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Navigation System for Autonomous Vehicle: A Survey

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ABSTRACT

Advanced Driver Assistance Systems (ADAS) apply to various high-tech in-vehicle systems designed to enhance road traffic protection by making drivers become more mindful of the road and its potential hazards, as well as other vehicles around them. The design of traffic sign, traffic light, traffic cone, car, road lane, pedestrian and road blocker detection and Recognition, a significant ADAS subsystem, has been a problem for many years and thus becomes an essential and successful research topic in the field of smart transport systems. This paper present different approaches Devised over the last 3 years for the diverse modalities. We present a survey of each challenge in form of table in terms of "algorithm, parameter, result, advantage, and disadvantage. For each survey, we describe the possible implementations suggested and analyze their underlying assumptions, while impressive advancements were demonstrated at limited scenarios, inspection into the needs of next generation systems reveals significant gaps. We identify these gaps in disadvantage block and suggest research directions that may bridge them. we identify the future solutions proposed and examine their underlying assumptions, although promising development has been shown in restricted contexts, analysis of next-generation applications requirements shows significant gaps. We define certain holes in the block of drawbacks and propose avenues for work that can cross them.

1. Introduction

Since the mid-1980s several institutions, research centers, car companies, and businesses from other sectors around the world have been researching and designing self-driving cars (also known as autonomous cars and driverless cars). In the last decade, the Defense Advanced Research Projects Agency (DARPA) sponsored three contests to accelerate technologies for the production of self-driving cars. The first, called the DARPA Grand Challenge, was realized in 2004 at the Mojave Desert, USA, and required self-driving cars to navigate a 142-mile long course across desert trails within 10 hours of time. Within the first few miles, all competing cars had failed. Repeated in 2005, the DARPA Grand Challenge (Buehler et al., 2007) allowed self-driving cars to negotiate a 132-mile long route across lakes, dry lake beds, and mountain passes, including three short tunnels and more than 100 fast left-and right turns. The third challenge, known as the DARPA Urban Challenge, took place in 2007 at the former George Air Force Base in California, USA, which allowed self-driving cars to negotiate a 60-mile-long route through a virtual urban environment, along with other self-driving and human-driven vehicles, within a 6-hour time limit (Wikipedia,2020).

The autonomous vehicles technology is increasing day by day. To drive a vehicle on road the vehicles must detect road edges, road lanes, road obstacle, pedestrian detection and traffic sign recognition. Each year approximately 1.3 million peoples are killed worldwide on roads, and among 10 to 50 million are injured due to road accident. A worthy explanation to this problem to develop machines, which cares for the environment. Due to this reason today, safe vehicles driving is charming a standard topic in many fields, from small projects to large automobile industries (Duan.j and Viktor.M, 2015). The technology of digital cameras is developing so fast. The progressive studies on camera-based observing and results are uses for benefit of humankind. Such as, the developments of computer vision and image processing are broadly used in the area of security. The improvement of cameras for road lane detection is also very useful to increase visibility. And we can drive more safely. One of the supporting technologies that extremely contribute to an Advanced Driving Assistance System (ADAS) is road lane detection. In general, significant traffic information presented to drivers is typically interpreted as visual signals such as traffic signs, traffic lights, road markings, traffic cones, pedestrian identification, vehicle detection etc. In certain cases, certain causes such as tiredness, drunk driving and driving anxiety may affect human visual perception. An ADAS will recognize this visual language in order to improve road safety and pass the information on to users using various approaches to traffic sign identification.

This paper discus different works and the sample description is as follows: in the next subsection we define road lane, traffic sign, pedestrian, traffic light, traffic sign, and car Detection role and link it to requirements of the automotive industry also provide a comprehensive overview table of each paper in sequence which consist more information such as “author name, title of research paper, work on , advantage, disadvantage and also discus result of relevant paper”. In last session concludes the Survey with a summary and suggestions for future directions.

2. Surveys of Recent Challenges

The general approach for navigation system detection, recognition and classification is, by dividing the task in to seven stages; traffic light, traffic sign, pedestrian, car, traffic lane, cone and road blocker detection stage and the classification (or recognition) stage.

