Co-operative Vehicle Overtaking in Co-operative Adaptive Cruise Control

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Abstract - *Cooperative Adaptive Cruise Control (CACC) is an extension of ACC. In addition to measuring the distance between own vehicle and predecessor vehicle, a vehicle can also exchange information by wireless communication. This enables a vehicle to follow its predecessor at a closer distance under tighter control. Currently we are focuses on Cooperative Adaptive Cruise Control (CACC) on high-way road vehicle flow and overtake characteristics. s. Intelligent vehicle, cooperation based on reliable communication systems contributes not only to reducing traffic accidents but also to improving traffic flow. Adaptive cruise control (ACC) systems can gain enhanced performance by adding vehicle-to-vehicle wireless communication to provide additional information to augment range sensor data, leading to Cooperative ACC (CACC). This paper presents the design, development, implementation, and testing of a CACC system*

Key Words*: *Intelligent Vehicles, Traffic-Flow efficiency, Traffic-Flow Simulation, Vehicle–Vehicle Communication,

1. INTRODUCTION

V2V Communication, reducing dashing between vehicles and improving highway capacity that results that highly reliable and safe than conventional ACC system. However, all of the research on improving Co-operative Adaptive Cruise Control (CACC) is a term that has been used for improving self-driving car techniques in recent decade, so that different people implementing different functions and capabilities to make sure CACC systems more reliable and efficient. In CACC the combination of automated speed control with a cooperative element, such as Vehicle-to-Vehicle (V2V). The V2V communication get information from the preceding vehicle, CACC systems can be implemented with V2V information sources by sensing actual distance data and share that information among platoon with efficient manner. There are two primary transportation system motivations for the development of CACC, reducing road accidents and decreasing fuel consumption, but additional features includes safety, customer satisfaction and comfort. Because of customer satisfaction, CACC is more reliable and enhanced than conventional autonomous ACC because the system responsive to the changes in the preceding vehicle distance due to changing speed, providing an improved sense of safety because of its quicker interaction between vehicle-to-vehicle and Controller-to-Sensors and vice versa, CACC may also reducing road accidents and improving performance, especially if combined with collision avoidance. The primary purpose for this development in CACC is to reduce load on vehicle driver. By using V2V Communication, reducing dashing between vehicles and improving highway capacity that results that highly reliable and safe than conventional ACC system. However, all of the research on improving fuel efficiency through shorter following distances utilized constant-clearance-following criteria in tightly-coupled platoons, rather than the constant-time-gap-following criteria that would be more likely to be used in a production CACC system. While tightly-coupled platooning can potentially improve fuel economy for both large trucks and passenger vehicles, fuel efficiency improvements with CACC using constant-time-gap-following criteria in normal traffic conditions have not yet been demonstrated.

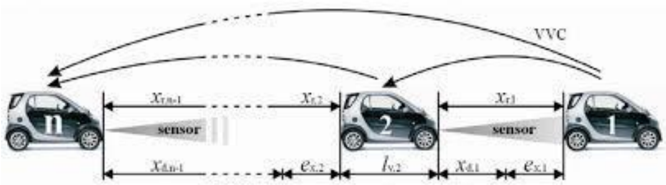

Fig1 :- Cooperative Adaptive Cruise Control

2. PROPOSED METHODOLOGY

This paper gives the thought to develop Co-operative Adaptive Cruise Control by utilizing sensors and two Raspberry Pi boards as controllers. The proposed framework comprises two Raspberry pi, One acts as Slave module and another one acts as Master. This module can be used to recognition different parameters like Distance between vehicle by using Ultrasonic sensor, Side obstacles by IR sensors, Speed control by utilizing PWM methodology and controlling DC motor. Here both Raspberry pi connected with through Wi-Fi communication. This Wi-Fi is used for exchange the information between vehicles. Sensor values such as distance must be defined as threshold values should be greater, if those measured value are less than threshold values then vehicle must slowdown. PWM signals used for controlling speed of the DC motor and also values are displayed on LCD display.

