T.C
REPUBLIC OF TURKEY
FIRAT UNIVERSITY
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DESIGN AND SIMULATION OF FOUR WALLS CROSSED SECURITY SYSTEM AGAINST INTRUSION USING PIC MICROCONTROLLER

MUHAMMAD BABALLE AHMAD

MASTER THESIS

Department Of: Mechatronics Engineering
Program: Electronic System
SUPERVISOR: Doç. Dr. Mehmet ÇAVAŞ

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January 2020

ÖNSÖZ

Bu araştırma, mühendislik hayatım ve akademik kariyerim için iyi bir referans olacak, benim lisans ve lisansüstü eğitimim sırasında edindiğim temel mühendislik deneyimimin uygulanması ve birleştirilmesi açısından önemli olacağı kanaatindeyim.

Bu araştırma, dünyanın birçok bölgesinde artan hırsızlık ve kaçırma olaylarına karşı alınabilecek önlemler açısından alternatif bir çözüm sunacaktır. Tehlike ile mücadele etmek için, özellikle teknolojinin gelişmesiyle birlikte ev ve işyeri güvenliğini sağlayacak güvenlik ve alarm sistemlerinin kullanılması, insanların evlerini ve işyerlerini güvence altına almalarını sağlayarak olası tehlikeleri de minimize edecektir. Bu güvenlik sistemleri sayesinde, ev ve iş yerlerinin davetsiz misafirlere karşı korunması ve izlenmesi sağlanacaktır.

Bu çalışmada her türlü desteği veren danışmanım Doç. Dr. Mehmet ÇAVAŞ'a teşekkür ederim. Fırat Üniversitesi Teknoloji Fakültesi Mekatronik Mühendisliği Bölümünde yapmış olduğum bu çalışmanın özellikle ülkeme döndükten sonra güvenlik sistemleri üzerine yapacağım çalışmalarıma ciddi katkılar sağlayacağı kanaatindeyim.

MUHAMMAD BABALLE AHMAD
ELAZIG-2020

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ÖZET

PIC16F877A MİKRODENETLEYİCİ KULLANARAK DUVAR-ÇAPRAZ SAPTANIM GÜVENLİK SİSTEMİNİN TASARIMI VE SİMÜLASYONU

Günümüzde her alanda kullanılan teknolojiler her geçen gün gelişmekte ve farklı uygulama alanlarında farklı teknolojiler kullanılmaktadır. Bu alanlardan biri de özellikle güvenlik sistemleri alanıdır. Bu gün farklı alanlarda farklı tip güvenlik sistemleri kullanılmaktadır. Özellikle ev ve işyerlerinde kullanılmak üzere kullanılan farklı tip güvenlik sistemleri olmak ile birlikte, fiyatların yüksek olması kullanımlarını sınırlamaktadır. Bu çalışmada maliyeti düşük fakat güvenirliliği yüksek bir güvenlik sistemi tasarlanmıştır. Bu kapsamda kuzey duvarı, güney duvarı, doğu duvarı ve batı duvarı olmak üzere dört kare duvarın arkasını kontrol edecek bir güvenlik sistemi geliştirildi. Her alanın kotrolünde ışığa bağımlı direnç (LDR) ve ışık yayan diyot (LED) kullanılarak tasarlanan optik sistem kullanıldı. Kullanılan mikrodenetleyicinin kontrolü sayesinde algılamanın olmadığı durumlarda sistem pasif iken, herhangi bir şekilde optik sensör bir algılama yaptığında ise sistem aktif hale gelerek davetsiz misafirin tespiti sağlanarak gerekli müdahalelerin yapılması gerçekleşecektir.

Anahtar Kelimeler: Güvenlik sistemi, PIC, LCD, CCTV

SUMMARY

Wall crossed detection system

Lately, the technologies are used in every field to the application in a different area. One of these areas is especially the security systems. To date, different types of security systems are used in different areas to provide security. Between this area especially home and workplaces more attractive than other areas. In this study, a security system was designed with low cost but high reliability. In this context, a security system was developed to control the north wall, south wall, east wall and western wall behind four square walls. The optic system was designed using light-dependent resistance (LDR) and light-emitting diode (LED). With the control of the microcontroller used in the absence of detection, the system is passive while in any way when the optic sensor makes a detection, the system will become active and the intruder will be identified, and the necessary interventions will be performed.

Keyword: Security systems, PIC, LCD, CCTV

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LIST OF SYMBOLS AND ABBREVIATIONS

ASM : Assembly Language
BOR : Brownout reset
CCTV : Closed Circuit Television
CISC : Complex Instruction Set Computer
CPU : Central Processing Unit
DC : Direct Current
EEPROM : Electrical erasable programming read-only memory
GFR : General function register
HS : High Speed
I/O : Input / Output
IC : Integrated Circuit
LCD : Liquid Crystal Display
LDR : Light Dependent Resistor
LED : Light Emitting Diode
LP : Low power
MCLR : Master Clear Reset
MCU : Microcontroller Unit
OST : Oscillator Start-up Timer
PIC : Peripheral Interface Controller
POR : Power-on reset
PWRT : Power-up Reset Timer
RAM : Random Access Memory
RC : Resistor Capacitor
RISC : Reduced Instruction Set Computer
ROM : Read Only Memory
SFR : Special Function Register
USART : Universal synchronous asynchronous receiver transmitter
VDD : Positive Supply
VSS : Negative supply
XT : Crystal resonant

1. INTRODUCTION

The most straightforward meaning of any security system originates in its name, it is exactly a means or process by which something is secured through a system of interworking mechanisms and appliances. In this instance, I am speaking about home security systems, which are systems of combined electronic appliances functioning together with the help of a central control panel to defend against housebreakers and other possible home burglars [1]. Figure 1.1 below shows a model of the home security alarm system.

Fig. 1.1: A model of home security system [18].

1.1 History of security system

Recently, home monitoring and security systems have become widespread. One of the reasons for the rise is the growing risk of crime and robbery and the demanding lifestyle of people in the world [2]. Many homes are battered mainly by force entry through illegal entry either through breaking a window, cutting a celling or entering from a locked door or an open window. Case studies show that most burglars are cut off by the simple presence of an alarm system in a home. Thieves attack far more vulnerable buildings than those guarded by an alarm system [3]. The advancement of alarm systems began with the formation of man. To give warning information, humans adopt a form of gesture, scream, and noise [4]. This was later replaced by the applause of hands and the ingraining of gongs to warn society or to spread particular information in the early periods of the world [5]. All these warning methods are rudimentary, undependable and disorganized. With the development of technology, these rudimentary techniques of creating alarm were changed by automated alarm systems in the late eighteenth century [6]. These electronic alarm systems work without any human effort. When it detects a certain signal, it gives a warning of high sound or noise depending on its design [7].

1.2 Discovery of security system

The first electronic fire alarm system was developed by William F. Channing. An electrical engineer, Mr. Moses G. Farmer fabricated the structure [8]. This system uses automatic signal boxes to designate the location of the fire and was first used in Boston, United States of America (U.S.A). Dr. William's development of this alarm system was followed by the advancement of numerous complex and sophisticated fire and burglar alarm technology that are too many to discuss. Important among these technologies is the remote signaling burglar alarm [9]. This system was invented in the early 1970s. This provided a quick artistic response to alarm calls. Though, industries based on the supply of security service equipment come in different designs to keep thieves and vandals away from public areas that are not built for them. Nowadays, we have a new generation electronic alarm system with sophistication at various levels [10]. With the recent surge in crime rates in the world, it has become important to protect our premises and our property with sophisticated levels of advanced security devices. The price of these security devices depends on equipment technology and application requests [11]. These security devices are termed modern electronic alarm systems. Some of today's modern alarm systems are burglar alarms, threat alarms, industrial alarms, speed limit alarms, and anti-theft vehicle alarms. The intruder alarm is triggered by a cycle, from a complete electronic circuit loop that is closed with an alarm at the output, or a signal to alert the owner of a threat or what to do [12]. A central control box monitors various motion detectors and boundary protectors and gives an alarm when any of them is triggered. Some burglar alarms operate sensitively on the concept of magnetic contact and others [13]. For those working on the sensors, the sensors are normally placed at any entrance of the building or limited entrance of the rooms; in this case, activates an alarm if the sensor receives a signal above its set threshold [14]. This work, the liquid crystal display (LCD) is used as a user interface. Each one of the four walls have a light beam (transmitter) and light-dependent resistor (receiver) the light beam is pointing at the light-dependent resistor (receiver) the system also has a real-time clock that use to save the time of when last a particular wall crossed and can be view by the user when pressing the view mode button. When the system is powered on, it displays on the liquid crystal display (LCD) ‘ALL 4 WALLS OK’ and the motor that rotating the (CCTV) camera is by default located at the north wall [15]. Whenever a wall (say east wall) is crossed by an intruder the system will alert the user (through buzzer) and display on the liquid crystal display (LCD) ‘EAST WALL CROSSED’ the system will also save the time at which the east-wall was crossed and will automatically control the motor to rotate and stay at east-wall in order to capture the real-time video of the area using closed-circuit television (CCTV) camera that is mounted on the motor [16]. The system will remain at the east wall and keeps alarming the user with the help of buzzer until another wall is crossed at the same time if all the walls are crossed it will still notify the house owner by displaying on the (LCD) the amount of the walls crossed [17].

1.3 How the home security system works

A home security system is made up of a central processing unit called an alarm control panel, a controller called an alarm keypad, various types of detection devices, and notification devices which are normally alarming sirens or strobes [18]. The alarm control panel needs power from an AC or DC transformer and usually has a backup battery supply in case of a power outage. The keypad used to arm or disarm the system is wired to the alarm control panel or, if it is a self-contained or all in one security system, the keypad is built right into the alarm control panel. When the home security system is armed, the detection devices are active and ready to activate the alarm. When the security system is disarmed, no alarm can be activated. Once an alarm is activated, the notification devices sound loud noises or flash bright lights to scare away intruders and alert people to the intrusion. A home security system can act as a local system that merely activates the notification devices when an alarm is activated, or it can be monitored by a central station. With a monitored home security system, the alarm activation is sent to the central station via telephone, internet or cellular signal so that a live operator can respond to the alarm signal and contact the homeowner and/or local authorities. Home security systems work on the simple concept of securing entry points into a home with sensors that communicate with a control panel or command center installed in a convenient location somewhere in the home. The sensors are typically placed in doors that lead to and from a house as well as easily accessible windows, particularly any that open, especially those at ground level. Open spaces inside of homes can be secured with motion sensors [18]. Figure 1.2 below shows how the home security alarm system works.

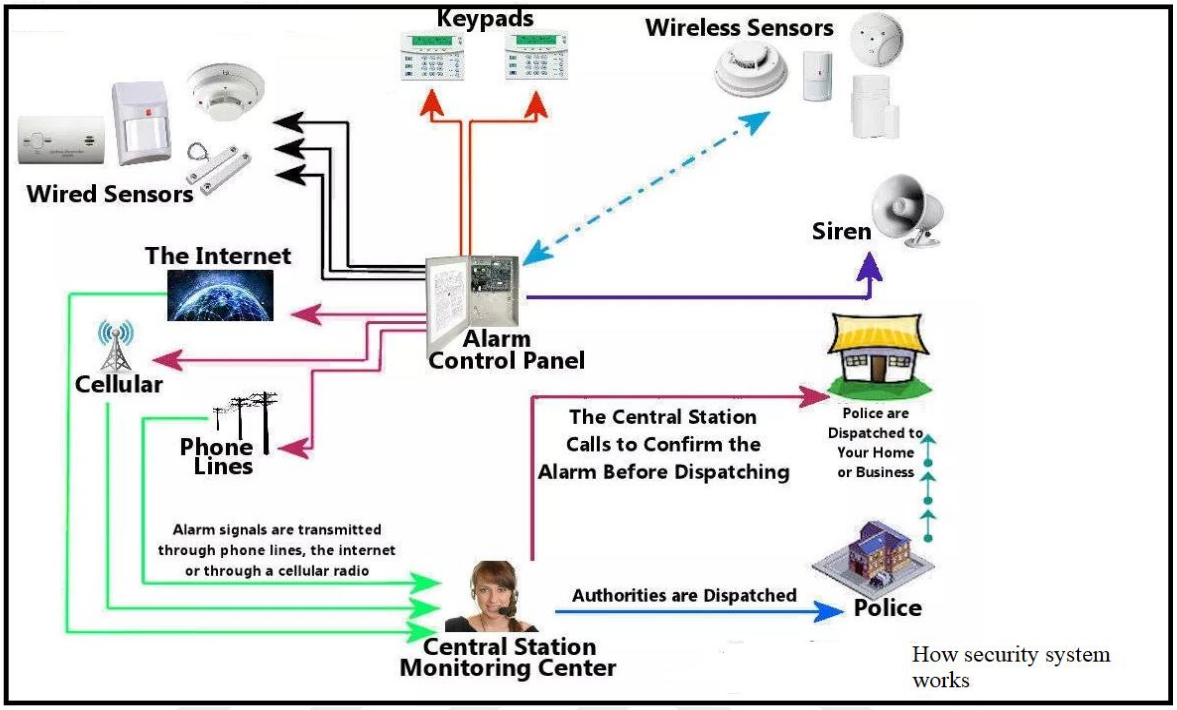


Fig. 1.2: How the home security system works [18].

1.3.1. Advantages of installing or having a home security system

1. Constant protection: Employing security guards or personally being there to protect the property all day is practically not possible. These security systems provide round the clock protection against burglars and break-ins.

2. Strong deterrent: Homes and commercial properties that have burglar alarm systems installed are at a lesser risk of being targeted by intruders and burglars. When infiltrators find out that you have an alarm system installed, they are persuaded to move away from your property. Even if they are not aware of its presence, the alarming sound will scare them off.

3. Uninterrupted functionality: There are two types of alarm systems. Wireless alarm systems work on batteries and not electricity. Which means they are effective during power-cuts as well. The hardwired system does not use batteries and consume electricity from the source. So, there is no need for regular battery charging or replacement.

4. Can relocate: The alarm system devices can be disconnected and installed at different places. It is easy to both, wireless as well as wired alarm security systems.

5. Special alarm systems: Modern alarm security systems provide the ability to monitor the activities happening on. Your property when you are away. There are security systems that have an add-on feature of detecting fire or smoke. These systems will instantly notify you during emergencies like a fire breakout, gas leak, or a flood emergency.

1.3.2. Disadvantages of having a home security system

1. False alarm: These security systems are prone to false alarms that involve the alarm ringing when anyone from your family enters the restricted area. Alternatively, there are instances when the alarm is triggered by itself without any reason.
2. Expensive: Both, wireless and hardwired alarm systems are expensive to install. They require an initial investment, which includes equipment cost, installation, and subscription of security monitoring service.
3. It can be stolen: irrespective of the type of burglar alarm you have, it can be stolen from the site where it is installed. Wireless systems are comparatively easier to disconnect. Some burglars can easily disconnect the wired alarm system [19].

1.4 A typical home security system component

1. A control panel, which is the primary controller of a home security system
2. Door and window sensors
3. Motion sensors, both interior, and exterior
4. Wired or wireless security cameras
5. A high-decibel siren or alarm
6. Carbon dioxide detector
7. Glass break detector
8. Some detector
9. Theft detector
10. Food detector
11. Temperature detector

Figure 1.3 below shows the Components of the security alarm system.

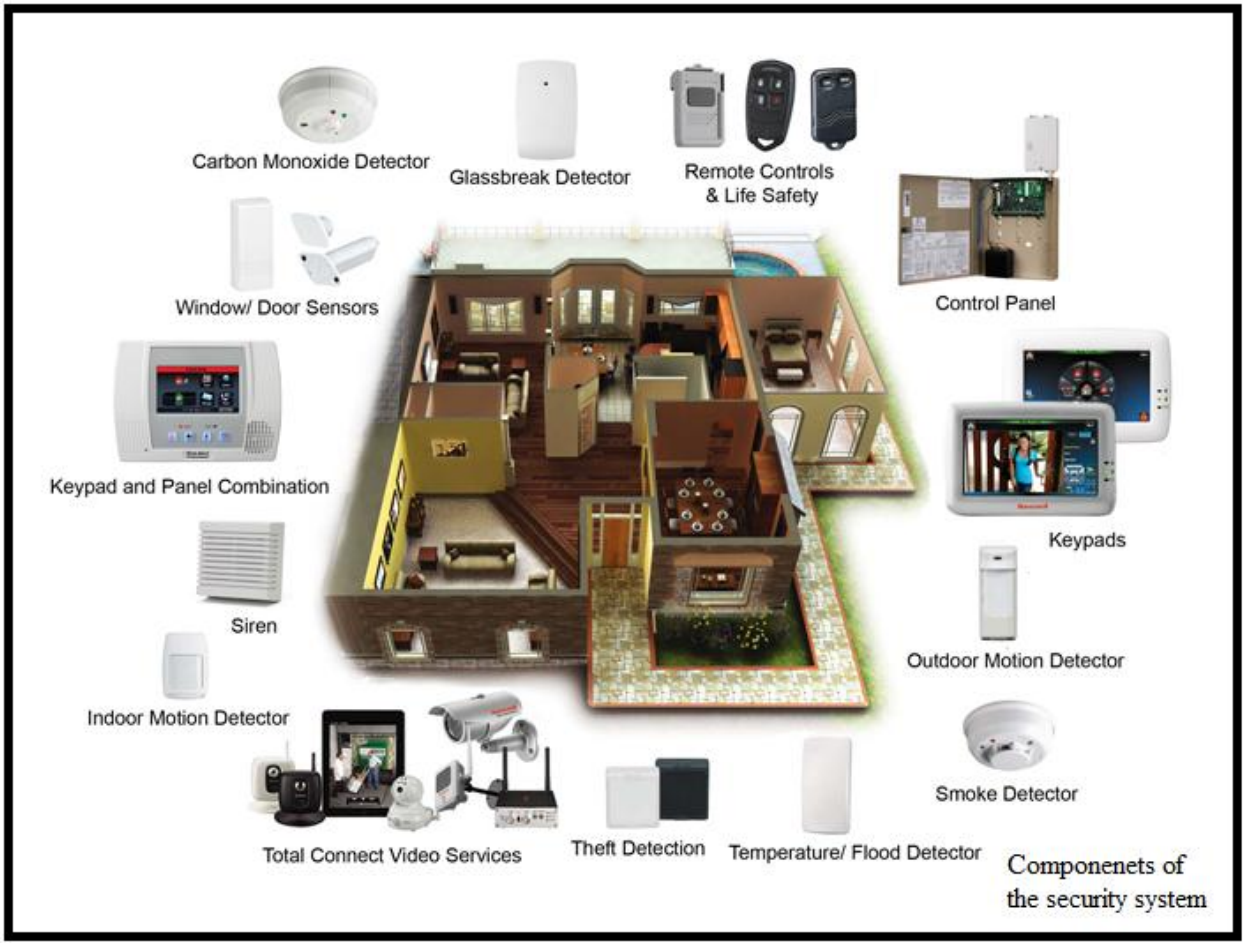


Fig 1.3: Components of the security system [18].

