Impact Factor (SJIF): 5.301

International Journal of Advance Research in Engineering, Science & Technology

e-ISSN: 2393-9877, p-ISSN: 2394-2444

Volume 5, Issue 3, March-2018

Landslide Detection and Propagation using Wireless Sensor Network

Geetanjali Bhujbal[1], Pratiksha Rao[2], Prajakta Rode[3], Vaibhav Shrivastav[4], Kaustubh Markhande[5]

[1]Computer Department, P K Technical Campus,Chakan

[2]Computer Department, P K Technical Campus,Chakan

[3] Computer Department, P K Technical Campus,Chakan

[4] Computer Department, P K Technical Campus,Chakan

[5]Assistant Professor, Computer Department, P K Technical Campus,Chakan

Abstract --- Landslides have frequently occurred on natural slopes during periods of intense rainfall. With a rapidly increasing population on or near steep terrain in Korea, landslides have become one of the most significant natural hazards. Thus, it is necessary to protect people from landslides and to minimize the damage of houses, roads and other facilities. To accomplish this goal, many landslide prediction methods have been developed around the world. In this study, a prototype of landslide detection is introduced. This system is based on the wireless sensor network (WSN) that is composed of sensor nodes, gateway, and server system. Sensor nodes comprising sensing and communication part are implemented to detect ground movement. A sensing part is designed to measure inclination angle and acceleration accurately, and a communication part is deployed with Bluetooth (IEEE 802.15.1) module to transmit the data to the gateway. To verify the feasibility of this landslide prediction system, a series of experimental studies was performed at a small-scale earth slope equipped with an artificial rainfall dropping device. It is found that sensing nodes planted at slope can detect the ground motion when the slope starts to move. It is expected that the prototype of landslide detection can provide early warnings when landslides occurs.

Keywords- Wireless sensor networks, debris flow, disaster management, landslide detection, wireless sensor node, wireless sensor network

I. INTRODUCTION

LANDSLIDE location should be detected to produce landslide inventories. Such a inventories are used for various purpose [1],[2],such as recording the landslide magnitude in a region ;implementing the initial stage for landslide susceptibility ,hazard and disaster management ; examining the distribution ,kinds and shapes of slope failures ; and studying the evolution of landscapes affected by landslides[1]. Landslides are a serious geological hazard caused when masses of rock , earth and debris flow down a steep slope during periods of intense rainfall and rapid snowmelt . It is reported that landslides happen more repeatedly than before and their damages are increasing due to global warming[2]. In order to prevent landslide, hill slopes that are unstable should be strengthened .

To mitigate its damage, a system that can predict the occurrence of landslide at a specific site is required. The immediate detection of landslide activity provided by real-time systems can be crucial in saving human lives and protecting property. The continuous study provided by remote real-time monitoring permits a better understanding of dynamic landslide behavior that enables engineers to create more effective design to prevent landslides . In this study, a prototype of landslide detection is introduced . This is based on wireless sensor network and design to detect debris flows that is frequently occur in Korea [3]. It is found that sensing nodes planted at the slope can detect the ground motion when the slope starts to move .To verify the feasibility of this landslide prediction system, a series of experimental studies was performed at a small-scale earth slope increasing soil moisture content .It is expected that landslide prediction system by wireless sensor network will provide early warnings when landslide occurs [4] .

II. RELATED WORK

Landslide is a general term used to describe the downslope movement of soil, rock and organic materials under the influence of gravity. The evolution of wireless sensor networks has fostered the development of real-time monitoring of critical and emergency applications. Wireless sensor technology has generated enthusiasm in computer scientists to learn and understand other domain areas which have helped them to propose or develop real-time deployments. One of the major areas of focus is environmental monitoring, detection and prediction. This system uses mobile communication to alert the users, whereas the deployed system uses real time data collection and transmission using the wireless sensor nodes, WiFi, satellite network and also through internet.
In the field of landslide monitoring, existing literature mostly relates to: (i) algorithms; (ii) proposals for infrastructures; (iii) on field experiences.

Works on the first category usually deals with the configuration of all sensors with the Rasberry pi taking readings.

