IJARCCE

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified
Vol. 5, Issue 7, July 2016

Robust Dynamic Vehicle Collision Avoidance System Using Wireless Communication: A Review

Vikas Chhabra[1], Er. Ankita Mittal[2]

M.Tech Reserarch Scholar, Electronics & Communication Engg Department, Galaxy Global Group of Institutes, Dinarpur, Ambala, Haryana, India[1]

Head of Department, Electronics & Communication Engg Department, Galaxy Global Group of Institutes, Dinarpur, Ambala, Haryana, India[2]

Abstract: In order to reduce the traffic accidents, it is necessary to control the speed of vehicle in freeway. Safety assurance of vehicles is of great importance to improve road transportation. For this, it presents a review on vehicle collision avoidance system using wireless communication. We consider the problem of collision avoidance at vehicular intersections for a set of controlled and uncontrolled vehicles that are linked by wireless communication. Inter-vehicle safety communication is also a method to improve road safety. In this work, it will design a controller using fuzzy approach for controlling the movement of vehicle. In this, it presents a WSN application to avoid obstacles and vehicle accidents. This system will contain a sensor set, a managing unit and a monitoring platform. The collected data will be transmitted wirelessly to monitoring platform for data processing. The main part of the work was to carry out a feasibility study on vehicle collision avoidance system using wireless sensor networks. We then pose the desired collision avoidance problem in the framework of the theory of supervisory control. The problem has major requirements: safety, i.e. vehicular collisions must be avoided; non-blockingness, i.e., vehicles should not deadlock and must reach their final destinations, which in this case means they must completely cross the intersection.

Keywords: VANET, Wireless Communication, Vehicle Collision Avoidance, Fuzzy Controller etc.

I. INTRODUCTION

Wireless communication involves the transmission of information over a distance without help of wires, cables or any other forms of electrical conductors. An electromagnetic signal is created, modulated, amplified, and broadcast to one or more receivers that can be fixed or mobile. The transmitted distance can be anywhere between a few meters (for example, a television's remote control) and thousands of kilo-meters (for example, radio communication).Some of the devices used for wireless communication are cordless telephones, mobiles, GPS units, wireless computer parts, and satellite television.

The success of the IEEE 802.11 WLAN technology, the availability of a satellite based global position system (GPS), and the allocation of a 75 MHz bandwidth in the 5.9 GHz frequency band by the US Federal Communication Consortium in 1999 stimulated a shift in the focus of subsequent research projects. These studies put more emphasis on the evaluation of architecture and protocol related issues, on a systematic exploration of possible application scenarios and use cases, as well as on the analysis whether the IEEE 802.11a standard specification is suited to support these applications and able to serve as a foundation for inter-vehicle communication systems.

Road crashes causing losses in lives, health and property have been occurring for many years. Studies have shown that most road accidents happen because of human error and could be avoided if drivers would be informed about the accident ahead at least several seconds before. With the development of communication technology, how to take advantage of advanced wireless communications network to improve road safety has been a focus. A Vehicular Ad-Hoc Network is a technology that uses moving vehicles as nodes in a network to create a mobile network. VANET is a sub-group of MANET where the nodes refer to vehicles.

The role of wireless communication in the intelligent transportation systems (ITS) has increased significantly in recent years. The Vehicular Ad hoc Network (VANET) is a wireless technology for communication of vehicles using the mobile ad hoc protocols in which each vehicle is modelled as a node in the network.

The main goal of VANET systems is to make roads safer and more efficient by providing information to the drivers and managing authorities. Such information may consist of traffic density, accidents, weather conditions and location of vehicles at blind points.

IJARCCE

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified
Vol. 5, Issue 7, July 2016

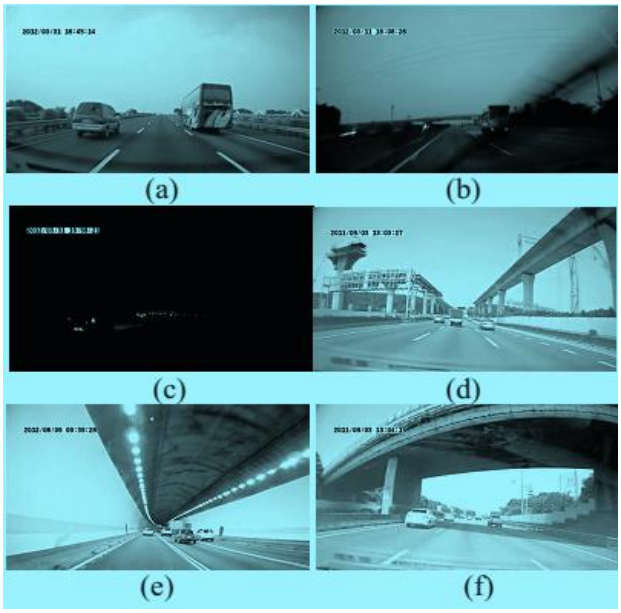

Figure 1: Examples of the Input Frames Taken [16]

