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Advanced Driver Assistance System using Vehicle to Vehicle Communication

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Abstract - *Increasing numbers of vehicles on the road are adding to the problems associated with road traffic. Efficient monitoring of vehicles is need of time for smooth traffic flow. Safety system for Vehicle collision avoidance is prime challenge to be met. Many technologies are in action for collision free traffic. Pertaining to this, Intelligent Collision Avoidance (ICWA) system based on V2V (Vehicle to vehicle) Communication is proposed which addresses the issue of collision avoidance. ICWA is one of the leading research feature of advanced driver assistance system (ADAS). In this paper optimized algorithm is developed for collision avoidance, safety zones are created for each vehicle. Overlapping of these safety zones found by this algorithm. It establishes Vehicle to Vehicle communication through wireless protocol Wi-Fi. In this frames Contain vehicular parameters (speed, location of car, turn signal etc.). Each car can transmit and receive the frames from other cars which are within the communication range. This information is takes as input to collision avoidance warning system algorithm. If there is accidental situation, system gives warning to the driver. Apart from this, Android application is developed to make the system more secure and user friendly. The system is implemented on Virtual car environment with street map and gives the warning based on the accidental situation predicted by the algorithm using vehicular information of all cars within the range of communication.*

Key Words: **Vehicle to vehicle communication, Android application, Virtual car environment, intelligent collision avoidance warning system, Wi-Fi.**

1. INTRODUCTION

Invention of automobiles was one of the greatest commercial achievements of mankind in the past century and has contributed lot in different ways to the growth of a nation. Perhaps, we can't ignore the fact that many of people lose their life or suffer life changing accidents due to vehicular collisions every year. Causalities in traffic accidents are mainly caused by collision between vehicles due to the inability of the drivers to gauge the perimeter of their vehicles. This is particularly accentuated in large vehicles like trucks where there are many blind spots. Therefore Advanced Driver Assistance system (ADAS) comes in to picture.

ADAS helps drivers in driving process for safe driving. ADAS has received widespread attention with active work being carried out for over four decades. ADAS consists of lots of adaptive cruise control, adaptive light control, Automatic parking, automotive night vision etc. The research is going on the key feature of ADAS that is collision avoidance warning system.

A vehicle collision avoidance system based on wireless communication and GPS can eliminate the drawbacks of the optical based technology even under high speeds or under near-zero visibility [1].

In this thesis, we are introducing to Intelligent Collision Avoidance Warning System using Vehicle to Vehicle (V2V) Communication, and it basically employs with the help of wireless communication protocol. We are transferring as well as receiving the vehicular parameters like speed, location of vehicle, turn signal information etc. through protocol frames within its range. Unlike current radar, camera, and other sensors, it can know what oncoming vehicles are doing-or even those around corners and out of sight. The idea is to use this information to help electronic safety systems work more smoothly and safely. Apart from this we have provided extra security to avoid cyber-attack by developing android application for log in to the system. Also this is provided as if anyone don't want to use this warning system because if he gets irritated then he/she can make it off, still there vehicle can transmits the vehicular information.

2. Related work

Vehicle collision avoidance warning system (CAWS) are of two types. In the start the work is focused on systems where a vehicle would gauge obstacles in its path through camera, radar, and ultrasonic sensors etc. [2]. Recently to detect potential accidents vehicular communication networking is using as the vehicles are not in sight. Most of research is going on in this field. Inter vehicular communication uses different protocols like Wi-Fi, zigbee or DSRC (Dedicated short range communication protocol). The paper [3] shows inter vehicular communication by using 802.11.Thus these collision warning system based

on inter vehicular communication involves the broadcast of the vehicle coordinates and other useful information like speed, direction of the vehicle.

