DESIGN AND CONSTRUCTION OF AN AUTOMATIC CAR THEFT ALARM

BY

ABU GIDEON ABU
2001/11891EE

A THESIS SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF BACHELOR OF ENGINEERING DEGREE(B.ENG) IN THE DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING, SCHOOL OF ENGINEERING AND ENGINEERING TECHNOLOGY,FEDERAL UNIVERSITY OF TECHNOLOGY,MINNA,NIGER STATE

NOVEMBER, 2007

DEDICATION

First of all, I dedicate this project to the Almighty God, the Alpha, the Omega, the Beginning and the End.

Secondly, I dedicate this project to my parents in persons of Mr. James .A. Abu and Mrs. Fatima .R. Abu whose effort to reach the level I am today will remain fresh in my memory for life.

DECLARATION

I ABU GIDEON ABU, hereby declare that this thesis is an original work of mine. All information obtained from published and unpublished works have been acknowledged.

CERTIFICATION

This is to certify that this project is carried out by ABU GIDEON ABU in the Department of Electrical/Computer Engineering, Federal University Of Technology, Minna.

	ABU 30/11/07
ABU GIDEON ABU (STUDENT)	SIGN/DATE
	30/11/07
MR.MICHAEL DAVID (SUPERVISOR)	SIGN/DATE
ENGR.M.D.ABDULLAHI (H.O.D)	SIGN/DATE
EXTERNAL EXAMINER	SIGN/DATE

ACKNOWLEDGEMENT

First and Foremost, I give all Glory to God Almighty for his guidance, protection and breakthrough in all my endeavors.

I wish to express my profound gratitude to my supervisor, Mr. Michael David for his assistance, guidance, kindness and constructive criticism at various stages of this project work which eventually led to its successful completion.

My gratitude also goes to the H.O.D of Electrical/Computer Engineering Department, Engr.M.D.Abdullahi for his moral and academic assistance through out this period.

My gratitude also goes to all my friends, well wishers and most especially my Parents, Mr. and Mrs. Abu for their love, encouragement and support throughout my course.

ABSTRACT

This work describes how the circuit of a car theft alarm is designed and constructed basically to discourage theft. The Reset Switch (Button) is Set to activate the circuit and Reset to deactivate. When the circuit is activated, it is capable of sensing a touch on the car's body (door knob) and opening of the door respectively to trigger the alarm. The circuit is also capable of sensing a close of the ignition switch and triggers the alarm. The Reset Switch is used to off the alarming sound in any of the above mentioned conditions and at the same time deactivating the circuit.

TABLE 0F CONTENTS

CHAPTER THREE:

CHAPTER FOUR:

CHAPTER FIVE:

CHAPTER ONE

1.0 INTRODUCTION

1.1 GENERAL INTRODUCTION

In the first generation, human beings depend on simple means of alerting each other for a breach in security. For instance, clapping of hands at a particular time in an environment can be interpreted by another person, smoke signals and drums used to warn villagers of approaching trouble or danger, little bells attached to a door to ring when opened, tin cans tied to a string tied across a pathway to ring when touched, etc [1].

With the recent advancement in technology, circuit design of alarm systems has grown over the years to meet with present day demands. This technological growth is with a view to go ahead of the ingenuity of burglars. From the manual ways that characterized the onset, most alarms are now automatic in operation with the connection of sensors like switches, pressure sensors and motion detectors. Sound producers like buzzers, sirens and loudspeakers have replaced horns and bells.

Alarm systems are electronic devices that give warning sound or signal of imminent event or danger to a person. Electronic security alarm systems are recognized all over the world as an important contributor to the security of life and property. Digitalization has also made room for smaller devices to be kept out of view from a burglar or intruder, unlike analogue components that could easily attract an intruder. Types of alarm systems are anti-theft car alarms, intrusion detection alarms, smoke alarms, fire alarms, speed limit alarms or instrumentation alarms as in metal detectors, clocks, digital phones, etc. Security alarms could be dual-tone or multi-tone as in siren and other hazard alarms. Alarms use to generate tones and loudness amplification has discrete electronic multivibrator circuits. Instrumentation alarms on the other hand give beeping tones or a particular melody. The beeping of these alarm circuits are achieved using a buzzer. This buzzer has a built in oscillator to generate a signal of a particular frequency and activated once powered [2].

Over a century ago, car theft alarms wouldn't have been thought necessary. At a time, cars were non-existing and when they were eventually made, there was no much need for a security system, since car stealing was not a problem. After the first documented case of car theft in 1896, that is a decade after gas powered cars were first introduced. From that era to today, cars have been a natural target for thieves because they are valuable, reasonably easy to resell and they have a built in get away system. This situation has compelled many electrical/electronic engineers to design and construct an automatic car theft alarm. The car theft alarm is an electronic device installed in vehicles in an attempt to discourage theft. Today, car theft alarms are now equipped with sophisticated electronic sensors, blaring sirens and remote-activation systems. These cars are high-security fortresses on wheels. Car theft alarm systems like any other alarm systems are in two categories. They are the contact operated alarms and remote alarm systems. The contact operated alarms are alarm systems that are activated either by touching of specific parts of the body, switching ON the ignition or opening of the car door .These alarm systems are designed to operate with a loudspeaker, a power transistor and an industrial relay to give an output as an audible warning device. Remote alarm systems on the other hand involve the transmission of trigger signals by either breaking an infrared, ultrasonic beam or a modulated radio frequency signal. A decoder at the receiver circuit decodes the received signal which is used to control the switch of the alarm system [3].

This project work falls under the contact operated alarm systems. The car theft alarm is designed and constructed with a view to applying it in safeguarding of cars from intruders or burglars. It is achieved by incorporating a circuit that arms the alarm in a split of seconds when the car's door knob is touched and opened respectively.The alarm can also be triggered by the switching ON of the ignition. Whenever the alarm is triggered ON, there will always be a drop in battery supply voltage. The touching and opening of the car's door also activates the interior light, leading to increase in electrical load and triggers ON the alarm.

This operating principle simplifies the installation for practically all vehicles having courtesy lights and actuating switches installed in at least two doors and it is fairly easy to install further switches in the rear door pillars if required. Both the boot and under bonnet areas may be protected in a similar manner since many vehicles have lights already fitted in these areas. If not, it is a simple matter to incorporate them in the circuit. These lights must be switch able at all time not just when the ignition is ON

1.2 AIM AND OBJECTIVE

The objectives of this project are,

(1) To design and construct a simple and portable automatic car theft alarm.

(2) For easy installation in automobiles or vehicles.

(3) To serve as a touch sensitive alarm, door switch alarm and voltage drop sensitive alarm.

(4) To design and construct an alarm strictly for vehicles with 12volts D.C battery supply.

1.3 METHODOLOGY

The door switch alarm circuit is activated by opening of the door and closing of the switch. The touch sensitive alarm circuit is activated by a sense of touch of a human finger or a body and produces a voltage to the Darlington pair in the circuit. The ignition sensitive circuit is activated by a sense in voltage drop of the battery.

