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Earthquake Detection using ADXL 335 Accelerometer

L. Hema Supriya Reddy[1], V. Deepakteja[2], P. Madhu[3] and R. Srinivas[4]
[1-4]Vignana Bharathi Institute of technology/Electronics and Communication Engineering, Hyderabad, India
Email: luckyreddy.hemasupriya@vbithyd.ac.in, 22p61a04i5@ vbithyd.ac.in, 22p61a04e3@vbithyd.ac.in, 22p61a04f3@vbithyd.ac.in

***Abstract*— This project focuses on designing a low-cost earthquake detection system using the ADXL335 accelerometer and Arduino Uno. The accelerometer measures real-time vibrations along the X, Y, and Z axes and sends analog data to the Arduino. The Arduino processes this data and compares it against predefined threshold values to detect unusual ground motion. When significant vibrations are detected, the system activates a buzzer to provide a local warning. The Arduino IDE was used to program the detection logic and to monitor sensor values through the serial monitor. This simple and efficient system provides basic early-warning functionality and can be further enhanced with wireless communication or data logging features for advanced applications.**

***Index Terms*— Diaster Preparedness, Sensor Calibration, Motion Detection, Seismic Activity Monitering.**

I. INTRODUCTION

Earthquakes can cause sudden damage, so early warning is helpful. This project uses an ADXL335 sensor and Arduino to find strong shakes and turn on a buzzer.

A. Sensor Setup and Vibration Detection

The ADXL335 accelerometer detects ground movement by measuring acceleration on the X, Y, and Z axes. It sends analog signals to the Arduino Uno, which calculates a baseline from initial readings. The Arduino compares live readings to the baseline and detects motion if values cross a set threshold. A buzzer is triggered locally to alert users of possible tremors. This setup works offline, making it suitable for areas without internet or GSM access.

B. Threshold Programming and Alert System

The Arduino is programmed to monitor changes in sensor readings compared to the initial baseline. If the difference exceeds a defined threshold, it indicates abnormal vibration. Once triggered, the Arduino activates a buzzer to provide an audible alert. The buzzer remains on for a fixed duration (e.g., 2 seconds) and then turns off automatically. This logic helps reduce false alarms from minor or normal vibrations.

C. Circuit Assembly and Testing

The circuit was assembled on a breadboard using the ADXL335 sensor, Arduino Uno, a buzzer, and a BC547 transistor.

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The sensor's X, Y, and Z pins were connected to the Arduino's analog inputs. The buzzer was connected to a digital pin via the transistor to handle switching. After uploading the code, the system was tested by simulating vibrations. The buzzer successfully triggered when strong motion was detected, confirming proper operation.

D. Arduino IDE and Code Dumping

The Arduino IDE is used to write and upload code to the Arduino Uno. It allows communication with the ADXL335 sensor to read vibration data.

TABLE I. TYPE OF COMPONENT, SPECIFICATION, PURPOSE

COMPONENT	SPECIFICATION / MODEL	PURPOSE
ARDUINO UNO	ATMEGA328P MICROCONTROLLER	MAIN CONTROL AND PROCESSING UNIT
ADXL335 ACCELEROMETER	3-AXIS ANALOG OUTPUT SENSOR	DETECTS GROUND VIBRATIONS
BUZZER	PASSIVE OR ACTIVE BUZZER	AUDIBLE ALERT
BC547 TRANSISTOR	NPN TYPE	SWITCH CONTROL FOR BUZZER
RESISTORS	220Ω, 10KΩ	FOR SIGNAL CONTROL AND PROTECTION
BREADBOARD	-	ASSEMBLING THE CIRCUIT
JUMPER WIRES	MALE-TO-MALE	CONNECTING COMPONENTS

II. HELPFUL HINTS

A. Figures and Tables

In this project report, various figures and tables have been included to provide a clear understanding of the system design, components used, and implementation details. The tables summarize important information such as the list of components, system behavior, and the Arduino IDE implementation of each part. These help in simplifying the technical structure of the project. The figures, including the block diagram and circuit layout, visually represent how the components are connected and how data flows from the ADXL335 sensor to the Arduino and finally to the buzzer. These diagrams are essential to understand the working principle and to guide the physical assembly of the prototype. Each table and figure is provided with a title and is referred to within the text for ease of explanation and correlation with the project implementation.

