DESIGN AND CONSTRUCTION OF TOUCH ACTIVATED ALARM

BY

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DEDICATION

This project work is dedicated to my uncle, Mr. John Ibe Oyida for his financial and moral support throughout my stay in the university.

DECLARATION

I Anichi Johnson Chinweike declare that this work was done by me 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

This project work deals with the design and construction of a touch activated alarm which provides security of a room, office etc. This device achieves its objective by incorporating a touch sensor and an alarm system, which triggers an alarm whenever an intruder touches the sensor.

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CHAPTER ONE
GENERAL INTRODUCTION

1.0 OVERVIEW

One of the must important things that man has discovered in history is the form of energy called electricity. This energy is utilized in varying forms to suit the needs of man as the years role by.

The fast changes in our technological world could not have come without this advancement in electrical and electronic engineering. It is with this modern technology that information can be passed through wires or wireless and can be received around the globe as in Radio, Television, Telecommunication, e.t.c without hitches.

The recurring incidence of burglary and theft in our present day society has necessitated the need for people, company and organization to protect their properties against theft, forced attack and organized robbery.

Several measures had been put in place by security agents of various classes and standard to improve on the security scheme of lives and properties. Most of these methods do not effectively checkmate the adaptative skills of the intruder. Due to these inadequacies of manual and mechanical measures adopted by man in crime prevention, the application of automatic electronic security system has proved to be the most reliable measure.

It is with this motive of making the security of properties easy, that alarms are designed to alert man of some pending danger or information.

There are basically three (3) main types of security system namely: space protection, spot protection and Hard coiled perimeter system.

1. Space protection system: this can protect large or very confined area with ultrasonic or infrared sensors.
2. Spot protection system: this protects a very confined area with one or more sensors.
3. Hard – coiled perimeter system: this protects windows, door, gates, fences and all parts of entry around the outside of a building using a sensing device.

Either of these systems are combined or used individually to develop a security system that provides maximum security for a specific area of application.

1.1 AIMS AND OBJECTIVES

Frequent attack by burglars, has become a common problem that occurs in our homes, offices and industries.

It has become a common occurrence in our modern world as homes, shops, offices and industries are burgled several times. This has led to a high level of insecurity in our community.

However, no home or property can be burgled without a touch. Since it is well known that the principle behind burglary has to do with touching, then we have to devise an alarm system that has to be touch activated. This will go a long way in combating the trouble, danger and problem of burglary in our society.

The essence of this project work is to design an alarm system that would be touch activated. This will alert people of some pending danger.

To devise an alarm system that would be simple, cost effective and affordable to all.

Therefore, there is no doubt that Burglar Alarms and systems are a worthwhile investment in the protection of your home and family. Studies reveal that it is far less likely that you will

become the victim of a burglary at home if you have a correctly fitted and well maintained burglar alarm. [1]

1.2 METHODOLOGY

This project work was carried out by the use of electronic components. The components were purchased from electronic parts store houses in Minna and Lagos. These components include the following:

Vero-board which was used as the panel for construction of the major work. Most of the components were soldered on the Vero-board.

The touch plate (contact surface) was connected to pin 2 of the 555 timer and will trigger the relay; using your body resistance, when touched. The 555 timer is connected to an external capacitor and resistor network to obtain the pulse width of the I.C [2]

The output of the relay is connected the tone generating unit which is made up of another 555 timer. The I.C is also controlled by an external capacitor and resistor network to provide a frequency of an audible tone. This frequency from the tone generator is feed into the speaker, so as to obtain an audible alarm.

Therefore, this shows that the circuit was connected according to the circuit diagram of this project work.

CHAPTER TWO

LITERATURE REVIEW

2.0 INTRODUCTION

Alarm is an electronic device that gives warning sound or signal of an impending danger or an eminent event such as the instability of a system under a given condition. In this chapter the understanding of industrial development of alarm, types and their operational usefulness, will be discussed.

2.1 THEORITICAL BACKGROUND

The 555 timer is the prime mover in this circuit. This is because it is the sensor that triggers the circuit in to action. The semiconductor device is utilized in monostable state. This is achieved by the external capacitor and resistor network, connected to the timer. [2]

Interestingly, the mode of operation of the security alarm is based on touch. The touch plate is connected to the trigger pin of the timer (pin 2). If triggered, the timer sends out a signal (pulse) at its output which forward bias the the switching transistor. This energizes the relay, which in turn activates the tone generator.The tone generator provides a frequency of an audible tone. This frequency is feed into the speaker to obtain an audible alarm. This will indicate that there is an intruder present, and the reset key will be used to reset the circuit.

Furthermore, the tone generator is made up of another 555 timer, utilized in the astable state. This is also achieved by the external capacitor and resistor network connected to the timer.[2]

The block diagram of the touch active alarm is shown in fig. 2.0.

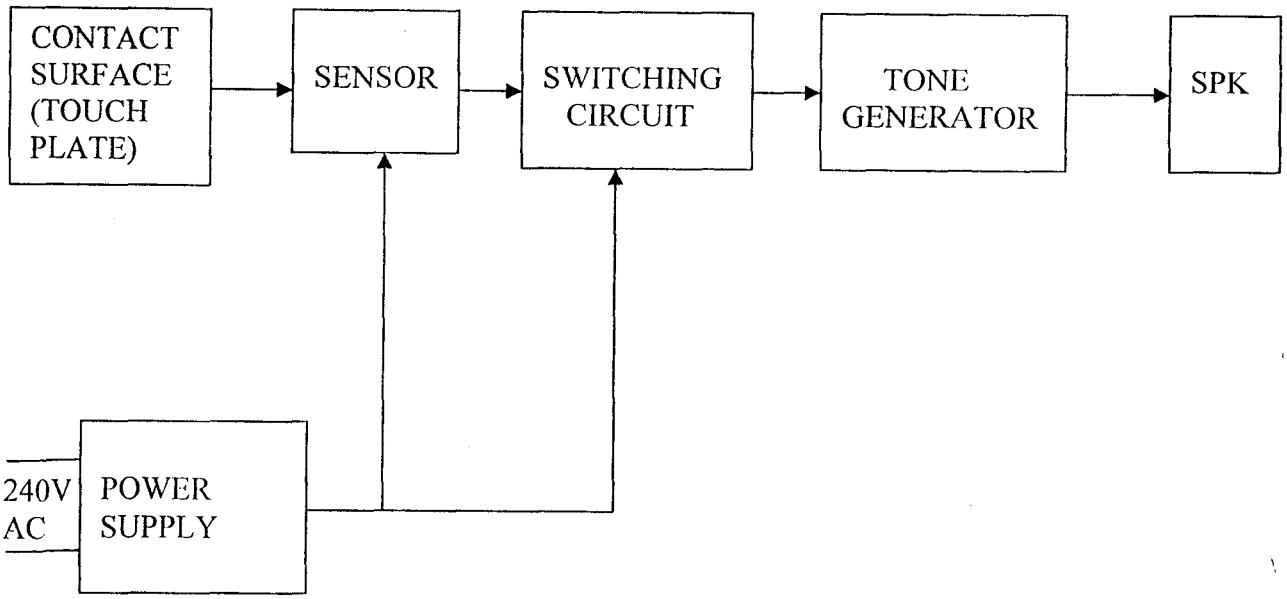


Fig 2.0 Block diagram of touch of activated alarm

2.2 HISTORICAL BACKGROUND

The use of alarm has been in existence, before the advent of technology. In most parts of primitive Africa, the soundings of drums were used to give villagers the warning of danger. In some places smoke signals were used to warn far villagers of approaching trouble.

