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A Low Cost GPS Enabled Earthquake Detection Using IoT

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Abstract

The world is suffering from various kinds of disasters. One such kind of disaster is earthquake. Many a times in certain places the effect of earthquake is severe. An earthquake is the shaking of the surface of the Earth resulting from a sudden release of energy in the Earth's lithosphere that creates seismic waves. Early detection of earthquake is possible, so that we can avoid some extent of damage or the loss caused by the earthquake. In this paper we have proposed an early detection of the earthquake using Internet of Things (IoT) technology ,Global System for Mobile Communication (GSM),Global Positioning System(GPS).Our proposed system uses the vibration sensor to detect the changes in the earth that causes the earthquake. Further the information along with the location can be communicated to the user's mobile using GSM and GPS technologies so that in advance we can mitigate the losses caused by the earthquake. Hence our system can be a low cost alternative for the early detection of earthquake.

Keywords*: - GSM, GPS, Vibration Sensor, Earthquake, Disaster, IoT.*

INTRODUCTION

Internet of Things (IOT) is a concept which enables communication between internetworking devices and applications, whereby physical objects or 'things' communicate through the Internet [1]. IoT is the transformation of basic technologies such as embedded devices, communication protocols, sensor networks, internet protocol and applications from conventional to smart ones [2]. The combining of the sensors accelerometers, gyroscopes, GPS, etc. and the different connectivity options allows to have well

equipped IoT devices [3]. IOT is the technique or network used to send the accurate alert message to the public [5]. Using an Accelerometer to detect the pre-earthquake vibrations. Acceleromet ER is highly sensitive to shakes and vibrations along with all the three axes [6]. Buildings can progressively damage during their operational lifetime, due to seismic events, unforeseen foundation settlement, material aging, design error, etc. Periodic monitoring of the structure for such damage is therefore a key step in rationally planning the maintenance needed to guarantee an adequate level of safety and serviceability [7]. Earthquake is one of the most damaging natural activities which offer serious threat to areas near major active faults on land or seduction zones offshore [8]. To enhance current earthquake early warning (EEW) systems, emerging technologies, including social and mobile computing, have been the focus of much attention [12] .The concept of IOT began with things classified as identity communication devices. Radio Frequency Identification Device (RFID) is an example of an identity communication device. IOT is the network of physical devices, vehicles, home appliances, and other items embedded with electronics, software, sensors, actuators, and connectivity which enables these things to connect, collect and exchange data. There are many application areas of IoT such as Smart city, Smart home, smart agriculture, smart communication, smart grid, smart supply chain, industrial internet and many more allied areas. The IoT can even be applied to solve the problems in the disaster management. The causes of disaster if can be predicted using environment conditions so that we can make it as the application of IoT. Some of the applications of IoT related to disaster management includes Earthquakes and Water floods Monitoring System, Early earthquake warning system. Earthquakes are one of the most devastating and frightening natural disasters a person can experience. They happen without warning in areas all around the world. An earthquake is the shaking of the surface of the Earth resulting from a sudden release of energy in the Earth's lithosphere that creates seismic waves [1]. There are lots of regions on our planet which consist of distributed faults. These faults are the main source for seismic events. Nowadays many countries are suffering from unpredicted earthquake disasters [11].Earthquakes can cause major damage and fatalities in populated areas, but the earthquake itself is not always to blame. Other natural disasters can be caused by earthquakes and these can be equally, and sometimes more,

destructive. Earthquakes may trigger volcanic eruptions. For example, in 1975, a massive earthquake hit Hawaii and a few hours later, the summit caldera in Kilauea erupted. Most earthquakes occur on or near the edges of tectonic plates. Similarly, a volcano is the result of the interaction of these plates. When the Earth moves during an earthquake, a landslide or avalanche can occur. Any area that has the right conditions, including moisture and the angle of the slope, can potentially experience these natural disasters. Both strong and weak earthquakes have the ability to cause tsunamis. When earthquakes rattle the sea floor, water is displaced and waves form. These waves can be large enough to be considered tsunamis. Tsunamis not only devastate the coastal area in the region where the actual earthquake occurred but can also cause damage on coasts thousands of miles away. Liquefaction can happen following an earthquake. Liquefaction is the mixing of sand or soil and groundwater during the shaking of a moderate or strong earthquake. The effects of an earthquake are terrible and devastating. Many building, hospitals, schools are destroyed due to it. A lot of people get killed and injured. Many people lose their money and property. It affects the mental and emotional health of the people. We can give a solution to the environment based disasters using IoT.

