NEAR EAST UNIVERSITY

Faculty of Engineering

Department of Electrical and 'Electronic Engineering

SOUNDACTIVATEDALARM

Graduation Project
EE-400

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ABSTRACT

This project is entitled Sound Activated Alarm. The idea arose because of its applicability to our daily lives, the most common uses for sound activated alarm are probably the automatic control of tape recorders and radio transceivers, but no doubt there are numerous other applications for this type of equipment, it also can be used to control a toy car, helping deaf people, robot to respond to a hand clap, a spoken commands, or even to switch on light or other electrically operated device in response to a sound.

This project contains electronic components; we will explain all them one by one initially from resistor to loudspeaker and capacitor. Some extra components will be added to this project in order to enhance its use.

We believe that the end project will enhance everyday living by making possible a convenient user interface for a common necessity.

CONTENTS

INTRODUCTION

This project is entitled Sound Activated Alarm. The idea arose because of its applicability to our daily lives, the most common uses for sound activated alarm are probably the automatic control of tape recorders and radio transceivers, but no doubt there are numerous other applications for this type of equipment, it also can be used to control a toy car, helping deaf people, robot to respond to a hand clap, a spoken commands, or even to switch on light or other electrically operated device in response to a sound.

The aim of this project is to design an alarm system that is activated by sound.

Chapter one will present the information on electronic components that will be used in this project. And safety guidelines for preparing electronic hardware projects will be described as well.

Chapter two will present general information about sound. Definition, attributes and characteristics of sound will be presented. In addition to frequency and wavelength, speed of sound, amplitude, and velocity will be presented as well.

Chapter three will present an explanation to the design of sound activated alarm circuit. In addition to the Information about the circuit functions and the usage fields will be provided as well in this chapter.

Chapter four will present the problems encountered the circuit after building, and the changes done to solve these problems. In addition to the Results and modifications made to enhance our work.

CHAPTER ONE

ELECTRONIC COMPONENTS

1.1 Overview

This chapter provides information on electronic components that are used in this project. Additionally, safety guidelines for preparing electronic hardware projects will be described.

1.2 Components

Explanation will be shown about the hardware components used in my project, and how it is functioning.

1.2.1 Resistors

The resistor is a component that has one purpose and that is to resist current and voltage by means of combining conductive material with a nonconductive one to form a substance that allows electrons to flow through its self but not as efficiently as a typical wire. It is the most commonly used component in electronic circuits, so the main function of the resistor is to reduce the flow of electric current. This symbol -",i\h- is used to indicate a resistor in a circuit diagram, known as a schematic as it can be shown in Figure (1.1); Resistance value is designated in units called the "Ohm." A 1000-0hm resistor is typically shown as lK-Ohm (kilo Ohm), and 1000K-Ohms is written as IM-Ohm (mega ohm), [1].

There are two classes of resistors, fixed resistors and the variable resistors. They are also classified according to the material from which they are made. The typical resistor is made of either carbon film or metal film. There are other types as well, but these are the most common.

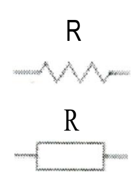


Figure 1.1: Resistor Symbols

The resistance value of the resistor is not the only thing to consider when selecting a resistor for use in a circuit. The "tolerance" and the electric power ratings of the resistor are also important.

The tolerance of a resistor denotes how close it is to the actual rated resistance value. For example, a ±5% tolerance would indicate a resistor that is within ±5% of the specified resistance value.

The power rating indicates how much power the resistor can safely tolerate. Just like you wouldn't use a 6-volt flashlight lamp to replace a burned out light in your house, you wouldn't use a 1/8-watt resistor when you should be using a 1/2-watt resistor.

The maximum rated power of the resistor is specified in Watts. Power is calculated using the square of the current (r2) x the resistance value (R) of the resistor. If the maximum rating of the resistor is exceeded, it will become extremely hot, and even bum.

$$P = f/:I$$

$$P \quad R \cdot I_2$$

$$P = \frac{V^2}{R}$$

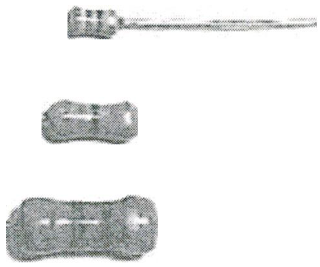
Resistors in electronic circuits are typically rated 1/8W, 114W, and 1/2W. 1/8W is almost always used in signal circuit applications.

There are two main types of resistors, which can then be broken down into other categories but lets first look at the two main types:

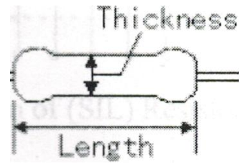
1.2.1.1 Fixed Resistors

A fixed resistor is one in which the value of its resistance cannot change. In this project I used a several values ofresistors.

Carbon Film Resistors



From the top of the photograph
1/8W
1/4W
1/2W



Rating power (W)	Rough size Thickness (mm)	Length (mm)
11S	2	
114	2	6
1/2		9

Figure 1.2: Common Resistors

This is the most general purpose, cheap resistor. Usually the tolerance of the resistance value is ±5%. Power ratings of 1/8W, 1/4W and 1/2W are frequently used. Carbon film resistors have a disadvantage; they tend to be electrically noisy. Metal film resistors are recommended for use in analog circuits. Carbon Film Resistor is shown bellow in Figure (1.2).

This resistor shown in Figure (1.3) is called a Single-In-Line (SIL) resistor network. It is made with many resistors of the same value, all in one package. One side of each resistor is connected with one side of all the other resistors inside. One example of its use would be to control the current in a circuit powering many light emitting diodes (LEDs), [1].

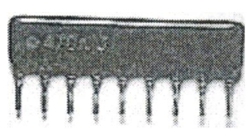


Figure 1.3: Single-In-Line resistor

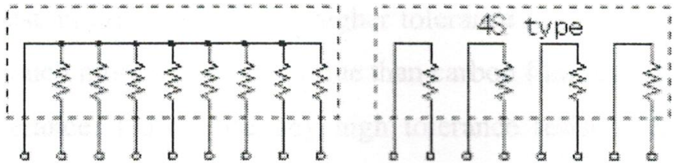
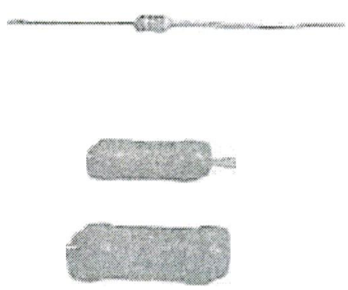
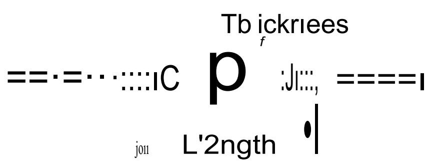


Figure 1.4: Internal Construction of (SIL) Resistor

In the Figure (1.3) above, 8 resistors are housed in the package. Each of the leads on the package is one resistor. The ninth lead on the left side is the common lead. The face value of the resistance is printed. (It depends on the supplier), Some resistor networks have a "4S" printed on the top of the resistor network. The 4S indicates that the package contains 4 independent resistors that are not wired together inside. The housing has eight leads instead of nine. The internal wiring of these typical resistor networks has been illustrated below. The size (black part) of the resistor network is as follows: For the type with 9 leads, the thickness is 1.8 mm, the height 5mm, and the width 23 mm. For the types with 8 component leads, the thickness is 1.8 mm, the height 5 mm, and the width 20 mm. also Figure (1.4) shows the internal construction of (SIL) resistor.

Metal Film Resistors





Rough size

Rating power (W)	Thickness (mm)	Length (mm)
1/8	2	3
1/4	2	6
1	3.5	12
2	5	15

From the top of the photograph
118W (tolerance ±1 %)
1/4W (tolerance ±1 %)
1 W (tolerance ±5%)
2W (tolerance ±5%)

Figure 1.5: Metal Film Resistor

Metal film resistors are used when a higher tolerance (more accurate value) is needed. They are much more accurate in value than carbon film resistors. They have about ±0.05% tolerance. I don't use any high tolerance resistors in my circuit. Resistors that are about ±1 % are more than sufficient. Ni-Cr (Nichrome) seems to be used for the material of resistor. The metal film resistor is used for bridge circuits, filter circuits, and low-noise analog signal circuits. Figure (1.5) shows the Metal Film Resistor.

1.2.1.2 Variable Resistors

There are two general ways in which variable resistors are used.. One is the variable resistor which value is easily changed, like the volume adjustment of Radio. The other is semi-fixed resistor that is not meant to be adjusted by anyone but a technician. It is used to adjust the operating condition of the circuit by the technician. Semi-fixed resistors are used to compensate for the inaccuracies of the resistors, and to fine-tune a circuit. The rotation angle of the variable resistor is usually about 300 degrees. Some variable resistors must be turned many times to use the whole range of resistance they offer. This allows for very precise adjustments of their value. These are called "Potentiometers" or "Trimmer Potentiometers", [1].

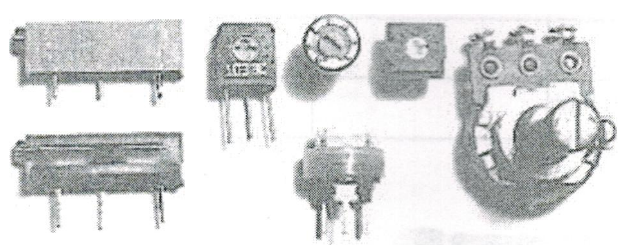


Figure 1.6: Variable Resistors

In the Figure 1.6 above, the variable resistor typically used for volume controls can be seen on the far right. Its value is very easy to adjust. The four resistors at the center of the photograph are the semi-fixed type. These ones are mounted on the printed circuit board. The two resistors on the left are the trimmer potentiometers.