According to Joe Maurath, [3], the development of alarm system started by the time man was created. Man has to forewarn himself of imminent danger. When a hand is clapped at a particular time and environment, a sign has been initiated which is interpreted by another person. Sooner the military introduced the use of whispering to indicate an action while laying ambush. Some coughs to give a sign, to be interpreted by another. Others make use of smoke signals to warn people of an impending danger. All these methods were crude and unreliable.

In 1884,the concept of utilizing the Boston alarm telegraph system of communication for reporting incident by means of alarm signal boxes; wired to the nearest station was realized in the

united states cities and greatly spread in the most other communities in the east by 1900 [4]. Here the dispatch teams know of the citizen calling for help and could respond to the location much rapidly. The Boston system is of great interest, since it was among the first and certainly sought after today.

Most principles of today's fire alarm telegraph were embodied in the system; namely a closed power factor circuit, street fire alarm boxes with code wheels and key breaks determine the number of circuit interruptions which produce coded signal, on local instruments at central offices. [3]

This completed system was placed in services at 12 noon April 28, 1852, with the first alarm office located in the city building at court square and William court. Staff included a superintendent, fire alarm operator and repair men. The original system had 40 street boxes in 3 box circuits and has its alarm bells on three circuits. Some underground cabling was introduced into the system when a new alarm office was commissioned into service on 20th may, 1895. By 1907 all fire alarm Boxes in the city of Boston were equipped into keyless doors. With the advancement in technology, other different alarms emerged. These systems were built not just for fire alarms like the Boston system but for various functions to be performed by each one. [3]

Recent developments in electronic have generated into more sophisticated security alarm system. One of the modern types is capable of transmitting a long distance radio signal to a nearby police or security terminal.

2.3 TYPES OF ALARM SYSTEM

There are many different types of burglar alarms available for domestic and business use. They can be broadly categorsed into two (2) main groups:-

- Bells only Alarms
- Monitored Alarms.

The issue is further complicated as both the above types can be available as "hard-wired" or "wireless" systems.[1]

Bells only alarms:-When the alarm is triggered by one of the alarm components, an outside bell or siren is activated. This will undoubtedly inform the burglar that they have been detected and may motivate them to leave. [1]

Monitored Alarms: - these are connected by telephone to an Alarm Receiving Centre (ARC). When activation occurs, the system automatically rings the ARC and notifies them of the activation. Staffs at the ARC then take the relevant action [1]

Alarms can be further classified, based on the function of each alarm. The function of each alarm depends on the system configuration, a few alarms are mentioned below:

I. Speed limit Alarms:- this is a wireless portable unit adaptable with most internal combustion engines. This device allows the driver of a vehicle to set a chosen speed, speed watcher will flash and sound an alarm any time the driver drives faster than the speed limit that have been set. This alarm remains on for as long as the driver is exceeding the set limit. Once the speed is reduced below the set limit, the alarm will stop. [5]

II. Anti – Theft Car Alarm:-This alarm unit is mounted some where in the car where it will be difficult to find and remove. The switch is located under the dashboard were the driver can reach it, but where a thief will not easily find it. When the ignition is

turned-on with the switch closed, whether by using the key or by "hot" wiring the circuit will be activated. [6]

III. Infra-Red Alarms: - one of the various types simply consists of an infra-red sensor which detects intrusion by motion and heat. It is commonly used in stores which have a beam of light crossing the room near the door; and a photo sensor on the other side of the room. When a customer breaks the beam, the photo sensor detects the change in the amount of light and rings a bell. [6]

IV. Professional Burglar Alarm: - this operates based on circuit breaker. The alarm is triggered when the protective circuit is opened. It is usually used to protect windows or glass area. Once triggered, it can only be turned-off by the opening of the master switch. [6]

V. Pressure Pad Switches: - These usually take the form of thin sealed heavy plastic pad suitable for placing under carpets near door or windows or under stair carpets. The pad, which is often referred to as a resilistor, contain carbon granules. The weight of a person stepping onto the pad compresses the granules, reducing their resistance and activating the alarm circuit. [7]

VI. Ultrasonic Motion Detector: - This detector works on a patented balanced signal processing system which recognizes the difference between random motion and intruder motion. Thus providing a high degree of immunity from false alarms. The detector generates a three dimensional oval volume detection area which may be adjusted by a range control up to a distance of 9m. A number of detectors can be fitted in the same room without needing synchronization. [7]

VII. Combined Microwave/Passive infra-red: - Detectors of this type combine a micro wave motion detector with a passive infra-red detector sensing heat radiating bodies.

The infra-red radiation given off by the heat source is focused onto the infra-red detector by a Fresnel lens and in some models a mirror is incorporated to detect objects immediately under the detector. The two units need to sense an intruder simultaneously before an alarm state is triggered, so as false alarms are very unlikely. [7]

VIII. Industrial Alarms: - This alarm comes in three versions. The 12v dc Grey bell is affordable home security, whenever any vehicle develops a fault. This is ideal for use in security system and complies with the requirements of BS4737 intruder alarm system in buildings. The unit must be mounted within a bell enclosure when used in external environments of BS 839 fire detection and alarm systems in building unit for use in industrial environments. The design avoids the need for mechanical contacts resulting in greater reliability efficiency and longer operating life. All units may be ceiling or wall mounted, with flush or surface wiring and require no final setting up adjustment. A chip holds the movement to a high polycarbonate base and a twist lock mechanism holds the gong in position. [6]

CHAPTER THREE

DESIGN AND IMLEMENTATION

3.0 PRINCIPLE OF OPERATION

The circuit takes advantage of the fact that an IC, the 555 connected in monostable mode; can be triggered whenever the voltage at pin 2 of the IC is less than 1/3 the supply voltage by touching the plate connected to this pin. The capacitor formed between the plate and the body grounds pin 2, taking its voltage below the threshold.

The high at the output of this IC (pin3) is used to switch on an NPN transistor serving as a driver to close some relay contacts which in turn supply current to the alarm unit. The alarm tone generator is yet another 555 IC but this time configured to operate in astable mode. The output signal of the 555 timer is amplified by a power transistor so that signal strength is enough to drive a loud speaker. The circuit is driven a 9v power supply obtained from a full wave rectifier.

The block diagram of the touch activated alarm system is shown in fig 3.0 below.

