NEAR EAST UNIVERSITY

Faculty of Engineering

Department of Electrical and Electronic Engineering

SOUNDACTIVATEDSWITCH

Graduation Project
EE-400

Student: TAHA EL-TAHA (20011171)

Supervisor: Assoc. Prof. Dr. Adnan Khashman

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ABSTRACT

Sound produced by a vibration of molecules above and below the current atmospheric pressure. The sound that is heard is caused by minute pressure difference, it can travel and be transmitted through matter over long distance accurately and by converting it to an electrical signal it could be used in much application such as sound activated switch where switch is activated by sound.

This small voice operated switch and relay is based on a circuit published in silicon chip. The circuit has improved by putting it on a point meter in order to adjust the sensitivity of it. The idea behinds a sound activated switch is that instead of the user pressing a switch to activate the relay, the sound of the user itself activate the relay.

Where sound activated switch is desired? It may be used with any type of microphone. The sound activated switch it self draws only 10 mA at 12V DC, and will directly switch low voltage leads up to 100 mA. The sound activated switch may be used to control radio transmitters, tape recorders or a fan as this project present.

CONTENTS

INTRODUCTION

Sound produced by a vibration of molecules above and below the current atmospheric pressure. The sound that is heard is caused by minute pressure difference, it can travel and be transmitted through matter over long distance accurately and by converting it to an electrical signal it could be used in much application such as sound activated switch where switch is activated by sound.

This project will present the design, building and testing of the sound activated switch. How to use sensitive switch and how active the time range.

First chapter of the project present the electronic components especially the components were used in this project such as resistor, capacitor, diodes, integrated circuits ICs and switches. Safety guideline also showed the ways that leads how to use the components in correct way, because if it done in wrong way it will bum or break the components. So that before doing any electrical project this chapter should be taken care.

Second chapter of the project is about applications on sound. It presents the sound characteristics such as amplitude of a sound, velocity of a sound, frequency of a sound and a wavelength of a sound. Definitions and illustrations of Pitch, sound wave, sound intensity and noise will be shown.

Third chapter of the project is most important one, which explains the hardware project in details, how to built it, how it work, what is the input and output of it. The circuit diagrams, component lists, assembly instructions and stages (first, second and third) of the circuit also will be shown.

CHAPTER ONE
ELECTRONIC COMPONENTS

1.1 Overview

In this chapter an introduction to electronic components will be presented. As in this caapter some knowledge about electronic components history will be given and ormation about its functions as well.

1.2 Components

Explanation about hardware components used will be shown by setting up the electronic circuit projects in general.

1.2.1 Resistors

The resistor's function is to reduce the flow of electric current. This symbol -A,.-.,"ı- is used to indicate a resistor in a circuit diagram, known as a schematic. The unit for measuring resistance is the OHM. (the Greek letter .Q). Higher resistance values are represented by "k" (kilo-ohms) and M (megohms). For example, 120 000 .Q is represented as 120k, while 1 200 000 n is represented as 1M2. The dot is generally omitted as it can easily be lost in the printing process. In some circuit diagrams, a value uch as 8 or 120 represents a resistance in ohms. Another common practice is to use the letter E for resistance. For example, 120E (120R) stands for 120 n, 1E2 stands for 1R2 etc [1].

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.

Resistors are color coded to read the color code of a common 4 band 120 k ohm resistor with a 5% tolerance, start at the opposite side of the GOLD tolerance band and read from left to right. Write down the corresponding number from the color chart below for the 1st color band BROWN. To the right of that number, write the corresponding number for the 2nd band RED. Now multiply that number (you should have 12) by the corresponding multiplier number of the 3rd band (yellow) (10,000). Your answer will be 120000 or 120K. As shown in figure 1.1.

120 Kohm resistor

first color

tolerance band

second color

third color

Figure 1.1: Resistor

The following table shows the colors used to identify resistor values:

Table 1.1: Resistor color code.

			Tolerance
Black	0	[illegible]	[illegible]
Brown	1	[illegible]	±[illegible]
Red	2	2	±2
Orange	3	[illegible]	[illegible]
Yellow	4	4	[illegible]
Green	[illegible]		
Blue	6		
Violet	7	7	
Gray	8	8	
White			
Gold			
Silver		--	±10
None			±20

Marking the resistance with five bands is used for resistors with tolerance of 2%, 1% and other high-accuracy resistors. First three bands determine the first three digits, fourth is the multiplier and fifth represents the tolerance.

For some electrical circuits, the resistor tolerance is not important and it is not specified. In that case, resistors with 5% tolerance can be used. However, devices which require resistors to have a certain amount of accuracy, need a specified tolerance[1].

1.2.1.1 Types of Resistor

- Carbon film resistor: cheap resistor the purpose for use it. It can work on the voltage over resistor, also works without noise on high frequency perfectly.
- Metal film resistor: are used when more accurate value is needed, it depends on low voltage. Works much more accurate in value than other resistors.
- Variable resistor: are used to adjust the operating condition by controlling the volume. Its rotation angle usually about 300 degrees, its value is very easy to adjust.
- Wire wound resistor: used mainly for high power resistors, can be made by curate for measuring circuits, high inductance because consists of wound wire.
- Chip resistor: is passive resistor with a form factor as an integrated circuit (IC chip). They are also known as surface mount resistors.
- Thick film resistor: has medium capacitance, a good long time stability and can survive relatively high temperatures.
- Thin film resistor: it has good voltage dependently rating, good long time stability, low noise and low surges handle capacity.

1.2.2 Capacitors

The capacitor's function is to store electricity, or electrical energy. The capacitor also functions as a filter, passing alternating current (AC), and blocking direct current (DC).This symbol -H---- is used to indicate a capacitor in a circuit diagram.

The capacitor is constructed with two electrode plates facing each other, but separated by an insulator. When DC voltage is applied to the capacitor, an electric charge is stored on each electrode. While the capacitor is charging up, current flows. The current will stop flowing when the capacitor has fully charged.The value of a capacitor (the capacitance), is designated in units called the Farad (F).

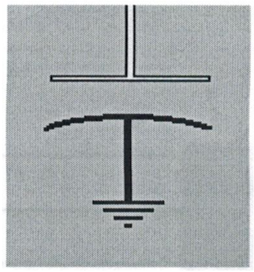


Figure 1.2: Capacitor shape in electronic circuit

The capacitance of a capacitor is generally very small, so units such as the microfarad (10-6F), nano _farad (10-9F), and pico _farad (10-12F) are used. Recently, an new capacitor with very high capacitance has been developed. The Electric Double Layer capacitor has capacitance designated in Farad units. These are known as "Super Capacitors."

Sometimes, a three-digit code is used to indicate the value of a capacitor. There are two ways in which the capacitance can be written. One uses letters and numbers, the other uses only numbers. In either case, there are only three characters used. [lün] and [103] denote the same value of capacitance. The method used differs depending on the capacitor supplier. In the case that the value is displayed with the three-digit code, the 1st and 2nd digits from the left show the 1st figure and the 2nd figure, and the 3rd digit is a multiplier which determines how many zeros are to be added to the Capacitance

1.2.2.1 Capacitor Color Code

A colour code was used on polyester capacitors for many years. It is now obsolete, but of course there are many still around. The colours should be read like the resistor code, the top three colour bands giving the value in pF. Ignore the 4th band (tolerance) and 5th band (voltage rating).

For example:

Brown, black, orange means 10000pF = 10nF = 0.01μF.

Figure 1.3: capacitor color code.

Table 1.2: Capacitor color code

	Colour Code
Colour	Number
Black	0
Brown	1
Red	2
Orange	3
Yellow	4
Green	5
Blue	6
Violet	7
Grey	8
White	9

1.2.2.2 Capacitors and Calculus.

Capacitors do not have a stable "resistance" as conductors do. However, there is a definite mathematical relationship between voltage and current for a capacitor, as follows:

"Obm's Law" for a capacitor

d.v

i=Cd[

Where,

I = Instantaneous current through the capacitor

C = Capacitance in Farads

$\frac{dv}{dt}$ = Instantaneous rate of voltage change (volts per second)

1.2.2.3 Series capacitance

When capacitors are connected in series, the total capacitance is less than any one of the series capacitors' individual capacitances. If two or more capacitors are connected in series, the overall effect is that of a single (equivalent) capacitor having the sum total of the plate spacing of the individual capacitors.