1.4.1. Control panel

The control panel is the computer that arms and disarms the security systems communicate with each installed component, sounds the alarm when a security zone is breached and communicates with an alarm monitoring company. They typically feature a touchpad for easy programming and interaction, is where passcodes are entered to arm and disarm the system, can work on voice commands, and can be programmed to work with wireless remote controls called key fobs. The control panel is the center of your home security system, where all of the action takes place. The reception hub where all the security detections devices such as fire detector, door sensor, motion sensor send their signals, the control panel is on throughout the day, ready to sound the immediate alarm and instantaneously alert the homeowner whether directly or through a monitoring service professional on call. An easy to use, access security control panel puts the control of your home's safety at your fingertips [20]. Figure 1.4 below shows the picture of the home alarm security control panel.

Fig. 1.4: Home security control panel [20].

1.4.2. How the control panel works

Either hardwired or wireless, the control panel is connected to every security detection device in your home security system. The status is available to you through the panel's built in the display window. If a door or window is open somewhere in the house, it will show you where. If an alarm is triggered, a quick glance at the control panel points you to it. Many control panels include a panic button to dispatch emergency personnel. Multiple controllers called keypads may be installed anywhere around the home such as places of entry, hallway or bedroom [20]. Figure 1.5 below shows the image of a control panel on how it works.

Fig. 1.5: A control panel how it works [20].

1. The control panel is essential for home security systems. Unless you choose a low technology solution involving traditional lock and key hardware, you need a home security panel to serve as the heart for the system, the place that links cameras and other sensory devices at the main point where you can arm your system. While many people may decide to install a comprehensive system that allows them to access most or all of their features from a smartphone, the panel is still the primary hub for the system.

2. Never ignore those beeping sounds when you hear them. Panels may beep for a variety of reasons. Low battery power, prolonged loss of electricity, and a unit in need of repair or replacement are the three most common reasons. If you notice the beeping sound, check your panel immediately. Sometimes, home security panels need to be rest. Yes, this may seem frustrating at the moment, but it is never an impossible task.

3. Remember the role of the tamper switch. The panel has a temper switch as an extra level of security to assure that if someone tries to modify the system, the event does not occur unnoticed. Even changing the batteries will trigger the tamper switch as a way of alerting the owner and the security monitoring firm that someone may have tried to compromise the panel’s operation.

4. Batteries in systems vary and they need to be replaced at some point. Whether you installed your own panel or bought a house with a pre-existing system, it makes sense to keep track of your batteries for the panel. Batteries are often measured in either in Amp-Hours (for larger batteries) or Milliamp-hours (For smaller batteries).

5. Choose a convenient location for your panel. Make sure it is easy to access, day and night. And also inform all family members of its basic operations [20].

1.4.3. Window and door sensors

Door and window sensors are comprised of two parts installed adjacent to each other. One part of the device is installed on the door or window and the other on the door frame or window sill. When a door or window is closed, the two parts of the sensor are joined together, creating a security circuit. When the security system is armed at the control panel, these sensors communicate with it by reporting that the point of entry is secure. Should a monitored door or window suddenly be opened, the security circuit is broken, and the control panel interprets this as a breach of a secured zone. A high-decibel alarm is sounded, and, in most instances, the alarm monitoring company is automatically notified [21]. Figure 1.6 below shows the window and door sensor image.

Fig. 1.6: Window and door sensor [21].

There are wired and wireless window and door sensors available, although most homeowners output for the wireless version to avoid the mess of cords. Most windows sensors, like door sensors, are composed of magnets and reed switches. Reed switches are commonly used in everyday household items. When you close a laptop and the screen goes dark, that usually the work of a reed switch. A window sensor works much the same way. A reed switch with a small circuit inside sits on the frame of the window, while a magnet attaches to the pane, right to the switch. When the magnet holds the switch metal contacts together, when the window is closed, an electric current flows in a continuous loop. When the two pieces separate when the window opens, the electrical current stops flowing and the circuit deactivates. The sensor then signals the security control panel, triggering the alarm. Door and window sensors generally come in two separate pieces. One-piece fits onto the door or window itself, while its counterpart attaches to the frame or the pane of the window. If you want, sensors can be screwed directly into the frame or around the window for extra support, although it is not necessary. Position the two pieces of the sensors right next to each other, because they interact when a door or window is moved. The sensors utilize magnetic fields in order to track movement between the door or window and the frame. When they separate, such as when the door is opened, the sensors send a signal to the alarm panel. The panel will then assess the situation and notify you of unusual activity inside your home. In the event of a burglary, your professionally monitored home security system will contact the emergency response center closet to you in order to dispatch help [21]. Figure 1.7 below shows the picture of how the door and window sensor work.

Fig. 1.7: How the door and window sensor work [21].

1.4.4. Motion sensor

A motion sensor (or motion detector) is the hub of your security system because it's the main device that detects when someone is in your home when they shouldn't be. A motion sensor uses one or multiple technologies to detect movement in an area. If a sensor is tripped, a signal is sent to your security system's control panel, which connects to your monitoring center, alerting you and the monitoring center to a potential threat in your home. These security components, when armed, protect a given space by creating an invisible zone that cannot be breached without sounding an alarm. These are typically used to protect rooms containing valuables, as well as areas less frequented in larger homes. Figure 1.8 below shows the picture of a motion sensor.

Fig. 1.8: A motion sensor [22].

An electronic motion detector contains an optical, microwave, or acoustic sensor, and in many cases a transmitter for illumination. However, a passive sensor senses a signature only from the moving objects via emission or reflection, that is, it can be emitted by the object, or by some ambient emitter such as the sun or a radio station of sufficient strength. Changes in the optical, microwave or acoustic field in the device's proximity are interpreted by the electronics based on one of the technologies listed below. Most low-cost motion detectors can detect up to distances of at least 15 feet (4.6m) specialized systems cost more but have much longer ranges. Tomographic motion detection systems can cover much larger areas because the radio waves are at frequencies which penetrate most walls and obstructions, and are detected in multiple locations, not only at the location of the transmitter. Motion detectors have found wide use in domestic and commercial applications. One common application is activating automatic door openers in business and public buildings. Motion sensors are also widely used in lieu of a true occupancy sensor in activating street lights or indoor lights in walkways, such as lobbies and staircases. In such smart lighting systems, energy is conserved by only powering the lights for the duration of a timer, after which the person has presumably left the area. A motion detector may be among the sensors of a burglar alarm that is used to alert the homeowner or security service when it detects the motion of a possible intruder. Such a detector may also trigger a security camera to record the possible intrusion. The main purpose of the motion sensor is to sense an intruder and send an alert to your control panel, which alerts your monitoring center. Sensors work when you are not home, or when you tell the system you are not there. Some security can be programmed to record events via a security camera when motion is detected. Motion sensors stand guard, ready to react to various situations, such as movement in your living room, windows or doors being opened or closed, or a broken window [22]. They are two types of motion sensors. Figure 1.9 below shows how the motion sensor works.

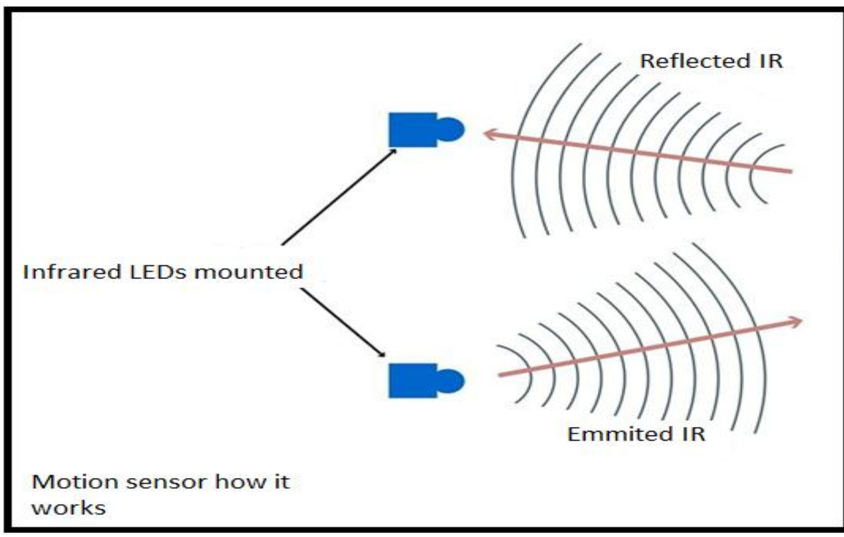


Fig. 1.9: How the motion sensor works [22].

Passive infrared sensors are used in home security systems for detection as well as the measurement of the infrared energy emanated by humans, along with motion detection. It detects body heat (infrared energy). Passive infrared sensors are the most widely used motion in home security systems. When your system is armed, your motion sensors are activated. Once the sensor warms up, it can detect heat and movement in the surrounding areas, creating a protective grid. If a moving object blocks too many grid zones and the infrared energy levels change rapidly, the sensors are tripped. The microwave sends out microwave pulses and measures the reflection of a moving object. They cover a large area than infrared sensors, but they are vulnerable to electrical interference and are more expensive. Figure 1.10 below shows the picture of the passive infrared sensor.

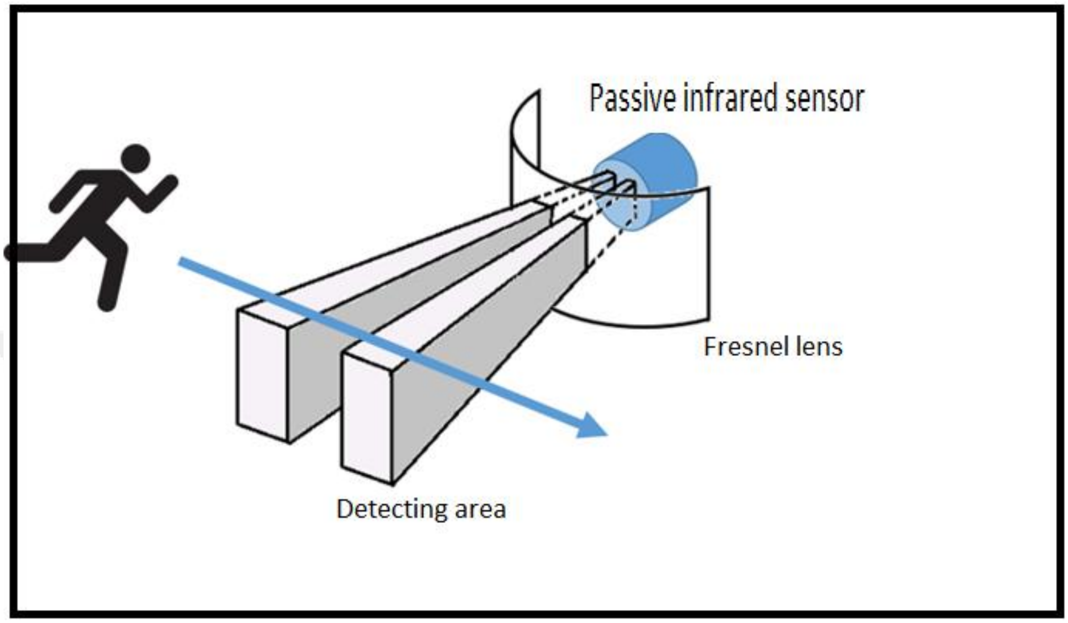


Fig. 1.10: Passive infrared sensor [23].

The dual technology motion sensor can have combined features in an attempt to reduce false alarms. For example, a passive infrared (PIR) sensor could be combined with a microwave sensor. Since each operates in different areas of the spectrum, and one is passive, and one is active, dual technology motion sensors are not as likely as other types to cause false alarms, because, in order for the alarm to be triggered, both sensors have to be tripped. However, this does not mean that they never cause false alarms [23]. Figure 1.11 below shows the dual technology motion sensor image.

Fig. 1.11: Dual technology motion sensor [23].

1.4.5. Surveillance camera (CCTV)

Available in both wired and wireless configurations, surveillance cameras can be used in several different ways as part of an overall security system. The closed-circuit television (CCTV), also known as video surveillance, is the use of video cameras to transmit a signal to a specific place, on a limited set of monitors. It differs from broadcast television in that the signal is not openly transmitted, though it may employ point to point (P2P), point to multipoint (P2MP), or mesh wired or wireless links. Though almost all video cameras fit this definition, the term is most often applied to those used for surveillance in the area that may need monitoring such as banks, stores, and other areas where security is needed. Though video telephony is seldom called (CCTV) one exception is the use of video in distance education, where it is an important tool. Surveillance of the public using (CCTV) is common in many years around the world. In recent years, the used of body-worn video cameras has been introduced as a new form of surveillance, often used in law enforcement, with cameras located on a police officer's chest or head. Video surveillance has generated significant debate about balancing its use with individual right privacy even when in public. In industrial plants, (CCTV) equipment may be used to observe parts of a process from a central control room, for example when the environment is not suitable for humans. (CCTV) systems may operate continuously or only as required to monitor a particular event. A more advanced form of (CCTV), utilizing digital video recorders (DVRs), provides recording for possibly many years, with a variety and performance options and extra features such as motion detection and email alerts. More recently, decentralized IP cameras, some equipped with megapixel sensors, support recording directly to network-attached storage devices or internal flash for completely stand-alone operation. They're about 350 million surveillance cameras worldwide as of 2016. About 65% of these cameras are installed in Asia. The growth of (CCTV) has been slowing in recent years. Closed-circuit television has been integrated into burglars alarms to identify the presence of unauthorized persons or activities. The closed-circuit television (CCTV), this is a television system in which you can monitor signal and at the same time is not publicly distributed and is primarily used for security and surveillance purposes. The closed-circuit television (CCTV) primarily depends on the tactical installation of cameras and viewing of the camera's input on your monitor screen [24]. Figure 1.12 below shows the picture of the surveillance camera (CCTV).

Fig. 1.12: Surveillance camera (CCTV) [24].

The closed-circuit television (CCTV), can send video through a closed-closed television, this simply means that the activities recorded cannot be transmitted to the outside device without your permission or you know. The closed-circuit television cameras monitor and recorder which you can directly connect all in order to provide you the user with immediate access to the security footage. The closed-circuit television camera can give you access to watch live streams of whatever the closed-circuit television is viewing. The footage is sent to a digital video recorder, where it is stored and can be accessed for future used. The closed-circuit television cameras are generally small in size. You can easily place them or mount them anywhere either on the exterior or interior of a building. You can also install small cameras in which no one will be aware of it [1]. Figure 1.13 below shows how the surveillance camera (CCTV) works.

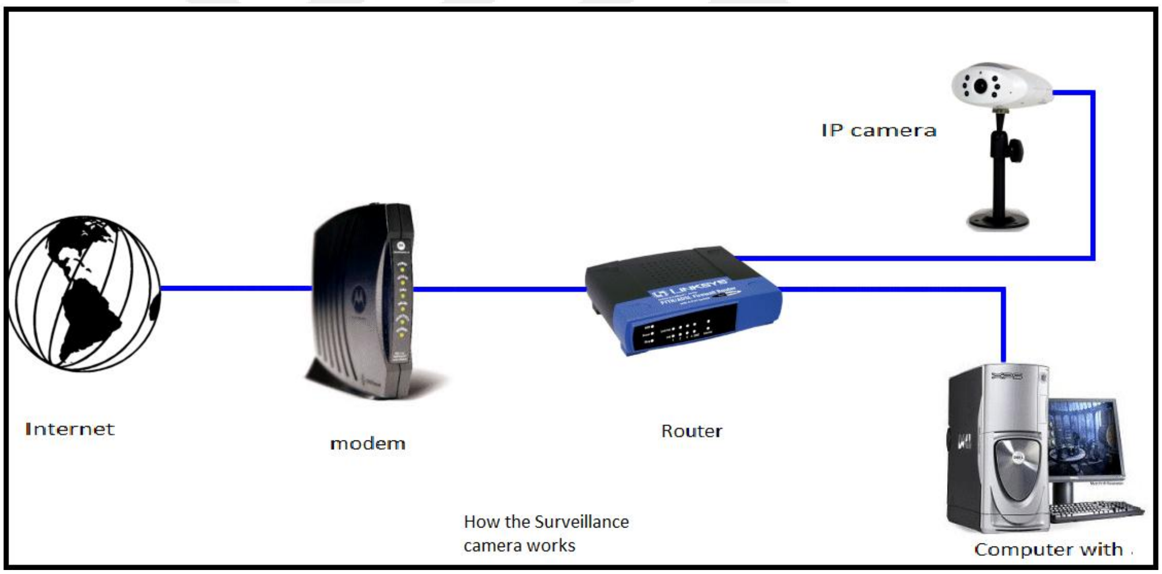


Fig. 1.13: How the surveillance camera work [25].

The used of surveillance camera (CCTV);

1. The closed-circuit television is used in traffic in monitoring the ups and downs of people and vehicles in case of unusual activities that may likely occur or taking of records of those people that don’t normally drive at the appropriate speed.

2. The closed-closed television is also used in banks in case of records of the day to day activities or in case of robbery, with the help of the closed-circuit television you can easily locate the people responsible for the robbery.

3. The closed-circuit television is also installed in school for the monitoring of the activities of the people in the school for the purpose records.

4. The closed-circuit is also installed in industries, especially in the monitoring of the premises or any unusual activities.

5. You can also install the closed-circuit television in the hospital, for monitoring the activities of the hospital.

6. Closed-circuit television is also mounted in government offices for the purpose of security reasons.

7. With the help of surveillance camera distance areas of your property can be seen clearly.

8. Remote buildings like garages, barns, and workshops are secured with the help of the surveillance camera.

9. Entry points, both exterior, and interior, like garage doors and front doors. Surveillance cameras can be accessed remotely on computers, smartphones, and tablets. They are often used in this method when homeowners are out of town, to watch for deliveries and other service personnel like caregivers and landscapers, and to monitor the arrival of children after school. They can also be used to record any security breaches, which could result in having footage of a home invasion, including a good look at the burglars and perhaps even the vehicle they.

Advantages of surveillance camera (CCTV);

1. Stop crime: with the currently used of the closed-circuit television, it can be used in stopping crime. If someone noticed they are closed-circuit television where he wants to do something bad that will stop him from doing such activities.

2. Monitor scenarios and activities: you can use closed-circuit television to be monitoring the activities that are going on in a certain organization or industry.

3. Gather evidence: the closed-circuit television will assist you in capturing the activities that are going on in the place you mounted the closed-circuit television, this will help in gathering the facts you need.

4. With the help of closed-circuit television, one can easily arrive at the right decision you want to make about certain scenarios or activities.

