An Idiosyncratic Rear End Collision Avoidance Technique Entailing CAN Protocol for Comprehensive Conveyances

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Abstract*—Passenger safety is the prime concern in modern day vehicles, especially in driverless automobiles. *Collision warning and collision avoidance systems are the latest emerging automotive safety technologies that assist the automobiles, especiallsy cars in avoiding accidents.* Alarming statistics of accidents and increased number of vehicles on road demands for an intelligent safety mechanism that helps the car in handling a type of immediate precarious situation, specifically a sudden probability of a rear- end collision. Accidents due to rear end collision is one of the major problems encountered in cars, because of the ordinary succeeding vehicle, which is not trained to respond automatically and instantaneously to react to sudden halts and other emergency situations. When a car decelerates or halts suddenly by sensing an , the following vehicle tends to collide at the rear as it does not have the knowledge and capacity to respond to this unexpected situation. This results in serious damage to both the vehicles, posing a very big danger to passengers within the vehicles. The solution to this impending danger can be eliminated by extensively employing different electronic sensors and protocols like CAN(Controller Area Network) .*The ARM processor* keeps a continuous check on vehicle parameters using MEMS sensor and temperature sensor and gas sensor. The CAN controller on receiving the equivalent results, is used to communicate within the car. This avoids collision between the cars.

Keywords - Controller Area Network (CAN), Micro-Electro Mechanical Systems (MEMS) Sensor, Collision avoidance

1. INTRODUCTION

The aggrandizing use of electronic controllers and instrumentation in modern automobiles have largely contributed towards complex circuitry deployed in vehicular control systems.In the early 1980s Bosch reinforced the Controller Area Network (CAN) which is a serial bus communications protocol .The transmission between actuators,controllers and sensors are efficiently done by the usage of CAN. CAN is termed as an important feature in a wide variety of networked embedded control systems.The vehicle industry highly supported the early CAN development: CAN is found in a wide variety of passenger trucks,cars,spacecraft,boats and other type vehicles.This CAN is broadly incorporated in industrial branches of automation and other areas of embedded control networks,used mainly in diverse products such as machinery production,equipments used for medical purposes,automation in building, weaving machines, and wheelchairs.The automotive industry has embedded control systems which ranges from highly independent systems to integrated systems and other controls for networking. The usage of electro-mechanical subsystems for networking ,it ensures feasibility to provide performances and hardware,which basically further provides ease of reusability and adding of more abilities.

The communication of the CAN and other controls like turbo,engine and fan are widely manages by the Engine Control Unit(ECU).The increase in reliability and production can be achieved efficiently by the combination of networks and mechatronic modules which further ensures feasibility by the reduction of cabling and connector counts.The introduction of automobile networking efficiently helps in analyzing and coordinating separate subsystem operations.

The different control systems and units in a vehicle are a share of a closed loop systems.It is essential for every Engine control unit(ECU) to perform transmissions with each other and provide further operations..For example, the combustion chamber is fired up by a spark from the ignition system's spark. To optimize the power and fuel-efficiency the initiation time of the ignition becomes very critical.This is thus attained by the communication between the Engine control unit(ECU) and the ignition system with the help of communicatin within the vehicle.Then the calculation of exact time to initiate the ignition is calculated accordingly.

In automatic cars,the Transmission control module is a complex system which exposes the control unit communication's importance.The change in speed in turn forces the change of the gear ratio by the Transmission control unit.To overcome this forced operation of the gear shifts ,data from ECU and other nodes are obtained and implemented respectively.The necessity for communication is incorporated highly,to develop a different perspective let's take a stroll at the early 70's when the surpass of electronic system over the different development stages started leaving quite an impact on the industry of automation

The vehicles started containing more number of electronic devices and also got complex correlation.The transmission of signals between each other and wiring between two points made the system more hard and clogged to manage.Besides,the transmission of data between the automotive Engine Control unit had to be more efficient in real-time applications.Many different control units needed an ideal bus system like CAN because of its atributes like data transfer which is faster,cost efficiency and diagnosis of errors.The CAN protocol helps in overcoming restrictions of adding new properties to the vehicle from complex wiring.

