

EMERGENCY BEACON FOR ELDERLY

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ABSTRAK

Sistem kecemasan menjadi satu keperluan untuk keluarga dua pendapatan yang semakin meningkat hari ini. Disebabkan had realiti, kebanyakan orang tidak mampu menjaga warga tua. Pada masa yang sama, kes-kes kematian meningkat dengan mengejut di kalangan golongan tua yang tinggal bersendirian. Isu ini telah menarik perhatian kepada masyarakat untuk mencari penyelesaian. Oleh itu, melampirkan satu sistem kecemasan dapat menjamin keselamatan warga tua di mana bantuan segera akan disediakan apabila sistem diaktifkan. Kini, beberapa jenis telefon bimbit di pasaran cuba untuk menyediakan penyelesaian kepada masalah tersebut dengan menambahkan fungsi kecemasan seperti dailan cepat. Walau bagaimanapun, sistem tersebut menggunakan sistem kecemasan berasaskan suara dan tidak cekap kerana sifat manusia akan berasa panik apabila kecemasan berlaku dan mengakibatkan kesukaran dalam menbagi maklumat yang tepat. Selain itu, ia juga merupakan satu masalah untuk warga tua yang mempunyai penyakit mata. Isu-isu ini akan menangguhkan masa menyelamatkan dan menyebabkan tragedi berlaku. Batasan-batasan ini menjadi motivasi untuk membina sebuah sistem kecemasan yang mudah beroperasi, kos murah, dan meminta pertolongan berasaskan SMS. Sistem kecemasan yang berasaskan mikropengawal dapat menghantar mesej teks kepada nombor yang tertentu dengan mengaktifkan satu butang melalui rangkaian GSM. Butang yang berlainan warna memudahkan warga tua untuk menghantar mesej kecemasan. Fungsi penggera akan mengingatkan warga tua untuk mengemaskini status semasa mereka untuk keluarga atau penjaga mereka. Maklumat yang diperlukan akan disimpan dalam sistem dan dihantar secara automatik untuk menyelesaikan isu-isu yang berlaku semasa kecemasan. Untuk memajukan sistem tersebut, sistem ini boleh diintegrasikan dengan menggunakan modul GPS untuk mengesan lokasi semasa dan ia akan menjadi sistem kecemasan yang sempurna dan dapat digunakan di mana-mana tempat.

ABSTRACT

Emergency Beacon System has become a necessity as the demand for double-income families is increasing these days. Due to the limitation of reality, people nowadays are not capable of taking care of the elderly. At the same time, the tremendous increase of cases of sudden death among solitary living elderly had drawn attention to the society to solve this problem. Hence, attaching an emergency beacon system with the elderly will guarantee the safety of the elderly where immediate assistance will be provided when the system is activated. Currently, several types of cell phones in the market attempted to provide solution to this problem by including emergency beacon function such as speed dialing. However, these beacons are using voice based emergency system and is not efficient due to the nature where human will feel panic or blank out their mind when emergency occurs and resulting in difficulties in providing correct information when something emergency occurred. Besides that, it is difficult for elderly with vision problem to press the speed dial button if depending on cell phone. These issues might delay the rescue time and cause some avoidable tragedies. These limitations become a motivation to develop an easy to operate, low cost, SMS based and user friendly emergency beacon system. The purpose of this microcontroller-based emergency beacon system is to send multiple text messages to certain preset numbers by activating a push button via GSM network. Color coded dedicated push button make it easy for elderly to send emergency message. An alarm function will remind elderly to update their current status for their family or guardian. Necessary information will preset into the system and sent out automatically to resolve the issues of blank out during emergency. For further enhancement, this system can be integrated using a GPS module to detect the current location and it will become a perfect emergency beacon system which can be used in any place to trace the location of the sender to provide necessary assistance immediately.

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CHAPTER 1

INTRODUCTION

1.1 Project Background

Children nowadays are busy with their careers and spend most time at work. In order to work without any trepidation, they prefer to send their elderly parents to senior care homes during working hours. Unfortunately, most of the elderly refuse to go or feel uncomfortable going to the senior care homes. They would rather stay at home alone. So, the only option for the children is to leave their elderly parent at home for most of the time. This is causing a burden or worry among children, especially if their elderly parent is ill. The elderly may face a higher risk in their safety. Serious illness such as heart disease or asthma, need emergency care and can be fatal if emergency aid was not provided. It is very dangerous if the illness becomes serious suddenly and there is nobody around or it is not being noticed, it may lead to death.

To solve this problem, most children will buy a cell phone for their elderly parent for contact purposes. They expect their elderly parent to call them or the emergency response center when they are not feeling well. Hence, for those who have elderly staying home by themselves, the elderly will be provided with a cell phone to be used in case of emergency as a solution.

1.2 Problem statement

Nowadays, the number of cases of death among solitary living elderly is still increasing. This is because, for the elderly, cell phone usually is not a good and effective method of contact during emergency situation. The elderly may fail to recall the phone number of their family members when they are in panic or in pain. Besides that, the probability of key-in wrong number is also high enough to be considering as a factor. Another factor is the failure of the elderly to deliver emergency message or failure to provide accurate information during emergency situation. These problems may delay the time taken to deliver the first aid fast.

In order to solve the problems of cases of key in the wrong phone number, failure to recall phone number or failure to deliver emergency message, an emergency beacon was develop where emergency message can be sent via short message service (SMS) to preset numbers by just pressing a button. This provided conveniences and developed an easy way for elderly to transfer their personal information including address and brief medical record in case of emergency.

1.3 Objective

The objective of this project is to develop a microcontroller based emergency beacon for the elderly utilizing the wide coverage of GSM network. In order to meet the main objective, the following sub-objectives were pursued:

- i. To develop an algorithm that relay an emergency message using short messaging service (SMS) over a GSM network.
- ii. To develop hardware circuitry for interfacing a GSM module with a microcontroller based human- machine interface (HMI) system.

1.4 Project Scope

The work reported in this thesis is limited to the design and development of an Emergency Beacon with the following specification:

- i. Utilize GSM 900/1800 network
- ii. Three (3) user programmable emergency preset number
- iii. One (1) emergency button (Red)
- iv. One (1) reply button (Black)
- v. User programmable Emergency message template
- vi. User programmable Message template

A wire-wrapped prototype was build for design verification. Basic functional tests were conducted to ensure the design prototype meets the required operating specification.

1.5 Organization of This Thesis

This thesis is discussed about the development of microcontroller based emergency beacon system. The emergency beacon system is using GSM network to send emergency SMS to certain contact numbers. This thesis begins with some overview of GSM network and comparison between different kinds of emergency beacon system that available in current market.

Major components and system algorithm will be discuss in detail includes how the components interface among each others. Result and several testing are presented before conclude the outcome of project development, future recommendation and commercialization.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter consists of the literature review on GSM technology that should be considered on developing this project. Research and analysis that had been carried out in the development of emergency beacon system which was done by others will be discussed also. There are four types of emergency beacon system currently available in the market. Each type of emergency beacon will be described in details including the advantages, disadvantages and the differences will be compared.

2.2 GSM Technology

GSM technology includes GSM, GPRS, EDGE and UMTS/HSDPA network. It is a technology that developed by European Telecommunications Standard Institute (ETSI) to replace the first generation (1G) analog cellular network. GSM technology is invented to standardise and compatibility the communication system by using Time Division Multiple Access (TDMA) standard. Mobile phone is

developing based on this GSM technology and allows global communication through different service operators.

According to GSM world, GSM technology is now used by over 1.5 billion people all over the world. It provides different kinds of no voice business and allow user to make multiple choice in distance communication. GSM brings a lot of benefit in high speed integrated data, mail, voice data, fax and SMS service and provides a safety and secured communication networks from intruders.

GSM is an open system network and is a non propriety technology. One of the great benefits of GSM is it facilitates international roaming. As it is adopted by more than 170 countries, users have the facility of using their GSM cell phone in all these places without having to change the phone number and service operator. GSM is also a low cost communication technology system, it only charge the fee after the time division data package had been send. Besides that, GSM network is also better than wire data transmission for remote distance transmission and poor environment condition. Construction cost for the GSM network is also cheaper than wire data transmission network [1].

2.2.1 GSM Network

Global System for Mobile Communications (GSM) network is a second generation (2G) cellular phone technology. This network is the most popular and widely used digital mobile telephony system among all of the GSM network technologies. It transmits data by digital circuit switch using one slot of the time division channel. A channel will be reserve during the process of data transmission and service charge is depending on the duration for channel reservation.

GSM network provides a more secure and best platform for more features communication network. Short Message Service (SMS) or text messaging is one of

the famous features that successfully apply on this 2G cellular phone technology. The other features include users are able to download content from service provider like picture message and ringtone [2].

2.2.2 GPRS Network

General Packet Radio Services (GPRS) network is a kind of technology that applies on GSM network and it is also call as 2.5 generation (2.5G) cellular phone technology. It transmits data by using packet switch through four slots of time division channel. Transmission data will be slide into packet form before transmit through the GSM network. This data transmission method allows data communication in higher speed and cheaper.

Multimedia Messaging System (MMS) is a feature that develops successfully with the technology of GPRS network. This allows users to send pictures, videos or sound clips to each others like SMS since GPRS can handle more data traffic [3,4].

2.2.3 EDGE Network

Enhanced Data rates for GSM Evolution (EDGE) network is also calling as enhanced GPRS (EGPRS) network. EDGE is using 8-PSK modulation during the data transmission process. Three bits of data is process simultaneously by using 8-PSK modulation, which mean triple the data rate per subscriber compare to GPRS network. EDGE enables the delivery of more demanding mobile services, such as the downloading of music clips, video, multimedia messaging, full web browsing and e-mail [4].

2.2.4 UMTS/HSDPA Network

Universal Mobile Telecommunications System (UMTS) is also call as third generation (3G) cellular communication network. It transmits data by using Code Division Multiple Access (CDMA) and make it has faster data transfer rate than EDGE since it can be transmitting in different frequency level.

However, only few areas and networks support UMTS since it is still an infancy technology. This technology might unable to use also when moving from one nation to another nation even with countries that support the technology. It is because the UMTS may have set in different spectrum [5].

2.3 Frequency Band of GSM Network

GSM supports multiple frequency levels like 850 MHz, 900 MHz, 1800 MHz and 1900 MHz. Different phone operators will use different frequency bands and allows distance communication as long as the frequency band is supported by the GSM phone. In Malaysia, 900 MHz and 1800 MHz frequency levels are provides by few service operators [6]. Mobile phone that supports multiple frequency levels is needed in order to use the service from different company operators.

The frequency bands that usually operate in mobile phone are Dual Band, Tri-Band and Quad Band. Dual band frequency is operates at 900 MHz and 1800 MHz and Tri-Band supports three frequency levels which are 900 MHz, 1800 MHz and 1900 MHz. Then for Quad-Band, it is supports four frequency levels which are 850 MHz, 900 MHz, 1800 MHz and 1900 MHz. This kind of mobile phone can be use in anywhere as long as the distance communication is following the GSM standard [7,8].

2.4 Protocol Architecture of GSM

GSM network is work based on three major systems. First of the system is SS (Switching System) and it consists of five databases. These databases are HLR, MSC, VLR, AUC and EIR. HLR (Home Location Register) is a database that use for storing and managing subscriber's information. Subscribers are needed to register in mobile phone company HLR before a new connection is purchase. MSC (Mobile Service Switching Centre) is use to perform switching functionality of the entire network. VLR (Visitor Location Register) is a database that uses to store temporary data regarding subscriber which is needed by MSC. AUC (Authentication Centre) is a filter that uses to secure the network system. Its major task is to authenticate and encrypt those parameters which verify user's identification and hence enables the confidentiality of each call made by subscriber. EIR (Equipment Identity Register) perform a task similar with AUC by restricting for calls been stolen.

The second GSM network system is BSS (Base Station). It includes BSC and BTS which use to connect subscriber to network by using radio transmission. BSC (Base Station Controller) responsible to connect a physical link from subscriber (MS) to BTS, configuration cell data and control radio frequency in BTS. The processed data from BSC will be sending to MSC (Mobile Switching Centre) and transmit to different mobile network. BTS (Base Transceiver Station) is radio equipment that uses to receive and transmit data that control by BSC.

Then, the last system is OSS (Operation of Support System). It is a system that uses to operate and maintain the connection between MSC and BSC. For sending a SMS, the text message from sender's phone will be stored in a central short message centre (SMSC) which then forwards it to the destination mobile through MSC [9,10].

