ABSTRACT

Landslides are very dangerous by all aspects. It harms not only living being but also economy. It is very important to study the landslide phenomenon to predict the landslide and also prepare counter measures for it. To study the landslide phenomenon, wireless sensors are the best equipment we are having till now. Sensors can detect inclination, moisture content and rate of sliding of earth material. When this happen, a signal sending device like sim module can send a message of danger to the near by station. Above work is totally laboratory based and also can be used on site. Due to shorter prediction time, our aim to re-study the landslide phenomenon through sensors and sim module. And increase the accuracy and duration of landslide predication.

Keywords: Landslide; prediction time

1. Introduction

The Landslide hazard is one of the most significant hazards that affect different parts of east India, Nilgiris, Western Ghats and Eastern Ghats, are affected by this hazard every year and suffer heavy losses in terms of life, infrastructure and property. Landslide is one of the major natural hazards that are commonly experienced in hilly terrains all over the world. Landslides are affect at least 15 percent of the land area of India—an area which exceeds 0.49 million km². In India the incidence of landslides in Himalayas and other hill ranges is an annual and recurring phenomenon. There is a variation in the degree of landslide incidences in various hill ranges. For example, the landslide incidences are high to very high in Himalayas, high in North-eastern hill ranges, high to moderate in Western Ghats & Nilgiris and low in the hill ranges of Eastern Ghats & Vindhyas. The disaster situation in the country is further compounded by increased vulnerabilities related to rapidly growing population, unplanned urbanization and fast-paced industrialization, rapid development in high risk areas, environmental degradation and climate change. It is observed that impact of natural disasters is felt more severely by people who are socioeconomically weak because their habitats are located in vulnerable areas and not designed to withstand the impact of natural disasters. Therefore, the processes of poverty eradication and disaster management are intricately linked.

Natural earth processes contribute significantly in shaping the landscape of earth, and some of them are hazardous to people. These natural hazards must be recognized and must be avoided wherever possible, and their threat to human life and property must be minimized. The landslides are one such type of hazards usually triggered by the neo-tectonic movements, earthquakes, heavy precipitation and those induced due to land-use changes such as felling of trees, agriculture, mining and road cutting in hilly terrain. Slopes are one the most common landforms, and though most slopes appear stable and static; they are actually dynamic evolving systems. Material on most of the slopes is constantly moving down at rates that vary with imperceptible creep of soil and rock to thundering avalanches and rock-falls moving at tremendous speeds. Landslides are caused in hilly terrains due to factors like gravity, weathering, deforestation, earthquake, heavy precipitation etc, and result in loss to property and life. Landslide is a general term used to describe the down-slope of soil, rock and organic material under the influence of gravity. This phenomena cause property damage, injury, death and adversely affect a variety of resources in the disaster areas. To monitor the landslide phenomena, it is imposed to represent the area under investigation by a number of points that are monument durably. Some stations are used to define a stable reference frame and the remaining stations are the monitoring points situated in the deformation area. In this way, the determination of the movement of the control stations is done relatively to the reference ones.

However, this disaster is largely unpredictable and occurs within very short spans of time. Therefore technology has to be developed to capture relevant signals with minimum monitoring delay. Wireless Sensors are one of the cutting edge technology that can quickly respond to rapid changes of data and send the sensed data to a data analysis centre in areas where cabling is inappropriate.
The Global Positioning System (GPS), also known as Navstar, is a global navigation satellite system (GNSS) that provides location and time information in all weather conditions, anywhere on or near the Earth where there is an unobstructed line of sight to four or more GPS satellites. The GPS system operates independently of any telephonic or internet reception, though these technologies can enhance the usefulness of the GPS positioning information. The GPS system provides critical positioning capabilities to military, civil, and commercial users around the world. The United States government created the system, maintains it, and makes it freely accessible to anyone with a GPS receiver. The United States began the GPS project in 1973 to overcome the limitations of previous navigation systems, integrating ideas from several predecessors, including a number of classified engineering design studies from the 1960s. The U.S. Department of Defense (DoD) developed the system, which originally used 24 satellites. It became fully operational in 1995. Roger L. Easton, Ivan A. Getting and Bradford Parkinson of the Applied Physics Laboratory are credited with inventing it. Advances in technology and new demands on the existing system have now led to efforts to modernize the GPS and implement the next generation of GPS Block IIIA satellites and Next Generation Operational Control System (OCX). Announcements from Vice President Al Gore and the White House in 1998 initiated these changes. In 2000, the U.S. Congress authorized the modernization effort, GPS III.

In the broadest definition, a sensor is an object whose purpose is to detect events or changes in its environment, and then provide a corresponding output. A sensor is a type of transducer; sensors may provide various types of output, but typically use electrical or optical signals.

