ISSN 2454-8065
International Journal of Applied Theoretical Science and Technology
Volume 16, Issue 01, pp01-09 January 2023

MICROCONTROLLER BASED EARLY WARNING SYSTEM FOR EARTHQUAKE AND TSUNAMI

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***Abstract*—.This paper proposes to enhance current earthquake warning systems, rising technologies, including social and mobile computing, have been the focus of much attention.It is now possible to capture various kinds of motion using a smart phone's sensors, (e.g., accelerometer, vibration, etc.) including earthquake motion. To that end, we developed smart phone software to capture and backend analytics to determine whether the motion captured by a smart phone is caused by an earthquake or by human motion. In so doing, our goal is to establish a new type of seismic network using smart phones which enhance traditional seismic networks. In this paper, we evaluated the use of mems as detection devices; collected both human and simulated earthquake data using the mems and water level sensor, and developed an algorithm to distinguish earthquakes from human activities. Our results show that using our algorithms, a smart phone or computer can not only be used as a recording instrument, but also a highly accurate earthquake detection tool. As a result, creating networks of axis sensors based on smart phones will enhance the safety of communities vulnerable to earthquakes, worldwide. The gateway which has the sensor node receiver and acts as an message transfers the warning to smart phones. Finally, many of the human lives can be saved.**

I. INTRODUCTION

Earthquake and tsunami constitute the worst natural hazards which often turn into disaster causing wide spread destruction and lose of human life and property. Effects of earthquake vary up on magnitude and intensity. Earthquake occurs every now and then all-round the world except in some places where earthquake occurs rarely. The devastation of cities and towns is one of the effects of earthquake. When earthquake strikes on track the bed of the ocean, millions of tons of water are suddenly pushed upwards or sinks dramatically downwards thus generating a powerful wave which causes tsunami.

Earthquake early warning (EEW) is the delivery of ground shaking alerts or warnings. It is distinguished from prediction in that the earthquake has nucleated to provide detectable ground motion when an EEW is issued. The warning time available is the time between detection and when ground motion is experienced by a user. Potential warning times are therefore seconds to minutes.

Tsunami is a system of ocean gravity waves formed as a result of large-scale disturbance of the sea floor that occurs in a relatively short duration of time. The Indian Ocean is likely to be affected by tsunamis generated mainly by earthquakes from the two potential source regions, the Andaman-Nicobar-Sumatra Island Arc and the Makran Subduction Zone. A state- of-the-art warning centre has been established at INCOIS with all the necessary computational and communication infrastructure that enables reception of real- time data from the network of national and international seismic stations, tide gauges and bottom pressure recorders (BPRs). Earthquake parameters are computed in the less than 15 minutes of occurrence. A database of pre-run scenarios for travel times andrun-up height has been created using Tsunami N2 model. At thetime of event, the closest scenario is picked from the database for generating advisories. Water level data enables confirmation or cancellation of a tsunami. Tsunami bulletins are then generated based on decision support rules and disseminated to the concerned authorities for action, following a standard operating procedure. The criteria for generation of advisories (warning/alert/watch) are based on the tsunamigenic potentialof an earthquake, travel time (i.e. time taken by the tsunami wave to reach the particular coast) and likely inundation. The performance of the system was tested on September 12, 2007 earthquake of magnitude 8.4 off Java coast. The system performed as designed. It was possible to generate advisories intime for the administration and possible evacuation was avoided.

II. PROPOSED SYSTEM

In this project, we are designing earthquake and tsunami alerting system using Arduino, MEMS sensor and water level sensor which is used to alert the people about an earthquake and tsunami using GSM module.

This system can also generate the seismic graph on the screen of the laptop to analyze the data of the intensity of the earthquake.

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Fig 1(a): Earthquake

Fig 1(b): Tsunami

III. DESCRIPTION OF PROJECT

In this project, we are designing earthquake and tsunami alerting system using Arduino, MEMS sensor and water level sensor which is used to alert the people about an earthquake and tsunami using GSM module.

Firstly, the power supply of 12v is given to AT mega 328 microcontroller. MEMS sensor continuously senses thevibration and sends the information to AT mega 328 microcontroller. The main function of microcontroller is to compare calculated value with threshold value. If it is greater than threshold value microcontroller activates buzzer and red light will be turned on and a message will be sent. If it less than threshold value than green light will be turned on.

Water level sensor senses the level of water and sends the information to microcontroller. If its range is greater than threshold value it activates buzzer and red light will be turned on and a message will be sent. If its range is less than threshold value than green light will be turned on.

