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ARM Controller Based Earthquake & Flood Detection and Alert System (EFDAS)

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Abstract: Disasters like earthquakes, floods can cause significant damage to the population nearby. Most of the time, people in affected area do not take any precautions as they are not aware of the occurrence of disaster. The system focuses on monitoring water level & earth vibrations via sensors, & generates alert signal when water level or level of earth vibrations crosses a threshold. System gives alert message to the concerned authorities through their mobile phones (SMS) and to the local people, nearby the river side. The module can also display real time status of water level on display.

Keywords: ARM7 LPC2148, MEMS, GSM, water level sensor.

I. INTRODUCTION

Natural disasters like earthquake and flood are worldwide phenomena. Earthquake is a sudden shaking of the earth surface because of the strong movements within the earth's crust which causes great destruction. A huge energy gets released and travels through rocks as waves, which causes vibrations and shaking of the earth surface. The word earthquake reveals its meaning very clearly (earth means ground or soil and quake means shake or tremble). From 29th July 2010 to 24th April 2012, over 26000 earthquakes were recorded by various agencies [1]. Since 1900, over 7000+ damaging earthquakes occurred worldwide [2]. The flood is one of the most destructive disasters in the world, causing tremendous structural, economic, environmental and most importantly human beings losses. In a single year, 2015, floods in Asia-pacific region caused 1863 deaths where almost 21.5 million peoples were affected and economic damage around 11.5 billion (USD) has been done [3]. As the earthquakes and floods cause significant damage to our society, so the system proposes cost effective and efficient design. The system focuses on monitoring water level & earth vibrations via sensors. It generates alert signal when water level or level of their mobile phones. Also the warning is sent to people using earth vibrations crosses a threshold. Alert message is in the form of SMS is sent to the concerned authorities and the local people through siren.

II. EARTHQUAKE DETECTION PROBLEMS

The problem for detecting an earthquake is the incapable early warning or alert systems. In 1993 as the earthquake struck in the middle of night at Killari, Latur, due to the absence of any kind of alarm system around 10,000 people died and 30,000 were injured [4]. In India there are only two places Delhi and Uttarakhand has successfully implemented the early earthquake alarm system which is developed by Indo-German companies who claims that the system can gives warning up to 10 seconds earlier [5]. But this early warning time is totally depends on the distance between epicenter and sensors of the system.

III. FLOOD DETECTION PROBLEMS

Flood is one of the most dangerous disaster due to which many people dies every year worldwide. In 1953 coastal floods killed 1835 people in the Netherlands and 313 people in the United Kingdom [6]. Flood detection is not easy as it doesn't depends on the specific area, heavy rain at one place can flood the area far away from it. As it is not depends on weather of one place, it is important to monitor parameters in wide area.

IV. PREVIOUS WORK IN EARTHQUAKE DETECTION

German company named 'Secty Electronics' had developed alarm system named as, "lifePatron: Earthquake warning and security management system". This system has been already implemented and working in 25 countries. Some systems are working based on fact that speed of advance electronic communications which is much faster relative to those of seismic waves. The available warning time increases from few seconds to tens of seconds with distance from the epicenter [7]. Most of the designed systems uses MEMS (Micro-Electro-Mechanical Sensor) accelerometer as it can sense very small vibrations very precisely [8].

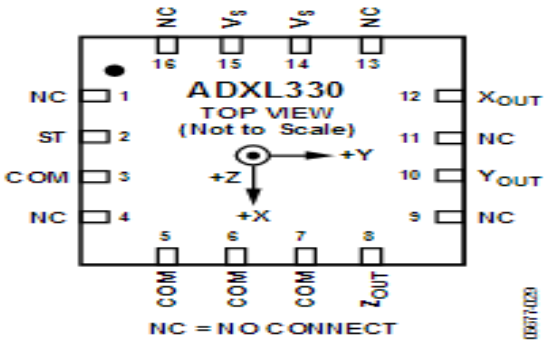

Figure 1: MEMS Sensor

Micro-Electro-Mechanical Systems (MEMS) is the integration of mechanical elements, sensors, actuators, and electronics on common silicon substrate through micro fabrication technology. MEMS uses a technology where number of components are integrated that sense and control environmental parameters. MEMS sensors are power efficient and more sensitive to input parameters compared to other sensors. MEMS is used as vibration sensor to detect earthquake vibrations and convert it into electric signal (voltage) [9].

