Home Alarm System

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Arduino Home Alarm System

By

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Approval

This dissertation, entitled **"Home Alarm System"** by **Delbert E. Zifungo** meets the regulations governing the award of the degree of **BSc Computer Science Honors Degree** of the **Midlands State University,** and is approved for its contribution to knowledge and presentation.

Supervisor's Signature: ………………………………………………….

Date: …………………………………………………………………...

Abstract

The crime rate in the nation of Zimbabwe has been steadily increasing in the past 3 years with about 10-15% annually and particularly in theft related crimes. It is due to the advent of this growth in crime that has led to the development of this system as a basis of a prototype to protect people's homes in particular. As the study in crime done by the ZRP and U.S Embassy OSAC the crimes are mainly based on breaking and entering, therefore this Arduino based alarm system is developed to detect intrusions in the vicinity is deemed a necessary improvement. It works with several pre-existing technologies to make a compound system through several components such as PIR motion sensors, Magnetic Contact Reed Switches and Ultrasonic sensors. This document highlights the several stages involved in the project from its initiation to the assembly of the system into a working prototype. The reader can therefore understand the steps that help them in coming up with a similar system and the amount of work and research involved. Through the explanations offered the reader can get an appreciation of concepts in electronics and the problem solving approach herein.

Dedication

To my dear mother, Mrs J Hungwe and dear sister Bernice Zifungo, to whom without, all this could not have been achieved for their love and support throughout all of my tertiary experienced have been with me and encouraged me to stay strong enough to see this through.

Acknowledgements

All the work done in this thesis cannot be attributed to any particular individual, therefore I would like to give a vote of thanks to all the authors mentioned and not, since mentioning all of them individually would be impossible since many of the ideas have contributed to the final work. The sweat and tears of my supervisor Mr Musungwini are at the top of my acknowledgements, as it would not have been possible to reach this point without his excellent eye of supervision. In addition the help Mr Taruvinga in my justification and understanding of some concepts of my project where I was slightly misguided and the help of close friends of mine who assisted me with my components and encouraged me to go through when times were tough.

I would like to thank the Entire Faculty of Science and Technology from the Dean Mr Nechibvute to the Head of the Department of Computer Science and Information systems Mrs Zhou along with the members of staff for having accorded us this opportunity of demonstrating all the knowledge gathered since the beginning of my Tertiary education and the Midlands state University. Thank You.

Declaration

I **Delbert E. Zifungo**, of Registration number **R144503R** state that I am the sole author of this dissertation hereby referred to as **Home Alarm System**. I will therefore allow only other students and Academic institutions to only use this for research purpose alone, otherwise any transmission in electronic means or otherwise is considered illegal.

Signature…………………………………   Date …………………………………………….

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Glossary of Abbreviations

MATLAB - matrix laboratory

OSAC - Overseas Security Advisory Council (US State Department)

ZRP – Zimbabwe Republic Police

CCTV - Closed Circuit Television

LCD – Liquid Crystal Display

RGB – Red, Green, Blue

LED – Light Emitting Diode

PIR – Pyroelectric Infrared

CHAPTER 1: INTRODUCTION

1.1 Introduction

This study is designed intently with the purpose that it may help home owners live in their homes being assured that while they are away and even during the night while they are sleeping, their house will always be safe and under constant monitoring. The use of an alarm system is often overlooked by most people but with a constant rise in the theft cases, home owners are now, more than ever in need of a home alarm system that can reduce unnoticed intrusions for their family. This is one way that can help a neighbourhood as a whole, to locate and isolate the thief and best assist in capturing the perpetrator. In such scenario's, it is therefore preferable to have a system developed that is responsible for assisting the home owners by means of an alarm system.

In reference to the use and effectiveness, the availability of a home alarm system that helps to alert home owners will certainly be efficient when searching for the culprits with the aid of Cameras and Sirens to alert the neighbourhood of the unknown presence on the premises. The end result is a system that notifies when an intrusion occurs and if not quickly attended to may help in identification of the thieves for the police.

1.2 Background of Study

The development of this here alarm system came as a tragedy to the author who personally came across this problem upon his first week of arriving at school. At the beginning of his fourth year semester, he had just started residing at his new residence and it had been the third night when it happened. On the very night of the theft, he woke up and found the door opened and completely failed to grasp how someone could have stolen his laptop whilst he was sleeping. The idea then came as to curb for that event, an entire system dedicated to monitoring the door and window activity. This then meant that the first part of the problem would be solved considering that you would be always inside the house when the intrusion occurs. Then after having a discussion with friends and family for a while, he discovered that most of their cases of theft would occur while they were at school or once they had left the premises. The further development of the idea then came instead as to develop a system that is capable of monitoring the place while the owner is home and even while they are away, all it needs is to be activated.

The final design then came as a compound system that would sense the presence of a human while people are away. It would capture video footage of anyone who enters the house while the owners are away so that the police may have a starting point for their investigation. Looking at further developments that would allow the system a full on defence mechanism enabled to at best protect the home we would incorporate a dial pad for entering the pin. The pin allows activation and deactivation of the alarm and therefore the overall goal came to be one where we develop an alarm system that not only monitors the home environment while the home owner is both in and outside the premises.

1.3 Problem Definition

Problem definition is simply the problems encountered that led to the development of the system as stated in Blanchard, Fabrycky, Fabrycky (1990)'s article on system analysis and design. The proposed system is aimed at the possibility of tackling problems that arise from the lack of a reliable home security system whether the home owner is present or not. The problem scope to be covered is based on how thieves would normally attack a home, this includes picking a door lock or breaking through the windows otherwise they may enter via the roofs and ceilings. As such, the problems seem feasibly addressable by the development of a home alarm system which when fully implemented can drastically reduce the number of theft cases nationwide. The catering for each problem stated above is done through Reed Switches for the Doors and Windows and a PIR motion sensor for detecting internal unwanted motion and a dial pad for entering the passcode to activate or deactivate the system by the home owners. An intrusion activated camera that faces the direction of the intrusion. Then finally an Ultrasonic sensor to detect an interruption between 4m vicinity distance and itself and can be implemented around the window areas and other sensitive regions of the house.

1.4 Aim

Mason et al (2013) defines an aim as your overall intention which you hope to achieve. The aim of this project is:

To Improve home security for the general home owners through using an alarm system to cater for motion, break-in and capture video footage in case of an intrusion.

1.5 Objectives

The objective, can be said to be the specific number of steps with which one intends to achieve their intended aim or goal as stated by Ang et al (2005) in their article on IEEE transactions on control **systems** technology.

- To alert home owners and/or neighbours of intrusion through the use of a siren for the door windows or move on the outside.

- To help in the identification of criminals through the use of cameras to aid in Video Footage.
- Allow one's home to be secured via pin entering system on the keypad of the house for activation and deactivation.
- Assist the police and home owners in where to start the investigation as they will have enough evidence to open docket by footage.
- Reduce number of break-ins and the crime rate by awareness and presence of a security alarm system.

1.6 Methods and Instruments

1.6.1 Data Collection Techniques

These are the tools used to analyse the system and create a platform for creation of the system and they include:

- ➢ Direct observation
- ➢ Questionnaires
- ➢ Interviews

1.6.2 Instruments Used in System Creation

The instruments we shall be to use for the system development include:

- Microsoft word
- C programming language
- Arduino IDE

1.7 Budget

Items Quantity	Description	Item Price	Item Total	Item Source
1	Mega 2560 (Arduino)	$35.00	$35.00	Blitztech
1	SainSmart LCD Module For Arduino 20X 4	$12.00	$12.00	Blitztech
2	Magnetic Door Window Contact Switch	$5.00	$10.00	Blitztech
1	Breadboard	$5.00	$5.00	Blitztech
1	Breadboard jumper wires	$10.00	$10.00	Blitztech
2	Male to Male Headers	$1.00	$2.00	Blitztech
2	Pyro electric Infrared Motion Sensor	$6.00	$12.00	Blitztech
1	Active Buzzer Alarm Module	$2.00	$2.00	Blitztech
1	4 x 4 Keypad Membrane	$5.00	$5.00	Blitztech
1	4.7k Potential meter	$0.70	$1.40	Blitztech
2	220 ohms resistor(Resistor 220R)	$0.05	$0.10	Blitztech
1	Servo	$5.00	$5.00	Blitztech
1	Recording camera	$5.00	$5.00	Intel Shop
		Total:	**$174.4**	

Figure 1.1 Budget for Components required (Designed by Author)

1.8 Justification

If the alarm system is successfully developed, it shall lead to improved home security and a decline in theft cases in the suburbs. This will be due to the improved home security offered by the proposed alarm system which will be affordable and requires less supervision from the home owners. The system comes with motion sensors and switches to detect forced entry long with a siren to notify those in the surrounding regions of break in. in addition to the sensors, the system is built so as to accommodate cameras to capture footage of the break in. the sound of the siren must cover a region of about 400 meters so s to alert other home owners therefore it also means the home owner has valid evidence to present to the police when they are to carry out their investigations.

1.9 Conclusion

A conclusion is defined as the chronological end of any discussion and a point where final arguments are made as defined by write a writing. This chapter is an introductory chapter, highlighting the undertakings that will be needed so as to development the home alarm system as it describes the most basic requirements in creating this home alarm system for the home owner. The success of this proposed system will see a reduction in the theft cases in the urban setup.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

An attempt is made to evaluate the system to be developed versus any other previous systems that have been made that are similar or of comparison. A further attempt will be made in this document that will show the possible improvements that overcome the previous implementations, its limitations and the possible foreknowledge that might be required before engaging in the project.

2.2 Crime rate background in Zimbabwe

The current 2018 levels of crime in Zimbabwe are at approximately ranging 51.32% to 53.03% as according to www.numbeo.com. The crime rate has been on a continuous rise at about 74.11% in the past 3 years therefore implicating that safety index of the country has declined to about 46.97% based on the crime index. The worries of homes being broken into have increased to 60.09% and crime of incidents was also reported to have had an increase of about 10-15%.

The United states department of bureau of diplomatic security reported that most civilians are in risk of being murdered or stolen from and as such they recommended that it is therefore highly advised that precautions be taken in installation of security measures in their 2nd of January 2017 report. The measures would include anti-forced entry devices such as solid doors/grills, robust perimeter fences reaching at least 6.5 feet topped by razor/electronic fence. In addition, the inclusion of an automated or manned gate is also recommended alongside the addition of an audible house alarm with a possible panic button feature is highly advisable. Residential Incidents reports to the Regional Security Officers showed that the suspects often flee at the sounding of an alarm or any other robust devices are encountered as encountered by U.S Embassy OSAC reports.

 A recently documented unlawful and entry case which was posted online by the ZRP occurred on the 21st of July 2017 in Belvedere at around 16:00 hrs. A 52-year-old man returned to his house hold and found his gate had been tampered with and as such it was not responding to its remote control. They found their house had been broken into and that their property including a 26 carat diamond set, 2 Acer and Lenovo laptops, 7 Samsung laptops and $20 000.00 worth of cash had been stolen. In addition, the ZRP continue to receive reports of large sums of money being stolen in homes and offices and cars. At the end of the day a major problem which would occur is that

all theft occurs and there is no alarm to notify neighbours of a break in, there is also no means of tracing the thieves or any means by which they may be identified.

2.3   Old Burglar Alarm System Evaluation

The older alarm system set up would usually be based on the installation of basic motion detection sensors throughout the area to be secured, that is, the house or office that intends to use the system. It is then devised such that it sounds an alarm when it has detected the motion of an unacknowledged entity that then requires a certain team to respond to the disturbance.

One particular system is the one that was developed by Omniva Security Systems for comparison. It is a good representation of how majority of the burglar alarm systems are like. The company also manages to provide a wide range of other security products including CCTV Systems, Gate automation, Burglar alarm system and even Gate Intercoms. Their alarm system installation for the home and the office is based on motion sensors to do the detection of the thieves which will then trigger the siren.

