IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.301
Volume 3, Issue 8, May 2023

Landslide Detection System using WSN

Chetan Kharkar[1], Nitesh Pawar[2], Shivaji Kosambe[3], Prof. J. A. Desai[4]
Students, Department of Electronics and Telecommunication Engineering[1,2,3]
Professor, Department of Electronics and Telecommunication Engineering[4]
Sinhgad College of Engineering, Pune, India

Abstract: *Landslides are one of the most devastating natural disasters that can cause loss of life and property damage. In recent years, advances in wireless sensor network (WSN) technology have enabled the development of cost-effective and efficient landslide detection systems. This paper provides a comprehensive review of the current state-of-the-art in landslide detection using WSNs. We discuss the various types of sensors used in WSNs for landslide detection, the data fusion techniques used to combine sensor data, and the algorithms used for landslide detection. We also highlight the challenges and future directions in this field.*

Keywords*:* Landslide, Arduino, Wireless sensor network, soil, Sensor Development

I. INTRODUCTION

Landslides are a significant natural hazard that can cause severe damage to infrastructure, property, and loss of human lives. Traditional landslide monitoring techniques involve the use of manual measurements and geotechnical instrumentation, which are expensive and time-consuming. In recent years, wireless sensor network (WSN) technology has emerged as a promising solution for landslide detection due to its cost-effectiveness, scalability, and real-time monitoring capabilities.

II. LITERATURE SURVEY

This study provides a comprehensive review of the current state-of-the-art in landslide detection using WSNs. The authors discuss the different types of sensors used, data fusion techniques, and algorithms used for landslide detection. They also highlight the challenges and future directions in this field. "Wireless sensor network-based landslide monitoring: a review" by Zhou et al. (2017)

This review article discusses the use of WSNs for landslide monitoring and focuses on the challenges and opportunities in this field. The authors provide an overview of the different types of sensors used, data processing techniques, and communication protocols used in WSNs for landslide monitoring.

"Landslide detection using wireless sensor networks and support vector machines" by Wang et al. (2019)

This study proposes a landslide detection system that uses a combination of WSNs and support vector machines (SVMs). The authors evaluate the performance of the proposed system using field data and demonstrate its effectiveness in detecting potential landslide events.

"An improved sliding window algorithm for landslide detection using wireless sensor networks" by Song et al. (2018)

This study proposes an improved sliding window algorithm for landslide detection using WSNs. The authors demonstrate the effectiveness of the proposed algorithm using field data and show that it outperforms existing algorithms in terms of accuracy and efficiency.

"An energy-efficient approach for landslide detection using wireless sensor networks" by Li et al. (2019)

This study proposes an energy-efficient approach for landslide detection using WSNs. The authors develop an adaptive sampling strategy and demonstrate that it can reduce the energy consumption of the system while maintaining high detection accuracy.

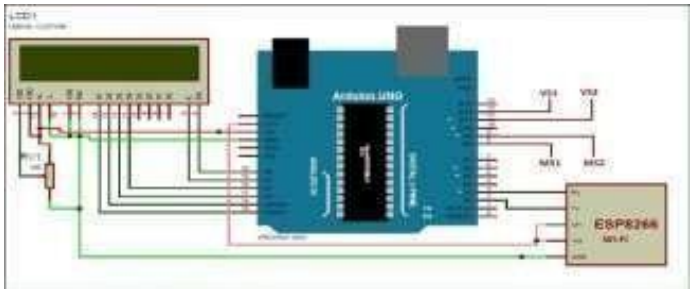
III. PROBLEM STATEMENT

Landslides are a significant natural hazard that can cause severe damage to infrastructure and loss of human lives. Traditional landslide monitoring techniques are expensive and time- consuming, making them impractical for real-time

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.301
Volume 3, Issue 8, May 2023

monitoring of large areas. Therefore, there is a need for a cost-effective and efficient landslide detection system that can provide real-time monitoring of critical locations on slopes. Wireless sensor network (WSN) technology has emerged as a promising solution for landslide detection due to its cost-effectiveness, scalability, and real-time monitoring capabilities. However, there are still several challenges that need to be addressed, including power management, communication protocols, and sensor placement optimization. Therefore, the problem statement for this research is to develop an efficient and reliable landslide detection system using WSN technology, addressing the challenges of power management, communication protocols, and sensor placement optimization to provide real- time monitoring of critical locations on slopes and reduce the impact of landslides on society.

IV. PROPOSED SYSTEM



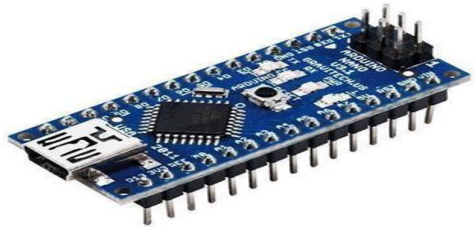
Circuit for Landslide Detection System

List of Modules and Functionality

Low cost and effective sensors are used to detect the moisture in the soil as well as the earthquake with the help of vibration sensors connected to the arduino development board. The list of the components are explain in detail given below –

Arduino NANO

The Arduino Nano is a small, complete and breadboard- friendly board on the ATmega328P. It offers the same connectivity and specs of the Arduino Uno board in a smaller form factor. The Arduino Nano is equipped with 30 male I/O headers, in a DIP-30 like configuration, which can be programmed using the Arduino Software integrated development environment (IDE), which is common to all Arduino boards and running both online and offline. The board can be powered through a type-B mini-USB cable or from a 9 V battery.



