DEMOCRATIC AND POPULAR REPUBLIC OF ALGERIA
MINISTRY OF HIGHER EDUCATION AND SCIENTIFIC RESEARCH

University Kasdi Merbah Ouargla
Department of Electronic and telecommunications

Matser Thesis

Home Automation System Controlled by Cell Phone using DTMF Technique

Presented by:
Mammadi Mohammed Lamine
Mokadem Zakaria

In partial fulfillment of the requirements
For the Matser degree in: Electronic, embedded systems

Jury members:

Mr. Abdessemed Djalal	Chair man	University Ouargla
Mrs. Samia Gamouh	Supervisor	University Ouargla
Mr. Benathmane Khaled	Jury member	University Ouargla

Ouargla, Algeria, 2020

Abstract

Generally, appliances used in our home are controlled with the help of switches that it need our presence to control them. we can see automation of these appliances using many technologies.Our project presents that how to control home appliances using DTMF technology. The process of home automation works by making everything in the house automatically controlled using technology to control and do the services that we would normally do manually.This project uses the Dual-Tone Multi Frequency (DTMF) technique which used in telephones, to control multi electronic devices from long distances using the cell phone. A practical application case for this system was implemented to control some electronic devices.The automation features makes it possible for us to control remotely a large number of appliances, such as TV, Air Conditioner, Fan, light and many more by using our cell phone. In this project we will give a circuit that let us operate the home appliances from the office or any other remote place.For example if anyone forgot to switch off the lights or other appliances while going out, it can help him you to turn off those appliances with his cell phone. The cell phone works as remote control to home appliances.We can control the desired appliance by press on the corresponding key. The system also gives us voice acknowledgement of the appliance status.
Keywords: Smart home,Home automation,DTMF,Dualt-tone Multi-frequency,Control system

ملخص

عموما، يتم التحكم في الأجهزة المستخدمة في المنازل بمساعدة المرحلات التي تحتاج وجودنا للتحكم فيها. يمكننا أن نرى أتمتة هذه الأجهزة باستخدام العديد من التقنيات الحديثة ، تتمثل عملية أتمتة المنزل في جعل كل شيء فيه تلقائي التحكم باستخدام التكنولوجيا للقيام بخدمات عادة ما نقوم بها يدويًا .
يقدم مشروعنا كيفية التحكم في الأجهزة المنزلية باستخدام تقنية$DualToneMultiFrequenc$الموجودة في الهواتف للتحكم عن بعد في عدد غير محدود من الأجهزة ، مثل التلفزيون ومكيف الهواء والمروحة والضوء وغيرها الكثير باستخدام الهاتف الخلوي كجهاز تحكم عن بعد مع اعطاء إقرار صوتي لحالة الأجهزة.
في هذا المشروع ، سنقدم دائرة كاملة للنظام ومحاكاتها على منصة $proteus$ حيث يمكن التحكم بها في الأجهزة المطلوبة عن طريق المفاتيح .

الكلمات المفتاحية : المنزل الذكي ، أتمتة المنزل ، $DTMF$ ، نغمة متعددة الترددات ، نظام تحكم في المنازل

Résumé

Généralement, les appareils utilisés dans notre maison sont contrôlés à l'aide d'interrupteurs dont il a besoin de notre présence . nous pouvons voir l'automatisation de ces appareils à l'aide de nombreuses technologies.Notre projet présente comment contrôler les appareils à l'aide de la technologie DTMF. Le processus fonctionne en rendant tout dans la maison et automatiquement commandé à l'aide de la technologie pour faire les services que nous ferions normalement manuellement.Ce projet utilise la technique Dual-Tone Multi Frequency (DTMF) qui utilisée dans les téléphones, pour contrôler plusieurs appareils électroniques à longue distance par utilisant le téléphone portable. Un cas d'application pratique pour ce système a été mis en œuvre pour contrôler certains appareils électroniques.Les fonctions d'automatisation nous permettent de contrôler à distance un grand nombre d'appareils, tels que la télévision, le climatiseur, le ventilateur, la lumière et bien d'autres en utilisant notre téléphone portable. . Dans ce projet, nous donnerons un circuit qui nous permettra de faire allumer les appareils électroménagers à partir du bureau ou de tout autre endroit éloigné.Par exemple, si quelqu'un a oublié d'éteindre les lumières ou d'autres appareils en sortant, cela peut vous aider à les éteindre.Les appareils électroménagers avec son téléphone portable. Le téléphone portable fonctionne comme télécommande pour les appareils ménagers.Nous pouvons contrôler l'appareil souhaité en appuyant sur la touche correspondante. Le système nous donne également un accusé de réception vocal de l'état de l'appareil.
Mots clés : Maison intelligente, Domotique, DTMF, Double-tone multi-fréquence, Système de contrôle

Acknowledgements

At the outset , i would like to express my sincere gratitude and appreciation to Mr,The committee chairman **Abdessemed Djalal** , and Jury member **Mr Benathmane Khaled** , Mrs supervising professor **Samia Gamouh** to evaluate this humble work which is entitled **Home Automation System Controlled by cellphone Using DTMF Technique** .
At this level of understanding, it is often difficult to understand the wide spectrum of knowledge without proper guidance and advice. Hence, we take this opportunity to express our heartfelt gratitude to our project guide **Mrs Samia Gamouh** for her immense interest, valuable guidance, constant inspiration and kind co-operation throughout the period of work undertaken. she had faith in us and guide us working on this project , which has been instrumented successfully . On a personal note, I would like to thank my parents,for their support and understanding throughout this project.
We also acknowledge our profound sense of gratitude to all the teachers who have been instrumental for providing us the technical knowledge and moral support to complete the project with full understanding especially **Mr Radouan Kafi** who helped me working with Latex in more professional way for texts editing . Equally we are thankful to our colleagues and students who challenged us to make this project.
Finally, we would like to thank all the people who directly or indirectly have contributed to the completion of this project.

Table of Contents

List of Tables

List of Figures

List of abbreviations

ATT	American Telephone and Telegraph
CCITT	Consultative Committee on International Telephony and Telegraphy
DFT	Discrete Fourier Transform
DTMF	Dual-Tone Multi-Frequency
FFT	fast Fourier Transform
GFSK	frequency-shift keying
GMSK	Gaussian minimum shift keying
GPS	Global Positioning Systems
GSM	Global System for Mobile Communication
IC	Integrated Circuit
LED	light-emitting diodes
IEEE	Institute of Electrical and Electronics Engineers
IP	Internet Protocol
IR	Infrared
IrDA	Infrared Data Association
ISM	Industrial, Scientific and Medical
ITU	International Telecommunications Union
LAN	Local Area Network
MFPB	Multi-Frequency, Push Button
PAN	Personal Area Network
PCB	Printed Circuit Board
PIC	programmable interface Controller
SD	Secure Digital
SMS	short message service
UART	Universal Asynchronous Receiver/ Transmitter

.

General Introduction

Today, technology has become an integrated part of people's lives. It has, and it continues to influence many aspects of daily life.Many devices such as mobile phones and computers have made many people relying on technology to communicate with their friends.The Smartphones have allowed people to connect to the internet without a computer, while still offering the same functionality but through different ways. A field that is recently gaining popularity is home automation which can also use cell phones as information or control functionality, the major aspect is how the cellphone can connect and communicate with other devices.
the issue is that these devices cannot communicate with each other or require an additional device to do so but it need an individual application on the cell phone or smartphone to be controlled, a much better option is to unify these devices into one program/device that controls them. As an example, it can control the lights, microwave, oven, TV, air-conditioning and door locks through one application on the cell phone, this gives more ability to control the home, and simplify many manual actions.
In this project we had firstly talked about The automation history and its definition ,types,the home automation as one type of automation and Its control systems and implementation platforms,that's all in the 1st chapter.
The 2nd chapter is about the original of DTMF technique and how it works, (the theory of the operation) .
The 3rd one is about the design of the system we created (Home Automation System), its architecture and how it operate.
The last chapter is about the simulation of the project to control 04 appliances by using cell phone.

Chapter 1

Overview on Home automation control systems

1.1 Introduction

Home automation, called also a smart home, is a home used an automation system to control lighting, climate, entertainment systems, and appliances. It may also include home security such as access control and alarm systems. A home automation system typically connects controlled devices with the users to control the system uses either wall-mounted terminals, tablet or desktop computers, or the cell phone when we need a remote control. Home automation can detect and identify the persons , automatically adjust the lighting to predefined taste, open doors automatically, play a music, water the flowers in the morning, switch on the security lights at night and switch them off in the morning, heat water for bathe and tea, that makes it possible to link lighting, entertainment environment, security, telecommunications, heating, and air conditioning into one central controlled system.

1.2 History of home automation

Home automation has been around since the first world war, in fact, the television remote was patented in 1893 . Since then different home automation systems have evolved with a sharp rise after the second World War. Its growth has been through various informal research and designs by technology enthusiasts who want a better way of getting things done at home without much effort on their part[17]. The systems evolved from one that can automatically do routine chores like switch on and off security lights, to more sophisticated ones that can adjust lighting, put the television channel to favourite station and control doors.

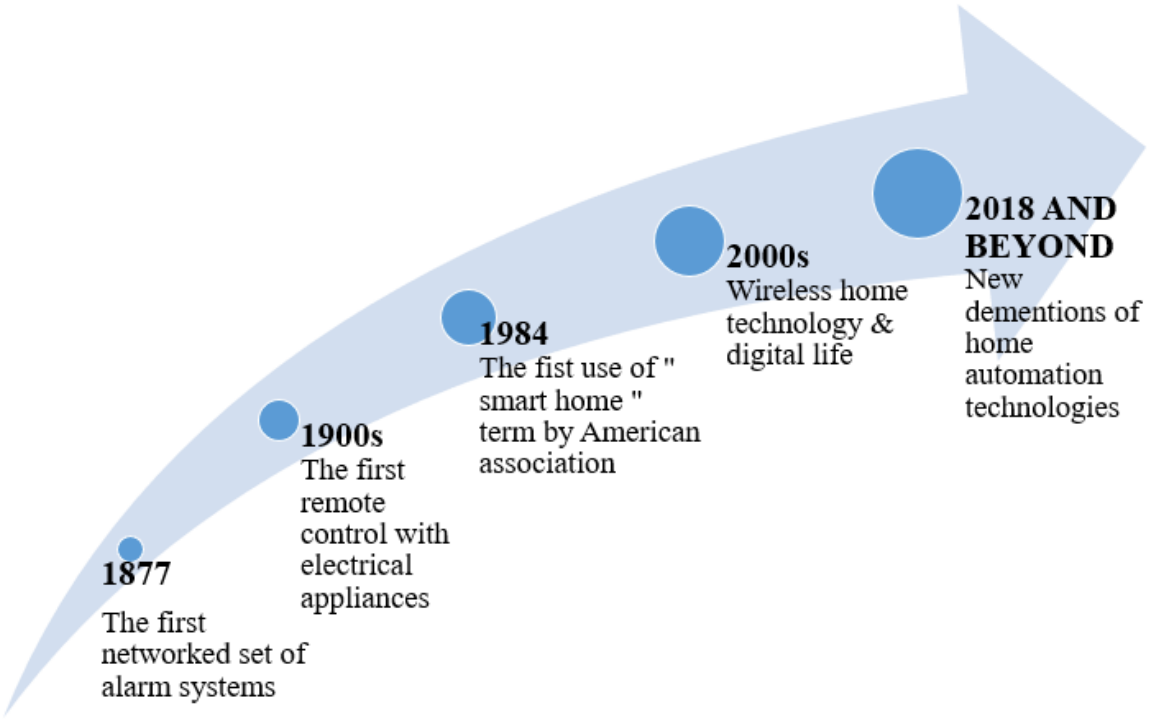


Figure 1.1: The timeline of home automation technology

1.3 Definition of automation

Automation is the use of control systems and information technology to control equipment, industrial machines and processes, reducing the human intervention. In the scope of industrialization, automation is a step after mechanization. Mechanization provided human operators with machines to assist them with the physical requirements of work while automation greatly reduces the need for human sensory and mental requirements as well.
The automation system replaces the conventional hard-wired relay system by automating the process functions using various hardware and software tools with minimal human intervention. There are different types of automation systems used in different applications, automated systems are not similar, Depends on application area and control nature, there are Office automation, Building automation, Power automation etc ... We will detail more the important one of them which is “Home automation».

1.4 Home automation

Home automation is an emerging practice of increased automation of household appliances and features in houses.

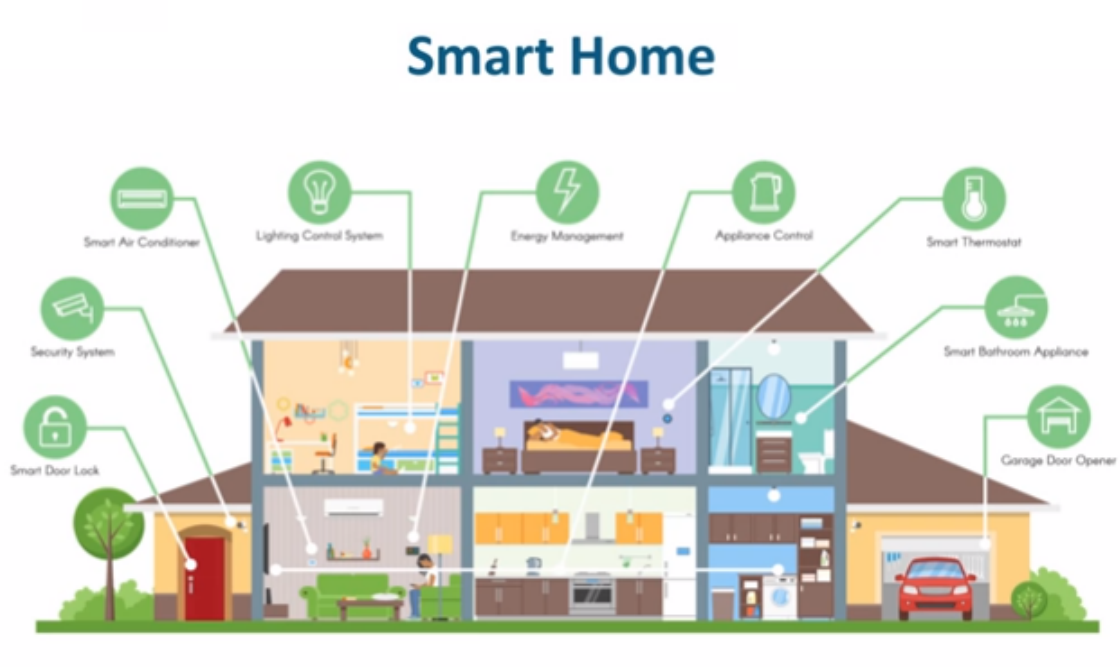


Figure 1.2: smart home

Home automation includes all that a building automation provides like climate controls, door and window controls, and in addition control of multimedia home theatres, pet feeding, plant watering and so on. But there exists a difference in that home automation emphasizes more on comforts through ergonomics and ease of operation.[17]

1.4.1 Home automation control systems

Home automation systems are an electronic systems in homes and residential buildings that make possible the automation of household appliances.
The new stream of home automation systems has developed into a vast one ,it can be an program/device use one or more technique .

The types of home automation systems based on their control systems are:

Figure 1.3: home automation control systems

1.4.1.1 Individual control systems :

These types were the first home automation systems in the early years, here each device has an independent control dedicated to it.[17]

1.4.1.2 Distributed control systems :

The main feature of these type of systems is emergency shut-down. With this system you can preset or change the control parameters of several similar devices, for example, the thermostat of several air conditioners and their ON/OFF timings.[17]

1.4.1.3 Central control systems :

These are computerized systems programmed to handle all functions of multiple utilities like air conditioning system, home entertainments, doors,windows, refrigerators and cooking systems, all at the same time. It is connected to the control system through telephone or internet from anywhere in the world.[17]

Figure 1.4: Central control systems

1.4.2 Carrier modes of home automation system :

There are many types of home automation systems based on different carrier mode which are:

1.4.2.1 Powerline carrier systems:

The least expensive type of home automation system operates over the home's existing wiring, or powerline carrier. These can range from lamp timers, to more sophisticated systems that require installation by a trained professional.[17]

1.4.2.2 Wireless systems:

Wireless systems utilize radio frequency technology. They are often used to operate lights or in conjunction with a hardwired lighting control system.[17]

1.4.2.3 Hardwired systems :

Wired, or "hardwired" home control systems are the most reliable and expensive. These systems can operate over high-grade communications cable , or their own proprietary "bus" cable. That is why it is best to plan for them when a house is being constructed. Hardwired systems can perform more tasks at a time and do them quickly and reliably, making them ideal for larger homes. They can also integrate more systems in the home, effectively tying together indoor and outdoor lighting, audio and video equipment, security system, even the heating and cooling system into one control package .[17]

1.4.2.4 Internet protocol control system :

Internet Protocol (IP) control automation system uses the internet, gives each device under its control an Internet Protocol address, and creates a local area network (LAN) in the home. Hence, the home can be interacted with over the internet with possibility of live video streaming and real-time control.[17]

1.4.3 Home automation implementation platforms :

Home automation can be implemented over a number of platforms namely, Powerline, RS232 serial communication, Ethernet, Bluetooth, Infrared and GSM. Each platform having its own peculiarity and area of application.[17]

1.4.3.1 Powerline communication :

Powerline communication is a system for carrying data on a powerline conductor also used for electrical power transmission. Though electrical power is transmitted over high voltage transmission lines, distributed over medium voltage and used inside buildings at lower voltages, powerline communication can be applied at each stage. All powerline communication systems operate by impressing a modulated carrier signal on the wiring system. Different types of powerline communications use different frequency bands, depending on the signal transmission characteristics of the power wiring used. Since the power wiring system was originally intended for transmission of alternating current (AC) power, in conventional use, the power wire circuits have only a limited ability to carry higher frequencies. The propagation problem is a limiting factor for each type of powerline communications. Data rates over a powerline communications system vary widely. Low-frequency (about 100 – 200 KHz) carriers pressed on high-voltage transmission lines carry one or two control circuits with an equivalent data rate of a few hundred bits per second; however, these circuits may be many Kilometers long.[17]

1.4.3.2 Ethernet :

Ethernet defines a number of wiring and signaling standards for the physical connection of two or more devices together. Ethernet was originally based on the idea of computers communicating over a shared coaxial cable acting as a broadcast transmission medium. The methods used show some similarities to radio systems, although there are fundamental differences, such as the fact that it is much easier to detect collisions in a cable broadcast system than a radio broadcast. The common cable providing the communication channel was likened to the ether and it was from this reference that the name "Ethernet" was derived. From this early and comparatively simple concept, Ethernet evolved into the complex networking technology that today underlies most local area networks. The coaxial cable was replaced with point-to-point links connected by Ethernet hubs and/or switches to reduce installation costs, increase reliability, and enable point-to-point management and troubleshooting. StarLAN was the first step in the evolution of Ethernet from a coaxial cable bus to a hub-managed, twisted-pair network. The advent of twisted-pair wiring dramatically lowered installation costs relative to competing technologies, including the older

