CLAP BASED SWITCHING SYSTEM

A MINIPROJECT REPORT

submitted by

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CERTIFICATE

This is to certify that the report entitled **'Clap Based Switching System'** submitted by **‘Abhay C’** to the APJ Abdul Kalam Technological University in partial fulfilment of the requirements for the award of the Degree of Bachelor of Technology in Electronics & Instrumentation is a bonafide record of the project work carried out by her under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

Internal Supervisors(S)

Miniproject Coordinator

HEAD OF THE DEPT

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ABSTRACT

A "Clap On Clap Off" switch is an interesting concept that could be used in home automation. It works as a switch which makes devices ON and OFF by making a clap sound. Although its name is “Clap switch”, but it can be turned ON by any sound of about same pitch of Clap sound. The main component of the circuit is the Electric Condenser Microphone, which has been used as a sound sensor. Condenser Microphone basically converts sound energy into electrical energy, that in turns used to trigger 555 timer IC, through a Transistor. And triggering of IC 555 TIMER works as a Clock pulse for D-type flip-flop and would turn ON the LED, which will remain ON until the next clock pulse means until the next Clap/sound. So this is the Clap Switch which will turn ON with first Clap and turn OFF with the second Clap. If we remove the D-type Flip flop from the circuit, the LED will be turned OFF automatically after some time and this time will be 1.1xR1xC1 seconds, which I have explained in my previous circuit of clap switch.

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CHAPTER 1
INTRODUCTION

1.1 GENERAL BACKGROUND

The earliest electrical switch was the electric light switch invented by Thomas Alva Edison, who was also one of the main inventors of the light bulb. In preparation for the New Year celebrations in 1880, Edison created a number of electronic components for light displays. Among these components were switched. After years, many changes occurred in the technology. Turning ON a light in our home became very easy using modern technologies like sensors, motion detectors etc.

Over the years, the simple clap-switch has been produced for fun projects and novelty gift ideas and today there are many examples to be seen from various suppliers, in many various designs. However, the “stock standard” clap-switch has a number of distinct shortcomings. If for example you have one in your bed room, throw a ball against the wall, or sneeze, and the light goes out! Similarly, a bump in the night can turn the light on. Any number of sharp sounds can switch the clap-switch either ON or OFF. A second shortcoming is that, unless a clap switch is adjusted to respond only to hard, sharp claps, it is likely to be triggered by a variety of unwanted sounds. This also means that “lighter” sounds, such as a clicking of one’s fingers, or tapping a pencil on a desk, are less likely to trigger a “stock standard” clap switch. Instead, far loader, disruptive sounds are required. A third shortcoming is that the standard clap switch offers little security. Anyone who can clap, or even click their fingers or shout, can trigger the switch. While this might not seem at first to hold much of a disadvantage, it significantly limits the possibilities of the switch.

An electronic device that can control light appliances by users clap sound is a clap switch. It was invented by R Carlile, Stevens, and E Dale Reamer on 20th February 1996. The main advantage of this technology is that it is mainly helpful for a mobility-impaired person. It also comes with the easiness of operating appliances without any locomotor movement. Actually it is a simple circuit for the application of clap switch. The condenser mic is one of the main components in the circuit that tracks the input clap sound based on the pitch of clap and transduces this sound energy into some electric pulses. These electric pulses are the desired input to the clap switch circuit. The circuit can be split into an amplifier section, timer section and an output section. The circuit is constructed with basic components like condenser microphone, transistors, resistors, capacitors, diode, relays and IC555, IC7474. This article gives an overview of the clap switch.

1.2 OBJECTIVES

i. The main objective of clap switch to set up a mechanism to turn ON and turn OFF the electrical appliances using clap sound.

ii. The circuit does not respond to noises from the surroundings. A rigid sound should be reached the condenser microphone for the operation.

1.3 ADVATAGES AND DISADVANTAGES

1.3.1 Advantages

i. Main benefit of clap switch is, we can control any electric load like light, a fan from any

ii. place in the room by clapping our hands.

iii. Energy-Efficient System.

iv. Less cost.

v. Circuit is reliable.

vi. High accuracy.

1.3.2 Disadvantages

i. The main drawback is that it is usually awkward to have to clap one’s hands to control the load

ii. It normally looks simple in most cases to utilize a normal light switch.

CHAPTER 2
LITERATURE SURVEY

2.1 RESEARCH REVIEW

[1] The main purpose of the clap switch is control the devices like fan or light or any other electronic devices with just a clap sound. This paper proposed by Somangshu Bagchi, Subhadip Ghosh, Deepak Nandi present a clap switching work prior to November 2013. In this project it gives knowledge of 555 timers, ie working of relay and clocks. In this type of device it provide the working of NE555 timer and the relay. The relay is switch it gives a path only when current flown through it. In this project the second timer triggers relay of conducting path it is established terminals of the load and the device is gets turned on. Time interval of the claps is checked with the time constant and it can be established by the RC configuration of $T=1.1R7*C3$ [1].

[2] This paper proposed by Kashinath Murmu and Ravi Sonkar present a control of Light and Fan with Whistle and Clap work prior accepted in November 2004. In this paper, it can detect clap and whistle properly by removing most of the noise. But it complicated to distinguish between clap and tap on a table with the analog circuits due to similar waveform generated by it.

[3] This paper is published Seyi Stephen Olokede work prior accepted in July-December 2008. In this paper the clap activated switching device function properly by responding to both hand claps at about three to four meter away and finger tap sound at very close range, since both are low frequency sounds and produce the same pulse wave features. The resulting device is realizable, has good reliability and its relatively inexpensive.