2. EXISTING SYSTEM

A) ANTILOCK BRAKING SYSTEM

An anti-lock braking system (ABS) is a safety mechanism which basically works as a skid control factor and is incorporated in today's aircrafts and automobiles like cars,buses,trucks,etc.The basic principle of ABS is to avoid the locking up of wheels during breaking in any automobile thus sustaining a frictional contact along the road surface.

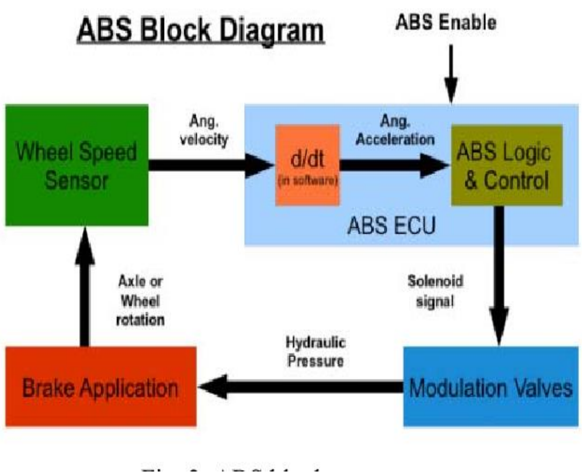

Fig 1.Antilock braking system

ABS is a self-regulating mechanism uses methods which many skillful drivers practiced before ABS such as braking based on threshold and cadence braking.The operation of automobiles are much faster and efficient compared with manual operations.In case of dry and slippery surfaces it is possible for ABS to provide advanced vehicle control also with the reduction of stopping distances.But in cases like road surfaces covered in snow,ABS must provide increase in breaking distances and also must provide an advanced control for steering. Since the introduction of ABS is practically done in production vehicles,those vehicles are highly civilized and effective.The alteration of the front-to-rear brake bias is also incorporated in modern vehicles other than that of the locking of wheels under braking. This functionality is known as the Electronic stability control(ESC).

II) B).ACCELERATION SKID CONTROL

Acceleration skid control prevents the drive wheels from spinning in two ways. On the one hand, it minimizes wheel spinning through a measured braking intervention. On the other hand, the torque of the engine is regulated via the accelerator pedal. During a full throttle level,the power provided by the engine is as much needed for the drive wheel to exchange in critical situations which is considered as a prime benefit in controlling the pulling away and stability of driving.

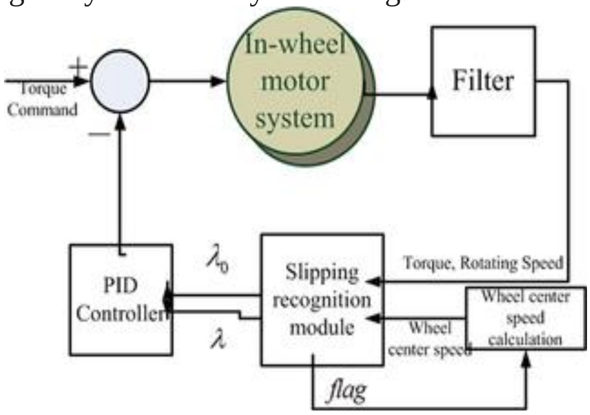

Fig 2.Acceleration skid control

The monitoring of wheel speeds and torques are carried out respectively during the start off.Thus by using this process,the prevention of spinning is done by controlling the distribution of torque. Thus provides guarantees the optimal power flow.Minimalization of risk of braking out of rear of the vehicle during acceleration and drive wheels spinning is ensured for the driver. Particularly engines which are high torque is provided with comfortability and increased safety especially on roads with differentiating frictions.

