Construction and Operation of a Clap Light Switch

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Abstract : A clap light switch which can light a bulb when one claps hand has been constructed. The device can be used to "ON" or "OFF" a bulb in our home and also for security purposes. For instance, when armed robber's invade a building, the security man clap his hands to "ON" a bulb inside the building for the people inside to be alert. The system consists of dynamic microphone which picks up the sound of one claps and produces a small signal, that is amplified by the succeeding transistor stage. Two transistors cross-connected as a bistable multivibrator changes state at each signal and one of these transistors drives a heavier transistor which controls the lamp or bulb.

Keywords: Amplifier, bistable multivibrator, clap light switch, microphone.

1. INTRODUCTION

The operation of almost every electronic devices is concerned with electrical signals that can be either ON or OFF [5]. 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 car horns.

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The operation of a clap light switch is a digital circuit because of its binary "ON" state and "OFF" state. A clap switch free from triggering turn ON/OFF any clapping. The sound energy produced is transformed by the circuit to electrical energy and its final output state changes to light energy.

2. MATERIALS AND METHODS

The components used as electronic switches in the construction are two transistors cross-connected as a bistable multivibrator to change state at each stage and a bipolar junction transistor.

2.1 MATERIALS

2.1.1 THE BIPOLAR JUNCTION TRANSISTOR

The bipolar junction is constructed with three doped semiconductor regions separated by two P-N junctions [1]. In another word, bipolar junction transistor consists of two back-to-back P-N junctions manufactured in a single piece of a semiconductor crystal. These two junctions give rise to three regions called emitter, base and collector. For its proper working, it is essential to apply voltages of correct polarity across its two junctions. Bipolar junction transistors are very often used as electronic switches. With the help of such a

switch, a given load can be turned ON or OFF by a small control signal [6]. Fig. 1 shows a transistor switching circuit.

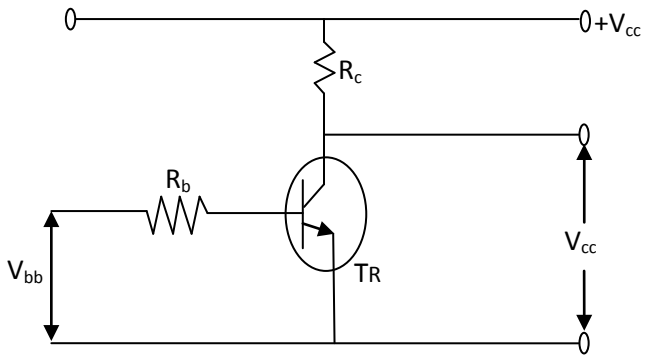

Fig. 1. A transistor switching circuit.

2.1.2 THE BISTABLE MULTIVIBRATOR

Fig. 2 shows the basic circuit of bistable multivibrator. Like the biploar junction transistor, it consists of two simple switching stages which are interconnected and a two stage common-emitter amplifier with positive feedback applied. It has two absolutely stable states. It can remain in either of these two states indefinitely (as long as power is supplied) unless an external trigger pulse switches it from one state to the other [4].

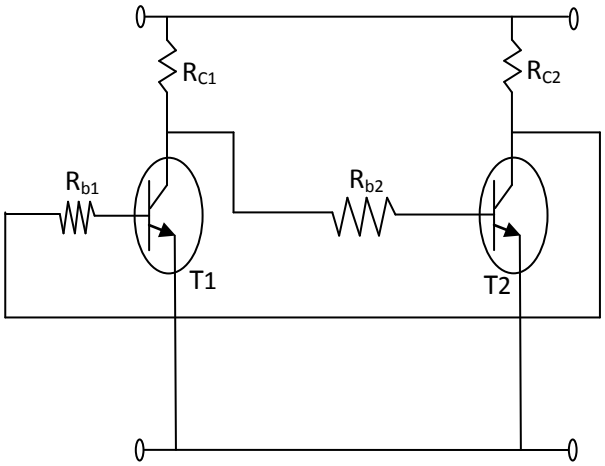

Fig. 2. A bistable multivibrator.

