yasin

Capt Kamran Zahid

Project Supervisor: Dr. Lt Col Adil Masood Saddiqui

Submitted to the Faculty of Electrical Engineering, Military College of Signals National University of Science and Technology, Rawalpindi in partial fulfillment for the requirements of a B.E. Degree in Electrical (Telecom) Engineering

JUN 2013

ABSTRACT

A switch has been designed to integrate land line number and 4 GSM SIM modules.It achieves the cost effectiveness by using the idea of the call between the homogenous and heterogeneous networks. It comprises of landline number, GSM landline switch which includes pic microcontroller 18F452 interfaced with the DTMF Decoder and 4xMultiplexers, 4xSIM modules for communication with the BTS. The cost reduction is achieved by converting the fixed to mobile call into mobile to mobile call. Interface between the landline call and the GSM network is given by GSM landline switch after reading the first four digits of the dialed number and routing it to the suitable service provider which is homogenous network. GSM network is acquired through the SIM modules of different service providers and landline number from Pakistan Telecommunication Limited. Pic Microcontroller 18F452 is programed in micro C language.

CERTIFICATE OF CORRECTNESS AND APPROVAL

It is certified that the work contained in the thesis titled "GSM LANDLINE SWITCH", carried out by NC Muhammad Salman, Capt Muhammad Abbas Yasin and Capt Kamran Zahid under the supervision of Dr. Lt Col Adil Masood Saddiqui in partial completion of the degree of Bachelor of Telecommunication Engineering, is correct and approved.

Approved by

____

Dr. Lt Col Adil Masood Siddiqui

Project Supervisor

Military College of Signals, NUST

بسم الله الرحمن الرحيم

DEDICATION

Allah, beginning with the Name of – The Most Gracious, The Most Merciful

To our families

ACKNOWLEDGEMENTS

Praise be to Allah, who has showered more blessings upon us than we can realize. We are grateful to our parents whose support got us going in the bleakest of hours. We thank our friends for their words of encouragement.

Due extension of gratitude to our project supervisor Dr . Lt Col Adil Masood Siddiqui for his continuous technical guidance and moral support throughout the project . His calm nature ensured smooth work and his composed manner helped us work around obstacles with perseverance.

CONTENTS TABLE

FIGURES LIST

TALBES LIST

ABBREVATIONS USED

GSM	Global System for Mobile Communication
SIM	Subscriber Identification Module
BTS	Base Transceiver Station
QoS	Quality of Service
DTMF	Dual Tone Multi Frequency
MODEM	Modulation and Demodulation
PIC	Peripheral Interface Controller
TX/RX	Transmission/Reception
GPIB	General Purpose Interface Bus
ATA	Advance Technology Attachment
IDE	Integrated Development Environment
RS 232	Recommended Standard 232
DTE	Data terminal equipment
DCE	Data Circuit-terminating Equipment
UART	Universal Asynchronous Receiver and Transmitter
TTL	Transistor Transistor Logic

Chapter 1 INTRODUCTION

1.1 Foreword

Today small or mid-sized companies have great concern about the big bill on office telephone calls, in which the cost for telephone calls that deal with mobile phone takes the largest proportion. Although different telecom operators possibly have distinct billing policies, there are some general rules that they are sticking to. For fixed-to-mobile or mobile-to-fixed calls and vice versa is higher than fixed-to-fixed phone call. As for mobile-to-mobile phone call, the cost varies greatly depending on the policies of different operators. However one basic rule could be followed in this way: when the caller and the called belong to different operators, the call cost is much higher than when both parties belong to the same operator. For some operators, the call cost even equals to zero if both the caller and the called are their subscriber.

1.2 OBJECTIVES

1.2.1 GSM landline switch installed on the office's switchboard (PBX) and functions as a link between the PBX and GSM network [1].

1.2.2 Used to avoid the high cost of fixed-to-mobile call by converting calls into mobile-to-mobile connections.

1.2.3 The GSM landline switch route telephone traffic in such a way that call traffic is originated and terminated within the same mobile operator's network.

1.2.4 The emergence of GSM landline switch helps to reduce high cost from fixed-to-mobile calls.

1.2.5 Mobile phone has already become a common tool for almost everyone in modern world, which offers people the worldwide availability to keep contact with each other.

1.2.6 As mobility poses significant importance, there exists a strong desire for enterprises to lower down the huge communication cost for mobile-to-mobile and mobile-to-fixed calls.

1.3SCOPE OF WORK

This project is focus on the design of a router intelligent for conversion to operate between the landline and mobile numbers. It uses GSM SIM for the user to reduce the cost and landline numbers as per requirement. Network is identified on area code or network identification numbers before establishing connection. Therefore the GSM router can be modified in the future to have option of holding more than one SIM Card allowing for different GSM networks. This will have greater implications for commercial as well as defense/military FO networks at a lower cost.

1.4 OUTLINE OF TASKS

Literature research was carried out where Dial over data via GSM gateway by Ning Zhou research papers was studied to understand the hardwareand software. In particular features of different service providers, their routing strategies and subscription charges were studied and analyzed. This helped to select suitable technique in reduction of cost to meet our project requirement. In designing of switch software was written in micro C language to interface with the hardware in more easily and economical way. Interfacing with the BTS and Landline number was studied to reduce the time delay while keeping in mind the parameters defining the QoS.

1.5 PALTFORMS USED

They are as follows:

1.5.1 Micro C language used for software designing

1.5.2 GSM SIM modules of 4 different service providers

1.5.3 Landline number

1.5.4 DTMF Decoder and multiplexers for the buffering of data

1.6METHODOLOGY

It comprises of three parts GSM, landline and switch. It is actually switching a dialed number between the PTCL landline (DTMF) and the 4 GSM mobile SIMS (MODEMS).To perform the functionality of this central "mobile phone what we in effect need is the SIM Cards, hence the name GSM router. Now the problem is to judge the number as it is dialed while keeping in mind the time frame to route it on either way. It is done by keeping in view the first two digits of every sequence because a GSM number starts with the sequence 03 and landline other than this. This project was built using a modular approach hence the thesis was divided into a sequence of steps to explain each aspect of the project in a modular form where the different modules are inter-dependent.

