Anti-Collision & Obstacle Notifier Using Machine Learning and Networking Technologies in VANET

Mrs. D. Anitha, Mrs. C. G. Anupama, Aditya Kumar Sinha

1,2,3 Department of Software Engineering, SRM Institute of Science and Technology, Chennai, India

e-mail: 1 anithad@srmist.edu.in, 2 anupamag@srmist.edu.in, 3 adityakumar_sh@srmuniv.edu.in

Abstract. Anti-Collision System for Avoidance of accident occurrence on road among the vehicle will be able to detect the object which is approaching the vehicle. And at the same time, it will also recognize the category of approaching objects to determine whether it comes in the category of obstacle or not. Apart from Object recognition, the system will also be able to determine the distance between the respective vehicle and the approaching object to the vehicle and if the object will come to the nearest distance to the vehicle, which is implemented as the danger distance for them, then the notification alarm will start to ring with the signature of warning signal to the vehicle driver site.

Due to this, the vehicle collision and the occurrence of road accidents among the vehicle will be reduced and also as the system is performing the recognition then the vehicle driver will also be able to see the color of the front traffic light on their display unit.

Keywords: Traffic Light Monitoring, Pattern Recognition, Internet of Things (IoT), Weighted Dataset, Intelligent System, Wireless Sensor Network in VANET

1. Introduction

Over the Years, the news is coming across us about the vehicle accident on the roadside due to some major or minor mistakes. Due to this, there is a lot of harm that occurs to the vehicle, vehicle owner and the person inside the vehicle as well. Already various smart systems have been developed in an attempt to make cars fully autonomous. But this paper is based on a semi automation car where the driver will have all the controls and our system will keep the tracking of blind view of driver sides like the backside of car, traffic lights, road sign board etc. There are many car companies like Tesla, have already implemented accident prediction systems in their vehicles. This prototype uses multiple technologies which will enhance the decision for accident prediction.

To reduce road accidents, traffic mistakes and casualties, this prototype is developed in which the camera and the ultrasonic sensor is fixed over the vehicle where camera capture the activity goes nearby to the vehicle and does monitor each and every object coming across to the vehicle driver. Whereas the ultrasonic sensor which is fixed to the vehicle starts to measure the distance between the vehicle and the approaching object to the vehicle. On its determination it regularly sends data to the
processing unit to do the functionality as per the distance of the object to the vehicle is getting captured by the sensor.

The processing unit which is designed with IoT devices using networking technologies in VANET, get the input from the defined source (i.e. camera which is installed at all side of the vehicle and the ultrasonic sensor which is also installed in each side of the vehicle) and start to interact with the pattern recognition layer, where a weighted dataset is called to categorize the input image pattern. When the captured images get categorized into obstacle category then it starts to send the warning notification message to the display unit so that the driver of the vehicle gets analysed that any obstacle is approaching their vehicle with a defined vehicle side. On the other hand, the data which is coming from the sensor unit as the distance between the vehicles to the other vehicle which is approaching from the side, get analysed with the processing unit and as per applied logic it starts to determine that the object which is approaching the vehicle is supposed to be dangerous or not. If it is analysed that it is dangerous in nature, then the warning notification will start to be sent to the vehicle driver with a danger signature.

Beyond from all this such processing in the system which is implemented to the vehicle for the collision avoidance, the camera that is installed to the front of the camera, gets analysed about the traffic light which is coming in front of the vehicle and continuously it sends its colour to the display which is installed at the driver unit in the vehicle so that the vehicle driver gets the information about the traffic light easily. Digital footprint of all the traffic sign boards and traffic signals has been trained from the datasets for proper recognition.

Using sensors like ultrasonic sensors and cameras, we are able to find the accurate and current events that are happening around the vehicle. This project is all about to show collaboration between IOT and Machine Learning techniques. As IOT refers to physical sensors for the environment around the vehicle while Machine Learning using camera refers to digital visuality for reading traffic signals, sign boards etc. Once data is collected from the sensors, one core intelligence will combine all different data and will take proper decisions for sending the right notification to the display for the drivers.

Decision and alert will be sent to the driver of the vehicle using display and sound mode in the vehicle that will keep track of all kinds of situations which will be happening around the vehicle. The display unit to the driver site in the vehicle that is used in the system is under friendly in nature. From this display unit the driver can easily track over the activity which is happening nearby to the vehicle in an easy manner and the alert notification is also convertible in sound in the manner of driver compatibility. So there is a very minimal chance that a driver can miss out form the notification coming from the side of the vehicle.

