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A Low-cost Design of Earthquake Detector with Rescue Message Deliver using Mobile Device

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Abstract

The earthquake detector is a complex and expensive device. It is necessary to design a simpler and cheaper earthquake detector for common use. Our research employs the ability of Android-based mobile device to design a minimal cost detector for sensing the earthquake. Therefore, as the earthquake occurring, the mobile device can detect the earthquake and issue a warning alarm to the phone owner. At the same time, a rescue messages including disaster location, earthquake level, and related information to the disaster center. Experimental results show that the proposed method can achieve the usage of disaster rescue.

Keywords: earthquake detection, earthquake early warning system, cell broadcast service

1. Introduction

Because earthquake occurrence is difficult to predict, the earthquake hazard plays a major role in the natural disaster. For seismic hazard mitigation, a practical earthquake forecast method appears to be far from realization, because of the extreme complexity involved in the earthquake processes. There are two types of seismic waves:[1-2]body waves that propagate through the earth's interior and surface waves that propagate along the earth's free surface or along other discontinuities in the earth's interior. Body waves traveling faster than the surface waves are classified to two types: compressional (longitudinal) and shear (transverse). Compressional waves travel about 1.7 times faster than transverse waves and are often called P waves or primary waves. Transverse waves are frequently called S waves or secondary waves. P waves are always the first among seismic waves that reach the recording station. Rock particles affected by a propagating P wave oscillate backward and forward in the same direction as the wave propagates. In the case of S waves, particles vibrate in planes perpendicular to the direction of travel [3].

In this investigation, an earthquake detector is designed using the accelerator which exists in the mobile device to immediately calculate acceleration, and therefore the earthquake amplitude can be detected.

2. Earthquake Detection Design

Due to the rapid development of mobile communications, mobile devices currently can provide anyone, anywhere, and any when to access the Internet through the communication network. For the reason of mobility, we implement the proposed method in the mobile device to reduce the cost of earthquake detector. We express the main process shown as follows. First, when earthquake is occurring, the earthquake signal will be detected by G-sensor, which can sense the acceleration and orientation. Next, the acceleration is calculated by the computation module and transferred as earthquake magnitude. The earthquake magnitude can be used for determining whether an alarm/message is issued, or not. That is, if the earthquake magnitude is greater than the specific threshold, then the location information (Latitude and longitude) is obtained by GPS which built in mobile device and thus the location information can be passed to the alarm module to issue alarm and rescue messages to notify the specific person or disaster center.

In order to obtain the smallest possible errors, the phone accelerometer is compared with a standard accelerometer located at the National Center for Research on Earthquake Engineering (NCREE) [4]. Fig. 1 shows our test phone (marked with red box) is set on the accelerometer calibration system. The process is shown as follows:

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(1) Set the phone on the fixed standard accelerometer

(2) Adjust the device parameters

(3) Repeat step 1 and 2 until the phone output a reasonable range.

Fig. 1 Comparison of the accelerator in mobile device and standard accelerometer at NCREE

3. Conclusions

We have integrated the gravity accelerometer, GPS module and communication modules and other hardware system to implement an earthquake detection APP in the mobile device. Demonstrations show that the APP can detect the earthquake intensity, latitude and longitude information, time of occurrence, phone number and other messages and forward these information to the specified relatives or disaster center using mobile communication. The proposed scheme with advantages of easy installing and no extra hardware cost.

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