Land Slide Detection and Conflict Avoidance in Deep Curves

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Abstract— 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 different sensors like Accelerometer Sensor, Rain Sensor 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. Further, Traffic Congestion and Accidents are very much common in hair pin curves due to lack of communication between the vehicles and zero visibility over the hair pin bends. Vehicle Detection and Collision Avoidance System in Hair Pin Curves" is a system which is used to detect the vehicles on one side of the hair pin curve and assist the vehicles on the other side of hair pin curve.

I. INTRODUCTION

Landslides pose significant threats to both lives and infrastructure in mountainous regions and areas with rugged terrain. The combination of steep slopes and adverse weather conditions often leads to the occurrence of landslides, causing devastating consequences such as loss of property, disruption of transportation networks, and, tragically, loss of lives. Among the various elements of infrastructure vulnerable to landslides, road networks traversing deep curves in hilly or mountainous regions stand out as critical areas requiring proactive mitigation strategies.

Deep curves along mountainous roads present unique challenges for both landslide detection and conflict avoidance. These curves are often situated in regions prone to geological instabilities, exacerbating the risk of landslides. Furthermore, the confined space and limited visibility within deep curves increase the likelihood of conflicts between vehicles, especially in adverse weather conditions or low-light environments. Addressing these challenges necessitates the development of comprehensive approaches that integrate advanced technologies, engineering solutions, and proactive management strategies.

II. LITERATURE SURVEY

[1] Harshada Targe, Anushka Mahajan, Mohit Patil, Yogesh Lilake and Vijay Sonawane, "Advance Road Safety For Ghat Road's At Hairpin Bend", International Research Journal of Engineering and Technology, Volume: 05, Issue: 01, January 2018.

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III. METHODOLOGY

1st Reference would be “Advance Road Safety for Ghat Road’s at Hairpin Bend” we learn about that In enhancing road safety on gh at roads with hairpin bends, a multifaceted approach is imperative. Firstly, meticulous road design and engineering considerations are pivotal, encompassing widening roads at bends, installing crash barriers, and bolstering drainage systems to mitigate risks of skidding. Equally crucial is the implementation of prominent signage and road markings, alerting drivers well in advance of impending bends and guiding them through safely. Stringent enforcement of speed limits and regulations, coupled with measures to deter reckless maneuvers like overtaking on blind corners, is indispensable.

2nd Reference based on Sensor Based Accident Prevention System we learn about a clear definition of the problem and scope, identifying target accidents and environments. A comprehensive literature review informs sensor selection, considering factors like accuracy and cost. The system design phase outlines architecture and decision-making logic, with attention to data collection, processing, and integration. Validation experiments assess performance, both in controlled and real-world settings.

3rd Reference based on Collision Avoidance at Hairpin Curves Using Sensors we learn about sensors that entails a systematic approach beginning with the precise definition of the problem and scope, focusing on mitigating collisions at hairpin curves in roadways. A thorough checkup guides the selection of appropriate sensors, considering factors such as their ability to detect vehicles, pedestrians, and obstacles in real-time, while also considering environmental conditions. Data collection and processing strategies are designed to capture and analyze relevant parameters such as vehicle speed, distance, and trajectory, ensuring timely detection of potential collisions.

4th Reference based on Sensor Based Accident Prevention System in Curving we learn about curving environments involves a systematic approach aimed at mitigating accidents in challenging roadway curves. We begin by meticulously defining the problem and scope, focusing on identifying potential hazards and accident-prone areas within curves. Advanced data processing algorithms are employed to analyze sensor inputs in real-time, identifying potential collision risks and triggering timely warnings or interventions.

5th Reference based on Implementation of Critical Intimation System for Avoiding Accidents in Hairpin Curves & Foggy Areas we learn about defining the problem scope, emphasizing the unique challenges posed by hairpin curves and foggy conditions, which often lead to accidents. Appropriate sensors capable of detecting crucial parameters such as vehicle speed, visibility, and proximity to obstacles. Advanced data processing algorithms are employed to analyze sensor data in real-time, enabling timely detection of potential hazards and triggering critical intimation alerts to drivers.

6th Reference based on Smart Transport System Signaling Sensor System Near Hairpin Bends we learn about delineate the problem scope, emphasizing the heightened risks associated with negotiating hairpin bends in transport systems. Sophisticated data processing algorithms are employed to analyze sensor inputs in real-time, enabling the system to promptly relay warnings or instructions to drivers approaching these hazardous bends. Validation procedures encompass controlled simulations and real-world trials to gauge the system's efficacy under varied environmental conditions.

