CONSTRUCTION AND IMPLEMENTATION OF CLAPPING SWITCH DEVICE

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CERTIFICATION

This is to certify that this project titled **"Construction and Implementation of Clapping Switch Device"** was carried out by Wakeel Lateef Elijah under the supervision of Mr. Harry Abode. of the department of physical science laboratory technology. The project meets the regulations governing the award of Higher National Diploma in Federal polytechnic Auchi, and is approved for its literary presentation and contribution to science and knowledge.

_____ _____

Mr. Harry Abode.
(supervisor)

Date

_____ _____

Mr. Jafaru Braimah

(Head of Department)

Date

DEDICATION

This project is dedicated to God Almighty, the custodian of life.

ACKNOWLEGMENT

I thank almighty God for granting me the opportunity in completing my project successfully. My sincere appreciation goes to my beloved parents Mr. and Mrs. Wakeel, and my siblings who have put their endless effort, encouragement and support in this project. Also, my sincere appreciation goes to my project supervisor Mr. Harry Abode for his help and guidance in this project work and also to all my lecturers in my department for their support and guidance in the course of my studies in federal polytechnic Auchi.

My special thanks also goes to my beloved friends, my project group (partner) and all who showed me love and assisted me. I really appreciate your, and support. Thanks and may God bless you all. Amen.

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ABSTRACT

This project proposal is of a clap switch device. Clap switch is a switch which can switch on/off any electrical circuit by the sound of the clap. The basic idea of clap switch is that the electric microphone picks up the sound of your claps, coughs, and the sound of that book knocked off the table. It produces a small electrical signal which is amplified by a succeeding transistor stage.

This circuit has been constructed using basic electronic components like resistors, transistors, relay, transformer, capacitors. This circuit will turn „ON" light for the first two claps. For the next two claps the light turns OFF. This circuit works with 12V voltage. Therefore a step-down transformer is employed.

CHAPTER ONE

BACKGROUND OF STUDY

1.0 INTRODUCTION

With the increasing interest in comfort and luxury and keeping in mind the disable person a clap switch was invented. A device which can turn ON/OFF an instrument with just a clap of hand. The basic idea of clap switch is that the electric microphone picks up the sound of your claps, coughs and the sound of a book, knocked off, the table to turn ON/OFF electric appliances.

A circuited switch, which operates with sound of clapping hands or something similar i.e. the switch come to "ON" position when clapped once or twice (depends on the circuit designed). A clap switch circuit is a sound sensitive circuit.

The motivating force behind this design is based in the desire to alleviate the problem faced by the aged and physically challenged persons in trying to control some house hold and industrial appliances. It also takes in consideration the illiterates that may have problems operating some "complex hand-held remote control unit, (RCUs)".

Therefore, this project gives an introductory study on the basic principle involved in utilizing acoustic energy to control switching processes. This is achieved by converting the energy generated by the "hand clap" into electrical pulse, which is in turn used to drive an electronic circuitry that includes relays which turns switches ON/OFF any appliance, connected through it to the main. The device is activated by clapping within a set time period that is determined by ICS capacitors and a step-down transformer. The condenser microphone picks up the sound of your claps, coughs and the sound of that book knocked off that table. It produces a small electrical signal which is amplified by the transistor stage.

1.1 DEVELOPMENT OF SWITCHES

The first light switch employing "quick-break technology" was invented by John Henry Holmes in 1884 in the Shield field district of Newcastle upon Tyne.

The word “switch” is a very common name found in almost all aspects electrical/electronic engineering. Switches can be found in information technology computers, telecommunications, power electronics, power systems, instrumentation etc.

They have been defined by various people or organizations in different ways. Some of the definitions of switches are listed below;

i. As a device that is used to break or stop the flow of charges in a circuit.
ii. As a device used to connect two or more computers together.
iii. A device used to interrupt the flow of electrons in a circuit.

