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SIMPLE CLAP SWITCH

BARANI DARAN R[1], KAVIN G[2], SUDHARSHAN B[3], CHANDHRU V[4]

Second year Instrumentation and Control engineering, Saranathan college of Engineering, Panjappur, Trichy, Tamil Nadu

Abstract:

This is a simple clap switch circuit with high sensitivity. It switches ON/OFF electrical appliances through claps. clap operated circuit is operated by clapping from a particular distance (Depends upon the microphone used). Then that leads to the first output of the circuit which is to be turned on, then when another clap is given to the circuit it will show us the next output & that continues with the clap. The main component of this circuit is the Electric Condenser Microphone, This Microphone used as a sound sensor and converts sound energy into electrical energy, and that continues with another two Ic's and then with the Transistor. Primarily it is a Sound operating switch. For example, real life application based on this device include fan, fluorescent light, tv and other appliances which can be switched on off by clapping. This clap switch circuit can be changed based on situation.

Key words:
Integrated circuit, Transistor, Resistors, Decade Counter, Operational Amplifier.

1. INTRODUCTION

An electronic device that can control appliances by users clap action is a clap switch. It was invented by R. Carlie 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. The condenser mic is one of the main components in the circuit that tracks the input clap sound based on the clap and transduces the sound energy into some electric pulses. These electric pulses are the desired input to the clap switch circuit. This circuit is mainly based on the two ICs i.e., Operational Amplifier IC741 and CD4017. Clapping hands basically produce about 2200 to 2800hz range and the total time taken for outcome from the circuit will be up to 3 seconds in maximum.

2. GENERAL DESCRIPTION OF THE COMPONENT USED

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**. Here, the diaphragm acts as one plate of a capacitor, and the vibrations produce changes in the distance between the plates. The voltage maintained across the capacitor plates changes with the vibrations in the air, according to the capacitance equation ($C = Q / V$), where Q = charge in coulombs, C = capacitance in farads and V = potential difference in volts. The capacitance of the plates is inversely proportional to the distance between them for a parallel-plate capacitor.

Resistor (R): A component is used for its resistance. 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. They are unsuitable for RF use because of their reactance.

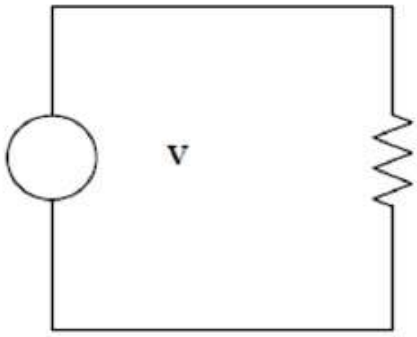

Figure 1

Diode (D): 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 (P junction) and a cathode K terminal (N junction).

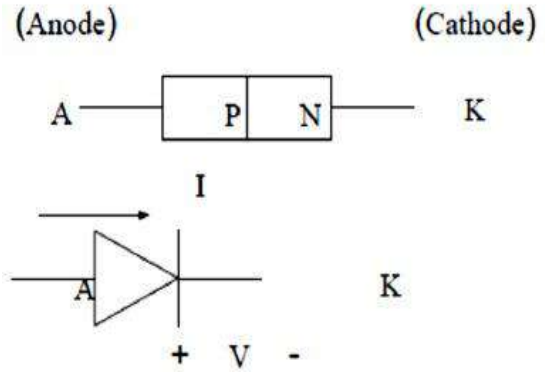

Figure 2

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.

Transistor BC 547: As a representative of the large family of bipolar transistors the BC547 provides a "stepping off point" to the use of more esoteric, higher voltage, current or frequency devices for beginners' theTO-92package is held in front of one's face with the flat side facing toward you and the leads downward, (see picture) the order of the leads, from left to right is collector, base, emitter.

The BC547 transistor is an NPN Epitaxial Silicon Transistor. The BC547transistor is a general-purpose transistor in a small plastic package. It is used in general-purpose switching and amplification BC547 series 45 V, 100 mA NPN general-purpose transistors.

The BC547 transistor is an NPN bipolar transistor, in which the letters "N" and "P" refer to the majority charge carriers inside the different regions of the transistor. Most bipolar transistors used today are NPN, because electron mobility is higher than hole mobility in semiconductors, allowing greater currents and faster operation. NPN transistors consist of a layer of P-doped semiconductor (the "base") between two N-doped layers.

