Challenges in Accident Collision and Prevention in Cyber-Road Traffic Control System

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Abstract— On a daily basis the number of automobiles have increased rapidly due to advances in automobile production and increased rate of population. As a result of which there is increased accident count. The next step is to improve communication among vehicles by connecting the vehicles and giving intelligence to them to communicate with other vehicles and also to interact with people. Cyber Physical Systems (CPS) are a natural consequence of an increasingly connected physical world. Cyber-Road Traffic control System can play a major role in reducing risks, high accidents rate, traffic congestion, carbon emissions, air pollution and on the other hand increasing safety and reliability, travel speeds, traffic flow and satisfied travelers for all modes. Our approach is to find a method by which vehicles can interact with each other, estimate the distances between each other and to alert the driver in case of any unfavorable conditions.

Key words: Cyber-Road Traffic control system, Management of transport networks, resiliency, Accident Collision, Accident Prevention

I. INTRODUCTION

In recent years, traffic congestion has become a significant problem. The simplest solution is to lay more lanes to reduce traffic density, but adding more lanes is not a feasible solution on account of time, cost and efficient utilization of the infrastructure. Traffic parameter estimation has been an active research area for the development of Intelligent Transportation systems (ITS) Cyber-Road Traffic control [1][2] is a sub domain of Intelligent Transport System to make daily road traffic system as smart. Cyber-Road Traffic control System can play a major role in reducing risks, high accidents rate, traffic congestion, carbon emissions, air pollution and on the other hand increasing safety and reliability, travel speeds, traffic flow and satisfied travelers for all modes. The resiliency[4][5][6] is a nonfunctional software requirement define as maintaining state awareness among them and if abnormality identified healing process occur to rollback normal operation.

The management of transport networks requires useful tools that help decision-making when a perturbation occurs. Nowadays, extreme weather takes place more frequently, which can be appreciated in the increment of the number of catastrophic events, damaging all kind of structures around the world. For that reason, the identification of the critical elements is an essential strategy to a robust, reliable development of a country's infrastructure system, as they are key-elements in the progress and well-being of a society. The concept that evaluates the behavior of a traffic network when a perturbation takes place is known as resiliency.

The most extended definition of resilience[3] was given “the capacity to absorb shocks gracefully”. This complex concept has been studied in different areas, i.e., ecology, socio-ecological systems, economics, urban infrastructure, telecommunication systems, water distribution systems, or internet protocol networks. In recent times resiliency definition has become more complex including concepts such as the ability of a system to prepare and to adapt to changes and the recovery of the system.

II. Collision avoidance and prediction methods

A. Crash Avoidance

1) Real-Time Crash Avoidance System On Crossroads

In this paper we study the contribution of inter-vehicular communication in ADAS applications. This paper by S.Ammoun [7] proposes a collaborative system on the crossroads using our 802.11g communications tools and a low cost GPS receiver. Once the vehicles positions exchanged, the crash avoidance is performed by predicting the future positions of both cars and calculating the time to impact and the region of high risk. The prediction is biased in time and space. The time error is due to the GPS and the communication latencies. The space error is caused by the uncertainty of the positions delivered by the GPS receivers.

2) Collaborative Vehicle Collision Avoidance System

The main feature of the proposed system by Konstantinidis E.I[8] is the wireless communication among vehicles during normal driving in case of emergency situations. The wireless communication is originated by a vehicle in emergency state while the vehicles in range get benefit of the transmitted information. The wireless communication packet is comprised of the type of the vehicle, which originates the transmission, the description of the current situation, and the geographical position of the vehicle which is provided by a Geographical Positioning System (GPS) module.

B. Prediction

1) Automotive Crash Prediction And Notification Technologies

The sensor system proposed by Sreevishakh K.P[9] development mainly concentrates on the relative velocity measurement of the vehicles. An isotropic magnetoresistive (AMR) and sonar/ultrasonic sensors are adopted for development of the proposed sensor system. AMR sensors are used to measure the magnetic field and to get the relative position of vehicles. The main aim of the object is to develop a unique sensor system which can be used to estimate the planer position and orientation of vehicles to avoid vehicle collision by effectively predicting the possibility for collision. Once the accident is predicted, the camera system embedded in the vehicle will get activated and will capture snaps to gather information of the vehicles near hit host vehicle. Once accident happens intimation in
the form of alert message including accident location long with the snap information will be send to nearby- hospitals or police station using GSM module.

2) Intelligent CAN-Based Automotive Collision Avoidance Warning System

In the paper proposed by An-Ping Wang[10], to construct a vehicle collision avoidance system, a laser radar and three ultrasonic sensors are integrated with the CAN bus to build the in-car network architecture to prevent the car on all directions. There are two sub-systems developed for this collision avoidance system: (a) the front-end sub-system and (b) the side and rear-end sub-system. The front-end collision warning sub-system is constructed for high-speed driving conditions by measuring the distance in the front with laser radar. For the collision avoidance on the side and the rear-end, the approaching speed from other cars in general is slow and available ultrasonic sensors with limited range and resolution are adopted. An intelligent approach is proposed to process the rough distance readout to render warning signals with suitable timing for the approaching car drivers to prevent the collision passively.