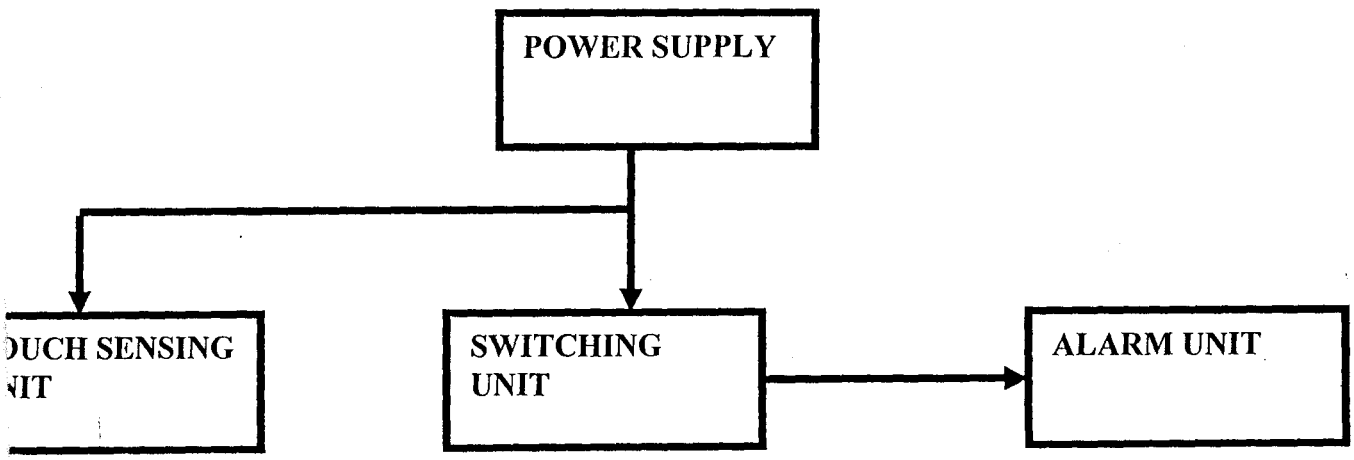


fig 3.0 block diagram of touch activated alarm system

3.1 POWER SUPPLY UNIT (PSU)

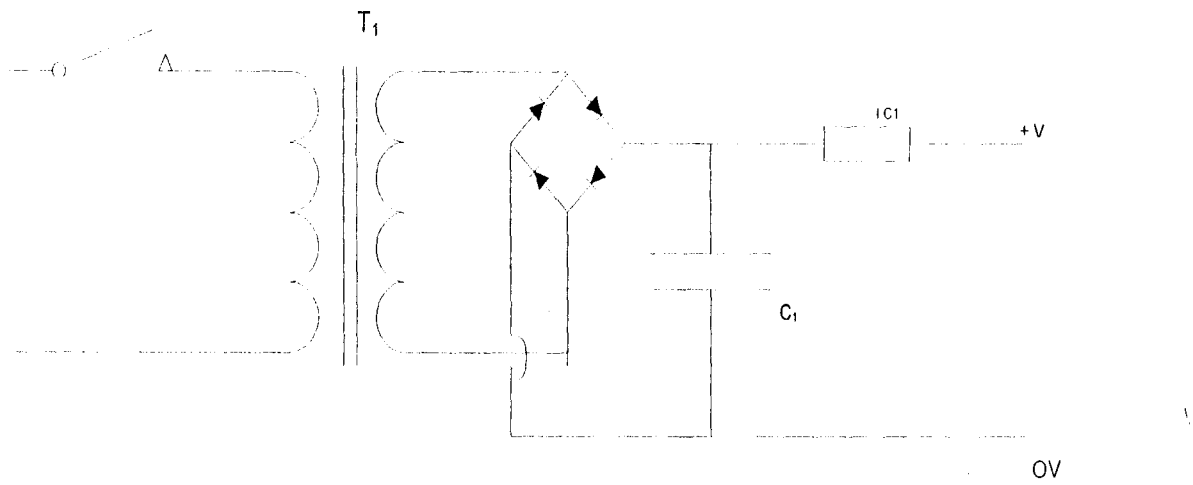


fig. 3.1 Circuit diagram of power supply unit

It is desired to operate the system at 9v dc. A 9v positive regulator is required. This result to a higher voltage rated transformer of 240/12v a.c is chosen, to allow for a wider range of voltage stabilization. 12volts from the step down transformer T_1 is rectified by a bridge rectifier of D_1, D_2, D_3, D_4 . The output is filtered by capacitor C_1 which is then regulated at 9v by IC_1, a positive voltage regulator.

Peak value of transformer secondary Vp= root mean square value, $V_{rms} \times \sqrt{2}$

$\therefore \quad V_p = 12 \times \sqrt{2} = 16.97 \approx 17v$

D_1, D_2, D_3, D_4 where chosen with PIV rating of 100v. Peak dc value of rectified voltage

$V_{dc} = V_p - V_d$

For full-wave rectifier voltage drop = $2V_d$

$V_{dc} = 17 - 2x0.6 = 15.8v$

The value of filter capacitor is given by

$$C = \frac{I}{V_r F_R}$$

Where I = Maximum value of load current

V_R = permissible peak to peak value of ripple voltage.

Fr = frequency of ripple voltage

For full- wave rectifier frequency = 2 x mains supply frequency = 2 x 50Hz = 100Hz

For permissible ripple voltage of 3v

Maximum load current from transformer = 0.5A

$$C = \frac{0.5}{100X3} = 1.67X10^{-3} F \approx 16770\mu F$$

Which is the minimal required value.

The voltage rating of the capacitor has to exceed V_p, therefore the choice of 25, 2200μF which is a standard value was used.

The filtered output was fed into the 9V regulator to get a 9V output.

