“EARTHQUAKE DETECTION SYSTEM”

PROJECT REPORT

Submitted for the course: ECE2001 Analog Electronic Circuits

By

Rishita Khandelwal	**16BEC0300**
Sanskar Biswal	**16BEC0403**

Slot: L45-
L46

Faculty: Professor Ravi Kumar CV

(SCHOOL OF ELECTRONICS ENGINEERING)

CERTIFICATE

This is to certify that the project work entitled "**EARTHQUAKE DETECTION SYSTEM**" that is being submitted by "***Rishita Khandelwal, , Sanskar Biswal***" for Analog Electronic Circuits(ECE2002) is a record of bonafide work done under my supervision. The contents of this Project work, in full or in parts, have neither been taken from any other source nor have been submitted for any other CAL course.

Place: Vellore

Date: November 5, 2016

Signature of Students: **Rishita Khandelwal**

Sanskar Biswal

Signature of Faculty: Professor Ravi Kumar C V

ACKNOWLEDGEMENTS

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b) We would also like to thank our esteemed school Dean, Dr. Elizabeth Rufus, for providing us with proper facilities for the experimentation phase of the project.

c) We would like to thank our teacher Professor Ravi Kumar C V for giving us the opportunity to take up this project.

Rishita Khandelwal
16BEC0300

Sanskar Biswal
16BEC0403

ABSTRACT

This project aims to use an ultra-sensitive piezo electric earthquake detector circuit that can sense seismic vibrations.

It can be used to detect vibrations in the Earth. So it is an ideal device to monitor entry passages. The circuit exploits the direct piezo electric property of the piezo element used in buzzers.

INTRODUCTION

Objective and goal of the project

The main objective of this project is to create a prototype of ultra-sensitive piezo electric earthquake detector circuit that can sense seismic vibrations.
It can be used to detect vibrations in the Earth. So it is an ideal device to monitor entry passages. The circuit exploits the direct piezo electric property of the piezo element used in buzzers.

Detailed Literature Survey

Seismometers are instruments that measure motion of the ground, including those of seismic waves generated by earthquakes, volcanic eruptions, and other seismic sources such as by the use of explosives. Records of seismic waves allow seismologists to map the interior of the Earth, and locate and measure the size of these different sources.

A simple seismometer that is sensitive to up-down motions of the earth can be understood by visualizing a weight hanging on a spring. The spring and weight are suspended from a frame that moves along with the earth's surface. As the earth moves, the relative motion between the weight and the earth provides a measure of the vertical ground motion. If a recording system is installed, such as a rotating drum attached to the frame, and a pen attached to the mass, this relative motion between the weight and earth can be recorded to produce a history of ground motion, called a seismogram.

Any movement of the ground moves the frame. The mass tends not to move because of its inertia, and by measuring the movement between the frame and the mass, the motion of the ground can be determined.

Early seismometers used optical levers or mechanical linkages to amplify the small motions involved, recording on soot-covered paper or photographic paper. Modern instruments use electronics. In some systems, the mass is held nearly motionless relative to the frame by an electronic negative feedback loop. The motion of the mass relative to the frame is measured, and the feedback loop applies a magnetic or electrostatic force to keep the mass nearly motionless.

The voltage needed to produce this force is the output of the seismometer, which is recorded digitally. In other systems the weight is allowed to move, and its motion produces a voltage in a coil attached to the mass and moving through the magnetic field of a magnet attached to the frame. This design is often used in the geophones used in seismic surveys for oil and gas.

Professional seismic observatories usually have instruments measuring three axes: north-south (y-axis), east-west (x-axis), and the vertical (z-axis). If only one axis is measured, this is usually the vertical because it is less noisy and gives better records of some seismic waves.

A piezoelectric sensor is a device that uses the piezoelectric effect, to measure changes in pressure, acceleration, temperature, strain, or force by converting them to an electrical charge.

