

Machine Learning-based Intelligent Smart Warning System in Twisty Swerve in Hill Station using IoT

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Abstract

The surveyed reports state that about 10% of car accidents in the hilly areas happen on curved roads. It is risky to drive through curves and bends. Therefore, this work suggests a hairpin bend road collision prevention system using Internet of Things (IoT). The proposed design employing IoT strives to prevent the collisions by initiating warning alarms on detecting vehicles on the either side of the hairpin bend. The detection of the vehicles in the either side is performed using an ultrasonic sensor.

Keywords: ESP8266 NodeMCU, Raspberry Pi Pico, Buzzer.200, LCD

1. Introduction

A simple survey on the road accidents in India has quoted that nearly sixty thousand people die every year due to accidents caused by four wheelers; though collisions are unavoidable it could be minimized to a certain extent [5]. The major cause of accidents is high speed or distraction. In hilly areas, accidents are usual in the curved areas like hairpin bends. The existing system employs convex mirrors at curves to allow the driver to readily spot

vehicles approaching from the other direction. This technique is successful during the day but not at night.

A system that operates well at day as well as night is put forth in this study. The problem may be fixed by adding sensors to each side of the bends. If the vehicle is 5 meters away, a light signal is transmitted to the vehicles approaching from the either side of the bend through the sensors. The suggested technology aims to prevent accidents, particularly in hairpin bend and U turns, to provide a safe and pleasurable hill journey. The dual warnings raised by the system in form of alarm and messages help in avoiding road accidents and improving the ability of vehicle detection in this research [6].

An intrusion detection system is employed to investigate hostile behaviour that takes place within a network or a system. Software or hardware used for intrusion detection searches a network or system for suspicious behaviour. By using the machine learning method, the centralized server i.e., cloud is used to collect the data by the help of sensors such as ultrasonic and flame sensor. From the cloud, data get stored and shared to the registered mobile number.

2. Related Works

A proposal for accident prevention and road safety in hilly regions in 2021 [2] utilized the Wireless sensor networks and the Internet of Things to monitor and enhance security in sloping areas. In locations susceptible to the aforementioned causes, self-contained detecting devices are used by remote sensing. These sensors then convey information to workers about the potential for failure, thereby enabling a warning to everyone so that proper help can be given, and actions can be taken to avoid or mitigate the disaster's consequences.

Research [3] planned an accident recognition and alert system employing GPS intended to give the driver quick assistance. Employing this work, accident rates are decreased by detecting accidents and alerting family members and neighboring police control rooms and hospitals. This also concentrates on accident prevention rather than immediate action in the case of an accident, to save lives.

A proposed accident detection and alert system [4], detects accidents using a vibration sensor when the car is involved in the collision and transmits the information, to a registered number using a GSM module. The location of the device is given by a tracking system that uses GPS to cover the full region's geographic coordinates.

Vehicle movement control and accident avoidance in hilly track which provides a human-machine interface that lowers the risk of mishaps and pressure placed on drivers was proposed in [1]. In order to provide a coordinated reaction to this threat, the system incorporated sensors, communication, and GPS. The technological GPS determines the position of the vehicles concerning the hairpin turn, which establishes the order in which the vehicles must move.

3. Theory

Machine learning is the use of data and algorithms to mimic human learning, gradually increasing the accuracy of the process. An alert system will go off at the distant location when the sensor values go above the threshold value.

The information gathering and monitoring unit gathers the information through different sensors using RASPBERRY PI PICO, and control. Information from the gathering and control is transmitted through a segment, consequently, it goes as a transmitting unit. This unit has a variety of sensors, for example, an Ultrasonic sensor, and a Flame sensor. The real-time monitoring networks are limited by energy consumption because of the implementation's remote postposition site and the unavailability of constant power. Considering these factors, the implementation site's sensor network puts into practice a wholly novel notion for distributed detection and estimation to arrive.

