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DEPARTMENT OF ELECTRICAL AND INFORMATION ENGINEERING

INTEGRATED BURGLAR ALARM SYSTEM

PROJECT INDEX: PRJ 079

BY

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DEDICATION

To my 6 Closest:

- Mum; you are just but wonderful.
- My 2 brothers; you inspire me much.
- Dad (deceased 28/07/2000); though gone physically, your spirit lives on and the faith you had in me keep me strong.
- Naomi and my daughter Vanessa; you are the source of joy in my life.

ACKNOWLEDGEMENTS

My first and greatest thanks go to the Almighty for his unconditional and immeasurable guidance and counsel during the preparation of this project. His unfailing love and providence is what has made all efforts geared towards this project materialize.

I am immensely humbled by the support and commitment provided by my supervisor; Dr. Kamucha. His wealth of knowledge and willingness to share it is what has opened my mind to view this project objectively and have clarity of vision.

I feel greatly indebted to the Department of Electrical and Information Engineering staff for their continued support. Their useful insights in helping me organize my ideas into a tangible research project.

I want to thank my family- the Waithaka family for their sacrifice, commitment, material and financial support that has seen me through university. Special thanks go to Joseph Mose for his love and sacrifice, mentorship and encouragement.

Finally, my heartfelt gratitude goes to my closest friends James Wanyiri, John Munyoki, Dominic Barngetuny and not forgetting Lucy Ragae. Your wisdom, sacrifice and positive view of life has been my greatest inspiration. You have been a source of strength and motivation for me during this challenging period.

THANK YOU.

DECLARATION AND CERTIFICATION

This BSc. work is my original work and has not been presented for a degree award in this or any other university.

………………………………………..

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F17/2362/2005

This report has been submitted to the Dept. of Elect and Info Engineering, University of Nairobi with my approval as supervisor:

………………………………

DR. KAMUCHA

Date…………………………….

ABSTRACT

The problem definition required an in-depth study regarding integrated burglar alarm systems. The alarm was designed to go on due to any of the following conditions which are monitored on PC: entry of burglar, door is opened and door handle is locked.

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CHAPTER ONE

INTRODUCTION.

1.1 Problem Definition.

Crime rates in Kenya have been on the increase lately. Hardly does a day pass without hearing cases of home burglary. Not only do people lose their property to the robbers but also lose lives when they try to put up a spirited fight against the robbers who are armed. As a result, people have been living in constant fear of being attacked by robbers. Installing of a burglar alarm system can protect homes from burglars and criminals.

Office premises, warehouses, banks etc have premises which are out of bounds to many individual with the exception of a few select employees. Managers and employers are in constant fear that people will gain entry into unauthorized premises and make away with either vital information or goods. It is therefore necessary to install an integrated burglar alarm system to monitor for any intrusion into the unauthorized premises.

Burglar alarm efficiency depends on the type of zone being triggered within your property. The desired output of your burglar alarm system causes a specified alarm output and quickly responds whenever the sensors identify valid conditions which have activated the alarm. The unit's ability in communicating back to its monitoring system is truly a crucial aspect for determining the efficiency of the alarm.

1.2 Objectives of the project.

To design an integrated alarm system which will go on due to any of the following conditions which are monitored on a PC: entry of burglar, door is opened and door handle is locked.

1.3 Project scope

i. To design a motion detector.

ii. To design a circuit to indicate whether the door is open or closed.

iii. To design a circuit to detect the touching of the door handle.

iv. To develop software for the PC which will indicate with the entry of burglar, door is opened and door handle is locked.

1.4 Organization of Report.

This report has been arranged into six chapters. In chapter two, a discussion of the major motion sensors, mechanical switches, magnetic contacts and transistors has been considered.

In chapter 3, the design decision for the components in the circuit design has been discussed.

In chapter four, the design process of integrated alarm system has been discussed. This chapter also includes designing of the software used to monitor the integrated alarm system.

In chapter five, the results have been presented and analyzed.

Chapter six gives the conclusion and the recommendation for improvements and further research which will improve the integrated burglar alarm system.

CHAPTER TWO

2.1 Basic sensor technology

A sensor is a device that converts a physical phenomenon into an electrical signal. As such sensors represent part of the physical world and the world of electrical devices such as, computers. The other part of this interface is represented by actuators, which converts electrical signals into physical phenomenon [1].

A sensor does not function by itself; it is always part of a larger system does not function by itself; it is always a part of a larger system that may incorporate many other detectors, signal conditioners, signal processors, memory devices , data recorders and actuators [2]. The sensor may be positioned at the input of a device to perceive the outside effects and to signal the system about variations in the outside stimuli. A sensor may also be an internal part of device that monitors the devices own state to cause the appropriate performance.

Sensors are used to measure basic physical phenomena including: acceleration, angular/ linear position, chemical / gas concentration, humidity, flow rate, force, magnetic fields, pressure, proximity, sound, temperature, velocity e.t.c. sensors are categorized according to the kind of energy they detect and convert. These categories are: acoustic, chemical, electromagnetic, mechanical, thermal, optical, motion detectors e.t.c.

2.2 Motion sensors

These are two basic kinds of motion detector sensors. They are based on how they detect motion. The first type is called an active sensor. An active motion sensor requires some form of external power to operate called an excitation signal which is used by the sensor to produce an output signal. The other type of sensor is the passive one which does not need any additional energy source and directly generates an electrical signal in response to an external stimulus [3]. Interior motion sensors include passive infrared, active infrared, photoelectric, dual technology, ultrasonic and microwave sensors which detect charges in a room caused by a human presence.

2.2.1 Passive infrared sensors

Passive infrared sensors (PIR) work by detecting heat emitted by people or objects. When the detected heat moves across two or more of the sensor's switching zones that a sensor has, the more sensitive the sensor is and the smaller the movement that it can detect [4]. A PIR sensor is able to reliably distinguish moving bodies from other objects as well as stationary bodies.

The advantages of PIR sensors lies particularly in its very easy installation which can be installed by in-house technician, reduced cost as compared to other sensors, small size and its availability in the local market. However, a PIR sensor may take 'some time' to detect motion depending on the 'apparent background'. In addition, during hot days, a brick wall which is struck by the sun becomes very hot and even a human moving in front of it is not 'noticeable' as the background heat of the wall [5].

2.2.2 Ultrasonic detectors

The active ultrasonic sensor is a motion detecting device that emits ultrasonic sound energy into a monitored area and reacts to a change in the reflected energy pattern. Ultrasonic sensors use a technique based on a frequency shift in reflected energy to detect intruders. Ultrasonic sound is transmitted from the device in the form of energy. the sound uses air as its reflected back from the surroundings in the room / hallway and the device 'hears' a pitch characteristic of the protected environment. When an intruder enters the room, the wave pattern is disturbed and reflected back more quickly thus increasing the pitch and signaling an alarm [6]. When used for sensing functions, the ultrasonic method has unique advantages over conventional sensors:

- Discrete distances to moving objects can be detected and measured
- Less affected by target materials and surfaces and not affected by colour.
- Offers resistance to external disturbances such as vibration, infrared radiation, and ambient noise [7].

Ultrasonic sensors offer the following disadvantages when used a motion detector:

- Don’t work in rooms with wall carpeting and drapery.
- Jingling key and ringing telephones can trigger a false alarm.
- Don’t detect very fast or slowly moving objects and hence an intruder could hide behind an object and move across the sensor’s viewable area and not set off [8].

2.2.3 Microwave sensors

Microwave sensors detect walking, running, crawling human targets in an outdoor environment. Microwave sensors generate an electromagnetic (RF) field between transmitter and receiver, creating an invisible volumetric detection zone. When an intruder enters the detection zone, changes to the field are registered and an alarm occurs [9].

The advantage of microwave sensors lies particularly in its ability to detect motion through metal and other solid objects. However, they are most prone to false positives as they are not sensitive to size, shape or heat signature [6].

2.2.4 Photoelectric sensors

Photoelectric beam sensors transmit a beam of infrared light to a remote receiver creating an ‘electronic fence’. These sensors are often used to ‘cover’ openings such as doorways or hallways, acting essentially as a trip wire. Often once the beam is interrupted, an alarm signal is generated [6].

2.2.5 Dual technology detectors

Dual technology uses a combination of both microwave and passive infrared technology in combination with AND logic to provide a lower false alarm rate (FAR) sensor than either of the sensor independently [6].

