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IOT Based Land Sliding Detection System

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ABSTRACT

Soil moisture plays a key role in triggering various types of landslides but measuring it directly in high-risk areas is often difficult. Thanks to advances in remote sensing, it's now possible to gather useful soil moisture data from space. In this study, researchers analyzed the latest soil moisture data from the European Space Agency's Climate Change Initiative and compared it to landslide events in northern Italy over a 14-year span (2002–2015).They discovered a strong link: over 80% of landslides happened when soil moisture was above the regional average. The team also looked into how different conditions—like vegetation cover, soil type, and slope—affect the moisture level needed to trigger landslides. Interestingly, slope made a noticeable difference: steeper areas required less moisture to initiate a landslide, meaning even drier soils in hilly areas could be risky. To test their findings, they analyzed 45 rainfall events from 2014 to 2015, using statistical tools like contingency tables and Receiver Operating Characteristic (ROC) analysis. They tested several threshold models and found the one using a 30% exceedance probability that gave the best results, accurately detecting 92% of landslides with a 50% false alarm rate.

Keywords: landslide, natural hazards, satellite remote sensing, soil moisture.

1. INTRODUCTION

Disaster management serves as a crucial support system designed to respond to unexpected and potentially dangerous events. Disasters can strike without warning and pose serious threats to lives and livelihoods. Effective disaster management acts as a response mechanism to reduce the impact of such emergencies. Disasters are generally classified into four categories: service-oriented, natural, post-disaster, and man-made. Among natural disasters, events like volcanic eruptions, floods, forest fires, landslides, and earthquakes are common. Of these, earthquakes and floods are the most frequent and recurring in our daily lives, often causing significant disruption and harm to communities. This highlights the need for proactive measures to enhance safety and preparedness before disasters occur. In this project, an Arduino Mega 2560 is used as the central controller, offering flexibility and ease of programming for managing the prototype system. Earthquakes occur due to seismic waves generated by shifts in the Earth's crust. When these vibrations are strong measuring 10 or higher on the Richter scale—they can lead to massive destruction and a high risk of fatalities. In contrast, earthquakes with a magnitude of 4 or lower are considered minor, usually causing minimal damage and rarely resulting in loss of life. Floods, on the other hand, are typically caused by the overflow of water bodies, often exacerbated by blockages or waste accumulation near riverbanks. There are five main types of flooding: urban, river, coastal, flash, and pluvial (pounding). Each type has its own causes and potential impacts, underlining the importance of targeted disaster management strategies.

2. LITERATURE SURVEY

Pradhan et al. (2010) used optical remote sensing and digital elevation models (DEMs) to create landslide susceptibility maps in Malaysia[1].Mondini et al. (2011) applied SAR interferometry to identify ground deformations, which are precursors of landslides[2].

Pham et al. (2018) developed models like SVM, Random Forest, and Neural Networks to improve landslide susceptibility mapping[3].Chen et al. (2020) integrated deep learning (CNNs) with high-resolution satellite imagery for real-time landslide detection[4].Park et al. (2019) developed a wireless sensor network to monitor rainfall, soil moisture, and ground vibration[5].

DATASET	DESCRIPTION	ALGORITHM	DESCRIPTION
Sensor Threshold Dataset	Contains sensor readings with labeled "Safe" or "Danger". Fields: temperature, humidity, soil moisture, vibration	Rule-Based Thresholding	If soil moisture > 80% and vibration > 6.5, trigger alert. Simple IF-ELSE rules based on fixed thresholds
Time-Series Sliding Data	Real-time sensor logs every second. Fields: timestamp, location, soi moisture, seismic wave reading	Moving Average Detection	Apply moving average detect sudden spikes vibration over time (e. last 10 readings). Alert on abnormal shift
Landslide Event History	Historical landslide data with sensor values before each event. Contains labels (0 = no landslide, 1 = landslide)	Logistic Regression	Learn the probability c landslide based on sensor values. Output binary (0 or 1).
Multisensory Environmental	Includes extra features: rainfall, slope angle, groundwater level, vegetation index, in addition to sensor data	Decision Tree / Random Forest	Classifies landslide vs no-landslide using multiple environmental features.
IoT Geo-Spatial Data	Sensor readings with GPS coordinates and elevation. Tracks landslide-prone zones over time	K-Means + Rule-Based Hybrid	Cluster high-risk zone: by sensor reading patterns + use rule-checking inside each cluster.

3. MATERIALS AND METHODS

1. Arduino UNO

A microcontroller board used to control sensors and devices in electronics projects.

2. LCD Display

A screen that shows text or data output from Arduino (commonly 16x2 characters).

3. Breadboard

A board used to build and test circuits without soldering.

4. Soil Moisture Sensor

Measures the water content in soil; useful for irrigation or landslide detection.

5. Servo Motor

A small motor that can rotate to a specific angle, often used for precise movements.

6. Jumper Wires

Used to connect components on a headboard or to Duino pins.

7. Resistor

Limits the electric current in a circuit to protect components.

8. Battery

Powers the Arduino and other components when not connected to a computer.

4. WORKING PRINCIPLE

The IoT-based landslide detection system works by using sensors like soil moisture, vibration, and rainfall sensors to monitor real-time environmental conditions in landslide-prone areas. These sensors are connected to an Arduino UNO, which collects and processes the data. When the sensor readings cross a predefined danger threshold—such as high soil moisture and strong ground vibrations—the system detects a potential landslide risk. It then activates an alert, which can be shown on an LCD display, sounded through a buzzer, or sent via IoT to a remote device or server. This early warning allows for quick action to prevent damage and ensure safety.

5. CONCLUSION

The above proposed system is effective in detecting earthquake and flood prior to the event through the blink app and even alerting is done through buzzer. The system demonstrated that IoT technology and soil sensors can be effective in detecting landslides and providing early warnings. The tollgate system provides a clear indication to people of the level of risk in the area, allowing them to take appropriate action to avoid potential danger. The system also provides valuable data for analysis and disaster planning.

Future work includes exploring the use of additional sensors, such as temperature and humidity sensors, to improve the accuracy of the system.

REFERENCES

Sure, I'll format the references in APA style for clarity and academic consistency. I'll get that ready for you shortly.

1. Pradhan, B., Lee, S., Mansor, S., et al. (2010). Landslide hazard mapping using remote sensing and GIS: A case study from Cameron Highland, Malaysia. Environmental Earth Sciences, 60(5), 1037–1054.
2. Mondini, A. C., Guzzetti, F., Rossi, M., et al. (2011). Detection of ground deformations with satellite SAR data: The case of the Tessina landslide. Remote Sensing of Environment, 115, 1743–1757. https://doi.org/10.1016/j.rse.2010.10.005
3. Pham, B. T., Bui, D. T., Prakash, I., et al. (2018). Comparative study of sequential minimal optimization and Bayesian optimization for landslide susceptibility modelling. Catena, 163, 399–413. https://doi.org/10.1016/j.catena.2017.11.001
4. Chen, W., Li, G., Wan, L., et al. (2020). Deep learning-based landslide detection using optical satellite imagery. Sensors, 20(3), 702. https://doi.org/10.3390/s20030702
5. Park, H. J., Jang, J. Y., Lee, J. H., et al. (2019). Development of landslide monitoring system using wireless sensor networks. Sensors, 19(10), 2227. https://doi.org/10.3390/s19102227