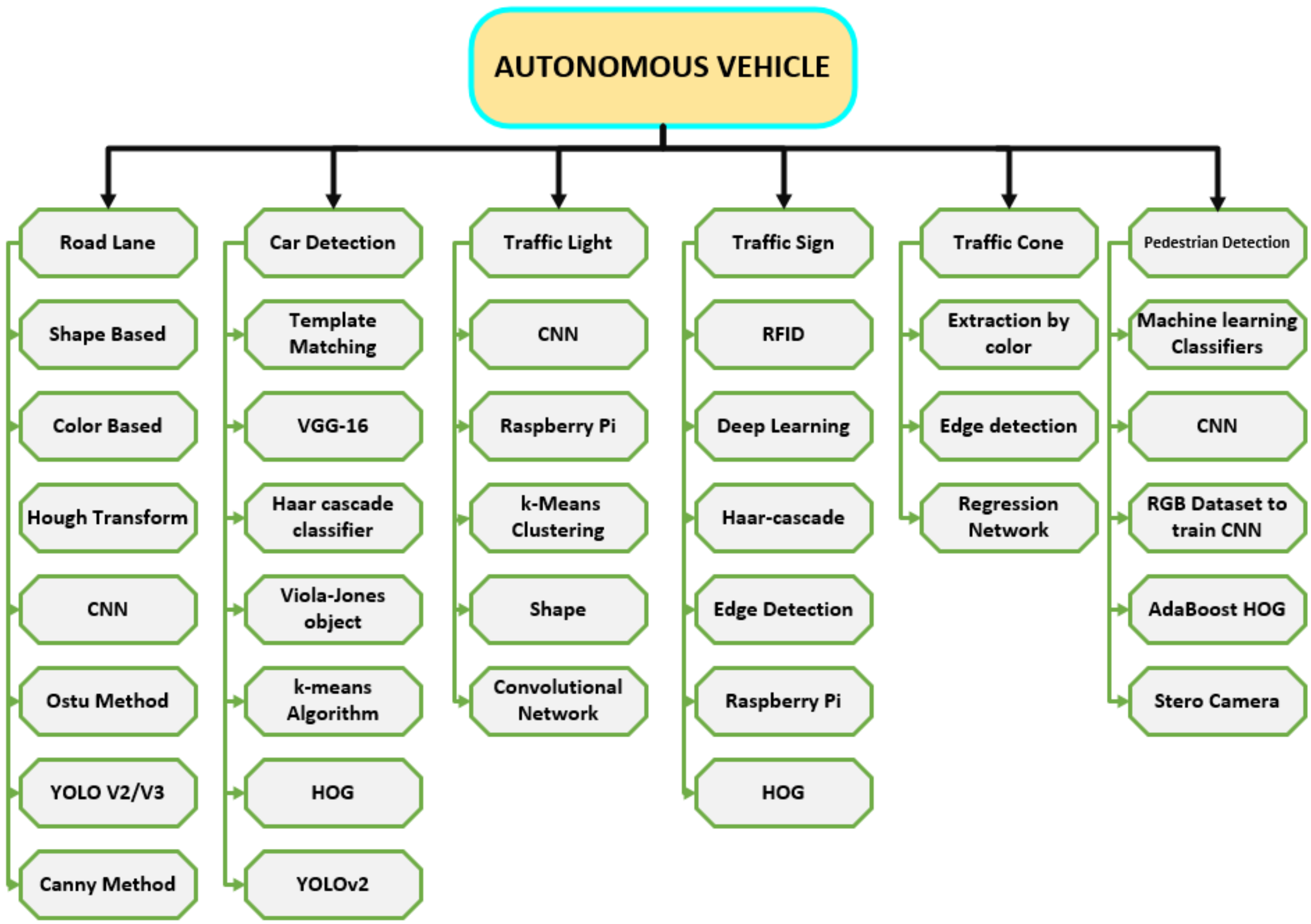

Figure 1: Autonomous Vehicle Navigation System

2.1 Road Lane

Road and Lane perception via the traditional cues remain therefore the most likely path for autonomous driving. Road lane understanding include detecting the extent of the road, the number and position of lanes, merging, splitting and ending lanes and roads, in urban, rural and highway scenarios. Although much progress has been made in recent years, this type of understanding is beyond the reach of current perceptual systems.

There are numerous sensing methods used for road lane detection such as monocular camera (Choi, 2019), LIDAR (Feng, 2018), Radar sensors (Song,2018) to obtained data from vehicle inertial measuring unit (IMU) with global positioning information using the Global Positioning System (GPS) (Su, 2017) normal map (Xing,2018) digital map (Yuan,2018) and space map

(Andrade,2018). For line segmentation from the input dataset use Deep convolution neural network (CNN) (Dhall,2019) and probabilistic voting procedure (Hoang,2019) to reduce the computing costs in the estimation of the vanishing point. Real-time vision-based lane detection algorithms are used to segment lanes from the road which can be done by Kalman Filter algorithm (Küçükmanisa,2019) and Hough Transform (Lee,2018). In addition, a reliable lane detection filter based on the Fuzzy Inference method, which requires three input parameters, the preceding being the difference between a line, the pixel deviation between the left and right neighbors, in a learning process is proposed in paper (Ouyang,2019).