2.2.5 Active infrared sensors

Most infrared cells use cadmium sulphide or cds cells to detect infrared radiation. In an active infrared system, an infrared laser shouts pulses of infrared light at the cds cell, which is attached to a detector circuit. As the pulses of light comes the resistance of the cds cell drops, producing a spike of current. If someone steps between the infrared laser and cell, the beam is broken. The current in the detector circuit then drops, triggering the alarm.

2.3 Magnetic contacts

Magnetic contacts are used to sense when a door or window has been opened. Contacts can be surface mounted on a door or window or flush mounted so that they can be concealed when the door or window is closed. They depend on the direct physical operation / disturbance of the sensor to generate an alarm.

Magnetic contacts are composed of two parts – a position magnetic switch mounted on the interior of a door, window or container frame and a two position, magnetically operated switch. When the door or window is closed, the magnet pulls the switch to its normal non alarmed position. When the door or window is opened, the magnet releases the switch, breaking the contact and activating the alarm [6]

2.4 Mechanical switches

Mechanical switches detect the opening of a protected door or window using mechanical contact switches, which are spring-loaded to trigger an alarm when a door or window is opened [10]. Mechanical switches depend on direct physical operation or disturbance of the sensor to generate an alarm [6]

2.5 Signal conditioning

To be usable, the signal from the sensor has to be amplified and then converted into digital value for further analysis in software [10] key signed conditioning technologies provide distinct enhancements to both the performance and accuracy of data acquisition systems [12].

Signal conditioners are measuring system elements that start with an electric sensor output signal and then yield a signal suitable for transmission, display or recording or that better meet the requirements of a subsequent equipment or device. They normally consist of electronic circuits performing any of the following functions: amplification, level of shifting, filtering, impedance matching, modulation and demodulation. Some standards call the sensor plus the signal conditioner subsystem a transmitter [13].

2.6 Bipolar Junction transistor.

A bipolar junction transistor (BJT) is a three terminal device. The term bipolar means that the BJT’s operation depend on the movement of two different carriers: electrons and holes. A BJT is basically two PN junctions connected back to back within the same piece of semiconductor material and sharing a common P- or N- doped semiconductor region. There are two types of bipolar transistors, the NPN and PNP.

2.6.1 NPN Bipolar Transistor.

Figure 2.1 is a simplified illustration of the composition of the NPN type of transistor. An NPN bipolar transistor is comprised of a P-doped semiconductor material sandwiched between two layers of N-doped material.

For normal operation, the emitter base (EB) junction is forward biased and the collector base (CB) junction reverse biased. The forward bias of the EB reduces the barrier voltage and causes electrons to flow from the emitter to the base. Holes also flow from the base to the emitter, but since the base is lightly doped than the emitter, almost all the current flow across the junction consist of electrons to the base from the emitter. Thus electrons are the majority charge carriers in an NPN transistor

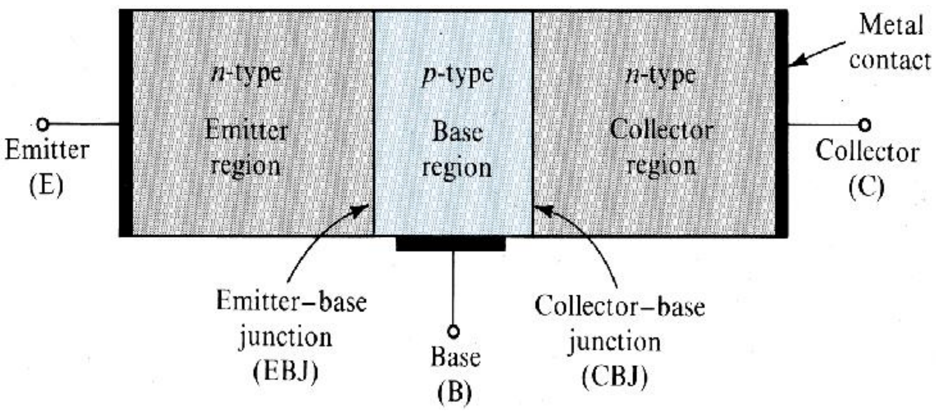


FIGURE 2.1

2.6.2 PNP Bipolar Transistor.

A PNP bipolar transistor is comprised of a N-doped semi-conductor material sandwiched between two layers of P-doped material.The PNP transistor works essentially the same as the NPN transistor. However, since the emitter, base, and collector in the PNP transistor are made of materials that are different from those used in the NPN transistor, different current carriers flow in the PNP unit. The majority current carriers in the PNP transistor are holes. This is in contrast to the NPN transistor where the majority current carriers are electrons.

2.6.3 Mode of operation of BJT

A BJT can be biased into one of four possible modes. These are saturation, active, inverted and cutoff. In the saturation mode, both the emitter-base and collector-base junctions are forward biased. The active mode consists of a forward biased emitter-base junction and a reverse biased collector-base junction. The inverted mode has the emitter-base junction reverse biased while the collector-base junction is forward biased. Finally, in the cutoff mode both the emitter-base and collector-base junctions are reverse biased []

Table is a summary of the four possible modes.

Biasing Mode	Emitter-Base Junctions	Collector –Base Junction
Cutoff	Reverse biased	Reverse biased
Active	Forward biased	Reverse biased
Saturation	Forward biased	Forward biased
Inverted	Reverse biased	Forward biased

The behavior of the device under each of the four biasing modes can be understood as follows:

i. The active mode is the most common mode for transistor amplification.

ii. In the saturation mode, both junctions are forward biased which corresponds to a high current flow with a low voltage drop. The saturation mode corresponds to the "on" state of the transistor in digital applications. Since the voltage of the device operated in the saturation mode is low, the saturation mode corresponds to "zero" in digital binary logic.

iii. In the cutoff mode, both junctions are reverse biased. As a result very little current flows and there is a high voltage drop. The cutoff mode corresponds to the off state of the device. Since the voltage drop is high in the cutoff mode (current is low) cutoff represents a “1” in digital binary logic. We can conclude that when a device switches from “1” to “0” it switches from cutoff to saturation. Likewise, when the device switches from “0” to “1” it switches from “0” to “1” it switches from saturation to cutoff.

2.7 Parallel port

The Parallel Port is the most commonly used port for interfacing homemade projects. This port will allow the input of up to 9 bits or the output of 12 bits at any one given time, thus requiring minimal external circuitry to implement many simpler tasks. The port is composed of 4 control lines, 5 status lines and 8 data lines. It's found commonly on the back of the PC as a D-Type 25 Pin female connector and is illustrated in Fig 2.3 and 2.4 below alongside its assignments.

FIGURE 2.3. Female D-25 connector

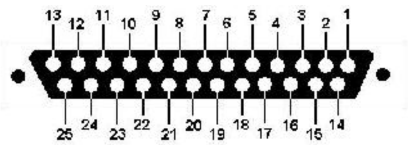


FIGURE 2.4 The D-25 pin assignments

Table 2.1 below shows standard pin Assignments of the D-Type 25 pin Parallel Port Connector.

Pin No (D-Type 25)	Direction In/out	Register
1	In/Out	Control
2	Out	Data
3	Out	Data
4	Out	Data
5	Out	Data
6	Out	Data
7	Out	Data
8	Out	Data
9	Out	Data
10	In	Status
11	In	Status
12	In	Status
13	In	Status
14	In/Out	Control
15	In	Status
16	In/Out	Control
17	In/Out	Control

CHAPTER THREE

DESIGN DECISIONS AND COMPONENTS

3.1 PIR SENSOR FUNDAMENTALS

PIR sensor detectors are very popular for security and energy management system. They are small in size, inexpensive, consume low power, easy to install and have a long life time. PIRs are basically made of pyroelectric materials which detect levels of infrared radiation.

3.1.1 Infrared radiation

Infrared radiation is that portion of the electromagnetic spectrum that extends from the long wavelength, or red, end of the visible-light range to the microwave range. The IR band in the electromagnetic spectrum ranges from 0.75 microns to 4000 microns in wavelength and 7.5*10^10 Hz to 4.0*10^4 Hz in frequency. Figure 3.1 represents the infrared region of the electromagnetic spectrum.