Finally, each stage of the circuit mentioned above is wired through the actuating circuit and delay circuit respectively.

1.4 SCOPE OF THE PROJECT

This project is designed to discourage an intruder and alert the owner of a car. The frequency range of alarming sound from the loudspeaker is approximately equal to 700HZ. The switching of the device is done with the use of an industrial relay and sound amplification with the use of a power transistor. Since the project is a prototype, the car key for switching on the ignition is by hot wiring.

1.5 SOURCES OF MATERIALS

Sources of information's for the write up of this project work are from lecture notes on analogue and digital electronics, textbooks, electronic circuit guard, internets, data sheets of active and passive components, encyclopedia, student project guidelines, advices from project supervisor, course mates laboratory technicians, etc.

Sources of materials or components for the construction work were gotten from electronic ships in Minna.

1.6 PROJECT OUTLINE

This project write up is divided into five (5) chapters; Chapter 1 presents a general introduction of the car theft alarm. Chapter 2 deals with the literature and theoretical background of the subject. Chapter 3 is the design and implementation of the circuit on a step-by-step basis. Chapter 4 discusses the construction, testing and results obtained from such tests. Chapter 5 is a summarized conclusion and recommendation of the work.

CHAPTER TWO

2.0 LITERATURE REVIEW/THEORETICAL BACKGROUND

2.1 LITERATURE REVIEW

After the advent of gas powered cars in 1886, cars have been a natural target for thieves till today. The strive to obtain solutions to car thefts have led to the inventions of different kinds of car alarms [4].

In the 1960's, an English man named David Striker invented a car alarm that horns or sound when the door, bonnet or boot is opened. The circuit is reset by closing the door, bonnet, boot and the ignition switch. Another kind of car alarm system that has a strain gauge under a driver's seat was also invented. This alarm sounds when the electrical equivalent weight of the car owner is compared with an already preset value to switch ON a relay. The relay contact feeds supply voltage to the coil of the car and this implies that any weight below or above the owner's weight will keep the car ignition system open circuited; although the car is able to detect the owner, the disadvantage is that it is only the owner that has the access to driving the car when the security is ON; and more so is the possibilities of an intruder having the same weight as the owner and can conveniently move away the car[5].

Electronic magazine of March 1993, affirmed that car alarm unit should be mounted somewhere inside the car where it will be difficult to find and remove it. The switch can be located under the dashboard or driver's seat where the driver can easily reach it. When the ignition is turned ON with the switch closed, whether by using the key or "hot wiring," the circuit will be activated [6].

In the late 19^{th} century, a kind of alarm system called lojack was invented. It is available only in few cities. The lojack is a hidden radio transmitter that can be activated after a car is stolen, to lead police to the thief. The transmitter is hidden randomly within the car, so thieves cannot easily find it and deactivate it. It is completely hidden and there's no way to look at a car and know whether it has a lojack installed. Lojack will never prevent any particular car from being stolen; it will only increase the chance of its being recovered [7].

Most modern car alarm systems are much more sophisticated that they might consist of an array of sensors that can include switches, pressure sensors and motion detectors, a siren often able to create a variety of sounds so that one can pick a distinct sound for one's car, a radio receiver to allow wireless control from a key fob, an auxiliary battery so that the alarm can operate even if the main battery gets disconnected and finally a computer control unit that monitors everything and sounds that alarm(the brain of the system).The brain in most advanced system is actually a small computer. The brain's job is to close the switches that activate alarm devices like the horn, headlights or an installed siren, which is when certain switches that power certain devices are opened or closed. Security systems differ mainly in which sensors are used and how the various devices are wired to the brain. The brain and alarm features may be wired to the car's main battery, but they usually have a backup power source as well. This hidden battery kicks in when somebody cuts off the main power source (by clipping the battery cables, for example).Since cutting the power is a possible indication of an intruder; it triggers the brain to sound the alarm [8].

2.2 THEORETICAL BACKGROUND

The automatic car theft alarm produces sound in an attempt to discourage a thief and as well alert the car owner or security personnel. To understand the theory of this car theft alarm, the operations of a thief that leads to the alarming sound will be carefully studied. Below is a block diagram which summarizes the operations of the car theft alarm from the input stage to the output stage.

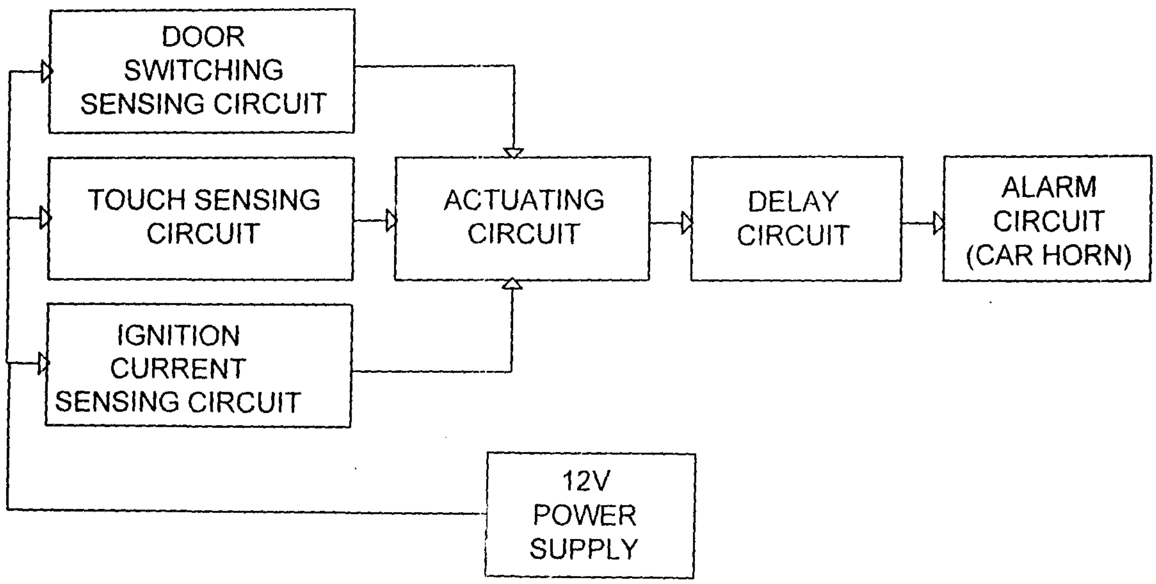


Fig.2.1 Block Diagram of an Automatic Car Theft Alarm

The alarm is activated when a thief tries to:

(i) Open any of the doors.

(ii) Touches the car body (door knob)

(iii) Switches ON the ignition.