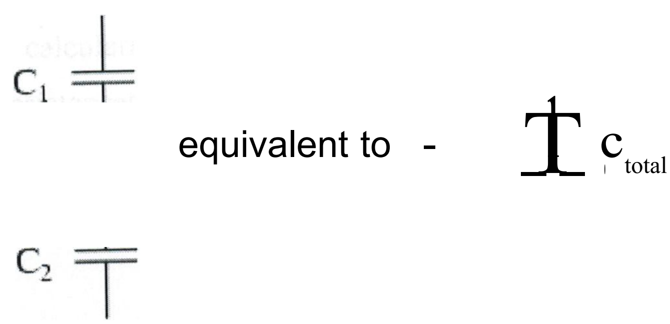


Fig 1.4: Series capacitance.

The formula for calculating the parallel total capacitance is the same form as for calculating series resistances:

Series Capacitances

$$C_{total} = \frac{1}{\frac{1}{C_1}+\frac{1}{C_2}+\ldots\frac{1}{C_n}}$$

1.2.2.4 Parallel Capacitance

When capacitors are connected in parallel, the total capacitance is the sum of the individual capacitors' capacitances. If two or more capacitors are connected in parallel, the overall effect is that of a single equivalent capacitor having the sum total of the plate areas of the individual capacitors [2].

Fig 1.5: Parallel capacitance.

The formula for calculating the series total capacitance is the same form as for calculating parallel resistances:

Parallel Capacitances

$$C_{total} = C_1 + C_2 + \ldots C_n$$

1.2.3 Semiconductor

Are materials which have conductivity between conductors (generally metals) and nonconductors or insulators (such as most ceramics). Semiconductors can be pure elements, such as silicon or germanium, or compounds such as gallium arsenide or cadmium solenoid. In a process called doping, small amounts of impurities are added to pure semiconductors causing large changes in the conductivity of the material

Doping can produce two types of semiconductors depending upon the element added. If the element used for doping has at least one more valence electron than the host semiconductor, then an n-type (negative type) semiconductor is created .

. If the semiconductor is doped with an element having at least one less electron than the host material, then a p-type (positive type) semiconductor

1.2.3.1 Diodes

A diode is an electrical device allowing current to move through it in one direction with far greater ease than in the other. The most common type of diode in modem circuit design is the semiconductor diode, although other diode technologies exist. diodes are essentially "pressure-" operated (voltage-operated) devices. The essential difference between forward-bias and reverse-bias is the polarity of the voltage dropped across the diode.

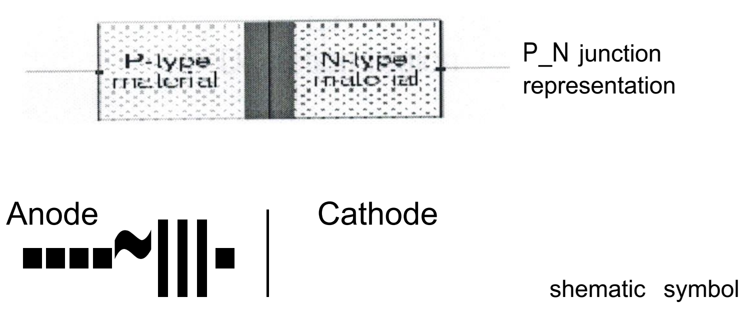


Figure 1.6: Diode

Semiconductor diodes are symbolized in schematic diagrams as such:

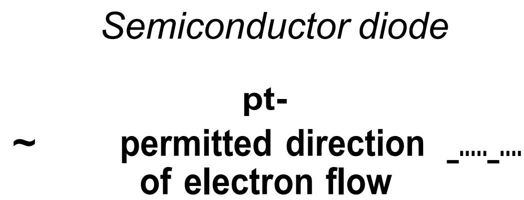


Figure 1.7: Semi conductor diode.

Forward Biased P-N Junction: forward biasing the p-n **junction** drives holes to the junction from the **p-type** material and electrons to the junction from the **n-type** material. At the junction the electrons and holes combine so that a continuous current can be maintained [3].

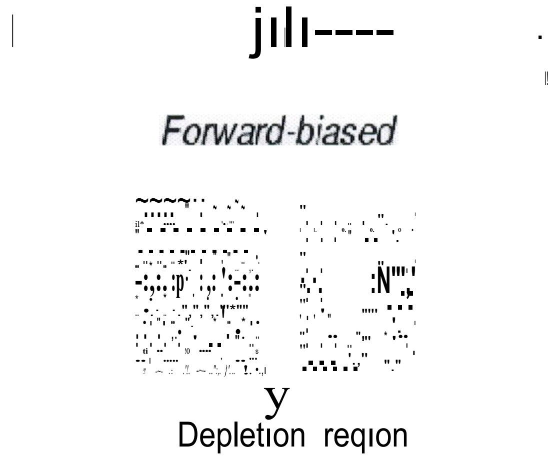


Figure 1.8: Forward biased P-N junction.

Reverse Biased P-N Junction: the application of a reverse voltage to the p-n junction will cause a transient current to flow as both electrons and holes are pulled away from the junction. When the potential formed by the widened depletion layer equals the applied voltage, the current will cease except for the small thermal current.

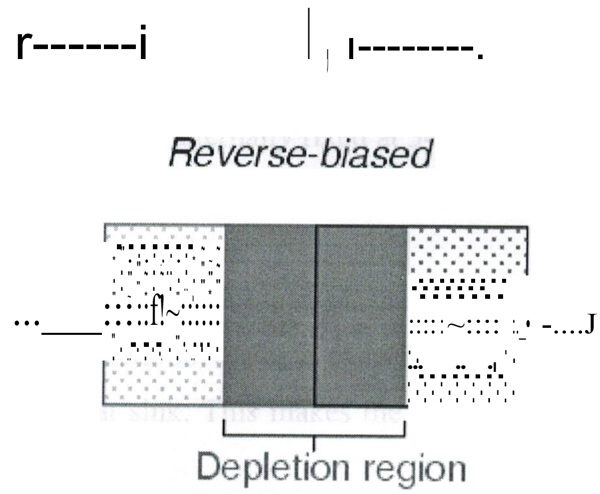


Figure 1.9: Reverse biased P-n junction.

1.2.3.2 Diode Equation.

In actuality, things are more complex than this. There is an equation describing the exact current through a diode, given the voltage dropped across the junction, the temperature of the junction, and several physical constants. It is commonly known as the *diode equation:*

$I_d = I_s (e^{qV_d/NkT} - 1)$

Where:

I_d =Diode current in amps.

I_s =Saturation current in amps (typically current in amps).

e =Euler 's constant (2.718281828).

q =charge of electron ($1.6*10^{-19}$ coulombs).

V_d =voltage applied across diode in volts.

N ="No ideality" or emission coefficient (typically between 1 and 2).

K =Boltzmann's constant ($1.38*10^{-23}$).

T =Junction temperature in degrees Kelvin.

1.2.3.3 LM380N

The LM380Nis 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. A selected part for more power on higher supply voltages is available as the LM380N.

```
                        +--()--+
              BYPASS  | 1   141  VCC
    NON-INV   INPUT   12    131  NC
                 GND  | 3   121  GND
                 GND  14    111  GND
                 GND  | 5   101  GND
INVERTING  INPUT  16     91  NC
                 GND  17     81
VOUT
                       +------+
```

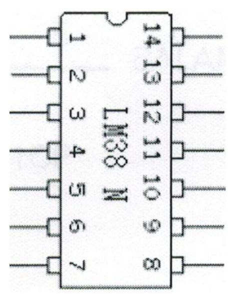


Figure 1.10: LM380N construction.

1.2.3.4 TL081CP

The TL081 is a low cost high speed JFET input operational amplifier with an internally input offset voltage(BI_FET IITM technology). The device requires a low supply current and yet maintains a large gain band with product and fast stew rate.

In addition will matched high voltage JFET input device provide very low input bias and offset currents.

The TL081compatable with the standard LM741 and uses the same offset voltage adjustment circuit. This feature allows designers to immediately upgrade the over all performance of existing LM741 designs.

TheTL081 may be used in applications such as high speed integators,fast *DIA* converters, sample and hold circuits and many other circuits requiring low input offset voltage, low input bias current high input impedence, high stew rate and wide bandwidth. The device 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 TL081CP is the better choice [3].

