Vehicular Distance Control With Collision Warning System

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Abstract *:* All over the world, every car making company insist to have Advanced Driving Assistance Systems . Cruise control in vehicles is becoming more and more a standard accessory in modern cars and it is an important part or feature of Advanced Driving Assistance Systems. On highways or in city's traffic areas, driving or keeping a safe distance to the preceding vehicle calls for a high level of concentration.In this paper, we implemented the system with distance control feature for vehicle. To improve the safety of vehicle in traffic or non-traffic area, we alert the driver by giving him or her a warning before the collision which leads to help the driver to maintain distance between two objects. If in case the driver have kept this system on active in rainy weather to prevent collision the system will alert the driver and will maintain safe distance.The predefined data set is developed for the adjustable distance coverage. A decision algorithm is deployed to automatically maintain a predefined minimum distance to the preceding vehicle. As a consequence, the driver enjoys more comfort and can better concentrate on the traffic.

***Index Terms* -** Adaptive Cruise Control, Advance Driver Assistance System, Warning System,Vehicular Technology

I. Introduction

Vehicular technology is used to not only serve as an impact to our every lives, but to provide a service for transportation, a safer environment, and profitable industries. Automobile companies try to ensure that certain vehicles are of highest quality. With large increase in the number of vehicles on the roads, new technological involvement like Advanced Driver Assistance System is becoming necessary part of every automobile. All over the world, every car making company insist to have it.

The development of ADAS is done to help driver and to reduce accidents. Accidents are often caused because of the mismatch between vehicle-driver surrounding. Most road accidents occurred due to the human error. Drivers are considered, partially or completely, to be the cause of about 80% accidents. If numbers of vehicle are increasing at a faster rate, thus there occurs a need of managing this huge traffic, so as to avoid fatalities due to accidents. The automated system which is provided by ADAS to the vehicle is proven to reduce road fatalities, by minimizing the human error[1].

Many researchers are working on this. Kadir Haspalamutg, Erkan Adali et al. [2], proposes adaptive cruise control method which is consist of two cascaded controllers for speed and distance. In this the switching algorithm compares the leading vehicle velocity with desired velocity of the speed controller and switches back to speed control mode. When the distance gets close again, it switches to time-gap control mode. The second controller receives the desired acceleration and outputs the actuator input to provide that acceleration. The first controller has two modes: speed control mode, and distance control mode which are responsible to calculate the necessary acceleration for the vehicle to keep the desired velocity, or a safe distance with the leading vehicle, respectively. While the reference of the speed control mode is desired velocity, reference of the distance control mode is desired time-gap. The cascaded architecture simplifies the design of the upper controllers. The lower controller makes sure that the actual acceleration tracks the desired acceleration. However, due to the finite bandwidth of the controller, tracking of the desired acceleration is not perfect, but this paper does not deal with pedestrian detection.

In the paper [3] Wonhee Kim, Chang Mook Kang , Young Seop Son et al, a vehicle path prediction employing yaw acceleration for adaptive cruise control is proposed. First, a path prediction method employing yaw acceleration is proposed to improve the path prediction performance of ego vehicles. In the proposed method, the vehicle path is predicted by using a clothoidal cubic polynomial curve model, and for this purpose, the curvature rate, yaw rate, and longitudinal velocity are required. Thus From the radar, the relative longitudinal position, velocity, and acceleration, and relative lateral position are measured at a slow sampling rate. In this section simulations modules are discussed those demonstrate the wide applicability in the cruise controller. Where this paper covered an overview PID,IPD controller structure. Different format are studied of different controllers [4].

Glenn R. Widmann, Michele K. Daniels, Lisa Hamilton et al., in the paper[5], the actual onroad test results of the Adaptive Cruise Control system are discussed and compared for the two types of sensors. They have compare the two main sensors Radar and Lidar and studies their working. The vehicle was uniquely configured to provide ACC functionality using either lidar- or radar-based object detection technology. The minimum sensor requirements for the ACC system are based on the ability to provide smooth adequate vehicle control that can be accommodated without the need for driver intervention. The object detection sensors and ACC-system performance was examined for several real-world driving scenarios.

