LINEAR INTEGRATED CIRCUITS

# SEISMIC SENSOR

# PROJECT REPORT

SUBMITTED TO

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## AIM

We aim to simulate and analyze a circuit of seismic sensor that could be used to alert people when an earthquake occurs.

We will also be making a hardware model for the same on breadboard and demonstrate how the circuit reacts when an input signal is provided as opposed to no input being provided.

## ABSTRACT

A seismic tremor (otherwise called a shake, tremor) is the consequence of a sudden arrival of vitality in the Earth's hull that makes seismic waves. The seismicity, or seismic movement of a territory alludes to the recurrence, sort and size of tremors experienced over a time of time.

The seismic tremors are measured using perceptions from seismometers.
The larger number of various quakes lesser than magnitude 5 reported by national seismological observatories are measured basically on the nearby extent scale, likewise alluded to as the Richter scale.

This circuit simulates a seismic sensor to detect vibrations/sounds. It is very sensitive and can detect vibrations caused by the movement of animals or human beings.

A standard piezo sensor is used to detect vibrations/sounds due to pressure changes. The piezo element acts as a small capacitor having a capacitance of a few nano farads.

## SOFTWARE USED

Proteus 8 professional

## COMPONENTS USED

1) 555 Timer IC
2) LM741
3) BC548
4) Piezoelectric element
5) Resistors

6) Capacitors

7) 10K Potentiometer

8) LED and Buzzer

9)12V Power source

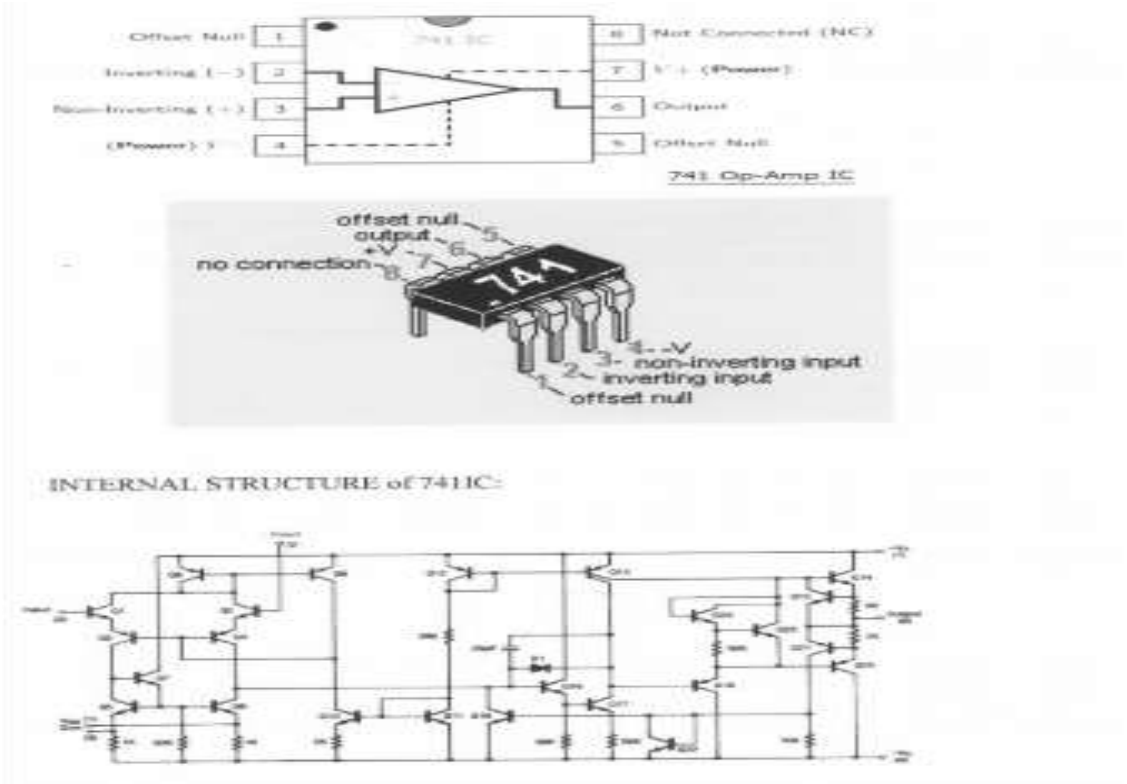
# THEORY OF COMPONENTS USED

## LM741 IC

The IC or integrated circuit is a little black chip, it is a root of modern electronics, and also an essential component circuit. The application of integrated circuits involves each and every electronics circuit board, embedded system and various electronic projects.

