DESIGN AND CONSTRUCTION OF SOUND ACTIVATED ALARM SWITCH SYSTEM

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2004/18826EE

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

FEDERAL UNIVERSITY OF TECHNOLOGY MINNA.

DECEMBER, 2009

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A THESIS SUBMITTED TO THE DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING, FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA

DECEMBER, 2009

DEDICATION

This project is dedicated to my beloved parents, family and other friends .May Almighty ALLAH reward them with al-jannatul Firdausi,ameen.

Declaration

I ISHAQ SULEIMAN, declare that this work was done by me and has never been presented elsewhere for the award of a degree. I also hereby relinquish the copyright to the Federal University of Technology, Minna.

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Signature and date

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Signature and date

AKNOWLEDGEMENT

All praise is due to Allah, Lord of the worlds. I am glad that it has all come to a befitting end. Without His will none of this would have been possible, so once again all praise is due to Allah.

I would like to express my deepest sense of gratitude to my Parents, who all my life has being striving hard to give me the best. For their patience, encouragement and excellent advice.

I would also like to extend my gratitude to the family of Dr. S.A Ma'aji for all their support, love and care they show me. I also acknowledge the support of my uncles and aunties (too numerous to mention). My sincere love goes to my brothers and my sisters.

My sincere gratitude also goes to my project supervisor Mr. P O Attah for his fatherly advice throughout this work

Abstract

The project presents the design, construction and testing of a simple sound activated alarm switch. The principle of operation of this burglar alarm is simple. When the intensity of sound exceeds certain intensity, the alarm is triggered and the buzzer will sound and the light comes on .These actions thus alert the owner of the residence and/or security personnel of the presence of an intruder.

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CHAPTER ONE

INTRODUCTION

Sound operated devices are not new over the years, as technological advancement and civilization are growing fast the aspect of electrical and electronics is leading in finding solution to the basic problems of our society today, among which is insecurity and others. This meet the electrical engineers to bring about the idea of using sound operated switches to triggered a load which will be use as a means of security in private homes, stores and offices. Today because of the technological improvement by electrical engineers this devices has become standard equipments especially in stores, warehouses, jewelry stores museums, etc. With the help of these devices we can make use of our precious time and energy which we use to protect our life and properties in other things that cannot be achieved easily.

Electronics devices has in the past and even in the present been used to solve problems in shortest, most economical and yet most effective ways. Alarm as the name implies are to alert in the event of any situation that is a threat. There are different kind of alarms which includes fire alarm, burglar alarm, indicator alarm, porch alarm, heat and smoke alarm, etc. [1]

Sound operated alarm switches are increasingly been used in private homes, warehouses, strong rooms in banks, etc. This system ranges from simple which you will design by yourself to sophisticated designed by professional.

1.1 BACKGROUND OF THE STUDY

As a result of insecurity in our society today no modern building is complete without solving the problems of insecurity in that building. But with this sound operated switch we can sleep with our eyes both closed after the stress of the day because of its ability to alert personnel when there is an intruder.

1.2 STATEMENT OF THE PROBLEMS

The rate of insecurity in our society is growing in multiples which need to be tackle in all area of our life, and with this sound operated alarm switch system the problems can be solve considerably.

1.3 PURPOSE OF THE STUDY

In order to provide protection to our private homes and other sectors, it is necessary to provide a means of security system in order to guarantee confidence. In an effort to enhance the optimality of security system, this project has added to the list of the available security systems, which among others are

(a) Anti-burglary, which triggers when a beam of light is broken. This has draw back because the beam can be detected and bypassed.

(b) A dark room, which is sensitive to light in the dark room. The alarm always triggers as a result of any beam.

(c) An anti-theft car alarm, which triggers ON when a thef touches the car. This also has the drawback of being demoralized by the thieves before touch ng.

1.4 AIMS AND OBJECTIVES OF PROJECT

The aim and objective of this project is to design and construct a sound operated alarm switch by using simple circuit design. It is design to provide security to places: b ware-houses, strong rooms in banks, jewelry stores, and also to improve the performance of the circuit.

It can also be used as indoor light controlled switch at homes, stores, offices.

It also aim at providing room for indigenous production

In pursuance of this, the following objectives of the project have been specified.

(a) Design and construction of power unit.

(b) Design and construction of sensor unit.

(c) Design and construction of amplification unit.

(d) Design and construction of timing unit.

(e) Design and construction of switching unit for the output of the load.

1.5 SIGNIFICANCE OF THE STUDY

Sound operated switch has been widely used for many years in radio communication especially in situation where the radio operator may not have a free hand to hold a microphone or press it switch "push to talk". Since most radio communication is either in the send or receive mode so it is convenient for radio switch to transmit when the operator start speaking and back to the receiver when the operator stop speaking which encourages a more natural conversation over the radio.

Also sound operated alarm switch system will safe life and properties in our societies, it will help in developing a well secured environment and great importance to all aspect of life such as domestic, banks, industries, prisons, hospitals, etc.

1.6 SCOPE OF THE STUDY

Sound operated alarm switch is all about providing the necessary security to our private homes, warehouses, jewelry stores strong rooms, etc.

1.7 LIMITATION OF THE PROJECT

Like every other works, sound operated alarm switch has its limitations despite its usefulness. The following limitation has been encountered during the designed and construction of the device:

(a) DETECTION

The device can only pick an audio signal within the hearing ranges of $20H_Z$ to $20KH_Z$ thus

[2] any audio signal that is above or below this ranges cannot be pick up by the microphone.

