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Landslide Detection using IoT

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Abstract: *The paper aims to decrease the number of accidents that occuron curved roadways. To do this, a warning LCD Display that displays as a vehicle approaches from the other side of the bend serves as a message to the driver. The IR transmitter and receiver sensor, which is connected to the Arduino Uno microcontroller, is used to detect the vehicle. And Motor operated gates are fixed uponeach sides for free passage of vehicles from one side to other side. On the winding roads in the ghat portion, this might save thousands of lives. By implementing a new technique, they come up with a plan to prevent accidents after determining their causes and effects. Two IR sensors make up the new method, which alerts the vehicle on the opposite road. Landslide is one of the hazardous and critical geographical process, which damages to civil infrastructure and property as well as causes loss of life. This paper is an attempt with regard to the expansion of a landslide susceptible approach by using Accelerometer Sensor. And Rain Sensor is used for detecting heavy rainfall. Upon detecting the landslide condition or Heavy Rains it warns on display as a message and closes gates on either sides of ghat till road condition gets normal*

Keywords: Automated Injury Identification; Object Detection Advancements; Transfer Learning Strategies; YOLO V8 Framework.

I. INTRODUCTION

The "Conflict Avoidance and Landslide Update System for Vehiclesin Deep Curves" project leverages a combination of advanced technologies, including Arduino Uno, IR sensors, ADXL sensors, LCD displays, and Zigbee communication, to enhance road safety inareas with deep curves and potential landslide risks. This system offers real-time assistance to drivers by detecting obstacles, monitoring vehicle dynamics, and providing critical updates on road conditions. Deep curves on mountainous roads and the threat of landslides pose significant hazards to drivers and passengers. These challenges include reduced visibility, limited reaction time, and the potential for sudden obstructions due to landslides. This project aims to address these issues by creating a comprehensive solution that assists drivers in navigating challenging road conditions while keeping them informed about potential landslide risks.

II. EXISTING SYSTEM

Sensor-based Collision Avoidance: Two Ultrasonic sensors are placed at a known distance on both side of the curve. Ultrasonic sensors are used to determine the vehicle position. Sensor placed at two distinct point, outputs high pulse when the vehicle passes near to them. The vehicle speed is calculated by knowing the distance between those two points and time required by vehicle to cover those points. When two vehicles approach the curve simultaneously, speed of both vehicles are calculated and vehicle with higher speed is made to pass through the curve.

Convex Mirrors: Convex mirror is a mirror whose reflective surface is bulged so that the incident light rays gets reflected back at a different angle. This set up is widely used in hilly regions which reflects the image of opposite vehicle approaching the hairpin curve.

Head lights and Horns: Both Headlights and Horns are extensively used while driving in hair pin curves. Head lights can be used only during night time by flashing on high beams.

III. PROBLEM STATEMENT

Landslides pose a significant threat to human lives and infrastructure in hilly and mountainous regions. Rapid detection and early warning systems are crucial for mitigating the impact of landslides. The aim of this project is to develop a

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landslide detectionsystem using ARDUINO and MEMS (Micro-Electro-Mechanical Systems) sensors to provide real-time monitoring and alerting in landslide-prone areas This sophisticated system detects the presence of vehicle on one side of the curve (vehicles ascending) using camera, classifies the following vehicle into 'light' or 'heavy' vehicle category.

It alerts the driver of vehicles on other side of the curve (vehicle descending) using LED display board. The specially designed LEDdisplay board consists of information such as vehicle class and traffic signals.

The principle behind reducing traffic congestion is, a vehicle can easily pass through the hair pin curve.

This system the driver is aware about the upcoming opposite vehicle's category i.e., either Light vehicle or Heavy vehicle and canjudge the distance with which the opposite vehicle can cross the curve and stop well behind wait for the approaching vehicle to crossthe curve

IV. METHODOLOGY

- IR Sensor Integration: Install IR sensors on the vehicle to detect obstacles and other vehicles in the proximity, especially in deep curves.
- ADXL Sensor Implementation: Use ADXL sensors to measure land tilt and ground vibrations and possible land slides, providing real-time data to assess the vehicle's stability.
- Arduino Uno Control Unit: Employ Arduino Uno as the central control unit to process data from IR and ADXL sensors and communicate with other components.
- LCD Display Interface: Design a user-friendly interface on an LCD display to show warnings and updates to the driver.
- Rain Sensor Integration: Updates about rainfall across the ghat or roads that are passing across mountains and update todriver.
- Zigbee Communication Network: Establish a Zigbee network for vehicles to communicate with each other, sharing information about road conditions and obstacles.

