NEAR EAST UNIVERSITY

Faculty of Engineering

Department of Electrical & Electronic Engineering

SOUND ACTIVATED SWITCH

Graduation Project
EE-400

Student: Omran AL-AKHRAS (980719)

Supervisor: Assoc. Prof. Dr. Adnan KHASHMAN

Lefkoşa-2002

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For the time being I would like to thank my parents for their endless support, and for their encouragement, because they were always giving me the moral to continue and to finish, so I am really proud of them all, and I would like to present my project to my father that because his endless sustains. I really LOVE YOU ALL.

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A general thanks for all the other friends in Cyprus

I hope them all success and good life.

ABSTRACT

By considering the comfortable world at these days; and the needs of the people so we see that we have to do something special for such a needs.

Our aim in this project is to build and configure a working circuit for a *SOUND ACTIVATED SWITCH,* and explaining the main reasons for doing such a practical projects.

So this project will help all people and especially the disabled, blind people so they can do what they want without getting tired, so it is very important to work on such a projects. This switching circuit could do what you order it by sound so you just say 'light' to turn the lights on without pressing any button or you just say 'condition' to switch your air-condition on, so it is so useful for all of us. This is a small circuit that can switch a small light (LED).

For the plan of work there are some sections that you have to pass through to be sure that the circuit is perfectly working with at least 90% efficiency, so the first thing that e had done that; selecting the correct components from the list especially the semi-conducting components (ICs and diodes), then we will step to the connection section and here be sure that you are always doing the correct connection especially for the capacitors (that mains you have to connect it by considering its polarity, otherwise you will have some faults in the circuit), that is also for the diode. Considering the inputs and the outputs of the ICs.

Of course you will not connect the power supply (source) before making a double check for all the circuit.

The last step of the work is connecting the source and checking the desired output, if it is not the wanted output so you make another check over the connection, finding the faults and trying to fix the problem to get the desired output is the tests that you are doing over the circuit, the tests helps you to get more and more efficiency from the circuit.

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3. SOUND ACTIVATED SWITCH

INTRODUCTION

We thought to do our project on Sound Activated Switch after we see that it is an important project to be worked on that because of its advantages for the people over their life, the world is becoming a digital world after implementing a lot of things that the people can do while they are sitting at home for example internet connection, you can do a lot of thing like checking your account, ordering some needs, buying books, learning the news and other good and helpful things, so with the same idea we got to do our project to do some favors for the people.

In this project you will see that you can turn the light on or off, or switch your air-condition on or off also and other thing, and all that by using a small switching circuit which is called *SOUND ACTIVATED SWITCH.*

This project consists of three chapters, the first chapter giving general information about the *SWITCHES* and how does it work, with some presentation of the used contact material in the switches also some and also some effect of the circuit parameters on the switch to know how to use them carefully, and other helpful information.

The second chapter is about the *SOUND* the definition of the sound (briefly: it is a wave), some properties of the sound, the speed of the sound and by that there are some losses it will be given as dB (decibel). Waves and its characteristics, the ultrasonic and infrasonic waves will be briefly explained, some application of waves and the speech signal will also include.

The third chapter is the main chapter which presenting the SOUND ACTIVATED SWITCH and its circuits, some explanations about the faults of the circuits, all the connections and the alternative components that may used instead of some components in the circuit, it will also has a section about the budgets of the projects separately.

The aim of this project is to design, build and test a working sound activated switch.

CHAPTER ONE

SWITCHES

1.1 Overview

This chapter presents general information about switches, types of switches and also shows the main structure of the switch, it also has a section which discuses the terminology of the switch.

Contact material have also been discussed, the use of the switches in the hostile environment and the effect of the acceleration, shocks and vibration also the effect of the circuit parameters on the switches has been discussed.

A sufficient section discusses how we can increase the switch life in end use of the switches by the electrical and mechanical factors of the switch.

1.2 Introduction to switches

Examples of electrical energy being converted into other forms of energy are Electricity into sound in a stereo speaker, electricity into rotary motion in a motor; electricity into heat in an electric heater, and electricity into light in an incandescent lamp. Examples of these same forms of energy being converted into electricity are sound into electricity in a microphone, rotary motion into electricity in a generator, heat into electricity in a thermocouple, and light into electricity in a solar cell.

Electrical energy is easily transported by means of conductors such as wires or bus bars, and is readily controlled by relays, potentiometers, and switches. Electrical energy is converted, transported, and controlled in an electric circuit.

An electric circuit can be simple or complex. An ordinary flashlight is an example of a simple electric circuit consisting of a battery, which provides the electrical energy; an incandescent lamp, which converts the electrical energy into light; connecting wires, which transport the energy between the battery and the lamp; and a switch, which controls the electrical energy.

This simple electric circuit, like its complex counterpart, consists of three principal parts:

- A source of electrical energy
- A load (converting device)
- A complete path for current

If any one requirement is not fulfilled, current will not travel in the circuit. A switch is used by an operator to open and close the path for current. As such, a switch is a basic element used for control of current in a circuit.

The source in the circuit is that device which provides the necessary energy to cause an electrical action to take place.

The load in an electric circuit is that device which converts electrical energy into some other form of energy. Regardless of the purpose of the circuit, a load is necessary to produce the desired output (energy conversion or signal development).

Energy is transferred between the source and load by means of an electrical current. This current travels from one terminal of the source, through the load, and back to the other terminal of the source.

The source provides the energy which causes the current to travel this path. Unless this path is present, current cannot travel through the load; electrical energy will not be converted, and no useful work will be accomplished. Thus the last requirement for an electric circuit is a complete path for current.

A switch performs its function by opening or closing the path for current in a circuit. When the path for current is open, the load is disconnected from the source, and there can be no current in the circuit. When the switch closes the circuit, the requirements are met and current travels through the load. This action by the switch is referred to as "making and breaking" the circuit. For our purposes, then, the basic definition for a switch is:

"A switch is a devicefor making or breaking an electric circuit"

The definition suggests the ultimate in simplicity-that a switch need be no more than the bare ends of two wires that can be touched to make a circuit or separated to break a circuit.

If we touch or separate the two bare wires of our "switch" while current is flowing in the wires, an arc appears between the two wires. Arcing is a natural phenomenon attendant to switching, the arcing being more intense on break (or separation) because of the induced current created by the collapsing magnetic field. Because arcing is damaging to switch contacts, much of switch design is devoted to taming the arc. As will be seen later in this chapter, the physics of arc extinction is a complex science, and many switch engineers have devoted entire careers to the understanding, and conquering, of this phenomenon.

Obviously, even though the two bare wires meet our fundamental definition for a switch, a device is needed to permit opening and closing the circuit in a more sensible way.
A great improvement over our crude bare wire "switch" is the familiar knife switch with its hinged copper blade, break jaw, and insulated handle and base. All switches today can trace their lineage back to this crude, but effective, switch which, for all its simplicity, did exactly what it was designed to do: make a circuit and break a circuit in an efficient, straightforward manner [3].

1.3 Switch structure

- The *actuator,* which initiates switch operation.
- The *contacts* made of low-resistance metal that make or break the electric circuit.
- The *switch mechanism,* linked to the actuator, which opens and closes the contacts.

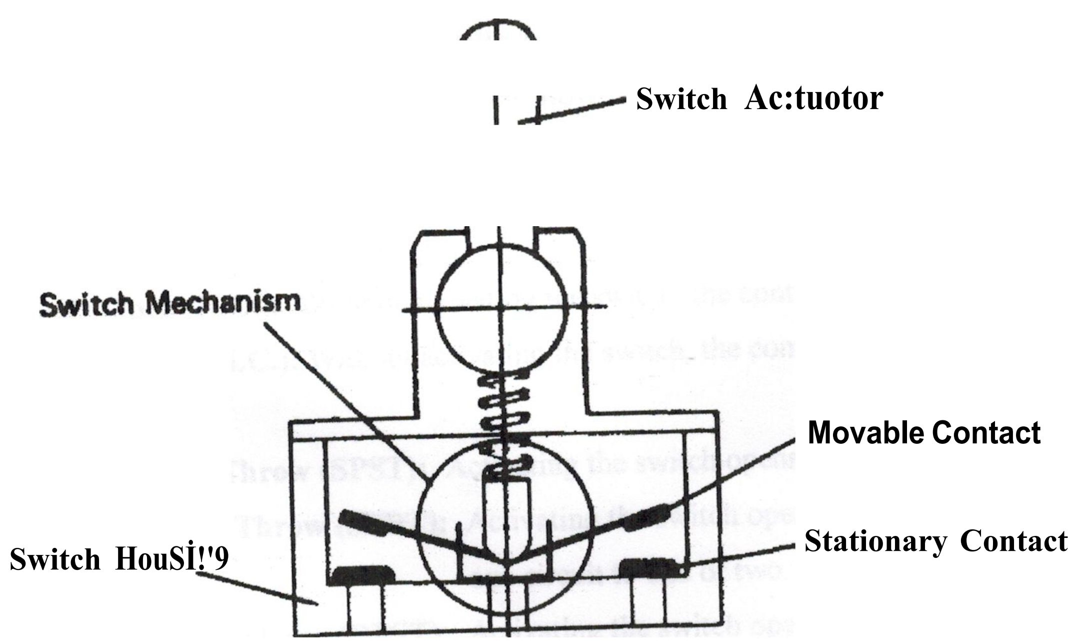

Figure 1.1 All switches have a common denominator in basic components (1].

If the original knife switch is compared with one of today's high-precision avionic-grade pushbutton switches, the same three basic components of a switch are in evidence. However, our advanced knowledge of such areas as vibration analysis, metallurgy, and polymer chemistry has pushed modern switches to high levels of performance and reliability.

The fact that a switch is nothing more than a device for making or breaking a circuit might suggest that the technology is equally simple. Nothing could be further from the truth! The discussions of switching technology in this and the following chapters emphasize to the reader that switch design is a complex interaction of a wide variety of disciplines, from chemistry to human factors, requiring careful attention to detail by switch manufacturers, regardless of whether the switch is destined to control an appliance in the innocuous ambience of a contemporary kitchen or to initiate the imaging system operation of an earth-launched probe in the hostile environment of deep space [1].

1.4 Switch Terminology

All switches, regardless of how they look or the size or what part of the body is used for control, operate in the same manner. *A switch is a mechanical device used to open and close a circuit.* Opening a circuit (usually turns a device OFF) is achieved by breaking a connection in the circuit. This stops current flow. Closing the circuit (usually turns device ON) allows the current to flow again. These are some terminologies associated with switches [7].

Normally Open (N.O.): Without activating the switch, the contact is open.
Normally Closed (N.C.): Without activating the switch, the contact is closed.

Single Pole Single Throw (SPST): Activating the switch opens/closes one circuit.
Single Pole Double Throw (SPDT): Activating the switch opens/closes the connection of one circuit to one of two.
Duuble **Pole Single Throw (DPST):** Activating the switch opens/closes the connection of two circuits to one.
Double Pole Double Thırow (DPDT): Activating the switch opens/closes two circuits.

Momentary: The switch is closed/open only when the switch is activated.

Latch: The switch remains closed/open until the switch is activated again.

Feedback: The switch indicates that it has been activated. For example: visual (light), audio (click).

Rating: The maximum voltage and / or current that the switch can handle without damage [7].