CHAPTER 3

THEORY

3.1 REQUIREMENT OF COMPONENTS

3.1.1 Microphone

Here we need a 5v condenser microphone. Condenser microphones are an excellent tool that delivers high sensitivity to capture subtle nuances and smooth frequency response. Whether you're plucking, drumming, singing or speaking, condenser microphones create high-quality audio. As the name implies, the condenser microphone or capacitor microphone uses a capacitance that varies in line with the incoming signal to generate the varying output voltage. The name condenser microphone still persists. The microphone was invented in the days when capacitors were still called condensers.

The actual condenser microphone element consists of a thin membrane in close proximity to a solid metal plate. The membrane acts as the diaphragm and is electrically conductive. Older microphones used a thin metal foil but more modern types may use a plastic coated with gold or aluminium. One common type is gold-sputtered mylar. When sound waves hit the microphone, the diaphragm moves backwards and forwards. This changes the level of capacitance and as a result small voltage changes are seen across a high load resistor connected across the microphone element.

As the impedance of the condenser microphone is very high, a buffer amplifier is needed. This has the effect of converting the signal so that it has a much lower impedance. This amplifier is also powered either from the internal battery or from the phantom power liner.

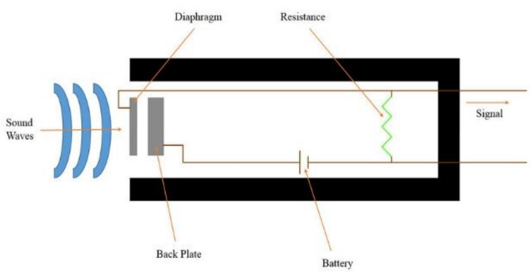


Fig. 3.1 Condenser microphone

3.1.2 Resistor

Different values of resistors are used in this circuit. A resistor is a two-terminal electrical or electronic component that resists an electric current by producing a voltage drop between its terminals in accordance with Ohm's law, R=V/I. circuits. Its unit is ohm. The primary characteristics of a resistor are the resistance, the tolerance, maximum working voltage and the power rating. Other characteristics include temperature coefficient, noise, and inductance. Less well-known is critical resistance, the value below which power dissipation limits the maximum permitted current flow, and above which the limit is applied voltage. Critical resistance depends upon the materials constituting the resistor as well as its physical dimensions; it's determined by design. Resistors can be integrated into hybrid and printed circuits, as well as integrated circuits. Size, and position of leads (or terminals) are relevant to equipment designers; resistors must be physically large enough not to overheat when dissipating their power.

There are many ways to manufacture them. 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.

Fig. 3.2 Resistor

3.1.3 Capacitor

A capacitor is a device that stores electrical energy in an electric field. It is a passive electronic component with two terminals. The most basic design of a capacitor consists of two parallel conductors (Metallic plate), separated with a dielectric material. When a voltage source is attached across the capacitor, the capacitor plate gets charged up. The metallic plate attached to the positive terminal will be positively charged, and the plate attached to the negative terminal will be negatively charged.

The unit of capacitance is Farad(F) which is equal to one coulomb per volt.

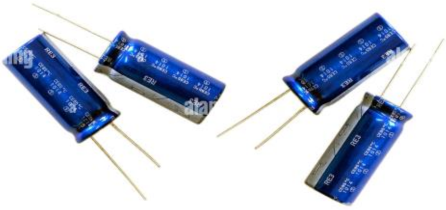


Fig. 3.3 Capacitor

3.1.4 Diode

diode, an electrical component that allows the flow of current in only one direction. In circuit diagrams, a diode is represented by a triangle with a line across one vertex. The most common type of diode uses a *p-n* junction. In this type of diode, one material (n) in which electrons are charge carriers abuts a second material (p) in which holes (places depleted of electrons that act as positively charged particles) act as charge carriers. At their interface, a depletion region is formed across which electrons diffuse to fill holes in the p-side. This stops the further flow of electrons. When this junction is forward biased (that is, a positive voltage is applied to the p-side), electrons can easily move across the junction to fill the holes, and a current flows through the diode. When the junction is reverse biased (that is, a negative voltage is applied to the p-side), the depletion region widens and electrons cannot easily move across. The current remains very small until a certain voltage (the breakdown voltage) is reached and the current suddenly increases. Light-emitting diodes (LEDs) are p-n junctions that emit light when a current flows through them. Several *p-n* junction diodes can be connected in series to make a rectifier (an electrical component that converts alternating current to direct current). Zener diodes have a well-defined breakdown voltage, so that current flows in the reverse direction at that voltage and a constant voltage can be maintained despite fluctuations in voltage or current.

Fig. 3.4 Ideal Diode

3.1.5 Transistor

Here we used BC547 npn type Bipolar Junction Transistor (BJT). In the BC, first letter denotes type of semiconductor used. B is for silicon and second letter indicates frequency of operation, which means C is for low frequency application. Transistors are at the very core of today's electronics technology. The development of the BJT has resulted in many changes to the world. The introduction of the bipolar transistor has enabled many technologies we take for granted today: everything from portable transistor radios, through to mobile phones, and computers, remote operation, the functionality we take for granted in current day automobiles etc. All these and many more everyday items have all been made possible by the invention of the transistor.

Today, bipolar transistors are available in many forms. There is the basic transistor in a leaded form or its available as a surface mount transistor. But transistors are also widely used within integrated circuits. Most digital ICs use field effect technology, but many analogue ICs use bipolar technology to provide the required performance. Together with their Field Effect Transistor (FET), relatives which use a very different principle, the bipolar transistor forms the basis of most of today’s electronic equipment, either as discrete devices or within integrated circuits.

