Clap Switch Controller by using IC555 Timer

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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 Mic, which has been used as a sound sensor. Condenser Mic 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. For better understanding, I recommend to study the previous circuit before study this one.

Index Terms *- Flip Flop Circuit, Audio Amplifier, Circuit Amplifier, Bc547 Transistor, Ic555 Timer, Led.*

I. INTRODUCTION

This is a project on CLAP SWITCH which can switch on/off any electrical circuit by the sound of a clap. The operation of the circuit is simple. If we clap the lamp turns on and to switch
it off clap again . The condenser 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 the succeeding transistor stage. Two transistors cross connected as a bi-stable multi vibrator change state at each signal. One of these transistors drives a heavier transistor which controls a lamp. This circuit can switch on and off a light, a fan or a radio etc by the sound of a clap
This circuit is constructed using basic electronic components like resistors, transistors, relay, transformer, capacitors. This circuit turns 'ON' light for the first clap. The light turns ON till the next clap. For the next clap the light turns OFF. This circuit works with 12V voltage. Therefore a step-down transformer 12V/300mA is employed. This working of this circuit is based on amplifying nature of the transistor, switching nature of transistor, relay as an electronic switch .Basically, this is a Sound operated switch.

The basic principle of this clap switch circuit is that it converts sound signal into electrical energy. The input component is a transducer that receives clap sound as input and converts it to electrical pulse. 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 the succeeding transistor stage. Two transistors cross connected as a bi-stable multi vibrator change state at each signal. One of these transistors drives a heavier transistor which controls a lamp.

II. CIRCUIT COMPONENTS

Resistors: 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. 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. This bonus chapter covers the resistor types and helps with picking the right one for your project.

resistor

All resistors are basically just a piece of conducting material with a specific value of resistance. For that piece of conducting material to be made into a practical resistor,
a pair of electrodes and leads are attached so current can flow. The resistor is then coated with an insulating material to protect the conducting material from the surrounding
environment and vice versa. 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.

Capacitor: 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 used in the circuit are electrolytic-capacitor.
In the circuit the electrolytic capacitor is used as a bypass capacitor. Any noise variation in the circuit is removed by the capacitor. A **capacitor** is made up of two metallic plates. With a dielectric material in between the plates. When you apply a voltage over the two plates, an electric field is created. And this is what the physicists mean when they say that "a **capacitor works** by storing energy electrostatically in an electric field".

capacitor

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 batteryindustry generates US$48 billion in sales each year, with 6% annual growth 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 exchanges and computer data centres.

Battery

BC547 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.

The bipolar NPN transistors used in this design are basically used as switch, to trigger the relay and as amplifier to boost the mic level to line level. When a transistor is used as switch, it must be either OFF or fully ON. In the fully ON state, the voltage VCE across the transistor is almost zero and the transistor is said to be saturated because it cannot pass any more collector current IC. The transistor is off when VIN is less than 0.7 V, because the base current will be zero. The power developed in a switching transistor is very small
In the OFF state IC555 Timer: The 555 timer is a very versatile 8-pin, which can be configured with a few external components and to build many circuits involving timing. The NE 555, 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.

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". A monostable circuit produces a single output pulse when triggered. It is stable in just one state; the "output low" state. This is also known as the triggered pulse producer.

OnceThe 555 timer IC is integreted circuit(chip) used in variety of timer pulse generation and oscillator applications.

The 555 timer can be used to provide time delays,as an oscillator and as a flip-flop element.Derivatives provide two (556) or four(558)timing circuiuts in one package

LED: "A light emitting diode is two-LED semi conductor light source .It is a p-n junction diode that emits light when activated. When a suitable voltage is applied to the leads ,electrons are able to recombine with electron holes within the device, releasing energy in the form of photons ".

Micro Phones: This type of microphone converts pressure fluctuations into electrical current. This microphone works by means of the principle known as faraday's law ,the principle states that when an electrical conductor is moved through a magnetic field ,an electrical current is induced within the conductor 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. The current generated in the microphone is the electrical pulse. There are two major types of microphones based on the technical methods of converting sound into electricity namely the organic and condenser microphone. Table 1 shows the comparison between the dynamic and condenser microphone. Condenser microphones generally have flatter frequency responses than dynamic, and therefore mean that a condense rmicrophone is more desirable if accurate sound is a prime consideration as required in this design.

III. PIN DIAGRAM OF IC555 TIMER

Pin 1: Grounded Terminal: All the voltages are measured with respect to the Ground terminal.