7th Reference based on Accident Prevention and Traffic Pattern Analysis System for Hilly Regions we learn about defining the problem scope, emphasizing the unique challenges posed by hilly landscapes, including steep gradients, limited visibility, and winding roads, which often contribute to accidents and traffic congestion. Advanced algorithms are employed to process the collected data, allowing for the identification of accident-prone areas and the prediction of traffic congestion hotspots. Validation experiments encompass both simulated scenarios and real-world trials conducted in hilly regions to assess the system's accuracy and effectiveness.

8th Reference based on Color Detection in RGB modeled images using MATLAB we learn about sequential steps for accurate identification and analysis. Initially, the RGB-modeled image is acquired either through direct capture or loading from storage. Subsequently, preprocessing steps are executed to enhance the image quality and facilitate subsequent analysis. This includes resizing, data type conversion, and adjustments for brightness or contrast. Following this, the image is often converted to an alternative color space such as HSV or LAB to simplify color detection. Thresholding techniques are then applied to segment the image, isolating regions corresponding to specific colors. Blob analysis methods, including functions like `regionprops`, are employed to identify connected regions within the segmented image. These regions are subsequently classified based on predefined criteria or reference colors. Finally, the detected colors and corresponding regions are visualized or highlighted on the original image for further examination or presentation. Throughout this process, MATLAB's extensive library of image processing and computer vision functions facilitates efficient implementation and customization to suit the specific requirements of the analysis.

IV. BLOCK DIAGRAM

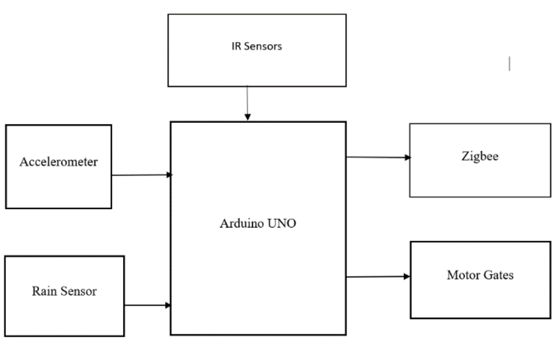


Fig 4.1 Vehicle Transmitter Model

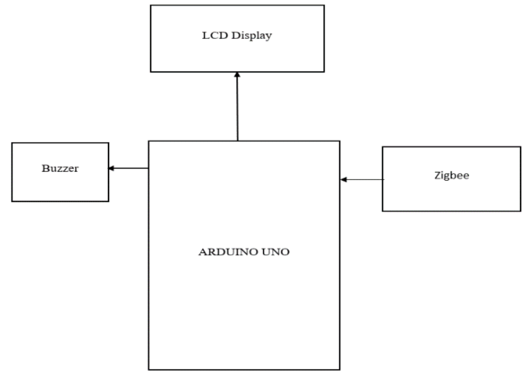
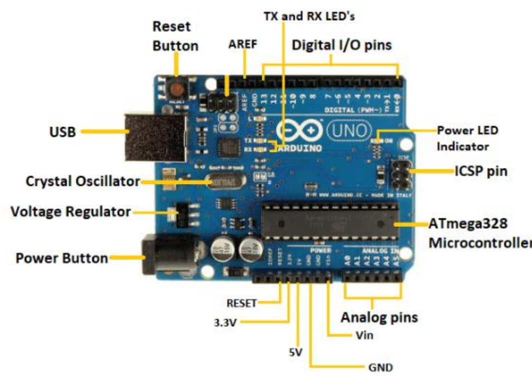


Fig 4.2 Hub Receiver Model

V. HARDWARE COMPONENTS

A. Arduino UNO



Arduino board designs use a variety of microprocessors and controllers. The boards are equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards or breadboards (shields) and other circuits. The boards feature serial communications interfaces, including Universal Serial Bus (USB) on some models, which are also used for loading programs from personal computers.

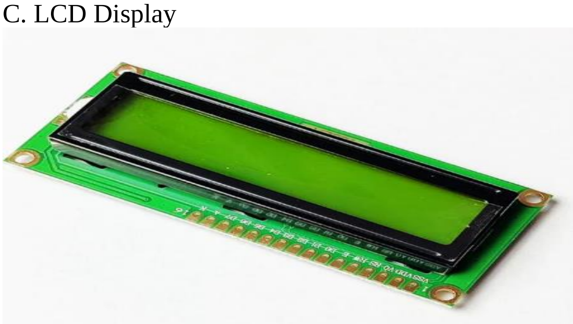
The microcontrollers are typically programmed using a dialect of features from the programming languages C and C++. In addition to using traditional compiler toolchains, the Arduino project provides an integrated development environment (IDE) based on the Processing language project.