This system can also generate the seismic graph on the screen of the laptop to analyze the data of the intensity of the earthquake. Our results show that using our algorithms, a smart phone or computer can not only be used as a recording instrument, but alsoa highly accurate earthquake detection tool. As a result, creating networks of axis sensors based on smart phones will enhance the safety of communities vulnerable to earthquakes, worldwide.BLOCK DIAGRAM

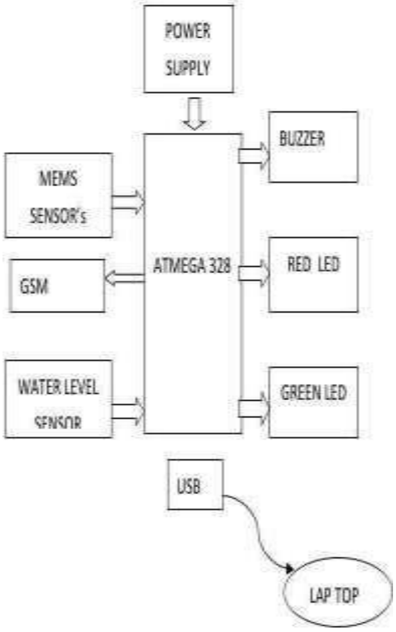

Fig 2: Block Diagram of Early warning system for Earthquake and Tsunami

IV. HARDWARE COMPONENTS

The monitoring system contains several components like power supply, ESP32, etc. This chapter gives a detailed review of each of this part along with its working.

- ATMEGA328 Microcontroller
- MEMS Sensor
- Water level sensor
- Buzzer
- Green LED
- RED LED
- USB
- GSM

V. HARDWARE DESCRIPTION

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A. ARDUINO NANO:

The Arduino nano is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

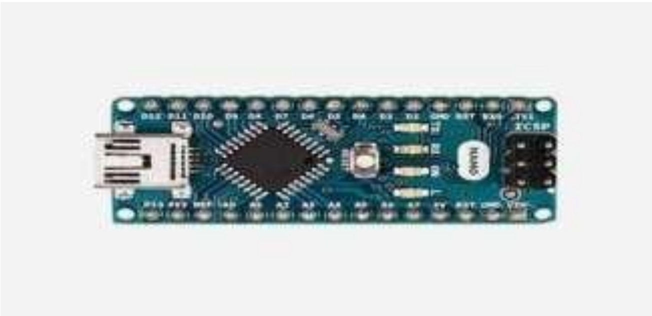

Fig4:Arduino nano

B.MEMS SENSOR:

MEMS (micro electro-mechanical systems) technology has gone from an interesting academic exercise to an integral part of many common products. But as with most new technologies, the practical implementation of MEMS technology has taken a while to happen. The design challenges involved in designing a successful MEMS product (the ADXL2O2E) are described in this article by Harvey Weinberg from Analog Devices. In early MEMS systems a multi-chip approach with the sensing element (MEMS structure) on one chip, and the signal conditioning electronics on another chip was used.

D. Buzzer:

A buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric. Typical uses of buzzers and beepers include alarms, timers and confirmation of user input such as a mouse click or keystroke. A piezoelectric element may be driven by an oscillating electronic circuit or other audio signal source, driven with a piezoelectric audio amplifier. Sounds commonly used to indicate that a button has been pressed are a click, a ring or a beep.

Fig 7: Buzzer

VI. SOFTWARE

ARDUINO UNO INSTALLATION:

In this we will get know of the process of installation of Arduino IDE and connecting Arduino uno to Arduino IDE.

Step 1

First we must have our Arduino board (we can choose

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Fig 5: MEMS Sensor

C.WATER LEVEL SENSOR:

The Moisture sensor is used to measure the water content(moisture) of soil. when the soil is having water shortage, the module output is at high level, else the output is at low level. This sensor reminds the user to water their plants and also monitors the moisture content of soil. It has been widely used in agriculture, land irrigation and botanical gardening.

Fig 6: Water Level Sensor

- Working Voltage:**5V**
- Working Current:**<20mA**
- Interface type:**Analog**
- Working Temperature:**10°C~30°C**our favorite board) and a USB cable. In case we use Adriana UNO, Arduino Duemilanove, Nano, Arduino Mega 2560, or Diecimila, we will need a standard USB cable (A plug to B plug), t In case we use Arduino Nano, we will need an A to Mini-B cable.