RELATED WORK

We can propose a solution to overcome certain extent the problems caused by earthquake. Various researchers given different solutions , some of them are considered here to conclude a new solution.

Alphonsa etl. proposed an Earthquake Early Warning System by IOT using Wireless Sensor Networks. This states the early detection of earthquake based on the natural and environmental parameters and the components are taken as the wireless sensor nodes, they used LABVIEW software for the results [1]. Abdulkadir KARAC etl. developed an IoT based earthquake detection system where they have used IMU sensor and ESP8266 , Wi-Fi module to detect and communicate about the happening of the earthquake [2]. Amjath Ali etl. Developed IoT Based Disaster Detection and Early Warning Device, with the help of Disaster-LINK a smart IoT device that acts as an alarm and monitoring system during natural disasters that operates by communicating over internet [3]. N N VENKATESH GUPTA etl. has proposed an IOT BASED EARTHQUAKE DETECTION BY

THINGSPEAK which consists of an alert system that has been proposed for all over the world would use a network of digital seismometers deployed around the state to give populated areas up to a minute of advance warning [4]. SHYAM JOSEPH etl. has developed an Earthquake Early Warning System by IOT Using Wireless Sensor Networks. This states the early detection of earthquake using the nature of ways and the components are taken as the wireless sensor nodes using Arduino software [5]. KM HINA etl. proposed an EARTHQUAKE DETECTOR, which is an arduino based system and uses sensing elements to reduce its destructive losses [6]. P.Ramanathan etl. has proposed Earthquake Evaluation of Concrete Buildings Using Low Power Wireless Sensor Networks which consists of the strain sensors which are mounted at the base of the building to measure the settlement and plastic hinge activation of the building after an earthquake. They measure periodically or on-demand from the base station. The accelerometers are mounted at every floor of the building to measure the seismic response of the building during an earthquake[7]. Prof. Pradeep etl. has proposed Earthquake Alarm System Based on Advanced Wireless GSM Modem which consists of an idea of low cost earthquake alarm system using ATmega328p, ADXL335 and XBee S2 [8]. Yogesh Sherki etl. proposed Design of real time sensor system for detection and processing of seismic waves for earthquake early warning system. This states that GSM communication module is used to send the data to the control centre which may be located far from the sensor system depending upon their respective locations. This data will be consist of exact P and S wave detection time, two planer azimuth angle, the magnitude of the occurred earthquake and the own location of sensor using GPS coordinates [9]. Meng-Yun Hsu etl. proposed A Low Complexity Algorithm for Earthquake Detection System to alert people by means of detecting earthquake events from raw information collected from acceleration sensor [10]. Navid Rajabi etl. proposed Real time earthquake prediction using cross-correlation analysis & transfer function model which states that cross-correlation analysis and calculation of data sensed by wireless sensor network[11]. Qingkai Kong etl. proposed Smartphone-based networks for earthquake detection. In this they have evaluated the use of smartphones as detection devices; collected both human and simulated earthquake data using the smartphones and developed an algorithm to distinguish

earthquakes from human activities[12]. The above research motivated to develop a low cost alternative for earthquake detection by keeping the cost of all the components and distance parameter.

PROPOSED WORK

Here in this paper we have proposed a low cost alternative system for the quick detection and notification about happening of earthquake such that mitigation of damage or losses by earthquake, includes minimize injuries, fatalities or prevent a disaster. In our proposed system we used a low cost vibration sensor SW-520D, Angle sensor module to sense the ground vibrations. Further the readings are send to the Arduino Uno where analog-to-digital conversion (ADC) converts the signals, these results are compared with threshold value to determine the happening of the earthquake. Based on the decision both the location and message is communicated to the mobile phone of the user using GSM Modem and GPS NEO-6M Module.

METHODOLOGY

Step 1: Initiate the system.

Step 2: Activate the vibration sensor to sense the ground vibrations.

Step 3: Compare ground vibrations with threshold to predict the earthquake.

Step 4: If earthquake is detected, alert GSM and GPS to prepare message along with the location for the communication otherwise go to **step 6**.

Step 5: Receive the message and the location from the mobile and proceed to the precautions of the earthquake.

Step 6: Repeat the above steps.