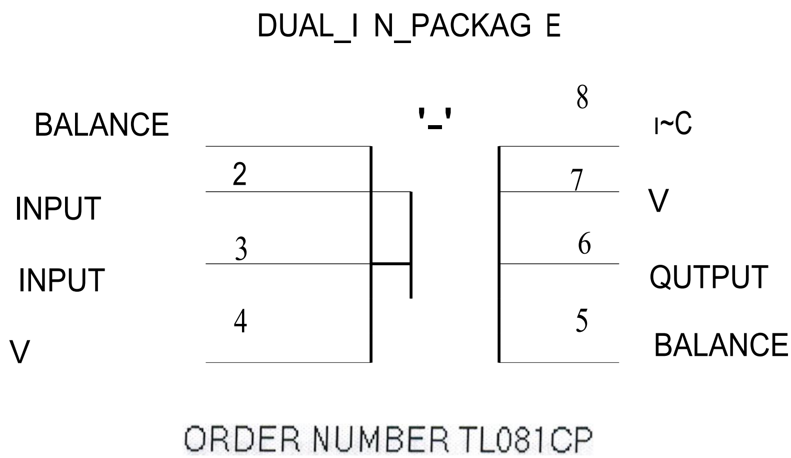


Figure 1.11: TL081CP Construction.

1.2.4 Loudspeaker Details

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.

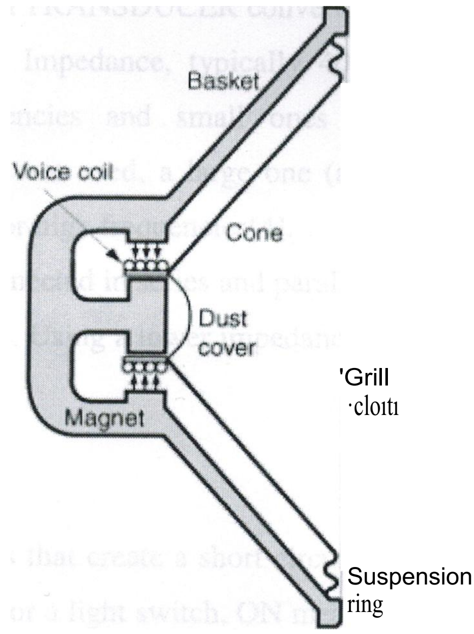


Figure 1.12: Loud speaker.

The most common type of loudspeaker is the MOVING COIL speaker, where a coil of wire is suspended in the magnetic field of a circular magnet. When a speech current is passed through the coil a varying magnetic field is generated by the coil. The two magnetic fields interact causing movement of the coil (see the page on the MOTOR PRINCIPLE). The movement of the coil causes a cone, which is attached to the coil, to move back and forth. This compresses and decompresses the air thereby generating sound waves.

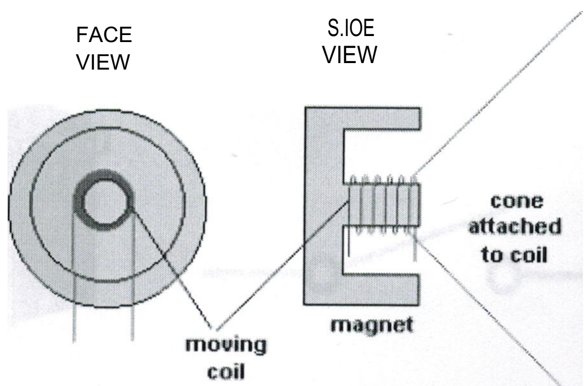


Figure 1.13: Moving Coil Speaker.

The loudspeaker is a TRANSDUCER converting one form of energy to another.

Loudspeakers have Impedance, typically 40 or 80 ohms.Large speakers cannot reproduce high frequencies and small ones cannot reproduce low frequencies. Therefore two speakers are used, a large one (a Woofer) for low frequencies, and a small one (a Tweeter) for high frequencies[4].

Speakers can be connected in series and parallel but the total impedance must match the amplifier impedance. Using a lower impedance than the correct one can blow up the amplifier.

1.2.5 Switches

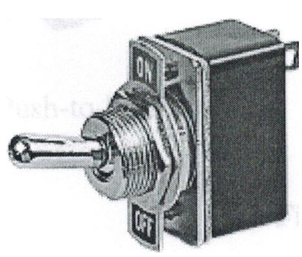
Switches are devices that create a short circuit or an open circuit depending on the position of the switch. For a light switch, ON means short circuit (current flows through the switch, lights light up and people dance.) When the switch is OFF, that means there is an open circuit (no current flows, lights go out and people settle down. This effect on people is used by some teachers to gain control of loud classes.) When the switch is ON it looks and acts like a wire. When the switch is OFF there is no connection[5].

1.2.5.1 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.



SPST toggle switch

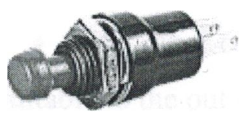
Single Pole symbol

Figure 1.14: SPST Toggle Switch and Symbol

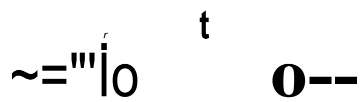
ON-OFF

Push-to-make = SPST Momentary

A push-to-make switch returns to its normally open (off) position when the button is released, this is shown by the brackets around ON. This is the standard doorbell switch.



Push-to-make switch



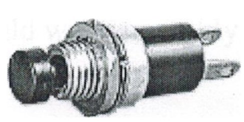
Push_to_make symbol

Figure 1.15: Push_to_make Switch.

ON-(OFF)

Push-to-break = SPST Momentary

A push-to-break switch returns to its normally closed (on) position when the button is released.



Push-to-break switch

Push_to_break symbol

Figure 1.16: Push_to_break Switch.

1.3 Safety Guidelines

In this project applications of low voltage are used. So here safety guidelines are not included human safety but included components safety. Also the technical mistakes whish can occur during connecting parts to the circuit cannot be avoided, so heat and current should be taken carefully.

- One of the component which are used in this circuit is the I.C., which is so sensitive, so while connecting its pins to the circuit they have to be attached in accordance with the manufacturing instructions layouts in order to keeping it working properly and without damaging it.
- An other component used in this circuit is loudspeaker, which has to be chosen suitable to the out put signal so as not to destroy diaphragm.
- An other component used in this circuit is capacitor. It should be taken care about connecting it in right way to avoid damaging it
- While connecting the circuit components to the power supply we have to be aware of misconnecting its polarity to assure the safety of used components.
- While the circuit is on, avoid touching the sensitive components like the diodes and capacitors and I.C. to avoid interfering with the out put signal.
- While soldering the parts to the circuit we have to be careful so as not to bum the parts which are sensitive and can be harmed by heat.

1.4 Summary

This chapter presented an introduction to electronic components that they are used in other projects, how they function, and how must be built and connected. The circuit should work smoothly by applying the safety guides lines.

CHAPTER TWO
TECHNICAL ON SOUND

2.1 Overview

This chapter presents general in function on sound applications. Definition and characteristics of sound will be shown. Sound frequency, sound speed, sound pitch and sound noise information will also be presented.

2.2 What is Sound

Sound is produced by a rapid variation in the average density or pressure of air molecules above and below the current atmospheric pressure. Sound perceive as these pressure fluctuations cause the eardrums to vibrate. When discussing sound, these usually minute changes in atmospheric pressure are referred to as sound pressure and the fluctuations in pressure as sound waves. Sound waves are produced by a vibrating body, be it an oboe reed, guitar string, loudspeaker cone or jet engine.

The vibrating sound source causes a disturbance to the surrounding air molecules, causing them bounce off each other with a force proportional to the disturbance. The energy of their interaction creates ripples of more dense (higher pressure) to less dense (lower pressure) air molecules, with pressures above and below the normal atmospheric pressure. When the molecules are pushed closer together it is called compression; when they are pulled apart, it is called rarefaction. The back and forth oscillation of pressure produces a sound waves.

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Figure 2.1: compression and rarefaction of sound.

Sound is a waveform that travels through matter. Although it is commonly associated in air, sound will readily travel through many materials such as water and steel. Some insulating materials absorb much of the sound waves, preventing the waves from penetrating the material.

Because sound is the vibration of matter, it does not travel through a vacuum or in outer space. Sound is created by back-and-forth vibrations, thus creating compression waves in the material where sound travels [6].

This is different than the up and down or transverse motion of a water wave or guitar string.

Nearly all sound sources emit sounds of more than one frequency. A sound which consists of a single frequency is called a pure tone.