IV. PROPOSED SYSTEM

Commercially obtainable wireless sensor nodes do not have fixed sensors to measure pore gravity, moisture content, vibration, earth movements, etc. This constraint has leaded us to implement data gaining boards to connect the outside sensors to the wireless sensor nodes. A WSN is a wireless sensor network consisting of spatially distributed autonomous devices using sensors to monitor physical or environmental conditions ,such as light, temperature, sound, vibration, pressure, motion or pollutants, at different locations [6]. In addition to one or more sensors, each node in sensor network is typically equipped with a radio transceiver or wireless communication device, a small microcontroller/Raspberry Pi and power supply usually a battery. The fundamental goal of wireless sensor network is to produce global information from local data by each sensors. By combining sensed data from large number of distributed sensors, a global monitoring can be performed [7].

A wireless sensor networks used to alarm the effects of landslides well in advance before land sliding occurs. The proposed work considers a sensor node for the application with base station or the access point. The wireless transceiver receives the data's from the sensors and transmitted to the access point or the base station. Continuous monitoring can also be done. When the angular sensor gets tilted some voltage gets produced when this voltage reaches or increases the threshold value it will produce an alert. It can be monitored from the base station[9].

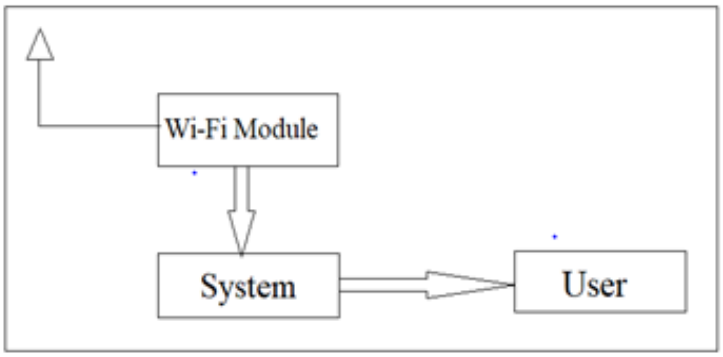

Figure 1. Receiver

V. SYSTEM ARCHITECTURE

System architecture includes different blocks like embedded devices, sensors, mobile devices, Computer station, Internet, Wi-Fi module, circuit. Circuit is nothing but the Raspberry Pi with all sensors.All the information which is sensed by sensors will be stored on cloud via Wi-Fi module.

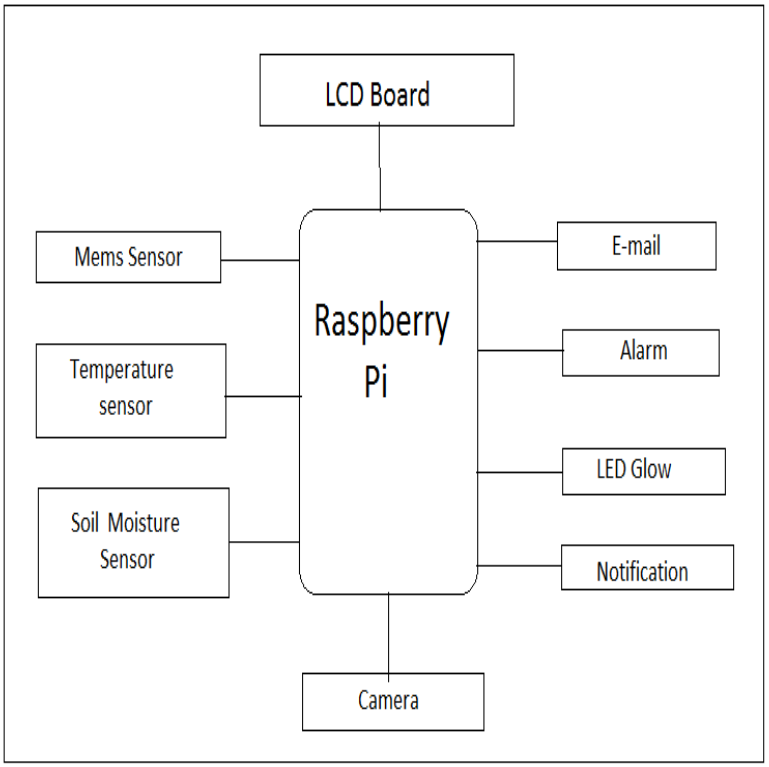

Figure 1. System Architecture

The architecture diagram shows how the Sensor's are connected with each other and how we implement the WSN's network to capture the image whenever the signal is broken.We are connecting the sensors with each node i.e the load on the sensors should be balanced.Lights and alarm are generated to aware the surrounding environment. In large multi-hop networks, cost of propagating event detection messages from originating nodes to the base station can be significant. Deployment of circuit on the surface area is necessary.

