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Earthquake and Tsunami Alert Through GSM Network

Saminathan V, Harikrishnan S, Karthik P, Sudharson V, Vimalkishore J

Abstract: ***The earthquake and tsunami are dangerous natural disasters that are unpredictable, which causes damage to lives and property. It happens all of a sudden, but we can alert from it. In this modern world, many modern technologies can easily analyze the small vibrations and knock so that we can take the necessary precautions. The usage of accelerometer ADXL335 paves the way to sense the earthquake vibrations and tsunami seismic waves in all three axes. This project setup includes the LoRa and GSM module in addition to the accelerometer. Hence, it acts as a perfect shield because it gives a warning, vibration graph on the computer and spread the warning via messages.***

Keywords: seismic waves, reporting of tsunamis and earthquakes, LORA module, accelerometer sensor, GSM **module**.

I. INTRODUCTION

The Earth consists of the crust and outer mantle layer, thus the outer mantle layer consists of seven humongous plates and many timid ones that fit together like puzzle pieces. When these pieces slip over or move unsequentially, huge energy is released as an earthquake. Earthquakes that happen at undersea results in the form of mighty tsunamis. These tectonic shifts also result in the creation of volcanoes, mountains and also play a role in the redrawing coastlines. According to the sources, there are over 5,00,000 earthquakes in which 1,00,000 of them were felt in a year. When the magnitude of the earthquake reaches 7 or greater, it results in a major catastrophe. These natural calamity setbacks .The nation several years back by crushing the nation's economy and destroys the lives of people without any prior warning. This stresses the importance of this project.

II. BLOCK DIAGRAM

A block diagram consists of the key element called a block. These blocks are interconnected by the lines which represent the relationship among the blocks. We can understand the project with the given below block diagram with ease as shown in figure 1 and 2.

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* Correspondence Author
Dr. Saminathan V, Associate Professor, Electronics and Communication Engineering, Karpagam College of Engineering – Coimbatore-641032 nvsami2010@gmail.com,
Harikrishnan S, Electronics and Communication Engineering,Karpagam College of Engineering – Coimbatore-641032.
Karthik P, Electronics and Communication Engineering,Karpagam College of Engineering – Coimbatore-641032.
Sudharson V, Electronics and Communication Engineering,Karpagam College of Engineering – Coimbatore-641032.
Vimalkishore J, Electronics and Communication Engineering,Karpagam College of Engineering – Coimbatore-641032.

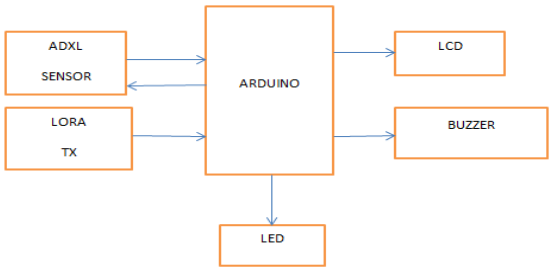

Fig.1.Transmitter

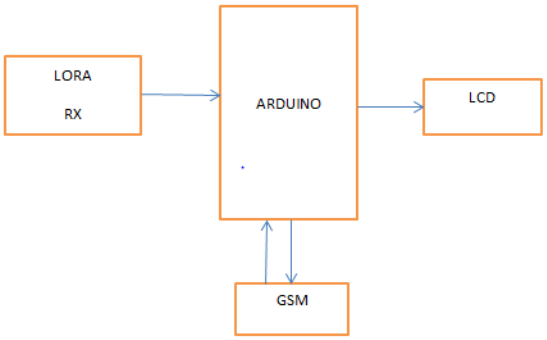

Fig.2.Reciever

III. HARDWARE COMPONENTS

3.1 ARDUINO

Arduino is an electronic device that is an open-source and easy-to-use hardware and software. Indeed, it can fetch inputs and gives us results in the form of activation of the motor and blinking of an LED. These actions are taking place by giving a set of instructions to the microcontroller with the help of the Arduino programming language and Arduino Software (IDE)[1]. The operating voltage of the Arduino is 5V as shown in figure 3. The memory capacities of RAM are 2Kb and for storing programs and parameters it takes 32 Kb and 1 Kb in EEPROM respectively. It functions at the 16MHz clock speed. It consists of 14 IO pins of digital and 6 analog input pins. This electronic device can be given a power source through USB or external power supply. The external power supply can be either from an AC-DC battery. The power supply ranges from 6 to 20 V.

Fig . 1 Arduino microcontroller

Fig.3. Arduino UNO

3.2 ACCELEROMETER

Accelerometers are used to measure acceleration. The acceleration is defined as the rate of change of the velocity of an object. They are used to sense static or dynamic forces. The former one includes gravity, while the other one includes vibrations and movements[2].

