Accident Avoidance and Vehicle Detection in Hairpin Curves using Machine Learning

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Abstract— **India has the highest rate of traffic accidents in the world. The majority of road accidents are caused at high speeds or when the driver is unaware of other vehicles coming opposite to it, especially in deep curves (hairpin curve). Due to a lack of communication and zero visibility over the hairpin curves, vehicles travelling around hairpin bends are extremely vulnerable to accidents. As a result, vehicles must take extreme caution when driving through hairpin curves. The existing systems detect only the incoming vehicles and not the type of vehicle. As a result, there is traffic congestion and delay in travel. The proposed system is used to detect the vehicles on one side of the hairpin and assist the vehicle coming opposite to it. The aim of proposed system is to classify different vehicles passing through one direction of the hairpin road and notify the vehicles those coming opposite direction of hairpin through a display board. This display board is a LED display contains the information about vehicle category, time taken to pass the vehicle at the curve and number of vehicles in the curve. By this way we can reduce accidents in deep curve roads in any conditions.**

Keywords—Convolutional neural networks,Vehicle detection, Uphill, Downhill, Accident prevention, Vehicle classification.

I. INTRODUCTION

Vehicles play a significant part in our daily lives, such as commuting from one location to another, transporting goods, food, and so on, by reducing travel time for humans. According to past knowledge and reports[1], [12]-[15] many accidents occur on mountainous roads owing to the lack of vision of other vehicles approaching from the opposite direction, landslides, and adverse weather conditions. However, no safeguards or actions to avoid them have been implemented. Human life is lost as a result of this.

Vehicles moving through hairpin bends have a higher chance of accidents. Because there is a lack of visibility between vehicles in the hairpins, therefore, drivers must be extremely cautious in these deep curves while driving. And also, there is traffic congestion due to unorganized movements.Vehicles are important in the day-to-day lives of every human being. Also, there is a high rate of accidents that occur due to high speeds and rash driving. The situation in hilly areas is more dangerous. Because of hairpin bends, the vehicles have zero visibility. So the proposed system will help to avoid accidents at hairpin bends and save lives.

Every day, accidents occur as a result of the increasing use of transportation and vehicles. Accidents are mostly caused by violations of traffic rules, negligence, and poor road conditions. Due to a lack of communication and zero visibility over the hairpin curves, vehicles travelling around these hairpin bends are extremely vulnerable to accidents. As a result, vehicles must use extreme caution when driving through hairpin curves. These problems are the major concerns in hilly areas. The proposed system detects the vehicles on one side of the curve using a highly configured camera, then classifies following vehicles into light motor vehicles (LMV) or heavy motor vehicles (HMV), and notifies the vehicles on the other side of the curve using a display board. This display board is a seven-segmented display that consists of information about the vehicle category, time taken by the vehicle to pass the curve, and the number of vehicles passing the curve. So the proposed system gives confidence to the drivers about the incoming vehicles in the deep curve and they are aware of the upcoming vehicle category. The proposed system reduces accidents in hairpin bends and there is less traffic congestion.

Every human being depends on vehicles in their daily lives. In addition, high-speed and rash driving are responsible for a high number of accidents. In hilly areas, the situation is even riskier. Because of the hairpin curves, automobiles have no visibility. The proposed system prevents accidents in hairpin curves and also reduces traffic congestion. It provides a real-time solution and vehicles can easily move through the hairpin curves.

II. RELATED WORK

Driving is one of the most challenging tasks in the hills. While driving in these areas, drivers must stay alert at all times. The driver does not see the car approaching from the opposite side in curves and hairpin bends, which is one of the leading causes of accidents in mountainous areas. A multitude of curves and hairpin bends can be found in mountainous areas. In these areas, the roadway is a popular form of transportation. In hilly areas, the number of accidents and deaths is steadily rising. Because the roads in this area will almost certainly feature twists and sharp curves, it will be difficult to see vehicles approaching from the other direction.

This paper[2]detects the presence of vehicle on one side of the curve using camera, classifies the following vehicle into ‘light’ or ‘heavy’ vehicle category and alert the vehicles on other side of the curve using LED display board. Our specially designed LED display board consists of information such as vehicle class and traffic signals which is used to alert the driver about the upcoming opposite vehicle. Our principle behind reducing traffic congestion is, A vehicle can easily pass through the hairpin curve, provided the driver is aware about the upcoming opposite vehicle’s category i.e. either light vehicle or heavy vehicle so that, the driver can judge the distance with which the opposite vehicle can cross the curve. This makes the driver more confident while driving in hairpin bends.