Table 1 : Road Lane Navigation system for Autonomous Vehicle

S.NO	Work on	Methodology	Parameter Obtained	Result	Advantage	Disadvantage
[3]	Lane Detection/ 2017	Robust lane detection method, Vanishing Point Estimation.	Color based	97 %	In the vanishing point, a system using a lookup table is proposed to reduce the computing costs.	Aim to determine right lanes that are well ahead of the car in a long distance. Extend the suggested solution to unstructured path identification as well.
[4]	Lane Detection/ 2018	Semi-Global Matching (SGM) algorithm, Canny algorithm, IPM algorithm, Hough Transformation and Lane Detection, CNN	Camera navigation	99%	Traffic lanes model with a full chance angle in Hough Space, and complex pole identification ROIs, which is resilient to road bumpiness.	To achieve a better outcome, plan to combine this approach with an interactive database, or GIS.
[5]	Lane Detection/ 2019	Deep CNN, YCbCr color space - Local adaptive threshold, VPGNet, BING and PCANet, DVCNN	Region based	N/A	Low response time and Extreme CNN Lower performance-based approaches in extreme conditions, resistant to various forms and sizes of road markings.	Quality may be influenced by different environmental factors, and additional pre-processing technique is needed.
[6]	Lane Detection/ 2017	Odometer and IMU, reference path, the lane markings, Dead Reckoning, Lane Marking Detector, and the GNSS stamps	Lane marking	99.9 %	Precise, accurate and detailed understanding of lane markings developed from a monocular in the vicinity of the car.	Sadly, regional maps providers cannot be used because they don't provide precise description of lane markings.
[7]	Lane Detection/ 2017	Stereo Camera, v-disparity image, Hough transform method, texture-based method, visual odometry (VO) method, Dijkstra shortest-path model,	Camera navigation	98.69 %	This approach will achieve good detection efficiency without considering any parametric lane model for both straight and curved lanes.	The challenges facing the lane identification and monitoring algorithm include lack of lane marking accuracy, poor visibility due to bad weather, lighting and light reflection, shadows and thick road-based guidance.
[8]	Lane Detection/ 2019	Straight-curve line detection, Curve	Bent model navigation	92-93 %	Improving the successful protective driving and aided	Improving the efficiency of this device relates directly

		prediction based on straight curve, Lane deviated angle warning			driving of the automobile which is under inclined road conditions is of considerable importance.	to the precision of lane identification. A fuzzy inference system-based filter for efficient lane identification needs to be studied for this.
[9]	Lane Detection/2018	Otsu's method, Elimination of edge noise, Hough Transform, least square method	Region and map	93.60 %.	This method provides more reliable results in different light or crowded traffic conditions.	The time factor for mobile devices can be reduced and the detection rate increased in more complex scenes.
[10]	Lane Detection/ 2019	FAST-based, YOLOv3,	Map based	99%	Map matching localization system which detects multi-stage road facilities and slowly reduces the ambiguity of position.	Endpoints are wrongly identified in the continuous photos, instead of defining the ego-lane along the time axis in one trial strategy to study the process that accumulates the effects of the ego-lane ident cation.
[11]	Lane Detection/ 2018	ED Lines method, Kalman filter, ROI algorithm, Canny edge detection and the PPHT, A-ROI, Hough transform	Video based	99%	Algorithm gives accurate results with low computing power.	The developments in this area in the potential viewpoint would bring these devices to the point of automated and cooperative driving, focused on sensor networks and sensor fusion.
[12]	Lane Detection/ 2018	(CODEC) encoding Process, approach Gamma Correction, Brazilian Transit Code (CTB), IPM algorithm adequate method, Canny filter, Hough transform (HT) algorithm,	Obverse monocular camera	98%	A creative lane identification and monitoring technique, which suits as a technical prerequisite for implementing DAS apps such as Lane Departure Alert.	Because of the broad information history and the low cost of camera equipment a substantial number of existing studies rely on researching vision-based lane detection methods.
[13]	Lane Detection/ 2018	Integration Methods Introduction, Vision-Based Lane Detection Systems, deep learning Models, (GAN),	parallel Navigation	N/A	There is a large volume of literatures that use vision-based algorithms because of the low cost of camera equipment and extensive background awareness in image processing.	In heavy traffic and adverse weather conditions, the huge challenge for potential vision-based systems is to retain stable and reliable lane dimensions.

[14]	Lane Detection/ 2018	RCS, RCS, Static Points Extraction, Hough Transform, Pattern Extraction.	Lane detection	N/A	Using vehicle radar sensors, sense the lane boundary by changing the current road markings and show and verify the effectiveness of road marking.	Further improvement of the clustering algorithm, monitoring techniques can be used to render identification more reliable and to reduce the technical necessity.
[15]	Lane detection/ 2019	fuzzy filter	Clustering	N/A	This technique is computationally lightweight, and is ideal for software and computers in real time.	Detection of road lane markings, and recognition of arrows and bike marks did not receive sufficient consideration needs to be enhanced.
[16]	Lane detection/ 2019	deep CNN, Road RMN, SBD method.	Color based	N/A.	Because of this method the computing expense has improved significantly, which will also affect the accuracy of the ballot.	Nevertheless, lane identification remains an unsolved issue, let alone other road direction markers, owing to the difficulty of recognition precision in different driving scenarios.

2.2 Traffic Cone

Intelligent technology like object recognition is becoming an increasingly hot topic in research on autonomous vehicles. Among the many objects it is important to recognize the traffic Cone as a guided Traffic Sign. Interestingly, these road Cones are static objects but they are frequently replaced and relocated around the urban driving scenario.

The traffic Cone detection and location of traffic cones is necessary for autonomous vehicles. The volatile conditions of light and the weather are a big challenge. A variety of realistic methods such as color space selection, segmentation, shape analysis, distance estimation, and detector training are combined to ensure good detection rate and localization accuracy (Yong,2015). A way of finding out where the impasse is in the image and of recognizing if it is the cone (Yoo,2017), based on the fusion of information between vision and Radar sensors. In addition, an object category that is important to autonomous traffic control is to examine traffic Cones. Intrinsically, 3D object detection using monocular camera images is an unplaced problem. In this study, take advantage of the unique traffic cone structure and suggest a pipeline approach to solve this issue (Zhang,2019).