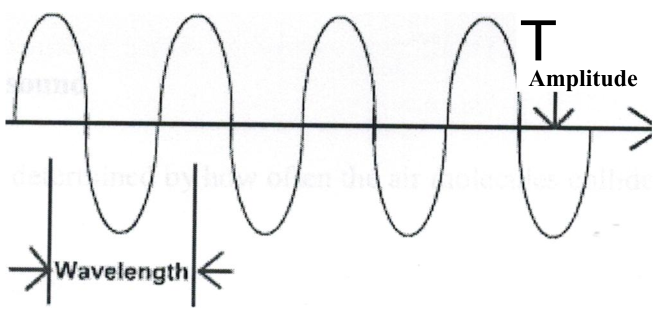


Figure 2.2: Transverse Wave.

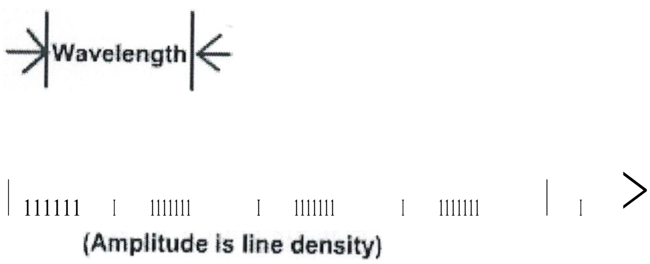


Figure 2.3: Compression Wave.

pure tone

s:ourıd
P'ressure
Level
aeı:

$S 126 250' 500 1000 2000 4000 80001-tı.
Frequency

Figure 2.4: Pure tone.

2.3 Characteristics of sound

A sound wave has characteristics just like any other type of wave. It has an amplitude, a velocity, a wavelength, and a frequency.

Amplitude

The amplitude of a sound wave is the same thing as its loudness. Since sound is a compression wave, its loudness or amplitude would correspond to how much the wave is compressed.

Speed or velocity of sound

Speed of sound is determined by how often the air molecules collide.

Wavelength

Wavelength is the distance from one crest to another of a wave. Since sound is a compression wave, the wavelength is the distance between maximum compressions.

Frequency

The frequency of sound is the rate at which the waves pass a given point. It is also the rate at which a guitar string or a loud speaker vibrates. Frequency is also called the pitch of a sound.

Relationship

The relationship between velocity, wavelength and frequency is: velocity = wavelength x frequency

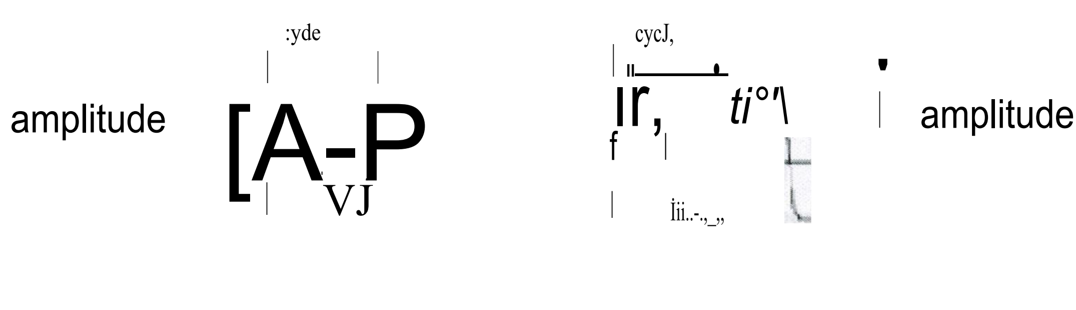
Since the velocity of sound is approximately the same for all wavelengths, frequency is often used to better describe the effects of the different wavelengths.

Pitch

The pitch or note of a sound that we experience is determined by its wavelength or its frequency.The shorter the wavelength, the higher the frequency, and the higher the pitch that we hear [6].

2.4 Sound wave

A sound wave is a classic example of a longitudinal wave. As a sound wave moves from the lips of a speaker to the ear of a listener, particles of air vibrate back and forth in the same direction and the opposite direction of energy transport. Each individual particle pushes on its neighboring particle so as to push it forward. The collision of particle #1 with its neighbor serves to restore particle #1 to its original position and displace particle #2 in a forwards direction. This back and forth motion of particles in the direction of energy transport creates regions within the medium where the particles are pressed together and other regions where the particles are spread apart.



Simple waveform Complex waveform

Figure 2.5: Sound wave.

2.5 Surface wave

Surface wave is a wave in which particles of the medium undergo a circular motion. Surface waves are neither longitudinal nor transverse. In longitudinal and transverse waves, all the particles in the entire bulk of the medium move in a parallel and a perpendicular direction (respectively) relative to the direction of energy transport. In a surface wave, it is only the particles at the surface of the medium which undergo the circular motion. The motion of particles tend to decrease as one proceeds further from the surface [6].

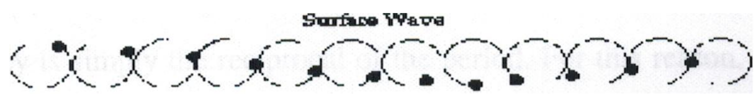


Figure 2.6: Surface wave.

2.6 Frequency of sound

The number of cycles per unit of time is called the frequency. For convenience. frequency is most often measured in cycles per second (cps) or the interchangeable Hertz (Hz) (60 cps = 60 Hz), named after the 19th C. physicist. 1000 Hz is often referred to as 1 kHz (kilohertz) or simply 'lk' in studio parlance.

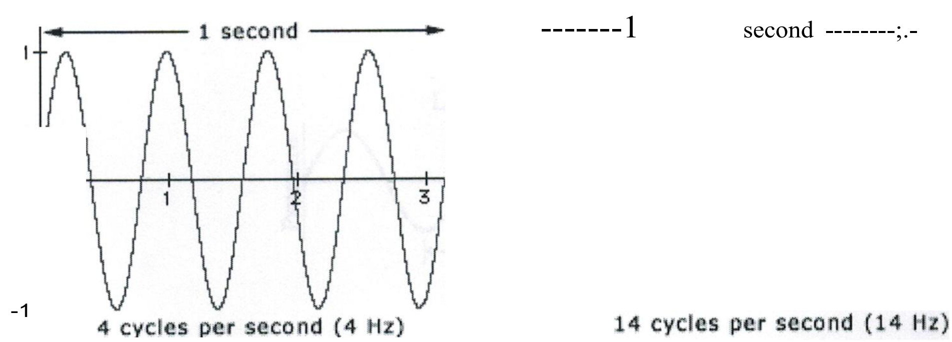


Figure 2.7: Frequency sound.

The range of human hearing in the young is approximately 20 Hz to 20 kHz-the higher number tends to decrease with age (as do many other things). It may be quite normal for a 60-year-old to hear a maximum of 16,000 Hz [7].

When the waves pass our microphone, the sound is detected. The distance between any two waves is called the wavelength and the time interval between waves passing is called the frequency. Frequency is directly related to wavelength, often represented by the Greek lambda (.?t.). The wavelength is the distance in space required to complete a full cycle of a frequency. The wavelength of a sound is the inverse of its frequency. The formula is: wavelength (A)= speed of sound/frequency

The frequency is simply the reciprocal of the period. For this reason, a sound wave with a high frequency would correspond to a pressure time plot with a small period - that is, a plot corresponding to a small amount of time between successive high pressure points. Conversely, a sound wave with a low frequency would correspond to a pressure time plot with a large period - that is, a plot corresponding to a large amount of time between successive high pressure points. The diagram below shows two pressure-time plots, one corresponding to a high frequency and the other to a low frequency.

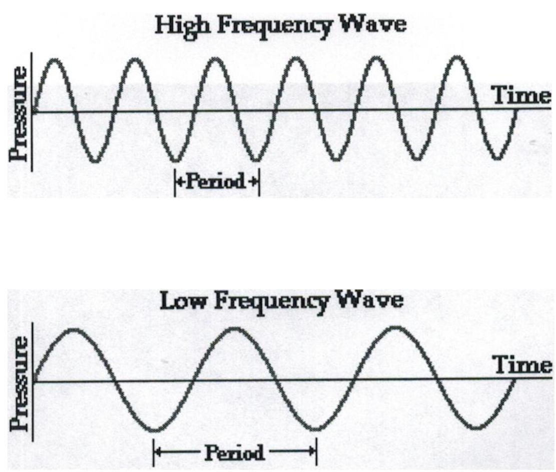


Figure 2.8: Frequency wave.