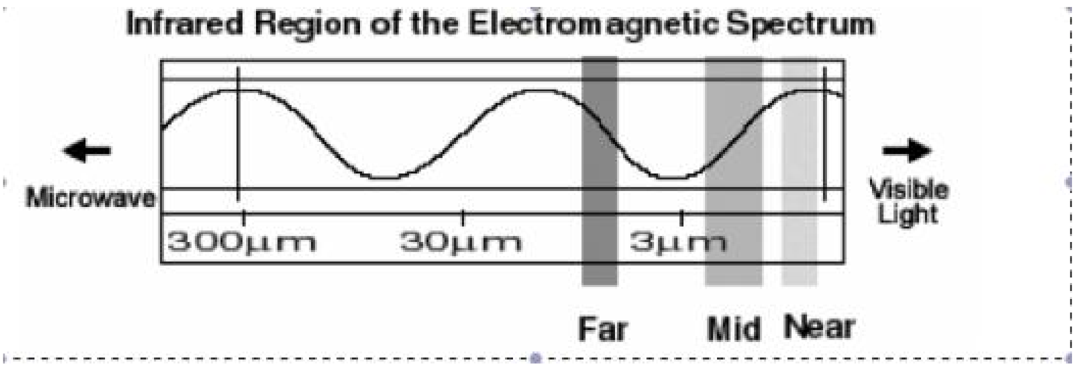


FIGURE 3.1: Infrared region of the electromagnetic spectrum

Fig 3.1 General System Flow Diagram

Within the Infrared band, there are three basic categories: near-infrared, mid-infrared and far-infrared. Far-infrared differs from the other two because it is thermal and is emitted from objects instead of being reflected off to them. Any object that is above absolute zero emits some degree of infrared energy [14].

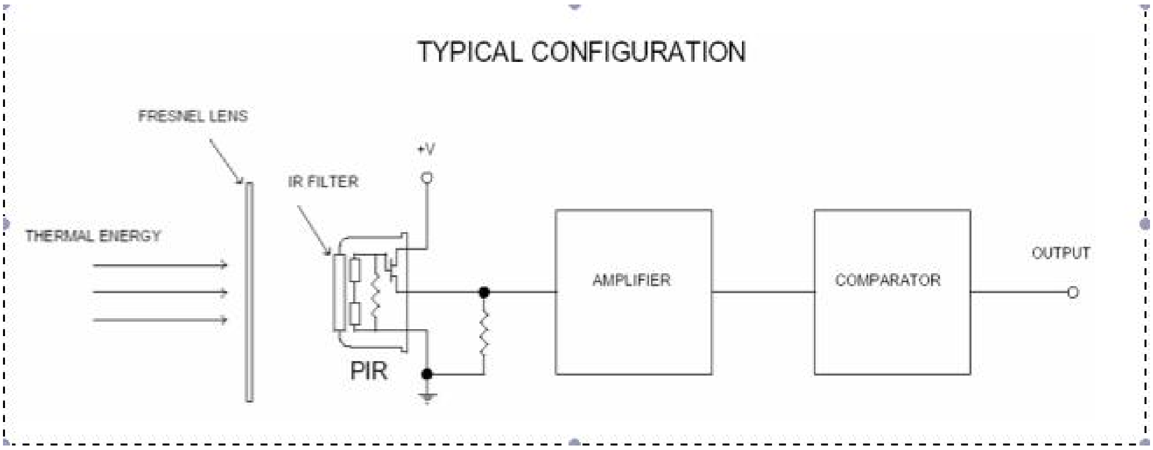
Human bodies generate heat whose radiation is strongest at a wavelength of 9.4 microns. The radiation emitted is invisible to the human eye, but it is easier detected by electronic means.

Infrared radiation in the range of 9.4 microns will not pass though many types of materials that pass visible light such as a transparent glass or plastic. However it will pass through, with some attenuation, material that is opaque to visible light such as germanium and silicon. An unprocessed silicon wafer makes a good IR window in a weatherproof enclosure for outdoor use. In addition, it provides additional filtering for light in the visible range [15].

3.1.2 Pyroelectric sensor

Pyroelectric elements are used almost exclusively for motion detection thanks to their simplicity, low cost, high responsivity and broad dynamic range. A pyroelectric material generates an electric charge in response to external energy flow through its body. Since all pyroelectric are also piezoelectrics, the absorbed heat results in the expansion of the front side of sensing element. The resulting heat induced stress lead to the development of piezoelectric charge on the element electrode [16].

Depositing metal electrodes on both sides of a pyroelectric substrate forms specialized temperature dependent capacitors. The absorption of infrared energy in the crystalline structure of the pyroelectric substance causes a change in its temperature, which causes its



substance to expand and effectively increases the distance between the capacitor plates. This causes an electric charge to be displaced in the material. The result of this displacement of charge is a current which is amplified by a MOS transistor based amplifier built into as shown in the figure 3.2 [1].Shown in figure 3.2 is a typical configuration where a pull-down resistor is connected between the output of the pyroelectric sensor and the ground and feeds an external amplifier circuit.

The purpose of the pull-down resistor is to convert FET current to a voltage. Hence the output voltage is a function of the amount of infrared radiation sensed at the input [17].

3.1.3 Fresnel lens

The Fresnel lens was invented by a French physicist named Augustin Fresnel. A Fresnel lens is a Plano convex lens that has been collapsed to itself to form a flat lens that retains its optical characteristics but is much smaller in thickness and therefore has less absorption losses [15].

A Fresnel lens is made of an infrared transmitting material that has an IR transmission range of 8 to 14 microns which is most sensitive to human body radiation. A Fresnel lens array monitors different spatial zones and concentrates the IR radiation from a body that moves within the monitoring area. The Fresnel lens is designed only to make sure that the incident IR radiation is concentrated on the pyroelectric detector surface [18]. Any movement between the spatial zones leads to a change in the IR energy received by the sensors [19].

3.1.4 Signal conditioning for pyroelectric sensor.

The signal from pyroelectric sensor is too small and needs to be amplified. Furthermore, the signal contains high frequency noise which ought to be removed. A two stage amplifier having signal conditioning circuits is employed to get the level of the signal right. The amplifier is typically bandwidth limited to normally below 10 Hz to reject high frequency.

The amplifier is followed by a window comparator that responds to both the positive and negative transitions of the sensor output signal. A window comparator is a electronic circuit used to indicate whether or not a voltage is within a range of values that is determined by two reference voltages [20].

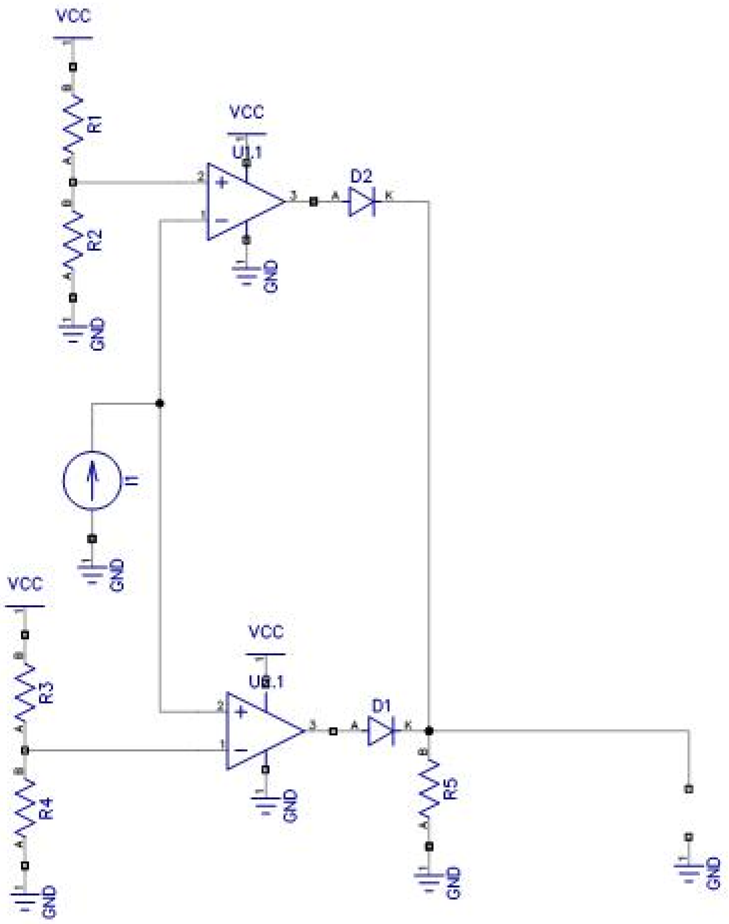


FIGURE 3.2

From the figure 3.2, divider networks R_1-R_2 and R3-R_4 are used to establish the upper and lower limits of the "window" according to

$$\mathbf{V_U = V_2 = R_4 / (R_3+R_4) * V_{CC}} \quad (3.1)$$

$$\mathbf{V_L = V_1 = R_2 / (R_1+R_2) * V_{CC}} \quad (3.2)$$

3.2 Transistor Switches.

A transistor can be used as a solid state switch. When a transistor is to be used as a switch, it has to be operated either in the cutoff mode (when it is not to conduct) or saturation region (when it is to conduct) , but not in the active region. The transistor switching losses take place when it is passing through the active region moving from cutoff to saturation and vice versa.