(b) LOAD CAPACITY

Right from the design of the circuit a specification of the load capacity that can be triggered has been made, therefore any load above that can easily damage the circuit.

(C) RELIABILITY OF LOAD

This is about the load that the device will trigger which must be reliable, i.e. the bulb and the alarm.

1.8 DESIGN METHODOLOGY

A microphone which is the sensor unit is being used to pick up the audio signal and convert it into electrical signal; the microphone serves as the transducer. The microphone serves as a great sensor that detects any audio sound and converts it light and alarm with the help of the relay, which indicate the presence of an intruder in any restricted area. In the design four entrances were selected to be monitored and protected by the light and alarm switch. To demonstrate the principle of operation of the sound operated alarm switch system, an integrated circuit (IC) that has three set and reset pins were employed.

1.9 PROJECT OUTLINE

Chapter one consists of introduction, background of study, statement of problem, purpose of study, significance, aims and objectives, scope of study, limitation, design methodology.

Chapter two consist of the literature review and a brief theoretical background of the work

Chapters three consist of the design analysis and calculation, including the block diagram of the work.

Chapter four consist of test, discussion and results; packaging, troubleshooting.

Chapter five consists of the conclusion, recommendation.

CHAPTER TWO

LITERATURE REVIEW

Security has always been the first priority of man, man by all means try to protect his family and properties. The population of man is daily increasing thus making it difficult for the government to protect all its citizenry. This however makes the need for more security to alert and protect man against predators and men of the underworld necessary.

The emergence of electronic intruder system came as relieve to man, it work is to try and deter a potential automatic sound operated switch at our houses [3].

As being practiced in the early times, man was used as the only form of security. But with the increase in the thinking of man and the advance in technology, a device was found to supplement the effort of man. This led to the introduction of solid state or semiconductor devices on which security system depends.

Early solid state sound operated light switch controls used shunt switches or momentary closures on the key circuit to arm and disarm the control. Modern controls use arming techniques but more frequently use a keypad which sends operating information to the control [4].

Further studies on sound operated light switch shows it relevant to our daily lives. Situation in our society have make the need for security a priority.

Today, sound operated switch technology has many useful applications. Some of these applications are:

- Homes for protection

- Museums, for safe guarding objects of lasting values
- Bank, to prevent unauthorized activities
- Military, to monitor enemy advancement, detection and tracking of ships and submarines.
- High tension electrical installation
- Prison, to prevent escape

2.2 THEORY OF SOUND

The term sound implies not only phenomena in air responsible for the sensation of hearing but whatever else is governed by analogous physical principle. Sound is a means of transmitting information. Sound wave is the pattern of disturbance caused by the movement of energy travelling through a medium (such as air, water e.t.c.)

2.2.1 TYPES OF SOUND ACTIVATED SWITCH

There are different types of sound activated, though they all perform the same function but still have so variations in the sense that are very expensive to achieve or non availability of components.

The simplest type consist of single 555 timers, in this type, the sensor unit is also called the loop. The IC in this circuit operates in monostable mode. Any voice signal in the air vibrates the diaphragm of the microphone .A non-inverting amplifier is used to amplifier the sound signal.

Some of the circuits are as follows:

(a) SOUND ACTIVATED SWITCH

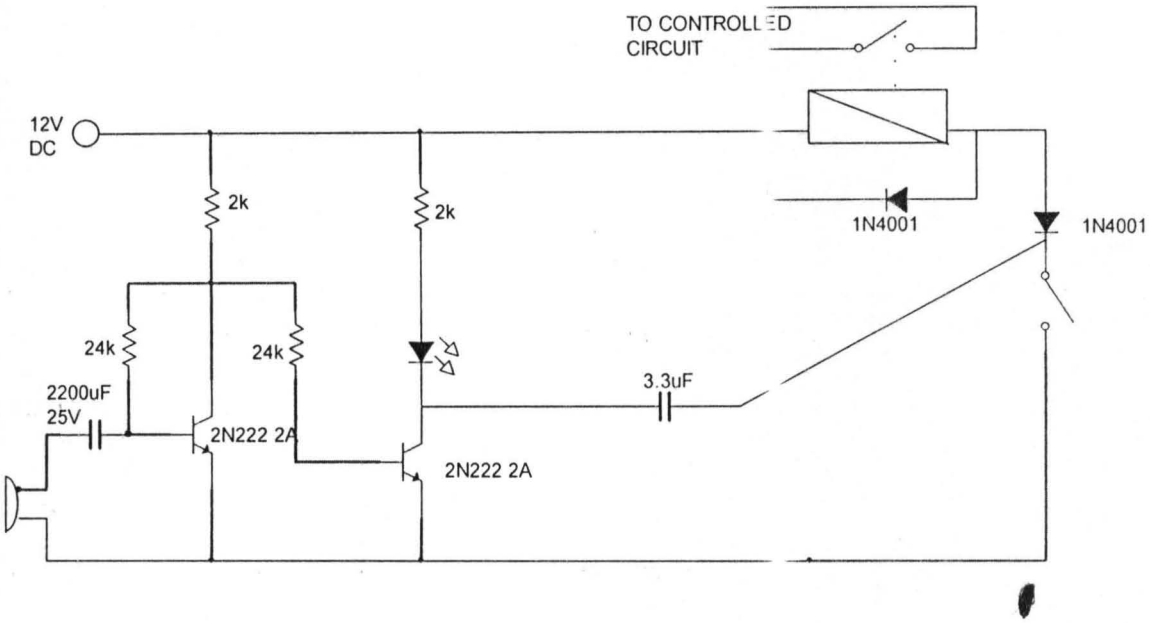


Fig.2.1 Sound Activated Switch

The sound is picked up by the microphone and convert it it into electrical signal. The voltage generated is applied to the base of the transistorQ_1, this amplifies the signal which with the use of coupling capacitor follows through Q_2 [2].

