DESIGN AND CONSTRUCTION OF A TOUCH ACTIVATED SECURITY SYSTEM

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DEDICATION

This project is dedicated to Almighty Allah, for his goodness and kindness, to my parents, Alhaji M.S Oloyede and Alhaja S.A Oloyede, to my brothers, Umar, Abdullahi and Sheriff and my friends at school.

DECLARATION

I, **OLOYEDE NASIF OPEYEMI** with matriculation number **2003/15438EE** declare that this work was done by me under the supervision of Mr M.B.Z Adamu and has never been presented elsewhere for the award of degree. I also relinquish the copyright to the Federal University of Technology Minna.

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ABSTRACT

The design presented by this project work is an integrated, multipurpose security system which can be connected to metallic gate, door handles and window protectors. It comprises of three units which integrate to function as a single electronics security system. These units are the power unit, the trigger unit and the alarm/amplifier unit. This integrated system uses a capacitive sensor which detects changes in electrostatic field and triggers the alarm unit to produce a large audible sound whenever there is an intrusion.

The sensitivity of the sensor was limited to human touch by altering the value of R2 in order to avoid cases of false alarm.

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CHAPTER ONE

GENERAL INTRODUCTION

.1 INTRODUCTION

Insecurity and crime constitute some of the major problems facing our immediate society oday. People live with fear of being attacked by buglers, vandals and thieves. Despite all the effort, resources and time that has been devoted to the development of tools that will reduce crime rates that will reduce crime rates and make the world a safer place to live, these problems are on the increase.

These gave rise to the need for an increasing development in the technology of alarm systems which utilizes various principles such as infrared motion detectors, light (photo) sensitive electronics devices and so on. Even into the introduction of these alarm systems which have greatly reduced the level of insecurity, there is still the problem of false alarm which needs to be minimized [1]. In order to effectively reduce the level of insecurity and avoid false alarms which can create unnecessary unrest, a touch activated security system is required. This system if properly designed will provide security and ensure alarms are activated only when an unauthorized person try to gain access to the protected area or device by touching the entrance or any other part of the device.

These are some of the reasons that prompted the design and construction of the touch activated security system presented in this work.

The system presented by this project work consists of three basic units viz:

The system presented by this project work consists of three basic units viz:

(i) The power supply unit which employs the use of both DC battery and mains supply to ensure constant power supply to the circuit.

(ii) The trigger unit which is responsible for activating the alarm unit. This unit was designed to have a lot time and period and moderate sensitivity in order to reduce the rate of false alarm and

(iii)The alarm amplitude unit which produces amplitude alarm sound when triggered by the trigger unit with the aim of producing a large audible sound that can alert the entire neighborhood or scare an intruder away.

The problem of frequent power outages in our country gave rise to the use of automatic power changeover switch which has the ability of between the mains supply and DC battery using a relay.

1.2 PROJECT OBJECTIVES

This project was carried out with the aim of meeting the following objectives

(a) To develop an electronic system that is power efficient, reliable and has the ability to use two independent sources of power supply with one acting as backup.

(b) To experiment the use of relays as automatic power changeover switch in portable electronic devices.

(c) To develop an alarm system with reduced rate of false alarm.

(d) To develop a portable security system that has multiple applications.

(e) To develop a cheap and reliable means for raising alert in the event of unauthorized intrusion to residential and commercial buildings.

(f) To develop a security system that will check the increasing activities of burglars and vandals thereby reducing crime rate in the society.

1.3 METHODOLOGY

The modular design approach was used in the design of the project. The circuit was broken down into modules (units) which were separately designed and then assembled to form the complete alarm system.

1.4 SCOPE AND LIMITATION

The project utilizes the basic operation of multivibrators (astable and monostable) in the trigger and alarm circuit. The multivibrators are used to ensure that the alarm circuit is only triggered when intruders try to gain access to the protected area or device. The entire equipment construction was manually done. Using tools and equipment available within the immediate environment and tested with the available measuring instruments.

1.5 SOURCES OF MATERIALS

Information that aid the successful design and construction of the alarm system were sourced from various sources including textbooks, internet, past lecture notes on digital and analogue electronics and consultation with colleagues who offer useful suggestion.

1.6 THESIS OUTLINE

The presentation of the project work in the five chapters is outlined below:

Chapter one presents the introduction, including objectives, methodology, scope of the work and sources of materials. Chapter two presents the literature review and historical background. Chapter three is the system design, analysis and relevant calculations. Chapter four explains the testing and implementation of the work and chapter five present the conclusion, problems encountered and useful suggestions for improvement on the design.

CHAPTER TWO

LITERATURE REVIEW

2.1 HISTORICAL DEVELOPMENT OF ALARM SYSTEMS.

An alarm is a loud noise or signal for alerting or informing people of danger or a problem. An alarm system is thus a security system that produces a form of sound to warn people of a particular danger. The development of alarm systems started with the creation of man. Man required giving alert, information and adopted a form of signaling, exclamation and shouting. This was later replaced by clapping of hands and beating of gongs by town criers to alert the community in order to disseminate information in the early African society. All these methods of raising alert were crude, unreliable and inefficient.

With the advancement in science and technology, these crude methods of generating alarm were replaced by electronic alarm systems in the late eighteenth century [4]. These electronic alarm systems operate without any human effort.

Once it senses a particular signal, it gives an indiction in form of a loud sound or noise depending on its design [12].

The first electronic fire alarm system was developed by Dr. William F. Channing and constructed by Mr. Moses G. Farmer, an electrical engineer. [3]. This system uses boxes with automated signaling to indicate the location of fire and was first put into operation in Boston in the United states of America (U.S.A).