2.2.1 THE OPENING OF THE CAR DOOR

The car door is wired to a switch in the door switch circuit. A switch is an Electronic device for completing or breaking an electrical circuit. Basically there are two types of switches namely; Press to make contact switch and press to break contact switch. However, the press to break contact switch is used for this project work and has a current rating of 5A. When a car door is opened, the switch will be closed, the transistor Q_1 will be OFF and an output will be produced at the end of D_1.In this case, the transistor Q1 Switches OFF by producing an output voltage of approximately zero volts (i. e in the Range of 0 to 0.2V). This also makes Q_1 to behave like logic OR gate. The HIGH 1 (high voltage) at D_1 reduces some amount of voltage from the 12V battery supply, therefore making the alarm to sound.

2.2.2 TOUCHING OF THE CAR BODY (DOOR KNOB)

The car door knob is wired to a touch sensor unit. The touch sensor unit Senses the touch of a human finger or body and triggers on the alarm. The resistance of a human body or finger is great enough to create a field on the door knob when touched. The human finger forms a voltage divider network with resistor R_3 in the touch sensor unit. A reasonable amount of voltage is made to flow through the base of transistor Q_2.Transistors Q_2 and Q_3 constitute the Darlington pair and acts as an amplifier. The voltage flowing from Q_2 and Q_3 will make the Darlington pair to be ON and the output end of the Darlington pair becomes low because it is fed into the base of Q_4.Consequently Q_4 will be OFF and the output at the end of Diode D_2 will be a high output. Theoretically, the current gain of Q_2 and Q_3 is the product of the current gain of Q_2 and Q_3.That is;

$\beta = \beta_2\beta_3$[9].

Where β_2 is the current gain of Q_2.

And β_3 is the current gain of Q_3

2.2.3 SWITCHING ON THE IGNITION

The ignition uses power supply from the battery for the movement of the car. The ignition can be switched ON either by kick starter or hot wiring. The hot wiring is used in this case since it is a prototype. The principle of operation of the ignition is that when it is switched ON, the normally open contacts of the (12V, 30A) relay coil will be closed, therefore making a complete circuit from the car battery to the relay coil.

2.3 TIMER CIRCUIT

The design of this part of the system uses an IC (Integrated Circuit) Neon 555 timers. This timer chip is very versatile and can be used in the monostable mode or astable mode.

The delay circuit is configured to operate in the monostable mode and the alarm circuit in the astable mode. To understand whichever configuration the timer is made to operate, the pins configuration and function of a Neon 555 timer will be helpful[10].

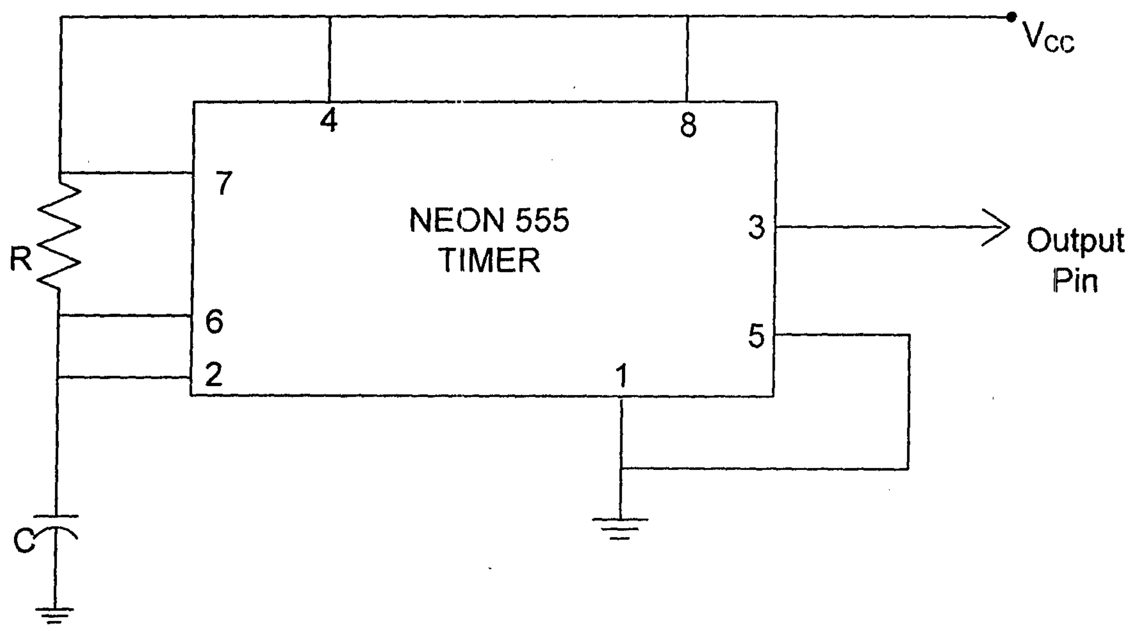


Fig 2.2 Pin Configuration of a 555 Timer

Where;

1 = GROUND PIN(Always at 0V).

2 = TRIGGER PIN (Used for triggering when voltage is ≤ 2/3 of a supplied voltage).

3 = OUTPUT PIN (For giving output signal).

4 = RESET PIN.

5 = CONTROL PIN (For control of voltage terminal).

6 = THRESHHOLD PIN (For determining the time a capacitor will be charged).

7 = DISCHARGE PIN.

8 = Vcc PIN (for sourcing power supply).

2.4 POWER SUPPLY

The power supply for the project work is a rechargeable 12V lead cell battery. Whenever any stage of the circuit is activated, there is always a drop in voltage from the battery supply.

CHAPTER THREE

3.0 DESIGN AND IMPLEMENTATION

3.1 DESIGN ANALYSIS

The entire system's design is divided into six main parts, with each having very unique importance. They are as follows;

(1) The Door Switch Unit.

(2) The Touch Sensor Unit.

(3) The Ignition Current Sensor Unit.

(4) The Actuating Unit.

(5) The Delay Circuit.

(6) The Alarm Circuit.

3.2 THE DOOR SWITCH UNIT

The door sensor/switch unit is a circuit which can detect the opening of the car door and triggers ON the alarm.

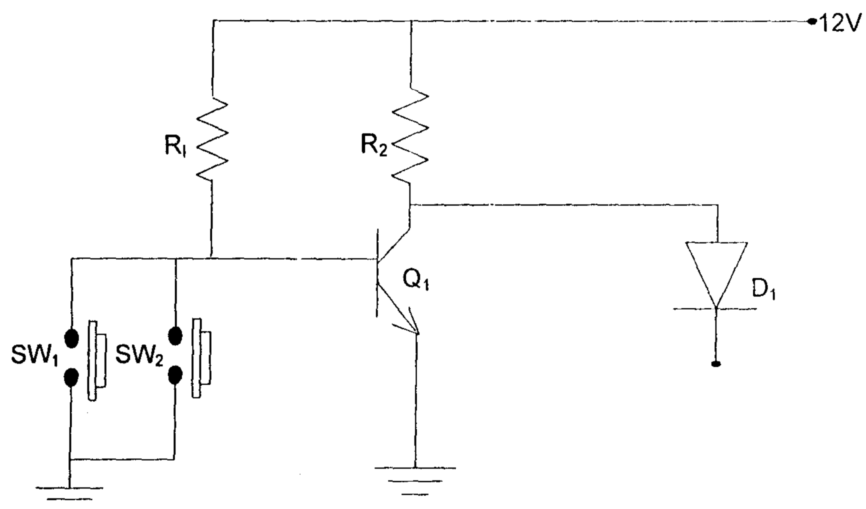


FIG. 3.1 The Door Switch Circuit

Fig 3.2 above gives an output if any of the car door is opened (an output equivalent of logic 1).From the above circuit, when any of the car door is closed, the switch will be open, the transistor will be ON and the diode will OFF so that there will be an output at the end of Diode D_1.