The system in itself is not bad when looking at it from a business perspective as it covers the basic function required by most homes and offices, but when looking at it from the customer's end it only provides a quantifiably low level of security. This is because the effectiveness of the system is relatively strong only if there is a person who can engage the intruder if not armed. In addition, this system only sounds an alarm if any motion has been picked up within the set up environment but it does not give the answer as to whom from this disruption was triggered. Such a system may be triggered of course by burglars otherwise on the other hand, children or other family members or by their pet or some random pest. This may then implicate that it makes unnecessary false alarms if not catered for accurately on the scheduled time on or time off. Although to a certain degree it manages to chase away those intruders who scare by the sound of an alarm since the burglars are not certain as to whether or not there are people in the household. Otherwise it is not as effective as it can be for an alarm as there lacks certainty in a lot of areas, and since some people may intrude knowing the owners are away then the system leaves the house vulnerable.
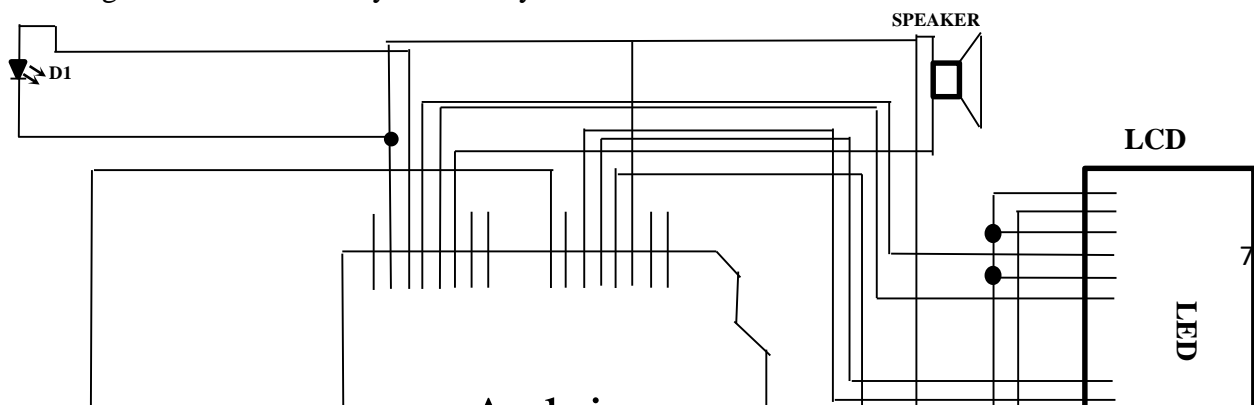
Figure 2.1 Circuit diagram of Old alarm system (Adapted from Adafruit.com)

2.3.1 Benefits of old system

- ✓ This system is very easy to set up.
- ✓ It is considerably effective as it scares away the intruder by the siren.
- ✓ It is largely profitable on the manufacturer's side as they can sell a lot of different products in place of one.
- ✓ It does not take time to install

2.3.2 Drawbacks of system

- It provides only minimal features of security.
- It only saves from burglars if there is someone present.
- It does not help in the further identification of criminals
- It is too simple

2.4 New Burglar Alarm System

The newly proposed system is basically similar to the old burglar alarm system and also functions almost similarly in that it also uses motion sensors for detecting the intrusions but it would include a few more features.

The new modifications that were added would include a live camera feed to help with the monitoring of the environment as well as the entities involved in the room. The cameras should, when installed be incorporated into the system to help constant monitoring. One IP camera that will be activated when the system has picked up motion and send directly to the server for direct and real time viewing by the owners. One other normal camera for constant home monitoring which behaves like a normal CCTV, both to compensate for the lack found in the old burglar alarm system.

This system has in addition to just the motion sensors, like most systems, an addition of a pair of Contact reed switches, the security will be increased on the side of the doors and windows. The reed switches are activated the same time that the alarm is set to begin working, but they are activated once the door or window is opened forcefully. This means if the home owners are asleep or away, the first sign of a forced entry or break in the alarm will be sounded, otherwise if they use ceiling for entry then the motion sensors come into play alongside the IP camera which is then activated and sends a live footage.

2.4.1 Benefits of new system
- ✓ It provides a higher level of security as it incorporates 4 pieces of technology instead of 2, each one meaning more security for the home owner instead of a basic feature as just motion detection.
- ✓ It uses better technology as it has IP camera's to give the home owner a live feed of the occurrences in their homes while they are away.
- ✓ It incorporates reed switch technology to detect forced entry without pin whether it would be a break in or lock pick, it will notify of the intrusion.
- ✓ The video feed gives the owner the ability to see intruder as camera faces direction where entry has been forced.
- ✓ Ability to see if intruder is armed or not via live feed therefore able to engage safely.

2.4.2 Drawback of system

- It requires a lot of equipment which may make it a bit more expensive to produce.
- The high cost in production means a slightly higher price for the customer.
- Without the presence of a response team, the system will only be able to make people aware of the intrusion but no one to act on it.
- It uses Arduino which is an open source software meaning anyone who is an expert in the technology may be able to exploit it.
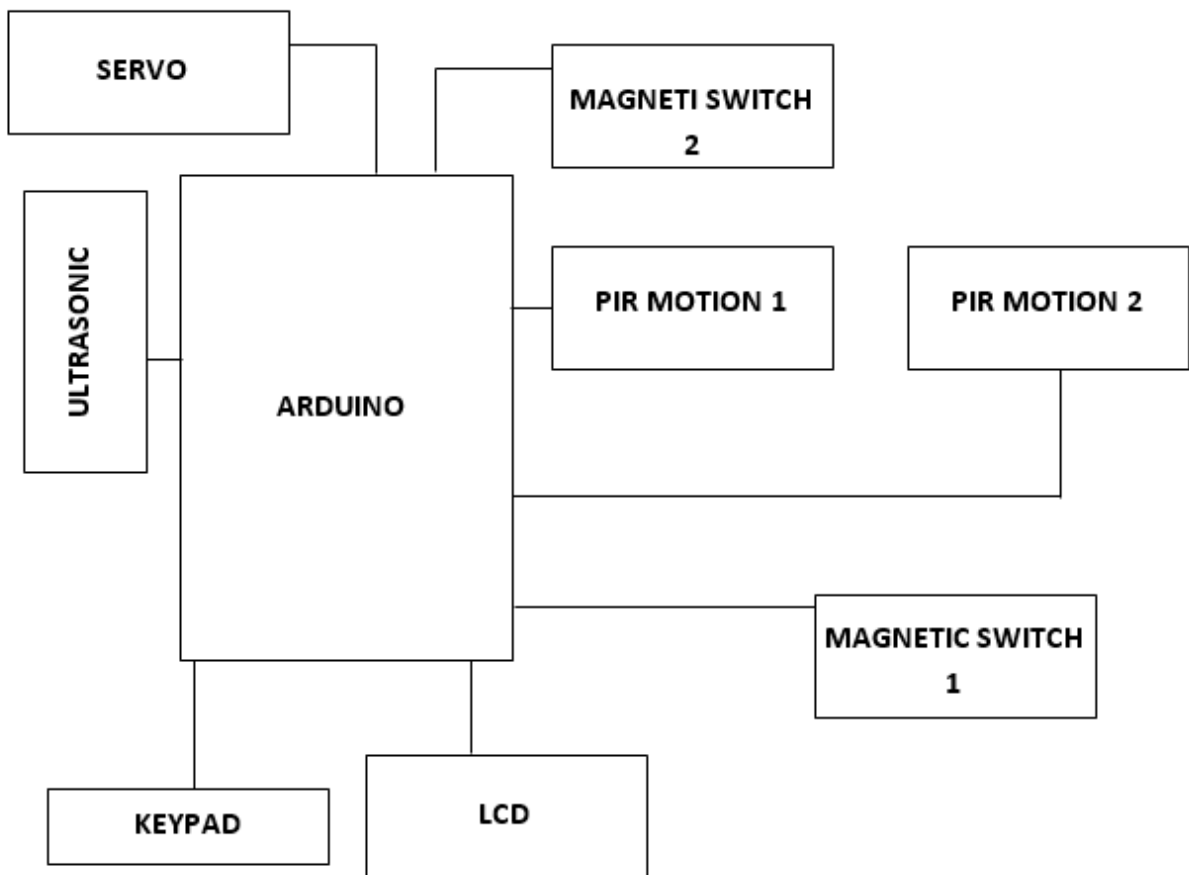

Figure 2.2 Block diagram of New Burglar alarm system (Designed by Author)

2.5   Foreknowledge on Project

The home alarm system design and implementation requires a little bit of foreknowledge on working with the Arduino Microprocessor. Arduino projects are based on an open source hardware and software environments. It provides micro controllers and kits that allow for building real time interactive objects and digital devices for both the digital and the physical world. The Arduino hardware devices provide the core of this project as they allow for quick and easy simulation. The hardware allows for the instructing of the components to be done in a wide variety of languages therefore providing convenience. In addition to that, there is need for a background in programming as the software is what makes the hardware serve its intended purpose. This particular project requires knowledge in basic programming for sending instructions. The use of simulation software and knowhow also aids in the emulation of the project as it verifies if the available resources can produce the required end result. Basic simulation software that is available includes the likes of MATLAB and Proteus and they both produce the expected result that is supposed to be found in an ideal situation. In short these are the expected values.

Finally, the knowledge of basic electronics is required as the interconnection of the components and knowledge of circuitry is deemed quite necessary. This knowledge was acquired during the lower levels of learning such ass in year 1 through 2 and without it this working might be close to impossible. Further researches also show that for a perfected project, one needs to have a background also in the security industry to act as an added advantage. The consumers of the product may often want to know what authenticates or gives the producer the right to make the device but for the sake of the thesis, only research may be deemed necessary.

2.6   Conclusion

This chapter dealt with the basic review of how the crime rate in Zimbabwe has been for the past few years and specifically narrowed down to the specific home related crime. This then showed that there is a need to use an alarm system as per household for increased security. It managed to cover one particular family's case study which proved beyond a reasonable doubt the need for home security. A comparison was then done versus the old alarm system in comparison with the new system alongside their individual merits and disadvantages.

CHAPTER 3: THEORETICAL INFORMATION

3.1 Introduction

In this chapter, a discussion upon the components used is propounded and their underlying workings so that a better understanding in their functionality can be understood. The components too be used in the project include the Arduino mega 2560, LCD, Servo, Twin Piezo Buzzer ,PIR motion sensor, Magnetic reed switch, RGB LED, Membrane Keypad , Breadboard , Camera, Jumper Wires and a LED Strip.

3.2 Components Used

3.2.1 Mega 2560 Board (Arduino)

Figure 3.1: Mega 2560Image (Adapted from Adafruit.com)

According to (www.adafruit.com) the Mega 2560 microcontroller was built based on the ATmega2560 and has 54 digital input/output pins. Of the 54 pins, 15 can be used as PWM outputs while the other 16 for analogue inputs whereas 4 are used as UARTs hardware serial ports. In addition to these, it has a reset button, 16 MHz oscillator (crystal) and a USB connection alongside a power jack and an ICSP header. The 2560 is highly compatible with majority of shields designed for Arduino boards.

<u>MODULE SPECIFICATIONS</u>

- 101.98mm/4.01inin length
- 53.63mm/2.11in in width
- 15.29mm/0.60in in height
- 34.9g/1.23oz in weight

3.2.2 LCD Module

Figure 3.2: Sain Smart LCD 2004A (Adapted from Adafruit.com)

Latest LCD by Sain Smart is a 20 by 4character display module. A 4 line with 20 characters not only sets the contrast but controls knob selector switch also has a backlight. It is well suited for beginners in the Arduino Development Environment since it is not so cumbersome or complex like other LCD driver circuit connections. The true significance of this module comes in its ability to simplify the connection circuit and it manages to directly display into the Arduino Sensor Shield V5.0 expansion board.

