DESIGN AND CONSTRUCTION OF AUTOMATIC BURGLAR ALARM

BY

OPITI DENNIS

2003/15451EE

ELECTRICAL/ COMPUTER ENGINEERING DEPARTMENT

FEDERAL UNIVERSITY OF TECHNOLOGY

MINNA.

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A THESIS SUMMITTED TO THE DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING, FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA.

NOVEMBER, 2008.

DEDICATION

This project is dedicated to the almighty God and my beloved parent Mr. and Mrs. John Opiti for the opportunity given to me to be educated.

DECLARATION

I, Opiti Dennis declare that this work was done by me and has never been presented elsewhere for the award of a degree. I also hereby relinquish copy right to the Federal University of Technology Minna

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ACKNOWLEDGEMENT

I am sincerely grateful to almighty God for seeing me through all odds and obstacles I have encountered during the period of my studies. I must confess, I have done nothing of my own strength, He did everything for me.

I am also grateful to my parents and my brothers; Mr. and Mrs John Opiti, Mr. Ernest Opiti, Mr. Emeke Opiti, Mr. Simeon Opiti for their moral and financial support ever since I started my school up till this moment. May God reward you all abundantly. My thanks also goes to my supervisor Mr. Suleiman Zubair for his encouragement and kindness.

I also want to thank my H.O.D, Engineer (Dr.) Adediran and my lectures for the knowledge they impacted on me throughout my stay in school.

I also want to use this medium to appreciate all the people involved both in terms of finance and spirituals for my successful completion of my study, but their names were not included. May God bless them all (Amen)

ABSTRACT

Over the years, the use of intruder alarm to protect area has become widespread in commercial and private uses. It s design and construction has also increased in sophistication and style.

This project is designed in order to detect the presence of a burglar, when a restricted area is invaded. This device detect a burglar by sounding alarm when an intruder open a door, window or gate..

The fact that the rate of crime has increased in our society and there is danger to lives and property, this device is useful in assisting to fight crime. A great advantage of this project is that it provide security in our homes, industry, hospitals, banks,, and offices

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CHAPTER ONE

GENERAL INTRODUCTION

1.1 INTRODUCTION

In the recent times, there has been a growing increase in incidence of theft which involves breaking into homes, offices, banks, laboratories and hospitals to rob innocent people of their hard-earned money and valuables. Robbers usually take advantages of the absence of burglar alarm in some homes, offices, banks, laboratories and hospitals.

This situation can be attributed to inefficiency and the ineffectiveness in the part of security officers of the government and private security or hired security men. The major cause of this inefficiency and ineffectiveness is simply because they either get information after the robbery incidence or without information at all. So, to ensure absolute or effective security system, there is need for adequate, urgent and reliable information about the robbers in a particular area.

In other to provide adequate and reliable information about thieves, robbers or burglars, a system that will be alert twenty four hours in a week is necessary since human beings no matter the amount of training become weak one time or the other. And thieves can take advantage of any slight slack in security to break into homes or offices. To avoid this kind of situation, one of the most efficient and effective way is to provide BURGLAR ALARM.

Burglar alarms are popular way of providing security for homes and businesses. In undertaking this project, if any of the doors, gates, windows or wherever the circuit is interfaced to break the circuit line the alarm is triggered on thereby exposing the intruder in the environment by sending message to the nearest armed security personnel.

However each year the council and the police receive a number of complaints relating to noise from burglar alarms. If you have a burglar alarm fitted to your home or businesses centre, then by a law you have a duty to ensure that it will not course a nuisance to residents in the locality.

If the council is required to deal with an alarm causing a statutory nuisance, the owner will be asked to pay any cost incurred. To avoid the alarm causing a nuisance, some steps can be followed and one such step is by registering your alarm with the council so that the council will examine the loudness of the sound to see if it conforms with the rules and the regulation governing the mounting of the alarm system. This will save you any expense caused by the sound of the alarm system in your home, offices and so on. (www.target woman.com/article/burglar_alarm_system)

1.2 AIMS AND OBJECTIVES

This project is designed to curtail the menace of criminals by detection of intruders.

1.3 SCOPE OF PROJECT

This project is motivated by the desire to contribute to the security of homes, offices and shops. It will try to solve the problem of an affordable security for the common man. Nevertheless, efficiency, durability and quality will not be compromised. With ultimate conviction, I believe that the adoption of burglar alarms by different homes, security agents will result in drastic reduction in the number of robbery and stealing in homes, offices and so on, since the information about an intruder is provided at the exact time the intruder breaks the circuit and the standby security agents will intervene immediately. This will also reduce labour

and stress on the security men. It also reduces cost by reducing the number of security personnel.

1.4 METHODOLY

In this project, the method of switching on the relay by energizing and de-energizing the relay via the removal of the power source is utilized. When the relay is energized, it is on the normally closed pin but when de-energized, it falls to the normally open pin. This result in powering the buzzer as a result of forward biasing the transistor.

CHAPTER TWO

LITERATURE REVIEW

2.1 BRIEF HISTORY

Security guarantees safety. A country with adequate security glows economically because of the attraction of foreign investors. As the world is getting more advanced in technology, so are the act to break these technologies by criminals, hence great importance must be given to home security. Having a security system monitored means that you are willing to pay a monthly fee to a monitoring center. This fee is used to hire people to sit and watch for and react to your security system in the event it calls in to report an alarm condition.

Most of the security companies on the market today either provide or have ties to a monitoring center. Whether it is a local presence or national operation is not the issue; it is how well they provide the service that is important.

Way back in the days of people much older than I, people would rely on simple means to alert others of a breach in security. Little bells attached to a door that rang when it was opened, tin cans tie to a string across a pathway, that sort of thing. One day, someone placed a large bell into a metal enclosure and placed four lantern batteries inside of it with a relay and mounted it to the outside of the building. From the enclosure, there were two sets of wires, one for the door contacts and one for the key switch that turned the bell on and off. This technology is commonly referred to as a ***"local bell."*** Maintenance was a snap. Depending on the usage, these batteries could last up to a year. When the bell rang weakly, you replaced the batteries.

This simple system used the relay to monitor the door contacts. The key switch was located outside, and the owner would close all of the doors and turn the key at night. If the doors were open with the key switch on, the bell would ring. Closing the door would not stop the bell; only by turning the key will silent it. The local bell uses a wiring scheme that latches the relay contacts into an alarm condition. (www.target woman.com/article/burglar_alarm_system)

This was very popular for a while, that is until people figured out that the bell could be yanked from the wall and quickly silenced. The other flaw was the locations of some of these businesses. The bell could ring all night and bother only the local night critters. There are four methods to detect the presence of an intruder. These are; passive infrared detector, glass break detector, vibration [shaker] detector, seismic glass break detector.