This paper[3] alerting the driver of a car approaching from the opposite direction This is accomplished by placing an ultrasonic sensor on one side of the road before the curve and an LED light on the opposite side, such that when a vehicle approaches from one end of the curve, the sensor detects it and the LED light glows on the opposite side. The driver can become alert and slow down the car by looking at the LED light on/off indicator.

Negotiating a hairpin bend on a mountainous track is not an easy feat, and it necessitates At all times, we expect a high level of competence from our drivers. One of the primary goals in developing An assistance system is to keep people safe on the roads. Nowadays, everyone needs to know that they will be able to travel safely. Human error is to blame for 95% of all fatal accidents. The rate of accidents can thus be lowered by building a precise help system. vehicle-to-hub Communication is becoming more popular as computerized technology improves. A collisionavoidance system protects both the vehicle and the driver while also minimizing damage. vehicle-to-hub Communication can assist in obtaining it. Safety and avoiding crashes are the primary motivations for car-to-car communication systems. Car-to-Hub communication This technology isn't tailored to a certain vehicle or manufacturer. With some modification, this may be used in any vehicle. The technology is developed in such a way that it may be used by a regular car drivers. Automobiles have become one of humanity's greatest economic triumphs. In the last century, they were sadly prone to accidents and became victims while travelling. Sensors monitor the position of the vehicles in relation to the hairpin turn to determine which Vehicles must move first. The system captures information exchange between vehicles. The decision regarding speed and distance is passed on to the vehicle via a visual display. based on algorithms. The hardware and software architecture are designed and developed. throughout the project is detailed in this [4]paper.

This paper[5]contains a set of ultrasonic sensors, warning lights combined with a convex mirror is installed by the side of the road. Wires link the sensors, which are mutually exclusive. The priority algorithm automatically limits vehicle travel at the hairpin curve based on sensor data, providing appropriate alerts when detection is detected. The appropriate warningis triggered for various scenarios, prioritizing the vehicle's movement. In the event of a system failure, a caution LED is activated, which sends a signal to the maintenance department.

The paper[6] aims in reducing the risk of driving vehicle in the terrain region with hairpin bends and steep curves. The deployed controller with ultrasonic sensor detects the vehicle approaching the bend and alerts it to the other side of the bend or curve; it provides three levels of LED notifications to the driver approaching the hairpin bend or curve from the other side. It also detects the vehicle's speed, and if the speed is too high, the drivers will be notified by a buzzer. These notifications will imply to drivers that they should reduce their vehicle's speed. The planned system's primary goal is to reduce fatality rates in hilly areas by preventing accidents for both drivers and passengers. By storing data in the cloud, this method also allows for analysis of the number of uphill and downhill cars in hill stations. A web application is used to see the analyzed data over the internet. People who want to travel down that road can use the online application as a traffic pattern analyst.

By this way, we can reduce accidents on deep-curve roads in any condition.

III. METHODOLOGY

A. *Proposed System*

The proposed system is used to detect the vehicles on one side of the hairpin and assist the vehicle coming opposite to it. The aim of the proposed system is to classify different vehicles passing through one direction of the hairpin road and notify the vehicles coming from the opposite direction of the hairpin through a display board. This display boardcontains information about vehicle category, time taken to pass the vehicle at the curve, and the number of vehicles in the curve.

B. *System Design*

The paper proposes that light vehicles, such as cars and jeeps, can make a small turn, whereas heavy vehicles, such as buses and trucks, take a longer turn. As heavier vehicles take longer to turn, they can take the entire hairpin curve, forcing other vehicle to wait until the heavy vehicle passes the curve. Light vehicle, on the other hand, take a shorter turn, so only half of the hairpin curve is occupied, leaving the other half unoccupied. If the other vehicle is also a light vehicle, it can occupy the remaining half and pass through the curve.

