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 **Osuwe Chuwukamadu Chuks** 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 and to all who desire to be a graduate.

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. John Osuwe, and my siblings who have put their endless effort, love, encouragement and support in this project.

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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

INTRODUCTION

1.1 BACKGROUND OF STUDY

Manual controlling methods were used in the past to control appliances and gadgets. The radio and cassette players that are available then had buttons and variable knob for switching on and controlling the sound. This made it difficult for appliances to be controlled from afar.

Then in the 1990s the remote control was invented, but these made use of a transmitter and receiver, enabling control through electromagnetic waves. It, however, has its own disadvantages even if it can control appliances from afar. The transmitter can get lost and it also requires consulting manuals to understand their operations, and also considering that it is not very applicable that certain appliances or gadgets are controlled by the remote control, a notable example is the light bulb.

The sound activated control system was later invented to overcome the shortcoming of the remote control. This made use of all type of sounds for controlling basic appliances and can be adjusted to different sensitivity level enabling it range to be variable.

The operation of almost every electronic devices is concerned with electrical signals that can be either ON or OFF. Thus, switches are essential to the operation of electronic circuits and is only operational in either an ON or an OFF state. They are important in engineering, since they are utilized in a great variety of machines and electronic circuits upon which today's industrial technology are based. A clap light switch is a circuit that light a bulb when sound is produced either by a claps of hand or by a snap of a finger.

This circuit can switch on and off a light, a fan or a radio etc. by the sound of a clap. This working of the circuit is based on amplifying nature of the transistor, switching nature of transistor, the ICs as controllers and relay as an electronic switch.

1.2 PROBLEM STATEMENT

Due to challenges faced by aged and physically challenged persons who meet difficulties in trying to control some household and industrial appliances. In the same manner, manual switching is an uphill task for the disabled and the aged due to movement constraints. Sometimes, we are victims of electric shocks from our devices when we try to switch them ON/OFF due to leaking currents from the electric switches. Therefore, there is a pressing need to find a solution to this matter of great importance by designing a good clap switch device.

1.3 AIM OF THE STUDY

The aim of this project is to construct a device which can be switched on and off using clap signals.

- The constructed device will be able to switch ON and OFF using double clapping signal.
- To design a system that will 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.
- To eliminate the stress in walking from end to end or room to room of a building to switch devices ON/OFF.
- To ensure a reliable and safe method of switching domestic and industrial devices.

- To eliminate the stress in walking from end to end, or room to room of a building to switch devices ON/OFF.
- The provision of remote switching helps to safe guard operators and equipment.
- To ensure a reliable and safe method of switching domestic and industrial 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 SCOPE OF THE STUDY

The scope of this project includes the construction and Implementation of a Clapping Switch. It will not also be limited to low voltage, low current AC/DC applications of 240V maximum operating voltage.

1.6 DEFINITIONS OF TERMS

Microphone: A microphone converts sound waves to electrical audio waves of the same frequency and relative amplitude.

Resistor: A resistor is an electrical component that limits or regulates the flow of electrical current in an electronic circuit. Resistors can also be used to provide a specific voltage for an active device such as a transistor.

Relay: A relay is an electrically operated switch that uses electromagnet to mechanically operate a switch. Relays are also used where it is necessary to control a circuit by a low-power signal or where several circuits must be controlled by one signal.

Capacitor: A capacitor is an electrical component that stores potential energy. Capacitors hold positive and negative energy on two separate plates separated by an insulator.

555 Timer: This is one of the most useful IC's ever made and It is can be used to build many circuits.

CHAPTER TWO

LITTERATURE REVIEW

This chapter will discuss more about all of the information related to the project. It discusses about the previous history and the present work about our project. The literature review in this paper is based on internet, journal, books, and articles.

2.0 HISTORICAL BACKGROUND

In 2008, Olokede 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 de-energize 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(Olokede, S.S., 2008).

In 2009, Ogunfayo performed a project titled “Design and construction of clap activated switch”. He add an Operational Amplifier 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 (Olaniyi, O.A., 2009).