A Raspberry Pi Pico is connected to a computer and how to program it using MicroPython is discovered. A cost-efficient microcontroller gadget is called a Raspberry Pi Pico. Despite being tiny processors, microcontrollers typically lack significant volume storage and connectable peripheral devices (for example, keyboards or monitors). Numerous programming languages can be used with the Pico and third-party RP2040 boards including MicroPython, Arduino language, C/C++, and Circuit Python. Even better, the Pico has Piper Play, a Python version built on blocks. The most popular Python IDE is Thonny, which is accessible for all the major operating systems. Popular tool for writing MicroPython code, makes it feasible to write code for the Raspberry Pi Pico.

4. Design and Framework

A. Road Section

The purpose of the research is to warn, detect, and notify the vehicles on the either side of the hairpin bend by gathering the data through ultrasonic sensor, an RF transmitter, as well as a receiver, and processing it on a Raspberry Pi before turning on or off an LED or displaying the message on an LCD. Both the ultrasonic sensor and flame sensor are installed at the appropriate height above the ground and at the appropriate separation from one another. The ultrasonic sensors are oriented towards the road, with one at the streetlamp and the other at a distance of 2-3 metres. If any fire is detected in the hilly areas, the flame sensor gives the alert to the vehicles which come in near the fire. Also, the system can be powered with the power source from a streetlamp. On the streetlamp, the display and LEDs are mounted, so that they are visible to the oncoming cars. To make the button conveniently accessible in an emergency, it is fixed above or below the ultrasonic sensor.

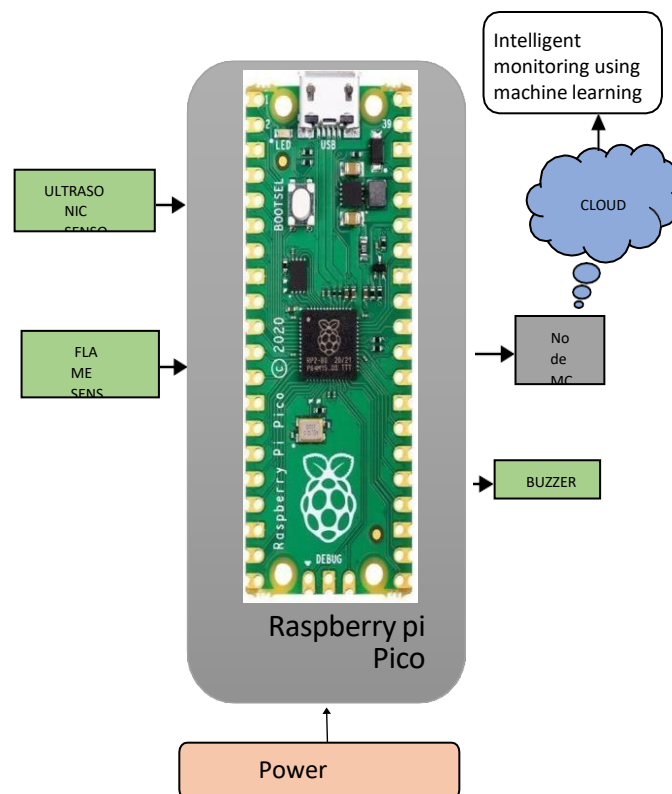


Figure 1. Block diagram of Road section

B. Vehicle Section

The proposed design gathers information from both sensors, and transmits it to Raspberry Pi, that forwards it to the LCD, and information from an encoder is transferred from the Raspberry Pi to an RF transmitter so that the location may be shared. In order to determine whether a vehicle is crossing from the same side or just the other, a raspberry pi will first be set up, and when two vehicles pass over it, it will start detecting them. The raspberry pi determines the direction of the vehicle and assigns a positive or negative value, and then turn on and off the LED in accordance. If somebody presses the switch during an accident or other emergency, the LCD will turn on, light red, and show a message.