The development of this alarm system by Dr. William was followed with the evolution of fire and bugler alarm technology of varying complexities and sophistications which are too numerous to mention. Notable among these technologies is the remote signaling intruder alarm system which was invented in the early 1970's [4]. This provided a rapid art full response to alarm calls.

The security industry is constantly evolving to come up with new and innovative techniques to keep off burglars and vandals [13]. Today we have the new generation of electronic alarm system which comes in various levels of complexities and sophistication [2]. These are usually called the modern electronic alarm systems.

2.2 MODERN ELECTRONIC ALARM SYSTEM

With the recent increase in crime rates, it has become important to protect our buildings and properties with adequate safety devices with increased level of sophistication [13]. The cost of these safety devices depend on the equipment technology and the application requirement. These safety devices are called the modern electronic alarm system [5].Some of the modern alarm systems commonly used these days is burglar alarms, industrial alarms, speed limit alarms, and anti-theft car alarms.

Burglar Alarm Systems

These usually involve a circuit loop system that rings a bell or activates a siren when set off. A central control box monitors several motion detectors and perimeter guards and sounds an alarm when any of them is triggered. Sensors are placed in the hallways or large rooms which activate an alarm when the beam of light is interrupted by a person walking across it [5]. Nowadays, closed circuit televisions are incorporated to burglar alarms to detect the presence of unauthorized persons and signal the police by auto dialers [6]. A pre-recorded message is then played to inform the police that their house is being burgled.

Duress Alarm System

They are used when under threat to send alarm signals to specific location, there are three general overlapping categories of duress alarms that can send one or more levels of distress signal to a particular location [7]. The types of duress alarm systems are:

(i)Identification Alarm: A portable device that identifies the owner of the device.

(ii)Panic button alarm: A push button mounted in a fixed location.

(iii)A location alarm: A portable device that locates and tracks the person who activated the alarm.

Industrial Alarm System

These alarms come in three versions. The 12V dc Grey bell is affordable and suitable for home security. It complies with the requirements of BS4737 intruder alarm system in buildings. The unit is mounted within a bell enclosure when used in external environments for fire detection. The design avoids the need for mechanical contacts resulting in greater reliability and efficiency.

Speed Limit Alarm Systems

These are wireless portable devices adaptable with most internal combustion engines. The circuit is designed to alert the vehicle driver when he has reached the maximum speed limit. It eliminates the need to look at the speedometer thereby reducing the risk of accident while driving. It monitors the revolution per minute and starts to beep when the maximum speed is attained.

Anti Car Theft Alarm system

This type of alarm system is usually mounted within the car where it will practically be inaccessible to intruders. The switch can be placed under the dash board or under the driver's seat. When the switch is activated or turned on, the electrical system of the car seizes to function or the fuel supply is cut off.

2.3 ADVANCEMENT IN ALARM SENSOR TECHNOLOGY

The increasing developments in science and technology have given rise to a tremendous improvement in the technology of alarm sensors. These sensors act as inputs which triggers the alarm. Some of the alarm sensor technologies that have evolved over the years are:

(i) Microwave sensors: These are motion detection devices that flood a designated area or zone with an electronic field. A movement in the zone disturbs the speed and sets off the alarm [9].

(ii) Vibration sensors: They are usually mounted on walls, ceiling and floor with the intention of detecting mechanical vibrations caused by chopping, saving, drilling or any type of physical intrusion [9].

(iii)Photo electric beam sensor: These sensors transmit a beam of infrared light to a remote receiver thereby creating an electronic fence. They are often used to cover openings such as doorways acting essentially as trip wires. Once the beam is broken or interrupted, an alarm signal is generated. [9]

(iv)Passive ultrasonic Sensor: These are motion detection sensors that listens for ultrasonic sound energy in a protected area and reacts to high frequencies associated with intrusion attempts.

(v) Active infrared sensors: These sensors generate a certain pattern of modulated infrared energy and react to a change in the modulation frequency or an interruption in the received energy. Both of these occurrences happen when an intruder passes through the protected zone [9].

(vi)Electrical field sensors: These sensors generate an electrostatic field between and around an array of conductors and an electrical ground. They detect changes or distortion in the field. These can be caused by anyone approaching or touching the sensor [9].

(vii) Audio sensors: These sensors respond to noise generated by intruders entry into a protected area and are generally used but exclusively for internal application.

(viii) Capacitive sensors: These sensors detect changes in the electric field. A signal is generated when an intruder changes the capacitance of the field by approaching or contacting the sensor wire [9].

The alarm sensor technology employed in this project work is the capacitance sensor. The sensor's wire is usually attached to metallic door handles and protectors etc. It normally require touch or close proximity and subsequent alteration of capacitance to trigger the alarm. This alarm sensor was adopted for this project work because it reduces the production of false alarms due to the fact that the sensor's detection ability is not affected by weather, electromagnetic and radio frequency interference.

CHAPTER THREE

DESIGN AND IMPLEMENTATION

3.1 STAGES OF IMPLEMENTATION

The system design was implemented in three units as shown in fig.3.1. These units are:

(A) The power supply unit

(B) The trigger unit

(C) The alarm/amplifier unit

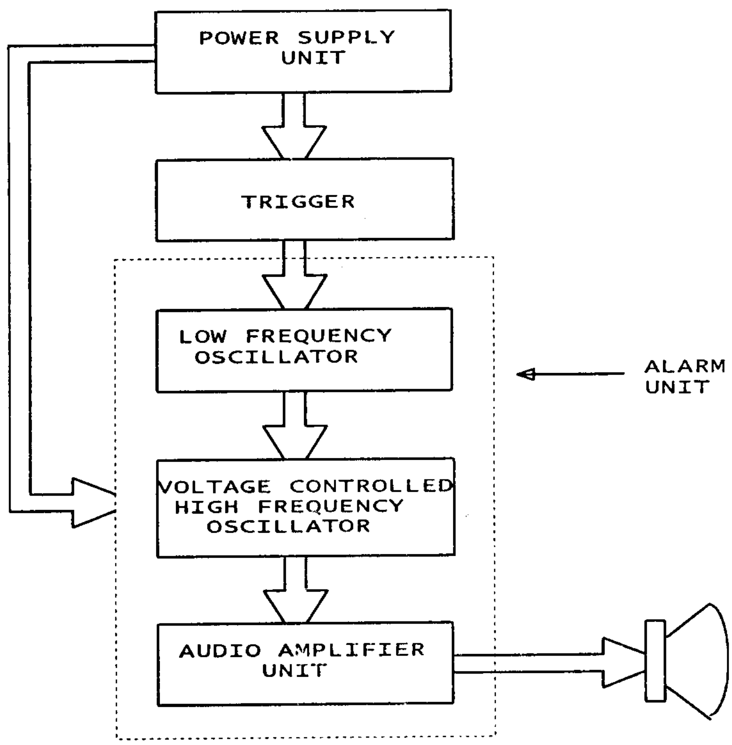

Fig 3.1 Block diagram of Touch Activated Security System

3.2 POWER SUPPLY UNIT

The power supply unit is a 2-way automatic power supply system. It gets input from both mains supply and battery supply. The two independent supply systems are connected to a relay switch which acts as automatic change over to switch on any of the available input supply to the main circuit. The power supply unit provides power supply of the other two units of the circuit.

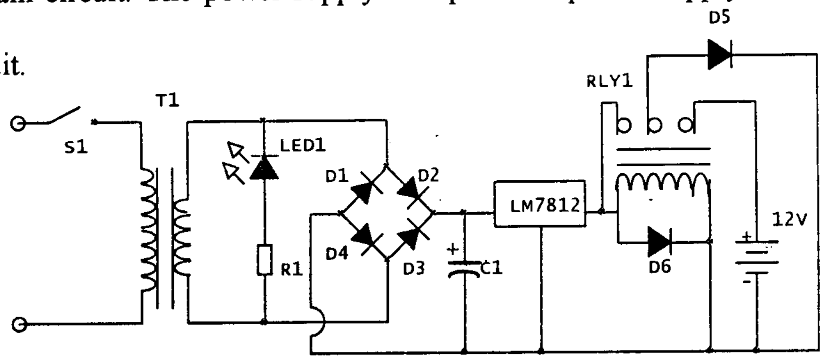

Fig. 3.2 The schematic diagram of the power supply unit

The schematic diagram of the power supply unit consists of two supply input sources- the a.c mains and the 12V d. c supply from battery. T1 is a step down transformer. D1, D2, D3 and D4 are rectifier diodes. C1 is a filter capacitor.IC1 is a regulator IC. Rly1 is a relay switch. R1 is a current limiting resistor protecting LED1. LED1 is used to indicate the presence of mains supply. D5 and D6 are protective diodes.

3.2.1 OPERATION OF THE POWER SUPPLY UNIT

The operation of the power supply unit can be illustrated by the block diagram below.

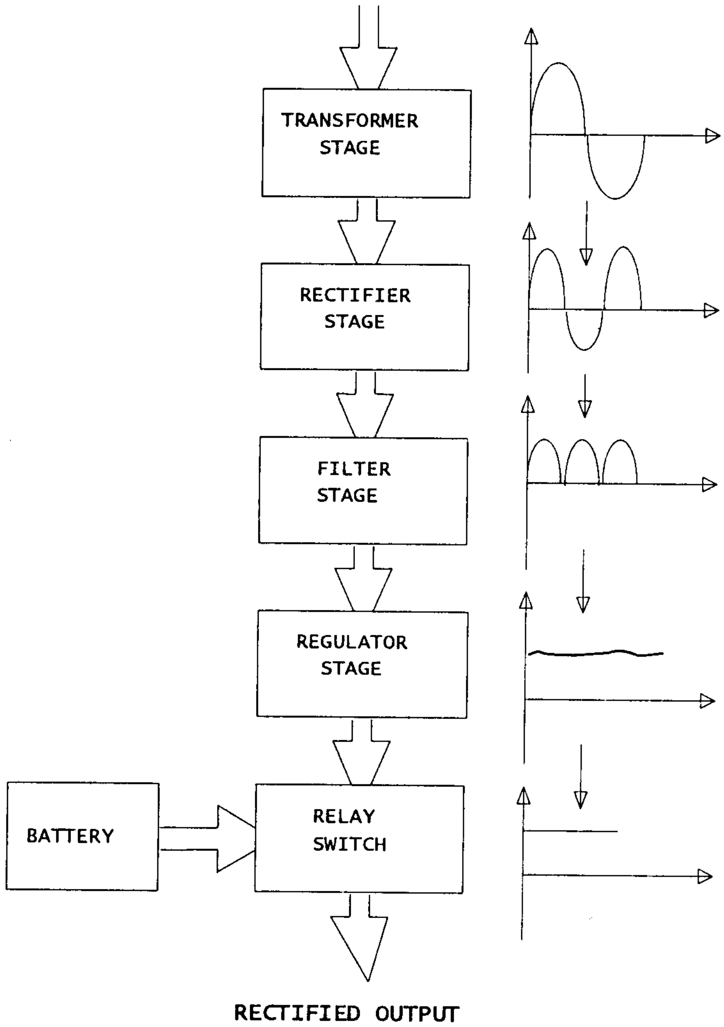

Fig 3.3 Block diagram of the power supply unit

The block diagram consists of 4 stages for rectification of the 240V a. c to 12V d. c., a battery supply and a relay switch. The description of each stage is given below:

(a) **TRANSFORMER STAGE**: This stage consists of a 240V/ 18V, step down transformer. It converts the 240V a. c from mains to 18V a. c which is then passed to the rectifier stage. A 220V/18V step down transformer was chosen because the regulator used required more than 12V for its operation.