A high gain at the output is achieved which excites the gate of the thyristorTR_1.Current flows and energies the relay which switches the light on. The relay remains on until reset.

(b) VOICE ACTIVATED SWITCH

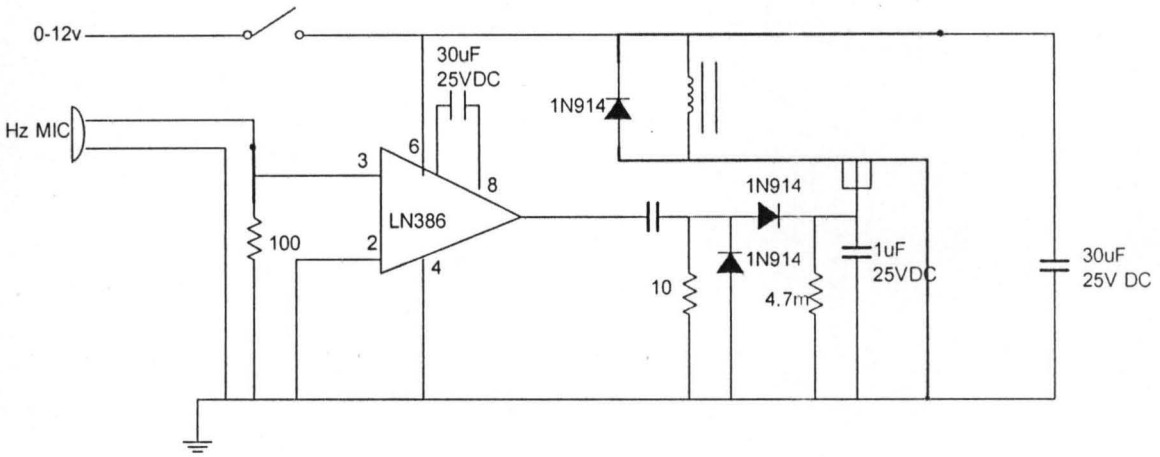


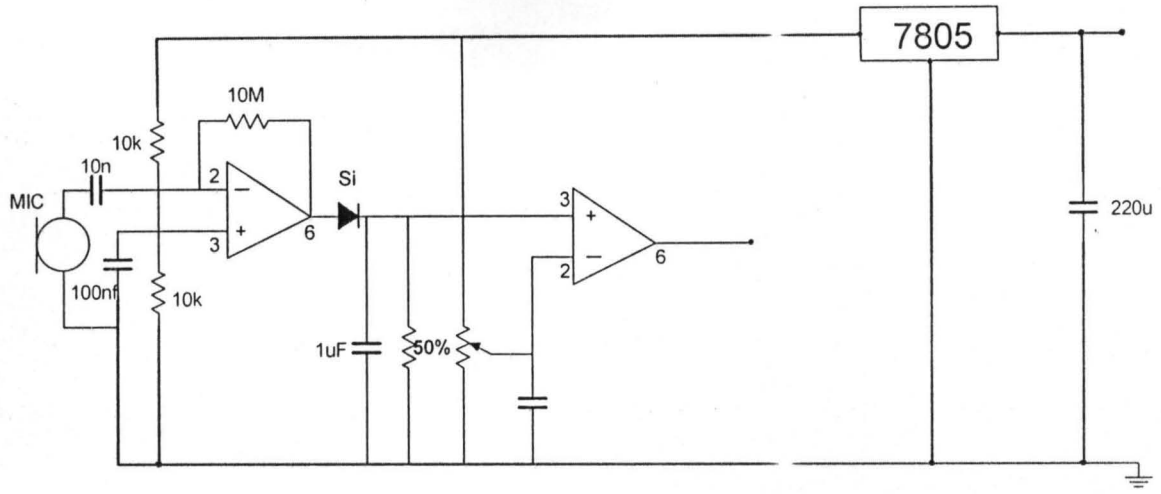
Fig.2.2 Voice Activated Switch

A amplified voice input turn on Q_1,when Q_1 is on, it energies the relay .A bulb can be wired in series with the motor; the motor supply should be separated from the power supply. This circuit is expensive and the components are relatively had to get.

(C) SOUND ACTIVATED SWITCH

Amplifier: TL081 Comparator: TL081 or CA3140R can be almost any value greater than about 10k. Use a small (low impedance) loudspeaker as a microphone. This circuit *must* have a 5v regulated supply. This is provided by the 7805 regulator.

The circuit shown above should be sensitive enough to respond to a reasonably loud clap of the hands at a distance of about a metre from the microphone. If the microphone (loudspeaker) is not very close to the circuit board, use screened lead to connect it to the rest of the circuit. If you require greater sensitivity, you can add the simple pre-amp shown below



.Fig 2.3 Sound Activated Switch

The sensitivity of the circuit can be adjusted using the variable potential divider connected to the inverting input of the comparator. To set the sensitivity to maximum, connect a voltmeter to the output of the second amplifier and adjust the variable potential divider to the point which just takes the voltmeter reading to its lowest figure (zero for CA3140, about 1·5v for TL081).