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 (Sahiti, *et al.*, 2010).

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 matlab. 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 aspects (Arnould, *et al.*, 2013).

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 2nd and 4th 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

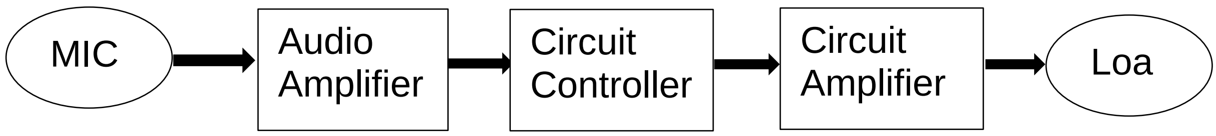

Figure 3.1. System block diagram

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

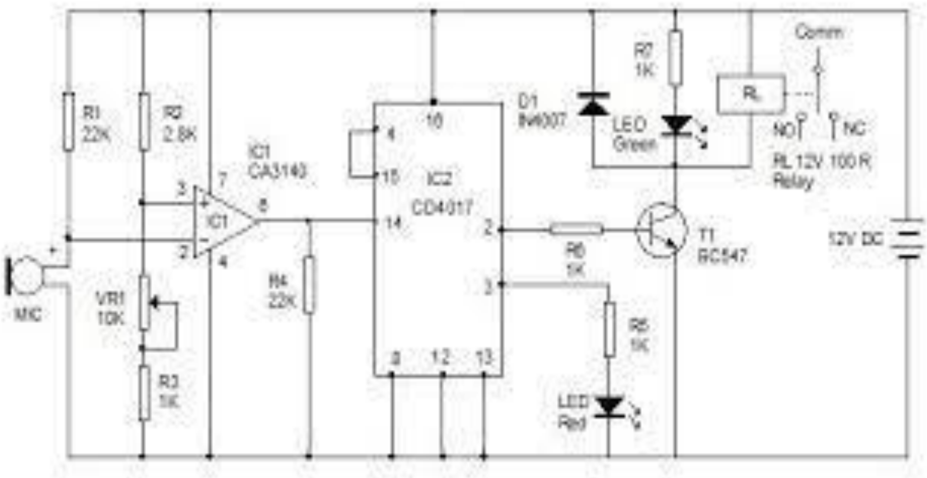

Figure 3.2. Circuit layout of a clap activated switch.

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).

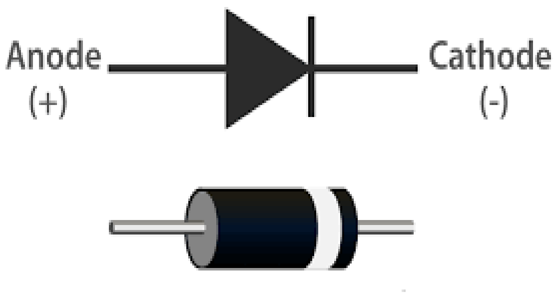

Figure 3.3. Diode

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).

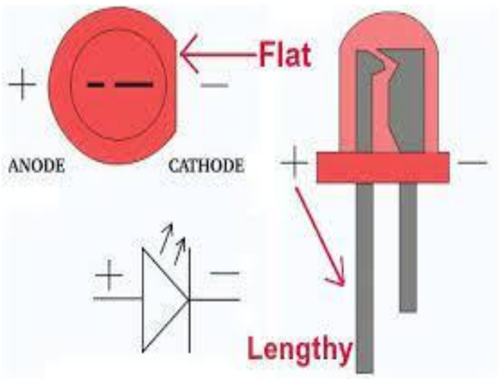

Figure 3.4. Light Emitting Diode (LED)

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).

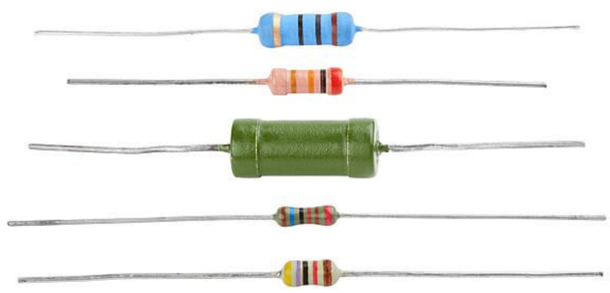

Figure 3.5. Resistor

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).