II) C). POWER TRAIN MANAGEMENT SYSTEM

The generation of power and delivering it onto the road surface,air or water in an automobile is carried out by the prime components under Power-trains.These prime components includes engines,differentials,shafts to drive and transmission and final drives.The inclusion of more than one electric motors for traction which is widely used in driving the vehicle wheels is known as the Hybrid power-trains.

For the purpose of propulsion most of the electric automobiles tend to rely completely on electric motors eliminating the engines completely.The different parts of power-train eliminating the engines completely categorised under the driveline of motor vehicles. Right after the prime mover,this power-train is the part of vehicle which changes depending on the type of vehicle(front-wheel,rear-wheel,four/eight-wheel drive).

The transformation of stored energy to kinetic energy for the purpose of propulsion is done by the components which are categorised under power-train. Power-train also includes power-sources for multiple components and non-wheel based vehicles.

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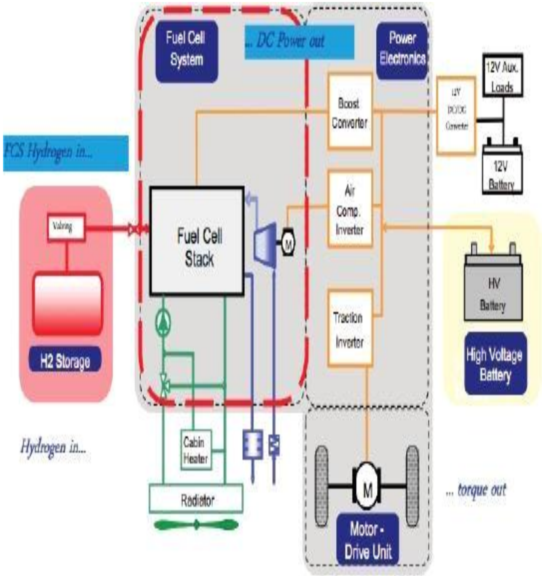

Fig 3.Power train management system

II) D). FORWARD COLLISION WARNING SYSTEMS

Forward collision warning systems are an active safety mechanism which warns driver of the automobile of an impending collision in the front end.For instance,a vechicle installed with FCW comes over the limit of the threshold distance of another vehicle in front of it,it produces a signal which is either visual or audible to alert the driver of the impending situation.Different degrees of support for brakes is provided by some newer FCW systems.

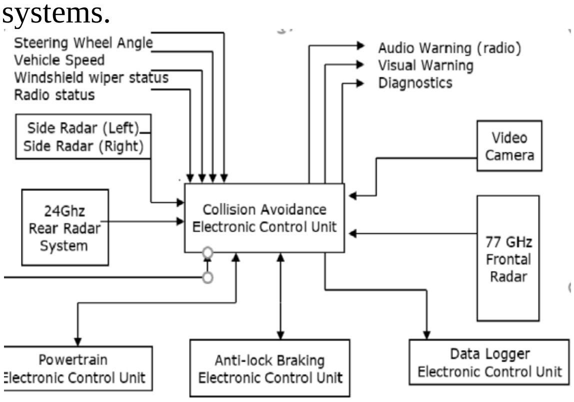

Fig 4.Forward collision warning system

Further if the systems identifies that there is no manual response to the collision warning then the FCW tries to slow the automobile by applying light brakes by itself.For the similar case,strong brakes are applied in the case of newer systems when the driver remains unresponsive to the warning.The applied brake may not be able to stop the automobile,but provides a reduction of speed,thus preventing crashes.There are different names given to FCW such as “Pre-safe Braking”, “Collision Warning with Auto-Brake”, “Pre-Crash Warning Systems”, “Collision Mitigation Braking System”,etc.Regardless of the overall goal to prevent the collsion in the front end,the system is capable of changing its functionalities and abilities.

3. PROPOSED WORK

In our proposed system we eliminate rear end collision by involving CAN protocol.

The system consists of a microcontroller, CAN controller and parameters of vehicle. The main factor in any processing module is the Microcontroller which basically helps in motoring the vehicle parameters.The physical parameters of the automobile are continuously checked by using sensors like Temperature sensor and MEMS sensor.In-vehicle communication can be easily done by the CAN controller.The microcontroller helps in pre-processing of the data which is sensed and accordingly the vehicle parameter values are updated to the central database for every particular amount of time.RS232 is used for serial communication between the PC and the CAN Bus.