Several work has propose different wireless technologies for vehicle communications based on existing wireless technologies that are standardized. In 2004, European Telecommunications Standards Institute (ETSI) has produced standards to utilize DSRC in 5.8 GHz band for Electronic Toll Collection [4]. Similarly, Federal Communications Commission (FCC) has released the standard for DSRC in 5.9 GHz band to protect the safety of the traveling public, and also for commercial use [5]. IEEE 802.11p is a draft amendment to IEEE 802.11 to evolve the wireless transmission in 5.9 GHz band to support vehicles of speed less than 200 km/hr and in communication range of 1 km [6], and the framework and application for vehicle communication are defined in IEEE P1609 Wireless Access in the Vehicular Environment (WAVE) [7].

3. Proposed System

Proposed scheme uses V2V communication and Android app to develop an Intelligent Collision Avoidance warning System.

3.1 System Methodology

- Design and develop the android application to avoid cyber-attacks.
- Development of virtual car environment using QT to provide real time traffic scenario to test our algorithm.
- Communication establishment of virtual cars to share the vehicular information to predict the accidental situation.
- Development of optimized intelligent collision avoidance algorithm to give the warning to the driver if there is any accidental situation.

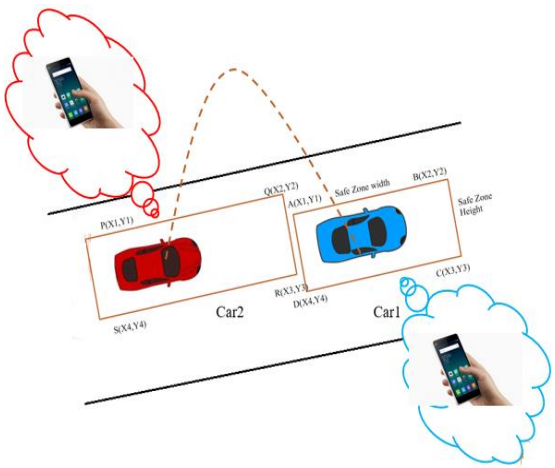

Fig -1: ICAW system

3.1 System flowchart

The following flowchart shows the overview of the entire system:

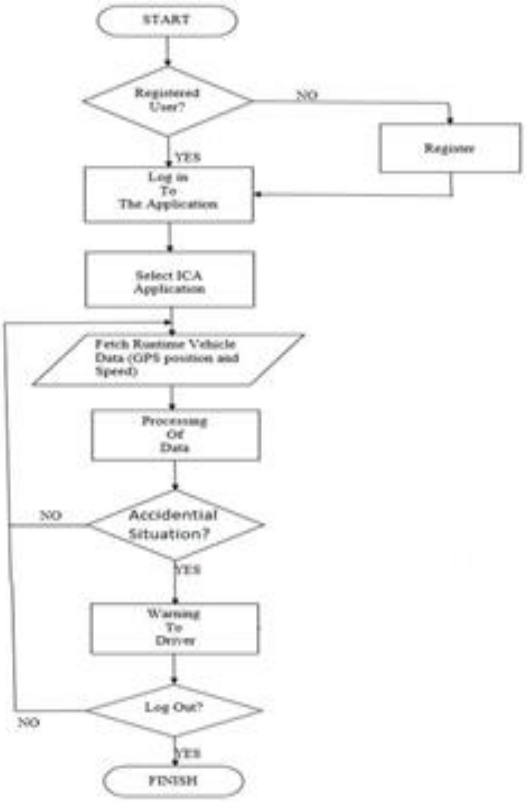

Fig -2: Flowchart of system

4. Implementation of System

Intelligent collision avoidance warning system is dived in to four parts as described below

4.1 Android application development

This application is created to authenticate the user to avoid cyber-attack. Now a days cyber-attacks are increasing day by day. In vehicle to vehicle communication, we are transferring frames of essential data. So to avoid congestion made by cyber attackers, android app will help. As one has to first of all register to the system and log in to the system to access the Intelligent Collision Avoidance system.

Another advantage is that if users don't want the warning system then he/she can make it off through android application their car can still communicate with car; just that car that has made system off can't access the warning system.

