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A NOVEL TECHNIQUE FOR AUTOMATIC DETECTION OF EARTHQUAKE AND LANDSLIDE USING IOT

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ABSTRACT

In recent years, the frequent occurrence of landslide and earthquake disasters, caused great harm to people's lives and properties. Here's a GSM-based seismic alert system that could warn before an earthquake or landslide strikes. An instrumentation system is presented here for the detection of the variations of these precursors which change well before the event using IOT. It consists of a sensor coupled to an embedded system to enable precise detection of variation in physical parameters. This helps us to interface it with the microcontroller through the related software and send an alarm in the audio and visual form when the parameters exceed beyond certain critical threshold. The instrumentation includes the vibration sensor and accelerometer are the predominant sensors for detecting the relative parameters from the simulations of the earthquake and landslide. The resulting damage can be minimized and lives can be saved if people living in the earthquake-prone area are already prepared to survive the strike. This system provides the monitoring center with warning information in time, so related departments can take effective measures rapidly to protect people's lives and properties.

Keywords: IOT; GSM; Vibration sensor; Accelerometer

1. INTRODUCTION

The combined and separated research advancement in the fields of sensing, communication, and computing has driven the research efforts in wireless sensor networks in recent years. A wireless sensor network is composed of a large number of sensor nodes that communicate with each other through multi-hop wireless links despite the absence of any fixed administration or established infrastructure. The WSNs have the potential utility values in many important fields such as national defense, agriculture, industry, city management, bio-medicine, environment monitoring, disaster relief, anti-terrorism, and remote monitoring in dangerous area, etc. An earthquake is a sudden vibration or trembling in the Earth. Earthquake motion is caused by the quick release of stored potential energy into the kinetic energy of motion. Most earthquakes are produced along faults, tectonic plate boundary zones, or along the mid-oceanic ridges. Landslide causes huge loss of personal property , the other hand, serious soil erosion, destruction of forest cover, land degradation and even desertification. We need to design a warning system about landslide and earthquake to tell us when landslide and earthquake will happen. Because of the extreme complexity involved in the earthquake processes, reliable earthquake prediction is not currently possible. Present technological advances in seismic instrumentation and in digital communication and processing permit the implementation of a real-time earthquake and landslide monitoring system. There are three major components for earthquake early warning system – (1) Real time earthquake information collection from the sensor nodes (2) Earthquake estimation with predictive result (3) Alarm messages delivery to users. This paper design the landslide and earthquake warning system based on the wireless sensor networks using GSM. This system achieves no wiring, no duty, 24 hours of continuous work, low cost, low power, remote monitoring. The idea of an earthquake early warning system was proposed more than one hundred years ago by Cooper (1868) for San Francisco, California. About a hundred years later, Japan Railways Company designed an EEW system in 1965 and started operation in the following year (Nakamura, 1988). In the past decade, progress has been made towards implementation of earthquake early warning in Japan, Taiwan, Mexico, Southern California, Italy, and Romania. In particular, the systems developed at the National Research Institute for Earth Science and Disaster Prevention (NIED) and the Japan Meteorological Agency (JMA) were integrated in June, 2005. The system was successfully activated during the 2007 Noto Hanto (Peninsula) and the 2007 Niigata Chuetsu-Oki earthquakes, and provided accurate information regarding the source location, magnitude and intensity at about 3.8 s after the arrival of *P* wave at nearby stations. Thus, it provided early warning before arrival of strong shaking. Currently, there are many seismic networks using real-time strong motion signals for earthquake monitoring. In this paper, we describe a method of generating an alarm on the arrival of P
– waves before the destructive S – waves and surface waves arrives.