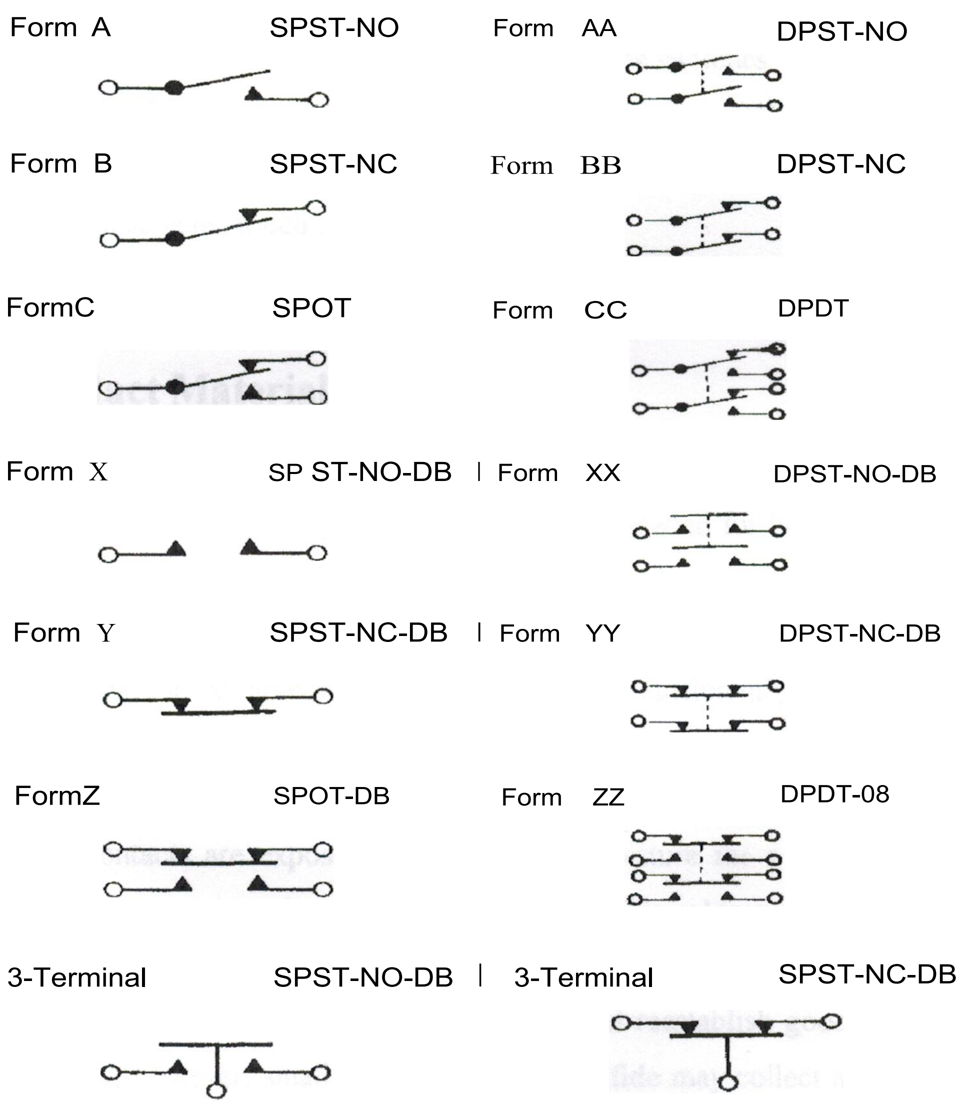

Figure 1. 2 Industry-standard contact forms [7].

1.5 Switch types

1. normally open and normally closed
2. precision snap-acting switches
3. rotary switches
4. thumbwheel switches
5. toggle switches
6. pushbutton switches
7. programmable switches
8. membrane switches
9. membrane-metal dome and rubber-metal dome switches
10. conductive rubber switches
11. dip switches
12. touch screens, touch switches, and light pens
13. photoelectric sensors and proximity switches[5]

1.6 Contact Materials

The most nearly universal contact material is silver. It combines the chemical, electrical, thermal, and mechanical properties that usually are needed for best contact performance in a wide range of applications. If silver contacts are clean, there is no lower limit to the voltage and current that they will control reliably.

This applies, for example, to a switch that is sealed sufficiently to keep out contaminates. Silver has a definite drawback and that is its tendency to tarnish in the presence ofH2S and moisture. This characteristic encourages the use of gold contacts in some applications.

If silver contacts are exposed to sulfides and moisture for a long enough time and in sufficient concentration, the contacts will tarnish. This seldom affects performance of the switch. Nearly always, the combination of mechanical force and movement of the contacts, and the circuit voltage, rupture the tarnish film and reestablish good electrical continuity. Occasionally, however, small amounts of silver sulfide may collect at the contact interface and increase the resistance of the closed switch enough to constitute an open circuit. Generally such a malfunction clears up on the next switch closure, but İt may not.

The likelihood that silver contacts will experience this kind of problem depends upon the voltage, current, inductive characteristics of the circuit; the temperature, humidity, and purity of the environment; the degree of sealing of the switch enclosure; the mechanical forces and movement of the switch contacts; the exposure time and number of switch operations; and the amount of switch resistance that constitutes an effectively open circuit.

Gold is nearly inert chemically and does not form sulfides or oxides in normal switching environments. It has some important limitations as a contact material. It is expensive, it is soft and ductile, and its usefulness is very limited where an electric arc is present. It does, however, prevent sulfide tarnishing if properly applied. To reduce cost and make contacts more nearly universal, silver contacts are sometimes plated with gold. Accordingly, the theory goes, if the voltage and current are low enough to make gold contacts desirable, they are low enough that they will not disturb the gold plate. If voltage and current are too high for gold contacts, they will bum the plate off and expose the silver, which is suitable for higher loads. However, there are some practical limitations. If gold is plated directly on silver contacts, sulfur atoms in the presence of moisture can penetrate the pores in the gold plate and react with the silver base metal, forming silver sulfide. The sulfide then migrates rapidly over the surface of the gold plate as a spongy deposit that can cause more trouble than would a sulfide tarnish on an unprotected silver contact. The heavier the gold plate, the more slowly this will happen, but the more expensive will be the switch. The usual procedure is to use a nickel barrier plate between the silver base metal and the gold plate. This stops the sulfide problem but adds to the cost and sometimes is incompatible with some of the switch manufacturer's production processes.

Cost aside, the answer would seem to be a solid gold contact, but gold is very ductile and may experience plastic flow under the influence of contact force on closure. This can be remedied by alloying other elements with the gold to harden it. Sometimes it is possible to alloy a high enough percentage of other elements with the gold that the cost of the contact can be significantly reduced. But this introduces other considerations, for example, polymer formation. Gold and gold alloy contacts can generate polymers at the contact interface when organic contaminants are present in the atmosphere. Silver does not form polymers. The type of polymer usually formed on pure gold contacts does not increase switch resistance, but the same is not always true for gold alloys. If the atmosphere around gold or gold alloy contacts is clean, no polymer will be formed, but then under such conditions silver contacts will not form sulfides and are considerably less expensive. In short, the choice of contact material involves a number of considerations and often a trade-off decision [4].

Other contact materials sometimes are used for applications of this kind. The most common materials are platinum, palladium, and their alloys. Although these materials are sometimes used as pure metals, they tend to have poor wear properties and are very soft-hence the use of alloys, which preserve some of the desirable properties of the elemental materials and improve hardness and wear resistance. The principal alloying elements are other metals of the platinum group, such as iridium, ruthenium, osmium, and rhodium. Others are silver, copper, and nickel. Most of the platinum and palladium alloys can form polymers that increase switch resistance.

In summary, although no universal rules can be laid down, the following practices usually are followed:

- If the switch is sealed, sulfides cannot enter and silver contacts can be used.
- If the switch is not sealed, the electrical load should be considered. If there is an arc, silver contacts can be used.
- If there is no arc, the environment is a controlling factor. If panicle contamination is likely to reach the contacts, gold is no help. Use a sealed switch or bifurcated contacts.
- If a completely alien film contaminant such as paint spray or oil mist can reach the contacts, gold does not help, so choose a sealed switch.
- If the environment of an unsealed switch contains significant amounts of moisture and H_2S (from sources such as decaying organic matter or vulcanized rubber), gold contacts can be a real help.

1.7 Applying Switches in Hostile Environments

In their simplest forms, electromechanical, electromagnetic, and solid-state control devices are designed for environments which may be called friendly, i.e., clean factory areas, offices, and other surroundings that are typical of room conditions. However, these devices often are needed for use in the presence of dust, dirt, metal particles, oil, corrosive agents, or very high or low temperatures.

For extreme environments such components usually are made from special materials, provided with protective enclosures, or changed in other ways to alter the immediate area of control and enable the device to survive and perform satisfactorily.

Switches control circuits safely and reliably in millions of applications. As the link between the mechanical and electrical parts of a system, a switch must perform well, both mechanically and electrically. It usually does, despite the complication effects temperature, humidity, and other environmental factors. Still, there are environments that reduce the reliability of switches and can even cause premature failure. High temperature can reduce contact life; a partial vacuum can encourage electrical breakdown to ground; oil can deteriorate plastics and disable the switch; ice can jam the actuating mechanism; the electric arc in an unsealed switch can detonate an explosive atmosphere.

The effects of environments on switches are not always obvious, and it is possible for a system design to be well advanced before a potential switch problem is recognized. Familiarity with the effects of environment on switch performance often can improve the design and save considerable time. This section discusses the factors to consider when applying switches in hostile environments.

Any specific environment consists of a unique combination of temperature, pressure, humidity, contamination, and the like, and these conditions sometimes conspire to cause switch problems. The environment in which a switch must operate is determined not only by the geographical location but also by the equipment and circumstances in which it is to be used. The table below illustrates some types-of hostile envy. To which some switches may exposed. The switch should be tested by exposing it to simulated conditions of end use (electrical, mechanical, and environmental) and evaluating it to be sure it performs as required [2].

Table 1.1 A Partial List of Typical Hostile Environments Encountered by Switches [2].

High temperature: Industrial and household furnaces, pasteurizing equipment, steam cleaning of Food processing machinery, foundıies, rolling mills, surfaces of high performance aircraft, jet engine afterburners, missile launchers.

Low temperature: Commercial refrigeration, military and commercial equipment in arctic regions, Aircraft flying above 35,000 ft, cryosurgical, liquid oxygen, and other cryogenic equipment.

Temperature shock: Transfer of equipment to and from heated shelters İn arctic regions, airdrops of military supplies, spacecraft reentry.

Vacuum: Aircraft and spacecraft, aerial cameras and weather instruments, industrial Vacuum processes.

High pressure: Undersea equipment, oil drilling instrumentation.

Humidity: Laundry machinery, dairy and meat packing equipment, textile plants, hothouses, carrier-based aircraft, pharmaceutical manufacture.

Liquid splash or shallow immersion: Sump pumps, aircraft landing gear, shipboard deck mounted equipment, Gasoline pumps, hydraulic production machinery.

Ice: Snow removal machinery, ski lifts, refrigeration controls, aircraft, arctic installations.

Corrosion: Marine and seaboard applications, plating departments, battery manufacture.

Sand or dust: Earth moving machinery, desert vehicles, air conditioners, foundries, cement mills, concrete block manufacture, textile manufacture, flour mills.

Fungus: Tropical military gear, geological and meteorological instruments.

Explosion: Starch packaging, coal mines, petroleum refining, grain elevators, flour mills, Coke manufacture, surgical operating rooms, machining operations producing aluminum or magnesium dust.

1.8 Effects of Acceleration, Shock and Vibration

When the switch is accelerating in any direction, the common contact experiences an apparent force in the opposite direction. This may act to keep closed contacts closed and open contacts open, in which case there is no problem. The force may be directed perpendicular to the line of movement of the common contact, and have no significant effect. However, if the force acts to separate closed contacts or to close open contacts, there is the possibility that the switch may experience a malfunction. During the launching of a high-velocity missile, switches on the missile are subjected to high linear acceleration. Switches used in the hub of a propeller or in a spinning projectile have a component of acceleration toward the center of rotation. The movable contact, as a passenger in the switch, may be forced in an unfavorable direction [6].