A small current entering the base in common-emitter mode is amplified in the collector output. In other terms, an NPN transistor is "on" when its base is pulled high relative to the emitter. The arrow in the NPN transistor symbol is on the emitter leg and points in the direction of the conventional current flow when the device is in forward active mode. An NPN transistor can be considered as two diodes with a shared anode region. In typical operation, the emitter base junction is forward biased and the base collector junction is reverse biased. In an NPN transistor, for example, when a positive voltage is applied to the base emitter junction, the equilibrium between

thermally generated carriers and the repelling electric field of the depletion region becomes unbalanced, allowing thermally excited electrons to inject into the base region. These electrons wander (or "diffuse") through the base from the region of high concentration near the emitter towards the region of low concentration near the collector. The electrons in the base are called minority carriers because the base is doped p-type which would make holes the majority carrier in the base.

Figure 3

Decade Counter (CD4017IC): 4017 IC is a common useful digital IC. [From input pin (14 nodes)]. This is called divided by10 counter because it produces one tenth of square wave frequency provided from input pin (pin 14) to output pin (on pin 12). Counter circuit is a digital circuit. Generally, counter is the circuit that counts the number of the square wave entered to the circuit. In CD 4017 IC means the symbol of the company that produces the IC. There are IC, with other letters, this IC is called 4017 IC is the form of 14 pin DIP which includes 16 pins.

IC 741 Op Amp (Operational Amplifier): The 741 Op Amp IC is a monolithic integrated circuit, comprising of a general-purpose Operational Amplifier. It was first manufactured by Fairchild semiconductors in the year 1963. The number 741 indicates that this operational amplifier IC has 7 functional pins, 4 pins capable of taking input and 1 output pin.

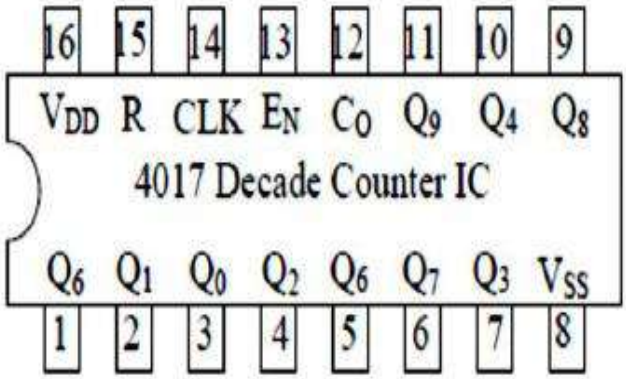

Figure 4

IC 741 Op Amp can provide high voltage gain and can be operated over a wide range of voltages, which makes it the best choice for use in integrators, summing amplifiers and general feedback applications. It also features short circuit protection and internal frequency compensation circuits built in it. This Op-amp IC comes in the following form factors:

- 8 Pin DIP Package
- TO5-8 Metal can package
- 8 Pin SOIC

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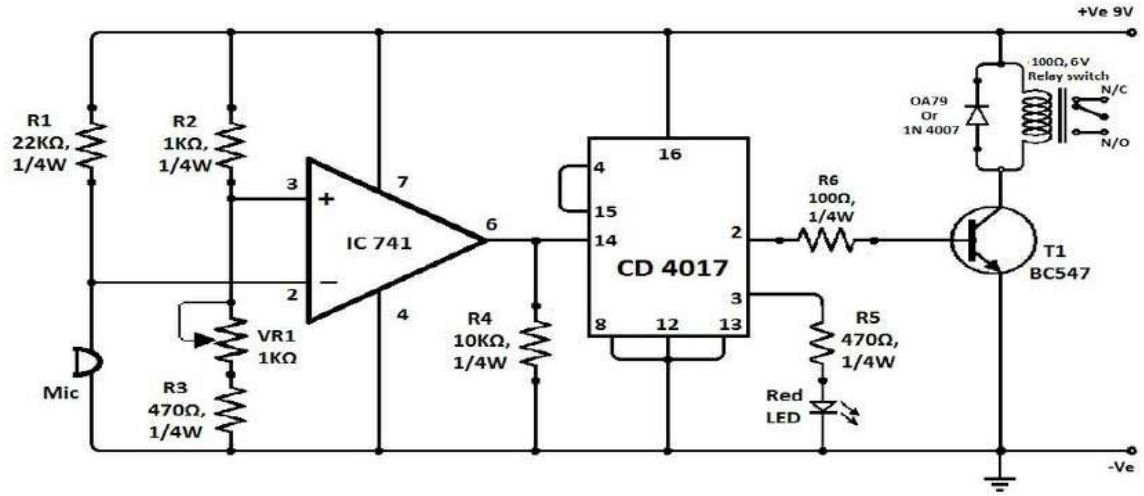