VI .METHODOLOGY

The required hardware for our system is as follows::

1.Soil moisture sensor
2.Temperature sensor
3.MEMS sensor
4.Rasberry Pi
5.Wi-Fi module

Where as the alarm is said to the threshold value, and when threshold value is reached the system raises alarm;and simlutanously the image of incident is captured using programming language with the desktop system for testing purpose.We are getting all readings from sensors through mail or we can get notification on our mobile.We can display warning message on LCD board but preferably Digital Boards should be used.

For prediction purpose we are using two parameters.These Parameters are as follows::

1. **Frequency Ratio**
2. **Certainty Factor**

Frequnecy Ratio is calculated by

FR i,j = ((N pix S i,j) / ∑ j N pix(S i,j))/(N pix (N i,j) / ∑ j N pix(N i,j)) .

Certainty Factor is updated by

CF = [ppa − pps ppa (1 − pps) ppa − pps pps (1 − ppa)].

A.Algorithm

i. Design or Implement the System.
ii. Check all sensor's are connected properly
iii. IF-->yes then
iv. Collect some soil for system testing.
v. Check whether the Software is properly connected across the WSN's to capture the image through software.
vi. Check Threashold values and alarm
vii. According to that take decisions.

VII. CONCLUSION

It includes a prototype of landslide detection by WSN. As information and communication technology develops, landslide monitoring systems are becoming more precise and cost effective. Landslide monitoring system by WSN will be an alternative to detect and predict slope failure including debris flow. It may difficult to determine whether the slope is stable or not solely using data collected by landslide monitoring because slope stability depends on soil type and soil condition, ground water , soil moisture content, slope failure type, rainfall, etc.

If the predefined threshold is too low, there will be too many false alarms, so that genuine warnings will not be heeded. On other hand , if the threshold is set too high, events that will cause damage may be ignore (miss-alarm). Therefore it is necessary to predefine the appropriate thresholds to determine the slope stability and related work is required.

VIII. REFERENCES

[1] Biswajeet Pradhan, Mustafa Neamah Jebur, Helmi Zulhaidi Mohd Shafri, and Mahyat Shafapour Tehrany,"Data Fusion Technique Using Wavelet Transform and Taugachi Methods for Automatic Landslide Detection From Airborne Laser Scanning Data and QuickBird Satellite Imagery",IEEE Transaction on Geoscience and Remote Sensing, Iss. 3, vol. 54, pp. 1610-1622, 2016.

[2] F.Guzzetti et al,"Distribution of landslides in the Upper Tiber River basin, central Itatly," Geomorphology,vol. 96, no. ½, pp. 105-122, Apr.2008.

[3] B. Pradhan, M. H. Abokharima, M. N. Jebur, and M. S. Tehrany, Landsubsidence susceptibility mapping at Kinta Valley (Malaysia) using the evidential belief function model in GIS, Nat. Hazards, vol. 73, no. 2, pp. 10191042, Sep. 2014.

[4] Wang, G., and K. Sassa., "Pore-pressure generation, and movement of Rainfall-induced landslide : Effect of grain size and fine particle content", engineering Geology vol 69, pp. 109-125, 2003.

[5] Iverson, R.M., "Landslide triggering by rain infiltration", Water Resource Research, vol 36, pp. 1897-1910, July 2000.

[6] Kim Hyoung Woo, "Development of Wireless Sensor Node for landslide Detection", pp. 1-5, August 2016.

[7] S . Misra, "Social sensing-based duty cycle management for monitoring rare events in wireless sensor networks", vol. 5,Iss. 2, pp. 68-75, April 2014.

[8] David C. Harrison, Winston K. G. Seah, Ramesh Rayudu, "Rare Event Detection and Propagation in Wireless sensor Networks",Acm Computing Surveys, vol. 48,No. 4,March 2016.

[9] Mr. C. C. Dakave, Dr. M. S. Gaikwad, "Landslide Detection and Alert System Using PSoC" , International Journal of Innovative Research in Computer Science & Technology (IJIRCST) ISSN: 2347-5552, Volume-3 Issue-3, May-2015