Step 2

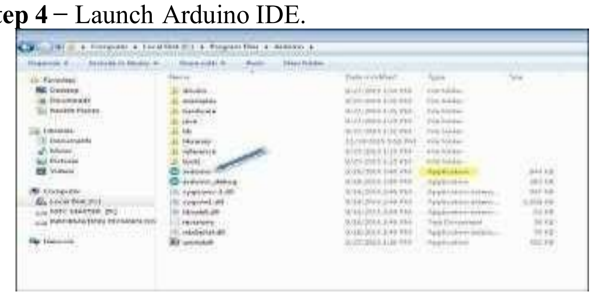
Download Arduino IDE Software. We can get differentversions of Arduino IDE from the Download page on the Arduino Official website. We must select wer software, which is compatible with wer operating system (Windows, IOS, or Linux).
After wear file download is complete, unzip the file.

Step 3

With a jumper, a small piece of plastic that fits onto twoof the three pins between the USB and power jacks. Check that it is on the two pins closest to the USB port.

Connect the Arduino board to wer computer using the USBcable. The green power LED(labeled PWR) should glow.

Step 4 − Launch Arduino IDE.



After our Arduino IDE software is downloaded, we need to unzip the folder. Inside the folder, we can find the applicationicon with an infinity label (application.exe).
Double click the icon to start the IDE.

Step 5 − Open our first project

Once the software starts, we have two options

* Create a new project

* Open an existing project example.

To create a new project, select File → New.

To open an existing project example, select File → Example → Basics → Blink.

Here, we are selecting just one of the examples with the name Blink. It turns the LED on and off with some time delay. We canselect any other example from the list.
Step 6 − Select our Arduino board.

To avoid any error while uploading wear program to the board, we must select the correct Arduino board name, which matches with the board connected to wer computer.
Go to Tools → Board and select wear board.

Here, we have selected Arduino Uno board according to our tutorial, but we must select
the name matching the board that we are using.

Step 7 − Select wer serial port.

Select the serial device of the Arduino board. Go to Tools → Serial Port menu. This is likely to be COM3 or higher (COM1 and COM2 are usually reserved for hardware serial ports). To find out, we can disconnect wer Arduino board and re-open the menu, the entry that disappears should be of the Arduino board. Reconnect the board and select that serial port.

Step 8 − Upload the program to wer board.

Before explaining how we can upload our program to the board,we must demonstrate the function of each symbol appearing in the Arduino IDE toolbar.
A − Used to check if there is any compilation error. B − Used to upload a program to the Arduino board. C − Shortcut used to create a new sketch.
D − Used to directly open one of the example sketch. E −

ISSN 2454-8065
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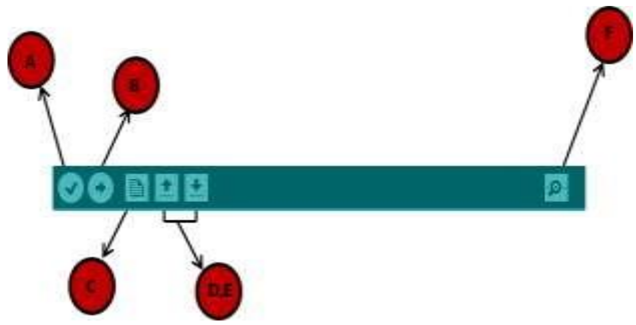
Used to save wer sketch.F − Serial monitor used to receive serial data from the boardsend the serial data to the board



Now, simply click the "Upload" button in the environment.Wait a few seconds; we will see the RX and TX LEDs on the board, flashing. If the upload is successful, the message

"Done uploading" will appear in the status bar.
Note − If we have an Arduino Mini, NG, or other board, we needto press the reset button physically on the board, immediately before clicking the upload button on the Arduino Software.

VII. RESULTS AND DISCUSSION

This product can be effectively utilized to measure various range of vibration intensity ranging from small to high and also for different distances. From all these analysis it is shown that the product can be used to detect minute vibrations and it helps to take preventive measures to avoid danger

VIII. CONCLUSION

Earthquake and tsunami indicator using Arduino mega has proved to be an economical and user friendly product. The product is affordable for common people in terms of product cost and installation cost. Frequent monitoring of the system is also not necessary. The product can be easily installed in home and industries. Power requirements of the system are also kept low. Precautionary measures are required for this product and itcan be easily operated by the user. It is expected that the productwill be widespread in the market due to its efficiency. The product can be installed in earthquake prone areas and sea shores.

Advantages:

1.This system is used for per warning of the natural hazards.2.It is very fast and economical.
3.One time instillation.

Disadvantage:

For seismic graph we are using the USB wired communication so range is limited.

Future scope:

To increase the range of the system IOT can be implemented.

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