1.8.1 Shock

Up to this point, we have considered acceleration that is fairly uniform. In practice, acceleration often is of a transient nature. When a device containing a switch is struck, dropped, or otherwise subjected to a disturbance, it under-goes a pulse of acceleration known as a shock. In its simplest form, this transient acceleration is all in one direction, but its magnitude varies with time. A graph of the acceleration versus time may be a simple half-sine wave, or it may have any of a wide variety of shapes and dimensions. Although ordinarily mechanical shock has little or no effect upon switch performance, a shock pulse having high acceleration and relatively long duration can cause a closed switch to open momentarily or an open switch to close momentarily. If acceleration is very high, in the thousands of gravity units, some switches ı:pay be permanently damaged by the shock [4].

To judge the effect of most mechanical shocks on switches. The common contact of a switch experiences similar forces when the switch is subjected to a mechanical shock, and the effect can be judged by considering the position of the contacts and the direction of the shock. If a shock pulse has a fairly simple waveform (such as half-sine), it is usually specified in terms of acceleration versus time. If the shock wave is complex and cannot readily be expressed in this way, it is sometimes specified in terms of acceleration versus frequency, and the resulting graph is called a shock spectrum. If the duration of the shock pulse is of the same order of magnitude as the half natural period of some part of the switch mechanism, its effects on the switch may be amplified or attenuated. Thus a shock pulse having a 50g peak acceleration may separate the closed contacts of a switch, while a steady acceleration of 50g in the same direction would not [6].

1.8.2 Vibration

Vibration is an oscillating movement which may have a consistent, repetitive pattern or may be irregular. Thus the acceleration may vary regularly or irregularly. Most laboratory vibration tests provide simple harmonic motion, which is a sine wave. The acceleration then follows a negative sine wave and is specified in terms of frequency and maximum acceleration. In applications where the vibration does not follow a simple waveform, conditions may be more difficult to specify. In some instances, the vibration is not periodic and the acceleration varies erratically [5].

In vibration, as with the other forms of acceleration, the common contact is a passenger in the switch and experiences an apparent force in the direction opposite to that of the acceleration. With vibration, the acceleration is along an axis, first in one direction, then in the opposite direction. The magnitude and direction of acceleration are reversed rapidly, and the rate of change affects the response of the switch to the vibration. The closed contacts of a vibrating switch may remain closed at 10g, 50 Hz, but may separate momentarily at IOg, 500 Hz.

In summary, acceleration is any change of the velocity's magnitude or direction. Shock and vibration are forms of acceleration in which acceleration varies with time. The common contact, as a passenger in the switch, behaves as though it were forced in the direction opposite that of the acceleration. With this in mind, one can judge whether a given acceleration, shock, or vibration will act to cause closed contacts to open or open contacts to close. If it appears that there may be a problem of this kind, several steps can be taken to prevent occurrence of the problem:

1. Use a miniature switch. The mass of its moving parts is a major factor in the response of a switch to acceleration, vibration, or shock. Use of a subminiature version of a particular switch type is one of the most effective and least expensive solutions.
2. Orient the switch so the acceleration, shock, or vibration will not tend to separate the closed contacts or close the open contacts. It may even be possible to orient the

switch so the acceleration helps to hold the contacts in the desired position.

3. On switches with these mechanisms, keep the switch plunger or actuation de vice fully released or fully depressed during acceleration, shock, or vibration. This takes advantage of the high contact force available at the extremes of plunger or actuator travel.
4. Be certain that the actuating device and switch mounting do not respond to acceleration, shock, or vibration in such a way as to cause movement of the switch plunger or actuator mechanism.
5. Where shock or vibration is a problem, install the switch on a shock mounted panel if the equipment itself is not shock mounted. The purpose is to attenuate the shock or vibration reaching the switch.
6. Use two or more switches oriented differently from each other. For example, use two switches with their plungers pointed in opposite directions but actuated by a common linkage. An acceleration, shock, or vibration tending to separate the closed contacts of one switch will tend to hold the contacts of the other switch closed. If the intent is to keep the circuit closed, connect the closed circuits of the two switches in parallel. If the intent is to keep the circuits open, connect the open circuits of the switches in series (Fig. 1.4) [6].

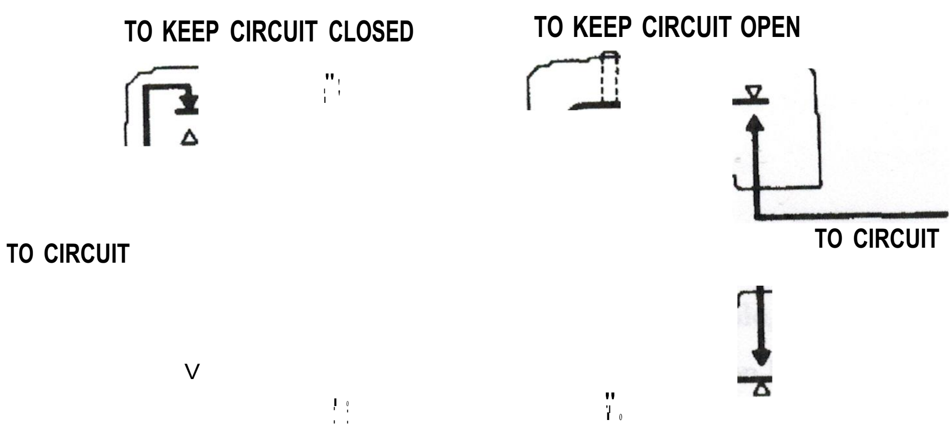

Figure 1.4 use of redundant switches [6].

7. Make the electric circuits less sensitive to momentary disturbance of the switch contacts. For example, if a switch is controlling a de relay coil, a capacitor connected across the coil can increase the response time of the relay.
8. Test the switch in end use conditions.
9. Specify performance requirements that reflect actual need. One of the best ways to save time and money is to put into the performance specification only those requirements that are needed for the switch to perform properly in end use. Acceleration, shock, and vibration are no exception.
10. If a problem arises, consult the switch manufacturer. The ability of a switch to resist the effects of acceleration, shock, and vibration is determined by a variety of factors such as the magnitude and direction of spring forces, the distribution of mass in the switch mechanism, and the elastic properties and physical strength of the various parts of the switch. These are a matter of switch design and are under the control of the switch manufacturer.

1.9 How to Increase Switch Life in End Use

Given a switch designed for long life, what can the user do to take maximum advantage of this feature? The variables of end use can be classified under the headings of electrical, mechanical, and environmental factors. The following are some ways to prolong switch life [5][3].

1.9.1 Electrical Factors

1.9.1.1 Voltage

In some instances where a switch is used to control, as an example, a 480-V ac load, the circuit can be arranged so the switch performs the required function but controls only 120 V. In this instance, the contact life of a switch is about the same at 240 Vas at 120 V ac, and is somewhat reduced at 480 V. The probability of dielectric breakdown, however, increases with the supply voltage, and switch life is appreciably longer at lower voltages [5].

1.9.1.2 Current

As a rule, the lower the current, the longer the switch life. Therefore, reducing the current that the switch must close and/or open usually increases the life of the switch. There are exceptions, such as cases where the switch utilizes a spring in its internal mechanism and spring life becomes the limiting factor. Circuits having high inrush current may limit switch life by contact erosion or welding. If the inrush is due to tungsten filament lamps, a resistor can be connected in parallel with the switch to keep the filaments warm and reduce the inrush current. If this is objectionable, a resistor or thermistor in series with the filament can reduce inrush current.

1.9.1.3 Arc Control

The less severe the arc, the longer the life of the switch contacts. The most severe arcing usually is encountered in de inductive circuits. Here the energy stored in the field is partially dissipated in the arc. Several arc-suppression techniques are available. One of the simplest and most effective is a diode connected in a blocking mode across the de coil. When the switch opens, the polarity of the voltage induced in the coil opposes that of the steady-state condition and the diode conducts, shorting the coil. This can greatly reduce arc energy at the switch contacts and give a corresponding increase of switch life. The diode can be of much lower current capacity than the steady-state current of the load, because the diode conducts only for an extremely short time. The diode should have a peak inverse voltage rating exceeding the source voltage. Use of a diode will delay drop-out time of the inductive device by a few milliseconds, but this is usually acceptable. The arc-suppression device should be tested to confirm its suitability. Reducing the arcing in this way can extend switch life greatly by reducing the rate of contact material migration and decreasing the heat dissipated by the arc [5].

1.9.1.4 Choice of Throw

On some switches, how a switch is designed internally may point to one throw as the preferred throw. For example, the normally closed throw of a snap-acting switch usually is better able to break contact welds than is the normally open, owing to the nature of the switch mechanism itself. If a circuit has a high inrush current on closure or requires the switch to open current near its rated load, switch life is likely to be longer if the normally closed throw is used to control the circuit[S].

1.9.1.5 Grounding

Switches are often mounted on a surface or bracket that is electrically grounded. In many cases this is desirable or necessary for safety. In other cases, it is optional. If the mounting is connected to a common electrical ground with the power supply, line voltage will be maintained between current-carrying parts of the switch and the mounting surfaces. This applies a continuous electrical stress and acts to encourage dielectric breakdown as switch life proceeds. The electrical ratings of switches are established with the mounting grounded, to provide "worst-case" conditions. However, if the switch is mounted on an insulator in end use and is actuated with an insulating member, the life of insulating parts of the switch will be prolonged [5}.

1.9.2 Mechanical Factors

1.9.2.1 Coaxial Aetna tion

As much as possible, actuate the switch coaxially with the plunger or actuator. If this is not practical, install a roller-type plunger or similar device to prolong the life of the plunger bearings or actuator-bearing surfaces [3].

1.9.2.2 Overtravel

Do not apply excessive force to the plunger or actuator at full switch overtravel.

1.9.2.3 Frequency of Actuation

Consult with the switch manufacturer to obtain maximum frequency-of-actuation parameters and design in a reasonable safety factor as recommended by the manufacturer. For example, Micro Switch generally recommends that when their snap-acting switches are controlling heavy electrical loads, frequency of actuation should be no higher than 20 operations per minute on de loads or 60 operations per minute on ac [3].

1.9.2.4 Mounting

Always follow the manufacturer's recommendations for mounting any switch, whether using mechanical fasteners or adhesives. If the user's requirements dictate an unusual installation method or atypical positioning of a switch, contact the switch manufacturer as early as possible in the design stage to avoid mounting or positioning the switch in such a way as to produce a less than optimum operating condition, greatly reduce switch life, or create a potentially hazardous condition [3].

1.10 Effect of Circuit Parameters on Switch Life

1.10.1 Current Rating of a Switch

The published current rating of a switch at a given voltage represents the maximum electrical load the switch is designed to control. As a rule it is based on connection of the circuit to either the normally open normally closed throw of the switch, and does not necessarily apply where both throws of one pole are connected simultaneously. If the switch has more than one pole, the electrical rating usually applies with one throw of each pole connected. The current rating generally assumes that, in the case of pushbutton- and snap-action-type switches, the plunger of the switch is driven to full overtravel and full release during actuation. The switch can close the circuit, carry the steady-state current indefinitely, and open the circuit during each cycle of operation through life. The ability of the switch to close and open the circuit reliably is affected by the current versus time characteristics of the circuit. The following figure shows the current rating, see fig (1.5).

