# “Earthquake Detector Using Arduino Uno”

*Project report submitted in fulfillment of the requirement for the degree of*

**BACHELOR OF TECHNOLOGY**

**IN**

**ELECTRONICS AND COMMUNICATION ENGINEERING**

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# DECLARATION BY THE SCHOLAR

I hereby declare that the work reported in the B-Tech thesis entitled **"Earthquake Detector Using Arduino"** submitted at **Jaypee University of Information Technology, Waknaghat India**, is an authentic record of my work carried out under the supervision of **DR. Rajiv Kumar**. I have not submitted this work elsewhere for any degree or diploma.

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# LIST OF FIGURES

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# CERTIFICATE

This is to certify that the work reported in the B.Tech project report entitled **"Earthquake Detector using Arduino"** which is being submitted by **Prabhat Kumar Singh(151062), Bhavishya Pathak(151020) and Anmol Sharma(141025)** in fulfillment for the award of Bachelor of Technology in Electronics and Communication Engineering by the Jaypee University of Information Technology, is the record of candidate's own work carried out by him/her under my supervision. This work is original and has not been submitted partially or fully anywhere else for any other degree or diploma.

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# ACKNOWLEDGEMENT

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Thanking you,

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# ABSTRACT

Today, Earthquake is a very big problem which causes damage to lives and property. Our project is an small step to save these losses by giving information about earthquake before it strikes, this device will depend on the motion in 3-D.

As the motion in any of the three dimensions occurs LED display will start showing the figures here arduino uno is the central system which can be software tunable and we can implement signal processing through algorithm where we can define the limits of Motion in 3-D by Checking the data of earthquake from Indian meteorological department, how much magnitude of earthquake is disastrous setting those figures as upper limit in algorithm if figures of motion in any of the three dimensions is greater than the fixed upper limit figure LED light will start to glow and buzzer will start ringing.

This three dimension motion will be detected by the MPU6050 sensor.

# CHAPTER-1

# INTRODUCTION

An earthquake is an unavoidable and unpredictable natural phenomenon that sometime's causes damage to lives and property. We cannot stop this phenomenon but we can stay alert and aware using technology. This project is an initiative, to be stay alert and aware before the earthquake come. technology we use in this module is very cheap and handy, all the components are easily available in the market and less power consuming, so that a user do not have any problem to run the device 24*7 for all 365 days .

This module contains Arduino UNO chip as a central component of device, MPU6050 sensor is the brain of module which detects all the motions in 3 dimensions, inductor & capacitors to match the impedance with the input impedance of module so that it cannot damage the device, transistor used for switching the circuit, wires for connections, LED & Buzzer used as an output indicator, LED display to get the output figures of motion in 3-D, At last a Breadboard to implement all the components to complete the desired circuit .

Now this device is to be mounted in the buildings, buzzer and led light will aware the members of building about the earthquake with all the parameters so that they can evacuate.

Earthquake is the trembling caused in the surface of the earth, which is caused by the

immediate energy release plates in the lithosphere layer of the earth which is resulted into creating waves referred to as the seismic waves.

Earthquake is caused by a vibration that occurs on the earth surface. It is the shaking of the Earth surface that is referred to as the earthquake. Earthquakes differ in parameters from the ones that can be hardly felt to the ones that are capable of tossing buildings around.

Earthquakes can also lead to landslides and can often cause volcanic activities. It is capable of even causing a tsunami as with the earth's tectonic plates shaking it can lead to raised water levels and therefore various water calamities. The point where the earthquake is caused or the initial rupture is referred to as the focus or hypocenter or epicentre. Many casualties occur during this time including the loss of lives and properties. Hence, the earthquake detector.

Earthquake detector is a safety device that can be used in homes as it senses the earth's seismic vibrations which can be used to alert the people a few seconds an earthquake occurs. The waves that are emitted by this device are of two types: dangerous wave and small wave that can be used to vacate accordingly. As the small wave travels faster, so it is easier to be detected first if your house is located a few kilometres away from the centre of the earthquake to occur. It can be used to monitor entry passages and therefore it is an ideal device for the detection. It has been depicted as a design to sense the compression wave which is referred to as the small wave of an earthquake which comes before the more destructive wave referred to as the shear wave. This circuit removes the guesswork as it

saves worthy seconds in earthquake detection. It is capable of working on a large scale area and is capable of detecting both minor to moderate earthquakes around the local area and many miles around it. It prevents the possibility of confusion, saves valuable time and many lives along with it as it eases the mind and helps it to find peace with this possibility.