Pin 2: Trigger Terminal: The trigger pin is used to feed the trigger input hen the 555 IC is set up as a monostable multivibrator. This pin is an inverting input of a **comparator** and is responsible for the transition of **flip-flop** from set to reset. The output of the timer depends on the amplitude of the external trigger pulse applied to this pin. A negative pulse with a dc level greater than Vcc/3 is applied to this terminal. In the negative edge, as the trigger passes through Vcc/3, the output of the lower comparator becomes high and the complimentary of Q becomes zero. Thus the 555 IC output gets a high voltage, and thus a quasi stable state.

Pin 3: Output Terminal: Output of the timer is available at this pin. There are two ways in which a load can be connected to the output terminal. One way is to connect between output pin (pin 3) and ground pin (pin 1) or between pin 3 and supply pin (pin 8). The load connected between output and ground supply pin is called the ***normally on load*** and that connected between output and ground pin is called the ***normally off load***.

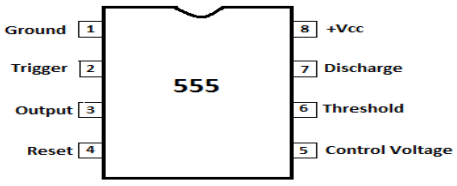
Pin 4: Reset Terminal: Whenever the timer IC is to be reset or disabled, a negative pulse is applied to pin 4, and thus is named as reset terminal. The output is reset irrespective of the input condition. When this pin is not to be used for reset purpose, it should be connected to + V_{CC} to avoid any possibility of false triggering.

Pin 5: Control Voltage Terminal: The threshold and trigger levels are controlled using this pin. The pulse width of the output waveform is determined by connecting a POT or bringing in an external voltage to this pin. The external voltage applied to this pin can also be used to modulate the output waveform. Thus, the amount of voltage applied in this terminal will decide when the comparator is to be switched, and thus changes the pulse width of the output. When this pin is not used, it should be bypassed to ground through a 0.01 micro Farad to avoid any noise problem.

Pin 6: **Threshold Terminal:** This is the non-inverting input terminal of comparator 1, which compares the voltage applied to the terminal with a reference voltage of 2/3 V_{CC}. The amplitude of voltage applied to this terminal is responsible for the set state of flip-flop. When the voltage applied in this terminal is greater than 2/3Vcc, the upper comparator switches to +Vsat and the output gets reset.

Pin 7 : Discharge Terminal: This pin is connected internally to the collector of transistor and mostly a capacitor is connected between this terminal and ground. It is called discharge terminal because when transistor saturates, capacitor discharges through the transistor. When the transistor is cut-off, the capacitor charges at a rate determined by the external resistor and capacitor.

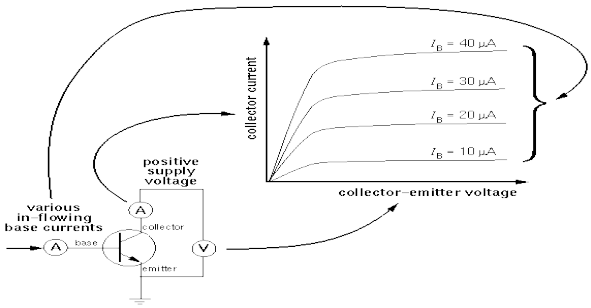
Pin 8: Supply Terminal: A supply voltage of + 5 V to + 18 V is applied to this terminal with respect to ground (pin 1).



NPN CHARACTERSTICS:

The behavior of an NPN bipolar transistor is largely controlled by the current flowing into the base (i.e., a positive current). For the usual collector-emitter voltage drops (i.e., the active region: positive voltages from a fraction of a volt up to some breakdown voltage) the collector current (IC) is nearly independent of the collector-emitter voltage (VCE), and instead depends on the base current (IB). (This is unusual behavior: usually more voltage produces to more current, but here the current only increases slightly with increasing VCE.) The current gain, i.e., the ratio of the collector current to the base current, is often denoted by or hFE:

hFE = IC/IB



NPN Characteristic curves

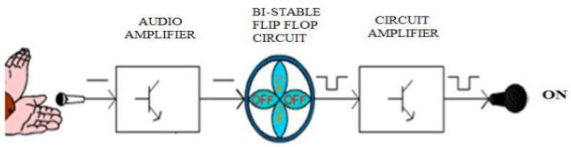
Specifications:

These specifications apply to the NE555. Other 555 timers can have different specifications depending on the grade (military, medical, etc.). These values should be considered "ball park" values, instead the current official datasheet from the exact manufacturer of each chip should be consulted for parameter limitation recommendations.