Adding this pre-amp to the sound operated switch will make it very sensitive so keep all connecting wires as short as possible

(c) SOUND ACTIVATED SWITCH

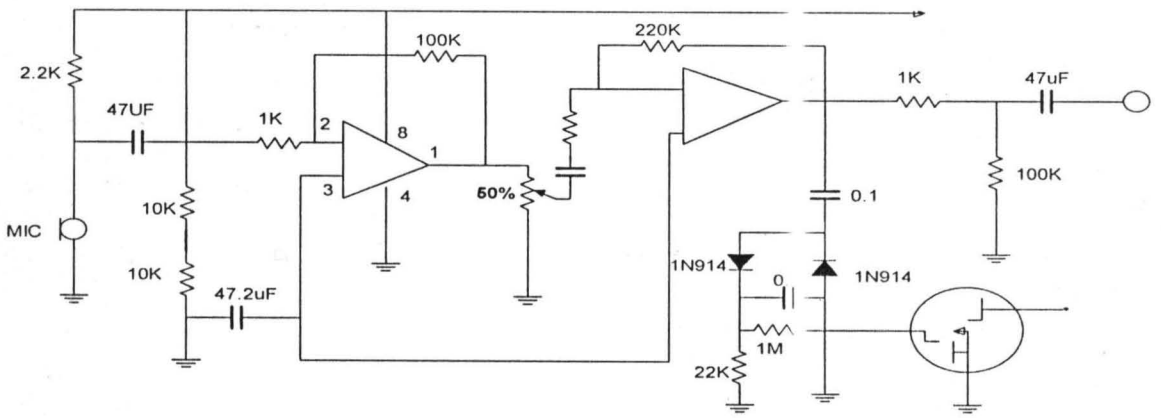


Fig.2.4 Sound Activated Switch

U_1 and U_2 =1F353 dual

A sensitive microphone picks up the sound and feeds it to a two stage circuit of $U_1$and U_2.

The amplifier output of V_1 is feed to voltage doubler circuit, which comprises diode D_1 and D_2 and capacitor C_4 and C_5. The output of the doubler is to the gate Q_1.This circuit can be used to drive a cassette, light etc. It is efficient and less expense but some components are scarce.

2.3 COMPONENTS USED IN THE WORK

The performance of a system, its availability and maintainability depend on the building blocks of that system; the components used in the construction of the system .Failure of one of the component will result of in the failure of the entire system. Some of the components used in the work are;

- Transformer
- Diodes
- Integrated circuit
- Transistors

CHAPTER THRI E

DESIGN AND IMPLEMEN TATION

3.1 BLOCK DIAGRAM

This Chapter is concerned with the design and analysis of the system, the entire project consists of eight-sub-units namely:

- power supply unit
- Microphone stage
- Amplifier stage
- Switch unit

The block diagram of the complete circuit is show below

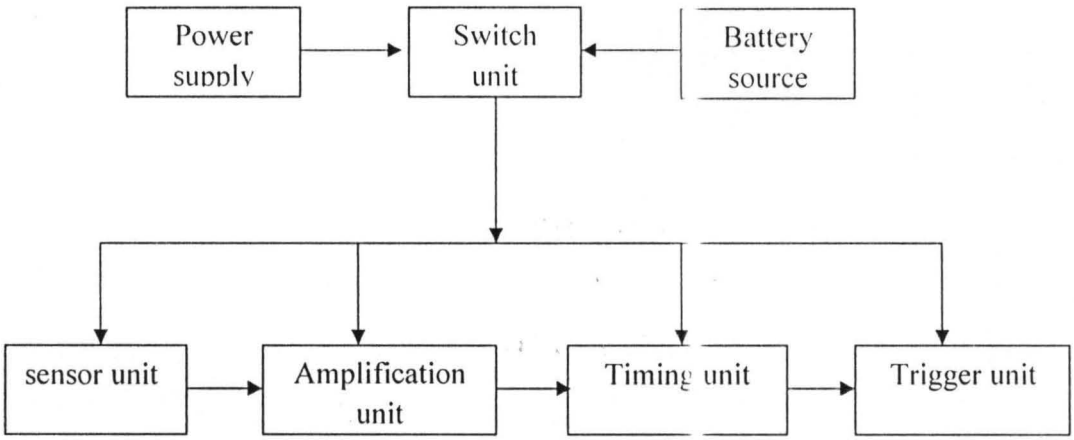


Fig.3.1 Block Diagram of the Circu t

3.2 POWER SUPPLY UNIT;

This consist of

(a) Transformer

(b) Rectifier

(c) Filter

d) Regulator

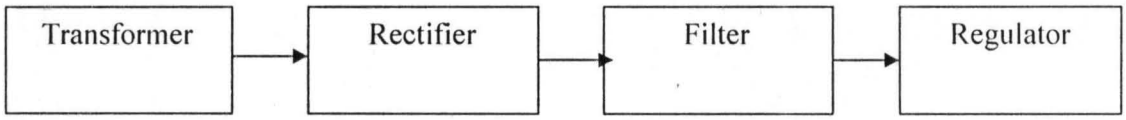


Fig 3.2 Block Diagram of Power Supply

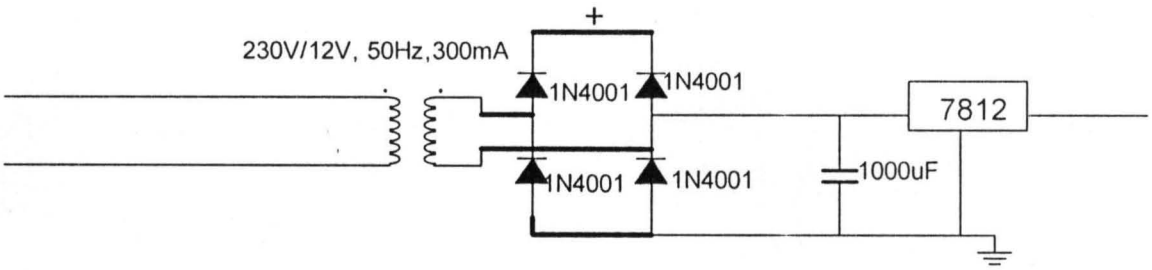


Fig 3.3 Circuit Diagram of the Circuit Unit

This project is designed to be powered from a wall outlet. The ac supply available at the ordinary wall outlet is 220v, 50Hz (line to neutral).

The voltage from the ac mains supply is stepped down 12v using a step down transformer and converted to dc using the bridge system rectification. The bridge rectifier system output still has a lot of ripples and has to be smoothed out in order to generate dc. Capacitors resist changes of

voltages across them: hence they are used to provide the desired smoothing action [3]. The ripple voltage is calculated thus:

The load resistance, R_L, is given as:

$$R_L = \frac{V_{out}}{I_{out}} \text{ [3]}$$

Where V_{out} = output voltage = 12

I_{out} = current output =0.3A

$$R_L = \frac{12}{.3} = 40$$

The transformer s voltage input is 220_{rms} which was stepped down to 12V and this means that the 220V was reduced by

$$\frac{220V}{12V} = 18.3\text{times}$$

The maximum voltage, $E_{m\ is\ given\ as}$:

$$E_m = 12_{rms \times \sqrt{2}} = 12_{rms \times 1.4142 = 16.9}$$

$$E_{m \approx 17\ V_{pk}}$$

The smoothing is performed by a large value of electrolytic capacitor. The capacitor used is 1000μF. To determine the ripple voltage in the power unit

7812(REGULATOR): This is an electronic control circuit which is capable providing a nearly constant dc output voltage even when there are variation in load or input voltage.[5]

3.3 SENSOR UNIT

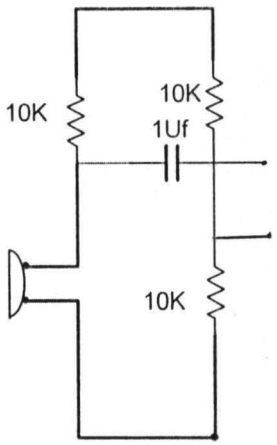


Fig3.1 Circuit Diagram of Sensor Unit

This is purely made up of an electrets microphone The reason for this is because of its high sensitivity. This transducer is capacitive in nature where charges are on the plate however any sound pressure tends to disturb the charges thereby producing an output signal. Usually in Mv.

To calculate current flowing through this unit

$$I_c = \frac{V_{in}}{R_1} = \frac{12}{10} = 1.2\text{A}. \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad 3.1$$

I_C= Collector current

V_{in}=Input Voltage

3.4 AMPLIPICATION UNIT

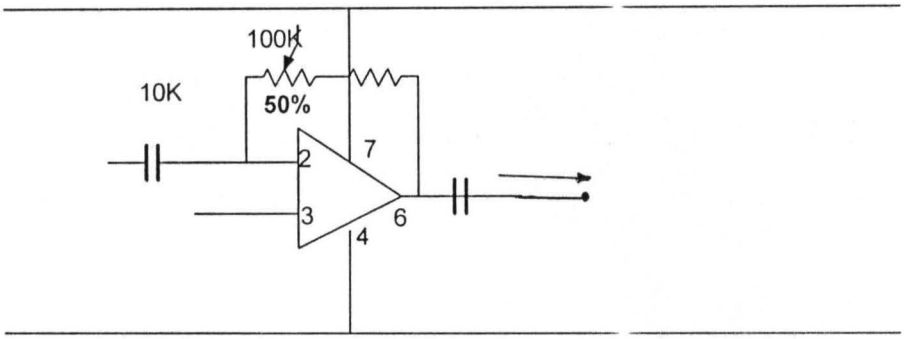


Fig 3.2 Circuit Diagram of Amplificatio n Unit

The first operational amplifier is a negative operational amplifie (inverting operational amplifier).

The voltage gain is given as:

3.4.1 DESIGN CALCULATION

From fig. $R_{1\ and}\ R_2$ form a potential divider, to reduce

the unregulated voltage to a low voltage of less than V. At 220V ıc input

let $V_{R2=}$ 1.5V

where $V^+ = V_{cc}$

Where V_{R2} is the adjusted value of variable resistor.

But, $V_{R1} = \frac{R_{1V^+}}{R_{1+R_2}}$ 3.2

Where V_{R2} is the drop across $R_2$and V^+ is the unregulated voltag . .it can be seen that V^+=12V

At 220V AC input.