All the above definitions are correct, but for this project a switch provide means for connecting two or more terminals in order to permit the flow of current across them, so as to allow for interaction between electrical components, and to easily isolate circuits so as to terminate this communication flow when needed (Sahiti *et al.,* 2010).

1.2 AIM OF STUDY

The aim of this study is to design and construct a clapping switch device that make the home appliances and other electronic devices in order to ease switching ON/OFF of electrical switches in helping the disable or aged persons.

1.3 SCOPE OF STUDY

The scope of this work is defined by the following points;

i. The switching interface in this project is of the general purpose type, as it is not restricted to only one type of load.

ii. The clap signal accepted by the computer, will not be limited to just one person.

iii. It will not be limited to low voltage, low current AC/DC applications of 240V maximum operating voltages.

iv. The type of control this project employs is the simple ON/OFF control of devices.

1.4 OBJECTIVE OF STUDY

i. Design the circuit

ii. Draw up a circuit diagram

iii. Sketch out the layout

iv. Ensure that components needed are available.

v. Testing of each component values to determine if suitability with a multimeter.

vi. Layout the component on a breadboard to determine the working of the circuit.

vii. Mount the circuit on the Vero board, then solder.

viii. Testing the constructed circuit.

1.5 SIGNIFICANCE OF STUDY

This project completion will be of great benefits to our ever demanding and developing society. Some of these benefits include:

i. Accidental switching of devices will be reduced to a minimum in our industries and homes.

ii. Walking from point to point to switch switches will be a thing of the past.

iii. This project will possess the LOCK and UNLOCK function which will prevent unintentional switching any time the user wishes.

iv. Our industries and homes will become easier to disable persons.

1.6 DEFINITION OF TERMS

RELAY: A relay is an electrical operated switch. Many relays use an electromagnetic to mechanically operate a switch but other operating principles are also used, such as solid state relays. Relay are used where is necessary to control a circuit by a lower power signal (with complete electrical isolation between control and control circuit) or where several circuit must be controlled by one signal.

TRANSISTORS: A transistor is a three terminal device in which current flowing between two terminals can be controlled by a signal on the third terminal. This means that a transistor has properties that enable it to be used in an electronic switch or amplifier.

RESISTOR: A resistor is an electrical component that limit or regulates the flow of electrical current in an electrical circuit.

CAPACITOR: A capacitor is a device used to store electrical charges consisting of conductor which are separated by an insulator.

DIODE: Diodes are two terminal devices consisting of PN junction found either with germanium or silicon semiconductors. When the diode is forward bias a conventional current flow is met and it is the same direction which the flow of the HOLES take place.

CHAPTER TWO

LITERATURE REVIEW

2.0 HISTORICAL BACKGROUND

Olokede in 2008, carried out a research titled “Design of a Clap Activated Switch”. He used IC 7490 to implement the clap activated switch. The clap activated switching device could basically be described as a low frequency sound pulse activated switch that is free from false triggering. The input component was a transducer that receives clap sound as input and converts it to electrical pulse. This pulse was amplified and was used to drive IC components which changes output state to energize and also deenergize a relay causing the device to be able to switch larger devices and circuits. The output state of the switching device circuit could only change, when the circuit receives two claps within a time period that will be determined by the RC component value in the circuit (Leonardo, 2008).

In 2009, Ogunfayo performed a project titled “Design and construction of clap activated switch”. He add an Operational Amplifier (741) in his block diagram. This project presented the design and construction of a clap activated switch device that would serve well in different phono-controlled applications, providing low expensive key and at the same time free from false triggering. The project involved the design of various stages consisting of the pickup transducer, signal amplification, pulse shaper and missing pulse detector (these were used for timing and clocking), bistable and switching circuit. The clap switch was used to switch ON and OFF two devices depending on the number of claps (Arnould *et al.,* 2013).