The primary goal of VANET is to provide road safety measures where information about vehicle's current speed, location coordinates are passed with or without the deployment of Infrastructure. Figure 1 show some input frames obtained by the recorder. In Figure 1, we observe that the content of input frames varies dependent on the time of day and the weather conditions. In Figures 1(a) and (d), examples of a sunny day are shown. Figure 1(b) is a rainy day, Figure 1(a) is daytime, Figure 1(c) night time, and Figure 1(e) and (f) show tunnels and under bridges respectively.

In this paper, it studies the concept of vehicle collision avoidance system using wireless communication. Further, in section II, it provides the related work of various researchers. In Section III, It defines basics of vehicle collision avoidance technique. Finally, conclusion is explained in Section IV.

II. LITERATURE SURVEY

This section provides literature survey related to vehicle collision avoidance system and provides various approaches related to them. Some authors [1] described the chance of smart video security system implementation. It was tuned for detecting unwanted situations that was induced by users in level crossing. This system was started for separating and tracking moving objects in level crossing. Then, it used a markov model concept for estimating trajectories. It allowed some detected targets for discarding some dangerous situations. After that dempster-shafer theory was used for finding level of risk.

Authors [2] developed a system for collision warning for detecting vehicles ahead and also used to identify safety distance for assisting a distracted driver prior to crash. It involved global haar like features for finding virtual symmetry and detection of vehicles etc. It also used the useful single sensor multi feature fusion method for improving accuracy of system. It was also used for detecting vehicles at both day and night and also for long distances.

Researchers [3] presented a real time system for collision avoidance. It was based on characterizing with B-Spline curves. This problem was formulated in output space rather than input. It was feasible because of flatness of system. It used a B-spline method for flat output trajectory. For reducing the computation time of optimal problem, it provided an aircraft and obstacle constraints in cost function.

Authors [4] presented a Wireless based system that was capable of detecting vehicle collisions with motorways guardrail. It was based on service oriented architecture with updated web services where different applications and wireless system were connected. It presented a model that was based on simulating finite element technique for enhancing reliability of detection. For better detection, a finite element model in ANSYS was developed for finding propagation waves. A sample frequency of 588 Hz was used in this system. It was enough for detection of signals.

Researchers [5] proposed a resolution algorithm using contention window. As the contention resolution system in IEEE 802.11, binary exponential back-off (BEB) has long been criticized because of its high collision probability in diffusion situation. The reason of poor performance of system was recognized as back-off interval and restoration of contention window to small value. Therefore two new concepts, namely back-off interval isolation (BII) and improved slow decrease (ISD), were proposed in enhanced collision avoidance algorithm. BII introduces an extra back-off interval selection process and stations at diverse stages have separated back-off intervals.

Authors [6] considered the collision avoidance problem at vehicular intersections for different types of vehicles in controlled and uncontrolled manner. It was linked by wireless communication. Each vehicle was modelled by a first order system. It used a disturbance for bounded model. It constructed a discrete event system and formulated the problem under supervisory control for discrete systems. This allowed us to mitigate computational limitations related to the presence of continuous dynamics and infinite state spaces. For solving the resulting supervisory control problem at the discrete event level, they developed an algorithm that exploited the structure of the transition map to compute the supremal controllable sublanguage more efficiently than standard algorithms.

Researchers [7] proposed real-time connection collision avoidance (ICA) system that was based solely on infrastructure communiqué. Nearly one third of all documented vehicle collisions were reported at urban and rural intersections, and this figure continues to rise in spite of technological innovations for vehicle safety. Most collision avoidance systems currently under investigation are based on road vehicle or inter-vehicle

IJARCCE
ISSN (Online) 2278-1021
ISSN (Print) 2319 5940
International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified
Vol. 5, Issue 7, July 2016

communication. However, reliability remains an issue, as high mobility often leads to message collisions and link breakage.