In this paper Petter Nilsson, Omar Hussien, Ayca Balkan, Yuxiao Chen, Aaron D Ames, formalized the ACC problem using a hybrid dynamical system model and an LTL specification. Then, they presented two solution approaches to synthesize correct by construction control software for ACC. Both approaches rely on fixed-point-based computation of a controller domain from where the LTL specification can be enforced, one computing such fixed points directly on the continuous state space, the other on a finite-state abstraction of the nonlinear dynamics[6].

In [7], Gao Zhenhai, Dazhi, and Wang Lin., discussed the switching process with three mode for cruise control. In order to overcome the shortage of existing switching strategy, a new switch strategy is put forward in this paper which considers three arguments: distance, relative velocity and acceleration. This new strategy can make vehicle acceleration continuous and smooth during control mode switching, which improves the comfort performance of ACC system. Moreover, the decision algorithms of cruise mode, follow mode and approach mode in ACC system are built. The new switching strategy with three arguments is established in this paper. At last, the road tests show that the proposed switching strategy is able to switch to correct control mode according to actual traffic scenes.

In this study, they obtained a basic safety distance using fitting function and add μ-safety distance, considering a friction coefficient and a relative velocity, to the results to calculate a final safety distance. In this paper, they calculated the safety distance by considering the friction coefficient and derived the equation of a required velocity, thus it allows vehicles to go as it maintains the safety distance. Especially, it is found that if a vehicle with μ-safety distance system runs, it can avoid collision, maintain the safety distance and follow the preceding vehicle even under unfavorable road conditions with low friction coefficient. The smooth driving reduces driver's anxiety and further it helps driver to drive vehicle stably under rainy and snowy conditions. In short, this technique is expected to raise convenience of drivers in every condition.

In[9] V.V Sivaji1, Dr. M.Sailaja, deals with the design of adaptive cruise control (ACC) which was implemented on a passenger car using PID controller. An important feature of the newly based adaptive cruise control system is that, its ability to manage a competent inter-vehicle gap based on the speed of host vehicle and headway. There are three major inputs to the ACC system, that is, speed of host vehicle read from Memory unit, headway time set by driver, and actual gap measured by the Radar scanner. The system is been adapted with the velocity control at urban environments avoids mitigate possible accidents.

1.1 Existing System and Issues

Adaptive Cruise Control (ACC) is an automotive feature that allows a vehicle's cruise control system to adapt the vehicle's speed to the traffic environment. It is basically an extension of conventional cruise control systems. The existing system has gain importance but there are some limitations of these technologies. Some vehicle manufacturers include warnings about the limitations of these technologies within car manuals.For example, the Volvo XC60 2017 manual states that: "Adaptive Cruise Control does not react to people or animals, or small vehicles such as bicycles and motorcycles. It also does not react to slow moving, parked or approaching vehicles, or stationary objects."

However, Dolf explains that such warnings aren't enough: "A written warning in a car manual is not enough. These assistance systems have to be tested properly and this should be part of the Type Approval test procedure for cars. A car with systems that fail this test procedure, should not be allowed on public roads."[8]

Published on 27 March 2018 by Robert Drane Research by Netherlands Vehicle Authority RDW has shown that adaptive cruise control (ACC) systems do not always detect motorcyclists. The study was conducted in response to concerns raised by the Federation of European Motorcyclists (FEMA, of which the BMF is a prominent member) and Dutch riding groups KNMV and MAG NL. The results demonstrated that, while motorcyclists are usually detected by systems like ACC, they do not always see and react to riders that are on the edge of the driving lane. The automobile companies present today are working more on developing the adaptive cruise control with speed and distance. There are not paying attention on detecting motorcycles as they are developing ACC for highway lanes. For bad weather conditions, automobiles companies suggest that the driver should take the whole control to himself but the system should at least give warning in such bad conditions before giving control to driver. .

1.2 Problem Definition

Thus, the above mention problems enforced a solution by adding some feature in present system which will adjust the distance control and will be helpful to avoid collisions even in bad condition such as rain. The system can be used to avoid the collision as it will maintain the relatable gap between vehicles and will give warnings to the driver to have his or her attention. In Existing system there is limitation of essential speed which should be above 25kmph. Also there is existing car which work its Acc on rainy weather so, in proposed system the car will move with the speed of less than or equals to 20 kmph by taking control of distances in rainy days only when the driver allows. The implemented system start with 0 speed.