- Registration activity
- Log in activity
- Features activity

Results are as shown below:

Fig -3: Ford safety application on Home screen

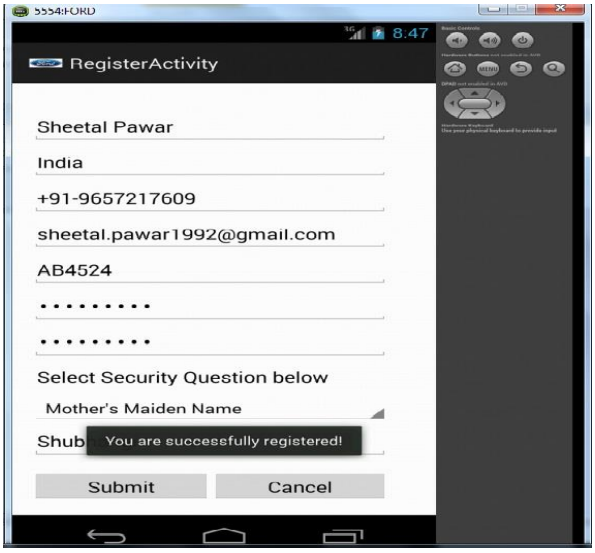

Fig -4: Register activity

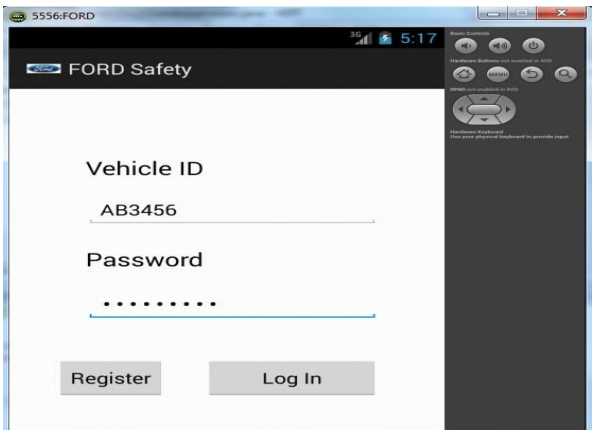

Fig -5: Log in activity

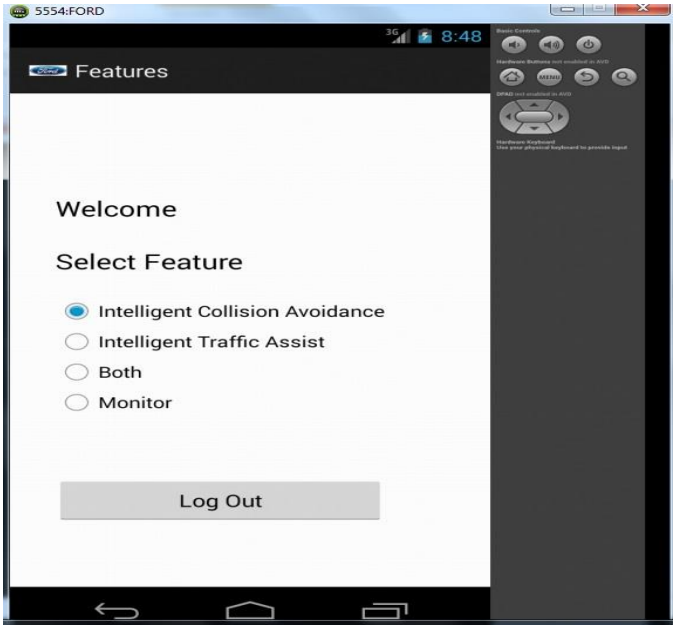

Fig -6: Features activity

4.2 Virtual car environment

Virtual car environment is the platform for the developing the intelligent collision avoidance warning algorithm. It is developed such that it provides the real traffic scenario. Here the real time physics is applied to achieve the real scenario. So that achieve the testing up to the mark.

This virtual car environment contains the cars with street map. Car having steering, gears, turn indicators. From this we get the location coordinates of the vehicle, vehicle size of the vehicle.

Virtual car environment developed in QT. This car is operated with the help of keyboard keys and mouse.