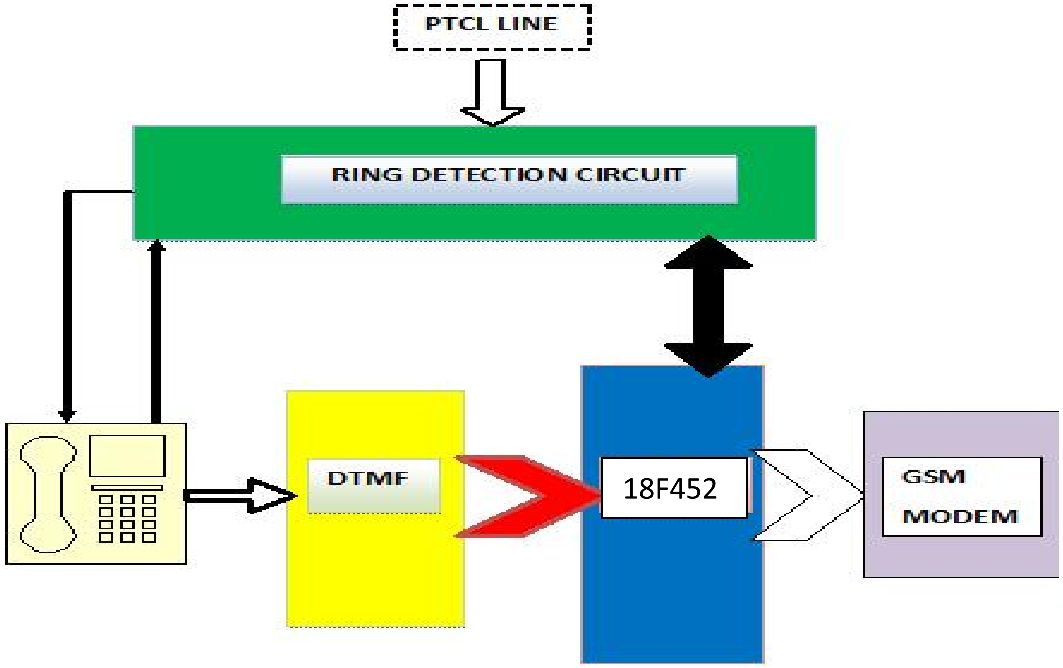

Figure 1 Block Diagram

This section discusses the interconnections of these devices forming the circuitry and the functionality being achieved through them. In order to present a clear view of the rather extensive circuit, it has been divided into four parts representing the four major functions being performed. These sub-circuits have been either named by function or else by a key identifying component, whichever was found to be convenient and are as such not strictly categorical. A landline phone is interfaced to an 18F452 microcontroller via a DTMF decoder. The purpose of the DTMF decoder is to feed the dialed number to the microcontroller for analysis. The microcontroller is programmed to determine which numbers to dial via the fixed line and which to dial using a given GSM network. When the dialed number is GSM bound, the microcontroller routes this number to the GSM Modem. The switch contains 4 GSM MODEMS that will dial the number. The ring detection circuit performs the function of determining whether the phone line is busy or not, providing this information to the 18F452 microcontroller.

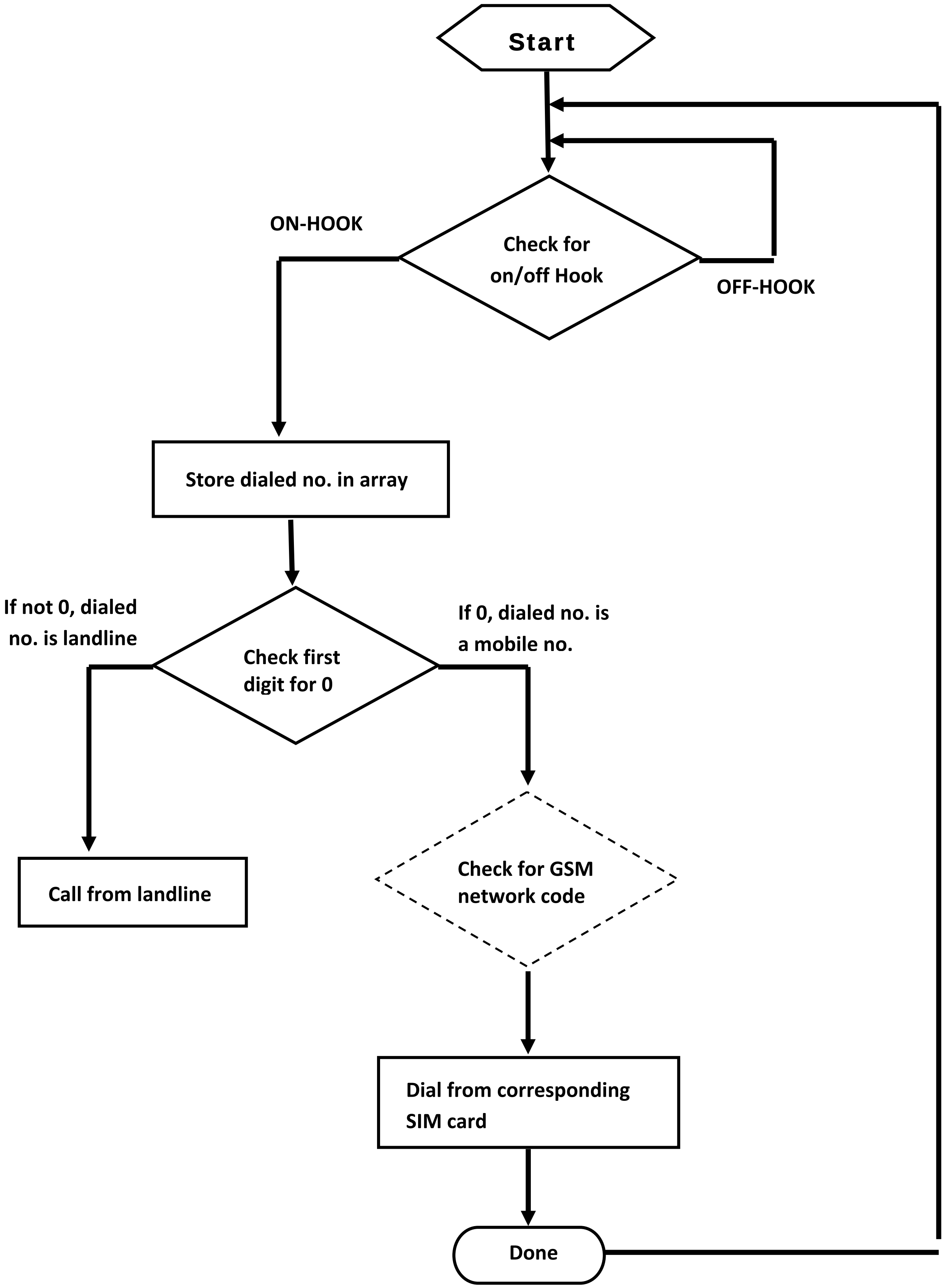

Figure 2 Flow Diagram

1.7 ORGANIZATION OF THE DOCUMENT

Chapter 1 contains the introduction to the project. Chapter 2 highlights the literature review while Chapter 3 entails the design of the patch array. Chapter 4 is about channel development and 5 explain the Algorithm development. Chapter 6 comprises of processing in MATLAB. Chapter 7 includes future prospect and conclusion.

