Project Report: Earthquake Detector Using Tilt Sensor

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1. Introduction

Earthquakes are natural disasters that can strike without warning, causing widespread damage and loss of life. Early detection of seismic activity can provide crucial seconds to respond and take safety measures. This project presents a simple and cost-effective earthquake detection system using an Arduino Uno and a tilt sensor to sense ground vibrations or tilting. The system provides immediate alerts using a buzzer and LED and displays the system status on an LCD screen.

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2. Problem Statement

There is a need for a low-cost, real-time earthquake detection system that can alert people to ground vibrations early enough to take protective action. Current professional-grade seismic systems are expensive and not easily accessible for households or educational institutions.

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3. Objective & Scope of the Solution

The objective of this project is to build a simple earthquake alert system using a tilt sensor, buzzer, and microcontroller (Arduino Uno). The system should be able to:

- Detect sudden tilting or vibration.
- Alert users immediately via audible and visual cues.
- Display status information on an LCD screen.

Scope:

- The project can serve as a learning model for students.
- It can be extended to real-world earthquake warning systems in small-scale areas.
- It offers flexibility to upgrade from a tilt sensor to more advanced accelerometers or IoT-based alerting systems.

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4. Required Components

Hardware

Component	Quantity	Description
Arduino Uno	1	Microcontroller board
Tilt Sensor (KY-002)	1	Detects angle changes or shaking
16x2 LCD Display	1	Displays status
Buzzer	1	Provides audible alert

Component	Quantity	Description
LED	1	Visual alert
10k Potentiometer	1	Controls LCD contrast
Breadboard & Jumpers	-	For connections
Resistors (220Ω)	2	For LED and buzzer

Software

- **Arduino IDE** – For writing and uploading the code.
- **Tinker CAD / Fritzing** – For simulating the circuit.
- **EasyEDA**– For PCB design and Gerber generation.

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5. Working Principle

- The tilt sensor contains a metal ball that moves when the sensor is tilted or shaken.
- The movement completes or breaks an internal connection, producing a HIGH or LOW signal to the Arduino.
- The Arduino continuously reads this signal.
- If a tilt or shake is detected (sensor triggered), the Arduino activates a buzzer and LED as an alert.
- A message is displayed on the LCD indicating "Earthquake Detected".
- When no tilt is detected, the system remains in standby mode.

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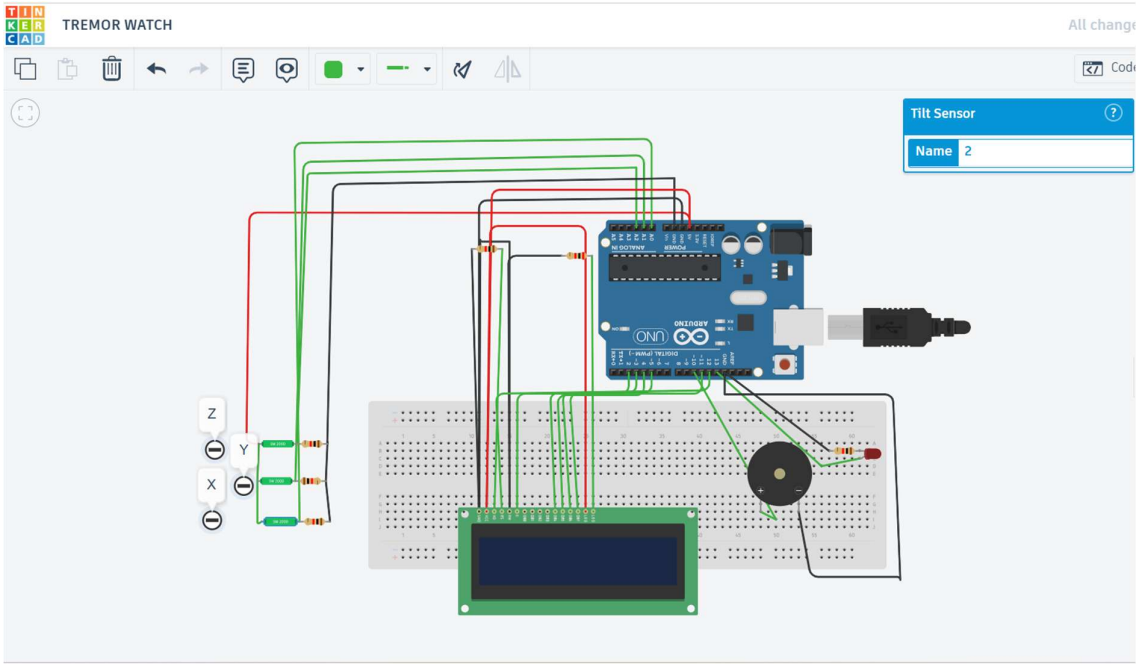
6. Simulated Circuit (Tinker CAD/Fritzing)

- The system was successfully simulated on **Tinker CAD** with all components connected to the Arduino Uno.
- LCD connected in 4-bit mode.
- Tilt sensor connected to digital input pin with pull-down resistor.
- LED and buzzer connected through digital output pins.



7. Results

Test Case	Action Performed	Expected Output	Actual Result
1	No motion	LCD shows "Monitoring..."	Pass
2	Slight tilt/vibration	Buzzer & LED activated	Pass
3	Constant vibration	Continuous alert triggered	Pass
4	Remove vibration	System resets to standby	Pass

- The system correctly detected tilt/shaking within milliseconds.
- Visual and audible indicators were clearly noticeable.
- LCD displayed real-time status updates accurately.

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8. Possible Challenges & Limitations

- **False Triggers:** Strong winds or slight table movements can falsely trigger alerts.
- **Limited Sensitivity:** Basic tilt sensors can only detect movement in limited directions. More precise detection requires accelerometers like ADXL335.
- **No Remote Alerting:** This version does not support IoT or SMS alerts, limiting usability in remote monitoring.

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9. Future Improvements

- **Use ADXL335 or MPU6050 accelerometer** for multi-directional motion detection and sensitivity control.
- **Integrate GSM module** (like SIM800L) for SMS alerts during real earthquake events.
- **Add IoT capabilities** via ESP8266/NodeMCU for cloud data logging and remote access.
- **Include battery backup** to ensure it works during power failure.
- **Build custom PCB** for a more professional and compact design.

10. Video Demo

https://drive.google.com/file/d/18gNwL6FbJ2uPKPVg_OW4hkh5esaVDGAn/view?usp=drive_link