Let R_1=10kΩ

R_2=10kΩ

=10k Preferred value

R_1=10kΩ, R_2=10kΩ

R_1 and R_2 from another potential divider for the reference .letting a maximum adjustable reference 6Vand setting R_3=10kΩ

$VR_4=R_{2V}+$ 3.3

R_1+10k

$V_{R4}=\frac{10\times12}{10+10}$

R_4=6V

=6Vpresent (preferred value)

R_3 =1.5v and R_4=6v preset.

For the comparator,

$V_{out}=A_0V_m$ 3.4

$A_0=\frac{V_{out}}{V_{in}}=\frac{6}{12}=0.5$

The amplifiers help in amplification, thereby increasing the voltage gain.

The coupling capacitor 741 operational amplifier (Inverting Amplifier) was

Used for this stage.

The 741op Amplifier is the basis of all operational amplifier .It has 8 pins.

For this purpose, it is used in the inverting mode. Since the inverted signal will be used for triggering inverting mode the next stage which could be used latter .The stage receives weak signal from the transducer through a coupling capacitor. The coupling capacitor helps in passing only A.C signal and blocking D.C The signal is amplified by the gain factor which is determined by the resistor. Shown in the diagram that it can be represented mathematically

A=$^{R_2}/_{R_1}$ where A = gain factor

ThereforeV_{out}=$V_{in} \times A$

$$V_{out} = V_{in} \times {}^{R_2}/_{R_1},$$

3.4.2 IC741 (COMPARATOR)

5ost op-amps are of different input type. The device is operated via power supply with a common ground, thus enabling the op-amp output to swing either positive or negative with respect to ground.

The 741 op-amp is a greatly improve third generation version of the 709 op-amp. It is immune to input latch up, has a short circuit proof output, and has a build in frequency compensation and it is prone to instability when used in linear mode.

3.5 TIMING UNIT

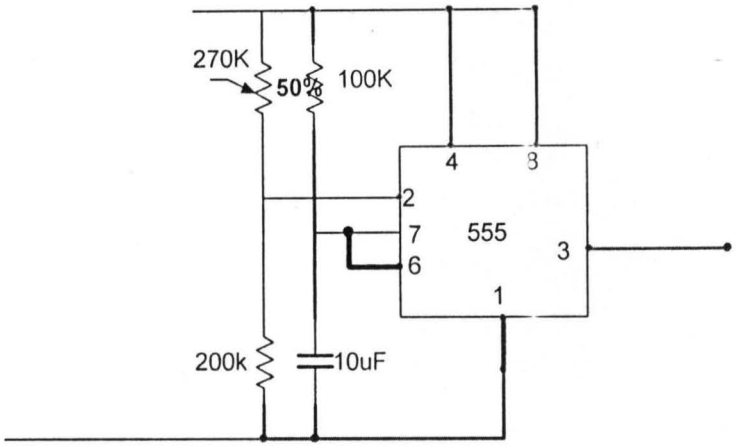


Fig 3.4 Circuit Diagram of the Timing Unit

The timing unit compresses of the 555 timer which operate in a monostable mode (one shot). In the one shot mode, the 555act like a monostable multivibrator.

The IC 555 time is wired monostable multivibrator for the purpose of this project. An external RC network is connected between the supply voltage and ground. The junction of the resistor and capacitor to the threshold input. An input trigger pulse is applied to the trigger input, which is the input to the lower comparator.

The multivibrator i.e. the Ic555is wired in a monostable mode and its reset pin 4 at high level when there is no light. Transistor T_1 conductor to trigger 555 timers

Whenever a trigger plus is applied to the input, the 555 will generate its signal duration output pulse. Depending on the values of external resistance and capacitance used, the output timing pulse may be adjusted from approximately 1 millisecond to as high as one hundred second. IC timers are normally used where long output pulses are required. In this application, the duration of the output in seconds is approximately equal to:

T =1.RC (second)

The output pulse width is Define by the above formula and with relatively few restriction, timing components $R_{(t)}$ and c (t) can have a wide range of values.

In the components R=100k, c= 10μf

T=1.1× 10^{-6} ×100× 10^{3}=1.1 seconds

3.6 SWITCHING UNIT

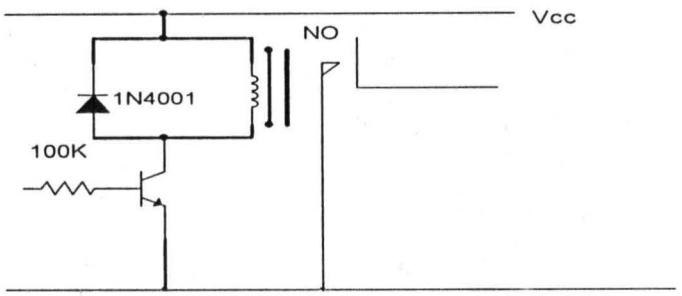


Fig 3.5 Circuit Diagram of the Switching Unit

The switching unit comprises a relay driver which triggers the load. A Relay is an electromagnetic device or switches a movable armature mounted above the core powered or energized, the armature is altered and the contact point change position, this relay is in a normally open stage when current passed through it, it then closed in order to allow passage of current which trigger the load. When the relay is closed, the circuit now closed and the timing module becomes active $R_1$and $R_2$from the voltage divider. Current flows from emitter to the base of the transistor. As current flows, C_1 starts to change. When fully charged. They become positive the relay switch on load

A base resistor is required to ensure perfect switching of the transistor in saturation. Diode D_5 protect the transistor from back e m f that might be generated since the relay coil presents an inductive load. In this caseR_c, which is the collector resistance, is the resistance of the relay coil, 400Ω for the relay type used in this project. Hence, give that R_C=400Ω