III. COLLISION AVOIDANCE AND PREDICTION TECHNOLOGIES

A. Auto Brake-Collision Warning-

With Auto Brake where the area in front of the vehicle is continuously monitored with the help of long range radar and a forward-sensing wide-angle camera fitted in front of the interior rear-view mirror. A warning and brake support will be provided for collisions with other vehicles, both moving and stationary. Additionally, if the driver does not intervene in spite of the warning and the possible collision is judged to be unavoidable; intervention braking is automatically applied to slow down the car. This aims at reducing impact speeds and thus the risk for consequences. This system has been verified using innovative CAE methods and practical tests. Finally, it is discussed how the benefit of such systems can be judged from real-life safety perspective using traffic accident statistics.

B. Lane Departure Warning-

A lane departure warning system is a mechanism designed to warn the driver when the vehicle begins to move out of its lane (unless a turn signal is on in that direction) on freeways and arterial roads. These systems are designed to minimize accidents by addressing the main causes of collisions: driver error, distractions and drowsiness. In 2009 the U.S. National Highway Traffic Safety Administration (NHTSA) began studying whether to mandate lane departure warning systems and frontal collision warning systems on automobiles. Lane warning/keeping systems are based on: Video sensors in the visual domain (mounted behind the windshield, typically integrated beside the rear mirror)

C. Lane Departure Prevention-

Camera unit installed behind the windshield detects lane markers in front of the vehicle and calculate its position relative to the lane markers. Brake actuator controls the brake pressure of each wheel individually to generate intended movement. When the vehicle is getting close to lane markers as a result of driver inattention, system warns the driver to pay attention to driving by display and audible buzzer and assists the driver to return the vehicle in the direction of center of the travel lane by generating part of necessary yaw moment.

1) Unique Points:

- Quick warning in case of un-intended lane departure.
- Gentle control firmly assists the driver’s maneuver.
- Braking actuator is used to turn the vehicle.

D. Adaptive Headlights-

Standard headlights shine straight ahead, no matter what direction the car is moving. When going around curves, they illuminate the side of the road more than the road itself. Adaptive headlights react to the steering, speed and elevation of the car and automatically adjust to illuminate the road ahead. When the car turns right, the headlights angle to the right. Turn the car left, the headlights angle to the left. This is important not only for the driver of the car with adaptive headlights, but for other drivers on the road as well. The glare of oncoming headlights can cause serious visibility problems. Since adaptive headlights are directed at the road, the incidence of glare is reduced. A car with adaptive headlights uses electronic sensors to detect the speed of the car, how far the driver has turned the steering wheel, and the yaw of the car. Yaw is the rotation of the car around the vertical axis -- when a car is spinning, for example, its yaw is changing. The sensors direct small electric motors built into the headlight casing to turn the headlights. A typical adaptive headlight can turn the lights up to 15 degrees from center, giving them a 30-degree range of movement.

E. Blind Spots-

Alerts the driver to the presence of vehicles in blind spots diagonally behind the car.However much a driver pays attention, there may be times when it is difficult to be aware of other vehicles traveling in what is commonly referred to as a driver’s “blind spot”. This system assists drivers in driving safely by detecting and warning them of the presence of other vehicles in the blind spot area.

1) Technology Functionality:

The system recognizes when another vehicle is traveling diagonally behind the driver’s car and signals the presence of the vehicle using indicators in the vehicle. These indicators are often found on either the side view mirror or the A-pillar (the part of the car body separating the door window and the windscreen). The driver is alerted to the presence of the other vehicle by the flashing indicator and an audible signal.

F. Forward Collision Warning-

ZF TRW’s Forward Collision Warning (FCW) systems are based on camera or radar sensors monitoring the road ahead. They provide object recognition and detect relative speeds between a vehicle and objects in the road. If the closing speed represents a risk of an impending collision, drivers can be alerted through a number of warning methods.

1) Camera-Based Forward Collision Warning:

The camera-based FCW system uses a forward-looking monocular camera with object recognition, mounted on the windscreen behind the rearview mirror. This is linked to a warning device. The camera-based system can also support Lane Departure Warning functionality.
2) Radar-Based Forward Collision Warning:
The radar-based FCW system consists of a 24GHz mediumrange radar sensor. The radar sensor is mounted at the vehicle front and linked to a warning device. Radar technology provides high performance with direct measurement of distance and relative speed, operating under all weather conditions.

IV. CONCLUSION
Cyber road traffic control is used to make daily road traffic system as smart and avoid accidents. To develop a road traffic avoidance infrastructure that is reliable, heterogeneous, federated and dynamic.

We have also discussed some of the existing solutions and we conclude that existing solutions helps to face the current challenges to some extent as the applications of the CPS are growing day by day still there are lot more challenges yet to come we need to fore predict the upcoming challenges and should develop new technologies to safe guard the applications from those challenges.

Hence we come up with a system that uses resiliency and exhibits robustness. This infrastructure maintain nominal operation by population based various multi agent paradigm using modified danger theory based optimized artificial immune network. This problem is addressed by checking the proximity of the nearby vehicles. We create an application that would identify the vehicle and calculate their dimensions and accordingly calculate a safe trip. The app is dynamic in nature and would alert the driver on any unavoidable circumstances. Hence developing a next generation system that is evolutionary.

REFERENCES