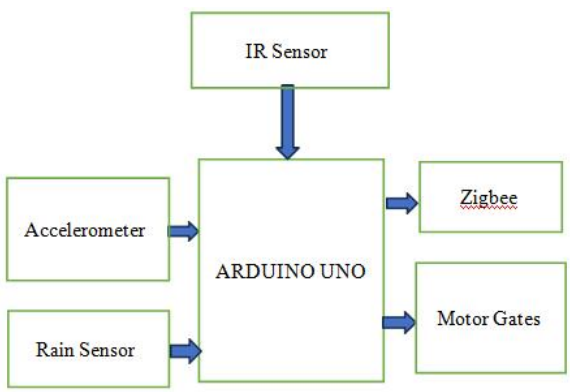

Fig 4.1 Hub Model of Landslide Detection

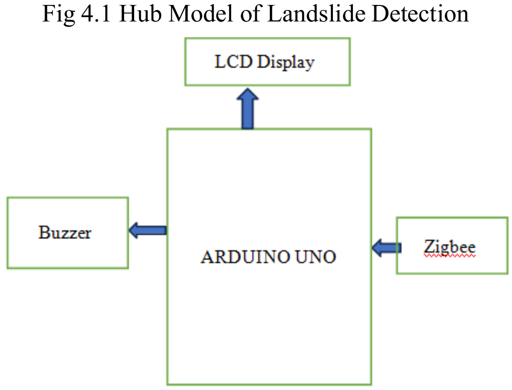

Fig 4.2 Vehicle Model

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V. IOT FOR LANDSLIDE MONITORING

1) Challenges: Techniques that utilize manpower (e.g., total station surveys, airborne imaging techniques) is a biggest challenge to be integrated as an IoT Edge device. However, the data from these techniques could be later made available in the Internet, which can be accessed at Fog and Cloud layers in IoT (e.g., the maps and models are part of Fog and Cloud). Copyright and policy restrictions from government and private agencies restrict the free access of data and that becomes another challenge for any device to be turned into an IoT.

2) Requirements: Each of the different techniques to efficiently identify and early warn a landslide demand the knowledge of real-time triggers and their evolution over time. In the recent decade, landslide research is moving toward knowing the futuristic conditions to forecast and provide early warnings rather than analyzing the cause for landslide after its occurrence. For instance, geotechnical instruments like piezometer and strain gauge are sensing devices, these devices can be turned into an IoT device by connecting them to a mote which has storage, processing, and communication capabilities. Usually these instruments are wired with appropriate signal conditioning circuitry to the motes. Some examples of mote are MicaZ, TelosB, WaspMote, emote, Shimmer, IITH-mote, EZ 430. Microcontrollers like Arduino, Raspberrypi are also used in place of motes. The motes are programmed with intelligent algorithms for adapting itself based on context and making local decisions. Intelligent algorithms need to be designed taking into consideration, the type of monitoring techniques, the amount of energy required for its operation, the kind of data that it is collecting, frequency of data transmission required for early warning, etc. These landslide monitoring systems are deployed in remote environments which are often constrained due to resources such as power. Based on the location where the monitoring system is deployed, it depends on renewable energy sources such as solar power, power from the grid, and hybrid methodologies to power the system. In adverse situations, when power levels are low but we want the system to be functional for a prolonged time, intelligence programmed in the Edge can help the system make intelligent decisions to utilize the limited power efficiently and extend the lifetime of the system. This can be accomplished by understanding the general pattern or trend in the data and then transmitting only the data of interest, so that unnecessary data transmission can be avoided and energy can be saved. Data compression algorithms can also be implemented at the Edge, so that the compressed data that consumes less energy can be transmitted instead of the original data. At times, we may need data at different sampling rates to understand the subsurface changes better. For instance, data need to be sampled at higher frequency during a disastrous context, whereas during a safe context, data sampling frequency can be kept minimal. Edge analytics can help achieve this functionality by understanding the environmental context such as amount of rain, moisture in the subsurface, etc., and make decisions to increase or decrease the sampling rate. However, computationally intensive algorithms such as inversion procedures need to run on the cloud. Even when most of the disaster monitoring applications need to be performed in a resource constrained environment, IoT system gives the opportunity to do better collection processing and transmission of the data through it intelligence The first level of processing to understand the variability can be done in the edge through Edge analytics, and the cloud system can be used for buildingt he dee per scale analysis to come up with the probability of an imminent landslides. Apart from these communication network also needs to be established for the IoT devices to communicate. All these together make a sensing device an IoT