Occasionally, the suggestion is made that switches be provided with minimum voltage and current ratings, i.e., values of voltage and current below which they should not be used. This derives from the erroneous impression that a given switch will develop performance problems below specific levels of voltage and current. In practice, this is not the case. A clean switch usually can control microvolt-microampere circuits without difficulty. There is no particular voltage or current level at which problems begin, and there is no technically valid way by which to set minimum electrical ratings. It is possible to establish minimum ratings on the basis of arbitrary resistance levels, but such figures are useless and meaningless for general application. Minimum ratings do not help prevent problems with switch resistance. Furthermore, they may mislead some users into thinking that the switch is satisfactory for any use above the specified current and voltage, without regard to the other variables which affect switch resistance. hı short, minimum electrical ratings can increase the cost of switches without a corresponding increase in performance [1].

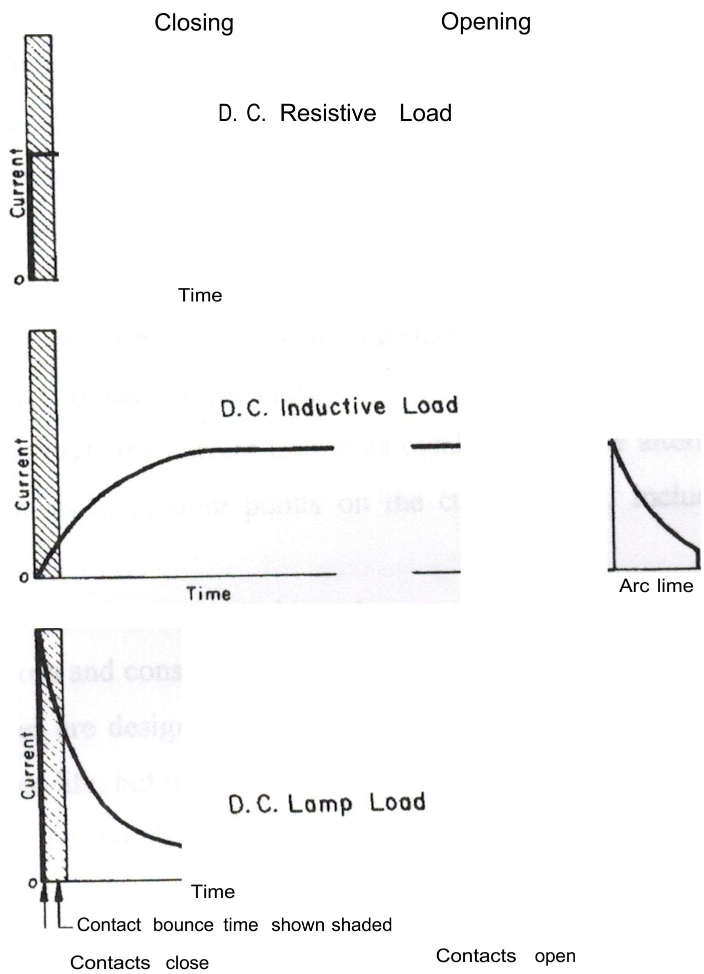

Figure 1.5 Current vs. time during switching [1].

1.10.2 Closing the Circuit.

In a de resistive circuit such as an electric heater, the steady-state current is present at the instant of switch closure. As the switch contacts strike and then bounce apart, each rebound draws an electric arc. This melts metal on the surfaces of the contacts, and some of the metal is evaporated. There may be some general erosion of material from both contacts, and a net transfer of material from one to the other. The contacts then re-close on molten metal, sometimes forming a weld when the metal solidifies. The higher the current the stronger the weld is likely to be, and the higher the force that the switch mechanism will have to provide to open the circuit. The strongest welds occur when the load is characterized by a high inrush current. If the inrush current persists during part or all of the contact bounce time, conditions are conducive to severe arcing and strong welds. Capacitive circuits often have high current at switch closure, encouraging contact welding. The highest current of all occurs when the switch is closed on a short circuit. Unless the switch is specially designed to with-stand closure on a short circuit, life under this condition can be predicted as zero.

In a de inductive circuit there is a time delay as the magnetic field builds up in the coil before current reaches its steady-state level. Since most of the contact bouncing occurs during the low-current part of the transient, there is little contact deterioration and almost no tendency to weld during closure.

In ac circuits the current transients combine with the alternation of the current, and the switch closes at random points on the current wave, including current peaks and zero current.

Ac inductive circuits, such as those containing solenoid coils, almost always involve moving iron and consequent inrush currents.

Switches are designed to resist contact deterioration and the effects of contact welding throughout life, but in all circuits, the lower the current on switch closure the longer will be the life of the switch [1].

1.10.3 Carrying the Steady-State Current.

Once the contacts have closed and stabilized, the switch carries the steady-state current of the circuit. This is simply a matter of controlling the *I2R* heating, and seldom presents a problem. 1 A ac has the same heating effect as 1 A de, since the equivalence of the two is based on heating. Control bodies may impose limitations on temperature rise at rated current. Except for very unusual overloads or short-circuit conditions, however, switch life is unaffected by the current the closed switch carries [1].

1.10.4 Opening the Circuit

Before the contacts can separate, any welds holding them together must be fractured by the switch mechanism. Many switches are designed to do this. *In a de resistive circuit* the steady-state current is present at the instant of switch opening. When the contacts of the switch separate far enough to extinguish the arc, nothing further happens. Arc time in a de resistive circuit usually is very short and arc energy is low. There is some erosion and migration of contact material.

In a de inductive circuit arcing is more severe, because the energy stored in the magnetic field of the coil is partially dissipated in the arc as the field collapses. The arc often persists after the contacts are fully separated, and contact erosion and migration continue as long as the arc lasts. During the life of the switch, migration gradually narrows the space between the open contacts and eventually may draw and sustain an arc, destroying the switch.

Normal arcing melts and evaporates contact material, some of which may condense on surfaces of adjacent insulators. The intense heat of the arc itself may gradually deteriorate insulators that are near it. *The general effect is to reduce their insulation resistance and dielectric strength.* This is encouraged in a *de inductive circuit* by the voltage transient that occurs just as the arc goes out. The current drops suddenly to zero, producing a voltage proportional to its rate of change. There is a little effect on the switch life because of the short duration of the high-voltage transient. Switches are designed to withstand these conditions during life, but at the end of switch life, one possible mode of failure is electrical breakdown of an insulator. The higher the source voltage the more prevalent is this mode of switch failure [1].

1.11 Abbreviations

P: **Pole** , the number completely separate circuit that can pass through a switch at one time. The number of poles is completely independent of the number of *throws* and number of *breaks.*

T: Throw, the number of circuit that each individual pole of a switch can control.

1.12 Glossary

Arc: A self-sustaining discharge of a highly conductive ionized gas which conducts electric current between tow electrodes.

Bounce: The rebound effect that occurs when hard switch contacts close on each other.

Break: Denotes the number of pairs of separated contacts a switch introduces into each circuit it opens.

Contact: The points of electrical interface in a switch.

1.13 Summary

In this chapter we have discussed the switches in general, the type of switches and also the effect of the circuit parameters, the effects of the acceleration, shocks and vibration on the switches.

Discussing the terminology of the switches lead us to some industry-standard contact form, see fig (1.2). And also the structure, the contact materials of the switches were been discussed, the use of the switches in the hostile environment and how we can increase the switches life in end use by considering the both factors electrical and mechanical of the switches.

CHAPTER TWO

SOUND

2.1 Overview

This chapter presents general information about sound, its properties and speed of the sound, characteristics of a wave and also there will be some types of the dB (decibel) and how we can calculate it in a wave.

Sound waves and its types and also some application of the waves will be mentioned, also there will be a small section illustrating the speech signal.

2.2 What is Sound

The answer is; sound is a wave. A wave is a transmission of energy by a series of vibrations.

If you've played with a slinky, you know that you can have a wave by either vibrating the spring up or down, or by pushing the spring back and forth. Well like the stars on my hat, the two waves are different. The waves you get when you push the slinky forward and backward are called ***longitudinal*** *waves.* The waves you get when you oscillate the slinky up and down are called *transverse waves,* what type of wave is sound?

In actuality there longitudinal, when you say hello!, you vibrate the air around you back and forth. You compress and stretch the air with your voice. Your voices are like saxophones or tubas - the sound comes from blown air and you make different sounds by moving your tongue [11].

- Sound is a wave, a longitudinal wave.
- Sound needs a medium to travel.
- Sound vibrates the air like a slinky.

Humans can hear sounds in the range 20 hertz to 20 000 hertz. This is often referred to as the range of hearing. Not everyone can hear over all of this range - the numbers are only approximate. In particular the high frequency limit reduces with age.

The loudness of a sound is a measure of the amplitude of the wave. The greater the amplitude, the louder the sound.

The pitch of a sound is a measure of the frequency of the wave. The higher the frequency, the higher the pitch [9].

2.3 Property of sound

2.3.1 Echo

When you think of sound you probably think of echo. Echo is one of the most interesting phenomena of sound. When you hear echo, it doesn't mean that someone else with exactly the same voice is calling out to you with exactly the same phrase, *it is the* reflection *of sound*

Mirror reflections. Well similarly, sound can bounce off of objects and reflect better in some materials than others. When you are in an open room or in a mountainous valley or when you scream, your voice vibrates the air around you, and the vibrations in the air vibrate all the air around you. But when these vibrations in air encounter say a mountain or a wall, some of the sound gets absorbed into the wall, and some gets reflected back.

The reflection is almost always reflected in your general direction, so you hear your voice again after you have vibrated the air, the air vibrates a wall, the wall vibrates the air again, and the air vibrates your ears. *An echo is a reflection of sound of an object [* 11].

2.3.2 The Speed of Sound

The speed of sound is a real neat thing to study. The best known example of this neat phenomenon is fireworks. Most of you know that when you see fireworks, you see the explosion before you hear the sound. That's because light travels much faster than sound. So the light reaches your eyes before the sound reaches your ears. Now, the speed of sound isn't always the same. If you observed a fireworks display in hot temperatures, and then in cold temperatures, you would notice a difference in time of sound arrival. Likewise, if the same fireworks display were conducted in say Helium (Not a very good idea) as opposed to the air in our sky, the sound would reach our ears much quicker. Now this explains the phenomena we hear when someone swallows some Helium - their voices become a lot higher. That's because sound travels faster in helium than in regular air, in this case the air being in the throat of the person [11].

For example, when an ambulance approaches, you can hear it getting louder and louder, and then as it passes you, the sound gets less and less?

Doppler Effect, the sound waves become more intense as the sound source (ambulance) approaches you and the sound becomes louder. When the sound source passes you, the sound becomes less intense. *Sound travels at the speed of sound (331 mis)* (11].

Since sound is dependent upon vibration, it can travel through anything except a vacuum. It travels through some materials faster than others; sound travels about four times faster in water than in air, and about ten times slower in rubber. [8]

In air at 0 degrees C and 1 atın (atmosphere- a pressure quantity), sound travels at a speed of 33 lm/s. Temperature can affect the speed of sound in any medium, but most drastically in gases. In air, the speed increases approximately 60 *mis* for each degree Celsius increase: (8]

$$v = (331 + 0.60T)\ mis \qquad (2.1)$$

Where T=degrees Celsius.

2.3.3 Noise

We are virtually always subjected to sounds. *Unwanted background sounds are sometimes called noise.* When the sound level of this noise rises to higher levels, we refer to this as noise pollution.

Sound levels are measured on a scale known as the decibel (dB) scale. The higher the number the greater is the sound level.