5. The closed-circuit television will assist you in taking the events that are going on in a certain environment, this will help in keeping the records of the activities [24].

Disadvantages of surveillance camera (CCTV);

1. Privacy is an issue: with the presence of closed-circuit television, one will not have enough privacy in the place or where it is mounted. Someone may be watching you without you even knowing.

2. Price: with the current situation of the world now people are thinking of how to survive and solves they day to day activities, one has to think deeply before mounting the closed-circuit television because it is expensive.

3. They can be vulnerable, when we, as users of security systems, we should not forget that intruders and criminals are doing the same too. A smart trespasser will probably know all about them and may have figured out a way to go undetected without you knowing of his presence.

4. The closed-circuit television can stop theft from stealing or stop unusual activities, it can only be viewing the crime and it can’t notify the police or the house owner or the people mounting the organization [25].

1.4.6. Wireless technology

Wireless cameras are a necessity for anyone needing video surveillance on a wireless system and a great solution if you need a camera somewhere that can’t be hardwired. Because most top securities provide [27]. Figure 1.14 below shows the picture of the wireless security surveillance camera (CCTV).

Fig. 1.14: Wireless security surveillance camera [28].

1.4.7. High-decibel alarm

Loud enough for neighbors to hear, home security alarms serve a few different purposes. First, they alert the people inside the house that a problem occurred. They are also shrill enough to send a burglar running while also notifying nearby to the situation [26]. Figure 1.15 below shows the picture of the high-decibel alarm siren.

Fig 1.15: High-decibel alarm siren [26].

1.4.8. Yard signs and window stickers

On the surface, these items might seem like nothing more than marketing tools for alarm companies, but they play important roles in home security. When you place a security company's sticker in a front window and plant their sign in your front yard, you are telling burglars you home is professionally protected and not a wise choice for an attempted burglary. They are effective at conveying this message and should be used as recommended by the security company [26]. Figure 1.16 below shows the image of the yard sign and windows stickers.

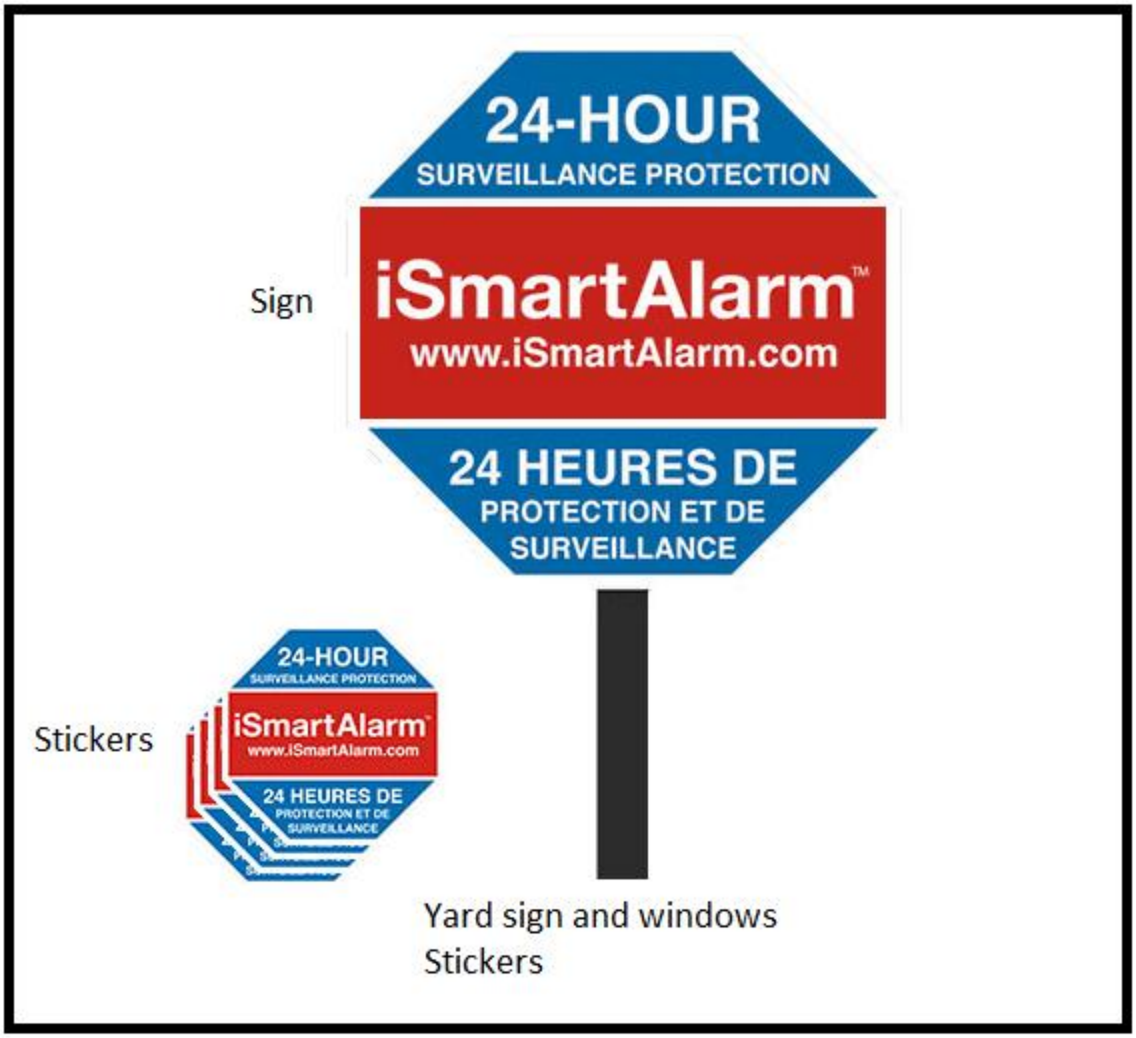


Fig. 1.16: Yard sign and windows stickers [26].

2. LITERATURE REVIEW

The main objective of this chapter is to give a review description of (PIC16F877A) microcontroller, its architecture, transistor, light-dependent resistor (LDR), liquid crystal display (LCD), Dc motor, a light-emitting diode (LED) and etc. are discussed moreover the source code (software programming).

2.1 The PIC16F877A Microcontroller

A microcontroller is an extremely combined device, which includes one chip, all, or most of the parts needed to perform an application control function. The PIC (peripheral interface controller) is an integrated circuit (IC) which was established to control peripheral devices, improving load from the central processing unit (CPU). It also has a low memory capacity, it is also used in performing calculations and is controlled by software just like the central processing unit (CPU). It is used in the designs where a local resolution needs to be taken [33]. Figure 2.1 shows the image of the microcontroller and its pins allocations. And table 2.1, shows the summary of the microcontroller PIC16F877A features.

Table 2.1: PIC16F877A features

Key feature	**PIC16F877A**
Operating frequency	DC-20MHz
Reset (and delay)	POR, BOR, (PWRT, OST)
Flash memory (14-bit word)	8K
The data memory (bytes)	368
The EEPROM data memory (bytes)	256
Interrupts	14
I/O ports	Ports A, B, C, D, E
Timers	3
Capture/compare/PWM module	2
Serial communication	USART
Parallel communication	None
10-bit analog-to-digital module	5 input channels
Analog comparators	2
Instruction sets	35
Packages	40-pins PCIP, 40-pin SOIC, 40-pin SSOP, 40-pin QFN

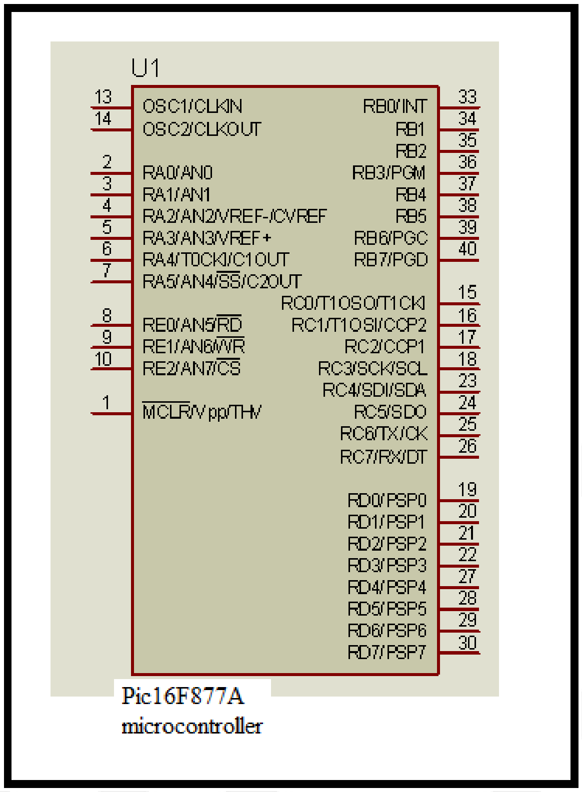


Fig. 2.1: Top view of the PIC16F877A Microcontroller [32].

2.1.1. The Microcontroller (PIC16F877A) Architecture

The PIC16F877A uses Harvard architecture design which is called reduced instruction set computer (RISC) architecture. In Harvard architecture, data bus and address bus are separate as opposed to the traditional Von Newman architecture (complex instruction set computer, CISC), which uses the same bus for data and address. Hence Harvard architecture provides a greater flow of data through the central processing unit and of greater speed of work. It is typically for Harvard architecture to have fewer instruction sets than von Newman's architecture. Figure 2.2 below shows the image of the Harvard Vs Von-Neumann architecture.

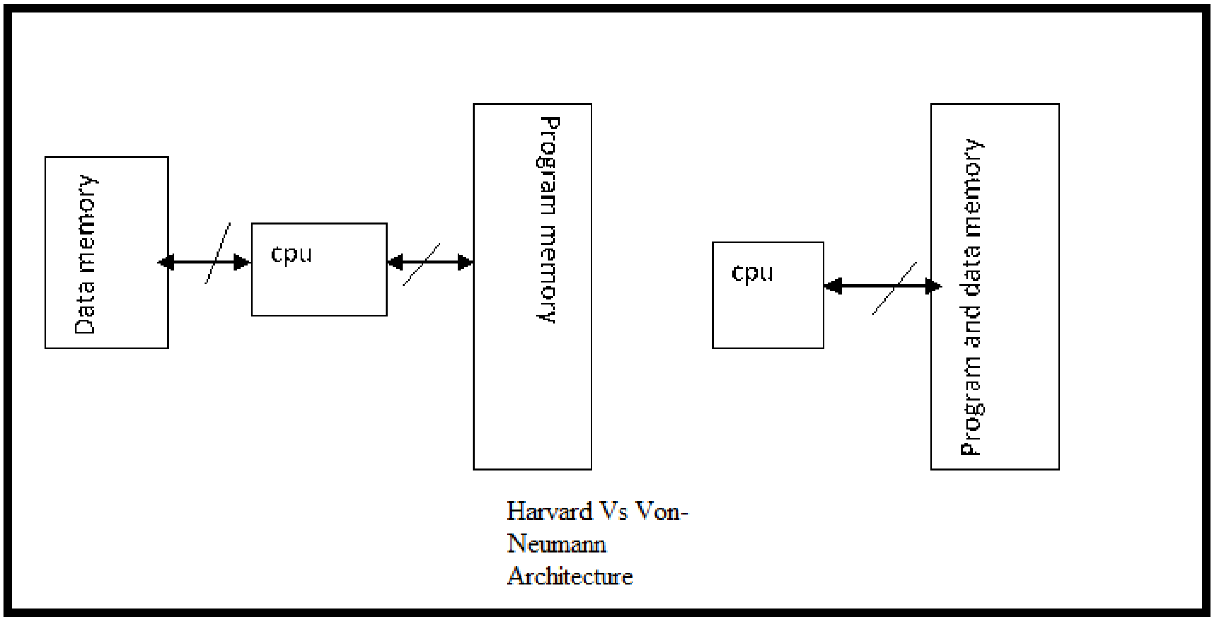


Fig. 2.2: Harvard Vs Von-Neumann architecture

2.1.2. Memory Organization of PIC16F877A

The PIC16F877A essentially has two memory blocks: the program memory and the data memory. Each memory has its own bus thereby allowing for access during an oscillation cycle.

a) The program memory is a ROM. PIC16F877A has a 13-bit program counter capable of addressing an 8K x 14 words program memory space. The first 1k x 14 (0000h-03FFh) are physically implemented. Accessing any location above the physically implemented address will cause a wrap-around. The memory is of flash type and can be reprogrammed. The program memory map and stack for PIC16F877A. Figure 2.3 below shows the picture of the PIC16F877A Program and Stack.

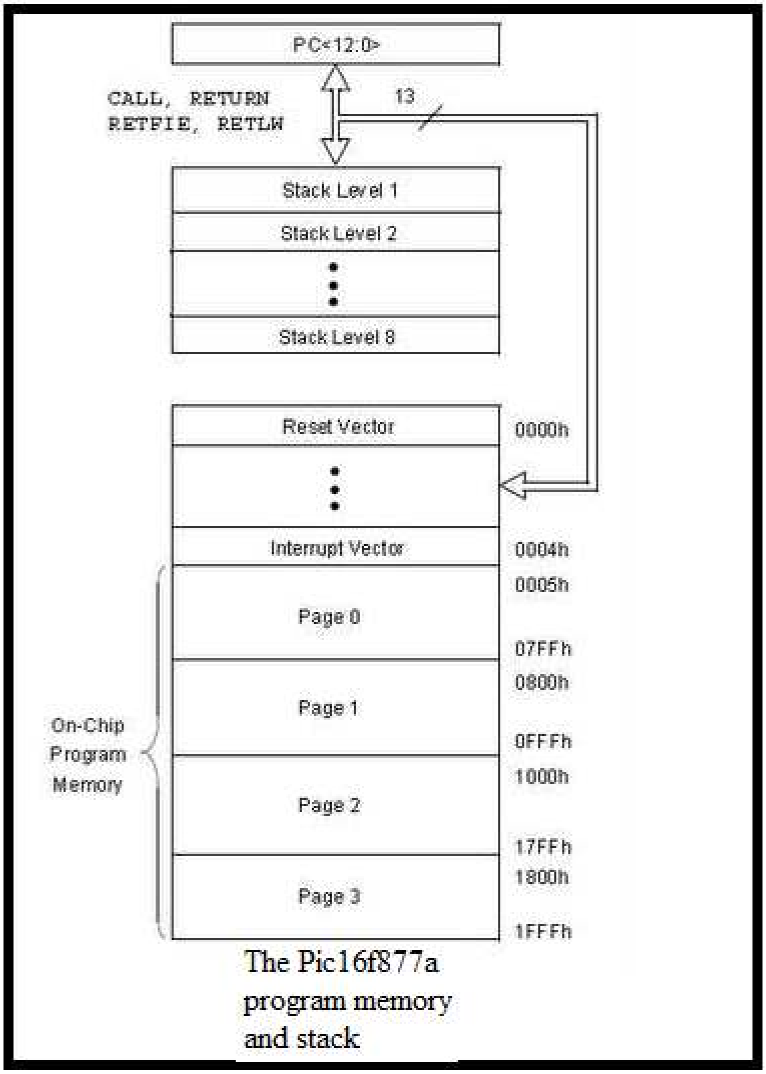


Fig. 2.3: The PIC16F877A Program and Stack [33].

b) The data memory can be broken down into the general purpose. RAM and the special function register (SFR). The SFRs control the "core" and hence the operation of the device.

The data memory is banked into two banks; bank0 and bank1. These banks can be accessed using control bit (bit 5/RP0) in the option register, clearing or setting RP0 select bank1 or bank 0 respectively. Bank1 is used to control the actual operation of the PIC while bank 0 is used to manipulates data. The first 12 locations of each bank constitute the special function register [32].

2.1.3. The Microcontroller (PIC16F877A) Pins Description

The pin description of the PIC16F877A

1. **Vss and Vdd**

   The Vss and Vdd are pins 11 and 12, 31 and 32 respectively. They are power supply pins. Vss is the negative supply while the Vdd is a positive supply.

2. **OSC1/CLKIN and OSC2/CLKOUT**

   The external clock is connected to these pins. The clock provides the required timing for the microcontroller.

3. **MCLR**

   The MCLR is used to erase memory locations inside the PIC whenever there is a need to reprogram it. It is connected to the positive power supply in normal use.

4. **The Input/output PORTS**

   These are a group of pins that can be simultaneously accessed. The PIC16F877A has 5 ports; portA, portB, portC, portD and portE which acts as the physical connection of the central processing unit (CPU) to the outside world. On power-up and reset, all the pins are configured as input pins by default. They can be however be reconfigured by the program.

i. PORTA

It is a 6 bits wide bi-directional port. RA0 – RA5 are purely bi-directional I/O pins while RA0 – RA3 can be used as an analog to digital conversion pins. RA4 – RA5 can be used as free run timers or counter in addition to Input/output function.

ii. PORTB

It is an 8 bits wide bi-directional port. RB0 – RB7are bidirectional Input/output pins. RB0 has an interrupt on change feature. RB1 to RB3 are purely bi-directional I/O pins while RB4 – RB7 also has the interrupt on change feature. The interrupt on change feature can be enabled only when the given pin is configured as an input pin.

iii. PORTC

It is an 8 bits wide bidirectional port. RC0 – RC7are bidirectional I/O pins.

iv. PORTD

It is an 8 bits wide bidirectional port. RD0 – RD7are bidirectional I/O pins.

v. PORTE

It is a 3 bits wide bi-directional port. RE0 – RE2are bidirectional I/O pins [32].

2.1.4. The Oscillator Configuration of PIC16F877A

The PIC16F877A can be operated in four different oscillator modes:

i. LP – low power crystal
ii. XT – crystal/resonator
iii. HS – high-speed crystal/resonator
iv. RC – resistor/capacitor

2.1.5. The Central Processing Unit (CPU) of the Microcontroller (PIC16F877A)

This is the brain of the system that processes all data and their travel along the bus. The central processing unit (CPU) will read/fetch the first instruction to be executed from the program memory, which is then decoded and finally executed. At the completion of the instruction, the next instruction is fetched from memory and executed. This is repeated until the end of the program. The central processing unit (CPU) connects to the other part of the microcontroller via the data and address bus. The central processing unit (CPU) of the PIC16F877A has certain features such as an oscillator selection pin, interrupt in-circuit serial programming capability, code protection and a host of resets power-up reset, Timer (PWRT), oscillator start-up timer (OST), power-on reset [33].

2.2 Transistor

The transistor is an active semiconductor device usually made of silicon or germanium having three electrodes. The three-electrode used is an emitter, base, and collector. Conduction is by means of electrons and holes. The transistor is an essential ingredient of every electronic circuit, from the simplest amplifier or oscillator to the most elaborated digital computer. A transistor normally works when the electrons and the holes start moving across the two junctions between the n-type and p-type silicon [30].

