Earthquake Indicator Using Arduino

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Abstract

An Earthquake detector using Arduino board and highly sensitive accelerometer that can detect minute vibrations is presented in this paper. The components are able to provide immediate alert and helps to take preventive measures against earthquakes accordingly.

Keywords: *Accelerometer, Arduino, earthquake, vibration*

INTRODUCTION

Earthquakes are the major natural disaster. Earthquakes are shaking of the Earth's crust caused by immediate release of energy in its interior, most often as a resulting in strains accumulated in rocks, exceeding its elastic limit and causing it to explode. An earthquake is generated when two crust of the earth experience friction against at one another. Thus, detection and prediction of the earthquake phenomenon to different areas could result in lowering the earthquake disaster generated by it. In this paper, an earthquake indicator using a micro-controller-Arduino UNO and a highly sensitive accelerometer- ADXL335 Accelerometer is used that can sense vibrations [1]. ADXL335 Accelerometer is very responsive to tremors in any of the three physical axes of the Accelerometer [2] [3]. ADXL335 Accelerometer provides analog voltage which is identical to imposed acceleration. The Accelerometer has three outcomes, each for of X-axis, Y-axis and Z-axes. The three analog outputs are linked with Arduino Uno Analog to Digital Convertor (ADC) pins and any vibration results due to fluctuation in any of the axes is detected by the accelerometer [4] and hence detected by Micro-controller. If dynamics are large enough in the middle of an earthquake and crosses a certain value called threshold value, a light, which acts as an indicator of earthquake glow as well as an alarm, is sound. While the alarm may be used for household principle, it can also be used in industrial purposes. The threshold regulation buttons are present for conducting this work. An LCD has been added in the device for monitoring threshold hence making the system efficient and user-friendly.

This paper consists of Implementation, Algorithm, Results and Discussions and Conclusion.

IMPLEMENTATION

The fig. 1 shows the block diagram of Earthquake indicator Using Arduino. Arduino Uno board is connected with Accelerometer, alarm system, Threshold Setting, Power supply and LCD screen. Arduino board is a micro-controller which is connected to illustrated hardwares and the vibration readings is processed by Arduino Board. Alarm system is used to buzz a sound when the vibration readings cross a certain threshold value. A power supply I of 5V is provided to the Arduino and an LCD display is used to display warning notifications to the user. The Arduino Uno board joined to ADXL335 accelerometer module with its ADC inputs: X-axis connected to pin A0, Y-axis connected to pin A1 and Z-axis connected to pin A2 as shown in fig. 2. Two push-

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buttons are used through supply of 5V which is connected to Arduino Uno pins 2 and 3 that are brought down to ground state via resistors R1 and R2. These buttons are used for increasing and decreasing the threshold value of tremor strike. A 16x2 LCD is connected in 4-wire method with Arduino pins disparity control and backlight enabled.

Figure 1: *Block diagram of earthquake indicator using Arduino.*

BC548 transistor is wired to pin5 of Arduino Uno for switching on the Alarm LED and a buzzer. Pins 11, 12, 9, 8, 7 and 6 are used to control LCD and data lines. When the setup is switched on, it saves and gathers real time accelerometer values in Arduino internal EEPROM regardless of its inclination. Since the ADC device is 10-bit device, special header file EEPROM X has been provided for all voltages and for the structure to be durable before any initial value is read. Arduino's microcontroller stores all the three axes saved values from the accelerometer and stores in the EEPROM.

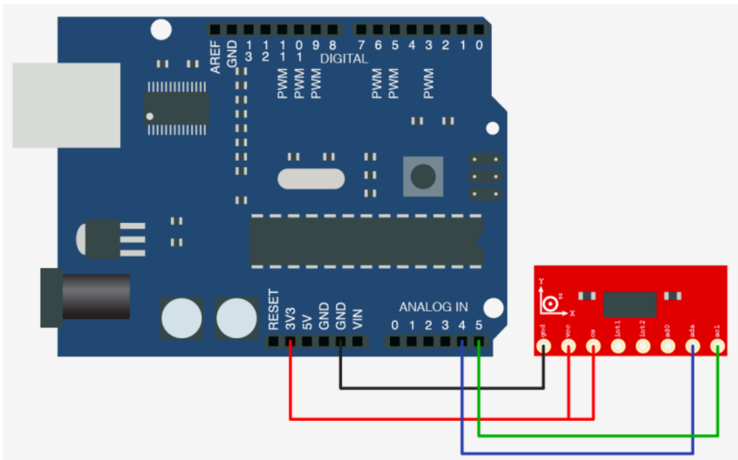

Figure 2: *Connections between Arduino Uno and ADXL335 Accelerometer.*

In initializing mode shown in fig.3, system frameworks are loaded. In monitoring mode as shown in fig.4, the system arrives into monitoring mode with present threshold value displayed on the second line of the LCD screen [4]. The indication of vibrations of accelerometer are processed in the indication mode as shown in fig,5 and the warning notification is displayed in Display mode as shown in fig.6. This architecture and coding hold positive as well as negative values in all

