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SMART EARTHQUAKE MONITORING AND WARNING SYSTEM

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Abstract - Earthquake is one of the devastating disasters that leads to heavy loss of life and property. The key factor is to reduce earthquake losses through early detection and warning. The project aims at designing an earthquake monitoring and warning system that is capable of detecting earthquakes as well as warning people to take necessary precautions. To develop a smart earthquake monitoring and warning system that senses tremors and warns users before the actual earthquake hits using a buzzer as well as an instant SMS alert remotely. The system makes use of a PIC16f877A microcontroller, vibration sensor sw-420 GSM module, LCD display, buzzer, etc. The PIC microcontroller constantly keeps monitoring the vibration sensor signals. In case a vibration is detected the sensor sends a signal output which is detected by the microcontroller. The controller now operates the buzzer to sound an alert to the users. Also, the controller communicates with the GSM module to send SMS alerts to the users. So, the system predicts the earthquake vibration earlier and gives a warning to the users to take necessary actions.

Key Words: Pic 167877a microcontroller, vibration sensor (sw-420), GSM module SIM 800C, LCD display, buzzer.

1. INTRODUCTION

Now, a day's earthquakes occurred more frequently around the world. On 6th February 2023, an earthquake hits Turkey and Syria, and more than 50,000 people lost their lives. It is difficult to predict the location and timing of a seismic event. The earthquake that occurs will not control by us but we can control the earthquake losses by early detection and giving warnings to the people. The aim of this project is to design an earthquake monitoring and warning system using a PIC microcontroller. This system consists of a PIC microcontroller (PIC16F877A), vibration sensor (sw420), LCD display, buzzer, etc. The main objective of this system is to predict the earthquake before the actual earthquake hits, and to intimate the users, by sending SMS to their phones and the buzzer produces a sound for them as a warning of an earthquake will occur. Here the software used is MP LAB for programming purposes designed by microchip technology and the proteus software for the graphical simulation of this system. The programming language used here is the Embedded C' language.

2. LITERATURE SURVEY

Earthquake is one of the most dangerous natural disasters that occur frequently around the world. In this literature survey, I read some of the earthquake early warning systems journals. Some of them are [1] Each year, hundreds of individuals lose their lives as a result of earthquakes that happen in risky areas or when they are sleeping helplessly. Here is a GSM-based seismic system of alerts that could sound before an earthquake occurs. Unpredictable earthquakes occur. If residents in the earthquake-prone area are already equipped to endure the strike, the resulting damage can be reduced and lives can be saved. This necessitates a notice before an earthquake's arrival that may cause significant ground motion. Because the energy pulse emitted at the earthquake's epicenter travels slower than light, such a warning system is feasible. Using a satellite communication network, fiber-optic network, pager service, cell phone service, or a combination of these, the earthquake warning signal can be sent from the epicenter to various locations. [2] When taking into account the station coverage, data quality, and related applications, seismic instrumentation for earthquake early warnings (EEWs) has increased dramatically in recent years. The Central Weather Bureau (CWB), which manages the official EEW system in Taiwan, is in charge of giving a regional warning for earthquakes of moderate to the large magnitude that takes place in and near Taiwan. Taiwan has a working P-Alert EEW system based on a low-cost micro-electro-mechanical system (MEMS) that can generate shake maps and issue on-site warnings. The National Taiwan University (NTU) installed the P-Alert system, which has shown to be crucial throughout numerous earthquakes that have damaged Taiwan since 2010. Despite having the ability to serve as both a regional and local warning system, the system is most effective when used for local warning. [3] It's crucial to minimize damage to vital infrastructure before an earthquake ever happens. In our effort, we created a system for earthquake protection and warning P-wave sensing that finds an earthquake's first signs before it causes harmful ground shaking. By using multiple channels (dual sensors), our method decreases the likelihood of false triggering from brief, harmless ground trembling. The system consists of a digital three-axis silicon accelerometer and a piezoelectric detector. The main focus of this study is on the detection algorithm that uses the gathered data to determine whether an earthquake is happening. The adaptive method maximizes event detection while

reducing the likelihood of false alarms below a specified rate. It is based on a probabilistic approach across a sliding window.[4] One of the most catastrophic natural catastrophes in the world is an earthquake and a flood. These natural disasters have a negative impact on the ecosystem, human lives, etc., which indirectly affect the nation's economic situation. The death rate of people and animals has decreased as a result of these natural calamities. Therefore, a monitoring and observatory system for earthquake and flood detection should be in place. The suggested system, which uses IOT technology, provides real-time earthquake and flood analyses so that authorities can keep an eye on affected areas. The Flood and Earthquake Observatory System is highlighted in this paper as a warning and alert system to effectively monitor the key flood-prone and earthquake locations in real-time while taking cost and safety into consideration.