Arduino NANO

ESP8266 Wi-Fi Module:

ESP8266 is best module for IoT based project that can easily connect with arduino. This Wi-Fi module allows microcontroller to access Wi-Fi network but you can also program it to act as a microcontroller as well. This module uses SOC (System On Chip) that does not require any type of microcontroller for manipulating the inputs

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.301
Volume 3, Issue 8, May 2023

ESP8266 Wi-Fi Module

Vibration sensor module:

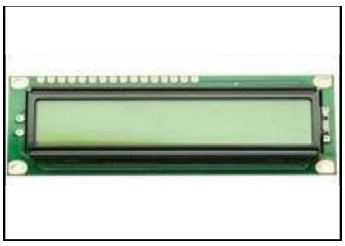
This module is based on the vibration sensor switch SW-420 and comparator LM393 to detect if there is any vibration beyond the threshold values. On board potentiometer is available for adjusting the threshold values. Features:

- Using SW-420 normally closed type vibration sensor.
- Comparator output, clean signal, good waveform, strong driving ability,>15mA.
- Using a wide voltage LM393 comparator.
- With bolt holes for easy installation

Vibration sensor module

LCD 16x2 Display:

ESP8266 is best module for IoT based project that can easily connect with arduino. This Wi-Fi module allows microcontroller to access Wi-Fi network but you can also program it to act as a microcontroller as well. This module uses SOC (System On Chip) that does not require any type of microcontroller for manipulating the inputs

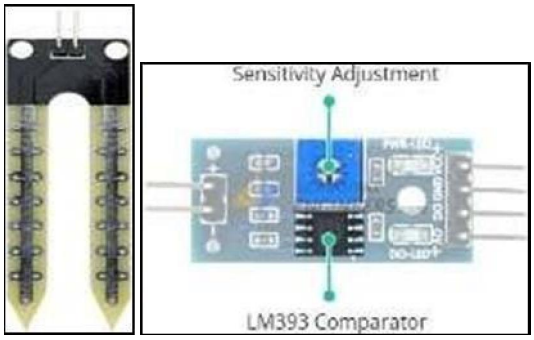


LCD 16x2 Display

Soil Moisture Sensor:

The sensor contains a probe and electronic module that connects it to the arduino. There is a fork-shaped probe with two exposed conductors goes into soil for detecting the soil moisture. The probe acts as a variable resistor whose resistance varies according to the soil moisture. The electronicmodule connects the probe to the Arduino. The module produces an output voltage according to the resistance of the probe and is available at an Analog Output (AO) pin. It consist of LM393 compactor the single fed by and available at an Digital Output (DO) pin. For adjusting threshold values potentiometer is available on board for Digital Output (DO).

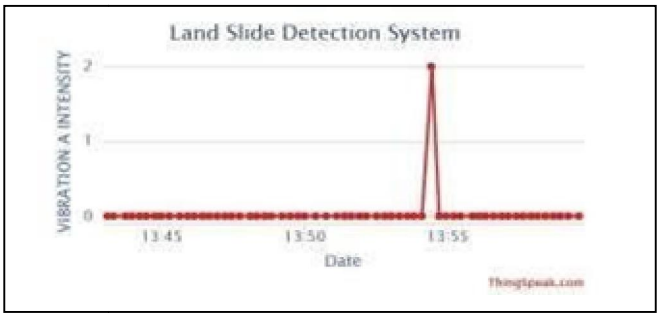
IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.301
Volume 3, Issue 8, May 2023