V. PREVIOUS WORK IN FLOOD DETECTION

An early flood warning system developed by Kathmandu-based International Centre for Integrated Mountain Development in collaboration with Assam-based NGO Aaranyak, makes use of simple electronic sensors to produce flood warning signals through wireless technology for sending flood warning messages to government agencies [11].

VI. SYSTEM DESIGN MODEL

Microcontroller gets the data from sensor and compares current value and threshold value. If current value crosses threshold value then it sends signal to GSM module and it will turn on buzzer. In this design model ARM LPC2148 microcontroller is used. The LPC2148 microcontrollers are based on a 16-bit/32-bit ARM7TDMI with real-time emulation and embedded support. ARM7 LPC2148 32 bit, RISC microcontroller. It has inbuilt ADC & DAC with 40kB on chip SRAM and 512kB flash memory. A 128-bit wide memory interface and unique accelerator architecture enable 32-bit code execution at the maximum clock rate. It has Low power Real-Time Clock (RTC) with independent power and 32 kHz clock input.

For detecting the earthquake MEMS accelerometer is used in this design model. MEMS sensors are power efficient and more sensitive to input parameters compared to other sensors. MEMS is used as vibration sensor to detect earthquake vibrations and convert it into electric signal (voltage). Water level sensor is used to detect the flood i.e., water level. Sensor includes reed float sensors switch because of its reliability.

In this design model GSM SIM300 is used to send SMS to the concerned government authorities and local people. Display is used to provide continuous information about water level.

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VII. BLOCK DIAGRAM OF PROPOSED SYSTEM

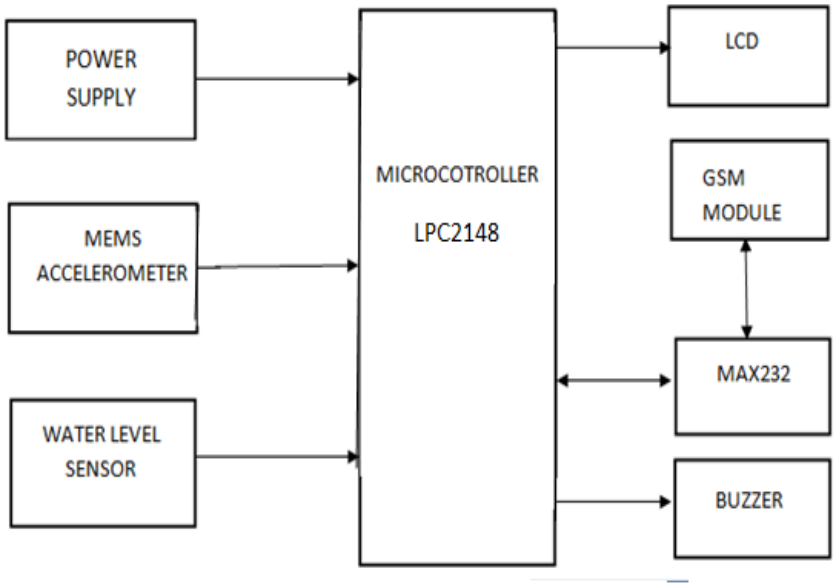
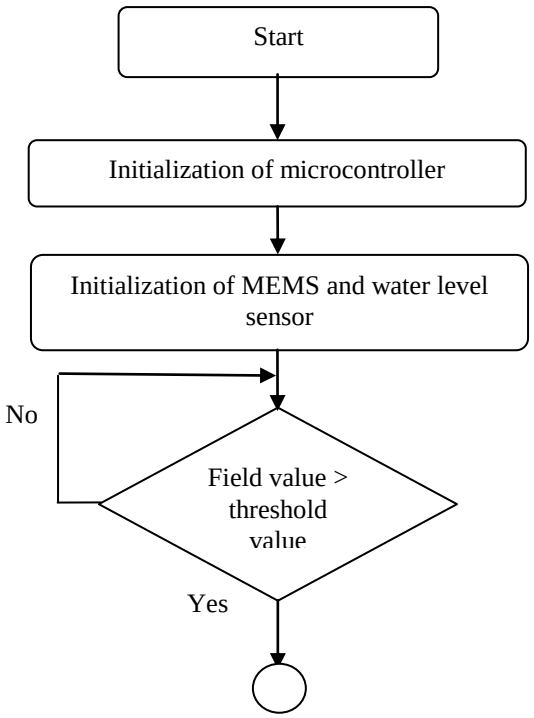