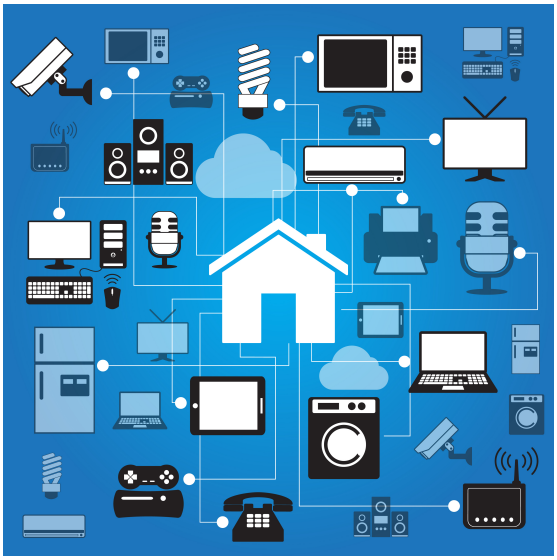


Figure 1.5: powerline carrier systems

Ethernet technologies. Through the physical connection, Ethernet stations communicate by sending each other data packets, blocks of data that are individually sent and delivered. Despite the significant changes in Ethernet from a thick coaxial cable bus running at 10 Mbits/s to point-to-point links running at 1 Gbit/s and above, all generations of Ethernet (excluding early experimental versions) share the same frame formats (and hence the same interface for higher layers), and can be readily interconnected. [1]

1.4.3.3 Bluetooth :

Bluetooth is an open wireless protocol for exchanging data over short distances from fixed and mobile devices, creating personal area networks (PANs). It was originally conceived as a wireless alternative to RS232 data cables. It can connect several devices, overcoming problems of synchronization. It is a standard and a communications protocol primarily designed for low power consumption, with a short range (power-class-dependent: 1 meter, 10 meters, 100 meters) based on low-cost transceiver microchips in each device. Bluetooth makes it possible for devices to communicate with each other when they are in range. Because the devices use a radio (broadcast) communications system, they do not have to be in line of sight of each other. Bluetooth uses a radio technology called frequency-hopping spread spectrum, which chops up the data being sent and transmits chunks of it on up to 79 frequencies. In its basic mode, the modulation is Gaussian frequency-shift keying (GFSK). It can achieve a gross data rate of 1 Mb/s. Bluetooth provides a way to connect and exchange information between devices such as mobile phones, telephones, laptops, personal computers, printers, Global Positioning Systems (GPS) receivers, digital cameras, and video game consoles through a secure, globally unlicensed Industrial, Scientific and Medical (ISM) 2.4 GHz short-range radio frequency band.

1.4.3.4 Infrared :

Infrared (IR) radiation is electromagnetic radiation whose wavelength is longer than that of visible light (400 – 700 nm), but shorter than that of microwave radiation. It's wavelength spans between 750nm and 100 µm and is employed in short-range communication among devices that conform to the standards published by the Infrared Data Association (IrDA). Remote controls and IrDA devices use infrared light-emitting diodes (LEDs) to emit infrared radiation which is focused by a plastic lens into a narrow beam. The beam is modulated, i.e. switched on and off, to encode the data. The receiver uses a silicon photo-diode to convert the infrared radiation to an electric current. It responds only to the rapidly pulsing signal created by the transmitter, and filters out slowly changing infrared radiation from ambient light. Infrared communications are useful for indoor use in areas of high population density. IR does not penetrate walls and so does not interfere with other devices in adjoining rooms. Infrared is the most common way for remote controls to command appliances.[17]

1.4.3.5 GSM :

Figure 1.6: wireless control device

GSM which stands for Global System for Mobile Communication, is the most popular standard for mobile phone communication in the world. It is used by over three billion people across more than 212 countries and territories [1]. GSM basically provides voice call and short message service (SMS). It operates as a cellular network that mobile phones connect to by trying to search for cells in their immediate vicinity. The modulation used in GSM is Gaussian minimum shift keying (GMSK), a kind of continuous-phase frequency shift keying. In GMSK, the signal to be modulated onto the carrier is first smoothed with a Gaussian low-pass filter prior to being fed to a frequency modulator, which greatly reduces the interference to neighboring channels (adjacent channel interference). GSM networks operate in the 900 MHz or 1800MHz frequency bands in most countries of the world except in few countries like USA and Canada where 850 and 1900 MHz bands are used as the 900 and 1800 MHz bands were already allocated. The GSM technology uses a 200 KHz radio frequency channels that are time division multiplexed to enable up to eight users to access each carrier.[1]

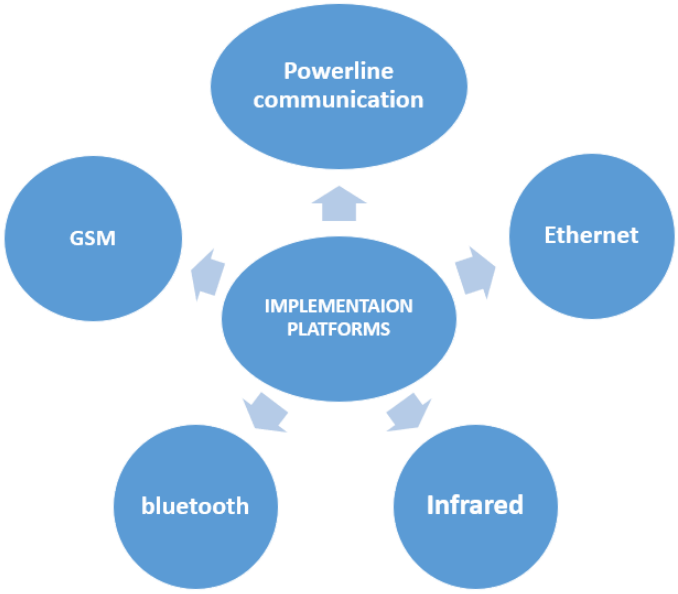


Figure 1.7: Home automation implementation platforms

1.5 Conclusion

Even though home automation is a new technology for home management, temperature control, ventilation, air conditioning and security but it may have some issues ,it might be vulnerable to hacking and penetration. When all of these devices and tools are managed via the Internet, they form a part called the "Internet of Thing", so if the internet is cut off, the interface of the smart system will crash , causing them to not work properly. In our project we are proposing a solution for this problem using a separate system from the internet which is GSM system ,with low cost and effective process ,and keeping the basic function which is remote control of home devices.

Chapter 2

DTMF Technique

2.1 Introduction

Dual-Tone Multi-Frequency is the generic name for pushbutton telephone signaling equivalent to the Bell System'sTouch-Tone®. DTMF signaling is quickly replacing dial-pulse signaling in telephone networks worldwide. In addition to telephone call signaling, DTMF is becoming popular in interactive control applications, such as telephone banking or electronic mail systems, in which the user can select options from a menu by sending DTMF signals from a telephone. DTMF tones were also used by cable television broadcast to indicate the start and stop times of local commercial insertion points.

2.2 Dual-Tone Multi-Frequency (DTMF)

Dual Tone Multi Frequency, is a method of sending and receiving control information over a communications channel. Each digit on the keypad is encoded as a DTMF tone, then it transmitted over an interface, and decoded at the receiving end. A keypad is usually used to generate the required DTMF tone. Each key is associated with a row frequency and a column frequency. When a key is pressed, the encoding circuitry mixes these two frequencies together, and transmits the result. Then, the receiver decodes the tone back into its two respective frequencies, and then the processing circuit will act accordingly.

Figure 2.1: DTMF communications channel

Dual-tone multi-frequency (DTMF) were developed by Bell Labs Standardized by International Telecommunications Union (ITU). The DTMF technique uses eight different

frequency signals transmitted in pairs to represent 16 different symbols. It consists two mutually exclusive frequency groups: the low-frequency group (< 1kHz) and the high-frequency group (> 1kHz). Four low frequency tones (697, 770, 852, 941 Hz) are assigned to rows, while four high-frequency tones (1209, 1336, 1477, 1633Hz) are assigned to columns. Thus, each pair of frequencies corresponding to the column and row are adopted as a unique DTMF tone.

2.3 DTMF Standards

The DTMF tone signaling standard is also known as Touch-Tone or MFPB (Multi-Frequency, Push Button). TouchTone was developed by Bell Labs for use by ATT in the American telephone network as an in-band signaling system to supersede the dial-pulse signaling standard. It is also known in UK as MF4 . Each administration has defined its own DTMF specifications. They are all very similar to the CCITT (ITU-T) standard, varying by small amounts in the guard bands (tolerances) allowed in frequency, power, twist (power difference between the two tones). The ITU-T standard appears as Recommendations Q.23 and Q.24 in Section 4.3 of the CCITT Red Book, Volume VI, Fascicle VI.1. Other standards (AT&T, CEPT, etc.). Two tones are used to generate a DTMF digit. One tone is chosen out of four row tones, and the other is chosen out of four column tones. Two of eight tones can be combined so as to generate sixteen different DTMF digits. Of the sixteen keys, twelve are the familiar keys of a TouchTone keypad, and four (column 4) are reserved for future uses. There also exists a standard describing requirements for systems which test DTMF systems. This standard is available from the IEEE as ANSI/IEEE Standards. 752-1986.

2.4 DTMF Encoding

DTMF signaling is commonly used in telephone equipment. A DTMF signal is a combination of two (02) pure sinusoidal waves, each with differing frequencies. According to the ITU Recommendation, there are eight (8) frequencies involved in DTMF signaling. These frequencies are grouped as Low Frequency and High Frequency, as shown in Table 1.

	1209Hz	1336 Hz	1477 Hz	1633 Hz
697 Hz	1	2	3	A
770 Hz	4	5	6	B
852 Hz	7	8	9	C
941 Hz	*	0	#	D

Table 2.1: DTMF Frequency Grouping

The Table 2.1 included frequencies for each group and the digits represented by these frequencies. Each DTMF digit is a combination of two frequencies: one from the Low Frequency Group and one from the High Frequency Group. The ITU also recommends that both DTMF signal duration and pause duration should be 40 ms.illustrates a standard DTMF signal.

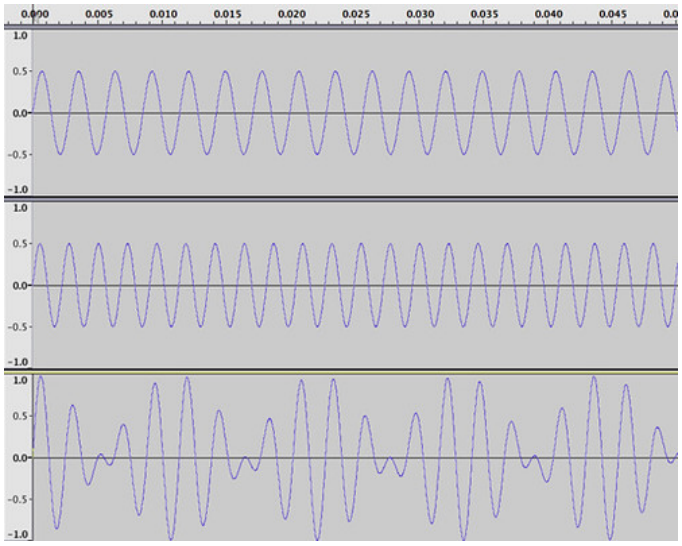


Figure 2.2: Combination of two sinusoidal waves

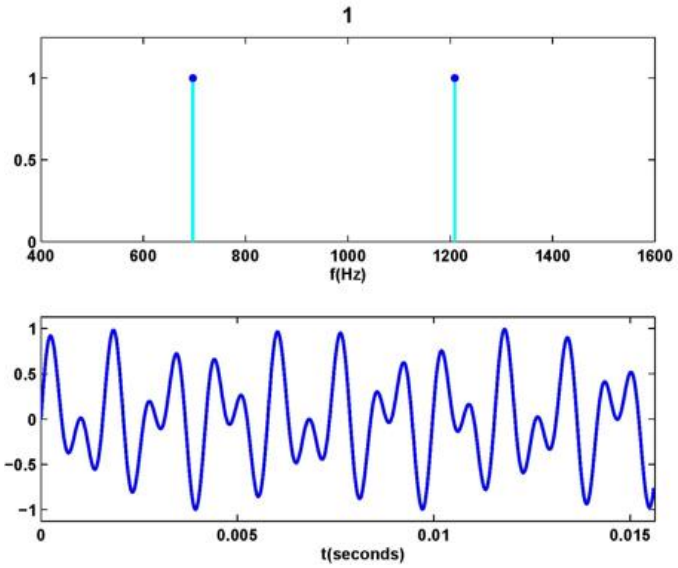


Figure 2.3: DTMF Frequencies representation

2.4.1 Automatic DTMF Tone :

The sending of each DTMF digit by pressing on its button individually, called manual sending. If the operator enter the codes manually with long delays between each DTMF digit sending , the decoder may time-out and refuse the code. Many decoders has one second time-out after , so the operator must enter each digit promptly and without delay. To avoid this problem we need to send DTMF digits quickly by using an automated encoder called a “Store and Forward” encoder, it Store the DTMF code into the register while programming, and Forward it to the entire DTMF code as one complete DTMF string of numbers . This program exist in the most smart phone .

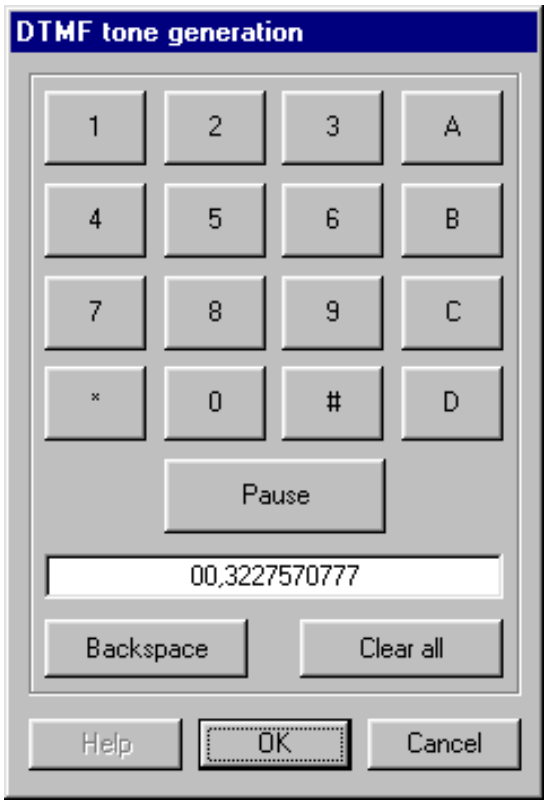


Figure 2.4: Automatic DTMF Generator

2.4.2 DTMF Tone-generator ICs :

The fundamental part of a DTMF encoder is a DTMF tone-generator IC which generate the desired DTMF signals by divide a crystal-generated reference frequency. The oscillator is on-board the IC; the crystal is connected across two terminals of the IC. However, other frequency references may be used for special purposes. The wanted DTMF signals are activated by a twelve-key (3 x 4) or sixteen- key (4 X 4) matrix keypad that is connected directly to the row-and column- input pins of the tone-generator IC.

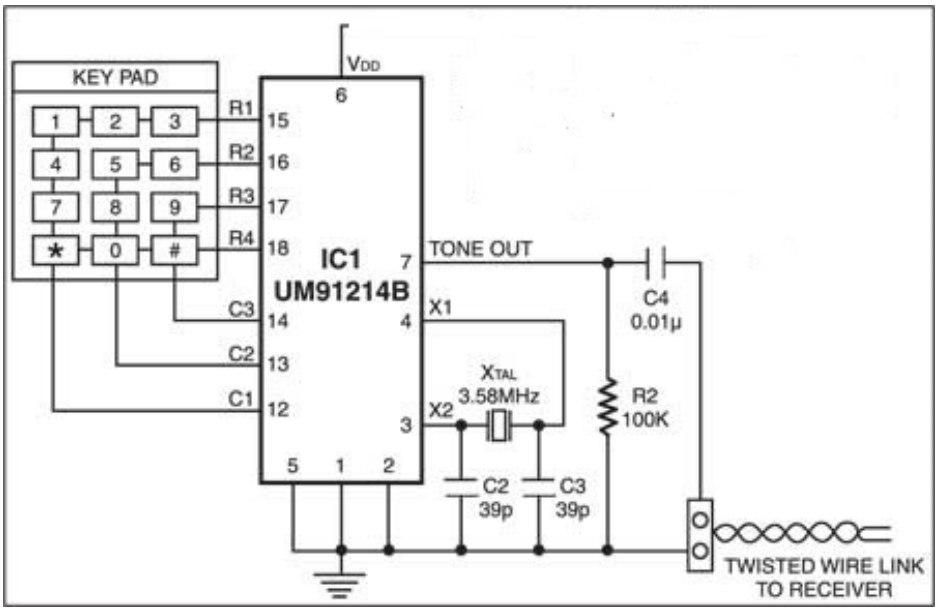


Figure 2.5: DTMF encoder circuit

The encoder portion and tone generation part of a DTMF code are based on two second order programmable digital sinusoidal oscillators, one for the row the other one for the column tone. For each digit that is to be encoded, each of the two oscillators needs to be loaded with the appropriate coefficient and initial conditions before oscillation can be initiated. DTMF frequencies range from 700 Hz to 1700 Hz, a sampling rate of 8 kHz . The tone duration specifid by ITU (Q.24) is :
- 10 digits/sec are the maximum data rate for touch tone signals.
- For a time slot the duration is 100 ms.
- For the actual tone is at least 40 ms and no longer than 55 msec.
- The minimum pause duration is 40 ms.