3) Opportunities: IoT provides a platform for efficient usage of multiple resources around us in an automated and controlled manner not only for environmental monitoring and disasters but also in many other fields like health care, smart cities, etc. IoT technology is unique in providing the opportunity to continuously monitor and study the variations of the patterns, incorporate machine learning algorithms at different layers and based on that arriving at decisions

VI. GEOTECHNICAL INSTRUMENTS

Geotechnical sensors are extensively used for monitoring landslides at site-specific scale. Prolonged rainfall or torrential rain fall are one of the main triggers of rain fall induced landslides. Extended effects of antecedent rainfall conditions lead to increased volumetric water content and generation of pore pressure in different soil layers. This may lead to slope instability based on varying conditions of these multiple triggering parameters. This demands monitoring of heterogeneous parameters. The monitoring and forecasting of landslides using geotechnical sensors integrate usage of sensors such as rain gauge, moisture sensor, piezometer, extensometers, inclinometer, and tiltmeters, etc. The monitoring is achieved through deployment of these sensors in soil layers. Geotechnical sensor-based measurements are

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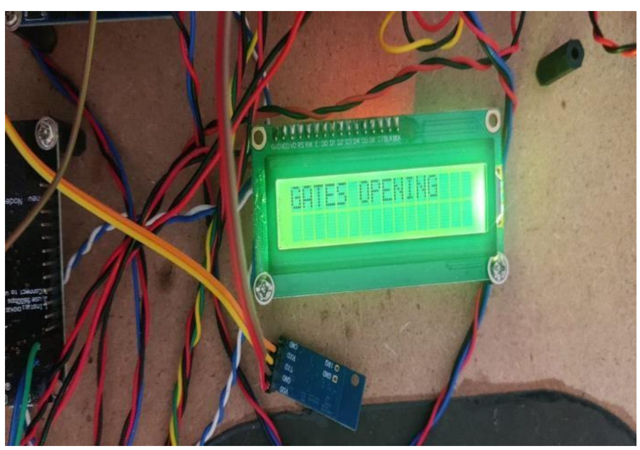
direct methods that can provide point measurements at or below the surface. This is in contrast to remote sensing and photo grammatric methods, which often only provide measurements of surface properties, and geophysical methods, which only provide indirect measurements of values critical to landslide processes. Multiple approaches are utilized in determining those hydro geological parameters at different spatial and temporal scales. Researchers have taken one step forward in deriving their interrelationship and utilized machine learning approaches to forecast pore pressure and other parameters that could provide the futuristic probability of landslides. These approaches can be seen on the research studies and deployment described in. Geotechnical sensors are either connected to loggers or have transmitting units themselves to send the data either to a field management center or directly to the data analyst or scientific organization. Inclinometers are geotechnical instruments usually installed different depths in a borehole drilled within the sliding mass. They are commonly used to measure horizontal displacements along various points in a borehole. The continuous and precise monitoring over the entire length of a borehole could be possible by taking a series of readings over time. Inclinometers are often applicable in monitoring all types of landslides provided the monitoring site is not susceptible to failure due to drilling activity. Real world examples where inclinometers are used are as follows, rockslide, rockfall topple , slow moving landslides , and deep seated complex type landslides In a monitoring system consisting of in-place inclinometers are installed at Castel Rotto (northern Italy), periodical measurements are gathered using a mobile probe. A local quadratic trend model is used to estimate the kinematic characteristics of deformation and a statistical approach is used for comparing the direction of displacement from in-place inclinometer data or mobile probe recordings. Some guidelines for addressing the installation factors and application of correction factors for common measurement errors are presented This article also presented three case histories to illustrate the confusion that can develop if these installation factors and monitoring factors are not considered. The main disadvantage of using this type of instrument is that the is only observed in one axis Inclinometers are used for landslide monitoring and early warning