ATmega328 Microcontroller: It is a single chip Microcontroller of the ATmel family. The processor code inside it is of 8-bit. It combines Memory (SRAM, EEPROM, and Flash), Analog to Digital Converter, SPI serial ports, I/O lines, registers, timer, external and internal interrupts, and oscillator.

B. Node MCU

Node MCU is an open-source LUA based firmware and development board specially targeted for IOT based Applications. It includes firmware that runs on the ESP8266 Wi-Fi SOC from Expressive Systems, and hardware which is based on the ESP-32 module.

C. LCD Display



LCD (Liquid Crystal Display) is a type of flat panel display which uses liquid crystals in its primary form of operation. LEDs have a large and varying set of use cases for consumers and businesses, as they can be commonly found in smart phones, televisions, computer monitors and instrument panels.

D. IR Sensor

An infrared sensor is an electronic device that emits in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. These types of sensors measure only infrared radiation, rather than emitting it that is called a passive IR sensor. Usually, in the infrared spectrum, all the objects radiate some form of thermal radiation. These types of radiations are invisible to our eyes, that can be detected by an infrared sensor. The emitter is simply an IR LED (Light Emitting Diode) and the detector is simply an IR photodiode that is sensitive to IR light of the same wavelength as that emitted by the IR LED. When IR light falls on the photodiode, the resistances and the output voltages will change in proportion to the magnitude of the IR light received.

E. Accelerometer

The ADXL335 is a small, thin, low power, complete 3-axis accelerometer with signal conditioned voltage outputs. The product measures acceleration with a minimum full-scale range of ±3 g. It can measure the static acceleration of gravity in tilt sensing applications, as well as dynamic acceleration resulting from motion, shock, or vibration.

The user selects the bandwidth of the Accelerometer using the CX, CY, and CZ capacitors at the XOUT, YOUT, and ZOUT pins. Bandwidths can be selected to suit the application, with a range of 0.5 Hz to 1600 Hz for X and Y axes, and a range of 0.5 Hz to 550 Hz for the Z axis. The ADXL335 is available in a small, low profile, 4 mm × 4 mm × 1.45 mm, 16-lead, plastic lead frame chip scale package (LFCSP_LQ).

6. ZigBee Communication

Range of action in the room, m	30
Effective range in free space, m	100
Maximum output power, mW	1
Data transmission rate over the air, kbit / s	250
Data transfer rate on the interface, kbps / s	1.2 .. 115.2
Sensitivity, dBm -92	
Supply voltage, V	2,8 .. 3,4
Current consumption in transmission mode, mA	45
Current consumption in receive mode, mA	50
Current consumption in energy saving mode, µA	10
Operating frequency, GHz	2.4
Number of channels	16
Number of addresses in the network	65000
Dimensions, mm	24,4 * 27,6
Operating temperature range, C	-40 ...+85

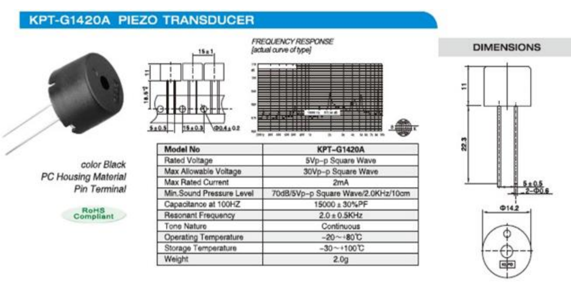
A temperature sensor detects the hotness and the coldness damage. Rain sensors can operate using different technologies, including capacitive, conductive, and optical methods, to sense and measure rain.

7. Rain Sensor

Model	ZM Sensor WXA100-ZRG
Measurement parameters	Rain
Type	Piezoelectric
Power supply	12...24VDC
Operating temperature	-40 ... +85 °C (-40 ... +185°F)
Relative humidity	0 ... 100 %RH
Barometric pressure	10 ... 1100hPa
Power consumption	10mA at 12VDC
Digital outputs	RS232/RS485
Communication protocols	ASCII,Hexadecimal, Modbus

A rain sensor is a device that detects the presence and intensity of rainfall. It is used in various applications to automate responses to rain, such as activating windshield wipers in cars, pausing irrigation systems to conserve water, or closing windows and skylights to prevent.