Table 2:Traffic Cone Navigation system for Autonomous Vehicle

S.NO	Work on	Methodology	Parameter Obtained	Result	Advantage	Disadvantage
[17]	Traffic cone/ 2014	Extraction by color distance,	Region based	88.0%	Real-world conditions show that the proposed method will meet the requirement for realistic competition in terms of detection and position.	In addition, this solution will be evaluated on this autonomous vehicle platform, which shows both reliability and instantaneity of the guarantee.
[18]	Traffic cone/ 2015	Chamfer matching, Edge	Video based	90 %	The suggested algorithm effectively and in real time senses cone by combining	Future work should concentrate on more specific objects such as pedestrians

		detection, threshold			input from two sensors: the radar and video.	or cars based on this approach.
[19]	Traffic cone/ 2019	structural regression network,	3d Traffic cone	N/A	Proposed pipeline is tested to show performance and precision on a real-time, automated racing car.	Use this algorithm in video processing to make it possible to actually apply software in a more practical way.

2.3 *Traffic Light*

Traffic Lights detection (TLs) for a temporary time between manually operated cars and a fully autonomous car network is an integral part of Driver Assistance Systems (DAS). The urban environment has many challenges for all parts of the DAS, in particular for systems relying on computer vision. The detection and recognition of TLs at intersections is one of the most important challenges. The conventional resolution of traffic light detection with cameras however, has led to the publication of many interesting approaches in the field of pattern recognition.

The positions of the TLs can be found easily in the image by conducting horizontal and vertical position (Zhou,2014), Deep Neural Network (CNN) (Ali,2017), shape-based segmentation (Kulkarni,2018) with efficient object detectors, Single Shot Multibox Detector (SSD) (Ozcelik,2017), Region-based Convolution Network (R-CNN) (Prabhakar,2017) and color-based segmentation. After the position of the TLs in the image is determined, color of the TLs is easily evaluated by SVM classification model, (Rajapaksha,2018). Real-time detection of TLs from images and takes advantage of a deep point-based detection architecture (Ali,2018), and RFID (Bruno,2018) to prevents problems that normally exist with ordinary TLs recognition systems and position of TLs is used as a landmark utilizing a traffic lights chart with substantial visual characteristics throughout the urban environment (Bruno,2018).

Table 3: Traffic Light Navigation system for Autonomous Vehicle

S.NO	Work on/year	Methodology	Parameter Obtained	Result	Advantage	Disadvantage
[20]	Traffic light /2017	R-CNN	High speed autonomous vehicle	73.2 %	This design, using an efficient GPU, fast enough frame rate, shows the suitability of the device for automated highway driving cars.	Using a much broader network model such as Google Web, the performance can be further improved.
[21]	Traffic light /2017	HSV, Raspberry Pi	Color	N/A	Detection and identification of fast, reliable and real-time automated traffic signs will help the driver and improve driving.	Differences in light intensity and shadows created by the presence of objects are just a few of the major issues this approach faces. For a system which is more effective.
[22]	Traffic light	Candidate region selection, k-means clustering, Black box selection, HSV color	Shape	96.2 %	It is very efficient to find the center pixels with k-means also this algorithm only performs Operation on a small candidate.	To find a better solution, further studies should be conducted with adaptive thresholding methods.
[23]	Traffic light /2019	The CNN classifier,	Video deep learning	96.6%)	Overcome low versatility and accuracy of deep learning methods focused on vision and	Alternatively, after the vehicle stops, use the gap between the vehicle and the stop line as another

					high-power consumption of heuristic algorithms.	indirect measure to check the process.
[24]	Traffic light /2018	SSD, Spatiotemporal filter,	Large dataset	84.20 %	Recent developments indicate that deep neural networks are commonly utilized on their own vehicles.	More modern architecture can provide better detection accuracy, such as Mask R-CNN.
[25]	Traffic light /2017	Frequency Identification (RFID)	Traffic light detection	Shape and deep learning	This solution eliminates problems usually faced in ordinary traffic light recognition schemes.	A deep learning algorithm should design for detection and classification using a regional CNN trained.
[26]	Traffic light /2017	R-CNN, faster R-CNN	Obstacle detection	73.2 %	This design, using an efficient GPU, fast enough frame rate, shows the suitability of the device for automated highway driving cars.	Using a much broader network model such as Google Web, the performance can be further improved.
[27]	Traffic light /2018	CNN classifier, R-CNN, YOLOv2, and SSD	Dynamic Range	96.8%	Important for autonomous vehicles because it could cause a red light to turn into a deadly car accident.	Future examination will investigate the use of both dark and light photos as contributions to the CNN network and will hold both contextual color and shape details.
[28]	Traffic light /2018	fully convolutional network (FCN), clustering using DBSCAN algorithm	Clustering	N/A.	Recalling traffic light identification is higher than SSD and greater than 0.9 for both testing and training applications.	A classification stage should be introduced for the identified areas.
[29]	Traffic light/ 2018	CNN, Faster r-CNN,	Moving vehicle	99	Faster R-CNN start-up process by moving information increases the performance of the framework for real-time applications.	Can also customize the system to ensure safe driving. It may also be fitted with the ability to respond to spoken orders or hand signals of law enforcement or highway safety employees.
[30]	Traffic light/ 2018	Vision-based localization, RTK-GPS, IMU, sensor fusion, traffic light, Kalman filter, inertial navigation.	Region based	N/A	Once the map is built correctly, a low-cost camera will help the vehicle easily locate itself in low signal	Boost precision, and combine certain forms of spatial positioning. V2V methods of localization may be a good choice for achieving good accuracy.