II. PROPOSED METHODOLOGY

As per discussed earlier, the existing system is good but there are some limitations. In this system, to overcome these problems, a system with less inter-gap distance between the vehicles and with collision warning system in rainy weather is proposed.

This proposed system has four objectives which are as follows:

1. To maintain the speed set by driver. Here the system will drive the vehicle with a fixed speed.

2. Check for the spacing to maintain safe distance.

3. To detect the presence of rain and act accordingly.

4. The system should take proper steps according to the situation where the distance between the objects is not secure by giving warning if the vehicle crosses safe distance.

2.1 Flow Of Proposed System

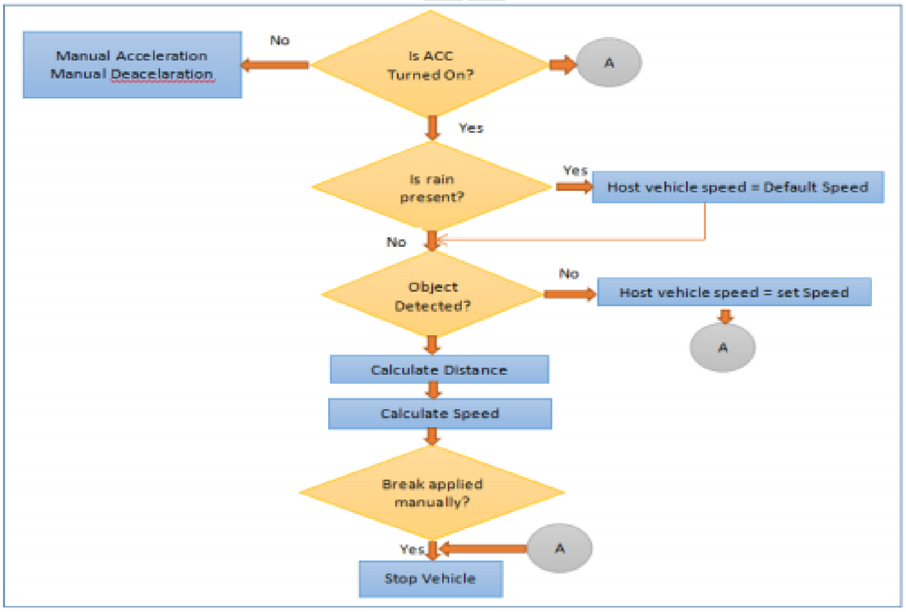
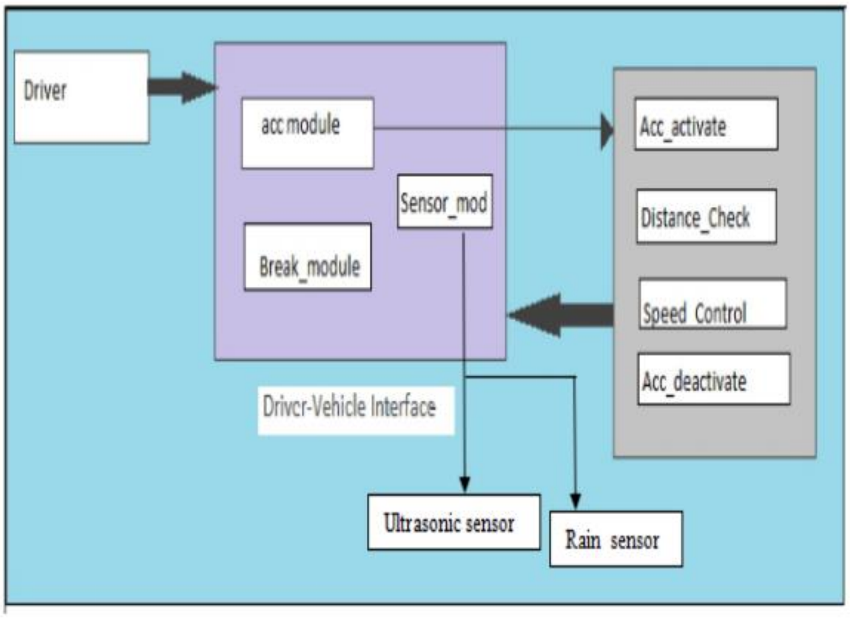