3. METHODOLOGY

In this model, the project aims at designing smart earthquake monitoring and alerting system using a PIC 16F877A microcontroller, vibration sensor(sw-420), LCD display, GSM module (SIM 800C), and buzzer. Firstly, the vibration sensor continuously monitors the earth's vibration, and if the vibration occurs it will show logic high. And at the same time, it will pass the signal to the microcontroller that the earthquake will happen and the microcontroller sends a signal to the GSM module and buzzer. Now the GSM module starts sending SMS to the registered mobile number and at the same time the buzzer starts producing a sound as a warning to the users. And, the LCD display shows the status of the result, if the earthquake occurs it will be displayed as "detecting" and if the earthquake wouldn't occur it will display as "Not detecting" in the LCD display. The software used in this project was MPLAB IDE designed by microchip technology for programming purposes and the programming language used here is the embedded 'C' language. Here, the proteus software is used to show the result in a graphical way. If the earthquake will not occur, the sensor shows a logical low.

4. BLOCK DIAGRAM

In this model for identifying the earthquake vibration using an sw-420 vibration sensor. Therefore, if any vibration occurs the sensor would sense and show logic high. Then it sends a signal to the PIC 16F877A microcontroller. Now, the microcontroller communicates with the GSM module to send SMS alerts to the registered mobile number of the users. And, at the same time, the microcontroller passes the signal to the buzzer to produce sound for the users as a warning of the earthquake will occur to make necessary precautions. The LCD display shows the state of the system.

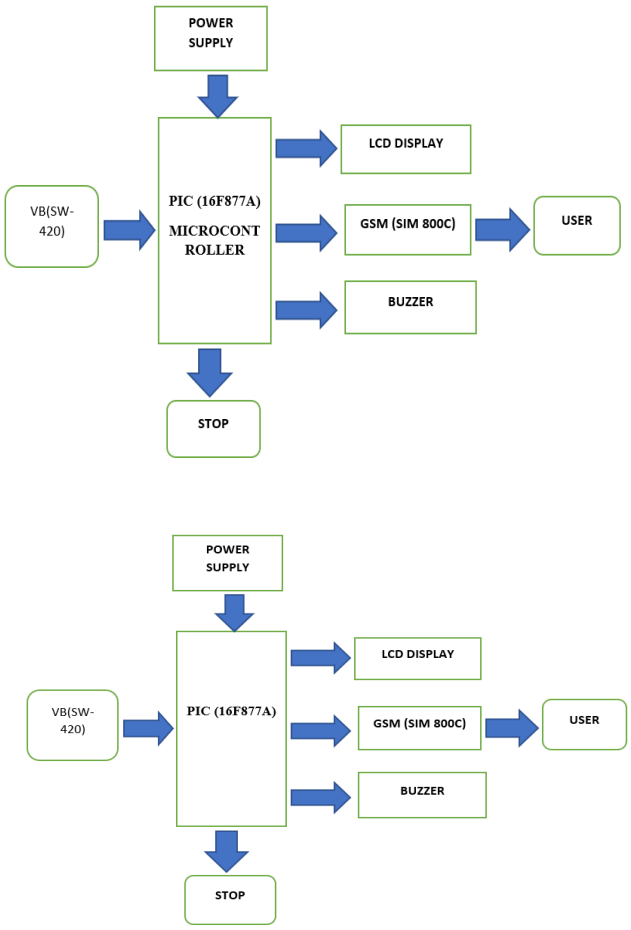


FIGURE 1: BLOCK DIAGRAM

5. ADVANTAGES

- This earthquake monitoring and warning system is low in cost.
- It will be installed easily in houses, streets, and other public places.
- This system will give a warning to the users before the actual earthquake occurs.
- It will save people and their lives.

