Earthquake Alarm System Based on Advanced Wireless GSM Modem

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Abstract -- Many life and properties have been lost due to the earthquake. Many countries have implements EEW (Early Earthquake Warning) System to save human lives. In this paper an idea of low cost earthquake alarm system using ATmega328p, ADXL335 and XBee S2 has been discussed.

I. INTRODUCTION

One can't ignore natural laws in spite of many developments in science and technology. Nature has forced the scientific community to think or predict some natural warnings. 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.

Earthquake happens due to the sudden release of large amount of energy from the earth's crust. Because of this energy earth generates some destructive waves known as seismic wave. It has been found that the seismic waves include shear-wave, longitudinal wave and surface wave. The longitudinal wave and shear wave are also known as P-wave and S-wave respectively. Out of all waves surface wave is the most destructive in nature, but the speed of the surface wave is slower than the other waves. The P-wave's vibration direction and the forward motion are found to be same, which is the fastest in nature among the all waves. However, the destructive force of P-wave is found to be low.

II. STRUCTURE OF THE SYSTEM

The structure of wireless Earthquake Alarm System includes one transmitting part and one or more than one receiving parts.

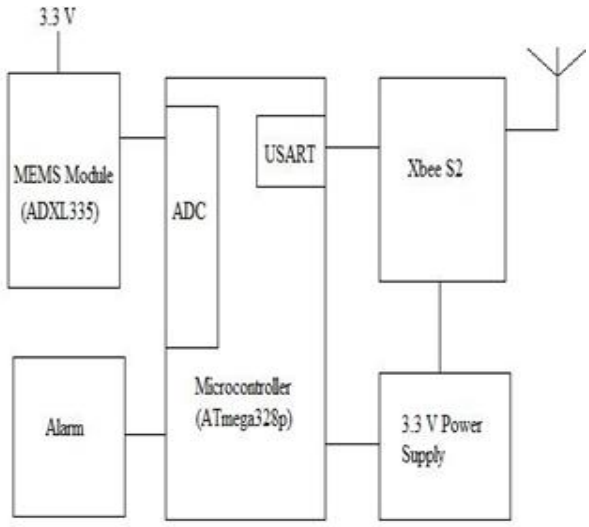

Figure 1: Transmitting part of wireless earthquake alarm system

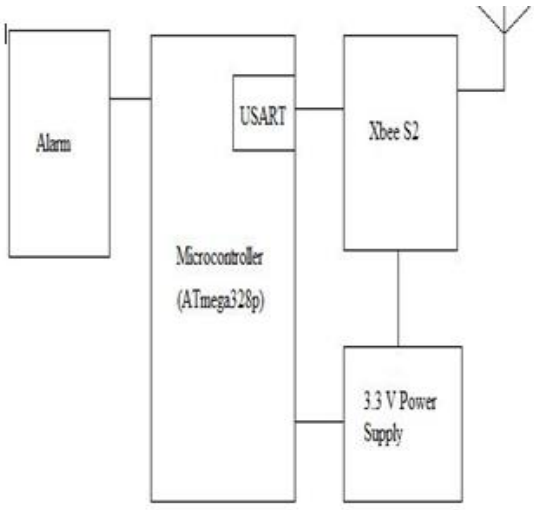

Figure 2: Receiving Part of wireless earthquake

The transmitting part includes the ADXL335 MEMS accelerometer made by Analog Devices, which can detect the vibration (Peak Ground Acceleration) produces due to earthquake. This part also includes a

microcontroller (ATmega328p) to process the values getting from ADXL335 and generate a signal when the ground acceleration is greater than the threshold value. The signal generated by the controller is then send to the receiving part wirelessly using XBee S2. Figure 2 and 3 shows the block diagram of the transmitting part and receiving part.

ADXL335: As reported earlier ADXL335 is a MEMS accelerometer made by Analog Devices. MEMS Accelerometer is a device which can detect gravity, vibration and shock etc. It has been found that MEMS Accelerometer has various applications such as for gaming applications in mobile phones, image rotation and stabilization in digital camera, automotive air bags etc. [5-6].

ADXL335 is a thin, low power, 3-axis accelerometer with a minimum full scale range of ±3g. Figure 4 shows the functional block diagram of ADXL335.