This symbol  is used to indicate a variable resistor in a circuit diagram.

1.2.1.3 Resistor Markings

Table 1.1: Resistor color code

COLOR	DIGIT	MULTIPLIER	TOLERANCE	TC
Silver		x 0.01 n	±10%	
Gold		x 0.1 n	±5%	
Black	0	x 1 n		
Brown	1	x 10 n	±1%	k1 00* 10₆/K
Red	2	x 100n	:r2%	±50*10^{-6}/K
Orange	3	x 1 kn		bt:15*10-6/K
Yellow	4	x lOkQ		±25*10^{-6}/K
Green	5	x 100 kn	±0.5%	
Blue	6	x 1 Mn	±0.25%	1±10*10-6/K
Violet	7	x lOMn	±0.1%	±5*10^{-6}/K
Grey	8	x 100 Mn	-	
White	9	x 1 on		k1 *10-6/K

Example 1

(Brown=l), (Black=O), (Orange=3)

-+ 10 x 10^3 = 1Ok ohm

Tolerance (Gold)= ±5%

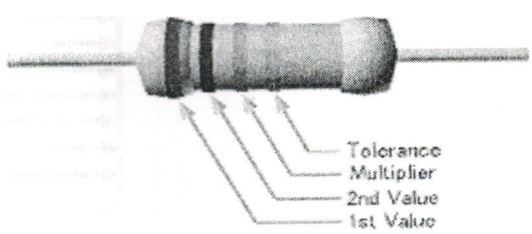


Figure 1.7: Resistor Color Code

Resistance value is marked on the resistor body. The first three bands provide the value of the resistor in ohms and the fourth band indicates the tolerance. Tolerance values of 5%, 2%, and 1% are most commonly available. The Table (1.1) shows the colors used to identify resistor values. The example above explains how to calculate the value of a resistor, depending on the colors on the resistor as it shown in Figure (1.7), [2].

1.2.2 Capacitors

A capacitor is a passive electronic component that stores energy in the form of an electrostatic field. In its simplest form, a capacitor consists of two conducting plates separated by an insulating material called the dielectric. Capacitance is directly proportional to the surface areas of the plates, and is inversely proportional to the plates' separation. Capacitance also depends on the dielectric constant of the dielectric material separating the plates, [3].

The capacitor also functions as a filter, passing alternating current (AC), and blocking direct current (DC). The value of a capacitor (the capacitance) is designated in units called the Farad (F), the capacitance of a capacitor is generally very small, and so units such as the microfarad (10^{-6}F), nanofarad (10^{-9}F), and picofarad (10^{-12}F) are used. This symbol -U- is used to indicate a capacitor in a circuit diagram; Figure (1.8) shows the internal construction of the capacitor, [4].

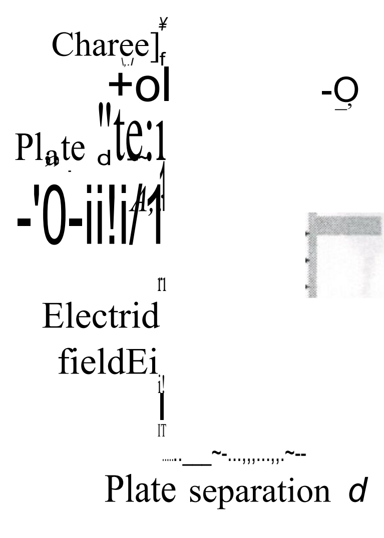


Figure 1.8: Internal Construction of the Capacitor

Now different types of capacitors will be introduced as below:

1.2.2.1 Electrolytic Capacitors (Electrochemical type capacitors)

Aluminum is used for the electrodes by using a thin oxidization membrane. Large values of capacitance can be obtained in comparison with the size of the capacitor, because the dielectric used is very thin. The most important characteristic of electrolytic capacitors is that they have polarity. They have a positive and a negative electrode. (Polarized) This means that it is very important which way round they are connected. If the capacitor is subjected to voltage exceeding its working voltage, or if it is connected with incorrect polarity, it may burst. It is extremely dangerous, because it can quite literally explode.

Generally, in the circuit diagram, the positive side is indicated by a "+" (plus) symbol. Electrolytic capacitors range in value from about 1 μF to thousands of μF. Mainly this type of capacitor is used as a ripple filter in a power supply circuit, or as a filter to bypass low frequency signals, etc. Because this type of capacitor is comparatively similar to the nature of a coil in construction, it isn't possible to use for high-frequency circuits. (It is said that the frequency characteristic is bad.)

Figure (1.9) shows the Electrolytic Capacitor, and the mark indicating the negative lead of the component can be seen, [3].

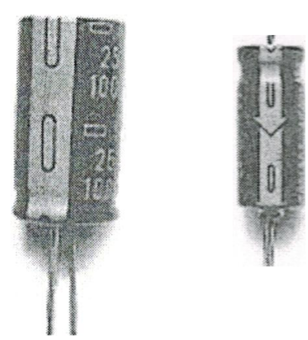


Figure 1.9: Electrolytic Capacitor

1.2.2.2 Tantalum Capacitors

Tantalum Capacitors are electrolytic capacitors that are use a material called tantalum for the electrodes. Large values of capacitance similar to aluminum electrolytic capacitors can be obtained. Also, tantalum capacitors are superior to aluminum electrolytic capacitors in temperature and frequency characteristics. When tantalum powder is baked in order to solidify it, a crack forms inside. An electric charge can be stored on this crack

Tantalum capacitors are a little bit more expensive than aluminum electrolytic capacitors. Capacitance can change with temperature as well as frequency, and these types are very stable. Therefore, tantalum capacitors are used for circuits, which demand high stability in the capacitance values. Also, it is said to be common sense to use tantalum capacitors for analog signal systems, because the current-spike noise that occurs with aluminum electrolytic capacitors does not appear. Aluminum electrolytic capacitors are fine if you don't use them for circuits, which need the high stability characteristics of tantalum capacitors.

These capacitors have polarity as well. Usually, the"+" symbol is used to show the positive component lead; It is written on the body, the Figure (1.10) shows that, [3].

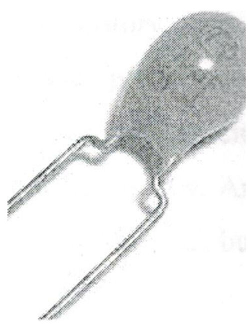


Figure 1.10: Tantalum Capacitor

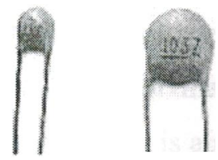


Figure 1.11: Ceramic Capacitor

1.2.2.3 Ceramic Capacitors

Ceramic capacitors are constructed with materials such as titanium acid barium used as the dielectric. Internally, these capacitors are not constructed as a coil, so they can be used in high frequency applications. Typically, they are used in circuits which bypass high frequency signals to ground. These capacitors have the shape of a disk. Their capacitance is comparatively small, Ceramic capacitors should not be used for analog circuits; because they can distort the signal, Ceramic Capacitors have no polarity, as it shown in Figure (1.11), [3].

1.2.2.4 Marking the Block-Capacitors

Commonly, capacitors are marked by a number representing the capacity value printed on the capacitor. Beside this value, number representing the maximal capacitor working voltage is mandatory, and sometimes tolerance, temperature coefficient and some other values are printed too. If, for example, capacitor mark in the scheme reads 5nF/40V, it means that capacitor with 5nF capacity value is used and that its maximal working voltage is 40v. Any other 5nF capacitor with higher maximal working voltage can be used instead, but they are as a rule larger and more expensive.

Sometimes, especially with capacitors of low capacity values, capacity may be represented with colors, similar to four-ring system used for resistors Figure (1. 12a). The first two colors (A and B) represent the first two digits, third color (C) is the multiplier, fourth color (D) is the tolerance, and the fifth color (E) is the working voltage, with disk-ceramic capacitors Figure (1.12b) working voltage is not specified, because these are used in circuits with low or no DC voltage.

One important note on the working voltage: capacitor voltage must not exceed the maximal working voltage as capacitor may get destroyed. In case when the voltage between nodes where the capacitor is about to be connected is unknown, the "worst" case should be considered. There is the possibility that, due to malfunction of some other component, voltage on capacitor equals the power supply voltage. If, for example, the power supply is 12V battery, then the maximal working voltage of used capacitors should exceed 12V, for security's sake, [5].

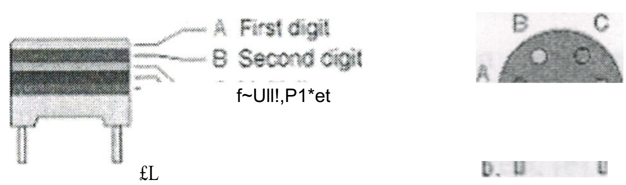


Figure 1.12: Capacitor Color Code

Table 1.2: Marking the Capacity using Colors

COLOR	DIGIT	MULTIPLIER	TOLERANCE	VOLTAGE
Black	0	x 1 pF	±20%	
Brown		x 10 pF	±1%	
Red	2	x 100 pF	±2%	250V
Orange	3	x 1 nF	±2.5%	
Yellow	4	x 10 nf		400V
Green	5	x 100 nf	±5%	
Blue	6	x 1 µF		
Violet	7	x 10 µF		
Grey	8	x 100 µF		
White	9	x 1000 µF	±10%	

1.2.3 Semiconductors

A semiconductor is a material that behaves in between a conductor and an insulator. At ambient temperature, it conducts electricity more easily than an insulator, but less readily than a conductor. At very low temperatures, pure or intrinsic semiconductors behave like insulators. At higher temperatures though or under light, intrinsic semiconductors can become conductive. The addition of impurities to a pure semiconductor can also increase its conductivity.

