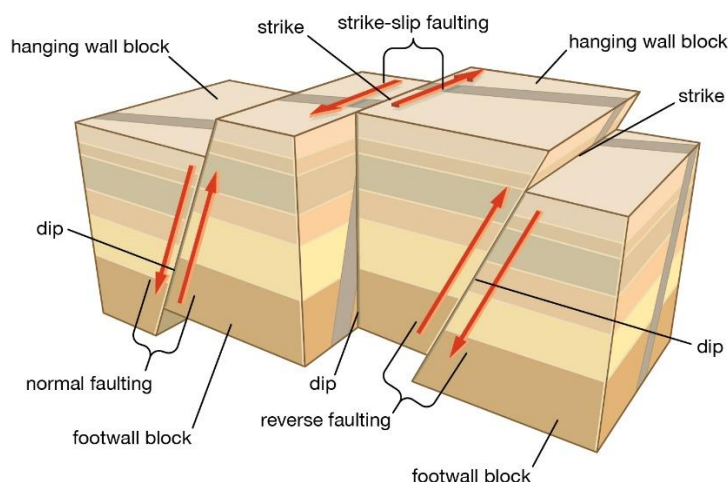


PROBLEM STATEMENT UNDERSTANDING:

An earthquake is the sudden shaking of the ground caused by the release of seismic energy from the earth's crust. Seismic energy is created by the movement of tectonic plates when large masses of rock straining against each other fracture and 'slip'.

Faults have a 'strike', which is the direction from north taken by a horizontal line in the fault plane and a 'dip', which is the angle from the horizontal shown by the steepest slope in the fault. The lower wall of an inclined fault is called the footwall. Lying over the footwall is the hanging wall. There are different types of fault slips that cause earthquakes:

- Normal dip-slip faults are produced by vertical compression as Earth's crust lengthens. The hanging wall slides down relative to the footwall.
- Reverse dip-slip faults result from horizontal compressional forces caused by a shortening, or contraction, of Earth's crust. The hanging wall moves up and over the footwall.
- Strike-slip faults are similarly caused by horizontal compression, but they release their energy by rock displacement in a horizontal direction almost parallel to the compressional force [1].



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Figure: Types of faulting in tectonic earthquakes (Encyclopædia Britannica)

Seismic waves are divided into Surface waves, Body waves and Normal Modes.

There are two types of Surface waves:

- P-Waves
- S-Waves

P-wave is the primary shock wave that is released from the epicentre. The movement of p wave is parallel to the direction of propagation of the seismic wave and hence it is not destructive for infrastructures. A series of destructive wave that follows p-wave are known as s-waves or secondary waves. S-wave has a speed of about 60% that of p-wave [2].

The proposed solution will detect p-waves and send alerts allowing early detection of the earthquake. It uses accelerometer as a vibration sensor to detect p-waves. The accelerometer does its work by sensing the ground shakes and sending the alert signal to the microcontroller where decision is taken according to the programmed feature [3]. Since earthquakes occur majorly at fault lines and plate boundaries the accelerometers are placed near such locations and at earthquake prone areas.

Then the communication technique has to be followed to deliver the earlier warning signal from the microcontroller to the PC where it acts as an IOT. The communication technique used is the ZIGBEE protocol, where the sensors that are randomly distributed in the ground senses and microcontroller decides and sends the alert signal by the ZIGBEE technique [3].

SOFTWARE AND HARDWARE REQUIREMENT:

Software –

- Proteus
- Arduino IDE
- Python
- HTML
- CSS
- JavaScript

Hardware –

- ADXL355 Accelerometer
- ARM Cortex M3 Microcontroller
- ZIGBEE Devices

ADDITIONS AND UPDATES:

The ZIGBEE technique is used in mesh topology to increase its range.

In order to avoid false readings, multiple accelerometers are placed nearby. Only when the microcontroller receives the same signal from all does it send an alert.

If placed near fault lines underwater, this system could also be used to detect tsunamis.

APPLICATION:

- Early Detection of Earthquakes and Tsunamis

ADVANTAGES:

- Sensors are low-cost
- Alerts to the public are faster and more accurate because of IOT

CHALLENGES:

- There can be false readings or noise due to volcanic activity, man-made causes, etc

CONCLUSION:

Earthquakes cause major loss of life and property. Therefore, this solution aims to create a system for early detection of earthquakes using accelerometers and IOT. The hardware portion plays the role of detecting and reading the signal successfully. Thereby the software portion is to deliver the alert signal to the public. This solution will not only let earthquake engineers monitor earthquakes in real-time but will also let the system send warnings all by itself. Further Machine Learning can be used to improve the performance and accuracy of the system.

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