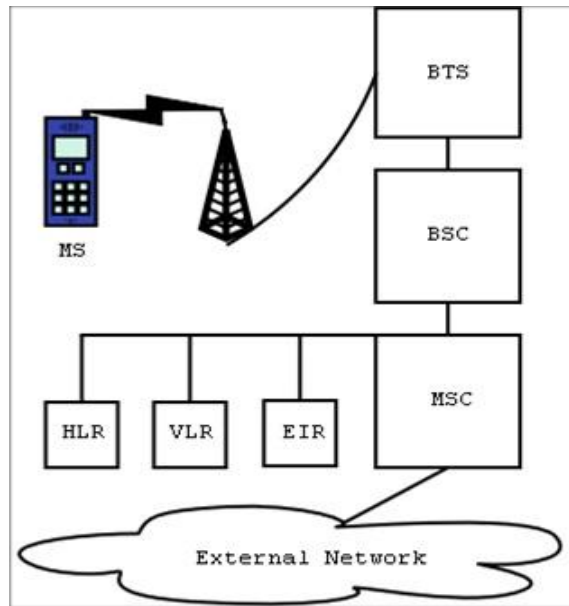


Figure 2.1: GSM architecture network

2.5 Interface Signal of GSM

All SMS will be sending in serial form. There are two ways to sending and receiving SMS message which are 'Text mode' and 'PDU mode'. Data receive might differ from data send if using text mode due to the encoder for transmitter and receiver might different. So, a preset encoder is always use when using text mode to send a SMS [1].

Message will be converted into hexa-decimal form by using PDU mode. Besides of SMS content, information of sender like service centre, stamp, message length and each others will be send along to receiver and provides a more secure and accurately method for sending a SMS. PDU mode is usually used in sending the SMS by mobile phone and GSM/GPRS modem. 'AT+CMGF=0' is the AT command to set up the PDU mode. Table 2.1 show the data send from sender and data receive by receiver [11].

Table 2.1: Data send by PDU mode

Data send	Data receive
AT+CMGF=0 AT+CMGS= "+60167623544" >Hello	0011000B910661673245F40000AA0AE8329BFD06

Table 2.2: Description of PDU string

Octet	Description
00	SMSC information
11	Define SMS send
00	TP-Message Reference
0B	Address length
91	Type of address
0661673245F4	Receiver's phone number
00	TP-PID
00	TP-DCS
AA	TP validity period
0A	Length of message
E8329BFD06	Data of message

In order to communicate between GSM/GPRS modem with microcontroller, command algorithm from microcontroller is encode into RS232 protocol and transmit through the serial port to GSM modem.

2.6 GSM Language

GSM modem is communicates by using AT command or Hayes modem command. AT command is a language that invented by a modem based manufacturer

which call Hayes Microcomputer Product. AT is the abbreviation of ‘attention’ and every command line of modem will start with ‘AT’. ‘AT’ is a prefix that uses for inform the modem about the start of command line. Basically, almost all of the dial up modem, GSM modem and GPRS modem are using AT command to communicate.

There are two types of AT command, which are basic command and extended command. Basic command is AT command that do not start with symbol ‘+’ while extended command is AT command that start with symbol ‘+’. All GSM/GPRS modem is using extended command. AT command with a GSM/GPRS modem can be use to access Fax service, MMS service, SMS service, configuration modem or SIM card and data link over a mobile network [12].

2.7 Comparison of GSM/GPRS Modem and Mobile Phone

GSM/GPRS modem is performing a same task with mobile phone. Both of it are uses for wireless communication and require a SIM card from a wireless carrier in order to operate. Generally, GSM/GPRS modem performs better task compare to mobile phone.

Concatenated SMS message is a text message that over the length limit. A division and combination process is needed to conduct in order to smaller the message size during transmission of message. Unfortunately, some mobile phone is failed to recombine the split message after the transmission process. Besides that, GSM/GPRS modem is also support more complete set of AT commands than mobile phone. This making the system becomes more flexible and reliable by using GSM/GPRS modem [13].

2.8 Application of GSM Network with Microcontroller



Figure 2.2: Application of GSM with microcontroller

There are many application of GSM network with microcontroller. GSM is mostly applying on access control device, transaction terminal and supply chain management. SMS service is always use in the access control device for long distance control task like home automation system. It achieves high security and reliability.

The second most famous application of GSM technology is on transaction terminal. Vending machine, ATM machine and others are using the technology to confirm the transaction and status of machine. Huge infrastructure costs due to it bring a lot of benefit in long distance communication and save a lot of unnecessary job.

The third application is supply chain management which is more focusing on leased line networking communication. GSM network is reducing huge cost on wireless networking and allow high speed global communication. This system is usually applied on communication system between head quarter with the branch office [14].

2.9 Comparison of Emergency Beacon

Emergency beacon is a useful and reliable electronic device that can provide safety and peace of mind for elderly people or patients. It is an ideal device during emergency to get medical help in shortest time [15]. Generally, emergency beacon system is divided into 2 types, the half duplex or full duplex communication system. Usually, emergency call numbers and messages was preset into the half duplex system and the machine will send the message to the preset contact number automatically once the emergency button was activated. While for the full duplex system, alert service centre will be in-charge of consulting the status of user [16].

Four different types of emergency beacon system available in the market are PRLOG, First Response Medical Alert, Spark Nano, and Emergency Panic Button SOS app + Android system. In this part, the differences as well as the pro and cons of the four different systems will be discussed and compared. Table 2.3 shows the main features of the emergency beacon systems.

There are two types of network technology used in the emergency beacon system which are Public Switching Telephone Network (PSTN) and Global System for Mobile Communication (GSM). Both of PRLOG and First Response Medical Alert are using PSTN technology. PSTN allows full duplex communication by using fixed line analogue communication system. The main disadvantage for both kinds emergency system is that the system can only be use at the places consisting of PSTN port or LAN port as home telecommunication system [17].

In term of message delivery, PRLOG uses SMS to deliver emergency message when activated. Short Message Service (SMS) provides low cost text message transfer among mobile phones [18]. It allows communication during high traffic of network and even simultaneous with telephone conversation. Messages can also be deliver to large quantity of peoples in short period and it is proven to be high reliability [19,20]. With a preset function, information like address, contact numbers and other SMS content can be store into the system before used. Correct information

can be delivered to certain people without any communication barrier during panic situation and time wasting issue can be avoiding [21].

Table 2.3: Comparison of different kinds emergency beacon system

Features	Brand			
	PRLOG	First Response Medical Alert	Spark Nano	Emergency Panic Button (SOS) App + Android System
Network	PSTN	PSTN	GSM	GSM
Message delivery type	SMS	Voice based call	SMS	SMS/Email
Location detection	Preset home address	Preset home address	GPS	GPS/Wi-Fi
Preset contact number	4 contact numbers	Contact with centre station	1 contact number	Unlimited
Preset message	Yes	No	Yes	Yes
Portability	No	No	Yes	Yes
Centre station	No	Yes	Yes	No
Report monitoring	No	Yes	No	No
Monthly charge	No	Yes (RM 64)	Yes (RM 64)	Internet fee (RM 64)

Different from PRLOG emergency system, First Response Medical Alert is using voice based call message delivery system. This emergency system is linked to a centre station service where constantly there is someone in-charge of monitoring the condition of user. User can deliver rescue message to centre station service in duplex communication when something occurred. With the monitoring service, unexpected situations such as comatose that happening on user can be discover and chances for survive will be higher due to immediate first aid provided from the centre station [22,23].

Spark Nano and Android phone emergency beacon system are using GSM network technology. GSM is a new technology that invented to replace the old technology communication system. It is a world's most dominant standard that allows system to communicate through different companies' service even roaming into different countries. This network technology allows emergency system to be use in any place as long as there is a service from mobile phone operator [24].

Due to GSM based emergency beacon system is using mobile voice and data transmitting services, a Global Positioning System (GPS) technology was added into both Spark Nano and Android system phone to detect the current location of system. With the GPS, actual location of the elderly can be detected and smooth up the rescue operation. Both emergency beacon systems are using data information preset function. Preset emergency message will be sent to preset contact numbers via SMS when the system is activated [25,26]. In addition, Android system phone is also providing a Wi-Fi based emergency beacon service. Emergency rescue messages can also be sent to certain people via email as long as the system is connected to the internet. With Wi-Fi service, the emergency system becomes more efficient [27,28].

Unfortunately, GPS is facing high interference when it is use between buildings or inside the building since it is transmitting signal in radio signal and requires a direct line of side to at least 4 satellites. The location of emergency beacon system can only be detected when it is activated at outdoor. Similarly, a Wi-Fi service is only applicable when there is an internet access [29,30]. Besides that, GPS and Wi-Fi are high power consuming and it is not efficient to be implemented on emergency beacon system [31].

In conclusion, a GSM network emergency beacon system is more suitable due to the convenience as users can apply the system in any places as long as there is a signal from service provider. GPS and Wi-Fi service is not a necessity since it is only applicable in certain places and costly. An easy to setup and real time locating system is more efficient although the user should update their current location manually once entering a new location [32]. Emergency beacon system should include data information preset function as well because user always cannot afford to make an emergency call or even dialling emergency numbers during panic situation

[33]. Unexpected situation like comatose occurring on user can be solved by adding a reminding alarm instead of monitoring from centre station service. With a reminding alarm, cost of emergency beacon will become cheaper and the system tends to be more applicable.

CHAPTER 3

METHODOLOGY

3.1 Introduction

This chapter describes the methodology on how the project is implemented. Block diagram is included to explain how the devices are interacting with others and explain the project development in more detail. All necessary main components will be clearly described with technical specification. Flow chart is included to show the design algorithm.

3.2 System Description

The first step of using this emergency beacon system is to key in all preset important information like emergency contact numbers and user detail by using a keypad. Three preset emergency contact numbers can be stored and user detail like name, address and medical record are require to be inputted for rescue purpose. Preset information will be stored into the EEPROM of PIC microcontroller and will not be erased even there is a power termination or interruption.

There are two emergency push buttons for the system, which are the well condition push button and panic condition push button. User may press the button according to their current condition. For the case when well button is press, a SMS will be sent to the first preset emergency number through GSM network to inform that the user or the person at home is in good condition. On the other hand, if the panic button is pressed, help requirement SMS which includes the user detail will be sent to all preset numbers and red colour indicator and buzzer will be turned on until the system is reset.

An internal alarm will start counting after all the important information is sent out. Once the alarm is activated, a yellow colour LED indicator will light on to remind user to update their current status. If user did not update their status within five minutes, GSM modem will automatically send a SMS to the first preset emergency number to inform that the user is not responding.

3.3 Hardware

The hardware configuration for the emergency beacon system is shown in figure 3.1. Basically, the system can be divided into blocks consisting of microcontroller, GSM module, emergency buttons, LCD display, keypad, LED indicator and buzzer.

The interfacing between GSM and microcontroller and the interfacing between keypad with microcontroller are the most critical for the hardware development. The specification of elements and their interface connection are discussed in detail.

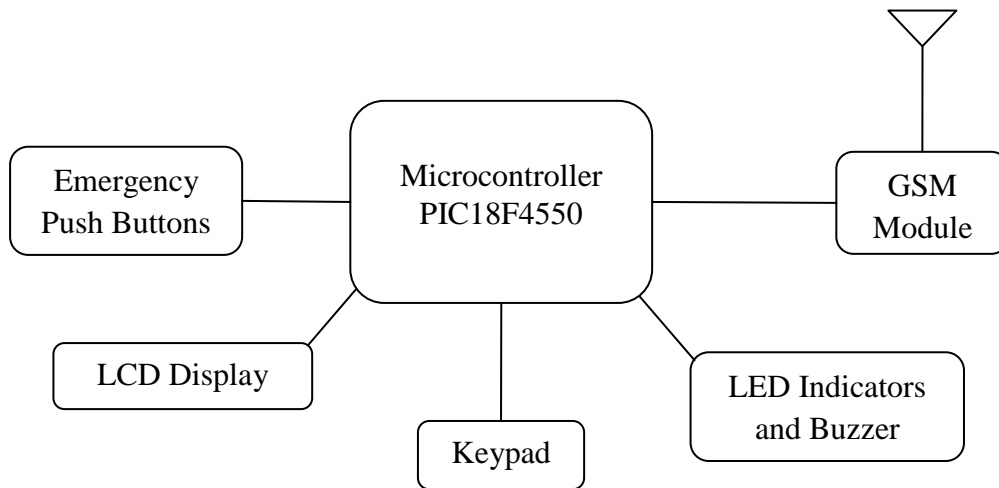


Figure 3.1: Emergency beacon block diagram

3.3.1 Microcontroller

There are several type of microcontroller in market such as PIC 16 series, PIC 18 series, MC68 series and 8051 family with different manufacturer. Basically, PIC and 8051 family are more commonly use due to more economical compare to MC68 series.