Table -1: Car movement functionalities

Car movement keys and functions	
Keys	Functions
8	Forward
2	Reverse
4	Left turn
6	Right turn
7	Left turn indicator
9	Right turn indicator
+	Speed increase
-	Speed decrease

Results are as shown below:

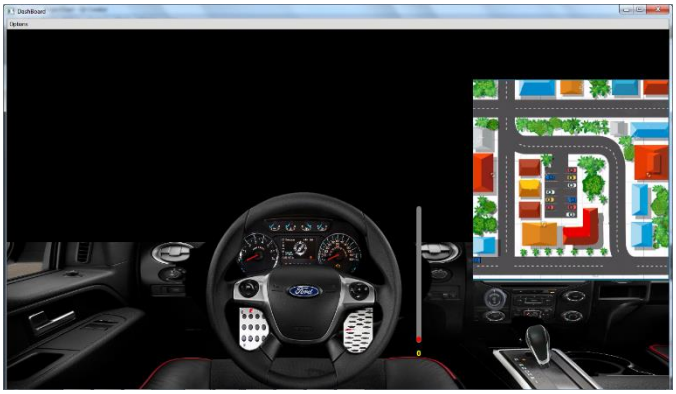

Fig -7: Virtual car environment

4.3 Creation of safety zones

We have created safety zone by considering:

- Size of vehicle(S)
- Distance covered due to human reaction time (D1)
- Distance travelled by the car after applying brake as per current speed.(D2)

Safe Zone width = S + D1 + D2

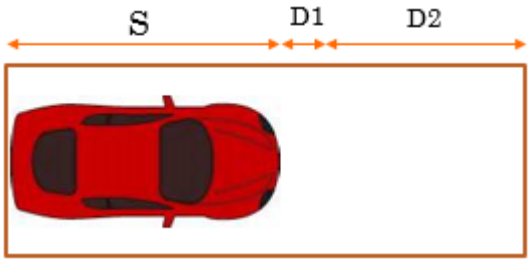

Fig -8: Safe zone of car

The width of safety zone changes with the speed of the car. If the speed increases safety zone width increases and vice versa.

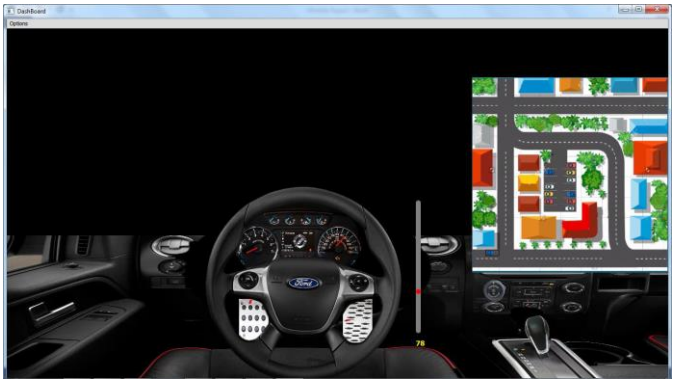

Fig -9: Safe zone of car

4.4 Communication of virtual cars

Communication of car is done through UDP socket programing. UDP frame of 22 bytes is developed.

UDP frame is as shown below.

No.	1	2	3	4	5	6	7	8	9	10
Fields	SOF	Vehicle ID	Latitude	Longitude	Speed	Steering angle	Safe Zone width	Left turn status	Right turn status	Reverse status
Byte	1	2	1	1	1	1	1	1	1	1

No.	11	12	13	14	15	16	17	18	19	20	21	22
Fields	Brake status	Vehicle size	Ax	Ay	Bx	By	Cx	Cy	Dx	Dy	Reserve bits	EOF
Byte	1	1	1	1	1	1	1	1	1	1	1	1