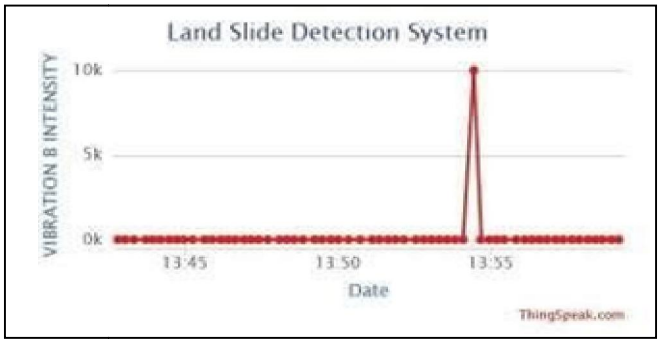
Soil moisture

VI. RESULTS

In phase, we took two sites name A and B for detecting the landslide. Moisture sensors as well as vibration sensors connected to the site. These sensors are connected to the arduino development board which is connected to the ThinkSpeak cloud service for monitoring the real time data. These sensors are adjusted to the programmed threshold values with the potentiometer available on the sensor boards. After turning ON the system the sensors on board Wif-Fi module get connected to the Wi-Fi router. After that the sensors getconnected to the ThingSpeak cloud service for IoT based projects. ThingSpeak provides a powerful graphic tools that help you to analyze data and can also comute with the third party app from where it can send alerts to the end user. These alerts are sent in the form of SMS to the registered mobile number on the end user mobile phone. IFTTT execution service is used for sending the SMS. The targeted phone uses IFTTT android app whose SIM number is registered. This IFTTT is used as a third party with the ThingSpeak servers. The test shows that the system, is working properly and is able to detect the earthquake vibrations as well as moistures present in the soil and can act according to the threshold values. The observed values can be seen in the Figures. At the end SMS is send to the end user.

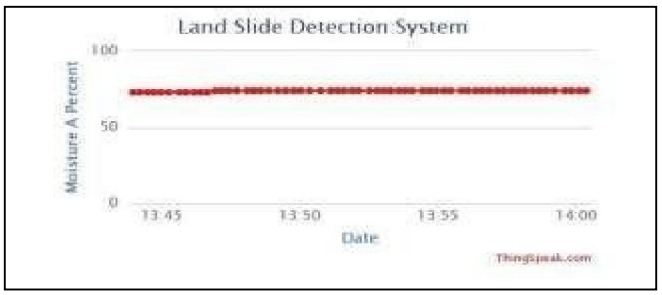


Vibration observed at A site

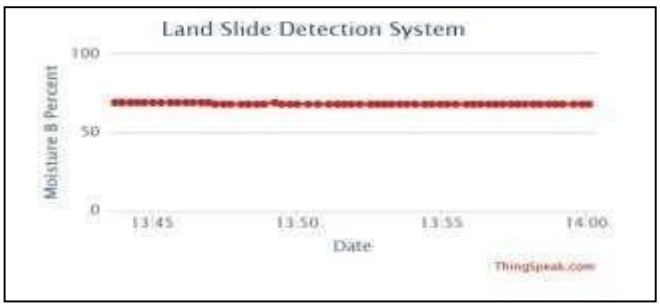


Vibration observed at B site

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.301
Volume 3, Issue 8, May 2023



Moisture observed at A site



Moisture observed at B site

VII. CONCLUSION

WSNs have emerged as a promising solution for landslide detection due to their cost-effectiveness, scalability, and real-time monitoring capabilities. This paper provides a comprehensive review of the current state-of-the-art in landslide detection using WSNs. We have discussed the various types of sensors used, data fusion techniques, and algorithms used for landslide detection. We have also highlighted the challenges and future directions in this field. Overall, we believe that WSN technology has the potential to significantly improve landslide detection and reduce the impact of landslides on society.

REFERENCES

[1] A. Dinagar, P. Karthick, K. Karthi, P. Tamilvanan, S. Premkumar, Landslide Monitoring System with GSMModule. International Journal of Innovative Research in Computer and Communication Engineering, Vol. 3, Special Issue 2, March 2015

[2] Department of Mineral Resources,"Landslides in Thailand". Online: http://www.dmr.go.th/main.php.

[3] Department of Water Resources,"Early Warning System project", Online: http://www.dmr.go.th/main.php.

[4] Pawan Nandkishor Hinge, Rohit Ramesh Bawage, Pallavi Nandkishor Hinge, Wireless Sensor Network for Detecting Vibrations, International Journal of Engineering Research & Technology (IJERT), Vol. 3 Issue 10, October-2014

[5] Sagar D. Solanki, Ankit Suthar, Wireless Sensor Network For Landslide Assessment, International Journal Of Engineering And Computer Science, Volume - 3 Issue - 8 August, 2014 Page 7793-7797.

[6] Y.Srinivas, K. Raghava Rao, Landslide Warning System Using ZigbeeAnd GPS, IOSR Journal of Engineering, Vol. 04, Issue 07 (July. 2014), Page 01-06

[7] U.S. Department of the Interior and U.S. Geological Survey, "Landslide Types and Processes", July, 2004.

[8] Mr.Sagar D. Solanki, Mr. Ankit Suthar "Wireless Sensor Network For Landslide Assessment", International Journal Of Engineering And Computer Science, Volume - 3 Issue - 8 August, 2014

[9] Satishkumar Chavan, Shobha Pangotra, Sneha Nair, Vinayak More, Vineeth Nair "Effective and Efficient Landslide Detection System to Monitor Konkan Railway Tracks", International Conference on Technologies for Sustainable Development (ICTSD-2015), Feb. 04 – 06, 2015, Mumbai, India

[10] Mrs. Dhole Minakshi Subhas1, Prof. More P.C. and Prof. Kharade S.N "Landslide Warning System using Wireless Sensor Network", Volume 2, Issue 10, October 2014