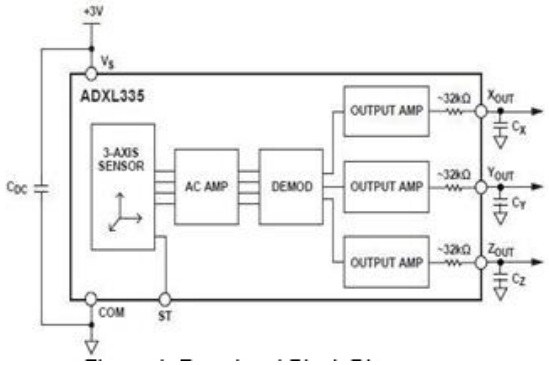

Figure 3: Functional Block Diagram

ADXL335 is connected to ADC pins of ATmega328p. It sends voltage levels to the microcontroller.

ATmega328p: ATmega328p is a high performance, low power AVR 8-bit Microcontroller. It has 23 programmable pins and operating voltage is low (1.8-5.5v).

The main function of this module is processing the acceleration signal and comparing with the predetermined threshold value. ATmega328p has 10-bit successive approximation ADC. The ADC is connected to an 8-channel Analog Multiplexer which allows eight single-ended voltage inputs constructed from the pins of Port A. The single-ended voltage inputs refer to 0V (GND). In this system, 3 pins of Port C are connected to ADXL335 and the USART (Universal Synchronous and Asynchronous serial Receiver and Transmitter) is connected to XBee S2 to send signal to the receivers. The microcontroller calibrates the values (voltage levels) get from ADXL335 and calculates the peak ground acceleration. As reported earlier, if calculated value is greater than threshold value then it generates alarm and sends a signal to the receivers.

XBee S2: XBee S2 is one of the powerful modules to communicate wirelessly. It has 40m in urban/indoor range and 120m outdoor line of sight range. It has been found that point-to-point, point-to-multipoint and peer-to-peer topologies are supported by XBee S2. X-ctu software is used for configuring XBee S2.

In this system XBee S2 is connected to the USART of the microcontroller. XBee S2 Dout pin is connected to Rx pin of ATmega328p. However, Din pin is connected to Tx pin of ATmega328p.

III. SYSTEM WORK FLOW

A workflow of a system is the stepwise representation of the operation of the system. The steps are represented as the boxes of various sizes. Figure 5 shows the workflow of the transmitting part and Figure 6 shows the workflow of receiving part.

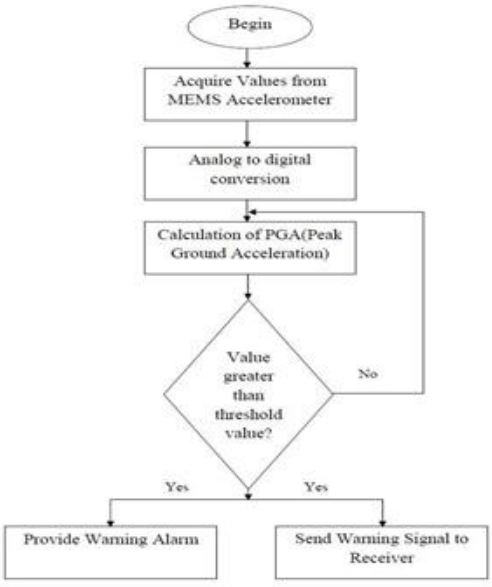

Figure 4: Transmitting part work flow

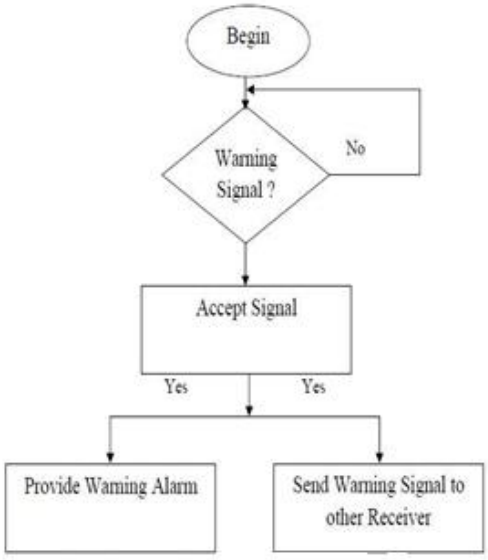

Figure 5: Receiving part work flow

IV. CONCLUSION

Through this paper a design of wireless earthquake alarm system is discussed. This system has many advantages such as low cost, low power consumption and small in size. As mentioned earlier it can be used in multistoried building with many receiving part with single transmitting part

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