Examples of semiconductors include chemical elements and compounds such as silicon, germanium, and gallium arsenide. The conductivity of a semiconductor increases with temperature, light, or the addition of impurities because these increase the number of conductive valence electrons of the semiconductor. Valence or outer electrons are the carriers of the electrical current, [6].

1.2.3.1 Diodes

A diode is a component that restricts the direction of movement of charge carriers. It allows an electric current to flow in one direction, but essentially blocks it in the opposite direction. Thus the diode can be thought of as an electronic version of a check valve. The Diode Symbol is shown in Figure (1.13).

Most modem diodes are based on semiconductor p-n junctions. In a p-n diode, conventional current can flow from the p-type side (the anode) to the n-type side (the cathode), but not in the opposite direction. Another type of semiconductor diode, the Schottky diode, is formed from the contact between a metal and a semiconductor rather than by a p-njunction, [4].

A semiconductor diode's current-voltage, or I-V, characteristic curve is ascribed to the behavior of the so-called depletion layer or depletion zone which exists at the p-n junction between the differing semiconductors. When a p-n junction is first created, conduction band (mobile) electrons from the N-doped region diffuse into the P-doped region where there is a large population of holes (places for electrons in which no electron is present) with which the electrons "recombine". When a mobile electron recombines with a hole, the hole vanishes and the electron is no longer mobile. Thus, two charge carriers have vanished. The region around the p-n junction becomes depleted of charge carriers and thus behaves as an insulator.

However, the depletion width cannot grow without limit. For each electron-hole pair that recombines, a positively-charged dopant ion is left behind in the N-doped region, and a negatively charged dopant ion is left behind in the P-doped region. As recombination proceeds and more ions are created, an increasing electric field develops through the depletion zone which acts to slow and then finally stop recombination. At this point, there is a 'built-in' potential across the depletion zone.

If an external voltage is placed across the diode with the same polarity as the built-in potential, the depletion zone continues to act as an insulator preventing a significant electric current. However, if the polarity of the external voltage opposes the built-in potential, recombination can once again proceed resulting in substantial electric current through the p-n junction. For silicon diodes, the built-in potential is approximately 0.6 V. Thus, if an external current is passed through the diode, about 0.6 V will be developed across the diode such that the P-doped region is positive with respect to the N-doped region and the diode is said to be 'turned on'.

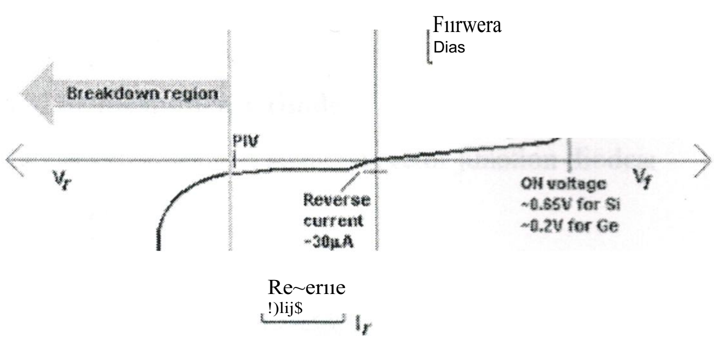


Figure 1.14: I-V characteristics of a P-N junction diode

Figure 1.13: Diode Symbol

A diode's I-V characteristic can be approximated by two regions of operation, below a certain difference in potential between the two leads, the depletion layer has significant width, and the diode can be thought of as an open (non-conductive) circuit. As the potential difference is increased, at some stage the diode will become conductive and allow charges to flow, at which point it can be thought of as a connection with zero (or at least very low) resistance. More precisely, the transfer function is logarithmic, but so sharp that it looks like a comer on a zoomed-out graph .In a normal silicon diode at rated currents, the voltage drop across a conducting diode is approximately 0.6 to 0.7 volts. The value is different for other diode types - Schottky diodes can be as low as 0.2 V and light-emitting diodes (LEDs) can be 1.4 V or more depending on the current. Blue LEDs can be up to 4.0 V, depending on the type and current. There is a substantial variation in forward current of LEDs, based on the manufacturing process. They are often binned, to lower the variation in sensitive applications, [4].

1.2.3.2 Types of Semiconductor Diode

There are several types of semiconductorjunction diodes:

Normal (P-N) Diodes

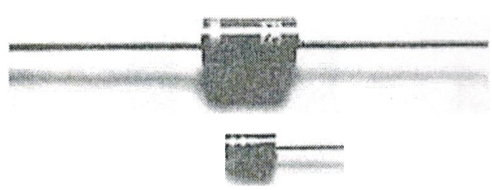


Figure 1.15: Normal Diode

which operate as described above. Usually made of doped silicon or, more rarely, germanium. Before the development of modern silicon power rectifier diodes, cuprous oxide and later selenium was used; its low efficiency gave it a much higher forward voltage drop (typically 1.4 - 1.7 V per "cell," with multiple cells stacked to increase the peak inverse voltage rating in high voltage rectifiers), and required a large heat sink (often an extension of the diode's metal substrate), much larger than a silicon diode of the same current ratings would require.

Zener Diode

Diodes that can be made to conduct backwards. This effect, called Zener breakdown, occurs at a precisely defined voltage, allowing the diode to be used as a precision voltage reference. In practical voltage reference circuits Zener and switching diodes are connected in series and opposite directions to balance the temperature coefficient to near zero. Some devices labeled as high-voltage Zener diodes are actually avalanche diodes.

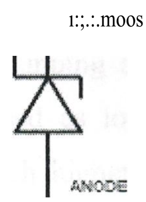


Figure 1.16: Zener Diode

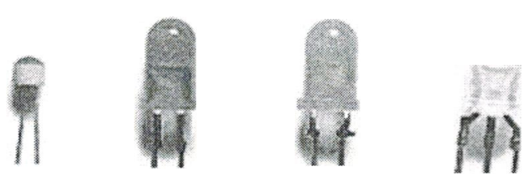


Figure 1.17: Light-Emitting Diode

Light-Emitting Diodes (LEDs)

In a diode formed from a direct band-gap semiconductor, such as gallium arsenide, carriers that cross the junction emit photons when they recombine with the majority carrier on the other side. Depending on the material, wavelengths (or colors) from the infrared to the near ultraviolet may be produced. The forward potential of these diodes depends on the wavelength of the emitted photons: 1.2 V corresponds to red, 2.4 to violet. The first LEDs were red and yellow, and higher-frequency diodes have been developed over time. All LEDs are monochromatic; 'white' LEDs are actually combinations of three LEDs of a different color, or a blue LED with a yellow scintillator coating. LEDs can also be used as low-efficiency photodiodes in signal applications. An LED may be paired with a photodiode or phototransistor in the same package, to form an opto-isolator.

Schottky Diodes

These have a lower forward voltage drop than a normal PN junction, because they are constructed from a metal to semiconductor contact. Their forward voltage drop at forward currents of about 1 mA is in the range 0.15 V to 0.45 V, which makes them useful in voltage clamping applications and prevention of transistor saturation. They can also be used as low loss rectifiers although their reverse leakage current is generally much higher than non Schottky rectifiers. Schottky diodes are majority carrier devices and so do not suffer from minority carrier storage problems that slow down most normal diodes. They also tend to have much lower junction capacitance than PN diodes and this contributes towards their high switching speed and their suitability in high speed circuits and RF devices such as mixers and detectors.

Figure 1.18: Schottky Diode

1.2.4 Integrated Circuits

An integrated circuit (IC) contains transistors, capacitors, resistors and other parts packed in high density on one chip. Although the function is similar to a circuit made with separate components, the internal structure of the components is different in an integrated circuit. The transistors, resistors, and capacitors are formed very small, and in high density on a foundation of silicon. They are formed by a variation of printing technology. There are many kind of ICs, including special use ICs, [7].

In this project, two kinds of integrated circuits are used, these are described bellow..

1.2.4.1 LM380N

The LM3 80 is a power audio amplifier for consumer applications. In order to hold system cost to a minimum, gain is internally fixed at 34 dB. A unique input stage allows ground referenced input signals. The output automatically self-centers to one-half the supply voltage.

The output is short circuit proof with internal thermal limiting. The package outline is standard dual-in-line. The LM380N uses a copper lead frame. The center three pins on either side comprise a heat sink. This makes the device easy to use in standard PC layouts.

Uses include simple phonograph amplifiers, intercoms, line drivers, teaching machine outputs, alarms, ultrasonic drivers, TV sound systems, AM-FM radio, small servo drivers, power converters, etc. Figure (1. 19) shows the chip and the distribution for the pins inside it, [8].

```
              +--()--+
      BYPASS | 1   14|VCC
NON-INV INPUT | 2   13| NC
          GND| 3   12|GND
          GND| 4   11|GND
          GND| 5   10|GND
INVERTING INPUT| 6    9| NC
          GND | 7    8| VOUT
              +------+
```

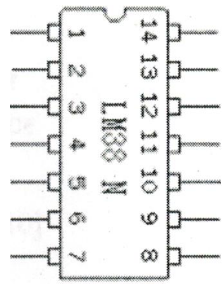


Figure 1.19: LM380N Construction [9]

1.2.4.2 TL081CP

The TL081 is a low cost high speed JFET input operational amplifier with an internally trimmed input offset voltage, (BI-FET IITM technology). The device requires a low supply current and yet maintains a large gain bandwidth product and a fast slew rate. In addition, well-matched high voltage JFET input devices provide very low input bias and offset currents. The TL081 is pin compatible with the standard LM741 and uses the same offset voltage adjustment circuitry. This feature allows designers to immediately upgrade the overall performance of existing LM741 designs. The TL081 may be used in applications such as high speed integrators, fast D/A converters, sample-and-hold circuits and many other circuits requiring low input offset voltage, low input bias current, high input impedance, high slew rate and wide bandwidth. The devices has low noise and offset voltage drift, but for applications where these requirements are critical, the LF356 is recommended if maximum supply current is important, however, the TL081C is better choice, [10].