In this project, a bigger space of RAM, EEPROM, flash memory and more input output pin microcontroller is needed. So, PIC18F4550 is chosen in this project development. PIC18F4550 is an 8 bit operation architecture low power consumption microcontroller. It consists of 2048 bytes of RAM, 256 bytes of EEPROM and 32 Kbytes of flash memory, 35 input and output lines and three 16 bits timers.

Flash memory is used to store the instruction program. Bigger flash memory is important as it allows long program to be execute and the system will become flexible and reliable with the enough space for more design. For RAM and EEPROM, they are used to store the emergency numbers and user detail. Hence, the bigger

space of RAM and EEPROM allows more information to be store and allow long message to be send in same moment through the GSM modem.

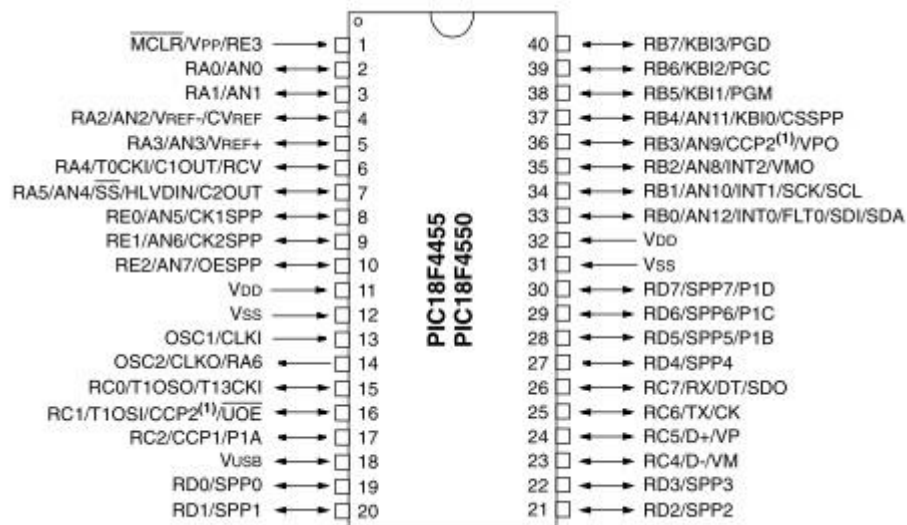


Figure 3.2: Pin Diagram of PIC18F4550

Table 3.1: PIC18F4550 specification

Architecture	8 bit
Flash Memory	32 Kbytes
RAM	2048 bytes
EEPROM	256 bytes
I/O lines	35
Timer	3 x 16 bit
Power supply	2.0-5.5V & 25mA

Figure 3.3 shows the circuit connection for microcontroller. Basically, microcontroller only requires a crystal and reset circuit to operate. Selection of oscillator frequency for the crystal is from 4 MHz to 48 MHz. Typically, 20 MHz crystal is use to provide 20 million clock cycles per second for the microcontroller operation. The crystal is connected to pin 13 and pin 14 of the microcontroller. The reset circuit is connected to pin 1 of microcontroller in order to return the algorithm progress to initial condition.

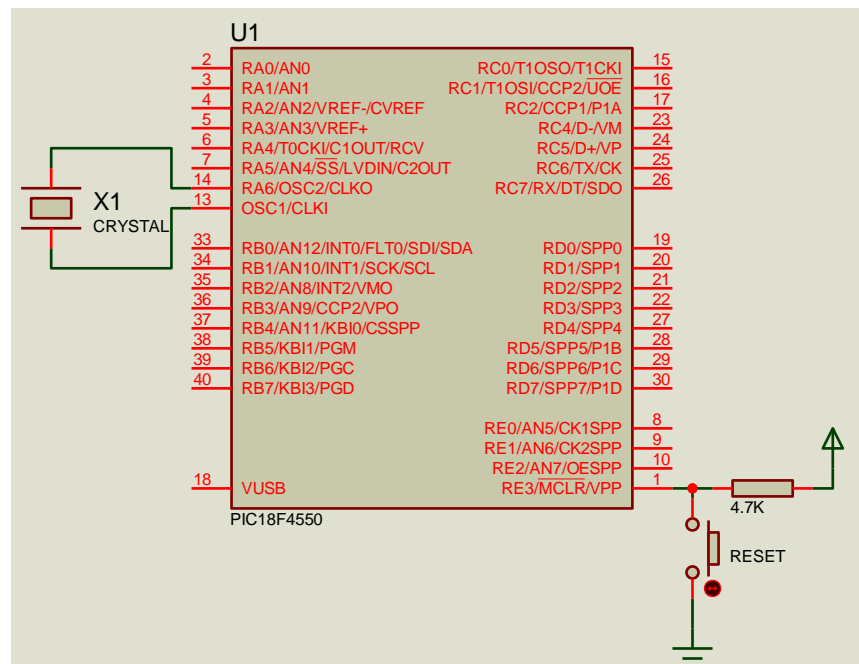


Figure 3.3: Circuit connection of PIC18F4550

3.3.2 GSM Modem

MOD9001D GSM modem is used instead of cellular phone in this project. This is because this GSM modem is functioning with AT command. It also consists of a RS232 protocol interfacing port and easy for testing purpose by using computer. AT command is a standard command set that applicable in various kinds of GSM module. It is different with others command set that is only useable on certain cellular phone. This GSM module will send the SMS following by the command from microcontroller. The operation power of this GSM modem is 5V and 300mA.

Table 3.2: AT command

AT+CMGF=1	Set up PDU mode SMS
AT+CMGS	Send SMS
AT+CSMP=17,168,0,0	English Test Parameter
AT+CMGD	Delete SMS

In order to interface with microcontroller, the protocol of GSM modem must be changed from RS232 to TTL level. In this case, MAX233 is used to change the protocol between microcontroller and GSM modem. Figure 3.4 show the circuit connection for the protocol converter. Note that pin 2 and 3 of MAX233 will be the TTL input and output pin from microcontroller and pin 5 and 18 will be the RS232 output that connects to the GSM modem.

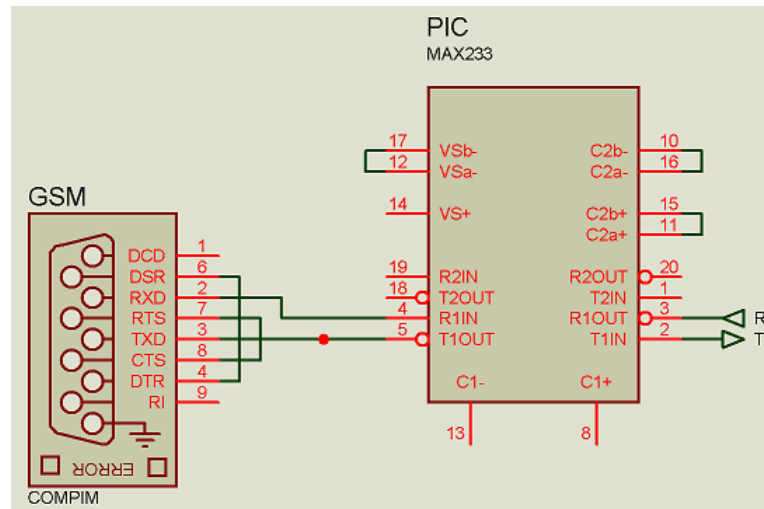


Figure 3.4: TTL to RS232 protocol converter

3.3.3 Matrix Keypad

A 4x4 keypad is chosen out from the several kinds of keypad. This is because the keypad button is good enough for user to key in alphabet, number and consist extra button that can use for other functions such as menu and backspace. Connection circuit of the keypad will be easier due to it is a matrix keypad and it is cheaper compare with the SPI output keypad.

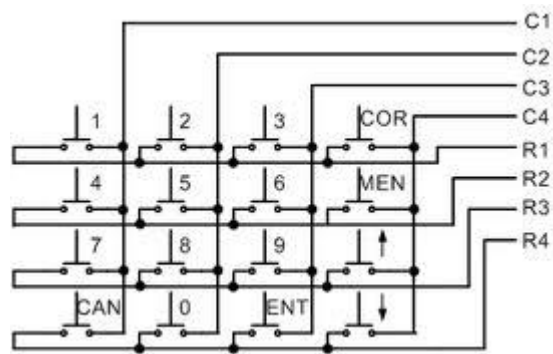


Figure 3.5: Internal Circuit of a 4x4 Matrix Keypad

In order to avoid new data keep renewing while a button of keypad is pressing, a keypad driver MM74C922 is used to solve the problem. By using the driver, a data available output will go to a high level when a valid keyboard entry has been made and returns to a low level when the entered key is released. Besides that, an internal register will remember the last key pressed even after the key is released. This will make the algorithm and the coding become more flexible and easier. Figure 3.6 shows the circuit connection of the keypad driver.

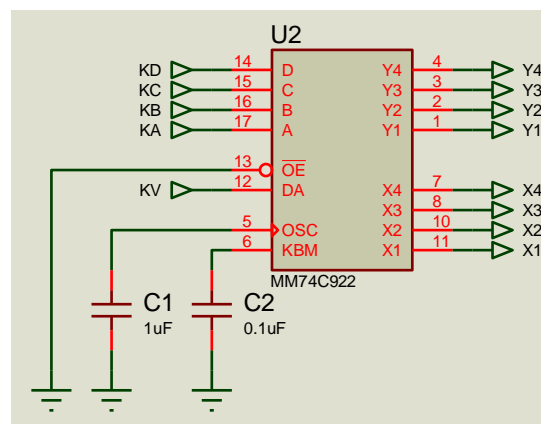


Figure 3.6: Circuit connection of MM74C922

3.3.4 LCD DISPLAY

The function of LCD in this project is to display the status of dialling or for setting purpose. A 2x16 LCD display was chosen to display the information while changing the setting. It will make the emergency system more user friendly.

Table 3.3: LCD Pin Table

Pin Number	Name	Description
1	VSS	Negative Supply
2	VCC	Positive Supply
3	VEE	Contrast Adjustment
4	RS	Register Selection (0:Command, 1:Data)
5	R/W	Read/Write Selection (0:Write, 1:Read)
6	E	Enable
7	DB0	X
8	DB1	X
9	DB2	X
10	DB3	X
11	DB4	Data Bus 0
12	DB5	Data Bus 1
13	DB6	Data Bus 2
14	DB7	Data Bus 3
15	LED+	Positive Supply for Back Light
16	LED-	Negative Supply for Back Light

In this project, 4 bits data bus is used for interface communication because less wire and few lines programming coding is needed.

3.4 SOFTWARE

In order to construct a reliable emergency beacon system, design algorithm is playing an important role to let the system hardware perform vividly. The system algorithm is constructed base on four programs of flow chart.

3.4.1 PROGRAM FLOW CHART

Figure 4.1 shows the first step after the system is switched on. User can key in preset data information by pressing '*' or skip the step by pressing 'D'.

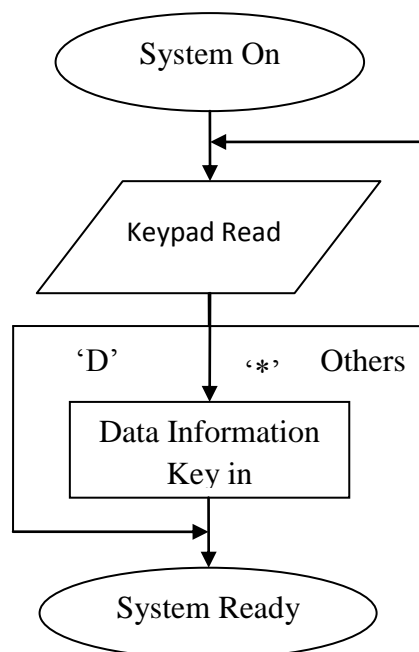


Figure 3.7: Flow chart of selecting preset data information mode

Next, the algorithm during emergency push buttons activation will be discussed. As in figure 4.2, once panic condition push button was activated, a red colour LED and buzzer will be activated and the microcontroller will obtain the

preset data information from EEPROM and a SMS will be sent to all preset emergency numbers. System can only reset manually by pressing button '1' on the keypad.