<u>**MODULE SPECIFICATIONS**</u>

- Pin Type: GND, VCC, SDA, SCL
- Backlight Colour: Blue with White character colour
- Voltage: 5V
- Size of PCB : 60mm×99mm
- Contrast: Adjust Potentiometer
- Backlight: Adjust Jumper

3.2.3   Servo

Figure 3.3: SG90 Servo (Adapted from Adafruit.com)

The servo motor is a rotary motor which was designed to move at specified angles due to the internal control systems within its wiring. It has three wires, 1 for grounding it (brown), 1 for power which is +5V (red) and the last one to provide the control (orange) to the Arduino board. It is important to note, that the servo's draw a considerable amount of power therefore will require that you use an external source of power if you need to power more than 1 at a time.

MODULE SPECIFICATIONS

- Motor: 3 Pole type
- Bearing: Dual Oilite type
- Speed: 0.21 / 0.16 sec @ 60 deg.

- Torque: 46 / 57
- Weight: 45g
- Size: 1.59" by 0.77" by 1.44"

3.2.4   Piezzo Buzzer
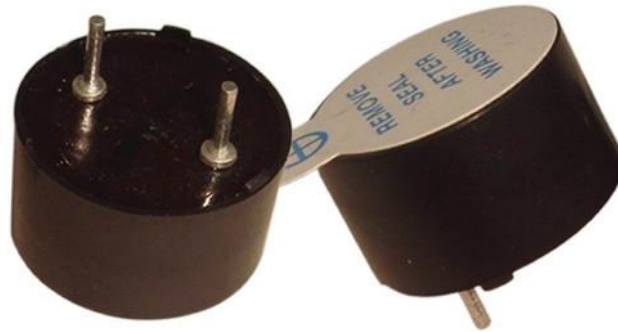
Figure 3.4: Active Piezo Buzzer (Adapted from Adafruit.com)

It is an active buzzer type which produces a very piercing siren. It is basically an active buzzer that has 2 pins underneath it and has a black circuit board to differentiate it from the passive one. It emits a pith of up to 104dB, a frequency of 2.8kHz and requires an input voltage ranging from 5 to 15v

<u>**MODULE SPECIFICATIONS**</u>

- Depth: 55mm
- Width: 84mm
- Type: Mini Siren
- Connection: Wire Terminals
- Height: 32.2mm

3.2.5   PIR Motion Sensor

Figure 3.5: Pyroelectric Infrared Motion Sensor (Adapted from Adafruit.com)

The Pyroelectric Infrared motion sensor "PIR in short" is a basic technology which helps in detecting the motion of objects through the use of Infrared signals. It basically has only two slots that provide it with the required signals but each for detecting its own special material. Though it has a lens, it barely serves any purpose but the really important pins can transmit the signal past the lens. When the sensor is not operational, both of the pins will receive an equal amount of ambient infrared from the room or outdoors or walls. When a warm body then enters the atmosphere the first pin detects it and causes a differential change in the infrared atmosphere enclosed and sends this signal. Likewise, if the body leaves the atmosphere the negative pin detects his and signals the device awaiting the next input.
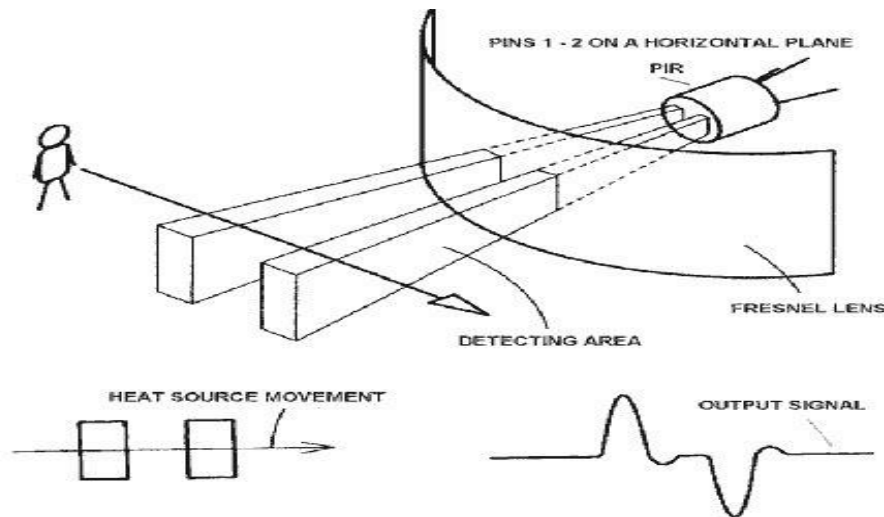
3.2.6 Reed Switch

Figure 3.6: Magnetic contact reed switch (Adapted from Adafruit.com)

This is an electronic appliance that is operated by a magnetic field to complete its circuit. It consists of a pair of ferromagnetic metallic reeds which are sealed in a hermetically sealed glass envelop and was developed in 1936 by W. B. Ellwood under Bell Telephone company. Whenever the magnet is in close circumference of the metallic reeds there is a continuous current flow. This means that when the magnet is distant, there is no current flowing and this can be recorded as a binary 0.

3.2.7 RGB LED

Figure 3.7: RGB LED Module (Adapted from Adafruit.com)

This is a led module that is compressed to contain 3 LED's in one and that is given as Red, Green and Blue. This primary colour combination provides the user with a range of up to 16 million colour hues. There are two basic types which is common cathode and common anode with the common cathode being most common. Common cathode means the long pin is connected to the ground and common anode meaning you connect to the positive. The common anode was used in this project to indicate alarm status.

3.2.8 Membrane Keypad

Figure 3.8: 4X4 Membrane Keypad (Adapted from Adafruit.com)

The 4X4 matrix keypad is a membrane electronic keypad that is made and arranged in a telephone like grid and provides function keys that range from 0 to 9 and alphabetic keys from A to D and 2 additional keys (* and #). The greatest advancement on the keypad is that instead of providing 16 serial lines, it gives 8 instead. In this project it is to provide the user with an input panel for user verification through passwords and uses the asterisk for enter and the pound for clearing erroneous passwords.

3.2.9   Breadboard
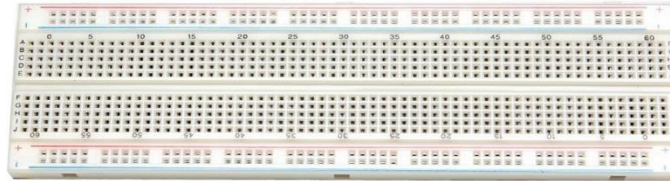
Figure 3.9: Breadboard (Adapted from Adafruit.com)

This is a basic tool in prototyping as it provides a connection base that is easy to connect, reusable and inexpensive as compared to the PCB. It may also be referred to as a plug board or terminal array board. For this project where the Mega 2560 has up to 53 pins, a 16 pin LCD and an 8 pin membrane keypad, the breadboard type best sited is the 830 pin instead of the 530 pin.

3.2.10 Camera

Figure 3.10: Driverless IP Camera (Adapted from vivitar.com)

The camera used for this project is basic Arduino driverless camera that does not require any additional hardware or software or hardware connections but simply uploads from the video footage to windows straight.

TECHNICAL SPECIFICATIONS

- Camcorder Media Type: Flash card
- Digital Zoom: 4 x
- Digital Video Format: AVI
- Image Recording Format: JPEG
- Interfaces Provided: USB 2.0, composite video/audio
- Image Recording Format: JPEG
- Digital Video Format: MP4
- Widescreen Video Capture: Yes

3.2.11 Jumper Wires
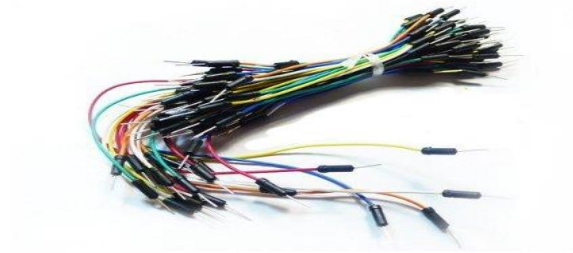
Figure 3.11Jumper Wires (Adapted from Adafruit.com)

Jumper wires are a group if wires that are wrapped together in a plastic coating and then at the tips soldered or bound to a connector. They are also often called as DuPont cable from the name of the Manufacturer. It is mostly used to connect breadboard to other components or even component to component as there is a range of them which include male to female or male to male otherwise female to female and there is also a range of colors to help in differentiating the connection type provided.

3.2.12 Ultrasonic Sensor

Figure 3.12: Ultrasonic Sensor (Adapted from Adafruit.com)

The ultrasonic sensor is great for projects that require measurement of distance and other functions such as avoiding obstacles. The specific module used in this case is the HC-SR04 which gives a distance range of between 2cm to 400cm non-contact measure with a slight range of accuracy of 3mm. It is built to include an ultrasonic transmitter, receiver and controller. It works by the trigger by sending a signal for at least 10microsecondsat a high level signal and automatically sends an 8 X 40 kHz signal to detect if a pulse has been sent back.

Distance = (Level Time X Velocity (340m/s))/2

The diagram which follows shows that the module requires you to first supply a short of 10 microsecond pulse to the trigger pin to start the ranging and then the module shall automatically send 8 cycle bursts of ultrasound at 40kHz and that raises the echo. The echo here is a distant object that is send back by pulse. In short if the sound bounces back with an echo that is different from the initially set values, it knows an object passed by.
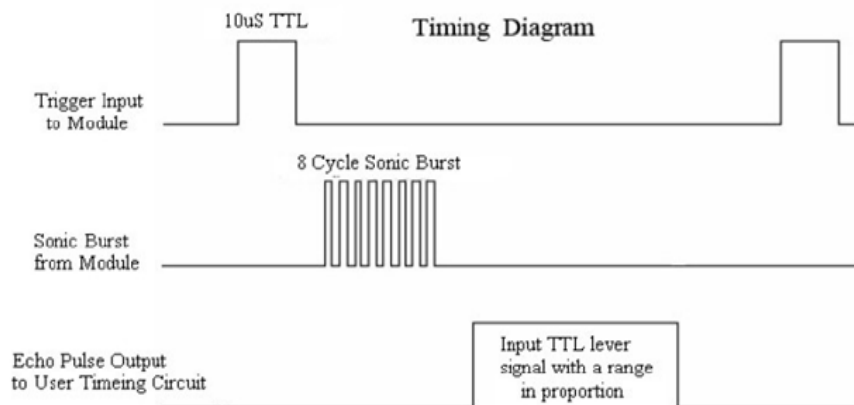

Figure 3.13: Ultrasonic Illustration (Adapted from elegoo.com)