Fig -10: Frame format

Communication result

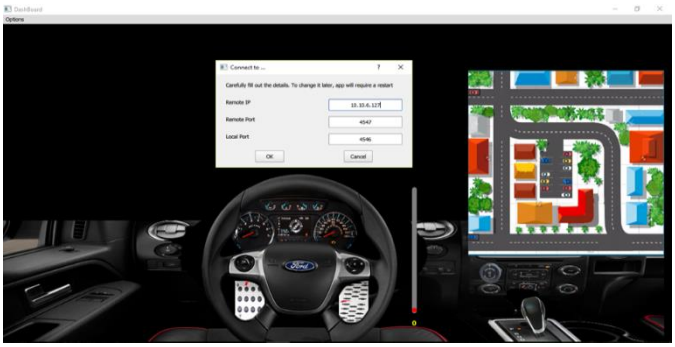

Fig -10: Connection to other car

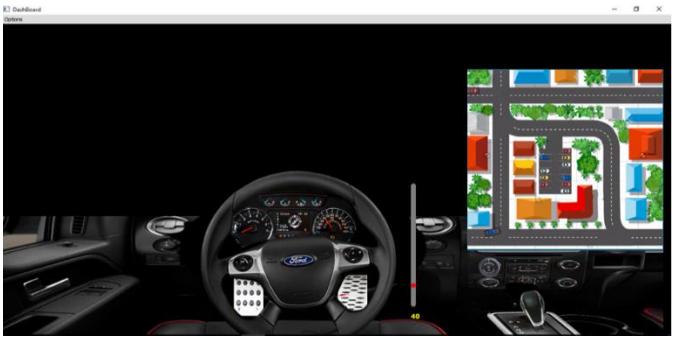

Fig -11: Blue car environment

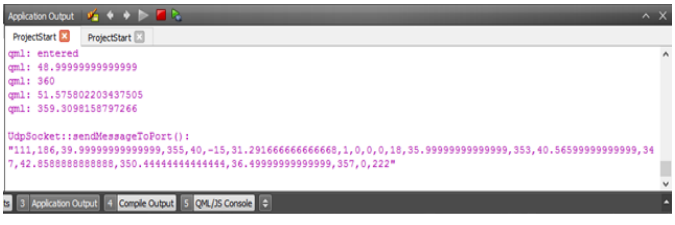

Fig -12: Frame sending from blue car to red car

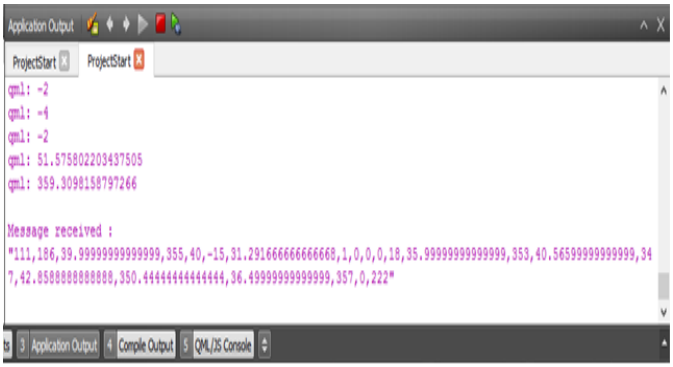

Fig -13: Frame received to blue car from red car

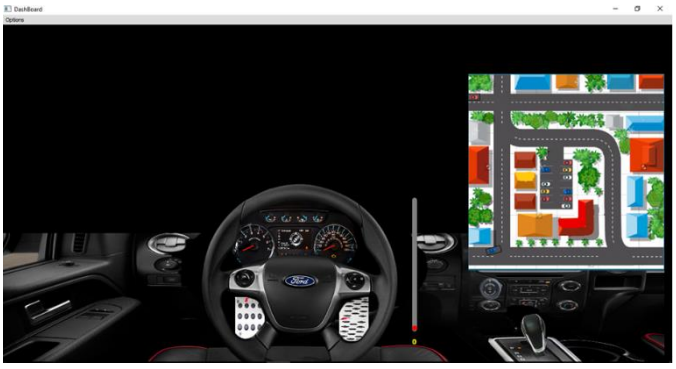

Fig -14: Red car environment

4.5 Intelligent collision avoidance algorithm

Accidental situations are

- Lane change collision
- Front end collision
- Rear end collision
- Intersection collision

To give the accidental warning to the driver the intelligent collision warning algorithm is developed as below.