Researchers [8] proposed a wireless sensor network (WSN) application to stay away from obstacles and vehicle accidents. The system was composed of sensor sets, a managing unit, a wireless communication card and a monitoring platform. The composed data was transmitted wirelessly to monitoring unit for data storage, processing and adjusting. Main objective was to incorporate the robust observers and decisions to build a fully autonomous vehicle, build intelligent driver assistances and embedded diagnosis system. A specific validation test to avoid wall crash through a smart algorithm was proposed. Collected sensor measurements were sent wirelessly and data was collected at mobile platform.

Some [9] examined the performance made possible using WAVE/DSRC standard when including pedestrians or two wheels. First, proposed a specific message format to encapsulate pedestrian and two-wheel position-data information. Second, it proposed a complete system for collision avoidance at intersection level. Afterwards, tests were performed to analyze the performance of system in terms of packets reception rate and transmission delay using specified standard with two modes of operation. Namely, comparison was made between using only the control channel to announce and forward messages as a safety service, and using one of the dedicated channels 172 or 184 after announcing the service on the control channel.

Table 1: Summary from Survey

S. N.	Author's Name	Title	Journal	Conclusions
1.	Houssam Salmane, Louahdi Khoudour	A Video-Analysis-Based Railway–Road Safety System for Detecting Hazard Situations at Level Crossings	IEEE 2015	• It evaluated the different level crossing accident scenarios. • Presence of obstacles, zigzag between barriers etc. were evaluated. • The process started by detecting and tracking objects by video camera.
2.	Mahdi Rezaei, Mutsuhiro Terauchi	Robust Vehicle Detection and Distance Estimation Under Challenging Lighting Conditions	IEEE 2015	• Proposed the real time vehicle detection and inter-vehicle distance estimation. • Proposed concept was able to detect vehicles at both day and night and also for short distances.
3.	Hamid Alturbeh, James F. Whidborne	Real-time Obstacle Collision Avoidance for Fixed Wing Aircraft Using B-splines	IEEE 2014	• Proposed a real time collision avoidance system using B-spline. • Different scenarios were tested like online avoidance, tracking of global trajectory using MATLAB/SIMULINK.
4.	J. Miranda, T. Gomes, R.Abrishambaf, F. Loureiro	A Wireless Sensor Network for Collision Detection on Guardrails	IEEE 2014	• Presented a real time collision detection system using WSN. • Developed a simulation based mathematical model using finite element method. • Results were validated using real time data.
5.	Chiung-Yao Fang, Jui-Hung Liang, Chiao-Shan Lo	A Real-time Visual-based Front-mounted Vehicle Collision Warning System	IEEE 2013	• Proposed a real time collision warning system for front of a vehicle. • It provided three stages namely lane marking detection, vehicle detection and distance estimation between vehicles. • Proposed concept was able to detect vehicles at both day and night and also for short distances.

IJARCCE
ISSN (Online) 2278-1021
ISSN (Print) 2319 5940
International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified
Vol. 5, Issue 7, July 2016

6.	Refik Caglar Kizilrmak, Mastaneh Torkamani-Azar	Reducing Collision Probability with Multi-hop Diversity for Vehicle-to-Roadside Networks	IEEE 2013	• Presented a vehicle to roadside transmission scheme and implemented a collision avoidance method. • Presented a multi-hop broadcast method for reducing collision probability on highway. • It assumed constant timing parameters for driver reaction time and delay of reception.

III. VEHICLE COLLISION AVOIDANCE SYSTEM

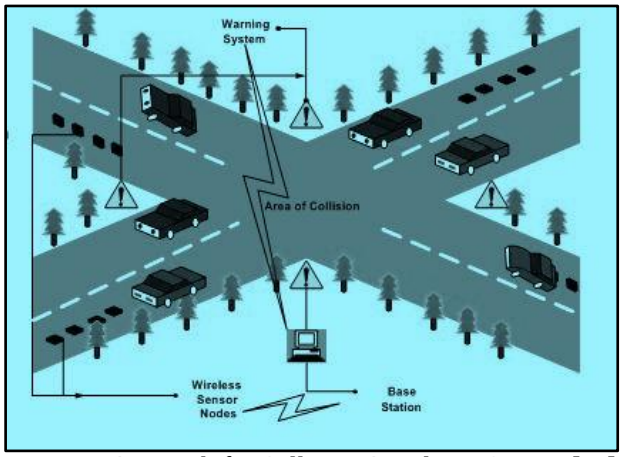

Figure 2: Approach for Collision Avoidance System [17]