Fig. 1. Proposed System's Methodology

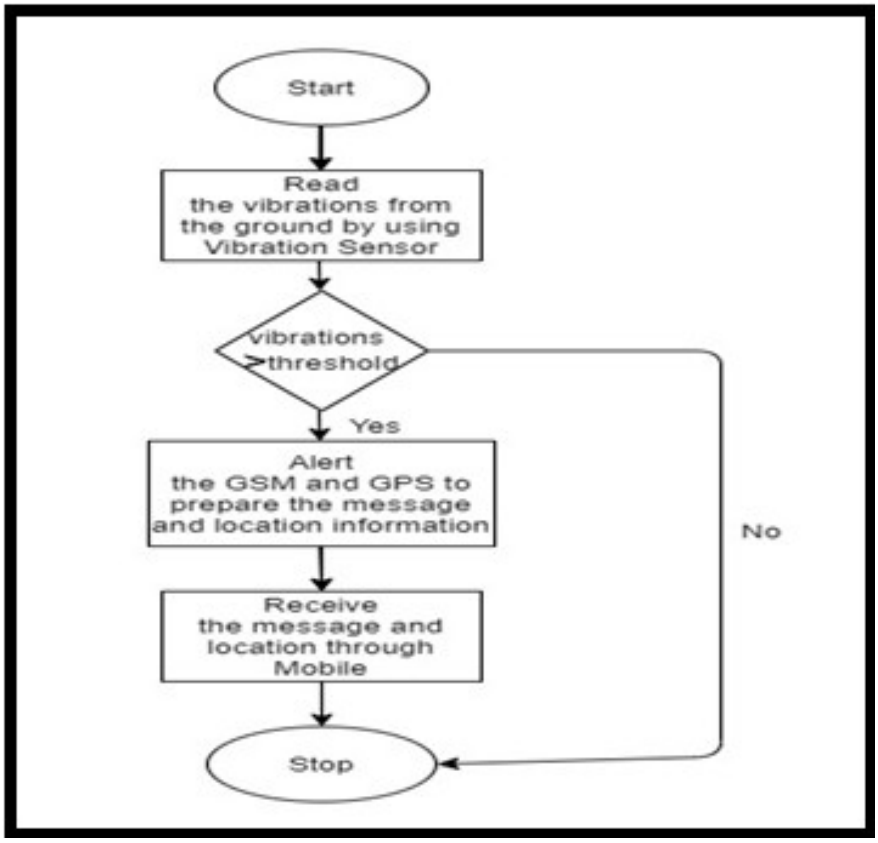

Fig. 2. Flow Diagram of Proposed System

BLOCK DIAGRAM

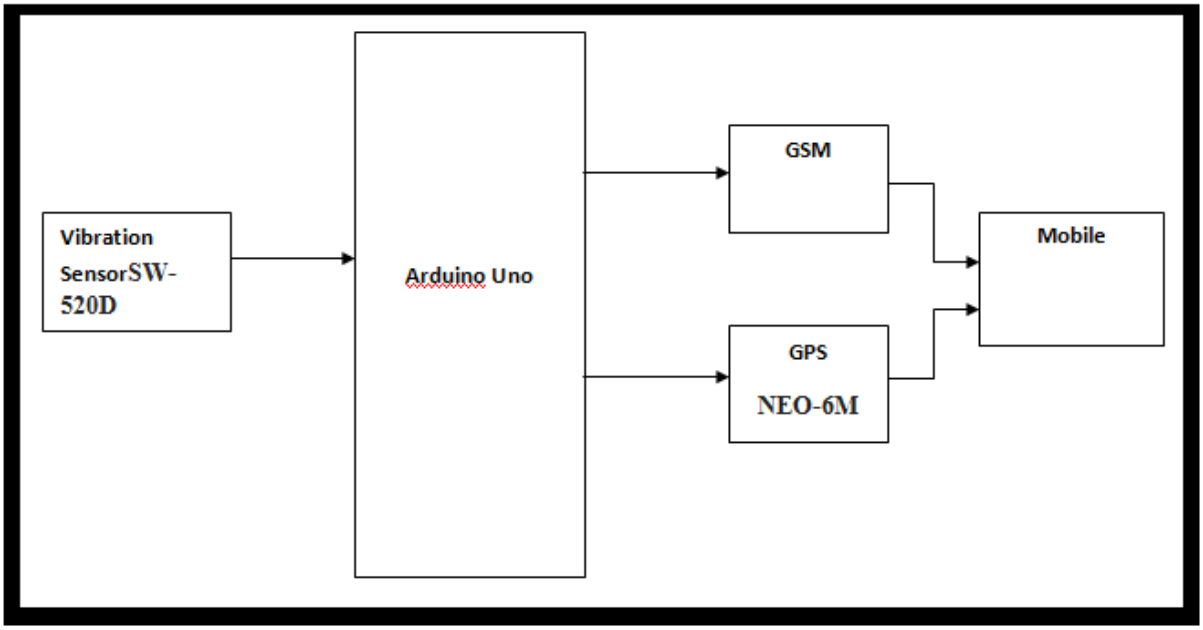

Fig. 3. Proposed System's Block Diagram

COMPONENTS USED

The “Vibration sensor” used is SW-520D Angle sensor module/Tilt sensor module ball switch / vibration switch.

The “Arduino Uno” is a micro controller board based on the ATmega328. It has 14 digital input/output pins, 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the micro controller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

Fig. 4. SW-520D Angle sensor module

Fig. 5. Arduino Uno

Fig. 6. GSM Modem

Fig. 7. GPS Module NEO-6M

The “GSM Modem USB” uses SIM900A based dual band 1800/1900MHz GSM / GPRS modem. It can be connected to USB directly or to a microcontroller UART using TTL levels.

The “GPS Module NEO-6M”,has 3V-5V power supply Universal Model: GY-GPS6MV1 Module with ceramic active antenna With data backup battery LED signal indicator Mounting Hole:3mm Baud rate: 9600 Compatible with various flight controller module EEPROM save the configuration parameter data when power-down.