VI. RESULT

A real-time conflict avoidance system using ARDUINO Uno and IR sensors to identify obstacles and potential conflicts on the road, especially in deep curves. An ADXL sensor to monitor Land Slides and provide drivers with information on vehicle tilt and lateral acceleration in real-time Detection of vehicles in curves and automating the vehicle operations an LCD display to present visual warnings and updates to the driver regarding road conditions and potential conflicts a Zigbee communication network between vehicles to exchange critical information about road conditions, obstacles, and potential landslide risks compatibility with existing vehicle systems and navigation devices, making it easy to retrofit vehicles with this system



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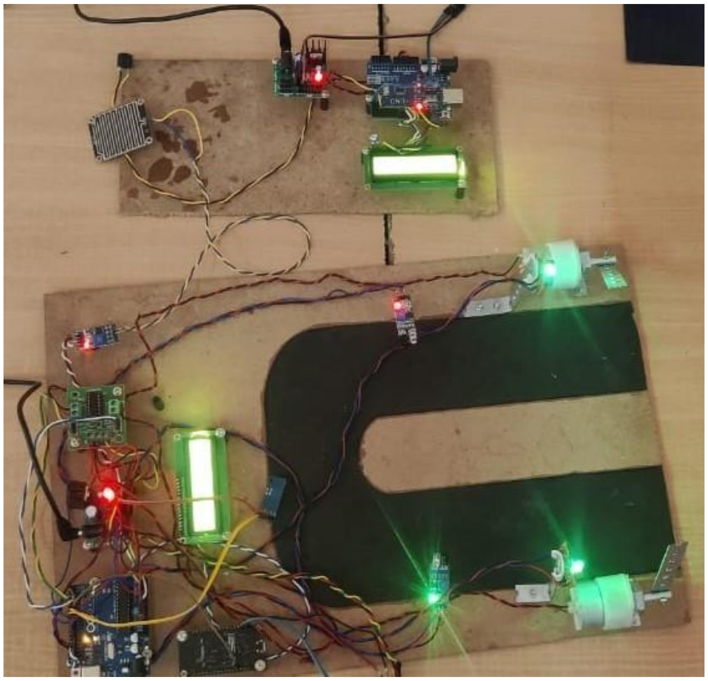

Landslide Detection Model

VII. CONCLUSION

The "Conflict Avoidance and Landslide Update System for Vehicles in Deep Curves" project utilizes ARDUINO Uno, IR sensors, ADXL sensors, LCD displays, and Zigbee communication to provide real-time assistance and updates to drivers navigating challenging terrains. This system aims to prevent accidents, improve road safety, and save lives while optimizing traffic flow in areas prone to deep curves and landslides.

For the driver to easily observe a vehicle approaching from the opposite direction, convex mirrors are utilized in the existing system at curves.

This system functions fine during the day but fails miserably at night. The suggested method makes advantage of sensors at hairpin turns, which function incredibly well at night.

We will be able to remedy the issue by placing the sensors on either side of the curves. The sensor sends a signal that looks like this if the vehicle is 10 meters from the bend. The various hazardous impact of landslides on environment where studied. An efficient environment for analyzing and displaying results with powerful set of tools.

This project aims at avoiding collision in hair pin curves as much as possible.

This system was also designed for reducing traffic congestion which accounts for easy vehicle movement in hilly areas.

VIII. FUTURE SCOPE

Integration of Advanced AI Algorithms:

Explore the use of advanced artificial intelligence algorithms for more accurate and efficient vehicle detection and classification. Machine learning techniques, including neural networks, can continuously improve the system's ability to recognize and respond to different types of vehicles.

Communication with Autonomous Vehicles:

Consider extending the system to communicate with autonomous vehicles. This can involve developing protocols for information exchange between the road safety system and autonomous vehicles to enhance cooperation and coordination on the road.

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Cloud Connectivity:

Integrate the system with cloud-based platforms to enable real-time data analysis and information sharing. This can facilitate centralized monitoring and management, allowing authorities to respond quickly to changing road conditions and incidents.

Dynamic Traffic Management:

Implement dynamic traffic management capabilities based on the data collected by the sensors. This could involve rerouting traffic, adjusting speed limits, or providing alternative routes in response to changing weather conditions, accidents, or other factors affecting road safety.

Enhanced Vehicle Communication:

Explore ways to improve communication between the road safety system and vehicles. This could include using Vehicle-to-Everything (V2X) communication protocols, allowing vehicles to receive warnings and information directly from the road infrastructure.

Integration with Emergency Services:

Develop mechanisms to integrate the system with emergency services. In case of accidents or extreme weather conditions, the system could automatically alert emergency

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