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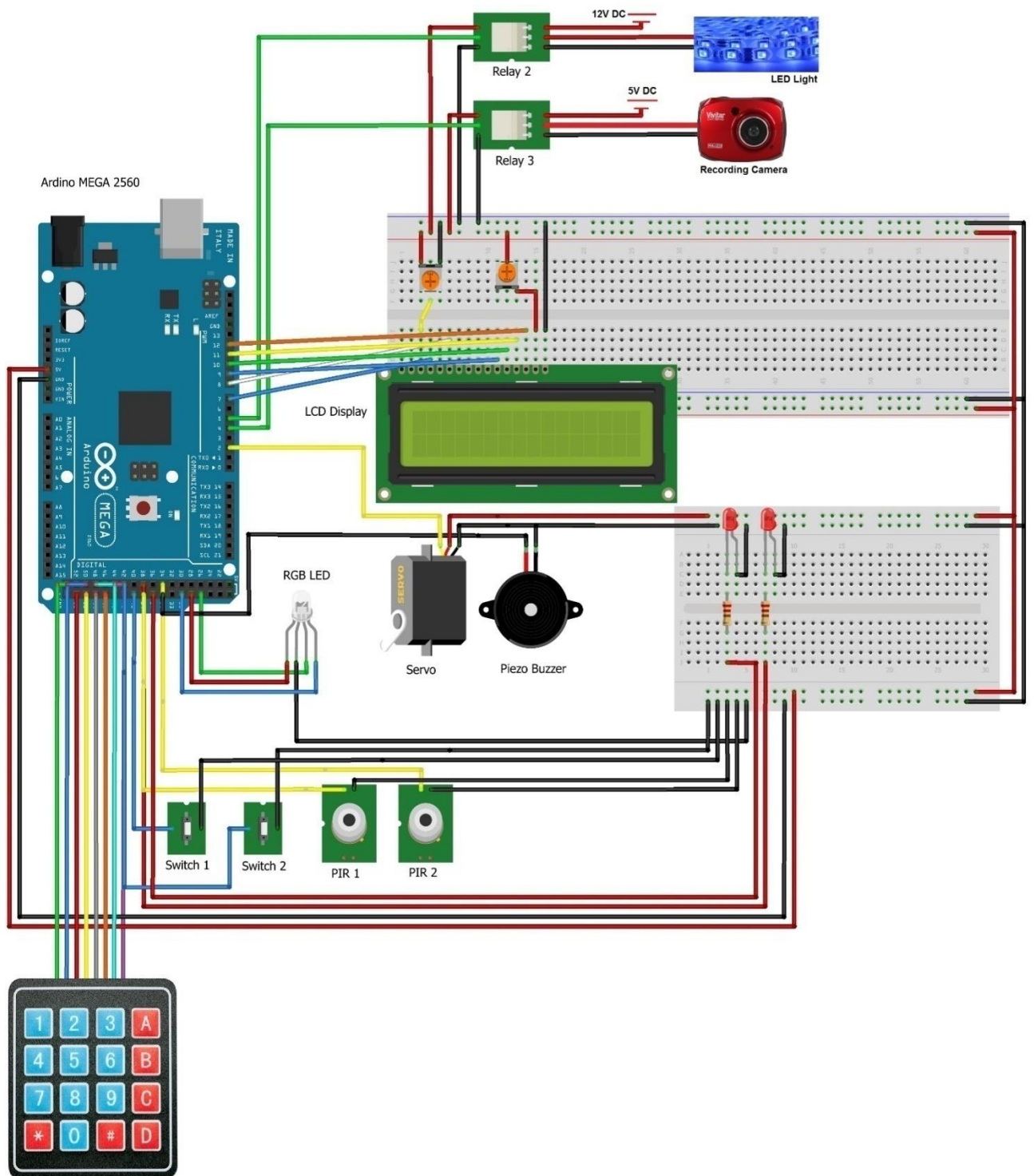## 3.3 Concept of Working the System

Figure 3.14: Complete system Structure (Designed by Author)

3.1 Explanation of Connection

1. Start by connecting the Arduino mega microcontroller to the PIR Motion Sensors to pin 34 & 39.
2. Add the Magnetic reed switches to pin 41 & 42 with the RGB LED on pin 27, 29 and 31.
3. Then finally add the Buzzer on pin 35 as this is completes the first stage of connection of basic I/O to help in detection and notification.
4. Follow this by connecting the LCD to the microcontroller to pins 7 ,8 ,9 ,10 ,11 &12 while VCC and GND to pin 1 & 2. Pin 2, add a potentiometer to control the LCD to VCC and pin 13.
5. Connect the Servo to pin 2 of the microcontroller to control the camera.
6. Add the Membrane Keypad to the microcontroller on pin 46 through to 50. In addition to the buzzer on pin 35, add a motor servo for direction on the camera devices to pin 2 in the system.
7. Add a 4 channel relay to the system to control the Led strips and the camera when input has been recorded on pin 4 and 5 for camera on/off and led power.
8. Then use pin 41 and 42 for the magnetic contact switches to detect window and door movements.

3.2 Explanation of working

The system is meant to be activated and deactivated using the keypad and it is to interact with the user from it. When set to active, the user has to first enter password and then all the sensors begin to await interruptions from intruders as input. The motion sensors are set in the rooms and contact switches for doors and windows. When alarm is triggered, you need to use the keypad to deactivate it. The camera immediately turns to the zone in which it has sensed the motion and tries to capture intruder, and turns on the lights for clarity. Otherwise if system is off, in all zones if there is any motion, the buzzer does not sound and camera goes back to initial position.

3.3 Software Design

This is an Arduino based system that assists the securing of a home. The open source design of the Arduino hardware and IDE allows the developer of the program to use any language. In this particular system, the internal home alarm system, the developer chose to use C programming language in the Arduino IDE to apply the logic. The concepts of C are seen in the application of the #include statement to import particular libraries from the Arduino packages, and three in particular had to be downloaded from the Arduino cc website as they are not included by default. These are the keypad, password and the real time clock that we need to use in the system to record date and time of event, password library to validate the password entered and the keypad library to enter password and change it, activate and de-activate the system. The rest of the language logic is applied as normal if else statements along with declaration of input/output pins. The software is designed in such a way as to take consideration of each component and how it is incorporated to assist in the construction of the overall system.

3.4 System Flow chart
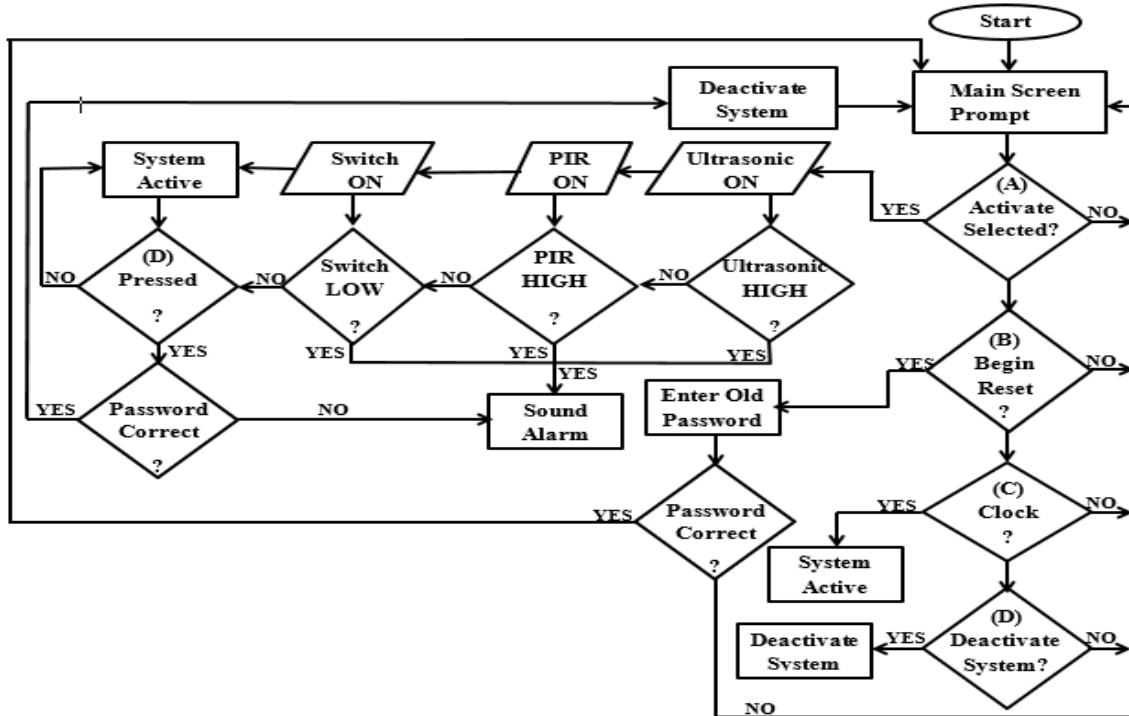
Figure 3.15 System Flow Chart (Designed by Author)

3.5 Conclusion

The basic theoretical information provided within this document provides a good understanding of the overall system requirements and it also manages to give the layout of how the general layout should be. It also gives how each of the parts is mapped onto the micro controller, its working and position in the system. The following chapter is intended to illustrate in further detail how each component is individually laid out in the final system and a bit of the explanations of the working.

CHAPTER 4: SIMULATION AND IMPLEMENTATION

4.1 Introduction

The Home alarm system having been reviewed in the previous chapters now needs a form of implementation and this chapter is aimed at the number of ways in which we can take the system into practicality. Using a number of separate tools to illustrate the inner workings of the system and the procedures it needs to go through in order for us to say the system was successfully implemented. This stage in our system helps us to identify systematic flaws, program logic flaws as well as even syntactical errors that may have occurred, in addition, it helps in fixing the system when it fails.

4.2 Interfacing Components

4.2.1   Interfacing 20 X 4 LCD

The LCD used is a 16 pin LCD which is a 20 by 4-character display meaning it displays 20 characters on 4 rows. The display is white characters on a blue background. We add a 10K potentiometer to it that helps in controlling the contrast.

Pin 1 – VSS connects to the ground pin on the breadboard

Pin 2 – VDD pin that connects to the 5V power supply from Arduino to breadboard positive pin.

Pin 3 – VO is the pin that manages the adjusting of the contrast

Pin 4 – RS is the register select pin that controls which part of the LCD memory you are writing your instructions to. You can

select either the data register, that holds what goes on the screen or the instruction register which is where the LCD Controller looks for instructions on what to do next.

Pin 5 – R/W is the pin that selects reading or writing mode

Pin 6 – E is the enabling pin that causes the LCD to execute relevant instructions when supplied with low energy.

Pin 7 to 14 – These are pins that read and write data

Pin A to K – Pins that control Backlight

Figure 4.1 Circuit diagram of LCD (Adapted from Elegoo.com)
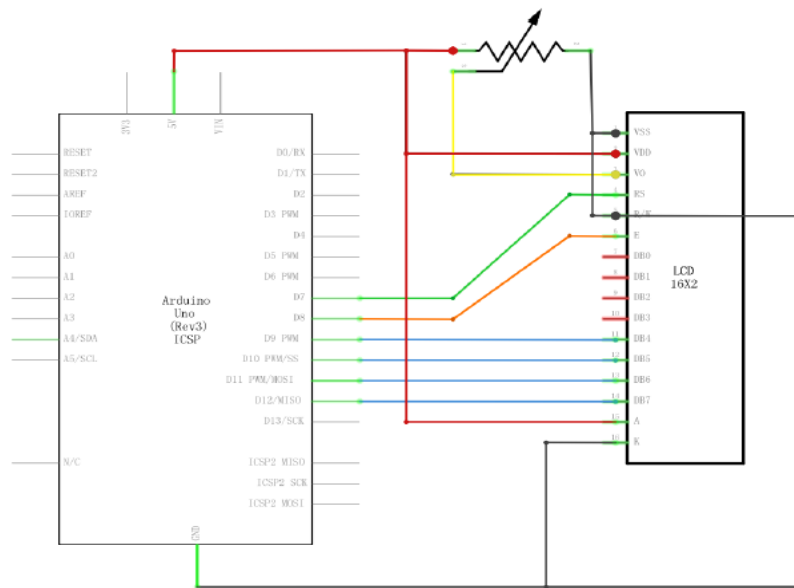
Illustration 4.1 Example Code snippet of LCD (Designed by Author)

```
1   // include the LCD library code:
2   #include <LiquidCrystal.h>
3
4   // initialize the library with the numbers of the interface pins
5   LiquidCrystal lcd(8,9,10,11,12,13);
6
7   void setup() {
8     // set up the LCD's number of columns and rows:
9     lcd.begin(20,4);
10    // Print a message to the LCD.
11    lcd.print("Home Alam Test Program!");
12  }
13
14  void loop() {
15    // set the cursor to column 0, line 1
16    // (note: line 1 is the second row, since counting begins with 0):
17    lcd.setCursor(0, 1);
18    // print the number of seconds since reset:
19    lcd.print(millis() / 1000);
20  }
```

4.2.2 Interfacing 4 X 4 Keypad

The keyboard is a 4 by 4 membrane keypad that has characters 0-9, A-D, * and #. It should therefore generally have 17 pins for output but it has 8 instead because of the encoding scheme used to simplify the connections, in short it is more efficient than a serial type connection. Connect first 4 pins from keypad to Arduino as they represent the rows on pins 46 to 49. The last 4 represent the columns and are connected pins 50 to 53.

