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A Survey on Autonomous Vehicle System with a Wide Range of Technologies

C E Mohan Kumar¹, S V Dharani Kumar², V Sornagopal³

Assistant Professor, Department of ECE, GRT Institute of Engineering and Technology, Tiruttani, Tamilnadu, India¹

Assistant Professor, Department of ECE, GRT Institute of Engineering and Technology, Tiruttani, Tamilnadu, India²

Associate Professor, Department of ECE, GRT Institute of Engineering and Technology, Tiruttani, Tamilnadu, India³

ABSTRACT: To ensure passenger and vehicle safety in a range of situations, autonomous vehicles must gather detailed and real-time information about objects in their vicinity. Autonomous automobiles have become one of the hottest topics in the field of intelligent transportation systems. Before the end of the decade, it is expected that the majority of large companies will have fully self-driving vehicles on the road. Such a system must provide a high level of safety on road networks to reduce the frequency of accidents due to human error. In this paper, a survey is taken for Autonomous vehicle detection. The techniques like object detection, signal detection, board detection and lane detection can be used for Autonomous vehicle detection methods. This paper survey various techniques in Autonomous vehicle detection and gives the best method.

KEYWORDS: Autonomous Vehicle, Image Processing, Machine Learning, Deep Learning

I. INTRODUCTION

The next significant disruptive breakthrough in the next years has been suggested to be autonomous driving. It has a major social influence in many sorts of fields, considered mainly technology driven. A quick summary of technology and development in this section will assist comprehend the need for consumer acceptability in the subject, which has been ignored until now.

In recent years, the development of advanced driver support systems has seen tremendous technical advances (ADAS). In order to be able to deploy conditional and highly autonomous automobiles (Sae levels 3 and 4). The aim is to increase safety, economy, sustainability and comfort in these new car models. Automated or autonomous automobiles, however, present additional technological and non-technical problems, to ensure that these new car types are safe in use. The interdisciplinary BRAVE project was initiated in the Horizon 2020 research initiative, with the aim of meeting these problems.

At the beginning of the 20th century, automatic driving technology originated. The technology then concentrated on self-sufficient speed, breakdown, lane control and other important cruise control capabilities. The Digital and 4th Industrial Revolutions incubative conditions, however, have only led to fast technological developments in that area in the past 10 or so years.

Several studies have been published in academic literature which record the technological evolution of AVs. But, despite a recent projection that AVs would account by 2045 for AVs in cities and the method in which policies have been enacted to encourage and manage the various perturbing impacts, the scholarly literature on AV-induced disturbances is rather restricted. In addition, we know no academic study which critically evaluates the situation of AVs from a combined point of view focusing on their ability, impact and future government measures to mitigate / foster disruptive effects.

Of course, not just technological challenges, but all of the advantages do not lack a number of barriers, problems and major modifications to current systems. In the US, some States have enacted regulations enabling independent cars to be tested on their roads. The National Highway Traffic Safety Authority (NHTSA) in the U.S. provides a formal self-driving classifier separating into non-automation, functional automation, combined automation, limited automation and complete self-driving automation. In order to be able to embrace this new technology, Europeans have also begun modifying the Vienna Convention on Road Traffic and the Geneva Convention on Road Traffic. The tests for crucial event monitoring and standard establishing include the management of the autonomous



driving sector across literature and the internet, as well as the requirements for 'driver,' ownership and maintenance, civil and criminal culpability, killing, insurance, privacy and privacy.

This work is not intended as a comprehensive overview of all criteria for every automated function in the vehicle, but as a basis for the evaluation of concepts and the knowledge of some of the essential elements affecting the conception and testing of TOR systems. It focuses on the important achievements in the discipline, the significant topics of discussions and the open issues of study.