An integrated circuit is an asset of various electrical and electronic components like resistors, capacitors, transistors.

All these components are integrated onto a single chip. The pin configuration of the LM741 IC is shown in the figure:



IC 741 Op-Amp Characteristics:

1. Short circuit and overload protection provided.
2. Low power consumption.
3. No latch-up problem.
4. Large common-mode rejection ratio (CMMR) and differential voltage ranges.
5. The Input impedance of the lC 741 op-amp is l00 kilo-ohms.
6. The O/P of the 741 lC op-amp is below 100 ohms.
7. The frequency range of amplifier signals for IC741 op-amp is from 0HZ-1MHZ.
8. Offset current and offset voltage of the lC 741 op-amp is low.
9. The voltage gain of the lC74l op-amp is about 20.

## BC548 TRANSISTOR

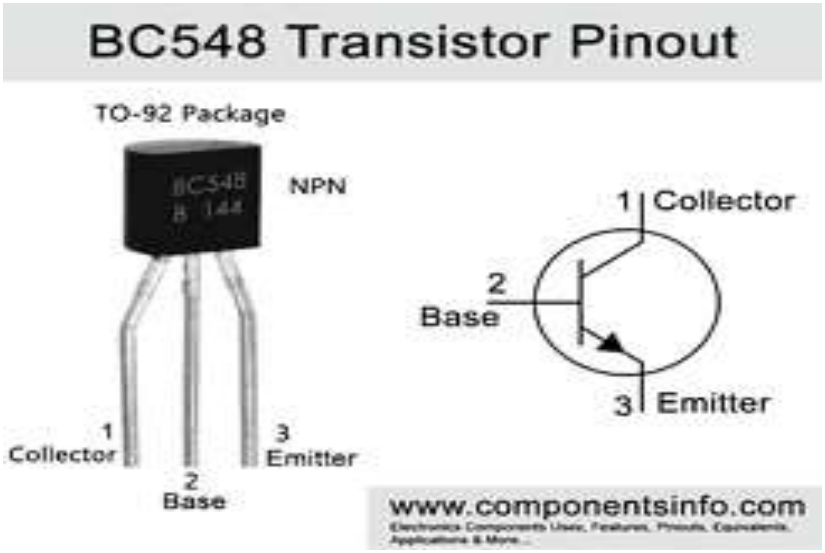
BC548 is another general purpose widely used transistor that can be easily get from reputable electronic components store, this transistor also have bunch of good features on the basis of which one can use it in their electronic circuit, it can handle maximum current of 500mA which is enough to drive many other components such as ICS, other transistors, portion of a circuits, relays, LEDs etc.

The max collector dissipation of the device is 625 miliWatt which is another good feature to use it as a small amplifier.

The transistor comes in four different part numbers like BC548, BC548A, BC548B and BC548C and the only difference between the four is their DC current gain value, like BC548 current gain value is from 110 to 800, BC548A is from 110 to 220, BC548B is from 200 to 450, BC548C is from 420 to 800.

