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ADVANCED SAFETY SYSTEM FOR VEHICLE DETECTION AND COLLISION AVOIDANCE IN HAIRPIN CURVES

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Abstract : The "Advanced Safety System For Vehicle Detection And Collision Avoidance In Hairpin Curves" is a system that is used to identify the vehicles on one side of the hairpin curve and employ vehicles to aid the vehicles on the other side. Because there is no communication between the vehicles and there is no view over the hairpin bends, traffic congestion and accidents are highly common in hairpin curves. Current prototypes certainly provide a way to avoid collisions, but they fall short when it comes to traffic control, which is especially important in mountainous locations. This project's goal is to intelligently identify and categorize cars, prevent collisions using vehicles and LEDs, and manage traffic efficiently utilizing knowledge of the many types of vehicles. In this project, we offer a methodical solution to the preceding problem statement and explain why efficient traffic management in hairpin curves is necessary.

Index Terms **- Vehicle detection, Collisions, Hairpin Turns, Congested Traffic, Hilly Regions, Traffic Management.**

I. INTRODUCTION

The Internet of Things (IoT) is a system of linked computing devices that are embedded in common place items and allow them to send and receive data. As an illustration, a motion sensor can be set within a room and programmed to turn on or off the lights whenever someone enters or exits the space. IoT has several uses, including smart watches, smart air conditioners, and automatic street lighting. Due to poor communication and poor vision over the hairpin turns, vehicles travelling through them are particularly vulnerable to accidents. Traffic congestion, which is brought on by the disorganised movement of vehicles, is another significant disadvantage of driving through hairpin curves. There are already several approaches and notions that offer a solution to the issue, but they each have drawbacks that limit their applicability in the present. We have developed a complex system that will offer the best answer for both of the aforementioned issues.

II. PROBLEM STATEMENT

This smart technology uses a camera to identify the presence of vehicles on one side of the curve (vehicles climbing), and it then categorizes the next vehicle as either "light" or "heavy." Using an LED display board, it warns the driver of vehicles descending the other side of the curve. Information on the specially created LED display board includes things like vehicle class and traffic signals. The idea behind decreasing traffic jams is that a car can simply navigate a hairpin turn. The driver can evaluate the distance with which the opposing vehicle can cross the curve and stop well behind to wait for the approaching car to cross the curve because of this system, which also provides information on the type of the approaching opposite vehicle, which is either a light vehicle or a heavy vehicle.

III. LITERATURE SURVEY

[1] A project titled "Advanced Road Safety for Ghat Roads at Hairpin Bend" was carried out by Harshada Targe, Anushka Mahajan, Mohit Patil, Yogesh Lilake, and Vijay Sonawane. They sought to make driving on winding mountain roads with tight curves safer. They recommended deploying sophisticated cameras (CCTV) and screens (LCD) inside automobiles in place of conventional mirrors. Drivers would have a better view of the road ahead thanks to these cameras' live video capture and display on the screens. They warned that the screens might only display the headlights of other automobiles at night, not their true size or type. They nevertheless believed that deploying cameras and screens may significantly increase traffic safety on these treacherous mountain roads despite this restriction. [2] The "Sensor-Based Accident Prevention System in Curving" project was created in December 2019 by authors Anand M. G., A. Dhanyakumar, Bhaskar N., and Mahaling S. B. They sought to make driving on roads with many turns safer. When a car approached, they employed specialized ultrasonic sensors to alert them. To alert other drivers and avoid accidents, the sensors delivered a signal when they detected a car. However, they discovered a few drawbacks. It could be a little bothersome that smaller vehicles had to wait longer for the sensors to detect them. Additionally, the sensors occasionally generated superfluous signals when they were activated by objects other than automobiles. [3] Priyanka N., Chaithra A., Trupthi Tagare, Vibha T. G., and Anuradha A. Kasangottuwar worked on a project titled "Avoiding Accidents in Hairpin Curves and Foggy Areas" in November 2018. To reduce accidents, they sought to make driving on tight turns and through dense fog safer. To gauge the speed of oncoming vehicles, they used specialized sensors known as IR sensors. Their system would give precedence to a car that was moving very quickly and

issue a crucial warning to other drivers to help them avoid collisions. But they discovered a minor flaw in their system. Their technology was unable to distinguish between two automobiles travelling at the same pace. Its capacity to avoid mishaps in those situations may be impacted by this.

IV. CURRENT SYSTEM

Sensor based Collision Avoidance: Sensor-based Collision Avoidance: On each side of the curve, two ultrasonic sensors are positioned at a specified distance from one another. The position of the vehicle is determined by ultrasonic sensors. When a vehicle approaches a sensor that is located at two distinct points, a strong pulse is produced. The distance between those two points and the time needed for the vehicle to travel those distances are used to compute the vehicle's speed. Two vehicles approaching a curve simultaneously are measured for speed, and the vehicle travelling faster is allowed to proceed through the curve. Convex Mirrors: A convex mirror has a reflecting surface that has been bulged such that light rays that strike it are reflected back at a different angle. In mountainous areas, this setup is frequently employed to mirror the image of the opposing car approaching the hairpin curve. Headlights and Horns: When driving through hairpin corners, both are frequently employed. Only at night, while the high beams are flashing, may headlights be used.

