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ARM-7 BASED DEVELOPMENT OF SEISMIC DATA ACQUISITION SYSTEM

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Abstract— **In this paper, we represents a development of a cost effective seismic acquisition system based on ARM-7.The processor manage reading large amount of data from a high resolution ADC. A accelerometer sensor is used for which convert nonelectrical quantity to electrical quantity. An Accelerometer sensor sense vibration due to earthquake in three dimensions i.e. X, Y, Z direction**

***Index Terms*— Accelerometer (ADXL335), Low pass filter, ARM-7, MATLAB & C, Wireless transmitter / Receiver (Xbee 802.15.4).Introduction**

I. INTRODUCTION

An earthquake is a natural disaster that can cause damage and loss of lives. Degree of the damage depends upon the distance between the affected area and the epicenter, and the magnitude which indicates how much energy is released from the origin to earth crust. These phenomena mostly historically reported for the site and surrounding area of the earthquake. Analysis of seismic signals is done by determining magnitude and recorded by Seismometers at monitoring stations. The seismic data is useful for monitoring or study of effects of the earthquake. Conventional Seismometers which was used in previous day's record signals in a permanent way such as a chart or drum recorder. The Seismometers which uses now a day are costly, require specialized maintenance and consumables,and are incompatible with computer data processing and analysis. [3] They are no longer produced although being still in operation at many older seismological stations and network centers. The overview was made by Lee and Stewart (1981), which, on the instrumental side, that was mainly dealt with micro earthquake networks. The Wilmore (1979) dealt with all the classical analog seismographs, but it is not consider now. are the basic information about earthquakes, chemical and nuclear explosions, Earthquakes rock bursts and other events generating seismic waves. Seismograms reflect the combined influence of the seismic source the, propagation path the frequency response of the recording instrument, and the ambient noise at the recording site these effects and their scientific usefulness. Accordingly, our review knowledge of seismicity, Earth's structure, and the various types of seismic sources is mainly the result of analysis and interpretation of seismograms [5]. The more completely we quantify and interpret the seismograms, the more fully we understand the Earth's structure, seismic sources and the Causing processes. Gunter Asch said in Seismic Recording Systems, A recording device is autonomous, self-contained equipment, designed to measure the output signal of a sensor, digitize the signal and record it. In seismological experiments, all three components of ground movement are important, whereas in reflection experiments, only the vertical component up to now has been taken into account. Specialized multi-channel recorders with more than 6 channels are not covered here. Data acquisition affects the seismic data processing effort. This includes information about array effects, aperture, aliasing, and the physical arrangement of the acquisition methods themselves. It may be that the most frequently asked question about seismic acquisition is about the optimum approach to seismic acquisition. Fundamentally this is a question about the geometry and sampling rate of the receiver array, but it easily expands to include what source we should use, what microphones we should employ, whether or not we should use geophone sub-arrays, how big our aperture should be, and, finally, what temporal and spatial sampling rates we should select. In the spatial sense, we have always acquired seismic data digitally. For each source, the receiver array should consist of point receivers (no arrays) densely sampled over a wide aperture array encompassing a large square area. The source, however it is formed, should be a point source (no arrays) generating energy uniformly in all directions.[6]

II. OVERALL SYSTEM DESIGN.

A low cost seismic data analysis system is designed, developed, and tested. An Infrared temperature sensor was integrated with a three lead ECG monitor (client unit) on a cellular (mobile) phone platform, which can be considered as a real- time transmission mode. Application software is required at the receiving mobile device (consultation unit) to decode the bio signal SMS messages and plot the ECG and display the body temperature. The new system has a

significantly reduced size and weight, which improves its versatility and mobility [4]. Besides, SMS can be the most suitable, if not the only, method of data transmission in emergency situations in remote area where broadband data communications (like GPRS, EDGE … etc.) are n. available. As mentioned earlier, system comprises a main board package where an ARM processor is fitted and an ADC package. This allows quicker development and easy debugging. In addition an interface board is designed and developed to provide connections and interfaces with peripherals.