Supply voltage Vcc=4.5 to 15V
Supply Current (+5V)= 3 to 6 mA
Supply Current (+15V)= 10 to 15 mA
Out Put Current 200mA
Maximum Power Dissipation 600mW
Power Consumption 30mW@5V, 225mW@15V
Operating Temperature 0 to 75 Degrees

IV. CIRCUIT DIAGRAM & WORKING OF CIRCUIT

Block Diagram



Audio Amplifier: when we clap our hands , the sound is received by by AUDIO AMPLIFIER.Here the given sound signal is converted into electrical signal and then amplified by usingAn **audio power amplifier** (or **power amp**) is an electronic amplifer that reproduces low-power electronic audio signals such as the signal from radio receiver or electric guitar pickup at a level that is strong enough for driving (or powering) loud speakers or headphones. This includes both amplifiers used in home audio systems and musical instrument amplifers like guitar amplifers. It is the final electronic stage in a typical audio playback chain before the signal is sent to the loudspeakers and speak

enclosers. The preceding stages in such a chain are low power audio amplifiers which perform tasks like pre amplification of the signal (this is particularly associated with record turn table signals, microphone signals and electric instrument signals from pickups, such as the electric guitar and electric bass), Equalization (e.g., adjusting the bass and treble), tone controllers, mixing different signal inputs or Adding electronic effects such as reverb. The inputs can also be any number of audio sources like record players, CD players, digital audio playersand cassette players. Most audio power amplifiers require these low-level inputs, which are line level. While the input signal to an audio power amplifier, such as the signal from an electric guitar, may measure only a few hundred microwatts, its output may be a few watts for small consumer electronics devices, such as clock radios, tens or hundreds of watts for a home stereo system, several thousand watts for a nightclub's sound system or tens of thousands of watts for a large rock concert sound reinforcement system. While power amplifiers are available in standalone units, typically aimed at the hi-fi audiophile market (a niche market) of audio enthusiasts and sound reinforcement system professionals, most consumer electronics sound products, such as clock radios, boom boxes and televisions have relatively small power amplifiers that are integrated inside the chassis of the main product.

flip-Flop Circuit: After amplifying the given input signal (sound of a clap) ,it is fed to flip flopcircuit. It consists of two transistors, one for the on position and the other for the off position. For this reason it is also known as bi-stable multi vibrator. In electronics, a **flip-flop** or **latch** is a circuit that has two stable states and can be used to store state information. A flip-flop is a bistable multivibrator The circuit can be made to change state by signals applied to one or more control inputs and will have one or two outputs. It is the basic storage element in sequential logic. Flip-flops and latches are fundamental building blocks of digital electronics systems used in computers, communications, and many other types of systems.

Flip-flops and latches are used as data storage elements. A flip-flop is a device which stores a single ***bit*** (binary digit) of data; one of its two states represents a "one" and the other represents a "zero". Such data storage can be used for storage of *state*, and such a circuit is described as sequential logic in electronics. When used in a finite-state machine, the output and next state depend not only on its current input, but also on its current state (and hence, previous inputs). It can \also be used for counting of pulses, and for synchronizing variably-timed input signals to some r eference timing signal. Flip-flops can be either simple (transparent or opaque) or clocked (synchronous or edge-triggered). Although the term flip-flop has historically referred generically to both simple and clocked circuits, in modern usage it is common to reserve the term *flip-flop* exclusively for discussing clocked circuits; the simple ones are commonly called *latches*.[1][2]

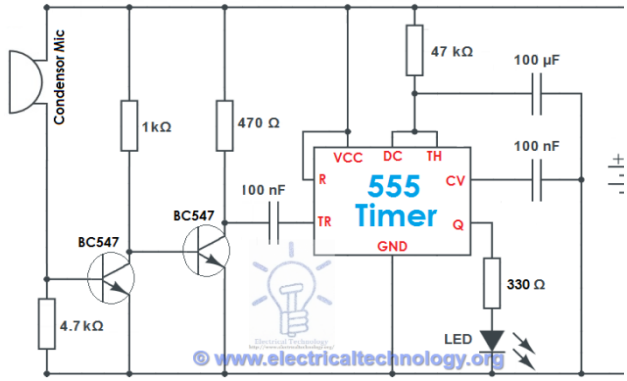
Using this terminology, a latch is level-sensitive, whereas a flip-flop is edge-sensitive. That is, when a latch is enabled it becomes transparent, while a flip flop's output only changes on a single type (positive going or negative going) of clock edge.