6. FLOW CHART

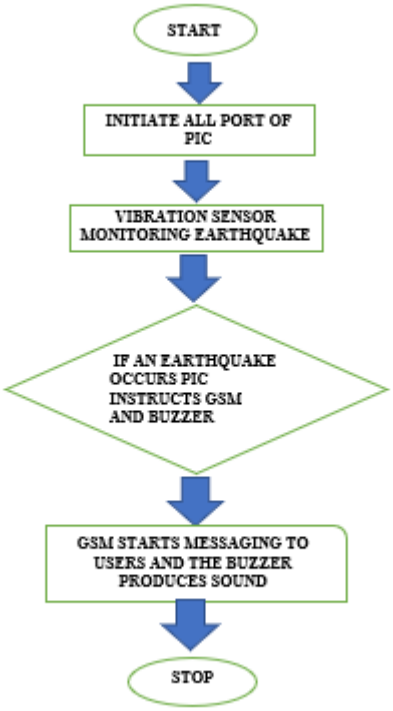


FIGURE 2: FLOW CHART

7. PIC16F877A

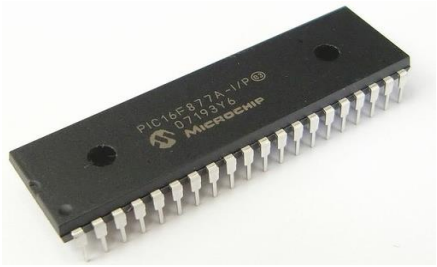


FIGURE 3: PIC16f877A

PIC stands for Peripheral interface controller or Programmable Intelligent Controller. PIC microcontrollers are designed with Microchip technology. This microcontroller is designed with Harvard architecture. PIC16F877A input is an 8-bit CMOS flash-based microcontroller in 44 pins. This microcontroller has two 8-bit timers/counters with a Prescaler. The processing speed of this CPU is 5 million instructions per second. It provides 8K bytes of flash, 368 bytes of RAM, 256 bytes of EPROM, 5 I/O ports, 3 timers, and 35 simple word instructions. In this project PIC 16F877a act as the heart of this system because it controls all functions of other devices connected to this project.

8. VIBRATION SENSOR(SW-420)

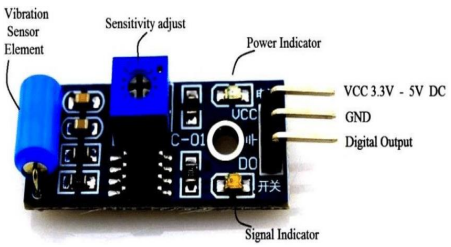


FIGURE 4: VIBRATION SENSOR

The vibration sensor used in this project was sw-420. The sw-420 is a vibration sensor that comprises resistors, capacitors, potentiometers, LM393 IC, power, and status led in an integrated circuit. It is useful to detect a variety of shocks. So, it has various applications like theft alarms, earthquake vibrations, etc. It has transducers that convert mechanical force caused by vibration or a change in motion into an electrical current using the piezoelectric effect. The operating voltage of this sensor is 3.3V to 5V. The sensor uses an LM393 comparator to detect the vibration over a threshold point and provide digital data, logic low or logic high. The frequency range of this sensor is 0.8GHZ to 4GHZ. In this project, the vibration sensor continuously monitors the vibration of the earth. If the earthquake occurs it would send signals to the pic 16f877a controller.

9. GSM MODULE (SIM 800C)

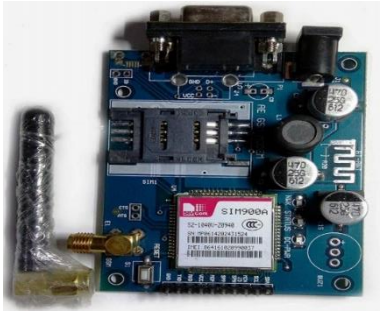


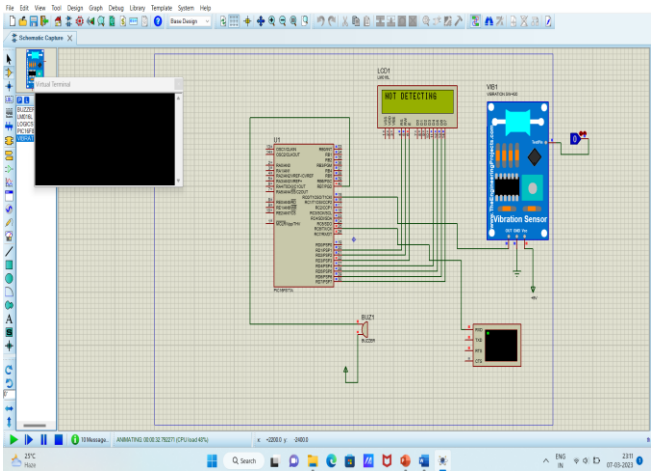
FIGURE 5: GSM MODULE

GSM (Global System for Mobile communications: originally from Groupe Special Mobile) is the most popular standard for mobile phones in the world. Its promoter, the GSM Association, estimates that 82% of the global mobile market uses the standard. GSM is used by over 3 billion people across more than 212 countries and territories. Its ubiquity makes international roaming very common among mobile phone operators, enabling subscribers to use their phones in many parts of the world. In this project, the PIC16F877A instructs the GSM module to send an SMS to the registered mobile numbers when an earthquake will occur. So, the GSM module communicates with the user to take preventive measures against earthquakes.