2.2.1. Emitter

It is more heavily doped than any of the other regions because its main function is to supply majority charge carriers (either electrons or holes) to the base.

2.2.2. Base

It forms the middle section of the transistor. It is very thin as compared to either the emitter or collector and is very lightly doped.

2.2.3. Collector

Its main function (as the name indicates) is to collect majority charge carriers coming from the emitter and passing through the base. In most transistors, the collect region is made physically larger than the emitter region, because it has to dissipate much greater power. Because of this difference, there is no possibility of inverting the transistor that is, making its collector the emitter and its emitter the collector [30].

2.2.4. Transistor Biasing

For the proper working of a transistor, it is essential to apply voltages of correct polarity across its two junctions. It is worthwhile to remember that for normal operation;

1. Junction: This is the Emitter-Base junction and is always forward-biased
2. Junction: This is the collector-base junction is always reverse biased [30].

2.2.5. Transistor used

The transistor to be used in this thesis is C945, table 2.2 shows its electrical characteristics.

Table 2.2: Transistor used

parameter	symbol	Test condition	min	max	unit
Collector-base	$V_{(BR)CBO}$	$I_C = 1000\mu A$,	60		V

breakdown voltage		$I_E = 0$			
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	$I_C = 0.1mA$, $I_B = 0$	50		V
Emitter-base breakdown voltage	$V_{(BR)EBO}$	$I_E = 100\mu A$, $I_C = 0$	5		V
Collector cut-off current	I_{CBO}	$V_{CB = 60v,}$ $I_E = 0$		0.1	µA
Collector cut-off current	I_{CER}	$V_{CE = 55v,\ R = 10M\Omega}$		0.1	µA
Emitter cut-off current	I_{EBO}	$V_{EB = 5v,}$ $I_C = 0$		0.1	µA
DC current gain	$H_{FE(1)}$	$V_{CE = 6v,}$ $I_C = 1$ mA	70	700	
DC current gain	$H_{FE(2)}$	$V_{CE = 6v,}$ $I_C = 0.1mA$	40		
Collector-emitter saturation voltage	V_{Cesat}	$I_C = 100mA$, $I_B = 10mA$		0.3	V
base-emitter saturation voltage	V_{Besat}	$I_C = 100mA$, $I_B = 10mA$		1	V
base-emitter voltage	V_{BE}	$I_E = 310mA$,		1.4	V
Transition frequency	Fr	$V_{CE = 6v,}$ $I_C = 10$ mA F = 30MHz	150		MHz

2.3. Voltage Regulator LM7805

Voltage sources in any electrical circuit may have variations resulting in not providing fixed voltage outputs. The voltage regulator integrated circuit usually maintains the output voltage at a constant value. 7805 integrated circuit, a member of 78xx series of fixed linear voltage regulators is used to maintain such variations, is a current-voltage regulator integrated circuit (IC). The xx in 78xx usually indicates the output voltage it provides. The 7805 integrated circuit provides +5 volts regulated power supply with requirements to add a heat sink. The 78xx (some time LM78xx) is a family of self-contained fixed linear voltage regulator integrated circuits. The 78xx family is commonly used in electronic circuits requiring a regulated power supply due to their ease of use and low cost. For integrated circuits (ICs) within the family, the xx is replaced with two digits, indicating the output voltage (therefore, the 7805 has a 5-volt output). The 78xx line is positive voltage regulators they produce a voltage that is positive relative to a common ground. There is a related line of 79xx devices which are complementary negative voltage regulators. T8xx and 79xx ICs can be used as the combination to provide positive and negative supply voltages in the same circuit [34]. Figure 2.4 below shows the image of the Voltage Regulator.

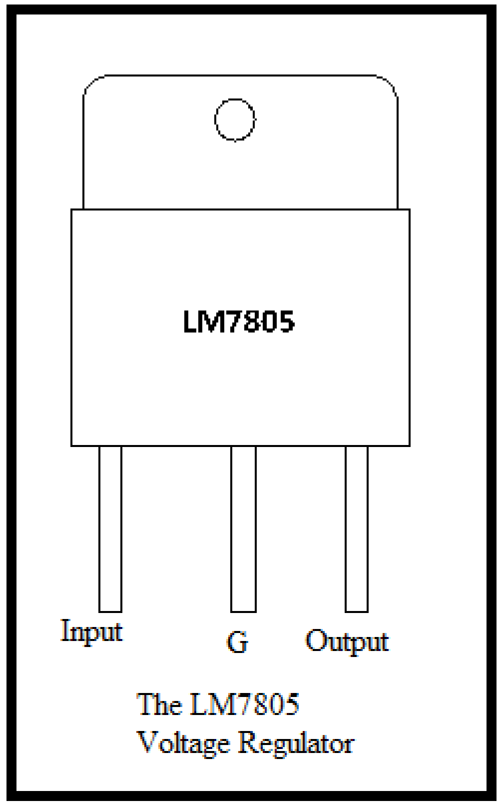


Fig. 2.4: Voltage Regulator [34].

2.4. Light Emitting Diodes

Mostly, the light-emitting diode is just small light bulbs that fit easily into any electrical circuit. But unlike ordinary incandescent bulbs, they don't normally have a filament that will burn out, and they don't get especially hot. They are illuminated merely by the movement of electrons in a semiconductor material, and they last just as long as a standard transistor. The lifespan of any light-emitting diode surpasses the short life of an incandescent bulb by thousands of hours. A light-emitting diode (LED) is a two-lead semiconductor light source. P-N junction diode, which emits light when activated. When a suitable voltage is applied to the leads, electrons are able to recombine with electron holes within the device, releasing energy in the form photons. This effect is called electroluminescence, and the color of the light (corresponding to the energy of the photon) is determined by the energy bandgap of the semiconductor. A light-emitting diode (LED) is often a small area (less than 1mm^2) and integrated optical components may be used to shape its radiation pattern [37]. Figure 2.5 below shows the picture of the Light Emitting Diode.

Fig. 2.5: Light Emitting Diode [37].

2.5. Light Dependent Resistor

A photoresistor or light-dependent resistor (LDR) or photocell is a light-controlled variable resistor. the resistor of the photoresistor decreases with increasing incident light intensity; in other words, it exhibits photoconductivity. A photoresistor can be applied in light-sensitive detector circuits, and light and dark activated switching circuits. The LDR is made of high resistance semiconductor. In the dark, a photoresistor can have a resistance as high as several mega ohms (MΩ), while in the light, a photoresistor can have a resistance as low as a hundred ohms. If incident light on a photoresistor exceeds a certain frequency, photon absorbed by the semiconductor gives bound electrons enough energy to jump into the conduction band. The resulting free electrons conduct electricity, thereby lowering resistance. The resistance range and sensitivity of a photoresistor can substantially differ among dissimilar devices. Moreover, unique photoresistor may react substantially different to photons within certain wavelength bands [29]. Figure 2.6 below shows the picture of the Light Dependent Resistor (LDR).

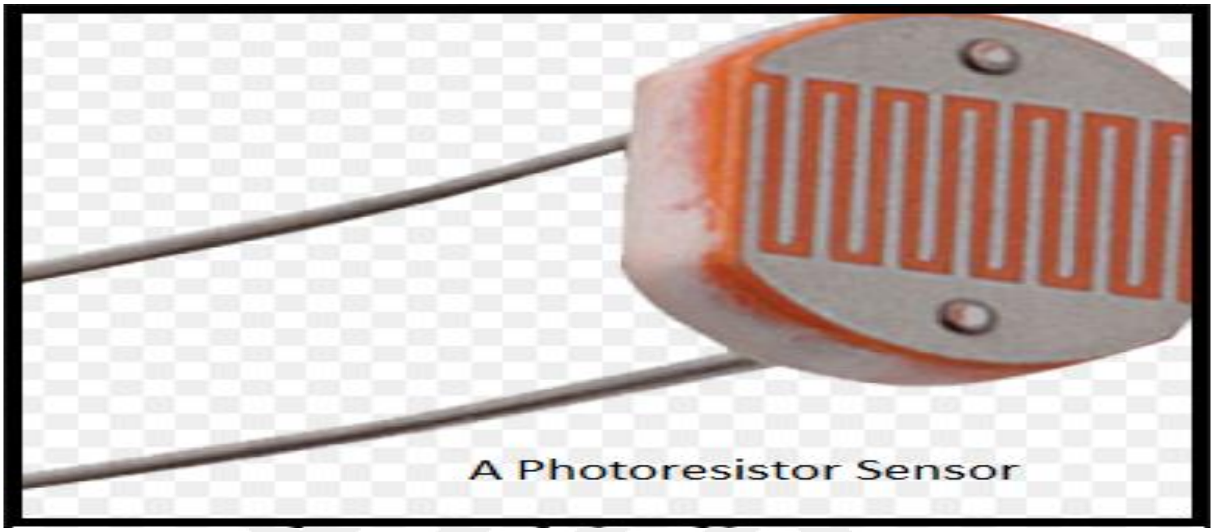


Fig. 2.6: Light Dependent Resistor [29].

2.6. Liquid Crystal Display (LCD)

The liquid crystal display (LCD) is now the common choice of alphanumeric, graphics and video displays. They exist in many forms, but the small monochrome LM016L is used in this thesis. The reason for choosing this particular liquid crystal display (LCD) is its availability in markets. Here the emphasis is laid on the small monochrome alphanumeric type which displays alphabets, numeric and symbolic characters from the standard ASCII character set. The display is standard LM016L which displays two lines of 16 characters (16x2). Each character is 5x8 pixels making a total of 80x16 pixels overall. The display receives ASCII codes for each character at the data input (D0 – D7). The data is presented to the display inputs by the MCU and latched in by pulsing the enable (E) input. The read/write (R/W) line can be tied low (write mode) as the LCD is receiving data only. Figure 2.7 shows the various control and data lines of the LCD (LM016L). The RS (select register) inputs allow commands to be sent to the display RS = 0 selects command mode, RS = 1 data mode. The display itself contains a microcontroller the chip in these types of the display is the Hitachi HD44780; it must be initialized according to the data and display is the option required. Data can be sent in 4-bit mode or 8-bit mode. The 8-bit code for each ASCII character is sent in two halves high nibbles first then the lower nibbles. To send the data and command the output data is initially masked so that only the high nibbles are sent. The lower nibbles are cleared during this action. However, the fact that the lower bits are needed to control the display RS and E they have to be set up after the data has been output in the port high bit. Data is usually saved on I/O pins and allows the liquid crystal display (LCD) to be driven using only 6 lines of a single port while making the software only slightly complex [31]. Figure 2.7 below shows the image of the Liquid Crystal Display (LCD).

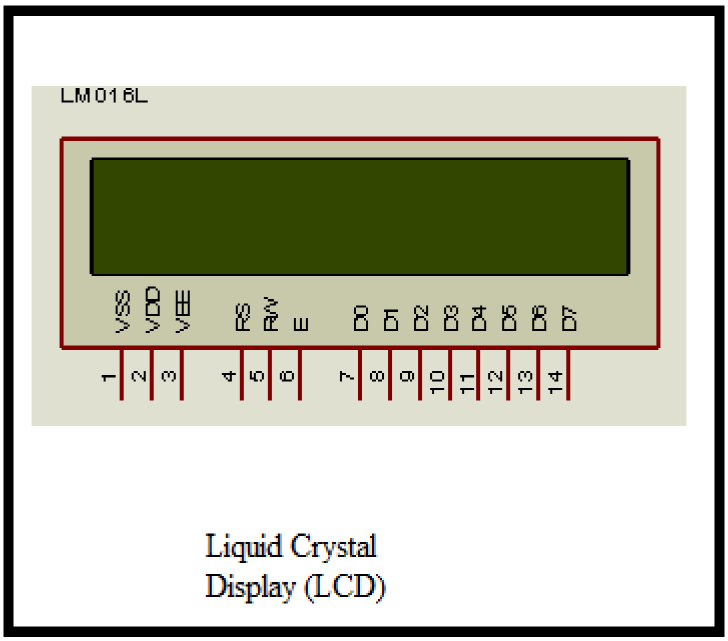


Fig. 2.7: Liquid Crystal Display [31].

2.7. Magnetic Buzzer

The vibrating disk in the magnetic buzzer is appealed to the pole by the magnetic field. When a fluctuating signal is moved through the coil, it produces a fluctuating magnetic field which vibrates the disk at a frequency equal to that of the drive signal [35]. The magnetic buzzer is just an electronic device that is being used as an alarming device in the design and simulation in case if they are any intrusion, it will sound an alarm to notify the house owner. Figure 2.8 below shows the image of the magnetic buzzer.

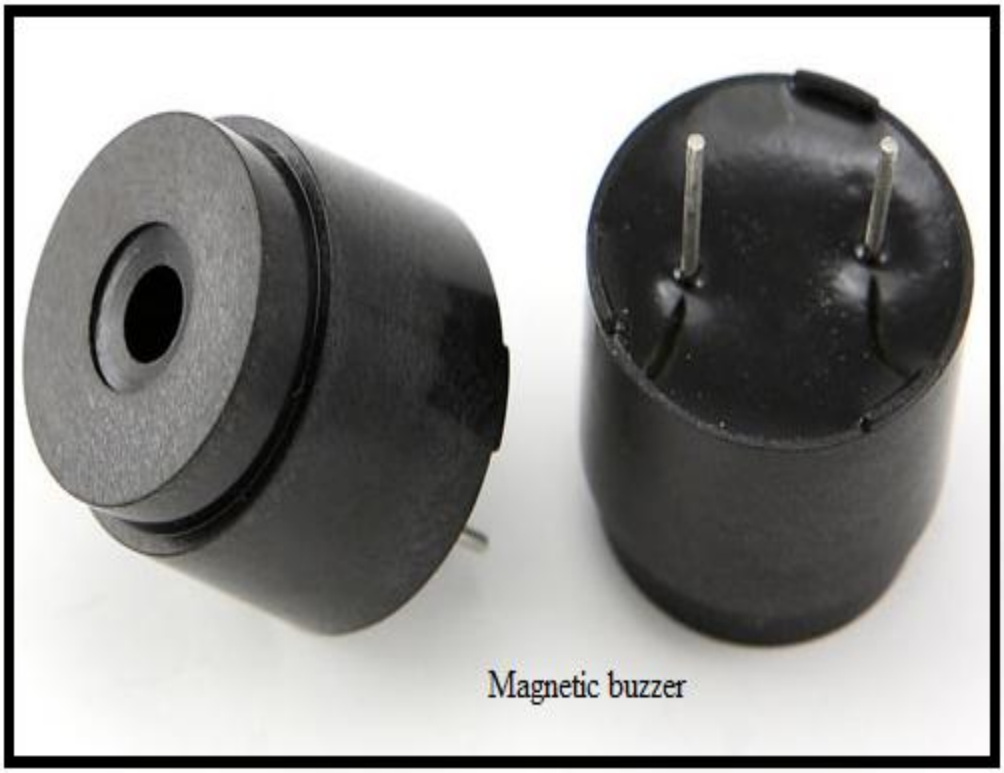


Fig. 2.8: Magnetic buzzer [35].

2.7.1. Features of the Magnetic Buzzer

1. Low frequency
2. Low voltage
3. Small and slim size

2.7.2. Application of the Magnetic Buzzer

1. Automatic control equipment
2. Communication equipment
3. Electronic instrument

2.8. The Microcontroller (PIC16F877A) Software Programming Process

The software actually refers to the program code that is loaded onto the microcontroller's program memory. It is the execution of the instructions contained therein that aids the microcontroller in carrying out its primary function of controlling the peripheral devices attached to it. The program is usually written in assembly language and then assembled to generate a hexadecimal code file (machine code). Writing the program and assemble it is made easy by the availability of a group of software known as the MPLAB IDE with an assembler called the MPASM assembler. Figure 2.9 below shows the block diagram of the entire research programming process.

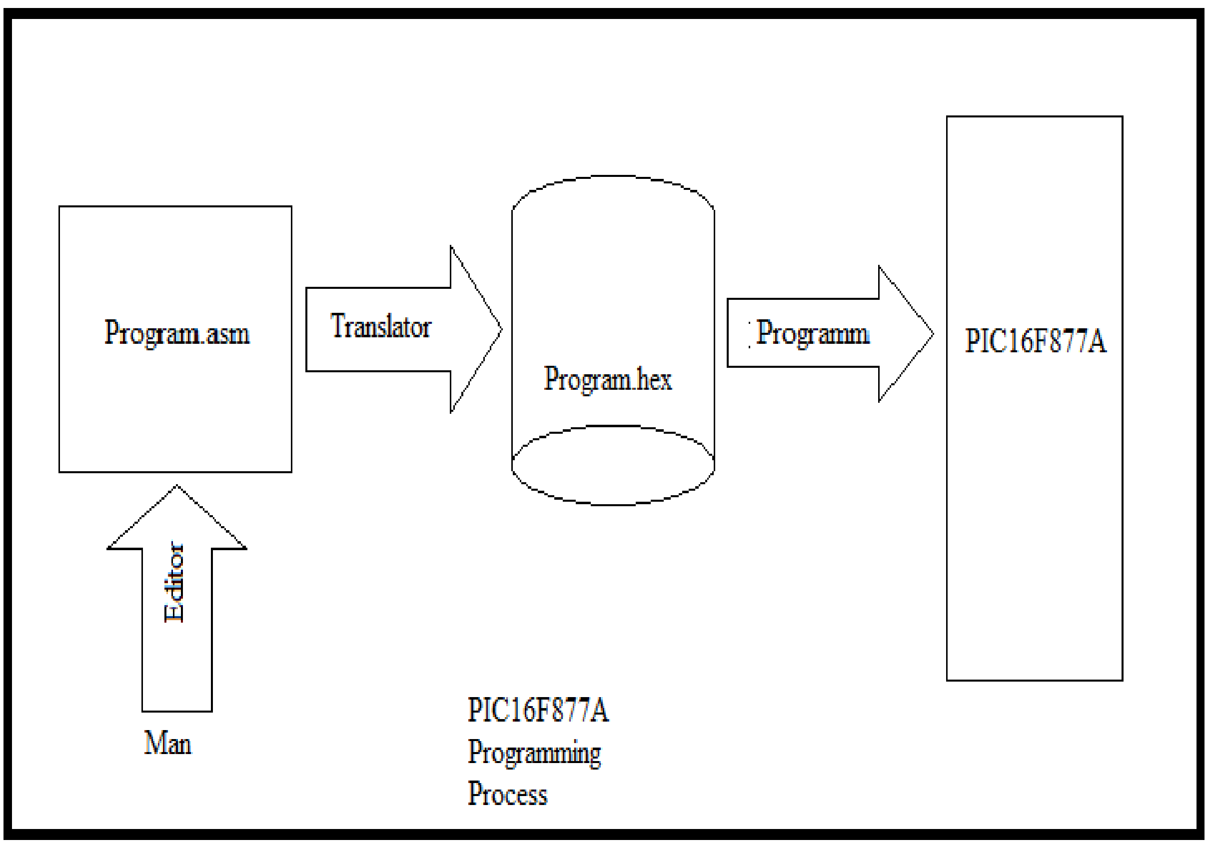


Fig. 2.9: The PIC16F877A Programming Process

2.9. MPLAB IDE Software

The MPLAB IDE (integrated development Environment) software brings ease of software development. It is a window based application that is used in the programming of the PIC16F877A microcontroller that contains. Figure 2.10 below shows the screenshots of the MPLAB IDE software environment.