2. RELATED WORK

To collect the real time earthquake information from the sensor nodes, there are several projects [1, 2] use digital

seismometers or customized sensors to collect the data. In [3], Heindl proposes an innovated idea tries to use the three-axis acceleration information in smart phones or hard disk as a collaborative sensor system. The other researches [4, 5, 6] focus on connection organization by using wireless mesh network, wireless sensor network P2P technology to collect the data rapidly. The Japan Meteorological Agency (JMA) started providing the Earthquake Early Warning by several means such as TV and radio on Oct 2007. Researches in [7, 8] tries to provide the alert notifications to the mobile users, home automated systems and vehicles. The telecom service providers do not enable Multimedia Broadcast and Multicast Services (MBMS) [9] in their network. MBMS enables the possibility to broadcast information simultaneously to many cellular subscribers, which is suitable for earthquake early warning system. It is also a bad idea to use SMS to deliver warning messages. Even the SMS messaging may beat out other technologies in terms of popularity, it suffers two disadvantages. First, the cost is relatively high – if we would like to send the message to large number of users. Secondly, although SMS message delivery is usually rapid, the receipt time and reliability can't be guaranteed, which is the fatal issue of SMS system. In general case, each SMS server only can handle two million messages per hour (around 500 messages per second).

3. PROPOSED SYSTEM

This system senses the earthquake and landslide vibrations and generates an alert signal when the level of earthquake and landslide vibrations crosses a threshold. This design combines GSM wireless communication technology and wireless sensor network. Vibrations created by the earthquake are sensed by a Accelerometer and vibrations created by the landslides are sensed by Vibration sensor. When the landslide or earthquake occurs after sensing those vibrations the buzzer will beep and displayed on LCD and that data is transferred to GSM module which sends messages to the public before disaster occurs. This systems main advantage is that warning message is sent to the public before the occurrence of disaster so the people in that particular region can move to the safer places and save their lives.

A. DESIGN CONCEPT OF PROPOSED SYSTEM

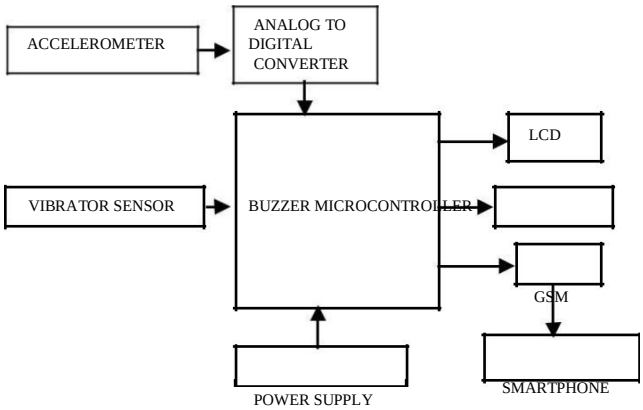

Figure 1. Block Diagram Of Earthquake And Landslide Early Warning System

B. Earthquake Detection And Warning Module

The Earthquake is detected on a simple principle of accelerometer. The sensing device is accelerometer, generates output on vibration. This output is analog in nature and contains noise, so this analog signal is digitalized by an ADC which is connected to an microcontroller. The program is loaded in microcontroller, it generates alarm/buzzer sound and displays the warning message “EARTHQUAKE” on LCD. The GSM sends the warning messages to the local residence in a fraction of seconds.

ALGORITHM: Earthquake detection and warning

Step 1:Input: Voltage to the **Accelerometer sensor** Step 2:Voltage generated is converted to analog signal Step 3:Convert analog to digital signal using ADC Step 4:Give this as a input to the microcontroller.

C. Landslide Detection and Warning Module

The Landslide is detected on a simple principle of vibrator sensor. The sensing device is vibrator sensor, generates output on vibration. This output is digital in nature, which is connected to an microcontroller. The program is loaded in microcontroller, it generates alarm/buzzer sound and displays the warning message “LANDSLIDE” on LCD. The GSM sends the warning messages to the local residence in a fraction of seconds.

ALGORITHM: Landslide detection and warning.