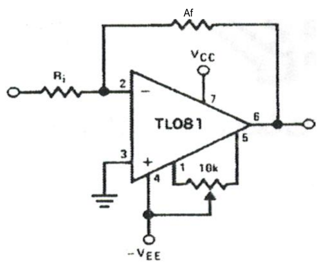


Figure 1.20: Typical Connection [10]

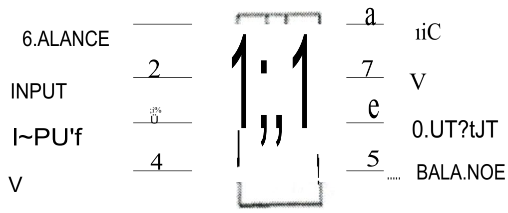


Figure 1.21: Internal Construction [10]

1.2.5 Loudspeaker

The loudspeakers are almost always the limiting element on the fidelity of a reproduced sound in either home or theater. The other stages in sound reproduction are mostly electronic, and the electronic components are highly developed. The loudspeaker involves electromechanical processes where the amplified audio signal must move a cone or other mechanical device to produce sound like the original sound wave. This process involves many difficulties, and usually is the most imperfect of the steps in sound reproduction, [11].

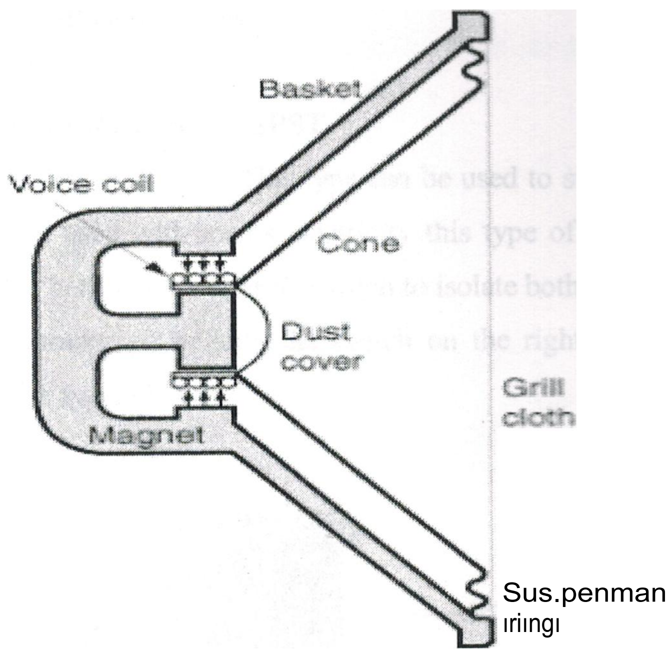


Figure 1.22: Loudspeaker

1.2.6 Switches

An electrical switch is any device used to interrupt the flow of electrons in a circuit. Switches are essentially binary devices: they are either completely on ("closed") or completely off ("open"). There are many different types of switches, and I will explore some of these types in this chapter.

The simplest type of switch is one where two electrical conductors are brought in contact with each other by the motion of an actuating mechanism. Other switches are more complex, containing electronic circuits able to tum on or off depending on some physical stimulus (such as light or magnetic field) sensed. In any case, the final output of any switch will be (at least) a pair of wire-connection terminals that will either be connected together by the switch's internal contact mechanism ("closed"), or not connected together ("open").

Any switch designed to be operated by a person is generally called a hand switch, and they are manufactured in several varieties, [12].

1.2.6.1 Types of SPST Switches

ON-OFF

Single Pole, Single Throw = SPST

A simple on-off switch. This type can be used to switch the power supply to a circuit. When used with mains electricity this type of switch must be in the live wire, but it is better to use a DPST switch to isolate both live and neutral.

In the photograph bellow, the switch on the right side represents the circuit symbol of this type, [13].

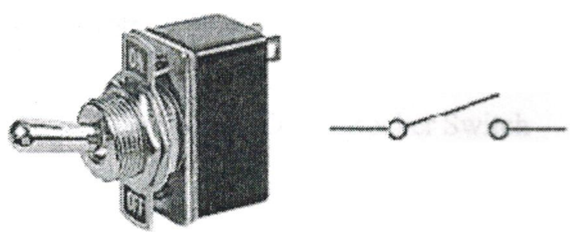


Figure 1.23: SPST Toggle Switch

1.2.7 Relays

A relay is an electrically operated switch. Current flowing through the coil of the relay creates a magnetic field, which attracts a lever and changes the switch contacts. The coil current can be on or off so relays have two switch positions and they are double throw (changeover) switches. And it is shown in Figure (1.27), [14].

Relays are usually SPDT or DPDT but they can have many more sets of switch contacts, for example relays with 4 sets of changeover contacts are readily available. Most relays are designed for PCB mounting but you can solder wires directly to the pins providing you take care to avoid melting the plastic case of the relay. The relay's switch connections are usually labeled COM, NC and NO:

- COM = Common, always connect to this; it is the moving part of the switch.
- NC = Normally Closed, COM is connected to this when the relay coil is off.
- NO = Normally Open, COM is connected to this when the relay coil is on.

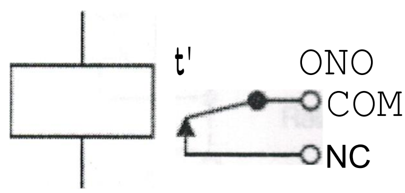


Figure 1.26: Circuit Symbol for a Relay [14]

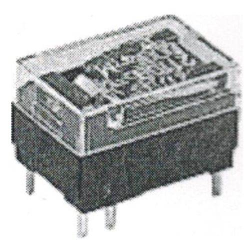


Figure 1.27: Relay [14]

Protection Diode for Relays

Transistors and ICs (chips) must be protected from the brief high voltage 'spike' produced when the relay coil is switched off. The diagram in Figure (1.28) shows how a signal diode (e.g. 1N4148) is connected across the relay coil to provide this protection. Note that the diode is connected 'backwards' so that it will normally not conduct. Conduction only occurs when the relay coil is switched off, at this moment current tries to continue flowing through the coil and it is harmlessly diverted through the diode. Without the diode no current could flow and the coil would produce a damaging high voltage 'spike' in its attempt to keep the current flowing, [14].

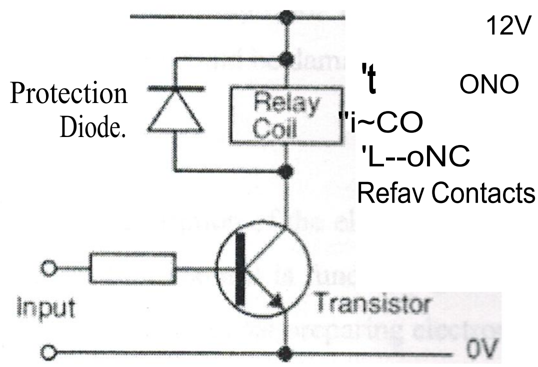


Figure 1.28: Relays Protection Diagram

1.3 Safety Guidelines

In this project, applications of low voltage are used. So here safety guidelines are not including the human safety but including only the components safety. Also the technical mistakes, which are probably, could occur during connecting the components, or while soldering the components on the board. So heat and current should be considered.

One of the main components, which I used in my project, is the capacitance. if the capacitor is subjected to voltage exceeding its working voltage, or if it is connected with incorrect polarity, it may burst. It is extremely dangerous, because it can quite •;.erally explode.

We need to pay attention to the polarity indication so as not to make a mistake assemble the circuit. Such as the ICs, Loudspeaker, Relay, and finally the power s-.çıpıy.

While soldering the parts to the circuit we have to be careful to do nm: components, which are sensitive and could be damaged by heat.

1.4 Summary

This chapter had provided a description of the electronic components, wlıi this project. And some information about it is functioning and the way we co~--::-~-- ·- the circuit, in addition to safety guidelines for preparing electronic hardware projects

CHAPTER TWO
TECHNICAL ON SOUND

2.1 Overview

This chapter will provide general information about sound. Definition, attributes and characteristics of sound will be presented. In addition to frequency and wavelength, speed of sound, amplitude, and velocity will be presented as well.

2.2 What **is Sound**

Sound is the vibration of matter, This vibration sets up a series of ripples or waves much like what is seen when a stone is thrown into a pond. Sound is capable of being perceived by the sense of hearing. We usually hear vibrations that travel through air, but sound can also travel through gases, liquids and solids. It can not travel through a vacuum (such as exists in outer space). When the vibrations reach our ears, they are converted into nerve impulses that are sent to our brains, allowing us to perceive the sound. Sound that the human ear can hear is from about 20 hertz (Hz) to 20,000 Hz.

2.3 Sound Waves

Sound in general is a series of compression waves that moves through air or other materials. These sound waves are created by the vibration of some object, like a radio loudspeaker. The waves are detected when they cause a detector to vibrate, our eardrum vibrates from sound waves to allow us to sense them, [15].

The matter that supports the sound is called the medium. Sound propagates as *waves of aJtematingpressure causing local regions of compression and raref-*action. Particles in the medium are displaced by the wave and oscillate.