II. LITERATURE SURVEY

This research involves a systemic literature evaluation in order to fulfil the research goals. An defined methodology for greater data dependability and for forming the variety of knowledge in a given field of inquiry is followed by a systemic literature assessment. Its purpose is to reduce partialities through extensive literary searches and to provide an assessment path for the judgments, processes and conclusions of reviewers. The examination includes three main actions (a) planning, (b) reporting and presentation, (c) implementation or review.

i) Lidar and sensor based detection

Jihun Kim et al. [2] They utilized radar and optical sensors to accurately recognize objects. Because sensor-specific data includes a variety of coordinates, data coordinate calibration is crucial. We discuss the coordinate calibration techniques between radar and vision pictures in this paper, as well as how to calibrate sensors using data from real sensors.

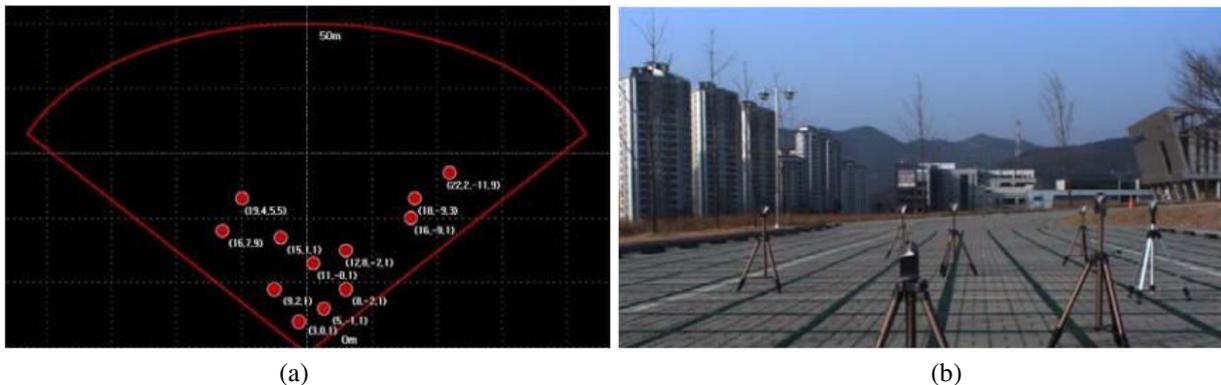


Figure1. a) Target information in radar coordinate system. b) Target information in vision sensor.

They described the sensor fusion approach for self-driving automobiles using radar and vision. Data from real-world trials was used to do sensor fusion. The sensor fusion technique is simple to develop and performs well, thus it may be used to identify obstacles around an autonomous vehicle.

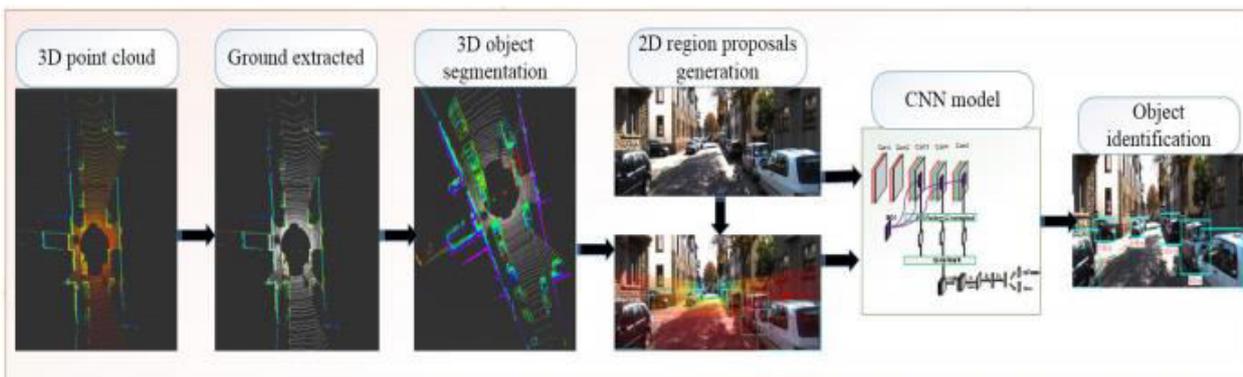


Figure2. The suggested framework for the multi-object detection method is described in detail.