Although we are working with Arduino Uno board but it can also work in combination with other devices like gas valve.

The device including gas valve contains a highly sensitive lever which is attached to spring and then a weight is connected to lever by a screw. It has a delay off circuit which is used to drive piezoelectric buzzer.

## 1.1. EARTHQUAKE CAUSES

- Earthquakes can be caused by two ways: natural or caused by humans. The constructions and deforestation of the green belt are the causes of many calamities. The trees help in binding the soil which helps in preventing landslides and earthquakes. The deforestation of these jungles or green belt leaves the soil loose and more prone to fall free.

- Earthquakes are mostly caused due to the tear of the geological faults and also by various other disasters such as landslides, mine blast, volcanic eruptions, and nuclear tests. These disasters cause the cosmic plates to fall apart which leads to earthquakes. They cause imbalance in the earth surface and leads to loss of lives and property.

- On the surface of earth, earthquakes occur due to the shaking and displacing or disrupting the earth's surface. These causes the casualties on life and on properties.

- Tectonic earthquake may occur anywhere in the surface of the earth, where there is enough stored elastic strain energy for driving fracture propagation within a fault region. The movements within these tectonic plates cause disruption of the plates and fractures the planes within that region. These often cause the upliftment of the

plates as the position cannot be the achieved as it was placed earlier. Some even cause the downfall of the plates which results in the large gap within the plates as the plates cannot be placed in their original places.

- The release of this energy which was stored as a combination of radiated elastic strain seismic waves, breaking of rocks and fault surface heating caused by friction, which causes an earthquake. This breaking of rocks often results in the growing of the land mass and thus may cause calamities as the sea or water level may increase which can cause damage to the lives and the surroundings. The fault surface heating caused by the friction between the tectonic plates may result in the causing of an earthquake. The radiated elastic strain of the seismic waves causes disruption within the earth surface and causes the moving of the plates within the surface of the earth.

- The three important types of faults that can cause an earthquake within the plates are:-
    - Reverse
    - Strike – slip
    - Normal

- Any seismic activity in the earth surface is used to describe the earthquake. These seismic events disrupt the actual layout of the earth crust thus resulting in mountains and valleys, which are the result of the inappropriate and the disruption of the earth crust and the alignment of the earth's tectonic plates.

## 1.2. PROBLEM STATEMENT

Earthquake is an unpredictable natural phenomenon which can cause a massive destruction. As we take an example of Nepal on 25april 2015 men and women are in regular routine of their work and children ran about happily on school playgrounds. None of them could foresee the incredible destruction that is going to be occurred.

The 7.8magnitude earthquake strikes at the country's core 9000 people died that day.

Many scientists have performed various experiments to detect the earthquake, because even a 60seconds warning can save the lives.

First time Earthquake is detected using piezoelectric pressure sensors and three steel balls and magnet tied with vertical rode to detect the magnitude of earthquake.

Main problem of earthquake detectors is they are not able to predict earthquake very early for this we need specialized sensors those can detect the seismic waves generated by the movement of tectonic plates.

| Sr.no. | Place | Deaths | Date | Magnitude () | Epicenter |
|---|---|---|---|---|---|
| 1. | Indian ocean | >2.5L | December26, 2004 | 9.1-9.3 | West coast of Indonesia |
| 2. | Kashmir | >1.3L | October8, 2005 | 7.6 | Muzaffarabad Pakistan |
| 3. | Bihar and Nepal | >30K | January15, 1934 | 8.7 | South of Mt .Everest |
| 4. | Gujarat | >20K | January26, 2001 | 7.7 | Kutch, Gujarat |
| 5. | Kangra | >20K | April4, 1905 | 7.8 | Himalayas |

## 1.3. OBJECTIVE

This project is aimed for designing and development of earthquake alarm detection circuit based on electronic devices which will be helpful to save lives and property.