Figure 4.2 Circuit diagram of Keypad (Adapted from Elegoo.com)
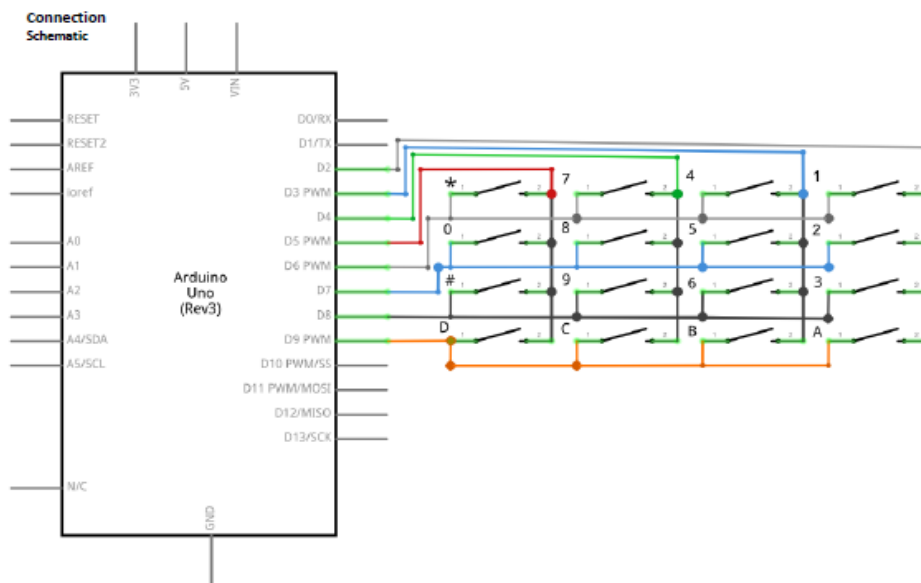
Illustration 4.2 Example code snippet of Keypad (Designed by Author)

```
#include <Keypad.h>
#include <LiquidCrystal.h>
const byte ROWS = 4; //four rows
const byte COLS = 4; //four columns
//define the cymbols on the buttons of the keypads
char hexaKeys[ROWS][COLS] = {
  {'1','2','3','A'},
  {'4','5','6','B'},
  {'7','8','9','C'},
  {'*','0','#','D'}
};
byte rowPins[ROWS] = {53,52,51,50}; //connect to the row pinouts of the keypad
byte colPins[COLS] = {49,48,47,46}; //connect to the column pinouts of the keypad

//initialize an instance of class NewKeypad
Keypad customKeypad = Keypad( makeKeymap(hexaKeys), rowPins, colPins, ROWS, COLS);
LiquidCrystal lcd(45,44,43,42,41,40);
void setup(){
  lcd.begin(20,4);
}
```

4.2.3 Interfacing Ultrasonic Sensor

Ultrasonic sensor module HC-SR04 provides 2cm-400cm non-contact measurement function, the ranging accuracy can reach to 3mm. The modules include ultrasonic transmitters, receiver and control circuit. The basic principle of connection:

Figure 4.3 Circuit Diagram of Ultrasonic Sensor (Adapted from Elegoo.com)
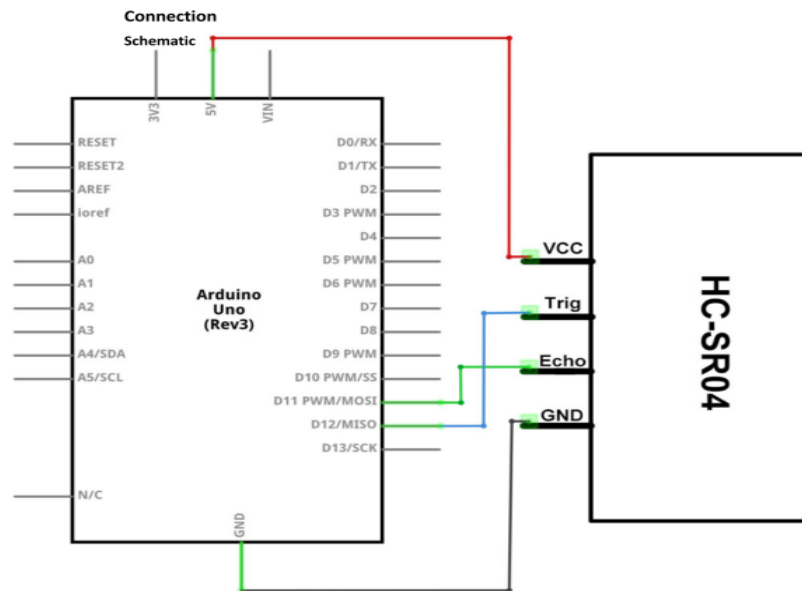
Illustration 4.3 Example of Code Snippetof Ultrasonic (Designed by Author)

```
    }
    lcd.clear();
    lcd.setCursor(0,0);
    lcd.print("Alarm Active");
    initialDistance = getDistance();
    activateAlarm = false;
    alarmActivated = true;
}
if (alarmActivated == true){
    currentDistance = getDistance() + 10;
    if ( currentDistance < initialDistance) {
        tone(buzzer, 1000); // Send 1KHz sound signal
        lcd.clear();
        enterPassword();
    }
    if(digitalRead(pir1)== HIGH || digitalRead(pir2)== HIGH){
        lcd.clear();
        lcd.setCursor(0,0);
        lcd.print("Movement Detected");
        tone(buzzer, 1000);
        enterPassword();
    }
}
if (!alarmActivated) {
```

4.2.4 Interfacing PIR Sensor

The PIR is an Infrared sensor that works based on the heat signatures of an object. It collects these signatures and sends them to the microcontroller as binary signals that indicate motion or no motion at all. To connect it, we use the three pins it has, both the HC-SR501 and HC-SR505 have first one for VCC to VCC on the controller, second one for out from sensor to Arduino and the third on for ground to Arduino ground pin.

Figure 4.4 Circuit Diagram of PIR Motion Sensor (Adapted from Elegoo.com)
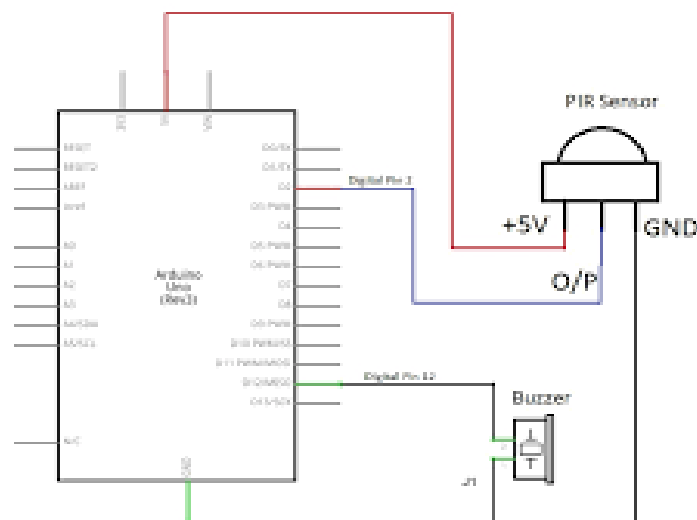
Illustration 4.4 Example Code Snippet of PIR (Designed by Author)

```
#define pirPin 2
int calibrationTime = 30;
long unsigned int lowIn;
long unsigned int pause = 5000;
boolean lockLow = true;
boolean takeLowTime;
int PIRValue = 0;

void setup(){ Serial.begin(9600); pinMode(pirPin, INPUT); }
void loop(){ PIRSensor(); }
void PIRSensor(){
  if(digitalRead(pirPin) == HIGH){
  if(lockLow){PIRValue = 1; lockLow = false;
  Serial.println("Motion detected."); delay(50); }
  takeLowTime = true;}
  if (digitalRead(pirPin) == LOW){
  if (takeLowTime){ lowIn = millis(); takeLowTime = false; }
  if (!lockLow && millis() - lowIn > pause){ PIRValue = 0;
  lockLow = true;Serial.println("Motion ended."); delay(50);
    }
  }
}
```

4.2.5 Interfacing Reed Switch

The reed switch is a device that works by generating current when the switch is intact and stops when the magnetic piece has been separated from the switch piece. In our circuit, we connected it to the Arduino pins 36 & 7 while the other part of it is connected to the ground. Their purpose in this program is to ensure that the door and windows aren't used as break in points. When disconnected they report the message to the LCD where it is then shown.

Figure 4.5 Circuit Diagram of Reed Switch (Adapted from circuitstoday.com)
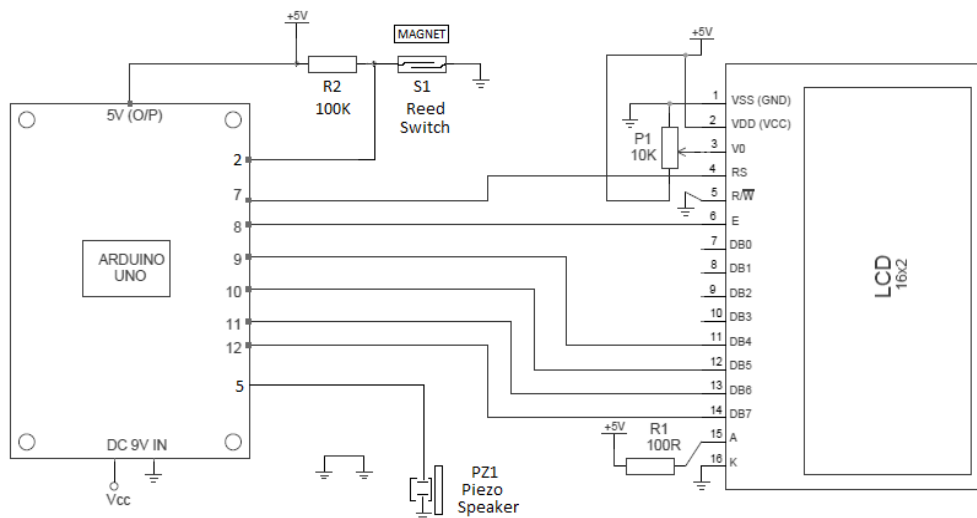
Illustration 4.5 Example Code Snippet of Reed Switch (Designed by Author)

```
int reedVal1, reedVal2;
void setup() {
pinMode(reed1, INPUT);
pinMode(reed2, INPUT);
pinMode(buzzer, OUTPUT);
pinMode(red, OUTPUT);
pinMode(green, OUTPUT);
pinMode(blue, OUTPUT);
Serial.begin(9600);}
void loop() {
  reedVal1 = digitalRead(reed1);
  reedVal2 = digitalRead(reed2);
  Serial.println(reedVal1);
  Serial.println(reedVal2);
  if(reedVal1 > 0 || reedVal2 > 0){
    digitalWrite(red, 0);
    digitalWrite(green, 255);
    digitalWrite(blue, 255);
    tone(buzzer, 100, 200);
    }else{
    digitalWrite(red, 255);
    digitalWrite(green, 255);
    digitalWrite(blue, 0);
      noTone(buzzer);}}
```

4.2.6 Interfacing Servo

The servo used in this circuit is connected to pin 9 and the other 2 points of connection on it are used to connect VCC and ground. The Orange wire is the one that goes to the Arduino, the red wire goes to VCC which is in the middle, and finally the brown wire goes to ground on the breadboard. Its purpose in this project is to allow for rotation of the camera in the direction of the motion