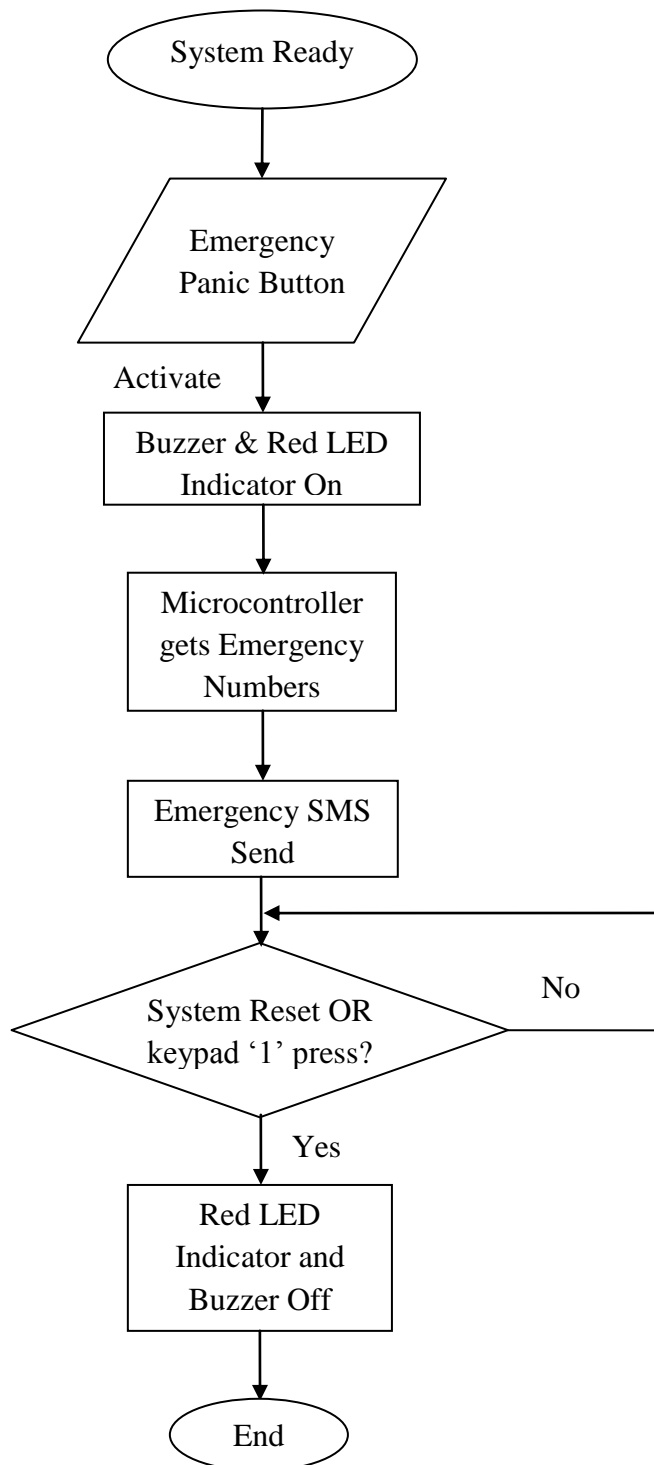


Figure 3.8: Flow chart of emergency beacon system – panic condition

The flow of program during activation of well condition push button will be the same with panic condition as in figure 4.3. The only different is the red colour LED and buzzer will not be activating and only one SMS will send to the first preset emergency number.

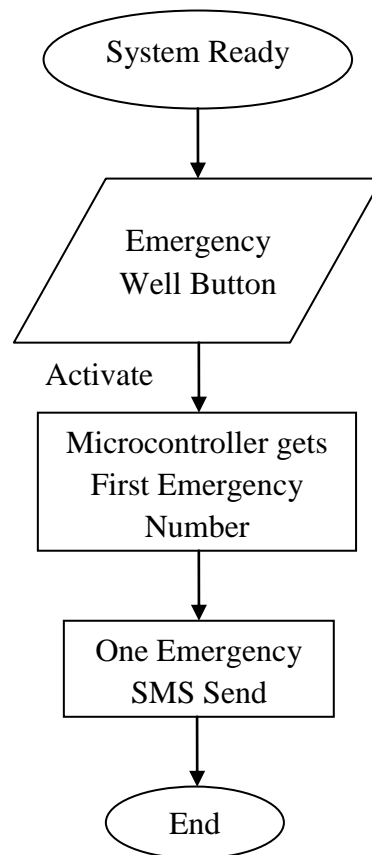


Figure 3.9: Flow chart of emergency beacon system - well condition

The last algorithm is a reminding alarm as in figure 4.4. A timer was added into the system to remind user that they have to send a SMS to report their current status by using a yellow colour LED indicator. A SMS will be sent to first preset number automatically informing that the user is not responding if the status was not updated manually within five minutes after the alarm is activated.

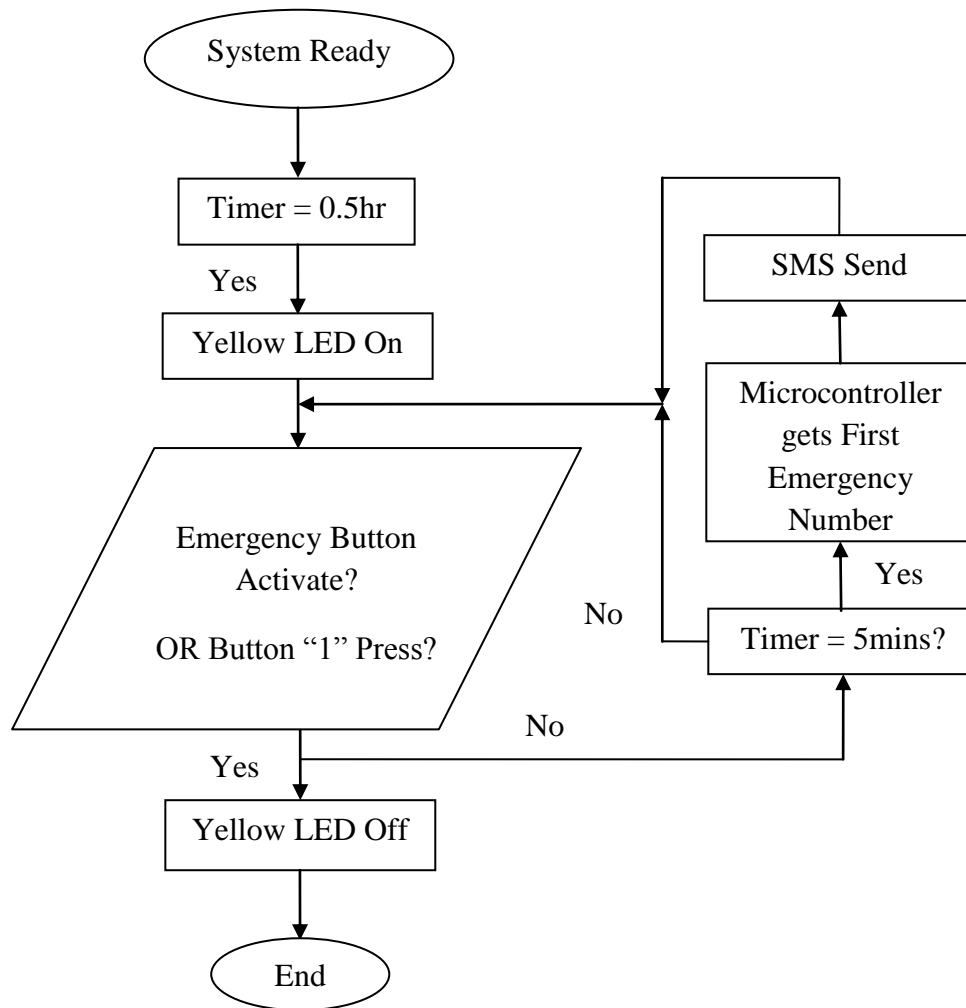


Figure 3.10: Flow chart of reminding alarm

3.5 Design Tools

Two design tools are frequent uses during the project development. The first design tool is Proteus IDE. Proteus IDE is free version circuit design software develop by Microchip. The software includes a lot of microcontroller element allowing user to draw and debug the circuit attach with the algorithm design.

Typical circuit design software did not have the algorithm debugging features like PSpice. This software brings a lot of benefit and convenience when doing testing on the system module. By Proteus, circuit connection can simulate with the present of h file before implement into the real circuit.

The second design tool is CCS PCW. PCW is a C language compiler that comes along with many library file. Coding algorithm is writing in C language and simulate by PCW. The way to do the simulation and compiler is easier compare to other type of compiler. It simplifies the coding construction and made the programming algorithm become more structure and tidy. Machine language or H file that generated by PCW is then burn into microcontroller by PICKIT2.

CHAPTER 4

RESULT AND DISCUSSION

4.1 Introduction

This chapter will discuss the result of hardware and software development which were mentioned in methodology. Main testing procedures are clearly describe and the fault occur during the project development will also be discuss. Each result outcome is also shown clearly.

4.2 Circuit Diagram

The complete circuit for this emergency beacon system is shown in figure 4.1. The circuit is simulated by Proteus software before implement into real hardware. After done the simulation, a real hardware circuit is constructed as in figure 4.2.