(b) **RECTIFIER STAGE**: In this stage, the rectifier converts the 18V a.c supply from the transformer into a pulsating d. c voltage. A full bridge rectifier was used for this purpose. It consist of four diodes (In 4001) arranged as shown in fig. 3.2. During the positive half cycles, diodes D2 and D3 are forward biased and current flows through the terminals. In the negative half cycle, diodes D1 and D4 are forward biased. Since load current is in the same direction in both half cycles, full wave rectifier signal appears across the terminals[11]

(c) **THE FILTER STAGE**: The pulsating d. c voltage that comes out from the rectifier stage is converted into a constant d. c voltage with the aid of a filter capacitor (C1). This capacitor is large value electrolytic capacitor. It charges up (i.e. store energy) during the conduction half cycle thereby opposing any changes in voltage. The filter stage therefore filters out voltage pulsations (or ripples).

(d) **REGULATOR STAGE**: The output of the filter stage varies slightly when the load current or input voltage varies and it is a 18V d.c supply which is higher than the circuit requirement. For these reasons, an L.M 7312 regulator was used to stabilize the voltage and also to reduce the voltage from 18V to 12V steady d.c supply.

3.3 THE TRIGGER UNIT:

Below is the schematic diagram of the trigger unit:

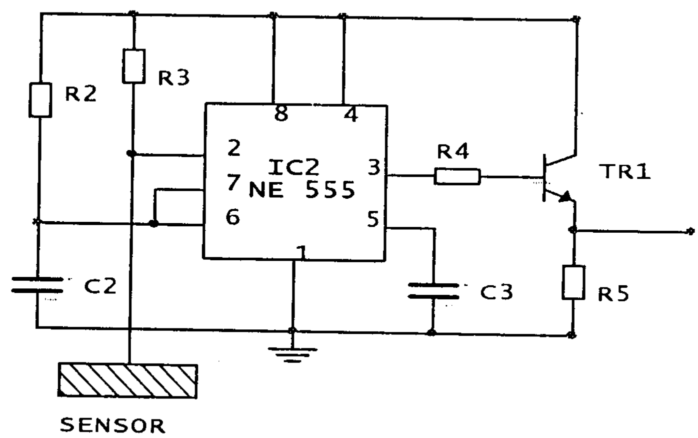

Fig. 3.4 Circuit diagram of trigger unit

As shown in fig.3.4, the schematic diagram of the trigger unit consist of two major components which are NE555 timer (IC2) and transistor TR1. The 555 timer(IC2) produces a trigger current which comes out through its pin 3 whenever pin 2 is activated through the sensor. Pins 4 and 8 are connected to positive power supply while pin 1 is grounded. R2 and C2 determines the time out period of the 555 timer (i.e. the period at which the alarm sound) while R3 determines the sensitivity of the sensor. The output form pin 3 (trigger current) is amplified by transistor (TR1). R4 act as base resistor to TR1 which is operating in common emitter mode. The 555 timer in this unit operates in a monostable mode.

3.4 THE ALARM UNIT

The schematic diagram of the alarm unit is shown in the figure below:

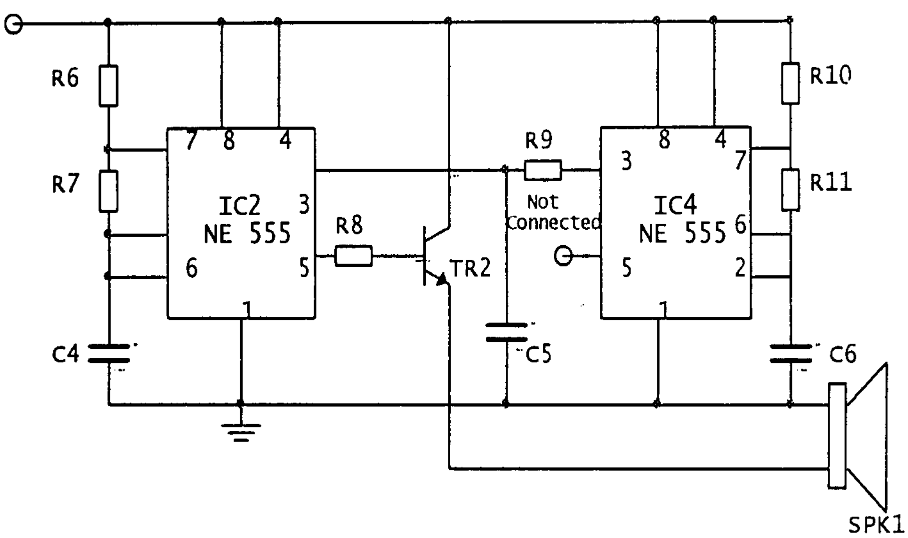

Fig 3.5 Circuit diagram of the alarm unit

The alarm unit, as shown above consists of three basic components which are (a) Two 555 timers IC3 and IC4 operating in a stable mode to produce a siren sound and also (b) a power transistor (TR2) used for further amplification of the audio output.

IC3 operates as high frequency oscillator (voltage controlled) operating at a normal frequency of about 481 Hz and producing a square wave. This forms the basic tone of the siren sound system. IC4 produces another square wave of much lower frequency of about (0.5 Hz). This lower frequency alters the rhythm of the steady tone from iC3 to the desired siren sound. The output of IC4(its pin 3) is actually coupled through R8 to control the voltage terminal of IC3. The low frequency (0.5Hz) output from IC4 is used to modulate the high frequency 481Hz produced by IC3 thereby alternating the frequency of operation of IC3 to produce a siren sound instead of a continuous 481 Hz tone.