Fig. 3.5 Transistor

A transistor is a semiconductor device used for amplifying or switching an electronic signal. BC547 is an NPN Bipolar Junction Transistor. And like all other transistors, BC547 has three pins called the emitter, collector, and base respectively. Some of the features of this transistor are;

a) The highest transition frequency of BC547 is 300MHz. Thus, it can also be used in RF circuits.
b) Amplification of current
c) Audio amplifiers

d) Switching loads less than 100mA
e) Quick switching
f) PWM (Pulse Width Modulation)

Like every other transistor BC547 transistor works in three regions:

- Active Region.
- Saturation Region.
- Cut off Region

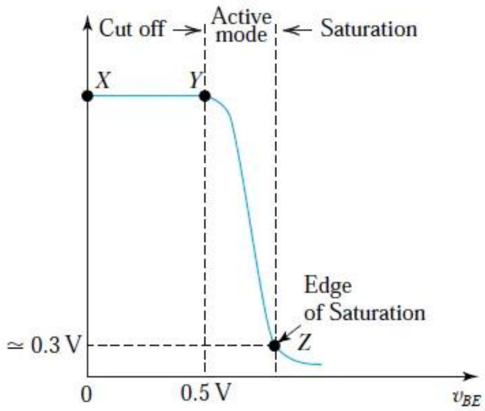


Fig. 3.6 Regions of operation of transistor

i. Active region

The active region lies between the cut-off and saturation regions. In the active region, the transistor emitter junction is forward biased and the collector junction is reverse biased. In the active region, the collector current is β times the base current,

$I_C = \beta\ I_B$

here, I_C = collector current

B = current amplification factor

I_B = base current

So the collector current increases in proportional to the base current.

ii. Saturation region

In this region, transistor works like a short circuit. The collector and Emitter currents are maximum in this region. In the saturation region, both the emitter and collector junctions are forward biased. In other words, the transistor operates as a closed switch or short circuit carrying maximum current which implies,

$I_C=I_E$

here I_C = collector current and I_E = emitter current.

iii. Cut-off region

In this region, transistor works as an open switch or open circuit. The collector, emitter, and base currents are all zero in this region. In the cut-off region, both the emitter and collector junctions are reverse biased. As in the cut-off region, the collector, emitter, and base current are zero, which gives,

$I_C=I_E=I_B=0$

here I_C = collector current, I_E = emitter current, and I_B = base current.

3.1.6 IC 555 Timer

IC 555 timer is used here for monostable operation. The 555 timer IC is an integral part of electronics projects. These provide time delays, as an oscillator and as a flip-flop element among other applications. Depending on the manufacturer, the standard 555 timer package includes 25 transistors, 2 diodes and 15 resistors on a silicon chip installed in an 8-pin mini dual-in-line package (DIP-8). Variants consist of combining multiple chips on one board. However, 555 is still the most popular. Let us look at the pin diagram to have an idea about the timer IC before we talk about 555 timer working.

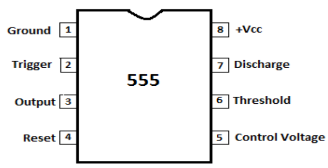


Fig. 3.7 8 pin DIP configuration

555 timer is used in almost every electronic circuit today. For a 555 timer working as a flip flop or as a multi-vibrator, it has a particular set of configurations. Some of the major features of the 555 timer would be,

i. It operates from a wide range of power ranging from +5 Volts to +18 Volts supply voltage.

ii. Sinking or sourcing 200 mA of load current.

iii. The external components should be selected properly so that the timing intervals can be made into several minutes along with the frequencies exceeding several hundred kilohertz.

iv. The output pin of a 555 timer can drive a transistor-transistor logic (TTL) due to its high current output.

v. It has a temperature stability of 50 parts per million (ppm) per degree Celsius change in temperature which is equivalent to 0.005 %/ °C.

vi. The duty cycle of the timer is adjustable.

vii. Also, the maximum power dissipation per package is 600 mW and its trigger pulse and reset inputs has logic compatibility.

The 555 generally operates in three modes,

a. Astable multivibrator
b. Monostable multivibrator
c. Bistable multivibrator modes.

Among these our operating mode is monostable. This configuration consists of one stable and one unstable state. The stable state can be chosen either high or low by the user. If the stable output is set at high (1), the output of the timer is high (1). At the application of an interrupt, the timer output turns low (0). Since the low state is unstable it goes to high (1) automatically after the interrupt passes. Similar is the case for a low stable monostable mode.

3.1.7 D flip flop

The D flip-flop is a clocked flip-flop with a single digital input 'D'. Each time a D flip-flop is clocked, its output follows the state of 'D'. The D Flip Flop has only two inputs D and clock pulse (CP). The D inputs go precisely to the S input and its complement is used to the R input. Considering the pulse input is at 0, the outputs of gates 3 and 4 are at the 1 level and the circuit cannot convert state regardless of the value of D. The D input is sampled when CP = 1. If D is 1, the Q output goes to 1, locating the circuit in the set state. If D is 0, output Q goes to 0, and the circuit switches to a clear state.

We connected two d flip flops back to back, like the Q bar is connected as the clock input for the second d flip flop.

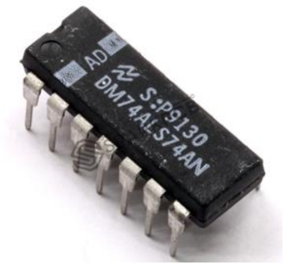


Fig. 3.8 D flip flop 7474 IC

3.1.8 Relay

Relay is one kind of electro-mechanical component that functions as a switch. The relay coil is energized by DC so that contact switches can be opened or closed. A single channel 5V relay module generally includes a coil, and two contacts like normally open (NO) and normally closed (NC). We use 5V single pole double throw relay for our application. A 5V relay is an automatic switch that is commonly used in an automatic control circuit and to control a high-current using a low-current signal. The input voltage of the relay signal ranges from 0 to 5V.