In 2010, Sahiti and Lakshmi performed a project titled “Clap Switch”. Their circuit is simple because there is no any integrated circuit (IC) in its block diagram. This was a project on clap switch which could switch on/off any electrical circuit by the sound of a clap. The operation

of the circuit was simple. If we clap the lamp turns on and to switch it off clap again. The condenser microphone picked up the sound of your claps, coughs, and the sound of that book knocked off the table. This circuit can switch on and off a light, a fan or a radio etc. by the sound of a clap (Olaniyi, 2009).

In 2013, Walchli and Arnould performed a project titled "Clap detection with microcontroller" they used both hardware and software. They emphasis on the software and algorithm aspects using mat lab. They realized that clap detectors have been around for quite some time to switch lights on and off and probably for other gimmicks. On the internet there are different suggestions on how to detect claps and even complete circuit diagrams for analog, digital and hybrid clap detectors. They wanted to see if we could implement their own clap detector using the AMIV Bastli AVR-board, which would require them to deal with both hardware and software aspects of the problem. They did, however, lay a special emphasis on the software and algorithmic aspect (Solomon *et al*., 1973).

This research will incorporate and intend to improve on Ogunfayo in (2009) research work titled "Design and construction of clap activated switch". This project presented the design and construction of a clap activated switch device that would serve well in different phono-controlled applications, providing low expensive key and at the same time free from false triggering.

2.2 REVIEW OF CLAPPING

A clap is the percussive sound made by striking together two flat surfaces, as in the body parts of humans or animals. Humans clap with the palms of their hands, often quickly and repeatedly to express appreciation or approval, but also in rhythm to match the sounds in music and dance.

Some people slap the back of one hand into the palm of the other hand to signify urgency or enthusiasm. This act may be considered uncouth by others. Clapping is used as a percussion element in many forms of music. One example is in gospel music. In flamenco and sevillanas, two Spanish musical genres, clapping often sets the rhythm and is an integral part of the songs. A sample or synthesized clap is also a staple of electronic and pop music.

The clapping patterns known as keplok are important in Javanese gamelan. A type of synthesized clap is popular in many rap and hip hop songs as well. This derived from and mimics the technique used in older popular music (e.g. disco and funk of the 1970s), in which multiple instances of real handclaps were recorded or a single recording was made of a group of performers clapping in unison. This was usually done for the purpose of reinforcing the snare drum beat on the 2^{nd} and 4^{th} beats of the bar (offbeat). Modern R and B, hip hop, and rap often omit the snare drum, making the claps a more obvious and center feature of the beat.

CHAPTER THREE

DESIGN METHODOLOGY

This research explains in detail the methodology and components of this project proposal. Each part and component that has been selected has as its own purpose mostly focused on functionality and low cost. In this chapter as well, the technical plan, analysis and the specifications are being explained.

3.1 SYSTEM BLOCK DIAGRAM

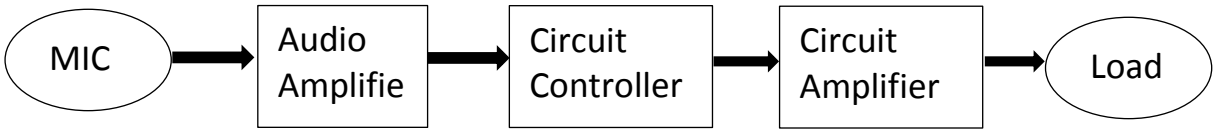

Figure 3.1. System block diagram

3.2 DESIGN AND OPERATION

This block diagram shows us how the circuit will be split up into different sections. At the time when someone claps in front of the microphone, the sound signal is converted into the electrical signal by the condenser microphone. This weak signal is then amplified by a transistor. The amplified signal provides a negative pulse to the timer turns on the counter for the predetermined time. Finally, the signal after this process the outcome electric signal becomes very weak. So, it is amplified using another transistor and given to relay, it acts as a switch.

3.3 PLANNING AND APPROACH

A part from the relay, transformer and the microphone, all other components will contained on a single circuit printed board (PCB). We will begin our construction by soldering in the

resistors and wire links. We will also ensure that all electrolyte capacitors, transistors, diodes and bridge rectifiers are well connected.