CHAPTER 2 REVIEW OF LITERATURE

2.1 INTRODUCTION

The following chapter highlights various components used in this project.

2.1.1 DTMF DECODER

DTMF is written abbreviation for Dual Multi-frequency Signaling which is used in signaling of telecommunication. DTMF signal which is sent to switch center (Phone Company) when ever phone keys are being pressed down. A signal made up of dual tone of specific frequencies is originated from each key which is pressed on telephone pad. One tone originates from higher group frequency and other originates from a lower group frequency. There are total of 16 DTMF tones, however out of 16 tones which are being used today are 12 only.

Table 1Frequency Pairs of DTMF Signal

Frequencies	**1209 Hz**	**1336 Hz**	**1477 Hz**
697 Hz	1	2	3
770Hz	4	5	6
852 Hz	7	8	0
941 Hz	*	0	#

In above mentioned table we can observe that row represents low frequency and columns represent high frequency. Sinusoidal signal which contains corresponding high and low frequency is sent after the pressing of a key. E.g. if we press key '3' sinusoidal signal will be comprising of two frequencies i.e. 697Hz &1477Hz .

Table 2 Bit Sequence of DTMF Output Pins

Digit (DTMF Tone)	Q1	Q2	Q3	Q4
Any	Z	Z	Z	Z
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1
0	1	0	1	0
*****	1	0	1	1
#	1	1	0	0
A	1	1	0	1
B	1	1	1	0
C	1	1	1	1
D	0	0	0	0

These tones can be decoded using the DTMF decoder by identifying the two frequency components and allocating to it the corresponding number, as shown in Table2. The decoder comes in the shape of either an 18 pin IC shown in figure, Figure3.

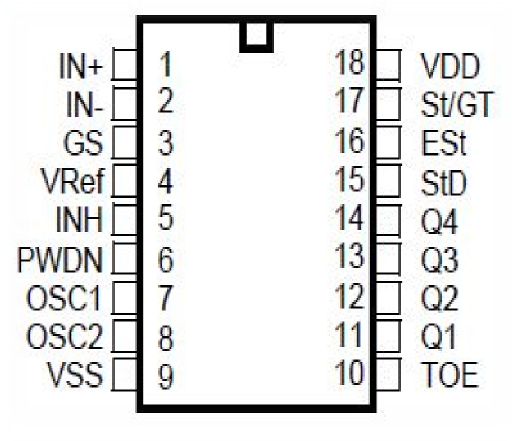

Figure 3 DTMF Decoder Pin Configurations

After detecting a valid tone-pair the decoder latches the output as a four bit sequence (Q1-Q4; decoder's output ports) according to the received tone-pair. This output can be fed to the microcontroller, where one number at a time, the dialed number can be stored in an array. The figure 4 below shows the connection of the DTMF decoder.

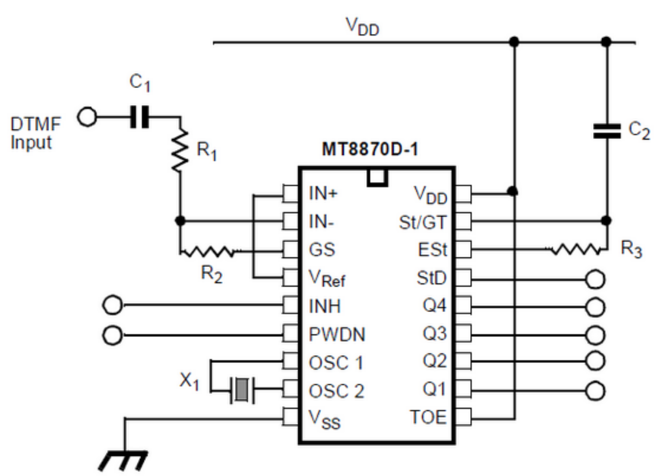

Figure 4DTMF Decoder Pin Connections

2.1.2 MICROCONTROLLER PIC 18F452

The microcontroller we have chosen for our project is the 18F452 while the programming has been done in C. In our circuit design we have interfaced the microcontroller with the DTMF Decoder as well as the GSM module (consisting of the GSM SIM900D) via multiplexers. Of the eighteen pins of the DTMF decoder four are connected to the 18F452 microcontroller. Pins 11-14(Q1-Q4) are the decoder's output pins that form the four bit binary sequence of the corresponding pressed key. This has been discussed in more detail in the previous section. This output can be fed to the microcontroller, where one number at a time, the dialed number can be stored in an array. The fifth connection between the two is from the Power Down pin (pin 6 of DTMF Decoder) which is an input pin. When set high it powers down the device stopping the oscillator and internal filter sections of the DTMF decoder from operating. For our purpose we set this pin to logic 0 via the microcontroller.

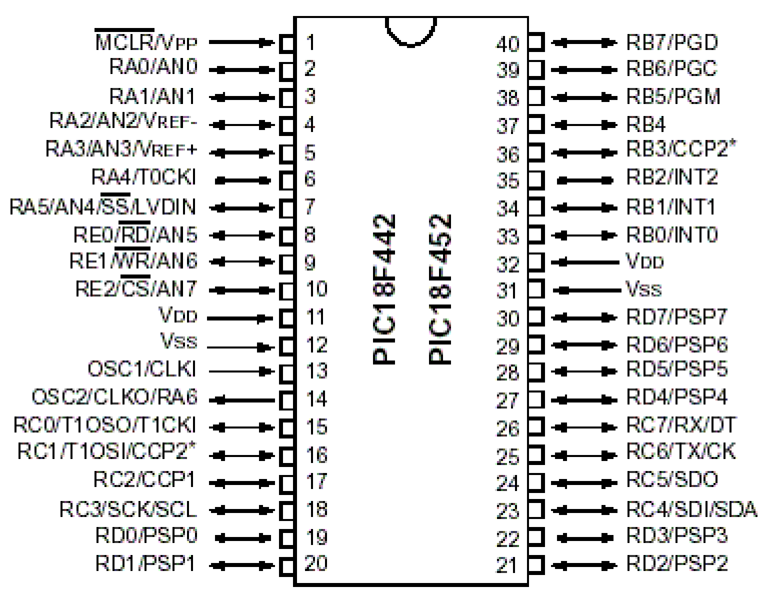

Figure 5 PIC 18F452 Pin Configurations

Lastly the STD (15, 16, 17 and 18) [6] pin of the 18F452 outputs logic high to the microcontroller. When tone-pair has been received and registered the output latch gets updated and it returns to a logic zero where the voltage on St/GT falls below a threshold value. The TX and RX pins of the 18F452 are connected to the Rx and TX pins of the multiplexer respectively. The transmitter/receiver pins of the two devices are used to establish the GSM call initiated at the landline phone, using the phone number input to and saved in the microcontroller.