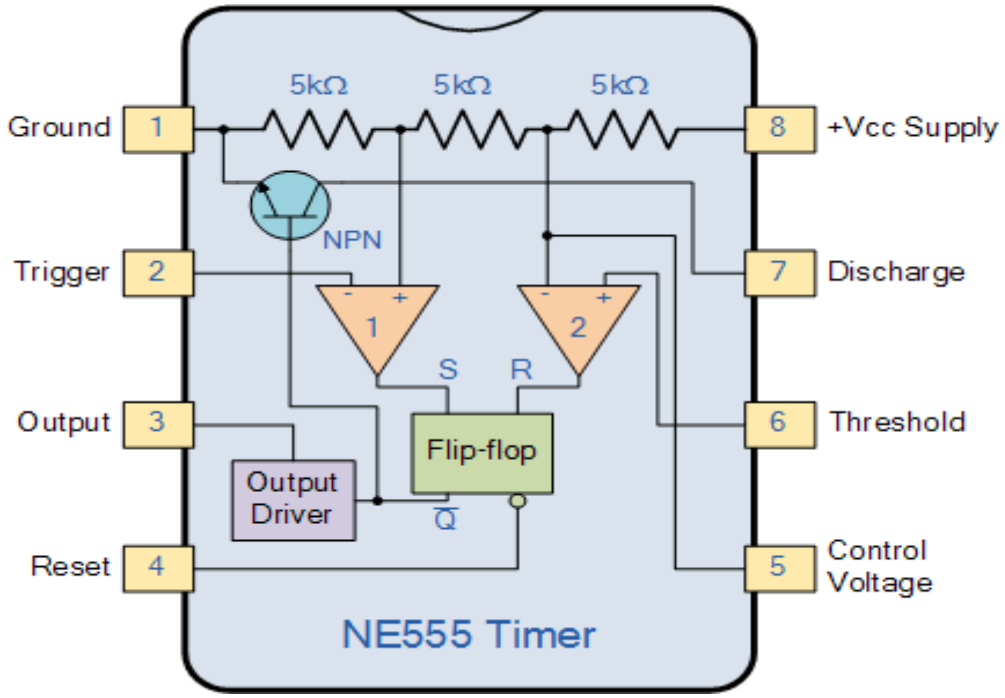
BC548 transistor can be used in many general purpose applications; you can use it in the replacement of other general purpose transistor 2N3904, BC547 etc. as described above. A part from that it can be used as a switch to drive load under 500mA.

The 500mA collector current is quite good feature for this size and type of transistor therefore you can drive wide variety of loads at the same time in an electronic circuit. Moreover this transistor also has a very good DC current gain and collector dissipation characteristics which makes it ideal to use it in amplification and pre-amplification stages of an electronic circuit.




## 555 TIMER

The 555 timer chip is extremely robust and stable 8-pin device that can be operated either as a very accurate Monostable, Bistable or Astable Multivibrator to produce a variety of applications such as one-shot or delay timers, pulse generation, LED and lamp flashers, alarms and tone generation, logic clocks, frequency division, power supplies and converters etc in fact any circuit that requires some form of time control as the list is endless.




The most common use of the 555 timer oscillator is as a simple astable oscillator by connecting two resistors and a capacitor across its terminals to generate a fixed pulse train with a time period determined by the time constant of the RC network.

But the 555 timer oscillator chip can also be connected in a variety of different

ways to produce Monostable or Bistable multivibrators as well as the more common Astable Multivibrator.

