

GSM based alert and warning system for LANDSLIDING and THUNDER activity

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Abstract - The occurrence of landslide and thunderstorm is harmful for human life and property. The natural causes cannot be stopped, but the system can alert before they occur. So for alerting people from landslide and thunderstorm this technique is useful. The data is collected from the input sensors, then and given to controller for transmission and an alert message is transmitted with the help of GSM Module. The sensors output is being displayed on the LCD in the form of percentage. The SMS system will alert the people and save life and also the property. The planet Earth has hundreds of impact events, with some occurrences causing both in terms of human casualty as well as economic losses. There are different types of sensors to measure the behavioral aspects of earth. The sensors integrated with WSN, provide an accurate and contiguous data for analysis and interpretation. This paper briefly addresses earth observation and areas of critical importance to people and society. The system monitors the changing geotechnical condition using various geo-technical sensors like soil moisture sensors, rain sensor, strain gauge. This paper also touches upon the aspects of data transmission over Global System for Mobile Communication (GSM) to a remote data center.

Key Words: Thunderstorm, GSM module, Strain gauge.

1. INTRODUCTION

1.1 Landslide

Wireless sensor network (WSN) technology has the capability of quick capturing, processing, and transmission of required data in real-time with high speed. This effect can occur in the form of intense rainfall, snowmelt, and changes in ground-water levels. [1] A landslide is a downward and outward movement of soil, rock or vegetation under the influence of gravity. Types of landslides include rotational landslide, translational landslide, rock fall, rock toppling, lateral spreading and debris flow. Debris flow includes down slope movement of collapsed, unconsolidated material typically along a stream channel. [2]

Landslide is caused due to some natural factors and anthropogenic factors. Natural factors are gravity, geological factors, heavy and prolonged rainfall, earthquakes, waves and volcanoes. Slides occur often with intense rain by creating zone of weakness; also water tables rise with heavy

rain makes some slopes unstable. Part of this water is absorbed by soil increasing its weight which can put an additional load on the slope. Cutting and deep excavations on slopes for buildings, roads, canals and mining causes modification of natural slopes, blocking of surface drainage, loading of critical slopes. [2] Landslide effects can be direct or indirect. Direct effects are deaths and injuries to people and animals. Physical damage due to debris blocks roads, supply lines (telecommunications, electricity, water, etc.) and waterways. Indirect effects are flooding cause by movements of large masses of soil into the reservoir. Landslides causes of loss of life, property, infrastructure, human settlements, agriculture, forestland, and lead to damage of communication routes. [2]

The term landslide describes many types of downhill earth movements ranging from rapidly moving catastrophic rock avalanches and debris flows in mountain regions to more slowly moving earth slides. [3]. Some landslides move slowly and cause damage gradually, whereas others move so rapidly that those can demolish property and lives suddenly and unexpectedly. [4] Landslides affect approximately 15% of land area of The Indian subcontinent and reaching around 0.49 million km². The India has a sensational record of catastrophes due to landslides. [4]

Example: Site Survey shown in Fig.1



Fig-1: Uttarakhand Landslide –16 June 2013.

1.2 Lightning

Thunderstorm is a climatic disturbance that is associated with heavy rains, lightning, thunders and thick clouds. Rainfall from thunderstorms causes flash flooding which

kills more people each year than hurricanes, tornadoes. One of the most significant lightning hazards is to the wildfires, as they can even ignite the ground surfaces. [5] When the clouds fill up with electric charges the positive charges or protons from at the top of the cloud and negative charges from at the bottom it causes lightning. There have been many theories of occurring lightning. [5]

1. Polarization mechanism theory: As ice falls through the Earth's atmosphere, they become electrically polarized.

2. Electrostatic induction theory: Two opposing charges get separated. The electricity gets stored in the middle of a cumulonimbus cloud. There the electricity collides with rain.

Types of lightning are intra-cloud lightning, cloud to ground lightning and cloud to ground lightning. Intra-cloud lightning happens inside a cloud. Cloud to ground lightning hits the earth from a cloud. Cloud to cloud lightning, is from one cloud to the other. Lightning strikes the earth 50 to 100 times per second. The duration of one stroke of lightning is 1/5 of a second. Lightning contains voltage of 1, 00,000kV and peak current of 30kA. The total energy released during lightning is 40GJ. During lightning temperature rises 50,000 degrees Celsius. Lightning can travel at speeds of 300,000 m/sec. Lightning heats nearby air to about 10,000 degrees Celsius. [5]

2. Problem Statement

Landslides and lightning due to the heavy rainfall damages several houses and structures, killing those who were trapped. So, due to loss of lives in landslides there is a need to develop a system which predicts its occurrence and alert the authority to take preventive measures.

3. Problem Definition

This project puts forward solutions to the landslide and lightning in heavy rainfall region. This system uses different types of sensors like rain, soil moisture, strain gauge etc. for detection. It uses Arduino which has inbuilt ADC modules, which collects the data from the sensors. Then this data is send over a large distance using GSM module and received at alert team.

4. Objective of Project

1. To design wireless system for lightning and landslide detection.
2. To predict the landslide and lightning.
3. To send the alert message to user with the help of GSM module (SIM800).
4. To achieve fast transmission of data using GSM.
5. To achieve real time monitoring of data.
6. To prevent loss of life, properties, farmland etc.

5. System details

5.1 Arduino UNO

Arduino UNO board has ATMEGA328 Micro controller IC. It processes the input from the different sensors and monitor data. It also displays output on LCD and sends the message with the help of GSM Module.