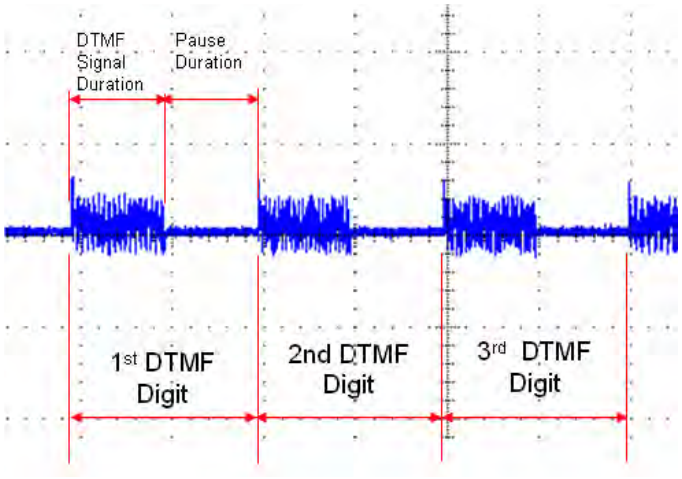


Figure 2.6: DTMF Tone duration

2.5 DTMF Decoding

Decoding a DTMF signal means extract the two tones in the signal and determine the intended DTMF digit from their values. The principle function of the detector is to determine whether a received signal within the DTMF frequency band (697-1633 Hz) is a true DTMF signal or just noise or speech. The detector must also be capable of detecting a DTMF signal that is combined with such noise, and it should recognize any valid DTMF signal that is within 2% of the standard value,

2.5.1 DTMF Detection Methods :

There are two basic methods used to detect a DTMF tones which are :

2.5.1.1 Zero-crossings counts method:

It is old method, Tone detection is often done in analog circuits by detecting and counting zero crossings of the input signal, this technique determinate the two frequencies that make up the DTMF tone. As the DTMF encoding scheme uses a 4x4 frequency matrix, the detector need only search for these eight particular tones.

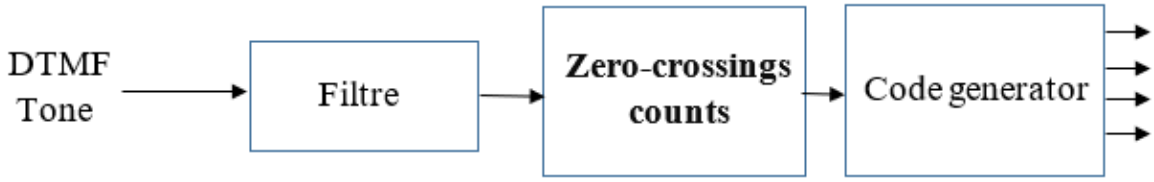


Figure 2.7: Zero-crossings counts technique

2.5.1.2 Goertzel Algorithm method :

This technic is used in digital circuits, tone detection is easier to accomplish mathematically by transforming the input time-domain signal into its frequency-domain equivalent. The correct detection of a valid DTMF digit must ensure that there is a minimum energy value at both of the required frequencies. The detection of a single frequency could be caused by a multitude of occurrences, ranging from human speech through to random noise, for avoid that, the Goertzel algorithm was used for transforming the DTMF signal into its frequency-domain equivalent. Most of the circuits required to decode DTMF signals is now available in digital IC form. This method is the basis of the DTMF detector. It is a very effective and fast way to extract spectral information from an input signal.

2.5.2 Goertzel Algorithm :

The Goertzel algorithm is the basis of the new DTMF detector. This method is a very effective and fast to extract spectral information from an input signal.
The Goertzel algorithm is a special case of the Discrete Fourier Transform(DFT), it is much faster than (FFT) fast Fourier Transform, because it only need a few of spectral line values for filters provided . The Goertzel algorithm needs only two coefficients for every frequency:

Goertzel Algorithm in short:

1. Recursively compute for n = 0 .. N

$$v_k(n) = 2\cos\left(\frac{2\pi}{N}k\right) \cdot v_k(n-1) - v_k(n-2) + x(n)$$

$$\text{where} \quad v_k(-1) = 0 \quad v_k(-2) = 0$$

$$x(n) = \text{input}$$

2. Compute once every N

$$|X(k)|^2 = y_k(N)y^*_k(n)$$

$$= v^2{}_k(n) + v^2{}_k(N-1) - 2\cos(2\pi f_k/f_s)v^2{}_k(N)\, v^2{}_k(N-1)$$

real and complex . The Base Goertzel algorithm calculate a complex, frequency-domain result just as a DFT does, but the base Goertzel algorithm can be modified algebraically to the Optimized Goertzel algorithm so that the result is the square of the magnitude of the frequency component (a real value). This modification removes the phase information. The advantage of this modification is that it allows the algorithm to detect a tone using only one, real coefficient. The Goertzel algorithm can process each sample as it arrives. There is no need to buffer N samples before calculating the N-point DFT, thus it can be thought of as a second-order IIR.

2.5.3 Precomputing process:

It need to select a sampling rate and block size N, after that a simple process to compute :

- During processing k: $k = ½ + target_frequ * N/sampling_rate$
- $w = (2 * /N) * k$
- $coeff = 2 * cos(w)$

1st Harmonics fs = 8 kHz			2nd Harmonics fs = 8 kHz		
DTMF frequency f/Hz	Detection freq bins at fk/Hz	Coefficient cos(2pi *fk/fs*)	2nd harm frequency f/Hz	Detection freq bin at *fk*/Hz	Coefficient cos(2pi *fk/fs*)
rows					
697	697	27980	1394	1394	15014
770	770	26956	1540	1540	11583
852	852	25701	1704	1704	7549
941	941	24219	1882	1882	3032
columns					
1209	1200 1218	19261 18884	2418	2418	−10565
1336	1327 1345	16525 16123	2672	2672	−16503
1477	1468 1486	13297 12872	2954	2954	−22318
1633	1624 1642	9537 9093	3266	3266	−27472

Table 2.2: Filter Coefficients for Row, Column and 2nd Harmonic Frequencies

The per-sample need three variables. Q0, Q1, and Q2. Q1 is just the value of Q0 last time. Q2 is just the value of Q0 two times ago (or Q1 last time). Q1 and Q2 must be initialized to zero at the beginning of each block of samples, and For every sample, you need to run the following three equations:

- Q0 = coeff * Q1 - Q2 + sample
- Q1 = Q0
- Q2 = Q1

After running the per-sample equations N times, a simple threshold test of the square of the magnitude will determinate if the tone was present or not.

- basic Goertzel algorithm :
  $real = (Q1 - Q2 * cos(w))$
  $imag = (Q2 * sin(w))$ $magnitude2 = real2 + imag2$

- optimized Goertzel algorithm:
  $magnitude2 = Q12 + Q22 - Q1 * Q2 * coeff$

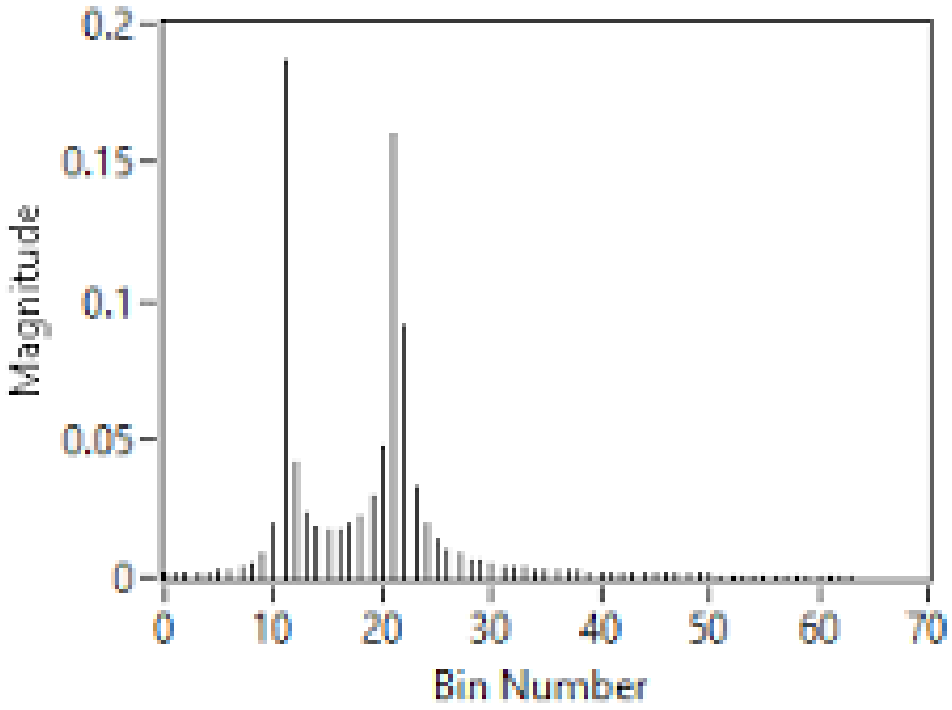


Figure 2.8: Detection of two frequencies by Goertzel algorithm

2.5.4 DTMF Tones Checking :

Once the spectral information in form of square shape , each of the row and column frequencies is collected, a series of tests needs to be executed to determine the validity of tone and digit results. The spectral information of the 2nd harmonic frequencies have not yet been computed for improve the execution speed, they will be computed conditionally within the 2nd harmonics check.
The first check makes sure the signal strength of the possible DTMF tone pair is sufficient. The sum of the squared magnitudes of the peak spectral row component and the peak spectral column component need to be above a certain threshold. Since already small twists (row and column tone strength are not equal) causes a significant row and column peak differences, the sum of row and column peak provides a better parameter for signal strength than separate row and column checks.
If the DTMF signal pair passes these checks, we can say that DTMF tone pair is valid , which corresponds to a present digit t. Essentially only the two second harmonic energies that correspond to the detected two fundamental frequencies are calculated using the Goertzel algorithm.

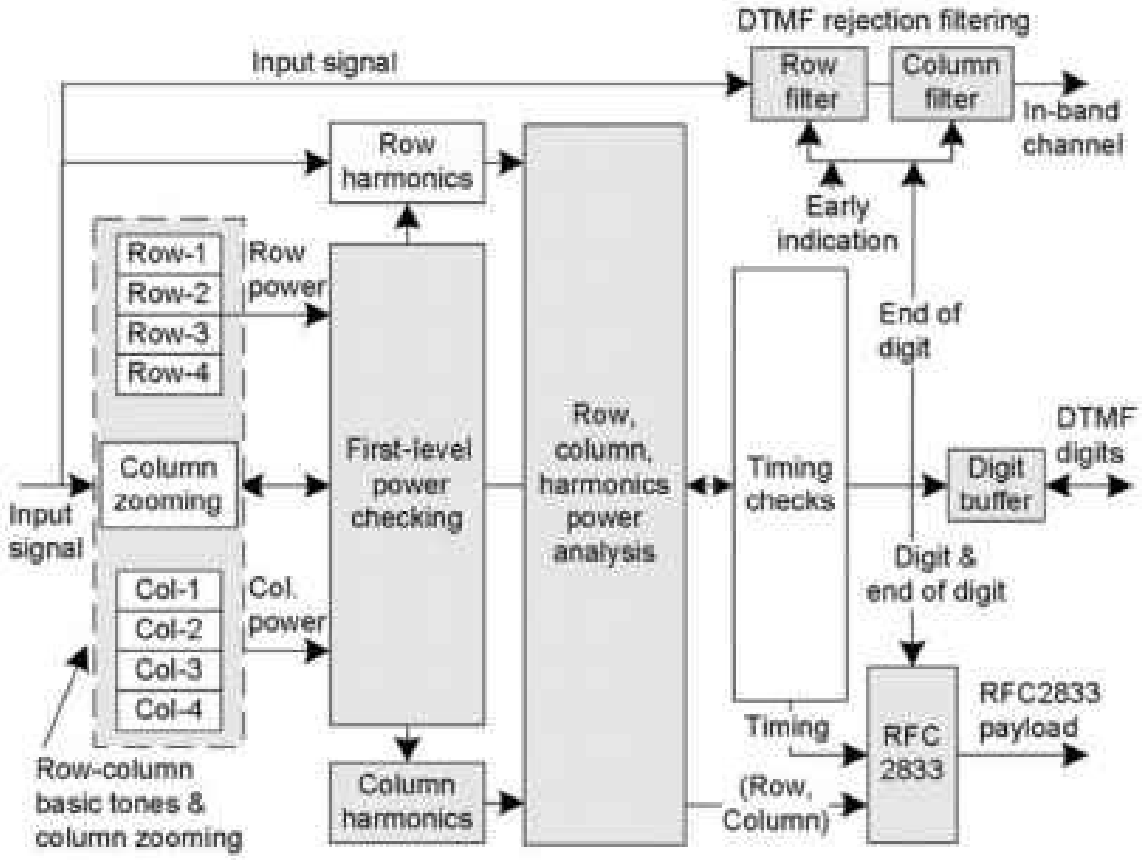


Figure 2.9: DTMF Tones Checking precess

2.5.5 DTMF Decoder:

Today,the DTMF decoder become an Integrate Circuits on the market they are extremely sophisticated signal-processing devices with switched-capacitor filtering that use digital frequency-detection techniques. They can reliably detect DTMF signals without pre-filtering. The decoder that we'll use in our circuit is The MT8870D, it produces an equivalent binary code whenever it receives a valid tone pair .The table [2.3] shows the DTMF frequencies and the associated key .

The MT8870D is a complete DTMF receiver integrating both the bandsplit filter and digital decoder functions. The filter section uses switched capacitor techniques to filter them into high and low frequency groups ; the decoder uses digital counting techniques to detect and decode all 16 DTMF tonepairs into a 4-bit code. External component count is minimized on chip provision of a differential input amplifier, clock oscillator and latched three-state bus interface.

F_{low}	F_{high}	Key
697	1209	1
697	1336	2
697	1477	3
770	1209	4
770	1336	5
770	1477	6
852	1209	7
852	1336	8
852	1477	9
941	1209	0
941	1336	*
941	1477	#
697	1633	A
770	1633	B
852	1633	C
941	1633	D

Table 2.3: DTMF frequencies and the associated key

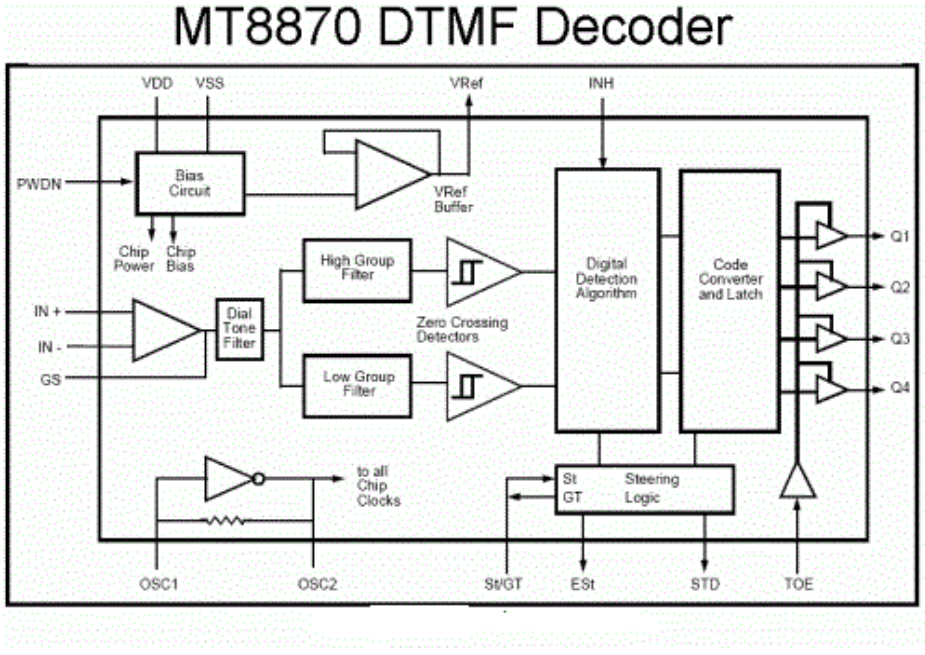


Figure 2.10: Functional block diagram of MT8870 DTMF Decoder

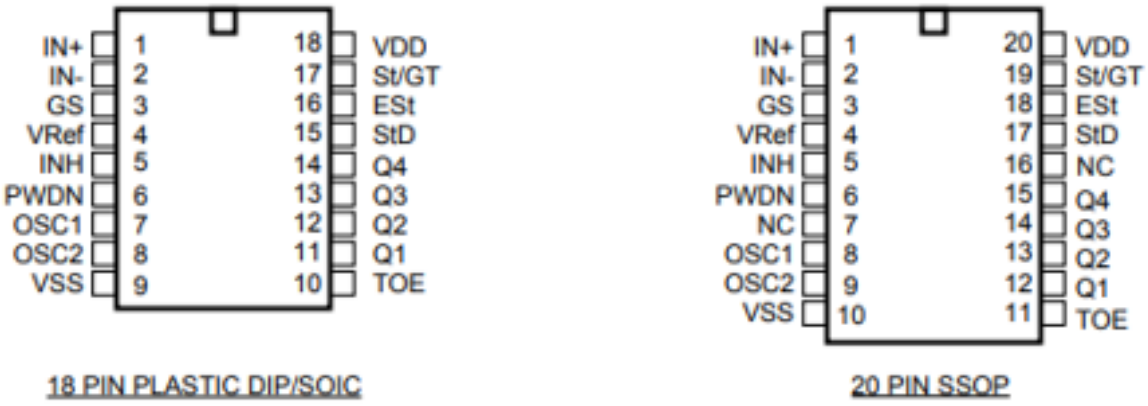


Figure 2.11: MT 8870D pin diagram

2.6 Conclusion

DTMF was originally designed to use the frequencies in the normal human voice range.As a result,it can easily pass over normal two-way radio channels, narrow band, and wide band.It was very productive and the DTMF tone encoding and decoding concepts and algorithms were described here in detail. The DTMF Technique is a straight forward technology that is easy to understand, and is compatible with most equipment and it can be used to provide an effective and flexible features with low costs because It does not require expensive equipment or special channels for transmitting the frequencies

Chapter 3

System Design

3.1 Introduction

Generally, appliances used in our home controlled with the help of switches that it need our presence in to control them, our project help user to control home appliances from remote unit by using cell phone; user should be send an authentication code (DTMF) along with the required action to the home control system via Global System for mobile communication (GSM). The system is protected by password, user need to enter a correct password to access to the controlling system; devices are switching by relays, it permit to the user to turn on or off the home appliances. Our system contains an extra option by sending vocal messages to user cellphone.

3.2 System operating

our system is easy to operate and more secure than the other systems,the working procedure is in few steps we listed them below :

- When user call the system by specific number, the Off/On-Hook module detect the phone ringtone and activate automatically the Off-Hook mode. The MP3 player module send a vocal message correspond to this step that stored before in the SD card.
- User needs to enter correct password to manage the system, if the password is incorrect, the system would activate On-Hook mode.
- If the password is correct the system would send a new vocal message explain the method to drive the system.
- User can control any appliances connected with the system by pressing on phone keypad and following the instructions sending by the system (Vocal messages).

- If user does nothing in one (01) minutes, the system would activate On-Hook mode.
- If user choose to turn off or turn on any home appliance the relay module will achieve his order.