Mathematically, the period is the reciprocal of the frequency and vice versa. In equation form, this is expressed as follows: Periodel/Frequency, Frequency=l/Period.

Since the symbol F is used for frequency and the symbol T is used for period, these equations are also expressed as: T=l/F, F=l/T.

2.7 Speed of sound

The speed of "sound" is actually the speed of transmission of a small disturbance through a medium. Sound itself is a sensation created in the human brain in response to sensory inputs from the inner ear.

Disturbances are transmitted through a gas as a result of collisions between the randomly moving molecules in the gas. The transmission of a small disturbance through a gas is an isentropic process. The conditions in the gas are the same before and after the disturbance passes through. Because the speed of transmission depends on molecular collisions, the speed of sound depends on the state of the gas.

The speed of sound is a constant within a given pure oxygen, carbon dioxide, etc gas and the value of the constant depends on the type of gas (air) and the temperature of the gas.

Sound travels faster in liquids and solids than in gases, since the particles in liquids and solids are closer together and can respond more quickly to the motion of their neighbors [6].

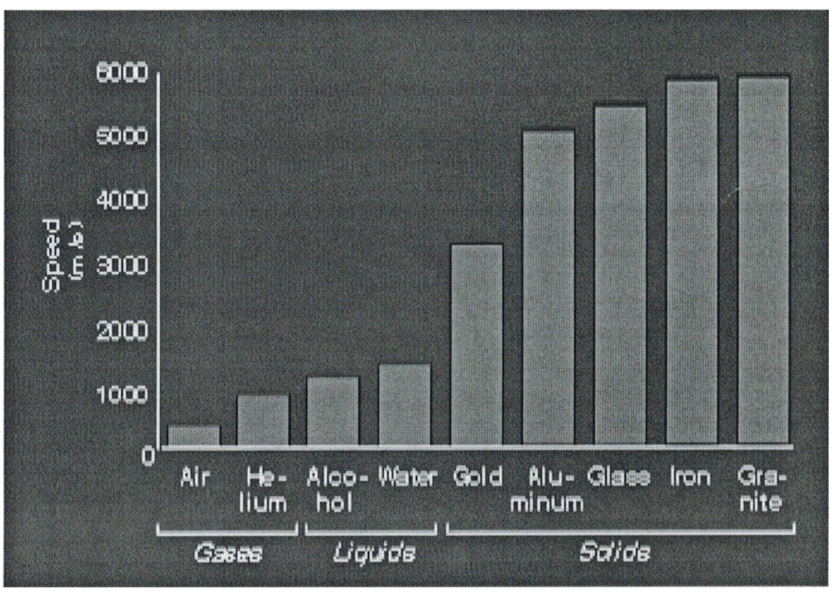


Figure 2.9: Sound speed classification.

2.8 Pitch

The frequency of sound vibrations governs pitch, or the perceived "highness" or "lowness" of the sound.

A high pitch sound corresponds to a high frequency and a low pitch sound corresponds to a low frequency. The pitch or note of a sound is determined by its wavelength or its frequency. The shorter the wavelength, the higher the frequency, and the higher the pitch that be heard.

Frequency and pitch should not be considered interchangeable terms [7].

2.9 Sound intensity

As a sound wave carries its energy through a two-dimensional or three-dimensional medium, the intensity of the sound wave decreases with increasing distance from the source.

The decrease in intensity with increasing distance is explained by the fact that the wave is spreading out over a circular (2 dimensions) or spherical (3 dimensions) surface and thus the energy of the sound wave is being distributed over a greater surface area. The diagram bellow shows that the sound wave in a 2-dimensional medium is spreading out in space over a circular pattern. Since energy is conserved and the area through which this energy is transported is increasing, the power (being a quantity which is measured on a per area basis) must decrease [6].

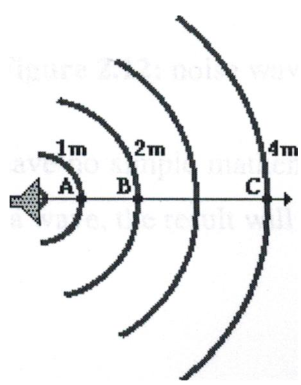


Figure 2.10: Sound in 2_dimentons.

2.10 Noise

Noise is characterized as being a periodic or having a non-repetitive pattern. There are many different types of noise, depending primarily on the random distribution of frequencies. For example, some types of noise may sound brighter than others.

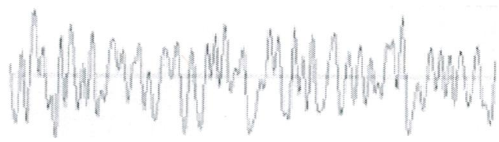


Figure 2.11: Bright noise.

Types of noise which are useful in sound synthesis and technical equipment alignment etc.

These are called white noise, pink noise and (the author has heard) blue noise. White noise contains all frequencies in equal amplitude distribution (and the metaphor is from white light which has a similar attribute). Pink noise is filtered white noise (some frequencies removed) and other colors of the noise rainbow represent other filterings [6].

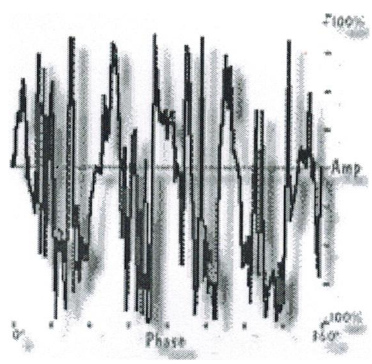
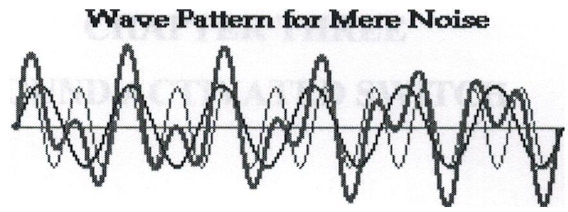


Figure 2.12: noise wave form.

If two sound waves which have no simple mathematical relationship between their frequencies interfere to produce a wave, the result will be an irregular and non-repeating pattern; this is "noise".



f_. : fblue is 37:20

Figure 2.13: More than one noise waveform.

2.11 Summary

This chapter presented general in function on sound applications. Sound and sound characteristics and definitions and effect of sound wave, frequency, speed and its pitch also presented.

Now after reviewing the techniques of sound and already an explination of the necessary components for the circuit is given. It is the time to start setting up the circuit.

CHAPTER THREE
SOUND ACTIVATED SWITCH

3.1 Overview

In this chapter we will explain the design of sound activated switch circuit, its functions and the use of it. This chapter also contains a brief explanation about the circuit and the components to be used.

3.2 Introduction To Hardware Description

The Sound activated switch module which may be used in any application where Sound activated switch operation is desired. It may be used with virtually any type of microphone. The circuit itself draws only 10mA at 9 volts DC and will directly switch low voltage loads up to 100 mA. Numerous small and inexpensive relays are available to permit switching of higher voltage and current. The VS Sound activated switch can be used to control ham radio transmitters, tap recorder, or similar equipment for other radio services.

3.3 How Circuit works

An explanation about each stage function of the circuit, what does the components contribute to the stages, and how they work together by giving the desired output will be shown as follow:

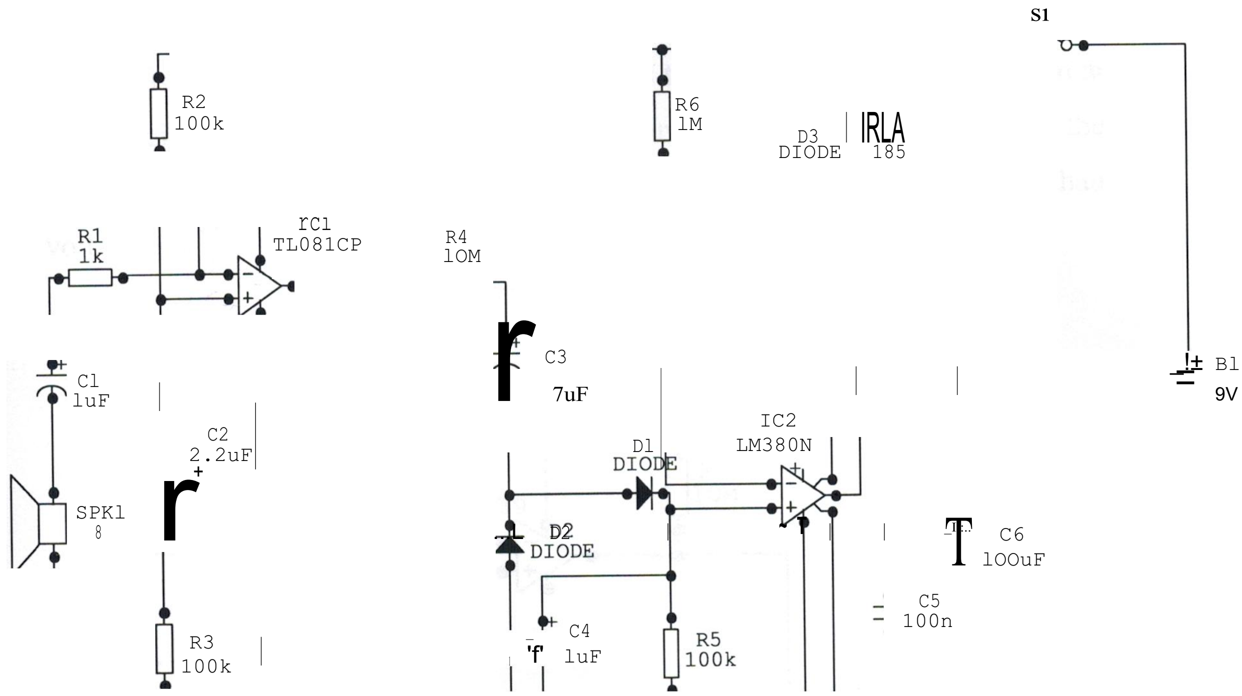


Figure 3.1: Voice activated switch circuit diagram.

3.3.1 How microphones work

Microphones just convert a real sound wave in to an electrical audio signal. In order to do so, they have a small, light material in them called the diaphragm. The diaphragm vibrates when the sound vibrations through the air reach the diaphragm. This in turns will vary some electrical current in the microphone.

3.3.2 First stage

Sound amplification stage is the first stage of sound activated switch, it is the receiver stage (sensor), it works when the sound entering the microphone and change to an electrical signal. So, the sound signal is sinusoidal signal which has two sides as a positive and negative. In order to adjust the all sound signal we located electrolytic capacitor that satisfies the positive side during changing itself. In other hand we have connected a resistor to satisfy the negative side. Thus, the all sinusoidal signal is going to be considered in circuit by the capacitor and resistor respectively. The capacitor working as short circuit, conduct the current to the input of the inverting amplifier ICl which is used as a straight forward 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 IC1 simply is not able to give such a high voltage gain at these frequencies. It is necessary to use the large amount of amplification due to the very low signal voltage provided by the microphone, which will normally less than mille volt.

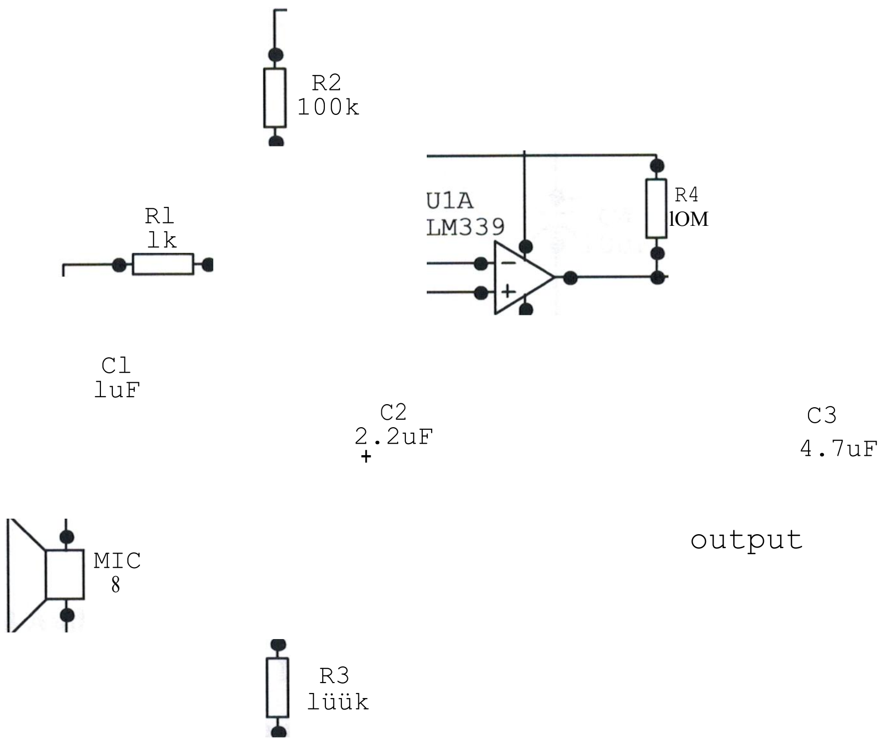


Figure 3.2: Sound amplification stage circuit diagram.

3.3.3 Diodes rectifying stage

The amplified signal (output from IC1) will be coupled by capacitor C3 to arectefier smoothing circuit which consist of diodes(Dl,D2) capacitor (C4) and resistor (R5). The diodes working as bias which is fed to the inverting input of IC2. Smooth circuit produces a DC signal that has a fast attack time so that the unit quickly responds of an input signal and almost instantly switches on to controlled equipments. However, the decay time is much slower, and this is advantageous since it prevents the controlled equipment from being switched off the type that occur in normal speech.

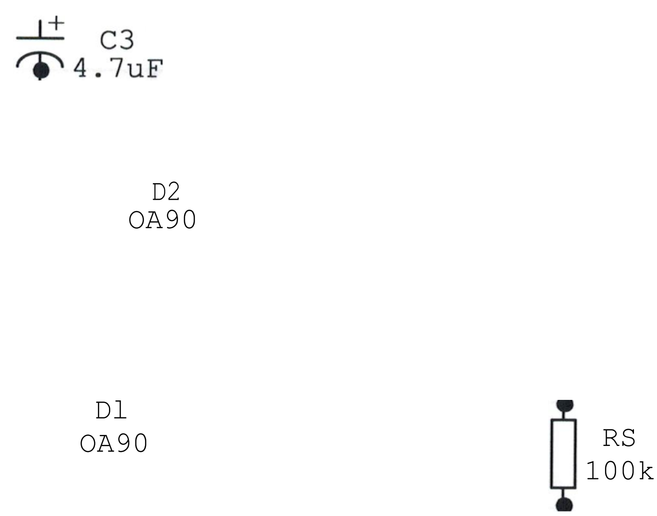


Figure 3.3: Diodes rectifying stage circuit diagram.

3.3.4 Audio amplifying stage

The integrated circuit IC2 is used as the relay driver and resistor R6 provides a small sensitive bias to the non inverting input of IC2. This keeps the output in the high state and the relay switched off until a suitable 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 make sure that the relay we use has contact that are up to the task and are not being over loaded. In its bread boarded from the unit can not 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 in advisable for inexperienced constructor to use the unit to control mains powered equipment.

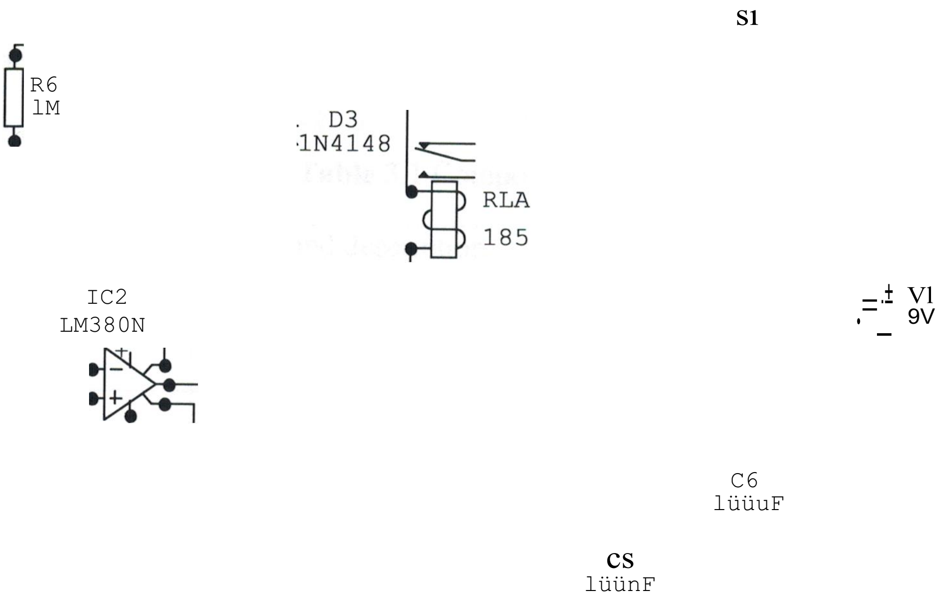


Figure 3.4: Audio power amplifying general description.