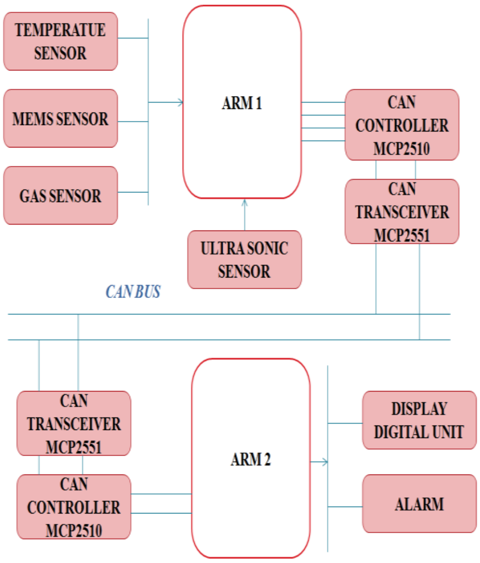

Fig 7.Block Diagram

The monitored vehicle parameters are exchanged between the automobile and the centre of control by the usage of the CAN interface module.This CAN interface module is a three component module such as: CAN Transceiver (MCP 255 1), DSPIC, CAN Controller (MCP 25 10). The potential difference levels of the controller is shifted to make it appropriate for CAN bus with the help of CAN transceiver.

Thus compairing with the common availabe systems the proposed system is better with respect to responsiveness and external infrastructure independence and is also cost effective and reliable in real time. Thus rear end accidents can be reduced effectively with the help of the proposed system.

4. OVERVIEW OF CAN PROTOCOL

In the early 1980s Bosch reinforced the Controller Area Network (CAN) which is a serial bus communications protocol. The transmission between actautors,controllers and sensors are efficiently done by the usage of CAN. CAN is termed as an important feature in a wide variety of networked embedded control systems. The vehicle industry highly supported the early CAN development: CAN is found in a wide variety of passenger trucks,cars,spacecraft,boats and other type vehicles. This CAN is broadly incorporated in industrial branches of automation and other areas of embedded control networks,used mainly in diverse products such as machinery production,equipments used for medical purposes,automation in building, weaving machines, and wheelchairs.The automotive industry has embedded control systems which ranges from highly independent systems to integrated systems and other controls for networking. The usage of electro-mechanical subsystems for networking ,it ensures feasibility to provide performances and hardware,which basically further provides ease of reusability and adding of more abilities.

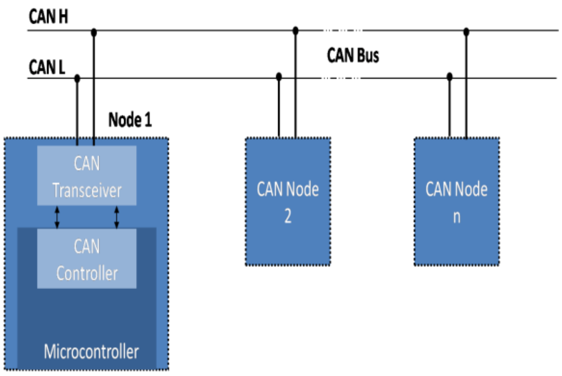

Fig 5.CAN protocol

The communication of the CAN and other controls like turbo,engine and fan are widely manages by the Engine Control Unit(ECU).The increase in reliability and production can be achieved efficiently by the combination of networks and mechatronic modules which further ensures feasibility by the reduction of cabling and connector counts.The introduction of automobile networking efficiently helps in analysing and coordinating separate subsystem operations.

The examination of the implementation of the CAN bus is carried out,presentation of different critical waveform are done and examination of the features of transceiver is implemented.The access of the CAN bus is always acheived by the identifier which has higher priority which basically means that transmission continues because of the identifier with high priority.The node which is arbitrating identifies whether it is placed on the bus which has logic-high value.This is because each and every node of a bus invloves itself in writing each bit.