A block diagram of the power supply unit is shown below

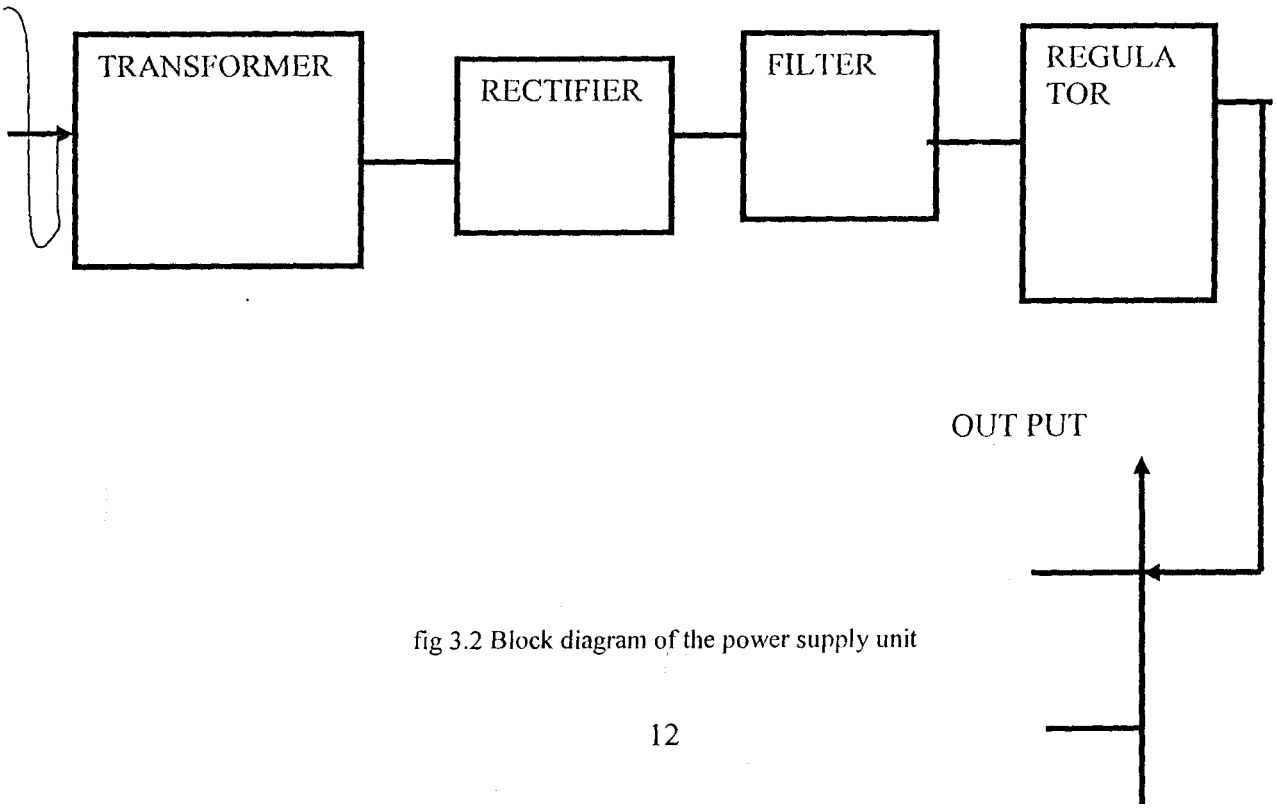


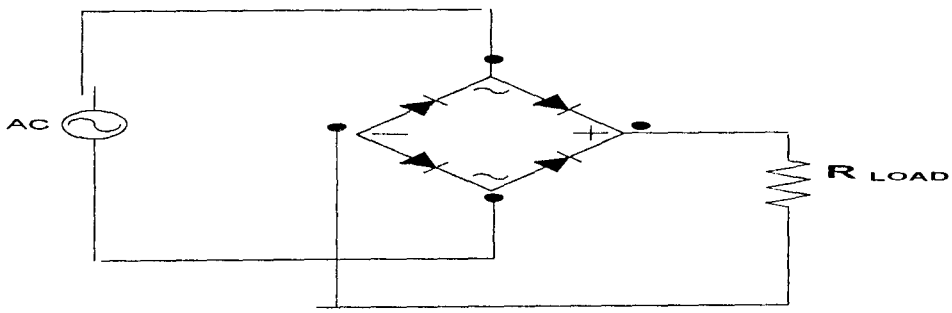
fig 3.2 Block diagram of the power supply unit

3.11 THE TRANSFORMER

The transformer steps down the a.c supply to suit the requirement of the solid state electronics devices and circuit fed by the d.c supply. The transformer steps down the voltage from 240v to 12v. The starting point is the a.c line voltage. The frequency is usually fairly stable but, the amplitude can fluctuate appreciably, depending on local load conditions. Fluctuation, of 15% is not uncommon and these must be taken into account when designing a power supply. The a.c voltage is stepped down to a level acceptable by the regulator by using a transformer of suitable voltage and power ratings. The transformer also affords electrical ground isolation to minimize shock hazards.

3.1.2 THE RECTIFIER

This is a circuit which employs one or more diodes to convert a.c voltage into pulsating dc. Voltage. For this project, we made use of full- wave rectifier circuit, incorporating four diodes IN4001. a



b

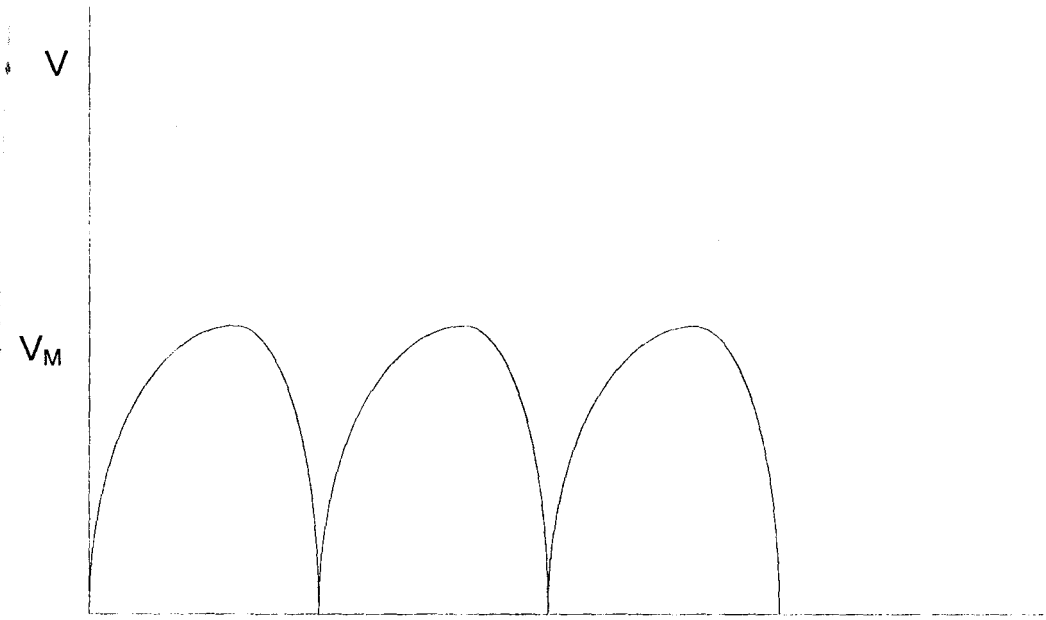


Fig: 3.3 full wave bridge rectifier (a) and output waveform (b)

3.1.3 THE FILTER CAPACITOR

The pulsating voltage provide by the rectifier is still unacceptable by the voltage regulator. A capacitor is therefore interposed between the rectifier and regulator to hold the voltage above , the prescribed minimum, during the holds between consecutive a.c alternation. Upon arrival of a.c peak voltage, the capacitor charge to V_1 (peak) $=V_m-V_{eref}$ where, V_m = either one or two forward diode drops , depending on the rectifier type.

Once the a.c signal has reached its maximum, the rectifier goes off and the capacitor starts discharging current I_1, absorbed by the regulator. By making capacitor C sufficiently large, we can manage to hold V_1 above the prescribed minimum until the arrival of the next a.c peak as shown in fig 3.4. V_1 has a saw tooth appearance of twice the frequency. Its peak to peak variation V_r is called ripple.