3.3.4.1 LM380 2.SW Audio Power Amplifier General Description

The LM380 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 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.

An interesting feature of the LM380N device is that it has two inputs, pin 2 is the non-inverting input and pm 6 is the Inverting input. An input signal to pin 6 produces a change in output voltage that is of the opposite polarity, whereas an input to pin 2 gives a change in output voltage that is of the same polarity as the input signal.

There is no audible difference between the two, and the fact that the signal is inverted through IC 1 if the input at pin 6 is used is not really of any practical importance. The circuit works equally well whichever of the two inputs is used and this fact can easily be demonstrated in practice.

3.4 Project components list

In chapter one, a description of the components and practical use of each one were given, but in this chapter, the value and type of each component, see table 3.1.

Table 3.1 Components' list

Symbol of the component	Value and description
Rl	lk Ohm Resistor.
R2	100k Ohm Resistor.
R3	100k Ohm Resistor.
R4	lOM Ohm Resistor.
RS	100k Ohm Resistor.
R6	IM Ohm Resistor.
Cl	1 µF 63 V electrolytic.
C2	2.2µF 63 V electrolytic.
C3	4.7µF 63 V electrolytic.
C4	1OµF 25 V electrolytic.
CS	1OOnF polyester.
C6	1OOµF 10 V electrolytic.
U1	ICl TL081CP.
U2	IC2 LM380N.
Dl	OA90.
D2	OA90.
D3	1N4148.
S1	SPST miniature toggle type switch.
Relay	RLA 6-12 volt. 185 Ohm.
Battery	9 V AA Size battery.
LSI	Loudspeaker 40-80 Ohm.

3.5 Summary

In this chapter the sound activated switch circuit was presented as shown in Fig 3.5. The stages of the circuit and the diagram of each one and components of it were listed on Table1, its function and working principle was shown also.

The problems and the development that face constructing the sound activated switch circuit and the solution for those problems and development will be presented in the next chapter.

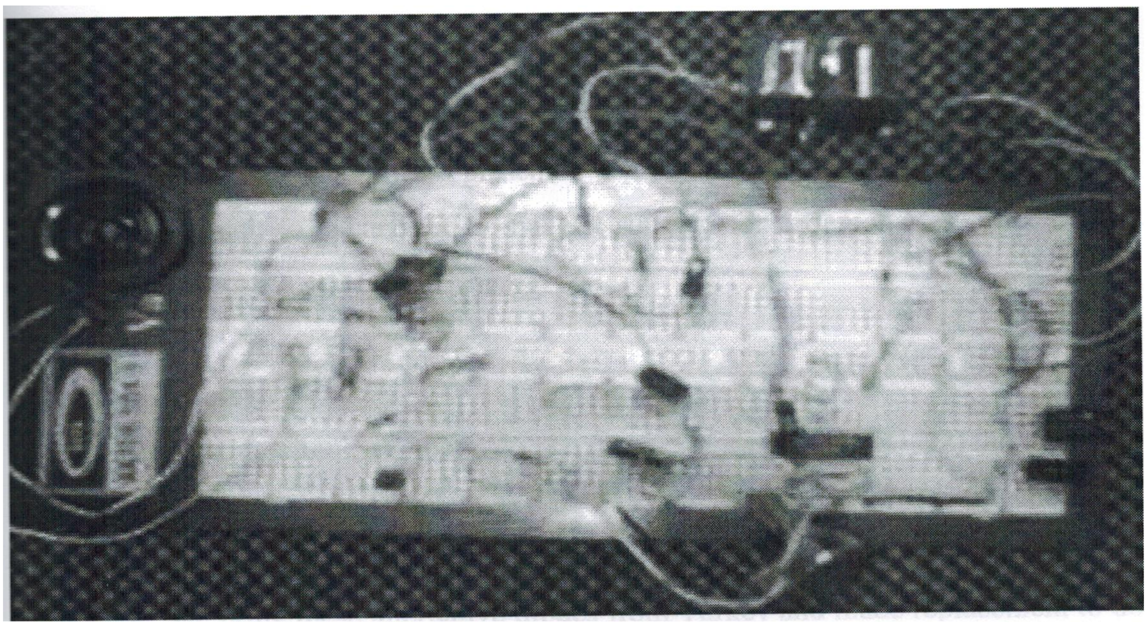


Figure 3.5: Complete circuit on board.

CHAPTER FOUR

IMPLEMENTATION OF SOUND ACTIVATED SWITCH

4.1 Overview

This chapter will present the problem facing the circuit after being built and the changes that done to solve that problem. Results and modifications are described as well, placing some LEDs (light emitting diodes) to show the device status (ON or OFF) also will be shown.

4.2 Modifications

The problems that face constructing the voice activated switch circuit and the solution for that problems will be presented at this section, also the development that occur on the circuit to enhance it to make it suitable for different uses. This will be shown as follow:

4.2.1 Rectifier stage

During collecting circuit components, the desired diodes (D1 AND D2) that carry the number (OA90) were not found at the market in Cyprus. Therefore, we check the components equivalents book and found an alternative diodes carrying number (GEAl lB). We bring these alternative diodes from Turkey and made replacement to do the same function.

4.2.2 Noise interference

When the circuit was built as showed in chapter three and switched on, the result (relay) was switching by it self regardless the input status, the assumption a highly responds for noise interference due to the components therefore we made them closer to each other.

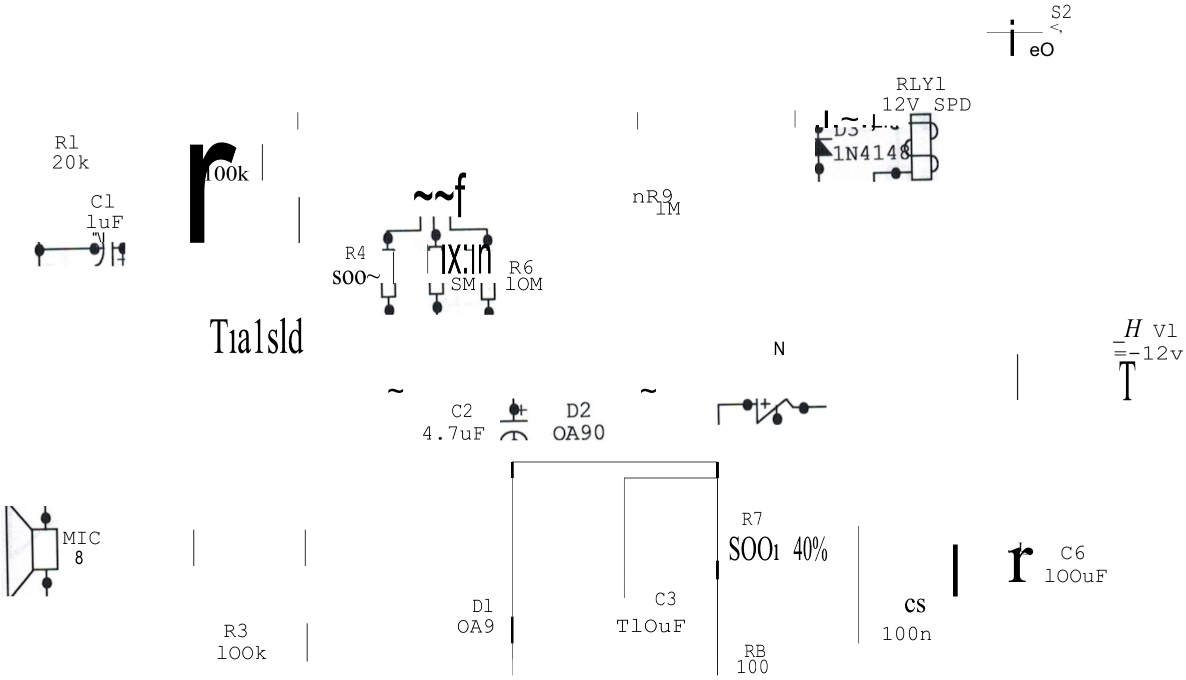


Figure 4.1: Complete improved sound activated switch circuit diagram.

