Just a Clap Away – A Sensor-Based Switching System for Automating Light Switching in Homes and Offices.

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ABSTRACT

This project on Clap Operated Switch describes a system where a switch board in homes or offices can be controlled by the sound of a clap. A single hand clap can switch ON the light and another corresponding clap switches it OFF. The Condenser Microphone basically converts sound of a clap into electrical energy; the output of the sensor which processes the signal triggers the 4017 timer IC, through a Transistor. The first clap triggers the CD4017BE IC which turns on the red LED and this LED automatically goes off after some time. The second clap also triggers the 4017 IC OFF the light and it's indicated by the green LED. The prototype of the system can work for claps within 1.5m distance and takes an interval of within 1second to turn ON/OFF the light bulb. The advantage of the system is that user would not use any mechanical switch or additional remote controller to control his appliance. This system may also be helpful for physically impaired person who will find it difficult locating the switch or remote to control the lighting.

Keywords: Sound, multi vibrator, microphone, relay, switch.

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1. BACKGROUND TO THE STUDY

In the current revolution of digital world, people like convenience in using technology to make their life more easy and comfortable. People feel better to control their home appliances like light etc. in a more convenient way rather than by walking across the room to either on or off such appliances. This motivated the developing of this device which allows the user to control the electrical appliances wirelessly without using the conventional switch board. One of the ways to control electrical appliances is by using Radio Frequency (RF) or Infrared (RF) remote control unit. But, it is not convenient in the sense that users require a little walk across the room in order to retrieve the remote control unit and sometimes when the remote control unit is misplaced or bad, it usually requires extra time and effort to find or fix it. Therefore, it will be more convenient if we use hand clap to control electrical appliance rather than using an extra device like remote controller [2]. **The Clap Operated Switch** is made up of several basic components to able to turn ON/OFF any electrical component or circuit by the clap sound using the condenser microphone for dictating clap sound as the input. We can also say that it converts the Sound energy into the Electrical Energy, because we are given an input to the circuit as a sound whereas the Circuit gives us the output as a LED glow (Electrical Energy) [4].

This working of this circuit is based on amplifying nature of the transistor, switching nature of transistor, and relay as an electronic switch. The Light Emitting Diode (LED) ON-time can be varied by changing the value of the capacitor (100mF). When the capacitor value is changed from 100 mF to 10mF, the LED ON time is decreased [1].

1.1 Statement of Problem

Internet of things makes usage of technology seamless. The thrust of this work is to leverage on electronic sensors to develop a switch that can identify sound which can turn ON/OFF a light within an interval of 1 second at a distance of 1.5m and can be used in homes or offices.

1. 2 Objectives Of The Study

The objective of this project is to implement a clap switch that can ON/OFF by the sound of clap based on the desire to alleviate the problem faced by the aged, sick and physically challenged persons in trying to control some household appliances. It also takes into considerations the illiterates that may have problems operating some complex hand-held Remote Control Units (RCUs).

1.3 Block Diagram

The diagram as shown in Fig 4.1 functions with the help of Sound activated sensor, which senses the sound of clap within the range of 1.5ms and processes it to the circuit in order to give the output. The IC 4017 timer generates the pulse to the LED. The first clap sends a signal as an input to the Electric Condenser Microphone, within an interval of 1 second, and changes the Electrical Energy as the LED turns on. The second clap sends a signal input which is fed to the relay which switches on the load then the output from the IC 4017 timer is received and it turns OFF automatically after few seconds.

2. METHODOLOGY

First the condenser microphone senses the sound of the clap captures the sound and converts it into an electric signal. The Transistor then amplifies the sound received from the microphone. The IC 4017 timer is used to modify the first and the second clap. Both claps are typically within the 1.5ms range. The microphone amplifies the signal which enables the IC 4017 timer to recognize the 1st clap and move to the ON state indicated by the red LED. Now, the 2nd clap is captured also by the IC 4017 timer within an interval of 1 second and moves to the OFF state. This time interval is possible with the help of the decade counter to ensure that both claps are generated within 1 second [1].