B. References

Number citations consecutively in square brackets [1]. Punctuation follows the bracket [2]. Use "Ref. [3]" or "Reference [3]" at the beginning of a sentence:
Give all authors' names; use "et al." if there are six authors or more. Papers that have not been published,

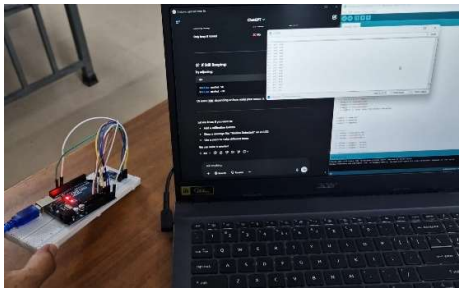

Figure 1. Note how the caption is left aligned

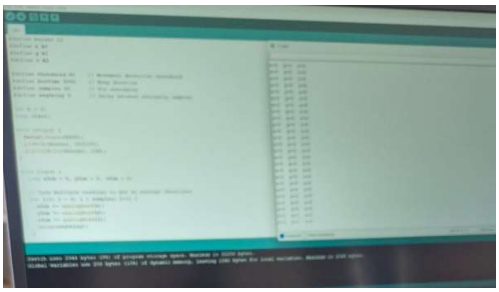

Figure 2. Note how the caption is right aligned

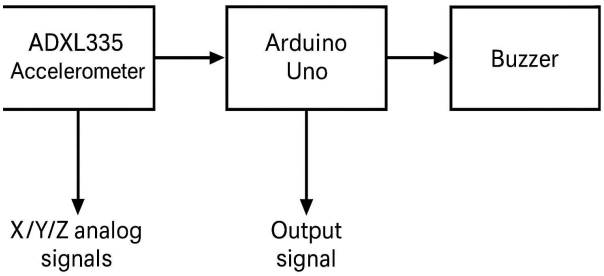

Figure 3. Note how the caption is centre aligned

C. Footnotes

The ADXL335 sensor is a 3-axis analog accelerometer developed by Analog Devices. It outputs a voltage proportional to acceleration on the X, Y, and Z axes.
Used to detect motion or vibrations
The threshold value in the code defines how sensitive the system is to vibrations. Too low a value may cause false alarms due to noise.

D. Abbreviations and Acronyms

ADXL - Analog Devices Accelerometer Line

E. Equations

Analog to Acceleration Conversion (optional, if using ADXL335 datasheet)
If you want to convert analog values into actual acceleration (in g), you can use:
Acceleration (g) = (V_out - V_zero_g) / Sensitivity. (1)

- Vout = sensor output voltage (from analogRead())
- Vzero gV_{\text{zero g}}Vzero g = baseline output voltage at 0g (~1.65V on 3.3V supply)
- Sensitivity = ~330 mV/g (for ADXL335)

ADC to Voltage Conversion
Voltage (V) = (ADC Value × V_ref) / 1023. (2)

- ADC Value = Analog value from analogRead() [0–1023]
- V_ref = Reference voltage of Arduino (usually 5V or 3.3V)

Motion Detection Logic
If |x - x_avg| > Threshold → Trigger Buzzer. (3)

- x = Current reading from sensor
- x_avg = Baseline average value
- Threshold = Predefined limit to detect abnormal vibration

TABLE II. NOTE HOW TABLE IS LEFT ALIGNED

Condition	System Response
No movement	Buzzer remains OFF
Small vibrations (normal)	No alert, ignored by threshold
Strong vibration detected	Buzzer turns ON for 2 seconds
System idle	Continues monitoring in real-time

TABLE III. NOTE HOW TABLE IS RIGHT ALIGNED

Component	Aurdino pin
ADXL335 Sensor	A0 (X), A1 (Y), A2 (Z)
Arduino Uno	USB Port
Buzzer	Digital Pin 12
BC547 Transistor	Connected to buzzer & GND
Serial Monitor	USB/COM Port

F. Other Recommendations

The system can be enhanced by integrating IoT platforms to send real-time alerts to mobile devices or cloud servers. It can also be upgraded with GPS, data logging, and machine learning for smarter earthquake prediction and analysis.

III. CONCLUSIONS

This presents a low-cost earthquake detection system using the ADXL335 sensor and Arduino IDE. It detects strong vibrations and activates a buzzer for local alerts. With further enhancements like IoT integration or data logging, the system can be scaled for wider and smarter early warning applications.

APPENDIX A APPENDIX TITLE

- Arduino Source Code

- Circuit Diagram
- Serial Monitor Output

ACKNOWLEDGMENT

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