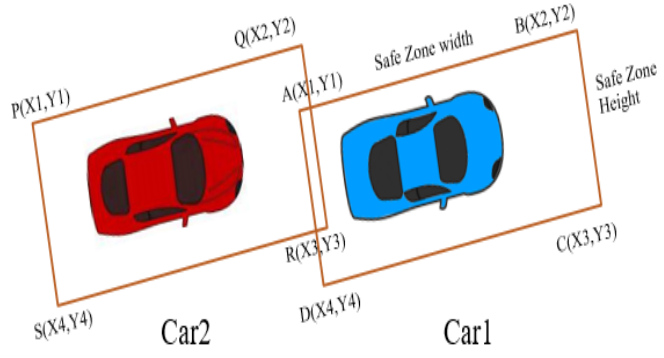

Fig -15: Safe zone intersection of cars

Safe zone intersection flowchart:

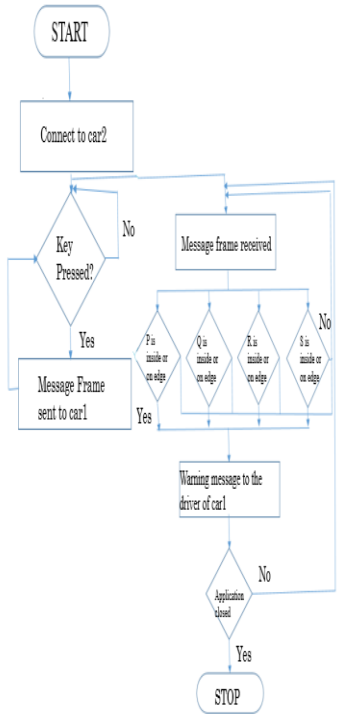

Fig -16: Safe zone intersection finding flowchart

Algorithm to find the overlapping of safety zone:

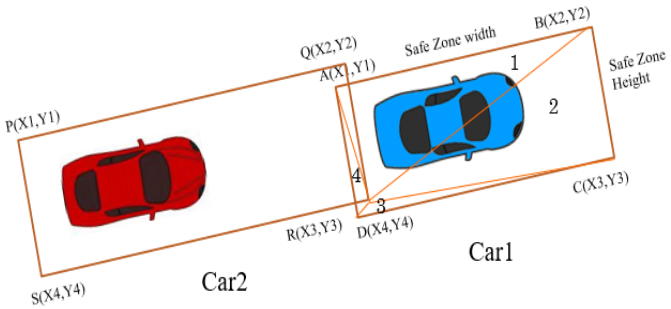

Fig -17: Safe zone intersect inside

Area (ABCD) = A (1) + A (2) + A (3) + A (4)

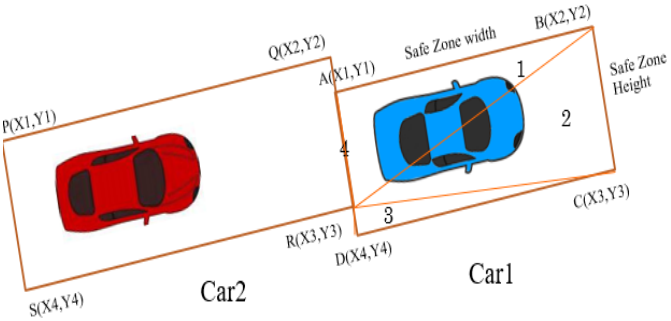

Fig -18: Safe zone intersect on edge

Area (ABCD) = A (1) + A (2) + A (3) + A (4)