2.1 Distance Measurement

Time taken by pulse is actually for **to and from** travel of ultrasonic signals, while we need only half of this. Therefore time is taken as time/2.

Distance = Speed * Time/2

Speed of sound at sea level = 343 m/s or 34300 cm/s

Thus,

Distance = 34300 * **Time (unit cm) /2.**

2.2 Communication

Wireless communication between vehicles known as Vehicle-to-Vehicle(V2V) communication, in which vehicle can send data to another vehicle via Wi-Fi as transmission medium. Raspberry-Pi have by default Wi-Fi feature for data sharing.

2.3 Speed Control

Pulse Width Modulation (or PWM) is a technique for controlling power. We use it here to control the amount of power going to the motor and hence how fast it spins. The diagram below shows the signal from the PWM pin of the Raspberry Pi.

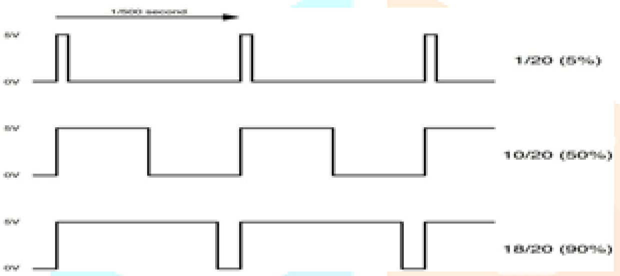

Fig. 2.3.1 PWM Pulse

Every 1/500 of a second, the PWM output will produce a pulse. The length of this pulse controls the amount of energy that the motor gets. If the pulse is active for half the time, then the motor will receive half the power it would if the pulse stayed high until the next pulse came along.

Duty Cycle =Active/High Value time/ (Total time).

2.4 Decision Making And Overtaking

If preceding vehicle come in predefined range then following vehicle must be reduce their speed and also check conditions and data to take decision of overtaking. Speed control in Vehicle Model is done by Pulse Width Modulation mechanism, where the different duty cycle gives different amount of power to motor, and motor rotations are depend upon power that it get

Based on Distance from predecessor vehicle, if preceding vehicle comes in overtaking range then, vehicle must check the side obstacles such as other vehicles or road dividers then take

decision of choosing which side to overtake depends upon where obstacles are not found.