8. Buzzer



Model No	KPT-G1420A
Rated Voltage	5Vp-p Square Wave
Max Allowable Voltage	30Vp-p Square Wave
Max Rated Current	2mA
Min.Sound Pressure Level	70dB/5Vp-p Square Wave/2.0KHz/10cm
Capacitance at 100HZ	15000 ± 30%PF
Resonant Frequency	2.0 ± 0.5KHz
Tone Nature	Continuous
Operating Temperature	-20～+80℃
Storage Temperature	-30～+100℃
Weight	2.0g

A buzzer is an audio signaling device that produces a sound, often used as an alert or notification. Buzzers are commonly found in a variety of devices and systems, including alarms, timers, and electronic devices. They can be electromechanical or electronic, and their sounds can range from simple beeps to more complex tones. damage. Rain sensors can operate using different technologies.

9. Motor Gates

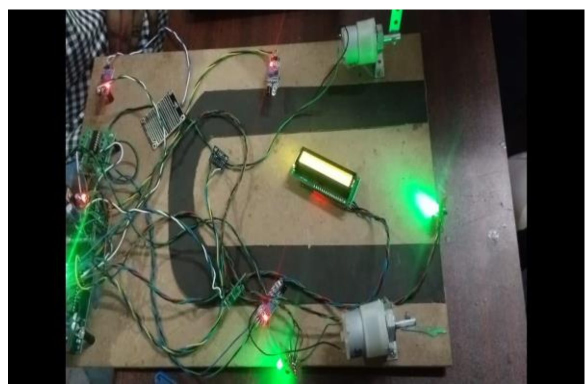
Motor

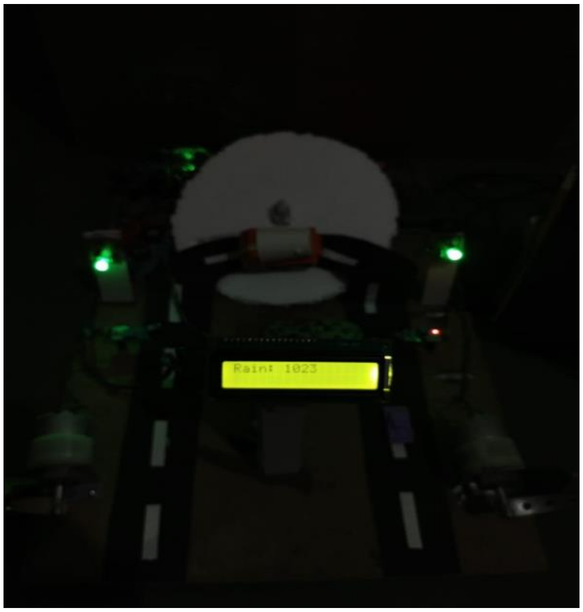
Voltage	DC 3V	DC 5V	DC 6V
Current	100 MA	100 MA	120MA
Reduction rate	48:1		
RPM (With tire)	100	190	240
Tire Diameter	65mm		
Car Speed(M/minute	20	39	48
Motor Weight (g)	29		
Motor Size	70mm*22mm*18mm		
Noise	<65dB		

Motor gates, also known as automated gates, are gates that are operated using an electric motor. These gates can be controlled remotely or via automated systems to allow or restrict access to a property. They are commonly used in residential, commercial, and industrial settings for security and convenience of the environment.

VI. RESULT

Detecting landslides and ensuring conflict avoidance in deep curves are critical aspects of road safety that require advanced technological solutions. Landslide detection can be facilitated through remote sensing using satellites and drones, ground sensors, and machine learning algorithms that analyze environmental data for predictive insights. Early warning systems play a crucial role in alerting authorities and residents to imminent landslide risks. Conversely, conflict avoidance in deep curves necessitates the integration of advanced driver assistance systems (ADAS), vehicle-to-infrastructure (V2I) communication, high-precision mapping, dynamic speed limit signs, and education initiatives to raise awareness among drivers. By combining these approaches, we can enhance safety measures and mitigate risks associated with both landslides and deep curves on roads.





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 metres 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. The system is robust in nature which includes advanced cameras and complex calculations which provides real time solution for collision avoidance and traffic congestion.

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