The final siren note is available at pin 3 of IC3 but its maximum current (as calculated on page32) is 0.038A. This current is not sufficient for 5W, 8 ohms speaker. The pin 3 output of IC3 is therefore fed to the transistor TR2 for further amplification enabling it to power the speaker thereby producing a very loud audible siren sound.

3.5 CIRCUIT OPERATION

The complete circuit diagram of the alarm system is shown in fig 3.6. the 555 timer in the trigger unit gets activated whenever pin 2 senses a smaller potential that is less than 1/3 the supply voltage. When activated it sounds for duration of time determined by R2 and C2, this also determines how long the alarm will sound before going off.

In reality, the sensor wire is usually connected to metallic door handles, protectors (for windows and doors) or even metallic gates. Whenever the human body comes in contact with such materials the trigger unit gets activated and the alarm sounds. A detailed explanation of this action is given by the following points: Pin 2 actually acts as a capacitance sensor and detest changes in electrostatics fields, The human body and most conductors in nature generates electrostatic charges which alters the capacitance of the field thereby inducing a small signal on the sensor wire [8]. This signal operates for a period of time determined by C2 and R2.

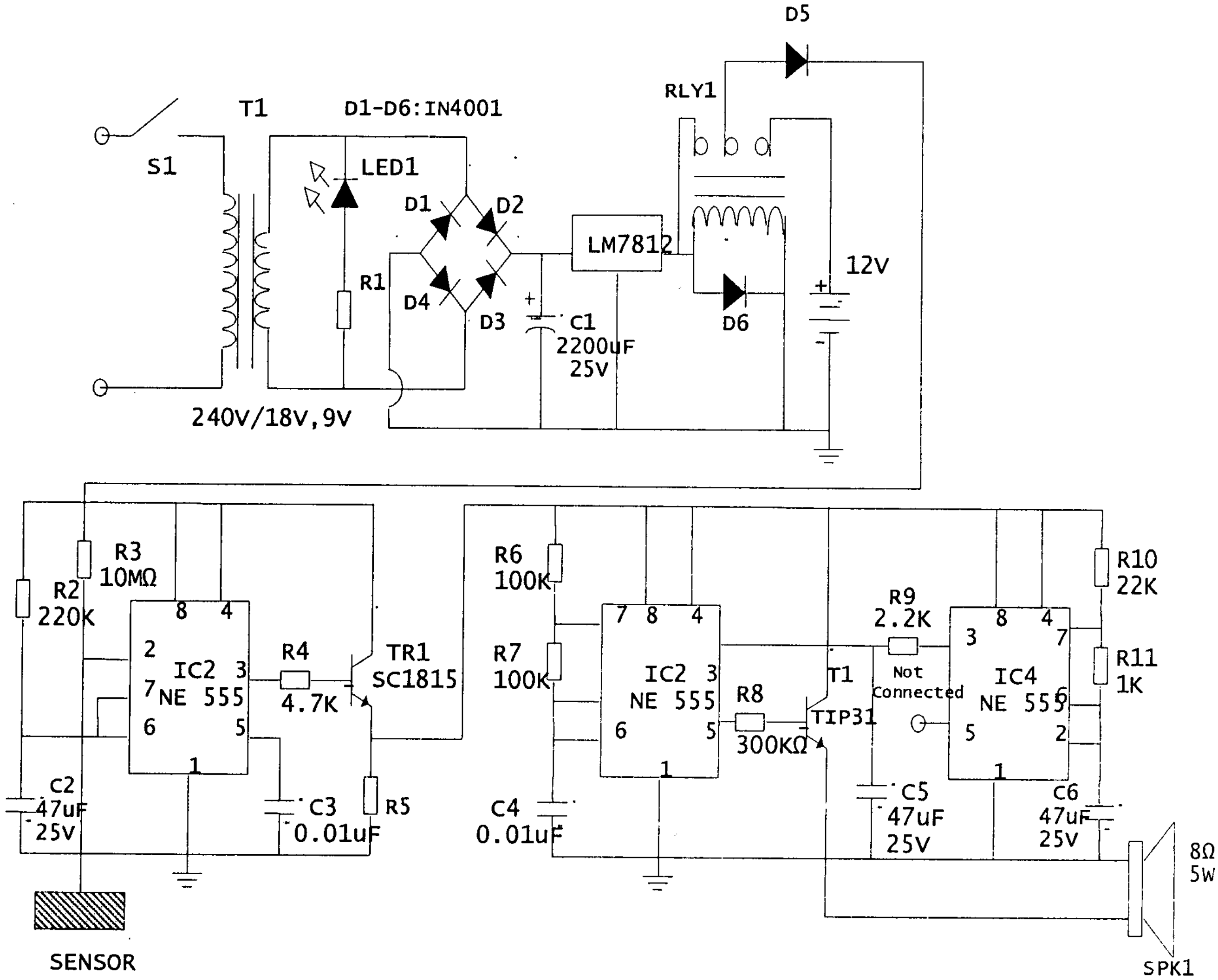

Fig 3.6 Circuit diagram of a Touch Activated Security System

3.6 OPERATION OF 555 TIMER IC

The 555 timer is an IC which consists of upper and lower comparators, control flip flop, discharge transistors and power output stage. It can be used as an oscillator as well as a timer. It has two basic mode of operation which are monostable mode which has only one stable state and astable mode which has no stable. The diagram below shows an 8 pin T-package and V-package 555 timer IC with its waveform and the internal circuitry.