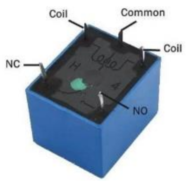


Fig. 3.9 Relay

3.2 BLOCK DIAGRAM

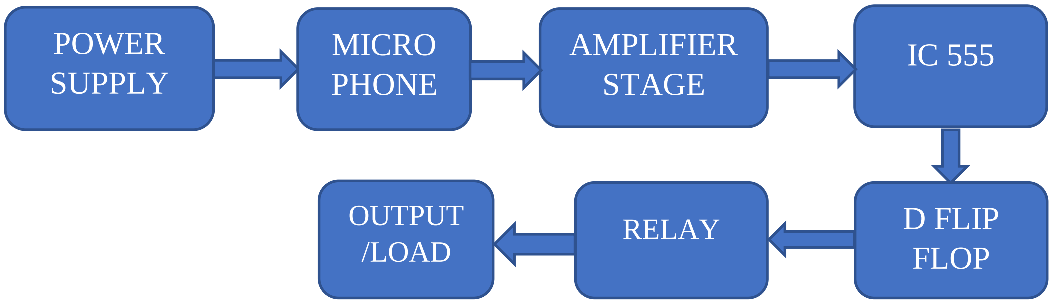


Fig. 3.10 Block Diagram

Power supply power up the microphone sensor and it is amplified to a strong signal. The transistor also act as a switch. The 555 IC gives a dc pulse for a time period and d flip flop remains the state until a trigger received. Relay drives the circuit and load.

3.3 CIRCUIT DIAGRAM

Following circuit diagrams are the main circuit portions of our project. First is power supply and second one is the main circuit of the project.

3.3.1 Power supply working

Power supply we needed in our circuit was just 5-6v, to get that voltage we are using a step-down transformer of secondary rating 9 volt & 1 amp to step down 230V/ 110V AC supply to 9 volt AC. Then we rectify the 9V AC to 9 V DC using a Full wave rectifier. After the rectifier, we have used capacitors to filter the ripple from the circuit and fed it to the input of the 7805 IC, voltage regulator. 7805 regulates the 9 volt DC to 5 volt DC and at the output of 7805 IC, we get constant 5 volt DC output. The LM7805 is a voltage regulator that outputs +5 volts. Like most other regulators in the market, it is a three-pin IC, input pin for accepting incoming DC voltage, ground pin for establishing ground for the regulator, and output pin that supplies the positive 5 volts. It has some features like,

- Output Current up to 1.5Amp
- Internal Thermal-Overload Protection

- High Power-Dissipation Capability
- Internal Short-Circuit Current Limiting
- Output Transistor SAFE-Area Compensation

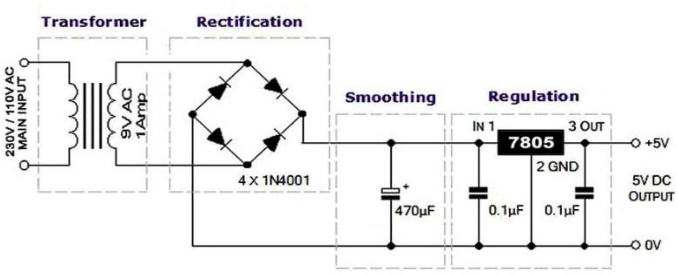


Fig. 3.11 5V DC Power supply circuit

Fig. 3.12 IC LM7805 Voltage regulator

3.3.2 Clap switch working

Working of circuit and analysis is discussed as follows. First we need the power supply to power up the whole circuit. The very first component of the circuit is a condenser microphone. Without any sound produced the microphone will be in less resistance, so the drop across the microphone will be less and the resistor connected to the negative terminal of the microphone and ground is responsible for the voltage drop in that condition. After making a clap sound the microphone get more resistance as compared to the previous condition and also the voltage drop across the microphone will be high. So a high base emitter voltage is developed at the transistor T1, now it is said to be ON. In the second phase of operation, the collector current at T1 is connected to the base emitter junction of the transistor T2. Now the transistor T2 is also in ON condition.

As the electric signal passed to the trigger 2 pin of the monostable multivibrator, the stable state is disturbed and a timing pulse is generated at the output pin 3. The time of the pulse generated is depends on the values of the resistor and capacitor connected to the pins of 6 and 7. The d flip flop is connected at the out of monostable. The d flip is acting as a counter here and it has two states 1 and 0, once it gets a pulse low to high it shows a state either 1or 0, and the state is remain continues until a next low to high pulse is given.

Loads like fan or light is connected to the two outputs of two d flip flop. Relay is used to control the load circuit and this circuit. It keeps the circuits safely.