## PIEZOELECTRIC ELEMENT

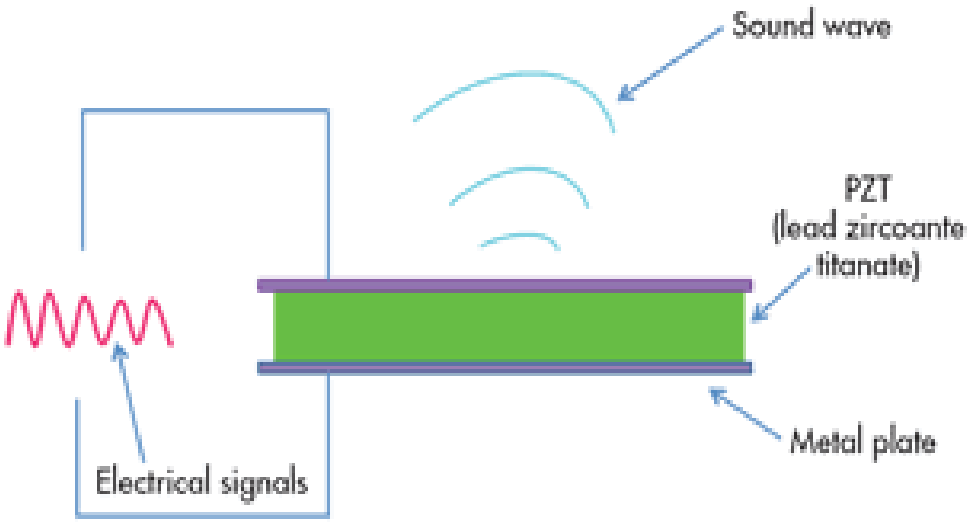
Piezoelectricity is the appearance of an electrical potential (a voltage, in other words) across the sides of a crystal when you subject it to mechanical stress.

Piezoelectricity is the process of using crystals to convert mechanical energy into electrical energy, or vice versa.

Regular crystals are defined by their organized and repeating structure of atoms that are held together by bonds, this is called a unit cell.

Most crystals, such as iron have a symmetrical unit cell, which makes them useless for piezoelectric purposes.

The Lead Zirconate crystals present in the piezo element can readily store current and can release the current when the orientations of the crystals are disturbed through mechanical vibrations.




## LIGHT EMITTING DIODE (LED)

A LED is a semiconductor device that emits visible light when an electric current passes through it. The light is not particularly bright, but in most LEDs it is monochromatic, occurring at a single wavelength. The output from LEDs can range from red(at a wavelength of approximately 700 nanometres) to blue-violet(about 400 nanometres).

Some LEDs emit infrared(IR) energy such a device is known as an Infrared Emitting Device(IRED). An LED or IRED consists of two elements of processed material called P-type semiconductors and N-type semiconductors. These two elements are placed in direct contact, forming a region called the P-N junction.

In this respect, the LED or IRED resembles most other diode types. The LED or IRED has a transparent package, allowing visible or IR energy to pass through. Also, the LED or IRED has a large P-N junction area whose shape is tailored to the application.