The passive infrared detector (PIR) is one of the most common detectors found in household and small business environments because it offers affordable and reliable functionality. The term *passive* means the detector is able to function without the need to generate and radiate its own energy (unlike ultrasonic and microwave volumetric intrusion detectors that are "active" in operation). PIRs are able to distinguish if an infrared emitting object is present by first learning the ambient temperature of the monitored space and then detecting a change in the temperature caused by the presence of an object. Using the principle of differentiation, which is a check of presence or no presence; PIRs verify if an intruder or object is actually there. Creating individual zones of detection where each zone comprises one or more layers can achieve differentiation magnetic field detector and taut wire detector.

The glass break detector maybe used for internal perimeter building protection. When glass breaks, it generates sound in a wide band of frequencies. These can range from

infrasonic, which is below 20 Hertz (Hz) and can not be heard by the human ear, through the audio band from 20 Hz to 20 kHz which humans can hear, right up to ultrasonic, which is above 20 kHz and again cannot be heard.

Glass break acoustic detectors are mounted in close proximity to the glass panes and listen for sound frequencies associated with glass breaking. Seismic glass break detectors are different in that they are installed on the glass pane. When glass breaks, it produces specific shock frequencies which travel through the glass and often through the window frame and the surrounding walls and ceiling. Typically, the most intense frequencies generated are between 3 and 5 kHz, depending on the type of glass and the presence of a plastic interlayer.

Seismic glass break detectors "feel" these shock frequencies and in turn generate an alarm condition. These simple devices are mounted on barriers and are used primarily to detect an attack on the structure itself. The technology relies on an unstable mechanical configuration that forms part of the electrical circuit. When movement or vibration occurs, the unstable portion of the circuit moves and breaks the current flow, which produces an alarm. The technology of the devices varies and can be sensitive to different levels of vibration. The medium transmitting the vibration must be correctly selected for the specific sensor as they are best suited to different types of structures and configurations. The buried security system is based on the Magnetic Anomaly Detection principle of operation. The system uses an electromagnetic field generator powering with two wires running in parallel. Both wires run along the perimeter and are usually installed about 5 inches apart on top of a wall or about foot buried in the ground. The wires are connected to a signal processor which analyzes any change in the magnetic field. This kind of buried security system sensor cable could be buried on the

top of almost any kind of wall to provide regular wall detection ability or be buried in the ground. (Adediran, 2000)

A taut wire perimeter security system is basically an independent screen of tensioned tripwires usually mounted on a fence or wall. Alternatively, the screen can be made so thick that there is no need for a supporting chain wire fence. These systems are designed to detect any physical attempt to penetrate the barrier. Taut wire systems can operate with a variety of switches or detectors that sense movement at each end of the tensioned wires. These switches or detectors can be a simple mechanical contact, static force transducer or an electronic strain gauge. Unwanted alarms caused by animals and birds can be avoided by adjusting the sensors to ignore objects that exert small amounts of pressure on the wires. It should be noted that this type of system is vulnerable to intruders digging under the fence. A concrete footing directly below the fence is installed to prevent this type of attack.

The advantage of this present project over the former once is the fact that this does not sound force alarm, in the sense that the alarm only sounds when the door is opened and will stop the moment the intruder leaves the door, unlike the others that will start sounding when the beam is cut even when it is not an intruder.

2.2 PRINCIPLE OF OPERATION

At the instance of switching on the circuit that is powering of the circuit by a Vcc of +9v the relay is set at normally closed position which power the transistor through the base, there by reverse biasing the NPN transistor. It should be noted that, with this configuration, the transistor will not conduct. As such, the alarm will remain silent (that is without sounding).

If for any reason, the power supply is cut-off via the door (push and break contact), the relay will be de-energized, thereby falling to position 2 as shown in the circuit diagram below. Then the negative supplies to the transistor PNP is activated causing forward biasing effect. This will trigger on the Monostable multivibrator, since the transistor start to conduct.

The result of Monostable multivibrator is only in one stable state. To avoid the ambiguity of the fact of only one stable state, we Power the buzzer by an astable multivibrator. If it is forced to the other state by momentary breakage of the circuit line, it will return after a delay time (as long as the circuit is broken) to its original state. This results to the stopping of the buzzer from sounding, giving the message that the intruder is no longer on that particular door. This help the security men to be able to detect easily the actual time the intruder passed the door rather than the alarm sounding even when the intruder is no longer there.

CHAPTER THREE

IMPLEMENTATION AND DESIGN

In this project design and construction, relay was used as a switching device for the sounding of the alarm. All the units of the project are powered by a single d.c voltage supply (Vcc of +9V). The relay unit acts as a control unit of the project. The transistors as indicated in the modular representation below acts as an amplifier of the voltage signal from the relay and from the -Vcc supply when the circuit line is broken. The modular representation of the circuit is shown below;

3.1 MODULAR REPRESENTATION

An empirical representation of this project design and it modular representation is given below

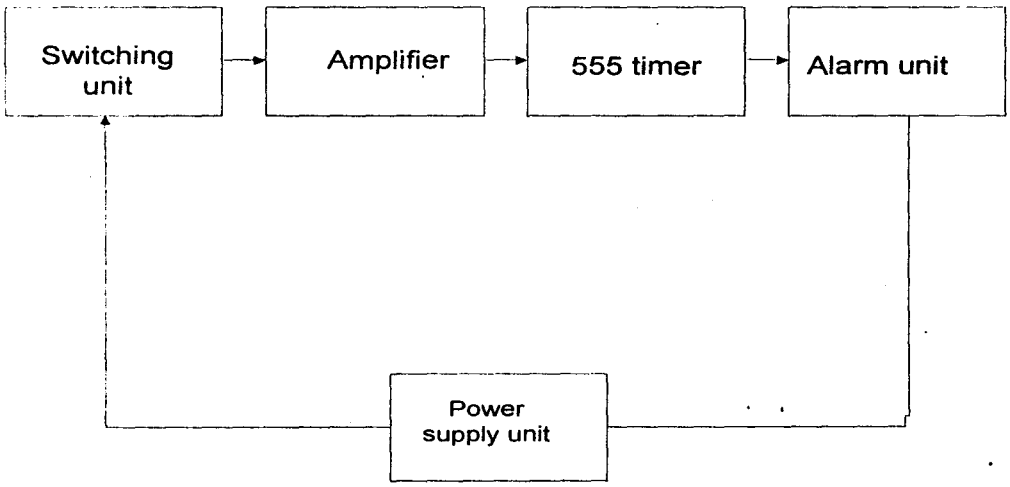

Fig 3.1 modular representation of automatic burglar alarm

The project is divided into five modules, these are

i. The power supply unit
ii. Switching unit
iii. Amplifier
iv. 555 timer

v. Alarm unit

3.2 POWER SUPPLY

The circuit is powered by 9V D.C (Direct Current) Lithium battery. All the units are powered by this single d.c source which can be replaced after a period of time. A 6V relay was chosen to match the supply voltage. The schematic diagram of a d.c supply is shown below.

