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Review Paper On Self-Driving Cars Implementation Techniques And Its Challenges

Rohaila Naaz[1], Diksha Sharma[2], Benit Thomas[3],Aksendra Kumar Saxena[4], Danish Ather[5]
[1,2,3,4,5]TeerthankarMahaveer University
Rohailanaaz2@gmail.com[1],sharmadiksha929@gmail.com[2]

Abstract— With the advancement in technology and growth, the world has simultaneously faced a number of adverse effects. Every invention and discovery has its own benefits and drawbacks. Spread of technology made the lives easier but, on the other hand, also caused negative effects on physical and mental health of humans as well as other living beings. Development of cars was a best thing since sliced bread until people started dealing with increase in pollution, increase in number of vehicles on roads and also increase in cases of road accidents and deaths caused due to them. To solve above problems, one solution can be "A self-driven Vehicle", Aself driving car is a vehicle that is sensitive to its environment and does not involve any human interference.

This paper discusses and reviews different aspects and methods like detection of weather conditions, lane detection, discovering topics that affect motion of a self driving car, detecting objects, tracking the detected objects, techniques to avoid collisions and methods for taking smart decisions related to these autonomous vehicles.

Keywords— self driving cars,collision-free,path-replanning,lane detection.

I. INTRODUCTION

Over a few decades government and the citizens have been witnessing the exponential increase in number of vehicles on road which further leads to accidents causing a lot of deaths. Annual Global Road Crash Statistics state that the death of around 1.25 in road accidents per year, on an average 3.287 people die in a day across the World. Additionally, 20-50 million are victim of injuries or specially abled. Majorly, of all road traffic deaths that occur are among 15-44 age group.To curb this figure, experiments on autonomous driving system have been conducted since at least 1920s. Trails began in the 1950s. The first semi-automated car was developed in 1977.by Japan's Tsukuba Mechanical Engineering interpreted by two cameras on the vehicle and an analog computer. The vehicle reached speeds up to 30 km per hour with the support of an elevated rail.

Autonomous cars are formed by combining a variety of sensors that help them to act in response to their environment such as Radar, Lidar, Sonar, GPS, and Odometry and Inertial measurement units. Advanced control systems interpret sensory information to identify appropriate navigation paths as well as obstacles and relevant signage.

PC Mag defines a self-defining car as "A computer-controlled car that drives it". UCSUSA states that self driving cars are "cars or trucks in which human drivers are never required to take control to safely operate the vehicle".

The first semi-automated car was developed in 1977, by Japan's Tsukuba Mechanical Engineering Laboratory, which required specially marked streets that were interpreted by two cameras on the vehicle and an analog computer. The vehicle reached speeds up to 30 kilometers per hour with the support of an elevated rail. The first truly autonomous car appeared in the 1980s, with Carnegie Mellon University's Navlab and ALV projects funded by DARPA starting in 1984 and Mercedes Benzand University Munich's Eureka Prometheus Project in 1987. By 1985, the ALV had demonstrated self driving speeds on two-lane roads of 31 kilometers per hour with obstacles avoidance added in 1986 and the first-off driving in day and night time conditions in 1987.

In the research paper [1] by "by Workneh y. Ayele, the author gathered 2738 corpus from Scopus in order to identify the relevant topics and research areas related to self-driving cars because it contains a collection of scientific documents of great importance and which are also large in number. Latent Dirichlet Allocation is used to unveil various aspects of this study.75% training set and 25% validation set and was cross-validated using 10-fold validation for better and sound evaluation of model's interpretation. As a result, they have found topics that are valid research agendas. Because of less time and few resources, only 2738 corpses were used, and if more iterations can be performed in cleaning and preprocessing, the output and standard of the research can be improved.

In paper [2] by HilwadiHindersah, discusses results obtained by implementing vehicle detection algorithm on toll road. This implementation solves the two problems, first, detecting an object and second, tracking the detected object. This study lacks methods that can adaptively change the parameters during day and nights so as to increase the efficiency as the results are 100% accurate in right brightness but it completely fails in darkness. Overall, the model is 90% accurate but still needs alteration in factors that affect its performance.

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The research paper [3] by Yang Liu does simulation by optimizing cellular automaton and based on spectral clustering it evaluates the human factors as real and practical which is perfectly favourable for large-scale simulation and management of crowd for smart cities of future. This paper also illustrates effective techniques for both self-driving cars as well as human-driven cars, according to which drivers or cars evaluate the surroundings and take instant decision, further avoiding the chances of collisions or getting stuck into traffic jams. In future, with improvement in technology and passage of time sensor's range can be increased and random factors can be changed to increase the speed and achieve a higher efficiency.

In research paper [4] by Jun Wang, a model based path planning algorithm for dynamic environment is proposed which states vehicle kinematics to guarantee smooth and feasible trajectories. While navigating if a collision is detected on road, the self-driving car starts re-planning to make sure the collision is avoided. The algorithm is demonstrated on straight roads and in curved scenarios where simulation of two moving obstacles with velocity less than the self-driven car's velocity. The algorithm has shown feasibility and highly efficient computational ability. Thus, it is both optical and practical and improves the performance of planning the path according to the environment it is in.