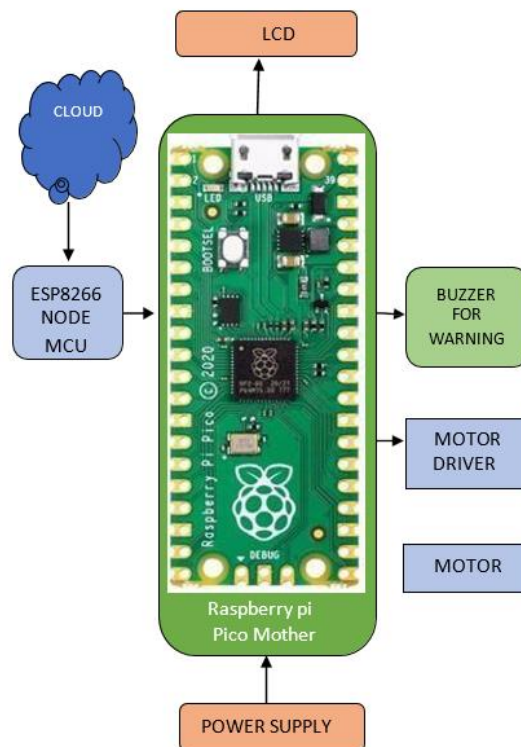
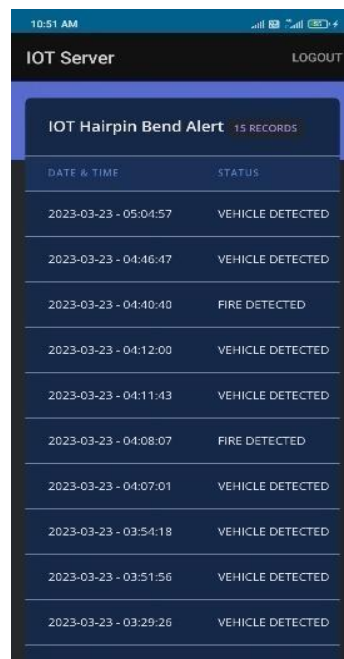


Figure 2. Block diagram of Vehicle section

5. Result And Discussion



DATE & TIME	STATUS
2023-03-23 - 05:04:57	VEHICLE DETECTED
2023-03-23 - 04:46:47	VEHICLE DETECTED
2023-03-23 - 04:40:40	FIRE DETECTED
2023-03-23 - 04:12:00	VEHICLE DETECTED
2023-03-23 - 04:11:43	VEHICLE DETECTED
2023-03-23 - 04:08:07	FIRE DETECTED
2023-03-23 - 04:07:01	VEHICLE DETECTED
2023-03-23 - 03:54:18	VEHICLE DETECTED
2023-03-23 - 03:51:56	VEHICLE DETECTED
2023-03-23 - 03:29:26	VEHICLE DETECTED
2023-03-23 - 03:28:50	VEHICLE DETECTED

Figure 3. Output of Vehicle and fire detection

The proposed system is mounted close to the hairpin bends to caution the vehicles on either side of the hairpin bends.



Figure 4. Display of Vehicle detection

Due to the limited visibility of traffic traveling in the opposite direction near hairpin bends, there is a risk of accidents. Figure 4 shows the message generated on detecting a vehicle at the bend.



Figure 5. Display of Fire Detected

Figure 5 shows the warning sent on detecting the flames or smoke on the road. The data is displayed in LCD and also notified to the customers registered phone number. The advantage of the proposed system is that it provides a safe and secure journey in hill stations.

6. Conclusion

This research has proposed a solution to overcome road accident occurrences on hairpin bends by implementing the vehicle detection system. The system provides a warning on detecting the vehicles on the either side of the hilly roads employing IoT. The proposed program conveys the vehicle detection message and provides the user a warning. For future scope, solar energy can be used to recharge the battery because it is difficult to bring electricity from urban areas. Machine learning can be used for image processing to give appropriate object detection like human beings, animals, vehicles, and many more on the bends.

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