Too much noise can damage hearing. Exposure to 90 decibel sound levels for a long time can cause permanent hearing loss. Exposure to a brief sound level of 140 decibels will cause pain and can cause permanent damage to hearing [9].

2.3.3.1 Decibel dB in General

The dB always describes a ratio of two quantities. It is important that we know that a logarithm describes the ratio of two powers, not the power value themselves [9].1

a- dB SPL

This is the one of the more common forms of the decibel. It measures sound pressure levels (SPL), the sound pressure is the level measured per unit area at a particular location relative to the sound source. When a dB describes a sound pressure level ratio, a "20 log" equation is used:

$$dBSPL = 20 \log (p1/pO)$$

where pO and p1 are the sound pressures, measured in dynes per square centimeter or Newton per square meter [9].1

b-dBW

dBm is a measure of electrical power, a ratio referenced to one milliwatt. dBm is handy when dealing with the miniscule power (in the millionths of a watt) output of microphones, and the modest levels in signal processors (in the milliwatt). One magazine wished to express larger power numbers without larger dB values... for example, the multi-hundred watt output of large power amplifiers. For this reason, that magazine established another dB power reference [9]. 1

$$dBW= 10 \log (pl/pO)$$

2.4 Characteristics of Waves

As you know, sound is a wave. If we take a look at our typical transverse wave, the ones we are most familiar with, you will notice some key elements. A wave has an up part, called a *crest,* and a down part called a *trough.* When a wave passes through a medium, these crests and troughs oscillate, going up and down. The distance between the beginning of a crest and the ending of a trough (or vice-versa) is called a ***wavelength.*** Typically, for sound, the wave lengths tend to be very small, smaller than the typical cm.

-avelength is usually represented by the Greek letter lambda (1ı,) [8].

$$')...,=Vlf$$

Where V is the Velocity and f is the Frequency.

You may have heard that light too is a wave. Light's wave length is so small, that we can only measure it with very precise and expensive equipment. The wave that got higher larger) amplitude has more energy then the one with smaller amplitude. In sound that means the larger the amplitude, the louder the sound, and the smaller the amplitude, the lower the sound is.

Frequency (j) means the number of waves that can pass by a point in one second. The filters are certain frequencies that irritate our hearing. The faster sound is created by an increased frequency of sound, the more of the sound passed to the air in a second; likewise, the sound becomes very slow because it has a lower frequency.

Waves have amplitude (volume) frequency (pitch) and wavelength (speed).4

2.4.1 Sound Waves

2.4.1.1 Ultrasonic Waves

Those sound waves which are above 20,000Hz and outside of the audible range frequencies. Many animals can hear ultrasonic frequencies; dogs, for example, can hear sounds as high as 50,000Hz and bats can detect frequencies as high as 100,000Hz [8].

2.4.1.2 Infrasonic Waves

Those sound waves whose frequencies fall below the audible range, or occasionally subsonic. Sources of infrasonic waves are earthquakes, thunder, volcanoes and waves produced by vibrating heavy machinery [8].

2.4.2 Fundamentals and Harmonics

The initial vibration of sound sources is called the *fundamental,* and thus the initial frequency is known as the *fundamentalfrequency.* The subsequent vibrations, which are exact multiples of the fundamental frequency, are called the *harmonics.* So, a note on a musical instrument with a fundamental frequency of 1OOHz will have a second harmonic at 200Hz, a third harmonic at 400Hz [11].

The term *octave* denotes the difference between any two frequencies where the ratio between them is 2:1. Thus, an octave separates the fundamental from the second harmonic in the above example: 200Hz: 1OOHz. An octave still separates 2000Hz from 1OOOHz. Whether the harmonics diminish in intensity or retain much of their energy depends on how the source is initially vibrated and subsequently damped.

2.4.3 Intensity

Loudness is a sensation in the consciousness of a human being. It is related to a physically measurable quantity, the intensity of the wave. *Intensity* is *defined as the energy transported by a wave per unit time across unit area: Since energy per unit time is power, intensity has units ofpower per unit area, or wattslmeter2 (Wlm2).* The intensity depends on the amplitude of the wave (it is proportional to the square of the amplitude). [The amplitude of the wave is the distance between the extremes of the vibration.]

The human ear can detect sounds with intensity as low as 10-12 W/m2 and as high as 1 W/m2 (and even higher, although above this it is painful). This is an incredibly wide range of intensity, spanning a factor of 1012 from lowest to highest. Presumably because of this wide range, what we perceive as loudness is not directly proportional to the intensity. True, the greater the intensity, the louder the sound. The relationship between the subjective sensation ofloudness and the physically measurable quantity intensity, it is usual to specify sound intensity using a logarithmic scale. The unit on this scale is the decibel, (dB). The intensity level, b, of any sound is defined in terms of its intensity, p, as follows:

$$b(dB) = 10 \log (pl/pO) \qquad (2.5)$$

pO is the intensity of some reference level. It is usually taken as the minimum intensity audible to an average person, the "threshold of hearing," which is 1.0×10^{-12} W/m^2. Notice that the intensity level at the threshold of hearing is 0dB; that is [11].

$$b = 10 \log (10^{-12}/10^{-12}) = 10 \log 1 = 0.$$

2.5 Some Application of Wave

The most common example is the ultrasound. You've heard of pregnant women having an ultrasound. An ultrasound bounces sound waves off of the baby, and the reflected waves reflect back at different speeds. These reflected waves are processed to give an image of the baby. Now ultrasounds are not only used in checking babies, but they also are used to check inside other precious equipment and objects. It is a very valuable tool for looking inside something without touching it. By the way *ultrasonic means frequencies of sound we can't hear through our ears. (greater than 20,000 Hz).* Ultrasounds, like audible sounds, are transmitted by means of longitudinal waves. Ultrasound is used in medicine to break up kidney stones and gall stones [9].

Sonar is an application of echo. Say you have a boat in water. With sonar, waves are continually sent to the ocean floor from the boat, and time of arrival for the waves is noted. Now if something gets in between the boat and ocean floor, the waves are reflected back to the boat in less time (less distance to cover).

Speaker, as we know that sound is a wave. Now what speakers do, is that they take a signal from a stereo and translate them into a series of vibrations. The speaker then takes these signals and vibrates the air. So the speaker vibrates the air in such a way that we hear the vibrations as sounds we recognize, say a song or a speech. The speaker is pushing the air towards you. A neat little experiment you can try is to place a piece of paper near the speaker and see what happens to it [9].4

2.6 The Speech Signal

Human speech is a continuous waveform with a fundamental frequency in the range of 100-400 Hz. (The average is about 100 Hz for men and 200 Hz for women.) At integer multiples of the fundamental are a series of changing harmonics called "formants" which are determined by the resonant characteristics of the vocal tract. Formants create the various vowel sounds and transitions among them. Consonant sounds, which are impulsive and/or noisy, occur in the range of 2 kHz to about 9 kHz. See fig (1.1)(10].

The sound power in speech is carried by the vowels, which average from 30 to 300 milliseconds in duration. Intelligibility is imparted chiefly by the consonants, which average from 10 to 100 milliseconds in duration and may be as much as 27 dB lower in amplitude than the vowels. The strength of the speech signal varies as a whole, and the strength of individual frequency ranges varies with respect to the others as the formants change.

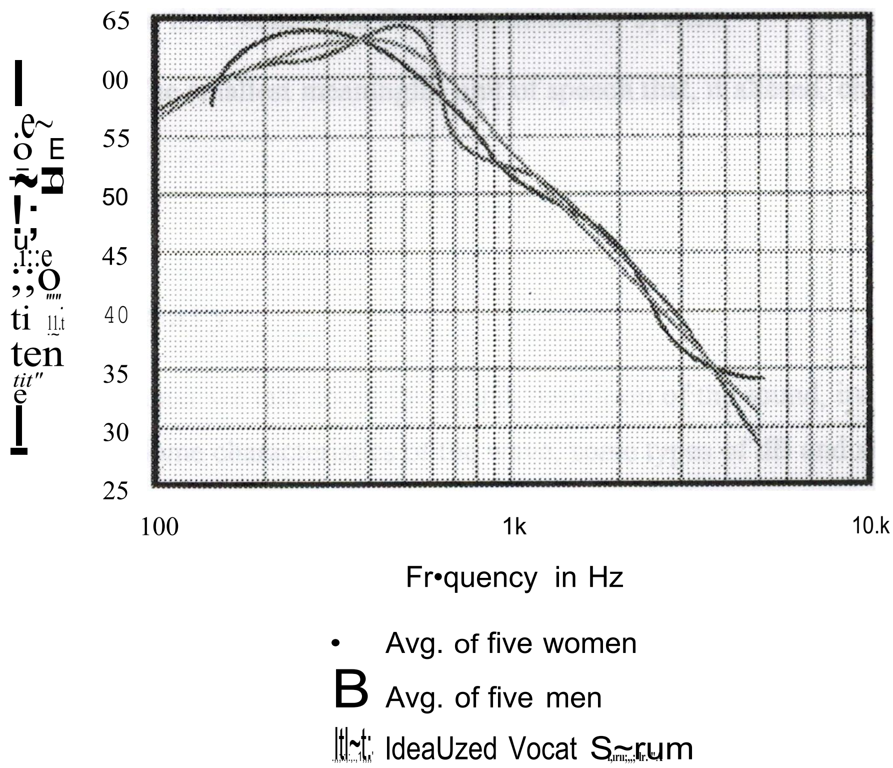

Figure 1.1 Average Vocal Spectrum for Male and Female Talkers [10]

2.8 Glossary

Articulation: "Word Articulation" refers to the number of test words correctly identified in intelligibility test. It is expressed in percent.

The term "articulation" also refers to the quality of a speaking person's enunciation. The _ eater a given talker's articulation (consonants are crisp and distinct, vowels are clearly ·culated and not slurred), the more intelligible his or her speech will be.

Reverberation: Reverberation is the persistence of sound in an enclosed space after the riginal excitation sound has ceased. It consists of a series of very closely spaced reflections, or echoes, whose strength decreases over time due to boundary absorption and air losses.

Intelligibility: The degree to which speech can be understood. With specific reference to speech communication system specification and testing, intelligibility denotes the extent to fiich trained listeners can identify words or phrases that are spoken by trained talkers and rransmitted to the listeners via the communication system.

Phoneme: The smallest meaningful unit of speech that, if altered, changes the meaning of the word.

2.7 Summary

In this chapter we talk about the sound, definition of the sound, its properties were presented. Some characteristics of the wave, some types of dB and also the types of the sound wave were also described.

CHAPTER THREE
SOUND ACTIVAVATED SWITCH

3.1 Overview

This chapter will present the main project and it will contain the components its values and prices that to illustrates the budgets of the project explained separately, and it will explain how you can read the resistors by using its color band theory, some figures of some components to be easily understand.

Two circuits will be presented in this chapter, the faults founding, and an explanation about how these circuits are working so you will understand the idea of operating the both circuits. A new use of some semi-conducting components and also the structure of some of them will be shown in figures that give full view for the reader about it.

3.2 Components

Before proceeding to the project a brief description of the components used will be given so that even a complete beginner should have no difficulty of understanding and knowing the used component in the project, and connecting each component into circuit correctly, the components are as follow:

Resistors

Integrated Circuits

Capacitors

Diodes

Switches

Loudspeaker

2.1 Resistors

Resistor is; a small cylindrical components having a leadout protruding from each end. alue of these resistors is not indicated by numbers and letters, but it is indicated by colored bands around the body of the component. The value is in unit called *ohms.*

The resistor color code is very straightforward, with the first two bands giving the first · digits of the value, the third band giving a multiplier; *first two digits are multiplied by the third digit in order to give the value of the ıponent in ohms* and the fourth band showing the tolerance of the component see -g 3.1). Resistors also have a power rating and this is not usually marked on the romponent. For this project 1/8, 1/4 or 1/3 watt resistors are satisfactory since the power ·el involved is very low.