The proposed system contains following components:

1. Highly configured camera
2. Display board

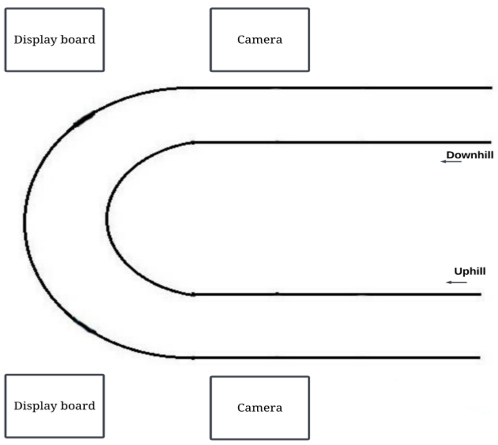

Fig.1:Design of the proposed system

1.*Highly configured camera*

The camera will capture live video from both the uphill and downhill areas. With the help of a machine learning algorithm, this live video will classify the type of vehicle.

2.*Display board*

The display board is a board with LED display that will show information about the vehicle category, the time taken to pass the vehicle at the curve, and the number of vehicles in the curve.

C. System Architecture

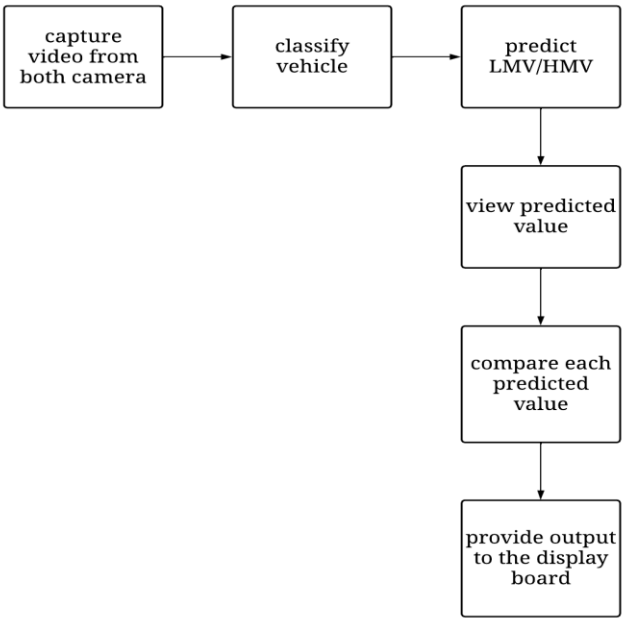

Fig.2: System Architecture

1.Capturing live video feed

The camera helps capture live video of vehicles on the road. The system gets a video capture object and removes noise using filters and segregates it into multiple frames depending upon frame rate.

2.Training and Classification

The collection of datasets is a required step in machine learning. This paper collects various vehicle datasets and the CNN algorithm[7], [10], [11] categorizes them into light motor vehicles and heavy motor vehicles. Then thealgorithm converts every image into grayscale images for easier calculation and predicts the vehicle as a light motor vehicle (LMV) or heavy motor vehicle (HMV).

3.Comparison of predicted value

All the predicted values are stored in a database. Then compare the values from each camera to get the accurate result. This system gives preference to heavy motor vehicles as they need the entire portion of the road to take the turn. Therefore, this system can reduce traffic congestion.The vehicles' movement through the hairpin[8] is controlled by this stage.

4.Displaying the result

The display board shows the type of vehicle coming from uphill, the time taken by that vehicle to take the turn completely, and the number of vehicles approaching the uphill turn.For showing the output of this system, we use a GUI Python library known as Tkinter[9].

D. Working

This system reads vehicles using the Webcam or gives a video as input. The next step is image acquisition. The CNN algorithm is used for real-time classification of vehicles. Based on the size of vehicles, they are classified into light motor vehicles (LMV) and heavy motor vehicles (HMV). This algorithm helps predict the vehicle class and count the number of vehicles. The predicted value is then stored in a database. The predicted values from both uphill and downhill are stored in the database. From this database, the comparison is happening. If LMVs are approaching from both sides of the curve, then it allows both to pass the curve. If it is a combination of LMV and HMV approaching the curve, then it allows HMV to pass the curve. If HMVs are approaching from both sides of the curve, then it allows the HMV from uphill. The GUI tkinter sends a request to the database for the output. Then the database sends back the accurate result.

There are some cases of vehicles approaching hairpin bends:

Case-1 (LMV from uphill and downhill): The LMV takes a short turn, so the display board will show the "GO" signal for the LMV coming from both sides of the curve, number of vehicles and time taken by the vehicles to pass the curve.
Case-2(LMV from one side and HMV from other side): The LMV takes a short turn, whereas the HMV takes a longer turn, so the display board will show the "STOP" signal for the LMV and “GO” signal for HMV. The display will show the time taken by HMV to complete the turn.