The power dissipated in the transistor is the product of the V_{CE} and I_C. For this reason, it is necessary for the value of V_{CE} to be as low as possible when the transistor is conducting, and for the value of I_C to be as low as possible when the transistor is off. Both of these conditions are achieved if the transistor is operated in the saturation and cutoff regions respectively.

In order to check that the transistor is fully saturated, the following inequality has to be satisfied.

$$\mathbf{I_c/(h_{fe} * I_b) < 0.85}$$

If the transistor is operating in the saturation region, then V_{CE} takes on its minimum value of 0.2 V for small signal transistors [21]. The following are the steps involved in designing the transistors as a switch:

i. Using the value of the load and the voltage between the collector-emitter saturation voltage calculate the collector current.

ii. Divide the collector current by the transistor current gain. This represents the minimum base current that is sufficient to just place the transistor on the edge between the active region and the saturation region.

iii. Divide the minimum base current by 0.85 (in order to push the transistor slightly in the saturation region) this gives the design base current.

iv. Select the size of the base resistor required to achieve the design base current, assuming the base emitter voltage to be 0.7v.

3.3 Push-Button switches

Push button switches are mechanical switches defined by the method used to activate the switch. The activation method is typically in the form of a plunger that is pushed down to open or close the switch. Pole and throw configurations for pushbutton switches can be single pole single throw (SPST) , single pole double throw (SPDT) double pole single throw (DPST), double pole double throw (DPDT) or solid state [22].

Pushbutton switches come in two forms: normally open (NO) switch that has contacts that are open or disconnected in the unactuated (normal position) and normally closed (NC) switch that has contacts which are closed or connected in their unactuated (normal) position. The actuator in pushbutton switches can recessed, flush or raised. Important switch specifications to consider when searching for pushbutton switches include maximum current, maximum ac voltage, maximum dc voltage and maximum power.

3.4 Microsoft Visual Studio

In computing, Microsoft Visual Studio is an Integrated Development Environment (IDE) from Microsoft. It can be used to develop console and graphical user interface applications along with Windows Forms applications, web sites, web applications, and web services in both native code together with managed code for all platforms supported by Microsoft Windows, Windows Mobile, Windows CE, .NET Framework, .NET Compact Framework and Microsoft Silverlight.

Visual Studio supports different programming languages by means of language services, which allow the code editor and debugger to support (to varying degrees) nearly any programming language, provided a language-specific service exists. Built-in languages include C/C++ (via Visual C++), VB.NET (via Visual Basic .NET), C# (via Visual C#).

Visual Studio does not support any programming language, solution or tool intrinsically but instead, it allows plugging in of various types of functionality. Specific functionality is coded as a VSPackage. When installed, the functionality is available as a Service. The IDE provides three services: SVsSolution, which provides the ability to enumerate projects and solutions; SVsUIShell, which provides windowing and UI functionality (including tabs, toolbars and tool windows); and SVsShell, which deals with registration of VSPackages. In addition, the IDE is also responsible for coordinating and enabling communication between services.

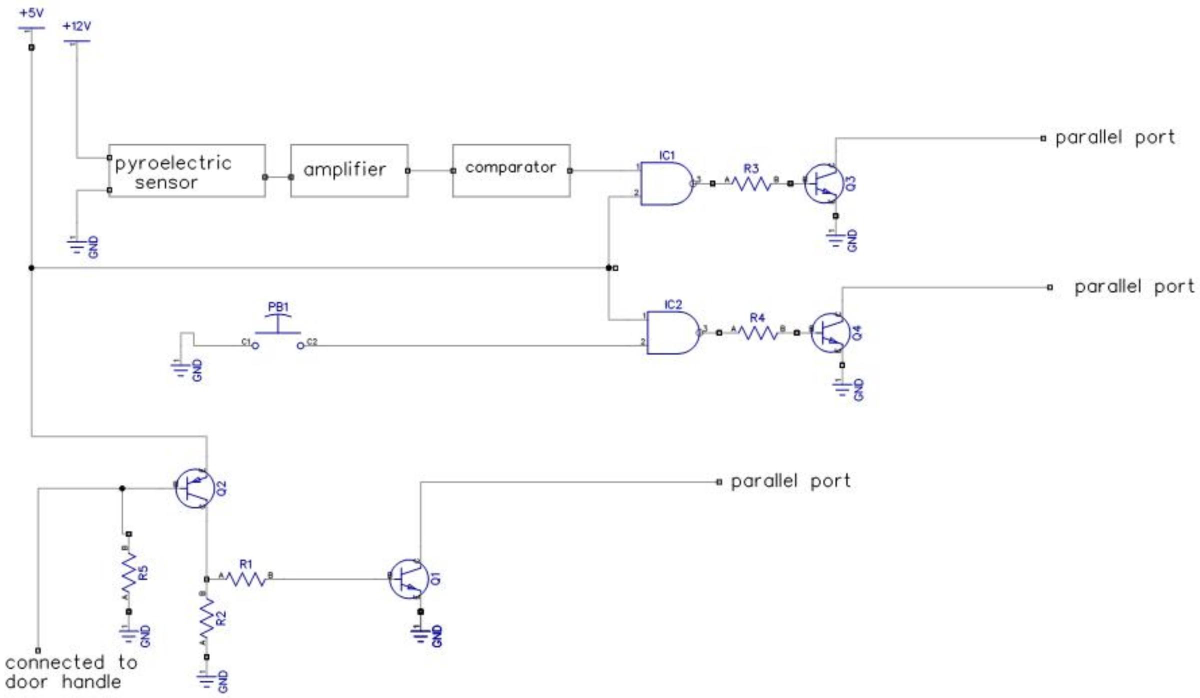
Support for programming languages is added by using a specific VSPackage called a Language Service. A language service defines various interfaces which the VSPackage implementation can implement to add support for various functionalities. Functionalities that can be added this way include syntax coloring, statement completion, brace matching, parameter information tooltips, member lists and error markers for background compilation. If the interface is implemented, the functionality will be available for the language. Language services are to be implemented on a per-language basis. The implementations can reuse code from the parser or the compiler for the language.

Visual Studio does not include any source control support built in but it defines the MSSCCI (Microsoft Source Code Control Interface) by implementing which source control systems can integrate with the IDE. MSSCCI defines a set of functions that are used to implement various source control functionality.

CHAPTER FOUR.

CIRCUIT DESIGN.