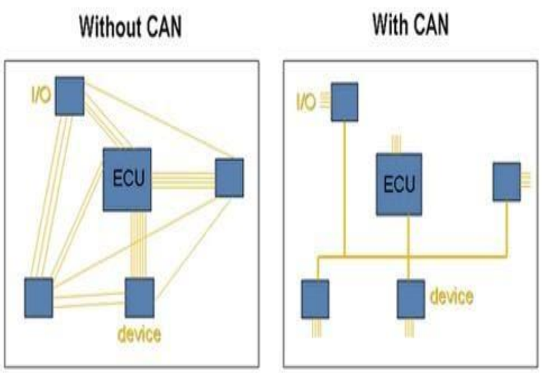

Fig 6.CAN architecture

The application such as requirement reliablity of short messages in operating environment which is rugged is acheived by CAN.CAN is incorporated when the information is required by more than one location and when data consistency is mandatory.This is becaus eof the fact that CAN is not address based and is completely message based.Another prime advantage of CAN is Fault confinement. CAN alsways ensures the presence of faulty nodes and drops them when it is found on the bus, which restricts other nodes from damaging the network and also ensures the presence of perfect bandwidth for exchanging of critical messages. Hot plugging is also done which is basically the addition of nodes to the bus while system is operating.The CAN protocol consisting of CAN transceivers started adapting to many rugged applications.Automobiles such as trucks,motorcycles,cars,bus,trains etc utilize the CAN applications of finding solutions.

5. EXPERIMENTAL RESULTS

Accidents due to rear end collision is one of the major problems encountered in driverless cars, because of the ordinary succeeding vehicle, which is not trained to respond automatically and instantaneously to react to sudden halts and other emergency situations. When a driverless car decelerates or halts suddenly by sensing an obstacle before it, the following vehicle tends to collide at the rear as it does not have the knowledge and capacity to respond to this unexpected situation. This results in serious damage to both the vehicles, posing a very big danger to passengers within the vehicles. The solution to this impending danger can be eliminated by extensively employing different sensors – electronic as well as electro-mechanical. The main objective is to avoid rear-end collision between cars.

6. WORKING

Our work proposes a mechanism that not only computes the deceleration of automobile because of braking and displays the braking intensity through an array of LED but also involves monitoring the braking intensity levels and communicate it to the vehicles that are following using IR transmitter module to avoid any collision before hand, due to any situation that will arise and cause immediate deceleration of the vehicle infront.An accelerometer is interfaced with ARM7 microcontroller which provides deceleration levels ,an LED array to display the braking intensity and inter-vehicle communication that can transmit pulses whose frequency is modulated proportional to the braking intensity is found by the IR transceiver module . To acquire a decision and automatically control the motion of the subsequent vehicle ,a collision avoidance system consisting of microcontroller is implemented that warns the succeeding car employing a buzzer and messages the active and passive safety mechanisms to be activated using CAN protocol and takes control decisions in line with the algorithm designed to handle this particular scenario.

Therefore,after the understanding the working of the CAN protocol.Here are the experimental results for various sensors.Those experimental graphs are shown below:

VI) A) MEMS SENSOR

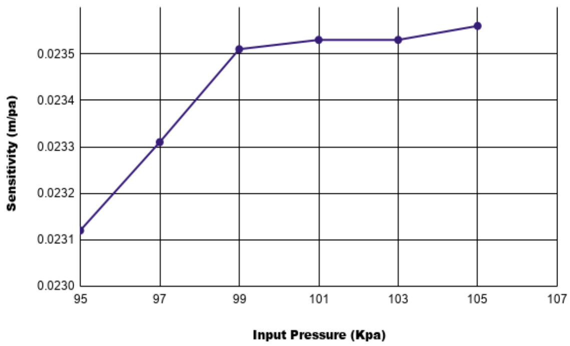

Fig 8.Sensitiviy Vs Input pressure

VI) B) TEMPERATURE SENSOR

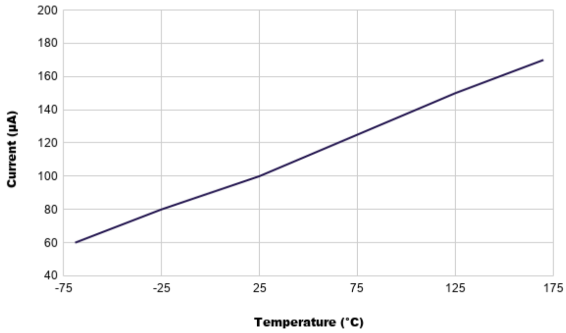

Fig 9.Current Vs Temperature

VI) C) GAS SENSOR

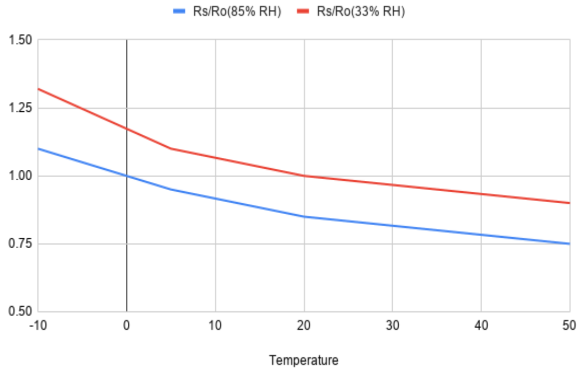

Fig 10.Rs/Ro Vs Temperature

VI) D) ULTRASONIC SENSOR

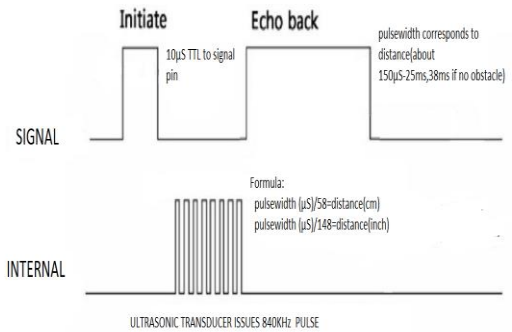

Fig 11.Ultrasonic sensor pulse diagram

VII.IMPLEMENTATION

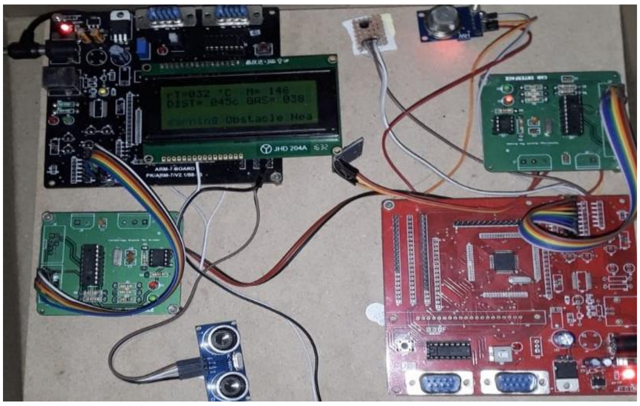

Fig 12.Hardware implementation

Fig13.Output 1 Display

Fig 14.Output 2 Display

By observing fig 13 and fig 14 ,the value displayed by "T" represents the temperature level,the value displayed by "M" represents the MEMS sensor value,the value that is diplayed as "GAS" represents the gas level and the "DIST" represents the distance between the obstacle and the ultrasonic sensor.

By comparing fig 13 and fig 14, fig 13 displays "no obstacle ahead" since the obstacle is in a safe distance with that of the ultrasonic sensor. But in fig 14 displays "stopping vehicle" since the distance between the obstacle and the ultrasonic sensor is very much lower and has exceeded the safe distance and also a beep is activated as soon as the obstacle exceeds the safe distance.