Table 3.1 Resistor color code

Color	1st/2nd Band	3rd Band	4tn Band
Gold	Not used	0.1	5%
Black	0	0	Not used
Brown	1	10	1%
Red	2	100	2%
Orange	3	1.000	Not used
Yellow	4	10.000	Not used
Green	5	100.000	Not used
Blue	6	1.000.000	Not used
Violet	7	Not used	Not used
Grey	8	Not used	Not used
White	9	Not used 0.0l	Not used
Silver	Not used		10%

1- band (yellow)

2nd band (violet)

L 3rd band (red)

| 14th band (gold)

47* 100 = 4700 ohm, 4.7k or 4k7

Tolerance 5%

Figure 3.1 calculating the value of the resistor using color code

3.2.2 Integrated Circuits

In this project we are concerned with two types of integrated circuits, the **TL081CP** *operational amplifier* it has an 8-pin DIL (dual in line) plastic package.

The **LM380N** *audio power amplifier* it has a 14-pin DIL plastic package.

The important point to watch when connected the integrated circuits is to make sure that it is not plugged in upside-down. Check that the indentation on the top of the package and at one end of the device corresponding properly with the component layout diagram, see (fig 3 .2).

There are alternative operational amplifier integrated circuits that can be used instead of the **TL081CP,** the standard **741C** operational amplifier is not suitable as it will not function properly, and the suitable alternatives are **LF351** and **TL071CP** devices. Notes that there are not common alternates to the **LM380N** so the 14-pin version of this device most be used.

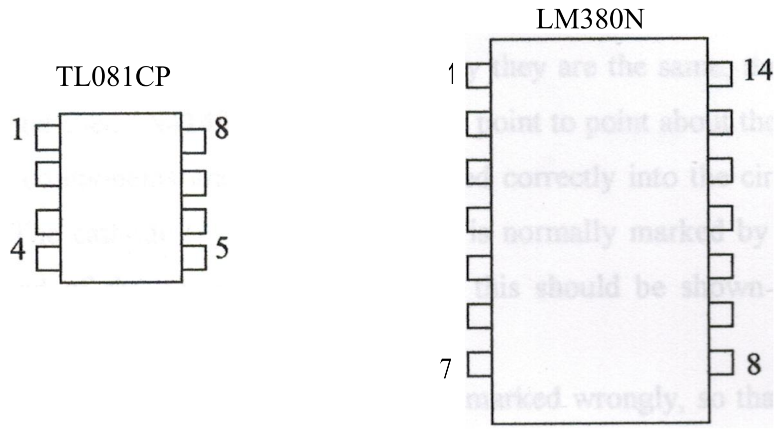

Figure 3.2 Pinout details of the TLO81CP and LM380N device

3.2.3 Capacitors

They look like the resistors but they are a little large and had the value written on their body instead of using the color code, they also have both leadout wires coming from the same end of the component (electrolytic) also there are some types of capacitors that the leadout wires coming from the opposite ends of the component (axial).

An important point to be in mind with the electrolytic capacitors is that they are polarized, so they most be connected to the circuit correctly. Axial types usually have an indentation around one end of the component's body; this indicates the end of the component from which the positive (+) leadout wire emerges. In some type of capacitors the value of the capacitors might be given in term of numbers, so that the first two numbers give the first two digits of the value and the third number indicates the number of zeros to be added to give the value in Pico farads (pF).

The other fixed value capacitors are the polyester variety, the value of these capacitors usually giving by five colored bands around the component. The first three given the value of the component in the same way as the resistor color code, the value will be given in Pico farads (pF), the last two bands show the tolerance and the maximum working voltage of the component see (fig 3.2).

3.2.4 Diodes

Two types of ordinary diode are used:

The **OA90** and **1N4148** silicon type. Physically they are the same; the **OA90** type being somewhat larger then **1N4148** device. The main point to point about the diodes is that they are polarized components and most be connected correctly into the circuit to be properly functioned. The cathode(+) lead of the diode is normally marked by a band around the appropriate end of the component's body and this should be shown on the component layout diagram to indicate the diode polarity.

There are some few diodes for no reasons be marked wrongly, so that if the circuit uses diodes fails to work it would be advisable to check the diodes with some sort of component tester if this is possible, another minor is that some diodes have a number of bands marked around their body, see (fig 3 .3), in such a case the manufacturer uses these bands to indicate the diode type number rather then simply marking the type number on the component.

Light emitting diode **LED,** there are various ways used to show which **LED** leadout wire is the anode and which is the cathode, one of the most common being to have one leadout wire shorter than the other, see (fig 3.4).

Usually the shorter leadout wire is the cathode one(+), but unfortunately this is not always the case, sometimes a different method of identification is used. With some **LEDs** the both leadout seems to be symmetrical. If this is the case you can simply try each **LED** either way round. If the device is wrongly connected it will fail to light but it is unlikely to sustain any damage.

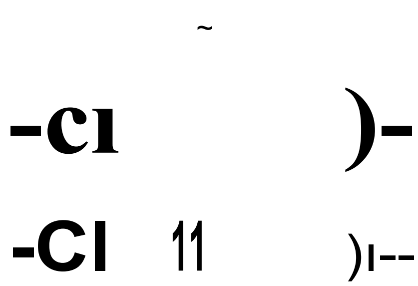

Figure 3.3 diode polarity

Figure 3.4 LED polarity

3.2.5 Switches

The SPST type; means *single-pole single-throw* type. It is just a simple on/off type switch, switches of this type sometimes advertised as *ON/OFF* switches rather then SPST type, (see chapter one).

The *RELAY;* this is a switch that is operated via an electromagnet, it is not operated manually. This project circuit can use any *RELAY* having an operating coil with a resistance of about 185 ohm or more, and 9 volt operating supply. Most *RELA Ys* operates two or four sets of switch contacts, and these are often of the changeover type rather then simple on/off contacts. Make sure that the voltage and current rating of the RELAY are sufficient to control the equipment concerned. *RELA Ys* do not have leadout wires, and the tags of the relay must be connected to the breadboard via suitable soldered or crocodile clip leads.

3.2.6 Loudspeaker

Any impedance in the range 40 to 80 is suitable. Loudspeaker should be treated carefully since the diaphragm is easily damaged, it should always be hold by the magnet housing at the rear of the component.

3.3 the Budgets of the Projects

Table 3.2 the Used Components and Budget of the First Circuit

Components Type	Components Value	Descriptions	Price $
Resistors			
RI	IK	Brown, Black, Red, Gold	0.13
R2	IOOK	Brown, Black, Yellow, Gold	0.13
R3	IOOK	Brown, Black, Yellow, Gold	0.13
R4	IOM	Brown, Black, Blue, Silver	0.13
RS	IOOK	Brown, Black, Yellow, Gold	0.13
R6	IM	Brown, Black, Green, Gold	0.13
Capacitors			
Cl	lμF	63V electrolytic	0.35
C2	2.2μF	63V electrolytic	0.35
C3	4.7μF	63V electrolytic	0.69
C4	IOμF	25V electrolytic	0.56
CS	lOOnF	Polyester (Brown, Black, Yellow, Red)	0.35
C6	IOOμF	10V electrolytic	0.35
Semiconductors			
ICI		TL081CP Op-Amp 8 pin DIL	0.63
IC2		LM380N Op-Amp 14 pinDIL	1.39
Dl		OA90 Diode	0.28
D2		OA90 Diode	0.28
D3		1N4148 Diode	0.13
Switches **S1**		SPST Miniature toggle type	0.56
Relay RLA		6/12 volt, 185 ohm	0.56
Battery Bl		PP6 size, 9 volt	1.57
Loudspeaker LSI		Miniature type, 40-80 impedance	0.7
Ele. Board			2.8
Total Expenses			12.33

Table 3.3 The Used Components and Budget of the Second Circuit

Components Type	Components Value	Descriptions	Price $
Resistors			
Rl	50K	Variable resistor	0.2
R2	15K	Brown, Green, Orange, Gold	0.13
R3	lOOK	Brown, Black, Yellow, Gold	0.13
R4	lOOK	Brown, Black, Yellow, Gold	0.13
R5	IK	Brown, Black, Red, Gold	0.13
R6	IM	Brown, Black, Green, Gold	0.13
R7	47K	Yellow, Violet, Orange, Gold	0.17
R8	100K	Brown, Black, Yellow, Gold	0.13
R9	lOOK	Brown, Black, Yellow, Gold	0.13
RIO	IK	Brown, Black, Red, Gold	0.13
Rll	470K	Yellow, Violet, Yellow, Gold	0.18
R12	50M	Variable resistor	0.17
Capacitors			
Cl	lμF	63V electrolytic	0.35
C2	lOμF	25V electrolytic	0.35
C3	lOOnF	Polyester (Brown, Black, Yellow, Red)	0.35
Semiconductors			
lCl		TL085 Op-Amp 14 pin DiL	2.00
IC2		NE4017 Op-Amp 14 pin DiL	2.00
IC3		MN555 Clock Pulse Generator	2.00
IC4		BU4066B Digital Switching	2.00
Dl,2,3,4,5		1N4148 Diode	0.53
Switches SI		SPST Miniature toggle type	0.56
Relay RLAl,2,3,4		5/6 volt	8.4
Battery Bl, B2		PP6 size, 9 volt	3.14
Loudspeaker LS1		Miniature type, 40-80 impedance	0.7
Ele. Board			2.8
Total Expenses			26.94

3.4 Sound Activated Switch

The most common uses for *Sound-Activated-Switch* are probably the automatic control of tape recorders and radio transceiver, but no doubt there are numerous other applications for this type of equipment. Figure (3.5) shows the circuit diagram of the *Sound-Activated-Switch.*

3.4.1 How does the First Circuit Work

IC1 is used as a straightforward inverting amplifier having a voltage gain of approximately 80 dB.

The output from IC1 is coupled by C3 to a rectifier and smoothing circuit which consist of Dl, D2, C4 and RS, this produces a positive DC bias which is fed to the inverting input of IC2. 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. IC2 is used as the relay driver, and R6 provides a small positive bias to the non-inverting input of this device, this will keep the output in the high state and the relay switched off until a suitably strong input signal produces a strong enough bias at the inverting input ofIC2 to send the output low and thus switch on the relay.

Voice Activated Switch, also known as VOX, kit will provide a switched output when it "heard" a sound. Use it to key a transmitter for hands-free PTT or to tum on a tape recorder automatically when people are talking. Tum your hallway or porch lights on at a whistle or tum on the garage lights when you beep your horn. Kit requires 6-12V DC and drives up to 100m load.