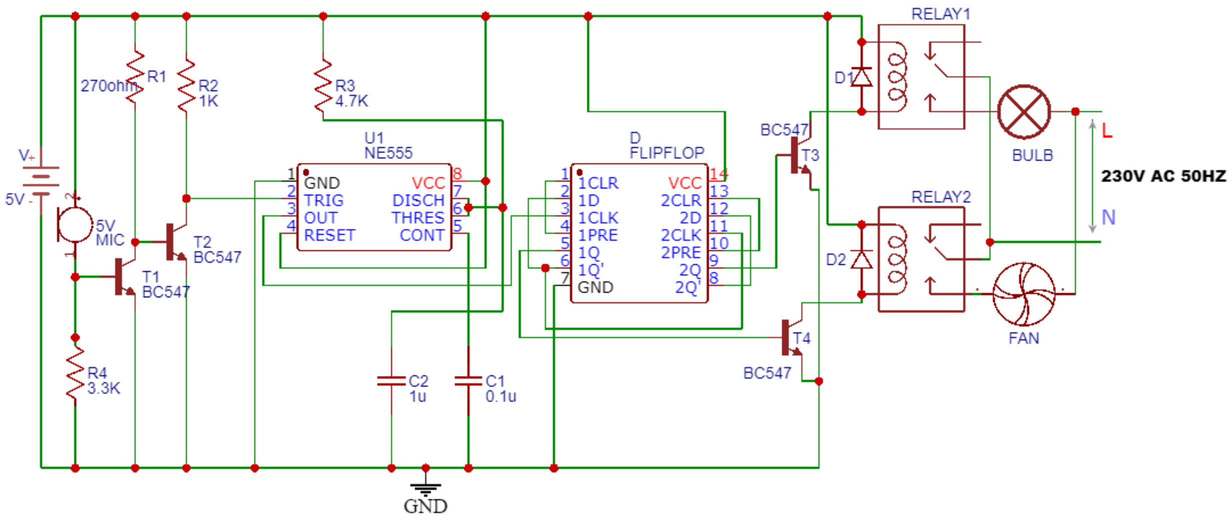


Fig. 3.13 Clap switch circuit diagram

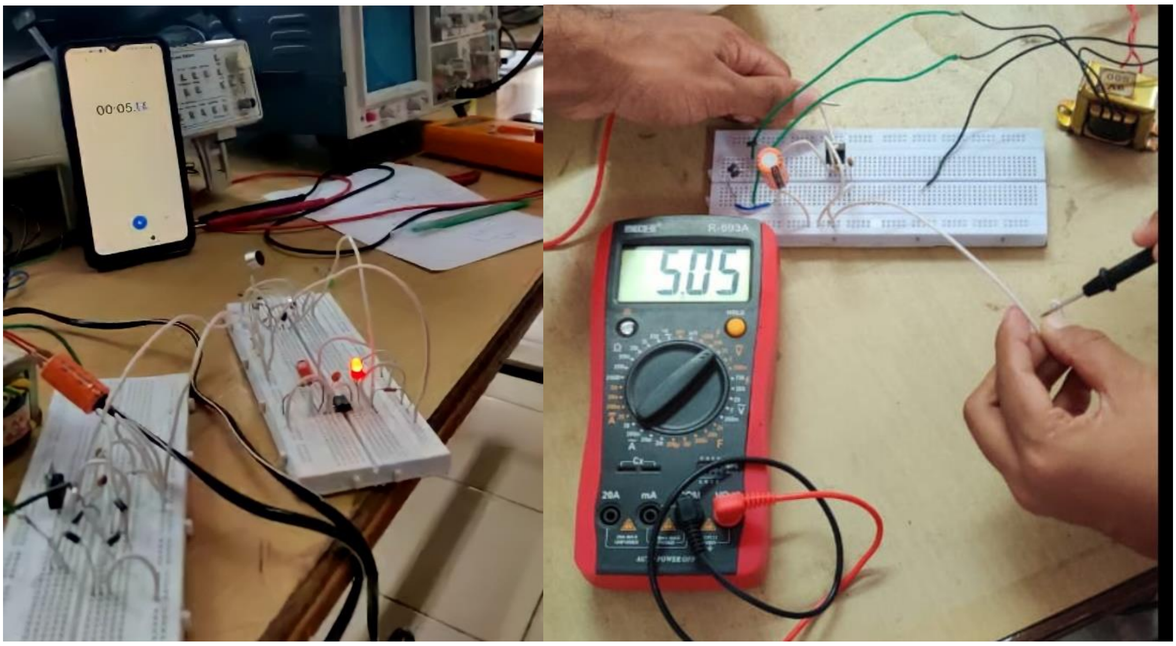


Fig. 3.14 Demonstration

3.3.3 Component Specification

Table 3.1 specification of components

SI.NO	Name of the component	Specification	No. of components used	Cost
1	Resistor	270ohm, 1k, 3.3k, 4.7k	1, 1, 1, 1	4/-
2	Diodes	1N4007	2	1/-
3	LEDs	-	2	5/-
4	Capacitor	1u, 0.1u	1, 1	1/-
5	NPN Transistors	BC547B	4	8/-
6	Transformer	230V/9V, 600mA	1	200/-
7	Microphone	5V	1	8/-
8	IC 555	NE555	1	10/-
9	D flip flop	7474LS	1	65/-
10	Relay	5V	2	95/-
11	Bread board	Solderless	1	100
12	PCB	General purpose	1	80/-

CHAPTER 4

RESULTS AND DISCUSSIONS

4.1 RESULTS

We have implemented a prototype circuit for a Clap based switching system. The prototype has been tested under the objectives and confirmed to be working as intended. The circuit is very simple and easy to build. When we clap, the sound is converted to a electric signal and the signal is fed to the upcoming circuits. The signal is actually turns ON and turns OFF the appliances connected to the outputs of the d flip flop etc. D flip flop has connected in a manner mentioned above and it has four combinations of results. The first clap turns ON the load 1 and the load 2 is currently in OFF condition. The second clap makes the load 1 OFF and load 2 ON. Third clap changes the load 1 ON, now the two loads are in ON condition. At last clap both loads gets OFF.