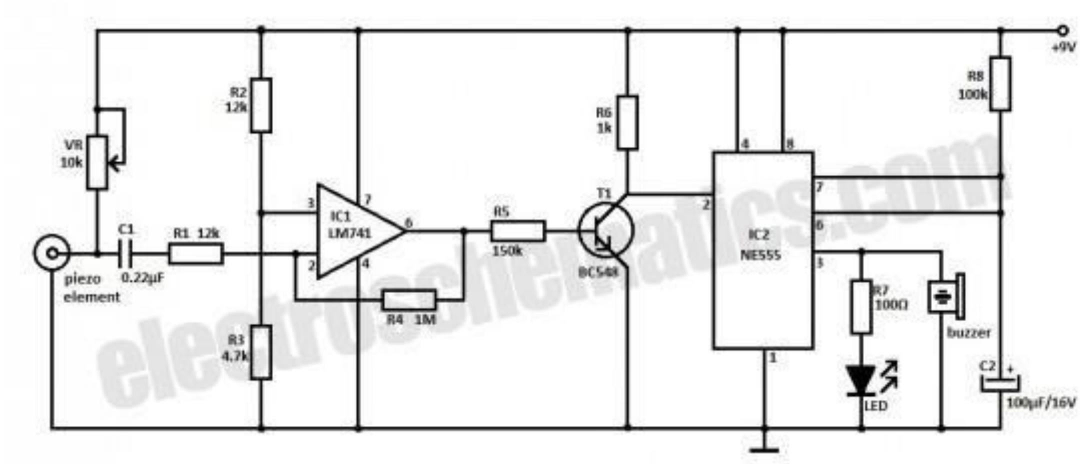
Piezoelectric sensors are versatile tools for the measurement of various processes. They are used for quality assurance, process control, and for research and development in many industries. Pierre Curie discovered the piezoelectric effect in 1880, but only in the 1950s did manufacturers begin to use the piezoelectric effect in industrial sensing applications. Since then, this measuring principle has been increasingly used, and has become a mature technology with excellent inherent reliability.

They have been successfully used in various applications, such as in medical, scientific, aerospace, nuclear instrumentation, and as a tilt sensor in consumer electronics or a pressure sensor in the touch pads of mobile phones. In the automotive industry, piezoelectric elements are used to monitor combustion when developing internal combustion engines. The sensors are either directly mounted into additional holes into the cylinder head or the spark/glow plug is equipped with a built-in miniature piezoelectric sensor.

The rise of piezoelectric technology is directly related to a set of inherent advantages. The high modulus of elasticity of many piezoelectric materials is comparable to that of many metals and goes up to 106 N/m^2. Even though piezoelectric sensors are electromechanical systems that react to compression, the sensing elements show almost zero deflection. This gives piezoelectric sensors ruggedness, an extremely high natural frequency and an excellent linearity over a wide amplitude range. Additionally, piezoelectric technology is insensitive to electromagnetic fields and radiation, enabling measurements under harsh conditions. Some materials used (especially gallium phosphate or tourmaline) are extremely stable at high temperatures, enabling sensors to have a working range of up to 1000 °C. Tourmaline shows pyroelectricity in addition to the piezoelectric effect; this is the ability to generate an electrical signal when the temperature of the crystal changes. This effect is also common to piezoceramic materials. Gautschi in Piezoelectric Sensorics (2002) offers this comparison table of characteristics of piezo sensor materials vs other types.

METHODOLGY

Circuit



The Lead Zirconate crystals present in the piezoelement can readily store current and can release the current when the orientations of the crystals are disturbed through mechanical vibrations. IC1 amplifies the signals from the piezo element and the high output from IC1 switches on T1. When T1 conducts, trigger pin 2 of the monostable (IC2) will grounded to give 3 minutes high output.

This high output is used to sound alarm and to light LED. VR adjusts the sensitivity of piezo element. Glue the fine side of the piezo element on the floor (if used as an entry alarm) or inside a metal box (if used to bury in soil to detect earth borne vibrations).