2.1.2.1 Serial Port (Pin 25 and 26)

Serial communication is common communication protocol which is not difficult to grasp. The serial port not only sends but receives bit of information, parallel communication is much faster than serial. Parallel communication transmission allow transfer of complete byte, this is much easier and can be utilized for far flung destinations. For example, An IEEE 488 contains cabling between equipment for parallel communications, which cannot exceed from 20 meters, where as in between any two devices it cannot be more than that of 2 meters. However, serial is extended too much of 1200 meters. Basically, serial can be utilized for transmission of ASCII data. Completion of Communication takes place by using 3 transmission lines: i.e. (1) Ground, (2) Transmit, (3) Receive. Since serial is simultaneous, the port transmits data on one of line and receive data on another. Other lines are accessible for handclasp, but they aren’t needed. Some vital serial attributes are data bits, baud rate, stop bits, and parity. For the two ports to transmit, the following parametric quantity must match:

2.1.2.2 Baud Rate

Baud rate is measurement for speed communication. This shows number of bit which transfers per second. For example, 1 baud is 1 bits per second. Where ever clock cycle is mentioned, it means the baud rate. E.g, if protocol calls for 4800 baud rate, then clock runs at 4800 Hz. This intends that serial port samples data line at 4800 Hz. Common baud rate for that of telephone lines are as follows 14400, 28800, and 33600 respectively. There is possibility that Baud rates are greater, these rates minimize distances by way of which the devices could be told apart. High baud rates can be utilized for communication device; the devices are found out together, such as in the case of GPIB devices.

2.1.2.3 Data Bits

The measurement of actual data bits in a transmission is called data bits. Where computer send packet of data, where as sum of actual data might not be full 8 bits .Following are the standard values for the data packets 5, 7, and 8 bits. The settings we select rely on data we are transferring. E.g. standard ASCII values starts from 0 to 127 (7 bits). Extended ASCII uses 0 to 255 (8 bits). If data that is transferred as simple text (standard ASCII), than sending 7 bits data per packet is adequate for communication. A packet pertains to single byte transfer, which consist of start bits, stop bits, data bits, and parity.

Number of actual relies on protocol choose; term packet is used to cover all cases.

2.1.2.4 Stop Bits

Stop bits, basically used to signal end of communication for a single packet. Following are the typical values i.e. 1, 1.5, and 2 bits. Data is quantified across the lines where as each device has its own clock, there might be possibility for two devices to become somewhat out of sync. That is why, stop bits not only shows the end of transmission but it also gives computer some space for fault in the clock speeds. Where there are more bits to be utilized for stop bits, larger is the lenience in sync different clocks, slower is data transmission rate. Serial communication might be faster than the parallel communication, with a proviso if the bits leave transmitting device with much higher speed. E.g. ATA 2 Serial port where serial can reach transfer rate of up to 300 MB/s, and traditional IDE port [P-ATA] reach to 133 MB/s up to maximum. There are hindrances by using parallel data transfer that is usages of many wires would be needed as the width of bus. A 32 bit PCI bus will have 32 wires and controls are needed for each. Where as in serial communication just two wires would do magic. Electromagnetic disturbances increases, where speed of data transfer increases which makes parallel data transfer much more difficult. One another difficulty with parallel communication. These bits might not grasp the goal at a same time. Different reception time of several bits can make device to waste its time, as to wait for all bits to arrive, it might show an important fall in execution. Eventually, parallel data TX is half duplex or semi duplex, and that of serial data TX is full duplex. In serial communication just two wires are used. But manufacturers normally make four wires usable, two wires are used for reception of data and two wires are used for transmission of data making it possible for the simultaneous reception and transmission of data. This type of architectural difference makes serial communication twice fast as that of parallel communication.

2.1.2.5 RS -232 Basics

Recommended Standard 232 is standard for serial binary data signals connecting between Data Terminal Equipment DTE and Data Circuit terminating Equipment DCE. The voltage level for RS 232 standard specifies voltage level that match to logic voltage all one and logical zero levels. Whereas the valid signals are plus or minus from 3 to 25 volts. Range which is near to zero volts is not a valid RS-232 level and logic one is defined s a negative voltage. The signal condition is known as marking and has functional importance of OFF. Where logic zero is positive one the signal condition would be of spacing and function will be therefore ON. So logic zero is represented as +3V to +25V and logic one is represented as - 3V to -25V