2.4 *Traffic Sign*

Advanced driver assistant system plays important rule in the area of automatic traffic sign detection and recognition (TSDR). Driving on correct lanes and limitation of speed and preventing obstacles, tracks for footmen, direction of destination, road access, current traffic condition etc. have been provided with important visual information by traffic signs for helping drivers in driving scenario.

Traffic sign detection and recognition in complex road scenarios is to achieve high performance in a low-cost system. To detect and recognize sample road signs and modern 3D signs (Ghallabi,2019) by using RFID-based system, neural network (NN) (Sari,2018), Deep Learning technique (Slavescu,2018) and CNN. Also, it can be detected by digital GPS maps (Luong,2017) color probability such is HSV (Gao,2018), Histogram of Gradient (HOG), Local Binary Patterns (LBP) (Guo,2019) combined with SVM classifier to eliminate all incorrect candidates (Navarro,2017). Further, traffic signs classification based on transfer learning (Temel,2019) to address the vulnerabilities in current databases by implementing the CURE-TSD Real dataset (Uçar,2017).

Table 4:Traffic Sign Navigation system for Autonomous Vehicle

S.NO	Work on	Methodology	Parameter Obtained	Result	Advantage	Disadvantage
[31]	Traffic sign/ 2017	radio frequency identification technology (RFID) technology	Shaped based	N/A	Avoids problems usually encountered with ordinary traffic light recognition systems	Still be a challenge for researchers and manufacturers to be able to apply in reality due to the strict requirements of the correct rate.
[32]	Traffic sign/ 2018	Deep Learning;	2D and 3D	98.3%	This enabled traffic signs to be detected in the most varied types of situations, and also with greater robustness when compared to other methods.	In future works intend to work with systems of visual attention, considering the context / zones of the scene and the fuzzy logic in order to better define the regions.
[33]	Traffic sign/ 2018	DCNN classification	2D and 3D	99.1 %	It allowed traffic signs to be identified in the most diverse types of situations and also with greater robustness relative to other approaches that only use 2D data.	Working with visual attention technologies, considering the context / zones of the scene and the fuzzy logic to better define the regions where traffic signs are required, thereby allowing us to develop the robotic computer vision system to detect and classify the most important signs.
[34]	Traffic sign/2019	Haar-cascade,	Neural network	N/A	This will reduce the number of injuries, effectively reducing the time lost during transportation	The number of loops done on the map can be improved to improve the accuracy of autonomous driving for effective level 5 autonomous car programmed.
[35]	Traffic sign/ 2018	Edge detection contour Detection, color filtering,	Shaped and color based	87.36 %	Bring us to eliminate standard methods for image processing and use recurrent neural networks.	Further decline in performance of the model may be eliminated.
[36]	Traffic sign/ 2019	CNN	Deep learning	83.7%.	Classify them correctly using Convolutional Neural Network to capture traffic signs, and respond to them in real-time.	RCNN can be used for further accuracy.
[37]	Traffic sign/2018	Raspberry Pi	Real time shaped based	N/A	Using a simulated GPS, designing a miniature self-driving vehicle was able to position the car and navigation on the race track.	Unmanned driving networks, real-time identification and effective traffic sign awareness are among the main concerns. For further research a radio-controlled vehicle is therefore proposed.
[38]	Traffic sign/ 2019	GNSS (Global Navigation Satellite Systems).	Region based	N/A	The proposed system expands the research in which a lane marking based localization program was created.	An image module to incorporate a visual-based localization will be included in future work.

[39]	Traffic sign/ 2017	Raspberry Pi	Real time Color and shaped based	N/A	This method is used when the vehicle depending on traffic lights has to take diversions and start / stop.	Variations in light intensity and shadows formed due to the presence of objects are just a few of the biggest problems this method faces.
[40]	Traffic sign/ 2017	HSV, Histogram of Oriented Gradients (HOG), adaptive threshold method, SVM	From Moving vehicle color based	98%	Good performance even in complicated backgrounds and overlapped signs in most test cases.	This algorithm can be used in video processing to make the program more realistic in practice.
[41]	Traffic sign/ 2018	Histogram of Oriented Gradients (HOG), deep learning approach, machine learning.	Distance based	96%	The distance calculation, which is an essential parameter in controlling an autonomous vehicle's longitudinal velocity.	More work includes gathering the complete data collection for preparation, checking and evaluation using the prototype vehicle's Point Grey system.
[42]	Traffic sign/ 2019	deep learning, OSCN model	Blocked sign	96.34%	Proposing an OSCN model for determining the occlusion of a road sign and ensuring appropriate protection of road signs.	In addition, various pre-trained deep learning models may be used to extract image features and further increase the accuracy and recall of the occluded classification of road signs.
[43]	Traffic sign/ 2018	Benchmark Algorithms, convolutional neural networks (CNNs)	Haunted characteristic variation	68%.	This method explores the results of spectral analysis of challenging conditions and reveals that the challenging conditions will contribute to distinct magnitude spectrum.	Future work, adaptive pooling, and spectral processing with no context are exciting avenues for study that can be further explored to predict detection.