1. An Interface to debugging tools
2. Simulator
3. Programmer (sold separately)
4. Emulator (sold separately)
5. An in-circuit debugger (sold separately)
6. A full-featured editor
7. A project manager
8. Customizable toolbar and key mapping
9. A status bar and on-line help

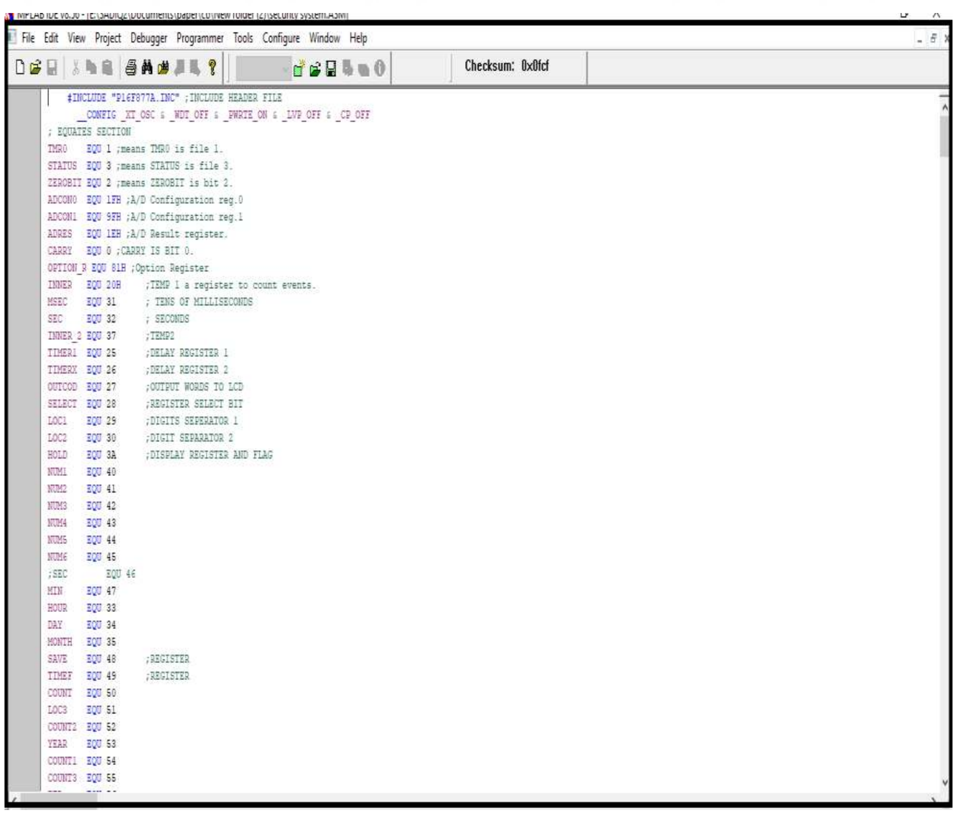


Fig. 2.10: MPLAB IDE Software environment

2.10. Direct current (DC) motor

The direct current (DC) Motors are an electromechanical gadget that normally uses the interaction of magnetic fields and that of conductors to transform the electrical energy into rotary mechanical energy. The electrical direct current motors are uninterrupted actuators that normally convert the electrical energy into mechanical energy. The direct current motors accomplish this by generating a continuous angular revolution that can be used to rotate pumps, fans, compressors, wheels, etc. As well as conventional rotary direct current motors, linear motors are also available which are capable of producing a continuous liner movement. In this research, the direct current motor is used to rotate the closed-circuit television that is mounted upon it clockwise or anticlockwise in case they are an intrusion with the help of the transistor [36]. Figure 2.11 below shows the picture of the direct current (DC) motor.

Fig. 2.11: Direct current (DC) motor [36].

3. METHODOLOGY

This chapter three of this thesis handled the calculation and theoretical part of the designing and simulation of the wall-crossed detecting security system. Figure 3.1 below shows the system block diagram.

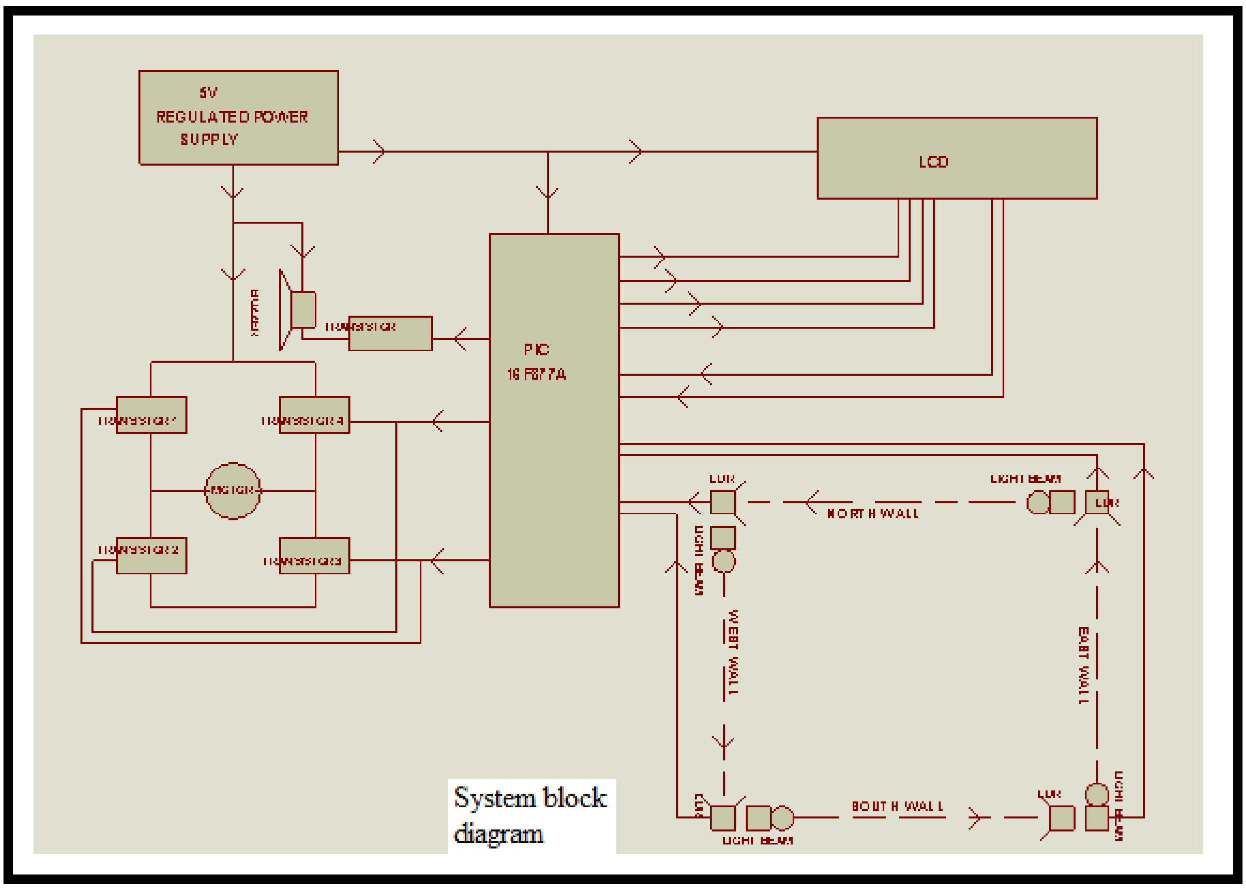


Fig 3.1: System block diagram

3.1. Mode of operation

The above figure 3.1, shows the system block diagram of this research, showing the method of operation. If the system is switched on, it displays the time and calendar on the liquid crystal display (LCD) and also display on the liquid crystal display (LCD) that all four walls are ok, That is if none of the four walls was crossed, but if one of the walls was crossed that is if they is interruption between the light-dependent resistor (LDR) and the light-emitting diode (LED) or light beam the system will immediately display the name of the crossed wall and rotating the motor that is carrying the closed-circuit television (CCTV) camera in order to start a real-time video recording while the buzzer will be on for alarm alerting the house owner until the system was reset. If all the walls were crossed at the same time, the system will be able to display them on the liquid crystal display (LCD) screen. In this simulation, the positive sign of the light-dependent resistor (LDR) light beam means no intruder (wall not crossed) that is if the light-dependent resistor is closed to the light beam and is not move away from it and the negative sign means intruder in between the light-dependent resistor (LDR) and the light beam that is the light beam is moved away from the light-dependent resistor by pressing the negative sign of the light beam (torch) [13]. Figure 3.2 below shows the circuit diagram.

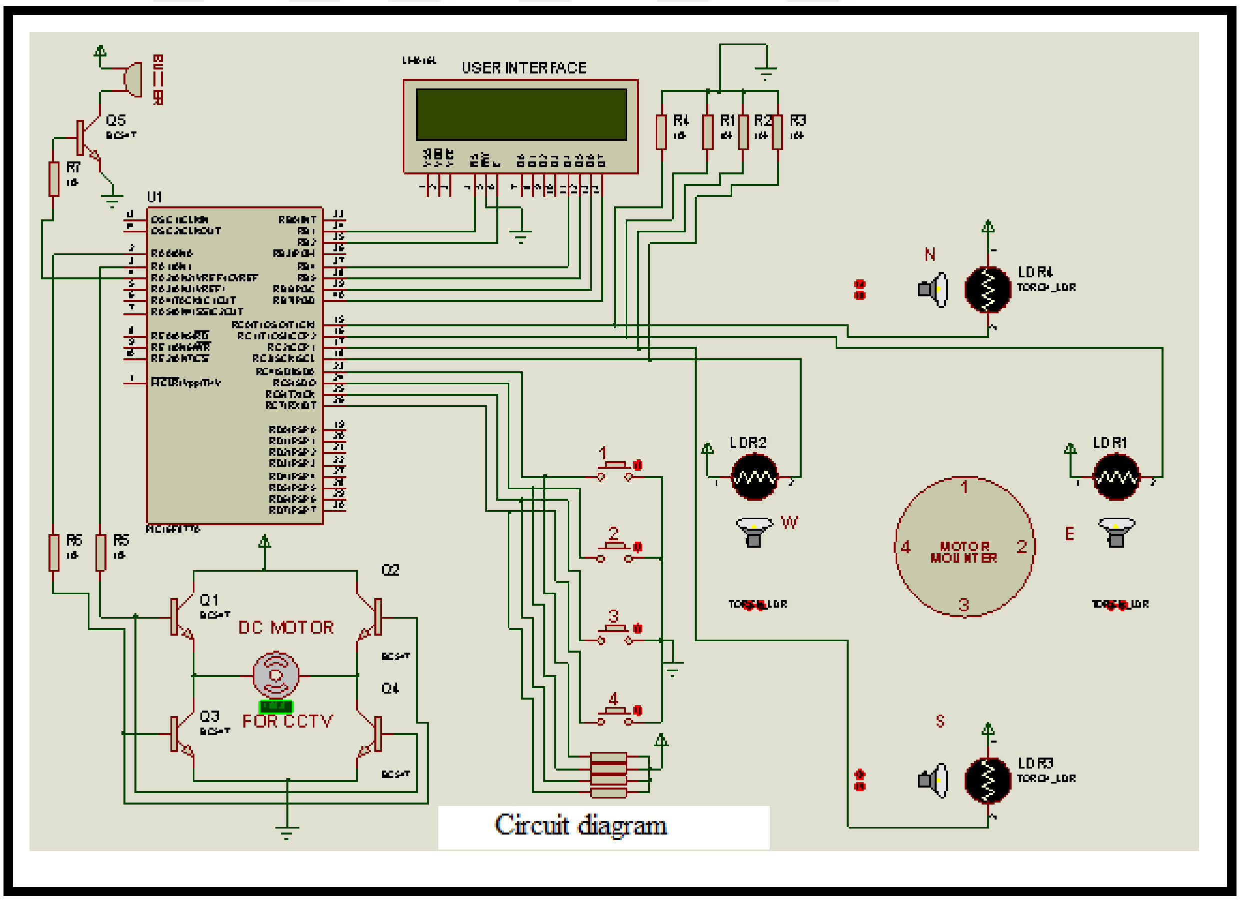


Fig. 3.2: Circuit diagram

3.2. Circuit description

The above figure 3.2 is showing the complete circuit diagram of this research. Here the (PIC16F877A) microcontroller has five ports. Port A, Port B, Port C, Port D, and Port E. Every port has eight pins such as B0- B7 similarly C0-C7, D0-D7, except Port E, which has 3-pins E0-E2 and port A which has 6 pins A0-A5. Pin 2 is connected to transistor base Q2 and Q3 through 10 kΩ resistors R5 in order to rotate the motor clockwise if the base of transistor Q2 and Q3 were biased. Pin 3 is also connected to the base transistor Q1 and Q4 through 10 kΩ resistor R6 in order to rotate the motor anticlockwise if the base of transistor Q1 and Q4 were biased. These two pins, 2 and 3 of the microcontroller are responsible for turning the motor clockwise or anticlockwise since the closed-circuit television is mounted on the motor in case they are intrusion or interruption between the light-dependent resistor (LDR) and its light beam (LDR TORCH). Pin 4 is connected to the transistor Q5 through 10 kΩ resistor which is responsible for switching the buzzer for notifying of an intrusion through 10 kΩ resistor R7. Pin 15, 16, 17 and 18 are connected to the light-dependent resistor (LDR) through a pull-down resistor of 10 kΩ on each line Pin 23, 24, 25 and 26 are connected to the buttons 1, 2, 3, 4 respectively to function as a dc motor stopper through 10 kΩ pull-down resistor. They were just a contact that the motor has to stop when making a contact at one of the walls that crossed. The push-button 1 is allocated to the north (LDR), 2 to the east (LDR), 3 to the south (LDR) and 4 to the west (LDR). If the closed-circuit television is pointing to the south direction and the north wall is crossed the motor will rotate the (CCTV) camera until it has contact with push button 1 which is allocated to the north wall and stop and take real video and images. Pin 34 and 35 are connected to the (LCD) control line. Pin 40, 39, 38 and 37 are connected to liquid crystal display (LCD) data line which is responsible for displaying alphanumeric characters on the liquid crystal display when you press the play button in the simulation or if any wall is crossed.

3.3. Design equations

Below is the formula used in designing the system and their values obtained

$$I_B = \frac{I_C}{\beta} \quad \textbf{(3.1)}$$

Below is the formula used in designing the system and their values obtained

Where

I_B is the transistor base current,

I_C is the transistor collector current,

β is the transistor gain current,

$$V_C = I_B R_B + V_{BE} \quad \textbf{(3.2)}$$

V_{BE} is the transistor base-emitter voltage = 0.7v, for silicon,

R_B is the transistor base resistor,

$$\beta = \sqrt[2]{\beta_{min} \times \beta_{max}} \quad \textbf{(3.3)}$$

$$I_{Sinking} = \frac{V_C}{R_{pull-up}} \quad \textbf{(3.4)}$$

3.4 A C945 is selected and used for switching. The following values were obtained from the datasheet of the transistor.

$$\beta_{min} = 70 \quad \textbf{(3.5a)}$$

$$\beta_{max} = 700 \quad \textbf{(3.5b)}$$

$$I_C = 100mA \quad \textbf{(3.6)}$$

3.5 Light-dependent resistor (LDR)

The light-dependent resistor (LDR) is used to detect the crossing body, that is anything that will interrupt or block the light beam which is also known as the light-emitting diode (LED) that makes the light-dependent resistor (LDR) to be in darkness. Therefore, the calculation is going to be in two parts. Figure 3.3 shows the light-dependent resistor interface.

1. When the LDR is in darkness, it sees no light, that is the light beam is blocked or moved away from it.
2. When the LDR is in light, that is they are no interruption between the light beam and light-dependent resistor.

In the presence of light

$$I_{LDR} = \frac{V_{LDR}}{R_{LDR}} \quad \textbf{(3.7)}$$

$$I_{LDR} = \frac{5}{100} = 0.05A$$

is the expected current passing through the LDR and 5volts is the voltage supplied by the microcontroller and 100 ohms is the resistor of the light-dependent resistor provided by the manufacturer. The light-dependent resistor will be active at this stage indicating no walls crossed if all the walls are having a follow of such currents 0.05mA.

In the Absent of light.

$$I_{LDR} = \frac{V_{LDR}}{R_{LDR}} \quad \textbf{(3.7)}$$

$$I_{LDR} = \frac{5}{2000000} = 2.5 \times 10^{-6}A$$

Very low value, if the light-dependent resistor sees this current is showing that it is not active it will output 0 volts which is a sign of interruption between the LDR and the light beam (LED). Figure 3.3 below shows the picture of the Light Dependent Resistor interface.