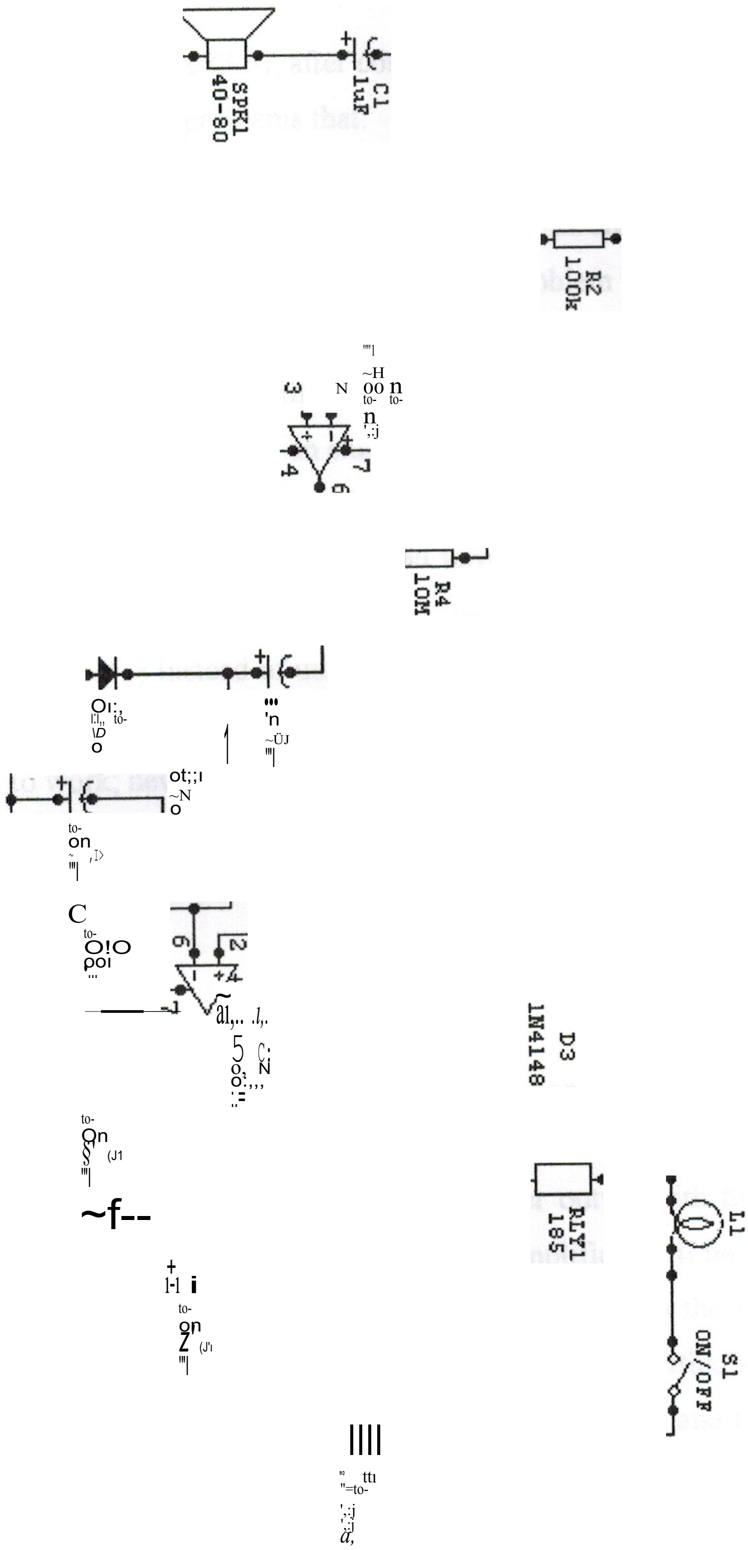

Figure 3.5 the First Circuit Diagram of the Sound Activated Switch

3.4.2 Faults Finding

For the circuit shown in figure (3.5), after connecting the circuit correctly and we had a double check on it we face some problems that:

When we use a conventional IC 471 instead of using IC TL081 the circuit could work but not as it should be so it worked as we touch the microphone, in another word we could not solve that problem with the same kind of IC 471, another problem that the microphone was has been work whenever we touch it and that was endless; so it will work until we turn the switch off that causes an extra load on the circuit and especially on the relay were it was turning on and off quickly so that causes an extra magnetic force inside the coil of the relay.

Those kinds of ICs *(1L081CP)* are very sensitive so any small increasing in the voltage or the load on the circuit will burn it that is why you have to be very careful while you are working on such a types.

Using the alternative *(LF351)* instead of using the required IC is causing a lot of problems on the circuit because the characteristic of the two ICs are not exactly the same, here the circuit is not going to work; never.

In such a circuits; all the components that required to be used should be exactly the same wanted value otherwise you will face the same problems that we faced.

3.5 How does the Second Circuit Work

Receiving the input pulse from the microphone (input component), the received signal will enter an *TL085* which contain four amplifiers inside; so it will amplify the signal to make it a suitable output. By connecting the first amplifier output with the non-inverting input for the second amplifier, the coupled output of the amplifiers will be an input for the second IC *(MN555),* this process will charge the first capacitor, so the timer inside the *MN555* will latch the input to its corresponding output, then the amplified signal will enter the *4017* which is a counter that arranges the path of the input signal and then to the relay which switch on after receiving that signal from *4017,* so that the relay will operate its output, that will be on till the *4017* receives another input signal from the *MN555,* so the first relay will switch's off and the second relay will switch's on so operating its output see (fig 3.6).

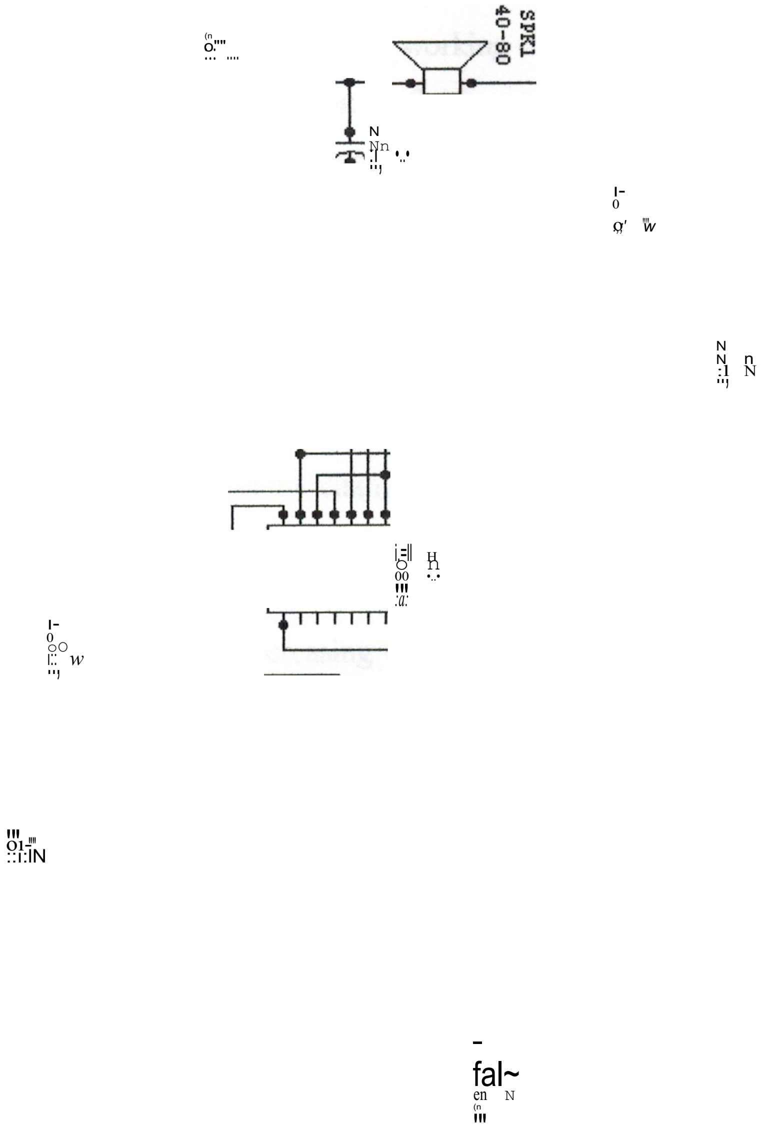

Figure 3.6 the Second Circuit Diagram of the Sound Activated Switch

3.5.1 Results of Testing the Second Circuit

For the circuit shown in (fig 3.6); after working over the circuit, it has passed through some tests to make sure that it working perfectly, so these tests helps us for finding any fault may occur in the circuit after connect it to the source, that includes the operations of all the components that by measuring the outputs, especially the semi-conductors because of their sensitivity, also the tests of the distance that may the circuit work on, after the testing we could see that this circuit could work up to 1m and after that distance the sensitivity of the microphone (input component) will not take the response so it should be increased and that can be done by changing the value of the variable resistor that is connected parallel to it (Rl), or by changing the parallel capacitor (Cl). And the most important test was done to the circuit is that which done to the outputs of the relays, that you can accelerate the response of the output by changing the capacitor that is connect to the output of the *4017* so by increasing the capacitor value it is decreasing the output response and vise versa.

After making sure that the circuit is working perfectly, so we could solder it to a special board.

3.5.2 Future Works

For the same circuit; you can do a lot of developments on it, you can connect a small microprocessor and by using an a simply language you can write a small program to save your voice so that the circuit will never work if it did not receive your voice or your voice frequency, and also you can program it to all the outputs by using a special name for each output and so on. As long as this circuit is small so you can not use it to do some huge works like opening the door although you can increase its components to be able to do such an order but that will need to connect an EPROM to the microprocessor also digital to analogue and analogue to digital converters. Also you can use a normal power supply instead ofusing 9V batteries but you have to connect an inverter to the input of the circuit.

3.6 Hardware Approach

3.6.1 Clock Pulse Generator (KA 555)

Produce clock pulses at a given frequency. The circuit requires the connection of two external resistors and two external capacitors. The cathode ray oscilloscope is used to observe the waveforms and measure the frequency.

IC Timer IC type *72555 (or 555)* is a precision timer circuit whose internal logic is shown in Figure (3.7). (The resistors R_A and R_s and the two capacitors are not part of the IC). It consists of two voltage comparators, a flip-flop, and an internal transistor.

It converts the analogue input (sound) to pulses to make it suitable for the 4017 (PIN 14); which is a clock.

3.6.2 Use of Johnson Counter (CD 4017)

It is a kind of decimal counter that operates respectively after receiving an input pulse. It has a Flip-Flop inside; so every received pulse got a new segment, and from the output of the *4017* it will be connected to the control leg of the *4066,* see (fig 3.8).

3.6.3 Use of Quad Bilateral Switch .(BU 4066)

Instead of using the transistors, it is used as a switching components; so when it receives the output pulse from the *4017* it switch's on and waits till it receives another response (pulse) from *4017* see (fig 3.9).

3.6.4 Use of TL085

It is a semi-conducting chip that contains four amplifier inside so we may use your need of the amplifier from one chip. In this project we used just two of them, for the connection see (fig 3. 10).