IMPLEMENTATION AND RESULTS

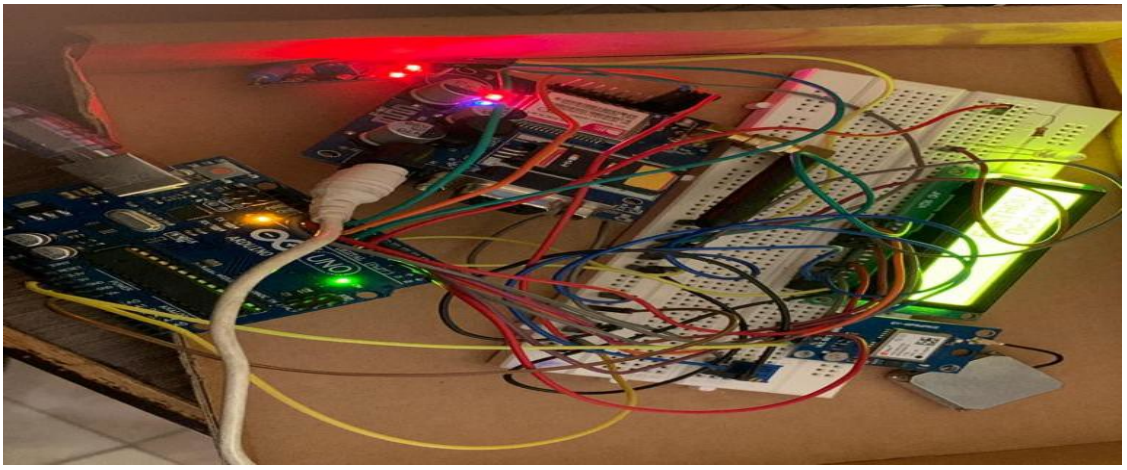

Fig. 8. Complete System Developed

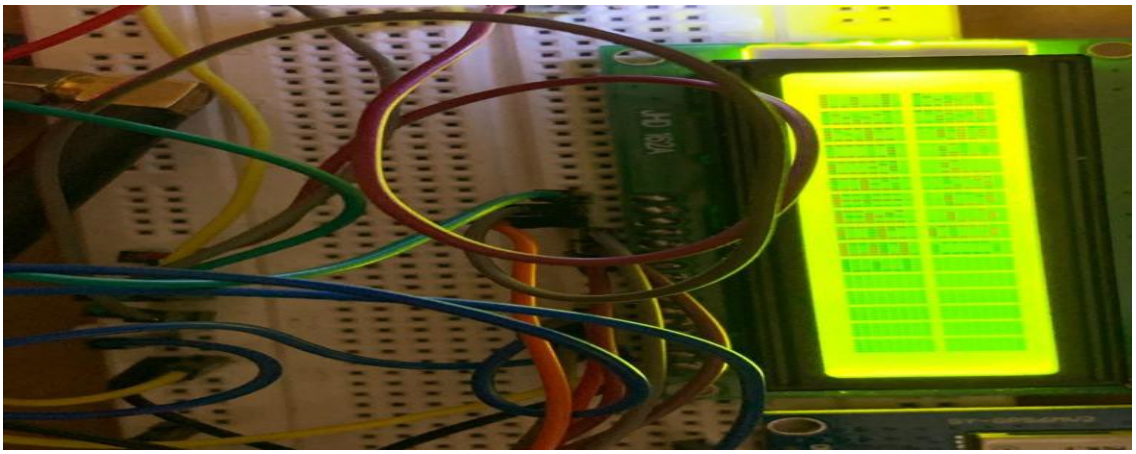

Fig. 9. Displaying message on LCD

Fig. 10. Receiving alert message along the location information.

CONCLUSION

We have developed and verified A LOW COST GPS ENABLED EARTHQUAKE DETECTION USING IOT. First the vibration sensor senses ground vibrations and then the system detects whether the earthquake happens. Based on which a message along with the location using GPS and GSM are communicated to user mobile so that the precautions to avoid the damages caused by earthquake can be initiated. As all the components in the system are available for low cost we can conclude that this system is a low cost alternative to the early systems existed.

FUTURE WORK

The future work may concentrate on the features like sending calls and messages to all the users of all zones. Earthquakes strike the earth all of a sudden. It poses a major threat to all the people and to all the living creatures. In future, Sensitive sensor will be used and perfect monitoring system will be maintained to detect the earthquake less than a fraction of milliseconds. And then, the Meteorological department can take further actions to intimate the people. Further based on the innovations in the components and technologies the system can be improved.

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REFERENCES

I. Alphonsa A., Ravi.G- “Earthquake Early Warning System by IOT using Wireless Sensor Networks”. Department of Electronics and Communication Engineering, Sona College of Technology, Salem. The IEEE International Conference on WISPNET 2016..

II. Abdul kadir - “IOT-BASED EARTHQUAKE WARNING SYSTEM DEVELOPMENT AND EVALUATION” KARACI. Engineering and Architecture Faculty, Kastamonu University.