4.2.3 Sensitivity

The selector switch S1 adjusts the sensitivity of the Sound Activated Switch. Varying the resistance of the amplifier will vary the DC voltage at the input of the first one-shot. Rotating S1 counter-clockwise causes the voltage at the input of the first one-shot to increase. This means that a louder clap is required to activate the first one-shot, making the Sound Activated Switch less sensitive to sound. Likewise, rotating S1 clockwise causes the voltage at the input of the first one-shot to decrease, making the Sound Activated Switch more sensitive to sound [9].

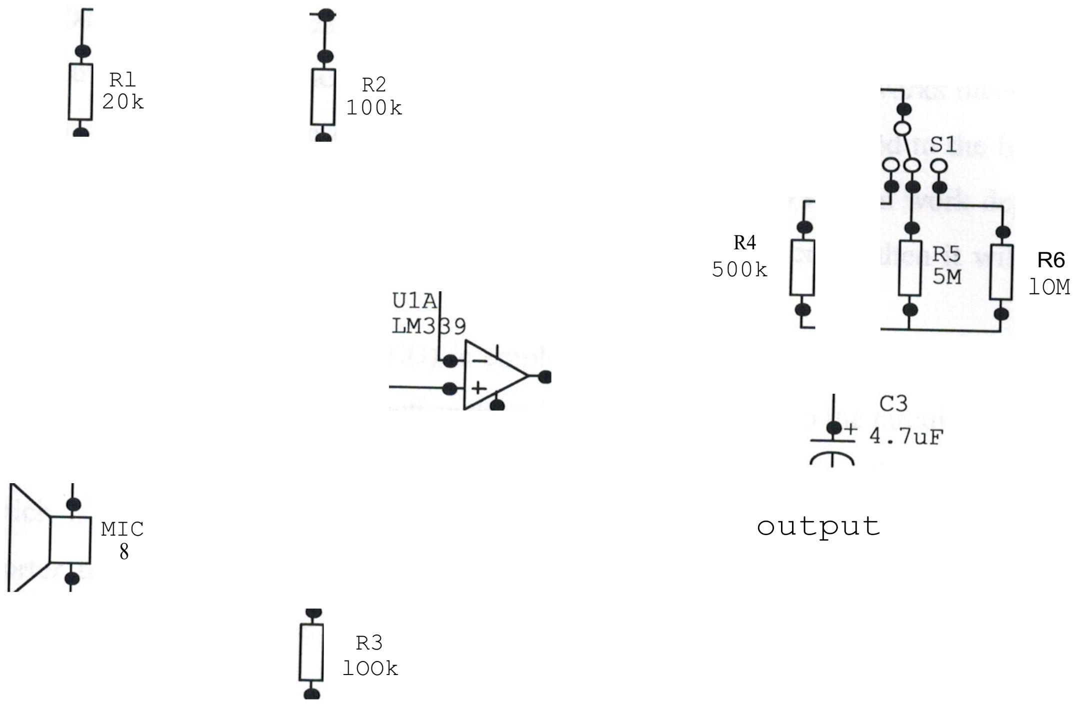


Figure 4.2: Sound amplification stage and the selector switch circuit diagram.

4.2.4 RC Timer

The duration of sound activated switch off delay is controlled by the values of C3 and the combination of resistors R8 and R7 variable resistor will provide excellent adjustment delay range. This produces a positive DC bias which fed to the inverting input ofIC2.

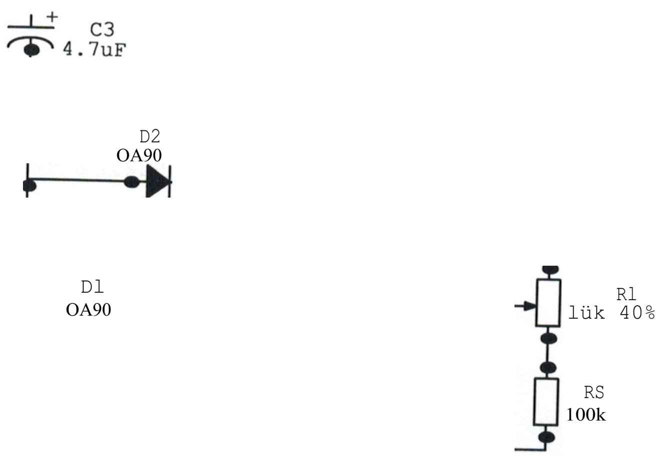


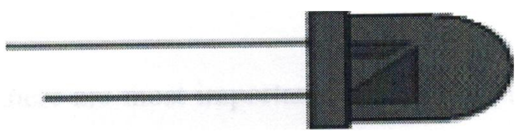
Figure 4.3: RC Timer circuit.

4.2.5 Other Modifications

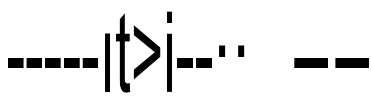
A fan is modified to the sound activated switch to see the circuit works nicer. It has two legs one connected to the relay output leg and the other connected to the battery (-1.5V). The other relay output leg connected to the battery (1.5V). Fan work depending on the plugs of sound activated switch, it will be on for 6 seconds then it will be off because the delay in the circuit.

One light-emitting diode (LED) is employed in the project, it connected to the DC power supply (12V) to check whether there is a voltage applied to the circuit or not.

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 shorter than the other. LEDs emit light when an electric current passes through them an example of a light emitting diode and its circuit symbol are shown Figure 4.4[9].



An example of light emitting diode



A circuit symbol of a light emitting diode

Figure: 4.4 [9].

LEDs must have a resistor in series to limit the current to a safe value, for quick testing purposes a lk resistor is suitable for most LEDs if the supply voltage is 12V or less as shown in figure 4.5.

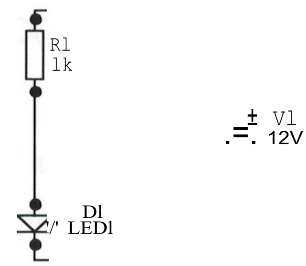


Figure 4.5: A LED connections diagram.

4.3 Results

This section provides which sensitive mediums that are used in testing part of the circuit. The circuit used is a multi sensitive, sound or voice activated switch which plugs to the fan (output of circuit) and turns it on when it detects a reselected level of sound. If the sound continues then the switch will self-trigger and remain on. If the sound once goes away then a delay in the circuit will turn off the fan after about 5 seconds.

Here in this section there are most important notices that have been reached during the modification's part of the project. Starting with light emitting diode results, this is considered as important results for electronic engineer.

4.4 Specification

Some people have thought that the sound activated switch can be used to switch a device such as air condition or computer on and off by sound or voice command. This toggling functions are not the applications for the output circuit of the sound activated switch designed. This case can be done by using flip-flop ICs such as the 4001 or 4011.

A simple toggle circuit can be built with a relay as illustrated, and the turning it off should be manually not by sound.

4.5 Summary

This chapter presented some problems faced during the preparation of the project. These problems were released with circuit after being built and the changes were done to solve those problems. This chapter also presented the main modifications and results that have been made on this project circuit in details. A specification has been viewed as well.

CONCLUSION

Electronic fields are considered as a real revolution in the world. As obviously see in the project chapters, that useful something can be created, practical and vital to the people life using that microprocessor.

Sound activated switch be built by combining the analog components such as resistors, capacitors and diodes, also integrated circuits ICs used like the operational amplifier and audio power amplifier, and a relay at the output.

Since this project is intended for undergraduate electrical and electronic engineering level, the electronic device that will be controlled via the switch is a simple device.

The aims of this project were:

- To have a hand-on experience in electronic hardware project.

  This aim accomplished by the search of this project and having mostly detailed ideas about electronic world.

- To design, build and implement a sound activated switch.

  This aim was accomplished by having practical experience of implementing sound activated switch.

- To modify the original circuit where possible.

  This aim accomplished by making the components closer to each other because of noise interference and adding resistor to the circuit, led also connected to the output of the circuit to show if its working or not.

- To investigate areas of used applications.

  This aim accomplished by referring to many references and having real-life applications to this project sound activated switch, that the circuit can turn on by sound or voice source and off manually by using flip-flop ICs such as 4013.

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