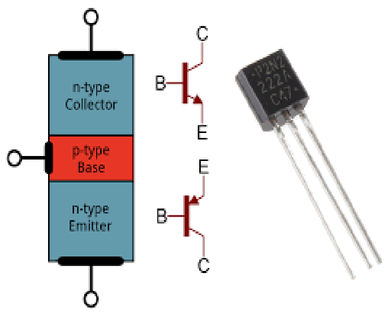

Figure 3.7. Transistor

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).

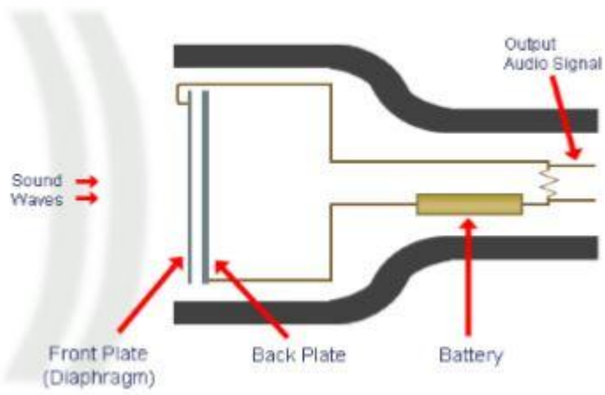

Figure 3.8. Cross-Section of a Typical Condenser Microphone

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).

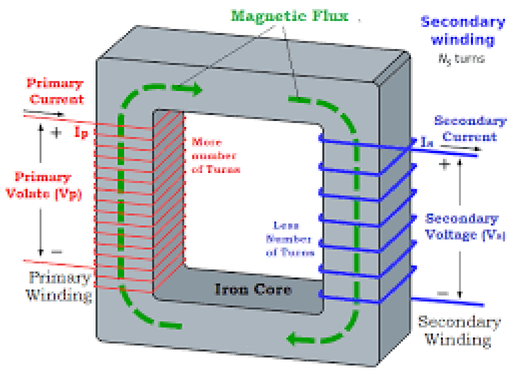

Figure 3.9. Step down transformer

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.

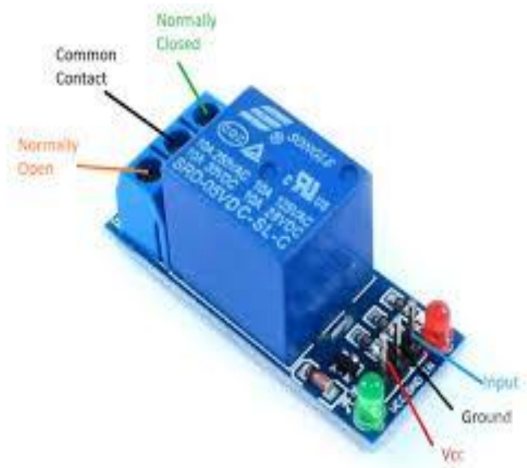

Figure 3.10. Relay

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).

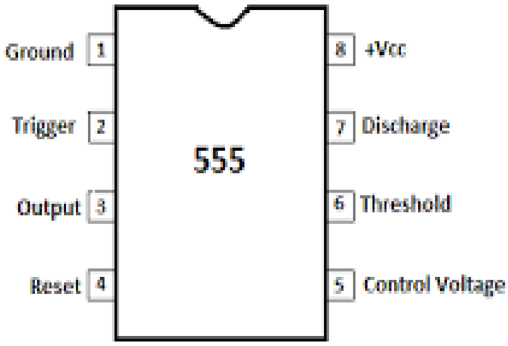

Figure 3.11. Pin out Diagram of 555 timer

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: $T=1.1 \times R7 \times C3$ 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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