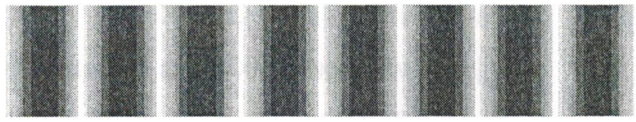


Figure 2.1: Sound Wave

Pitch and Frequency

A sound wave, like any other wave, is introduced into a medium by a vibrating object. The vibrating object is the source of the disturbance which moves through the medium. The vibrating object which creates the disturbance could be the vocal chords of a person, the vibrating string and sound board of a guitar or violin, the vibrating tines of a tuning fork, or the vibrating diaphragm of a radio speaker. Regardless of what vibrating object is creating the sound wave, the particles of the medium through which the sound moves is vibrating in a back and forth motion at a given frequency. The frequency of a wave refers to how often the particles of the medium vibrate when a wave passes through the medium. The frequency of a wave is measured as the number of complete back-and-forth vibrations of a particle of the medium per unit of time. If a particle of air undergoes 1000 longitudinal vibrations in 2 seconds, then the frequency of the wave would be 500 vibrations per second. A commonly used unit for frequency is the Hertz (abbreviated Hz), where:

1 Hertz= 1 vibration/second

As a sound wave moves through a medium, each particle of the medium vibrates at the same frequency. This is sensible since each particle vibrates due to the motion of its nearest neighbor. The first particle of the medium begins vibrating, at say 500 Hz, and begins to set the second particle into vibrational motion at the same frequency of 500 Hz. The second particle begins vibrating at 500 Hz and thus sets the third particle of the medium into vibrational motion at 500 Hz. The process continues throughout the medium; each particle vibrates at the same frequency. And of course the frequency at which each particle vibrates is the same as the frequency of the original source of the sound wave. Subsequently, a guitar string vibrating at 500 Hz will set the air particles in the room vibrating at the same frequency of 500 Hz, which carries a sound signal to the ear of a listener, which is detected as a 500 Hz sound wave, [17].

The back-and-forth vibrational motion of the particles of the medium would not be the only observable phenomenon occurring at a given frequency. Since a sound wave is a pressure wave, a detector could be used to detect oscillations in pressure from a high pressure to a low pressure and back to a high pressure. As the compression (high pressure) and rarefaction (low pressure) disturbances move through the medium, they would reach the detector at a given frequency. For example, a compression would reach the detector 500 times per second if the frequency of the wave were 500 Hz. Similarly, a rarefaction would reach the detector 500 times per second if the frequency of the wave were 500 Hz. Thus the frequency of a sound wave not only refers to the number of back-and-forth vibrations of the particles per unit of time, but also refers to the number of compression or rarefaction disturbances, which pass a given point per unit of time. A detector could be used to detect the frequency of these pressure oscillations over a given period of time. The typical output provided by such a detector is a pressure-time plot as shown in Figure (2.2), [17].

Since a pressure-time plot shows the fluctuations in pressure over time, the period of the sound wave can be found by measuring the time between successive high pressure points (corresponding to the compressions) or the time between successive low pressure points (corresponding to the rarefactions).

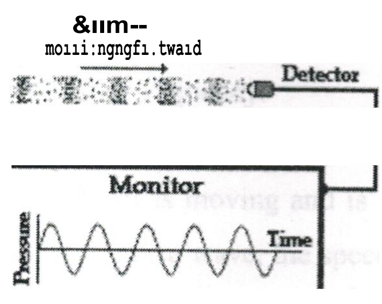


Figure 2.2: Pressure-Time Detector

qwA qµOJ pıra){::mq ::)lUJq}A tmo ::)AtlM tl pus '.pggds IltllUS tl ::)Atıq l::)A 'ı(pmnbgJJ ı(1gA qµoJ pıra)l::mq gın1q}A ımo ::)AtıM V 'puooos rod pgT::)AUJl sıoıouı oqı oı srojor pcods ::)AtıM 'puooos rod 'aU}JJn::ı::ıo sgpı(::ı JO .ıoqumu gqı oı s.ıgp1 ı(::,ugnbgJJ ::)AtıM gEqM os 'ourn JO pouod ugAI'a tı ti! (ısoro tı stı qons) ::)AtıM gqı uo ıurod U::)A}'a tı ı(q pgTgAtı1ı ootraıstp cqı SI pocds gq.ı 'gAtıM tı *10:1* ·pAtı1ı JO ounı rod pgpAtıJl g::ıutıısıp oqı stı possordxc ı(nnnsn SI pıra 'ati!Aonı SI ıoofqo ua ıstıJ Moq oı s1gJg.ı ıoofqo tm JO pocds gqı ·pggds f\-lqutınb gq.ı qı}M posnjuoo OSTtı S} ı(::,ugnbgJJ A-lilUtınb gqı ·ı(::,ugnbgJJ MOT tı oı roqıo oqı pun ı(::,ugnbg.ıJ q'aiq tı oı 'au}puodsgırn::ı ouo 'sıojd cum-amsscrd oMı sMoqs gAoqtı (s·z) g.m'aid

:stı possardxc OSTtı gm suouanbo osoqı 'pouod JOJ posn S} .L [oqtnxs oqı ptm ı(::,ugnbgJJ .IOJ pcsn S} **J** [oquı/s gqı g::,u!s

$$\text{frequency} = \frac{1}{\text{period}}$$

kıuanoo.q = popad

'sıutod amssord q'aiq ::)A}ssg::ı::ıns uggA\lgq cum JO ıunoum gfütıT n oı 'au}puodsg.IJo::ı ıojd tı 'SI ıaqı - poucd g'amT u lJ"llM ıojd ounı aınssaıd tı oı puodsorroo PTUOM ı(::,ugnbgJJ MOT tı qlIM ;)AtıM punos tı 'ı(ps.1gAUO;:) -sıurod crnssard q'aiq ::)Aissg::ı::ıns uggMlgq gnıiı JO ıunoure nnıus ı:ı oı 'au}puodsg.IJo::ı ıojd tı 'sI rsqı - pouod nnıus tı qFM ıojd gnı!ı aınssaıd tı oı puodsorroo PTUOM kmgnbgJJ q'aiq tı qlIM ;)AtıM punos tı 'uosnar S}q.ı .10:ı 'pouod gq.ı JO TtıJOJdI::ıgJ gqı ATdlU}S S} ı(::,ugnbgJJ gqı

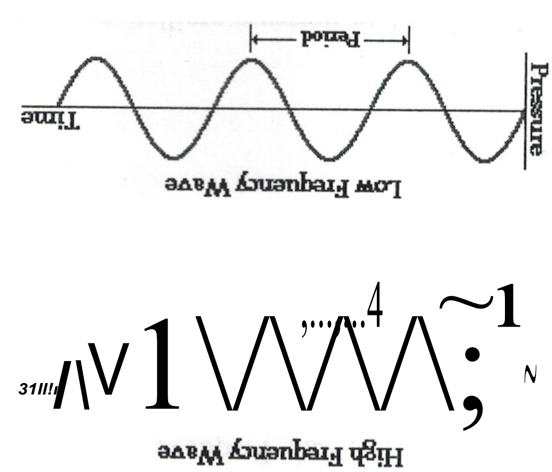


Figure 2.3: Pressure-Time Plot

a low frequency, yet have a high speed. Frequency and speed are distinctly different quantities, [17].

2.4 Attributes of Sound

The characteristics of sound are Frequency, Wavelength, Amplitude and Velocity or Speed.

Frequency and Wavelength

The frequency is the number of air pressure oscillations per second at a fixed point occupied by a sound wave. One single oscillatory cycle per second corresponds to 1 Hz. The wavelength is the distance between two successive crests and is the distance that a wave travels in the time of one oscillatory cycle.

The wavelength of a sound wave of frequency f and traveling at speed c is given by c/f. given a speed of 343 m/s; a 20 kHz sound wave has a wavelength of about 17mm. The sound is emitted as a sine wave traveling outward spherically from a point source, the pressure of the sound wave can be written as:

$$P(r,t) = P_0 \sin\left[2\pi f \left(t - \frac{r}{c}\right)\right]$$

Where $P(r,t)$ is the pressure at distance r at time t, P_0 is the amplitude of the pressure. And it can be measured in Pascals. Figure (2.3) shows the wavelength.

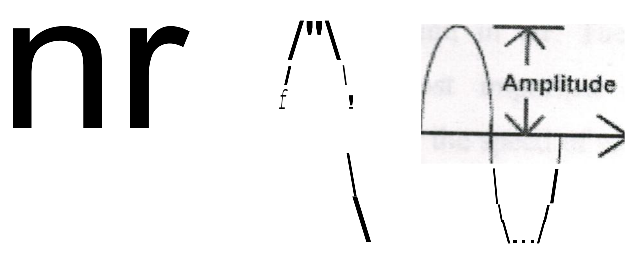


Figure 2.4: Sound Sine Wave

;Jpnmduıv

'gAtıM.. gqı u;ql!M.. sg'.EUtıqJ crnsscrd punos JO gpnı1u:Etım cqı st gpnı11dmu gqı

·gAtıM.. punos gqı ut ıutod Alitı ıtı crnsscrd JO ıunoure umunxeuı gqı 'AUtıJ!Stıq *10*

JO) sıuıod tmnroo w o.mssaıd ut sgstıgJJU~ Aq AUUJ;:)l!l postmo st ;:)J\.tıM.. punos V

gqı gJtı sıuıod crnssard q:E1q oqı 'pJtıM..ıno pgJJg otnuıop, tı 13u~sntıJ (ltı!.1gıum tı

-uıoqı Ell+ qJ!qM.. sıutod crnssord M..0l ore uıoqı purqoq putı 'gAoqu pguoqugm sısoro