Figure 4.6 Circuit Diagram of servo (Adapted from Elegoo.com)
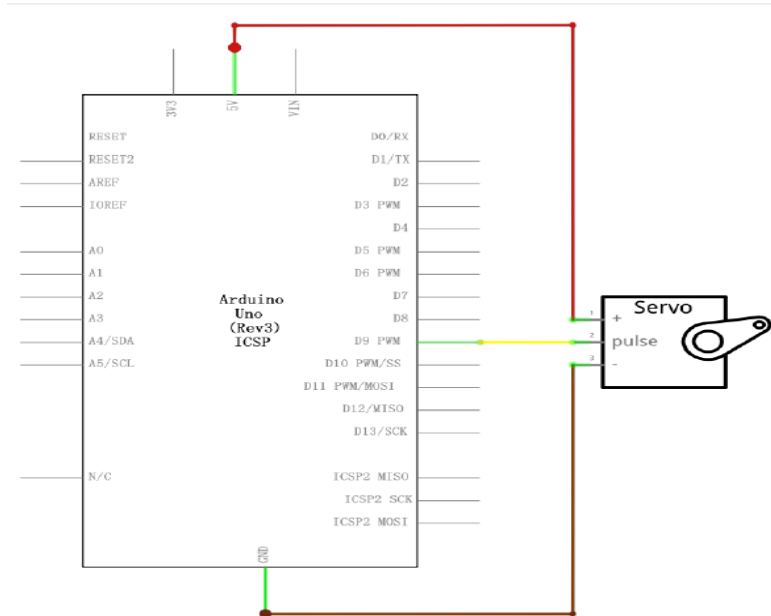
Illustration 4.6 Example Code Snippet of Servo

```cpp
#include <Servo.h>

Servo myservo;  // create servo object to control a servo
// twelve servo objects can be created on most boards

int pos = 0;    // variable to store the servo position

void setup() {
  myservo.attach(9);  // attaches the servo on pin 9 to the servo object
}

void loop() {
  for (pos = 0; pos <= 180; pos += 1) { // goes from 0 degrees to 180 degrees
    // in steps of 1 degree
    myservo.write(pos);               // tell servo to go to position in variable 'pos'
    delay(15);                        // waits 15ms for the servo to reach the position
  }
  for (pos = 180; pos >= 0; pos -= 1) { // goes from 180 degrees to 0 degrees
    myservo.write(pos);               // tell servo to go to position in variable 'pos'
    delay(15);                        // waits 15ms for the servo to reach the position
  }
}
```

4.2.7 Interfacing Buzzer

The Active buzzer is a DC powered device like most sound emitting devices but is set in two states that one can be purchased in, active or passive. Turn the pins of two buzzers face up. The one with a green circuit board is a passive buzzer, while the other enclosed with a black tape is an active one. For this project we opted to use an active piezo buzzer and it is interfaced such that the positive is set on the Arduino 37 and the negative to the ground of the breadboard. It requires between 2K to 5K powering.

Figure 4.7 Circuit Diagram of Buzzer
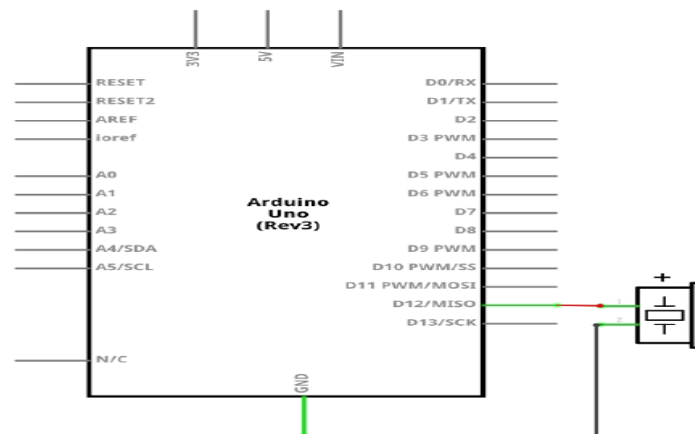
Illustration 4.7 Example Code Snippet of Buzzer (Designed by Author)

```
#include "pitches.h"
int buzzer[] = {
  NOTE_C4, NOTE_G3, NOTE_G3, NOTE_A3, NOTE_G3, 0, NOTE_B3, NOTE_C4
};
int noteDurations[] = {
  4, 8, 8, 4, 4, 4, 4, 4
};
void setup() {
  // iterate over the notes of the melody:
  for (int thisNote = 0; thisNote < 37; thisNote++) {
    int noteDuration = 1000 / noteDurations[thisNote];
    tone(37, buzzer[thisNote], noteDuration);
    int pauseBetweenNotes = noteDuration * 1.30;
    delay(pauseBetweenNotes);
    // stop the tone playing:
    noTone(37);
  }
}
void loop() {
  // no need to repeat the melody.
}
```

4.2.8 Interfacing RGB LED

In this project, the LED used is called an RGB LED that stands for Red, Green, Blue LED and it manages to provide a wide range of values that range between the three primary colours. There are two kinds of RGB ED diodes, which are cathode and anode RGB ED's, the difference being in the Long pin in the middle. If common cathode, the long pin is grounded but otherwise if it is common anode, the long pin is grounded. When interfacing this device, there needs to be 3 220Ohms resistors, one for each internal LED. Red is connected to Arduino pin 13, Green 12 and blue to pin 11 coming from the resistors to provide colours.

Figure 4.8 Circuit Diagram of RGB LED
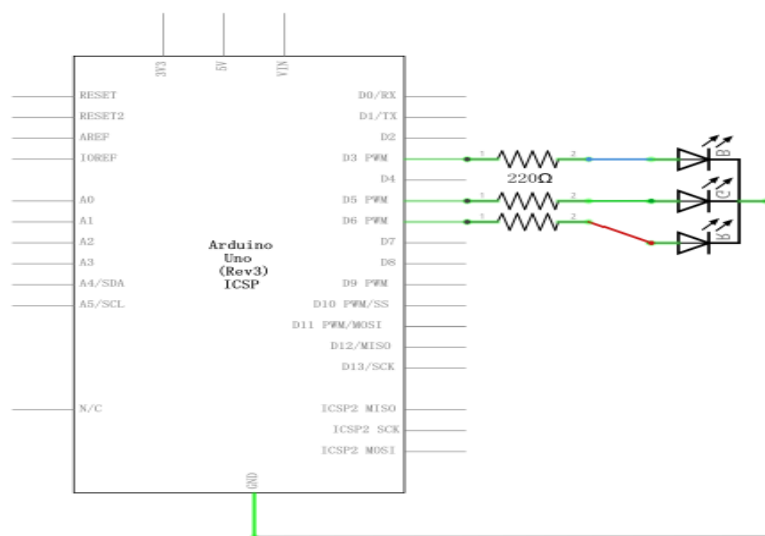
Illustration 4.8 Example Code Snippet RGB LED (Designed by Author)

```
int red = 13;
int green = 12;
int blue = 11;

void setup() {
  // put your setup code here, to run once:
  Serial.begin(9600);
  pinMode(red,OUTPUT);
  pinMode(green,OUTPUT);
  pinMode(blue,OUTPUT);
}

void loop() {
  // put your main code here, to run repeatedly:
  analogWrite(red,80);
  analogWrite(green,255);
  analogWrite(blue,100);
}
```

4.3 System in Idle Mode (Circuit design)

When the system is off, it does not take in any data from the doors, windows. The system is by design activated and deactivated by the entering of the password. It does however manage to keep the LCD on to show that the system is there to keep watch of the household. The diagram below shows the illustration of the system when off and how the internal connections are supposed to be structured. It shows the design of each of the components with their relative alignments.
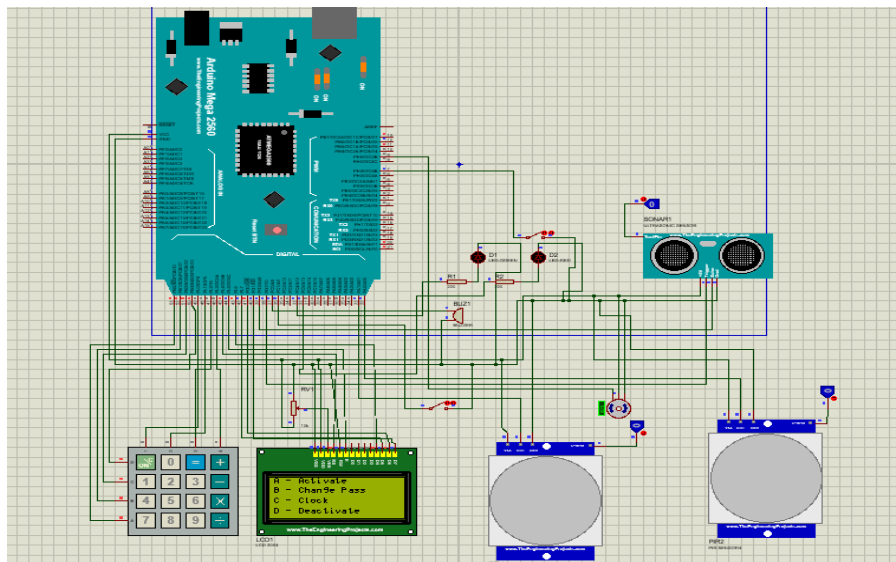
Figure 4.9 Diagram of Idle alarm (Designed by Author)

4.4 System in Active Mode: (Circuit design)

The activated system is designed to take input from the ultrasonic sensor, reed switches, and PIR sensors to detect as an intrusion. The activation of the system is done via keypad and likewise the de-activation. The reed switches are set on the door and window as a signal of forced entry, then the PIR sensors are set in the rooms and the ultrasonic sensor is for the outside. The system when in actual implementation will require that 2 keypads be set, one for activation and deactivation while outside and one for the inside, then a reed switch for every door and window in the house. It will also require that there be an ultrasonic at every full corner side of the house.
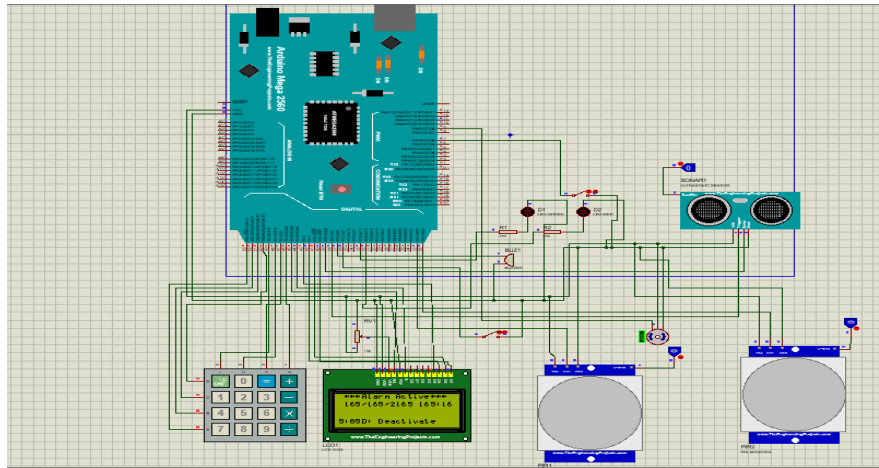
Figure 4.10 Diagram of Active alarm (Designed by Author)

4.5 Implementation and Result

The systems implementation is based on a microprocessor as the central point of the components, an LCD and LED's to provide output for the user, sensors for input such as motion sensors and contact switches along with a membrane keypad. The end result for the system as a collective is a system that takes in data from its real time environment and displays the output to the home owners. Depending on the actual setup of the house, there are supposed to be 2 keypads, to activate system from inside and out. The additional motion sensor in every room and contact switches for every window and door. The overall expected result with a perfectly implemented system is a general decrease in the number of break-ins and burglary when it comes to home theft.