FIGURE 2: THE BLOCK DIAGRAM OF PROPOSED SYSTEM

VIII. FLOWCHART



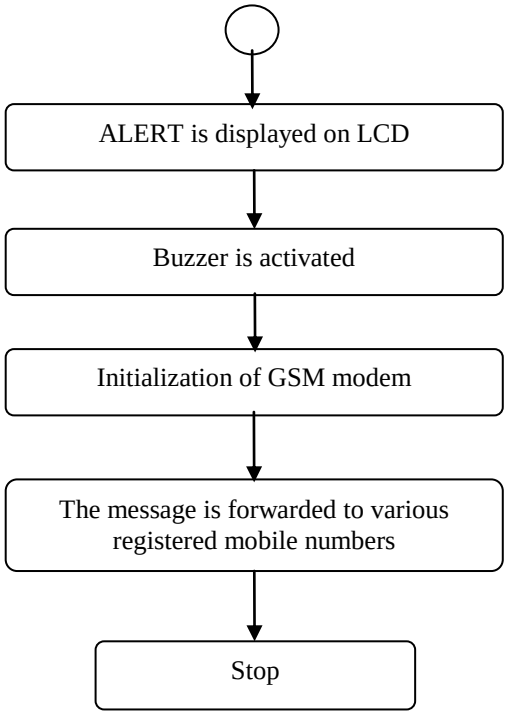


FIGURE 3: FLOWCHART OF EFDAS SYSTEM

Once the system initializes microcontroller, MEMS accelerometer and water level sensor, microcontroller continuously collects the outputs of all sensors and compares with the programmed threshold values.

If any of the sensor output crosses the threshold values, the microcontroller quickly initializes GSM as per the type of disaster i.e. earthquake or flood, and sends the SMS to concerned government authorities and locals too. Microcontroller also turns on the siren so that people can get alert.

IX. EXPERIMENTAL RESULTS

In this experimental results water level float switches and MEMS sensors are tested with the physical simulations. For water level detection three different float switches are mounted at three different levels.

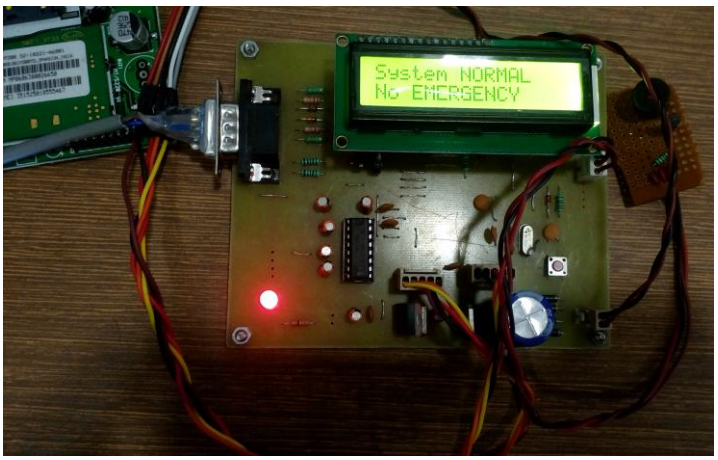


FIGURE 4: HARDWARE FOR EFDAS SYSTEM

FIGURE 5: WATER LEVEL SENSORS

As the water level varies LCD shows three different levels. For first two water levels system shows

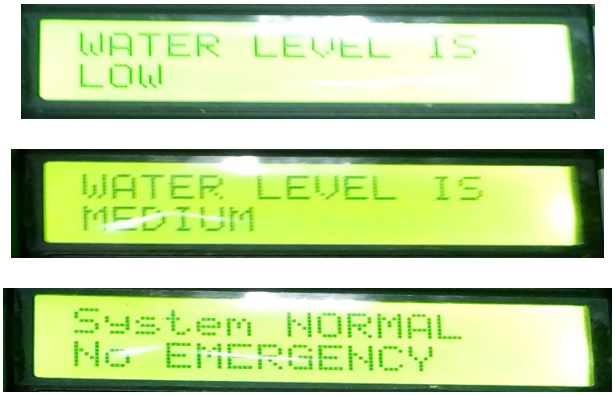


FIGURE 6: RESULTS FOR DIFFERENT WATER LEVELS

For highest level system displays emergency message, turns ON buzzer and also sends the SMS to authorities