Model:

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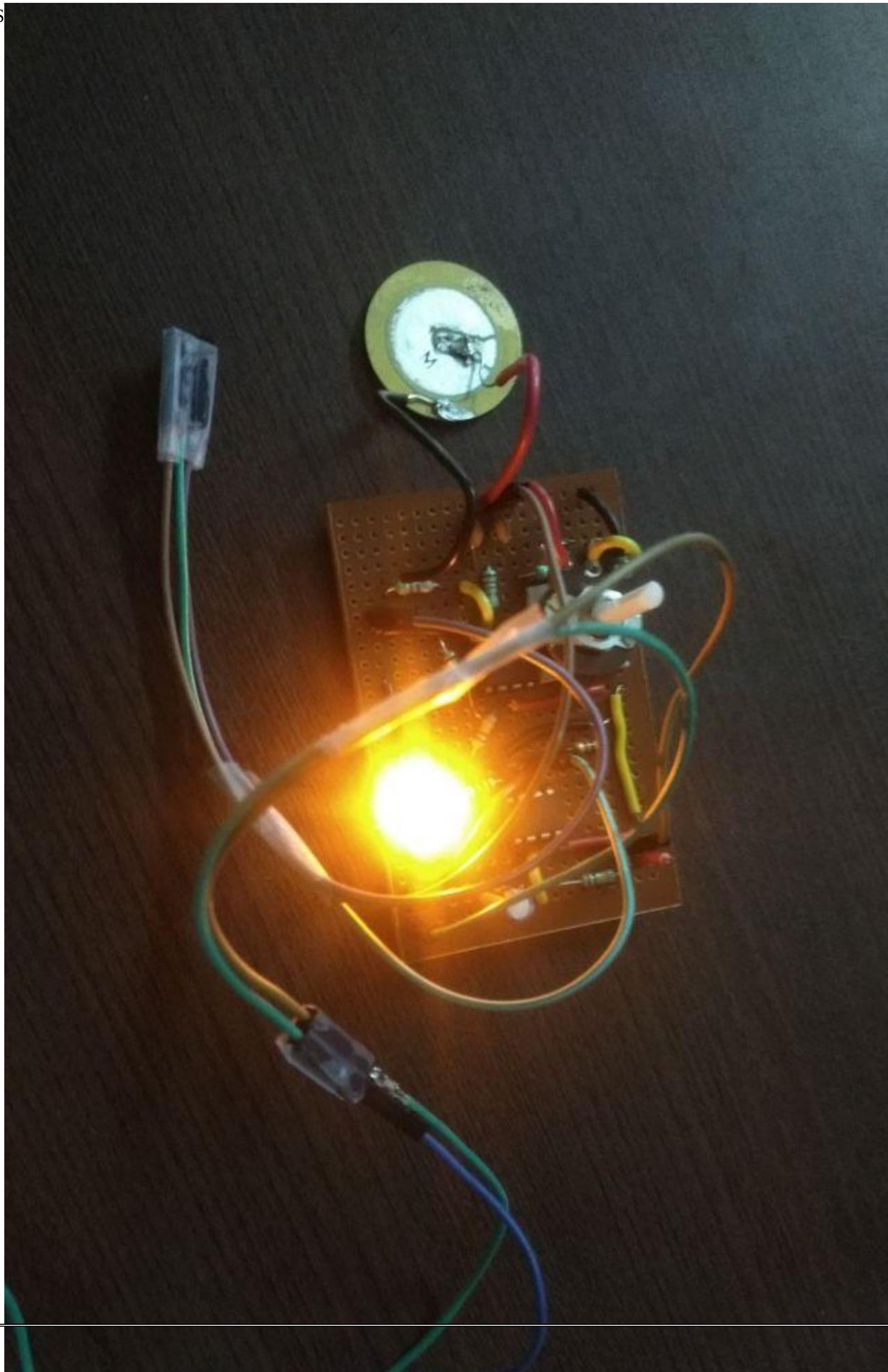

Conclusion:

The required objective of the project has been feasibly achieved and the prototype is market ready. The present prototype enables us to visualise the incoming disturbances from a 180 ^{o} perspective.

As a future enhancement, many such modules can be interfaced to collect the geo-seismic data of a wide region and the accumulated data can be used by seismologists for the purpose of earthquake preparation, mitigation and evacuation.

References:

www.electroschematics.com/3625/seismic-sensor/

www.instructables.com/id/Earthquake-Detector-1/