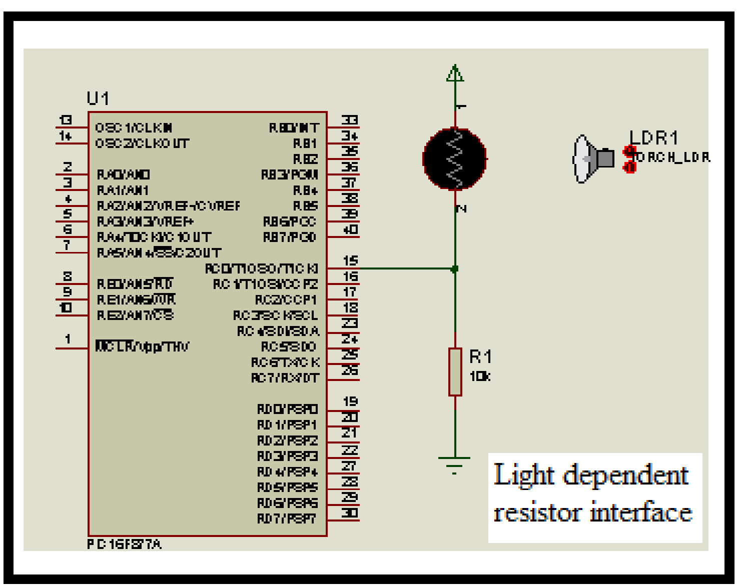


Fig. 3.3: Light Dependent Resistor interface

3.6 The light-emitting diode (LED)

The following data are gotten from the datasheet of the LED

$I_{LED} = 25mA$, which is the current of the LED from the datasheet

$V_{LED} = 1.8V$, which is the voltage of the LED also obtained from the datasheet

$$R_{LED} = \frac{V_{CC}-V_{LED}}{I_{LED}} = \frac{5-1.8}{25\times10^{-3}} = \frac{3.2}{0.025} = 128\Omega \quad \textbf{(3.8)}$$

is the resistor obtained using the above values of the light-emitting diode

3.7 Transistor driven buzzer

Substituting Equation (3.5a) and (3.5b) in Equation (3.3) in order to obtain the DC current gain of the transistor (β)

$\beta = \sqrt[2]{(700 \times 70)} = 221.4$

Substituting β and equation (3.6) in equation (3.1)

Therefore,

$$I_B = \frac{I_C}{\beta} \quad \textbf{(3.1)}$$

$I_B = \frac{I_C}{\beta} = \frac{100\times10^{-3}}{221.4} = 451\mu A$

And $V_{BE} = 0.7$ (for voltage drop across a silicon transistor)

Substituting the above values in equation (3.2)

$$V_C = I_B R_B + V_{BE} \quad \textbf{(3.2)}$$

$5 = 299 \times 10^{-6} \times R_B + 0.7$

V_C is the voltage supplied to the microcontroller, which is 5 volts

$R_B = \frac{5-0.7}{451.7\times10^{-6}} = \frac{4.3}{0.0004517} = \frac{9519.59}{1000} = 9.52k\Omega$

R_B = 9.52kΩ is the base resistor obtained

3.8 For 8 ohms Buzzer

$$I_{buzzer} = \frac{V_{buzzer}}{R_{buzzer}} = \frac{5}{8} = 625mA \qquad \textbf{(3.9)}$$

5 volts is voltage and 8 ohms is the resistor of the buzzer that comes with it. And 625 mA is the value of the current obtained from the calculations and is the current passing through the buzzer that is going to make the buzzer active in case they are any interruption between the LDR and its light beam. Figure 3.4 shows the image of the transistor that used to make the buzzer active. Figure 3.4 below shows the image of the transistor driven buzzer.

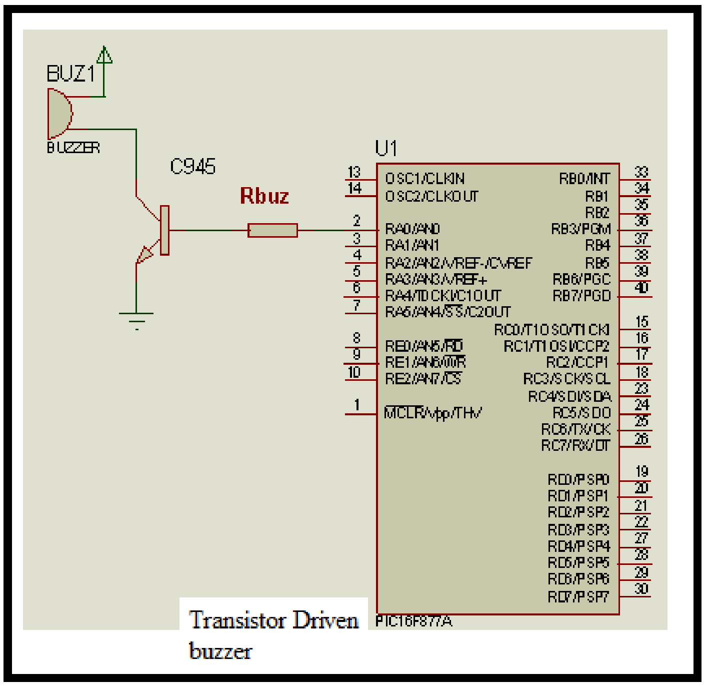


Fig. 3.4: Transistor driven Buzzer

3.9 Push Button

The pushbuttons are not physically to be used in the main simulation. They were just a contact that the motor has to stop when making a contact at one of the walls that crossed, that is if you want the motor to stop rotating you have to press the specific switch attached to that wall. The maximum sinking current of PIC is 25 mA, therefore we need to calculate sinking current to be much less than the maximum sinking current. Figure 3.5 shows the image of the push button sinking current.

$$I_{sinking} = \frac{V_C}{R_{pull-down}} \frac{5}{10} = 0.5mA \tag{3.4}$$

Therefore, a 10 kΩ resistor was used to meet the requirements set by the microcontroller manufacturers on the PIC sinking current. Figure 3.5 below shows the image of the Push Button Sinking current.

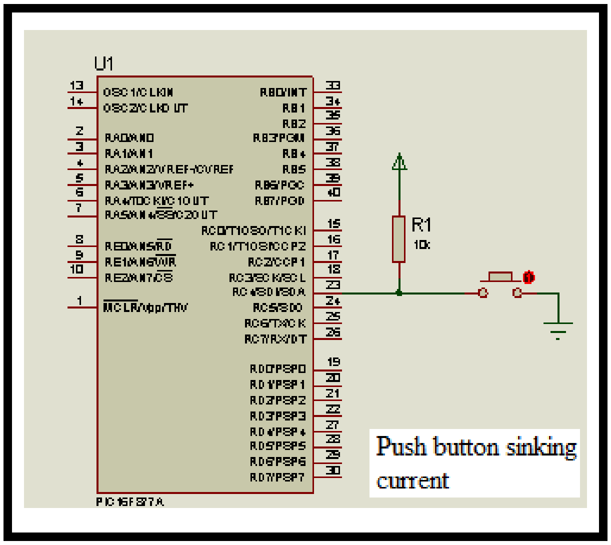


Fig. 3.5: Push Button Sinking current

3.10 Dc Motor

$$I_{motor} = \frac{V_{motor}}{R_{motor}} = \frac{5}{8} = 625mA \tag{3.10}$$

I_{motor} is the current drawn by the motor

V_{motor} is the voltage of the motor which is 5v

R_{motor} is the resistance of the motor 8Ω

The calculation of the transistor driven motor is the same as the transistors driven buzzer.

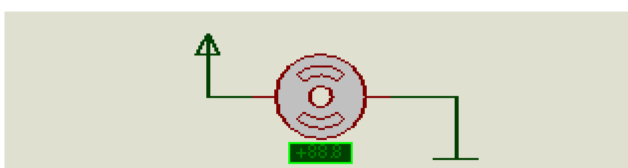


Fig. 3.6: Shows the current passing through the dc motor

4. TESTING and RESULTS

This chapter is to deal with the description of the test performed on the various sections of the overall system and their corresponding result as well as the result of the overall system. The system is purposely made to improve the effectiveness and reliability of a wall-crossed detecting security system. Being something in which human life will depend. The test carried out on the system as a whole and during the simulation process the results obtained, the problems encountered will be discussed.

4.1. Implementation and Testing

The section describes tests that were carried out on the software and the simulation parts of the thesis.

4.1.1. Software Testing

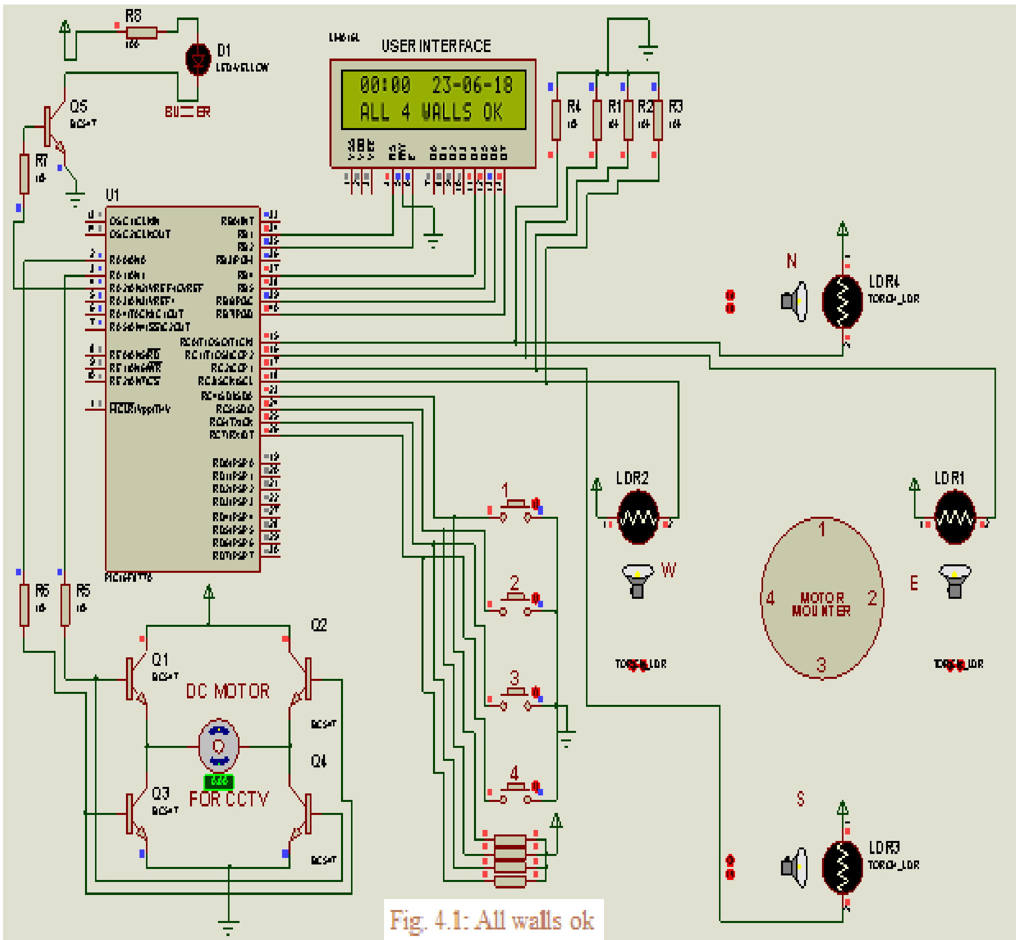
The program for the wall-crossed detecting security system was written using MPLAB IDE. After the program was written, it was simulated using the MPLAB SIM which is part of the MPLAB software. This was done to ensure that the program performed as expected and to detect any bugs that exist in the program. The circuit diagram was drawn using Proteus ISIS which is an electronics design software and the respective programs for the peripheral interface controller (PIC) were loaded into the designed diagram. The circuit was then simulated to see if it performed the desired function. All necessary corrections were made to the software at this stage until the desired results are obtained. The program for the wall-crossed detecting security system was written using MPLAB IDE. After the program was written, it was simulated using the MPLAB SIM which is part of the MPLAB software. This was done to ensure that the program performed as expected and to detect any bugs that exist in the program. The circuit diagram was drawn using Proteus ISIS which is an electronics design software and the respective programs for the peripheral interface controller (PIC) were loaded into the designed diagram. The circuit was then simulated to see if it performed the desired function. All necessary corrections were made to the software at this stage until the desired results are obtained.

4.1.2. Simulation Testing

Table 4.1: Shows the simulation testing and result

S/No	Test Conducted	Result obtained
1	Play button pressed	Ports, LCD, sensors initializing & LCD display “time and date & ALL WALLS OK” (figure 4.1)
2	If north light-dependent resistor blocked from the light beam	LCD display “north wall crossed” system rotate the motor until when it makes contact to the north point (north button pressed) it then stops to capture a real-time video by CCTV (figure 4.2)
3	If south light-dependent resistor blocked from the light beam	LCD display “east wall crossed” system rotate the motor until when it makes contact to the south point (south button pressed) it then stops to capture a real-time video by CCTV (figure 4.3)
4	If west light-dependent resistor blocked from the light beam	LCD display “south wall crossed” system rotate the motor until when it makes contact to the west point (west button pressed) it then stops to capture a real-time video by CCTV (figure 4.4)
5	If east light-dependent resistor blocked from the light beam	LCD display “west wall crossed” system rotate the motor until when it makes contact to the east point (east button pressed) it then stops to capture a real-time video by CCTV (figure 4.5)

The circuit was tested and tried using the electronic design software called PROTEUS ISIS. The simulation was found to be functional. The program was written into the actual microcontroller using a microcontroller programmer. Writing the program into a microcontroller requires a hex file of the program code. The hex file is a file containing hexadecimal codes that represent the program code written in the microcontroller assembly language. The hex file is generated using the MPASWIN software which is also of the MPLAB software suit.