2.2 METHOD

The Vero board forms the chassis on which all other components such as resistors, capacitors, diode and transistors were mounted and soldered as shown in the circuit diagram in Fig. 3. Care were taken to avoid bridging in the circuit.

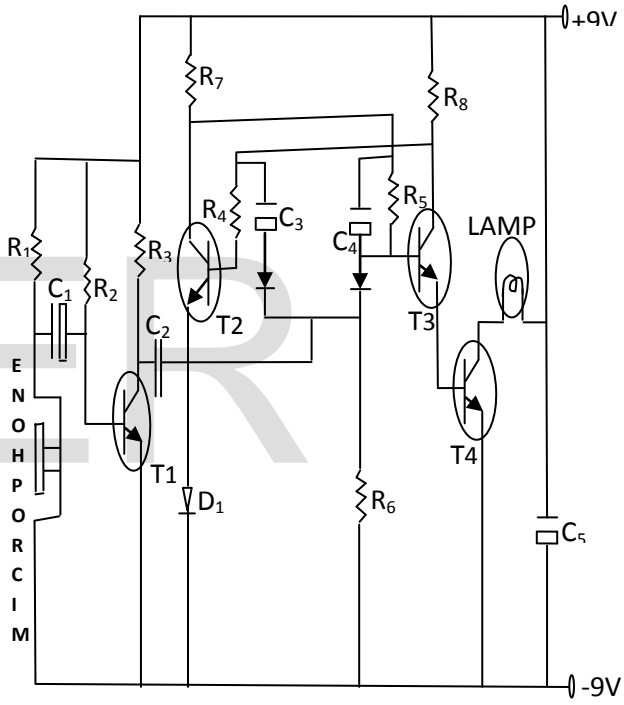

Fig. 3. Circuit diagram of the constructed clap light switch.

T1 acts as an amplifier and was connected such that the emitter is passed to the ground and the output current, I_c from the collector terminal is passed through C_2 to the bistable state stage. T2 was connected such that the emitter terminal is join to a diode D_1 of its positive terminal and the negative terminal to the ground. T3 and T4 are Darlington connections. The emitter of T3 connected to the base terminal of T4 and the emitter of T4 to the ground and the collector terminal of T4 connected to the lamp and the other terminal through an electrolytic capacitor C_5 to the ground. The microphone and the battery was then connected as shown in the circuit diagram above.

The circuit diagram of the constructed clap light switch shown in Fig. 3 helps in providing the knowledge of the position of a particular component and how it is linked up with other components in the circuit.

3. OPERATION

When one claps the hand, the microphone picks the sound and transduces the acoustical sound energy into electrical current and voltage output will flow out because the microphone is in parallel with the resistor (by voltage divider method). The output signal is then amplified by the succeeding transistor stage, T1. The amplified signal will flow across a ceramic capacitor to remove ripples, then to the