In this case, it is like biasing the common-emitter or self biasing the transistor Q_1 with a 12Volts from the car battery.

If any of the car doors is opened, the switch will be closed, the transistor will be off and the diode will be ON. There will be an output at diode D_1.

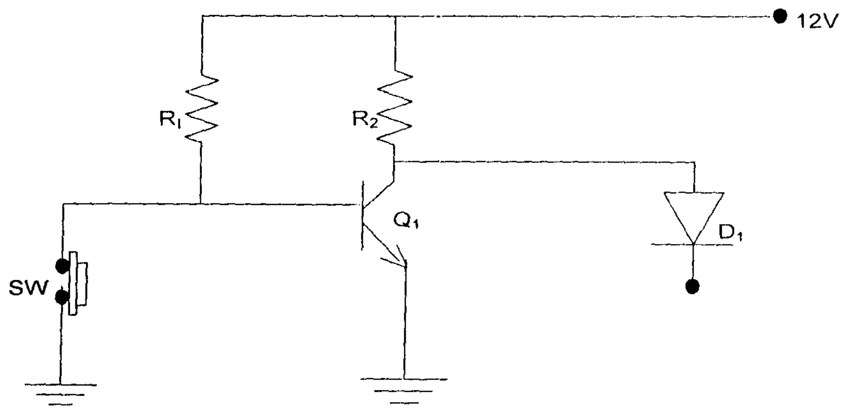


FIG. 3.2 The Closed Door Switch Cut

From the circuit above, the common emitter or self biased transistor Q_1 is behaving like a logic OR gate. The switch is closed (shorted to the ground) and gives an output. From the logic OR gate, the truth table can be drawn and used to illustrate the output at all positions of the door.

The truth table of the OR gate showing the output when any of the car door is opened (i. e the switch is closed) is shown below;

Table 3.1 Truth Table For The Logic OR Gate.

SW1	SW2	OUTPUT
0	0	0
0	1	1
1	0	1
1	1	1

The above table shows that when any switch is closed, the output is logic 1 or high and when the entire switch is closed, the output is also logic 1 or high.

DESIGN CALCULATION

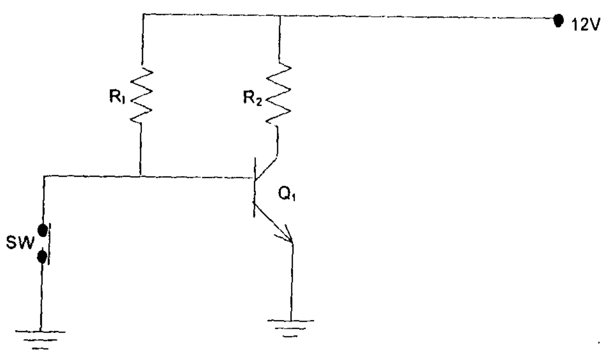


FIG. 3.3 (i) The Closed Switch Circuit

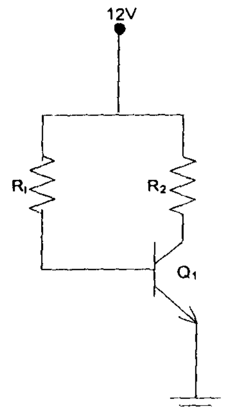


FIG. 3.3 (ii) The Equivalent Closed Switch Circuit

In the circuit above, the 12Volts provides forward bias and reverse bias condition for the common-emitter configuration. For step by step analysis, the base emmiter circuit in the forward bias condition is considered and illustrated in the partial circuit diagram below.

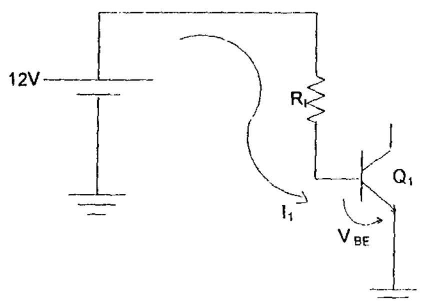


FIG. 3.4 Partial Forward Biased Circuit

For the circuit above, the kirchoff voltage equation for the loop can be written as;

$$V_{cc}-I_1R_1-V_{be}=0$$

Solving for R_1, we have;

$$R_1=\frac{V_{cc}-V_{be}}{I_1}$$

But for amplification operation, the collector current is related to the base current by the transistor current gain β (beta) and given by the relation,

$$I_2=\beta\times I_1$$

Where I_1 and I_2 are the base current and collector current respectively;

ASSUMPTION;

Let the collector current $I_2 = 10mA$,

Transistor current gain $\beta = 100$

From $I_2 = \beta \times I_1$ above,

$$I_1 = \frac{I_2}{\beta} = \frac{10 \times 10^{-3}}{0.1 \times 10^{-3}} = 0.1mA$$

Therefore R1 can be calculated as,

$$R_1 = \frac{V_{cc} - V_{be}}{I_1} = \frac{12 - 0.6}{0.1 \times 10^{-3}} = \frac{11.40}{0.1mA}$$

$$R_1 = 114000\Omega = 114K\Omega \text{(100K the preferred value)}$$

Where $V_{be} = 0.6V$.

To calculate for R_2, the collector emitter circuit in the reversed biased condition is considered and illustrated in the output collector emitter loop circuit below;

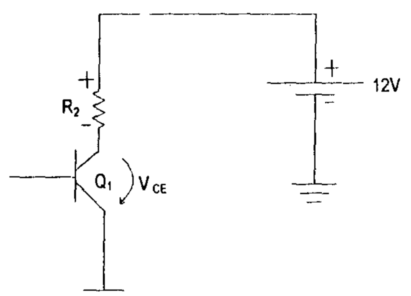


FIG. 3.5 Partial Reverse Biased Circuit

Applying kirchoff's voltage law to the circuit above, we will have;

$V_{cc} - I_2R_2 - V_{ce} = 0$

$I_2R_2 = V_{cc} - V_{ce}$

$$R_2 = \frac{V_{cc} - V_{ce}}{I_2}$$

But $I_e = I_c + I_b$. Since the emitter terminal is shorted, then $I_e = 0$, and

$0 = I_c + I_b$

So, $I_c = -I_b$.