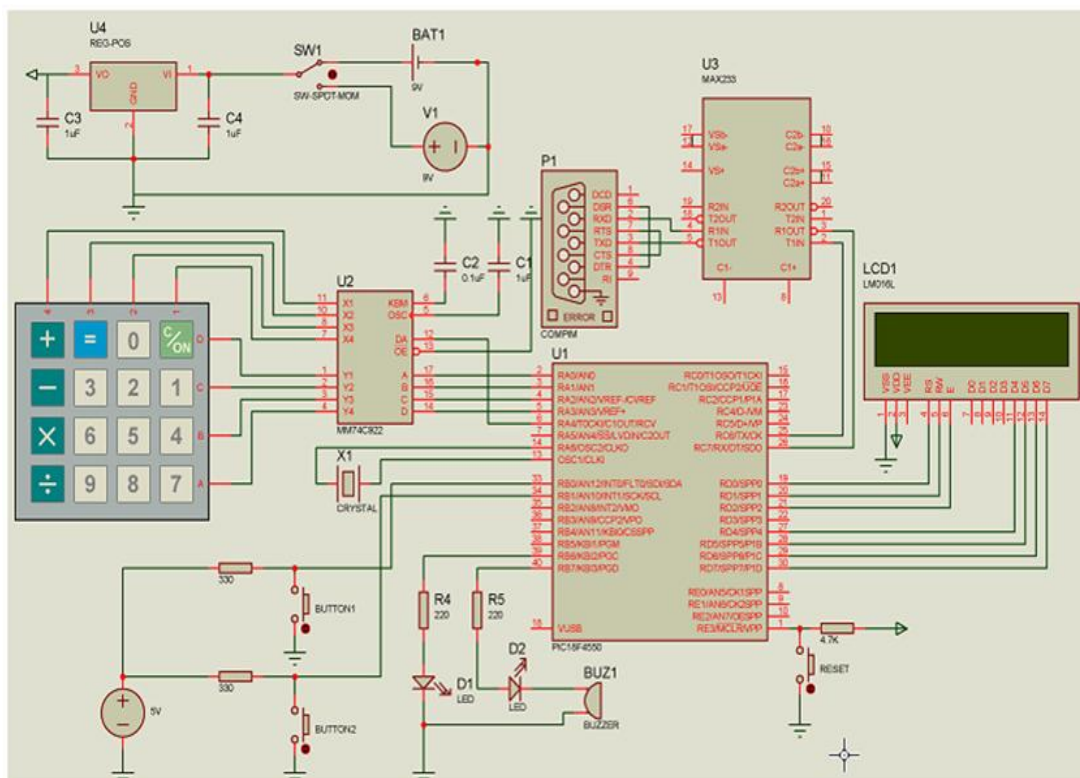


Figure 4.1: Complete circuit diagram of system

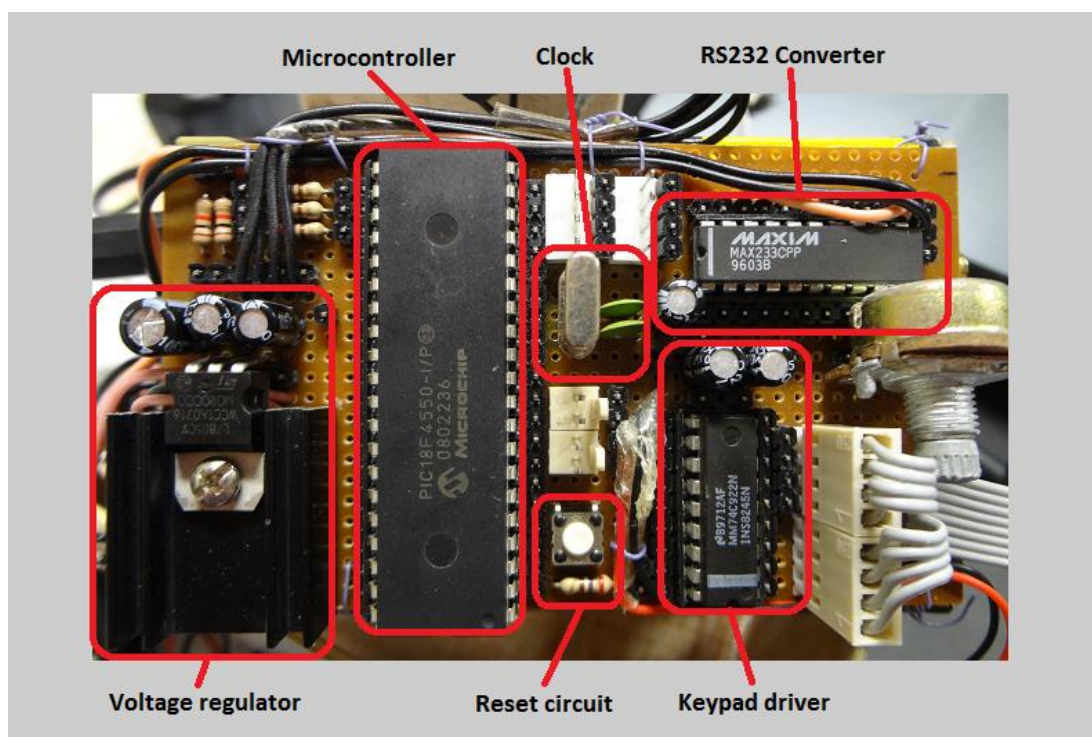


Figure 4.2: Actual hardware circuit of system

4.3 Program Coding

Basically, there are three important programming skills that need to grasp before start to develop the project. The first important skill is keypad programming. The difficulty for this keypad part is on how to key in others alphabet also in the same time by just pressing a button. This keypad programming is shown in figure 4.3.

Keypad coding is using 16x6 matrix function in operation. The 16 elements in row of the matrix indicates the total 16 buttons of the keypad and the 6 elements in column of the matrix indicates the total alphabet and number that need to key-in by certain button. By using this keypad coding, modification is available at all the time and easier by changing the matrix size and the elements of the matrix.

```
char const Keys[16][6]=
{
  {'1', ',', '/', '-', '!', '\0' },
  {'2', 'A', 'B', 'C', '\0', '\0' },
  {'3', 'D', 'E', 'F', '\0', '\0' },
  {'Menu', '\0', '\0', '\0', '\0', '\0' },

  {'4', 'G', 'H', 'I', '\0', '\0' },
  {'5', 'J', 'K', 'L', '\0', '\0' },
  {'6', 'M', 'N', 'O', '\0', '\0' },
  {'Up', '\0', '\0', '\0', '\0', '\0' },

  {'7', 'P', 'Q', 'R', 'S', '\0' },
  {'8', 'T', 'U', 'V', '\0', '\0' },
  {'9', 'W', 'X', 'Y', 'Z', '\0' },
  {'Down', '\0', '\0', '\0', '\0', '\0' },

  {'Ent', '\0', '\0', '\0', '\0', '\0' },
  {'0', '+', ' ', '\0', '\0', '\0' },
  {'Bs', '\0', '\0', '\0', '\0', '\0' },
  {'Esc', '\0', '\0', '\0', '\0', '\0' }
};
```

Figure 4.3: Keypad programming in C language

The second important programming skill is on how to store and load a data into and from EEPROM. This step is use to store the preset user's information and to avoid data volatise issue. Figure 4.4 show the example coding on how to store a data into EEPROM and figure 4.5 show the example coding on load the data from EEPROM.

```

void SaveTelNo(int TelNoIndex)
{
    int BaseAdd, pos;

    BaseAdd=(TelNoIndex-1)*16;

    for(pos=0;pos<16;pos++)
    {
        write_eeprom (pos+BaseAdd, PhoneNumber[pos]);
    }
}

```

Figure 4.4: Sample coding on how to store data into EEPROM

‘TelNoIndex’ in the coding is use to select which portion of EEPROM that need to use. In case of storing the first emergency number, TelNoIndex will be define as ‘1’ and made the ‘BaseAdd’ became ‘0’. ‘BaseAdd’ is the starting EEPROM address that use to store the key-in data. ‘BaseAdd’ is multiply by 16 to make sure a total 16 bytes of space is reserved for storing the phone numbers which from address \$0000 to \$000F. A counter is use in the coding to make sure all 16 bytes data of ‘PhoneNumber’ are save into defined EEPROM address continuously.

In case of load the data from EEPROM, the step is same as storing data. Data from EEPROM will be saving into RAM after load from EEPROM. Coding ‘PhoneNumber[pos]’ is defined as a total 16 bytes space of RAM.

```

void LoadTelNo(int TelNoIndex)
{
    int BaseAdd, pos;

    BaseAdd=(TelNoIndex-1)*16;

    for(pos=0;pos<16;pos++)
    {
        PhoneNumber[pos]= Read_EEPROM (pos+BaseAdd);
    }
}

```

Figure 4.5: Sample coding on how to load data from EEPROM

The last programming skill that needs to grasp is on how to send the AT command to the GSM module. Figure 4.6 show the sample coding on how to send the AT command to GSM module.


```

lcd_putc("\fNow SMS to Tel#1");
sprintf(AT_Command, "AT+CMGS=\x22%s\x22\r", PhoneNumber);
do
{
    charSend=AT_Command[p];
    delay_ms(10);
    putc(charSend);
    p++;
}while (charSend!='\0');

```

Figure 4.6: Sample coding on sending AT command

The second line of the coding is use to place the AT command ‘AT+CMGS=“xxxx”’ to RAM. After save the data into RAM, AT command will be start to sent to GSM modem one by one until there is no alphabet obtain. Quotation mark is converted into ‘\x22’ in order to understand by GSM modem.

4.4 Design Verification

Before apply all elements into complete circuit, program algorithm, GSM modem, microcontroller and power supply are testing to make sure it is functioning.

4.4.1 Testing of GSM Modem

GSM was tested with some AT command set and is operating in different baud rate by using HyperTerminal before implemented into microcontroller. Figure 4.7 shows the different baud rate program result and the response from GSM modem by different patterns of AT command set. It is important that the sending of a SMS will be successfully if and only if country code and quotation mark is added into the AT command set.

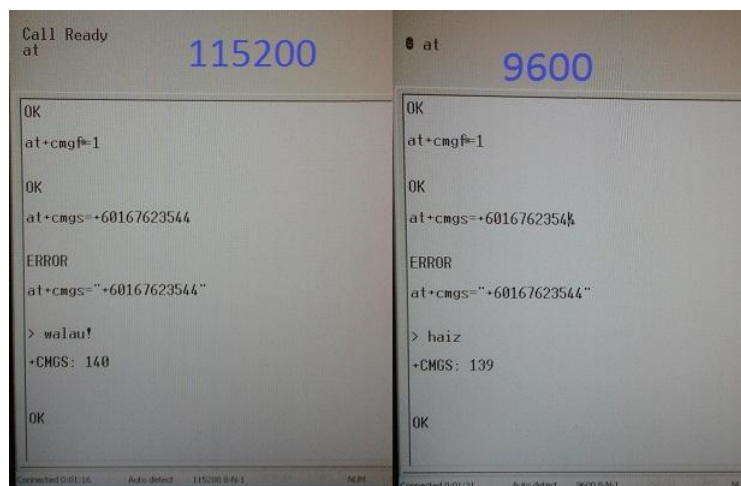


Figure 4.7: Communication between GSM modem and Hyperterminal

Basically, only three main AT command sets are needed to send a SMS. There command sets are as follows:

First command set:

At+cmgf=1

This is to initial the SMS mode.

Second command set:

At+cmgs= "+60167623544"

This is to send SMS to the particular number.

Third command set:

>Hello~ I'm Soon Woei, pls gv me A in my PSM.

This is the SMS content that will be sent to the particular number after an end signal is given.

The end signal is Ctrl + Z using Hyperterminal software or 0x1A using in programming language.

4.4.2 Testing of Program Algorithm

Program flow chart was converted into C language and AT command set was added into the coding. The program was compiled and HEX file was generated using PCW software. The algorithm coding was then tested with virtual hardware using Proteus software. Virtual terminal is used to represent real GSM modem in the testing process. After obtaining the expected result from Proteus, the coding was implemented into the real microcontroller.

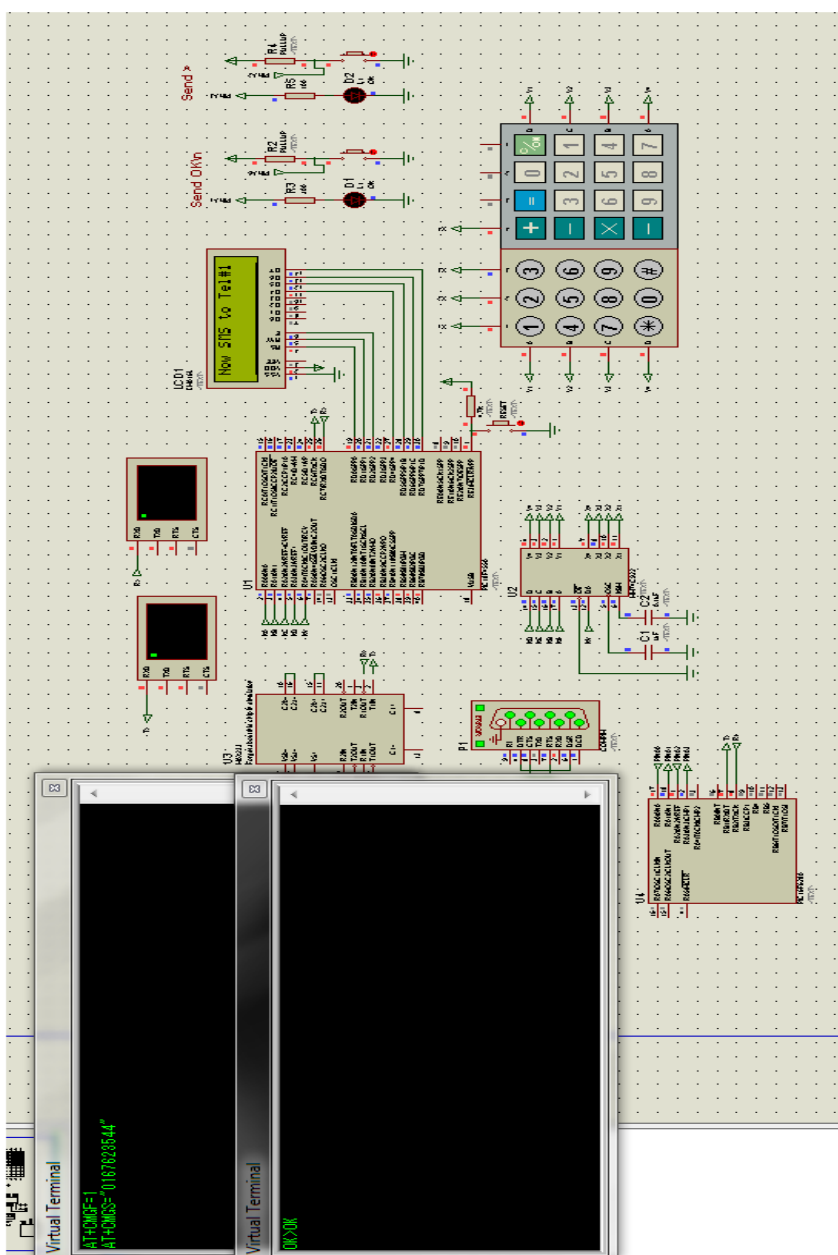


Figure 4.8: Proteus simulation

4.4.3 Testing of Microcontroller

GSM modem is interface with microcontroller after testing the program algorithm, communication between GSM modem and microcontroller is fail. Several steps are gone through on debugging the error which is handshaking and baud rate.