Case-3(HMV from uphill and downhill): As the HMV takes a longer turn, the display board will show the "STOP" signal to the HMV coming from downhill and the time taken by the HMV from uphill to pass the turn.

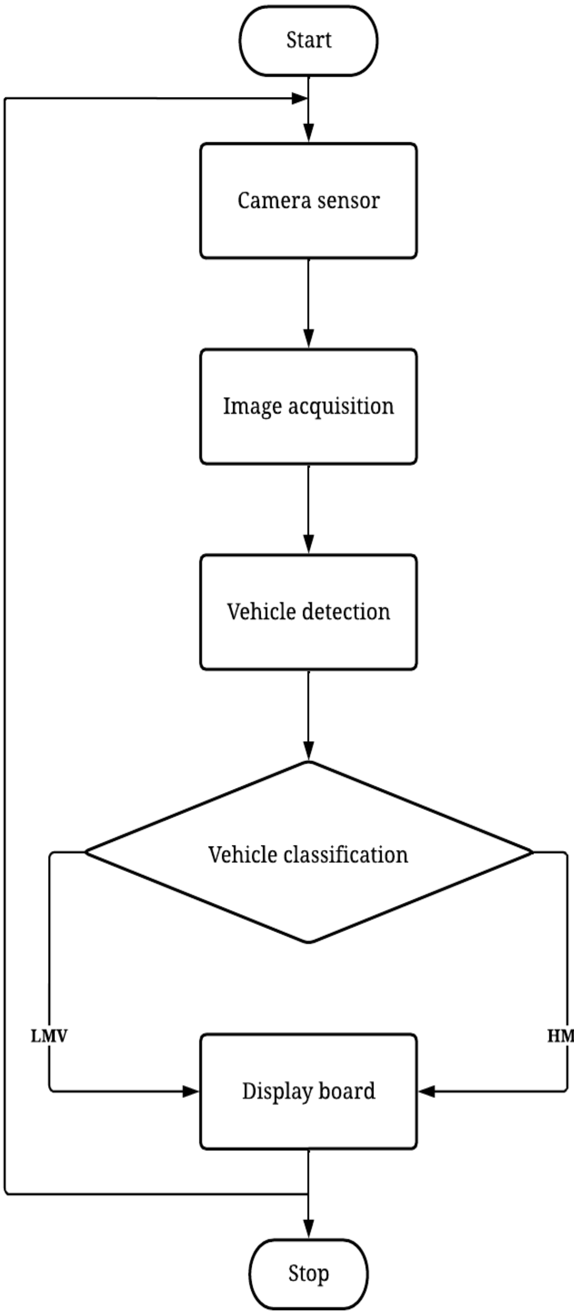

Fig.3: Flowchart

IV. RESULT

The proposed system helps with accident avoidance and effective traffic management in hairpin curves. This system consists of two cameras and two display boards. To demonstrate the system, it uses webcams for reading input and the Python GUI library Tkinter for display. This system is accurate for vehicle classification. It gives the preference for a vehicle according to its class. The proposed system assists the vehicles in the hairpin curve, so there is less traffic congestion.

V. FUTURE SCOPE

The proposed system helps with accident avoidance and effective traffic management in hairpin curves. In the future, there could be more functionalities that can be added. Some functionalities can be added to the camera in hairpin curves to record the vehicle and its number from the number plate, so that if an accident happens, then details of the vehicle can be taken from the camera and also investigate that accident by checking the footage. A warning system can be added if a vehicle crosses the opposite lane.

VI. CONCLUSION

People have become much more reliant on transportation systems in recent years, and transportation systems themselves confront both opportunities and limitations. The world's population continues to rise, posing a significant challenge to transportation management systems.The vehicle moving through hairpin bends are very much susceptible to accidents due to lack of communication and zero visibility over the hairpin curves. Hence, drivers must be extremely cautious while driving in hairpin curves. The proposed system aims to reduce traffic congestion and prevent collisions in hairpin curves as much as possible, allowing for easy vehicle movement in hilly areas.So the drivers can easily drive through hairpin curves and accidents can be prevented.

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