3.3.1 WORKING OF THE BASIC CIRCUIT COMPONENT

First we take a condenser microphone that senses the sound of the clapping. Next is the amplifying stage that will amplify the sound received from the microphone. Two ICs have been used. The first one senses the first clap and the output of which gives power to the second IC. The second IC is activated by the second clapping sound and its output is fed to the relay which switches on the load when output from the second IC is received.

3.4 CIRCUIT LAYOUT

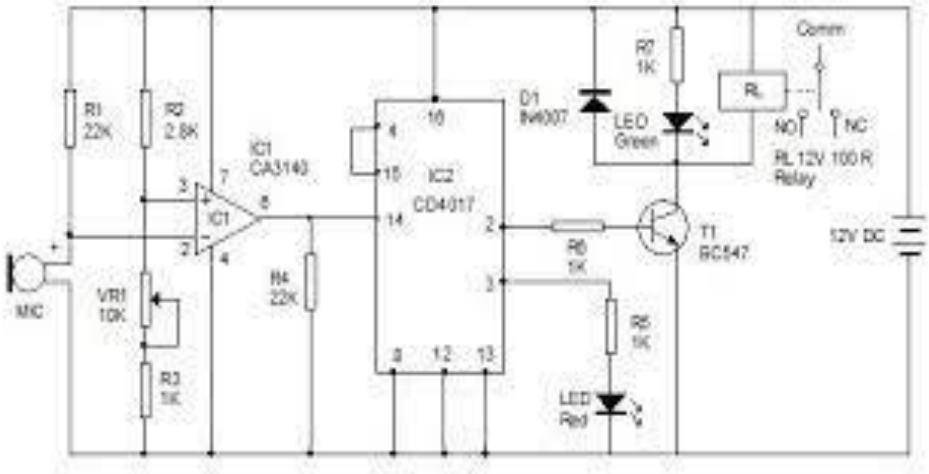

Figure 3.2. Circuit layout of a clap activated switch.

3.5 COMPONENTS/ MATERIALS USED FOR THE CONSTRUCTION

i. Diode

ii. Light Emitting Diode (LED)

iii. Resistor

iv. Capacitor

v. Battery

vi. Transistor

vii. Condenser Microphone

viii. Electrical power transformer

ix. Solid state relay

x. 555 timer

3.5.1 DIODE

Electronic current converter: an electronic device that has two electrodes and is used to convert alternating current to direct current (Marston *et al.,* 1994).

Diode can be made of either two of semiconductor materials, silicon and germanium. Power diodes are usually constructed using silicon and germanium. Silicon diode can operate at higher current and at higher junction temperature, and they have greater reverse resistance. The structure of a semiconductor diode and it symbol are shown in Figure. The diode has two terminals, an anode, a terminal (Pjunction) and a cathode K terminal (Njunction). When the anode voltage is more positive than the cathode, the diode is said to be forward biased and it conducts current readily with a relatively low voltage drop. When the cathode voltage is more positive than the anode, the diode is said to be reverse biased, and it blocks current flow. The arrow on the diode symbol shows the direction of convection current flow when the diode conducts (Boylestad *et al.,* 1997).

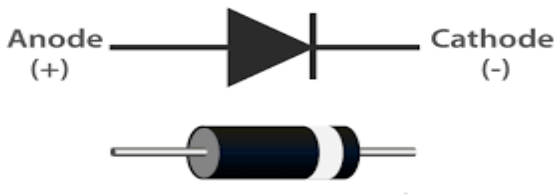

Figure 3.3. Diode

3.5.2 LED (LIGHT EMITTING DIODE)

A light-emitting diode (LED) is a semiconductor device that emits visible light when an electric current passes through it. The light is not particularly bright, but in most LEDs it is monochromatic, occurring at a single wavelength. The output from an LED can range from red (at a wavelength of approximately 700 manometers) to blue-violet (about 400 nanometres). Some LEDs emit infrared (IR) energy (830 nanometres or longer); such a device is known as an infrared-emitting diode (IRED). An LED or IRED consists of two elements of processed material called P-type semiconductors and N-type semiconductors. These two elements are placed in direct contact, forming a region called the P-N junction (Marston *et al.,* 1994).