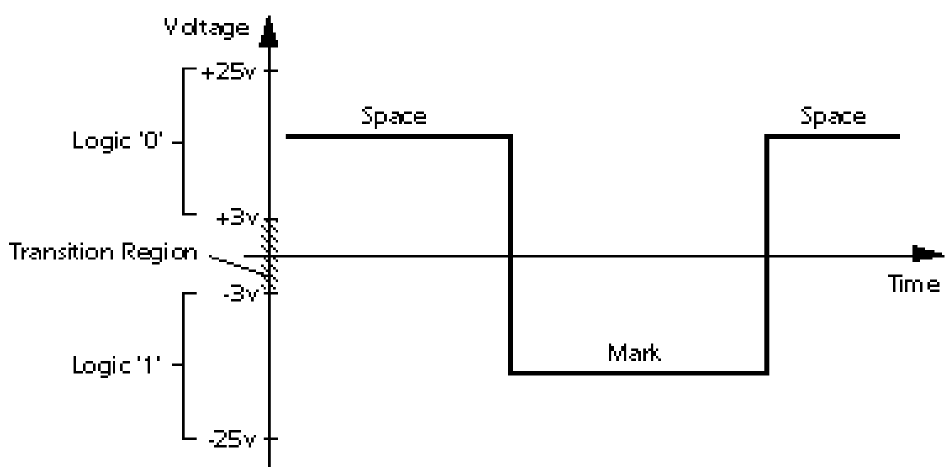

Figure 6RS-232 Level Converters

2.1.2.6 RS-232 Serial Protocol

RS -232 communication protocol is standard protocol used in asynchronous serial communication. Which is prime protocol used over modem lines. Several different components in serial ink are as follows UART, the serial channel and interface logic. Interface chip called as universal asynchronous transmitter/ receiver or UART is utilized to apply serial data transmission. UART is located between the host computer and serial channel. Serial channel is group of wires on which bits are transmitted.for improvement of bandwidth,removal of noise and increasing the range TTL logi level is alter in it to RS-232 logic level 12 or+12 before it is being sent out over the serial channel. Frame is complete and non-divisible packets of bits .Frame consists of both information i.e. data and characters and over head e.g. start bit fault checking and stop bits. Asynchronous serial protocols such as RS -232 frame comprises of one start bit seven or eight data bits, parity bits and that of stop bits. The timing diagram for RS-232 consisting of 1 start bit,7 data bits,1 parity bit and 2 stop bits is displayed below in figure 2. It must be noted here that precise structure of frame must correspond with transmitter and receiver before comm.-link is opened.

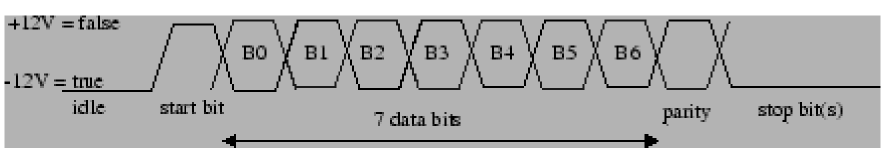

Figure 7 RS-232 Frame

Baud rate is total number of bits information ,overhead, and idle per time which is transmitted over the serial link.

Table 3 Baud Rates

Baud Rate Code	Desired Rate	Actual Rate	Difference
0	2400	2441	+1.73%
1	4800	4808	+0.16%
2	9600	9615	+0.16%
3	19200	19231	+0.16%
4	38400	38462	+0.16%
5*	57600	58140	+0.94%
6*	115200	113636	-1.36%
7**	31250	31250	0.00%

2.1.2 SIM 900D

SIM900D is described as "complete Tri-band GSM/GPRS solution in a SMT module which could be engrafted in customer's usage." The GSM bound calls from the landline will be routed to this. The module pins are

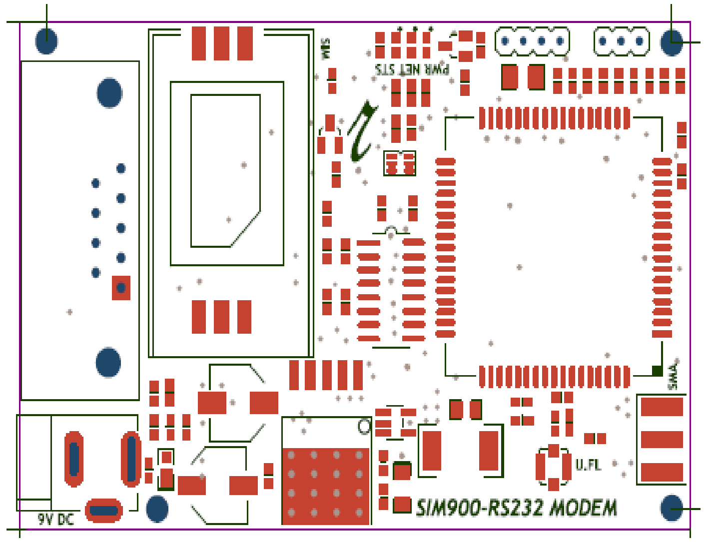

Figure 8 SIM900DModules

Shown in Figure 4.3. It provides two channels for both speaker and microphone, which are detailed in the table 5.

Table 4 Audio Channels Available in SIM900D Module

	Name	Pin	Function
Channel 1	MIC1P	20	Microphone1 input+
	MIC1N	21	Microphone1 input-
	SPK1P	23	Audio1 output+
	SPK1N	24	Audio1 output-
Channel 2	MIC2P	18	Microphone2 input+
	MIC2N	19	Microphone2 input-
	SPK2P	26	Audio2 output+
	SPK2N	25	Audio2 output-

In order to perform the calling function the SIM900D module has to be connected to a SIM holder. These connections are made via the four pins available for communication between the modem and a SIM card. These are detailed in Table6.

Table 5 SIM900D Pins for SIM Card Communication

Pin	Signal	Description
62	SIM_DATA	SIM Card data I/O
63	SIM_CLK	SIM Card clock
64	SIM_RST	SIM Card reset
65	SIM_VDD	SIM Card Power supply,

As a whole setup of the SIM900D, audio interfacing circuitry and other components with external antenna supporting GSM services is shown in the photo below.

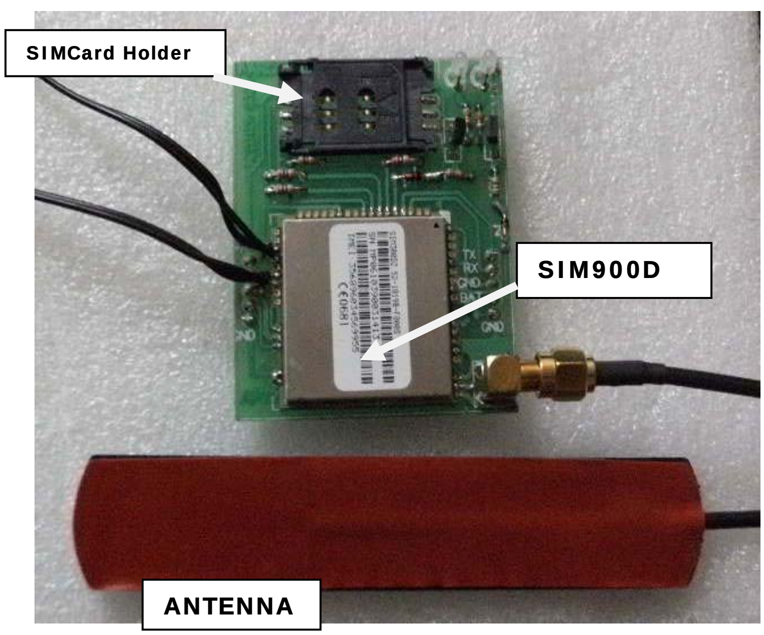

Figure 9 GSMSIM Modem

Table 6 SIM900D Serial Port

	Name	Pin	Function
Serial Port DB9	GND	5	Ground
	CTS	8	Clear to send
	RTS	7	Request to send
	TXD	2	Transmit data
	RXD	3	Receive data

GSM module is planned as Data Communication Equipment DCE that follows traditional DCE-DTE Data Terminal Equipment connection.GSM Modem and client DTE are connected up trough following signal as shown in the following figure. Auto bauding supports baud rate from 1200bps to 57600bps.