2. **Procedure**
   1. Get the image from the fixed camera around the Vehicle.
   2. Get the distance of the respective Vehicle or the object which is approaching to the respective vehicle.
   3. Send the input raw to the processing unit of the system to get the analysis, whether the approaching object comes in the category of obstacle and their distance comes in the defined danger zone to the vehicle or not.
   4. Continuously update the colour of the front traffic light to the driver screen.
   5. Raise the Alert to the vehicle driver with danger signature, if any obstacle got approached near to the vehicle.

3. **Preliminaries**
   
   **A. Methodology used**

   To perform the analysis of the approaching object to the vehicle, Machine Learning technologies are applied with the pattern recognition methodology. At the same time, to determine the distance
between the respective vehicle and the approaching object from the side of the vehicle, the Internet of things using networking terminology in VANET is used.

To reflect all such activity near to the vehicle, the display screen is allowed to the driver by the means of using Web front-end Technology. And to maintain the connectivity among them, the server unit will be provided with the connectivity of the dataset.

B. Hardware component

To the determination of distance in between the vehicle and approaching objects, it requires the Internet of Things setup using the networking terminologies in the VANET environment.

As in Fig. 1, we can see that the physical setup is done for Ultrasonic Sensor with the central processing unit for the system. Here, danger zone distance will be defined to the central unit and if the reading of distance from the sensor will be sent to the central unit then it will perform to generate the notification warning with danger signature if required.

Similarly, a High definition Camera will be attached with the central processing unit who will capture the pattern of the image that is approaching the vehicle and send it to the Central unit for the categorization of its type.

And the Display unit, which will give the view of all the activity to be happening around the vehicle will be attached to the central unit and fixed over the driver unit.

![Fig. 1: Hardware Setup for the Prototype Development for Sensor Device with Central System in VANET Environment](image)

4. Data Prediction And Its Analysis

From the generated graph as shown in Fig. 2 below, it can be analysed that if the captured image from the camera unit will be increased respectively to the video, then periodically the analysis time also will get to be increased.

In a similar fashion as the graph shown in Fig. 3 below, when the distance in between the vehicle to the object will be more than the accuracy to define that the vehicle came into the danger zone and accordingly to raise the alert notification accuracy will be decreased. And as per the distance in between the object and the vehicle the accuracy will get reflected.

From the generated graph as shown in Fig. 2 below, it can be analysed that if the captured image from the camera unit will be increased respectively to the video, then periodically the analysis time also will get to be increased.
Fig. 2: Number of frame analysis of a captured image to be recognized with respect to the Time (in Seconds).

Fig. 3: Analysis of distance of the vehicle to object processing with respect to the percentage of accuracy.

In a similar fashion as the graph shown in fig. 4 below, when the distance in between the vehicle to the object will be more than the accuracy to define that the vehicle came into the danger zone and accordingly to raise the alert notification accuracy will be decreased. And as per the distance in between the object and the vehicle the accuracy will get reflected.

In a similar way the graphical view shown below in Fig. 5, if the number object will be more in amount nearby the vehicle to the categorization of them will be time-dependent and as per the crowd near to the vehicle the time to generate the alert notification will vary.

Fig. 4: Dependent Accuracy to determine the distance to vehicle type
5. Result
The core feature of the system to avoid the collision in between the vehicle is, the driver of the respective vehicle will get the notification warning once the approaching vehicle will come into the obstacle category and if the distance between the vehicle and the object comes into the defined danger distance.

As we can see in Fig. 6, the display unit of the system which is fixed over the vehicle driver site, the driver will always be able to monitor the ongoing activity outside of the vehicle into this unit. Not only the generation of danger notification will be covered to the display unit, but the front traffic light colour will also be displayed to this unit itself and all the sign of sign board which is supposed to be fixed nearby to the roadside will also to analyse and get to be displayed over this display unit. And when the vehicle driver will miss the track on the road then by the means of path strike dimension, they will be able to control the vehicle.

6. Existing Methodologies
In the current system for the avoidance of collision among the vehicle is implemented by the means of alloying Internet of Things devices using networking terminologies which are fixed on the top of the vehicle and the camera is also to be fixed onto the top of the vehicle which will attach to the processing unit. By the means of which, when the other vehicle gets approached by the respective vehicle then the processing unit will start to produce the Beep sound inside the vehicle so that the vehicle driver will stop or alter the vehicle to resist it to collide with them.

Fig. 5: Time delay dependency on the number of the object present to the vehicle

Fig. 6: Display unit to the vehicle driver site for the continuous monitoring and alert notification display in the VANET environment.
7. Conclusion And Future Works

From this project to the creation of a prototype to avoid the accidents to occur on the road in between the vehicle and to display all the ongoing activity around the vehicle so that the driver will alter in the unpleasant situation. We have seen how the accuracy can be increased in collision avoided systems using machine learning and also how the object to be recognized in the absence of internet connectivity using the VANET setup, Weighted dataset in Yolo.