4.1 Circuit Diagram.



R1 = 100 Ω , R2=500 Ω , R3 = R4 = 4.7 K Ω , R5 =150 K Ω

Q1, Q3, Q4 – BC546 Q2- BC556

FIGURE 4.1

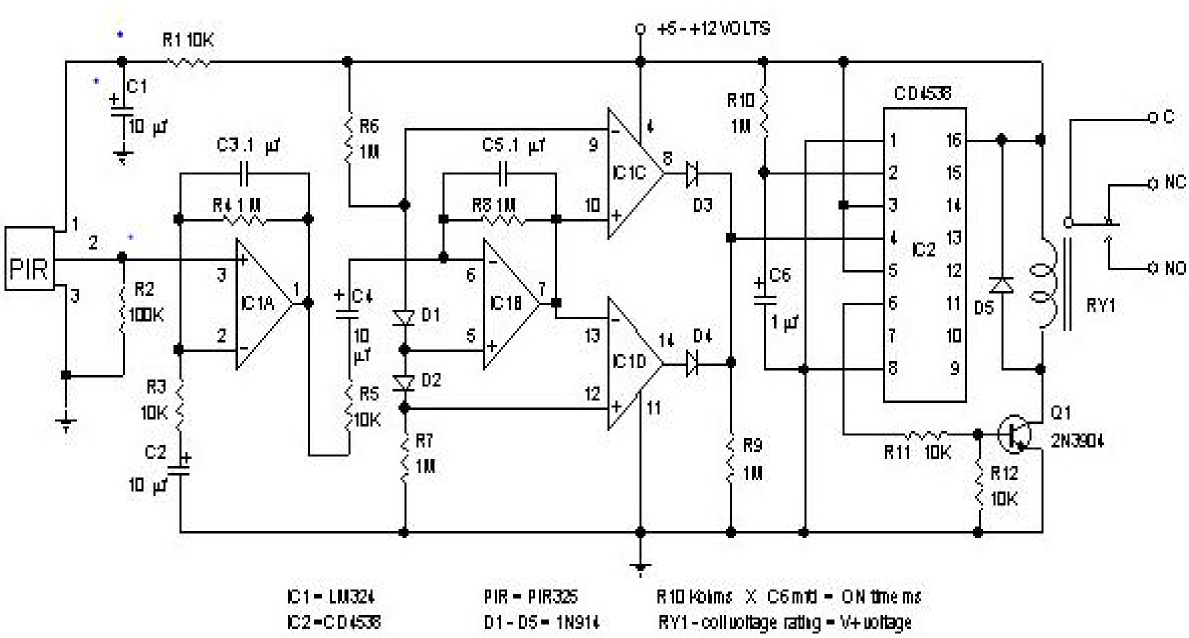
The circuit in figure 4.1 is divided into three parts:-

i. PIR motion detection unit.

ii. Door opening detection unit.

iii. Door handle detection unit.

4.2 PIR Motion Detection Unit.



MOTION DETECTOR

The PIR detection unit consists of a pyroelectric sensor made of a crystalline material that generates a surface electric charge when exposed to the heat in the form of infrared radiation. The human body emits infrared radiation with wavelength centered at about 9.4 microns. An IR window is used to limit the range of sensitivity between 8 microns to 12 microns.

Charges in the amount of radiation striking the crystal results in to changes in the amount of charge which is then measured with a FET device built into the sensor. Fig 4.2 shows how typically, the FET source terminal pin 2 connects through a pull down resistor of about 100k to ground. The purpose of the resistor is to provide a voltage converter.

The voltage signal is then fed into a two stage amplifier having signal conditioning circuits. The voltage gain of the first stage amplifier is given by:-

$$\mathbf{A_{V1} = -R_4 / R_3}$$

$$\mathbf{= -1M/10K = -100}$$

The voltage gain of the second stage amplifier given by :-

$$\mathbf{A_{V2} = - R_8 / R_5}$$

$$\mathbf{= -1M/ 10K = -100}$$

The overall gain of the two stage amplifier is given by :-

$$\mathbf{A_V = A_{V1} * A_{V2}}$$

$$\mathbf{= (-100) * (-100)}$$

$$\mathbf{=10000}$$

The amplifier is typically bandwidth limited to below 10Hz to reject high frequency noise and is followed by a window comparator that responds to both the positive and negative transistors of the sensor output signal. ICIC and ICID form a window comparator that responds to signals about 200 millivolts above and 200 millivolts below V_{CC} / 2. This window is set by low current voltage drops across D1 and D2. Therefore the upper and lower limits of the “window” are

$$\mathbf{V_u = V_{CC}/ 2 + 0.2}$$

$$\mathbf{= 12/2 + 0.2}$$

=6.2 V

$V_L = V_{CC}/2 - 0.2$

=12/2-0.2

=5.8V

The comparator output feeds through D3 and D4 that pass only the positive transitions.

The PIR motion detector is normally closed (NC). The output is HIGH when idle (no motion detected) during which the LED is OFF. The output remains low when sensor is triggered (motion is detected) during which the LED is ON. The output of the PIR motion detector is fed to a NAND gate with the other input coming from +5V supply.

For proper operation, a +5V supply should be present. The output of a NAND gate is HIGH when one or both the inputs are low. Whenever motion is detected, the output of the PIR motion detector is LOW resulting to a HIGH output of the NAND gate. In the absence of motion, the output of the PIR motion detector is HIGH yielding a low output of the NAND gate. Table 4.1 summarizes the inputs and outputs of the NAND gate.

INPUTS		OUTPUT
A1 (+SV Supply)	A2 (PIR motion detector output)	Y
0	X	X
1	0	1
1	1	0

Table 4.1

The output from the NAND gate is fed to a parallel port for further signal conditioning. Due to the high impedance from the parallel port, the port is pulled to ground so that a zero can be read.

4.3 Door Opening Detection Unit.

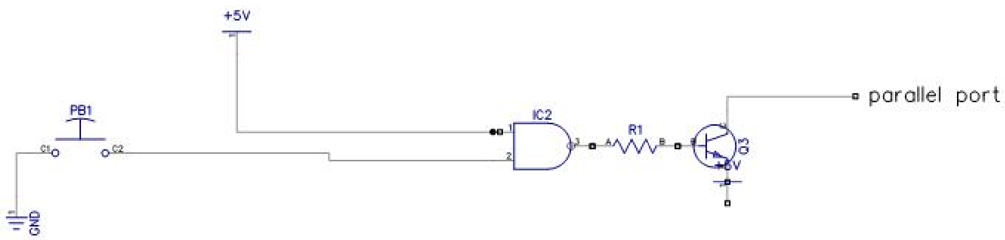


FIGURE 4.3

The door opening detection unit consists of a pushbutton switch connected to a +5V supply. An ideal switch must posses the following features;

i. No limit on the amount of current the device can carry when in the conduction state.

ii. No limit on the amount of the device-voltage when the device is in the non-conduction state.

iii. Zero on-state voltage drop when in the conduction state.

iv. Infinite off-state resistance.

v. No limit on the operating speed of the device when changes state, i.e. zero rise and fall time.

The practical switch has the following switching and conduction characteristics:

i. Limited power handling capabilities i.e. limited conduction current. When the switch is in the off-state, and limited blocking voltage when the switch is in the off-state.

ii. Limited switching speed that is caused by the finite turn on and turn-off times.

iii. Finite on-state and off-state resistance.

iv. Practical switches experience power losses in the on and the off states and during switching transistors [23].

The push-button switch used in figure is normally open (NO). A normally open switch is one in which its contacts will close when actuated and will open while in the unactuated position. Electricity only flows when you give it a path between two points of opposite charge. To turn the electricity on or off, one has to open or close part of the circuit. When the door is shut, the electric circuit is closed and electricity can flow from one end of the circuit to the other. However, when the door is open, the circuit is open and no current can flow in the circuit. With an open door, the voltage at the end of the switch is OV. Since one of the inputs of the NAND gate is low, the output of the gate will be HIGH. With the door open and a voltage of 5V applied to it, the voltage at the end of the switch will be 5V. If both of the inputs of the NAND gate are HIGH, the output of the gate will be low. The output from the NAND gate is fed to a parallel port via a transistor for further signal conditioning.

4.4 Door Handle detection unit.

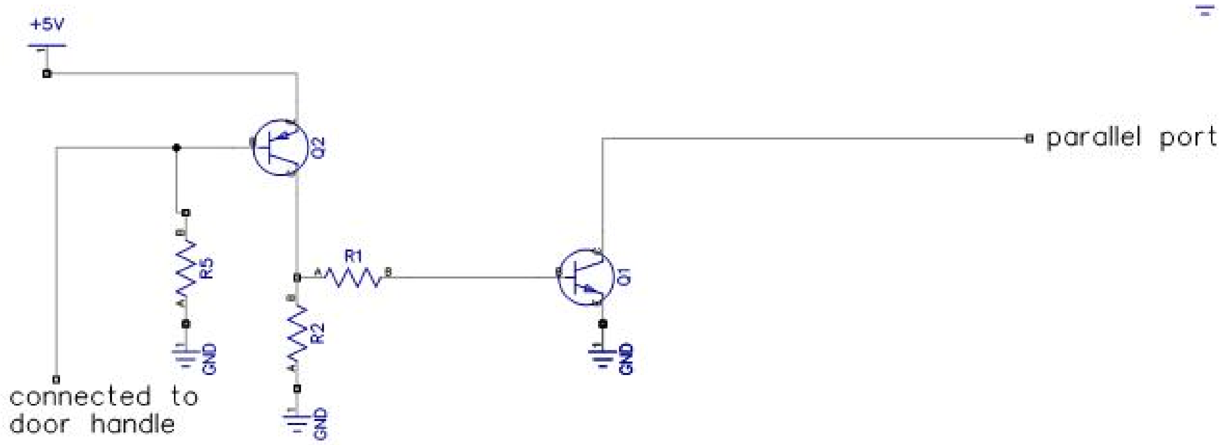


FIGURE 4.4

The door detection unit of two transistors Q1 and Q2. The base of Q2 is connected to a wire which is carefully wound round the door knob. A resistor R5 is connected to the base of Q2 to help in the biasing.