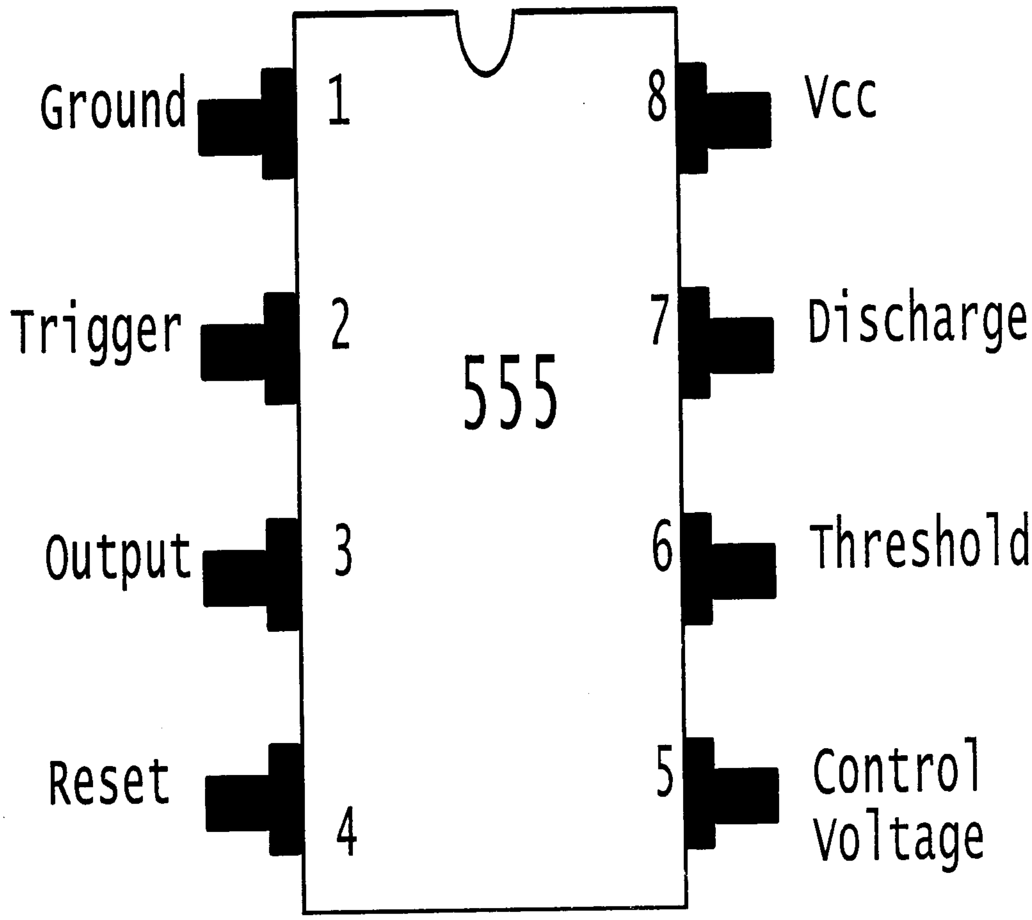

Fig 3.7 the 8-pin 555 Timer

3.6.1 PIN DEFINITION

(a) Pin 1(ground): This is the most negative supply potential of the 555 timer IC which is normally connected to the circuit ground when operated from positive voltage.

(b) Pin 2 (Trigger): This pin is the input to the lowest comparator and is used to set the latch which in turn causes the output to go high.

(c) Pin 3 (output): This pin is set to high condition when ever pin 2 is momentarily taken from a high to low level. The output voltage available at this pin is approximately equal to the supply voltage applied to pin 8 minus the 1.7V

(d) Pin 4 (Reset): This pin is used to reset latch and return the output to a low state.

(e) Pin 5 (Control voltage): this pin allows direct access to the 2/3 Vcc voltage divider point, the reference level for the upper comparator.

(f) Pin 6 (Threshold): This is one of the input to the upper comparator and is used to reset the latch which causes the output to go low.

(g) Pin 7 (Discharge): This pin act as the discharge for the 555 timer IC. A timing capacitor is usually connected between this pin and the ground and is discharged whenever the internal transistor of the 555 timer turns on.

(h) Pin8 (+Vcc): This is the positive supply voltage of the 555 timer IC. The operating range of the IC voltage supply is 4.5V (minimum) to 16V (maximum).

3.6.2 MONOSTABLE OPERATION

In monostable mode due to the internal latching mechanism of the 555, the timer will always time-out once triggered, regardless of any subsequent pulses on the input trigger pin 2 when the trigger input is initially high (about 1/3 of Vcc). When a negative-going trigger pulse is supplied to the trigger input, the threshold on the lower comparator is exceeded. The lower comparator, therefore, sets the flip-flop that causes a positive-going output level which is the beginning of the output timing pulse. The capacitor (C) connected to pin6 now begins to charge through the external resistor (R). As soon as the charge on the equals 2/3 of the supply voltage, the upper comparator triggers and reset the control flip-flop. That terminates the output pulse which switches back to zero. At this time, T1 again conducts thereby discharging the capacitor. If a negative-going pulse is applied to the reset input while the output pulse is high, it will be terminated immediately as that pulse will reset the flip-flop.