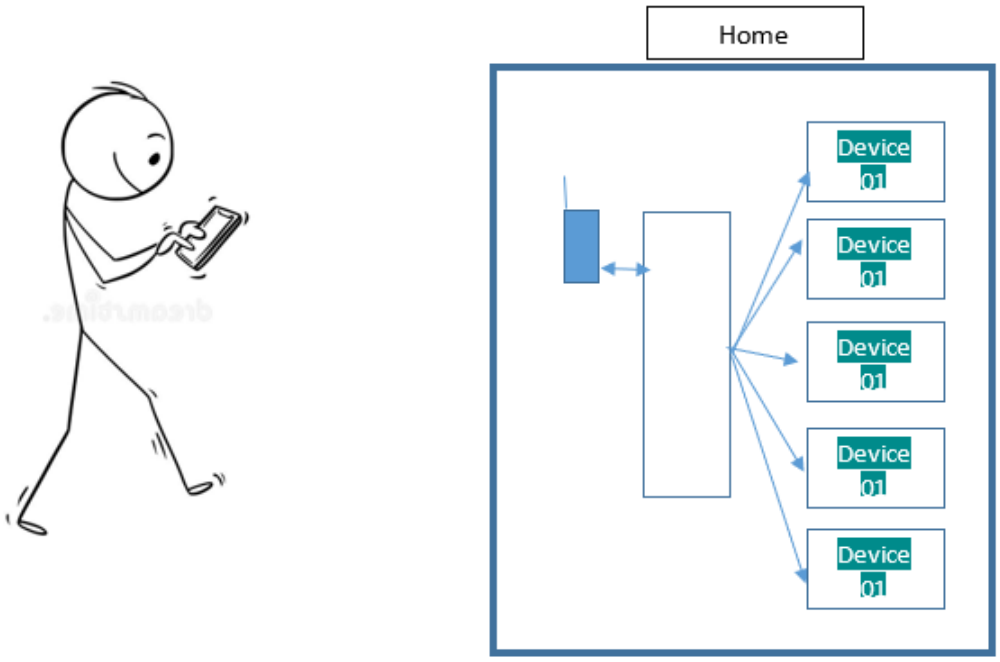


Figure 3.1: system design

3.3 System architecture

Basically, the system compose of two basic parts :

- Remote Section : Remote section is the transmitting or the wirelessly remote controlling section that generates the DTMF signals. Here, we have used a Mobile phone for this purpose.
- Local Section : Local section is installed at the house to which the appliances are connected for automation and for control them.

DTMF signalling, which is the standard dialling technique for telephone and GSM systems is used to transmit the codes to the local section from remote section. the block diagram of the system below present the relationship between different modules.

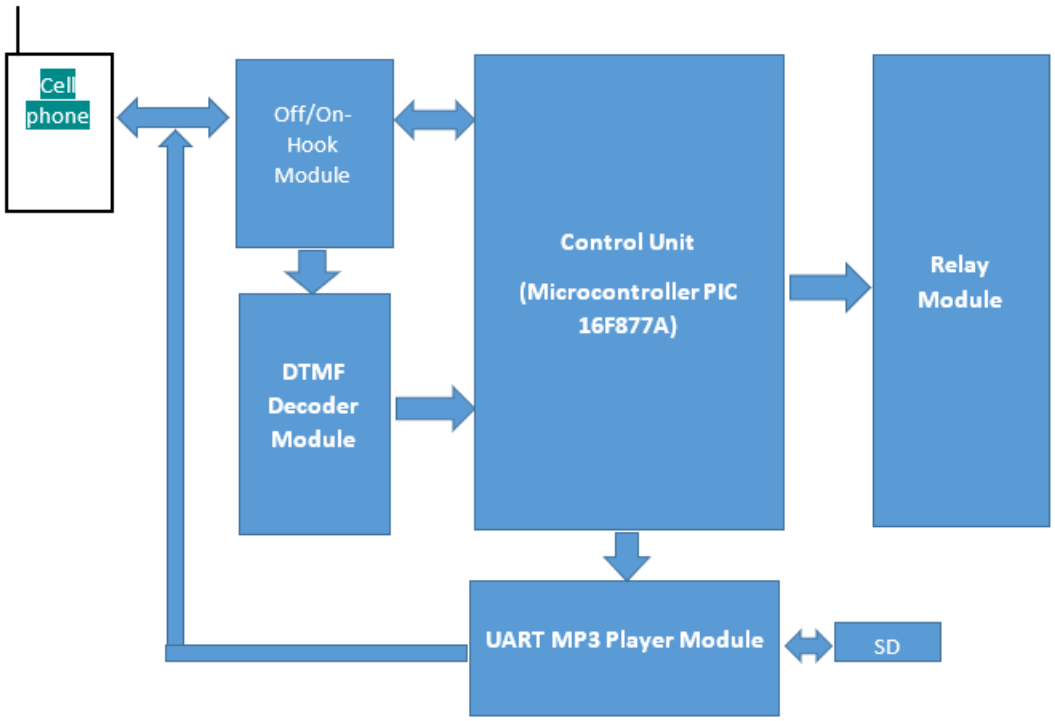


Figure 3.2: Block Diagram of the project

3.3.1 System components :

Our project has three basic sections which are DTMF decoder , microcontroller , relays . it has also some specific parts like on/off-hook module , UART MP3 player module . we are focusing on the specific elements that are more difficult to find data about .

3.3.1.1 DTMF decoder Module :

A decoder is a circuit that changes a code into some corresponding set of signals.

MT8870 DTMF decoder : MT8870 DTMF decoder is the basic component in our project its Functions are to detect and decode DTMF tones pairs sending by user cell phone into 4-bit code, that the microcontroller treat it. The standard DTMF encoder/decoder it is possible to signal at a rate of 10 tones per second and can be played for at least 50ms with a further 50ms space duration for maximum reliability.

There are many types of it , in our project we used the MT8870 IC , which is one of the common DTMF receiver IC that is widely used in electronic communications circuits. The MT8870 is an 18-pin IC. It is used in telephones system and a variety of other applications. This IC can be used to decode the DTMF signals.

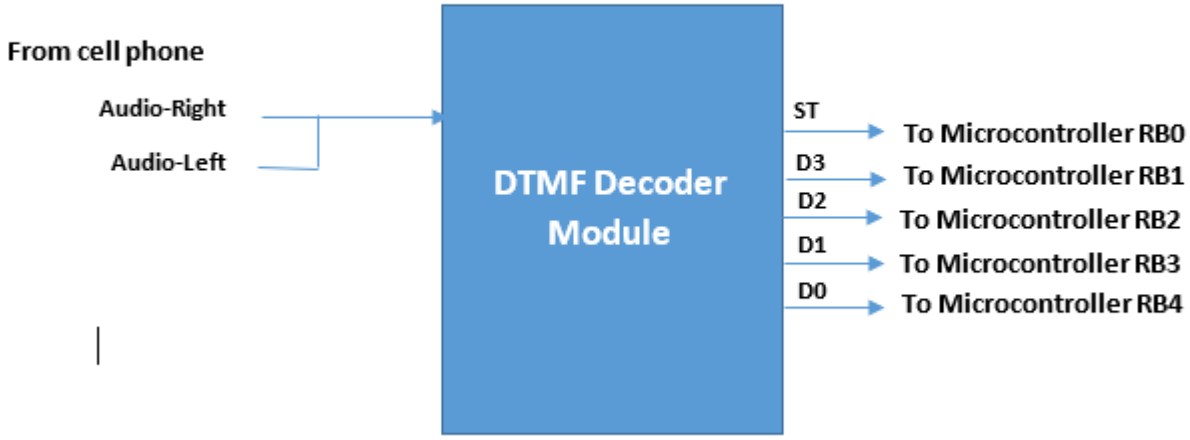


Figure 3.3: Block diagram of DTMF Decoder Module

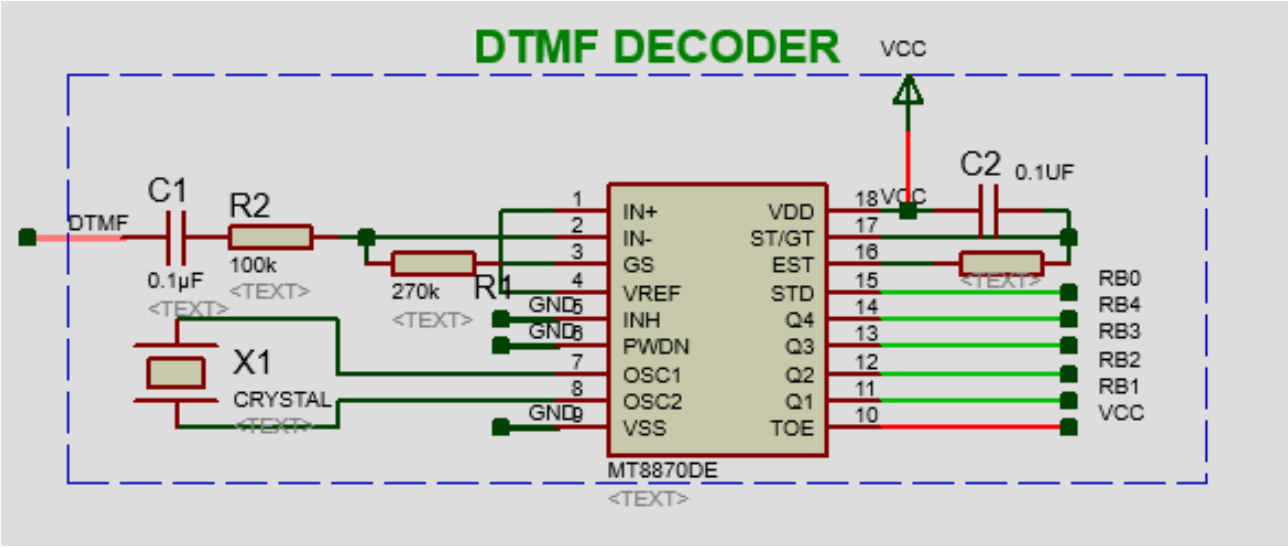


Figure 3.4: Circuit diagram of DTMF Decoder Module

it consists of an inbuilt Operational Amplifier, the output of Op-Amp is given to the pre-filters to separate low and high frequencies then it passes to the frequency and code detector circuit. Thus 4-bit binary code is latched .

Input			Output				
Low frequency	High frequency	Nbr	ST	D0	D1	D2	D3
697	1209	1	1	0	0	0	1
697	1336	2	1	0	0	1	0
697	1477	3	1	0	0	1	1
770	1209	4	1	0	1	0	0
770	1336	5	1	0	1	0	1
770	1477	6	1	0	1	1	0
852	1209	7	1	0	1	1	1
852	1336	8	1	1	0	0	0
852	1477	9	1	1	0	0	1
941	1336	0	1	1	0	1	0
941	1209	*	1	1	0	1	1
941	1477	#	1	1	1	0	0

Table 3.1: Relationship between tone frequencies and 4-bit code of DTMF decoder

3.3.1.2 On/Off-Hook Module:

The main function of the On/Off-Hook Module is to activate Off-Hook mode when the cell phone ring or On-Hook mode if the Microcontroller decide to. A quick short circuit between the microphone wire and the Ground permit to activate On-Hook and Off-Hook mode. Its block and ircuit diagrams are represented below:

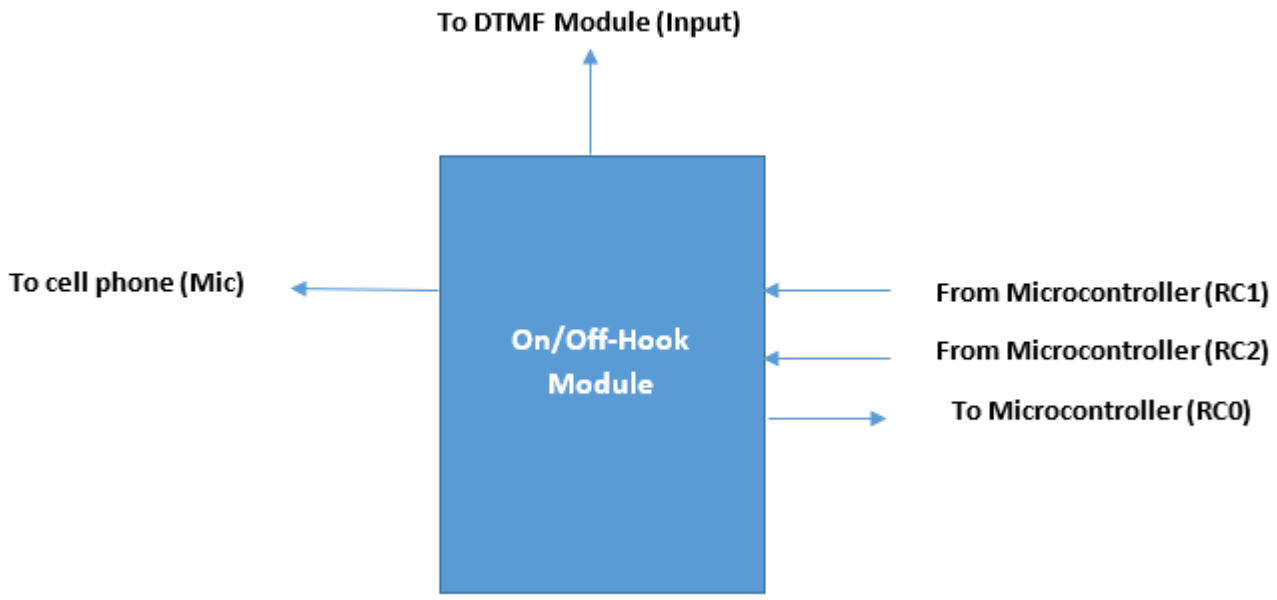


Figure 3.5: Block diagram of On/Off-Hook Module

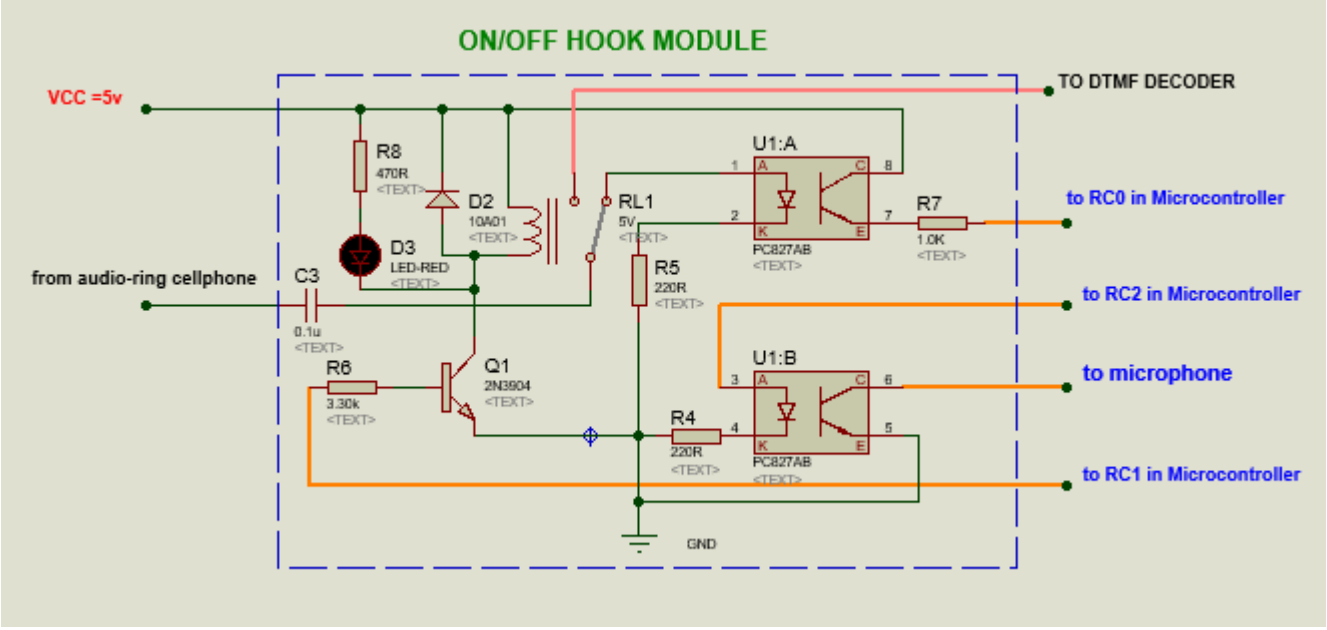
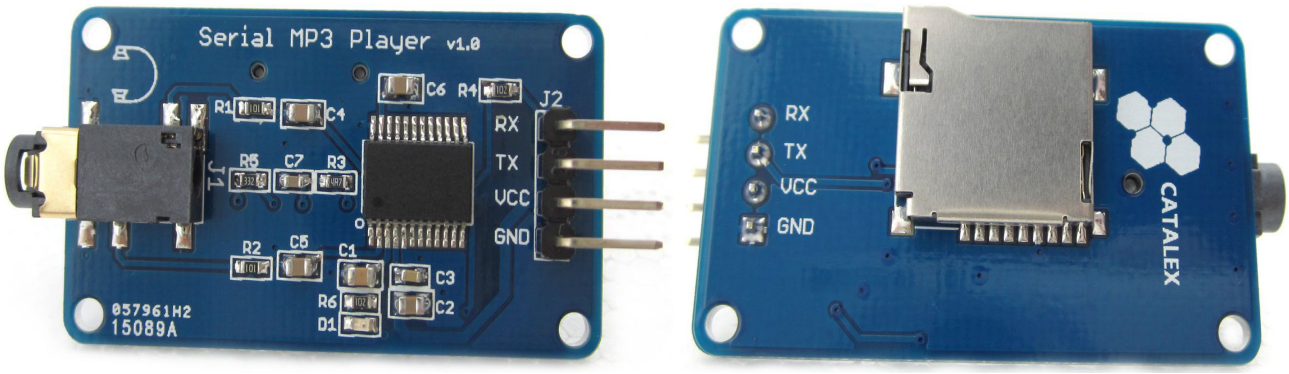


Figure 3.6: Circuit diagram of On/Off-Hook Module

3.3.1.3 UART MP3 Player Module :

The YX5300 module is a TF card socket on board manufacturing by CATALEX, with this module we can plug the micro SD card that stores audio files. MCU can control the MP3 playback state by sending commands to the module via UART port, such as switch songs, change the volume and play mode and so on.. It is compatible with Arduino / AVR / ARM / PIC.



