COLLISION AVOIDANCE IN VEHICLES

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Abstract— Collision avoidance is the prime factor to be considered in vehicles to provide road safety. Due to increased traffic and number of vehicles on road it is necessary to have an efficient safety mechanism that helps to avoid collision between vehicles. There has been a large number of works done to avoid collision; hence it is desirable to compare the summary of them. This paper presents a survey on the major collision avoidance systems.

I. INTRODUCTION

Vehicles play an important role in human’s daily life, at the same time they may cause dangerous problem to life of people and property due to accidents. Every day around the world, several hundreds of people die from various collisions of vehicles. The National Highway Traffic Safety Administration (NHTSA) estimates that about 88% of rear-end collisions in the United States are caused by driver inattention or by vehicles following too closely. The main challenge encountered to avoid accidents is to avoid collisions. In order to avoid collisions there has been a great amount of work done in this field, many papers featuring different Collision Avoidance Systems (CAS) have been published. Insurance Institute for Highway Safety has added collision-avoidance system testing to its suite of safety evaluations, the key safety measures considered in this system are bumper, air bag and so on. Avoiding collision is a crucial issue in most transportation systems. Several studies have been done in different fields of applications to detect and avoid collision. The ultimate task of any collision avoidance system is to avoid two or more objects from colliding. The systems will collect valid information from the vehicles which are moving forward and behind using sensors such as radars or cameras, the information includes speed, distance and braking signals [2]. This paper provides a survey on various ideas proposed for collision avoidance as well as their advantages and disadvantages.

II. SURVEY

A collision avoidance system is an automobile safety system designed to reduce the severity of a collision. Radar, laser and camera are used to detect an imminent crash. In 1995 the first demonstration of forward collision avoidance was performed by a team of scientist and engineers at Hughes Research Laboratories in Malibu, California. The system was radar based which was available only at Hughes Electronics. The forward radar-head, plus the signal processing unit and visual-audio-tactile feedbacks were first integrated into a Lexus SC400, and shortly thereafter into a Cadillac STS [3]. And also it is observed that at low vehicle speeds collision avoidance by braking is appropriate, while at high vehicle speeds collision avoidance by steering is appropriate [1]. The paper [4] presents a risk of collision of the ego vehicle based on the scene analysis, which includes object trajectory prediction. The trajectory prediction is done by using a method called Maneuver Recognition Module (MRM) which predicts all the possible changes in the vehicle’s behaviour. And also the paper uses Monte Carlo Strategy to estimate the risk of collision between two vehicles at a given time. The proposed method of the paper is tested by considering two scenarios, where the first scenario is collision during an overtaking and second is front to front collision. This approach reduces the false alarms and changes the driving behaviour to avoid collision. In paper [5] demonstrates a FECAS (Front End Collision Avoidance System) that uses proximity sensors and ultrasonic sensors. Proximity sensor is used to alter the host vehicle as soon as the preceding vehicle comes in the range and this sensor is fixed at the front middle of the host vehicle. The ultrasonic sensor is used to measure the distance of the following vehicle which should be less than the host vehicle stopping distance to reduce collision. The paper proposes an algorithm which uses these sensors to ensure the safety depending on the response time of the system hardware and speed of the host vehicle. The algorithm responds well for obstacles within the zones by taking suitable braking action. FECAS is implemented in real time, the car used in the system is DC motor driven. Real time testing is done by running trolley car in front of the scaled model car. Overall the Front End Collision Avoidance system offer automatic braking for the vehicle along with the warning. The paper [6] provides a solution to avoid collision between chain vehicles. The proposed framework is a lane-level beacon-less, infrastructure-less, and GPS-less cooperative collision avoidance (BIG-CCA) to avoid rear end collision, which mainly comprises of distributed grouping mechanism and a receiver-based forwarding scheme. The grouping mechanism is used to provide emergency warnings whereas forwarding scheme minimizes the rebroadcasts of updating and
warning messages. The future work of this paper is extending BIG-CCA for identifying the lane position of a vehicle and requesting the information of lane position of other vehicles which are in the same lane to achieve road safety.

The paper [7] provides an interesting approach based on ARM Cortex M0 processor which is an efficient microcontroller. The response time of the system is very quick when compared with GPS based system. It is cost effective as all its components are cheaply available. The system is integrated with a CAN controller for effective control of collision avoidance. It was found that the main cause of rear end collision is following vehicle, hence omnidirectional broadcasting of message is found undesirable in rear end collision avoidance system.

The paper [8] presents an approach to avoid collision by allowing the vehicles to communicate with each other and share an exact knowledge of their state. The main goal of this paper is to avoid collision of vehicles at intersecting roads. Mathematical approaches are described for the creation of collision avoidance algorithms for human-driven vehicles. These algorithms help the vehicles to sense and share the information based on the current state of the system and also corrects the human decisions that would lead to a collision.

The [9] paper proposed a collision avoidance system by considering the relation between mathematics, nature and engineering. Echolocation in animal technique is used where many animals detect any obstacle using the interpretation of transmitted ultrasound by them and the reflected pattern of ultrasound from the environment. In this paper [9] they have used ant and ant colony which tells how they react when facing any obstacle, along with this they also combined the study of Bat’s ultrasound echolocation technique. The authors implemented a robot which detects obstacle by using ultrasound like bat and makes decisions like ant to avoid obstacles.

In this [10] paper car-following model based on risk perception is used in design. This approach uses connected vehicles where the useful information is collected by the sensors, based on the collected information the controlling subsystem reduces the speed of following vehicle and the gap between the vehicles increases, which eliminates the potential dangerous and avoids rear-end collision. The system is classified into three situations: general collision avoidance, the special collision avoidance and stop-aid collision avoidance. For all this three situations, the system is tested and its function is feasible and stable. The main advantage of this system is the driver never feels uncomfortable and also system has ability to adjust the speed to keep the following vehicle safe.

III. CONCLUSION

According to the survey by 2030 accidents going to be the fifth place in causing death to people. To avoid collision between vehicles many techniques have been proposed. In this paper we have presented a survey of major collision avoidance system from various papers. We have discussed the different types of techniques used in collision avoidance system based on different situation which leads to collision. Many techniques have already been implemented in real time systems. Some systems warns the driver to take a correct decision and some systems are built in such a way that they themselves can make a right decisions based on the current situation.

REFERENCES