Whenever a trigger pulse is applied to the input, the 555 will generate its single-duration output pulse. Depending upon the values of external resistance and capacitance used, the output timing pulse may be adjusted from approximately one millisecond to as high as one hundred seconds. The duration of the output pulse in seconds is approximately equal to:

T= 1.1 x R x C (in seconds)\

3.6.3 ASTABLE OPERATION

In astable mode both the trigger and threshold inputs (pin 2 and 6) to the two comparators are connected together and to the external capacitor. The capacitor charges toward the supply voltage through the two resistors Ra and Rb the discharge pin 7 connected to the internal transistor is connected to the junction of the two resistors. When power is first applied to the circuit, the capacitor will be uncharged, therefore, both the trigger and threshold inputs will be near zero volts. The lower comparator sets the control flop-flop causing the output to switch high. That also turns off transistor T1, which allows the capacitor to begin charging through Ra and Rb. As soon as the charge on the capacitor reaches 2/3 of the supply voltage, the upper comparator will trigger causing the flip flop to reset. That causes the output to switch low. Transistor T1 also conducts. The effect of T1 conduction causes register Rb to be connected across the external capacitor. Register Rb is effectively connected to ground through internal transistor T1. The result of that is that the capacitor now begins to discharge through Rb.

As soon as the voltage across the capacitor reaches 1/3 of the supply voltage, the lower comparator is triggered. That again causes the control flip flop to set and the output to go high. Transistor T1 cuts off and again the capacitor begins to charge. That cycle continues to repeat with the capacitor alternately charging and discharging, as the comparator cause the flip-flop to be repeatedly set and reset. The resulting output is a continuous stream of rectangular pulses.

$t1=0.693(Ra+Rb)\ C$

$t2=0.693x\ Rb\ x\ C$

3.7 DESIGN CALCULATIONS AND COMPONENTS SELECTION

3.7.1 THE POWER STAGE

A 240/18V transformer was chosen because its rating is capable of meeting the current demand of the circuit and it is protected by the 1A fuse against excess current. The limiting resistor (R1) for the LED1 was calculated as shown below:

$$R1 = \frac{(\text{Voltage drop})}{\text{LED current}}$$

$$R1 = \frac{Vcc - v\ (LED)}{I\ (LED)}$$

Where Vcc = supply voltage=18V

V (LED)=supply voltage=2.2V

I(LED)=maximum allowable current across the LED=35mA

$$R1 = \frac{(18\text{-}2.2)\ V}{35mA}$$

$$= \frac{15.8V}{0.035A}$$

R1 = 451.43 Ohms

V (LED)=supply voltage=2.2V

I(LED)=maximum allowable current across the LED=35mA

$$R1 = \frac{(18-2.2)\ V}{35mA}$$

$$= \frac{15.8V}{0.035A}$$

R1 = 451.43 Ohms

The preferred resistor value closest to 451.43 Ohms is 470 Ohms. Therefore 470 Ohms was voltage drop adopted in the design.

$$\text{Current drawn by LED 1} = \frac{18V}{470\ \text{Ohms}}$$

$$= 0.038\ mA$$

The peak inverse voltage (PIV) obtainable at the secondary terminal transformer is twice the terminal transformer is twice the terminal voltage Vs [10]

i.e. PIV = 2 x Vs = 2x 18=36V

At the full bridge rectifier circuit IN4001 diode was used because its PIV which is 50V is greater than the PIV of the secondary terminal which is 36V[11]. This was done to avoid damage to the diodes in case reverse operation occurs.

The value of the filter capacitor C1 was obtained as shown below.

$$C = \frac{1}{4\sqrt{(3f \square R)}}$$ (for full wave rectifier circuits) [10]

Where f= frequency of ripple voltage = 50 Hz

□= ripple factor= 5%=0.05

R= resistance of the regulator= V/ I

V= Constant output voltage from the regulator=12V

I= Constant output current from the regulator = 500 mA=0.5A

R= 12/0.5

= 24 Ohms

$$C = \frac{1}{4 \times \sqrt{(3 \times 24 \times 50 \times 0.05)}}$$

$C=2.4056 \times 10^{-6}$ LED current

C=2.4056 μF

A 2200μF was used in the design because it is the closest value of a standard capacitor

2.4056 μF

3.7.2 THE TRIGGER STAGE

The time out period (T) and the frequency (f) were determined by the values of R4 and C2 as follows:

$T = 1.1\ (R2 \times C2)$

But $R2 = 220K$ Ohms $= 220 \times 10^3$ Ohm

$C2 = 47\ \mu F = 47 \times 10^{-6}$ Ohms

$T = 1.1\ (220 \times 10^3 \times 47 \times 10^{-6})$ secs

$= 11.374$ secs □ 11 secs

But $f = 1 / T$

$= 1 / 11.374 = 0.09$ Hz

The values of R3 and C2 were chosen in such a way that they can produce a approximate period of 11 secs delay.

The basis resistor R4 for transistor Tr1 was chosen as a result of the following calculations:

$R5 = (Vcc - VBE) / I_B$

Where Vcc = supply voltage= 12V

VBE= Base emitter voltage=0.6V

I_B = Base current

$I_B = Ic$ / gain supply voltage

Gain = 25

Ic = collector current= maximum Relay current $= \dfrac{\text{Supply voltage}}{\text{Coil resistance}}$

$= 12 / 400 = 0.03$ A

$I_b = 0.03 / 25 = 0.0012$ A

To ensure that the current is insufficient to drive the transistor into saturation, the quantity of the current is doubled i.e.

$I_b = 0.0012 \times 2 = 0.0024$ A

$$R4 = \frac{12 - 0.6}{0.0024} = 47050\ \Omega \text{ approx. equals } 4.7\ K\Omega$$

A 4.7 KΩ resistor was chosen to serve as the base resistor (R5) to the transistor because it is the closest value of standard resistor value 47050 Ω

3.7.3 THE ALARM / AMPLIFIER STAGE

The design for this stage was done in three stages.