5.2 Soil Moisture Sensor

Soil moisture sensor measure the moisture content in the soil. LM393 comparator is used to give both analog and digital output to the controller.

5.3 Rain Sensor

Rain sensor module is used for rain detection. It is also used for measuring the intensity of rain. Analog output is used in detection of drops in the amount of rainfall. It is connected to 5V power supply.

5.4 Strain Gauge

Strain gauge is a type of pressure sensor. It detects the pressure and gives the output in the form of electrical resistance. It converts force, pressure, tension, weight, etc. into the change in resistance.

5.5 LCD

The output of the different sensors is displayed on the LCD. It displays the character and numeric values and also the alert message.

5.6 GSM SIM800

GSM SIM800 works on the frequencies 900/1800 MHz. It sends message to the mobile number which is feed into the controller. This module is used to make audio calls, SMS, Read SMS.

5.7 Buzzer

When the alert message is generated by the controller, then the buzzer rings.

5.8 Power Supply

We require +5, +12 Volts DC supply. +12 volts is given to arduino and GSM module, +5 volts to all sensors, buzzer and LCD.

6. Algorithm

1. Start.
2. Initialize input and output pins of arduino.
3. Initialize the LCD.
4. Initialize the GSM Module.

5. Initialize input and output variables.
6. Fetch the sensor value and display it.
7. Compare sensor value and threshold value.
8. If the sensor value is greater than threshold value, display landslide and lightning detection.
9. An alert message is send through the GSM module.
10. Stop.

7. Activity Diagram

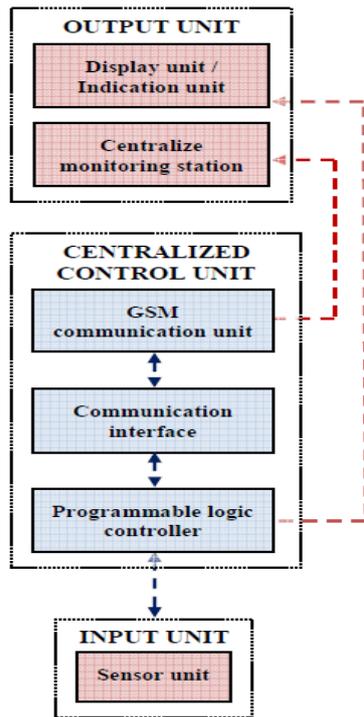


Fig-2:Flow chart

8. Testing

8.1 Hardware

The hardware with all the components connected to the power supply along with the main circuit.

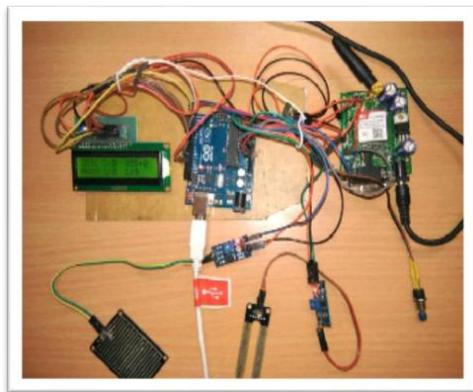


Fig-3: Sensor interfacing with LCD.

8.2 Alert message on LCD

When sensors output exceeds the threshold value, an alert message is generated and being displayed on LCD.

8.3 Alert message on mobile handset

When the landslide or lightning is detected, an alert message is sent through GSM. Module to the mobile handset.



Fig-4: Alert message on mobile handset.

9. Applications

1. In Himalayan regions
2. In the area where heavy rainfall occurs.
3. In the earthquake prone areas like Delhi, Chennai, Nepal, etc.

10. System Diagram

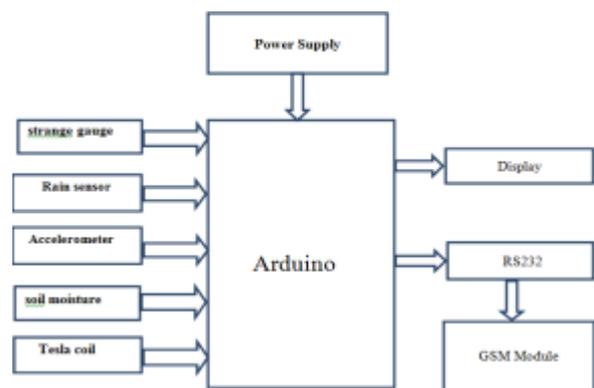


Fig-5: System Diagram.

11. Results

1. Sensors output is observed on the LCD in the form of Percentage.
2. Alert message for Land Slide and lightning Detection is displayed on LCD.

3. When the land slide and lightning is detected, Buzzer rings as an alert alarm.

4. An alert message is sent to the rescue team with the help of GSM module.

12. Future Scope

By using a Wi-Fi module, the data can be uploaded to the web server continuously. Weather forecasting can be done by adding the sensors such as temperature sensor, humidity sensor, anemometer, etc. We can monitor other environmental parameters by adding sensors such as Soil PH sensor, CO₂ and Oxygen sensor.

13. CONCLUSIONS

Wireless sensor network for landslide detection is one of the challenging research areas available today in the field of geophysical research. Landslides have become very serious problem at hill and mountain area. Because of landslide and thunderstorms disaster many people lost their lives and also property.

This system uses arduino interfaced with sensors, LCD and GSM module for real time monitoring of data. Data from sensors is sent to arduino and displaying alert message on LCD. The results of the analysis in the form of landslide and lightning warnings will be provided to the user with the help of GSM. Hence landslide and lightning detection system alert before landslide and lightning by using sensor values.

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