4.4.3.1 Handshaking

For the data to be transmitted, clock for both receive and transmit line must have same baud rate. So, handshaking will be used to solve the baud rate issue. There are three general kinds of handshaking, which are software handshaking, hardware handshaking and Xmodem. Hardware handshaking will be used in this project because is easier to be implemented in the design. Figure 4.9 shows the connection of hardware handshaking. RTS line is short with CTS line and DTR line is short with DSR line.

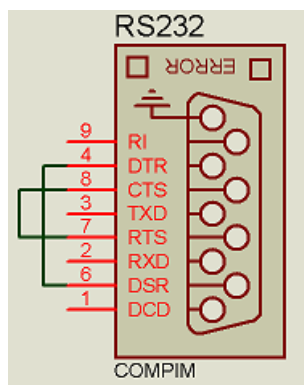


Figure 4.9: Connection of hardware handshaking

4.4.3.2 Baud Rate

The GSM is still failing to send SMS after solving the handshaking issue. GSM modem cannot receive proper AT command from microcontroller and cannot proceed to next step. Hence, RealTerm software is used to trace the transmission data. The circuit connection for the tracking of data transmission from microcontroller to GSM modem is shown in figure 4.10.

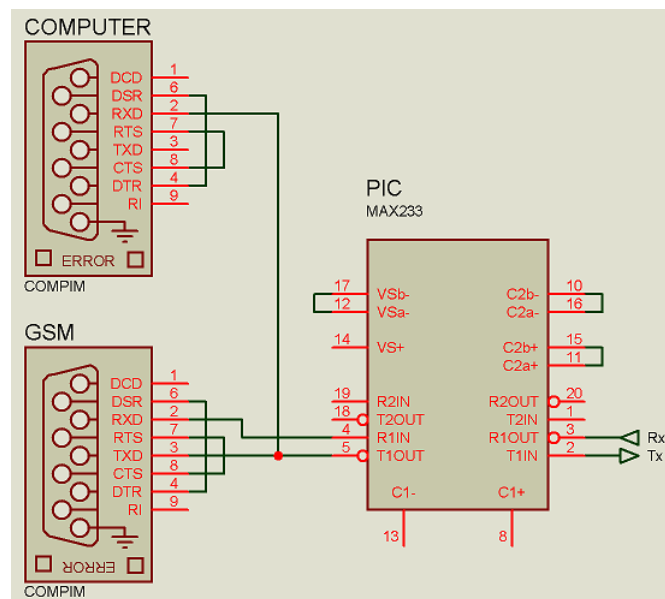


Figure 4.10: Tracking circuit by RealTeam

GSM is receiving incorrect AT command data from microcontroller and cause failure on sending SMS. GSM receive 'X' or 'NUL' from microcontroller as shown in figure 4.11. After troubleshooting, a solution is found by adjusting the baud rate of the coding. The baud rate in the coding must be operating in 48MHz instead of 20MHz although the crystal used in the hardware is 20MHz. This mean the microcontroller need to operate in different input and output clock speed. In order to solve the problem, PLL function is added into the coding as in figure 4.11.

```
#include <18F4550.h>
#fuses PLL5, NOWDT, NOPROTECT, NOLVP
#use delay(clock=48000000)
```

Figure 4.11: Use of PLL function in microcontroller

PLL stand for Phase Locked Loop, it is an internal clock source of microcontroller. PLL is always use to make sure a fixed input and output clock or use to change the operation system clock by using the same oscillator input. Figure 4.12 shows the effect of baud rate during data transmission from microcontroller to GSM modem.

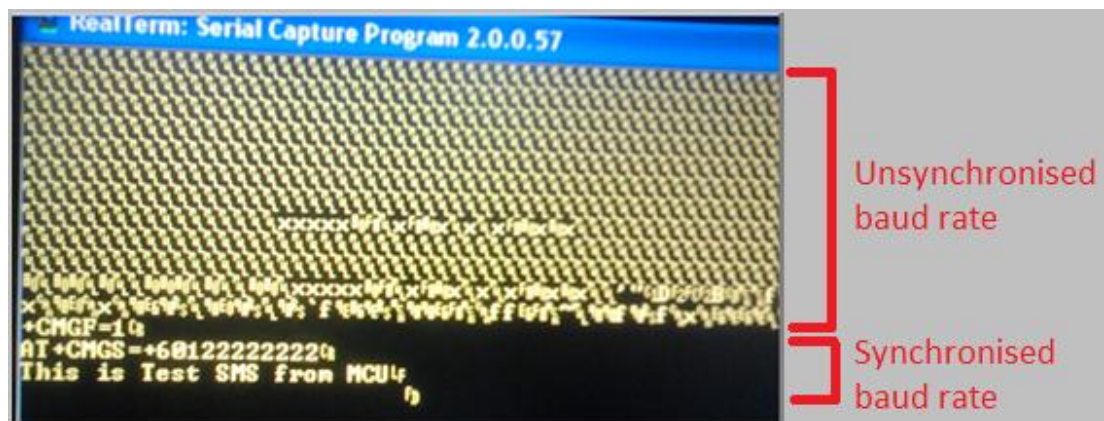


Figure 4.12: Data receive by GSM by different baud rate

After solving the handshaking and baud rate issue, SMS was sent successfully. Figure 4.13 shows the message received while panic emergency button is activated and figure 4.14 shows the message received while well condition push button had been activated. SMS will show user name, address and medical record so that rescue team can get ready before despatch.



Figure 4.13: SMS received after panic push button activated

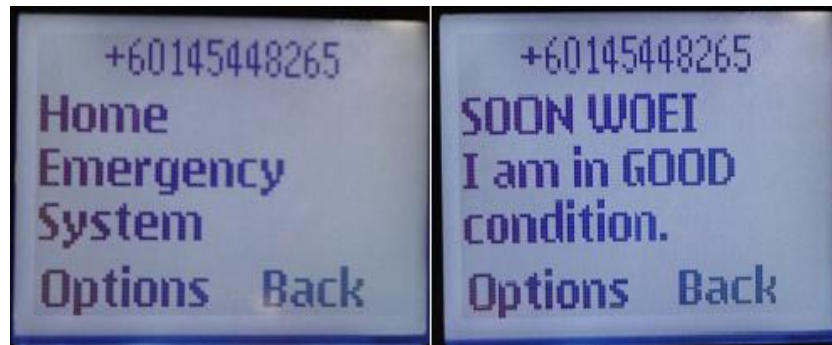


Figure 4.14: SMS received after well condition push button activated

4.4.4 Testing of Power Supply

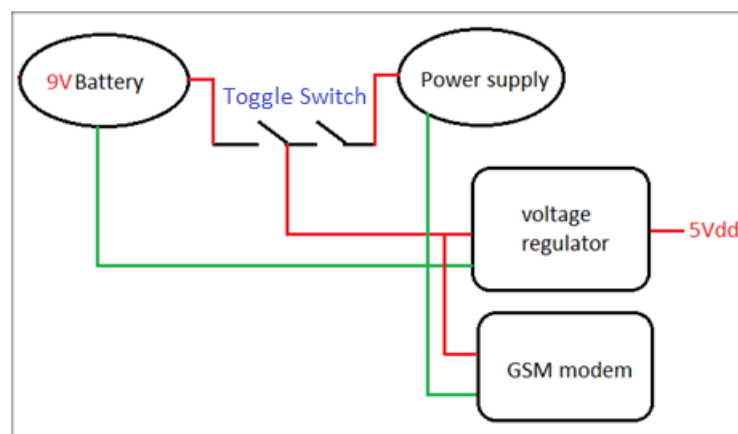


Figure 4.15: Circuit connection from different power source

This step is preceded after solving the SMS sending problems. Since this project is developing a portable emergency system, a 9V battery is trying to be implemented into the system. The system turned on successfully but failed to send SMS. This is due to the insufficient of current supply by the battery in supporting the GSM modem and this had caused the signal disappear during the data transmission process. The current use in the system is clearly shown in table 4.1.

Table 4.1: Current of different kind elements

Element	Current (mA)
9V Battery	565
PIC18F4550	25
GSM modem	300
MM74C922	0.005
MAX233	15
LED x 2	3
Buzzer	35
LCD	3

According to table 4.1, the current supply is almost the same as current consumption. After considering the current absorbed by passive load like resistor, capacitor, inductor and some losses during system operation, the system is lack of current supply and is unable to function well. So, to let the system become portable and functional, a 1A current 9V supply battery is needed.

4.5 Functional Testing

A prototype was build after done all the hardware and software tasks. Two emergency buttons are allocating at the surface of prototype and make it easier for user to activate it during emergency moment. A keypad is hiding inside the emergency beacon device since it is only use for preset user data before start to use the system. A LCD and LED are use to display the status of the system. After done the prototype, device is conducting a system test to make sure it is functioning well.



Figure 4.16: Prototype model

4.5.1 User Programmable Emergency Number and Message

The first step of using this emergency beacon system is to preset certain user information data into the system. Once the system is switch on, there will be a selection for user to edit the data by pressing 'enter' or 'escape' to maintain the preset data information that key in before.



Figure 4.17: Data edit selection

All data information is preset into the system by using a 4x4 keypad following the map as in table 4.2. Users are required to press longer the button in order to key in different kinds of alphabet. The number and alphabet key-in is depend on the design algorithm as in figure 4.3.

Table 4.2: Keypad map

1 , / - !	2 ABC	3 DEF	Menu
4 GHI	5 JKL	6 MNO	Up
7 PQRS	8 TUV	9 WXYZ	Down
Enter	0 + Space	Backspace	Escape

If user select 'enter' for the data edit, the first data that need to key in is the emergency number. System will request user to key in three emergency numbers according to the order. User may skip entering the emergency number by pressing 'enter' button. One thing has to take note is that condition well response SMS will be only send to the first preset emergency number.



Figure 4.18: Setting emergency contact numbers

After finish to key in the emergency contact numbers, the next step is to key in user address. Rescue team will despatch to this address after receive the rescue SMS from user. So, user is request to key in their actual current location to smoothing the rescue procedure. The maximum lengths of address that can store into the system consist of 48 alphabets.



Figure 4.19: Setting current address

The third data that need to preset into the system is user's name. The maximum lengths of user name that can store into the system consist of 32 alphabets.



Figure 4.20: Setting user's name

Then, the following step is to key in user's medical record. Users are advice to key in their brief medical record in order to let the rescue team understand more on user condition during the rescue operation.



Figure 4.21: Setting user's medical record

After key in emergency numbers, user's name, address and medical record, the system will start functioning. In this moment, a 30 minutes reminder alarm will start counting. User may check the preset data by pressing 'Menu' button.



Figure 4.22: System functioning

4.5.2 Sending of Emergency Message

During emergency moment, user is just need to activate the emergency button and all preset data information will be send to certain emergency contact numbers. A buzzer and a red colour LED will be turn on once the emergency button had been activated. Emergency SMS will be sent to all preset emergency numbers and system can only be reset by pressing button '1'. Figure 4.22 show the condition when SMS is sent to emergency contact number and figure 4.23 is the message that display on receiver's mobile phone.