4.2 SIMULATION

We did our simulation part in Proteus 8

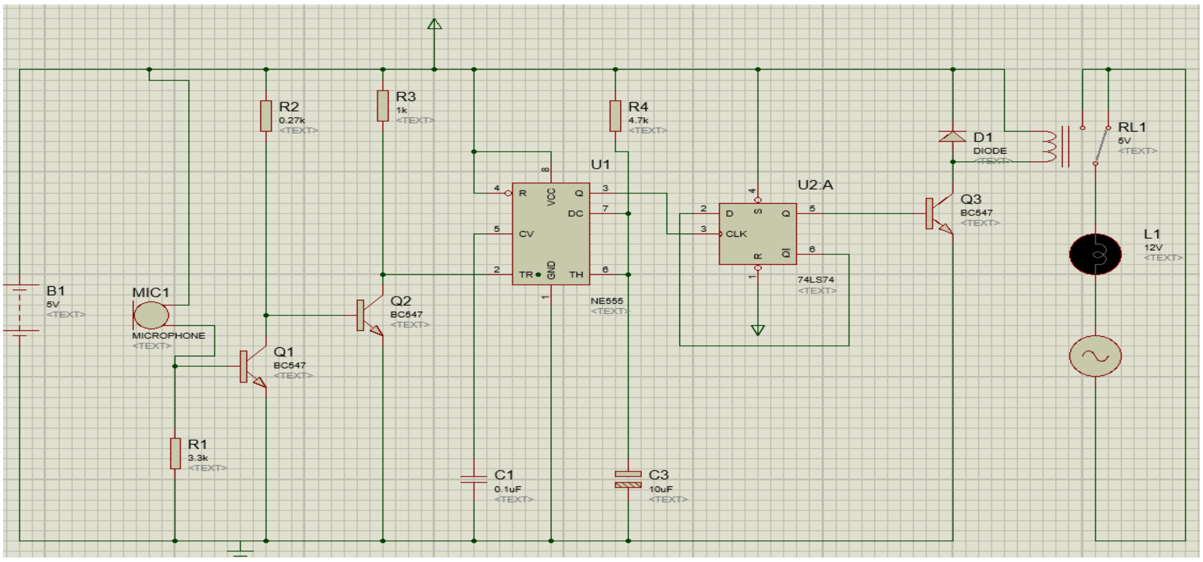


Fig. 4.1 When there is no clap

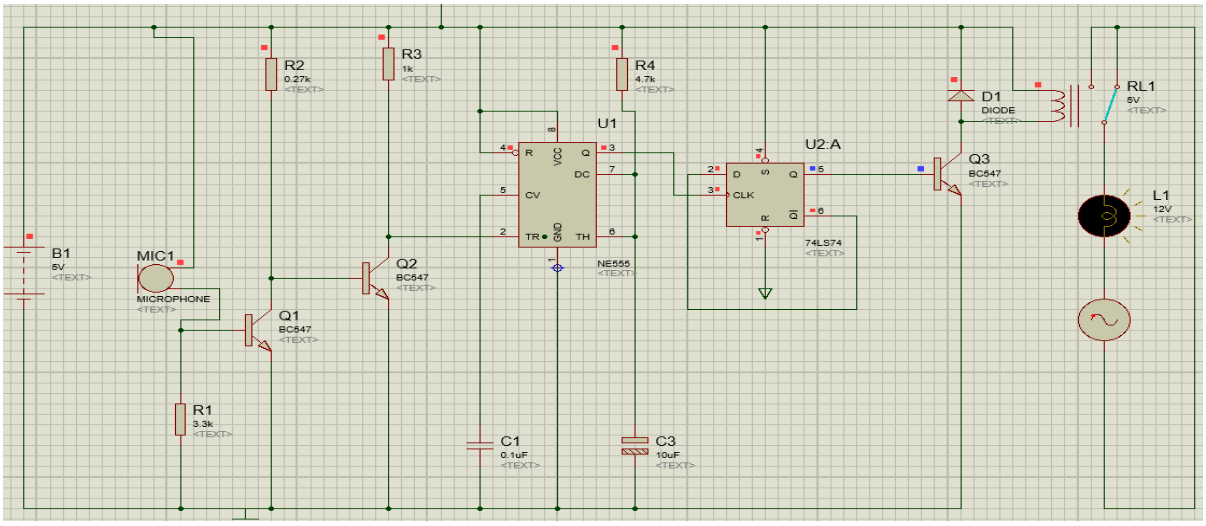


Fig. 4.2 When clap is detected

Simulation part was very exciting to do with Proteus 8 and it is very easy to use.

4.3 PCB DESIGN

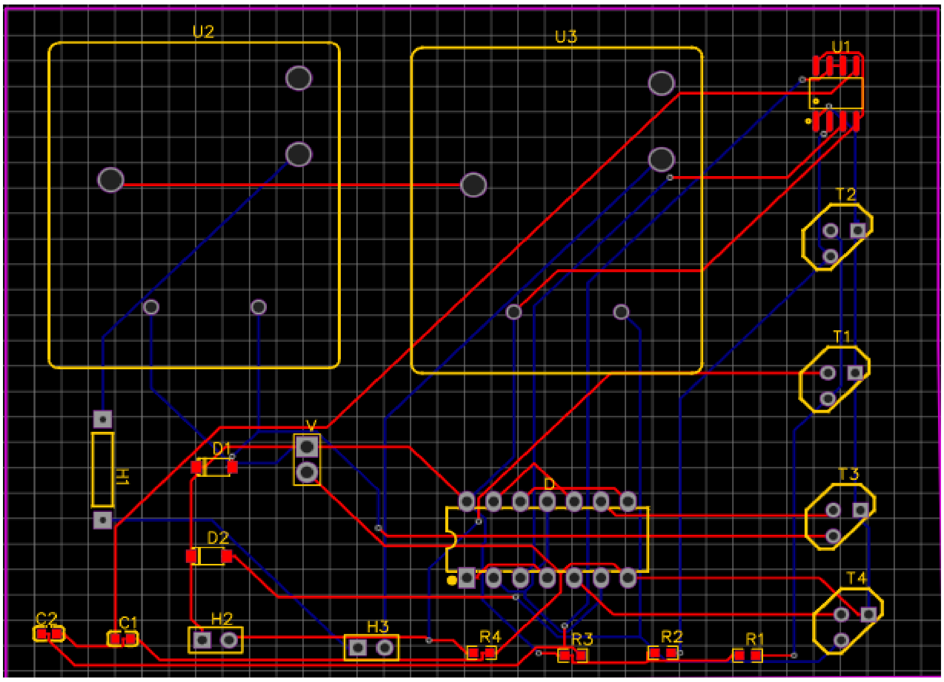


Fig. 4.3 PCB (Component Side)

PCB is designed using Easy EDA (Online Simulator).