Step 1:

Input: Voltage to **Vibrator Sensor**

Step 2:Voltage generated is converted to Analog signal Step 3:Convert Analog to Digital using ADC Step 4:Give this as input to the microcontroller

D.GSM Module

Global System for Mobile communication is a telephony system which uses time division multiple accesses. Earthquake and landslide early warning system is build using GSM Module and which can be used for both accessing the Internet and for oral communication like SMS.GSM send messages to respective authorities as soon as it receives the command signal from microcontroller.

ALGORITHM:GSM Module.

Step 1:clear previous data in buffer

Step 2:

Input: **ASCII value** of the message

Step 3:Convert **ASCII value** into string format command

Step 4:Command is send to the SIM module

Step 5:Wait for the response

Step 6:Response is analyzed

Step 7:Using SIM module the message is send to all the phone numbers with message body

Step 8:

Output: Message is send successfully

E.PROPOSED ALGORITHM

INPUT: vibrations generated by earthquake or landslide.
OUTPUT: early warning messages to local residents through GSM.

1: **if**(vibration==1) detection of landslide
goto step 3
else Idle
end if
2: **if**(accelerometer==1) detection
of earthquake goto step 3
else Idle
end if
3: Display message on LCD and Buzzer on
4: Send messages to mobile phones through GSM.

F. Hardware Description

Accelerometer:

An Accelerometer measures the real time, instantaneous acceleration of the object on which the accelerometer is mounted. It transduces the acceleration, which results from some shock or vibration, onto a proportional analogue signal. Although there exist numerous types of accelerometers, the piezoelectric type is the most widely used. It senses the vibration and gives corresponding output.

ADC 809:

ADC0809 data acquisition component is a monolithic CMOS device with an 8 bit analog-to-digital converter,8 channel multiplexer and microprocessor compatible control logic. The 8 bit A/D convertor uses successive approximation as the conversion technique. The convertor features a high impedance chopper stabilized comparator, a 256R voltage divider with analog switch tree and a successive approximation register. The 8-channel multiplexer can directly access any of 8 single ended analog signals. The device eliminates the need for external 0 and full scale adjustment.

P89V51RD2 Microcontroller:

The P89V51RD2 are 80C51 microcontrollers with 64KB flash and 1024 B of data RAM. A key feature of the P89V51RD2 is its X2 mode option. The design engineer can choose to run the application with the conventional 80C51 clock rate. The flash program memory supports both parallel programming and in serial ISP. Parallel programming mode offers gang programming and high speed, reducing programming cost and time to market ISP allows a device to be reprogrammed in the end product under software control. The capability to field/update the application firmware makes a wide range of application possible.

Vibration Sensor:

The Vibration Sensor Detector is designed for the security practice when Vibration Sensor Alarm recognizes movement or vibration ,it sends a signal to either control panel developed a new type of Omni-directional high sensitivity security Vibration Detector with Omni-directional detection.

GSM:

Global System for Mobile communication is a telephony system which uses time division multiple accesses. GSM provides terminal mobility, with personal mobility provided through the insertion of a subscriber identity module (SIM) into the GSM network (mobile station). The SIM carries the personal number assigned to the mobile user. The GSM-based cellular mobile networks are currently in widespread.GSM defines a number of network databases that
are used in performing the functions of mobility management and call control in a public land mobile network (PLMN). These elements include the location registers consisting of the home location register (HLR), and the visiting location register (VLR), the equipment identity register (EIR), and the authentication center (AC).

LCD:

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on. A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.

4.CONCLUSION

We have presented a novel technique for the detection of earthquake and landslide using wireless sensors and sending a early warning messages to the local residence through GSM in time so that they can safeguard their lives. In our system the majority of cases offers real practical benefits in the event of earthquake and landslide.

FUTURE SCOPE

As we have proposed our system, so that it can send messages to the local residence to alert about an earthquake or landslide. As illiterate peoples does not read or check messages, so in future work they can make a call to the local residence to give an alert about earthquake or landslide.

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