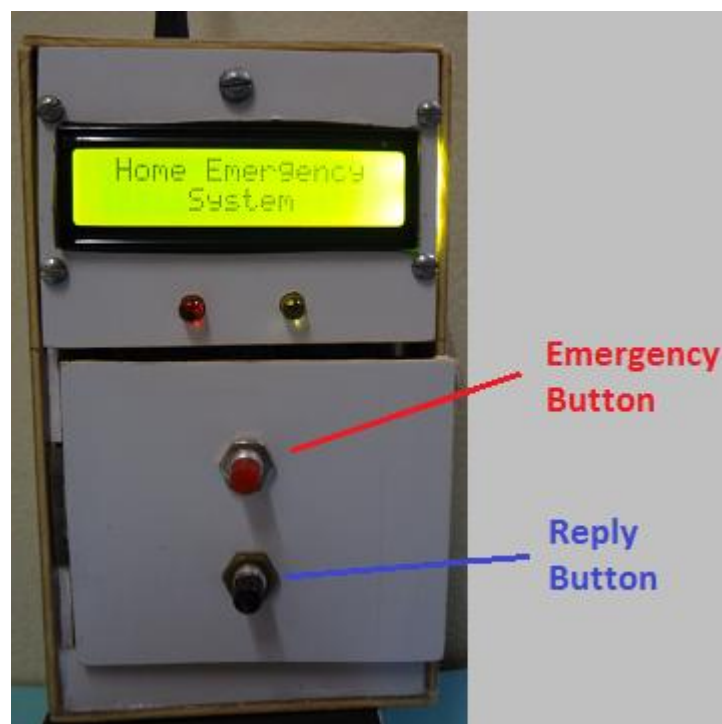


Figure 4.23: Functionary of buttons

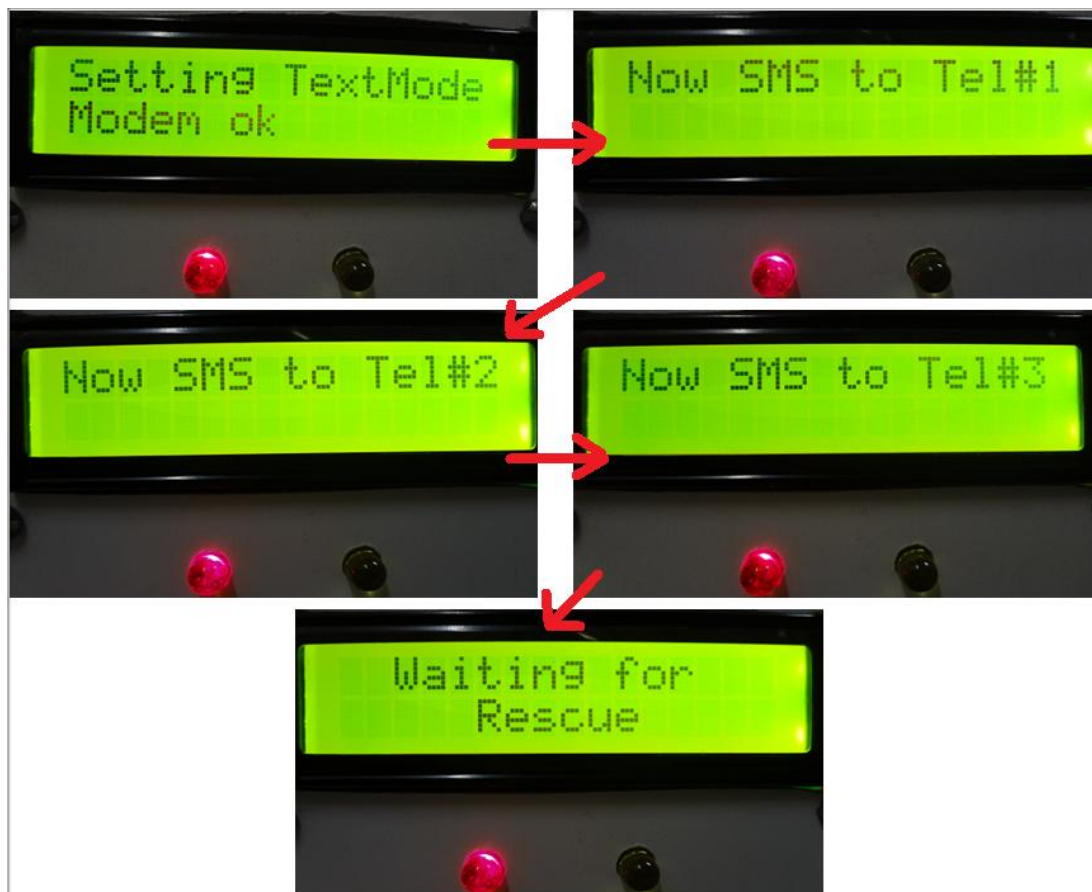


Figure 4.24: Procedure of sending emergency message

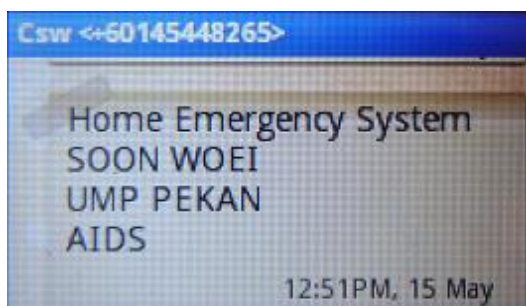


Figure 4.25: Emergency SMS receive by emergency contact number

4.5.3 Sending Well Condition Message

A well condition message will be sent to the first preset emergency contact number once the reply button has been activated to inform the user is in good condition. The user can proceed with this step after the reminder alarm is activated. Figure 4.26 shows the condition of the emergency beacon system when the reply button is activated, and Figure 4.27 shows the SMS received by the receiver's mobile phone.

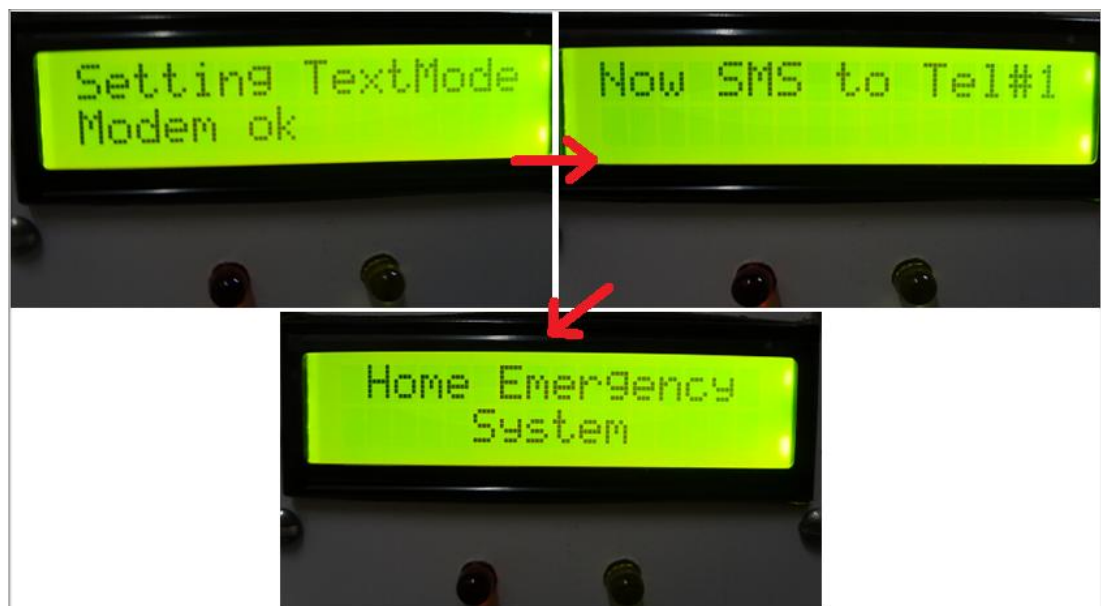


Figure 4.26: Procedure of sending well condition message

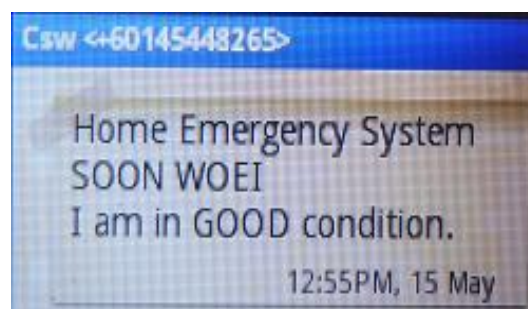


Figure 4.27: Well condition SMS received by emergency contact number

4.5.4 Reminder Alarm

A 30 minutes internal alarm is use for remind user to update their status on certain period time. Yellow colour LED will be turn on each 30 minutes and only will be turn off after either emergency and reply button had been activated. A remind SMS will automatically send to first preset emergency number after 5 minutes the reminder alarm activate if none of the button is activated as in figure 4.29.



Figure 4.28: Reminder alarm activating

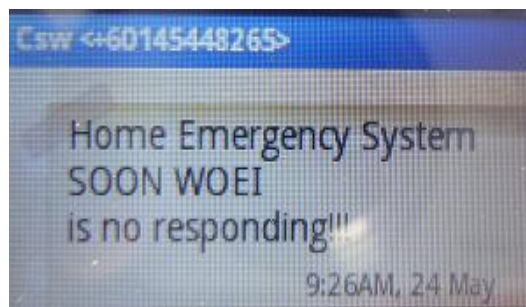


Figure 4.29: Reminder SMS receive by emergency contact number

4.6 Discussion

The development of program algorithm and hardware interfacing between GSM modem and microcontroller is success after solving the handshaking and baud rate issue. SMS is successfully to send using the GSM network.

User data can be also save into the system which include three emergency contact numbers, user's address, user's name and user's medical record. These data is programmable and do not volatise during voltage supply interruption by storing these data into EEPROM.

Emergency SMS and condition well SMS is successfully send to the preset emergency contact numbers by using emergency button and reply button. Both of the buttons are easy to activate during panic situation.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter will discuss the conclusion from the overall project outcome and future recommendation work for enhancement.

5.2 Conclusion

As conclusion, the objective of the project has been achieved as mentioned in chapter 1 including all the project scope. An emergency beacon for elderly has been successfully developed.

However, a few problems like SMS can only be successfully send when the signal of GSM from service provider is strong enough still exists. This is due to the poor design architecture of the GSM antennal. The antennal is not strong enough to receive and transmit signal from the telecommunication tower. This problem can be solved by change the antennal to a higher gain antenna. In order to make the system

become more applicable, wire wrapping connection circuit should be changed to printed circuit board in real life application, so the size of this emergency beacon system will become smaller and easy to carry.

A lot of programming and hardware knowledge are gained from the development of this project. The process of sending a SMS is clearly discovered throughout the project. With this emergency beacon system, it can reduce the worries for those who have elderly in their home. The cost of this emergency beacon system is estimated to be around RM250 under mass production, and is affordable by the public.

5.3 Future Recommendation

Despite the fact that this project has been successfully implemented, it can be improved for future usage to target higher market demand and better applications. For future improvement, there are several recommendations that can be done to achieve to next level:

- i. A GPS based GSM modem can be use to represent the current GSM modem. With the GPS function, users are only needed to update their current location if they are in indoor places. Unexpected situation like faint suddenly while user is walking from one point to another destination can be detected
- ii. A small size high current battery can be attached to the emergency beacon system. With the battery, the system does not required to be connected to a power supply frequently. It brings a lot of convenience for user to carry the system to any places.

- iii. A bigger LCD can be implemented on the emergency beacon system, so that user can read pre-store message content clearer without having to scroll up and down the display.

5.4 Commercialization

Although there is some emergency beacon system available in market, but all of the emergency system is consisting some weakness like too expensive, non-portable, less preset emergency numbers and without SMS service.

This emergency beacon system is improved based on the above weakness and bringing a lot of benefit to user. Only a SIM card is needed to function the emergency beacon system and it is quite user friendly. User information data is need to key in at the first time when use the system and will not volatile although there is a current supply interruption.

The target market of this emergency beacon will be those people who have elderly in their home. With a microcontroller and GSM module, this system is available below price RM250 and it is affordable by public.