The human body offers different resistances when either dry or wet. The resistance of the human body decreases with increase in degree of wetness. For a PNP transistor to conduct, the emitter should always be more positive with respect to both the base and collector. When one comes into contact with the wire wound round the door knob, his body will act as a ground resulting to the base terminal being biased negative with respect to the emitter.

When Q2 is conducting, the voltage drop across V_{EC} is 0.2V. Therefore the voltage at the collector terminal will be given as:-

$\mathbf{V_C=V_{EE}-V_{EC}}$

=5- 0.2

=4.8V

When Q2 is not conducting, the voltage drop across V_{EC} is normally 5V. Consequently, the voltage at the collector terminal will be given as:-

V_C=V_{EE}-V_{EC}

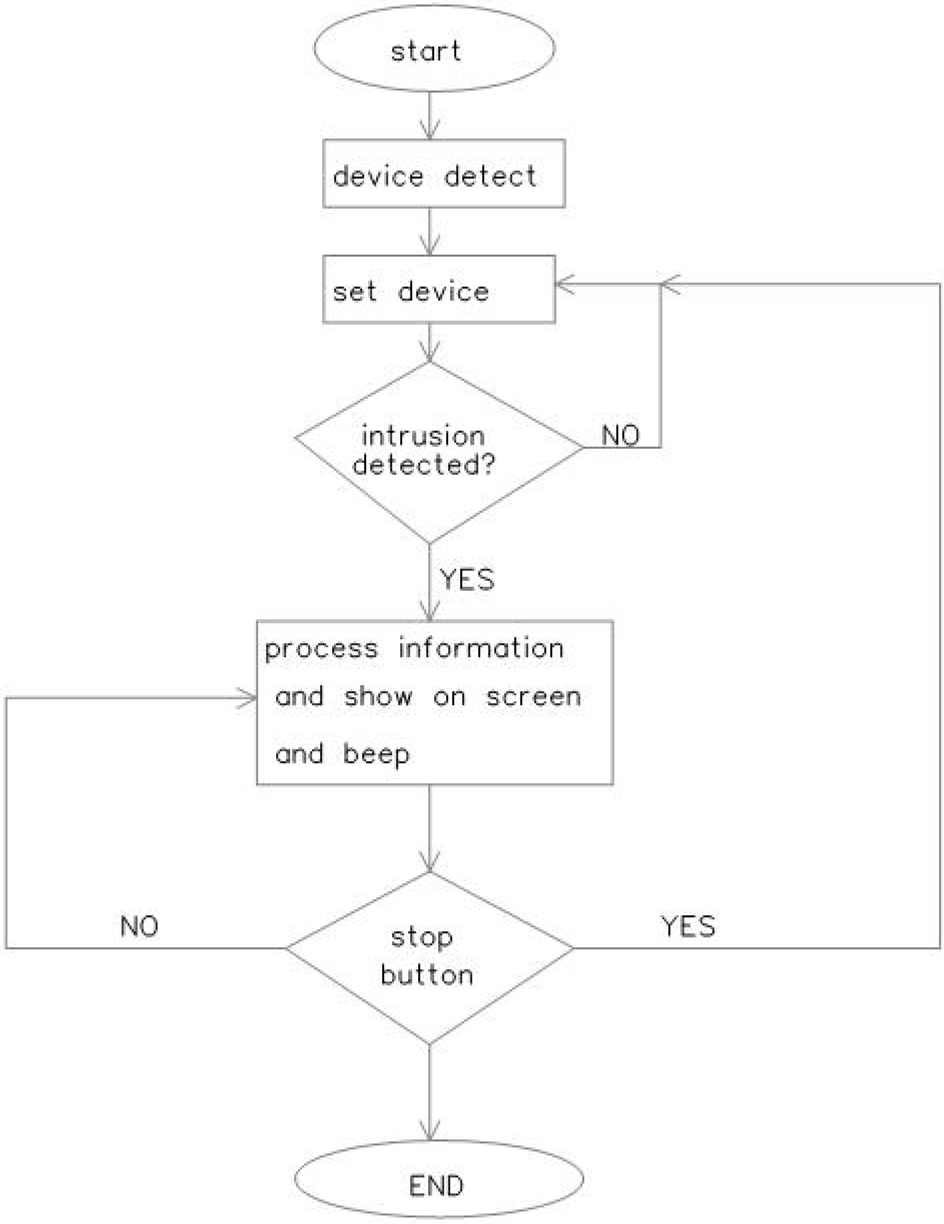
=5- 5

=0V

The purpose of R1 is to limit the base current of Q1. An NPN transistor is usually biased with the application of a voltage on its base which is greater than V_{BE} so that base current can flow. With base voltage greater than $V_{BE, Q1}$ is set into conduction with the V_{CE} = 0.2V .V_{CE} is 5V when the base voltage is less than $V_{BE.}$ The output from the NPN transistor is fed to the parallel port for further signal conditioning.

4.5 System flow diagram.

Figure 4.5 represents the flow diagram for the software to monitor an integrated alarm system



CHAPTER FIVE

TEST AND RESULTS

The circuit of figure 4.1 was set up and connected to a power supply. The output of the device was conected to the computer to monitor for any kind of intrusion. When the device is connected and running, the monitor displays figure 5.1.

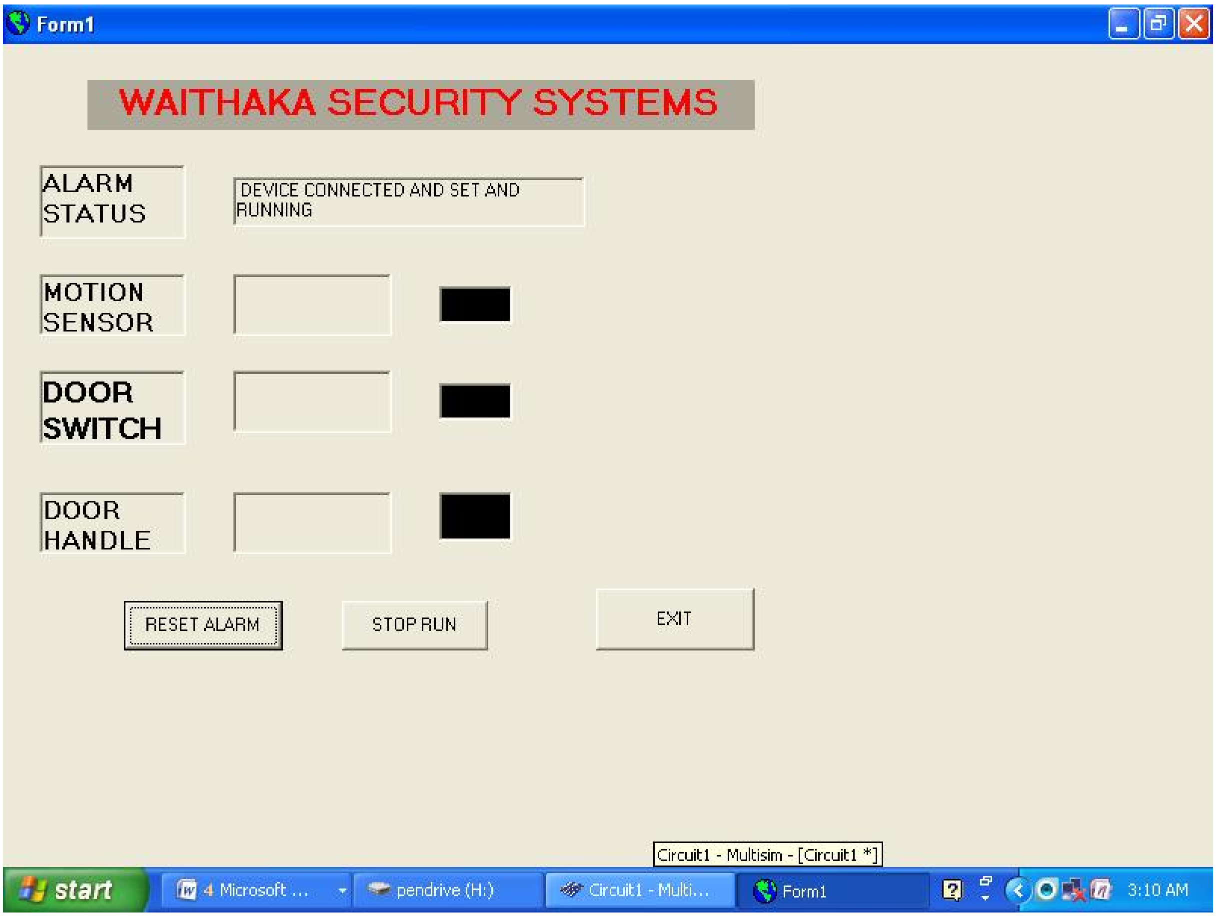


Figure 5.1

When someone touches the door handle with the device connected and running , the monitor displays figure 5.2