U! poureıqo S! reqı .1;:)UtlUI JO sgp!µBd JO ıugUI;:):)tı1ds1p ltllU!XtlUI gqı S! opnnjdurv

ornssord pUtı roqıo tptıg spJtıM..0l gA0lU Jglıtım JO sgl~!µtıd gqı gJgqM.. 'suo1ssgJdmoJ

gqı 'ısouı cqı suossct ornssaıd gqı gJgqM.. 'suo1ıJtıJ;:)Jtı.r ti! putı ısouı gqı soseoıoın

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gm'.E!d ·:Eu!ıq13!gM.. V JO (VHP) pgntıJ st l! 'AJugnbgJJ uo pgstıq ssgupno1 sgA!gJJgd

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gqı qJ!qM.. q:Enoıqı umtpouı gqı uo '.Eti!pugdgp sgµtıA :J punos JO poods gqı

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punos stı cums gqı s~ ıı Al!JopA punos gJfiltıJglH Jgqug!JS ut pus osn 1tıuo1ıugAUOJ

punos ql!M.. posnjuoo gq ıou p1noqs punos JO Al!JOPA JO :J Al!JOpA pımog :J poods

g.1ow ·sgp~µtıd 1tınp!A~pu~ oqı JO Al!JOpA oqı S! qJ!qM.. 'ıı Al!JOPJ\. gp!µBd

S;:)!JtlJ\. poods gqı 'J!U U! punos JO poods aqı oı S.1;:)J;:)J uıoı gqı AlUOUIUIO:)

gqı st roioej ıutıµodm~ ısouı gqı :suo~ı~puoJ Jµgqdsomıtı uo :au1pugdgp

gqı gl!qM.. 'punos JO poods gqı uo pgJJ;:) gnm ıJ;:)J\. saq Al!P~uınq gqı ';:)JfiltlJgdmgı

gpnlqltl pgstıgJ:)U~ Utı qWr\ J;:)M..0lS Sl;:)J\.tlJl punog ·pgJp Utl saq cınsscıd J~tl

pUtı orruaıeduıcı JO ı1nsgJ tı stı Alµtım~Jd '(qµtıg P!1os uo gJtı gM.. J~ uoqtıAgp)

pgw1nJp~J gq uBJ (puooos rod sıcıcuı ut) poods gwm~xoJddtı UV ·sg'.Eum.p Al~P!umq

:UIOJJ

$$c_{\text{air}} = (331.5 + (0.6 \cdot \theta))\ \mathrm{ms}^{-1}$$

Where θ (theta) is the temperature in degrees Celsius, [16].

Amplitude

The amplitude is the magnitude of sound pressure changes within the wave, or basically, the maximum amount of pressure at any point in the sound wave.

A sound wave is caused literally by increases in pressure at certain points (of a material) causing a "domino effect" outward, the high pressure points are the crests mentioned above, and behind them are low pressure points which tail them. Amplitude is the maximal displacement of particles of matter that is obtained in compressions, where the particles of matter move towards each other and pressure increases the most and in rarefactions, where the pressure lessens the most, the amplitude is more often referred to as sound pressure level and measured in decibels (dB). When the measurement is adjusted based on how the human ear perceives loudness based on frequency, it is called (dBA) or A weighting. Figure (2.3) above shows the wave amplitude.

Speed of Sound

The speed of sound *c* varies depending on the medium through which the sound waves pass. It is usually quoted in describing properties of substances. In conventional use and in scientific literature sound velocity *v* is the same as sound speed *c.* Sound velocity *c* or velocity of sound should not be confused with sound particle velocity *v,* which is the velocity of the individual particles. More commonly the term refers to the speed of sound in air. The speed varies depending on atmospheric conditions; the most important factor is the temperature. The humidity has very little effect on the speed of sound, while the air pressure has an effect. Sound travels slower with an increased altitude (elevation if we are on solid earth), primarily as a result of temperature and humidity changes. An approximate speed (in meters per second) can be calculated from:

$$c_{air} = (331.3 + 0.606\,\theta)\ ms^{-1}$$

Where θ (theta) is the temperature in degrees Celsius, [16].

2.5 Sound Measurement

Sound pressure, Amplitude, sound intensity, will be presented under this title.

Sound Pressure

Sound pressure p (or acoustic pressure) is the measurement in Pascal of the root mean square (RMS) pressure deviation (from atmospheric pressure) caused by a sound wave passing through a fixed point. The symbol for pressure is the lower case *p*. The upper case *P* is the symbol for power. The unit is Pascal (symbol: Pa) and that is equal to a force F of one Newton (1 N) applied over an area A of one square meter (Inr'). The amplitude of sound pressure from a point source decreases in the free field (direct field) proportional to the inverse of the distance *r* from that source. That is *lir* and really not squared, [16].

Sound pressure level is a decibel scale based on a reference sound pressure of 20 µPa (micro-Pascal)(Air), calculated in dB as:

$$L_P = 20 \log_{10} \left(\frac{p_1}{p_0} \right) \text{ dB}$$

This is written "dB".

Reference sound pressure $p_0 = 2 \times 10^{-5}$ Pa= 20 µPa (Air)

Sound pressure p in N/m^2 or Pa is:

$$p = Zv = \frac{I}{v} = \sqrt{IZ}$$

Z: acoustic impedance, sound impedance, or characteristic impedance; Pa·s/m

V: particle velocity; *mis*

I: acoustic intensity or sound intensity; W/m^2

Sound pressure pis connected to particle displacement (or particle amplitude) ~m, by:

$$\xi = \frac{v}{2\pi f} = \frac{p}{Z\omega} = \frac{p}{2\pi f Z}$$

Sound pressure p:

$$p = \xi Z \omega = [illegible] = [illegible] = \frac{aZ}{\omega} = [illegible] = [illegible]$$

The distance law for the sound pressure p is inverse-proportional to the distance r of a punctual sound source. This is not like sound intensity, which follows the inverse-square law.

$$p \propto \frac{1}{r} \text{ (proportional)}$$

$$\frac{p_1}{p_2} = \frac{r_2}{r_1}$$

$$p_2 = p_1 \cdot \frac{1}{r_2}$$

Amplitude

Amplitude is a nonnegative scalar measure of a wave's magnitude of oscillation, that is, magnitude of the maximum disturbance in the medium during one wave cycle.

In the Figure (2.5) below, the distance y is the amplitude of the wave. Sometimes this distance is called the "peak amplitude", distinguishing it from another concept of amplitude, used especially in electrical engineering: the root mean square (RMS) amplitude, defined as the square root of the temporal mean of the square of the vertical distance of this Figure from the horizontal axis. The use of peak amplitude is unambiguous for symmetric, periodic waves, like a sine wave, a square wave, or a triangular wave, [16].

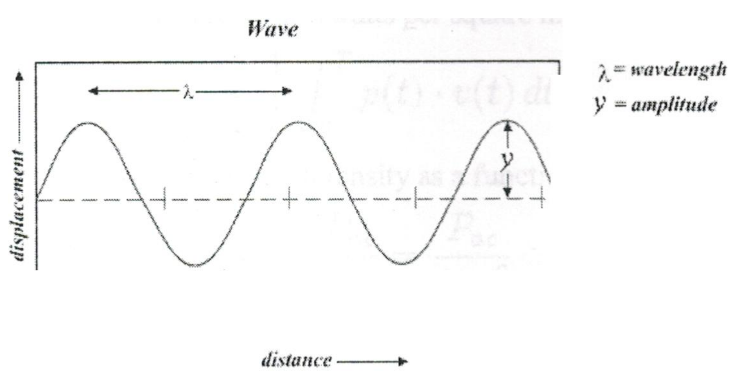

Figure 2.5: Sine Wave Signal

For an unsymmetrical wave, for example periodic pulses in one direction, the peak amplitude becomes ambiguous because the value obtained is different depending on whether the maximum positive signal is measured relative to the mean, the maximum negative signal is measured relative to the mean, or the maximum positive signal is measured relative the maximum negative signal and then divided by two.

For complex waveforms, especially non-repeating signals like noise; the R' amplitude is usually used because it is unambiguous and because it has physical significance. For example, the average power transmitted by an acousnc o-electromagnetic wave or by an electrical signal is proportional to the square of the RMS amplitude (and not, in general, to the square of the peak amplitude).

There are a few ways to formalize amplitude. In the simple wave equation:

$$x = A \sin(t - I\{) + b \,,$$

A is the amplitude of the wave, and the units of the amplitude depend on th type of wave. The amplitude of sound waves and audio signals conventionally refers to the amplitude of the air pressure in the wave, but sometimes the amplitude of the displacement (movements of the air or the diaphragm of a speaker) is described. The logarithm of the amplitude squared is usually measured in dB, so null amplitude corresponds to -oo dB, [16].

Sound Intensity

The sound intensity, I, (acoustic intensity) is defined as the sound power P_{ac} per unit area A. The SI units are W/m2 (watts per square meter).

$$I = \frac{1}{T} \int_0^T \text{Jr;iJ} \,.\, 1 \cdot t,t)\, di$$

For a spherical sound source, the intensity as a function of distance r is:

$$I_r = \frac{P_{ac}}{A} = \frac{P_{ac}}{4\pi r^2}$$

The sound intensity I in W/m^2 of a plane progressive wave is as follows:

$$I = p \cdot 1 \cdot = \frac{J^2}{Z} = Z \cdot t \cdot - = t,- \cdot (ti- \cdot Z = \frac{\sim[^2 \cdot L;}{ur!} = P \cdot c = \frac{P_{i!C}}{\_-i}$$

Where:

Table 2.1: Symbols and Units

Symbol	Units	Meaning
p	Pa	Sound Pressure
f	Hz	Frequency
ç	m	Particle Displacement
c	mis	Speed of Sound
v	mis	Particle Velocity
co= $2nf$	rad/s	Angular Frequency
p	$Kglm_3$	Density of Air
$Z=c \cdot p$	N-s/m3	Acoustic Impedance
a	m/s2	Particle Acceleration
I	W/m2	Sound Intensity
E	W·s/m3	Sound Energy Density
Pac	W	Sound Power
A	m2	Area

2.6 Waveform Noise

Waveforms such as sound waves, alternating current (AC) electrical cycles, and electromagnetic waves--including visible light waves-can include noise. Extra or unwanted waveforms and static are considered noise for the original waveform. The noise can be irritating and interfere with communication. The signal-to-noise ratio determines how much noise there is.