10. RESULT AND DISCUSSION

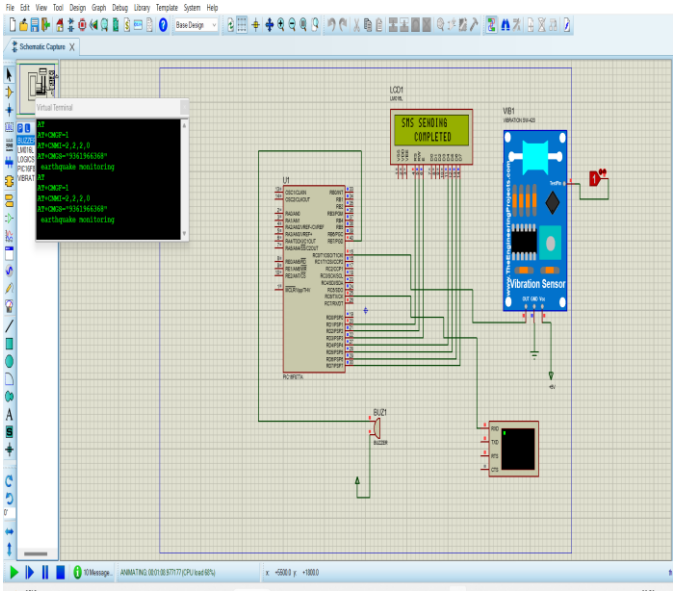
Here the results will be shown as software-based using the proteus simulation software. And the MPLAB IDE is used to program the microcontroller and its interfaced components.

WHEN AN EARTHQUAKE WILL NOT OCCUR:



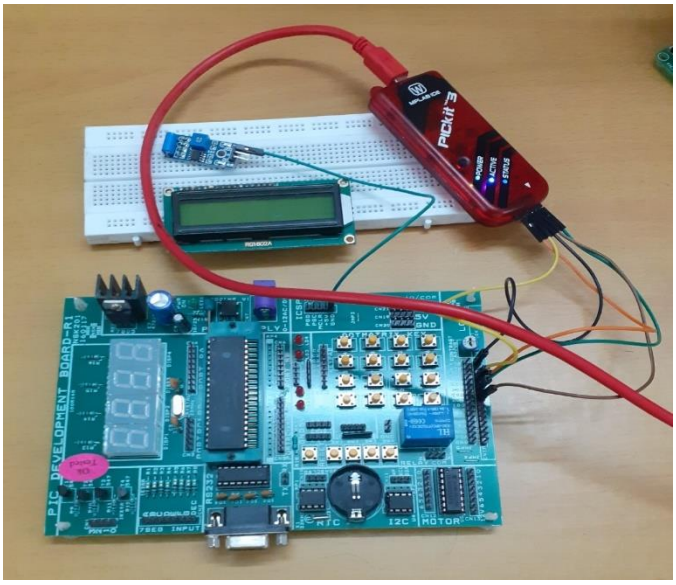
When an earthquake will not occur the vibration sensor shows a logically low value of 0.

BEFORE WHEN AN EARTHQUAKE WILL HAPPEN:



when an earthquake will happen, the vibration sensor will show a logically high value of 1. Then it passes the signals to the PIC microcontroller and it will communicate with the GSM module and buzzer to alert an earthquake.

HARDWARE PART:



11. CONCLUSION

Recently earthquakes occurred frequently around the world. In India,60% of the land is more prone to earthquakes. On 6th FEB 2023 robust earthquake occurred in Turkey and Syria, and more than 50,000 people lost their lives. So, the places which are more prone to earthquakes are to be installed with earthquake early warning systems. This system measures the vibration of the earthquake previously and gives a warning to the users. It is a low-cost warning system and it can be portable to all places .it can be installed in all places. so, the conclusion is to monitor the earthquake and give a warning to the people before an actual earthquake hits.

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