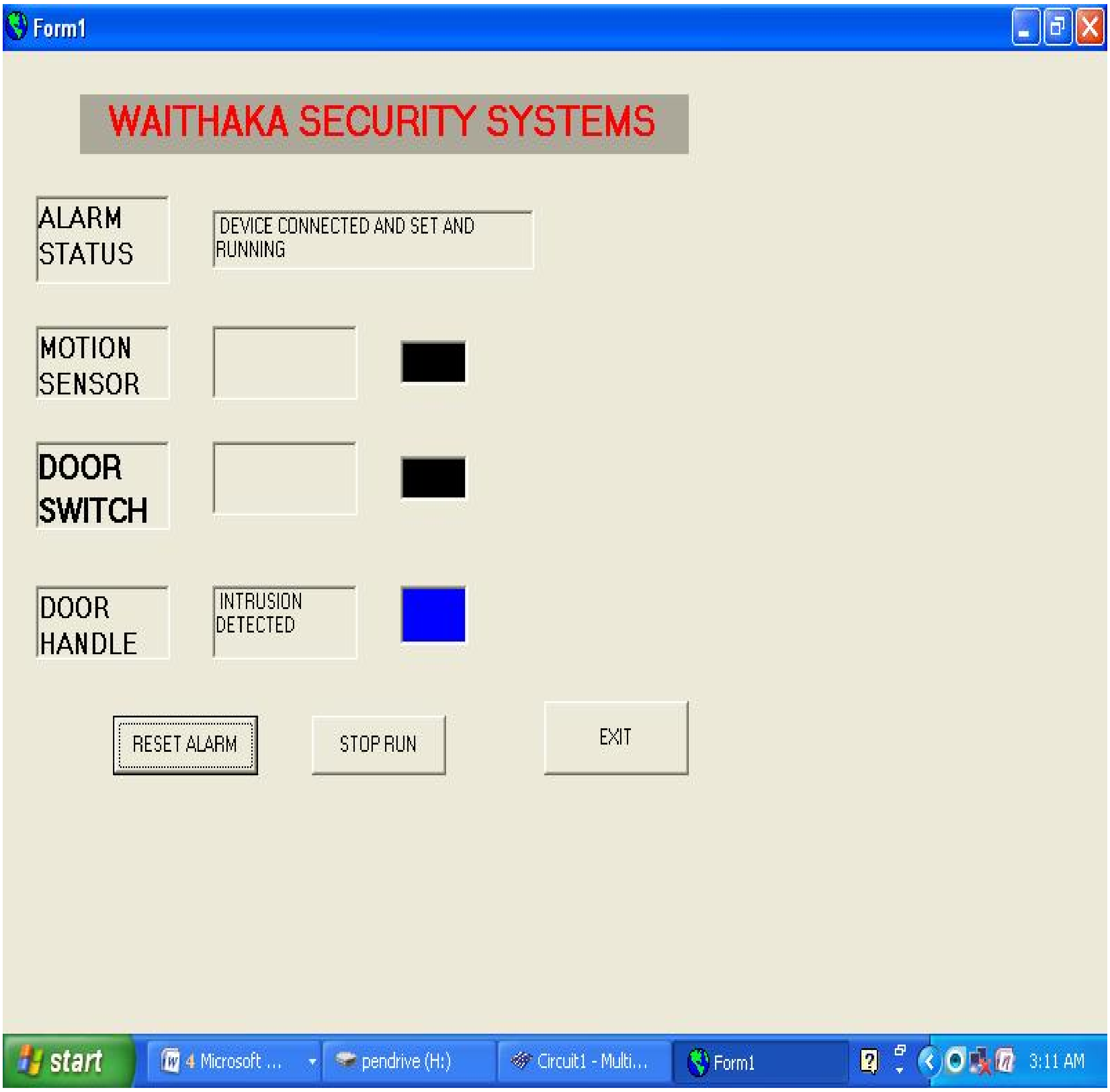


Figure 5.2

CHAPTER SIX.

CONCLUSION AND FURTHER RECOMMENDATIONS

6.1 Conclusions

This project was set out to realize an integrated burglar alarm system that could monitored on PC. The project was implemented and determined to be functional correctly for the monitoring of the three conditions as laid out in the objectives.

6.2 Further recommendations.

Further studies can be undertaken in the research and implementation of an integrated burglar alarm system. There are two main categories of alarm-wired and wireless. Wireless burglar alarms work from using radio waves instead of wires to communicate between the control panel and detection devices. Wireless burglar alarm systems offer the following advantages over wired burglar alarm systems:

i. Overall cost is significantly cheaper than wired alarm systems.
ii. Wireless burglar alarm systems are very convenient to install.
iii. More secure since it is difficult to hack.
iv. Wireless burglar alarm system can cover a wider coverage.
v. It is easy to add an extra detector and sensor unlike wired burglar alarm system.

An alarming sounding system can also be introduced in the system. Sirens will undoubtedly inform the burglar that they have been detected and may encourage them to leave before they can be apprehended by authorities.

The integrated burglar alarm systems can also be monitored with the burglar alarm activation posed either to a pre-selected list of telephone auto-dialer is connected to the alarm system or to a central monitoring station if a digicom is connected to the alarm system. The telephone auto dialer is suitable for domestic and small commercial installation and maintenance is minimal. The central monitoring station is the highest security and the most expensive both for installation and maintenance.

