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Landslide Detection and early warning system with vibration and weather sensor

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ABSTRACT:

Landslides harm human life, property, and buildings. Every year, landslides present the greatest threat to human life as many individuals perish as a result. Early detection of landslides is essential if one is to reduce their impact on human life and property. Finding landslides before they happen would help us save many lives. This paper summarizes landslip early detection techniques. The project report indicates that soil and sensors including vibration sensors, wind sensor, air quality sensors and temperature and rain sensors are used to detect land slides. Large and unpredicted rain-triggered landslides are becoming more common in India. Landslides cover 12.6% of the land in India. This problem provides a complete answer to satisfy this pressing need by means of the Internet of Things (IoT). Most of the present research focuses on vibration sensors and slope movement sensors, which might lead to inadequate real-time data. Our proposed method enhances data accuracy and integration by therefore combining soil moisture sensors and rainfall measurement with vibration and slope movement sensors. The main concept is to evacuate the landslide-prone area before the landslide occurs, so preserving human life. After detecting the landslide, it sends warning alerts to the disaster management authorities in that particular area. Emphasizing early detection and warning capabilities therefore helps the IoT-based landslide detection system to significantly solve the issues brought on by landslides and to minimize environmental consequences by supporting proactive evacuation plans.

KEYWORD: Landslide Detection, Early Warning System, Vibration Sensor, Weather Sensor, Disaster Mitigation

INTRODUCTION:

Much of improving early warning systems and lowering possible hazards depends on IoT. Landslides are a significant threat to both human settlements and natural surroundings all over since they destroy infrastructure, kill people, and harm the environment. A possible method to lower these risks and enhance early warning systems is by using Internet of Things (IoT) technology for landslide detection. The Internet of Things (IoT) is the interconnection of many embedded computer devices inside the present Internet framework. This calls for online connectivity and electronic sensors linking devices and cars. Ranging from cars and gadgets to structures, the Internet of Things (IoT) is a network of physical objects embedded with electronics, software, and sensors. These components enable seamless data transfer between connected entities. Using present networks, this interconnection allows objects to be controlled and monitored from afar. This mix of sensors and actuators pushes the IoT, thus categorizing it as a subset of physical systems next to technologies such smart grids, intelligent transportation, and smart cities. In the architectural framework of IoT, specialized hardware boards, software systems, web APIs, and protocols work together to produce a seamless environment for connecting smart embedded devices to the Internet. The internet provides access to sensory data and remote control system activation. Devices can link to the internet via various techniques, including Wi-Fi, Ethernet, and others. Conversely, clusters of devices such sensor networks can be built with a base station or cluster head serving as the internet connection point, so generating a more abstract architecture. Ranging from high-level to low-level implementations, this approach addresses many different communication protocols. Devices in IoT networks have to be unique to ensure seamless operation. Giving each device its own IP address helps to attain this uniqueness. In the realm of the Internet of Things (IoT), devices mostly run on an IPv6 addressing system. The aim is to maintain uniqueness among devices whether given fixed addresses or subnet-mask IPv6 addresses. Unique IP addresses help to facilitate the straightforward discovery of IoT devices as independent nodes on the internet, therefore stressing their relevance. Gaining a comprehensive understanding of IoT operations depends on first grasping this concept.

REVIEW OF LITERATURE:

The next chapter discusses the earlier studies on early landslide detection. All of these fit under online databases, conference proceedings, books, and academic journals. Below is a thorough summary of these earlier studies: Chaturvedi et al. (2014) looked at the high relief, brittle, tetanized, and heavily worn rocks, glacial debris, and human-made activities such road construction and step agriculture; landslides are common in the Himalaya. Long-lasting or strong rain is the main cause of landslides. Himalayan landslides result in annual losses of Rs. 550 crores and roughly 200 fatalities. Therefore, finding landslide risk is quite important. Remote sensing and GIS offer a powerful tool for evaluating landslide susceptibility at the regional level. The present work centers on the Chamoli- Joshi Math region. Input data for this study include satellite data, toposheets, digital elevation model data, field observations, and satellite-based rainfall data. Manual remote sensing-based analyses produce thematic layers related to lithology, fault, lineament, drainage, slope angle, slope aspect, land use/land cover, soil texture, and soil depth. Combining the set hematic layers according to defined weights and rankings generated by map algebra in a GIS environment produces maps of landslide susceptibility. Field validation reveals the results indicate that this method of assessing susceptibility is quite exact and accurate. A landslide susceptibility map combining spatial probabilities of landslides with empirical rainfall thresholds can be used to notify local governments and communities of the danger as soon as possible. The developed landslide susceptibility maps will be used in future research on risk perception in the area of interest. Thakur and coworkers (2019)Landslides threaten society badly and damage the environment, the economy, and human life. Often, lowering the possible effects of landslides calls for putting into practice difficult and expensive policies. Building and maintaining linear infrastructures in landslide-prone areas—such as road, pipeline, and rail networks—often calls for this. Monitoring landslide triggering factors and offering early warnings is one of the often used strategies to reduce the negative effects. It is crucial to develop a landslide monitoring and early warning system for both regional and local sizes since the linear infrastructures and the landslide triggering factors—such as major weather systems and local man-made triggers—operate at different spatial scales. This paper quickly describes the Norwegian technique for early warning of regional-scale landslides caused by severe weather, which has proven to be successful. The standard for sending an early warning is set by the soil's saturation level and the amount of water being supplied to it by snowmelt and precipitation. On the other hand, tracking a single slope at the local level can be difficult and expensive. Indian Institute of Technology Mandi created a low-cost landslide monitoring and early warning system to provide single slope landslide monitoring systems at a low cost. These devices are tracking more than fifteen landslide sites in the Mandi district of Himachal Pradesh, India. This article also discusses a recent case study in which these systems warned people and moved an impending landslide. Ramesh, Vinodini, M. (2014) This paper also discusses a recent case study demonstrating how these technologies supported Alert wireless sensor networks, among the most fascinating new technologies allowing real-time monitoring of hostile and isolated areas vulnerable to disasters. Concentrating on landslide detection, this work confirms wireless sensor networks' ability for disaster reduction. In Idukki, a district in the southwest of 10 Kerala State, India, a severely landslide prone area, a fully operational system comprising 50 geological sensors and 20 wireless sensor nodes was deployed. The wireless sensor network system has collected a ton of data over the last three years—including correlated sensor data values on rainfall, moisture, pore pressure, and movement—as well as other geological, hydrological, and soil characteristics, all of which have helped to clarify the landslide situation. Wireless sensor networks were used to create a new three level landslide warning system (Early, Intermediate and Imminent). This system has demonstrated its dependability by giving the neigh a real warning under severe downpours in the monsoon season of July 2009. This system is implemented using contemporary data collecting techniques for field deployment power optimization. Unforeseen difficulties encountered during the field deployment of wireless sensor networks and the creative solutions developed to solve such problems are covered in this paper.

METHODOLOGY:

1. Literature study
2. Project identification.
3. Project literature study.
4. Field work.
5. Design stage.
6. System drawing.
7. Material procurement.
8. Manufacturing stage.
9. Fabrication of assembly.
10. Trials and troubleshooting.
11. Testing.
12. Conclusion.
13. Report and project presentation anywhere