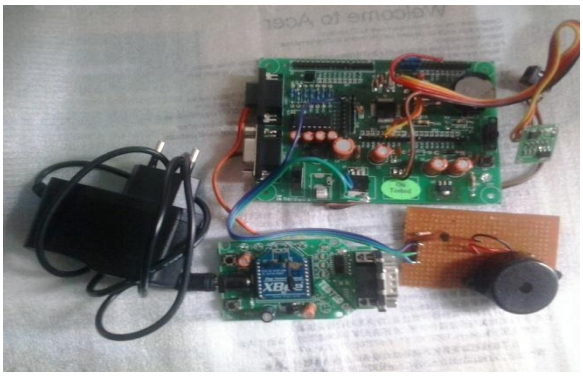
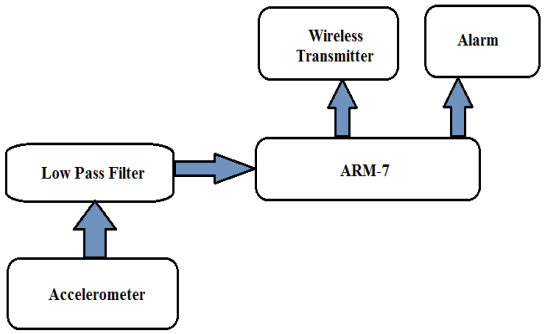


Fig. 1 System Hardware model

Fig. 2 Xbee Transreceiver



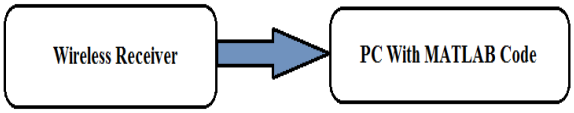


Fig. 3 System Diagram

III. HARDWARE SYSTEM.

The hardware system comprises i)Accelerometer; ii) Low Pass Filter; iii) 24 bit ADC;iv) SPI interface; v) ARM-7 processor; vi) wireless transmitter; vii) alarm; viii) wireless receiver.

A. Accelerometer

The first block is Accelerometer sensor which converts nonelectrical signal into electrical quantity which is in the range of (0-1.76V).The ADXL335 is a small, thin, low power, complete 3-axis accelerometer with signal conditioned voltage outputs.

First accelerometer sensor sense the vibrations due to the earth quake in three directions i.e. X, Y, Z direction. Accelerometer sensor is the MEMS type sensor i.e. Mechanical electromagnetic type sensor. After sensing the vibrations the sensor converts the vibrations in to some voltage levels then accelerometer transfer the signal to the LPF Low pass filter. [See Appendix A]

B. Low Pass Filter.

Low pass filter is used to reduce the high frequency component from the received signal means it reduce the distortion in to the signal. Then it send the signal to the ADC which inbuilt in the ARM 7 microprocessor. [2]

C. Analog to Digital Converter

In this system we are using 24-bit ADC. The ADS1232 is 24 bit Analog to digital converter. The input multiplexer accepts either two (ADS1232) or four (ADS1234) differential inputs. The ADS1232also includes an onboard temperature sensor to monitor ambient temperature.ADC converts the analog signal in to digital form. Then the signal is given to ARM processor. [See Appendix A]

D. SPI BUS

There are tree SPI data transfer formats ARM, one of which was chosen to interface with the ADC.the maximum number of SPI bits is 16; therefore, if the ADC data to be read is greater than that, the MPU has to deal with SPI signals more than once per read. For example, if 6 times. Hence this paper demonstrates the use of help the MPU manage data transfer over an SPI bus. [See Appendix A]

E. ARM-7.

The LPC 2141/42/44/46/48 microcontrollers are based on a 16-bit/32-bit ARM7TDMI S CPU with real-time emulation and embedded trace support, that combine the microcontroller with

embedded high-speed flash memory ranging from 32 kB to 512 kB. A 128-bit wide memory interface and unique accelerator architecture enable 32-bit code execution at the maximum clock rate. For critical code size applications, the alternative 16-bit Thumb mode reduces code by more than 30 % with minimal performance penalty. Due to their tiny size and low power consumption, LPC2141/42/44/46/48 are ideal for applications where miniaturization is a key requirement, such as access control and point-of-sale. Serial communications interfaces ranging from a USB 2.0 Full-speed device, multiple UARTs, SPI, SSP to I2C-bus and on-chip SRAM of 8 kB up to 40 kB, make these devices very well suited for communication gateways and protocol converters, soft modems, voice recognition and low end imaging, providing both large buffer size and high processing power. Various 32-bit timers, single or dual 10-bit ADC(s), 10-bit DAC, PWM channels and 45 fast GPIO lines with up to nine edge or level sensitive external interrupt pins make these microcontrollers suitable for industrial control and medical systems. [See Appendix A]

F. Wireless transceiver (Xbee 802.15.4).

The Xbee transreceiver is a low cost true single chip 2.4GHz transceiver designed for very low power wireless applications. The circuit is intended for the Application Programming Interface (API) the RF transceiver is integrated with a highly configurable baseband modem. The modem supports various modulation formats and has a configurable data rate up to 250 kbps. [8]

Feature*:*

Linear separate pin out for transmit data pin (TXD) & received data Pin (RXD)

Six LED showing status TXD, RXD, SUSPEND, RSSI, ASSOC & Power LED.