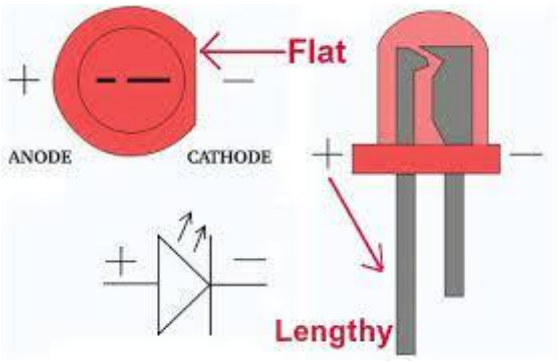

Figure 3.4. Light Emitting Diode (LED)

3.5.3 RESISTOR

Resistors are the most common passive electronic component (one that does not require power to operate). They are used to control voltages and currents. While a resistor is a very basic component, there are many ways to manufacture them. In the past, most resistors were manufactured from carbon composition, a baked mixture of graphite and clay. These have been almost completely superseded by carbon or metal film resistor. Wire-wound resistors are used for comparatively low values of resistance where precise value is important, or for

high dissipation. Each style has its own characteristics that make it desirable in certain types of applications. Choosing the right type of resistor is important to making high-performance or precision circuits work well. There are several different resistor construction methods and body styles (or packages) that are designed for a certain range of applied voltage, power dissipation, or other considerations. The construction of the resistor can affect its performance at high frequencies where it may act like a small inductor or capacitor has been added, called parasitic inductance or capacitance (Horonitz *et al.*, 1995).

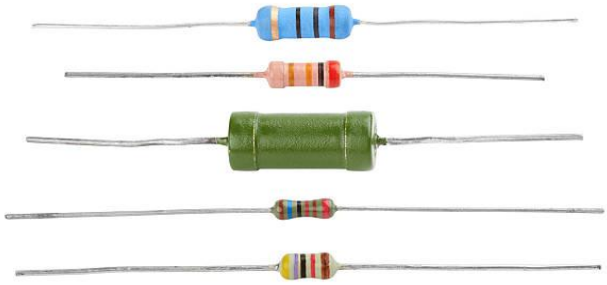

Figure 3.5. Resistor

3.5.4 CAPACITOR

A capacitor is a tool consisting of two conductive plates, each of which hosts an opposite charge. These plates are separated by a dielectric or other form of insulator, which helps them maintain an electric charge. There are several types of insulators used in capacitors. Examples include ceramic, polyester, tantalum air, and polystyrene. Other common capacitor insulators include air, paper, and plastic. Each effectively prevents the plates from touching each other (Horonitz *et al.*, 1995).

Capacitor has ability to store charge and release them at a later time. Capacitance is the measure of the amount of charge that a capacitor can store for a given applied voltage. The

unit of capacitance is the farad (F) or microfarad. The capacitors that will be used in the circuit are electrolytic-capacitor (Horonitz *et al.*, 1995).

Figure 3.5. Capacitor

3.5.5 BATTERY

In electricity, a battery is a device consisting of one or more electrochemical cells that convert stored chemical energy into electrical energy. Since the invention of the first battery (or "voltaic pile") in 1800 by Alessandro Volta and especially since the technically improved Daniel cell in 1836, batteries have become a common power source for many household and industrial applications. According to a 2005 estimate, the worldwide battery industry generates US$48 billion in sales each year, with 6% annual growth (Olokede, 2008).

There are two types of batteries: primary batteries (disposable batteries), which are designed to be used once and discarded, and secondary batteries (rechargeable batteries), which are designed to be recharged and used multiple times. Batteries come in many sizes, from miniature cells used to power hearing aids and wristwatches to battery banks the size of rooms that provide standby power for telephone exchanges and computer data centers (Olokede, 2008).