2.5 Pedestrian Detection

In year 2019 self-supporting vehicles on the roads are more popular, their success draws attention to safety issues for vulnerable road users such as pedestrian. Autonomous vehicles as driverless cars, pedestrian recognition and monitoring have received significant attention and are also rising rapidly with the advancement of self-driving techniques, it as one of the major issues for autonomous vehicles. While the work around pedestrian detection using vision-based approaches has expanded.

3D LIDAR, SVM-trained Classifier (Wang,2017), KNN, NBC (Chen,2019), local multiple Convolutional Neural Networks (LM-CNNSVM) (Das,2017) and CNN (Gao,2018) will be used to identify pedestrians and alarms will be generated when pedestrians are detected on the road. Another strategy is suggested in (Li,2018) which has reduced the computation complexity based on extraction of features such as color image, discrepancy map, thermal data (Qu,2016).

Table 5:Pedestrain Navigation system for Autonomous Vehicle

S.NO	Work on	Methodology	Parameter Obtained	Result	Advantage	Disadvantage
[44]	Pedestrian detection / 2018	radial basis function (RBF) kernel, SVM, GPS, IMU and, DMI, Hash table techniques	3D LIDAR	N/A	For applicants who become too close to the autonomous moving vehicle, where only a few laser beams are irradiated on pedestrians, the true positive rate is increased.	Includes applying the algorithms proposed in this paper to sparse data, recognizing other interested objects such as cars and bicycles etc. its batter to detect with machine learning approach.

[45]	Pedestrian detection/ 2016	Machine learning algorithm, (KNN), (NBC), and (SVM).	Machine learning 3D range	96.2%	The use of such histograms is one of the most significant developments in developing algorithms that track pedestrians.	Not only for people but also building thinking machines capable of detecting and understanding certain critical items in the image, such as motorcycles, vehicles, traffic signs and lights, etc.
[46]	Pedestrian detection/2017	Convolutional neural networks (CNNs), Local multiple system (LM-CNNSVM)	Deep leaning	92.80%	Incorrect entity identification and object detection, which can contribute to the prevention of harmful accidents by implementing a LMCNN- SVM program.	The range is related to the Red Green Blue (RGB) data and fed into a deep CNN to improve the accuracy and time complexity generating a point cloud of LIDAR data up sampling and translating into pixel-level detail.
[47]	Pedestrian detection/ 2018	RGB-LIDAR dataset to train CNNs,	Camera navigation	96 %	This approach is also implemented to maintain equal precision of classifying items and minimum damage.	Real-world tests will be carried out and the capacity of the conceptual method to identify artifacts in an autonomous vehicle environment based on a vehicle domain controller will be tested.
[48]	Pedestrian detection/ 2018	R-CNN, Fast R-CNN, Faster R-CNN, R-FCN.	classification	95.0%	After this, designation approach eliminates wasteful operations in pedestrian identification.	To build an autonomous vehicle speed control algorithm, implement an updated value-sensitive architecture approach to safely navigate the occluded pedestrian crosswalk.
[49]	Pedestrian detection/ 2019	HOG, SVM, CCF, AdaBoost	Camera	90 %	Combining color and thermal results, and adding variance as an additional function, achieves the best performance.	Certain specialized techniques for collecting and classifying features will be called to further improve performance of the pedestrian detector.
[50]	Pedestrian detection/2018	(POMDP), QMDP,	From moving vehicle	N/A	The public would certainly evaluate an autonomous vehicle on similar values after such as health, legitimacy and mobility.	Through integrating stereo vision cameras with thermal camera, while traveling on city roads, a car design is created from the data recorded from the test vehicle.

2.6 Car Detection

Autonomous vehicles have received greater attention, since safety is of supreme importance. In addition, significant progress in software and hardware allows driving to develop into a smarter and more independent stage. Autonomous vehicles basic requirements are that vehicles can be followed safely and that appropriate measures are taken to prevent rear-end collisions and injuries. Detection of moving vehicles is an important part of aerial visual surveillance systems since vehicles are often very interesting objects. Moving identification of vehicles remains a difficult job.

A real-time approach to detect a car with high speed in image is based on color and distance measurement (Surinta,2019), Neural network convolution (Bougharriou,2017), Hungarian algorithm approach (Do,2017). Vehicles can be detected robustly by using the deep classifier by integrating multi-layer LIDAR (Li,2018) and to adjust road orientation V-J vehicle detectors are used to rotate images with high precision rate (Navarro,2017). To successfully detect a vehicle in urban environments for autonomous driving systems by using HOG and SVM (Xu,2016), Super-Resolution Convolutional Neural Network (SRCNN). To increase detection accuracy rate by using deep neural net- work algorithms such as YOLOV2 (Yang,2018) and YOLOV3 (Zhang,2018).