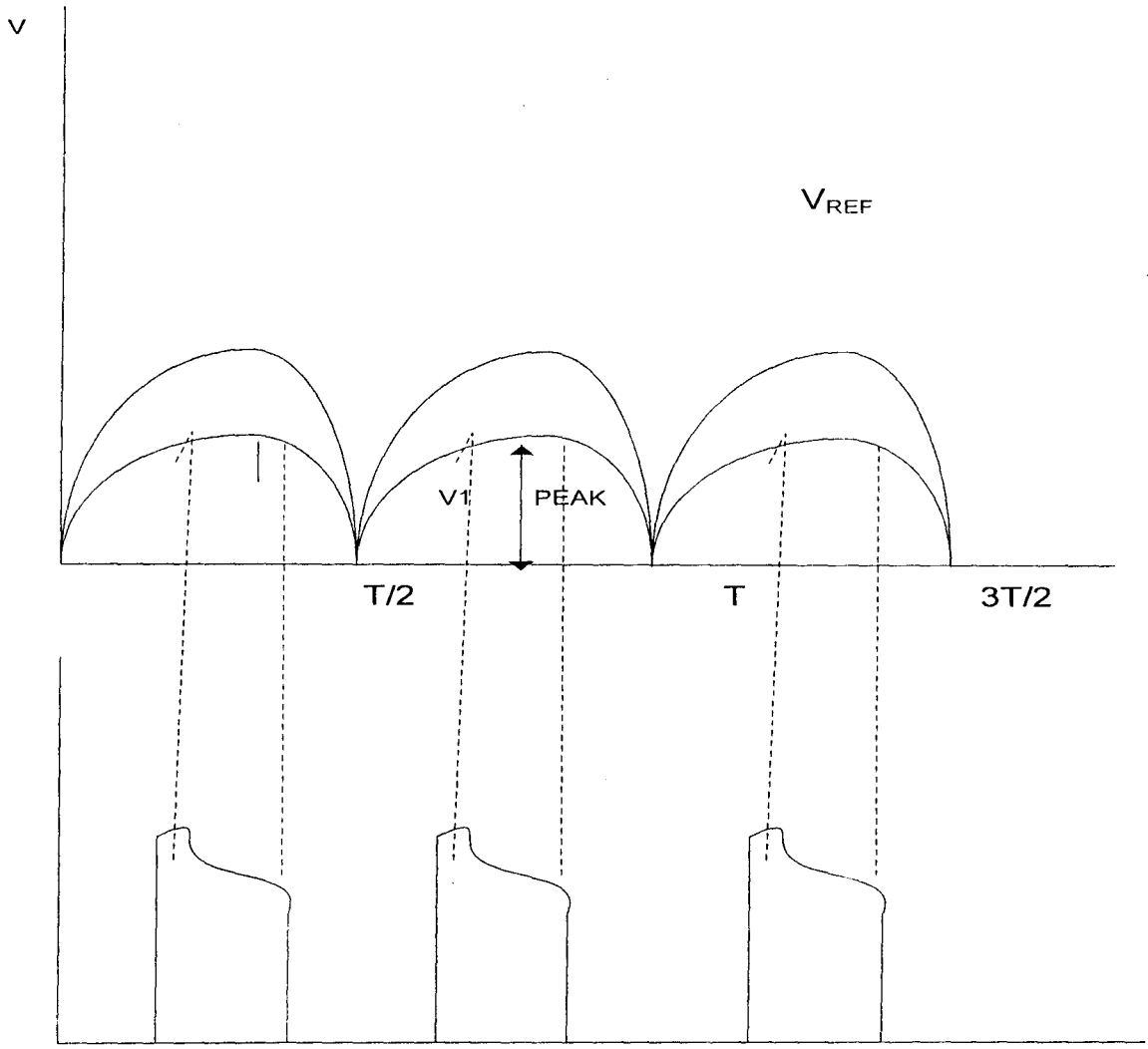


Fig 3.4 Rectifier wave form {a} and regulator output {b}

3.2 TOUCH SENSING UNIT

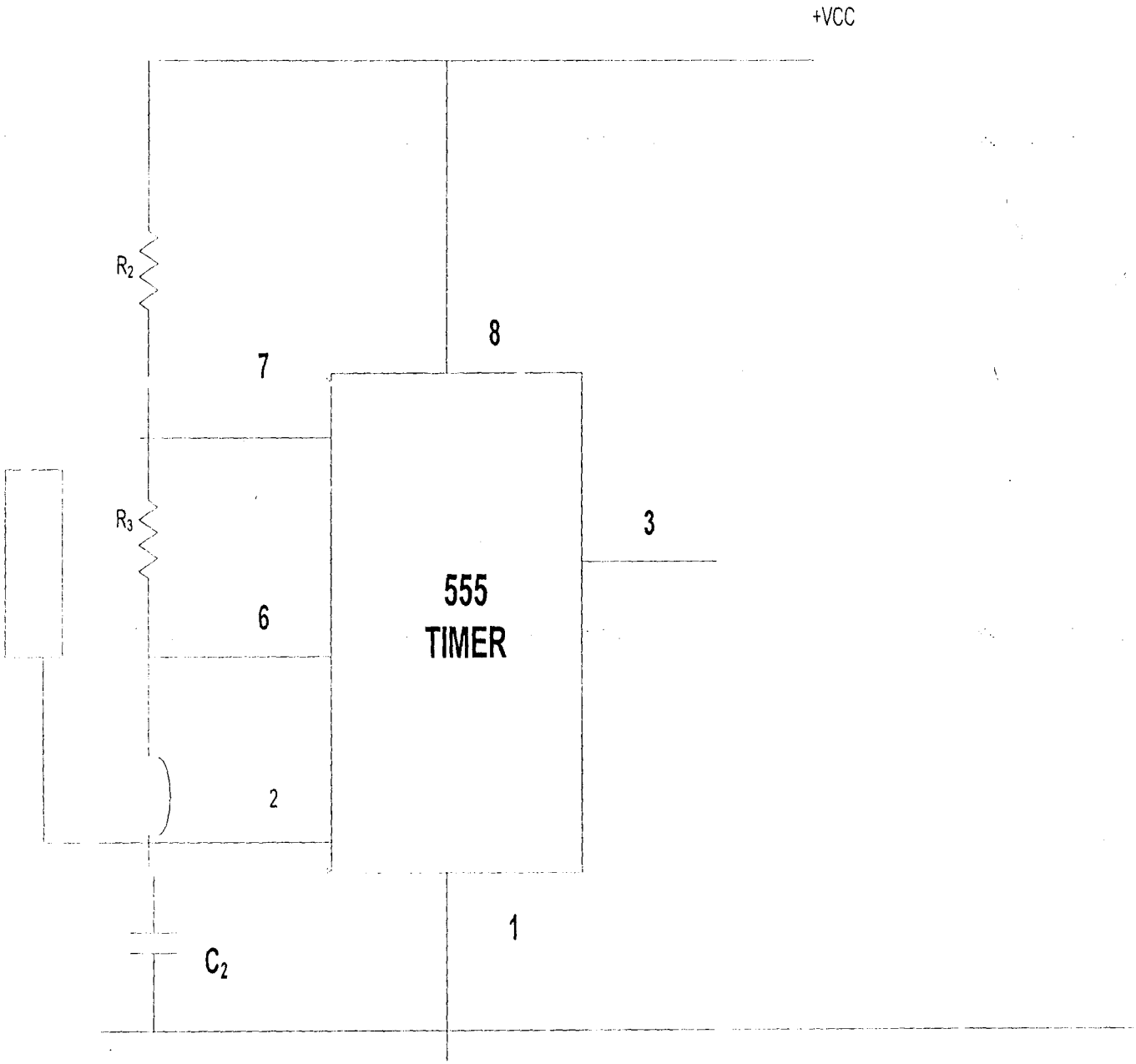


Fig 3.5 Circuit Diagram of the Touch Sensing Unit.