Figure 3.6. Rechargeable battery

3.5.6 TRANSISTOR

A transistor is a semiconductor device used to amplify and switch electronic signals and electrical power. It is composed of semiconductor material with at least three terminals for connection to an external circuit. A voltage or current applied to one pair of the transistor's terminals changes the current flowing through another pair of terminals. Because the controlled (output) power can be higher than the controlling (input) power, a transistor can amplify a signal. Today, some transistors are packaged individually, but many more are found embedded in integrated circuits. Transistors fall into two major classes: the bipolar junction transistor (BJT) and the field effect transistor (FET).We will use bipolar junction transistor (BJT).

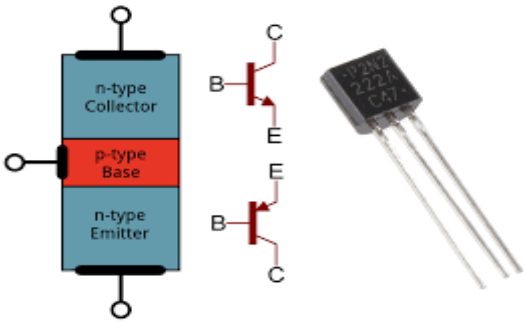

Figure 3.7. Transistor

3.5.7 CONDENSER MICROPHONE

A microphone is an acoustic-to-electric transducer or sensor that converts sound into an electrical signal. The condenser microphone, invented at Bell Labs in 1916 by E. C. Wente is also called a capacitor microphone or electrostatic microphone (Marston *et al.,* 1994).

Condenser microphones require power from a battery or external source. The resulting audio signal is stronger signal than that from a dynamic. Condensers also tend to be more sensitive and responsive than dynamics, making them well-suited to capturing a sound.

Microphones are types of transducers, they convert acoustic energy i.e. sound signal. Basically, a microphone is made up of a diaphragm, which is a thin piece of material that vibrates when it is struck by sound wave. This causes other components in the microphone to vibrate leading to variations in some electrical quantities thereby causing electrical current to be generated (Boylestad *et al.,* 1997).

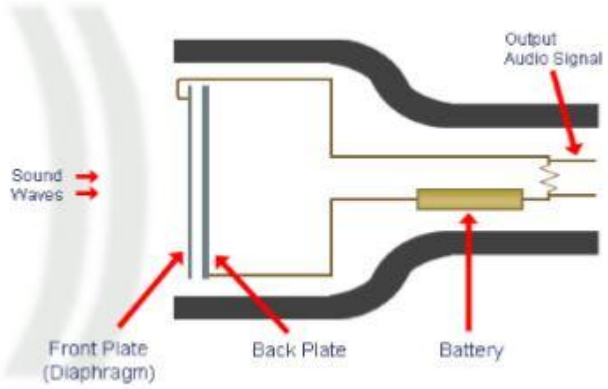

Figure 3.8. Cross-Section of a Typical Condenser Microphone

3.5.8 ELECTRICAL POWER TRANSFORMER

A transformer is a static machine used for transforming power from one circuit to another without changing frequency. This is a very basic definition of transformer (Hughes *et al.*, 2001).

A transformer is an electrical device that transfers electrical energy between two or more circuits through electromagnetic induction. Commonly, transformers are used to increase or decrease the voltages of alternating current in electric power applications (Hughes *et al.*, 2001).

A varying current in the transformer's primary winding creates a varying magnetic flux in the transformer core and a varying magnetic field impinging on the transformer's secondary winding. This varying magnetic field at the secondary winding induces a varying electromotive force (EMF) or voltage in the secondary winding. Making use of Faraday's Law in conjunction with high magnetic permeability core properties, transformers can thus be designed to efficiently change AC voltages from one voltage level to another within power networks (Hughes *et al.*, 2001).