Figure 2 shows the framework of the recommended object detection method. Here, Velodyne 64E LIDAR data and color pictures from the KITTI benchmark dataset are combined to create a 3D point cloud.

ii) *Machine learning for autonomous vehicle*

QiaoMeng et al. [12] Based on the SSD model, they presented an object detection method for autonomous driving. Consisting of convolution layers with feature fusion to guarantee that object attributes are efficiently communicated. During the training phase, an image block method was utilized to increase the detection performance of tiny objects. As part of their solution to the problem of big object feature loss due to photo segmentation, they also presented an image pyramid for huge objects. A new dataset for autonomous vehicle technology was created by defining labeling criteria and item classifications.

iii) *Deep-learning for autonomous vehicle detection*

Long Chen et al. [17] Nighttime turn sign recognition was achieved using a CNN detector as well as perceptual hashing tracking. There are modules for identifying and tracking cars in the system's code structure. For nocturnal vehicle identification, a novel technique combining a breakthrough ROI extraction technology with region-based CNN features is being employed. The suggested detection approach outperforms both the DPM and the RCNN methods. The researchers also devised a hashing-based approach for rapid and reliable tracking, as well as a way to identify turn signals from vehicle sequence tracking. During testing, it was found that the suggested approach can identify and track the car ahead of it in low-light circumstances, as well as recognize the vehicle, as well as recognize turn signals.

iv) *KITTI data based method*

Hai Wang et al. [4] On KITTI data, they evaluated and examined the performance of five key deep learning object identification algorithms in automobile recognition, while paying special attention to YOLOv3, RetinaNet and R-CNN. Five object-detection algorithms are compared on the KITTI test set in terms of detection speed and accuracy; detection accuracy is assessed using the PR curve and AP value.

v) *Lane and road sign detection*

Qing Li et al. [13] They presented the prototype and detail lane detecting tasks. Intelligent vehicle road-boundary identification requires precision and Road surface type, lane arrangement, weather conditions and noise are all factors that affect road surface resilience. Adaptive RHT, an efficient way of implementing the RHT, is used to cope with these issues while retaining the high accuracy of the RHT. This is especially useful for noisy pictures. This is done in order to decrease the high processing costs associated with using the original input image. Using a gray-edge map with a very low threshold value, you can deal with a congested environment and determine the real lane lines. The three-dimensional Hough space is reduced to two dimensions to make the procedure easier. Random sampling and an iterative "coarse-to-fine" accumulation and search technique are used to conserve memory storage and reduce computing costs.