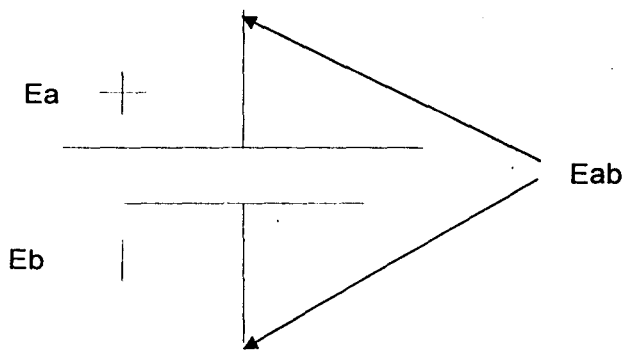

Fig3.2 Schematic diagram of a battery

3.3 SWITCHING PART:

Relay is chosen as the switching component of this project, when the relay is energized the circuit is completed. When there is a breakage, the circuit is incomplete and there will be no supply in the positive side, and the supply would go via the negative side. This suggests that the buzzer will come on only when there is a negative supply.

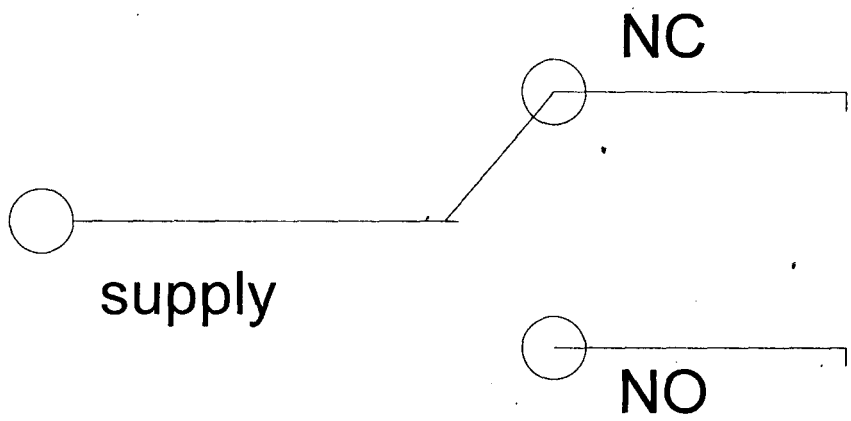

Fig 3.3 Switching unit

3.4 Amplifier

Transistor provides the power gain that is needed for most electronic applications. These power gains are provided by current and voltage. For the purpose of this project, I will be concerned with bipolar junction transistors; in which electrons and holes are responsible for the flow of electric current. There are basically two classes of BJT transistor; PNP and NPN transistors. There schematic diagram are shown below;

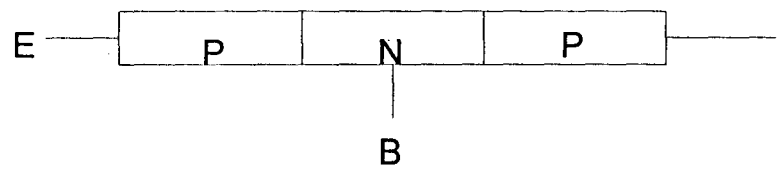

Fig 3.4 Schematic diagram PNP structure

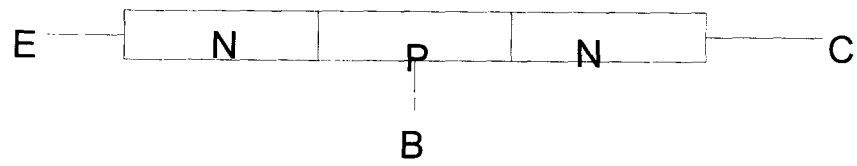

Fig 3.5 Schematic diagram of NPN structure

The circuit symbols of the above mentioned classes of bipolar junction transistors are shown;

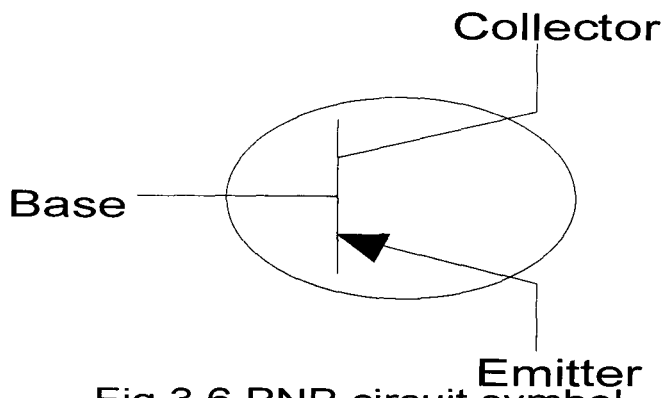

Fig 3.6 PNP circuit symbol

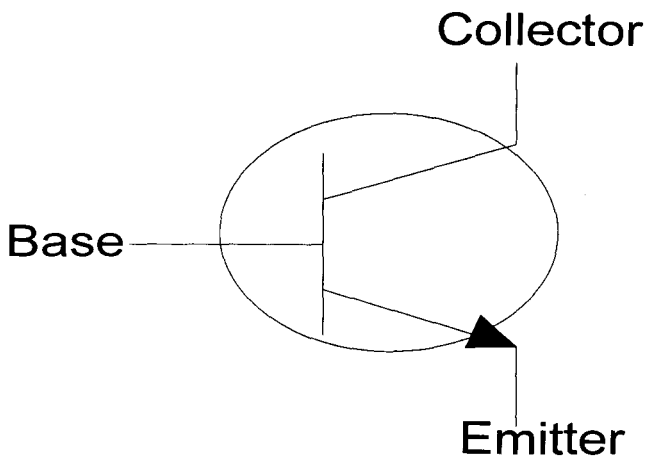

Fig 3.7 NPN circuit symbol

A transistor would be classified as NPN transistor, if the base designated by B is positive with respect to the emitter E. The emitter is more heavily doped than any of the other regions because its main function is to supply majority charge carrier (either electrons or holes) to the base. The base B, form the middle section of the transistor. It is very thin (10^{-6}m) as

electrons or holes) to the base. The base B, form the middle section of the transistor. It is very thin (10^{-6}m) as compared to either the emitter or collector and it's very lightly doped. The collector main function (as indicated by its name) is to collect majority charge carriers coming from the emitter and passing through the base. However a transistor must be properly biased for it to function normally. The emitter-base junction is always forward biased and the collector based junction is always reversed biased. The direction of the arrows below shows the direction of current flows. Fig 3.9 shows a forward biased PNP transistor while fig 3.10 shows an NPN forward biased mode.