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three axes of the Accelerometer. Pushbuttons connected to pins 2 and 3 of Arduino Uno micro-controller deals as a delay for increasing and decreasing threshold values for subtlety improvements. For an earthquake, threshold value of 10 to 12 is better.

The different stages in vibration detection are shown below:

Figure 3: *Initializing mode.*

Figure 4: *Monitoring mode.*

Figure 5: *Indication mode.*

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Figure 6: *Display mode.*

ALGORITHM

The algorithm for the earthquake indicator using Arduino Uno is shown below. In the first step, System guidelines are initiated in the initialization mode (fig. 3). According to the accelerometer readings in X, Y and Z axes, the values are processed in the monitoring mode (fig. 4). Threshold value is set to 25. If the threshold value is crossed, buzzer will sound. The readings from the Accelerometer and the Threshold value are compared. During this time, "Monitoring" will be displayed on the LCD screen giving idea that the values are being calculated [5][6]. If the Accelerometer reading surpasses threshold value, buzzer will sound. LCD screen will display" Alarm!!! Please evacuate" which will give to user notification that earthquake is happening. The alarm will buzz for some time limit and then it will re initialize the value and reprocess the whole thing from the initializing mode. If the Accelerometer value is less than threshold value, the process goes back to initializing mode. This will monitor the whole process step by step and user will get warning alarm as well as warning notification.

STEP 1: START
STEP 2: INPUT INITIAL VALUES A0, A1, A2
STEP 3: INITIALIZE Th=25
STEP 4: GIVE INPUT X, Y, Z, Th
STEP 5: PRINT "MONITORING"
STEP 6: IF {(X>A0+Th) || X>(A0-Th)) || ((Y>A1+Th)) || Y>(A1-Th)) || ((Z>(A2+Th)) || Z>(A2-Th))}
STEP 7: MAKE ALARMPIN = HIGH, PRINT "ALARM!!! PLEASE EVACUATE."
STEP 8: DELAY TIMER
STEP 9: RETURM TO STEP 5
STEP 10: ELSE RETURN TO STEP 5
Algorithm for Earthquake Indicator

RESULTS AND DISCUSSIONS

Using this device, result was achieved by observing the distance of source of vibration from the accelerometer static and fluctuating the magnitude of vibration. For small vibration intensity, the LCD screen noted the following readings- For X-axis: 341 Hz, Y-axis: 320 Hz and for Z-axis: 265 Hz. For medium vibration intensity, the LCD screen noted the following readings- For X-axis: 345 Hz, Y-axis: 325 Hz and for Z-axis: 260 Hz and for large vibration intensity, the LCD screen noted the following readings- For X-axis: 330 Hz, Y-axis: 325 Hz and for Z-axis: 300 Hz. Another result was achieved by observing the source of vibration static and varying the distance. For a distance of 5cm, the following values were noted: for X-axis: 320 Hz, for Y-axis: 323 Hz and for Z-axis: 268 Hz. For a distance of 10cm, the following values were noted: for X-axis: 330hz, for Y-axis: 333hz and for Z-

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axis: 266hz and for a distance of 15cm, the following values were noted: for X-axis: 332hz, for Y-axis: 338hz and for Z-axis: 260hz These two results illustrate that this device can be effectually and efficiently be employed to measure distinct amplitudes of vibration and magnitude scaling from limited to large and also for distinct distances. Result from al the analyses, it is demonstrated that the device could be used to detect even limited tremors and it helps to take preventive measures to avoid causalities.

CONCLUSION

Earthquake indicator using micro-controller- Arduino Uno and Accelerometer ADXL 335 has settled to be a decisive, salvage and a user-friendly device. The product is requires less money for large majority of people in terms of device cost and installation cost. Casual controlling of the system is not mandatory. The device can be easily established in resident places and industrial places. Power provision of the system is also limited to minimum. Careful management is essential for this device and it can be readily regulated by the user. It is expected that the device will be largely available in the display due to its user-friendly nature and efficiency. The device can be used in earthquake possible areas. This product can be improved and can be used in machine learning applications. It will help in predicting earthquakes with ease.

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