Main objective is to detect S-waves (seismic waves) or we can say high frequency vibrations at the Arduino uno input through MPU6050 sensor .which will give us an indication about earthquake before it strikes at the core of that place.

Another thing is to make a device compact, cheap and error free because earthquake is a very big event in this error may cause very big loss.

To make a device error free we have to find a position where the device should be mounted on the building which will sense the best frequency vibrations, and the device should not damage until the building do not fall.

Because the device has done its work it alarmed all the members of building to escape before the building fall over.

# CHAPTER-2

# METHODOLOGY

The primary techniques used in developing earthquake detector is the motion in 3-D for this we use Arduino uno and a highly sensitive accelerometer MPU6050 is presented that can indicate vibrations,

We know accelerometer like MPU6050 are highly sensitive to knocks and vibrations in any of the three physical axes so this device can be modified and used as a knock and shake detector of ATM's, vehicles or door break alarm, But its main work is to detect Earthquake.

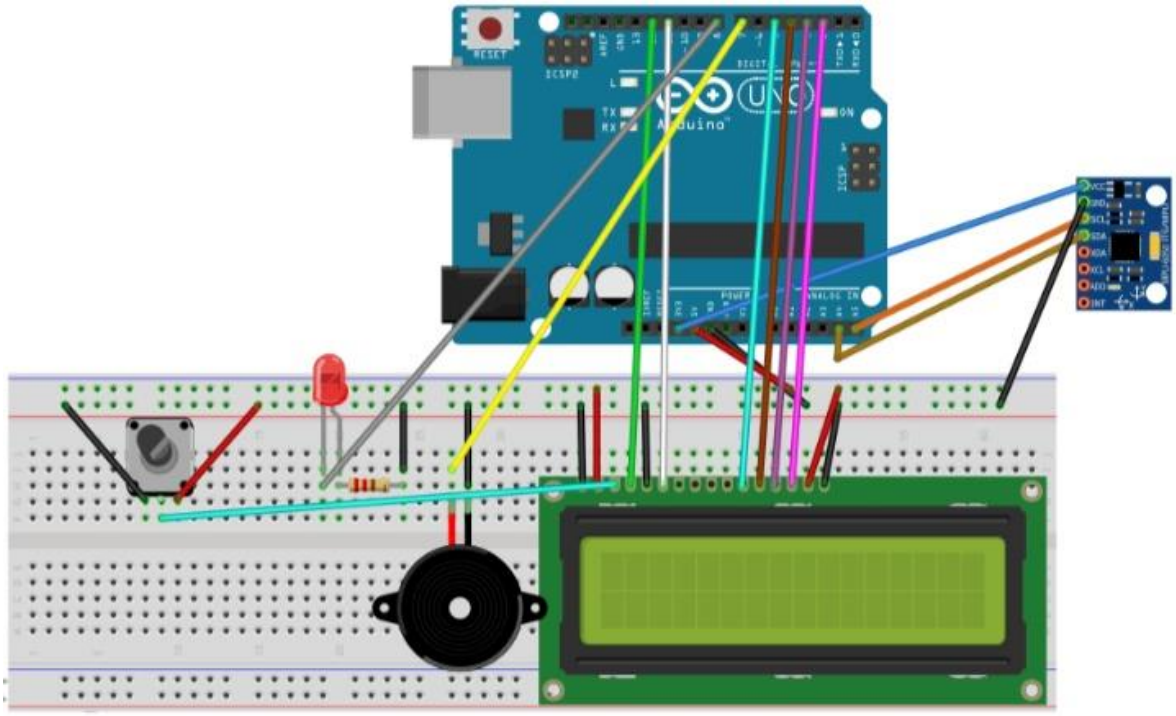
MPU6050 gives analogue voltage imposed to equivalent acceleration, it has three output one each for three X-,Y-,Z-axes, three analogue outputs are input to Arduino uno ADC pins. By this way acceleration is detected by accelerometer and simultaneously by Arduino ADC pin.

If motion is violent enough during an earthquake and crosses the threshold value alarm light LED glows, a buzzer sounds as an indicator of earthquake in the core of the land where the building is situated.

Threshold adjustment button is there to carry out different task. An LCD is used to verify threshold value and to make system user friendly.