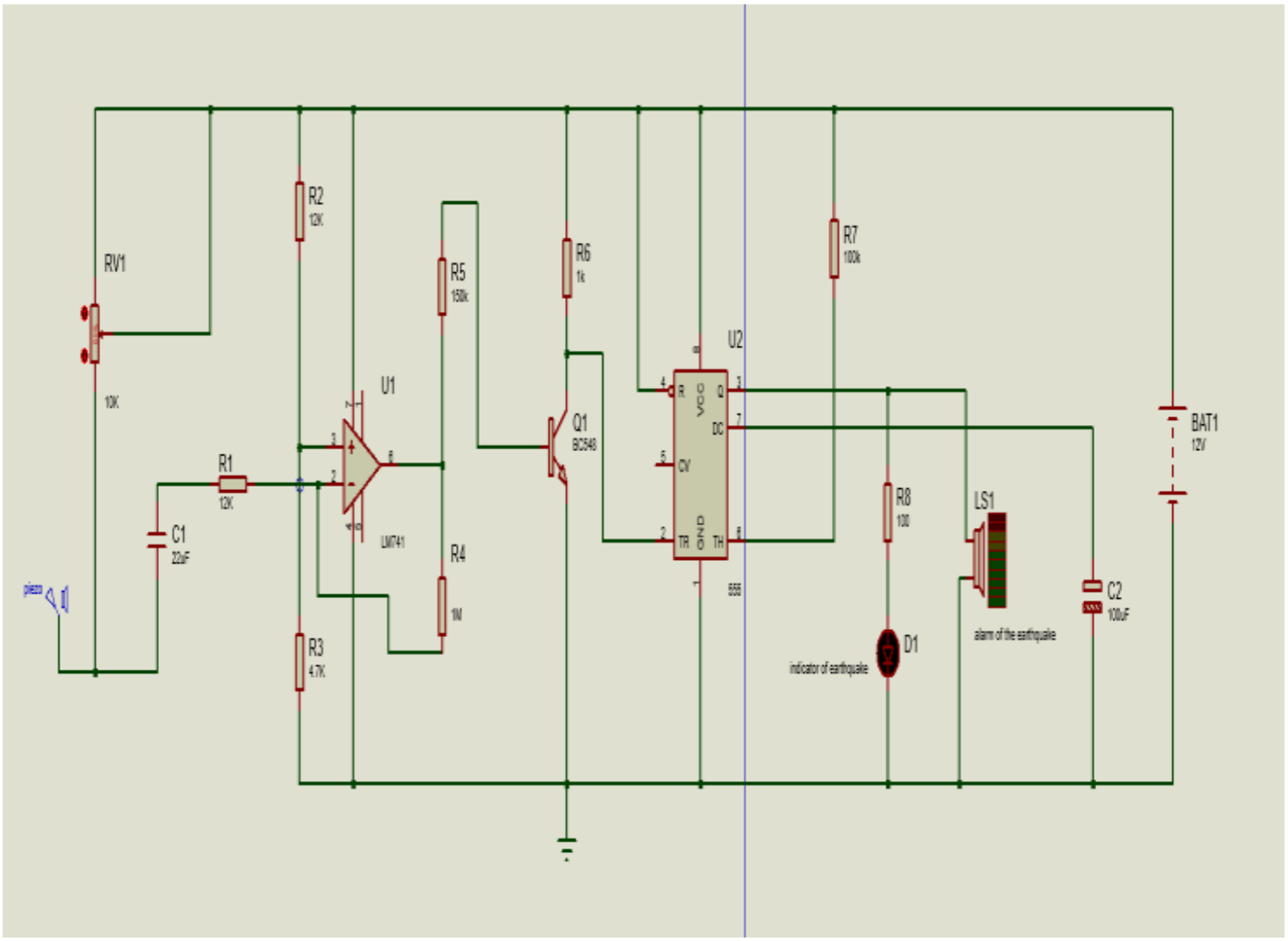
## BUZZER

A buzzer or beeper is an audio signalling device, which may be mechanical, electromechanical, or piezoelectric. Typical uses of buzzers and beeper include alarm devices, timers and confirmation of user input such as a mouse click or keystroke.

Early devices were based on an electromechanical system identical to an electric bell without the metal gong. Similarly, a relay may be connected to interrupt its own actuating current, causing the contacts to buzz. Often these units were

anchored to a wall or ceiling to use it as a sounding board. The word "buzzer" comes from the rasping noise that electromechanical buzzers made.

# CIRCUIT DIAGRAM




# WORKING OF THE CIRCUIT

When an earthquake occurs , the piezo electric element gets subjected to mechanical stress and deformation which gets converted to electric potential or energy due to the disturbance in orientation  of lead zirconate crystals.

A potentiometer is used here to adjust the sensitivity of the piezo element used.

These signals are then amplified by the op amp LM741 which has resistors connected to it to limit the current entering the op amp.

The high output from the op amp LM741 switches on the transistor BC548. Resistors are connected to the transistor to limit the current entering it .

The transistor BC548 conducts and  it is connected to trigger pin 2 of the 555 Timer which gets activated and gives high output.

555 timer is used as a pulse generator in this circuit and it is in general,  a versatile IC which can be used to produce oscillations or highly stable time delays.

The high output from the 555 timer is then used to activate our LED and buzzer/ alarm that we have used as indicators in the event of an earthquake.

Several capacitors are used in the circuit to add time delay in order to make sure that the LED doesn't turn off immediately.