Where the negative sign means that the collector current is opposing the base current.

$I_2 = -I_1$

$$R_2 = \frac{Vcc - Vce}{10mA} \text{ (where Vce = 0.2 at saturation)}$$

$$R_2 = \frac{12 - 0.2}{10 \times 10^{-3}} = \frac{11.80}{10 \times 10^{-3}} = \frac{11.80}{10^{-2}} = 1180\,\Omega$$

Therefore, $R_2 = 1.18K\Omega$ (where $1K\Omega$ is the preferred value).

3.3 THE TOUCH SENSOR UNIT

The touch sensor unit is the second specification considered in the design. The unit is capable of sensing any touch on the car's body(door knob) and triggers ON the alarm.

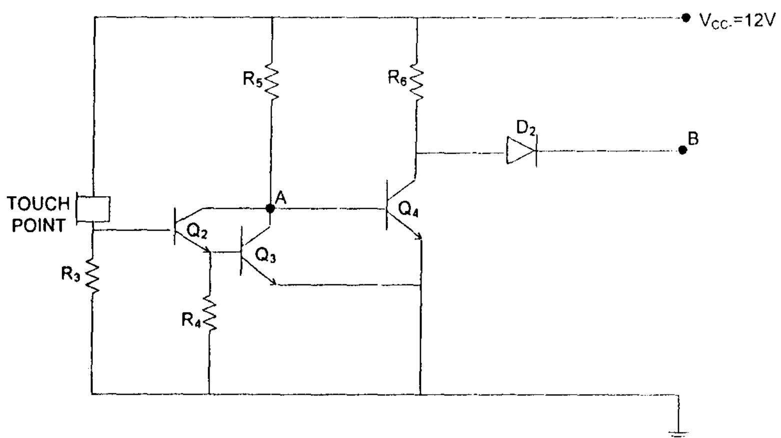


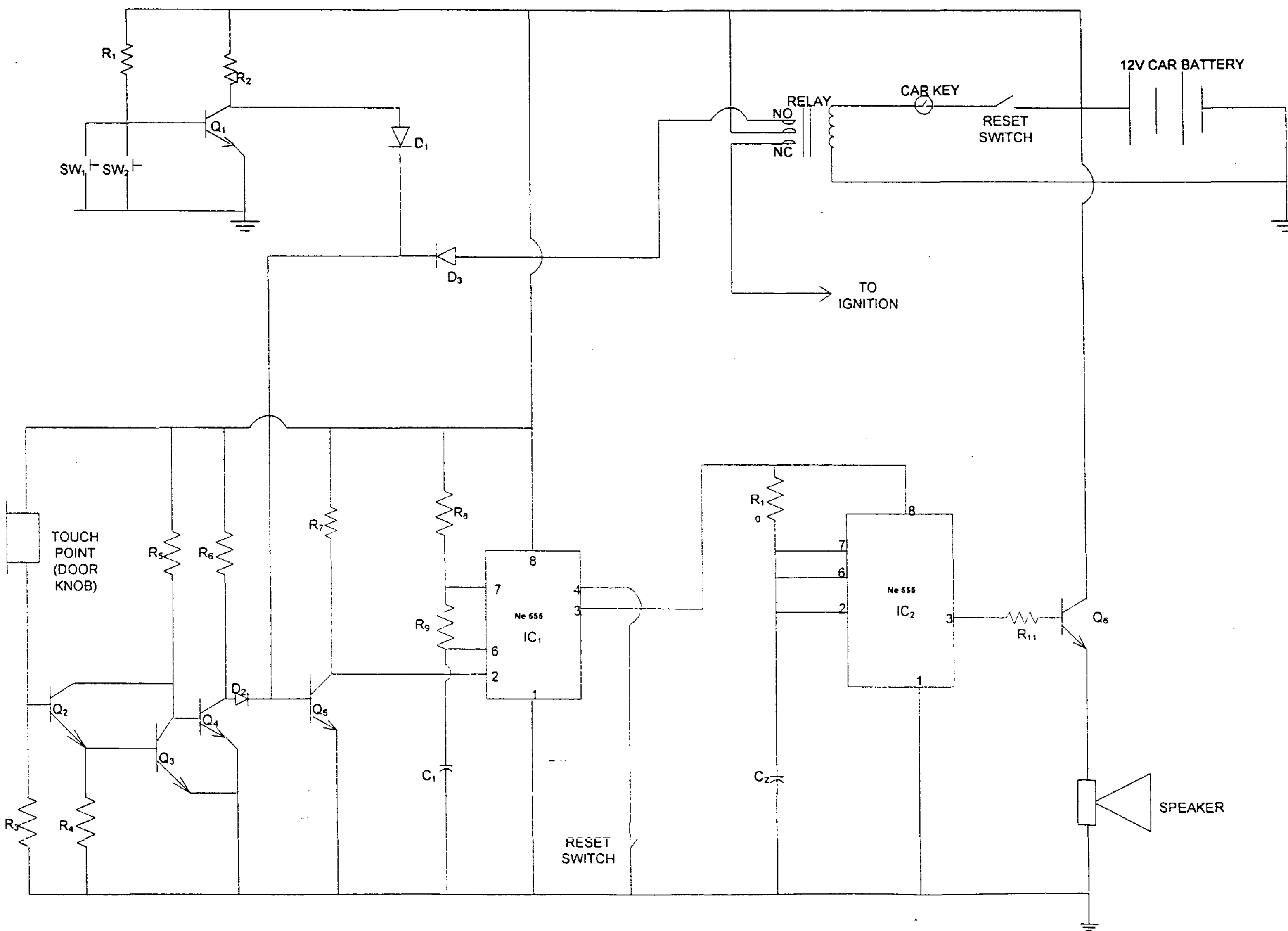
FIG. 3.6: The Touch Sensor Circuit

The resistance of the human finger is great enough to create a field on the door knob when the touch point is close. The finger resistance forms a voltage divider network with R_3.A voltage is also developed to flow through the base of transistor Q_2 and Q_3.Q_2 and Q_3 constitute a Darlington pair. If there is a voltage flowing through the Darlington pair,$Q_2$and Q_3 will be ON or HIGH so that a low output will be obtained at the end of point A. The low output from point A is fed into transistor Q_4,Q_4 will be OFF and the output end of point B will be high.

Furthermore, if the touch point (door knob) is open such that there is no voltage flowing through the base of Q_2, Q_2 and Q_3 will be OFF. The resulting output at point P will be HIGH and fed into the base of Q_4.Q_4 will ON and the resulting output at the end of point B will be LOW or 0.