Their usage ranges from vehicle acceleration to seismic activity.

There are many types of accelerometers, namely :

- Piezoelectric accelerometer
- Quantum (Rubidium atom cloud, laser-cooled)
- Resonance
- Seat pad accelerometers
- Shear mode accelerometer
- Strain gauge
- Surface acoustic wave (SAW)
- Surface micromachined capacitive (MEMS)

It can measure the acceleration in three-dimensional axes. Accelerometers consist of capacitive plates, some of them are interconnected to a timid spring that will be in motion when the force acts on it[3]. Hence, the capacitance among them changes which paves the way to find the acceleration. It will give us the output in three forms such as analog, digital and pulse width modulation as well. It is a low-power device. The required current will be in micro or milli-amp range and supply voltage of 5 volts or less.

Pin Description of accelerometer:

X-OUT, Y-OUT, Z-OUT: These pins provide associate degree Analog output of x, y and z directions respectively.

ST Pin: This is used for the sensitivity of the device.

GND: It denotes the ground.

3.3 LED

A light-emitting diode is a diode that emits light passes through it with the semiconductor as a source. This light emission mechanism consists of the recombination of electrons and releasing energy in the form of photons. The color of the light is the result of the amount of energy released. There are many advantages to using LEDs. They emit the intended color without using the color filter and very small in size.

3.4 LORA

The LoRa mainly utilized in a long-range transmission with less power consumption and wireless as well. It does a major impact on the IoT sector. It is very useful in long-range transmission because of its radio interface design to receive minute signal levels as well[4]. It paves the way for long-range transmission with ease. The LoRa modulation and radio interface are designed and optimized to supply precisely the style of communications required for remote IoT and M2M nodes.

Although LoRa has been basically developed by Semtech, a gap he customary out enabled it to be adopted by a large range of corporations, thereby growing the scheme and gaining considerably larger engagement, a wider form of merchandise associate degreed an overall increase in usage and acceptance.

The range of the LoRa is about fifteen-twenty kilometer.

The battery life is about more than 10 years. There square measure varied parts to LoRa technology that offers the practicality and property for the system :

LoRa PHY / RF interface:

This layer plays a vital role in the transmission and receiving the signals between the transmitting points and receiving points[5]. The physical layer or radio interface governs aspects of the signal together with the frequencies, modulation format, power levels, the signal between the sending and receiving parts, and alternative connected topics.

LoRa protocol stack: additionally to the LoRa physical layer, the LoRa Alliance has additionally outlined associate degree open protocol stack. The creation of the ASCII text file stack has enabled the thought of LoRa to grow as a result of all the various kinds of corporations concerned in LoRa development, use and readying are ready to move to form a straightforward to use, low-priced resolution for property all manner of connected IoT devices.

LoRa spec (LoRaWAN): except the RF parts of the LoRa wireless system, there square measure alternative parts of the spec, together with the system design, backhaul, server and application computers[6]. the design is usually brought up as LoRaWAN. LoRa wireless technology is ideally placed to be utilized in a large form of application.

The low power and long-range capabilities mean that endpoints are deployed during a big variety of places, in buildings and out of doors and still have the potential of having the ability to speak with the entry.

LoRa technology is especially engaging for several applications owing to its long-range capability. New nodes will simply be connected and activated and coverage is simple to supply.

IV. SOFTWARE

1.Arduino IDE

Arduino IDE permits the user to perform real-time operations by writing and uploading the code since it is open-source that makes easy to use. It is available for a wide range of operating systems such as MAC, Windows, and Linux. It accepts Java Platform as well.

It is gifted with many inbuilt functions that help in debugging and to compile in the environment. It also holds other salient features as we can easily share any details with others. We are not restricted in changing the schematics when required. It also has guidelines for installation for beginners.

2.PROCESSING:

Processing is easy to use since it is open-source. It helps in building the graphical interpretation of the result. It mainly designed for the student community who were not programmers, to create a visual context. It uses java along with the computer program for graphs which paves the way for simplified execution and compilation.

It additionally permits users to form their categories at intervals the Applet sketch. This enables complicated knowledge sorts that will embrace any variety of arguments.

V. WORKING

Working on this setup is much easier. The accelerometer sensor in this setup is highly sensitive which helps in the detection of the seismic activities and minute vibrations as well. It senses vibrations in three dimensions. Due to varying data, an average of the multiple data is taken into account. When the resultant data is reached beyond the threshold level, the primary alert is displayed via LCD[7][8][9]. With the help of the LoRa module, we can carry out the transmission and receiver operation with the GSM module. Based on our configuration we can use the LoRa module as either transmitter or receiver. The final alert will be done with the help of the GSM module, it alerts the people by sending messages. It is very much helpful since this involves one to one relationships with the user and setup as shown in figure 4 and 5. There is no intermediate between them[10]. Hence, it is highly reliable and efficient.