Stage 1: This is the high frequency oscillator stage. The period (T_H) and frequency (F_H) for this stage were calculated as follows:

T_H=t1 + t2

Where t1 =0.693 x C4 (R6+ R7)

But C4=0.01 μF = 0.01 x 10^{-6}F

R6=R7=100 KΩ=100 x 10^3Ω

t1 = 0.693 x 0.01 x 10^{-6}(100 x 10^3 + 100 x 10^3)

= 1.386 x 10^{-3} secs

t2= 0.693 x 100x10^3x0.01x10^{-6})

= 0.693 x 10^{-3} secs

Therefore T_H=1.386 x 10^{-3}+0.693 x 10^{-3}

=2.079 x 10^{-3} secs

F_H = 1 / T_H

= 1 / (2.079 x 10^{-3})

= 481 Hz

Duty cycle= t1 / T_H

= $\underline{1.38 \times 10^{-3}}$ x 100%

(2.079×10^{-3})

$= 66.95\%$

The value of C4, R6, and R8 were manipulated in order to get the desired frequency that will modulate the low frequency (IC3) to give the desired tone.

Stage 2: This is the low frequency oscillator stage. The period (T1) and frequency (fl) for this were calculated as follows:

$T_1 = t1 + t2$

Where $t1 = 0.693 \times C6\ (R10 + R11)$

But $C6 = 47\ \mu F = 47 \times 10^{-6} F$

$R6 = R7 = 1K\Omega = 1 \times 10^{3}\Omega$

$t1 = 0.693 \times 47 \times 10^{-6}(1 \times 10^{3} + 22 \times 10^{3})$

$= 10741.003 \times 10^{-3}$ secs$= 1.041$ secs

$t2 = 0.693 \times C6 \times R12$

$t2 = 0.693 \times 47 \times 10^{-6} \times 22 \times 10^{3})$

$= 995.74 \times 10^{-3}$ secs $= 0.0996$ secs

Therefore $T_1 = 1.041 + 0.996 = 2.037$ secs

$F_H = 1 / T_H$

$= 1 / (2.037)$

$= 0.491$ Hz

Duty cycle= $t1 / T_1$

$$= \frac{1.0411}{2.037} \times 100\%$$

$= 51.1\%$

The values of C6, R10 and R11 were manipulated in order to get the desired frequency that will modulate the high frequency oscillator (IC3) to give the desired tone.

Stage 3: This is the audio amplifier stage. It is this stage that gives the final power output to the speaker. The actual power output by the transistor (Tr2) was calculated as follows:

Power output= I_E x Vcc

Where Vcc = supply voltage= 12V

I_E =Emitter current= $(1 + \text{gain}) I_B$

Gain = 100

I_B= (Vcc-VBE) / V $_{RB}$

= (12 – 0.6) / 300

=11.4 / 300 = 0.038A

and I_E =(1+100) 0.038= 0.418 A

substituting back into the first equation:

P out= 0.418 x 12 = 05.016 Watts

= 5 Watts

This means that the amplifier stage of the alarm unit (Tr2) gives an output of 5 Watts. Therefore, a 5Watt, 8 Ω speaker was employed at the output stage for maximum power transfer.

CHAPTER FOUR

TEST, RESULT AND DISCUSSION OF RESULT

4.1 CASING AND CASING CONSTRUCTION

Casing refers to the outer covering or something that serves as a container or covering. For the purpose of this project, the material used for the casing was a plastic. Proper dimensioning of the casing was marked out to give the desired shape based on the size of the constructed project work on vero board. After fabricating the casing, finishing was done on it with cardboard paper to give aesthetic values to the work.

4.2 TESTING AND RESULT OBTAINED

In testing the designed and constructed project work, four basic steps were taken, these steps are sequentially listed below;

Step 1: To ensure that all the components to be used are functioning properly, they were first tested with a digital multi meter and failed ones replaced before finally soldering them on the veroboard.

Step 2: To ensure that there was no breakage in the circuit path on the Vero board, immediately after soldering on Vero board, the circuit path was tested using the digital multimeter. This is done to ensure continuity of circuit on the Vero board.

Step 3: The period of time for the alarm sound (Time out period) was manually tested. This was achieved using Digital Stop Watch and the result obtained was found to be 10.60

seconds. The value obtained from the manual testing closely agrees with that obtained in the design specifications i.e. 11.37 seconds.

4.3 DISCUSSION OF RESULT

The sole reason of testing all the components before they were finally soldered on the Vero board is to avoid the painstaking effort it will take to desolder faulty components at the end of the day. From the continuity test carried out on the Vero board to check the circuit path, it was discovered that the circuit was in perfect working condition as continuity was ensured. Simulation of the circuit design was also done as mentioned earlier, with the sole objective of comparing the results obtained from the design calculations to that obtained from simulation. The two results when compared closely correspond with only a very slight difference.

4.4 PROBLEMS ENCOUNTERED

It should be noted at this junction, that the realization of the final project work was not without problems. The various problems encountered by the student include:

(1) Some basic components to be used for the project work were not within reach as it was not available in town.

(2) Some measuring instruments that would have provided the student with detailed analysis of the circuit like transistor tester, oscilloscopes were unavailable.

(3) The biggest problem encountered was at the implementation stage as the circuit was triggering itself without touch. The sensitivity of the circuit was reduced.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1 CONCLUSION

It can be concluded that the sole aim of carrying out the design and construction of this project was achieved because the aim was to develop a cheap, affordable, reliable and efficient security system, which was successfully realized at the end of the project work.

Cheapness was achieved due to the choice of components used and reliability was achieved by integrating automatic change over switch to the circuit such that A.C mains supply and the battery are cold redundant.

5.2 RECOMMENDATIONS

It is recommended that the security system is interfaced with a microcontroller to improve its effectiveness.

It is also recommended that the security system is used in residential areas, Offices and commercial centers to ward of intruders and burglars.

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