2. Objective

Following are the proposed objectives of the project:

1) Studying the natural phenomenon of landslide through sensor nodes and gps module.
2) Creating an autonomous GPS module which can send signal before and after the landslide.
3) Also making pre-counter measure to avoid landslide or to increase the prediction accuracy of landslide.
4) And to study the landslide phenomenon more precisely through above mentioned points.

3. Literature Review

1. **Author Name** – Prof. More P. C., And Prof. Kharade S. N.
   **Title** – Landslide warning system using wireless sensor network.
   **Published** – 10 October 2014

   In recent years, the frequent occurs of landslide disasters, caused great harm to people’s lives and properties. This research includes some wireless sensor monitoring node distributed on the hillside; they construct a wireless data connection network based on Zigbee. This combines GSM technology and wireless technology. This design can collect depth of the water in the mountain and slope angle of the hillside, and provides the monitoring center with warning information in time, so related departments can take effective measures rapidly to protect peoples and property. In this paper we are going to study about landslide warning system, as the occurrence of landslides is a big loss for human life and property. We can’t stop the natural causes but we can be alert before they occur. So for alerting people from landslides we use this technique. In this design we have used three sensors of Angle sensor which gives the readings of slope angle if there is any movement in landslide and we have Liquid level sensor it collects the depth of water at the mountains. Temperature sensor gives the changes in the temperature. These all nodes of sensors are connected to the LPC 2148 ARM processor for collection of data. As the data is collected then GPS gives latitude and longitude and all the readings are given to Zigbee for transmission. As we obtain the information at the receiver side by LCD display at receiver station or by SMS we can alert the people and save lives and property.

2. **Author Name** – Harshini S., Alisha Begum, Shobhana N., Bildas Santhosam
   **Title** – Landslide Pre-Warning System For Railway Track In Hill Station Using WSN
   **Published** – 3 March 2015

   The down sliding of rock, soil and organic material due to various parameters under the influence of the gravitational force causes a considerable hazard to natural habitat, environment, economy and other resources. Real-time monitoring of landslide is a very complex technology and the product of multi-disciplinary
combination of detection, monitoring and control of the hazard. In this paper a disaster pre-warning system is being developed for the railway track in hill stations, where the railway transport is affected due to heavy rainfall and frequent landslides. Integrating MEMS, Flex, PIR and Moisture sensors forming a heterogeneous wireless network helps in identifying the abnormalities and this paper also includes development, deployment (analysis) and data retrieval of the sensors information using WSN along with the specification of the location of occurrences of landslide with the help of GPS.

3. **Author Name** – SM Ramasamy, M. Muthukumar, M. Subagunasekar  
**Title** – Malin-Maharashtra Landslides: a disaster triggered by tectonics and anthropogenic phenomenon  
**Published** – April 25, 2015

The landslide that occurred on 30 July 2014, at Malin village, Ambegaon Taluka 110 km from Pune, West Maharashtra, was a major disaster that crushed a large number of houses and trapped/killed over 160 people in the village. A team of geologists from the Geological Survey of India (GSI) which conducted an on-the-spot study after the event, observed that multiple factors may have caused the disaster. The team observed prominent bench cultivation of paddy in the upsloperegion of Malin village and the heavy impounding of water demanded by the crops might have promoted infiltration into the soil and loosened it, leading to the major mudflow, burying the Malin village.

4. **Methodology**
   - We bifurcated the work into two parts i.e. making the landslide demonstration model and making sensor module.

**Actual Work**

**LANDSLIDE MODEL**

*Material Used For Making The Model*
1) Waterproof Plywood  
2) Nails  
3) Stays  
4) Hinge

**Actual Model**

Laying Of Soil Material In To The Model.

Laying of soil material according to stratification-
1) Horizontal
Inclined Stratification study is necessary to achieve natural landslide phenomenon. Without this, we cannot achieve not only accurate result but also we can only able to get laboratory related results.

**SENSOR NODES AND GPS MODULE**

**Material Required**

1) **Arduino Board**
Arduino Board is the heart of the sensor node. It controls the sensor and gives the results on Computer screen.

2) **Moisture Sensor**
This sensor detects the moisture present in the soil.

3) **Gyroscope And Accelerometer**
This sensor gives the acceleration of landslide and direction through which landslide took place.
4) **Sim Module**-
Sim module send a message to the near by station indicating the danger or the landslide warning.

![Sim Module Image](image)

**Results**-
We tested the sensor nodes and the module over the landslide model. We observed that the prediction time is very less within the seconds. And it is not possible to rehabilitate the people from this very short duration of time.

**Conclusion**-
It is possible to make an autonomous system which can send signal of danger and warning. Also we observed that to increase the prediction time it is very important to conduct the survey over the area having human societies to check the parameters like moisture content present into the soil. Different causes that can trigger the landslide are only applicable after the human activity also mudflow is different phenomenon than landslide phenomenon.