VIII.MERITS

This is mainly useful in Collision Mitigation by Braking due to this the crash avoidance can be done.It is also used for road safety,with this injuries and accidents can be prevented.This can be done with low cost itself and the main thing is that product excellence can be achieved with minimum requirements.

7. CONCLUSION

This project is meant for a secure and simple journey. The vehicle itself is aware of its movement. If the driver himself is not concentrating on driving or any other parameters, which may cause damage to vehicle as well as life, this intelligent car/ vehicle warns the driver regarding the danger ahead. This reviews the vehicle collision avoidance problem in order to accomplish safer transportation on highways. Once accomplished ,this will not only save lives,but also results in considerable amount of financial gains as well. In order to develop the so-called smart highways and smart cars,it is stated that the most important difference from the old practice is the fact that new design approach attempts to entirely avoid collision instead of reduction of the damage caused by over-designing cars.

8. FUTURE SCOPE

This proposed work can be used in various fields in the future like it can be:

This can be implemented in Robotic applications as well as in Aircraft and Aerospace electronics.It can be used in large vehicles like trucks,buses,Passenger,Cargo trains and in Maritime electronics.And this can be mainly used as a Warning system to avoid collision in National Highways.

9. REFERENCES

[1] R. Khamamkar, A. Jadhav, S. Thoke and G. Chaple, "Smart Vehicle Safety Monitoring System Using CAN Protocol," 2018 IEEE Punecon, Pune, India, 2018, pp. 1-5.

[2] N. Lu, N. Cheng, N. Zhang, X. Shen and J. W. Mark, "Connected Vehicles: Solutions and Challenges," in IEEE Internet of Things Journal, vol. 1, no. 4, pp. 289-299, Aug. 2014.

[3] A. Mukhtar, L. Xia and T. B. Tang, "Vehicle Detection Techniques for Collision Avoidance Systems: A Review," in IEEE Transactions on Intelligent Transportation Systems, vol. 16, no. 5, pp. 2318-2338, Oct. 2015.

[4] N. Klausner and M. R. Azimi-Sadjadi, "Detection in multiple disparate systems using multi-channel coherence analysis," in IEEE Transactions on Aerospace and Electronic Systems, vol. 48, no. 4, pp. 3554-3566, October 2012.

[5] N. Klausner, M. R. Azimi-Sadjadi and L. L. Scharf, "Detection of Spatially Correlated Time Series From a Network of Sensor Arrays," in IEEE Transactions on Signal Processing, vol. 62, no. 6, pp. 1396-1407, March15, 2014.

[6] X. Xiang, W. Qin and B. Xiang, "Research on a DSRC-Based Rear-End Collision Warning Model," in IEEE Transactions on Intelligent Transportation Systems, vol. 15, no. 3, pp. 1054-1065, June 2014.

[7] D. Lee and H. Yeo, "Real-Time Rear-End Collision-Warning System Using a Multilayer Perceptron Neural Network," in IEEE Transactions on Intelligent Transportation Systems, vol. 17, no. 11, pp. 3087-3097, Nov. 2016.

[8] Mayur Shinde, Nidhi Pandey, Pritham Shetty, Harsh Umrania & Prof.Manoj Mishra, "Can Based Accident Avoidance System " in IOSR Journal of Engineering (IOSRJEN) www.iosrjen.org ISSN (e): 2250-3021, ISSN (p): 2278-8719 Volume 2, PP 21-25,March 2018.

[9] M. D. Vaio, P. Falcone, R. Hult, A. Petrillo, A. Salvi and S. Santini, "Design and Experimental Validation of a Distributed Interaction Protocol for Connected Autonomous Vehicles at a Road Intersection," in IEEE Transactions on Vehicular Technology, vol. 68, no. 10, pp. 9451-9465, Oct. 2019.

[10]K.Lee and D.Kum, "Collision Avoidance/Mitigation System: Motion Planning of Autonomous Vehicle via Predictive Occupancy Map," in IEEE Access, vol. 7, pp. 52846-52857, 2019.