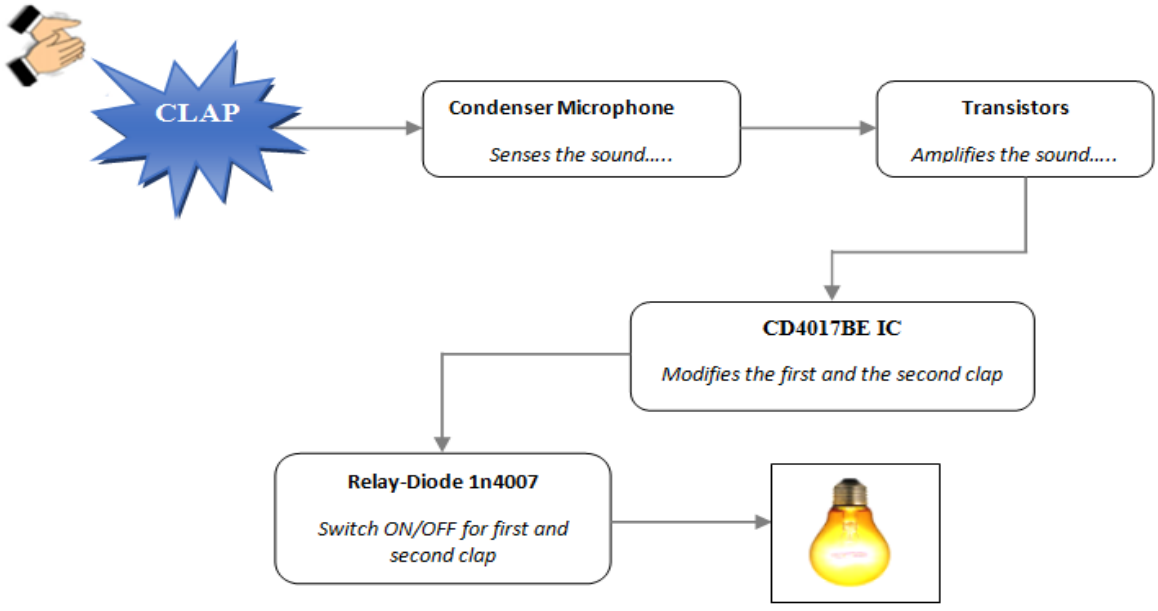

Fig 1: Block Diagram of the Clap Switch

3. EXPLANATION OF CIRCUIT DIAGRAM

This is the circuit of a very sensitive clap switch. It switches ON/OFF electrical appliances through claps. The circuit changes its output state only when you clap once from a distance of 1.5 meters.

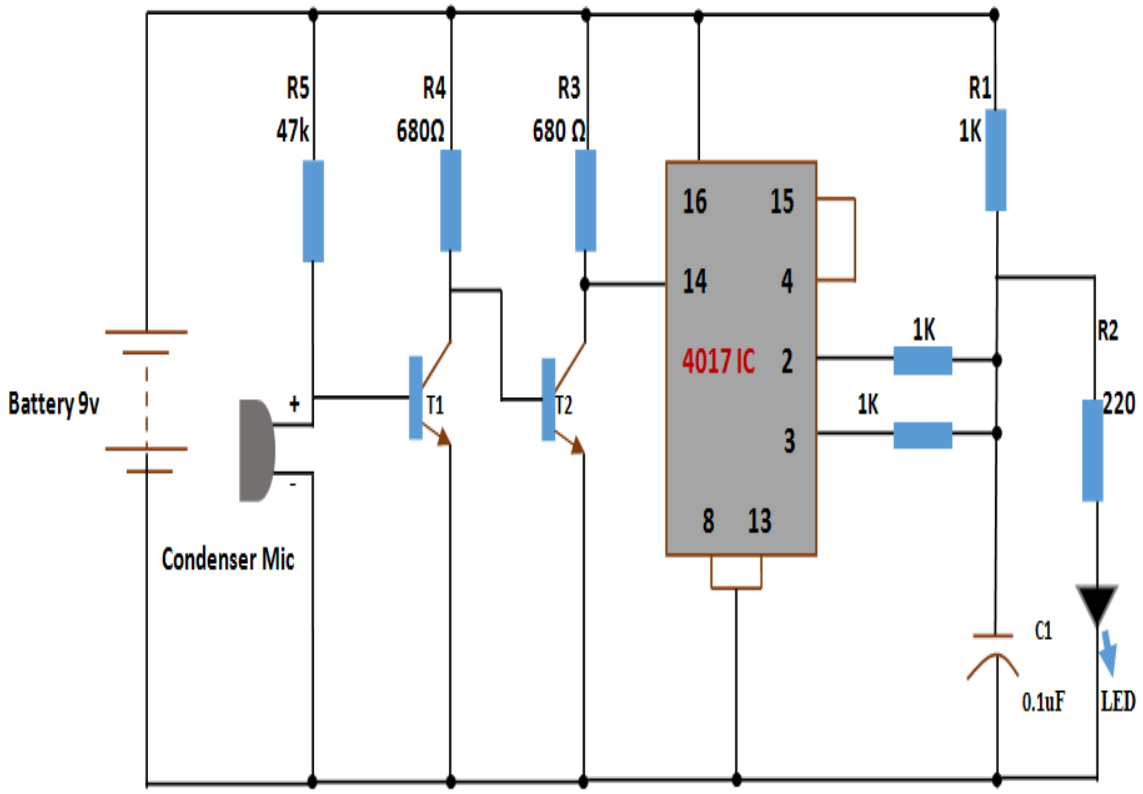

Fig. 2: Circuit Diagram

Here, after the clap it takes within 1 second to either to turn ON/OFF the light. The Condenser Microphone is amplified by transistor T1 and T2, and picks up sound vibrations caused by the clap. The amplified signal provides negative pulse to pin 14 triggering the CD4017BE IC commonly used as a timer which is wired here as a monostable multivibrator. Triggering of IC 4017 causes pin 2 to receive the sound, it remains high for a certain period depending on the selected values of Resistor and C1. This 'on' time (T) of IC 4017 can be calculated using the following relationship: T=1.1R1*C1 where R1 is in ohms (k) and C1 in microfarads. On first clap, output pin 3 of IC 4017 goes high and remains in this standby position for the preset time. The red LED also glows for this period.

