Vehicle Overtaking Control System

Ajeet R Math1 Arunkumar B V2 Pramod R3 Sunil M S4
1,2,3,4Department of Computer Science & Engineering
The National Institute of Engineering Mysuru, Karnataka

Abstract—Overtaking Control System is an important component of Advanced Driver Assistance System (ADAS). It can be used to alert the driver about driving conditions, possible collision with other vehicles, or trigger the automatic control of the vehicle for collision avoidance and mitigation. Overtaking Control System based on active sensors such as IR sensor and wifi-tethering technique based detection approach i.e. vision-based method, is becoming widely used due to their low cost and less interferences between vehicles as they proceed to overtake the other vehicle.

Key words: Control System

I. INTRODUCTION

The overtaking process is one of the critical actions that a driver performs while travelling on a highway. Errors in this decision-making process, typically caused by driver’s failure to accurately interpret the information about other vehicles in close proximity, that have often resulted in catastrophic accidents. In order to eliminate such errors, or at least minimize their impact, and increase the level of safety, the vehicles of the future would have to incorporate intelligent algorithms that will allow them to accurately consider all aspects of a lane changing/overtaking process. A number of real-time issues would need to be addressed (i) calculating proximities to other vehicles, (ii) determining when the lane-change process should start, and (iii) developing optimal and safe trajectories.

![Fig. 1: Block Diagram of Vehicle Overtaking Control System](image)

Let us first consider the simplest highway overtaking scenario, namely, where a vehicle A is driving with a velocity \( v \), while in front of it, another vehicle B is travelling with a slower velocity. There exists no (obstacle) vehicle in the passing lane that would influence the overtaking manoeuvre, which can be performed by the Driver of A in three phases: (i) move from the driving lane to the passing lane, (ii) travel in the passing lane and, thereafter, (iii) return to the driving lane. In the more complex scenario, one could be forced to consider another (obstacle) vehicle in the passing lane, which would not allow the A to immediately overtake B due to safety considerations. In this case, an additional velocity-adjustment phase would need to be included: during this phase, A would adjust its velocity according to the velocity of B until the passing lane becomes free of obstacles.

II. GENERAL INSTRUCTION

In this paper we are approaching the system that concentrates more on the efficient decision making algorithm to provide safe overtaking decision rather than using the too many sensors.

a) The camera which is attached to the receding vehicle provides the information if any vehicles are moving in front of it and this information will be transferred as a video to the overtaking vehicle through wifi tethering.

b) In Vehicle Overtaking Control System, IR distance sensors are attached to the vehicle for measuring the distance of opposite vehicle.

c) System calculates the speed and distance of the vehicle through sensors and notifies the driver whether overtaking is safe or not.

d) The proposed system makes efficient decision that prevent collision with opposite vehicle while overtaking the receding vehicle.

e) Initiating overtaking from unsafe distance from front vehicle

f) In this scenario simulator sent front lasers output to application and application then took decision of not overtaking the front vehicle and sent text information through communication port and message will be displayed on application window. This test was repeated for multiple distances between two vehicles where in system could be able to give correct indication for driver.

g) The application provides information such as how much distance to travel to completely overtake the receding vehicle and also the time required to overtake. It also displays the speed of the opposite vehicle.

For all scenarios where total distance travelled was less than actual distance travelled, system have shown warning for driver for unsafe overtaking.

III. IMPLEMENTATION

A. Variables

- \( a \rightarrow \) Length of Vehicle A
- \( b \rightarrow \) Length of Vehicle B
- \( 2e \rightarrow \) Width of Vehicle A
- \( 2z \rightarrow \) Width of Vehicle B
- \( c \rightarrow \) Distance between Vehicle A & B
- \( d \rightarrow \) Distance between Vehicle A & B after overtaking

\( HW \rightarrow \) Hardware
\( V1 \rightarrow \) Speed of vehicle A
\( V2 \rightarrow \) Speed of vehicle B
\( V3 \rightarrow \) Speed of vehicle C
\( p \rightarrow \) Distance between moving vehicles(shown in diagram)

\( X \rightarrow \) Slope calculation
\( H \rightarrow \) Distance to travel overtake
\( t \rightarrow \) Time
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REFERENCES


B. Equation

Slope calculation

\[ X = \sqrt{(b+c)^2 + (3e+f)^2 + b} \]

\[ Decision = p - \frac{5}{18} \cdot (t + VI \cdot \frac{5}{18} \cdot (t - 0.5) \]

which should be greater than 50m (Vehicle A must be 50m far from the vehicle coming in the opposite direction, say vehicle C)

\[ H = \sqrt{(b+c)^2 + (2e+f)^2} \quad \text{and} \quad V = \sqrt{(d+a)^2 + (2e+f)^2} + b \]

\[ (VI - V2) \cdot t = H \]

\[ V3 = \frac{\Delta}{\Delta t} \]

\[ V3 = V3 - V1 \]

Fig. 2: Implementation Representation

Fig. 3: Slope Calculation

\[ Decision = p - \frac{5}{18} \cdot (t + VI \cdot \frac{5}{18} \cdot (t - 0.5) \]

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