Sound Noise

Any type of sound that interferes with your normal hearing can be considered noise. It is often loud and irritating. Some noise can also be quiet sounds that you can barely hear but can affect your desire for quiet.

2.7 **Summary**

This chapter presented in general the Definition, attributes and characteristics of sound, in addition to sound measurement and noise, which were also presented in this chapter.

CHAPTER THREE
SOUND ACTIVATED ALARM

3.1 Overview

In this chapter an explanation to the design of sound activated alarm circuit is presented. Information about the circuit functions and the usage fields will be provided as well.

3.2 Introduction

This project is entitled Sound Activated Alarm. The idea arose because of its applicability to our daily lives, the most common uses for sound activated alarm are probably the automatic control of tape recorders and radio transceivers, but no doubt there are numerous other applications for this type of equipment, it also can be used to control a toy car, helping deaf people, robot to respond to a hand clap, a spoken commands, or even to switch on light or other electrically operated device in response to a sound.

3.3 Hardware Description

The simple design featured in the circuit can be activated by speech, or hands clap at normal volume at a range of up to about 1 meter or so, and this is adequate for most practical application. Higher sensitivity is not really a good idea as it is merely likely to lead to spurious operation of the device, and has no real advantage under normal operating conditions.

3.4 Sound Activated Alarm Circuit

This section will present circuit works, and explanation about each stage function of the circuit, and description for some important components will be presented as well. Figure (3 .1) shows the schematic of sound activated alarm circuit, [18].

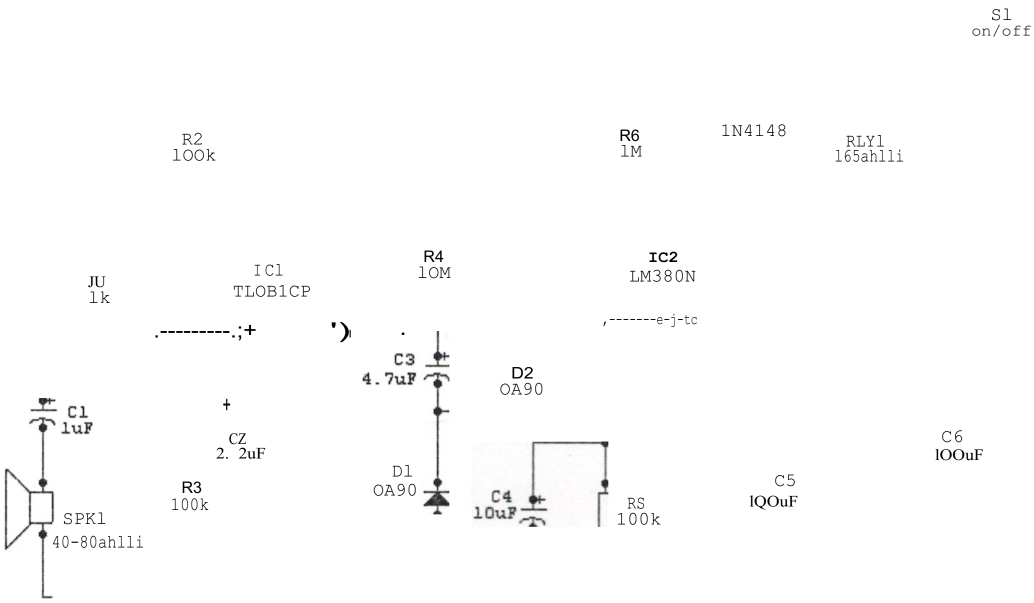

Figure 3.1: Sound Activated Alarm Circuit

3.4.1 First Stage

The microphone used in the unit is a high impedance loudspeaker, which is used in reverse as a sort of crude moving coil microphone. This does not give very good sound quality, but the microphone is only used to produce a signal, which is amplified and used to control a relay. Figure (3.2) shows the loudspeaker in the first stage.

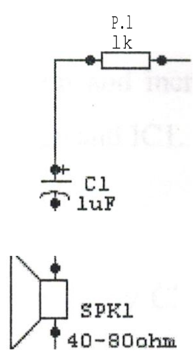

Figure 3.2: Loudspeaker with High Impedance

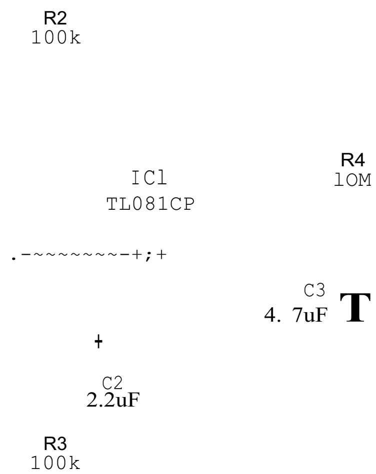

Figure 3.3: Second Stage

3.4.2 Second Stage

ICl is used as a straightforward inverting amplifier having a voltage gain of approximately 80 dB (10,000 times), although the gain is substantially less than this at higher audio frequencies since ICl simply is not able to give such a high voltage gain at these frequencies. It is necessary to use this large amount of amplification due to the very low signal voltage provided by the microphone, which will normally be less than a millivolt. ICl is connected using negative feedback that is to stable the gain and increase the frequency response. Figure (3.3) above shows the second stage and ICl.

3.4.3 Third Stage

The output from ICl is coupled by C3 to a rectifier and smoothing circuit, which consists of Dl, D2, C4, and RS. This produces a positive DC bias, which is fed to the inverting input of IC2.

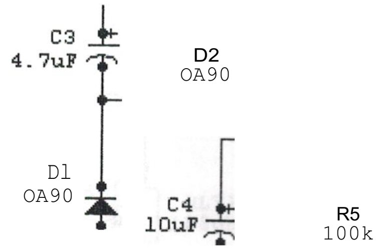

Figure 3.4: Third Stage Circuit

This circuit produces a DC signal that has a fast attack time so that the unit quickly responds to the commencement of an input signal and almost instantly switches on the controlled equipment (our output device). However, the delay time is much slower, and this is advantageous since it prevents the controlled equipment from being switched off during brief pauses of the type that occur in normal speech. Figure (3.4) shows diodes rectifying stage schematic.

3.4.4 Fourth Stage

IC2 is used as the relay driver, and R6 provides a small positive bias to the non-inverting input of IC2. This keeps the output in the high state and the rela switched off until a suitably strong input signal produces a strong enough bias at the inverting input of IC2 to send the output low and thus switch on the relay. The unit is capable of controlling practically any item of electronic or electrical equipment, but we must make sure that the relay we use has contact that are up to the task and are not being over loaded. In its bread board from the unit cannot control a piece of mains-operated equipment if it is constricted as permanent project and the necessary safety precaution are observed. However, it would be inadvisable for inexperienced constructor to use the unit to control mains powered equipment.

The output stage is shown in Figure (3.5), IC2, Relay, and switch are also shown.

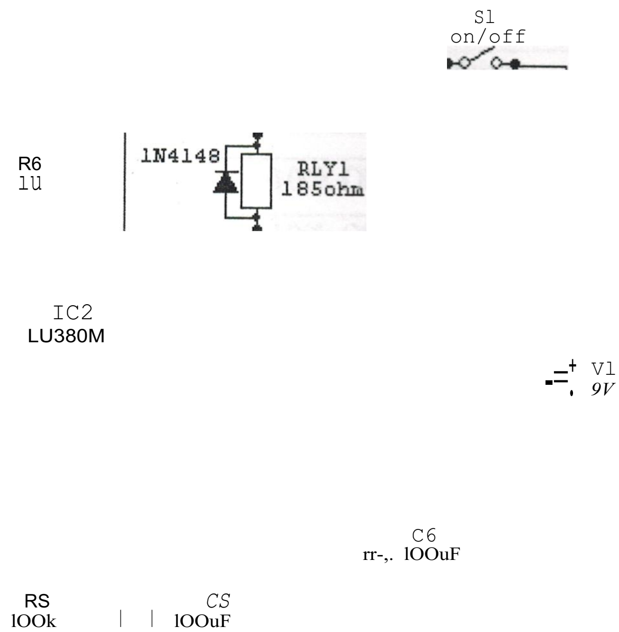

Figure 3.5: Fourth Stage Schematic

3.5 Safety Guidelines

We need to pay attention to the polarity indication so as not to make a mistake when we assemble the circuit. Such as the ICs, Loudspeaker, Relay, and finali the power supply. While soldering the parts to the circuit we have to be careful not to bum the components, which are sensitive and could be damaged by heat.

3.6 Project Components List

A description of the components used in general hardware projects and the practical sides of each one were presented, but now the numeric values of the components will be shown in this section as in Table (3.1).