The output of IC 4017 provides supply voltage at pins 8 and 13. On second clap, a negative pulse triggers IC 4017 and its output pin 3 goes high for a time period depending on Resistor. This provides a positive pulse at clock pin 14 of decade counter IC 4017. Each pulse applied at clock pin 14 changes save as input pulse. The relay indicates the on/off status of the LED (green/red) In the second clap, output pin 2 becomes low and red LED will be switched on while the green LED) indicates the OFF position [5].

4. IMPLEMENTATION

This system is implemented as a prototype to ascertain its reliability. **Fig. 3, Fig. 4** and **Fig. 5** capture images of the prototype. The clap activated switching device functions properly by responding to one clap at a time at about 1.5 meter away. The resulting device is realizable, has good reliability and it is relatively inexpensive.

Fig 3: When the battery is not connected

In the output, a LED is used instead of a bulb. A red LED is used to indicate ON for the first clap. When the CD4017BE IC timer generates the output, the LED glows and the green LED indicates OFF for the second clap. A 9 volts power supply was used to correspond to the battery voltage for desired result.

Fig 4: When the device senses the first clap (red LED turns ON)

Fig 5: When the device senses the second clap

Here the above figure shows that the device is OFF after the second clap which is indicated with the green LED until the battery is disconnected.

5. RESULTS AND DISCUSSION

This circuit was assembled on a general-purpose printed circuit board (PCB) and enclosed in a suitable box. This prototype was able to turn ON the red LED at the first clap and OFF at the second clap indicated by the green LED This system is beneficial to elderly, physically impaired persons and illiterates that cannot control hand held devices. This circuit is very useful in the field of electronic circuits, and if properly modified can be applied in various fields. It can also be used to raise alarm in security system.

The time it takes for the sound to trigger the IC 4017 to turn ON/OFF the LED is calculated by the formula:

T = 1.1R1 *C1

According to the theoretical values, the time period should be:

T = 1.1 x1K x 0.1uF
=1.10

The practical value of T in this circuit is 1.33 seconds which is slightly greater than the calculated theoretical output due to the tolerance of the components used in the circuit.

Design and calculation for IC 4017

The ON time (T) is the duration of the pulse and it is determined by the values of resistor and capacitor R1 and C1 respectively. The ON time (T) duration of the pulse is determined by the selected values of R1 and C1. Choosing C =0.1uF, since there are few available values: calculating for a time period of 1 second.

$T = 1.1 \times R_1 \times C_1$

$R_1 = T/1.1 \times C_1$

$= 1/0.1 \times 100 \times 1.1$

$= 110K\Omega$

Viable resistor chosen as $R_1 = 110K\Omega$

T = 1.1 x R1 x C1

T = 1.1 x 110 KΩ x 1uF

= 1.21

6. ADVANTAGES AND APPLICATIONS

The clap operated switch offers lot of advantages which can be applied in other household and office appliances.

Advantages:

- Energy efficient
- Low cost and reliable circuit
- Complete elimination of manpower
- High Accuracy

Applications:

- The primary application is basically for mobility, the elderly and impaired person. A clap switch can be used to operate a light, television, radio or similar electronic device that needs to be turned on/off within the home or office.
- A Clap Switch can also be used as a security gadget for emergency by triggering an alarm.

7. CONCLUSION

The clap activated switching device, operates appropriately to both claps indicating ON and OFF at a distance of about 1.5 meters and within an interval of 1 seconds away from the switch. This circuit functions using the sound energy provided by the clap which is converted into electrical energy by condenser microphone. In this project as soon the microphone picks the 1st clap, IC 4017 timer triggers the relay conducting path is established between terminals of the load and hence the red LED is turned on. The IC 4017 timer also triggers the light OFF after the second clap. The time interval between the claps is judged with the time constant established with the RC configuration which is T=1.1R1.Therefore we would like to conclude that the circuit is very much useful to switch ON and OFF household appliances just by clap. But the major limitation of this switch is false triggering and ability to receive clap at longer distance. The switch can be triggered by any two sounds similar to that of hands clapping. The prototype so far developed is inexpensive, reliable and makes life easier.

8. FUTURE SCOPE

This project can be enhanced by introducing circuit lock to the switch board so as to restrict unwanted sounds that could obstruct its normal operation. It can be further implemented by increasing the frequency of the clap to accommodate a long distance from the switch. To add more sensitivity to the switch, the amplification factor can be increased.

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