Table 6:Car Detection Navigation system for Autonomous Vehicle

S.NO	Work on	Methodology	Parameter Obtained	Result	Advantage	Disadvantage
[51]	Car Detection/ 2016	Template matching approach, RANSAC algorithm, Frame difference method, Deep convolutional neural network	Moving vehicle detection	90%	The method is capable of processing real data rapidly, which will enable UAVs to automatically identify moving vehicles.	Focuses on improving classification process precision. More photos are needed to expand the dataset for different categories.
[52]	Car Detection/ 2018	VGG-16 Convolution layer, Multi-level feature fusion, RPN binary classification	Vehicle Detection	67.4%	proposed method incorporates optimization identification and monitoring and fast detection speed	Locate more efficient vehicle tracking strategies in UAV traffic images.
[53]	Car Detection/ 2019	Haar cascade classifier, max-margin, convolutional neural network-based features (MMODCNN), HSV color space	People and object detection	N/A	The project findings can be acknowledged to conform to the smart-city's surveillance of people and objects.	Build with a particular UAV platform which can adjust the camera angle.
[54]	Car Detection/ 2019	Canny, Hough transform, correlation filter-based vehicle detection	Vehicle detection and Lane detection	96.4%	The approach suggested also applies to various systems which detect objects such as pedestrians, traffic lights.	In addition, conceptual algorithm for an autonomous unmanned aerial vehicle (UAV) to identify and monitor individuals and automobile.
[55]	Car Detection/ 2016	combining IBEO, Sensor fusion, adaptive road segmentation method, Fast vanishing point ROI convolutional neural	Based Brake-Lights Recognition	99%	Such work is worth undertaking, because it could significantly reduce the identification errors induced by the illumination.	Tools that can reduce the cost of computing very deep CNNs while not rising error could be explored.

[56]	Car Detection/ 2016	Viola-Jones object detection scheme, road orientation adjustment method, and Enhanced viola-jones.	UAV Image	92.49%	The improved V-J approach provides good performance on both traveling and static UAV platforms.	Future research will focus on expanding existing methods of identifying certain modes of transportation.
[57]	Car detection/ 2017	Candidate Targets Clustering morphological closing, GNN method, Extended Kalman Filter.	Multiple Moving Target	N/A	Results of the experiment demonstrate that the algorithm can control abundant goals in real time with performance.	The next stage is to examine the 3D attribute of different types of artifacts and classify object classifications.
[58]	Car detection/ 2017	Otsu binarized, Histogram optical flow, Accurate bounding box Localization for accurate distance measurement	Improvement and Passing Vehicle Detection	87%	The current work suggested an add-on to some particular algorithm based in ML or non-ML, but the concept of motion was also built on mathematically.	The most critical solutions needed to be implemented are vision-based driver assistance services.
[59]	Car detection/ 2017	Gradient histograms, Support Vector Machines	Shape based classification	83 %	Increased the performance of proposed vehicle detection system	There should be environmental factors that boost system performance and make the system more resilient.
[60]	Car detection/ 2018	YOLOv2, k-means algorithm, Hard Negative Mining deep learning, Detection tuning	Video based detection	61.34%	Improve the accuracy of identification while maintaining good detection efficacy.	More Convolution Networks can be called to improve the performance of the design features built into the deep network.
[61]	Car detection/ 2019	yolov3 network, deep neural network, Sample Expanding for the Intensive Transfer Learning	Based on Satellite image	97.4%	Intensive transfer-learning is implemented to improve accuracy of identification.	Detection efficiency is far from acceptable relative to the results of detection on everyday images Inspired by the positive effects of (SRCNN).

2.7 Road Blocker Detection

After implementation of the detection of the road blocker on the road, Autonomous vehicles has capability to survive with road blocker when hydraulic road blocker rapidly displayed at a very short distance, and the accidents of autonomous vehicles must be overcome. In addition, detection of road blocker will provide safety to the vehicle and its passenger. Road blocker detection and distance calculation algorithm increased navigation system on autonomous vehicle because of their visibility during driving scenario. Detection of road blocker is great inventory on navigation system of autonomous vehicle also, it gives us acceptable result which is more accurate as compare to other navigation systems in autonomous vehicle (Farhat,2020).

Table 7:Road Blocker Navigation system for Autonomous Vehicle

S.NO	Work on	Methodology	Parameter Obtained	Result	Advantage	Disadvantage
[62] [63]	Road blocker detection /2020	Color Detection, SVM, KNN, Naïve Bayes, Decision tree	Color Based	97%	Autonomous vehicles have capability to survive with road blocker when displayed at a very short distance	Future research will focus on expanding existing methods of identifying certain modes of transportation.

Numerous studies have been conducted on issues related to the detection of signs, traffic lights, etc. The existing navigation framework is limited, which has motivated many scholars to improve the navigation performance, detection and recognition of the ADAS navigation system in complex situations. Table 5.6 shows past navigation system of autonomous vehicle in driving scenario.