REFERENCES

- [1] Ma Yuchun et al., "General Application Research on GSM Module", 2011 International Conference on Internet Computing and Information Services, Sanya, China, Sept.17, 2011
- [2] Adam Fendelman. About.com - What is GSM. [Online]. Available: <http://cellphones.about.com/od/phoneglossary/g/gsm.htm>
- [3] Mohamed F. Madkour, "Effect of High GSM Voice Traffic on GPRS Data Network and the Proposed Solutions", unpublished.
- [4] Andrea Basso et al., "Performance Evaluation of MPEG-4 Video over Realistic EDGE Wireless Networks", The 5th International Symposium on Wireless Personal Multimedia Communications, vol. 3, pp. 1118- 1122, Oct.27 2002
- [5] O'Mahony, D., "UMTS: the fusion of fixed and mobile networking", Internet Computing, IEEE, vol.2, pp. 49- 56, Feb 1988
- [6] "List of GSM cell phone frequencies by country", <http://allworldcellphones.com/gsm-frequencies-list.htm>
- [7] "GSM Frequencies and Frequency Bands", http://www.radio-electronics.com/info/cellulartelecomms/gsm_technical/gsm-frequency-frequencies-bands-allocations.php
- [8] Vieri Vanghi et al., "Frequency Coordination between UMTS and GSM Systems at 900 MHZ", The 18th Annual IEEE International Symposium on Personal, Indoor and Mobile Radio Communications (PIMRC'07), 2007
- [9] Moe Rahnema, "Ovewiew of The GSM System and Protocol Architecture", IEEE Communications Magazine, pp. 92 - 100, April 1993

- [10] Martini, G., Rosenga, G., "Distributed Architecture for Applications based on the GSM Short Message Service", Services in Distributed and Networked Environments, 1995., Second International Workshop, pp. 140- 145, 1995
- [11] Lars Pettersson, "SMS and the PDU format", <http://www.dreamfabric.com/sms/>
- [12] "Introduction to AT Commands", <http://www.developershome.com/sms/atCommandsIntro.asp>
- [13] "Introduction to GSM / GPRS Wireless Modems", <http://www.developershome.com/sms/GSMModemIntro.asp>
- [14] "Applications of GSM Modem", http://www.ravirajtech.com/Applications_of_GSM_Modem.html
- [15] Dak. (2011, February 8). Panic Button – Emergency Button for Elderly. [Online]. Available:<http://expertscolumn.com/content/panic-button-emergency-button-elderly>
- [16] Tracy Ann Smith. (2010, December 08). Panic Buttons For The Elderly. [Online]. Available:<http://ezinearticles.com/?Panic-Buttons-For-The-Elderly&id=5516461>
- [17] Mostafa Hashem Sherif, Multimedia Networks and the Public Switched Telephone Network, IEEE Communications Magazine, January 1996, pp.92-94.
- [18] PRLog, Call Button For Elderly, United States, Oct 11, 2009
- [19] Emergency Phone Dialer Owner's Manual, RadioShack, 1999.
- [20] Mohammad Shirali-Shahreza1 et al., "Rescue SMS", 2006 ICASE, SICE-ICASE International Joint Conference 2006, Bexco, Busan, Korea, Oct.18-21, 2006

- [21] Mohammad Shirali-Shahreza, "Emergency SMS", 2006 ICASE, SICE-ICASE International Joint Conference 2006, Bexco, Busan, Korea, Oct.18-21, 2006
- [22] First Alarm, First Response Medical Alert Systems, New York, 2009
- [23] Kosuke Miyauchi et al., "A Mobile phone-based Safety and Life Support System for Elderly People", unpublished.
- [24] Kamlesh Patel. (2008, September 16). Wireless Security GSM, LAN and Wi-Fi Networks. [Online]. Available:<http://www.articlesbase.com/information-technology-articles/wireless-security-gsm-lan-and-wifi-networks-564519.html>
- [25] Brick House Security, Spark Nano 3.0, United States, 2011
- [26] Kelly Jackson Higgins. (2010, March 19). Personal Panic-Button Apps Land On Mobile Phones. Available:<http://www.darkreading.com/blog/227700689/personal-panic-button-apps-land-on-mobile-phones.html>
- [27] Google Play Android, Emergency +, United States, February 19, 2012
- [28] Christopher Pavlovski et al., "Ubiquitous Mobility in Clinical Healthcare", IDEAS-DH'04, IDEAS Workshop on Medical Information Systems, 2004
- [29] Bruce Tang and David E. Dodds, "Weak Signal GPS Synchronization For Locating In-Building Cellular Telephones", IEEE CCECE/CCGEI, Ottawa, May 2006
- [30] Robert A. Malaney, "A Secure and Energy Efficient Scheme for Wireless VoIP Emergency Service", unpublished.
- [31] Bharath Patil et al., "Energy Saving Techniques For GPS Based Tracking Applications", unpublished.

[32] Mi Zhao et al., "Directional Wi-Fi Based Indoor Location System for Emergency", 2010 Symposia and Workshops on Ubiquitous, Autonomic and Trusted Computing, 2010

[33] Pavel Pesout and Ondrej Matustik, "On The Way To Smart Emergency System", 2010 Seventh International Conference on Information Technology, 2010

APPENDIX A

Source code for whole project “Emergency Beacon for Elderly system”

```

#include <18F4550.h>
#include "mylcd.c"
#include <string.h>

#define KV=Port_A.14
#define SW0=Port_B.0
#define SW1=Port_B.1
#define Buzzer PIN_B5
#define LED1 PIN_B6
#define LED2 PIN_B7

char LcdDisplay[16];
char PhoneNumber[#14];
char House[48];
char Name[132];
char MediRec[480];
char AT_command[50];
char gsm_response[80];

int const Key[16][6]=
{
  {'1', ',', '/', '-', '!', '\0' },
  {'2', 'A', 'B', 'C', '\0', '\0' },
  {'3', 'D', 'E', 'F', '\0', '\0' },
  {'Menu', '\0', '\0', '\0', '\0', '\0' },

  {'4', 'G', 'H', 'I', '\0', '\0' },
  {'5', 'J', 'K', 'L', '\0', '\0' },
  {'6', 'M', 'N', 'O', '\0', '\0' },
  {'Up', '\0', '\0', '\0', '\0', '\0' },

  {'7', 'P', 'Q', 'R', 'S', '\0' },
  {'8', 'T', 'U', 'V', '\0', '\0' },
  {'9', 'W', 'X', 'Y', 'Z', '\0' },
  {'Down', '\0', '\0', '\0', '\0', '\0' },

  {'Ent', '\0', '\0', '\0', '\0', '\0' },
  {'0', '+', '-', '\0', '\0', '\0' },
  {'Bs', '\0', '\0', '\0', '\0', '\0' },
  {'Esc', '\0', '\0', '\0', '\0', '\0' }
}

void ClearRom()
{
  int x;
  for(x=0;x<16;x++)

```

```

    {
        LcdDisplay[x]='\0';
    }
}
/////////////////////////////////////////////////////////////////
void SaveTelNo(int TelNoIndex)
{
int Pos,BaseAdd;
BaseAdd=(TelNoIndex-1)*4;

    for(Pos=0;Pos<4;Pos++)
    {
        write_eeprom(BaseAdd+Pos,PhoneNumber[Pos]);
    }
}
/////////////////////////////////////////////////////////////////
void LoadTelNo(int TelNoIndex)
{
int Pos,BaseAdd;
BaseAdd=(TelNoIndex-1)*11;

    for(Pos=0;Pos<11;Pos++)
    {
        PhoneNumber[Pos]=read_eeprom(BaseAdd+Pos);
    }
}
/////////////////////////////////////////////////////////////////
void KeyPhoneNumber()
{
int i=1;
int BackSpace=0;
int EnterKey=0;

    switch(Key)
    {

        case 1;
            if(!BackSpace && i<14)i++;
            BackSpace=0;
            if(EnterKey==1)return;
            break;
            delay_ms(300);
            goto start;
    }
}
void EnterPhone()
{
    lcd_putc("\fEnter Phone #1");
    lcd_putc("\n\3");
    ClearRom();
    KeyPhoneNumber();
}

```

```

TelNo(1);
lcd_putc("\f\4Phone #1");
lcd_putc("\nSave");

LoadTelNo(10);
lcd_putc("\fPhone #1 is load");
printf(lcd_putc,"\n%s",PhoneNumber);

lcd_putc("\fEnter Phone #2");
lcd_putc("\n\3");
ClearRom();
KeyPhoneNumber();
}

////////////////////////////////////

void KeyMain()
{
int SubKeyCnt=0;
KeyNo=Port_A & 0x00;
Key= Keys[KeyNo][SubKeyCnt];

if(Key==Ent)
{
EnterPhone();
Key=Esc;
}
}

////////////////////////////////////

void gsm_send_command()
{
int p=0;
int charSend;
do
{
charSend=AT_Command[p];
delay_ms(10);
putc(charSend);
p;
}while (charSend!="0");
}
void GSMWell()
{
ModemWell:
if( KV \& Key!=Esc)return;
lcd_putc("\fSetting TextMode");
delay_ms(200);
}

```

```

printf(AT_Command,"AT+CMGF=1\r");
gsm_send_command();
if (gsm_read_OK())
{
    lcd_putc("\nModem ok");
}
else
{
    lcd_putc("\nModem fail");
    delay_ms(500);
    goto ModemWell;
}
////////////////////
// Send SMS 1
////////////////////
Well1:
    lcd_putc("\fLoad Phone #1");
    LoadTelNo(1);
    printf(lcd_putc,"\n%s",PhoneNumber);
    if(PhoneNumber[0]!='+')goto WellFinish;

    lcd_putc("\fNow SMS to Tel#1");
    printf(AT_Command,"AT+CMGS=\x22%s\x22\r",PhoneNumber);
    gsm_send_command();
    printf(AT_Command,"Home Emergency System\r");
    printf(AT_Command,"%s\r",Name);
    gsm_send_command();
    printf(AT_Command,"I am in GOOD condition.");
    gsm_send_command();

    if (gsm_read_CMGS())
    {
        lcd_putc("\nSMS1 Send ok");
        delay_ms(500);
    }
    else
    {
        lcd_putc("\nSMS1 Send fail");
        delay_ms(500);
        Well1;
    }
WellFinish;
    delay_ms(300);
}
void Data()
{
    DataStart;
    KeyNo=Port_A & 0x0F;
    Key= Keys[KeyNo][0];
    int i=1;

```

```

if(KeyV)
{
    if(Key==Up)
        if(i<=1)
            {
                i=7;
            }
        else
            {
                i;
            }
    if(Key==Down)
        if(i>=7)
            {
                i=1;
            }
        else
            {
                i;
            }
    delay_ms(200);
}

if(i==1)
{
    lcd_putc("\fPhone #1");
    delay_ms(100);
}

if(Key==Ent || i==1)
{
    while(Key!=Esc)
    {
        Key= Keys[KeyNo][0];
        LoadTelNo(1);
        lcd_putc("\fPhone #1 is");
        printf(lcd_putc,"\n%s",PhoneNumber);
        delay_ms(200);
    }
    DataStart;
}
if(Key==Ent && i==2)
{
    while(Key!=Esc)
    {
        Key= Keys[KeyNo][0];
        LoadTelNo(2);
        lcd_putc("\fPhone #2 is");
        printf(lcd_putc,"\n%s",PhoneNumber);
    }
}

```

```

        delay_ms(200);
    }
    DataStart;
}
if(Key==Ent && i==3)
{
    while(Key!=Esc)
    {
        Key= Keys[KeyNo][0];
        LoadTelNo(3);
        lcd_putc("\fPhone #3 is");
        printf(lcd_putc,"\n%s",PhoneNumber);
        delay_ms(200);
    }
    DataStart;
}
DataReset;
Key='1';
return;
}

////////////////////////////////////
void main()
{
int k=0;
TimeOutCounter;
BuzzerCounter;
Port_A=0;
Port_C=0;
lcd_init();
TimeOutCounter=1800000;
BuzzerCounter=2400000;

SystemRestart;
    lcd_putc("\fData Edit:");
    lcd_putc("\nEnter / Return");

    while (Key!=Esc)
    {
        KeyMain();
    }
    lcd_putc("\f Home Emergency");
    lcd_putc("\n  System");

    while (FALSE)
    {
        if(KV)
        {
            KeyNo=Port_A & 0x0F;
            Key= Keys[KeyNo][0];

```

```

if(Key==Menu)
{
    Data();
    lcd_putc("\f Home Emergency");
    lcd_putc("\n  System");
}
if(Key=='1')
{
    output_low(LED1);
    output_low(LED2);
    output_low(Buzzer);
    k=0;
    SystemRestart;
}
}
if(!SW0)
{
    output_low(LED2);
    output_low(Buzzer);
    GSMWell();
    lcd_putc("\f Home Emergency");
    lcd_putc("\n  System");
    TimeOutCounter=1800000;
    BuzzerCounter=2400000;
    k=0;
}
if(!SW1)
{
    output_low(LED2);
    output_high(LED1);
    output_high(Buzzer);
    GSM();
    lcd_putc("\f Waiting for");
    lcd_putc("\n  Rescue");
    TimeOutCounter=1800000;
    BuzzerCounter=2400000;
    k=0;
}
if(BuzzerCounter==0 && k==1)
{
    GSMCheck();
    lcd_putc("\fPlease update");
    lcd_putc("\ncurrent status!");
    TimeOutCounter=1800000;
    BuzzerCounter=2400000;
    k=0;
}
}
}
}

```

APPENDIX B

Circuit diagram