Table 7 Audio Interfaces

	Name of pin	Number of pin	Role
AIN/AOUT	MIC	1	Microphone Input+
	GND	2	Common Ground
	SPK	3	Audio Output +

GSM Modem fives one parallel input channel, AIN , which might e utilized for microphone. The electrets microphone is proposed when the interface is utilized for microphone. Outputs link up to receiver only can directly drive 32Ω. External line inputs are given directly mix or multiplex externally that originates analog signals which are polyphonic tones from an external melody IC or music originated by an FM tuner IC or module. We can use AT+CMIC to set the input gain level of microphone, use AT+SIDET to set the side-tone level.

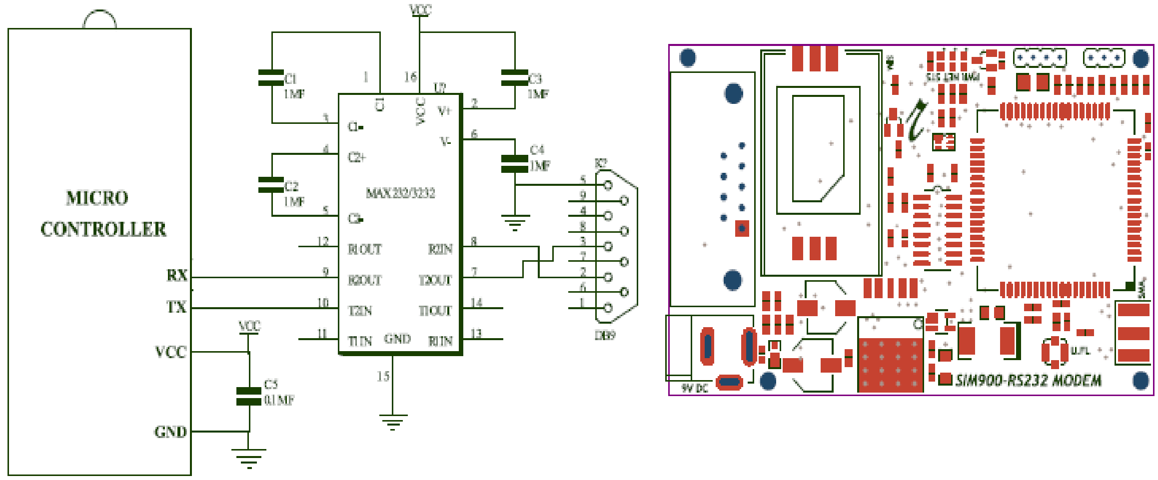

Figure 10 Interfacing the Modem to Microcontroller

Modem can be directly port with 5V microcontrollers such as PIC, AVR, 051 Derivatives, Arduinos and 3V3 Microcontrollers like ARM, ARM Cortex XX etc. Be sure of that V_INTERFACE pin is given same voltage level as that of micro controller. As in the figure 4.7 only two connections are needed for the use of modem. Both RX pin of modem and TX pin of microcontroller are connected, and TX pin of modem is connected to that of microcontrollers RX pin. Connected power supply is (4.2v to 12v dc) must be surefooted and competent of handling current up to 1A.

2.1.3.1 GETTING STARTED

INSERTION OF SIM CARD. Sim card holder is opened by sliding it up as the arrow shown. Now infix the sim card, to adjust the chamfered corner must suits in the card holder. After sim card is being infixed, card holder is locked y sliding it in opposite direction where arrow is being marked.

CONNECTION OF THE ANTENA. Supplied RF antenna is fixed with SMA antenna connector. It is further stiffening by rotating the nut. (Do not rotate antenna for stiffening).

CONNECTION OF PINS. Now connect GSM modem as per circuit diagram been given.

POWERING THE MODEM. Modem is powered by sufficient power supply, that has adequate current capacity i.e. (>1A).

Baud rate. Baud rate supported by modem is within between 9600 and 115200.modem is automatically adjusted to the baud rate. With very first command made by the host system a command is send their of first after it is powered up. User is required to send "A" first to sync with the baud rate.

Chapter 3 DESIGN AND DEVELOPMENT

Number is dialed on telephone set keypad which will send the signal to DTMF decoder and the telephone exchange simultaneously. Landline phone is interfaced to an 18F452 microcontroller via a DTMF decoder. The purpose of the DTMF decoder is to feed the dialed number to the microcontroller in the form of 4 lines for analysis. The microcontroller is programmed to determine which numbers to dial via the fixed line and which to dial using a given GSM network. When the dialed number is GSM bound, the μC routes this number to the GSM Modem. The modem contains 4XSIM Card that will dial the number.

3.1 POWER SUPPLY

The purpose of this circuit is to provide power to the circuitry as well as the GSM modems. Voltage regulators have been used to achieve the desired voltage level. The LMxx series of voltage regulators, give as an output voltage the value of the number xx. Thus LM7805 gives an output voltage of 5V, whereas LM7815 outputs 15V. To achieve the desired voltage level for Sim900D a diode is placed at the output node of power supply, providing a voltage drop of 0.7V. The input to the circuit consists of a 15V transformer connected across a bridge rectifier.

3.2 PIC 18F452 MICROCONTROLLER CIRCUIT

Microcontroller used is the 18F452 while the programming has been done in microC.In circuit design microcontroller is interfaced with the DTMF Decoder as well as the GSM module (consisting of the GSM SIM900D).