The future work on this system can be applied by the means of applying the more advanced algorithm to increase the rate of object recognition when the number of the object is much more in amount. And to restrict the accident among Vehicle to Body (V2B) will also be covered into the system and to test the whole system on the installation into the vehicle in a real time environment.

References

[1] KhanhDuy Tung Nguyen, Long Duy Nguyen, Son Hai Le, Thu Van Le, Van-Giang Nguyen, "Vision-based Driverless Cars in the Condition of limited Computing Resource: Perspectives from a Student Completion", IEEE Conferences, vol. 1, pp. 978-1-5386-0746-5/17, 2017.
[2] Xianwen Wei, Zhaojin Zhang, Zongjun Chai, Wei Feng, "Research on Lane Detection and Tracking Algorithm Based on Improved Hough Transform", IEEE, vol. 1, pp. 978-1-5386-7416-1/18, 2018.
[3] Vicente Milanes, Enrique Onieva, Joshue Perez, Jorge Godoy Villagra, "An Approach to Driverless Vehicles in Highway", IEEE Conferences on Intelligent Transportation System, vol. 1, pp. 978-1-4577-2197-7/11, 2011.
[4] Giuseppe Edwardo Thum, Ashraf Gaffar, "The Future of Brain-Computer Interaction: How Future Cars will Interact with Their Passengers", IEEE Conferences, vol. 1, pp. 978-1-5386-0435-9/17, 2017.
[5] Yeka Joseph Abueh, Hong Liu, "Message Authentication on Driverless Cars", IEEE Conferences, vol. 1, pp. 978-1-5090-0770-7/16, 2016.
[6] Saurav Agarwal, Dr. Mrs. S. W. Varade, "Collision Detection and Avoidance System for Vehicle", IEEE Conferences, vol. 1, pp. 978-1-5090-5013-0/17, 2017.
[7] Amir Mukhtar, Likun Xia, "Vehicle Detection Techniques for Collision Avoidance System", IEEE Conferences on Intelligent Transportation System, vol. 16, 2015.
[8] VikasNyamati, TridhaCahudhri, KayalvizhiJayavel, "Intelligent Collision Avoidance and Safety Warning System For Car driving", IEEE Conferences, vol. 1, pp. 978-1-5386-2745-7/17, 2017.
[9] Lovely Gaur, Imdad Rizvi, "Improved Vehicle Collision Avoidance", IEEE Conferences on Electronics, Communication and Aerospace Technology, vol. 2, pp. 978-1-5386-0965-1/18, 2018.
[10] Daniel Anadu, CharmantMushagalusa, NesreenAlsibou, Alaeddin S. A. Abuaheb, "Internet of Things: Vehicle Collision and Avoidance in a VANET Environment ", IEEE Conferences, vol. 1, pp. 978-1-5386-2222-3/18, 2018.
[11] DUAN Jianmin, ZHENG Kaihua, SHI Lixiao, "Road and obstacle Detection Based on Multi-layer Radar in Driverless Car", 2019.
[12] Abdullah FarwazAlijuayfi, Karim Djenname, "Simulation of an Augmented Reality Application for Driverless Cars in an Edge Computing Environment", IEEE Conferences, vol. 1, pp. 978-1-5386-6224-3/18, 2018.
[13] Xin Zhang, Maolin Chen, Xingqun Zhan, "Behaviour Cloning for driverless cars using transfer learning", IEEE Conferences, vol. 1, pp. 978-1-5386-1647-5/18, 2018.
[14] Liudmila P. Kozlova, Wang Tong, "Model of Motion Control System of Driverless Car", 2019.
[15] Prabu Krishnan, “Design of Collision Detection System for Smart Car Using Li-Fi and Ultrasonic Sensor”, 2018.
[16] Unghui Lee, Sangyol Yoon, HyunChul Shim, Pascal Vasseur and CédricDemeureux, “Local path planning in a complex environment for self-driving car”, 2014.
[17] Li Li, Xinyu Peng, Fei-Yue Wang, Dongpu Cao and Lingxi Li, “A situation-aware collision avoidance strategy for car-following”, 2018.
[18] Yeong-Kang Lai, Yao-Hsien Huang, Chih-Ming Hwang, “Front moving object detection for car collision avoidance applications", 2016.
[19] Stefan K. Gehrig, Fridtjof J. Stein, “Collision Avoidance for Vehicle-Following Systems”, 2007.

[20] Liang Li, Guangquan Lu, Yumpeng Wang and Daxin Tian, “A rear-end collision avoidance system of connected vehicles”, 2014.

[21] Chaohe Chen, Yong Huang and Guangfan Li, “Research on Collision Avoidance Method of Car Anti-Head-and-Rear Based on Safe Distance Model”, 2011.