Table 3.1: Components Description

Symbol of the Component	Value and Description
R1	1k Ohm Resistor.
R2	1Oük Ohm Resistor.
R3	1Oük Ohm Resistor.
R4	1OM Ohm Resistor.
R5	1Oük Ohm Resistor.
R6	1M Ohm Resistor.
C1	1µF 63 V Electrolytic.
C2	2.2µF 63 V Electrolytic.
C3	4.7µF 63 V Electrolytic.
C4	lüµF 25 V Electrolytic.
CS	100 nF Polyester.
C6	lOOµF 10 V Electrolytic.
1C1	TL081CP.
IC2	LM380N.
D1	OA90 Gi
D2	OA90 *Gi*
D3	1N4148 Si
S1	SPST Miniature Toggle Type Switch.
RLA	RELAY 6-12 volt. 185 Ohm.
B1	PP6 size 9 V.
LS1	Loudspeaker 40-80 Ohm.

3.7 **Summary**

In this chapter the sound activated alarm schematic was presented, hardware description, in addition to the stages of the circuit, and the list of components used in this project are also shown in this chapter.

CHAPTER FOUR
Results and Analysis

4.1 Overview

This chapter will present the problems encountered with the circuit after building, and the changes done to solve that problems. Results and modifications will be presented as well.

4.2 Modifications

In this section problems encountered during building the circuit will be presented, solutions and improvements are going to be produced to this section as well, in addition to the components that we have added to the circuit. Figure (4.1) shows the modified circuit. LEDs (light emitting diodes) that show the device status (ON or OFF) and activation of the sound switch are added to the circuit in Figure (4.1).

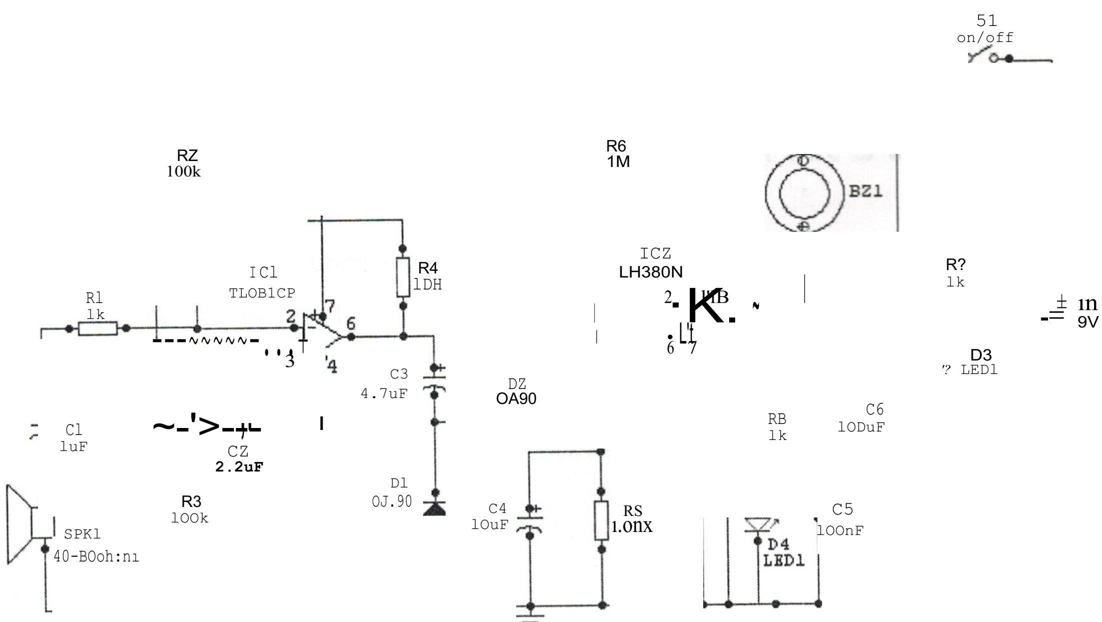

Figure 4.1: Modified Sound Activated Alarm Circuit

4.2.1 Light Emitting Diodes

Two light-emitting diodes (LED) are employed in this project, and these light-emitting diodes (LED) are small types (3 mm or 0.125 in), these LED are TIL211, which are green and red devices. Many component suppliers do not use type numbers for the LEDs and simply describe them as LED of a certain color, diameter, and shape like TIL211.With most LED circuits, including those described here, from the electrical viewpoint the size, color, and shape of the LED is not important and with exception of a few special types such as infra-red and multi-color types any LED can be used. For circuit that use both types it is not even essential to use LEDs of different colors, but a two- current display will probably be clearer than one having LEDs of the same color.

There are various way used to show which LED lead-out wire is the anode (+) and which is the cathode (-), one of the most common being to have one lead-out wire shorter than the other, usually the shorter lead-out wire is cathode one (-), but unfortunately this is not always the case, and sometimes different method of identification is used. With some LEDs there is no obvious way of telling which lead-out wire is which as they seem to be symmetrical if the manufacturer's or retailer's data is not available, or does not make it clear lead-out wire is which, you can simply try each LED either way round.

If the device is wrongly connected it will fail to light but is unlikely to sustain any damage, and it will merely be necessary to reverse the polarity of the device in order to make the circuit function correctly.

Viewing some general detailed information about light emitting diodes will be produced.

- **Function**

LEDs emit light when an electric current passes through them an example of a light emitting diode and its circuit symbol are shown Figure (4.2).

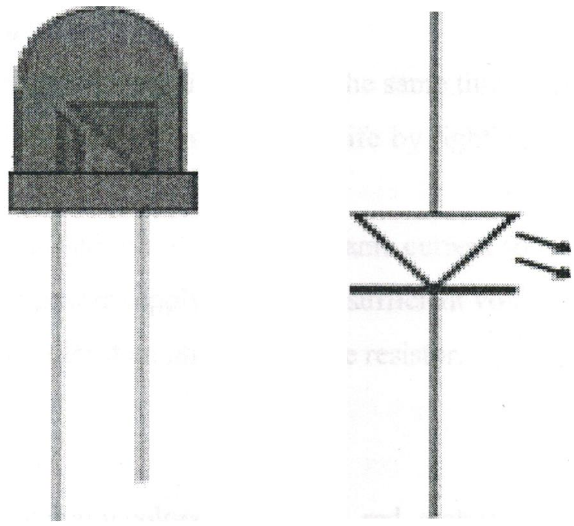

Figure 4.2: Red Light Emitting Diode and its Circuit Symbol

- **Connecting the LEDs**

  LEDs must be connected the correct way round, the diagram shown in Figure (4.3) may be labeled (a) or(+) for anode and (k) or(-) for cathode. The cathode is the short lead and there may be a slight flat on the body of round LEDs. If you can see inside the LED the cathode is the larger electrode (but this is not an official identification method).

  LEDs can be damaged by heat when soldering, but the risk is small unless you are very slow. No special precautions are needed for soldering most LEDs.

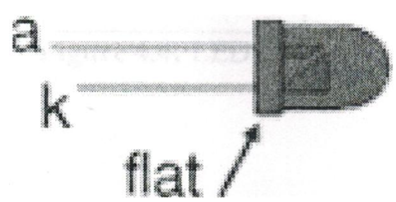

Figure 4.3: Light Emitting Diode Diagram and its Polarities

- **Connecting LEDs in Series**

If it is desired to have several LEDs on at the same time it may be possible to connect them in series. This prolongs battery life by lighting several LEDs with the same current as just one LED.

All the LEDs connected in series pass the same current so it is best if they are all the same type. The power supply must have sufficient voltage to provide about 2V for each LED plus at least another 2V for the resistor.

- **Colors of LEDs**

LEDs are available many colors like orange, red, amber, yellow, green, blue, and white. Blue and white LEDs are much more expensive than the other colors.

The semiconductor material determines the color of an LED, not by the coloring of the 'package' (the plastic body).

LEDs of all colors are available in uncolored packages which maybe diffused (milky) or clear (often described as 'water clear'). The colored packages are also available as diffused (the standard type) or transparent.

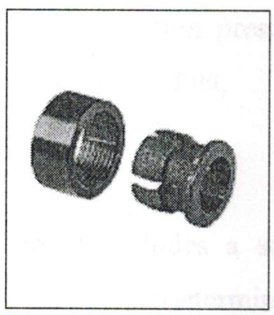

Figure 4.4: LED Clip

4.3 Problems and Solutions

- During constructing the circuit we have had problem, which is the components Dl, D2 having codes (OA90) and the integrated circuit (LM380N) were not available at the market in Cyprus, even after checking the equivalent components we couldn't find an alternative, so I had no other choice but to order those missing components from Jordan after longtime waiting.

- **Loudspeaker**

  The required loudspeaker in the sound activated alarm circuit was 40-80ohm; we replaced another loudspeaker with 4-Sohm, and connected 50ohm resistance in series to this loudspeaker.

4.4 Design Verification

Having the design of the project in mind and on paper, it was necessary to test if the design would work as intended. Much testing was done as the project was being assembled; components were tested, circuits were verified. Once the parts have been assembled and interfaced, more testing was done to check the functionality of the product. This section presented the various testing that we done to check the workability of the product.

4.5 Results

The switching alarm circuit includes a sound activated switch, which is energized in response to a sound of predetermined frequency emanating from the sound sensed from the loudspeaker. This creates an electrical signal that passes through the circuit to actuate the alarm. The alarm may be audible and/or visual and the sound activated switch after a predetermined time may denergized the audible alarm. The sound source is positioned at the location where the change in condition is to be sensed. All other parts of the system are adapted to be spaced remotely.

4.6 Future Work

Instead of using LEDs, a florescent lamp or an ordinary lamp could be used for added practicality. Also, to enhance the aesthetic value of the project, the circuits could be soldered together on a PCB and then mounted in a

4.7 Summary

This chapter presented the problems encountered during building the circuit and also the main modifications added to this project. The results and solutions have been included as well.

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