(a) UART face 01 (b) UART face 02

Figure 3.7: UART MP3 Player Module

3.3.1.3.1 Features

- Support sampling frequency (kHz): 8 / 11.025 / 12/ 16/ 22.05/ 24 / 32/ 44.1/ 48
- High quality
- Support file format: MP3 / WAV
- Support Micro SD card, Micro SDHC Card
- 30 class adjustable volume
- UART TTL serial control playback mode, baud rate is 9600bps
- Power supply can be 3.2 5.2VDC
- Control logic interface can be 3.3V / 5V TTL

3.3.1.3.2 Specification:

- Power Supply(VCC) 5.2 Max VDC
- Supported Card Type Micro SD card(<=2G);Mirco SDHC card(<=32G)
- File system format : Fat16 / Fat32
- Uart baud rate : 9600 Bps

3.3.1.3.3 Interface :

- Control interface: UART TTL interface. (GND, VCC, TX, RX).
- TF card socket: The micro SD card.
- Playback indicator: Green light. If it is ready to play or it is paused, it keeps lighting. If playing, it blinks.
- Headphone jack: It connected with the headphone.

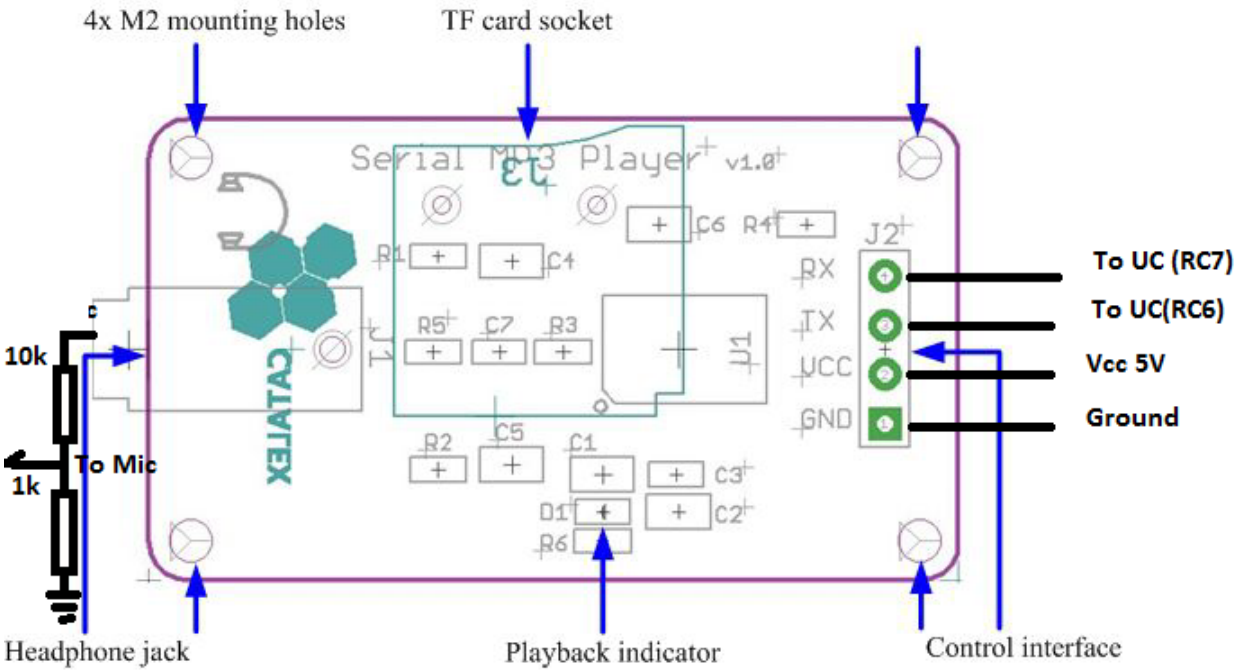


Figure 3.8: UART Interface

3.3.1.4 SD card :

Secure Digital, officially abbreviated as SD, is a proprietary non-volatile memory card format, it has a good speed of data transition with a large capacity of storage . in our project we use the SD card for storing the vocal messages respectably with different names so the system could replay to users with the appropriate vocals,

Vocal messages list : The vocal messages are saved in SD card memory with respect keeping the same File names and delays as mentioned in the table below,

N°	File name	Vocal message	Delay (MS)
01	Msg00.mp3	مرحبا بك في نظام التحكم المنزلي، هدا المشروع من اعداد الطالبان زكرياء مقدم ومحمد الأمين مدادي في اطار نيل شهادة الماستر من جامعة قاصدي مرباح ورقلة	12000
02	Msg10.mp3	للتحكم في المكيف،تشغيل اضغط على صفر،ايقاف اضغط على واحد للتحكم في المراب،فتح اضغط على اثنان،اغلاق اضغط على ثلاثة للتحكم في الباب،فتح اضغط على اربعة،اغلاق اضغط على خمسة للتحكم في مضخة الماء،تشغيل اضغط على ستة،ايقاف اضغط على سبعة لفتح الباب اضغط على ثمانية للخروج من البرنامج اضغط على دياز	33000
03	Msg20.mp3	لقد تمت العملية بنجاح	3000
04	Msg30.mp3	شكرا على استعمالك هدا النظام	4000
05	Msg40.mp3	لقد ادخلت كلمة سر خاطئة	3000
06	Msg50.mp3	من فضلك اضغط على نجمة	3500
07	Msg60.mp3	عند سماع الجرس ادخل كلمة السر ثم اضغط على دياز	5500
08	Msg70.mp3	الجرس	500

Table 3.2: Vocal messages list

3.3.1.5 Relay Module :

A relay is an electrically operated switch. It consists of a set of input terminals for a single or multiple control signals, and a set of operating contact terminals. The switch may have any number of contacts in multiple contact forms, such as make contacts, break contacts, or combinations thereof. The advantage of relays is that to take a relatively small amount of power to operate the relay coil, but the relay itself can be used to control home appliances such as door, lamps or AC circuits which themselves can draw a lot more electrical power. The electro-mechanical relay is an output device (actuator) which come in a whole host of shapes, sizes and designs, and have many uses and applications in electronic circuits. But while electrical relays can be used to allow low power electronic type circuits(12V) to switch relatively high currents or voltages (220V) both “ON” or “OFF”.
In this project we used NPN Relay Switch Circuit,the figures below represent its block and circuit diagrams :

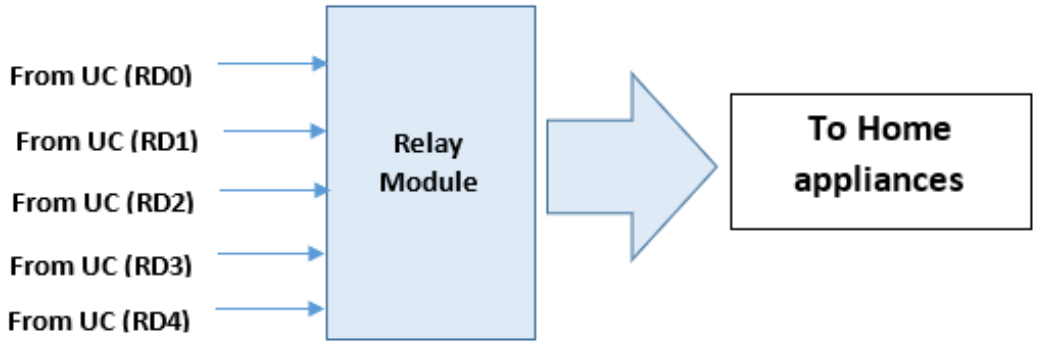


Figure 3.9: Block diagram of Relay Module

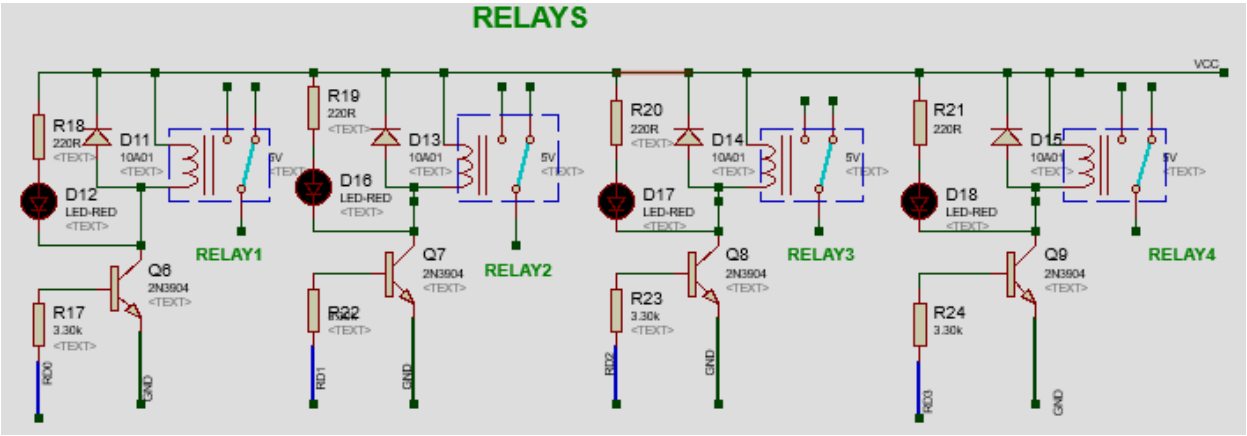


Figure 3.10: Circuit diagram of Relay Module

3.3.1.6 Control unit (Microcontroller PIC 16F877A):

In our project we used the PIC (programmable interface Controller) PIC 16F877A series of microcontrollers manufactured by Microchip Technology Inc.
Microcontroller is a single-chip computer. It is embedded controller built into the devices they control. Microcontrollers traditionally is programmed by using the assembly language of the target device. Although the assembly language is fast, but we can also program it using a high-level language, such as C. High-level languages are much easier to learn than assembly languages. They also facilitate the development of large and complex programs. In our project we programmed the PIC microcontrollers by using the popular C language known as mikroC, developed by mikroElektronika. Basically, a Microcontroller executes a user program which is loaded in its program memory. Under the control of this program, data is received from external devices (inputs), manipulated, and then sent to external devices (outputs).
In this project the control of home appliances is by relay module that is connected to PORT D of a PIC16F877A microcontroller, and the microcontroller is operated from a 8MHz internal resonator.

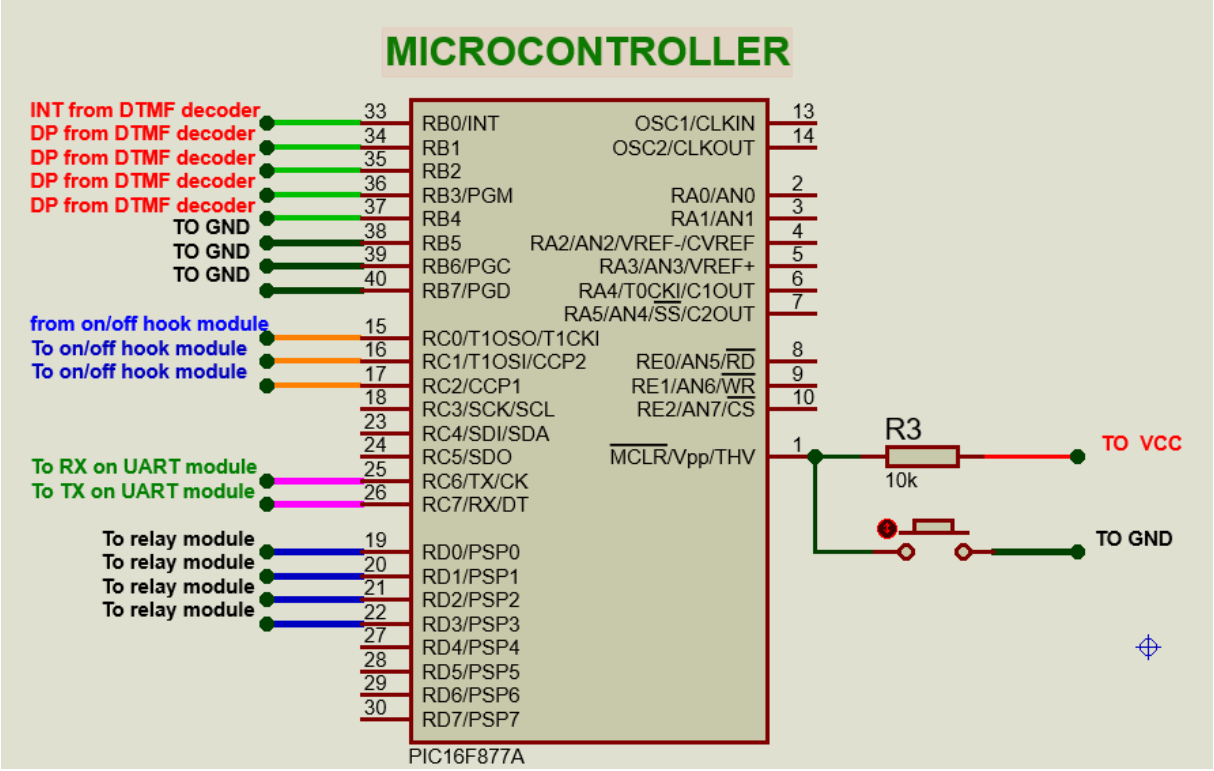


Figure 3.11: Control unit (Microcontroller PIC 16F877A)

3.3.1.7 Project Program :

In programming the microcontroller, mikroC compiler was used to write the PIC C code that was built into an hexadecimal code to be programmed into the PIC16F877A microcontroller.

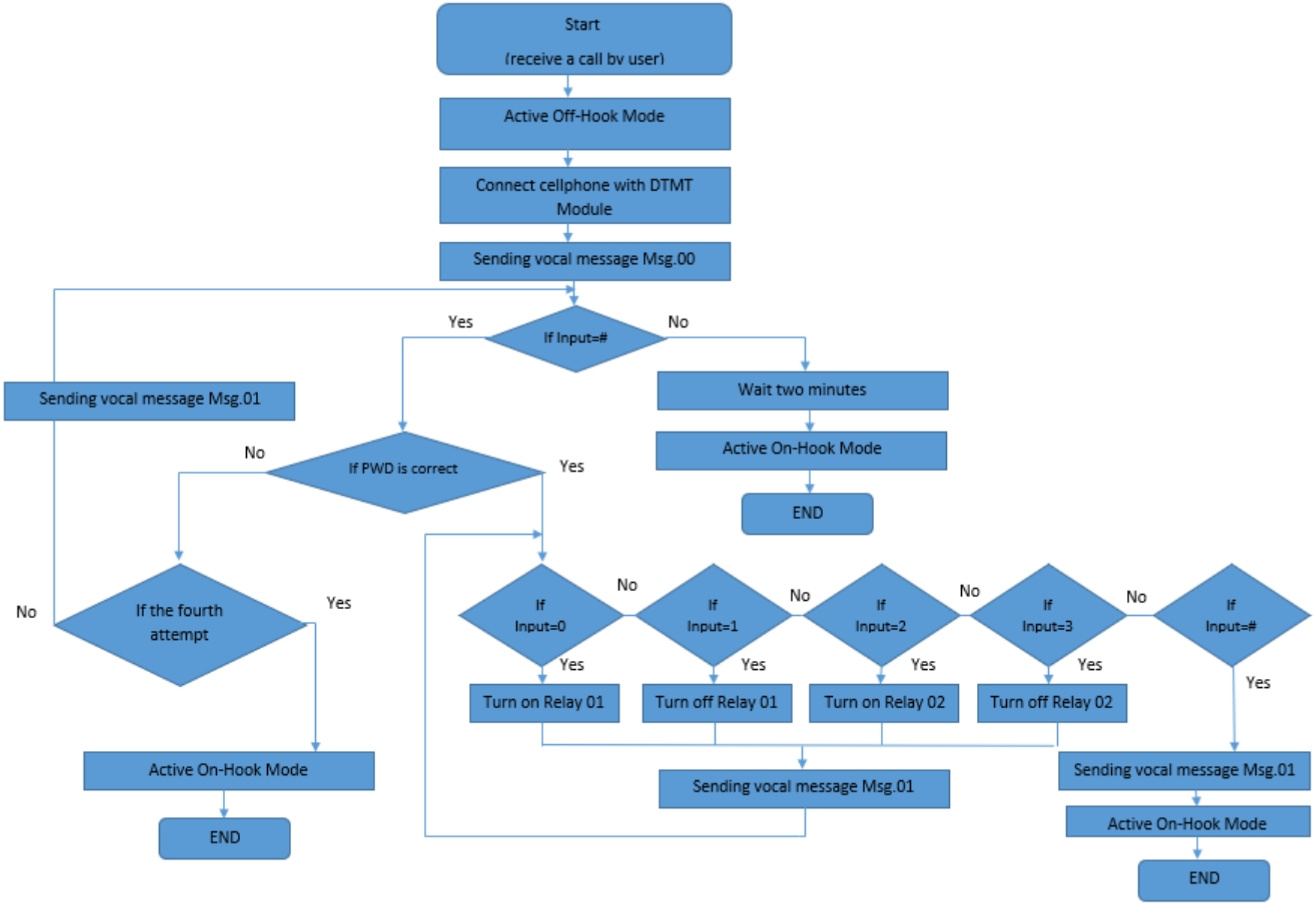
Project settings should be configured to 8MHz clock, and WDT ON. The HEX file (DTMF.HEX) should be loaded to the using either an in-circuit debugger or a programming device.

3.3.1.8 mikroC Programming Language:

There are several C compilers on the market for the PIC microcontrollers, they have many similar features, some of the C compilers used most often in commercial, industrial, and educational PIC microcontroller applications are mikroC, PICC18, C18 and CCS. We used In our project the popular and powerful one, it is mikroC, developed by MikroElektronika , it is easy to used and comes with rich resources, such as a large number of library functions and an integrated development environment with a built-in simulator and an in-circuit debugger (mikro ICD).

3.3.1.9 General flow chart of system :

The design of this project involved coupling several components and testing on Proteus software . the flow chart as shown in the figure below was developed for the design indicating the processes involved.


Start
(receive a call by user)
Active Off-Hook Mode
Connect cellphone with DTMT Module
Sending vocal message Msg.00
If Input=#
Yes
No
Wait two minutes
Active On-Hook Mode
END
Sending vocal message Msg.01
If PWD is correct
No
Yes
If the fourth attempt
No
Yes
Active On-Hook Mode
END
If Input=0
If Input=1
If Input=2
If Input=3
If Input=#
Turn on Relay 01
Turn off Relay 01
Turn on Relay 02
Turn off Relay 02
Sending vocal message Msg.01
Sending vocal message Msg.01
Active On-Hook Mode
END

3.4 Conclusion

At the end of this chapter we know what the system basic components are , also their architecture (Block and circuit diagrams) and how the components connect to each other . we have also talked about the system architecture (Block and circuit diagrams) and how it operate in few steps. The system flow chart also was given to understand the programming code sequence.