Driving safety is an important issue. There are several factors like human error, mechanical failure of vehicle, inclement weather conditions and roadway limitations that present a real challenge to the safety of the driver by causing road accidents. We consider the problem of collision avoidance at vehicular intersections for a set of controlled and uncontrolled vehicles that are linked by wireless communication. The collision avoidance method is used in various networks and communications for handling contention problem. This method is used to remove situation in which multiple nodes wants to access same resource. This ensures that any node in a network can transmit a signal without colliding with other traffic on the network. Vehicle and Road coupling model must be built in order to ensure vehicle natural operating on the road. When the vehicle is operating on the road, the tire is only part that bring correlation between vehicle and road surface. The vehicle operating capability is affected directly by tire. So the precision of tire model is very importance to veracity of solution for vehicle dynamics and kinematics.

For the collision avoidance capability enabled vehicles, in order to supply sufficient risk evaluation information to indicate and avoid potential conflicts with other vehicles in the time or space domain, both the accurate absolute location and relative motion state between a subject vehicle (SV) and other vehicles (OVs) are critically required for safety purpose. As the fundamental information, location is crucial to realize self-state awareness for SV, and meanwhile the assessment of its safety situation is carried out based on the estimated location of neighbourhood OVs connected in the intersection area. After that, evaluated collision risk will be "understood" and used to generate the assistant safety alerts to the driver or automatic control orders to brake until the safety criterion if fulfilled. While driving, the driver not only needs to control his vehicle but also needs to pay attention to the movements of the vehicles around him. Roads conditions may not always be good. A stretch of a road may be heavily damaged and the driver may not know about it. Also, there may be very poor visibility on the road.

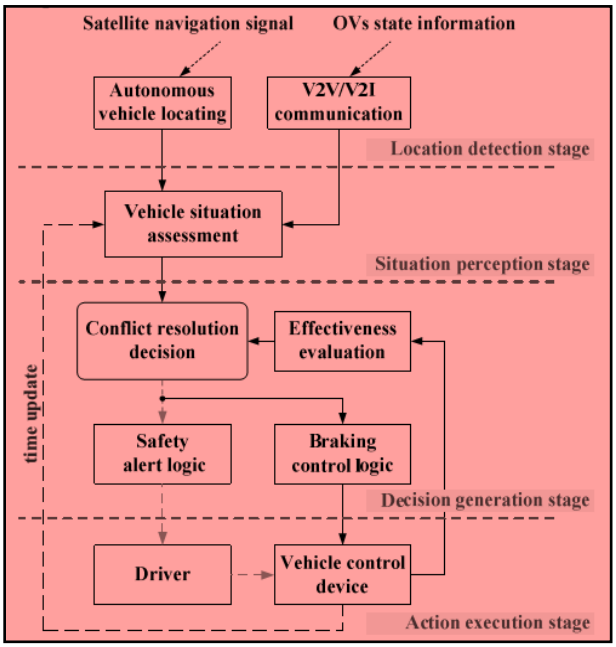

Figure 3: Actual Framework for Cooperative Collision Avoidance System [17]

Weather conditions are not totally favourable all the time. There may be medium to heavy rains or snow fall on the road, or it may just be foggy, temporarily. Accident analysis results indicate that mis-judgments made by the driver are among the leading causes of accidents. Many accidents are caused when drivers lack a better understanding of the surrounding traffic conditions. This is compounded with adverse road and weather

conditions, fatigue, and some temporary lapse of focus. With the rise of computer and wireless technologies, new solutions can be developed to assist the driver in hazardous situations and to decrease road accidents. It can be possible to enhance the vehicles' safety by making use of the wireless sensors or sensor technologies. Advanced safety features such as, collision avoidance; obstacle detection, range detection, reversing sensors, automatic braking, intelligent headlights, etc. can assist them to drive safely. The concept of such driver-aid systems is that, by using the information collected by the sensors on the vehicle, potential unsafe situations could be detected rapidly and automatically; and this captured data can be used to alert the driver or help the driver with appropriate actions.

IV. SIMULATION PARAMETERS

This section describes the general simulation parameters that will be used for simulation purpose. It will help for providing the performance of system. These parameters will used to estimate the collision probability of vehicle. The main parameters are velocity of vehicle, angle of orientation, distance from wall and time of simulation etc.