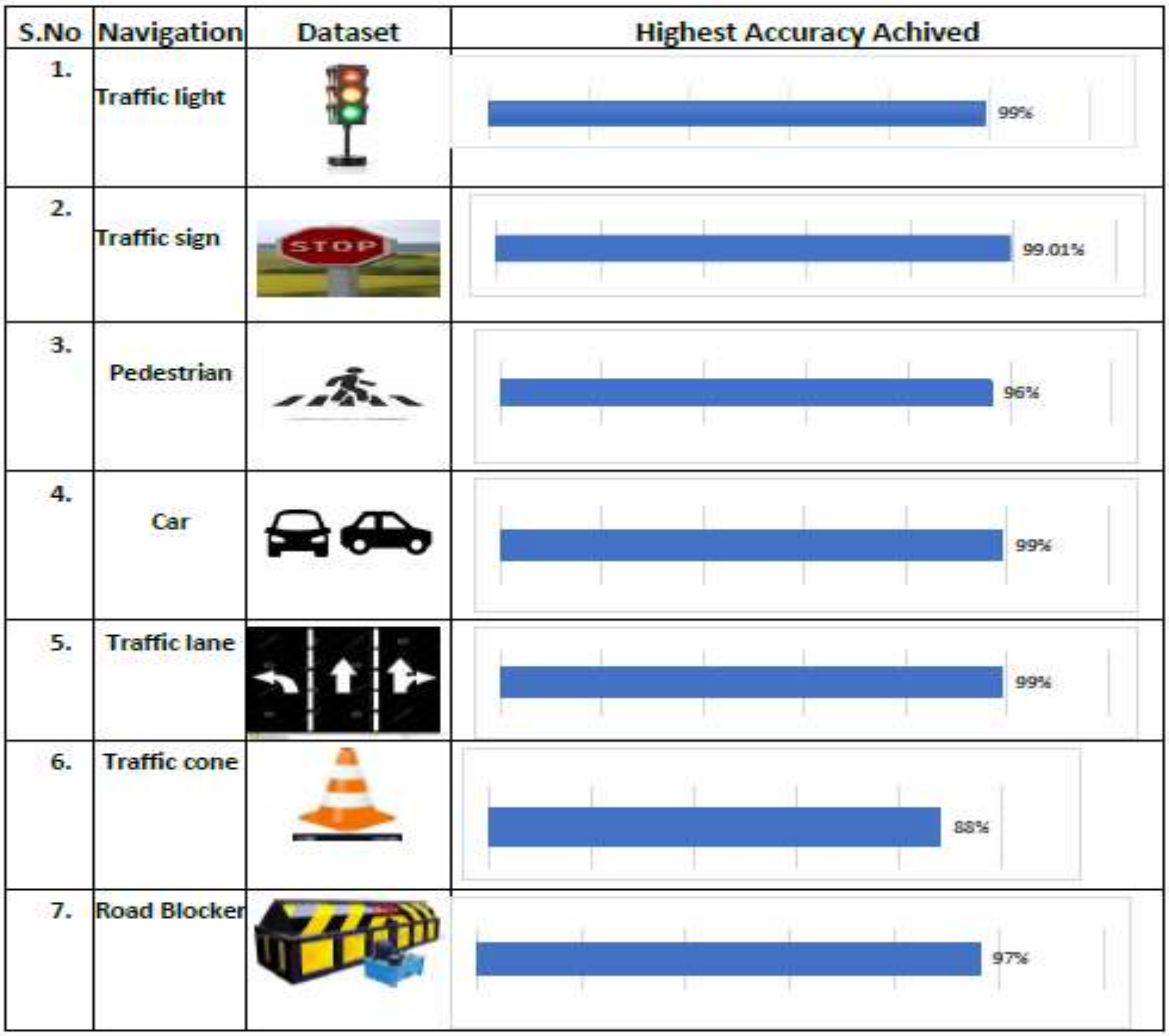

Figure 2: Highest Accuracy Achieved in Different Navigation System

3. Conclusion

Although the existence navigation system will be needed more enhancement for fully autonomous vehicles. Traffic cone, pedestrian, road sign, road lane, road blocker, road cone in potential smart cities, Detection and recognition remains an important issue for research groups. Because of the high demands in terms of reliability, designing a vision-based system is a huge development task, even for the simplest applications. Several functional elements are needed for a stable system, and the recognition and handling of many different conditions and assumptions. Moreover, a great testing effort is required, as many of the cases of failure are rare and difficult to forecast. The high difficulty of the infrastructure and the great development work required to build effective networks greatly hinder the knowledge of roads through research and development. Based on this review, driver intention inference is believed an important function for ADAS and intelligent vehicles, which is able to reduce the conflicts between the driver and the intelligent vehicle. Understanding of human intention also enables a better design of the decision-making algorithms for automated vehicles. In this article we have analyzed the major recent developments reported from 2017 onwards in this field of science, outlining specific phases of most approaches. Future scope in this area includes introducing more efficient techniques for road sign, road lane, cone, traffic light, car, and pedestrian, text detection and recognition to move from one place to another Also, the existing methods in autonomous vehicle does not provide any attention to the road blocker to detect the road blocker and find distance between road blocker and vehicle.

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