Specification:

Powersupply-5V (only from USB)

Dimensions: 66mm*40mm*12mm (l*b*h)

Temperature range:0^0C To 70^0C[6]

IV. SYSTEM SOFTWARE

In this paper, we have used the keil software for compiling c code into hex file and load this hex file we have used Philips flash utility. MATLAB is used for showing seismic graph or signal (voltage (v) Vs time (S) for X, Y, Z, direction) developed on a MATLAB which especially patched for the ARM MPU on the main board. Programming is done on PC using C language and a tool chain is required for cross compiling to make application and modules run on the ARM MPU [7]

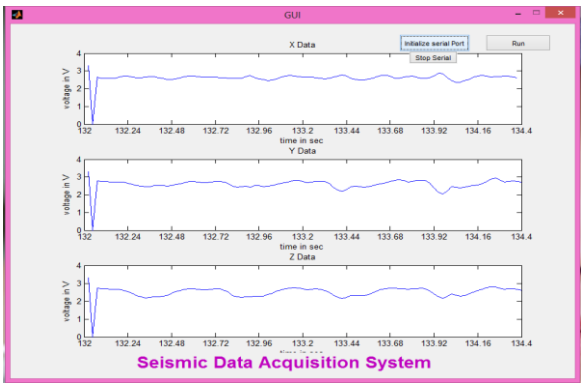


Fig 4.Seismic Signal

V. RESULTS OR FINDING

In this paper we find out first accelerometer sensor sense the vibrations due to the earth quake in three directions i.e. X, Y, Z direction. Accelerometer sensor is the MEMS type sensor i.e. Mechanical electromagnetic type sensor. After sensing the vibrations the sensor converts the vibrations in to some voltage levels then accelerometer transfer the signal to the LPF Low pass filter.

Low pass filter is used to reduce the high frequency component from the received signal means it reduce the distortion in to the signal. Then it send the signal to the ADC which inbuilt in the ARM 7 microprocessor. ADC converts the analog signal in to digital form. Then the signal is given to ARM processor.

ARM processor compares the input signal and referenced signal which already set in to the processor. If input signal is not greater than the referenced signal then buzzer will not ON and the signal is transfer to the receiver section from the transmitter section through wireless transceiver. If input signal is greater than the referenced signal then processor sends the signal to driver circuit of buzzer to ON the buzzer also sends the data through wireless transceiver. [1]

At receiver section the signal will be detected and we get output on computer in the form of sine waves.

VI. CONCLUSION

This paper has presented a developed of a seismic data acquisition system based on ARM-7.An ARM-7 hardware platform and a high resolution ADC have been used with some devices drivers to implement the system to deal with the wide dynamic range of the concerned seismic signals. How features contribute to better system performance has also been discussed. In the further scope we can reduce time & we can make more the system work more efficiently. This platform is cost-effective and can also be developed further in any other application.

VII. ACKNOWLEDGMENT

A work of such a great significance is not possible without the help of my guide prof. A. V. Nikalje for suggestions, cooperation & continuous guidance. It's my pleasure to thank to my principal who always a constant source of inspiration & always provided joyful atmosphere.

APPENDIX A

System specification:

Processor board: ARM-7.

- Microprocessor: LPC2148 with 512K on chip memory
- Crystal for LPC2148: 12Mhz
- Crystal for RTC: 32.768KHz
- Operating Supply: 3.3V
- Power on reset circuit with MCP 130T brownout detection
- 16-bit/32-bit ARM7TDMI-S microcontroller in a tiny LQFP64 package.
- 8 kB to 40 kB of on-chip static RAM and 32 kB to 512 kB of on-chip flash memory.
- 128-bit wide interface/accelerator enables high-speed 60 MHz operation.
- In-System Programming/In-Application Programming (ISP/IAP) via on-chip boot loader

ADC: system sampling rate 0.1 to 2000Hz (programmable device driver)

Accelerometer (ADXL335)

- 3-axis sensing
- Small, low profile package
- 4 mm × 4 mm × 1.45 mm LFCSP
- Low power : 350 μA (typical)
- Single-supply operation:1.8V to3.6V
- 10,000 g shock survival
- Excellent temperature stability
- BW adjustment with a single capacitor per axis

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