4.6 Practical set-up and Result

The practical setup incorporates all of the different components of the system to make up one final alarm system. On the house entry, there is the keypad that is for entering the options of the system and the password once system has been activated. It has an LCD for displaying output that has been sent from the Micro controller and displays the options. There is also a RGB LED to indicate the state of the system. The door and window are secured with magnetic reed switches which work by being in close proximity of each other. When separated, they send a signal to the controller which then indicates door open on LCD and changes RGB LED colour to red to indicate intrusion. There is also an Ultrasonic sensor that is to the right side of the house model which detects movement outside the house and has a distance coverage of 4m which helps to monitor the house premises.
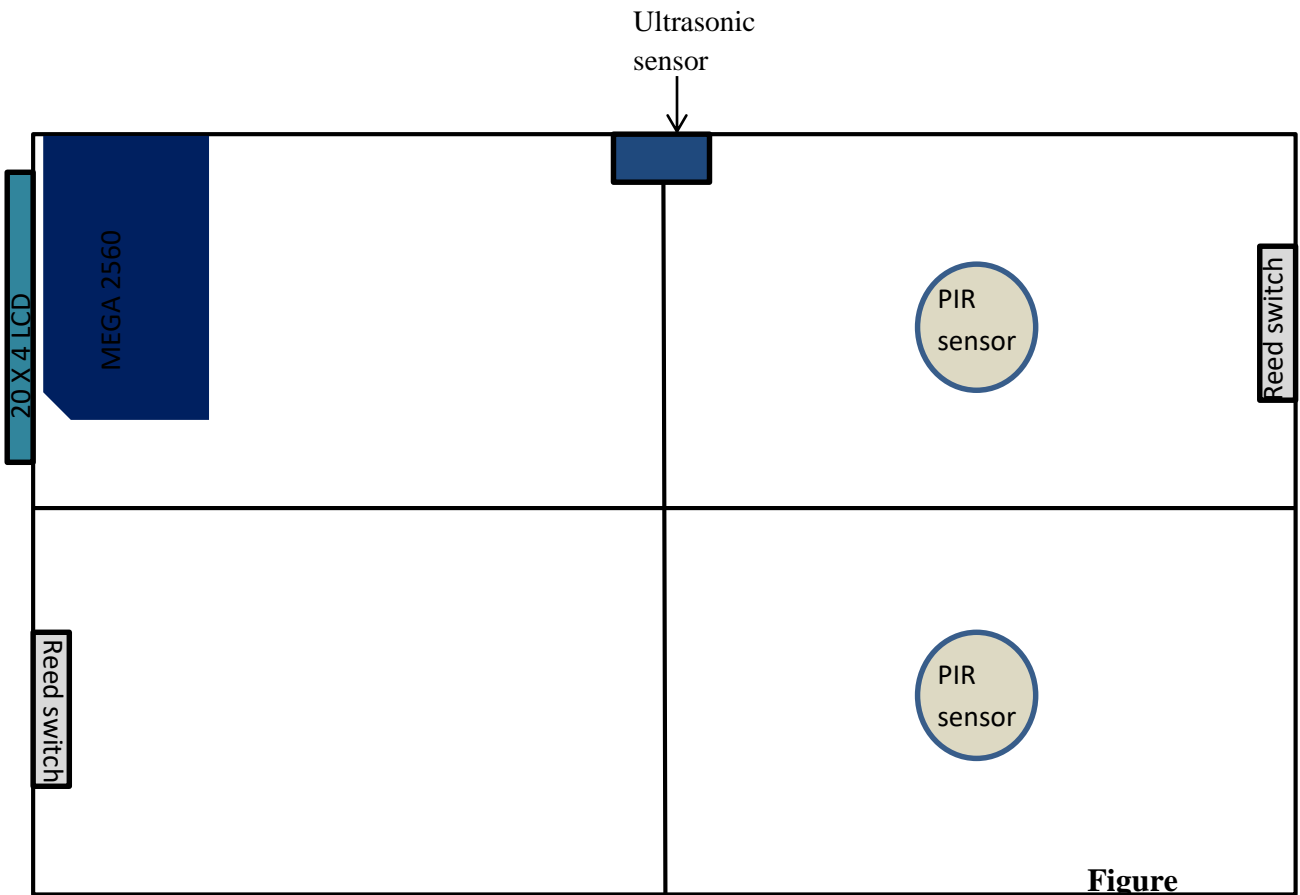
4.11 House Setup Diagram: Schematic View (Designed by Author)

Figure 4.12 House Setup Diagram: Front View (Designed by Author)

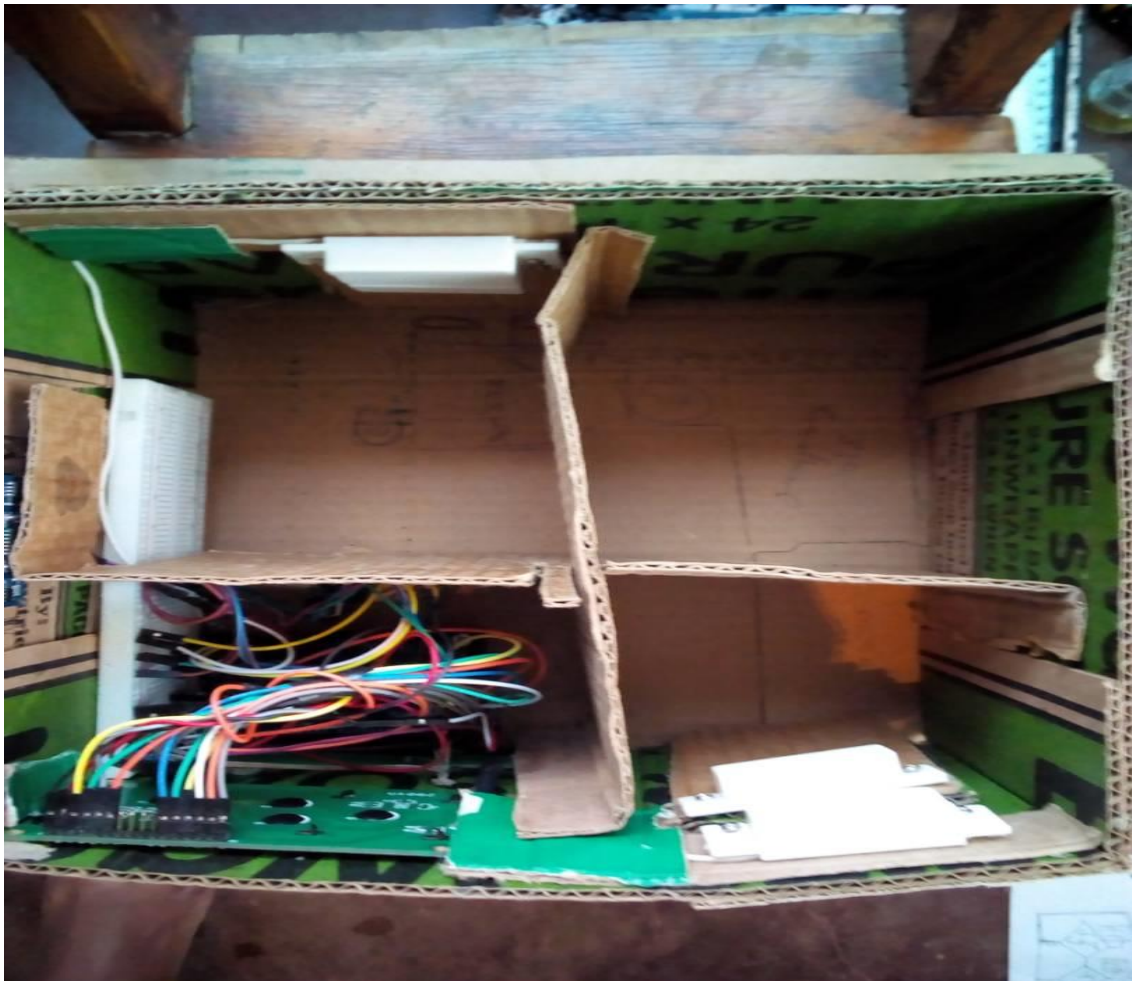**Figure 4.13 House Setup Diagram: Right View (Designed by Author)**

Figure 4.14 House Setup Diagram: Top View (Designed by Author)

4.7 Conclusion

This chapter was focused on the steps taken in migrating the system from the simulation stage until it materialised. The provision of circuit diagrams and a bit of basic theory means that the two aid in one's understanding when needing to develop devices.

CHAPTER 5: CONCUSION AND RECOMMENDATIONS

5.1 Introduction

The Home Alarm System prototype was successfully developed with the incorporation of a few sensors. With the implementation of these in real life situations, there is a reasonable level of expectation as too the decline in burglary cases. It is not criminal proof though it is reasonably capable of performing the primary objectives of detecting a person outside, inside and when a case of forced entry occurs.

5.2 Discussion

The reviews based on the prototype of how the alarm system works are variably consistent but seem to be very promising generally as their aim is to deter criminals from unnoticed theft. From the outside, the Ultrasonic captures that range of about 4 meters, and implies that any general movement within its radius is captured and will result in sounding the alarm. On the ports of entry, there is use of magnetic contact switches. These ports include both door and window and these are notified on the LCD as having been opened. Finally, the detection of internal motion within the house makes it impossible for a thief to go through all three layers of security undetected. The inputs are accepted by the sensors and switches but also through the provision of a membrane keypad and is all processed by the Arduino Microcontroller and is output via the LCD and the LED.

5.3 Limitations

The Limitations of the Home Alarm System are that:

1) The PIR Motion sensors need at least 3 years of calibration before they can be fully utilised with in depth accuracy for detecting human motion.

2) The ultrasonic also needs time for calibration as well as that it has no capability of differentiating between human motion and mere object motion. It has an additional problem of a short range of detection, 400cm (4 meters) approximate range is too short of a range

3) The magnetic reed switches aside from needing time for calibration also have quite a range of picking up the magnet that a human could slide in especially since the case would be sneaking in they may try and not open the door fully.

4) The system alone has no capability of stopping the intruder, it only sounds an alarm but does stop the burglary.

5.4 Recommendations

1) The system as is not perfect as it allows room for improvement like any other system would, so as for recommendations, it is most important to state that the system before full on home implementation should allow for the sensors to go through a stage of calibration for at least 3 years to allow a higher range of accuracy.

2) Unlike in this case where there was only one motion sensor which is Pet Immune (HC-SR505) used, the system in its entirety should incorporate each of these in a separate room in place of the Generic Sensor (HC-SR501).

5.5 Future Scope

The system in the near future where funds are plentiful should have:

1) A panic button for allowing people to know when one has been attacked.

2) It should add onto its level of surety an automatic door lock to work with the reed switches

3) There may also b ad on a finger print sensor to allow for biometric identification instead of a keypad

4) Also vibration sensor for detecting the breaking of window glass

5) Automated gate locking and unlocking using proximity sensor to automate and allow for the home to be more user friendly as sometimes people get robbed while opening the gate of their premises.

6) A response team to allow for checking one's home in case intrusion occurs while you are away to cater for the limitation of inability to capture the perpetrator.

7) Finally, the addition of tracking devices that work with GPS for family gadgets and family members by the use of RFID chips on each device and most possibly in each house member's wrist watch to allow tracking of family member.

5.6 Conclusion

The home alarm system in overall if implemented and tested for a prolonged period can allow for improvement in the general Zimbabwean society as a whole. It is a work under constant development that can allow homes and the families within to be under security which is both low cost and effective.