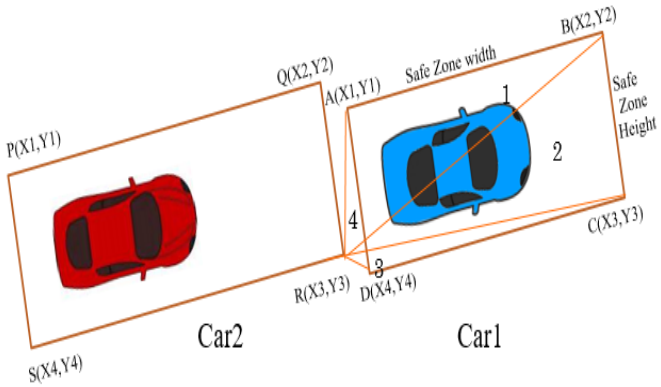

Fig -19: Safe zone not intersected

Area (ABCD) < A (1) + A (2) + A (3) + A (4)

Algorithm steps for the ICAW system.

- Find out area of the safe zone of car1.
  Safe zone Area = Safe zone width X Safe zone height
- Find out distance RA, RB, RC and RD.
- Find out area of RAB, RBC, RCD and RAD.
- Add these areas and store as
  Covered Area = Area (RAB) + Area (RBC) + Area (RCD) + Area (RAD)
- If Covered Area = Safe zone Area
  Then R on the edge of safe zone or inside the safe zone of car. Warning to the driver.
  Else R is outside the safe zone of car1.

Results of the ICAW system.

- Lane change collision warning

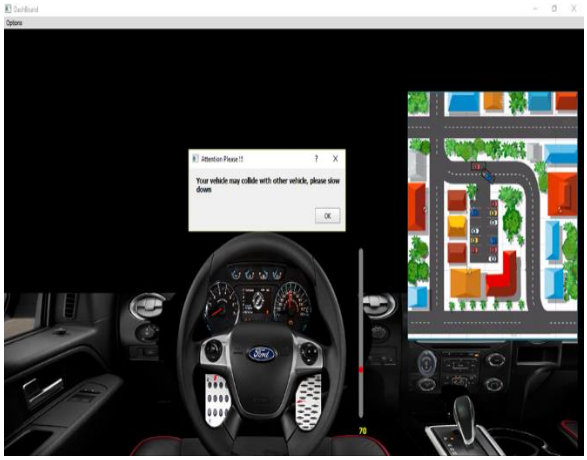

Fig -20: Lane change collision warning

- Rear end collision warning

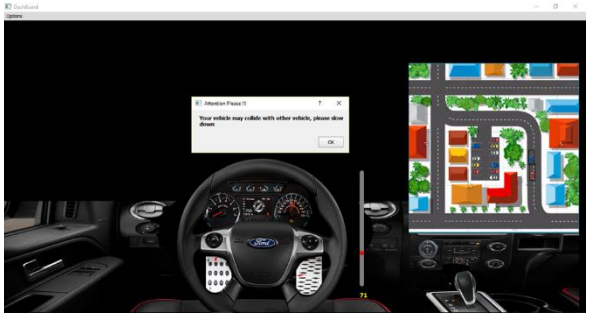

Fig -21: Rear end collision warning

- Intersection collision warning

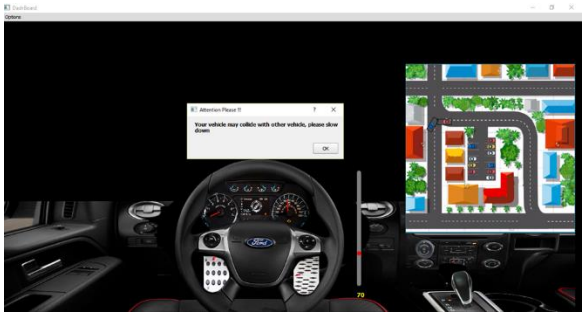

Fig -21: Intersection collision warning

5 CONCLUSION

In this way the ICAW system is developed, which provides 360° view to the driver so that accidents are minimized. Addition to this android application provides cyber-attack security to avoid congestion of frames and to work system smoothly. It becomes easy and minimizes the time required to identify the accidental situation due to the safety zones overlap algorithm. It provides all the warnings like lane change collision, rear end collision, front end collision and intersection collision with the help of this algorithm.

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