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# Survey Paper on Landslide Detection and Propagation using Wireless Sensor Network

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***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. LITERATURE SURVEY

Biswajeet Pradhan, Mustafa Neamah Jebur, Helmi Zulhaidi Mohd Shafri, and Mahyat Shafapour Tehrany[1], proposed to produce an accurate landslide areas by using data fusion,rule based object-oriented image classification.

Wang, G., and K. Sassa.[4], has proposed that if the sand included differing amounts of fine particles (loess), the flow slides were quite different in character. The tests showed that the peak velocity of flow slides became greater with increase of loss content from 10%-30%.

Iverson, R.M.[5], said that the Landslide responses to rainfall involve transient processes with different intrinsic timescales. A new model of these transient processes inks slope failure and landslide motion to groundwater pressure heads that change in response to rainfall. The model developed here predicts key aspects of the behaviour of "fast" and "slow" landslides but it neglects factors that can be important. In particular, it neglects soil strength evolution such that due to contractile strain weakening and fabric development and it neglects mechanical effects of three dimensional landslide geometries.

Kim Hyoung Woo[6], talked about, How landslide monitoring systems are becoming more precise and cost-effective. And also how we can maintain are system in real time scenario.

S . Misra[7], has proposed the duty cycle management as an objective of the management system, and is performed through the observation and measurement from social media. In the future, we plan to investigate the following that if we can sense the location of an event using web crawler, then we can predict the next movement path of that event or activity using artificial intelligence methods. This will result in the design of cluster duty cycle management scheme.

David C. Harrison[8],discovered that the simplest way for a sensing node to conserve energy and in doing so maximise its operational life is to power down for extended periods. As well as how to deal with Component deactivation, Duty cycling, Energy Harvesting.

## III. EXISTING SYSTEM

Traditional Wireless Sensor Network (WSN) nodes are small battery powered devices typically consisting of a microcontroller, a modest quantity of random access memory, some nonvolatile storage capacity, one or more sensors, and a low power radio transceiver. The finite charge storage capacity of batteries shapes WSN research to the extent that minimizing energy consumption becomes a preoccupation; the less energy consumed, the longer the network will continue to operate. The simplest way for a sensing node to conserve energy, and in doing so maximize its operational life, is to power down for extended periods . each node can adopt an independent duty cycle and a Media Access Control (MAC) protocol based on un-slotted Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA). Nodes deployed to periodically sample data for multi-hop transmission to a base station can synchronize their activity to ensure network connectivity and employ algorithms that minimize overuse of individual routing nodes. It should be noted that the term rare event is uncommon in WSN research [8].

### 3.1 Disadvantages of Existing System

1. The WSN are highly expensive due to use of external battery support and high network speed.
2. The sensor life is decreased as the load of sensors are not shared.
3. Rainfall causes the problem as use of ad hoc networks within the location crashes if the Network connection is lost.
4. Density of the sensor is Low.

## 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].

### 4.1Advantages of Proposed System

1) Sensors are deployed over surface of mountain which collects information locally and that information will be shown as globally.
2) All the sensors deployed in the landslide prone area can be assigned with a weightage with regard to its impact on landslide detection, and a common consensus value can be achieved executing the algorithm at once, for all deployed sensors.
3) Landslide susceptibility parameters such as certainty factor and frequency ratio will be checked.
4) Collaboration

## 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.

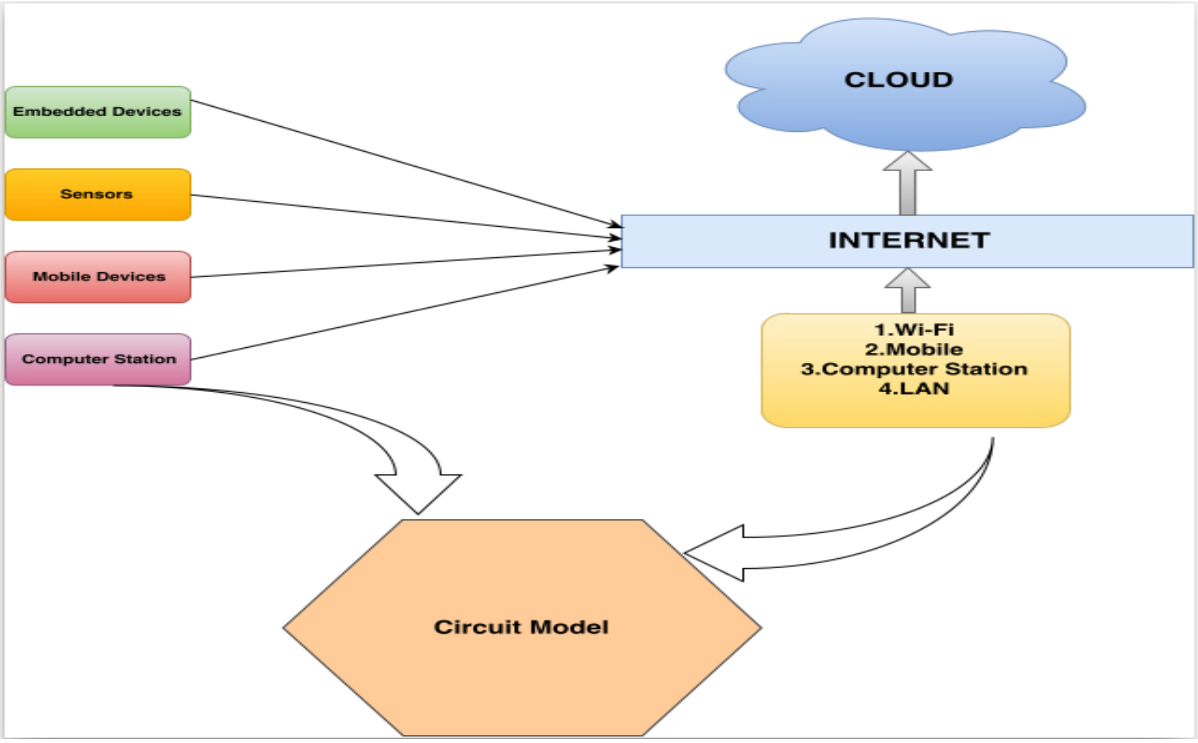


***Figure 1. Proposed System Architecture***

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.DEPLOYMENT

As the landslide effects slope failure, maintaining the circuit is difficult. For maintaining all sensors and processing unit , it is better to use small plastic box as shown in figure [6].


***Figure 2: Deployment Diagram***

## 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.

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