In research paper [5] by Abdur R. Fayjie, a reinforcement learning dependent technique with Deep Q Network is applied in independent driving is presented. The reward function and agent actions are defined and the neutral network is trained according to maximize the positive reward. The simulated urban environment that was designed using UnityGamesEngine is presented and the car is also tested for independent driving with the trained network in simulation. All-in-all, a car instance dependent on our simulation experiments which is capable of running a DQN in real-time is designed.

In research paper [6] by Md. Azharul Islam, demonstrates the use of priority queue sorting for making ethical decisions .It uses heap sorting, insertion and deletion in binary heap ,tree sorting and crash-optimization algorithm for taking decisions on the basis of morality in cases of accidents and helps in reducing the harm. This study needs to be worked upon finding the value of probability of survival for different scenarios.

In paper [7] by Seongrae Kim, a technique to predict where the vehicle will be found laterally in the next image frame is proposed, which can anticipate the speed-adaptive lateral ratio left and right lanes by using speed of the vehicle and camera frame information. The experimental results that proved the accuracy and efficacy of this algorithm as all of the image processing and the proposed algorithm are implemented by C++ using OpenCV library and the resolution of the taken video image is 720*480 pixels.

The research paper [9] by HajraRiaz, emphasize about the methods which are used for obstacle detection of self-driven cars and also states the better way with reference to Pakistan's road. This paper reviews different approaches and also shows the best way that can be used to detect obstacles in the surroundings as we know Pakistan is a country where the traffic rules are not obeyed as precise at otherplacesand the non- motor barriers can appear at any period of time. With the use of self-driven cars we can have an assurity that there will be fewer accidents on the roads and also it can improve the regulation of traffic rules. But self driven cars should have a speed limit because if not the non motor things can create havoc by coming in between of the path. The data collected from the lidar can be used to trace on the spot time location and also be applied to discriminate static and dynamic scenes to lessen computational cost

In research paper[10] by Chuan Wang, it briefs about self driven cars with the help of magnetic field. The real time operating system installed in the machine alerts about the start and stop formation and various other functions. This particular paper tells about the use of wireless communication and magnetic field together to work at a particular place. But there will be some problems as the vehicles will be functioned through magnetic waves and they all will travel in a destined path, they should be kept at a distance and also on a particular low speed otherwise they will hit each other.

In research paper [11] by Shahroz Tariq, it tells about how self driven cars should be parked and how to navigate the closest parking slot. For that they used a path finding algorithm and used graphs for the representation of the parking lot structure and then used that graph in the algorithm to find the shortest path. All the cars will be connected to a particular server which will enable the worker to shift cars as per the need but if the commands are given out in a wrong way it will create a havoc in the parking lot. This paper only talks about the parking lot spaces when it is pre programmed, it didn't tell us about the real time parking spaces and it should be trained in such a way.

In research paper[12] by Renjith R, it speaks about the implementation of traffic signs and obstacle detection in self driven cars. This paper focuses on implementation of the core features of self driving cars which is traffic sign and

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hurdle detection. The Purpose of this paper is to implement some major features in self-driven cars like Detection of different signs, recognition of traffic light, pedestrian and obstacle recognition. But the camera used in the device can only accurately detect objects at a distance up to 60cm and not more than that and it should be improved.

In research paper [13] by PetruRadu, an algorithmic fusion method is discovered to notice how two different approaches for hurdle detection of camera's field of view improve the detection rate when fused. Camera-based algorithms' operation is negotiated upon if the given image consists of noise factors. This research finds out howcamera obstruction algorithms for ADAS can be used to improve the efficiency in terms of higher detection rates and lower missed detections. It says if the value of output is very high, the result of the system will be choked. So it should be processed in a way that it gives accurate and precise results.

In research paper [14] by Zixin Mu, this paper presents a self-tracking smart car control algorithm with openMV as the as the main development platform. OpenMV which has a digital CMOS image sensor is selected in the smart car system to realize the black and white trajectory reorganization. It presents an improved self-tracking algorithm with the overall design and operational process. But if the algorithm does not perform according to the matter, the vehicle will go off the charts and it will not follow the path defined. Through many practices and accurate design the intelligence can be improved.

In [16] by Dongkyu Lee, the paper says about the Interactive Simulation Platform using Processing-based Visualization for Safe Collision-Free Autonomous Driving Development. This paper introduces an interactive simulation platform using processing-based visualization for safe collision-free autonomous driving development. There are many variables in the AVC algorithm. We can't predict all the variables. In order to increase the performance of the collision free AVC algorithm, apply the AVC algorithm in this platform and iterate changing variables and simulating. It will not only reduce the cost and time involved in developing a safer and more effective AVC algorithm, but will also allow for visualizing the performance of the AVC algorithm for easy analysis.