## EXPECTED OBSERVATIONS

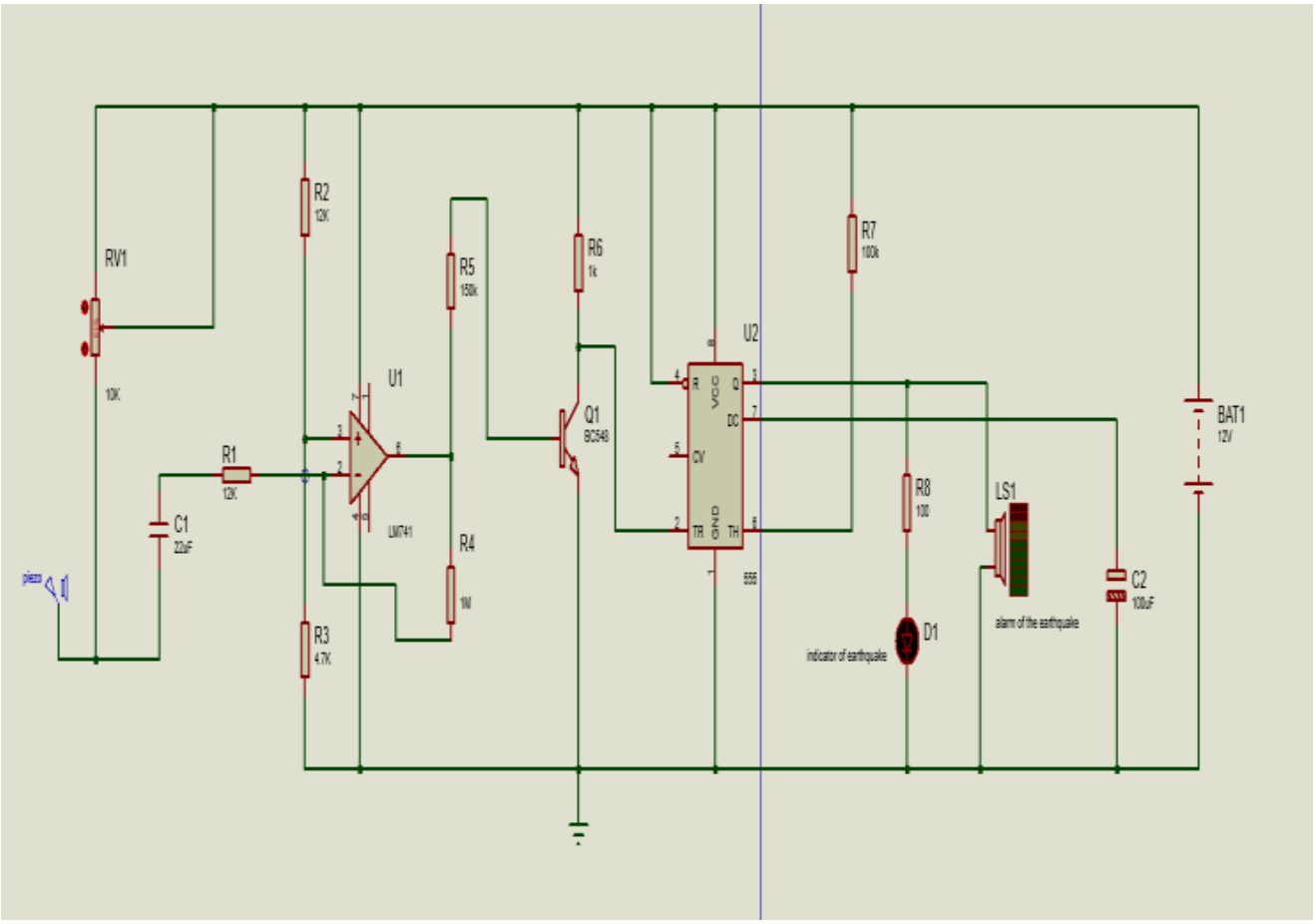
The expected observation is that when no input is applied to the piezo element , the circuit would not get activated and both the buzzer and the LED would remain off.

In the case of applied input, we expect both the buzzer and the LED to get activated .

