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Landslide Detection and Propagation using Wireless Sensor Network

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Abstract --- The origin of wireless sensor network technology has provided the faculty of developing large scale systems for real-time monitoring. This paper describes the civilization of a wireless sensor network system for landslide detection in India, where a region known for its heavy rainfall, steep slopes, and frequent landslides.The system focuses on monitoring landslide and moisture detection and generate warning using sensors,alarms and controllers. This will generates warning when level of earth vibrations crosses a threshold and then alarm will raise. Also camera is used to capture the images and send an email with captured images to authorised person. Temperature sensors used to detecting a temp if temp exceeds then also email will be send. Vibration sensor detect an vibration of landslide. The sensor outputs are given to the control unit. Raspberry pi micro controller is used to controlling the whole system. If the any sensor detect and exceeds the value of sensor then camera capture the image and send a mail .

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

I. INTRODUCTION

Landslide become one of the major problem in most of the countries around the world. This is cannot be eliminated, i.e. it is not possible to control the Landslide, however this condition can be prevented. If the authorities always know the current state of the earth vibrations level. The Disaster Alert systems have been introduced to notify people in the early stage about the possible threat. So that safety precautions can be taken to avoid any mishap. Real-time monitoring of environmental disasters are one of the prime necessity of the world. Different technologies have been developed for this purpose. Wireless sensor networks(WSN) is one of the major technology that can be used for real-time monitoring. WSN has the capability of large scale deployment, low maintanence, scalability, adaptability for different scenarios etc. WSN has its own limitation

such as low memory, power, bandwidth etc, but its capability to be deployed in hostile environment, and low maintanence requirement made it one of the best suited technology for real-time monitoring. This paper discusses the design and deployment of a landslide detection system using wireless sensor network. Landslides are major geo-hazards heavily impacting many regions of the world in terms of human lives and economic losses . The large magnitude of natural forces that are involved in landslides makes actions of mitigation or prevention unfeasible, with exceptions for small occurrences or under particular conditions. According to , on the basis of methods employed landslide research can be classified into theoretical, analytical and numerical studies along with laboratory experiments, field investigations, monitoring and inventory mapping, as well as GIS/Remote Sensing application. Landslide assessment, susceptibility mapping, monitoring (in situ and remotely) and early warning systems all play an important role in landslide investigations thereby being directly related to disaster reduction and hazard mitigation. Remote sensing, especially from high-resolution satellite imagery is gaining importance in landslide investigation due to its wide coverage With its increasing spatial and temporal resolution, remote sensing has been widely adopted in landslide mapping for rapid response and recovery after hazard occurrence by government agencies as well as research community

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.

III. 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].

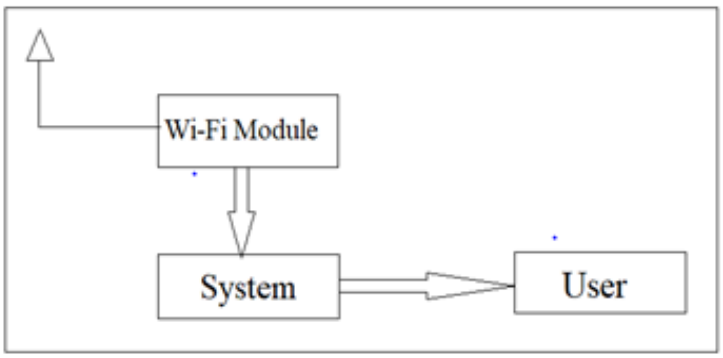

Figure 1. Receiver

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.

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.