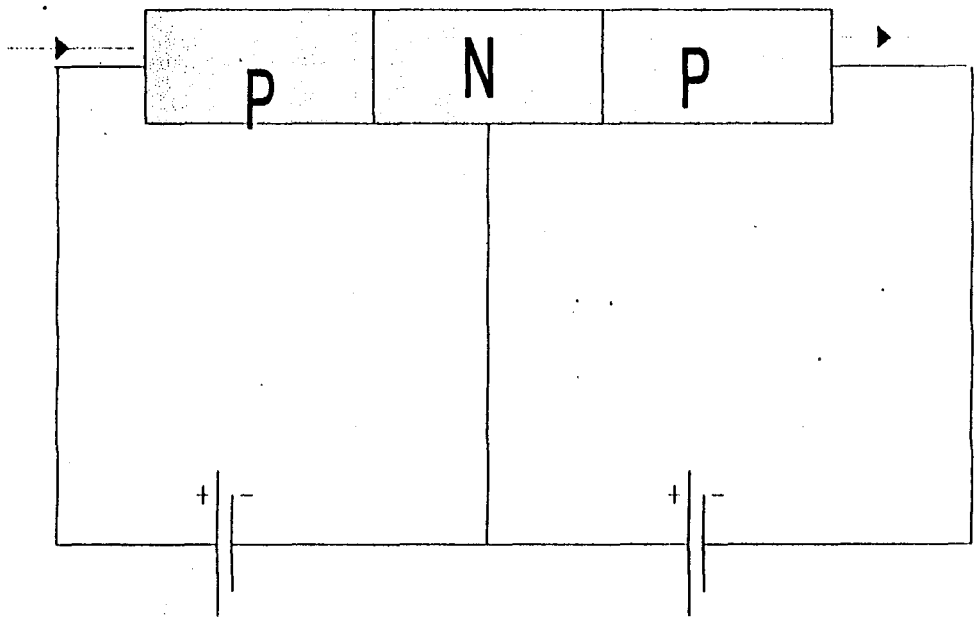

Fig 3.8 Representation of PNP biasing

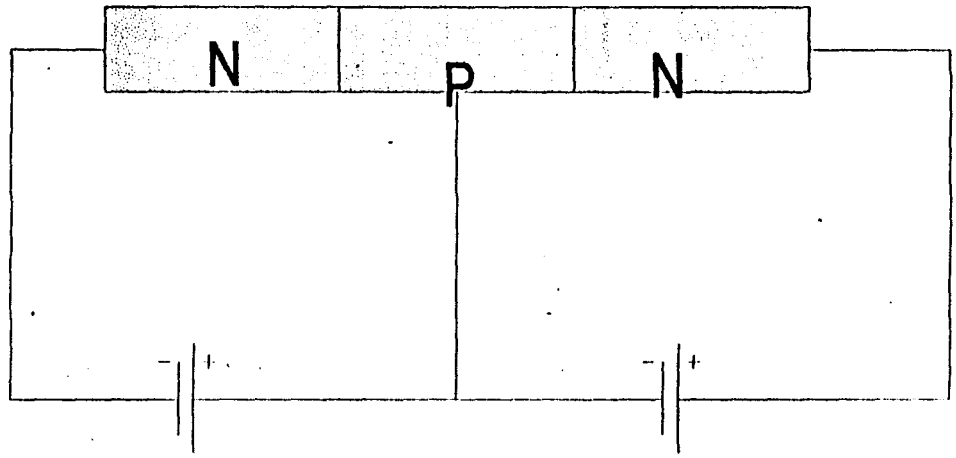

Fig 3.9 Representation of NPN biasing

3.5 NEE 555 Timer

The NEE 555 timer is a device use for generating accurate time delay or oscillating. 555 timers can be used with a supply voltage in the range of +5v to 18v and can drive load up to 200mA. It is compatible with both TTL (Transistor Logic gate) and CMOS (Complementary Metal Oxide Semiconductor) logic circuit. Because of the wide range of supply of voltage, the 555 timer is versatile and low cost; the NEE 555 timer has become very popular, with circuit designers and use in various applications, such as oscillator, mono shot multivibrator, burglar alarm, traffic light control and voltage monitor. The 555 timer IC contains two voltage comparators, a bistable flip flop, discharge transistors, a resistor divider network. This project uses the NEE555 timer with 8 pin package. The figure 3.12 shows the pin diagram of NEE 555 timer. (www.wikipedia\burglar\555 and 556 Timer Circuits.htm).

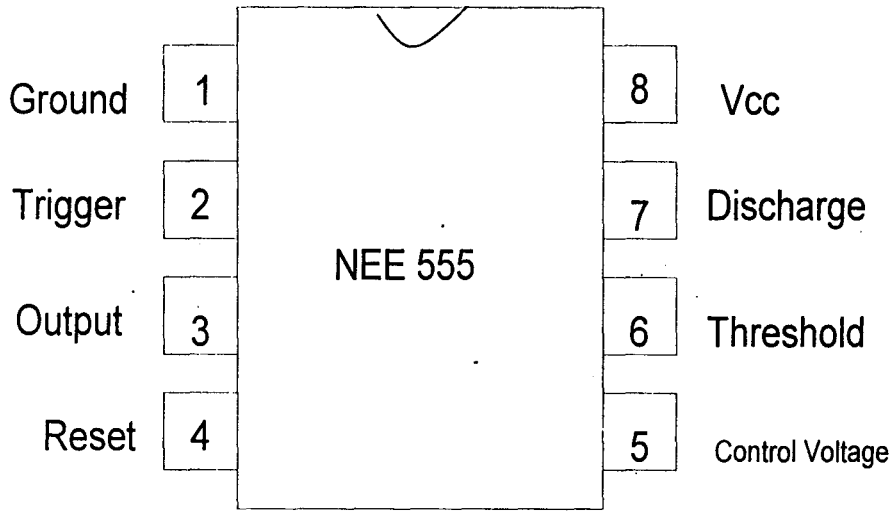

Fig 3.10 8-pin package of 555 timer

Pin 1 is the ground or common terminal to which the negative pole of the power supply is connected inverting terminal of the lower comparator. The trigger input is initially set at above 1/3 Vcc. Triggering is accomplished by taking the input from above to below 1/3 Vcc.

Pin 3 is the output terminal connected to the collector of an NPN transistor, the emitter of which goes to ground. Pin 4 is the reset input used to reset the flip-flop and return the output to low state. When less than about 0.7V, it overrides other input. The pin is activated by momentarily connecting it to ground.

Pin 5 takes the control voltage which allows direct access to the reference level, 2/3Vcc,of the upper comparator, making it possible to control the width of the output pulse independent of the external RC components.

Pin 6 is the input of the non –inverting input of the upper comparator used to reset the flip flop, which cause the output to go low.

Pin 7 is connected to the open collector of an NPN transistor, the emitter of which goes to ground. When the transistor is turn on, pin 7 is effective discharge shortened to ground (as in the output), facilitating the discharge of the external (timing) capacitor to almost 0V.

Pin 8 is connected to the supply terminal Vcc.

A Monostable circuit produces a single output pulse when triggered. It is called Monostable because it is stable in just one state "output low". The output high state is temporary. The figures below show the 555 mono stable circuits with manual triggers and output in a single pulse.