## 2.1. Entity Relationship Diagram

In the given Fig(1), we can see the relationship and connections of all the components of the Earthquake detector .



Fig(1)

## 2.2 Hardware and Software Requirements:

For the product to have the capacity to run effectively on PCs, it needs certain equipment segments or some product to be available. The product necessities are:

i. Arduino Software IDE.

ii. Operating System.

The hardware requirements are:

i. ArduinoUNO

ii. MPU6050

iii. LCD

iv. Capacitor (100nF)

v. Inductor

vi. Resistor

vii. Transistor (BC548)

viii. LED

ix. Bread board

x. Buzzer

xi. Wires

## 2.3. Organization

As we know earthquake is unpredictable we cannot stop this natural phenomenon but precautions can be taken so that we can save livelihood and some amount of precious thing for this thing to be done we need some time space between the space of shocks. .

This time space is governed by many government and private authorities that continuously track the data of tectonic plate movements from the high frequency vibrations by the devices.

Some of the world's government authority who keep the check in their countries:

i. Indian Meteorological department

ii. National disaster management authority

iii. UNESCO

iv. U.S. geological society (USGS)

There are many organizations those who work on the earthquake, different countries of world have different organizations but UNESCO is an UN government based organization gets a world level donations to work on all the natural disasters occurring in the world.

# CHAPTER-3

# LITERATURE REVIEW

Such a large number of looks into have been done identifying the problem of Earthquake, as it is a major problem for world. It can't be stopped but precautions and detection of it is possible so that to give sometime space to escape from disastrous place. In order to get this time space many of researches has been done by the scientists and other organizations those who are working for safety from the earthquake.

Some of the most important researches on earthquake detection in past and in current years are:

## 3.1 Japan Meteorological Agency (JMA):

The Japan meteorological agency has developed an earthquake early warning system to release information in the event of earthquake, and the system used in 2007. Meanwhile, structural health monitoring technology has been attracting attention from those who want to save time in determining the structural health of buildings. Practical application of this technology, have also begun. Seismic isolated buildings have been developed to protect building structures and keep properties safe from earthquakes and this is significantly effective means to protect.

The technology is based on past experiences of the great Hanshin Earthquake in 1995. Seismic disaster prevention technologies have been further developed since then against the large scale damage to buildings and losses of human life which could be incurred by earthquakes. This should be a system as safe addition to the current situation and earthquake and earthquake disaster prevention of structure itself.

## 3.2 National Earthquake information center (U.S.A):

NEIC is the part of USGS established in 1966. It was made part of USGS in1973.

• NEIC determines the location and size of all destructive earthquakes that occur worldwide and disseminates the information to the appropriate national or international agencies, government public information channels, news media, scientists and scientific groups, and the general public.

• With the advent of the USGS Earthquake Notification Service (ENS), notifications of earthquakes detected by the ANSS/NEIC are provided free to interested parties. Users of the service can specify the regions of interest establish notification thresholds of earthquake magnitude, designate whether they wish to receive notification of aftershocks, and even set different magnitude thresholds for daytime or night time to trigger a notification.

• For earthquake outside the United States, the NEIC notifies the state Department operations center and often sends alerts directly to staff at American embassies and consulates in the effective countries, to the international Red Cross, the U.N. Department of humanitarian affairs, and other recipients who have made arrangements to receive alerts.

## 3.3 International Platform on Earthquake Early Warning Systems (IP-EEWS):

UNESCO has been very active in promoting international cooperation, scientific knowledge exchange and capacity building for the development and implementation of geo-hazard Early warning systems, including Earthquake Early Warning Systems (EEWS), Worldwide. The sendai framework for disaster risk reduction 2015-2030 recognizes the need to "substantially increase the availability of, and access to, multi-hazard early warning systems and disaster risk information and assessments to the people by 2030" as one of its global targets while considerable progress has been made in recent decades in the field of early warning Systems for specific hazards and significant challenges remain in advancing the development of Early Warning Systems for specific hazards, particularly for sudden-onset hazards such as earthquakes. An earthquake early warning system (EEWS) helps in disseminating timely information about potentially catastrophic earthquake hazards to the public, Emergency managers and private sector to provide enough time to implement automatized emergency measures. At the same time, these helps to reduce considerably the

CO2 emissions produced by catastrophic impacts and subsequent effects of earthquakes, such as those generated by fires, collapses, and pollution, as well as those produced in the recovery and reconstruction processes. In addition, EEWS can be better considered in risk management, emergency planning, disaster management, climate change adaption, and risk communication in order to reduce Natech risks.