Figure 5

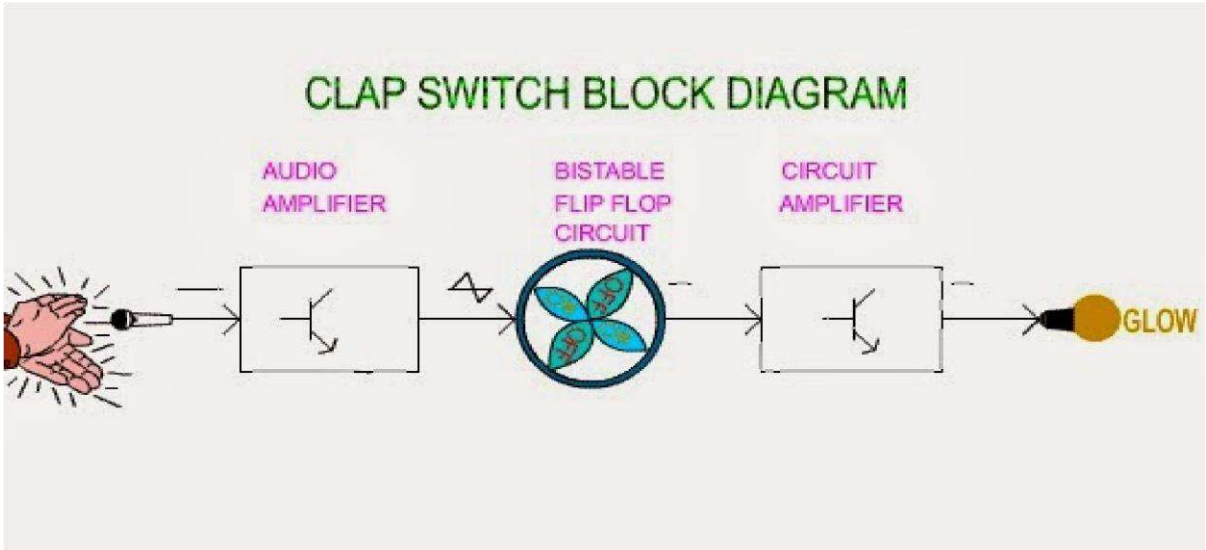

Figure 6

3. DESCRIPTION OF BLOCK DIAGRAM AUDIO AMPLIFIER

When we clap our hands, the sound is received by audio amplifier. Here the given sound signal is converted into electrical signal and then amplified by using transistors

3.1 FLIP FLOP CIRCUIT

After amplifying the given input signal (sound of a clap), it is fed to flip flop circuit. 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.

3.2 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.

3.3 METHODOLOGY

When you clap your hands near the microphone. The sound signal is converted into the electrical signal by the condenser microphone. These sound vibrations are given to the inverting input of IC 741 as op-amp (amplifier) merged with IC 4017 as a flip flop to get on and off. Then connected to the T1 as the driving force of the Relay. The Relay is connected to other electronic or electrical devices. Resistors R2, R3 and the variable resistor VR1 adjusts the sensitivity of the amplifier. Resistor R1 sets the sensitivity of the Mic. The Output pulses are amplified from IC1 passes to the input (CD 4017). Resistor R4 make input of IC2 to low so as to prevent false triggering.IC2 is a decade counter IC Which receives a clock signal through the clock input and it turns ON all the 10 outputs one by one, every time it gets the clock input pulse. When you clap once, the relay is activated and the LED (or any load) is turned ON. When you clap for the second time, the relay is deactivated and the LED is turned OFF. Red LED indicates OFF position.

From CD 4017(Approx.) - Supplied voltage 3V–15V, Max: out current 10mA.

3.4 ADVANTAGE

1. Energy efficient
2. Low cost and reliable circuit
3. It provides good output efficiency
4. High Accuracy

5.This is helpful technology for Person with broken leg or physically disabled.

3.5 APPLICATION AND FUTURE SCOPE

Clap activated switch device will serve well in different phono-controlled applications. 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. The primary application involves elderly or physically disabled person. 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.

Here we Have done a simple home-based simple clap switch with commonly used electrical components.

This circuit can be made further as more accurate and more sensible. By increasing the sensitivity, the amplification from the circuit may be increased and used in some modified circuits.

4. RESULT AND CONCLUSION

During the practical implementation of the project, some of the values or components had to be changed in order to get more accurate result. The circuit was successfully performed on bread board (PCB). A red LED is used to indicate the first clap. When the first IC471 generates the output, the LED glows. The relay can drive any common home electrical appliance like fan, light, etc.

The practical value of T in this circuit is 2 seconds, which will be having some variation in theoretical output. That is due to the tolerance of the components used in the circuit.

The clap activated switching device function properly by responding to both hand claps at about one metre 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. This circuit is very useful in the field of electronic circuits. By using some modification, we can use this in various fields.

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