The operation of the Darlington pair always make transistor Q_4 to behave like an inverter (logic gate) in the sense that whenever the output at point B is HIGH or 1, transistor Q_4 WILL be OFF. Whenever the output at point B is LOW or 0, it indicates that Q_4 is ON. Resistors R_3 and R_4 are connected to the ground. The function of R_3 is to maintain the system at earth potential always so that any external source or effect like a charge will not turn ON the Darlington pair. The function of R_4 is to take care of any leakage of collector current that may arise from Q_2, such that Q_3 does not turn ON. The Darlington pair is considered in the design of this alarm because its high output impedance can be used to match the high input impedance at the touch point when open.

CIRCUIT DIAGRAM OF AN AUTOMATIC THEFT ALARM



REFERENCES

[1].Steven Filippini A Brief History on the security Alarm, sound and video contractor

http: //www. Google. Com/

[2] A.I. Menkity, Introduction to Electronics Spectrum Books Limited, 1994,pp.17-40

[3]. Tom Harris, How Burglar Alarm works , Howstuffworks, Inc. http:// Electronics. Howstuffworks.com/alarm.

[4]. Tom Harris, How car Alarms works , Howstuffworks, Inc. http:// Electronics. Howstuffworks.com/alarm.

[5]. J.K. Millman and C.T.Halkias Integrteted Electronics.Third Edition, Mc Graw Hill 1982, pp. 6-12.

[6]. Malvin Paul, Electronics principle , Third Edition 1980, pp. 30-46.

[7]. "http:// www.springerlink.com/car alarm."

[8]. "http:// www.google.com/car theft alarm."

[9]. M.D. ABDULLAHI, Lecture Note on Analogue Electronics, Minna, Nigeria, 2004, pp.26-40

[10]. " http:// www. Kpsec. Freeuk. Com/555. timer. htm.

3.3.3 DARLINGTON CURRENT GAIN

Theoretically the overall current gain of a Darlington pair is the product of their individual current gains. The current gain of Q_2 and Q_3 can be achieved by considering the circuit diagram below.

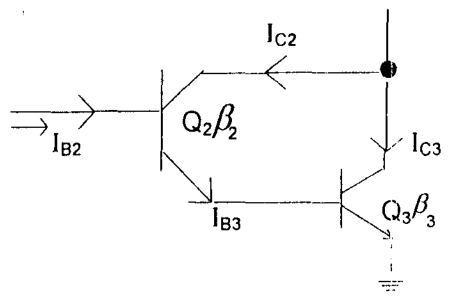


FIG. 3.7 The Darlington Pair Circuit

$I_{C2} = I_{B2}\beta_2$, where β_2 is the current gain of Q_2.

Also, $I_{C2} = I_{E2} = I_{B3}$

$I_E = I_C + I_B$

Where IB can be considered negligible.

So, $I_E = I_C$

Therefore, $I_{C2} = I_{B3} = I\beta_2\beta_2$ ……………………………………………(1)

From Q_3,

$I_{C3} = I_3\beta 3$ …………………………………………………………………(2)

Where $\beta 3$ is the current gain of Q3.

Substituting equation (1) and (2), we have;

$I_{C3} = I_{B2}\beta_2\beta_3$ ……………………………………………………………(3)

The current gain of the Darlington pair will be output current over the input current. That is,

$$\frac{I_{C3}}{I_{B2}} = \frac{I_{B2}\beta_2\beta_3}{I_{B2}} = \beta_2\beta_3 \qquad \text{....(4)}$$

Therefore, the current gain of the Darlington pair is the product of the current gains of Q_2 and Q_3.

3.3.2 INVERTING OPERATION OF Q_4

The inverting operation of transistor Q_4 can be considered by looking at the circuit diagram below.

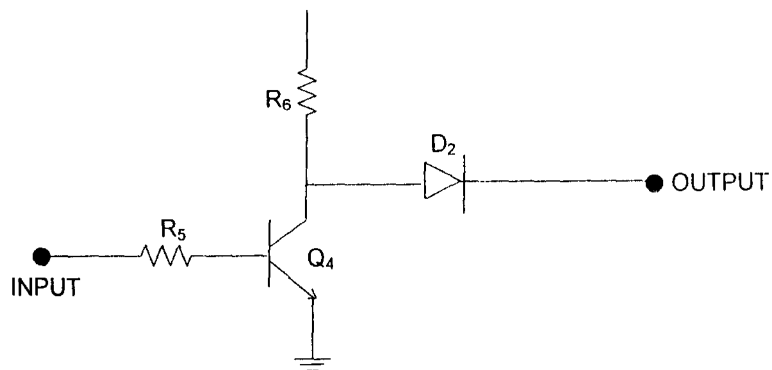


FIG. 3.8 The Inverter Circuit

INPUT	OUTPUT
0	1
1	0

Table 3.2 Truth table Of The Inverter Circuit.

The truth table above shows that the inverter will be HIGH when a low input is received and vice versa. This further shows that transistor Q_4 is operating either in saturation (ON) or in cut off (OFF) stage.

3.4 THE IGNITION CURRENT SENSOR UNIT.

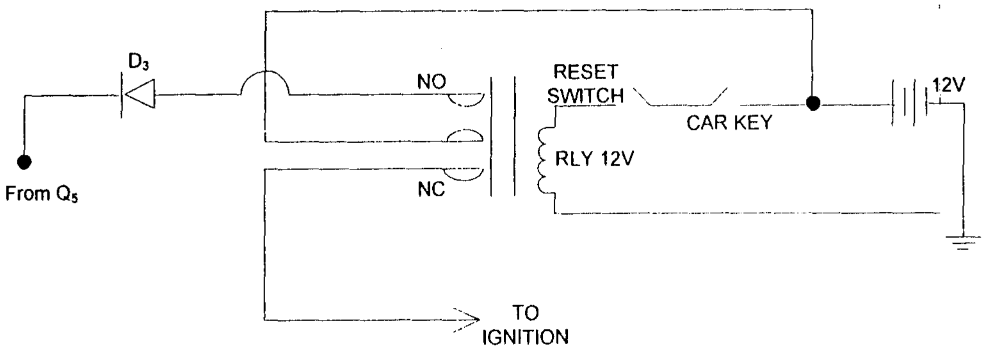


FIG. 3.9: The Ignition Current Sensor Circuit

When the Reset switch is closed, the relay will be in a ready position as soon as the car key is switched ON.A complete circuit is formed from the car battery to the relay coil. The relay will be activated and the normally open contact will be closed. Voltage from the battery is supplied to the base of transistor Q_5, switches it ON and triggers ON the alarm. The Diode D_3 prevents currents from the other units from interfering with the ignition activating circuit.