## 3.4 Indian Meteorological Department:

To upgrade basic leadership. This has offered ascend to the development of smart frameworks or instruments that encourage fast access to pertinent substance found in the Internet. For creating nations like Nigeria, the travel industry is one of the undiscovered yet conceivably huge pay generators. There are around 142 vacationer goals that spread over the 36 conditions of the government republic of Nigeria. Though some exist normally, others are artificial.

In this time has seen fast advances in data innovation, data over-burden has turned into a difficult issue to those looking for data on the web. As of late, savvy seek components have been sent on the web that demonstrates that the issue of data over-burden can be halfway disposed of by furnishing a stage with more knowledge to help voyagers in the scan for important data. Google.com is a case of an insightful internet searcher that helps clients

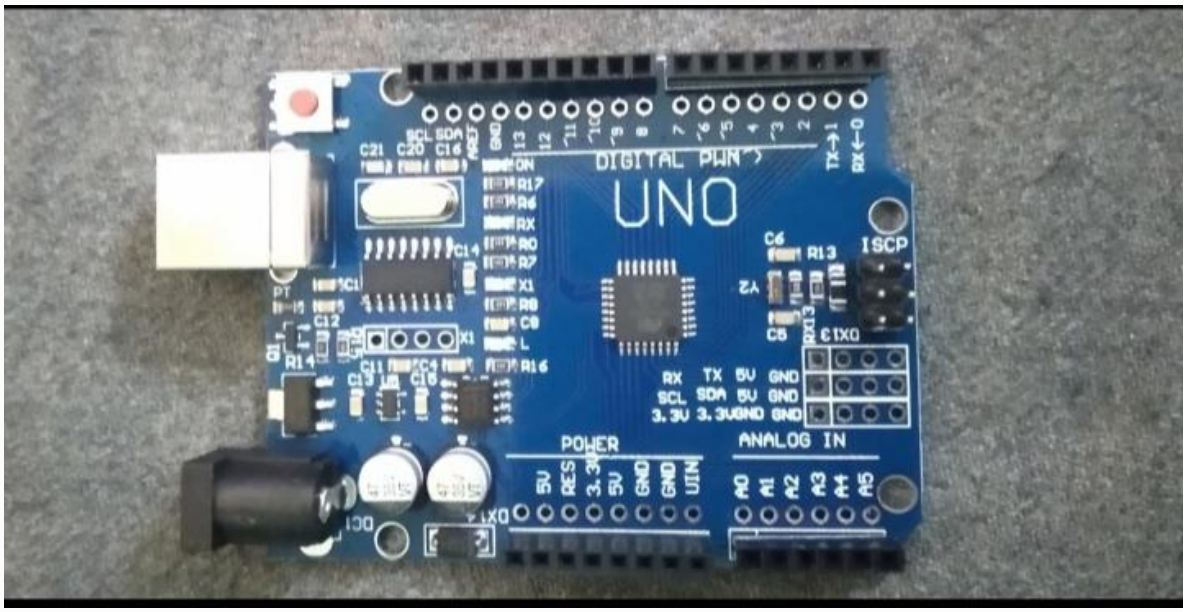
with data and another class of keen framework that has demonstrated applicable in tending to the issue of data over-burden is recommender frameworks.

The objective of this exploration is to structure and actualize keen stage that will help voyagers in Nigeria to approach data on vacationer areas in this way help attach their basic leadership process.

# CHAPTER-4

# PROJECT DEMONSTRATION

## 4.1. ARDUINO UNO BOARD:-




**Fig(2)**

It is a microcontroller board which contains microchip ATMEGA328P. There are 14 digital pins and 6 analog i/o pins. Arduino IDE software is used to program this board. A type B cable is used to connect computer and Arduino board. An external source between 7-20 volts can be used to power this board. The microchip ATMEGA328P is pre-programmed. Boot-loader is used to upload new code in this microchip. It has flash, EEPROM storage of

32 kb. 0.5kb of this 32kb is used by boot loader. Operating voltage of this board is 5v. It consists of 2kb SRAM memory. Weight is around 25g. 6 of the digital pins give PWM output.