## RESULTS OF SIMULATION

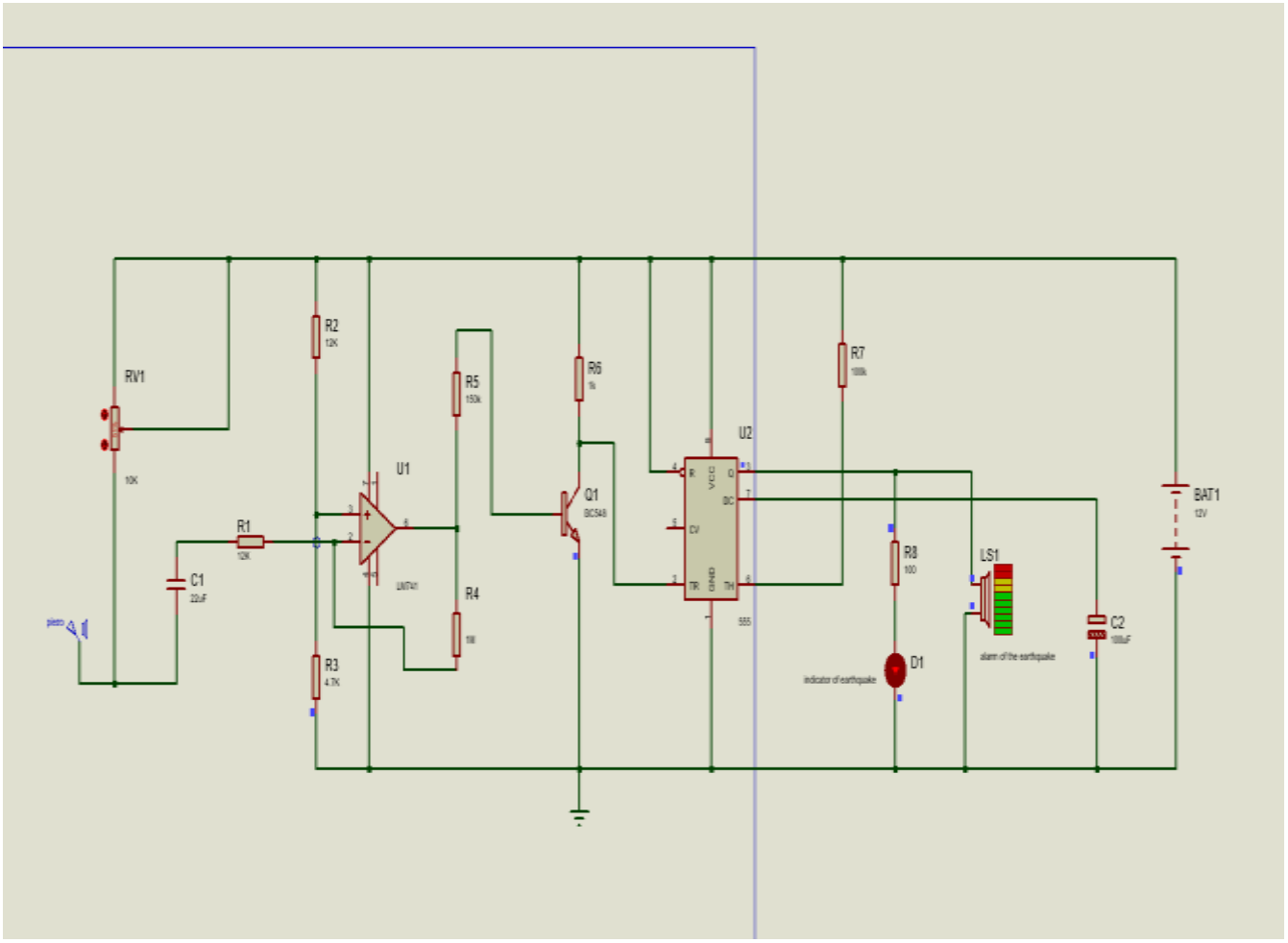
### IN CASE OF NO INPUT

As can be seen when no input is provided to the piezo element, both the LED and the Buzzer don't get activated and remain switched off