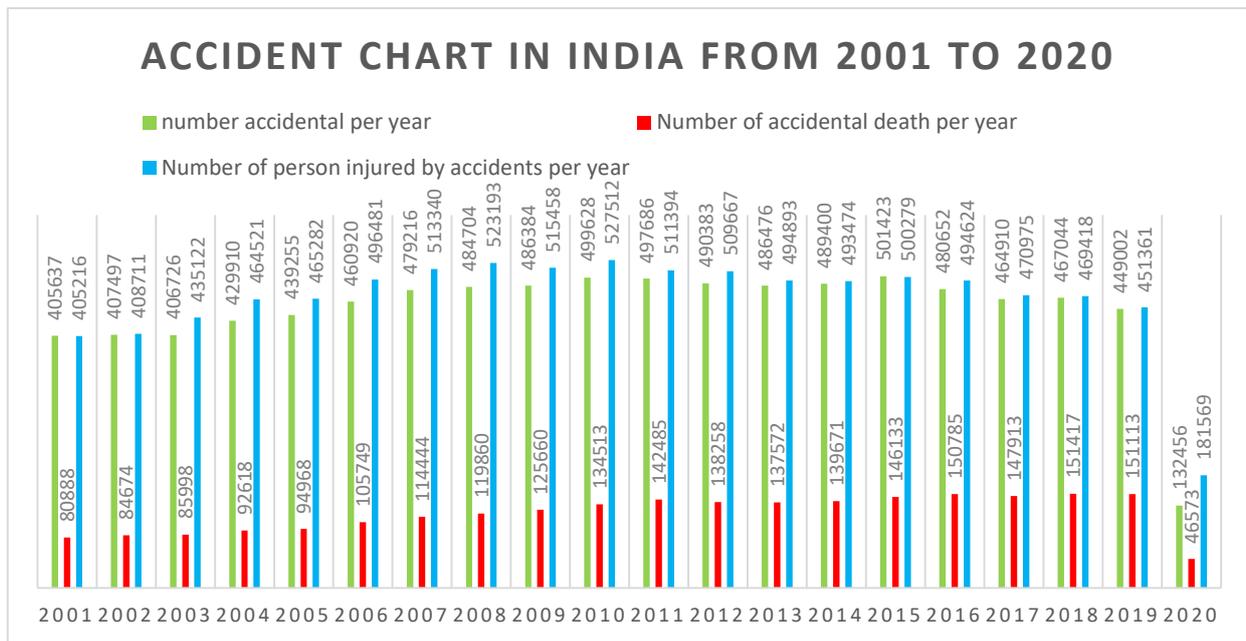
III. RESULTS

Number of road accidents, people dead and injured during the period of 2001 to 2020 in India

Year	number accidental per year	Number of accidental death per year	Number of person injured by accidents per year
2001	405637	80888	405216
2002	407497	84674	408711
2003	406726	85998	435122
2004	429910	92618	464521
2005	439255	94968	465282
2006	460920	105749	496481
2007	479216	114444	513340
2008	484704	119860	523193
2009	486384	125660	515458
2010	499628	134513	527512
2011	497686	142485	511394
2012	490383	138258	509667



2013	486476	137572	494893
2014	489400	139671	493474
2015	501423	146133	500279
2016	480652	150785	494624
2017	464910	147913	470975
2018	467044	151417	469418
2019	449002	151113	451361
2020	132456	46573	181569



Accuracy of the Autonomous Vehicle detection.

Ref. no	Author	Year	Technologies	Accuracy
[1]	Mehdi Masmoudi	2019	Image processing, machine learning, vehicle detection, Autonomous vehicle, deep learning.	91%
[2]	Jihun Kim	2018	Autonomous Vehicle; Sensor fusion; radar; Vision; Sensor calibration	89%,
[3]	Xiangmo Zhao	2020	Object Identification, 3D LIDAR, CNN, Sensor Fusion, Autonomous Vehicle, Object Detection.	89.04% and 78.18%
[5]	Xuerui Dai	2018	Vehicle detection, CNN, two-stage, decision refinement.	94.83%
[6]	Huieun Kim	2016	advanced driver assistance system; deep neural network; object detection; localization	86.7%
[7]	Mennatullah Siam	2017	KITTI object detection	74.07%
[9]	Bichen Wu	2016	Object detection, KITTI	80.4%
[10]	Xiaozhi Chen	2017	KITTI object detection	89.05%
[14]	Qingquan Li	2014	lane detection, light detection and ranging (LIDAR), multilevel feature fusion, vision, Autonomous vehicles, drivable-region detection,	82.7%
[17]	Long Chen	2017	Turn signals detection, deep convolutional neural network, hash perceptual tracking, Intelligent transportation system, assistant and autonomous driving.	92.9%



IV. CONCLUSION

Thousands of people have died as a result of catastrophic accidents caused by the industrialization of the transportation sector. Lane detection, signal detection, board detection, and object detection for autonomous vehicles and sophisticated driver support systems have all been investigated to tackle the problem. We studied the approaches of several detection methods for identifying autonomous vehicle apps in this survey. From table 2 Object detection is a critical problem for self-driving cars and it is the best method in Autonomous Vehicle detection. Which can be overcome by deep learning concepts with large dataset.

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