Appendix

```
#include <RTClib.h>

#include <LiquidCrystal.h> // includes the LiquidCrystal Library

#include <Keypad.h>

#include <Wire.h>

#include <Servo.h>

#include "RTClib.h" //end of #include's

#define trigPin 32

#define echoPin 33

#define pir1 23

#define pir2 22

#define reed1 31

#define reed2 30

#define buzzer 38  // end of #define ports

Servo myservo;      // create servo object to control a servo

int ledDelay = 50;    // delay LED by 50ms

int passwd_pos = 15;  // the postition of the password input

int red = 10;        // red RGB pin

int green = 9;      // green RGB pin

int blue = 8;       // blue RGB pin

int zone = 0;       //Camera region facing

long duration;      // time for ultrasonic to echo back

int distance, initialDistance, currentDistance, i;

int screenOffMsg = 0;          // beginning screen
```

```
String password = "1234";

String tempPassword;          //Store temporary Password or new system
password

boolean activated = false;      // State of the alarm

boolean isActivated;

boolean activateAlarm = false;   //choose to activate Alarm

boolean alarmActivated = false;  //alarm currently active

boolean enteredPassword;        // State of the entered password to stop the
alarm

boolean passChangeMode = false;

boolean passChanged = false;     // end of common pin variables

const byte ROWS = 4;           //four rows

const byte COLS = 4;           //four columns

char keypressed;

//define the cymbols on the buttons of the keypads

char keyMap[ROWS][COLS] = {{'1', '2', '3', 'A'}, {'4', '5', '6', 'B'}, {'7', '8',
'9', 'C'}, {'*', '0', '#', 'D'}};

byte rowPins[ROWS] = {53, 52, 51, 50}; //Row pinouts of the keypad

byte colPins[COLS] = {49, 48, 47, 46}; //Column pinouts of the keypad

Keypad myKeypad = Keypad( makeKeymap(keyMap), rowPins, colPins,
ROWS, COLS);

LiquidCrystal lcd(45, 44, 43, 42, 41, 40); // Creates an LC object.
Parameters: (rs, enable, d4, d5, d6, d7)

void setup() {

  lcd.begin(20, 4);

  pinMode(buzzer, OUTPUT); // Set buzzer as an output
```

```
pinMode(trigPin, OUTPUT); // Sets the trigPin as an Output

pinMode(echoPin, INPUT); // Sets the echoPin as an Input

pinMode(reed1, INPUT); //Door reed switch

pinMode(reed2, INPUT); // Window reed

pinMode(pir1, INPUT); //Door reed switch

pinMode(pir2, INPUT); // Window reed

pinMode(red, OUTPUT); //red led

pinMode(green, OUTPUT);//green led

pinMode(blue, OUTPUT);//blue led

myservo.attach(39); // variable to store the servo position
}
void loop() {
  if (activateAlarm) {
    lcd.clear();
    lcd.setCursor(0, 0);
    lcd.print("Alarm activated in: ");
    int countdown = 5; // 5 seconds count down before activating the alarm
    while (countdown != 0) {
      lcd.setCursor(8, 1);
      lcd.print(countdown);
      countdown--;
      tone(buzzer, 700, 80);
      delay(1000);
    }
```

```
lcd.clear();

lcd.setCursor(1, 0);

lcd.print("***Alarm Active***");

lcd.setCursor(4, 2);

delay(1000);

lcd.print("D: Deactivate");

initialDistance = getDistance();

activateAlarm = false;

alarmActivated = true;

}

if (alarmActivated == true) {

StrokeLight();

currentDistance = getDistance() + 10;

if ( currentDistance < initialDistance) {

tone(buzzer, 1000); // Send 1KHz sound signal

digitalWrite(red, 0);

digitalWrite(green, 20);

digitalWrite(blue, 5);

zone = 0;

if (zone == 0) {

myservo.write(175);

lcd.clear();

lcd.setCursor(5, 2);

lcd.print("Motion Outside");
```

```arduino
      delay(3000);

   }

   enterPassword();

}

if (digitalRead(reed1) == HIGH) {

  digitalWrite(red, 0);

  digitalWrite(green, 20);

  digitalWrite(blue, 5);

  tone(buzzer, 1000);

  zone = 1;

  if (zone == 1) {

    lcd.clear();

    lcd.setCursor(5, 2);

    lcd.print("Front Door Open");

    myservo.write(10);

    delay(5000);

  }

  enterPassword();

}

if (digitalRead(reed2) == HIGH ) {

  digitalWrite(red, 0);

  digitalWrite(green, 20);

  digitalWrite(blue, 5);

  tone(buzzer, 1000);
```

```
  zone = 2;

 if (zone == 2) {

  lcd.clear();

  lcd.setCursor(5, 2);

  lcd.print("Window Open");

  myservo.write(80);

  delay(5000);

 }

 enterPassword();

}

if (digitalRead(pir2) == HIGH) {

 digitalWrite(red, 0);

 digitalWrite(green, 20);

 digitalWrite(blue, 5);

 tone(buzzer, 1000);

 zone = 2;

 if (zone == 2) {

  lcd.clear();

  lcd.setCursor(0, 2);

  lcd.print("Motion in Bedroom 2");

  myservo.write(70);

  delay(5000);

 }

 enterPassword();
```

```
  }
 if (digitalRead(pir1) == HIGH) {
  digitalWrite(red, 0);
  digitalWrite(green, 20);
  digitalWrite(blue, 5);
  tone(buzzer, 1000);
   zone = 3;
  if (zone == 3) {
    lcd.clear();
    lcd.setCursor(0, 2);
    lcd.print("Motion in Bedroom 1");
    myservo.write(45);
    delay(5000);
  }
  enterPassword();
 }
keypressed = myKeypad.getKey();
if (keypressed == 'D') {     //If D is pressed, deactivate the alarm
  digitalWrite(red, 0);
  digitalWrite(green, 0);
  digitalWrite(blue, 40);
  enterPassword();
}
digitalWrite(red, 0);
```

```
    digitalWrite(green, 50);

    digitalWrite(blue, 0);

  }

  if (!alarmActivated) {

   digitalWrite(red, 50);

   digitalWrite(green, 50);

   digitalWrite(blue, 0);

   if (screenOffMsg == 0 ) {

     digitalWrite(red,10);

     digitalWrite(green,0);

     digitalWrite(blue,0);

     lcd.clear();

     lcd.setCursor(0, 0);

     lcd.print("A - Activate");

     lcd.setCursor(0, 1);

     lcd.print("C - Change Pass");

     lcd.setCursor(0, 2);

     lcd.print("D - Deactivate");

     screenOffMsg = 1;


   }

   keypressed = myKeypad.getKey();

   if (keypressed == 'A') {      //If A is pressed, activate the alarm

     tone(buzzer, 1000, 200);
```

```
      activateAlarm = true;

    }

  else if (keypressed == 'C') {

    lcd.clear();

    int i = 1;

    tone(buzzer, 2000, 100);

    tempPassword = "";

    lcd.setCursor(0, 0);

    lcd.print("Current Password");

    lcd.setCursor(0, 1);

    lcd.print(">");

    passChangeMode = true;

    passChanged = true;

    while (passChanged) {

      keypressed = myKeypad.getKey();

      if (keypressed != NO_KEY) {

        if (keypressed == '0' || keypressed == '1' || keypressed == '2' ||
keypressed == '3' || keypressed == '4' || keypressed == '5' || keypressed ==
'6' || keypressed == '7' || keypressed == '8' || keypressed == '9' ) {

          tempPassword += keypressed;

          lcd.setCursor(i, 1);

          lcd.print("*");

          i++;

          tone(buzzer, 2000, 100);
```

```
    }
  }
  if (i > 5 || keypressed == '#') {
    tempPassword = "";
    i = 1;
    lcd.clear();
    lcd.setCursor(0, 0);
    lcd.print("Current Password");
    lcd.setCursor(0, 1);
    lcd.print(">");
  }
  if ( keypressed == '*') {
    i = 1;
    tone(buzzer, 2000, 100);
    if (password == tempPassword) {
      tempPassword = "";
      lcd.clear();
      lcd.setCursor(0, 0);
      lcd.print("Set New Password");
      lcd.setCursor(0, 1);
      lcd.print(">");
      while (passChangeMode) {
        keypressed = myKeypad.getKey();
        if (keypressed != NO_KEY) {
```

```
      if (keypressed == '0' || keypressed == '1' || keypressed == '2' ||
keypressed == '3' ||
          keypressed == '4' || keypressed == '5' || keypressed == '6' ||
keypressed == '7' ||
          keypressed == '8' || keypressed == '9' ) {
      tempPassword += keypressed;
      lcd.setCursor(i, 1);
      lcd.print("*");
      i++;
      tone(buzzer, 2000, 100);
     }
    }
    if (i > 5 || keypressed == '#') {
     tempPassword = "";
     i = 1;
     tone(buzzer, 2000, 100);
     lcd.clear();
     lcd.setCursor(0, 0);
     lcd.print("Set New Password");
     lcd.setCursor(0, 1);
     lcd.print(">");
    }
    if ( keypressed == '*') {
     i = 1;
```

```
            tone(buzzer, 2000, 100);

            password = tempPassword;

            passChangeMode = false;

            passChanged = false;

            screenOffMsg = 0;

          }

        }

      }

    }

  }

  else if (keypressed == 'D') {      //If D is pressed, deactivate the clock

    lcd.clear();

    lcd.setCursor(4, 3);

    lcd.print("Deactivate System");

    enterPassword();

    lcd.clear();

      lcd.setCursor(0, 1);

      lcd.print("System Deactivated");

      delay(1000);

      myservo.write(90);

      screenOffMsg = 0;

  }

}
```

```
}
void enterPassword() {
 int k = 5;
 tempPassword = "";
 activated = true;
 lcd.clear();
 lcd.setCursor(0, 0);
 lcd.print(" ***STOP ALARM *** ");
 lcd.setCursor(0, 1);
 lcd.print("Password:");
 while (activated) {
  keypressed = myKeypad.getKey();
  if (keypressed != NO_KEY) {
   if (keypressed == '0' || keypressed == '1' || keypressed == '2' ||
keypressed == '3' || keypressed == '4' || keypressed == '5' || keypressed ==
'6' || keypressed == '7' || keypressed == '8' || keypressed == '9' ) {
    tempPassword += keypressed;
    lcd.setCursor(k, 24);
    lcd.print("*");
    k++;
   }
  }
  if (k > 9 || keypressed == '#') {
   tempPassword = "";
```

```
      k = 5;

      lcd.clear();

      lcd.setCursor(0, 0);

      lcd.print(" ***STOP ALARM *** ");

      lcd.setCursor(0, 1);

      lcd.print("Password:");

    }

    if ( keypressed == '*') {

      if ( tempPassword == password ) {

        activated = false;

        alarmActivated = false;

        myservo.write(90);

        noTone(buzzer);

        lcd.clear();

        lcd.setCursor(0, 1);

        lcd.print("System Deactivated");

        delay(1000);

        screenOffMsg = 0;

      }

      else if (tempPassword != password) {

        lcd.setCursor(0, 1);

        lcd.print("Wrong! Try Again");

        delay(2000);

        lcd.clear();
```

```
      lcd.setCursor(0, 0);

      lcd.print(" ***STOP ALARM *** ");

      lcd.setCursor(0, 1);

      lcd.print("Password:");

    }

  }

 }

}

void StrokeLight() {//Stroke LED Lights

 digitalWrite(red, HIGH);      // turn the red light on

 delay(ledDelay); // wait 50 ms

 digitalWrite(red, LOW);       // turn the red light off

 delay(ledDelay); // wait 50 ms

 digitalWrite(red, HIGH);      // turn the red light on

 delay(ledDelay); // wait 50 ms

 digitalWrite(red, LOW);       // turn the red light off

 delay(ledDelay); // wait 50 ms

 digitalWrite(red, HIGH);      // turn the red light on

 delay(ledDelay); // wait 50 ms

 digitalWrite(red, LOW);       // turn the red light off

 delay(ledDelay); // wait 50 ms

 delay(10); // delay midpoint by 100ms

 digitalWrite(blue, HIGH);      // turn the blue light on

 delay(ledDelay); // wait 50 ms
```

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```
  digitalWrite(blue, LOW);        // turn the blue light off

  delay(ledDelay); // wait 50 ms

  digitalWrite(blue, HIGH);       // turn the blue light on

  delay(ledDelay); // wait 50 ms

  digitalWrite(blue, LOW);        // turn the blue light off

  delay(ledDelay); // wait 50 ms

  digitalWrite(blue, HIGH);       // turn the blue light on

  delay(ledDelay); // wait 50 ms

  digitalWrite(blue, LOW);        // turn the blue light off

  delay(ledDelay); // wait 50 ms
}

long getDistance() { // Custom function for the Ultrasonic sensor

  digitalWrite(trigPin, LOW);

  delayMicroseconds(1);

  digitalWrite(trigPin, HIGH);

  delayMicroseconds(1);

  digitalWrite(trigPin, LOW);

  duration = pulseIn(echoPin, HIGH);

  distance = duration * 0.034 / 2;

  return distance;
}
```

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