Chapter 4

Simulation and implementation of the project

4.1 Introduction

A simulation is the imitation of the operation of real-world process or it can help in understanding how the system operates, the purpose of this last is to test the project which makes it possible to detect certain errors before the implementation .
In this chapter we will construct a model in conceptual framework that describes our system , then we will operate our system over few steps in order to study the behavior of the system and gain knowledge about improving it .

4.2 Proteus software

Proteus 8 is a best simulation software for various designs with microcontroller. It is mainly popular because of availability of almost all microcontrollers in it. So it is a handy tool to test programs and embedded designs for electronics students. we can simulate our microcontroller programation in Proteus 8 Simulation Software. After simulating our circuit in Proteus 8 Software we can directly make PCB design with it so it could be an all in one package for students.
In this project we used this software to testify and build the project circuit, Also we simulate the system operation and here are the parts of the simulation procedure.

4.3 Project simulation

The simulation procedure compose of two sub-parts which makes it possible to detect and correct the errors ,further because of some missing components or parts in Proteus to build the whole software circuit .

4.3.1 Simulation of the On/Off-Hook and UART Modules with Microcontroller:

In this section we will make sure that the on/off hook circuit is automatically picking up to incoming calls and make the pic sending orders to UART module to reply with the appropriate vocal message from the SD card.

firstly, we upload the "WAV" audio file (phone ringtone) on the audio generator with an Amplitude equal to 4v . Then , we upload the code file named "DTMF.hex" into the pic 16F877A with a hex extension . we set the pic clock frequency as 8MHz and the other component values as resistors,capacitors ..etc, are shwon in the figure below.

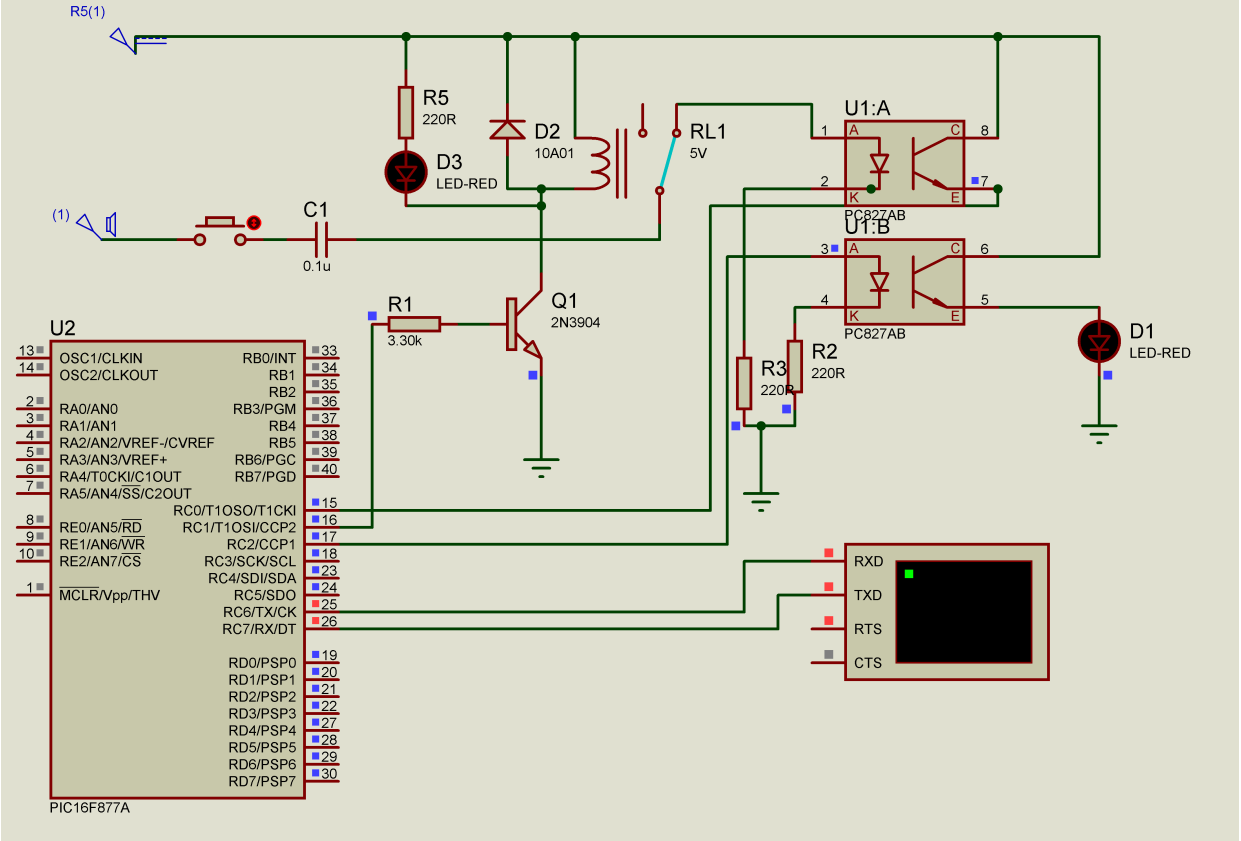


Figure 4.1: Standby mode (OFF HOOK mode)

The figure represents the system after running the simulation which means that the system is in standby mode.
when we press the push button so the audio sound enter that means an incoming call is ringing ,the system will automatically picks up by making a closed circuit connecting the output to the ground, the Led D1 will light up for a short time as an indication of that.

The system will play a greeting vocal message(file 00) from the SD card. The running of led D3 also indicate that the Relay RL1 is in the second position which means the system is accepting the inputs made by the user, this last go directly to DTMF decoder (MT8870) in order to decode the keys pressing tones into a 04 bit binary code.
The virtual terminal is an addition part to show the status of code running and the orders that made by the pic to UART module in order to play the appropriate sound track.

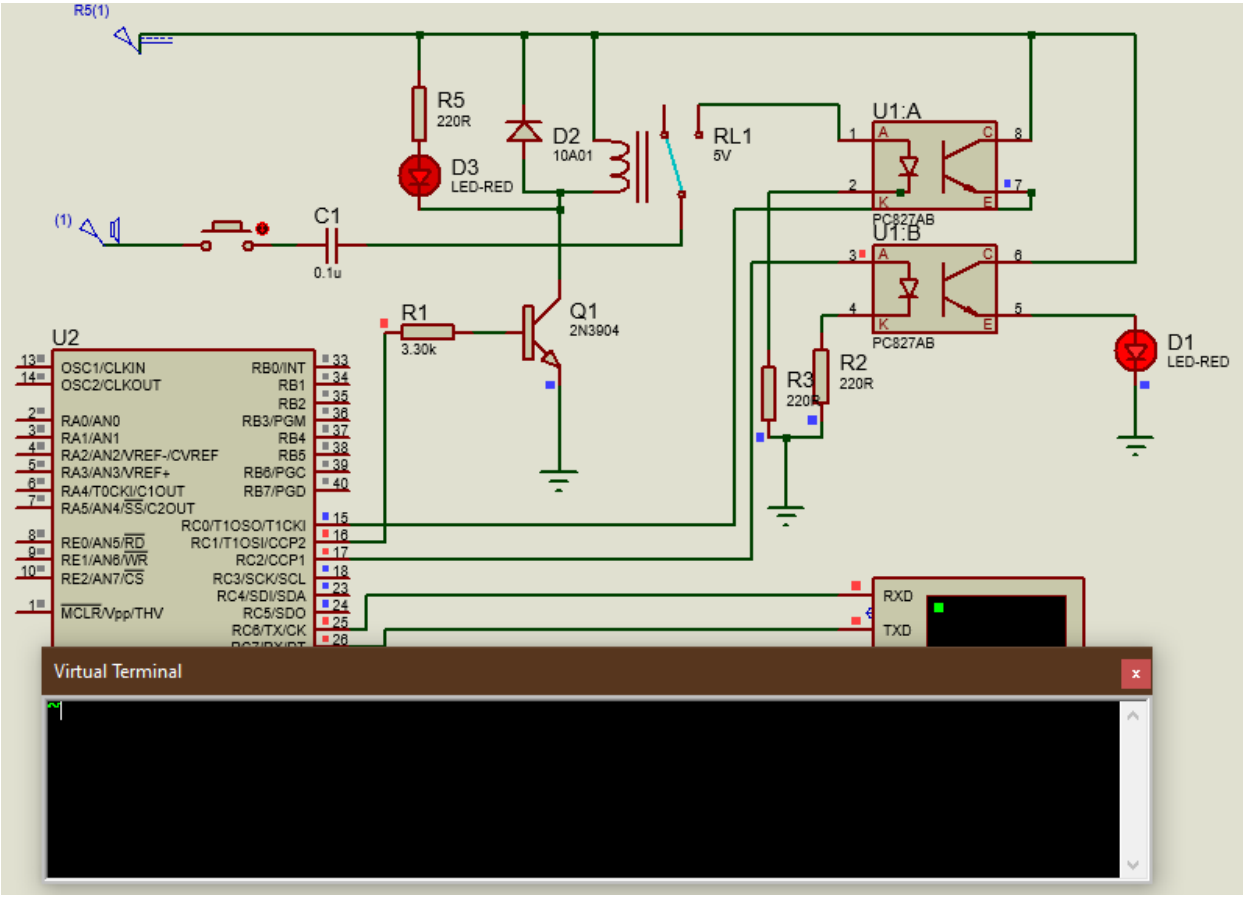


Figure 4.2: switching up from OFF-HOOK to ON-HOOK mode

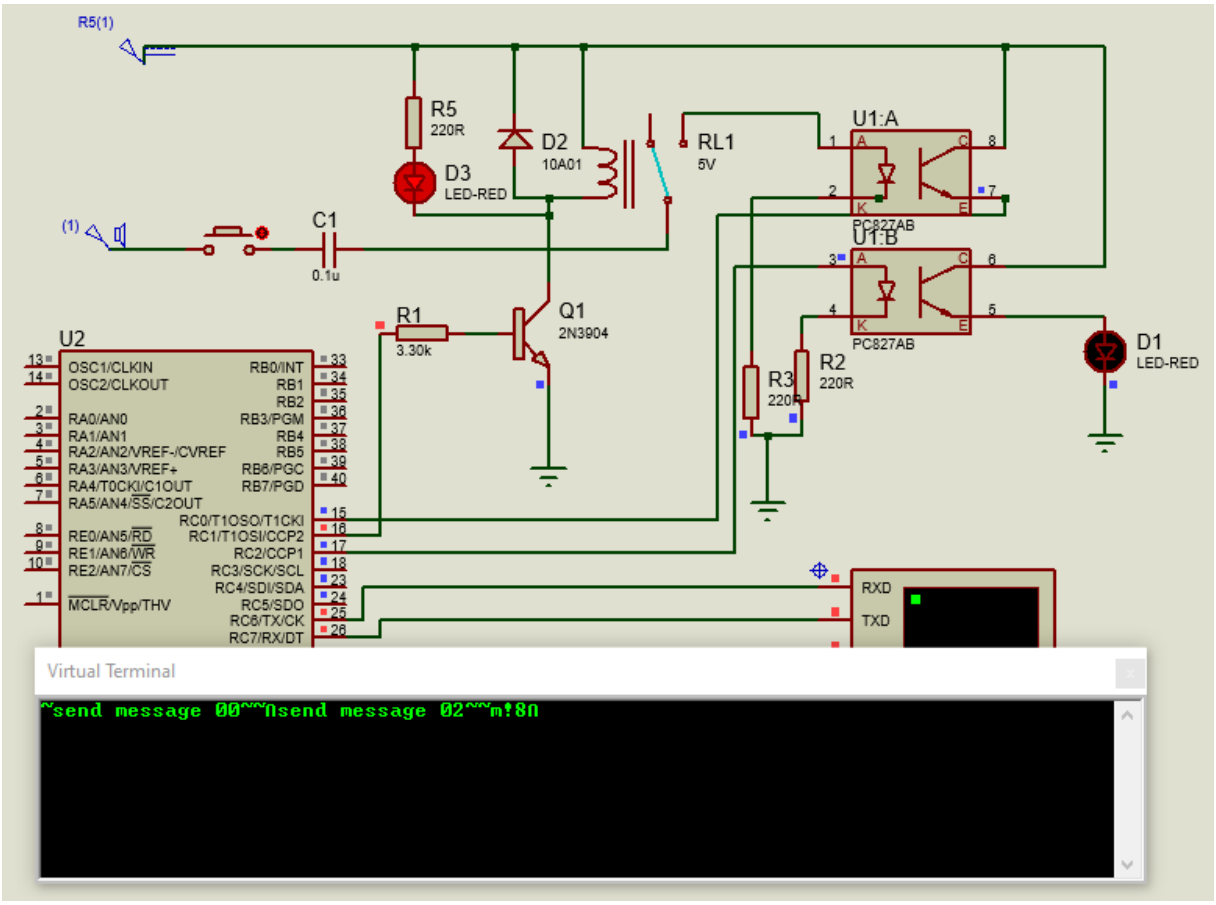


Figure 4.3: ON-HOOK mode

The system will automatically end the call after few seconds if there is no key pressed by the user. Ending the call is by the same way it picked up , the led D1 will run for a while again as an indication of the closed circuit .
The pic will give the order to play the gratitude sound track as the terminal shows, then hang up the call.
The relay RL1 will turn into the fist position making the system in a standby mode.

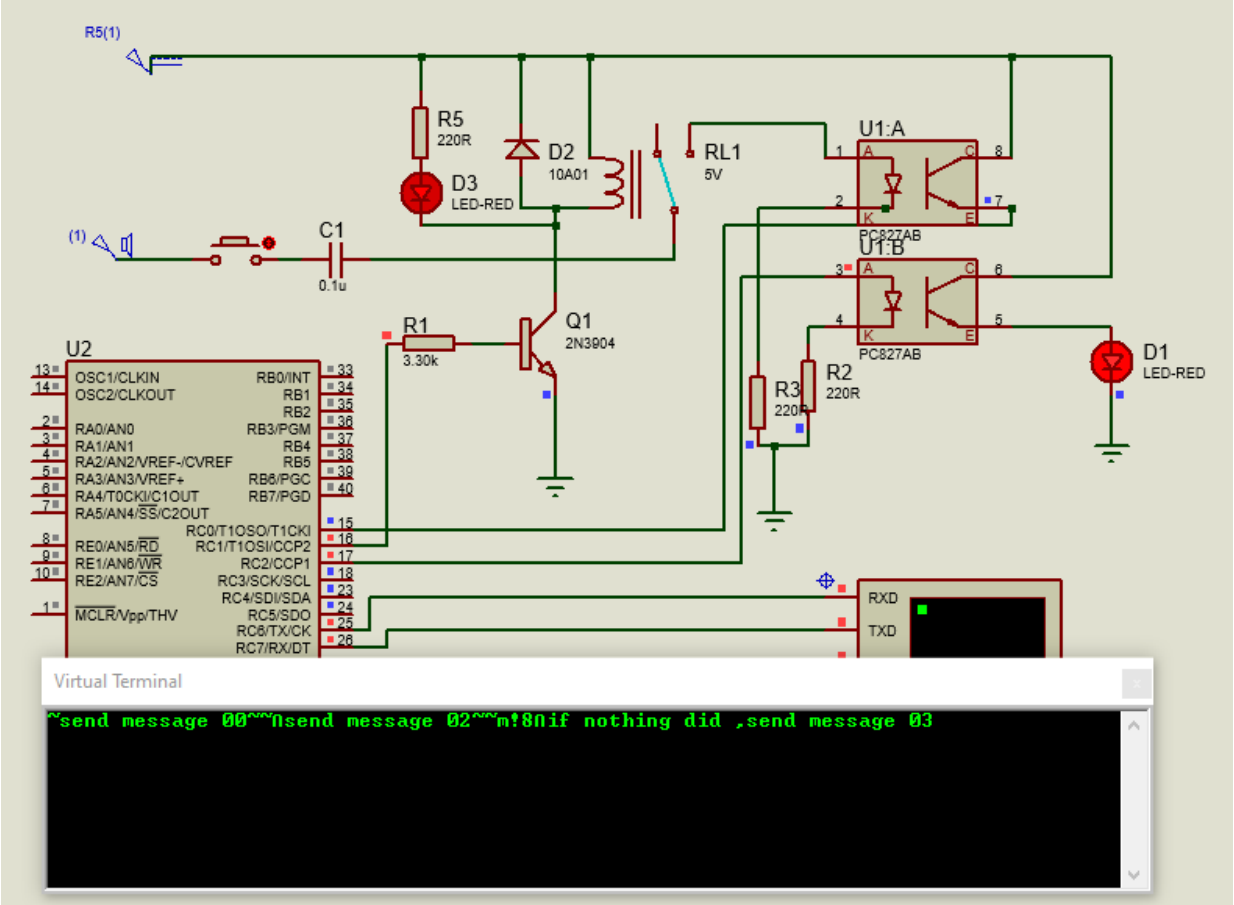


Figure 4.4: switching up from ON-HOOK to OFF-HOOK mode

4.3.2 Simulation of the relay Module with Microcontroller :

In this section we will make a test to control four relays which represent the electronic devices in our system by the microcontroller. As we mentioned before that the DTMF receiver decode the key pressing tones into a 04 bit binary code, We have replaced the output of DTMF decoder module (MT8870) with a Binary code generator (4 bit) to switch off/on the relays. Each relay has two codes one for switching on and the other for turning off.the table below show the codes:

Relay number	switching on code	switching off code
relay 01	1010	0001
relay 02	0010	0011
relay 03	0100	0101
relay 04	0110	0111

Table 4.1: Relay control binary code

Firstly we upload the code file on the PIC , then we set the clock at 8MHz .After that we run the simulation and adjust the binary code at "1010" to switch On the relay 01 :