S.No	**Paper Title**	**year**	**Description**	Insights
1	Implementation of Vehicle Detection Algorithm for Self-Driving Car on Toll Road Cipularang using Python Language[1]	2019	They have worked on Time series analysis and LDA to find hidden and emerging trends in Self driving cars using Online databases like scopus.	If the no of sampleiterations in preprocessing is increased then standard of research could be improved
2	Implementation of Vehicle Detection Algorithm for Self-Driving Car on Toll Road Cipularang using Python Language[2]	2017	It solves two problems first detection of the object and then tracking of object	Performance of method for detecting and tracking of object is not good in darkness as it works accurately in right brightness.
3	A Microscopic Traffic Simulation Model to Mingle Manual and Self-Driving Cars	2015	It states the algorithm for complex multi obstacle paths in real time	However they shoes simulation results to verify the algorithm but they have used onlky those obstacles whose velocity areless than the self

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				driving cars.
4	" Driverless Car: Autonomous Driving Using Deep Reinforcement Learning in Urban Environment"	2017	They have used deep deterministic policy gradient in (DDPG) in The Open Racing car Simulator they have designed their own critic and rewarder	Stability of driver still varies and when no of episodes increased then it stabilizes to a certain period ,also they only consider spped in one direction,and drifting speed is not counted here.
5	Algorithm for Ethical Decision Making at Times of accidents for Autonomous Vehicles	2018	They uses Min heap sort structure in priority queue to make ethical decisions on saving lives at accident times for self driving cars	The major gap is algorithm has to be adjustable for the reason that different individual may have different ethics and can make different decisions and also decision must be made in various scenarios like what if a mother and her child are stick to one other which happens in most of
				cases.
6	Adaptive Ratio-Based Lane Detection Algorithm for Self–Driving Vehicles	2016	They propose a Lane detection Algorithm for fast moving self driving cars with a 94.72% accuracy for different cars and cameras.	They uses one frame ahead of the vehicle's current frame location in case of fast speed cars,it should be integrated with real location of frame when the car speed is normal to give better reults in both slow speed and fast speed scenarios.
7	Obstacle Detection for Self Driving Car in Pakistan's Perspective	2018	A review paper on various methedologies and algorithms on obstacle detection for autonomous self driving cars in Pakistan's perspective	They suggests that LIDAR in fusion with other vision sensors can be proved good for gathering accurate information of dynamic obstacles, which is mandatory for making a robust self-driving car.
8	Controlled Parking for Self-Driving Cars	2016	They proposes a methodology for parking slots for Autonomous cars	They used only static data for car parking in and out and distance given for the links are static in

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			by building a graph and used Shortest path dijkstra Algo.	nature so real time distance calculation and collisions on the same time has to be considered in this approach.
9	Algorithm Fusion for Windscreen Obstruction Detection in Autonomous Driving	2017	They proposed a fusion of classical Algorithm and machine learning based Algorithm for windscreen blockage detection and showed the effectiveness of this fusion technique	The present paper investigates how camera obstruction algorithms for ADAS (Advanced Driver Assistance Systems)can be fused for an improved performance in terms of higher detection rates and lower missed detections however experiments have considered images for day so day and night both scenarios should be considered for better results
10	Intelligent Tracking Car Path Planning based on Hough Transform and Improved PID Algorithm	2018	They have used openMV in self driving cars which are used to track black and white trajectory reorganizations.it also uses hough transform technique for path planning and PID based algorithm for making the car follows scheduled path.	One drawback of hough transform is that it may not work well in shadowy images [28]which could be produced during overbridge roads and at night.
11	Interactive Simulation Platform using Processing-based Visualization for Safe Collision-Free Autonomous Driving Development"	2017	They have developed platform for self driving cars so that fast development of self organizing driving algorithms can be achievd	They have used some variables of Autonomous vehicle control algorithm(AVC) like distance between the vehicles etc while leaving other variable like Vehicle orientation angle,path curvature etc
12	Multi-smart car control system	2014	They have build a prototype	As they have provided ZigBee chip ZICM2410 for users,this

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	design and research based on ZigBee		for multi smart cars environment with the help of ZIgbEE protocol stack	chip can handle 64 task where 8 As ZigBee has limitation of not be used in outdoor wireless communication system due to its short coverage so it is not beneficial for controlling smart cars spread over wide area.

Conclusion

This paper concludes that various challenges were found while implementing and applying self driven cars such that iteration can be increased during preprocessing of images but, on the contrary, it also increases the computational time required, the parameters that can work efficiently during day and night ,we have analyzed that major concerns of all research which we have discussed on self driven cars emphasize higher efficiency, planning the path according to environment, real time execution in terms of vision quality of self driving cars and computational cost should also be reduced, intelligence of cars has also been a major point so that it can maintain the distance between the forward and backward objects and socio –economic benefits of applying self driven car system.

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