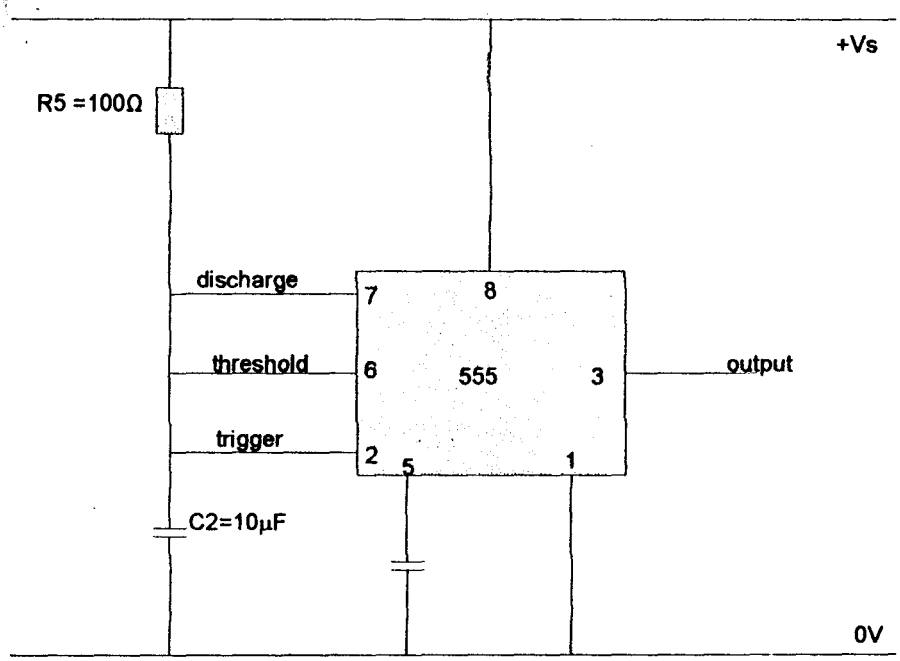

Fig 3.11 Monostable vibrator using 555 timer

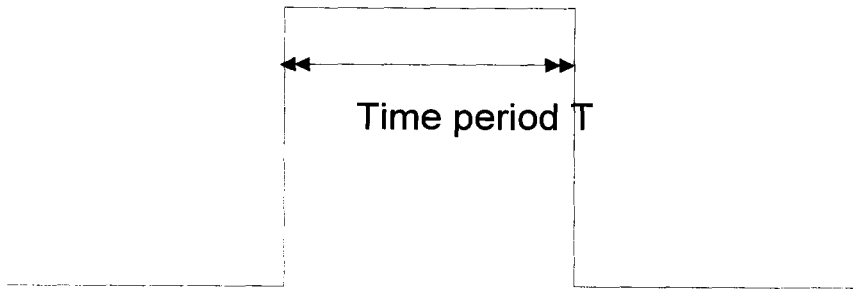

Fig 3.12 Output, a single pulse of monostable

The derivation of the pulse is called the time period (T) and this is determined by the resistor R1 and capacitor C1.

Time period (T) =1.1 R_5C_2

T = time period in second (s)

RS = resistance in ohms (Ω)

C_2 = capacitance in farads.

Application equation above to the value of resistor and capacitor used in the circuit, the resistor value is 100 ohms and the capacitor value is 10μF

From $T = 1.1C_2R_5$

$= 1.1x10^{-6}x100$

=0.0011 seconds

The timing period is triggered (started) when the trigger input (pin 2) is less than 1/3Vs, this makes the output high (+ve) and the capacitor c_1 start to charge through resistor R_1. Once the time period has started further trigger pulses are ignored. The threshold input (pin 6) monitor the voltage across C_1 and when it reaches 2/3Vs the time period is over and the output becomes low. At the same time, the discharge (pin 7) is connected to 0V (ground), discharge capacitor ready for the next trigger. The input (pin 4) overrides all other input and the timing

may be cancelled at any time by connecting reset to 0V, this instantly make the output low and discharges the capacitor. If the recent function is not required, the reset pin should be connected to +Vs. The figure below shows the timing pulses of Monostable vibration.

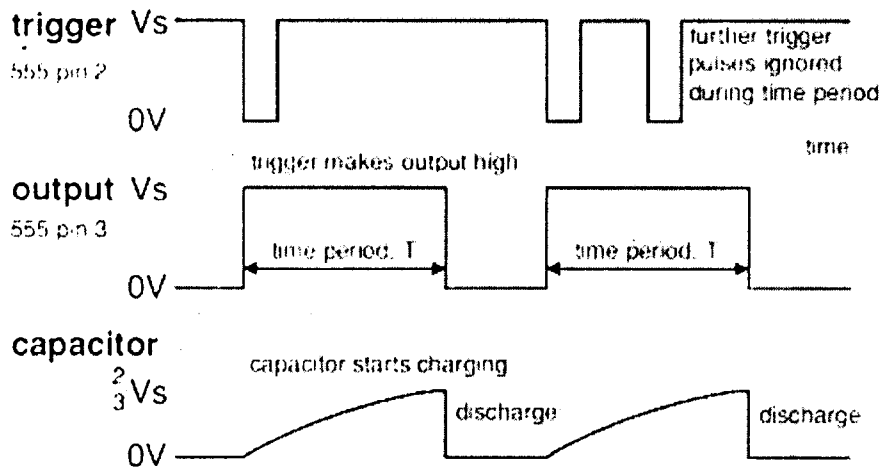

Fig 3.13 Timing sequence of Monostable vibrator

Astable Multivibrator produces a square wave; this is a digital wave form with sharp transition between low (ground) and high (+V). Note that the duration for the low and high state may be different. The circuit is called an astable multivibrator because it is not stable in any state. The output is continually charging between 'low and high'. The figures below show the circuit diagram and 555 astable output and a square wave (www.wikipedia\burglar\555 and 556 Timer Circuits.htm)