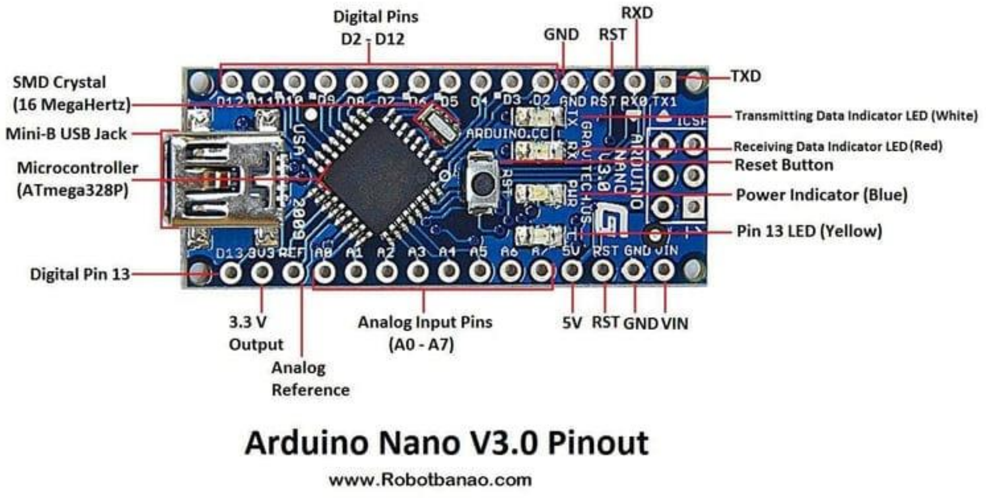
COMPONENTS:

1.NANO ATMEGA328

Microcontroller: Microchip ATmega328P[4]

- Operating voltage: 5 volts
- Input voltage: 5 to 20 volts
- Digital I/O pins: 14 (6 optional PWM outputs)
- Analog input pins: 8
- DC per I/O pin: 40 mA
- DC for 3.3 V pin: 50 mA
- Flash memory: 32 KB, of which 2 KB is used by bootloader
- SRAM: 2 KB
- EEPROM: 1 KB
- Clock speed: 16 MHz
- Length: 45 mm
- Width: 18 mm
- Mass: 7 g

• USB: Mini-USB Type-B [5]
• ICSP Header: Yes
• DC Power Jack: No



ESP8266:

The ESP8266 is a low-cost Wi-Fi microcontroller, with built-in TCP/IP networking software, and microcontroller capability, produced by if Systems in Shanghai, China. Source: Wikipedia CPU: Diamond Standard 106Micro (aka. L106) @ 80 MHz (default) or 160 MHz
Input: 16 GPIO pins
Manufacturer: Systems
Memory: 32 KiB instruction, 80 KiB user data
Power: 3.3 V DC
Successor: ESP32

WIND SENSOR:

A physical device measuring wind speed is a wind speed sensor. The central axis drives the internal sensing element to generate an output signal that could be used to calculate the wind speed; the top three wind cups spin with the wind generated by the airflow.

VIBRATION SENSOR:

Monitoring and analyzing soil vibrations depends on the vibration sensor in Figure 1, which therefore helps to predict soil movement and ensures early landslide detection.

RAIN SENSOR:

This sensor module uses good quality of double-sided material.
• Anti-conductivity & oxidation with long time use
• The area of this sensor includes 5cm x 4cm and can be built with a nickel plate on the side
• The sensitivity can be adjusted by a potentiometer
• The required voltage is 5V
• The size of the small PCB is 3.2cm x 1.4cm
• For easy installation, it uses bolt holes
• It uses an LM393 comparator with wide voltag
• The output of the comparator is a clean waveform and driving capacity is above 15mA

SENSOR DHT11 AND HUMIDITY:

Temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air, and spits out a digital signal on the data pin (no analog input pins needed).

SUMMARY:

Built to monitor and predict landslides in real-time, the IoT-based landslide detection system using vibration sensors increases early warning capabilities and reduces possible damage. The system using vibration sensors like accelerometers or geophones detects ground movements and vibrations that could indicate the beginning of a landslide. Strategically placed in landslide-prone areas, these sensors connect to a microcontroller or IoT module processing the sensor data. The processed data is then wirelessly sent to a central monitoring system or cloud-based platform using IoT protocols such as MQTT or LoRa WAN. The system examines the data in real-time using algorithms to separate normal environmental vibrations from those indicating a landslide. Should a possible landslide be found, the system notifies residents and authorities right away by SMS, email, or mobile apps, so enabling prompt evacuation and reaction. By combining sensor networks, IoT technology, and data analytics, this project provides a fairly priced, scalable, reliable solution for landslide detection and disaster management.

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