(Relay coil resistance)

V^+=12V (regulator voltage from the power supply stage)

VBE=0.7V (silicon)

VCE=V (when transistor is switched)

V_{in}=12V (from switching stage)

V_{fe}=300(from data sheet for BC108) since,

V^+=ICRC+VC 3.6

$I_c=\frac{V^+-V_c}{R_c}=\frac{12-6}{400}$

I_c=0.015A

V_{in}=IBRB+VBE 3.7

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

$I_B=\frac{12-0.7}{10}$=1.13A

$VR_4=\frac{V_{IN}-V_{BE}}{I_B}$

$VR_4=\frac{12-0.7}{1.13}$=10k

$I_c=\frac{V^+-V_C}{R_C}$

Where $V_C=\frac{1}{2}V_{CC}$

$I_C=\frac{12-6}{400}$=0.015A

Where,V_C=collector current,$I_{B=base\ current}$

V_{in}=input voltage, V^+=supply voltage

V_{CE}=collection-emitter voltage,H_{fe}=current gain.

From Equation I_C=15A

From Equation $I_{B=113uA}$

From Equation R_B=10k

=10KΩ(preferred value)

3.6.1 LOAD

A 220v, 60W lamp filament bulb was used for the purpose of this project and the Alarm which aid the Relay and comes on together with the bulb.

3.7 CHOICE OF COMPONENTS

The choice of component in many engineering designs is considered as one of the major factor in carrying out an engineering design. The circuit is attributed to low power, simple and design.

In designing the power unit, three items are taken into consideration: transformer, rectifier and filter [6].The Choice of the transformer used is a step down transformer, so as to stop down the input voltage from the main power source. Next is the choice of rectification, there are three types of rectifier systems available for use in power supplies: half-wave, full wave and bridge [7]. The bridge rectifier system was chosen for a. c to d. c conversion for the following reasons:

1. The four diode rectifiers provides a greater d. c output voltage than the centre tapped full wave rectifier circuit [8].

2. The four diode rectifier provides a greater dc output voltage than the centre tapped full wave rectifier circuit.
3. The need for centre tapped transformer is eliminated.
4. The full wave bridge rectifier utilizes both half-cycles of the ac input voltage to produce the dc output

3.8 CIRCUIT OPERATION

Figure 3.5 shows the schematic circuit diagram of a voice operated switch system. This circuit runs on 12v dc , and will drive up to 300mA load. Such as a tape recorder motor .The input of the microphone is the transducer (sound) will passes sound signal to pin 2 of the negative input (i.e the inverting terminal) of the operational amplifier this is because the sound pick up by the microphone is very weak with the gain factor of this of the op- amp the signal will be amplified to the require level. The capacitor through which the signal will pass is a coupling one and will only allow ac signal to pass there by blocking the dc signal.[9] The potential divider will reduced the value of the unregulated voltage to alow voltage less than V. And tis is the value that will be at output of the op-amp i.e pin 6 then the fraction of the output will pass through the feedback resistor to input of the operational amplifier.then to the next stage which is a timing unit , the component there is a 555 timer and its operate in a monostable mode (one shot). This 555 timer is acting like a monostable multivibrator. The output pulse will pass through pin 2 and the ic will generate its single duration output pulse. Depending on the value of the external resistor and capacitor used, the output can be adjusted from one second to one hundred seconds The reason for choosing this is because of long output pulses which [10] is what we need for the purpose of this project.The output of the 555 timer will pass through the base resistor to the transistor which is the switching unit and is the one to trigger our load with the help of the relay.