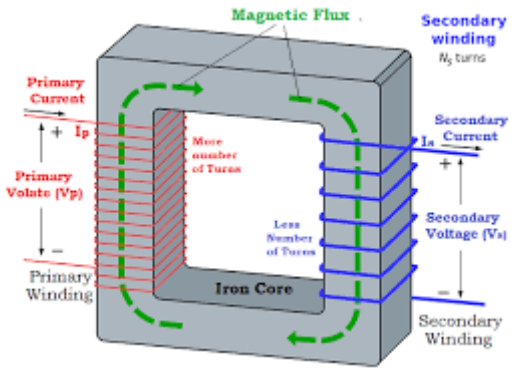

Figure 3.9. Step down transformer

3.5.9 SOLID-STATE RELAY

A solid-state relay (SSR) is an electronic switching device that switches on or off when a small external voltage is applied across its control terminals. SSRs consist of a sensor which responds to an appropriate input (control signal), a solid-state electronic switching device which switches power to the load circuitry, and a coupling mechanism to enable the control signal to activate this switch without mechanical parts. The relay may be designed to switch either AC or DC to the load. It serves the same function as an electromechanical relay, but has no moving parts (Olokede *et al.*, 2008).

Packaged solid-state relays use power semiconductor devices such as transistors, to switch currents up to around a hundred amperes. Solid-state relays have fast switching speeds compared with electromechanical relays, and have no physical contacts to wear out.

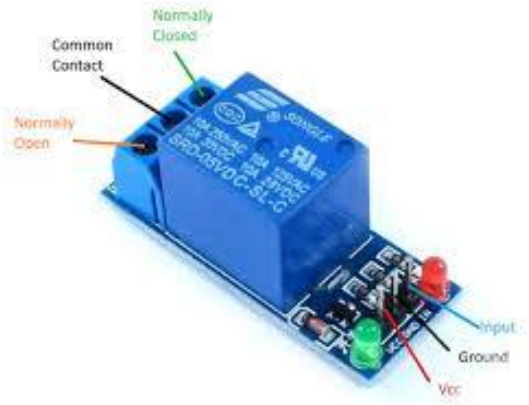

Figure 3.10. Relay

3.5.10 555 TIMER

The 8-pin 555 timer must be one of the most useful ICs ever made and it is used in many projects. With just a few external components it can be used to build many circuits, not all of them involve timing. The NE 555, to be used in this design is a popular version that is

suitable in most cases where a 555 timer is needed. It is a dual in -line (DIL) package (Horonitz *et al.*, 1995).

The 555 timer IC is an integrated circuit (chip) used in a variety of timer, pulse generation, and oscillator applications. The 555 can be used to provide time delays, as an oscillator, and as a flip-flop element. Derivatives provide up to four timing circuits in one package. Depending on the manufacturer, the standard 555 package includes over 20 transistors, 2 diodes and 15 resistors on a silicon chip installed in an 8-pin mini dual in-line package (DIP-8) (Horonitz *et al.*, 1995).

The 555 timer configuration can be done in three modes but for the purpose of this design, two of them are required namely; Astable and Monostable mode. An astable circuit produces a square wave with sharp transitions between low and high. It is called astable because it is not stable in any state since the output is continually changing between "low" and "high" (Horonitz *et al.*, 1995).

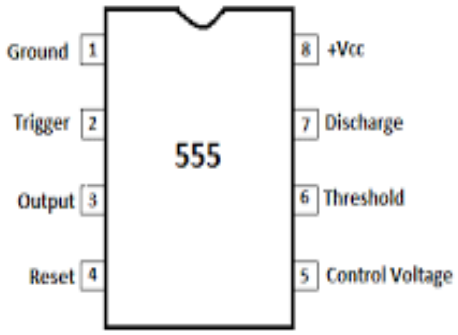

Figure 3.11. Pin out Diagram of 555 timer

3.6 CASING AND PACKAGING

All the components were soldered onto the Vero board. Then after that, a case was gotten where the entire circuit was mounted following by other external components such as, microphone, indicators, and switch. Having done the above, the complete circuit was designed and coupled.