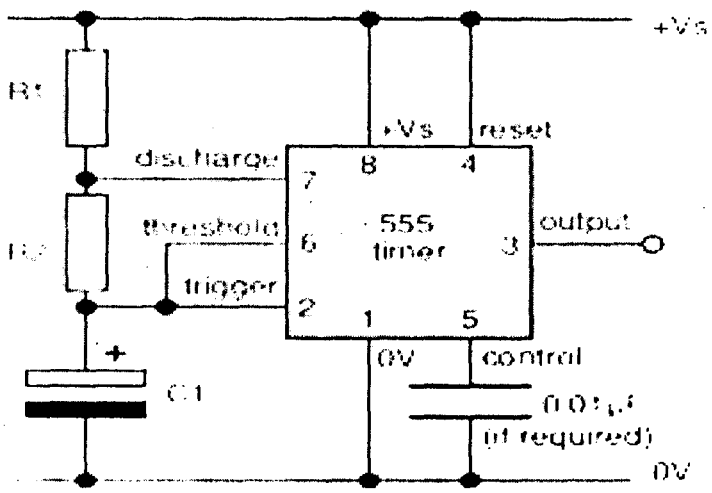

Fig 3.14 Circuit diagram of 555 timer astable multivibrator

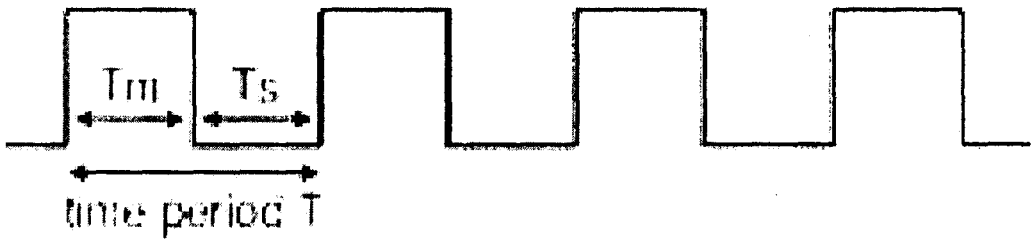

Fig 3.15 Astable output, a square wave.

The time period (T) of the square wave is the time for one complete circle but it is usually better to consider frequency (f) which is the number of circle per second.

$$T = 0.7 \times (R1 + 2R2) \times C1 \quad \text{and} \quad f = \frac{1.4}{(R1 + 2R2) \times C1} \qquad \text{----------(1)}$$

T= time period in seconds (s)

F= frequency in hertz (Hz)

R1= resistance in ohms

R2= resistance in ohms

C1= capacitance in Farads (F)

From the above equations,

Applying the value of R1, R2, and C1 in the circuit

$F= 1.44/(1000+2(22000))10x\ 10^{-6}$

$=1.44x10^{6}/45000x10$

=14,400 000/ 450,000

=3.2Hz

$T=0.7x\ (1000+2(22000))\ 10x10^{-6}$

=0.315secs

The time period (T) can be split into two parts.

T= Tm + Ts

Mark time (output high): $Tm=0.7x\ (R1+R2)\ C1$

$=0.7x\ (1000+22000)\ 10x10^{-6}$

=0.161secs

Space time (output low): Ts= 0.7xR2xC1

$=0.7x22000x10x10^{-6}$

=0.154secs

Many circuit requires Tm and Ts to be almost equal, this is achieved if R2 is much large than R1. With output high (+Vs) the capacitor C1 is charged by current flowing through R1 and R2. The threshold and the trigger input monitor the capacitor voltage and when it reaches 2/3Vs (threshold voltage) the output becomes low and the discharge pin is connected to ground. The capacitor now discharges with current flowing through R2 into the discharge pin. When the voltage falls to 1/3Vs (trigger voltage) the output becomes high again and the discharge pin is disconnected, allowing the capacitors to start charging

disconnected, allowing the capacitors to start charging again. This circle repeat continuously unless the reset input is connected to ground which force the output low while reset is 0V. An astable can be used to provide the clock sign for circuit such as counter. The figure 3.18 below shows the timing sequence of astable multivibrator

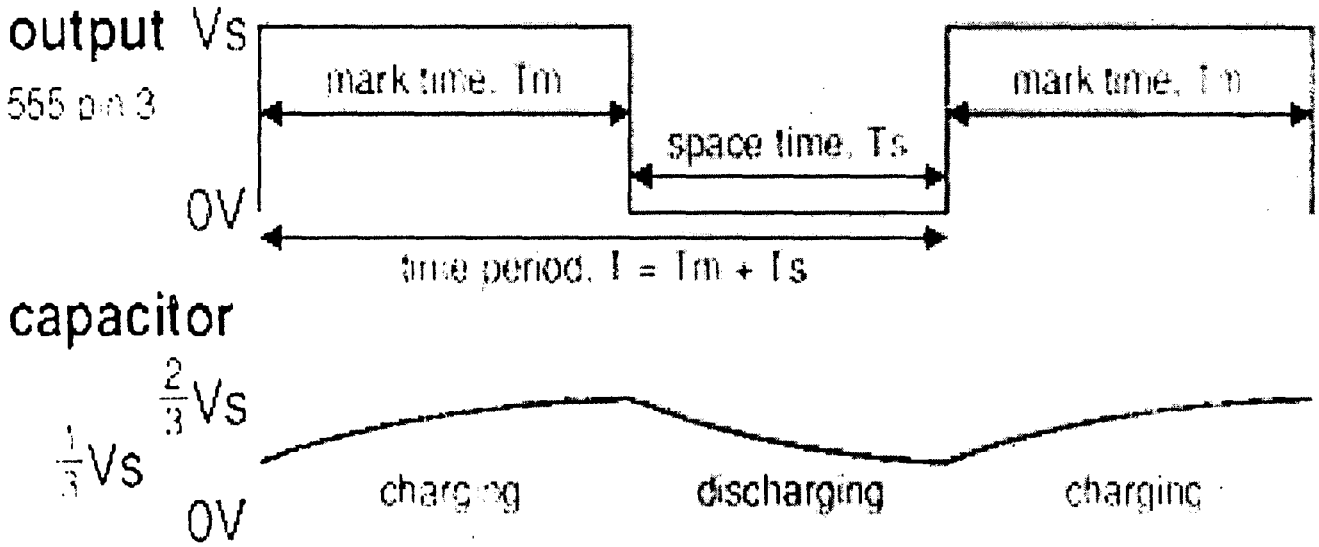

Fig 3.16 Timing sequence of astable multivibrator

3.6 ALARM UNIT

This uses a 555 timer in astable mode to generate a frequency of about 3.2 Hz to drive the buzzer. The astable configuration of 555 timers is shown below.

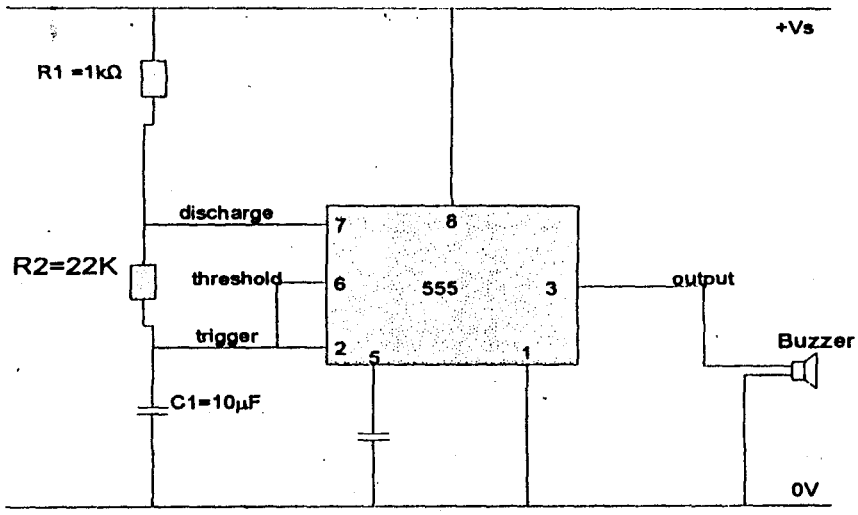

Fig 3.17 555 IC in astable vibrator mode

CHAPTER FOUR

TESTING AND RESULTS.