4.1 Restrictions of Current System

Sensor based Collision Avoidance: This technique has significant drawbacks when moving uphill. High-speed cars are always given priority, which not only causes traffic congestion but also a lack of efficient traffic management.

Convex Mirrors: This system's primary flaw is that the reflective surface ages over time and is only effective at certain times of the year. Therefore, it cannot be used at night, in a foggy environment, or during the rainy season. Headlights: During the day, headlights may not be an effective strategy.

Horns: Horn sounds vary in intensity and can sometimes be muffled by other noise, making them difficult to hear while driving.

V. PROPOSED SYSTEM

A night vision camera, an Arduino microprocessor, and a specially made LED display board make up the system. Our custom-made LED board has a traffic light and nine LEDs arranged in a 3x3 matrix.

At two distinct corners of the hairpin bend are located the camera and LED display board. To get a clear view of the oncoming vehicle, the camera's viewing angle is adjusted, and its position is placed at one end of the curve.

At the other end of the curve, an LED display board is put in place and set up so that the display signal can be seen clearly. The live video stream is recorded by the primary camera sensor. Using an Arduino and Micro-Python interface, this data is being extracted.

Detection and categorization of vehicles based on the classification of vehicle types and the vehicle height algorithm. employing LEDs to indicate the class of a vehicle.

In order to process and show vehicle class information in an LED display board utilizing Micro-Python's processed output signal, Arduino is interfaced with it.

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5.1 Advantages of Proposed System

- Reduced casualties are possible.
- It works occasionally, such as when it's dark, rainy, or foggy outside.
- Traffic snarls can be lessened.
- The driver can confidently make decisions since they are quickly aware of the type of vehicle that is coming from the other side.

5.2 Functionality of The System

- Capture live video feed
- Detect vehicles
- Classify vehicles
- Display vehicle class and traffic signal information.

VI. SUMMARY

Due to poor communication and poor vision over the hairpin turns, vehicles travelling through them are particularly vulnerable to accidents. As a result, motorists must drive in hairpin turns very carefully. Traffic congestion, which is brought on by the disorganized movement of vehicles, is another significant disadvantage of driving through hairpin curves. In hilly areas, these two

problems pose a serious challenge. There are already several approaches and notions that offer a solution to the first problem statement, but they each have drawbacks that limit their applicability in the present.

We have created a sophisticated system that uses a camera to detect the presence of a vehicle on one side of a curve, classifies the next vehicle into the "light" or "heavy" vehicle category, and uses an LED display board to alert the vehicles on the opposite side of the curve. Our guiding principle for reducing traffic congestion is that a vehicle can easily pass through a hairpin curve as long as the driver is aware of the type of vehicle that will be driving in front of them, such as a light vehicle or a heavy vehicle, so that they can gauge the distance at which they can pass the curve. As a result, the driver feels more secure when navigating hairpin corners.

VII. System Analysis

The process of defining a system's architecture, components, modules, interfaces, and data in order to meet certain criteria is known as system architecture. It is possible to think of system design as the application of systems theory to the creation of products. The most common techniques for computer system design are increasingly based on object-oriented analyses and procedures. Thus, the process of designing and creating systems in order to fulfil the user's given criteria is known as system design. The language for object-oriented analysis and design has evolved into UML.

A conceptual model known as system architecture describes the structure and behaviour of the system. It includes the system's constituent parts and the relationships outlining how they interact to construct the whole system.