Simulation results showing all 4 walls ok

Fig 4.1: Simulation result obtained showing all 4 walls are ok

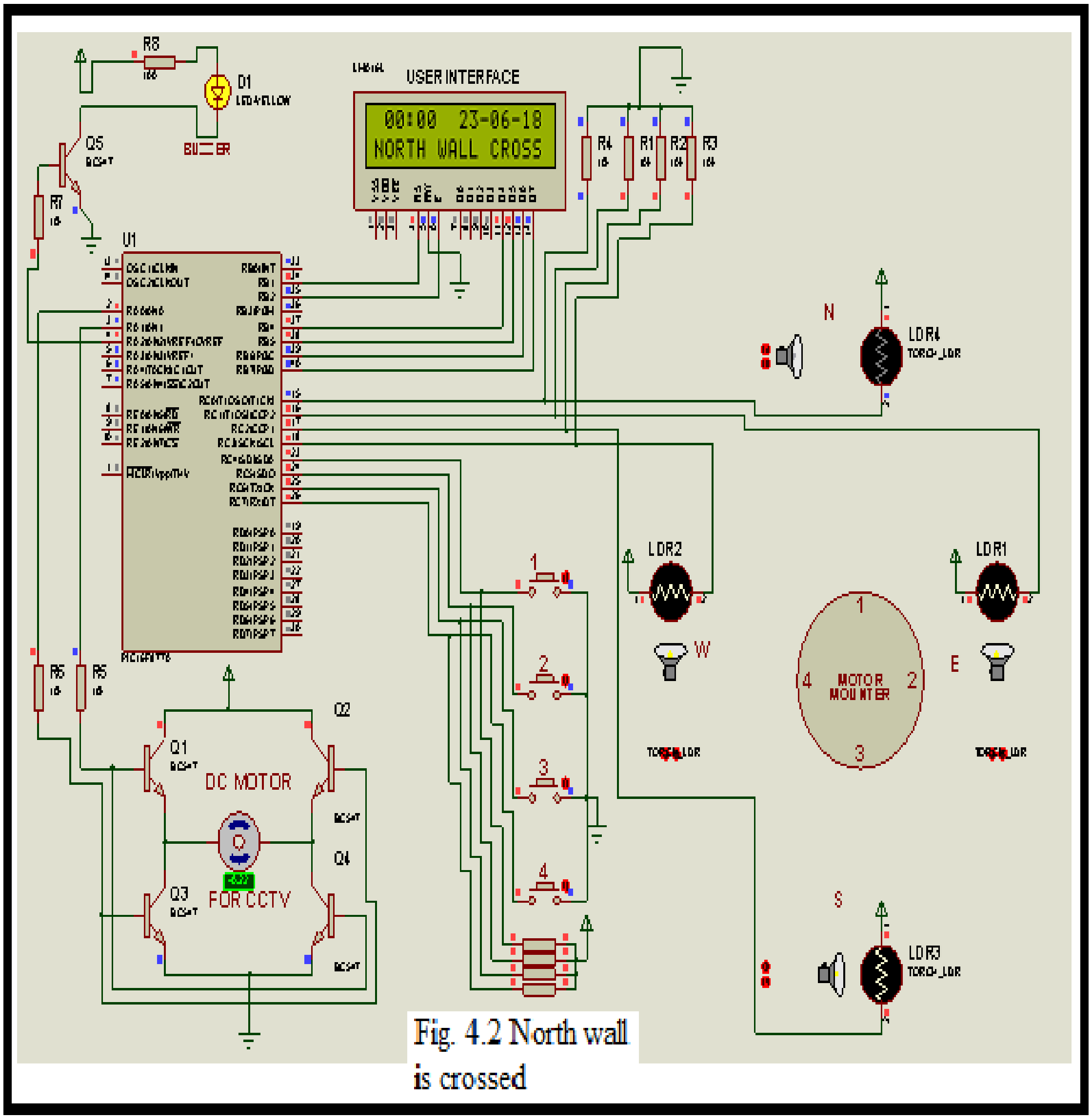


Fig 4.2: Simulation result obtained showing north wall crossed

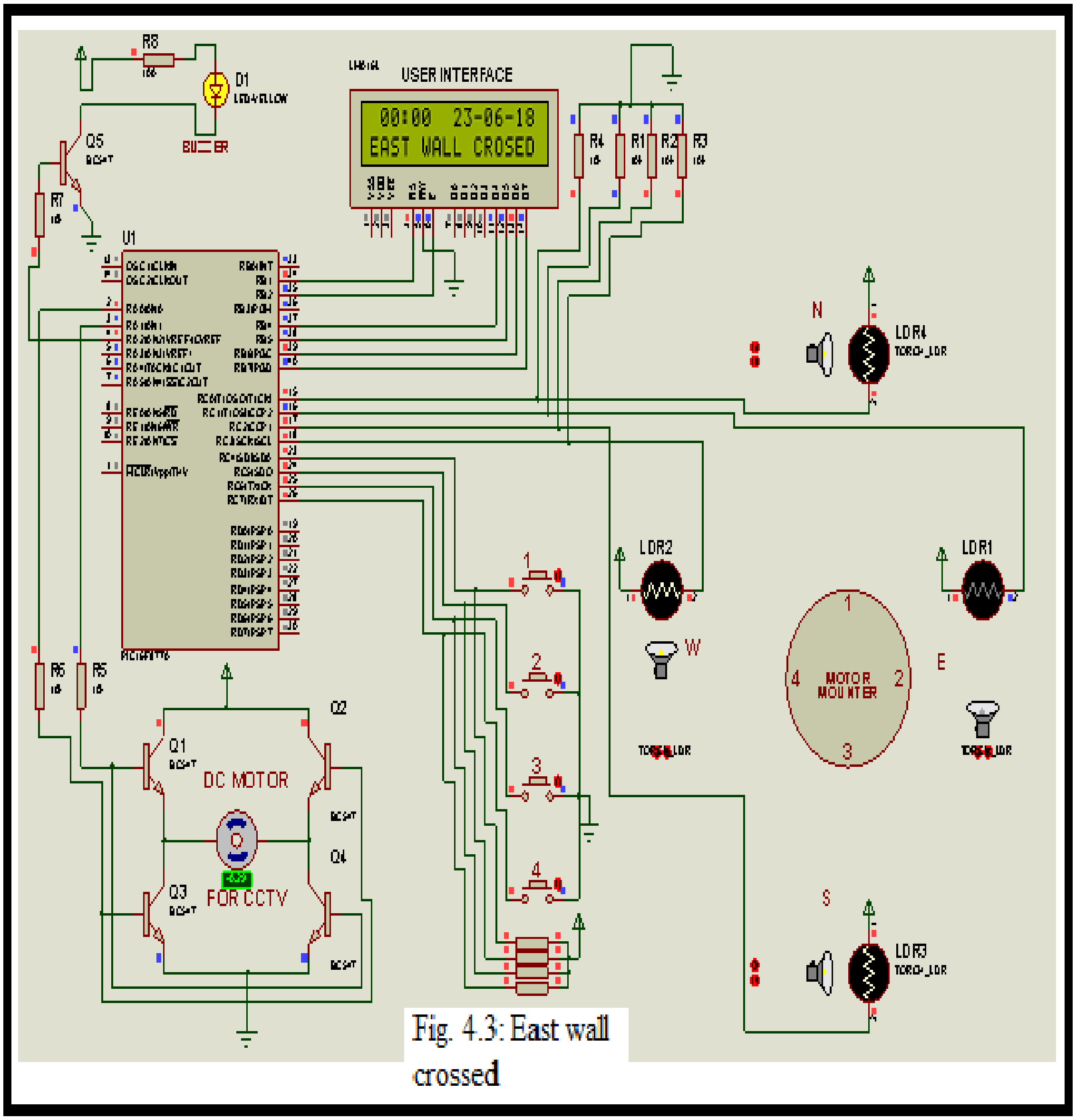


Fig 4.3: Simulation result obtained showing east wall crossed

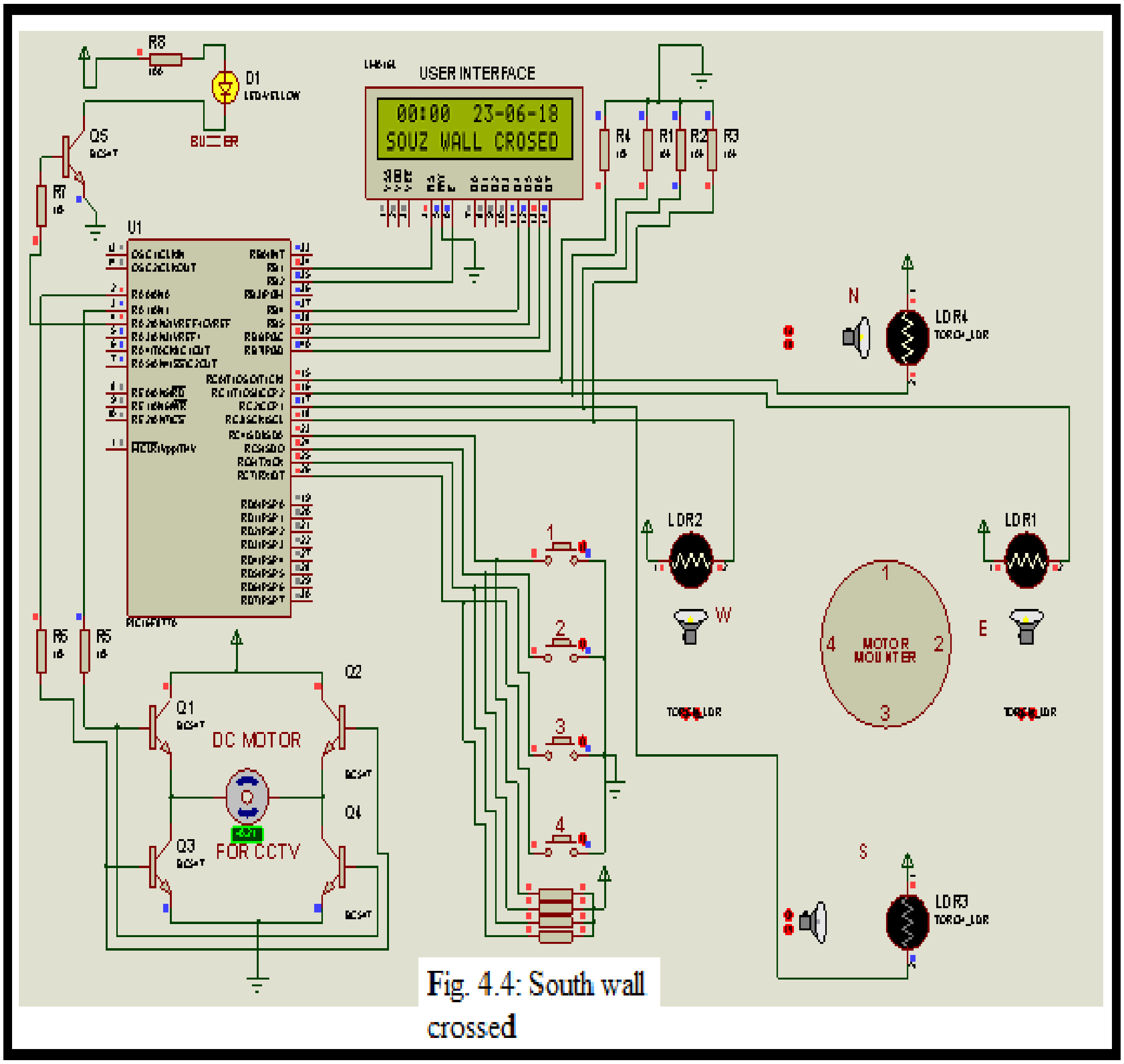


Fig 4.4: Simulation result obtained showing south wall crossed

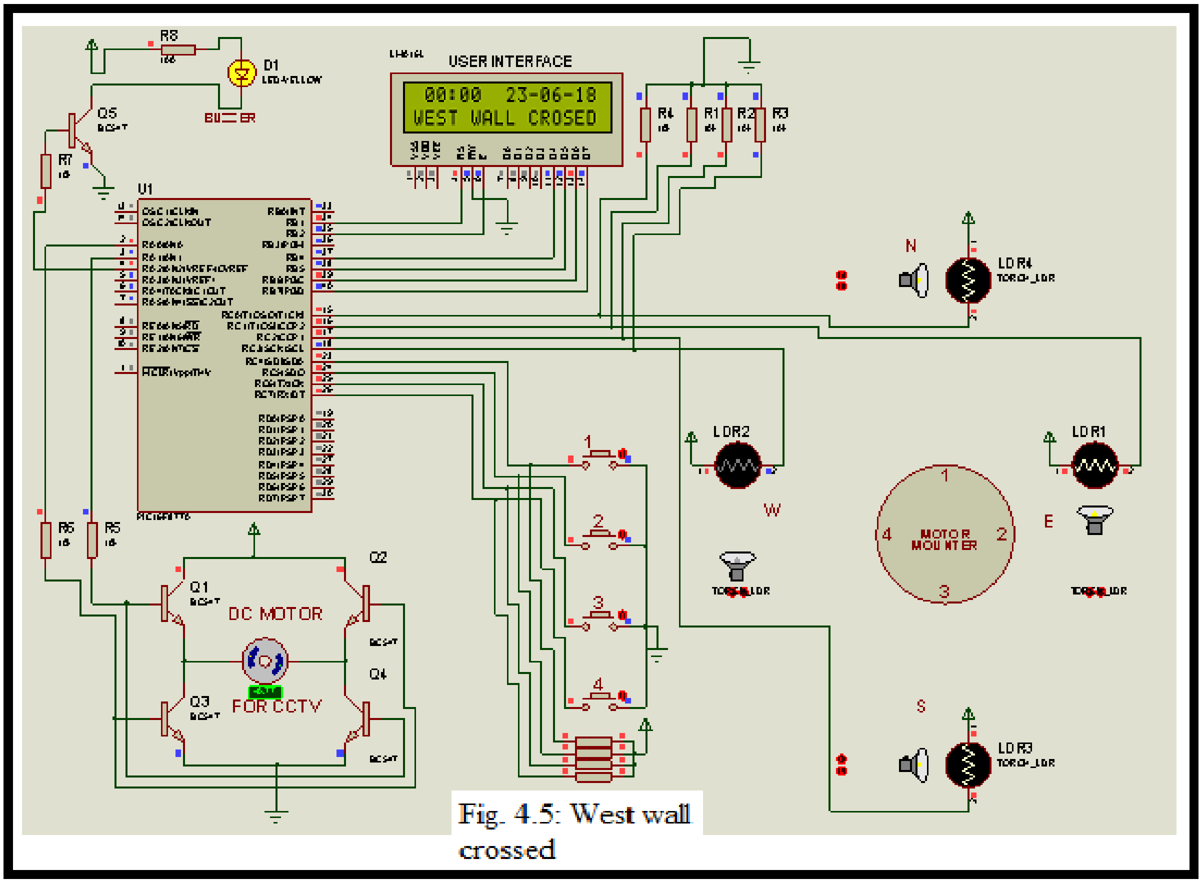


Fig. 4.5: West wall crossed

Fig 4.5: Simulation result obtained showing west wall crossed

4.1.3. Reliability Testing

The reliability of every system is very important. Especially a system like the one under consideration on which human life developed. This section of the report will deal with how reliable this system will be seen. The reliability of a system falls within the range of 0 and 1or if calculated in percentage, within the range of 0% to 100%. It is not likely to have the extreme values of either 0 or 1 but lies between two extreme values.

The reliability assessment procedure consists of the following:

1. List of component parts of the equipment,
2. State the basic failure rate for each part,
3. Multiply by the number of similar parts,
4. Multiply by all available weighting factors,

5. Add up all the products from steps (1) through (4) to give overall failure rate,

Determine the equipment reliability R, for a given operating time t, using the expression,

$R = e^{-\pi t}$, **(4.11)**

Table 4.2: Reliability table for the system showing the individual failure rates of the components and their weighting factors.

Component	Number used	Basic failure rate,λi (%/10⁻³hrs)	The weighting factor due to the environment	Weighting factor due to temperature	Weighting factor due to W_r	Overall failure rate, λoi
Resistor	11	0.003	1.0	1.5	1.0	0.0495
LCD	1	0.02	1.0	1.5	1.0	0.03
PIC	1	0.02	1.0	1.5	1.0	0.03
LDR	4	0.002	1.0	1.5	1.0	0.012
Buzzer	1	0.002	1.0	1.5	1.0	0.003
Transistor	5	0.03	1.0	1.5	1.0	0.225
Oscillator	1	0.005	1.0	1.5	1.0	0.0075
LED	4	0.01	1.0	1.5	1.0	0.06
Connection	21	0.001	1.0	1.5	1.0	0.0315

Table 4.2 gives the reliability assessment of the thesis at 40℃ operating temperature. The failure rate is given in percentage per 1000 hours (%/1000hrs). The rating factor W_r is taken for operation in a normal office, laboratory or home.

The overall failure rate of the system is the summation of the failure rates, λoi is given by

$\sum \lambda oi = \lambda_T = 0.0495 + 0.03 + 0.03 + 0.012 + 0.003 + 0.225 + 0.0075 + 0.06 + 0.0315 =$

$0.4485\%/1000hrs = 0.4485 \times \frac{1}{100000} = \frac{0.4485}{100000} = 4.485 \times 10^{-6}$

For the operating time of one year, that is 365 days

t = 24hrs x 365 = 8760

Therefore,

The failure rate of the device for a year, $\lambda_T \times t = 4.485 \times 10^{-6} \times 8760 = 0.03929$

Therefore,

The reliability, $R(t) = e^{-\lambda_T \times t} = e^{-0.03929} = 96\%$

From the value obtained, it can be seen clearly that the system would be quite reliable under favorable conditions.

4.2. Problems Encountered

Initially, the peripheral interface controller (PIC) is not responding to the crossing light-dependent resistor (LDR) until after a long time debugging then the peripheral interface controller (PIC) starts reading the light-dependent resistor (LDR). Displaying time and date (calendar), however, resulted in a very complex and difficult process of programming and circuitry design.

5. CONCLUSION AND RECOMMENDATION

This chapter concludes the report on this thesis while providing a recommendation for future research to be carried out in these fields and related ones.

5.1 Conclusion

The design and simulation were successfully carried out as well as the design and implementation of the software. The two were successfully integrated to give a workable system. The operation of the complete thesis was simulated and expected results were obtained. Also, after conducting reliability tests, the system was seen to be sufficiently reliable and capable of performing its function. In this research, it has been seen that the simulation model works successfully without any basic error. So, this research can be applied in the practical field. Besides the cost of this research is not too expensive. Here the one closed-circuit television has provided maximum security than using four closed-circuit television, so you can see it is quite impossible for any intruder to enter the secured environment without concern of the owner. The operation of the complete research was simulated and expected results were obtained. Also, after conducting reliability tests, the system was seen to be sufficiently reliable and capable of performing its function. Therefore, it can be concluded that the aim of this research has been achieved, which is a simulation of a security system against any kind of intrusion.

5.2. Recommendations

It is recommended that more research should be carried out in the future to improve on this thesis so as to come up with a better and more reliable wall-crossed detection security system. Some of the recommendations for future developers are:

1. To use solar energy inverter as a main power source for the system.
2. To develop angular-crossing scanning to improve the system capacity.
3. The used of short message service (SMS) notification in case if an intruder enters the secured environment instead of to sound an alarm it will automatically send an SMS to the house owner.
4. The introduction of the personal computer by the used of parallel port connection to see the clear display of the intruder.

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PUBLICATIONS

1. **Paper title:** "A REVIEW ADVANCEMENT OF SECURITY ALARM SYSTEM USING INTERNET OF THINGS (IoT)" International Journal of New Computer Architectures and their Applications (IJNCAA) 9(2): 38-49 The Society of Digital Information and Wireless Communications, 2019 ISSN 2220-9085 (Online); ISSN 2412-3587 (Print).
2. **A paper entitled**: "A REVIEW ON SPIDER ROBOTIC SYSTEM" International Journal of New Computer Architectures and their Applications (IJNCAA) 9(1): 19-24 The Society of Digital Information and Wireless Communications, 2019 ISSN 2220-9085 (Online); ISSN 2412-3587 (Print).
3. **Paper entitle** "DESIGN AND SIMULATION OF FOUR WALLS CROSSED SECURITY SYSTEM AGAINST INTRUSION USING PIC MICROCONTROLLER" American Journal of Engineering Research (AJER) E-ISSN 2320-0847 p-ISSN: 2320-0936 Volume-7, Issue-12, pp-233-244 www.ajer.org.
4. **Paper entitle "**REVIEW OF HOME ALARM SECURITY SYSTEM AGAINST INTRUSION" bilisim 2018 conference Ankara turkey.

Proceeding link: http://www.asafvarol.com

5. **Paper entitle:** "GABOR BASED BAND SELECTION FOR MULTISPECTRAL PALMPRINT RECOGNITION SYSTEM USING FEATURE FUSION" I-manager's Journal of Image Processing, ISSN : 2349 – 4530, Volume 6. No. 2 April - June 2019.
6. **Paper entitle:** "DESIGN AND SIMULATION OF PERSONAL COMPUTER BASE WALLS CROSSED SECURITY SYSTEM AGAINST INTRUSION USING PIC MICROCONTROLLER" International Journal of Engineering Science Invention (IJESI) ISSN (Online): 2319 – 6734, ISSN (Print): 2319 – 6726 www.ijesi.org ||Volume 8 Issue 03 Series. II || March 2019 || PP 59-74.