When the plate is touched, the voltage level at pin2 is momentarily earthed through the capacitance formed between the body and the touch plate. The 555 timer is triggered so that a high appears at the out put at pin 3 of the IC . The time period for the out put to remain high is given by the formula

T=1.1RC, where $R=R_2+R_3$ and $C=C_2$

Where T = period in seconds

For a period of 4 minutes where $R_1 = 1M\Omega$. $R_2 = 1K$

C_2= ?

$$c_2 = \frac{T}{1.1R} = \frac{4X60}{1.1X(1X10^6 + 1000)} = 2.2X10^{-4} = 220\mu F$$

So with this value of capacitor for C_2 the output of the 555 timer remains high about 4 minutes , before returning low.

3.3 SWITCHING UNIT

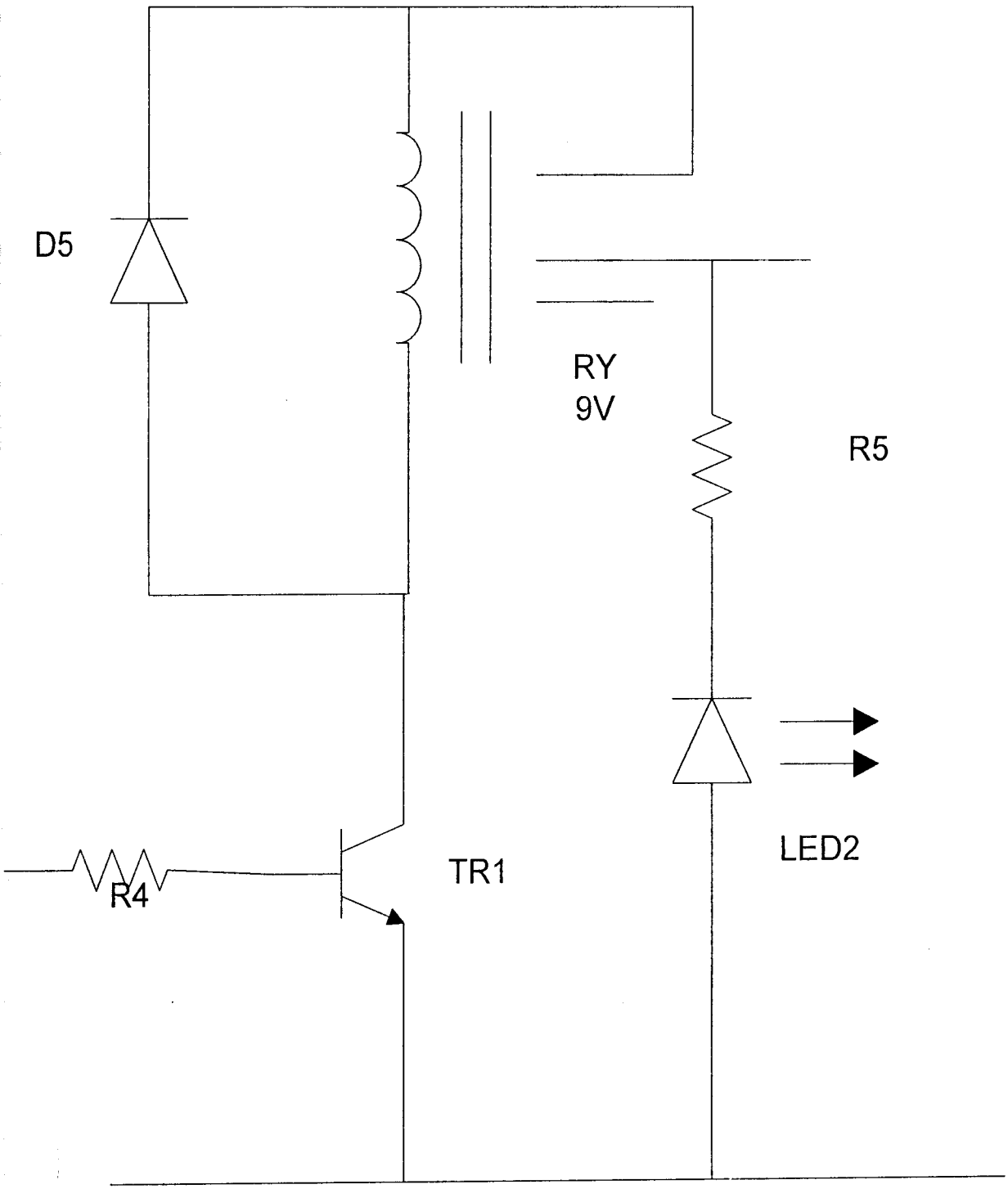


Fig.3.6 circuit diagram of the switching unit

This circuit responds to the high out put of the 555 timer and activate a relay whose normally open contacts become closed and current is supplied to the alarm unit .

TR1 is an NPN transistor with its data sheet specification given below

Transistor: BC 548

Type: NPN

V_{ce}= 40v

I_c = 0.6A maximum

β = 200 typical

Pd_{max} = 0.5 w

Ft = 300mHz

This transistor is responsible for switching on and off the relay connected to its collector. As a switch TR1 must be driven into saturation.

Resistance of relay coil = R_c= 200Ω

$$I_{c(sat)} = \frac{V_{cc}}{R_C}$$

$$I_{c(sat)} = \frac{9}{200} = 0.045 \ A$$

$$I_{B(SAT)} = \frac{I_{c(sat)}}{\beta} = \frac{0.045}{200} = 0.000225 \ A$$

Required base resistance:

$$R_B = \frac{V_{CC} - V_{BE}}{I_B}$$

$$R_B = \frac{9 - 0.6}{0.000225} = 37,333.3\Omega$$

$$\approx 37.3K$$

This is not a standard value, the nearest available standard is 33kΩ

When ever the relay is activated, LED2 glows to indicate that the sense plate has been touched. Then current limiting resistance to the LED. R_5 is given as

$$R_5 = \frac{V_S - V_d}{I_d}$$

Where Vs is the supply voltage

V_d is the voltage across the LED

I_d is the current through the LED, for a current of 7mA through the LED for V_d of 2v

$$R_5 = \frac{9 - 2}{7X10^{-3}} = 1000\ \Omega$$

D5 acts a free wheeling diode to the relay the value of IN4001 has been chosen for this purpose

3.4 THE ALARM UNIT

This consist mainly of a 555 timer I.C connected in astable mode , as a tone of generator and a power transistor to amplify the tone signal so that a loud speaker can be driven