APPENDIX A

```
                    VERSION 5.00

Begin VB.Form Form1
   Caption         =   "Form1"
   ClientHeight    =   6570
   ClientLeft      =   120
   ClientTop       =   450
   ClientWidth     =   8010
   Icon            =   "Form1.frx":0000
   LinkTopic       =   "Form1"
   ScaleHeight     =   6570
   ScaleWidth      =   8010
   StartUpPosition =   3  'Windows Default
   Begin VB.Timer Timer1
      Enabled         =   0   'False
      Interval        =   1000
      Left            =   7560
      Top             =   5400
   End
   Begin VB.CommandButton Command3
      Caption         =   "STOP RUN"
      Height          =   495
      Left            =   3360
      TabIndex        =   14
      Top             =   5520
      Width           =   1455
   End
   Begin VB.CommandButton Command2
      Caption         =   "RESET ALARM"
      Height          =   495
      Left            =   1200
      TabIndex        =   10
      Top             =   5520
      Width           =   1575
   End
   Begin VB.CommandButton Command1
      Caption         =   "EXIT"
      Height          =   615
      Left            =   5880
      TabIndex        =   9
      Top             =   5400
      Width           =   1575
   End
   Begin VB.Label Label12
      BorderStyle     =   1  'Fixed Single
      Height          =   495
      Left            =   4320
      TabIndex        =   13
      Top             =   4440
      Width           =   735
   End
   Begin VB.Label Label11
      BorderStyle     =   1  'Fixed Single
      Height          =   615
      Left            =   2280
      TabIndex        =   12
```

```
  Top           =  4440
  Width         =  1575
End
Begin VB.Label Label10
  BorderStyle    =  1  'Fixed Single
  Caption        =  "DOOR HANDLE"
  BeginProperty Font
    Name           =  "MS Sans Serif"
    Size           =  12
    Charset        =  0
    Weight         =  700
    Underline      =  0   'False
    Italic         =  0   'False
    Strikethrough  =  0   'False
  EndProperty
  Height        =  615
  Left          =  360
  TabIndex      =  11
  Top           =  4440
  Width         =  1455
End
Begin VB.Label Label9
  BorderStyle    =  1  'Fixed Single
  Height        =  375
  Left          =  4320
  TabIndex      =  8
  Top           =  3360
  Width         =  735
End
Begin VB.Label Label8
  BorderStyle    =  1  'Fixed Single
  Height        =  375
  Left          =  4320
  TabIndex      =  7
  Top           =  2400
  Width         =  735
End
Begin VB.Label Label7
  BorderStyle    =  1  'Fixed Single
  Height        =  615
  Left          =  2280
  TabIndex      =  6
  Top           =  3240
  Width         =  1575
End
Begin VB.Label Label6
  BorderStyle    =  1  'Fixed Single
  Height        =  615
  Left          =  2280
  TabIndex      =  5
  Top           =  2280
  Width         =  1575
End
Begin VB.Label Label5
  BorderStyle    =  1  'Fixed Single
  Caption        =  "DOOR SWITCH"
  BeginProperty Font
    Name           =  "MS Sans Serif"
    Size           =  13.5
```

```
      Charset        =   0
      Weight         =   700
      Underline      =   0   'False
      Italic         =   0   'False
      Strikethrough  =   0   'False
   EndProperty
   Height          =   735
   Left            =   360
   TabIndex        =   4
   Top             =   3240
   Width           =   1455
End
Begin VB.Label Label4
   BorderStyle     =   1  'Fixed Single
   Caption         =   "MOTION SENSOR"
   BeginProperty Font
      Name           =   "MS Sans Serif"
      Size           =   12
      Charset        =   0
      Weight         =   700
      Underline      =   0   'False
      Italic         =   0   'False
      Strikethrough  =   0   'False
   EndProperty
   Height          =   615
   Left            =   360
   TabIndex        =   3
   Top             =   2280
   Width           =   1455
End
Begin VB.Label Label3
   BorderStyle     =   1  'Fixed Single
   Height          =   495
   Left            =   2280
   TabIndex        =   2
   Top             =   1320
   Width           =   3495
End
Begin VB.Label Label2
   BorderStyle     =   1  'Fixed Single
   Caption         =   "ALARM STATUS"
   BeginProperty Font
      Name           =   "MS Sans Serif"
      Size           =   12
      Charset        =   0
      Weight         =   700
      Underline      =   0   'False
      Italic         =   0   'False
      Strikethrough  =   0   'False
   EndProperty
   Height          =   735
   Left            =   360
   TabIndex        =   1
   Top             =   1200
   Width           =   1455
End
Begin VB.Label Label1
   BackColor       =   &H80000011&
   Caption         =   "   WAITHAKA SECURITY SYSTEMS"
```

```
      BeginProperty Font
         Name            =   "MS Sans Serif"
         Size            =   18
         Charset         =   0
         Weight          =   700
         Underline       =   0   'False
         Italic          =   0   'False
         Strikethrough   =   0   'False
      EndProperty
      ForeColor       =   &H000000FF&
      Height          =   495
      Left            =   840
      TabIndex        =   0
      Top             =   360
      Width           =   6615
   End
End
Attribute VB_Name = "Form1"
Attribute VB_GlobalNameSpace = False
Attribute VB_Creatable = False
Attribute VB_PredeclaredId = True
Attribute VB_Exposed = False
Private Sub Command1_Click()
End
End Sub

Private Sub Command3_Click()
Timer1.Enabled = False
Label3 = " ALARM SET BUT NOT RUNNING"
End Sub

Private Sub Timer1_Timer()
 detect
Label6 = ""
Label7 = ""

If detect_door = 1 Then
Label9.BackColor = vbRed
Label7 = "INTRUSION DETECTED"
Beep
Else

If detect_pir = 1 Then
  Label8.BackColor = vbYellow
  Label6 = " INTRUSION DETECTED"
Else
If detect_handle = 1 Then
  Label12.BackColor = vbBlue
  Label11 = " INTRUSION DETECTED"

Else
If detect_handledoor = 1 Then
   Label12.BackColor = vbBlue
   Label11 = " INTRUSION DETECTED"
   Label9.BackColor = Green
   Label7 = "INTRUSION DETECTED"

  Else
If detect_doorpir = 1 Then
```

```
   Label8.BackColor = vbRed
   Label9.BackColor = vbGreen
   Label9 = " INTRUSION DETECTED"
   Label6 = " INTRUSION DETECTED"

Else
If detect_pirhandle = 1 Then
   Label12.BackColor = vbBlue
   Label11 = " INTRUSION DETECTED"
   Label8.BackColor = vbYellow
   Label6 = " INTRUSION DETECTED"
Else
If detect_all = 1 Then
    Label9.BackColor = vbGreen
    Label7 = "INTRUSION DETECTED"
    Label8.BackColor = vbYellow
   Label6 = " INTRUSION DETECTED"
   Label12.BackColor = vbBlue
   Label11 = " INTRUSION DETECTED"
If detectsignal = 1 Then Timer1.Enabled = False

End If
End If
End If
End If
End If
End If
End If

End Sub


Private Sub Command2_Click()

Label9.BackColor = vbgrey
Label7 = ""

 Label8.BackColor = vbgrey
 Label6 = ""
 Label12.BackColor = vbgrey
  Label11 = ""

Label3 = " DEVICE CONNECTED AND SET AND RUNNING"

Timer1.Enabled = True
If detectsignal = 1 Then Beep
'Label3 = " ALARM SET NOT RUNNING CLICK RESET "
End Sub

Private Sub Form_Load()
If status = 1 Then
Label3 = " DEVICE CONNECTED "
Command2.Enabled = True
Command3.Enabled = True

Else
 Label3 = " DEVICE NOT CONNECTED "
 Command2.Enabled = False
End If
```

```
portaddress = 890
value = 32
Out portaddress, value
portaddress = 888

Dim indata As Integer

End Sub


VERSION 5.00
Object = "{831FDD16-0C5C-11D2-A9FC-0000F8754DA1}#2.0#0"; "mscomctl.ocx"
Begin VB.Form Form2
   Caption         =   "Form2"
   ClientHeight    =   3030
   ClientLeft      =   120
   ClientTop       =   450
   ClientWidth     =   4560
   Icon            =   "Form2.frx":0000
   LinkTopic       =   "Form2"
   ScaleHeight     =   3030
   ScaleWidth      =   4560
   StartUpPosition =   3  'Windows Default
   Begin VB.CommandButton Command1
      Caption         =   "Continue"
      Height          =   375
      Left            =   1200
      TabIndex        =   2
      Top             =   2400
      Width           =   1335
   End
   Begin VB.Timer Timer1
      Interval        =   100
      Left            =   4080
      Top             =   2640
   End
   Begin MSComctlLib.ProgressBar ProgressBar1
      Height          =   255
      Left            =   480
      TabIndex        =   1
      Top             =   1680
      Width           =   3735
      _ExtentX        =   6588
      _ExtentY        =   450
      _Version        =   393216
      Appearance      =   1
   End
   Begin VB.Label Label1
      Caption         =   "LOGIN SUCCEDED CLICK CONTINUE"
      Height          =   375
      Left            =   840
      TabIndex        =   0
      Top             =   480
      Width           =   2895
   End
End
Attribute VB_Name = "Form2"
Attribute VB_GlobalNameSpace = False
Attribute VB_Creatable = False
```

```
Attribute VB_PredeclaredId = True
Attribute VB_Exposed = False
Private Sub Command1_Click()

Dim count As Integer
Dim count2 As Integer
Dim value As Integer
Dim portaddress As Integer


Timer1.Enabled = True
ProgressBar1.value = 0


portaddress = 888
value = 0
status = 0

 Out portaddress, value
 portaddress = 890

 value = 32

 Out portaddress, value


  value = 0
  portaddress = 888

 count2 = Inp(portaddress)

 If count2 < 248 Then
 MsgBox " device detected "
  status = 1
  Form1.Show
End If

If count2 = 248 Then
MsgBox " device detected "
status = 1
Form1.Show
End If

  If count2 > 248 Then
  status = 0
   MsgBox " device not connected "

End If

Form1.Show
Form2.Hide

End Sub

Private Sub Form_Load()

ProgressBar1.value = 0
Timer1.Enabled = True
End Sub
```

```
Private Sub Timer1_Timer()

 Label1 = " DETECTING DEVICE "

 ProgressBar1.value = ProgressBar1.value + 10
 If ProgressBar1.value >= 100 Then Timer1.Enabled = False

End Sub
```

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