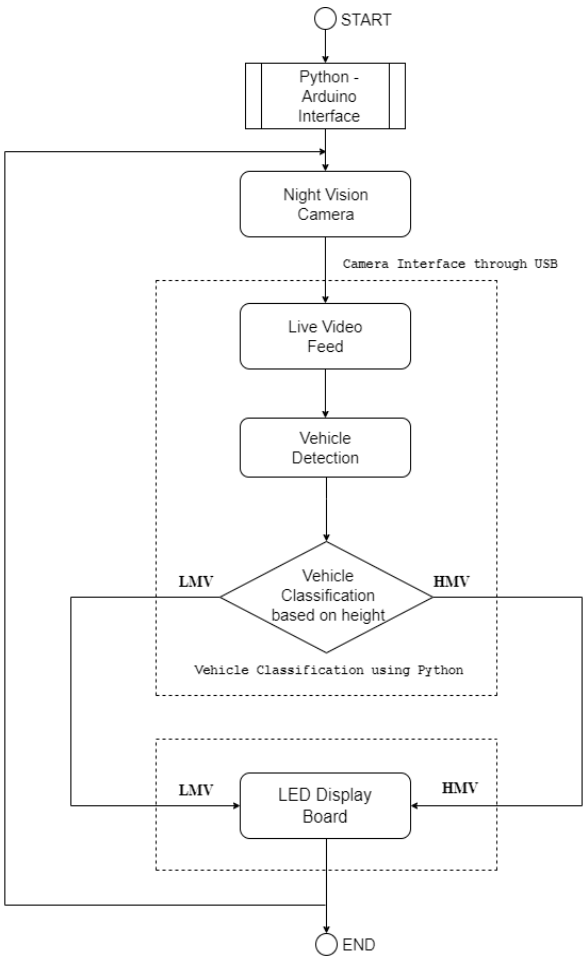

Figure 1: System Architecture

We recognize the coming cars in the frames by utilizing object detection algorithms like YOLO (You Only Look Once) or R-CNN (Regional Conventional Neural Network).

A vehicle's height is determined from detected incoming vehicles, and the type of vehicle is identified as either a light or heavy motor vehicle (LMV or HMV) utilizing a machine learning classifier, such as the SVM (Support Vector Machine), to categorize the different kinds of vehicles based on the height of the extracted vehicles.

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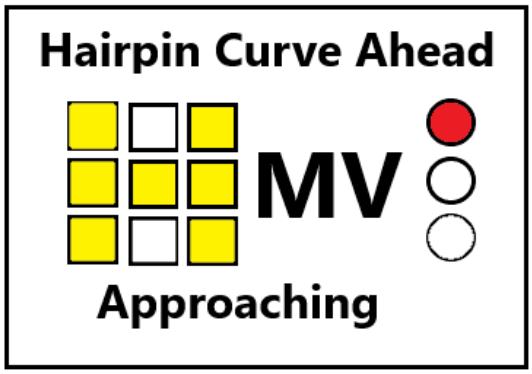


Figure 2: Heavy Motor Vehicle Detected

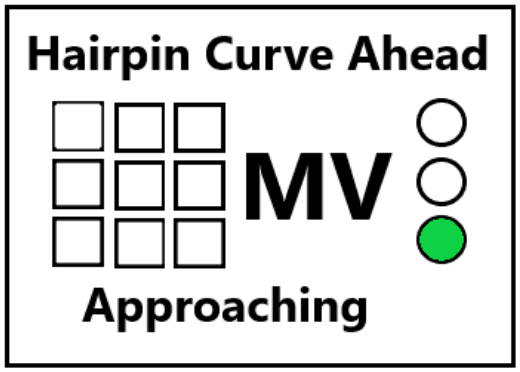


Figure 3: Default State

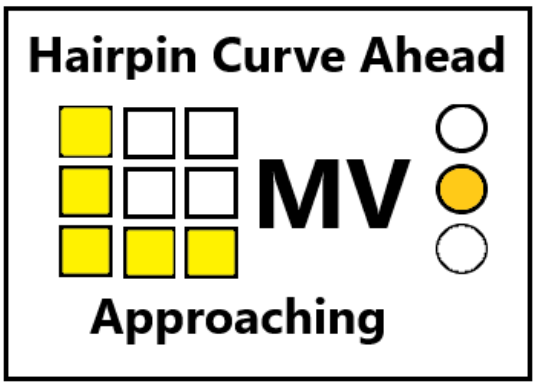
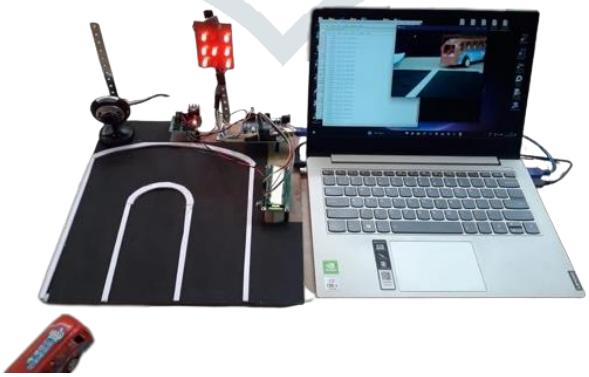


Figure 4: Light Motor Vehicle Detected

VIII. MODULES

- Capture the image
- Identify the Vehicle from the image
- Recognize the Vehicle.
- Classify
- Communicate by operating traffic signal

IX. OUTPUT



X. CONCLUSION

The main goal of this research is to reduce the likelihood of crashes in hairpin corners as much as is practical. Additionally, by promoting efficient and smooth vehicle flow, the system has been specifically created to reduce traffic congestion, particularly in mountainous areas. Because it makes use of sophisticated cameras and complex algorithms, the system is able to provide realtime solutions for traffic congestion management and collision avoidance. This system offers a complete strategy to improve safety and optimize traffic flow in difficult road conditions by utilizing cutting-edge technologies.

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