CHAPTER 5

PRINTED CIRCUIT BOARD FABRICATION

Printed Circuit Board (PCB) fabrication is the process of transcribing a circuit board design onto the physical structure of the board. By contrast, PCB assembly is the process of actually placing components onto the board to make it functional.

PCB Development: PCB development can be defined as the process of taking a circuit board design from the design to the production. This typically includes three stages: design, manufacturing and testing. And for all but the simplest designs, this process is iterative with the objective of arriving at the highest quality design within the development time allotted.

PCB Manufacturing: PCB manufacturing is the construction of your board design. This is a two-step process that begins with board fabrication and ends with printed circuit board assembly (PCBA).

PCB Testing: PCB testing, sometimes referred to as bring up, is the third stage of PCB development; performed after manufacturing. Testing during development is done to evaluate the board's ability to perform its intended operational functionality. During this stage, any errors or areas where the design should be modified to improve performance are identified and another cycle is initiated to incorporate the design changes.

PCB Assembly: PCB assembly or PCBA is the second step or stage of PCB manufacturing in which the board components are mounted to the bare board through a soldering process.

i. Imaging desired layout on copper clad laminates.

ii. Etching or removing excess copper from inner layers to reveal traces and pads.

iii. Creating the PCB layer stack up by laminating (heating and pressing) board materials at high temperatures.

iv. Drilling holes for mounting holes, through hole pins and vias.

v. Etching or removing excess copper from the surface layer(s) to reveal traces and pads.

vi. Plating pin holes and via holes.

vii. Adding protective coating to surface or solder masking.

viii. Silkscreen printing reference and polarity indicators, logos or other markings on the surface.

ix. Optionally, a finish may be added to copper areas of surface.

CHAPTER 6

CONCLUSIONS

6.1 CONCLUSION

The clap activated switching device function properly by responding to both hand claps at about three to four meter away and finger tap sound at very close range, since both are low frequency sounds and produce the same pulse wave features. The resulting device is realizable, has good reliability and it is relatively inexpensive. Assemble the circuit on a general purpose PCB and enclose it in a suitable box. This circuit is very useful in field of electronic circuits. By using some modification its area of application can be extended in various fields. It can be used to raised alarm in security system with a noise, and also used at the place where silence needed. To conclude my project I think that I have carried it out to a reasonably high level. I am glad that my build has worked and although problematic setbacks and I had reasonable time to conclude the end of my project.

Other improvements that could have been made include, the overall size of the board although it is small and reasonable, it would be ideal to get it even smaller so it could fit into other products such as desk lamps, toys and other range of products.

6.2 FUTURE SCOPE

a. We can increase the range of this equipment by using better microphone.
b. We can use this as Remote Controller. No filter has been used here so the switch will respond to more or less every two sounds similar to clapping that comes with a gap of in between 3 seconds. But if a simple bandpass filter is used then this problem could be avoided.
c. The frequency range of hand clapping is in between 2200 and 2800 Hertz. Here the signal from the condenser mic is beta times amplified by the amplifier stage. To add more sensitivity to the switch, the amplification factor may be increased.

REFERENCES

[1] Unconventional Uses for IC Timer, Jim Wyland and Eugene Hnatek, *Electronic Design*, June 7, 1973, pp. 88-90.

[2] Muhammad Ali Mazidi,Janice Gillispie Mazidi, *The 8051 Microcontroller and Embedded System*, Pearson Education,Inc.,2000

[3] Olokede, S.S., 2008. Design of a Clap Activated Switch. *Leonardo Journal of Sciences*, 7(13), pp.44-58.

[4] https://circuitdigest.com/electronic-circuits/clap-switch-project

[5] https://www.electronicsforu.com/electronics-projects/hardware-diy/clap-switch#:~:text=Here's%20a%20clap%20switch%20free,within%20the%20set%20time%20period.

APPENDIX

NE555
SA555 - SE555

General-purpose single bipolar timers

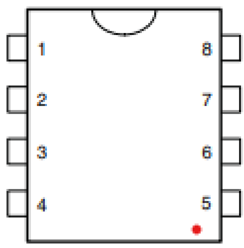
Features

- Low turn-off time
- Maximum operating frequency greater than 500 kHz
- Timing from microseconds to hours
- Operates in both astable and monostable modes
- Output can source or sink up to 200 mA
- Adjustable duty cycle
- TTL compatible
- Temperature stability of 0.005% per °C

N
DIP8
(Plastic package)

D
SO8
(Plastic micropackage)

Pin connections
(top view)



1 - GND	5 - Control voltage
2 - Trigger	6 - Threshold
3 - Output	7 - Discharge
4 - Reset	8 - V_{CC}

Description

The NE555, SA555, and SE555 monolithic timing circuits are highly stable controllers capable of producing accurate time delays or oscillation. In the time delay mode of operation, the time is precisely controlled by one external resistor and capacitor. For a stable operation as an oscillator, the free running frequency and the duty cycle are both accurately controlled with two external resistors and one capacitor.

The circuit may be triggered and reset on falling waveforms, and the output structure can source or sink up to 200 mA.

MOTOROLA

SN54/74LS74A

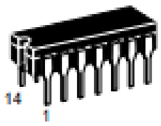
DUAL D-TYPE POSITIVE EDGE-TRIGGERED FLIP-FLOP

The SN54/74LS74A dual edge-triggered flip-flop utilizes Schottky TTL circuitry to produce high speed D-type flip-flops. Each flip-flop has individual clear and set inputs, and also complementary Q and $\overline{Q}$ outputs.