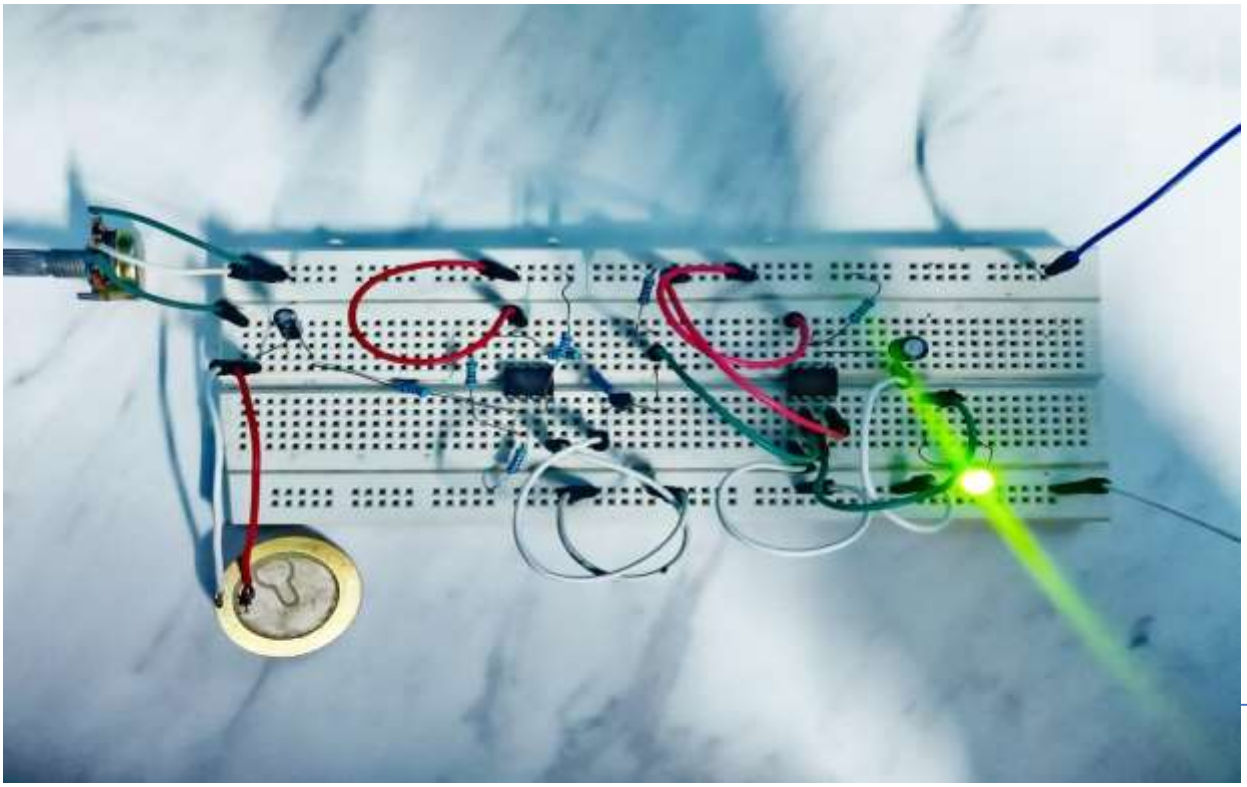


## IN CASE  INPUT IS PROVIDED

As can be seen when an input signal is provided to the piezo electric element the circuit gets activated and both the LED and the buzzer turn on and indicate the same.




## HARDWARE MODEL ON BREADBOARD



# CONCLUSION

We have successfully simulated the circuit of a seismic indicator and demonstrated how the circuit would react in the event of an earthquake ( ie. When input signal is provided to the piezo electric element).

We have also made a functional hardware model on breadboard and demonstrated the same with videos as well.

# REFERENCES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