Figure 3.12. Clap activated switch casing

CHAPTER FOUR

RESULTS AND CONCLUSSION

4.0 TESTING OF SYSTEM OPERATION

At this stage, the coupled system was checked for its workability and functionability. The output signal was tested using a multimeter, the output stage generated a signal which shows that there was a power supplied to the system. When light was cut off from reaching the photodiode, the voltage dropped and the signal was read by the multimeter but the signal generated was not enough to power the buzzer to a level that the human ear could hear.

4.1 CIRCUIT OPERATION

The clap sound sensed by condenser microphone is amplified by transistor T1. The amplified signal provides negative pulse to pin 2 of IC1 and IC2, triggering both the ICs. IC1, commonly used as a timer, is wired here as a monostable multivibrator. Triggering of IC1 causes pin 3 to go high and it remains high for a certain time period depending on the selected values of R7 and C3. This ‘on’ time (T) of IC1 can be calculated using the following relationship: T=1.1×R7 ×C3 Seconds where R7 is in ohms and C3 in microfarads. On first clap, output pin 3 of IC1 goes high and remains in this standby position for the preset time. Also, LED1 glows for this period. The output of IC1 provides supply voltage to IC2 at its pins 8 and 4.Now IC2 is ready to receive the triggering signal. Resistor R10 and capacitor C7 connected to pin 4 of IC2 prevent false triggering when IC1 provides the supply voltage to IC2 at first clap.

On second clap, a negative pulse triggers IC2 and its output pin 3 goes high for a time period depending on R9 and C5.This provides a positive pulse at clock pin 14 of decade counter IC 4017 (IC3). Decade counter IC3 is wired here as a bi-stable. Each pulse applied at clock pin

14 changes the output state at pin 2 (Q1) of IC3 because Q2 is connected to reset pin 15. The high output at pin 2 drives transistor T2 and also energizes relay RL1. LED2 indicates activation of relay RL1 and on/off status of the appliance. A free-wheeling diode (D1) prevents damage of T2 when relay de-energizes.

4.2 DISCUSSION OF RESULT

After testing the coupled system, it was suggested that since the phono-diode could not generate a signal that could power the buzzer an alternative sensor was suggested. This necessitated the use of a PIR sensor.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1 CONCLUSIONS

We assembled the circuit on a general-purpose PCB. This circuit is very useful in field of electronic circuits. By using some modification it area of application can be extended in various fields. It can be used to raise alarm in security system with a noise, and also used at the place where silence needed.

This project gives us a great deal of knowledge about the 555 timer chips, working of clocks and the relay. This type of device provides us with the working of NE555 timer chips and the relay. The relay is a type of switch which provides a conducting path only when current flows it. In this project as soon as the 2nd timer triggers the relay a conducting path is established between terminals of the load and hence the device is turned on. The time interval between the claps is judged with the time constant established with the RC configuration which is T=1.1R7*C3.

This switch is very low cost and is very useful to the elderly and physically challenged people. But the major disadvantage of this switch is false triggering. The switch can be triggered by any two sounds similar to that of hands clapping. So care has to be taken to avoid this kind of false triggering and the switch should not be used in very sensible applications. It is only for home uses. But nevertheless it is an excellent example of electronics evolution and how engineering and electronics have made our life easier.

5.2 RECOMMENDATIONS

There is a further scope of work on this project. This circuit can be made more accurate and more sensible to suit the practical use in our daily lives.

No filter has been used here so the switch will respond to more or less every two sounds similar to clapping that come with a gap of in between 3 seconds. But if a simple band pass filter is used then this problem could be avoided. The frequency range of hand clapping is in between 2200 and 2800 Hertz.

Here the signal from the condenser microphone is beta times amplified by the amplifier stage. To add more sensitivity to the switch, the amplification factor may be increased.

We can increase the range of this equipment by using better microphone. It can also be used as Remote Controller.

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