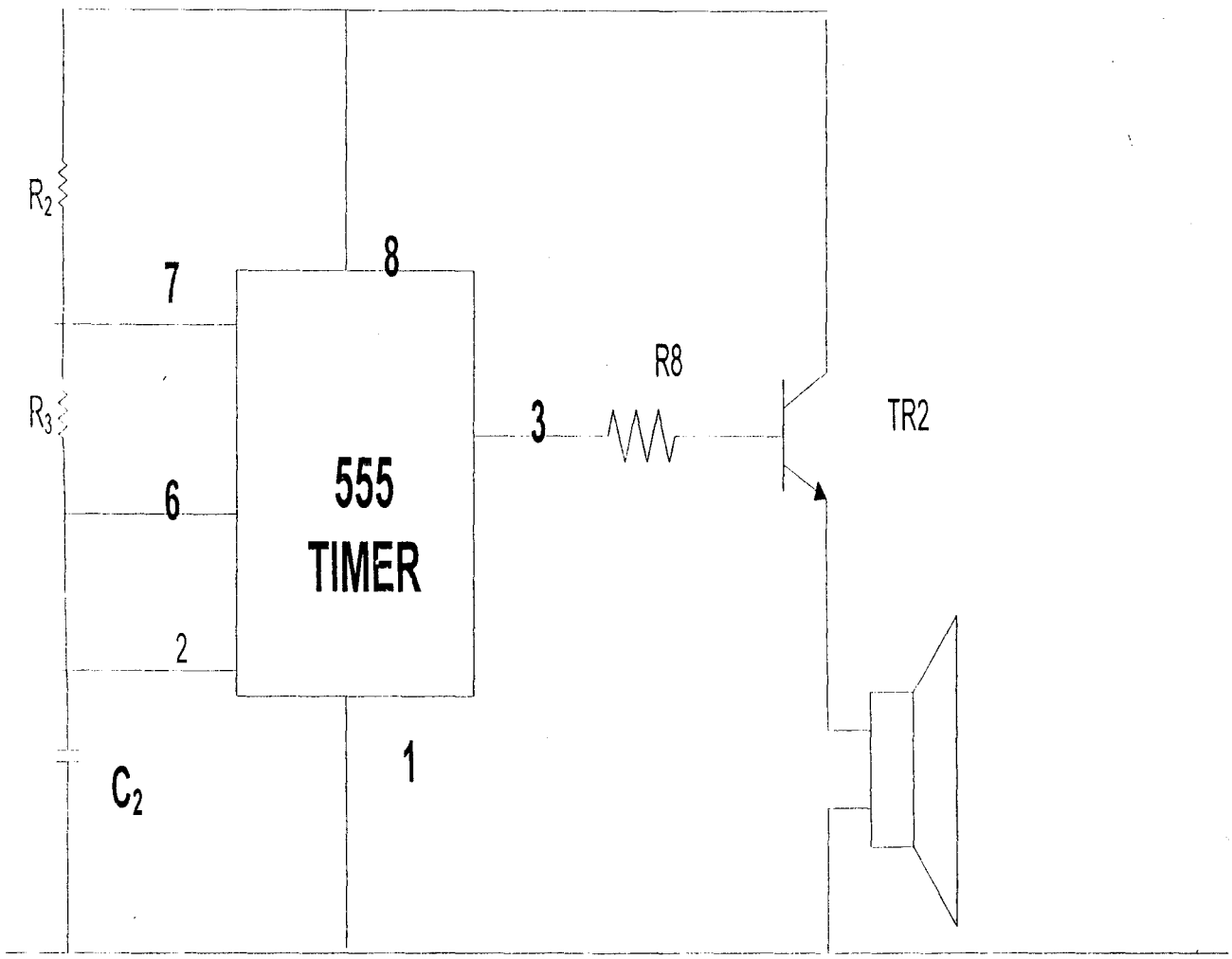


Fig. 3.7 circuit diagram of the Alarm unit

The frequency of oscillation of the 555 timer connected in a stable mode is given by

$$F = \frac{1}{T}$$

where $T = T_1 + T_2$

and $T_1 = 0.69(R_6 + R_7)C_3$ *and* $T_2 = 0.69R_7C_3$

$\therefore R_6 = 1K\Omega, R_7 = 10K\Omega$ and $R_6 + R_7 = IK + 10K = 11K$

A tone frequency of about 700Hz is desired

$$700 = \frac{1}{\{(0.69x11x10^3) + (0.69x10^4)\}c}$$

$$C = \frac{1}{700x[7,590 + 6,900]} = 0.000000098$$

$\approx 0.1uF$

the power transistor TIP31 with the following data was chosen

type: NPN

$V_{CE} = 60V$

$I_C = 4A$ *MAX*

$\beta = 40Min$

$P.D = 40$ *watts*

This transistor is connected in common collector mode for maximum current gain

The emitter resistance is that of the speaker which is 8Ω.

$$I_E \text{ max } imum = \frac{V_{cc}}{R_E} = \frac{9}{8} = 1.1A$$

$$I_B = \frac{I_E}{\beta + 1} = \frac{1.1}{40 + 1} = 0.027\ A$$

$$R_B = \frac{V_{CC} - V_{BE}}{I_B} = \frac{9 - 0.6}{0.027} = 311.1\Omega$$

About half this value, 150Ω was used so that TR2 is over driven by a factor of 2 to guarantee maximum signal strength to the speaker.