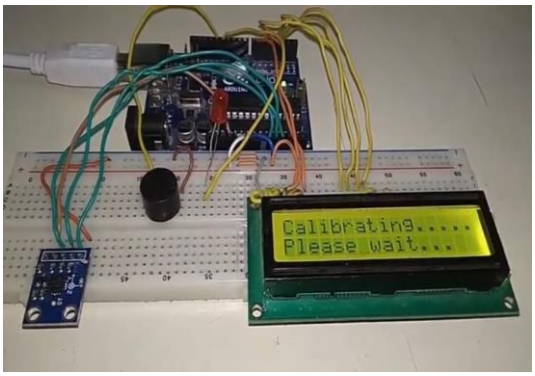

Fig.4.Project setup for earthquake and tsunami detection.

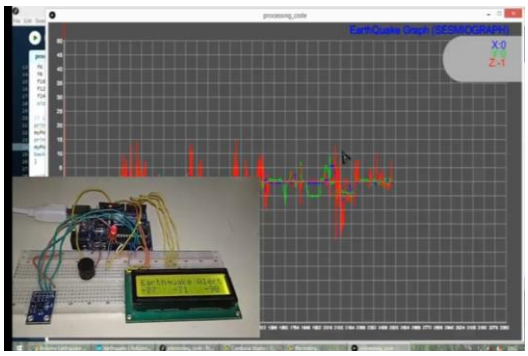

Fig.5.Processing output of the accelerometer

VI. RESULT AND DISCUSSION

This project has many options to add further modifications and to update the project to a whole new level. We can develop it into a mobile application. By this, we can widespread the news of the threat. In this paper, the LoRa module provides a viable solution to warn the people. With the cooperation of the government, we can implement this project on a large scale. Due to this, we can save the lives of people and government properties as well.

VII. FLOW DIAGRAM

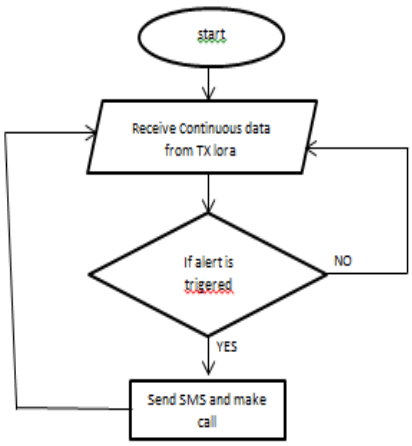

Fig.6.Flow Diagram

As per the figure 6 the flow diagram helps to understand the concept easily. The below flow diagram depicts the function of transmission and receiver respectively. In this operation, accelerometer reads the seismic waves continuously and transmit the data to the receiver. If the data goes beyond the threshold range, it will alert the people via LCD, LED, buzzer or text messages based on the setup.

VIII. CONCLUSION

Thus, to sum up, we've got introduced this product with a read to reducing the destruction caused by Associate in Nursing earthquake and wave, by alerting the individuals. it's economical and its worth is quoted in such a way that it's cheap by each individual[11][12]. we've got bestowed a completely unique technique to resolve the automated detection and classification drawback of earth tremors in an exceedingly single step by victimization Arduino based mostly earthquake and wave detection. In our system, the bulk of cases offer real sensible edges within the event of Associate in Nursing earthquake and tsunami to safeguard lives and resources.

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AUTHORS PROFILE

Dr. V. Saminathan. Completed HIS B.E, Ece IN THE YEAR 2005 AND Me Ae IN 2008 AND Ph.D. Ice IN THE YEAR 2018, Presently WORKING AS AN Associate Professor IN THE DEPARTMENT OF Electronics AND Communication Engineering, Karpagam COLLEGE Engineering Coimbatore.

Vimal Kishore J CURRENTLY PURSUING B.E Electronics AND Communication Engineering IN Karpagam COLLEGE Engineering Coimbatore AND CURRENTLY DOING A PROJECT ON Gsm Based Applications.

Karthik P,CURRENTLY PURSUING B.E Electronics AND Communication Engineering IN Karpagam COLLEGE Engineering Coimbatore AND CURRENTLY DOING A PROJECT ON Gsm Based Applications.

Sudharson V, CURRENTLY PURSUING B.E Electronics AND Communication Engineering IN Karpagam COLLEGE Engineering Coimbatore AND CURRENTLY DOING A PROJECT ON Gsm Based Applications.

Harikrishna,N S CURRENTLY PURSUING B.E Electronics AND Communication Engineering IN Karpagam COLLEGE Engineering Coimbatore AND CURRENTLY DOING A PROJECT ON Gsm Based Applications.