DESIGN AND CONSTRUCTION OF AN AUTOMATIC CAR THEFT ALARM

BY

ABU GIDEON ABU
2001/11891EE

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

SCHOOL OF ENGINEERING AND ENGINEERING TECHNOLOGY

FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA, NIGER STATE

NOVEMBER, 2007

3.5 THE ACTUATING CIRCUIT

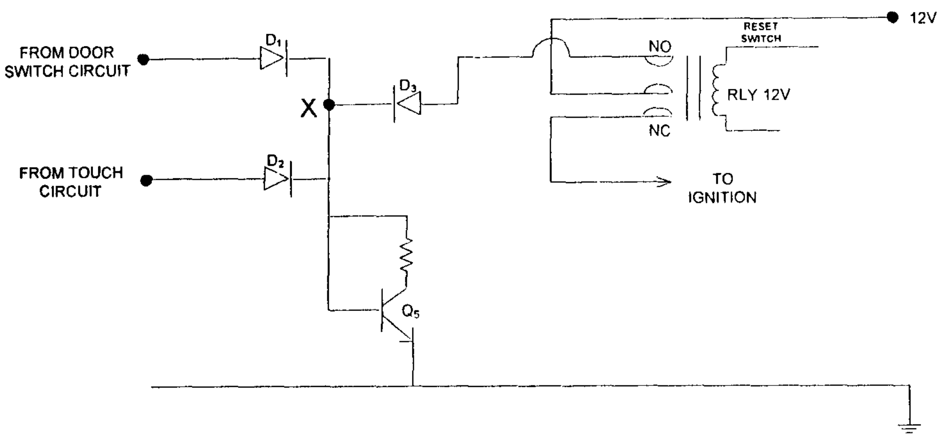


FIG. 3.10 The Actuating Circuit

The point X in the circuit above is a summing junction through which the output from the door switch circuit, the touch circuit and the ignition current sensor circuit passes into the actuating circuit and as well as to the timer circuit. The timer processes its input and gives an output to transistor Q_5 and the relay. The actuating circuit operates when there is a voltage drop by any of the unit and as well actuates the relay. Therefore, the actuating circuit functions only when the voltage from the timer circuit biases the relay coupling transistor Q_5 and again forms a complete circuit of voltage from the summing junction X to the emitter of Q_5.

3.6 THE DELAY CIRCUIT

The delay circuit uses a Neon 555 timer and it is configured to operate in the monostable mode.

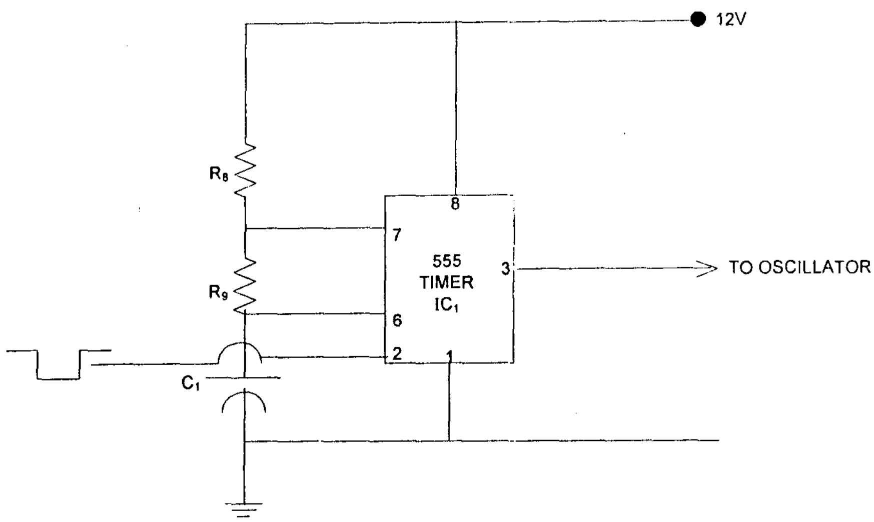


FIG. 3.11 The Delay Circuit

When the sense point at the base of Q_2 is touched, the body resistance forms a voltage divider network with R_3.This transistor is switched ON, a high appears at Q_5.Q_5 is acting as a NOT gate which inverts the HIGH to a LOW at pin 2.The low at pin 2 triggers IC_1 which is connected in the monostable mode, a HIGH appears at pin 3(output) which lasts for a time period set by the values of R_8, R_9 AND C_1.

DESIGN CALCULATION;

The time period for the alarm sound is given by T = 1.1RC1

Where R = R_8+R_9.

Suppose the HIGH is to last for 10secs and R_8 and R_9 are chosen as 220K and 1K respectively, then the required value of C is given by C = $\frac{T}{1.1R}$, where R = 220K+1K = 221K.

$$C = \frac{10}{1.1 \times 221 \times 10^3} = 4.1 \times 10^{-5} = 41\mu F$$

But 41µF is not a standard value. The nearest available value used is 33µF.

The time duration is;

$T = 1.1RC = 1.1 \times 221 \times 10^{-3} \times 33 \times 10^{-6} = 8secs.$

Practically,8seconds was achieved. Switch SW_2 serves as a reset switch any timing operation is stopped and the output at pin 3 will go LOW whenever pin 4 is taken LOW by closing SW_2.

3.7 THE ALARM CIRCUIT

IC_2 is a Neon 555 timer configured to operate in the astable mode. It is configured to oscillate at a frequency within the audible frequency range. The frequency of the astable multivibrator is given by $F = \frac{1}{T}$, where $T = 1.1R_{10}C_2$.

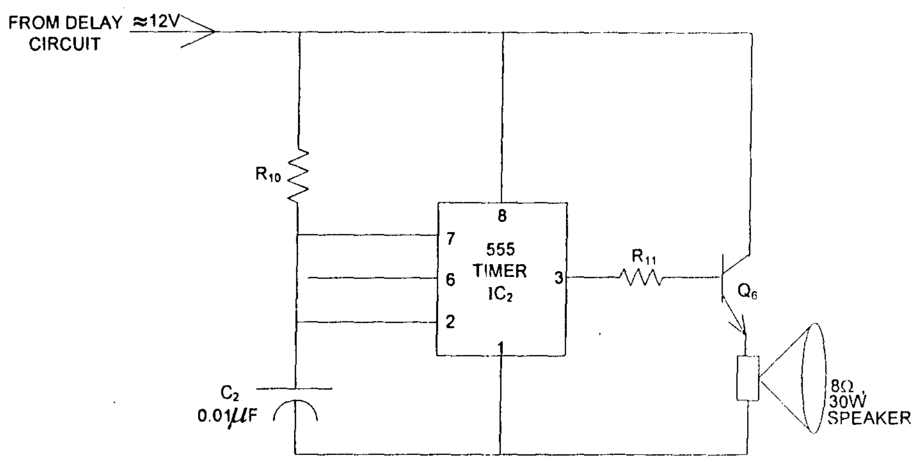


FIG. 3.12 The Alarm Circuit

In this design, it is intended that the frequency of oscillation or tone of the Alarm is that of 700HZ.

DESIGN CALCULATION:

If R_{10} is chosen as $100\,K\Omega$, then by change of subject of formula from $T = 1.1R_{10}C_2$,

$$C_2 = \frac{1}{1.1 \times F \times R_{10}}$$

$$C_2 = \frac{1}{1.1 \times 700 \times 100 \times 10^3} = 1.3 \times 10^{-8}\ \text{F}$$

Therefore $C_2 = 0.013 \times 10^{-6}$(i.e. approximately equal to 0.01μF).