V. CONCLUSIONS

In this work, it reviews on collision avoidance approach based on integrated sensors. It will use the concept of fuzzy controller for controlling the movement of vehicles in roadside area. The performance of collision avoidance depends upon roadmap area. In this, we need to deal with high dimensions for parameters and challenges for obtaining robust result. It will work on different scenarios for collision avoidance. In this work, the main focus will be on vehicle collision avoidance using fuzzy controller by controlling the speeds of vehicle under different lane conditions. It will also use for distance and velocity estimation of vehicle.

The future work includes lane detection and collision avoidance system under hilly areas under heavy traffic. Also implement this system with hardware configuration.

REFERENCES

[1] H. Salmane, L. Khoudour, Yassine Ruichek, "A Video-Analysis-Based Railway–Road Safety System For Detecting Hazard Situations At Level Crossings", IEEE Transactions on Intelligent Transportation Systems, 2015.
[2] M. Rezaei, M. Terauchi, "Robust Vehicle Detection And Distance Estimation Under Challenging Lighting Conditions", IEEE Transactions On Intelligent Transportation Systems, 2015.
[3] Hamid Alturbeh, James F. Whidborne, "Real-time Obstacle Collision Avoidance for Fixed Wing Aircraft Using B-splines", IEEE International Conference on Control, July 2014.
[4] J. Miranda, T. Gomes, R. Abrishambaf, "A Wireless Sensor Network for Collision Detection on Guardrails", IEEE 2014.
[5] Hongwei Cheng, Xiao Yan, Hao Lian, "A Novel Collision Avoidance Algorithm for IEEE 802.11 Wireless LANs", IEEE Military Communications Conference, 2014.
[6] Eric Dallal, Alessandro Colombo, Domitilla Del Vecchio, "Supervisory Control for Collision Avoidance in Vehicular Networks Using Discrete Event Abstractions", American Control Conference (ACC)Washington, USA, June 17-19, 2013.
[7] Fadi Basma, Yehia Tachwali and Hazem H Refai, "Intersection Collision Avoidance System Using Infrastructure Communication", IEEE Conference on Intelligent Transportation Systems, USA. October 5-7, 2011.
[8] H.Nasser, "Wireless Sensor Network for Monitoring, Diagnosis and Supervision", IEEE Mecatronics, Paris, pp.32-39, 2012.
[9] Mohamed Amine Abid, "Pedestrian Collision Avoidance in Vehicular Networks", IEEE ICC-Communication Software and Services Symposium, pp.2928-2932, 2013.
[10] Sok-Ian Sou, "Modeling Emergency Messaging for Car Accident over Dichotomized Headway Model in Vehicular Ad-hoc Networks", IEEE Transactions on Communications, Vol. 61, No. 2, February 2013.
[11] Yuancao Li, Zhesheng Lin, Huan Liu, Yuehong Gao, "Performance Evaluation of A Resource Allocation Scheme for Mixed Traffic in Dynamic-TDD Network", IEEE 2014.
[12] Yi Song and Jiang Xie, "BRACER: A Distributed Broadcast Protocol in Multi-Hop Cognitive Radio Ad Hoc Networks with Collision Avoidance", IEEE Transactions on Mobile Computing, Vol. 14, No. 3, pp. 509-524, March 2015.
[13] P.J.A Vignesh, "Relocating Vehicles to Avoid Traffic Collision through Wireless Sensor Networks", 4th International Conference on Computational Intelligence, Communication Systems and Networks, pp. 407-412, Phuket, July 2012.
[14] Huang Zhu and Gurdip Singh, "A Communication Protocol for Vehicle Collision Warning System",Green Computing and Communications, IEEE International Conference on & International Conference on Cyber, Physical and Social Computing, pp. 636 – 644, Hangzhou, December 2010.
[15] Umair Ali Khan, "Inter-vehicle Collision Avoidance Using Zigbee Sensor Networks", International Journal of Scientific & Engineering Research, Vol. 4, Issue 4, pp. 359-365, April 2013.
[16] Chiung-Yao Fang, Jui-Hung Liang, Chiao-Shan Lo, "A Real-time Visual-based Front-mounted Vehicle Collision Warning System", IEEE 2013.
[17] Liu Jiang, Cai Bai-gen, Wang Yun-peng, "Location-based Cooperative Vehicle Collision Avoidance for Unsignalized Intersections: A Multi-sensor Integration Approach", IEEE International Conference on Connected Vehicles and Expo, 2012.