This board has various facilities for communication with other microcontrollers. There is a library named software serial, which allows serial communication for all digital pins. There is no need to press the reset button before an upload because this board allows to reset by software. This board basically works as brain of this project.

### 4.1.1. Some Of The Pin Functions Of Arduino Uno Board:-

- LED:-

  Digital pin 13 is used to give input to LED. When the pin is set to low, LED is Off and when high, LED turns On.

- 5V:-

  This pin gives output of 5v and can be used to give input to other microcontrollers.

- Vin:-

  It is used to supply voltage. We access this pin to supply voltage using power jack.

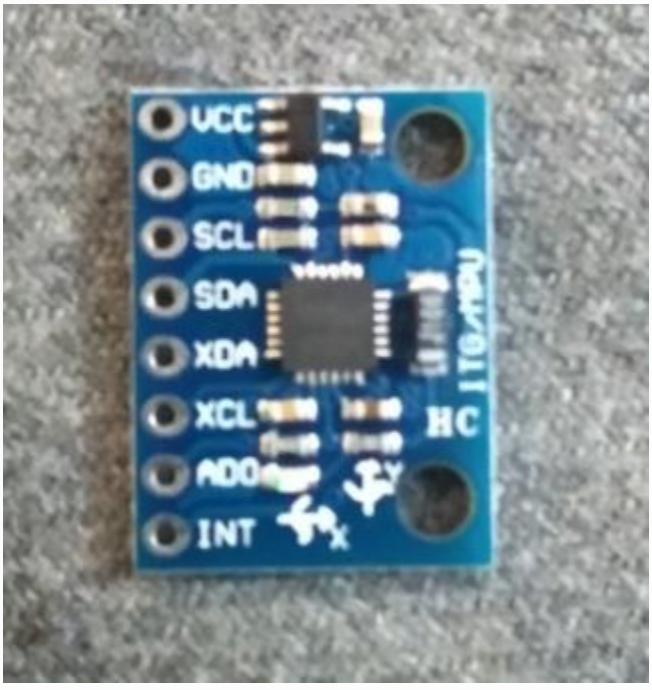
- SPI:-

This stands for serial peripheral interface. Pin number 10, 11, 12 and 13 support communications via SPI library.

- TWI:-

This stands for two wire interface. Using wire library SDA and SCL pins support this type of communication.

## 4.2. MPU 6050:-




Fig(3)

It is a motion tracking device and basically works as a sensor. It is a 6 axis device which consists of 3 axis for gyroscope and 3 for accelerometer. It also has processor for digital motion. It uses I2C for communication. It works on 3.3V input. The DMP is used for processing algorithms related to motion. DMP provides motion data which it takes from gyroscope and accelerometer.

The 8 pins of MPU6050 are:-

- INT :

  This pin stands for interrupt. It is a digital o/p pin.

- AD0:

  It is a slave I2C pin and $0^{th}$ bit address in device. When connected with VCC logic is read as 1.

- XCL:

  It is a oxcillary clock pin which is used for connecting with other I2C sensors.

- SCL:

  This pin stands for serial clock and used for connecting to SCL of other microcontrollers.

- SDA:

  This pin stands for serial data and used for connecting to SDA of other microcontrollers.

- GND:

  This pin stands for ground and is used for ground connection.

- VCC:

  This pin is used to supply DC power.

## 4.3. LED and Buzzer:

These are used as indicators. Buzzer makes an alarming sound when an earthquake is detected and LED glows red.