3. IMPLEMENTATION

3.1 System Architecture

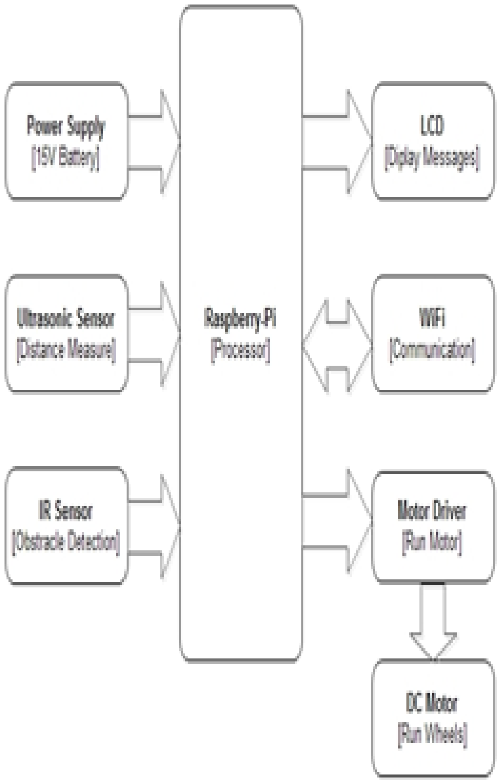

Fig. 3.1.1 System Architecture

3.2 Flow Chart

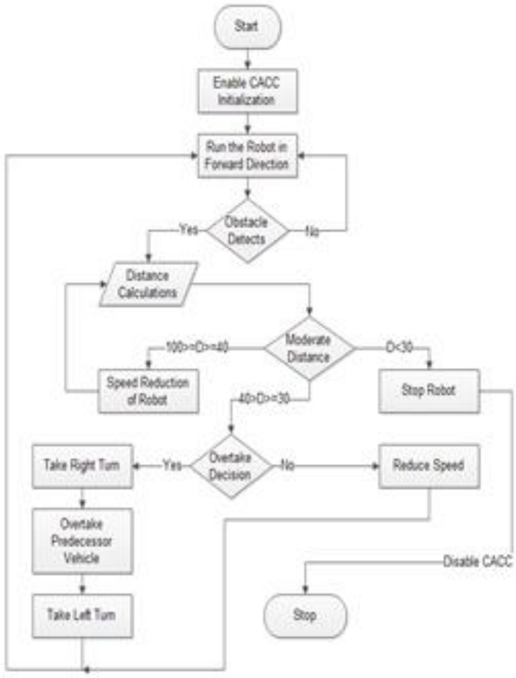

Fig. 3.2.1 Flowchart

3.3 Algorithm

1. Start
2. When user press start button then Enable cooperative adaptive cruise control
3. Initialize communication with other co-operative vehicle
4. Calculate forward distance and left right side objects and send details to other cooperative vehicles continuously.
5. If any vehicle detected less than 20m then stop otherwise run vehicle in forward direction.
6. If distance of preceding vehicle is greater than 30m and less than 40m then check right side IR sensor status of preceding vehicle if status is 1 then go to step 8 otherwise go to step 7.
7. Overtake vehicle from right side.
8. Check left side IR status of preceding vehicle if it is 1 then run vehicle in forward mode otherwise overtake from left .
9. Continue steps from step 4 to step 7 until user press disable stop button.
10. Stop.

4. RESULTS OBTAINED

4.1 Vehicle to vehicle Communication Obtained

Fig.4.1 Communication Snapshots

4.2 CACC Model

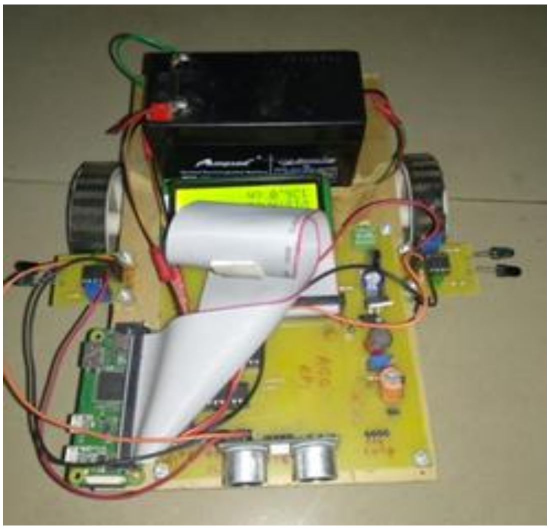

Fig. 4.2 CACC Model

5. CONCLUSION

This paper has presented the design, development, implementation, and testing of enhancement to commercially available ACC systems, based on introducing V2V communications, to produce CACC. The CACC controller design takes advantage of wireless communication information; introducing feed forward terms in the control logic, to enable significant reductions in inter vehicular gaps. The system must be test on public roads showing good performance. First, reduced gap variability was demonstrated. Then, the ability to gracefully handle unequipped vehicles cutting in and out was also validated. Finally, a comparative study between the production ACC system performance and the new CACC controller was carried out. The CACC clearly showed improvements in response time and stability, indicating the potential for a CACC system to attenuate disturbances and improve highway capacity and traffic flow stability. Ongoing and future research on this topic is mainly focused on assessing the potential magnitude of improvements that a CACC system might have on traffic response, both with respect to ACC and as a function of market penetration.

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