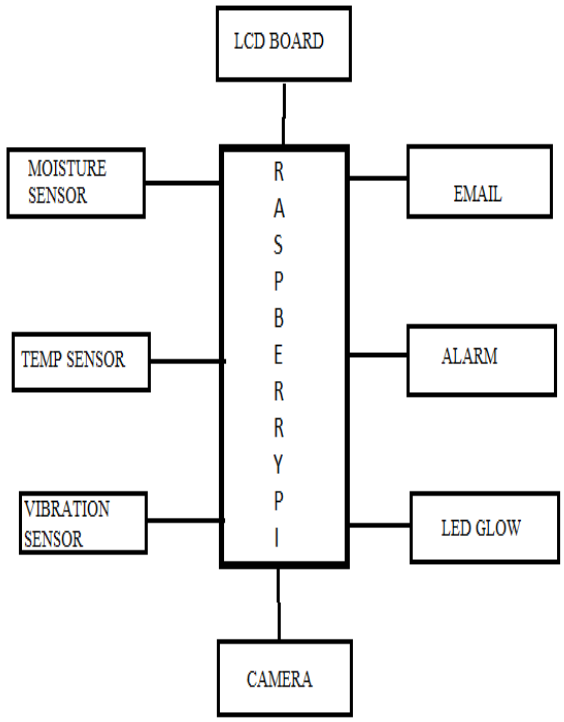

Figure 1. System Architecture

VI .METHODOLOGY

The required hardware for our system is as follows::

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

When sensors output reached at threshold value then 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.

1.Soil moisture sensor:- Here we are using this sensor for calculating moisture in soil. It gives analog output that moisture is present in soil or not. Soil moisture is used for combination with temperature sensor for detecting landslides. Soil moisture sensors measure the volumetric water content in soil.

Specification:

- Range: 0 to 45% volumetric water content in soil (capable of 0 to 100% VWC with alternate calibration)
- Accuracy: ±4% typical
- Typical Resolution: 0.1%

2.Temperature Sensor:- This is the main sensor for predicting pre-Landslide. In this ,we are using combination of soil moisture sensor and temperature sensor.In this we are giving threshold values to temperature sensor, if it crosses that threshold value then output is generated in three formats like email,LED,Alarm.

Specification:

- 0.5°C Ensured Accuracy (at 25°C)
- Rated for Full −55°C to 150°C Range
- Operates From 4 V to 30 V

3.Vibration Sensor:- Vibration sensors are sensors for measuring, displaying, and analyzing linear velocity, displacement and proximity, or acceleration. Vibration — however subtle and unnoticed by human senses — is a telltale sign of machine condition.

4.Rasberry pi:- The **Raspberry Pi** is a series of small single board computer. Several generations of Raspberry Pis have been released. All models feature a Broadcom system on a chip (SoC) with an integrated ARM compatible central processing unit(CPU) and on-chip graphics processing unit (GPU). In this scenario Rasbierry Pi is used as controller for processing input data , storing that data and sending the data. For more Details of Rasberry Pi visit https://en.wikipedia.org/wiki/Raspberry_Pi.

5.Wi-Fi Module:- The ESP8266 is a low-cost Wi-Fi microchip with full TCP/IP stack and microcontroller capability .... The "Pitch" is the space between pins on the ESP8266 module. ESP8266 is Wi-Fi enabled system on chip (SoC) module developed by Espressif system. It is mostly used for development of IoT (Internet of Things).The **ESP8285** is an ESP8266 with 1 MiB of built-in flash, allowing for single-chip devices capable of connecting to Wi-Fi.[4]

IV. DEPLOYMENT

We can doploy the kit as follows where slope of surface is incline.These are multiple kits which are we going deploy on the surface. We can use Optical sensors for covering large area.

Fig: Deployment

VII. CONCLUSION AND FUTURE SCOPE

The mudslides and landslides have consumed many lives. Landslide causes significant changes in the Earth's natural environment. It is relatively local event. Therefore, non-geodetic monitoring technique might help more significantly. WSN is also an emerging, reliable and inexpensive technology and is capable of presenting the real time monitoring over a long distance and inhospitable terrains. Integrating features of all the hardware components used have developed it. Presence of all reasoned out and placed carefully thus contributing to the best working. This method concludes the recent technological advances in communication made new trends in the disaster monitoring system.

IN FUTURE WE CAN ADD This can also be used to detect the humans in disaster area. Human detection robot can be used at the time of natural calamities to save the lives of human. This can also be used to detect the humans in the war field.

VIII. RESULT

Result of landslide detection system is in three formats 1)Email 2)Alarm 3)LED 4)LCD board or Digital Board.

1)Email:- Whenever Moisture is detected or temperature is increased then mail is automatically send to administrature or authorized person.

2)Alarm:-To alert the peoples which are present in that area so that they can move to safer place.

3)LED:- (Light Emitting Diode.) These LEDs are used if prediction of landslide is there then stop peoples who are coming there and save them.

4)LCD Board and Digital Board:- (Liquid crystal display) For displaying messages and output values of sensors LCD is used. You may use digital boards for displaying message and warn the peoples.

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