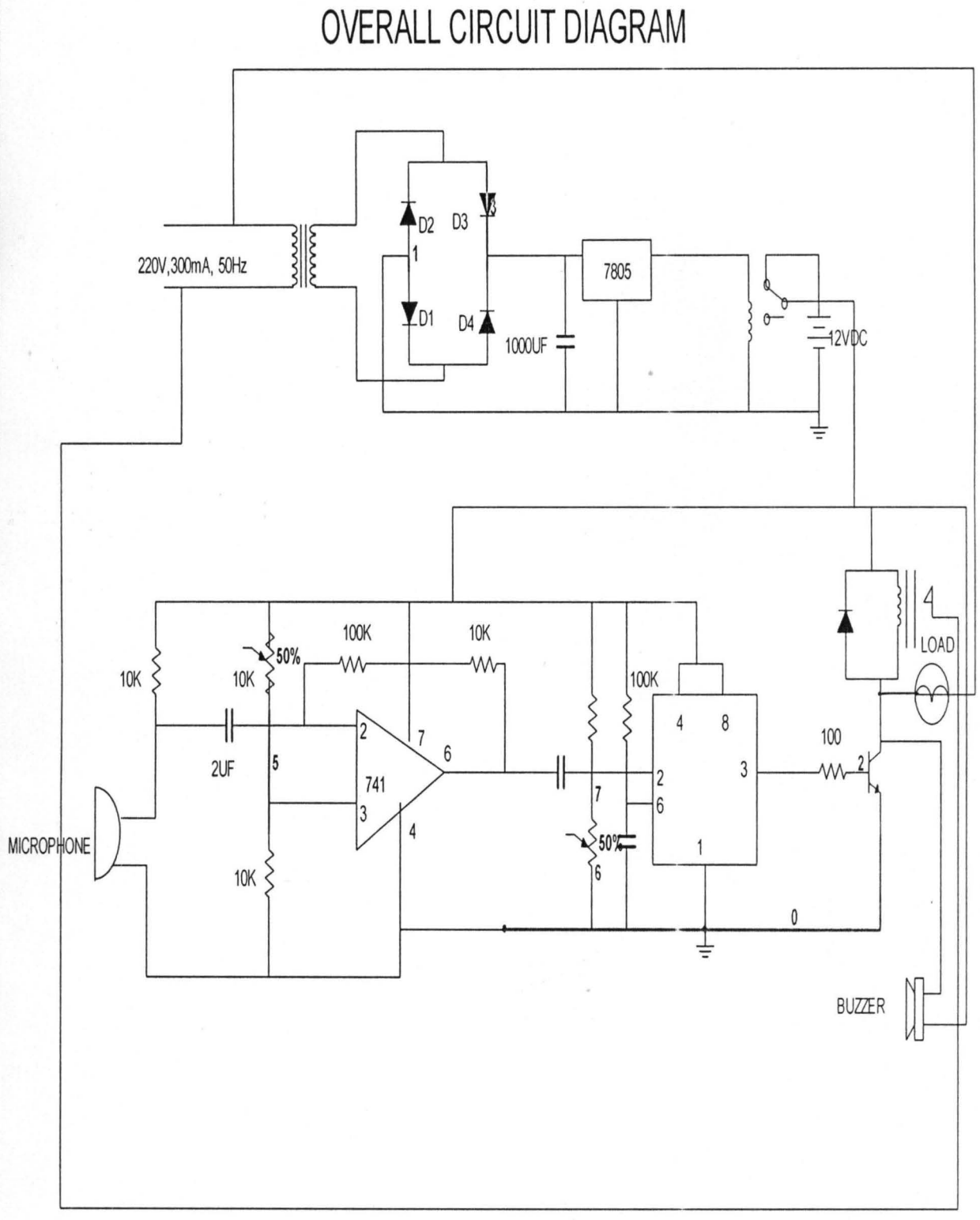


Fig. 3.6 Overall Circuit Diagram of Sound Activated Alarm Switch

CHAPTER FOUR

TESTS, RESULTS AND DISCUSSION

The detail of the transformation of the design concept of a voice operated switch system into a prototype .the test was carried out on it and the result of the test presented in this chapter, also it is included with the bills of quantities, likely faults on the device and a guide to troubleshooting the circuit.

4.1 CIRCUIT CONSTRUCTION

The project was constructed after the calculation design and designing the circuit. The circuit was first constructed on bread board. This was done to ascertain the workability and to arrange the circuit to design specification, and also to make modification by soldering on bread board.

The circuit was transferred to the Vero board and then neatly soldered. The sub unit constructed include; the power unit, sensor unit, the amplification unit and the switching unit.

4.1.1 SOLDERING

During soldering the following precautions and techniques are taken

1. The tip of soldering iron was cleaned with emery paper to allow the solder to melt easily.
2. The tip of the solder iron is applied lightly to the points or terminals to be soldered, soldering lead is then applied so that it melt down the joints.
3. Overheating of the terminals is avoided to prevent damage of the components.
4. Soldering is done neatly , after connecting all the modules the circuit was checked for a possibility of open and short circuit.

   The diodes and capacitors are oriented with the polarity as shown in fig 4.2 and the transistors flat sides are in the direction shown also integrated circuit has the end notch or

dot placed as shown from the figure . since many of the resistors have similar values (i.e 10k or 1k),so care were taken not mix them up.

4.1.2 TESTING

The entire circuit was tested during and after the construction. The multi-meter was used to test each unit and confirm efficiency. The circuit was checked for any open circuit or short circuit and also to ensure continuity.

4.1.3 TROUBLE SHOOTING

If the device is not working, check the orientation of all parts or units so to be sure that, the proper components are put in the proper location. Check all soldering joints for any short

Circuit and Open circuit. Below are some possible faults and there solutions.

Table 4.1 Faults and Solutions

Faults	Solutions
Power supply No output voltage	Open circuit
Low gain at the switch	Faulty capacitor or variable resistor
No signals Un operative load	Defective switching circuit

4.2 PACKAGING

The whole system was cased after in a .The case was design after the circuit has been completed. Proper ventilation was provided by giving adequate space.

If the device is not working, check the orientation of all parts or units so to be sure that, the proper components are put in the proper location. Check all soldering joints for any short circuit and open circuit.

CHAPTER FIVE

CONCLUSIONS

The success in designed and construction of a voice operated switch system had provided a practical experience on how to design and construct an electronics circuit by putting theoretical aspect taught into practice. The problem encountered during this project is much due to unavailability of some components used in construction of the work. Having design this project and constructed the aim of the project has been achieved.

This project was designed putting some factors into considerations; economic application, design economy, availability of components and research materials, portability and durability.

5.2 PROBLEMS ENCOUNTERED

Some problems were encountered during the process of the design and construction

Particularly, in the power supply and amplification circuit. 12v alkaline battery was initially

used for powering of the device. It was observed that its value dropped with the time (as low as 9v after some hours).the microphone's sensitivity reduces and stops working at that voltage.

5.3 RECOMMENDATION

A microphone with a higher sensitivity should be provided so as to sense lower sounds .A flip-flop circuit could be incorporated for possible operation of the device in either bistable or monostable mode.

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