Fig 2.1 Flow Chart

The Flow of proposed system starts with the driver willingness to start ACC. If the the driver turn on the ACC, the system start working. Otherwise the car will work manually. When driver wants to drive the vehicle in our system mode, he selects cruise control mode, the system starts working as shown in fig 2.1. The user sets the minimum distance he wants as a critical distance. Depending on the user set distance the ACC mode on condition start working. After the initialization if the presence of rain detected them the host vehicle will move with the default low speed in case the driver has forgotten to turn off the ACC system. The actual working is based of the detection of objects. If there is no object present in front of the host vehicle the the car will cruise with the set speed. When the object is detected the system will calculate the distance and speed.

2.2 System Architecture

In this system we have used ultrasonic sensor as the distance measurement unit, rain sensor foe detecting range and raspberry pi as a controller. Vehicles with ACC move in cruise mode at a preset speed. Rain sensor checks for the rain presence. If rain present and driver has forgotten to deactivate the system the car will cruise with default speed. Ultrasonic sensor sends signals at regular interval and these signals are reflected from vehicle in front of our car. If signal is reflected within safe distance, the presence of lead object is notified and the speed of the car decelerates or slows down. An adaptive control refers to the algorithm parameter in which adapt to present status in place of constant set of parameters. It calculates output value for control signals. The value of safe distance, mid distance and critical distance and preset cruise velocity are inputs to a data unit in acc module. Acc module has inputs of set data and observed data. It sends output as input to the algorithm where it sends output.



There are 3 modules in this implemented system.

1. Sensor Module
2. ACC Module
3. Break Module

1. ACC module : It is activated when the driver selects the ACC mode. The ACC module after the target detection receives the information from the ultrasonic sensor and based on that information it calculates the safe distance between the host vehicle and target vehicle. Based on the distance and safe distance the ACC module will send signals giving command to accelerate or de-accelerate the vehicle to avoid collision and also alert the driver by warnings.

2. Sensor Module: This module has two types of sensor , one is ultrasonic sensor and other is rain sensor.

i. An ultrasonic sensor is used to measure the distance of respective object by sending the sound wave of specific frequency. This sound wave is reflected after the collision with respective object and this wave is received by the ultra-sonic receiver. Distance is measured by calculating sending and receiving time of this sound wave. This data is send to the ACC module ass input.
ii. Rain sensor is used to detect the rain condition. If there is rain (not heavy) and driver forgets to disabled the active control system then at that time this sensor detects the presence of rain and slows down the speed of vehicle and send data to Acc module.

3. Break Switch Module :It looks after the deceleration of the vehicle after the ACC module determine whether the preceding vehicle is within safe distance with respect to ego/host vehicle and checks for the break applied by driver

III. RESULTS AND DISCUSSION

If object is beyond the sight of host vehicle, or the distance between the object and vehicle is greater than safe distance, the vehicle will cruise with set speed by the driver.When the object is detected and distance is mid distance, the system will give alert by indicating with Led and Buzzer. It will slow down the speed of vehicle.When the distance between object and vehicle is too close i.e. critical distance ,the vehicle will stop immediately by giving warning to the driver in the form of Led and Buzzer.