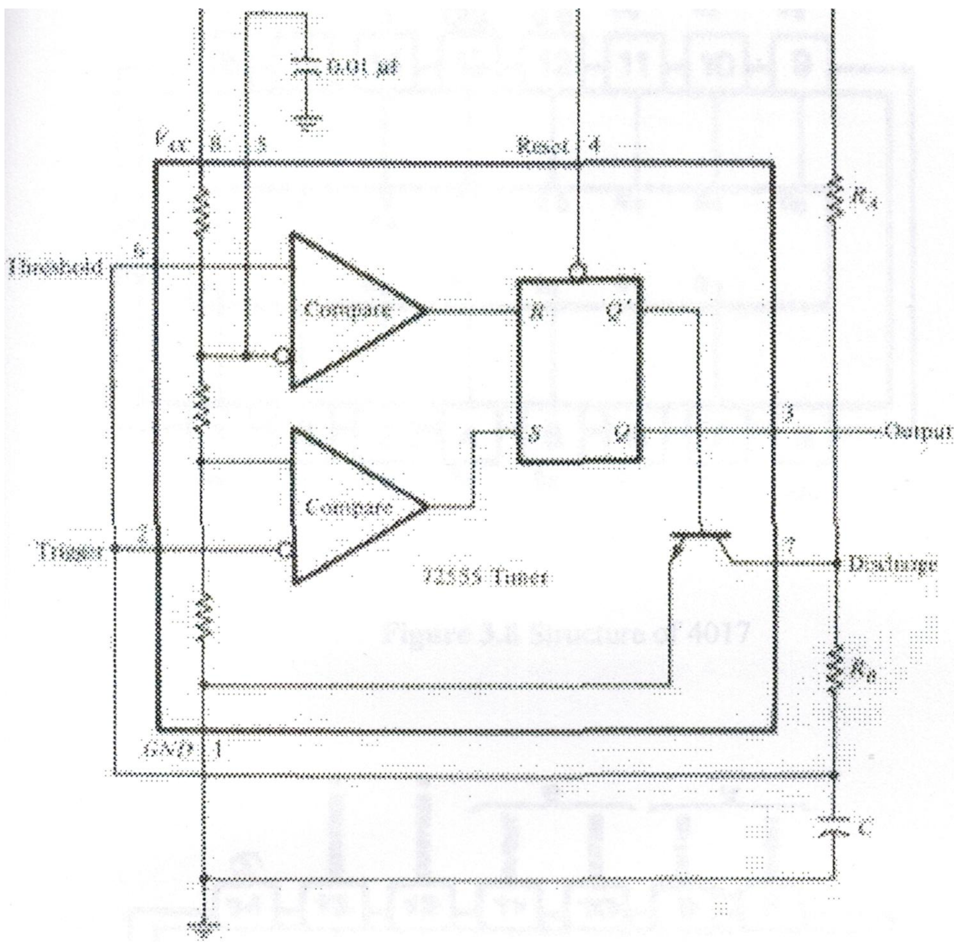

Figure 3.7 IC type 72555 Timer Connected as a Clock Pulse Generator

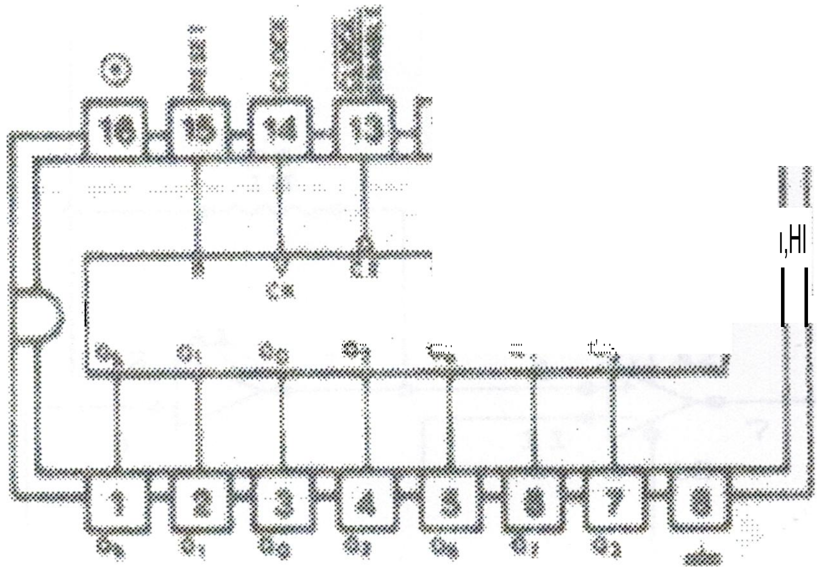

Figure 3.8 Structure of 4017

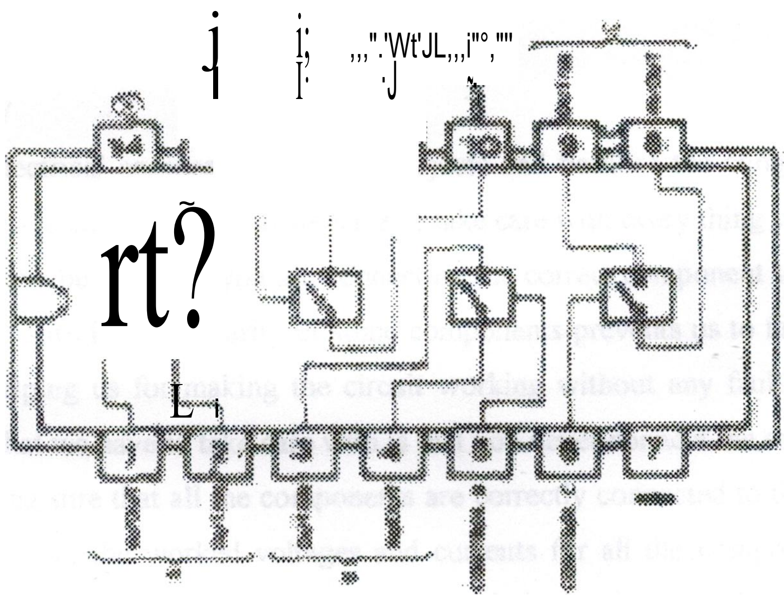

Figure 3.9 Structure of Quad Bilateral Switch (4066)

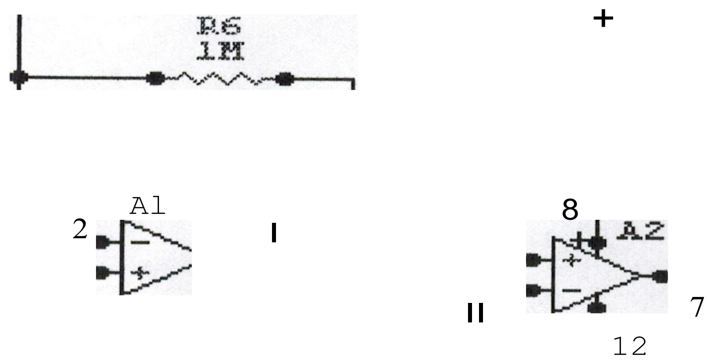

Figure 3.10 Structure of TL085 and How the Amplifiers are Connected Inside the chip

3.7 Safety

As an electrical engineer for such a projects and because the components that we are using (sensitive components), so we have to take care with every thing we are doing.
So you always be sure that you are connecting the correct component to the corresponding place, being sure for the polarity of some components prevents us to fall in some mistakes and also helping us for making the circuit working without any faults. Some important thing also that we have to take care with is that you never connect the source (power supply) without being sure that all the components are correctly connected to the circuit, taking by consideration all the worked voltages and currents for all the components (knowing the characteristics of the components, and also the limited voltages and currents). Because we are working with a small voltages that is not that dangerous for the human life does not mean that we have to forget all that thing.
So always check and always be sure of what you are doing.

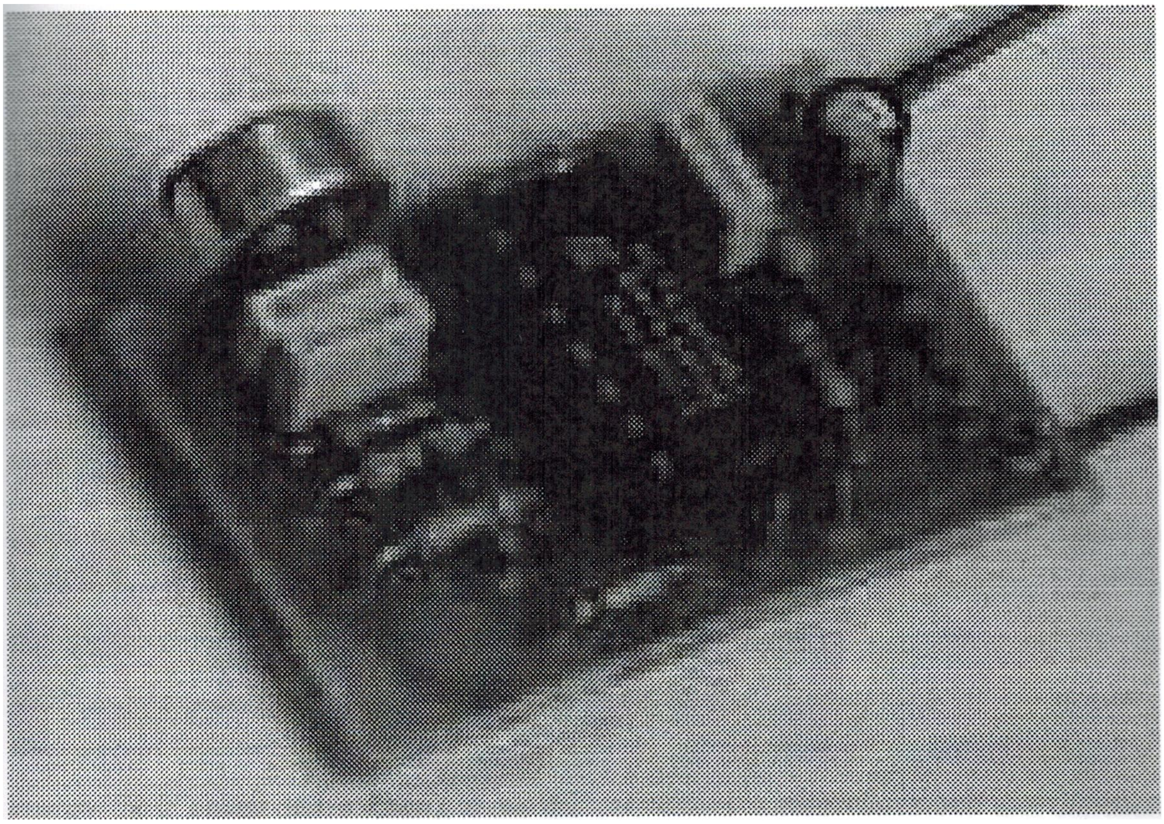

Figure 3.11 Sound Activated Switch

3.8 Summary

In this chapter we have seen two circuit diagrams of the sound activated switch, new components were used and there were some figures illustrate the structure of the semi-conductors that were used in those two circuits. The budgets were also described, the connection of the amplifiers also the future work over the circuit and considering the safety as an electrical engineer. The use of some components was also describe.

CONCLUSION

From the working over this project we have learned a lot of things about the switches, the sound and finally the sound activated switch. As an electrical engineers we learned a new thing about the semi-conductors and the characteristics of it, also how its operation going. After the tests that we set the circuit to, we could find the desired output for such a circuit so it is not easy to know the fault without having some tests.

This project was consist of three chapter, the first chapter explained the switches, so that we could see that the switch is *a device for making or breaking an electric circuit,* also we have to know that there are some effects on the switch form the circuit parameters and from outside the circuit. We can increase the switch life in end use by mechanical and electrical factors.

The second chapter described the sound; *so it is an longitudinal waves (transmission of energy by a series of vibration),* there are two sound waves *Ultrasonic and Infrasonic Waves,* the sonar and the speaker are some application of waves.

The third chapter which the main was explained the Sound Activated Switch. After built the circuit and making sure that it is working with 95% efficiency, we could develop the same circuit for more then one relay and one output, that because we could understand the idea of working.

The aim was to build a *SOUND ACTIVATED SWITCH CIRCUIT* This circuit got a lot of advantages for all people (e.g. it is very good project especially for the disabled or bland people so that they can do their needs without getting tired inside their houses), The Sound Activated Switch is also called *VOICE ACTIVATED SWITCH* or *VOX* and it is operating when it heard a sound that in its level frequency, this is a small circuit but it can be improved to more reliable outputs with of course different components. So that can be by using a small microprocessor, analogue to digital, digital to analogue converters and an EPROM (memory), to make that circuit working digitally instead of working analogously.

The main aim of our project was to design, build and test a working Sound Activated Switch. All the aims were successfully achieved.

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