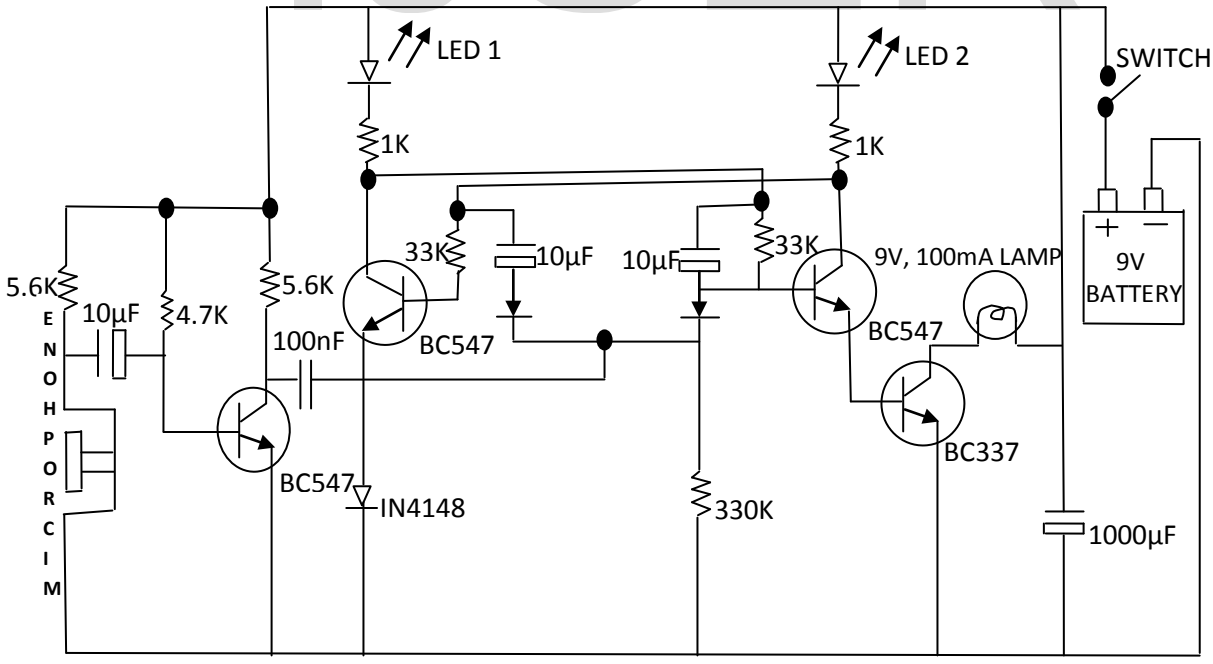

Fig. 4. Schematic diagram of a clap light switch (saint419.removed.us).

bistable stage which changes state at each signal (first clapping and the second clapping). That is, the bistable multivibrator is made by interconnecting two switches such that regeneration occurs. Since resistor R_7 and resistor R_8 are equal in value as resistor R_4 and resistor R_5, the amplified signal that passes across the capacitor C_2 will cause the base current, I_b of transistor 1, T1 to drop slightly, so that the collector current, I_c of transistor 2, T2 becomes less and the voltage across the collector of transistor 1, T1 rises. Consequently, the base current in transistor 2, T2 becomes less.

The reduction in the voltage of the collector current, I_c of transistor 2 causes the base current I_b of transistor 1 to drop further. Transistor 2, T2 turn ON, transistor 1, T1 turn OFF and because of the positive feedback, the circuit gets into its final state with T2 ON and T1 OFF. The output signal from T2 will be made more amplified when it passes through T3 (Darlington connection) and the lamp will turn ON. At the second clap, the reverse will be the case and the lamp will go OFF.

3.1 TEST AND RESULTS

When the constructed circuit was completed , it was necessary that some tests be conducted to confirm that the circuit is working properly. The battery when connected to the switch and the switch closed supplied the required 9V dc needed to power or turn ON the lamp. LED 1 and LED 2 was “ON” when transistor 2, T2 and transistor 3, T3 was triggered to show that the transistors are working. Finally, the lamp glows when the switch was closed and a sound (clap) is picked by the microphone to confirm that the battery was delivering the required voltage. At the second clap, the reverse will be the case and the lamp goes OFF.

Thus, the result obtained from the test shows that there was no short circuit in the system and that the designed circuit worked as it was meant to.

4 . CONCLUSION

The process of constructing a clap light switch just like that of any other electronic device is interesting but not quite easy. This is due to variations in theoretically calculated components values and those actually used. The variations pose problems in a situation where the researcher is a neophyte in the field of electronics. For instance, the practical output voltage of the clap light switch was measured to be 8.85V on the multimeter while its theoretically calculated value from components was 9.0V. This error is mainly due to the tolerances of the components.

The result obtained really satisfied its goal as the ON and OFF of the lamp was controlled by the acoustical sound signal produced.

4.1 RECOMMENDATION

This work is worth's to be recommended as it could applied not only in our homes to “ON” or “OFF” a bulb and for security purposes but also for opening of gate. That is, the sound produced by a car when it horn's could cause a circuit to be ON as a result of which a gate can be open.

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