CIRCUIT AMPLIFIER:

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 mechanical switch *This article is about electronic amplifiers. For other uses, see Amplifier (disambiguation).* A 100 watt stereo audio amplifier used in home component audio systems in the 1970s. An amplifier, electronic amplifier or (informally) amp is an electronic device that can increase the Power of a signal (a time-varying voltage or current) An amplifier uses electric power from a power supply to increase the amplitude of a signal. The amount of amplification provided by an amplifier is measured by its gain: the ratio of output voltage, current, or power to input. An amplifier is a circuit that has a power gain greater than oneAn amplifier can either be a separate piece of equipment or an electrical circuit contained within another device. Amplification is fundamental to modern electronics, and amplifiers are widely used in almost all electronic equipment. Amplifiers can be categorized in different ways. One is by the frequency of the electronic signal being amplified. For example, audio amplifiers amplify signals inthe audio (sound) range of less than 20 kHz, RF amplifiers amplify frequencies in the radio frequency range between 20 kHz and 300 GHz, and servo amplifiers and instrumentation amplifiers may work with very low frequencies down to direct current. Amplifiers can also be categorized by their physical placement in the signal chain; a preamplifier may precede other signal processing stages, for example.[4] The first practical electrical device which could amplify was the triodevacuum tube, invented in 1906 by Lee De Forest, which led to the first amplifiers around 1912.

Clap switch is a circuit that can switch ON & OFF a light, fan, radio etc. by the sound of clap. The sound of clap is received by a small microphone that is shown biased by resistor R1 in the circuit. The microphone changes sound wave in to electrical wave which is further amplified by Q1.Transistor Q1 is used as common emitter circuit to amplify weak signals received by the microphone. Amplified output from the collector of transistor Q1 is then feed to the bi-

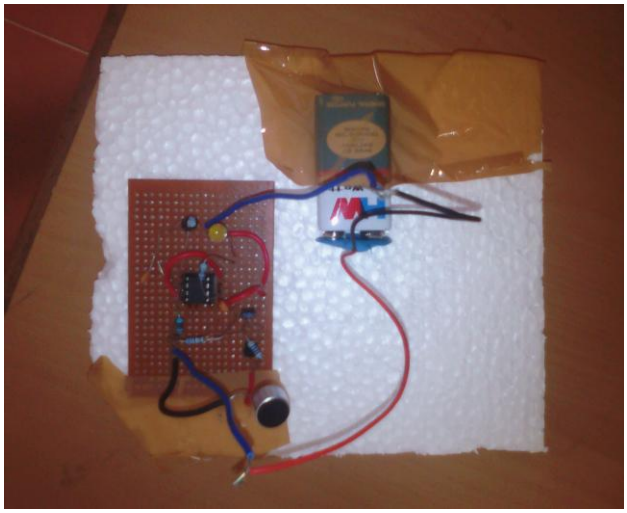
stable multi vibrator circuit also known as flip-flop. Flip-flop circuit is
made by using two Transistors, in our circuit Q2 and Q3.
In a flip-flop circuit, at a time only one transistor conduct and other cut off and when it gets a trigger pulse from outside source then first transistor is cut off and 2nd transistor
conducts. Thus output of transistor is either logic-0 or logic-1 and it remains in one state 0or 1 until it gets trigger pulse from outer source. The pulse of clap which is a trigger for flip-flop which makes changes to the output which is complementary (reverse).Output of flip-flop which is in the low current form is unable to drive relay directly so we have used a current amplifier circuit by using Q4 which is a common emitter circuit. Output of Q4 is connected to a Relay (Electromagnetic switch), works like a mechanical switch.



Circuit Diagram of Clamp Switch Controller

RESULTS:

We constructed the circuit as per circuit diagram . And we verified the clap switch circuit. i. e when sound occurs near by the circuit the led in the circuit glows and for the second clap it is in off
condition .



V. ADVANTAGES

1. The primary application involves an elderly or mobility-impaired person.
2. We can turn something (e.g. a lamp) on and off from any location in the room (e.g. while lying in the bed) simply by clapping our hands.
3. Low cost and reliable circuit.
4. Complete elimination of man power.

VI. DISADVANTAGES

1. It is generally cumbersome to have to clap one's hands to turn something on or off and it is gerally seen as simpler for most use cases to use a traditional light switch.
2. Unless we use a filter in the circuit , it is not that advantageous. So that circuit activates only for clap of particular frequencies and then it becomes accurate.

VI. APPLICATIONS

1. Clap activated switch device will serve well in different phono-controlled applications.
2. Clap switch is generally used for a light, television, radio or similar electronic device that the person will want to turn on/off from bed.
3. This circuit functions on using the sound energy provided by the clap which is converted into electrical energy by condenser microphone . Using this converted electrical energy which is used to turn on relay
(an electronic switch).
4. The primary application involves an elderly or mobility-impaired person.
5. The major advantage of a clap switch is that you can turn something (e.g. a lamp) on and off from any location in the

room (e.g. while lying in bed) simply by clapping your hands.
6. The major disadvantage is that it's generally cumbersome to have to clap one's hands to turnsomething on or off and it's generally seen as simpler for most use cases to use a traditional light switch

VII. 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's 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 it 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.

VIII. FUTURE SCOPE

We can increase the range of this equipment by using better Mic 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. 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.

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