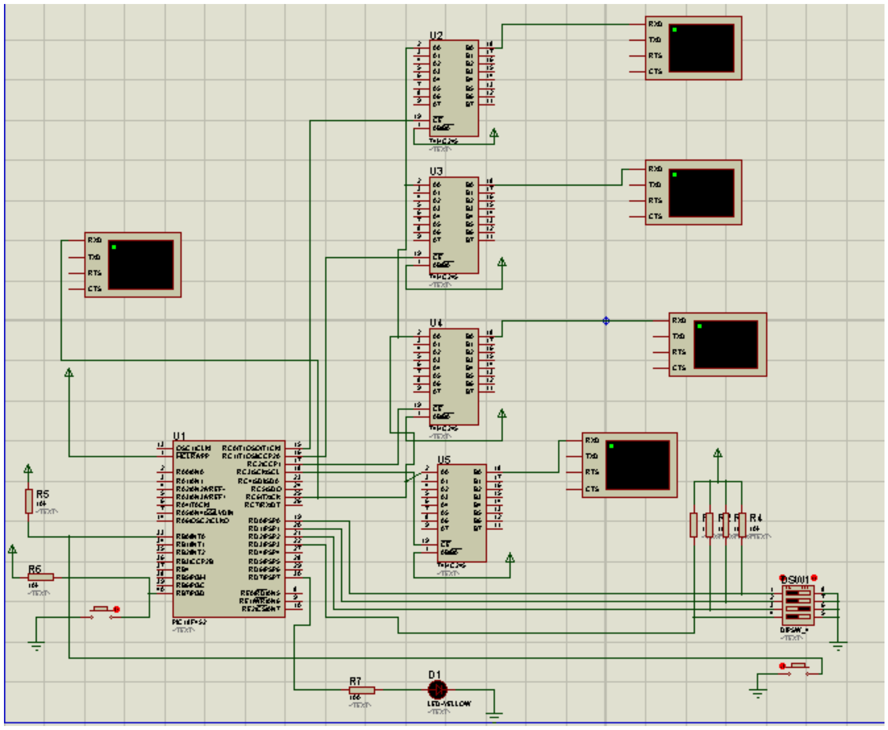

Figure 11 Circuit for PIC 18F452

4 pins of DTMF decoder are connected to the 18F452 microcontroller. Decoder's output pins that form the four bit binary sequence of the corresponding pressed key. This has been discussed in more detail in the previous section. This output can be fed to the microcontroller, where one number at a time, the dialed number can be stored in an array. The fifth connection between the two is from the push button output pin.

3.3 BUFFER CIRCUIT

IC SN74HC245N is used as multiplexer in the circuit for buffering. It is due to the reason that the output of DTMF Decoder is given to PIC 18F452 in array. The microcontroller 18F452 will read the number and then send it to the respective GSM SIM module through the buffer. 4xMultiplexer are used for each network SIM module. They are excited from the power supply and enabled by giving input at pin 19 as shown in figure 11.

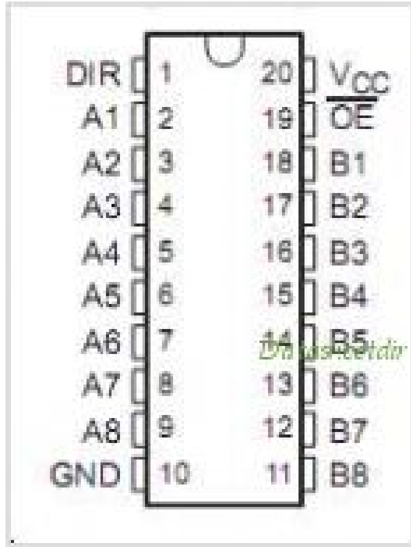

Figure 12 IC SN74HC245N Pin Configuration

After reading the number, microcontroller enable the respective multiplexer by sending enabling bit and start communication from its serial pin number 25.

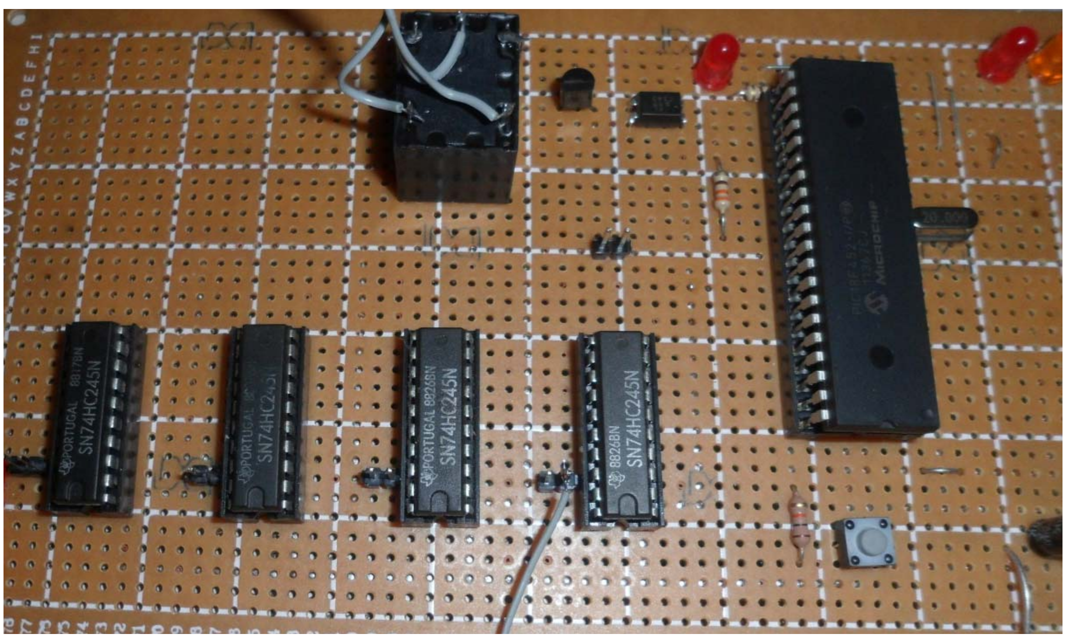

Figure 13 Buffer Circuit using Multiplexer

AS the signal is being transmitted to PIC 18F452 and the PTCL exchange simultaneously, if the number is of GSM network then the microcontroller will cutoff the PTCL exchange through a relay by send a high signal which will enable the relay.

Figure 14 Pictorial Overview

Chapter 4ANALYSIS AND EVALUATION

4.1 OVERVIEW

This chapter describes the programming of the PIC Microcontroller 18F452. The microcontrolleris programmed using MicroC software tool.