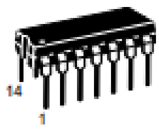
Information at input D is transferred to the Q output on the positive-going edge of the clock pulse. Clock triggering occurs at a voltage level of the clock pulse and is not directly related to the transition time of the positive-going pulse. When the clock input is at either the HIGH or the LOW level, the D input signal has no effect.

DUAL D-TYPE POSITIVE EDGE-TRIGGERED FLIP-FLOP

LOW POWER SCHOTTKY



J SUFFIX
CERAMIC
CASE 632-08



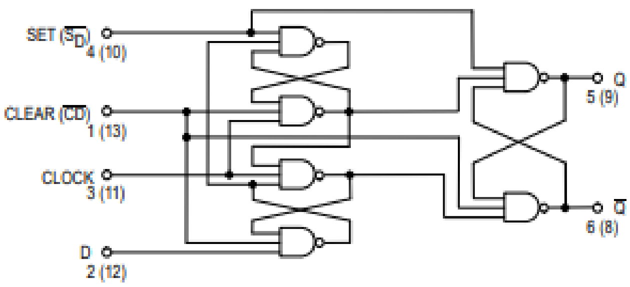
N SUFFIX
PLASTIC
CASE 646-06

D SUFFIX
SOIC
CASE 751A-02

ORDERING INFORMATION

SN54LSXXJ	Ceramic
SN74LSXXN	Plastic
SN74LSXXD	SOIC

LOGIC DIAGRAM (Each Flip-Flop)



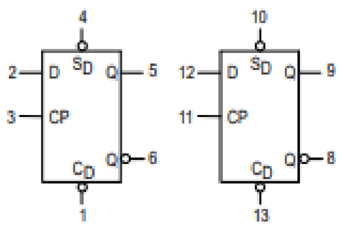
MODE SELECT — TRUTH TABLE

OPERATING MODE	INPUTS			OUTPUTS	
	$\overline{S}_D$	$\overline{S}_D$	D	Q	$\overline{Q}$
Set	L	H	X	H	L
Reset (Clear)	H	L	X	L	H
*Undetermined	L	L	X	H	H
Load "1" (Set)	H	H	h	H	L
Load "0" (Reset)	H	H	l	L	H

* Both outputs will be HIGH while both S_D and C_D are LOW, but the output states are unpredictable if S_D and C_D go HIGH simultaneously. If the levels at the set and clear are near V_{IL} maximum then we cannot guarantee to meet the minimum level for V_{OH}.

H, h = HIGH Voltage Level
L, I = LOW Voltage Level
X = Don't Care
i, h (q) = Lower case letters indicate the state of the referenced input (or output) one set-up time prior to the HIGH to LOW clock transition.

LOGIC SYMBOL



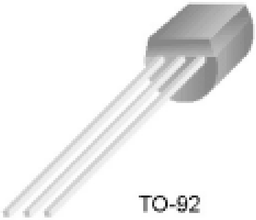
V_{CC} = PIN 14
GND = PIN 7

Switching and Applications

High voltage: BC546, V_{CEO}=65V

Low Noise:BC549,BC550

Complement to BC556…BC560



1 TO-92

1. Collector 2. Base 3. Emitter

NPN Epitaxial Silicon Transistor

Absolute Maximum Ratings Ta=25℃ unless otherwise noted

Symbol	Parameter	Value	Units
V_{CBO}	Collector-Base Voltage :BC546	80	V
	:BC547/550	50	V
	:BC548/549	30	V
V_{CEO}	Collector-Emitter Voltage: BC546	65	V
	:BC547/550	45	V
	:BC548/549	30	V
V_{EBO}	Emitter-Base Voltage :BC546/547	65	V
	:BC548/549/550	45	V
	:BC548/549	30	V
I_C	Collector Current (DC)	100	mA
PC	Collector Power Dissipation	500	mW
TJ	Junction Temperature	150	℃
T_{STG}	Storage Temperature	-65~150	℃

Electrical Characterististics Ta=25℃ unless otherwise noted

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Units
I_{CBO}	Collector Cut-off Current	V_{CB}=30V, I_E=0			15	nA
h_{FE}	DC Current Gain	V_{CE}=5V, I_C=2mA	110		800	
V_{CE}(sat)	Collector-Emitter Saturation Voltage	Ic=10mA, I_B=0.5mA		90	250	mV
		I_C=100mA, I_B=5mA		200	600	mV
V_{BE}(sat)	Base-Emitter Saturation Voltage	Ic=10mA, I_B=0.5mA		700		mV
		I_C=100mA, I_B=5mA		900		mV
V_{BE}(on)	Base-Emitter On Voltage	V_{CE}=5V, Ic=2mA	580	660	700	mV
		V_{CE}=5V, I_C=10mA			720	mV
f_T	Current Gain Bandwidth Product	V_{CE}=5V, I_C=10mA, f=100MHz		300		MHz
Cob	Output Capacitance	V_{CB}=0.5V, I_C=0, f=1MHz		3.5	6	pF
Cib	Input Capacitance	V_{EB}=0.5V, Ic=0,f=1MHz		9		pF
N_F	Noise Figure : BC546/547/548	V_{CE}=5V, Ic=200μA		2	10	dB
	:BC549/550	f=1KHz,R_G=2k Ω		1.2	4	dB
	:BC549	V_{CE}=5V, I_C=200μA		1.4	4	dB
	:BC550	R_G=2k Ω, f=30~15000MHz		1.4	3	dB

h_{FE} Classification

Classification	A	B	C
h_{FE}	110~220	200~450	420~800