4.1 COMPONENT TESTING

The component were first mounted on the breadboard and tested to ensure that the respective modules operate efficiently. After testing on breadboard, the components were then transferred to a Vero board and soldered.

4.2 CASING DESIGN

The casing is made up of ply-wood. The ply-wood was cut into the required forms to hold the circuit.

4.3 TESTING

The testing of this project was carried out in two different phases:

i. Breadboard stage

ii. Vero board stage

The components were first mounted on the breadboard to ensure that the circuit was working normally before soldering permanently on the Vero board of which a satisfactory result was obtained.

Also, the final testing was done on the Vero board after soldering. The following tests were carried out on the various components in the following order.

i. The power supply unit was tested.

ii. When the door was opened, the alarm was triggered; this confirmed that the astable and Monostable oscillators were functioning properly.

4.4 RESULT

The following results were obtained after carrying out the various tests on the project.

i. A 10V power was supplied to the main circuit

ii. The alarm triggered when the door is opened

iii. The relay was deactivated when an intruder entered, there by causing a negative flow to the Darlington pair transistor.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1 CONCLUSION

It can be seen from the foregoing report that the design of an automatic burglar alarm system, just like any other, requires careful planning and implementation.

The relay contact was use in switching the circuit. The relay is incorporated with the transistor and 555 timers IC to drive the buzzer.

5.2 RECOMMENDATIONS

To ensure a system such as this in providing maximum protection and security of properties, the Nigerian police force should employ the use of 24 hours security watch gadget.

If the design can still be improved upon, it will serve as a stepping stone for who ever is interested in building modern burglar alarm system with higher sensitivity and lower rate of false alarms. Thus, it is hoped that it will stop or lead to a solution of the high rate in loss of lives and properties, problems associated with prevalent robbery and assassination in the country today.

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APPENDIX

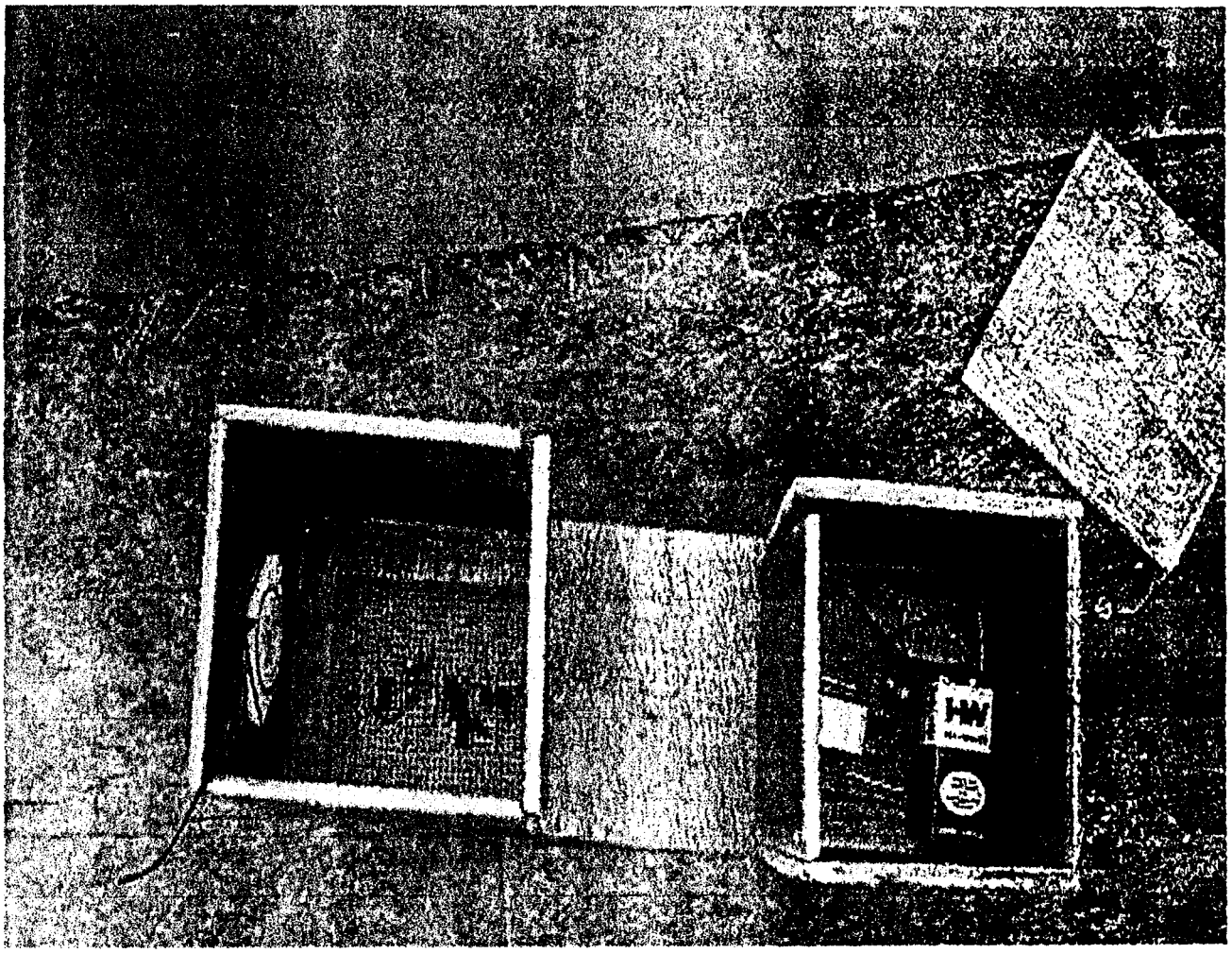

Fig. 4.1 A cross-section of the partly covered project.