4.2 CODE

```
void call_zong1()
{delay_ms(100);
output_low(PIN_C0);delay_ms(500);
putc('A');delay_ms(100);putc('T');delay_ms(100);putc('D');delay_ms(100);putc('+');delay_ms(100);

putc(mobile_number[0]);putc(mobile_number[1]);putc(mobile_number[2]);putc(mobile_number[3]);
putc(mobile_number[4]);putc(mobile_number[5]);putc(mobile_number[6]);putc(mobile_number[7] );
putc(mobile_number[8]);putc(mobile_number[9]);putc(mobile_number[10]);putc(';');delay_ms(100);
output_high(PIN_C0);
}
void call_jazz()
{delay_ms(100);
output_low(PIN_C1);delay_ms(500);
putc('A');delay_ms(100);putc('T');delay_ms(100);putc('D');delay_ms(100);putc('+');delay_ms(100);
```

```
putc(mobile_number[0]);putc(mobile_number[1]);putc(mobile_number[2]);putc(mobile_number[3]);
putc(mobile_number[4]);putc(mobile_number[5]);putc(mobile_number[6]);putc(mobile_number[7] );
putc(mobile_number[8]);putc(mobile_number[9]);putc(mobile_number[10]);putc(';');delay_ms(100);
output_high(PIN_C1);
}
void call_uf()
{delay_ms(100);
output_low(PIN_C2);delay_ms(500);
putc('A');delay_ms(100);putc('T');delay_ms(100);putc('D');delay_ms(100);putc('+');delay_ms(100);
putc(mobile_number[0]);putc(mobile_number[1]);putc(mobile_number[2]);putc(mobile_number[3]);
putc(mobile_number[4]);putc(mobile_number[5]);putc(mobile_number[6]);putc(mobile_number[7] );
putc(mobile_number[8]);putc(mobile_number[9]);putc(mobile_number[10]);putc(';');delay_ms(100);
output_high(PIN_C2);}
void call_tln()
{delay_ms(100);
output_low(PIN_C3);delay_ms(500);
putc('A');delay_ms(100);putc('T');delay_ms(100);putc('D');delay_ms(100);putc('+');delay_ms(100);
```

```
putc(mobile_number[0]);putc(mobile_number[1]);putc(mobile_number[2]);putc(mobile_number[3]);
putc(mobile_number[4]);putc(mobile_number[5]);putc(mobile_number[6]);putc(mobile_number[7] );
putc(mobile_number[8]);putc(mobile_number[9]);putc(mobile_number[10]);putc(';');delay_ms(100);
output_high(PIN_C3);
}
void main()
{
char c;
char time_aa[6];
comp_bit_ready=0;
set_tris_a(0x255);
set_tris_c(0x80);
set_tris_d(0x0f);
set_tris_e(0x06);
set_tris_b(0x255);
PORTB=255;
lcd_init();
SETUP_ADC_PORTS(NO_ANALOGS);
ext_int_edge(L_TO_H);
enable_interrupts(INT_EXT);
enable_interrupts( INT_RDA );
enable_interrupts(GLOBAL);
```

```
port_b_pullups(TRUE);
restart_wdt();
delay_ms(200);
PORTA=255;
lcd_putc("......MMS.....\n    System");
while(1)
 {
PORTC=255;
output_high(PIN_D7);
while(dail);
byt_cnt=0;
printf("Dail ready\r");
do{
  }while(!dail);
comp_bit_ready=1;
printf("Dail End\r");
  if(comp_bit_ready)
  {
    if(mobile_number[1]=='3')
    {
output_low(PIN_D7);
    //   putc('O');putc('K');putc('\r');
      if(mobile_number[2]=='1')
      {
        call_zong1();
```

```
        }
        else if(mobile_number[2]=='0')
        {
call_jazz();
        }
        else if(mobile_number[2]=='4')
        {
call_tln();
        }
        else if(mobile_number[2]=='3')
        {
call_uf();
        }
comp_bit_ready=0;

    }
#define ALL_PINS (ALL_ROWS|COL0|COL1|COL2)

// Keypad layout:
char const KEYS[4][3] = {{'1','2','3'},
                {'4','5','6'},
                {'7','8','9'},
                {'*','0','#'}};
```

CHAPTER 5 FUTURE PROSPECTS AND CONCLUTIONS

5.1 FUTURE PROSPECTS

Improvements can be made to further reduce call costs and to accommodate more and more users. Keeping in mind, that not only mobile-to-mobile callsarecheaper than fixed-to-mobile ones but, calls within one GSM network are cheaper than those between two different networks. Therefore the GSM router can be modified to have the option of holding more than one call at a time, allowing for different GSM networks to be represented. The code can then be written to check, for all GSM bound traffic, the dialed number to determine the network it belongs to, as the first few digits represent the network code. The call will then be routed to a SIM card of the same network; thus further reducing costs.

5.1.1 Two or more users can be accommodating simultaneously.

5.1.2 Conference call

5.1.3 Priority setting among the users to facilitate the import calls first.

5.1.4 QoS can be increased by using the more perfect components.

5.2 CONCLUTIONS

A practical setup of a switch for the conversion of calls into fixed or mobile on the basis of dialed number is designed. First, a software part is implemented used to collect real data measurements of the call routing and its implementation while interfacing different components. Results obtained then checked in hardware part after the practical implementation. So the result show the call routing on economic base.

BIBLIOGRAPHY

1. Dial over data via GSM Gateway by Ning Zhou, Department of microelectronics and information technology royal institute of technology, Stockholm London.

2. Http://en.wikipedia.org/wiki/Dual-tone_multi-frequency_signalinghttp://multyremotes.com/introduction-to-keil.htm

3. Http://www.siongboon.com/projects/2005-07-18_dtmf_circuits/

4. Pic microcontroller 18F452 www. Microchip. com/ downloads/en/ devicedoc/ 39564c.pdf

5. Pin Configuration and baud rates : http:// www. Futurlec.Com/ Microchip/ PIC18F452.shtml

6. Calculation of baud rate for call set up and data transfer. Www. ijsrp.org/ researchpaper_ dec2011/ijsrp-dec-2011-03

7. Sim 900 rs 232 GSM/GPRS Modems. www.rhydolabz.com

8. SIMCOM. SIM900DZ GSM/GPRS Module. Http:// www.funrock. com.hk/ pdf/ SIM900D%20SPEC.pdf (datasheet)

9. SIMCOM. HARDWARE DESIGN SIM900D_HD_V2.03.www.ele.tut.fi/teaching/ele-2000/sim900d_hw.pdf

10. SIMCOM. HARDWARE Designsim900d_Hd_V2.03.www.ele.tut.fi/teaching/ele-2000/sim900d_hw.pdf

11. http://www.mt-system.ru/sites /default/files/ sim900_ serial_ port_ application_ note_v1.03.pdf

12. LOW POWER JFET QAUD OPEARTIONAL AMPLIFIER.pdf (datasheet)

13. QUAD BILATERAL SWITCH FOR TRANMISSION OR MULTIPLEXING OF ANALOG OR DIGITAL SIGNALS.pdf (datasheet)

14. Relay. Wikipedia.http://en.wikipedia.org/wiki/Relay

ACKNOWLEDGMENT

This project is sponsored and funded by National ICT R&D Fund program.