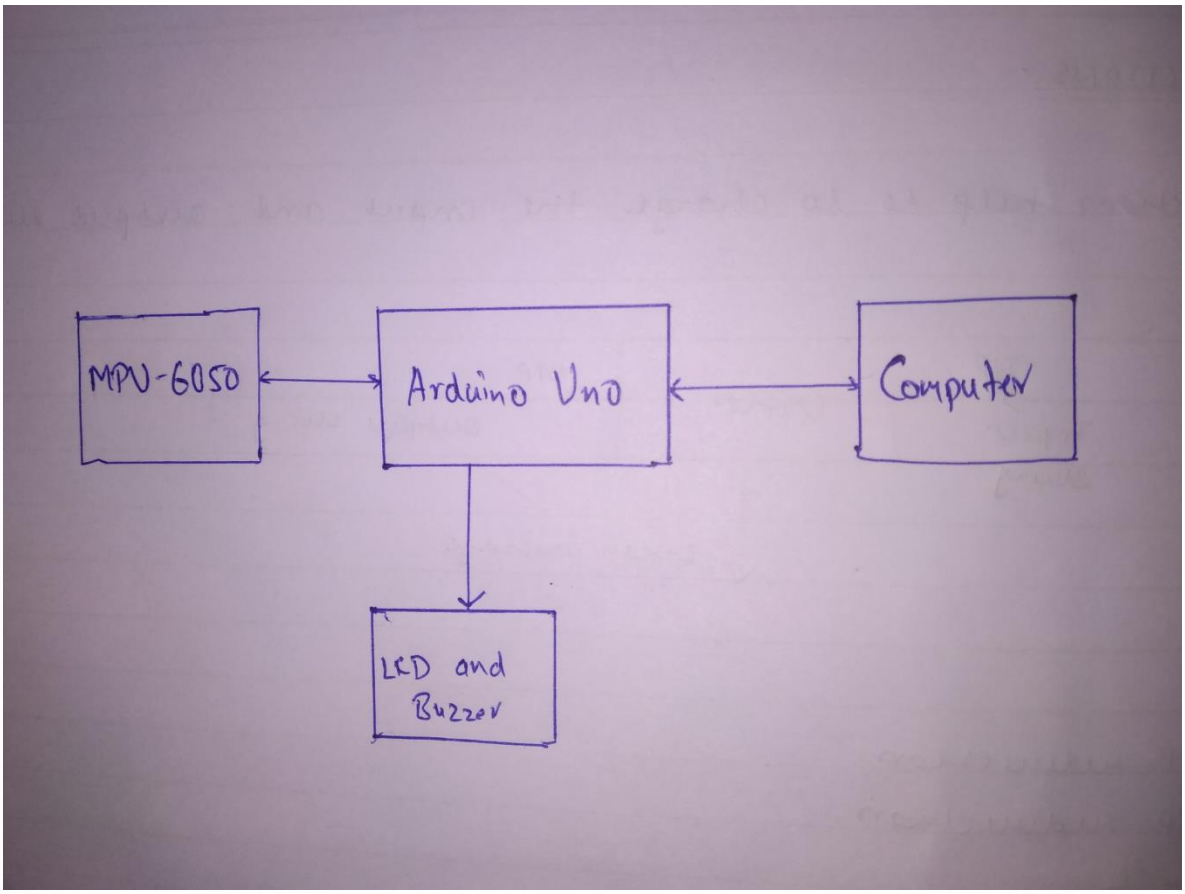
Fig 4 LED

## 4.4. Resistor and Jump Wires:

Fig 5 1 k resistor

It is used to complete connections and makes the circuit complete.

## 4.5. Block Diagram:




Fig(6)


Fig. 7 Bread Board

## 4.6 Arduino IDE used for coding

The open source Arduino software(IDE) was used to write the code. This softwares makes very easy to write and upload code in Arduino uno board. We can run it either on Windows

or MAC OS. The code is written in java and based on other open source software. The code is upload to Arduino Uno board using b type usb cable.


**Fig. 8**

# CHAPTER-5

# CONCLUSION

- Earthquake has been a very often occurring disaster which needs proper alarming devices.
- Since digital devices available in the market are rather expensive, the technology we offer is comparatively very cheap and easily accessible.
- Since it is a light weight device it can be carried along and can be readily used.
- This device also ensures information or detection and alarming at the level where only minor shocks occur, the inhabitants can take action accordingly and can inform others and generate awareness among others.
- It is more reliable as the circuits used are easily available and because of it small size and lightweight it is mobile which makes using this device a lot easier.
- It can be used by anyone and anywhere as the usage of this device is not very technical and can be easily used by anyone anywhere.
- The device contains an LED which glows red even when the minor shocks occur and the buzzer can alarm from a distance and even when the residents are sound asleep.

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