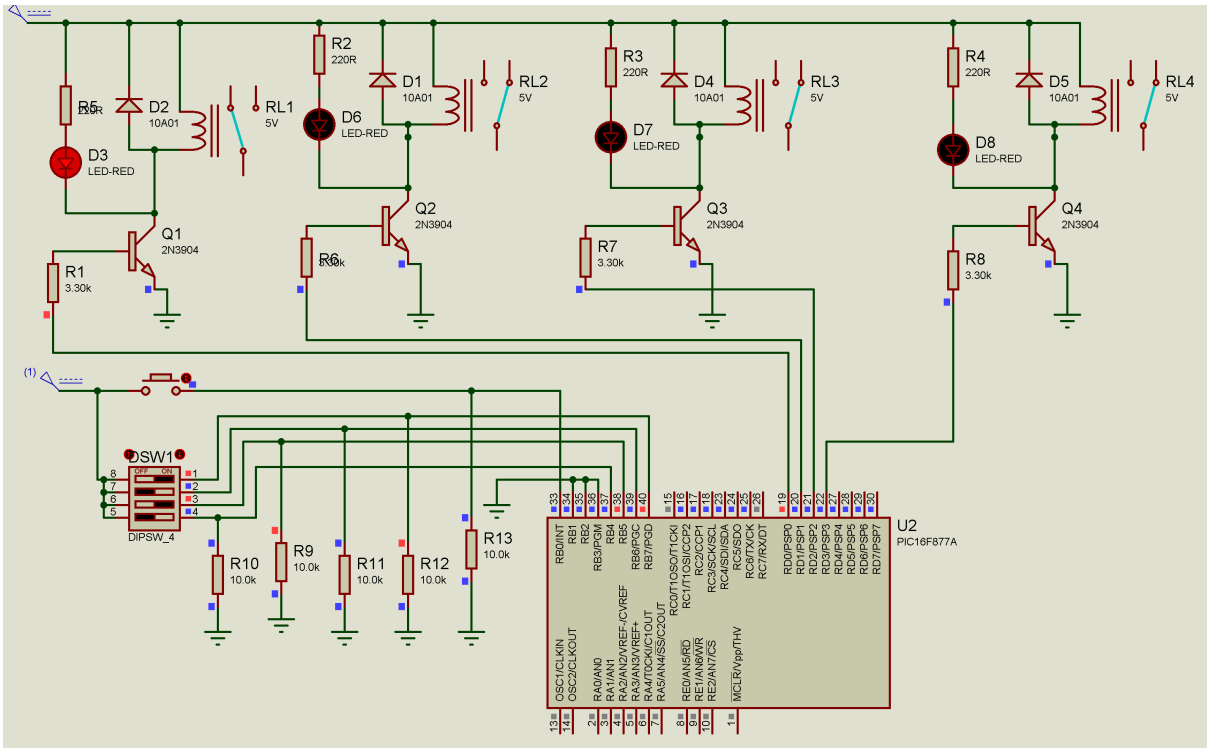


Figure 4.5: switching on relay 01

To turn off the relay 01 we need to enter the code ”0001” as shown in figure below :

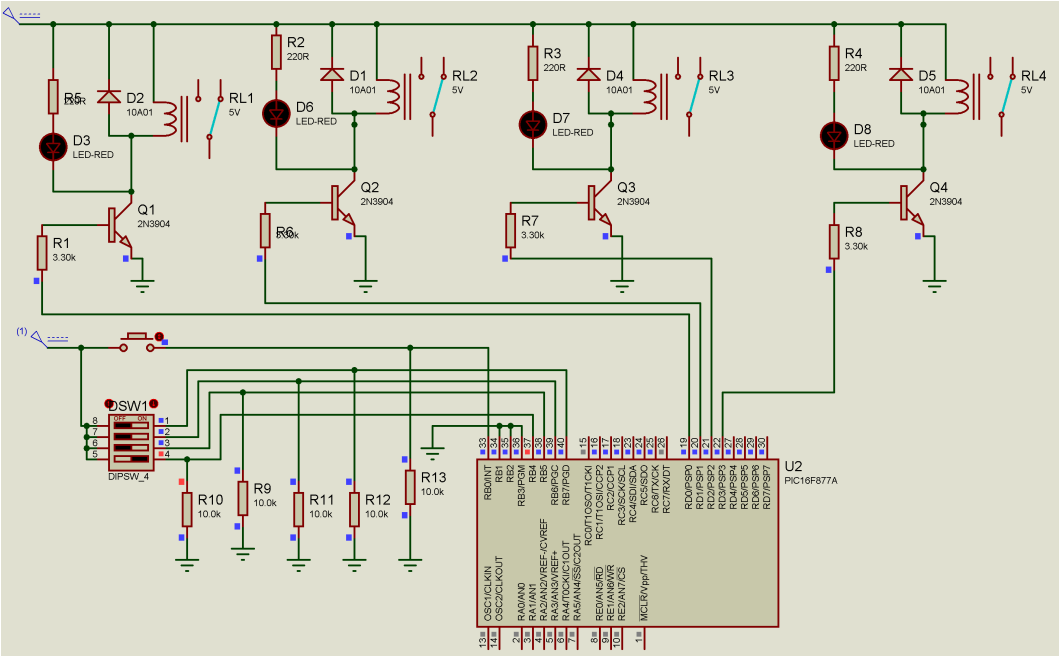


Figure 4.6: switching off relay 01

The relay 02 switch on when the code is ”0010”

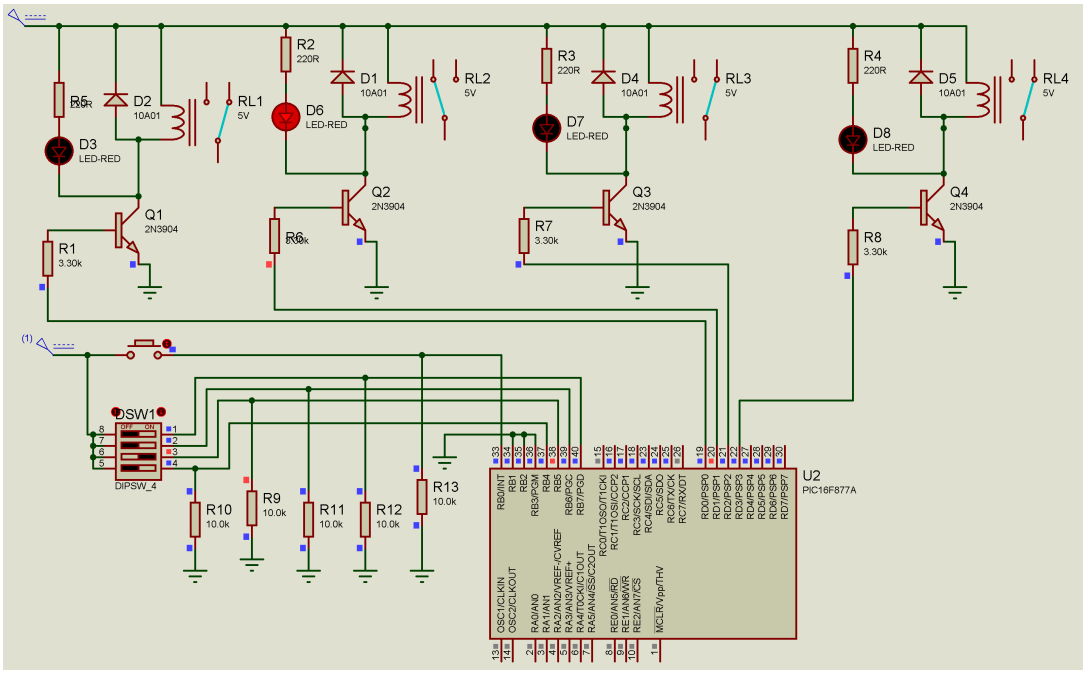


Figure 4.7: switching on relay 02

To turn of the relay 02 we need to enter the code ”0011” as shown in figure below :

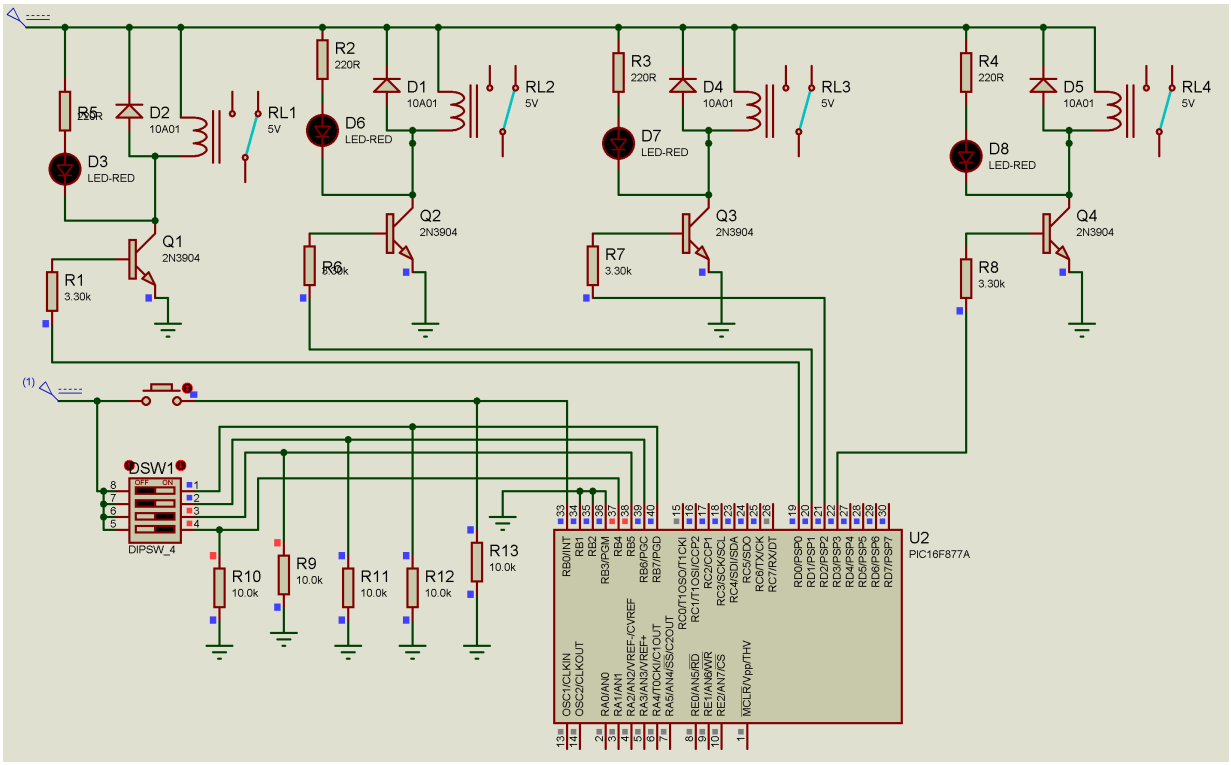
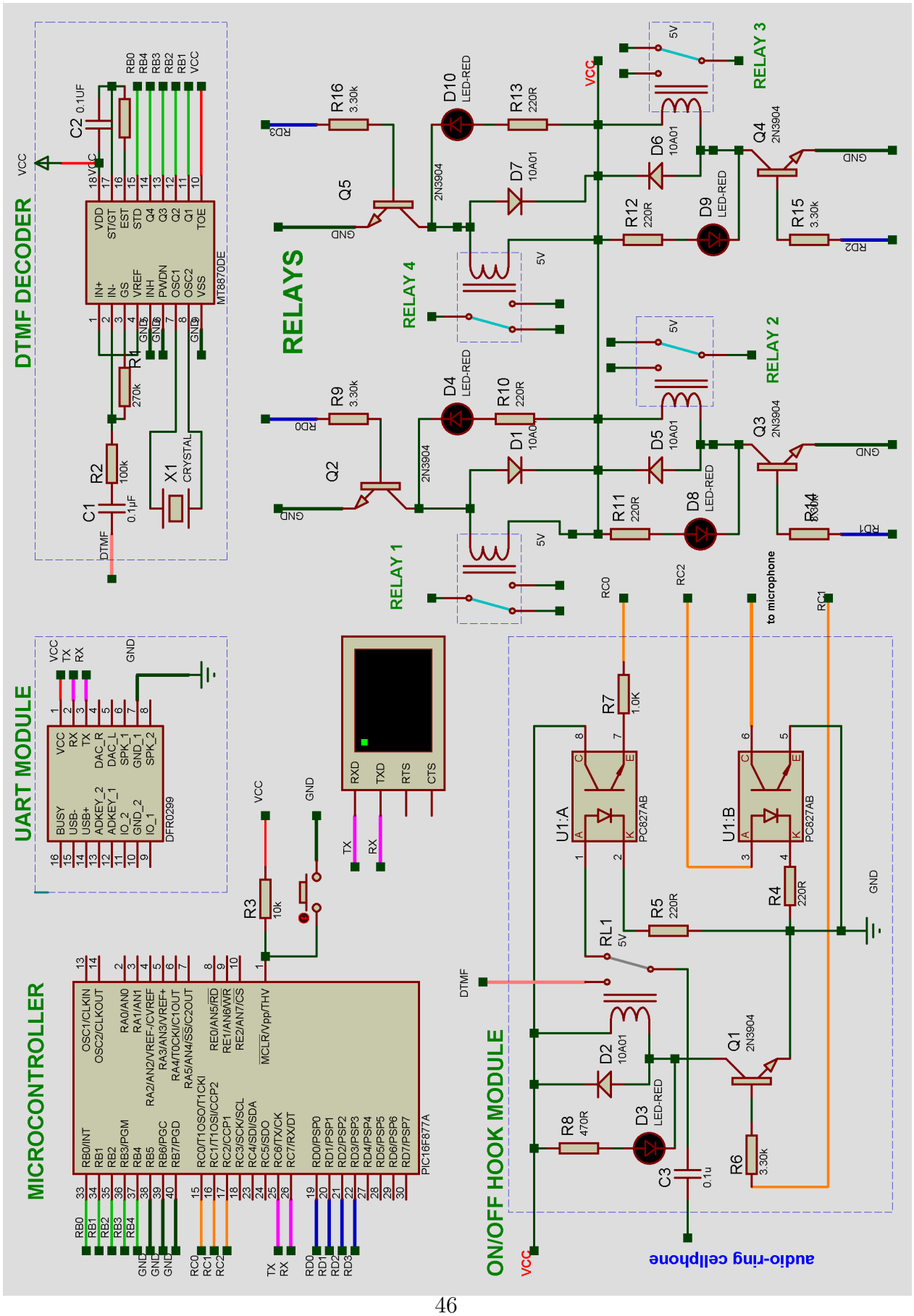


Figure 4.8: switching off relay 02

The same way with relay 03 and 04 we need to enter the code in order to switch on or off . finally, we can get the whole system circuit gathering the sub-circuits .the reason why we can’t simulate this global part is because of some missing operating parts in Proteus software (UART,MT8870) .The circuit is shown in the figure bellow :



46

Figure 4.9: Global system circuit

4.4 Project Implementation

The implementation of the system provides the technical information, the different used components , the Printed circuit board layouts and also the 3D form of the circuit.

4.4.1 Required components :

- 01 PIC 16F877A
- 01 MT8870 DTMF decoder
- 01 DFR0299 UART module
- 02 PC 827AB Optoisolator Transistor
- 17 Resistors (01R 100K,01R 10K,05R 3.3K,06R 220,02R 300K,01R 1K,01R 470)
- 03 Capacitors(0.1µF)
- 04 electromagnetic relays
- 05 Transistors (NPN type)
- 01 Crystal oscillator
- 05 LEDs(red and green)
- 05 Diodes

4.4.2 PCB Designing :

this section is about the printed circuit board design,

4.4.2.1 Film generation :

On the basis of the previous general circuit on Proteus software, we have created the film of the circuit which is shown below :

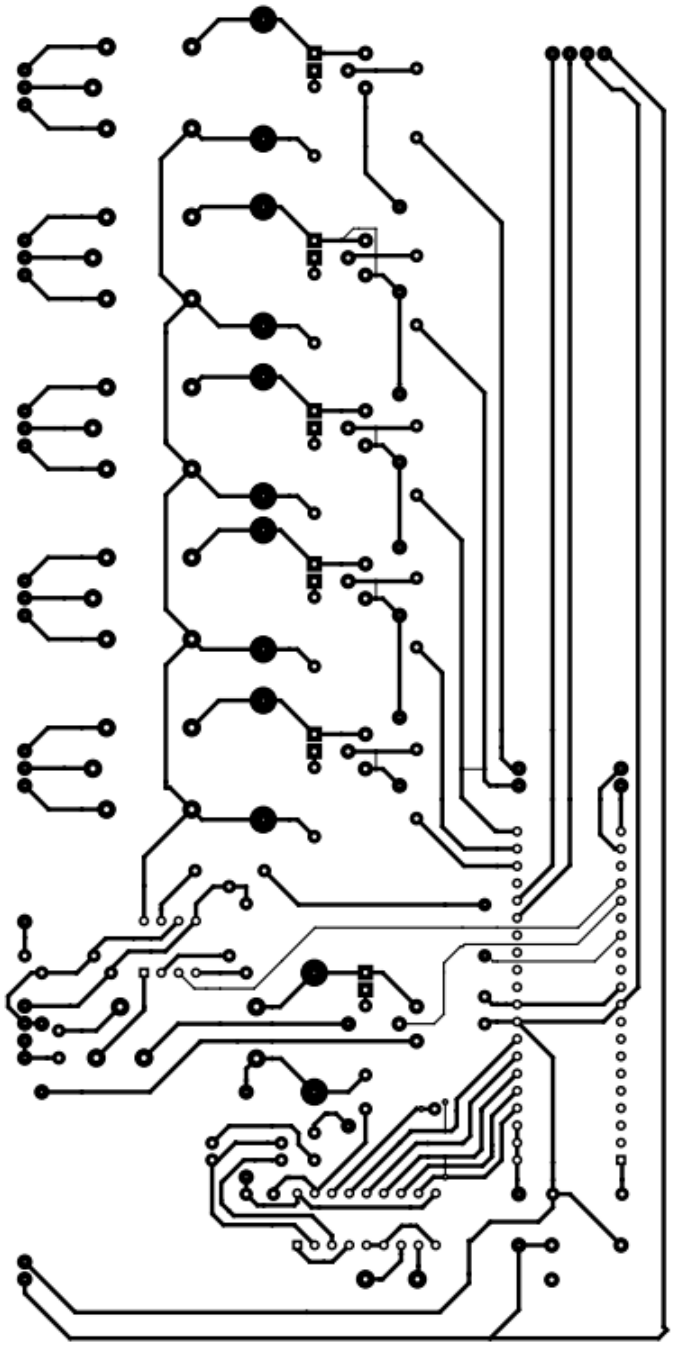


Figure 4.10: Film of circuit

4.4.2.2 Printed circuit board layout :

The Printed Circuit Board layout of our system is shown below,

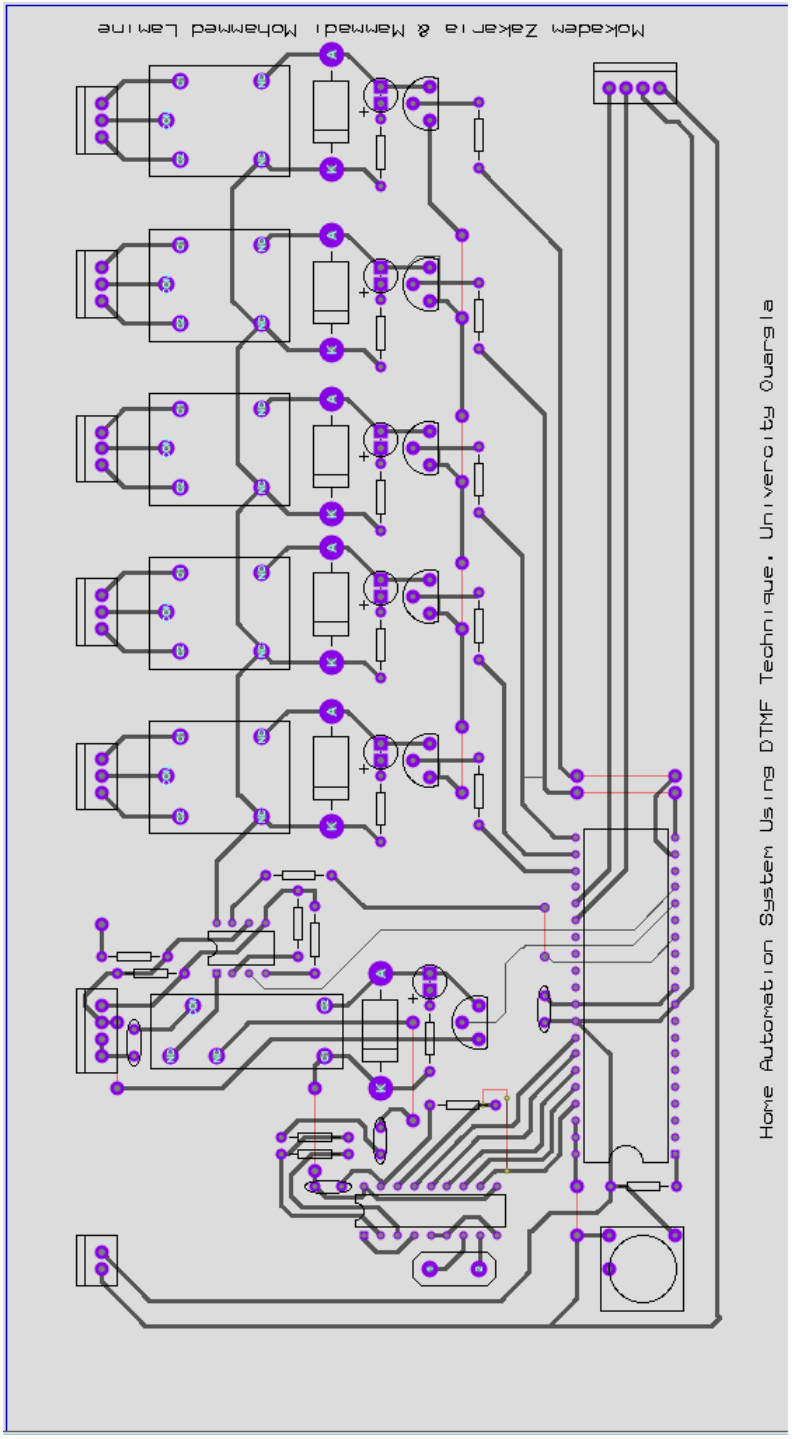


Figure 4.11: Printed Circuit Board layout

4.4.2.3 components placing :