The output of the oscillator at pin 3 is further boosted by the transistor amplifier Q_6 connected in the emitter follower mode. The speaker resistance of $8\,\Omega$ acts as a load or emitter resistor.

$$\text{Therefore,} I_E = \frac{V_{CC}}{R_E} = \frac{12}{8} = 1.5\text{A}$$

Required base current is given by,

$$I_b = \frac{I_E}{\beta + 1}$$

Where $\beta = 60$

$$I_b = \frac{1.5}{61} = 2.5 \times 10^{-2} = 25 \times 10^{-3}$$

R_B(Base resistor) = $\frac{V_b - V_{be}}{I_b} = \frac{12 - 0.6}{25 \times 10^{-3}} = 456\,\Omega$. But $456\,\Omega$ is not a standard value. Therefore, a standard value of $330\,\Omega$ was used.

3.8 PRINCIPLE OF OPERATION

The operation of this circuit is that it triggers ON the alarm when it senses any of the car door is opened, the body is touched or the car key is switched ON. The circuit sources its power supply from a 12V D.C battery. The alarm will trigger ON when the circuit is activated by pressing (setting) the reset switch down. The alarm can be switch OFF by repressing (resetting) the reset switch.

When the car body (door knob) is touched and opened respectively, the sensing unit of both touch and door circuit will be activated to trigger ON the alarm. That is the outputs from D_2 and D_1 respectively passes through the actuating circuit and delay circuit to give out an alarming sound from the alarm circuit.

When the car key (ignition) is switched ON, a complete circuit is formed from the car battery to the relay coil. The relay will be activated and the normally open contact will be closed. An output is developed at the end of D_3.This output passes through the actuating circuit and delay circuit to give out an alarming sound. The function of D_3 is to prevent current interference from other sensing units with the ignition current sensing unit.

3.9 LIST OF COMPONENTS

Table 3.3 Components Used

SYMBOL	COMPONENT	TYPE
R_1,R_3,R_5,R_{10}	RESISTOR	100 KΩ
R_2,R_4,R_6,R_9	RESISTOR	1 KΩ
R_7	RESISTOR	10K Ω
R_8	RESISTOR	220K Ω
R_{11}	RESISTOR	330K Ω
C_1	CAPACITOR	33μF
C_2	CAPACITOR	0.01μF
D_1,D_2.D_3	DIODE	IN4001
Q_1,Q_2,Q_3,Q_4	TRANSISTOR	BC548(NPN)
Q_6	TRANSISTOR	TIP 31C(NPN)
RLY	RELAY	12V,30A
IC1,IC2	TIMER	NEON 555
SW1,SW2	SWITCH	BREAK CONTACT
R/SW	RESET SWITCH	5A
SPK	SPEAKER	8 Ω ,30W

CHAPTER FOUR

4.0 TEST, RESULTS AND DISCUSSION

4.1 TEST

The construction of the project was done in stages, first of all on a bread-board to be sure that it works before it was transferred and assembled on the vero-board and finally soldered. Construction, in general, entails mounting and assembling all the required components for the project work in their respective positions and wiring them permanently.

The equipments used in testing the project are;

(1) Digital multi-meter

(2) Stop watch.

For effective workability of the project at hand, the following steps were taken;

(i) The power supply from the battery was measured to ensure that it was approximately or equal to 12Volts.

(ii) The components were firmly connected on the bread-board to avoid open-circuiting.

(iii) The length of the jumper wires were minimal to ensure effective transfer of voltage from one point to another, and neatness of the work.

(iv) Test for continuity and discontinuity were often carried out to ensure that open and short circuits were maintained as reflected in the original design of the Project.

(v) Excess accumulation of load during soldering was avoided so as to bring about dry joints and avoid short-circuiting.

(vi) A soft lead was used for soldering to ensure easy melting.

(vii) Continuity tests were always carried out to ensure that there were no deviations or alterations of the original circuit representation. It was only after this confirmation was made that the circuit was powered ON.

4.1.1 CONSTRUCTION ON BREAD-BOARD

The circuit was initially assembled on the bread-board, each unit of the alarm circuit was tested stage by stage and the system was found to be working satisfactorily according to the design specifications. The circuit was powered with a 12Volt D.C power supply for the testing purpose.

4.1.2 CONSTRUCTION ON VERO-BOARD

The circuit was mounted on the vero-board. This is to ease the construction work and also minimize error during the soldering process. It also allows test to be carried out at different stages when tracing a fault on the system.

When assembling the components on the vero-board, the polarity of the capacitors, pin configurations of the timers as well as the transistors were carefully observed. All soldering were checked for dry joints or for drops of solder that may cause shorting across the tracks before it was powered.

4.2 RESULTS

Below is a table of results for the alarm duration with the use of stop watch. The time durations were determined with the use of the expression below;

$T=1.1RC_1$

Where $R = R_8+R_9 = 221K$

Values of C_1 used are 10uf, 20uf, 30uf and 33uf.

When C_1=10uf,

$$T=1.1\times 221\times 10^3 \times 10\times 10^{-6} =2 .43\text{secs.}$$

When C_1 = 20uf,

$$T=1.1\times 221\times 10^3\times 20\times 10^{-6} = 4.86\text{secs.}$$

When C_1=30uf,

$$T=1.1\times 221\times 10^3\times 30\times 10^{-6} = 7.293\text{secs.}$$

When C_1=33uf,

$$T=1.1\times 221\times 10^3\times 33\times 10^{-6} = 8.02\text{secs.}$$

Table 4.1 Time durations of capacitors

CAPACITORS USED(µf)	TIME DURATION OF ALARM(SECS)
10	2.43
20	4.86
30	7.30
33	8.02

4.3 DISCUSSION OF RESULTS

The time duration of the alarm increases for higher values of capacitor C_1 used. The time duration can also be increased by making the value of C_1 constant and increasing the value of R. The 33uf was chosen because it is a standard value and nearest available to other higher values available but not standard.

It was discovered that during the construction process, not all realized circuit worked hand in hand with the theoretical measured value, but some initiatives and adjustment was carried out or employed to realize the objectives.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATION

5.1 CONCLUSION

Based on the theoretical analysis, design and testing of the project work; the automatic car theft alarm was able to give an alarm sound at the designed frequency range. The alarm can be used as a voltage drop alarm, door switch alarm or touch sensitive alarm. The components used in the construction are readily available. The automatic car theft alarm is designed strictly for automobile vehicles using 12volts battery supply. Nearly hundred percent success of the design specification and workability of the system were achieved.

5.2 RECOMMENDATION

The design can be improved upon, since there is always room for improvement on ideas. The author wishes to suggest that further work on this project should be in the area of incorporating a plate that can create electrical field on the touch sensitive circuit and this plate should be connected at strategic parts on the car body. All the doors should have the press to break contact switch.