Appendix

The program is usually written in assembly language and then assembled to generate a hexadecimal code file (machine code). Writing the program and assemble it is made easy by the availability of a group of software known as the MPLAB IDE with an assembler called the MPASM assembler. After the program was written, it was simulated using the MPLAB SIM which is part of the MPLAB software. The program was written into the actual microcontroller using a microcontroller programmer. Writing the program into a microcontroller requires a hex file of the program code. The hex file is a file containing hexadecimal codes that represent the program code written in the microcontroller assembly language. The hex file is generated using the MPASWIN software which is also of the MPLAB software suite. Below are the codes;

```
#INCLUDE "P16F877A.INC"; INCLUDE HEADER FILE
        __CONFIG _XT_OSC & _WDT_OFF & _PWRTE_ON & _LVP_OFF & _CP_OFF
; EQUATES SECTION
TMR0 EQU 1 ;means TMR0 is file 1.
STATUS      EQU 3; means STATUS is file 3.
ZERO BIT EQU 2 ; means ZEROBIT is bit 2.
ADCON0      EQU 1FH ;A/D Configuration reg.0
ADCON1      EQU 9FH ;A/D Configuration reg.1
ADRES       EQU 1EH ;A/D Result register.
CARRY       EQU 0 ;CARRY IS BIT 0.
OPTION_R EQU 81H ;Option Register
INNER       EQU 20H     ;TEMP 1 a register to count events.
MSEC EQU    31          ; TENS OF MILLISECONDS
SEC         EQU   32          ; SECONDS
INNER_2     EQU   37          ;TEMP2
TIMER1      EQU   25          ;DELAY REGISTER 1
TIMERX      EQU   26          ;DELAY REGISTER 2
OUTCOD      EQU   27          ;OUTPUT WORDS TO LCD
```

```
SELECT      EQU   28          ;REGISTER SELECT BIT
LOC1  EQU   29          ;DIGITS SEPERATOR 1
LOC2  EQU   30          ;DIGIT SEPARATOR 2
HOLD EQU   3A          ;DISPLAY REGISTER AND FLAG
NUM1 EQU   40
NUM2 EQU   41
NUM3 EQU   42
NUM4 EQU   43
NUM5 EQU   44
NUM6 EQU   45
;SEC        EQU   46
MIN         EQU   47
HOUR EQU   33
DAY         EQU   34
MONTH       EQU   35
SAVE  EQU   48          ;REGISTER
TIMEF       EQU   49          ;REGISTER
COUNT       EQU   50
LOC3  EQU   51
COUNT2      EQU   52
YEAR EQU   53
COUNT1      EQU   54
COUNT3      EQU   55
PER         EQU   56
TENS  EQU   57
FIRST_DIG   EQU   58
SECOND_DIG        EQU   59
THIRD_DIG   EQU   60
OPTION_REG        EQU         H'0081'     ;OPTION REG.
MSF         EQU   0           ; MILLISECOND FLAG
MSD         EQU   0X4B        ; CRYSTAL DIVIDER (75)
```

```
PSD             EQU    0X05            ; MILLISECOND DIVIDER
RS      EQU     1                      ;REGISTER SELECT BIT
E       EQU     2                      ;ENABLE BIT
K       EQU     2                      ;DISPLAY FLAG
SF              EQU    1               ; SECOND FLAG
MF              EQU    2               ; MINUTE FLAG
HF              EQU    3               ; HOUR FLAG
DF              EQU    4               ; DAY FLAG
MONFEQU 5                      ;MONTH FLAG
YF              EQU    6               ;YEAR FLAG
;*********************************************************
                LIST P=16F877A                   ;we are using the 16F818.
                ORG    0                                ;the start address in memory is 0
                GOTO            START                          ;goto start!
                ORG             0X04                           ;INTERRUPT VECTOR
                GOTO ISR                                ; VOID INTERRUPT(VOID)
;*********************************************************
;*****************************************************
;SUBROUTINE SECTION.
ONEMS
        MOVLW           D'245'          ;COUNT FOR 1MS DELAY
        MOVWF           TIMER1                  ;LOAD COUNT
LOOP1
        NOP                     ;PAD FOR 4 CYCLE LOOP
        DECFSZ          TIMER1,F                ;COUNT
        GOTO LOOP1                      ;UNTIL Z
        RETURN                          ;AND FINISH
ONE_SEC                 ;1 SECOND DELAY
        MOVLW           .250
        CALL  XMS
        MOVLW           .250
```

```
        CALL  XMS
QS
        MOVLW       .250
        CALL  XMS
DELAYP1
Q_SEC
        MOVLW       .250
        CALL  XMS
        RETURN
XMS
        MOVWF       TIMEX                   ;COUNT FOR X MS
LOOPX
        CALL  ONEMS                 ;DELAY 1MS
        DECFSZ      TIMERX,F                ;REPEAT X TIMES
        GOTO LOOPX                  ;UNTIL Z
        RETURN
PULSEE
        BSF    PORTB,E              ;SET E HIGH
        CALL  ONEMS                 ;DELAY 1MS
        BCF    PORTB,E              ;RESET E LOW
        CALL  ONEMS                 ;DELAY 1MS
        RETURN                      ;DONE
SEND                                        ;
        MOVWF       OUTCOD                  ;STORE OUTPUT CODE
        ANDLW       0XF0            ;CLEAR LOW NYBBLE
        MOVWF       PORTB                   ;OUTPUT HIGH NIBBLE
        BTFSC       SELECT,RS       ;TEST RS BIT
        BSF         PORTB,RS        ;AND SET FOR DATA
        CALL  PULSEE                ;AND CLOCK DISPLAY
        CALL  ONEMS                 ;WAIT ONEMS FOR DISPLAY
        SWAPF       OUTCOD,F                ;SWAP LOW/HIGH NYBBLES
```

```
        MOVF OUTCOD,W   ;RETRIEVE OUTPUT CODE
        ANDLW   0XF0        ;CLEAR LOW NYBBLE
        MOVWF   PORTB           ;OUTPUT LOW NYBBLE
        BTFSC   SELECT,RS   ;TEST RS BIT
        BSF     PORTB,RS    ;AND SET FOR DATA
        CALL  PULSEE        ;AND CLOCK DISPLAY
        CALL  ONEMS         ;WAIT 1MS FOR DISPLAY
        RETURN              ;DONE

INIT
        MOVLW   D'100'      ;LOAD COUNT 100MS DELAY
        CALL  XMS       ;AND WAIT FOR DISPLAY
        MOVLW   0XF0        ;MASK FOR SELECT CODE
        MOVWF   SELECT          ;HIGH NYBBLE NOT MASKED
        MOVLW   0X30        ;LOAD INITIAL NIBBLE
        MOVWF   PORTB           ;AND OUTPUT IT TO DISPLAY
        CALL  PULSEE        ;LATCH INITIAL CODE
        MOVLW   D'5'        ;SET DELAY 5MS
        CALL  XMS       ;AND WAIT
        CALL  PULSEE        ;LATCH INITIAL CODE AGAIN
        CALL  ONEMS         ;WAIT 1MS
        CALL  PULSEE        ;LATCH INITIAL CODE AGAIN
        BCF     PORTB,4         ;SET 4-BIT MODE
        CALL  PULSEE        ;LATCH IT
        MOVLW   0X28        ;SET 4-BIT MODE, 2 LINES
        CALL  SEND      ;AND SEND CODE
        MOVLW   0X08        ;SWITCH OFF DISPLAY
        CALL  SEND      ;AND SEND CODE
        MOVLW   0X01        ;CLEAR DISPLAY
        CALL  SEND      ;AND SEND CODE
        MOVLW   0X06        ;ENABLE CURSOR AUTO INC
```

```
        CALL  SEND          ;AND SEND CODE
        MOVLW       0X80            ;ZERO DISPLAY ADDRESS
        CALL  SEND          ;AND SEND CODE
        MOVLW       0X0C            ;TURN ON DISPLAY
        CALL  SEND          ;AND SEND CODE
        RETURN                      ;DONE
LINE2
        ADDWF       PCL,F           ;MODIFY PROGRAM COUNTER
        RETLW       '0'             ;POINTER = 0
        RETLW       '1'             ;POINTER = 1
        RETLW       '2'             ;POINTER = 2
        RETLW       '3'             ;POINTER = 3
        RETLW       '4'             ;POINTER = 4
        RETLW       '5'             ;POINTER = 5
        RETLW       '6'             ;POINTER = 6
        RETLW       '7'             ;POINTER = 7
        RETLW       '8'             ;POINTER = 8
        RETLW       '9'             ;POINTER = 9
        RETLW       ':'             ;POINTER = 10
        RETLW       '-'             ;POINTER = 11
        RETLW       ' '             ;POINTER = 12
        RETLW       '?'             ;POINTER = 13
INITIATE                    ;LCD INITIALISATION
              BSF           HOLD,K
        CALL  INIT
        BSF         SELECT,RS
        RETURN

INITIATE2
        MOVLW       0XC0
        BCF   SELECT,RS
```

```
        CALL  SEND
        BSF         SELECT,RS
        RETURN
BURST
        MOVWF       LOC1            ;DIGIT SEPERATOR
        CLRF  LOC2
NODE
        MOVLW       D'10'
        SUBWF       LOC1,F
        BTFSC       STATUS,Z
        GOTO NODE1
        BTFSC       STATUS,C
        GOTO NODE1
        MOVLW       D'10'
        ADDWF       LOC1
        RETURN
NODE1
        INCF  LOC2,F
        GOTO NODE
;^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
DISPLAY
        CALL  INITIATE
LINERS
        MOVLW       ' '
        CALL  SEND
        MOVF HOUR,W
        CALL  BURST
        MOVF LOC2,W
        CALL  LINE2
        CALL  SEND
        MOVF LOC1,W
```

```
        CALL LINE2
        CALL SEND
P6
        MOVLW       D'10'
        CALL LINE2
        CALL SEND
        MOVF MIN,W
        CALL BURST
        MOVF LOC2,W
        CALL LINE2
        CALL SEND
        MOVF LOC1,W
        CALL LINE2
        CALL SEND
P7
        MOVLW       ' '
        CALL SEND
        MOVLW       ' '
        CALL SEND
        MOVF DAY,W
        CALL BURST
        MOVF LOC2,W
        CALL LINE2
        CALL SEND
        MOVF LOC1,W
        CALL LINE2
        CALL SEND
P8
        MOVLW       D'11'
        CALL LINE2
        CALL SEND
```

```
        MOVF MONTH,W
        CALL BURST
        MOVF LOC2,W
        CALL LINE2
        CALL SEND
        MOVF LOC1,W
        CALL LINE2
        CALL SEND
P9
        MOVLW       D'11'
        CALL LINE2
        CALL SEND
        MOVF YEAR,W
        CALL BURST
        MOVF LOC2,W
        CALL LINE2
        CALL SEND
        MOVF LOC1,W
        CALL LINE2
        CALL SEND
        CALL INITIATE2
        MOVLW       ' '
        CALL SEND
        MOVLW       'A'
        CALL SEND
        MOVLW       'L'
        CALL SEND
        MOVLW       'L'
        CALL SEND
        MOVLW       ' '
        CALL SEND
```

```
        MOVLW   '4'
        CALL  SEND
        MOVLW   ' '
        CALL  SEND
        MOVLW   'W'
        CALL  SEND
        MOVLW   'A'
        CALL  SEND
        MOVLW   'L'
        CALL  SEND
        MOVLW   'L'
        CALL  SEND
        MOVLW   'S'
        CALL  SEND
        MOVLW   ' '
        CALL  SEND
        MOVLW   'O'
        CALL  SEND
        MOVLW   'K'
        CALL  SEND
        GOTO TTTTTTT

NORTH_WALL_CROSSED
        CALL  INITIATE2
        BSF     PORTA,2                 ;BUZZER ON
        MOVLW   'N'
        CALL  SEND
        MOVLW   'O'
        CALL  SEND
        MOVLW   'R'
        CALL  SEND
```

```
        MOVLW       'T'
        CALL  SEND
        MOVLW       'H'
        CALL  SEND
        MOVLW       ' '
        CALL  SEND
        MOVLW       'W'
        CALL  SEND
        MOVLW       'A'
        CALL  SEND
        MOVLW       'L'
        CALL  SEND
        MOVLW       'L'
        CALL  SEND
        MOVLW       ' '
        CALL  SEND
        MOVLW       'C'
        CALL  SEND
        MOVLW       'R'
        CALL  SEND
        MOVLW       'O'
        CALL  SEND
        MOVLW       'S'
        CALL  SEND
        MOVLW       'S'
        CALL  SEND
        BSF         PORTA,0                 ;MOTOR THAT CARRY CCTV
START ROTATING
N1
        BTFSSPORTC,4                ;CHECK IF CCTV COVERING NORTH
WALL
```

```
        GOTO STOP_AT_NORTH              ;IF CCTV IS AT NORTH WALL GOTO STOP
MOTOR
        GOTO N1                                    ;REPEAT UNTILL CCTV IS AT
NORTH WALL
STOP_AT_NORTH
        BCF         PORTA,0                            ;MOTOR OFF
        CALL  ONE_SEC                          ; ONE SECOND DELAY. A TOTAL OF
3 SECONDS
        CALL  ONE_SEC
        CALL  ONE_SEC
        ;BCF        PORTA,2                            ;AFTER 3
                RETURN
EAST_WALL_CROSSED
        CALL  INITIATE2
        BSF         PORTA,2                            ;BUZZER ON
        MOVLW       'E'
        CALL  SEND
        MOVLW       'A'
        CALL  SEND
        MOVLW       'S'
        CALL  SEND
        MOVLW       'T'
        CALL  SEND
        MOVLW       ' '
        CALL  SEND
        MOVLW       'W'
        CALL  SEND
        MOVLW       'A'
        CALL  SEND
        MOVLW       'L'
        CALL  SEND
```

```
        MOVLW       'L'
        CALL  SEND
        MOVLW       ' '
        CALL  SEND
        MOVLW       'C'
        CALL  SEND
        MOVLW       'R'
        CALL  SEND
        MOVLW       'O'
        CALL  SEND
        MOVLW       'S'
        CALL  SEND
        MOVLW       'E'
        CALL  SEND
        MOVLW       'D'
        CALL  SEND
        BSF         PORTA,0                     ;MOTOR THAT CARRY CCTV
START ROTATING
E1
        BTFSSPORTC,5                            ;CHECK IF CCTV COVERING EAST
WALL
        GOTO STOP_AT_EAST               ;IF CCTV IS AT EAST WALL GOTO STOP
MOTOR
        GOTO E1                                 ;REPEAT UNTILL CCTV IS AT EAST
WALL
STOP_AT_EAST
        BCF         PORTA,0                     ;MOTOR OFF
        CALL  ONE_SEC                           ; ONE SECOND DELAY. A TOTAL OF
3 SECONDS
        CALL  ONE_SEC
        CALL  ONE_SEC
```

```
        ;BCF        PORTA,2                     ;AFTER 3
                RETURN
WEST_WALL_CROSSED
        CALL  INITIATE2
        BSF         PORTA,2                     ;BUZZER ON
        MOVLW       'W'
        CALL  SEND
        MOVLW       'E'
        CALL  SEND
        MOVLW       'S'
        CALL  SEND
        MOVLW       'T'
        CALL  SEND
        MOVLW       ' '
        CALL  SEND
        MOVLW       'W'
        CALL  SEND
        MOVLW       'A'
        CALL  SEND
        MOVLW       'L'
        CALL  SEND
        MOVLW       'L'
        CALL  SEND
        MOVLW       ' '
        CALL  SEND
        MOVLW       'C'
        CALL  SEND
        MOVLW       'R'
        CALL  SEND
        MOVLW       'O'
        CALL  SEND
```

```
        MOVLW       'S'
        CALL  SEND
        MOVLW       'E'
        CALL  SEND
        MOVLW       'D'
        CALL  SEND
        BSF         PORTA,0                     ;MOTOR THAT CARRY CCTV
START ROTATING
W1
        BTFSSPORTC,7                        ;CHECK IF CCTV COVERING WEST
WALL
        GOTO STOP_AT_WEST               ;IF CCTV IS AT WEST WALL GOTO STOP
MOTOR
        GOTO W1                             ;REPEAT UNTILL CCTV IS AT EAST
WALL
STOP_AT_WEST
        BCF         PORTA,0                     ;MOTOR OFF
        CALL  ONE_SEC                       ; ONE SECOND DELAY. A TOTAL OF
3 SECONDS
        CALL  ONE_SEC
        CALL  ONE_SEC
        ;BCF        PORTA,2                     ;AFTER 3
              RETURN
SOUTH_WALL_CROSSED
        CALL  INITIATE2
        BSF         PORTA,2                     ;BUZZER ON
        MOVLW       'S'
        CALL  SEND
        MOVLW       'O'
        CALL  SEND
        MOVLW       'U'
```

```
        CALL  SEND
        MOVLW       'Z'
        CALL  SEND
        MOVLW       ' '
        CALL  SEND
        MOVLW       'W'
        CALL  SEND
        MOVLW       'A'
        CALL  SEND
        MOVLW       'L'
        CALL  SEND
        MOVLW       'L'
        CALL  SEND
        MOVLW       ' '
        CALL  SEND
        MOVLW       'C'
        CALL  SEND
        MOVLW       'R'
        CALL  SEND
        MOVLW       'O'
        CALL  SEND
        MOVLW       'S'
        CALL  SEND
        MOVLW       'E'
        CALL  SEND
        MOVLW       'D'
        CALL  SEND
        BSF         PORTA,0                 ;MOTOR THAT CARRY CCTV
START ROTATING
S1
```

```
        BTFSS PORTC,6                           ;CHECK IF CCTV COVERING SOUTH
WALL
        GOTO STOP_AT_SOUTH              ;IF CCTV IS AT WEST WALL GOTO STOP
MOTOR
        GOTO S1                                 ;REPEAT UNTILL CCTV IS AT
SOUTH WALL
STOP_AT_SOUTH
        BCF             PORTA,0                         ;MOTOR OFF
        CALL ONE_SEC                            ; ONE SECOND DELAY. A TOTAL OF
3 SECONDS
        CALL ONE_SEC
        CALL ONE_SEC
        ;BCF            PORTA,2                         ;AFTER 3
                RETURN

;*******************************************************
;CONFIGURATION SECTION.
START
                BSF     STATUS,5; Turns to Bank1.
                MOVLW   B'00000000' ;6 bits of PORTA are SET TO BE OUTPUT
                MOVWF   TRISA
                MOVLW   B'00000000' ;8 bits of PORTB are SET TO BE OUTPUT
                MOVWF   TRISB
                MOVLW   0X06   ;ALL ANALOGUE PIN OFF
                MOVWF   ADCON1
                MOVLW   B'11111111'   ;8 bits of PORTC are SET TO BE INPUT
                MOVWF   TRISC
                MOVLW   0X7D          ; RBPU=OFF, INTEDG=OFF, T0CS=OSC,
PSA=TMR0
                ANDLW   PSD           ; PSD = B'101' [64]
                MOVWF   OPTION_REG
```

```
                BCF     STATUS,5 ;Return to Bank0.
                BSF ADCON0,0 ;Turn ON A/D
                CLRF PORTA ;Clears PortA.
                CLRF PORTB ;Clears PortB.
                CLRF PORTC; Clears PortC.
                CLRF  SEC
                CLRF  MIN
                CLRF  HOUR
                CLRF  DAY
                CLRF  MONTH
                CLRF  YEAR
                MOVLW       D'23'
                MOVWF       DAY
                MOVLW       D'6'
                MOVWF       MONTH
                MOVLW       D'18'
                MOVWF       YEAR
                MOVLW       D'0'
                MOVWF       MIN
                MOVWF       HOUR
;*****************************************************
;Program starts now.
        ;       CALL  ACTIVATE
;##########################################################################
####################
        ;       MOVLW       0X00            ; DISABLE TMR0 INTERRUPT
START_FAR
                MOVLW       0XA0            ; ENABLE TMR0 INTERRUPT
                MOVWF       INTCON                  ;
UPDATE_TIME
                BSF         INTCON,7
```

```
                BSF             HOLD,K
                GOTO DISPLAY
TTTTTTT
;               CALL  DISPLAY_IN
TTTTTTT_1
                BTFSS HOLD,K
                GOTO UPDATE_TIME
                BTFSS PORTC,0
                CALL  NORTH_WALL_CROSSED
                BTFSS PORTC,1
                CALL  EAST_WALL_CROSSED
                BTFSS PORTC,2
                CALL  SOUTH_WALL_CROSSED
                BTFSS PORTC,3
                CALL  WEST_WALL_CROSSED
                GOTO TTTTTTT_1

ISR
        BSF             HOLD,K                  ; {
        MOVWF           SAVE            ;       SAVE(ACCU);
CLOCK
        BCF             INTCON,T0IF             ;       INTCON,T0IF = 0;
        INCF    MSEC,F                  ;       MSEC++;
        BSF             TIMEF,MSF       ;       MSF = 1;
        MOVF    MSEC,W                  ;       ACCU = MSEC;
        SUBLW           MSD             ;       IF ((ACCU-XD) != 0)
        BTFSS   STATUS,Z        ;       RETURN;
        RETFIE                          ;       ELSE {
        CLRF    MSEC            ;       MSEC = 0;
        BSF             TIMEF,SF        ;        MSF = 1;
        INCF    SEC,F           ;       SEC++;
```

```
;       MOVF SEC,W              ;   ACCU = SEC;
;#################################################################
NEXT6
;#####################################################################
        MOVF SEC,W
        SUBLW      0X30         ;             ;   IF ((ACCU-48) != 0)
                                              ;   IF ((ACCU-60) != 0)
        BTFSS STATUS,Z     ;        RETURN;
        RETFIE                          ;   ELSE {
        CLRF  SEC          ;        SEC = 0;
        BSF        TIMEF,MF     ;       SF = 1;
        INCF  MIN,F        ;        MIN++;
        MOVF MIN,W              ;       ACCU = MIN;
        SUBLW      0X30              ;3B          ;   IF ((ACCU-60) != 0)
        BTFSS STATUS,Z     ;         RETURN;
        GOTO OUT           ;                  ;   ELSE {
        CLRF  MIN          ;         MIN = 0;
        BSF        TIMEF,HF     ;      HF = 1;
        INCF  HOUR,F            ;        HOUR++;
        MOVF HOUR,W             ;        ACCU = HOUR;
        SUBLW      0X18         ;      IF ((ACCU-24) != 0)
        BTFSS STATUS,Z     ;          RETURN;
        GOTO OUT                ;      ELSE {
        INCF  DAY,F
        CLRF  HOUR
OUT
              MOVF SAVE,W
              BCF        HOLD,K
              RETFIE                   ; }

              END
```