III. Amjath Ali J , B. Thangalakshmi A. Vincy Beaulah3 Lecturer-“IoT Based Disaster Detection and Early Warning Device”. Amjath Ali J , B. Thangalakshmi A. Vincy Beaulah3 Lecturer, Department of

Electrical and Electronics Engg., Ibra college of Technology, Oman.

IV. N N Venkatesh Gupta, Mr. S. Rinesh –"IOT BASED EARTHQUAKE DETECTION BY THINGSPEAK ",UG Scholar, Assistant Professor.

V. Shyam Joseph, Arunkumar, Jayasudhakar, Manikandan P- "Earthquake Early Warning System by IOT Using Wireless Sensor Networks", Assistant Professor, Dept of Electrical And Electronics Engineering, Sri Ramakrishna Engineering College, Coimbatore.

VI. KM Hina, Sanvi kumari – "EARTHQUAKE DETECTOR", IIMT COLLEGE OF ENGINEERING, GREATER NOIDA.

VII. P.Ramanathan Assistant Professor –"Earthquake Evaluation of Concrete Buildings Using Low Power Wireless Sensor Networks". Achariya College of Engineering Technology, Electronics and Communication Engineering, Pondicherry, India.

VIII. Prof. Pradeep khatwa, Gaurav ingle, Rameshhwar shinde, Ajay sane –"Earthquake Alarm System Based on Advanced Wireless GSM Modem", Dr. D.Y.Patil School Of Engineering, Pune .

IX. Yogesh Sherki, Nikhil Gaikwad, Jayalakshmi Chandle, Anil Kulkarni –"Design of real time sensor system for detection and processing of seismic waves for earthquake early warning system". Mumbai, India.

X. Meng-Yun Hsu, Shiann-Tsong Sheu –"A low complexity algorithm for earthquake detection system". Taipei, Taiwan.

XI. Navid Rajabi, Omid Rajabi –"Real time earthquake prediction using cross-correlation analysis & transfer function model". Tehran, Iran.

XII. Qingkai Kong, Young-Woo Kwony; Steven Allen- "Smartphone-based networks for earthquake Detection". Nuremberg, Germany.

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