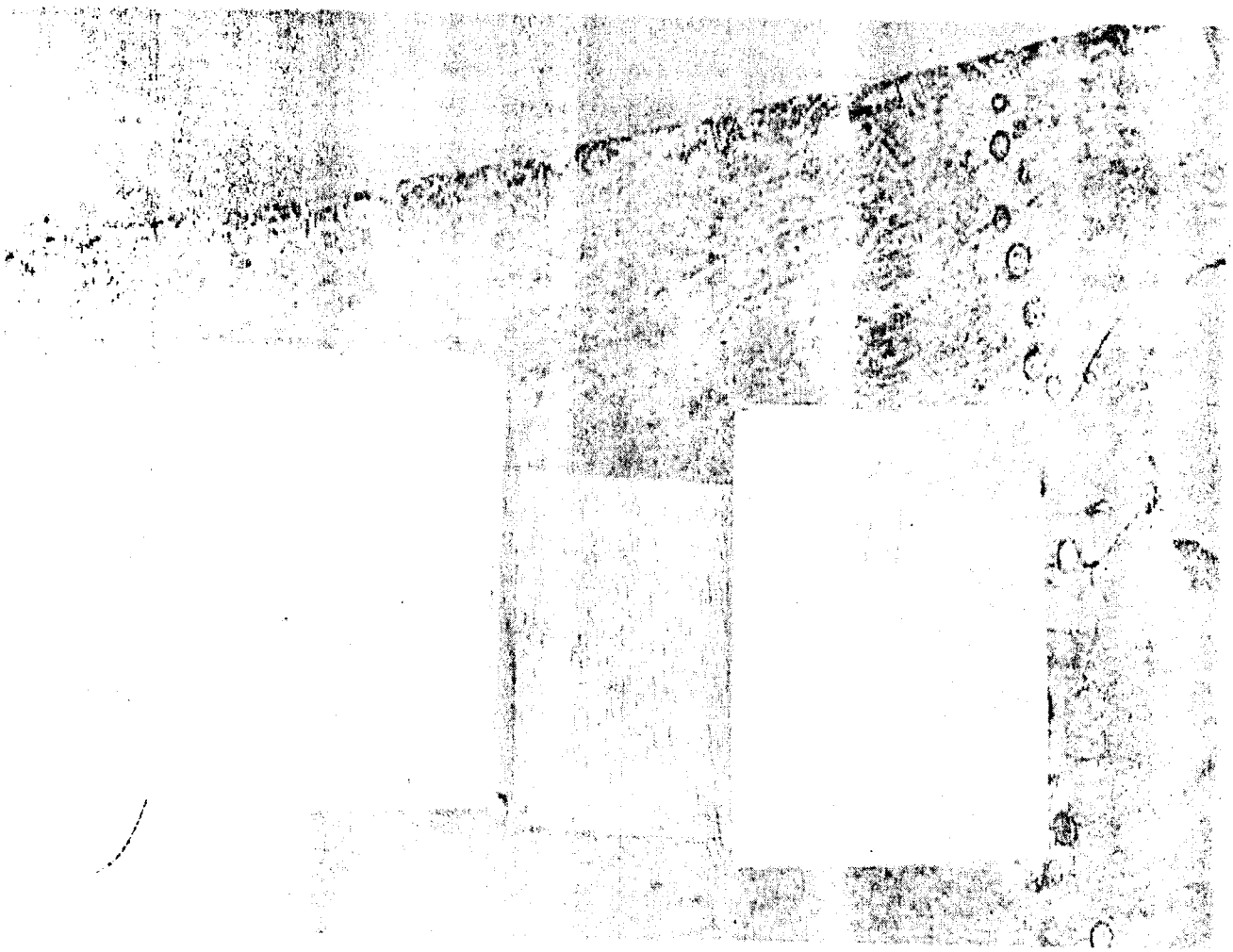

Fig. 4.2 The finished project

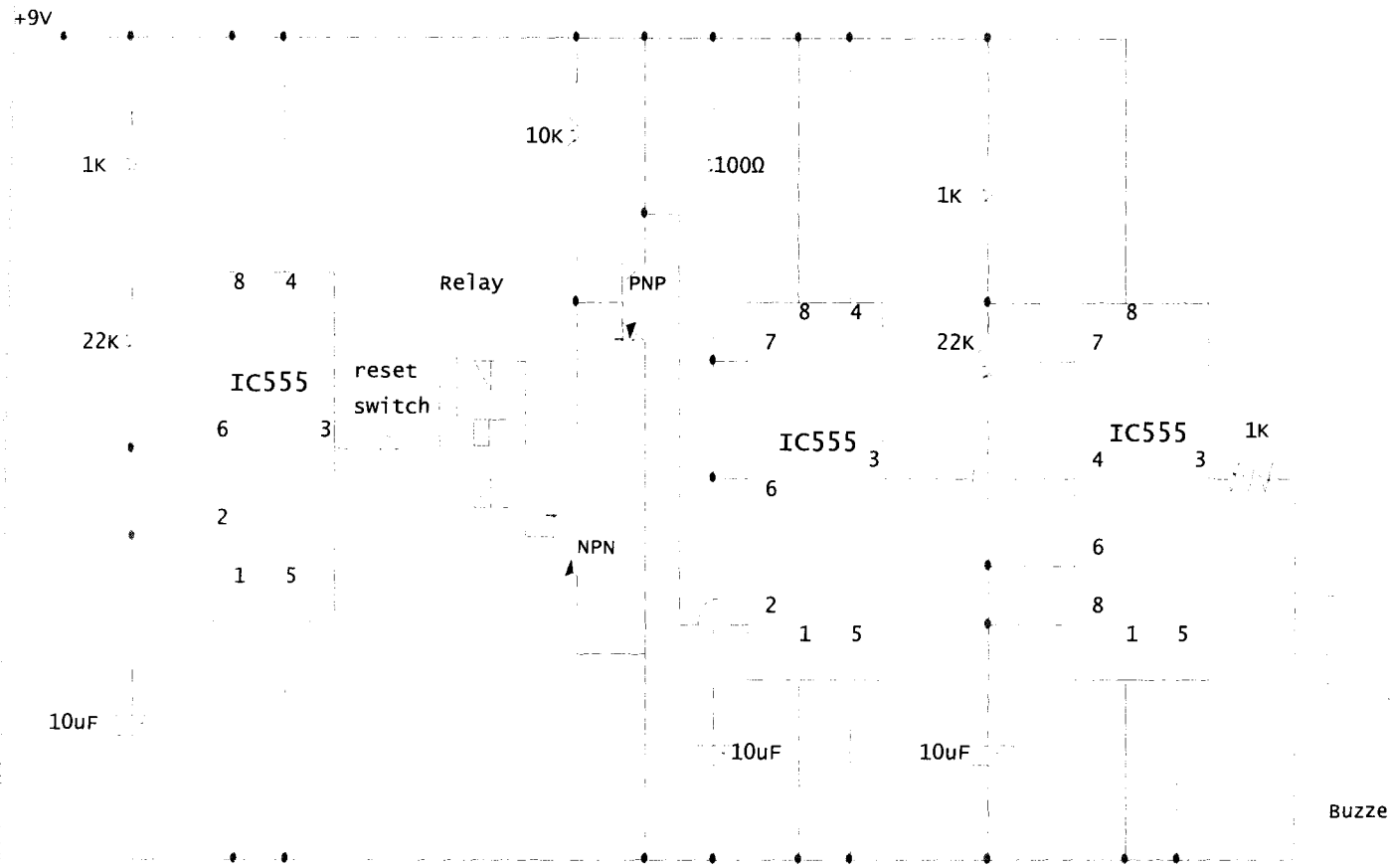

Figure 3.18 Circuit diagram of automatic burglar alarm