It involves soldering the electronic components on the circuit bord.The 3D circuit forms are shown below:

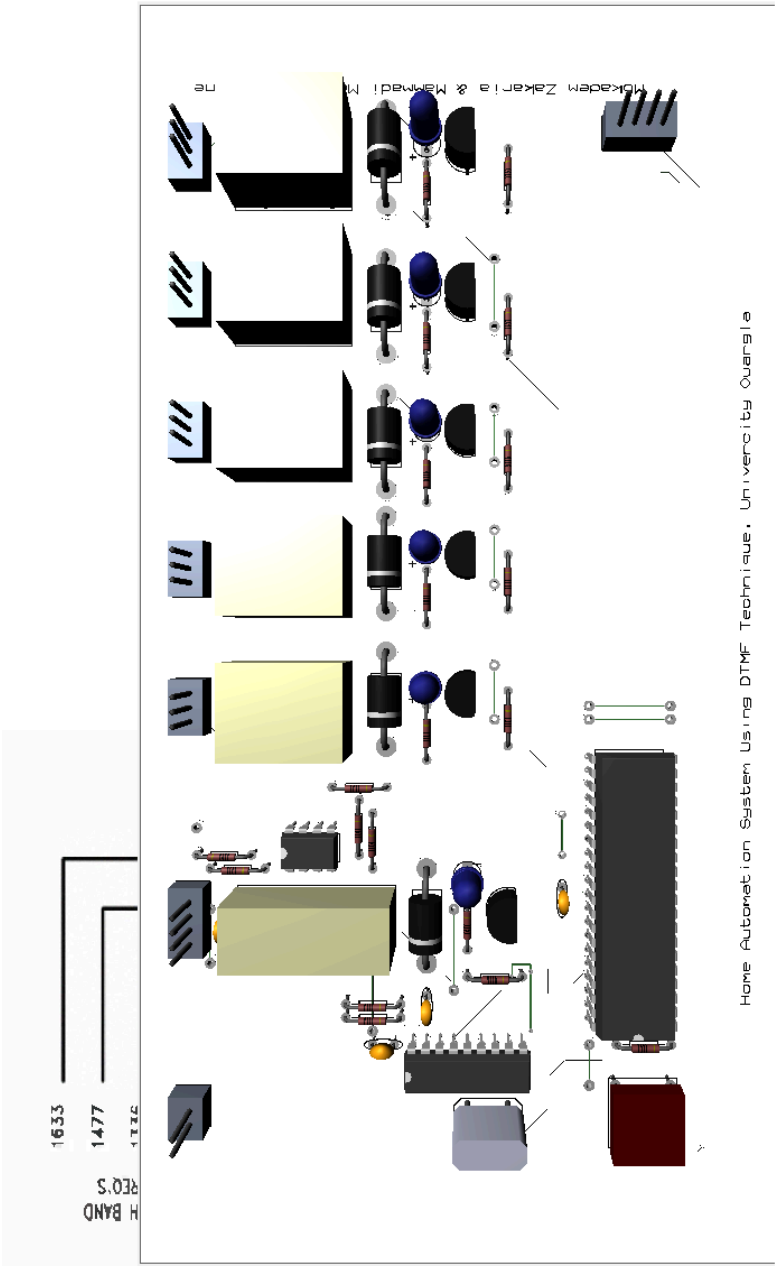


Figure 4.12: 3D circuit design(Top)

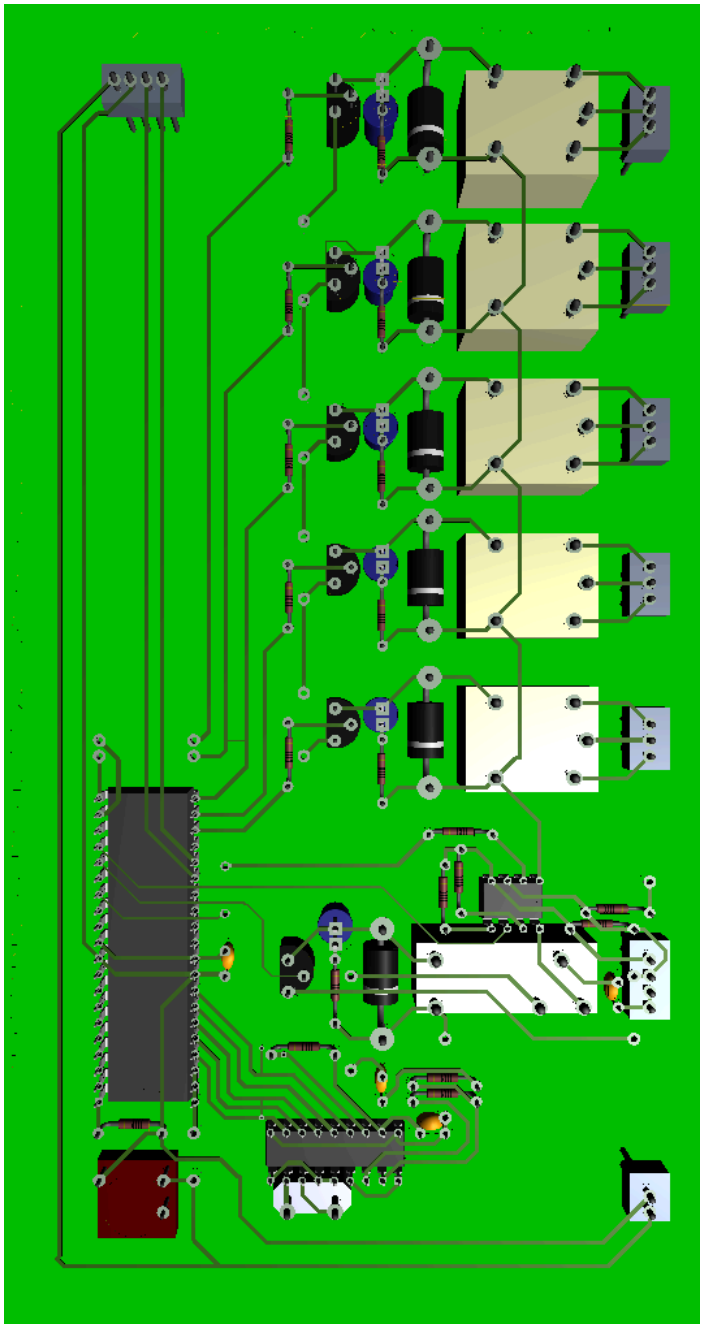


Figure 4.13: 3D circuit design (Bottom)

4.5 Conclusion

At the end of this chapter we can say that the system is well operating with no strict errors , so we can print the system circuit board and using it . the improving of the system could be by replacing the PIC 16F with PIC 18F so we can get high performance.
we could also add more devices and vocal messeges to make it easy understand the system operation.

General conclusion

It is evident from this project work that an individual control home automation system can be cheaply made from low-cost locally available components and can be used to control multifarious home appliances ranging from the security lamps, the television to the air conditioning system and even the entire house lighting system. And better still, the components required are so small and few that they can be packaged into a small inconspicuous container.
This Project presented a method to control home appliances using mobile phone and DTMF decoder. DTMF tone is generated by pressing the keypad buttons of the mobile phone. The extensive capabilities of this system are what make it so interesting. From the convenience of a simple cell phone, a user is able to control and monitor virtually any electrical device in a household.
This makes it possible for users to rest assured that their belongings are secure, that the garage door is shut, and that the television was not left running when they left the house to just list a few of the many uses of this system. The end product will have a simplistic design making it easy for users to interact with. This will be essential because of the wide range of technical knowledge that homeowners have.
The popularity and availability of the mobile and mobile network makes this kind of control very useful and powerful. The main advantages of the proposed system are its reliability, low cost, and wide area coverage. Future works for this system can be following

- Adding SMS message to carry controlling commands as alternate way for DTMF tone.
- Upgrading the system to control more than one machine at same time.

Finally, this home automation system can be also implemented over Bluetooth, Infrared and WAP connectivity without much change to the design and yet still be able to control a variety of home appliances. Hence, this system is scalable and flexible.

FUTUR SCOPE

- this project can be further developed to control more than one home appliance at once through the use of short message service texts rather than voice dial though it will be more expensive and will require more relay circuits, making it a distributed control home automation system.
- Also, to cut the cost of mobile phone, the project may be implemented using standalone GSM modems that only perform specialized functions like text messaging and/or phone calls. This GSM modems often are cheaper and more reliable than GSM mobile phones.
- This project can be further enhanced to be high voltage ac applications by changing the rating of the Relay
- We can control and monitor the high speed induction motors as well as synchronous motors. This can be done in an economical way.
- In this project we can add a multimedia camera to see what is going inside the home by sitting in office or somewhere.

APPENDICES

MT8870 DTMF pin description

5	5	INH	Inhibit (Input). Logic high inhibits the detection of tones representing characters A, B, C and D. This pin input is internally pulled down.
6	6	PWDN	Power Down (Input). Active high. Powers down the device and inhibits the oscillator. This pin input is internally pulled down.
7	8	OSC1	Clock (Input).
8	9	OSC2	Clock (Output). A 3.579545 MHz crystal connected between pins OSC1 and OSC2 completes the internal oscillator circuit.
9	10	VSS	Ground (Input). 0V typical.
10	11	TOE	Three State Output Enable (Input). Logic high enables the outputs Q1-Q4. This pin is pulled up internally.
11 14	12 15	Q1-Q4	Three State Data (Output). When enabled by TOE, provide the code corresponding to the last valid tone-pair received (see Table 1). When TOE is logic low, the data outputs are high impedance.
15	17	StD	Delayed Steering (Output).Presents a logic high when a received tone-pair has been registered and the output latch updated; returns to logic low when the voltage on St/GT falls below VTSt.
16	18	ESt	Early Steering (Output). Presents a logic high once the digital algorithm has detected a valid tone pair (signal condition). Any momentary loss of signal condition will cause ESt to return to a logic low.
17	19	St/GT	Steering Input/Guard time (Output) Bidirectional. A voltage greater than VTSt detected at St causes the device to register the detected tone pair and update the output latch. A voltage less than VTSt frees the device to accept a new tone pair. The GT output acts to reset the external steering time-constant; its state is a function of ESt and the voltage on St.
18	20	VDD	Positive power supply (Input). +5V typical.
	7, 16	NC	No Connection.

The commands of UART module

Command	Command bytes without checksum(HEX)	Remark
Next Song	7E FF 06 01 00 00 00 EF	
Previous Song	7E FF 06 02 00 00 00 EF	
Play with index first song	7E FF 06 03 00 00 01 EF	Play the first song
Play with index second song	7E FF 06 03 00 00 02 EF	Play the second song
Volume up	7E FF 06 04 00 00 00 EF	Volume increased one
Volume down	7E FF 06 05 00 00 00 EF	Volume decrease one
Set volume	7E FF 06 06 00 00 1E EF	Set the volume to 30
Single cycle play	7E FF 06 08 00 00 01 EF	Single cycle play the first song
Select device	7E FF 06 09 00 00 02 EF	Select storage device to TF card
Reset	7E FF 06 0C 00 00 00	EF Chip reset
Sleep mode	7E FF 06 0A 00 00 00	EF Chip enters sleep mode
Wake up	7E FF 06 0B 00 00 00 EF	Chip wakes up
Play	7E FF 06 0D 00 00 00 EF	Resume playback
Pause	7E FF 06 0E 00 00 00 EF	Playback is paused
Play with folder and file name	7E FF 06 0F 00 01 01 EF	
Play the song with the directory:/01/001xxx.mp3	7E FF 06 0F 00 01 02 EF	
Stop play	7E FF 06 16 00 00 00 EF	
Play with volume first song	7E FF 06 22 00 1E 01 EF	Set the volume to 30 QND play the first song
Play with volume second song	7E FF 06 22 00 0F 02 EF	Set the volume to 30 QND play the second song

Latex Sources of Information

This thesis has written by Latex text editor in more professional way .
The best source of information about LATEX is the two books mentioned below.
-Michel Goossens, Frank Mittelbach, and Alexander Samarin. The LATEX Companion. Addison-Wesley, Reading, Massachusetts, 1994.
-Leslie Lamport. LATEX — A Document Preparation System. Addison-Wesley, Reading, Massachusetts, second edition, 1994.

Another excellent resource is the UseNet newsgroup comp.text.tex. A frequentlyasked-questions (FAQ) list is also maintained by this news group. You might also search the World Wide Web for “LaTeX” for other sources of help.

References

[1] Anton A.Huurdeman. *The Worldwide History of Telecommunications*. John Wiley, Sons,page 529, 31 July 2003.

[2] Abdiweli Abdillahi Soufi; Abdirasoul Jabar Alzubaidi2. *Remote Control System through Mobile and DTMF*. International Journal of Computational Engineering Research.

[3] ATT. *Notes on Distance Dialing*. 1968.

[4] CATALEX. *Serial MP3 Player manual*. CATALEX inc,2015.

[5] L.T.; Hwang S.H. Chu, C.P ; Shen. *A New Algorithm for Tone Detection. In Proceedings of the AASRI*. Conference on Sports Engineering and Computer Science, London, UK„ pp. 118–122, 21–22 June 2014.

[6] Daniel D.Gajski and Frank Vahid. *Specification and Design of Embedded Hardware-Software System*. 1995.

[7] Jack Ganssle and outher. *embadded system*. 2012.

[8] Mikell Groover. *Fundamentals of Modern Manufacturing*. Materials,Processes and Systems, 2014.

[9] H.Schulzrinne and T. Taylor. *TRTP Payload for DTMF Digits*. Telephony Tones, and Telephony Signals, IETF RFC 4733, December 2006.

[10] Cheng-Yu Yeh; Shaw-Hwa Hwang. *Efficient Detection Approach for DTMF Signal Detection*. Department of Electrical Engineering, National Chin-Yi University of Technolog, 27 January 2019.

[11] Dogan Ibrahim. *Advanced PIC Microcontroller Projects in C*. Elsevier Ltd, 2008.

[12] Lucio Di Jasio. *Programing 16-bit Microcontrollers in C*. Elsevier Inc,2007.

[13] X.T. Liang. *A PSTN terminal for FSK decoding and DTMF dialing applications*. 2015.

[14] John lovine. *PIC Microcontroller Project Book*. McGraw-Hill Companies,2000.

[15] Rolin D.MacKinlay MUHAMMAD ALI MAZlDl and Danny causey. *PIC Microcontroller and Embadded system*. Pearson Education Inc,2008.

[16] SARMAD NAlMl MUHAMMAD ALI MAZlDl and SEPMR NAlMl. *the avr microcontroIIer and embedded system,Pearson Education*. Inc,2011.

[17] Olafusi Michael Olalekan. *Individual control home automation system*. federal university of technology, akure, October, 2009.

[18] Abdelmajid OUMNAD. *les microcontrolleurs étude détaillée du PIC 16F887*. ellipses Edition Marketing ,2012.

[19] Mr.Akash Pareek. *DTMF BASED HOME AUTOMATION*. Howrah, West Bengal, APRIL,2016.

[20] Monika Sevda ; Neha Choudhary ;Pragya Rohatgi. *home automation using mobile phones*. Faculty of Engineering Technology Lakshmangarh, Sikar, November, 2012.

[21] Gunter Schmer. *DTMF Tone Generation and Detection*. Texas Instruments,2000.

[22] Kiyofumi Tanaka. *EMBEDDED SYSTEMS THEORY AND DESIGN METHODOLOGY*. EMB,InTech,2012.

[23] W.D.Reeves. *Subscriber Loop Signaling and Transmission Handbook—Analog*. IEEE, p.27, (1992).

[24] Tim Wilmshurst. *Designing Embedded Systems with PIC Microcontrollers*. Elsevier Ltd,2007.

[25] Richard Zurawski. *NETWORKED EMBEDDED SYSTEMS*. Taylor Francis Group, LLC,2009.

[2] [1][3][10][5][8][13][20][19][17][23][9][4][24][22][7][25][12][15][14][6][12][21][18][11][16]