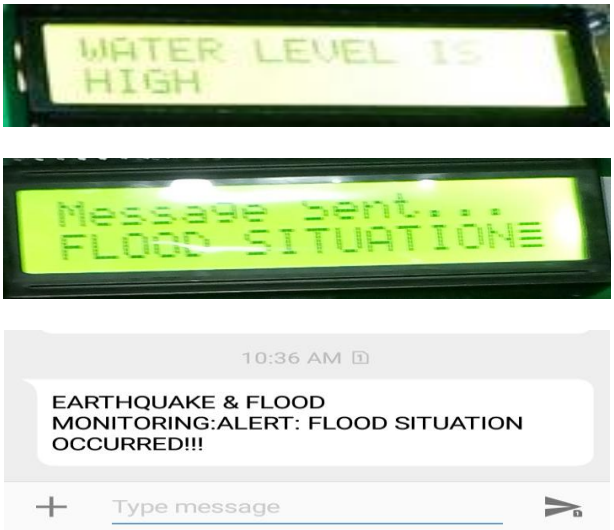


FIGURE 7: RESULTS FOR DETECTION OF HIGH WATER LEVEL

In this design model MEMS sensor is mounted on a mechanical vibration model for simulating earthquake.

FIGURE 8: MECHANICAL VIBRATION MODEL

When the vibrations increases beyond a threshold level, buzzer is turned ON and SMS is sent to the programmed mobile numbers.

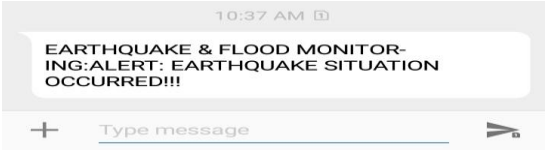


FIGURE 9: SMS SENT AFTER EARTHQUAKE DETECTION

X. CONCLUSION

The system focuses on monitoring water level & earth vibrations via sensors, & generates alert signal when water level or level of earth vibrations crosses a threshold. Alert message in the form of SMS will be sent to concerned authorities through the GSM. It also includes siren to broadcast the messages to the local people, nearby the river side. The system can also shows status of water level through the LCD display.

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REFERENCES

[1]. J.E. Daniell, "Earthquake Report – a worldwide earthquake and volcano real-time reporting platform".
[2]. J.E. Daniell, "The worldwide economic impact of historic earthquakes".
[3]. United Nations, ESCAP (Economic and Social Commission for Asia and the Pacific). "Disasters in Asia and the Pacific: 2015 Year in Review".
[4]. Sudhir K. Jain, C.V.R. Murty and Navin Chandak, "The September 29, 1993, M6.4 Killari, Maharashtra Earthquake in Central India".
[5]. https://www.secty-electronics.de/en/projects/overview-about-projects-and-references.html
[6]. Ir. S.N. Jonkman, "Loss of life caused by floods: an overview of mortality statistics for worldwide floods".
[7]. R. Allen, H. Brown, M. Hellweg, O. Khainovski, P. Lombard, and D. Neuhauser. "Real-time earthquake detection and hazardassessment by ElarmS across California. Geophysical Research Letters, 36(5), 2009".
[8]. Angela I Chung, Jesse F. Lawrence, Carl Christensen "Evaluating the Integrability of the Quake-Catcher Network (QCN)".
[9]. Sanjib Kalita, J.N.Borole, "Application of MEMS Accelerometer to Consumer Electronics" International Conference on Modeling and Simulation in Engineering and Technology.
[10]. Elizabeth Basha, and Daniela Rus, "Design of Early Warning Flood Detection Systems for Developing Countries", paper was supported in part by Microsoft Corporation, NSF Graduate Fellowships, NSF CNS- 07601 and NSF IIS-0426838
[11]. Ponthip Limlahapun and Hiromichi Fukui," Japan Flood Monitoring and Early Warning System Integrating Object Extraction Tool on Web-based", ICROS-SICE International Joint Conference 2009, August 18-21, 2009, Fukuoka International Congress Center, Japan.
[12]. www.engineersgarage.com/articles/gsm-gprs-modules.
[13]. http://www.circuitstoday.com/simple-water-level-idicator.