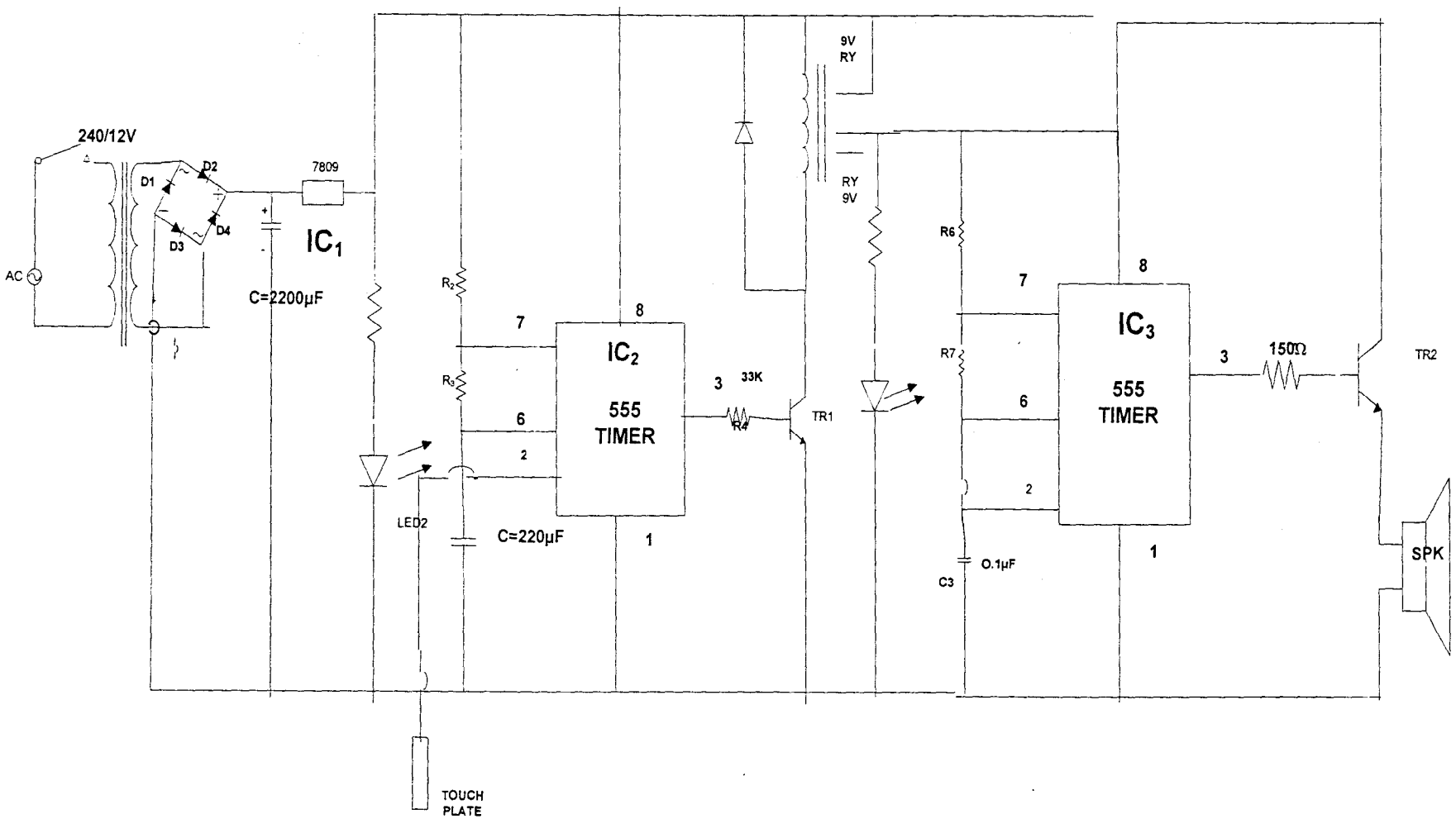


Fig.3.8 Circuit diagram of touch activated alarm

CHAPTER FOUR

TEST AND DISCUSSION OF RESULTS

4.0 TEST AND MEASUREMENT METHODS

The circuit was first simulated using electronic workbench software, on the computer. Then the components were mounted on the bread-board and was tested to ensure that the respective modules operate efficiently. A digital multimeter was used to measure the various outputs from the components, within each module.

4.1 RESULTS

Table 4.0 result of measurements

Stage	Components	Output voltage (volts)	Output current (ampere)
Power supply stage	Transformer, T,	12.00	-
	rectifier regulator	11.40	-
	Regulator	9.00	-
Touch sensing	555 timer	7.39	$2.24x10^{-4}$
Switch stage	Transistor TRI	8.93	$4.50X10^{-2}$
	LED 2	7.00	6.95
ALARM	555 TIMER	4.05	$2.6X10^{-2}$
STAGE	Transistor, TR2	8.80	1.10

4.2 DISCUSSION OF RESULTS

The results are approximately equivalent to the calculated values. The slight differences are due to error. However every necessary precaution was taken to ensure accurate result.

The result, shown in table 4.0 are the measured outputs from various components, using a digital multimeter.

4.3 SHORTCOMING / LIMITATION OF WORK

Noise due to soldered joint was a problem because of its effect on the circuit. Also when soldered joint to pin2 of the IC, touches any thing that is grounded, it triggers the alarm. This result to false alarm which is not desired. However, this is overcome by the proper casing of the Vero- board as shown in fig 4.1

The project has its source of power from the a.c main supplied by PHCN. Therefore, if there is a power outage, the system will not function

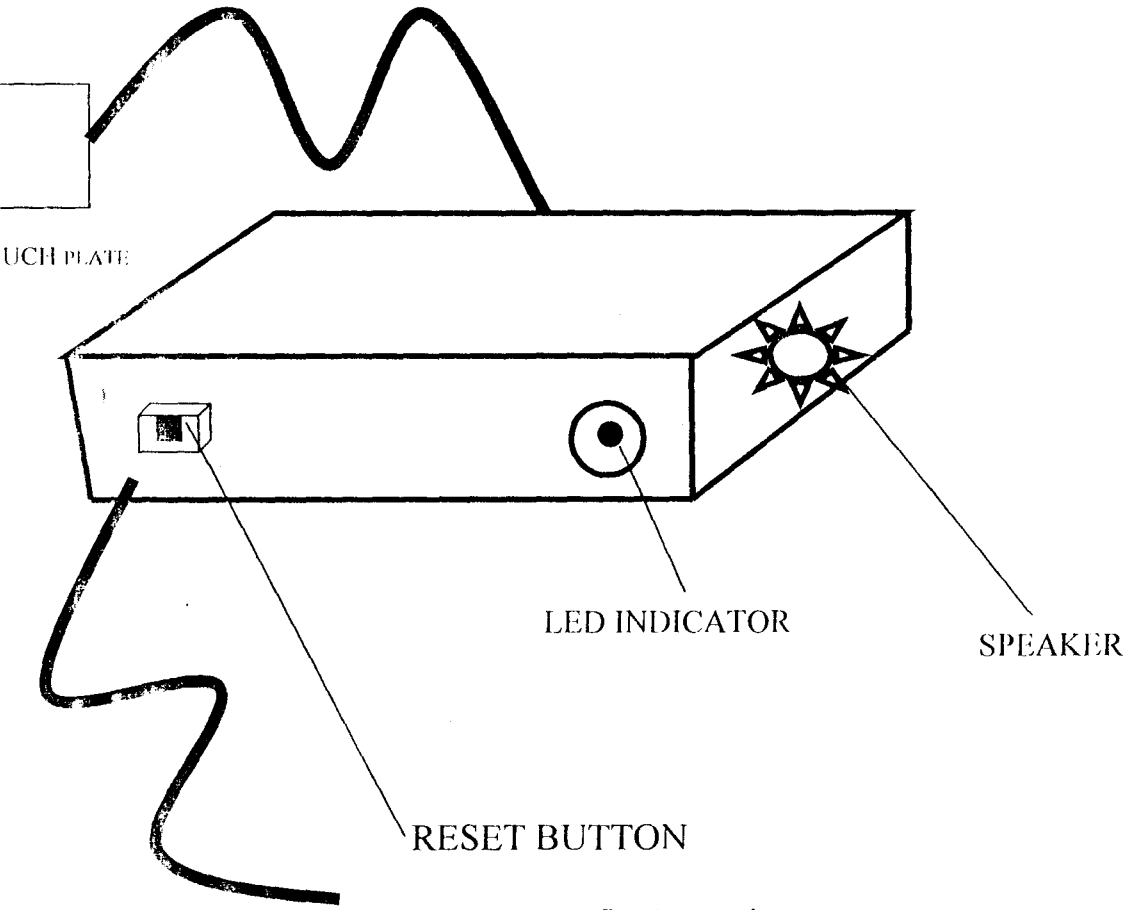


fig 4.1 casing

CHAPTER FIVE

CONCLUSION

5.0 SUMMARY OF WORK

Alarm system is a device that provides warning signal when there is a breach of security that is when there is an intruder within an area. It has incorporated a 555 timer utilized in the monostable mode, to keep the alarm on for four minutes ; once activated, this timing is reasonably enough to alert a security agent of the presence of an intruder or a thief.

5.1 PROBLEMS ENCOUNTERED

The problems encountered in carrying out this project work include the lack of proper equipment to assist in easy construction. However, some of the equipment had to be hired.

The unavailability of needed components posed a very big problem to the execution of this project. Alternative arrangement was made to get some of the components from Lagos

5.2 RECOMMENDATION

Every functional system (even operating normally without fault) has imperfection in its design. Therefore this project can be improved in certain aspect, such as:

i The reset could be designed in such a way that it can be turned –off by the use of a remote control

ii The system could be interfaced to a GSM hand set

iii The problem of power failure can be overcome by incorporating a back- up battery

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