Fig 3.1 Implemented System

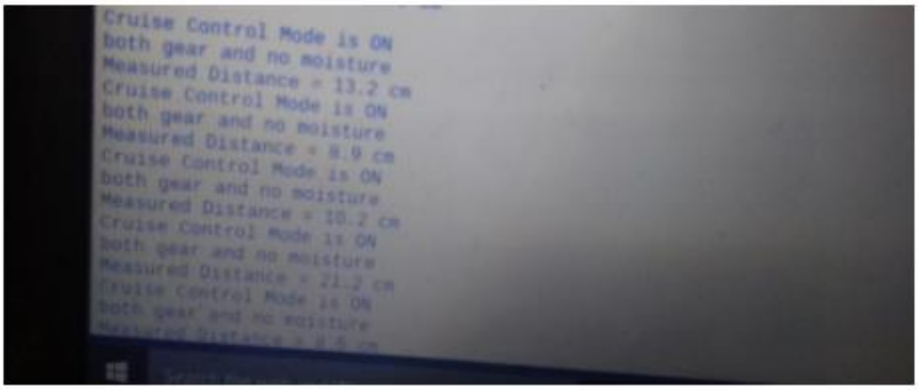


Fig 3.2 Message displays

When driver activates the cruise control mode and rain starts, the rain sensor will detect the presence of rain and will give warning to the driver. It will slow down the vehicle's speed and the vehicle will cruise with the 20kmph speed. When rain detected and distance is close, message displays output as warning and vehicle stop. Otherwise vehicle will move with low speed of 20kmph only if driver wants.

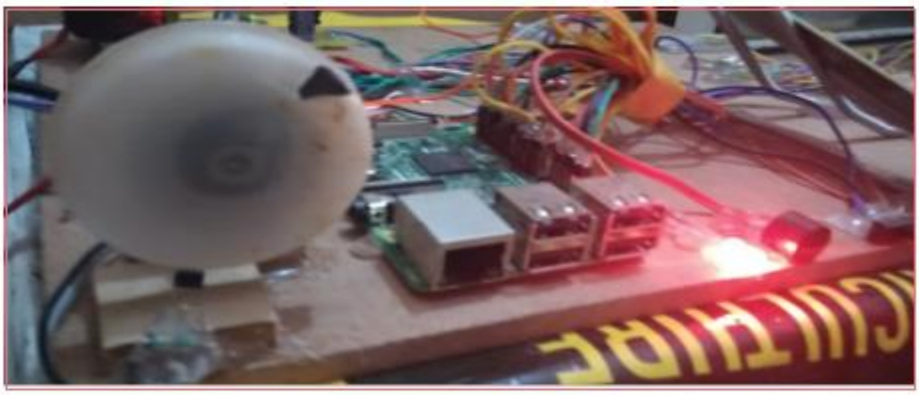


Fig 3.3 Warning system

Figure 3.4 represent the Coverage report generated by the Reactis after the model is tested against it.In this we tested the system with the existing one. As we can see the project nearly covers all the decision, condition, and branches. Also it covers the 83% of MC/DC and the total coverage amounts to the 97%.Since the total coverage is above 90 percent therefore we do not need to cover the MC/DC manually. Thus the project successfully passed the test suite generated by the Reactis.

System: acc_project_v1

	Local				Cumulative			
Coverage Metric	Covered	Unreachable	Uncovered		Covered	Unreachable	Uncovered	
Branch	0	0	0	--	157	5	2	99%
Decision	0	0	0	--	30	0	0	100%
Condition	0	0	0	--	60	0	0	100%
MC/DC	0	0	0	--	25	0	5	83%
Total	0	0	0	--	272	5	7	97%

Fig 3.4 Coverage Report

IV. CONCLUSION

In this paper, we have implemented a system with adjustable distance control which controls the inter gap and alert the driver using collision warning system. In the existing system all efforts had made to developed system in normal weather. Whereas, in our work we have proposed a cruise control mode in rainy weather. The major focus of our work is to prevent collision by the detection of objects. Another objective is to maintain the speed of the vehicle under no lead vehicle or object condition and maintain the speed of the vehicle after detection of object and rain.

The operation of the implemented system manages speed to a complete stop and resumes the set speed based on driver input. A sensing system attached to the front of the vehicle is used to detect whether slower moving vehicles are in the host vehicle's path. If a slower moving vehicle is detected, this system will slow the vehicle down and control gap between the host vehicle and the lead vehicle. If the system detects that the forward vehicle is no longer in the host vehicle's path, the system will accelerate the vehicle back to its set cruise control speed. This operation allows the host vehicle to autonomously slow down and speed up with traffic without intervention from the driver.It gives warning to the driver to avoid collision.

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