Review on Machine Learning based algorithms used in Autonomous cars

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Abstract

Machine learning is now used widely for finding the resolutions to numerous challenges like market prediction, self-driving cars and several others. Integrating sensors in centralized electronic control unit in a car can increase the use of Machine learning to perform new functions. To drive a vehicle without human interference, there requires a sophisticated framework of sensors to capture vehicle data as well as surroundings data. These sensors comprise LiDAR, video, cameras, RADAR etc. that generate a high amount of data continuously in real time about the surrounding environment of car. In this paper, we are going to discuss about the Machine learning algorithms that are used in autonomous cars.

Keywords: Self-driving cars, Machine learning, LiDAR, RADAR.

I. INTRODUCTION

Machine Learning is a field of Artificial intelligence that emphasizes on improving how a machine can performs an intended task. Intelligent systems that are constructed on Machine learning procedures have ability to learn from the past understanding and historic information. Key goal is to make computer system learn automatically without any human interference or assistance. There are several fields in which Machine learning is being used nowadays like, medical diagnosis, regression, image processing, prediction, classification and many more. Machine learning is classified into supervised and unsupervised learning algorithms. Supervised algorithms use a reference dataset to learn and keep learning until they hit their target to a level of confidence. Regulation, classification and detection of anomalies or reduction in dimension can be classified under the supervised algorithms. Whereas unsupervised algorithms try to derive value from the data. Unsupervised algorithms can be sub-divided in the analysis and clustering of interaction laws. One of the primary roles of an autonomous car is to continually create the environment and to anticipate the possible changes to that surroundings. The tasks are divided into four subtasks:

1. Object detection.
2. Object identification or classification of object.
3. Localization of object and movement prediction.

Machine learning algorithms can be broadly categorized among following four classes: Algorithms of decision-based matrices, clustered-based algorithms, pattern detection algorithms and regression-based algorithms.

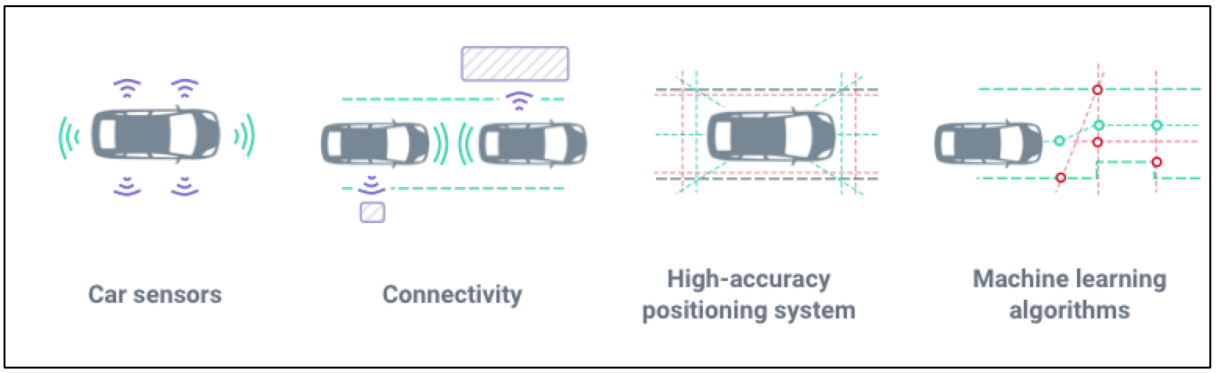

Figure 1: Overview of autonomous driving functionality

Decision matrix

Decision Matrix algorithm recognizes, evaluates, and rates the performance of relationship between information and data values. Such algorithms are primarily used for making decisions. Whether the vehicle needs to stop or turn left/right depends on how sure the algorithms are when identifying, classifying & estimating the subsequent drive of objects.

Clustering Algorithms

The clustering algorithms are focused on defining the construction from data arguments. It defines the methods of class and problem of class as regression. The methods of clustering are systematized by modelling methodologies such as hierarchical and centroid based. Most commonly used clustering algorithms are K-means, Neural network, Multi-class.

Pattern recognition algorithms (Classification)

In Advanced Driver Assistance Systems (ADAS), the number of images obtained through sensors consist of all type of outside world data; images filtering is necessary for determining the category of an item by apart from the inappropriate data-points which is carried out by Pattern recognition algorithms. In a data-set pattern recognition is an essential step before the artefacts are categorized. These algorithms can also be termed as algorithms for data reduction.

Regression algorithms

These algorithms are perfect for event prediction. The regression algorithms that are used in autonomous cars are: Bayesian-regression, decision-forest-based-regression, neural-networks regression etc. The Analysis of Regression estimates the relationship between two or more than two variables and collects the possessions of variables on a different scale.

1. Regression line shape.
2. Types of dependent variables.
3. Number of dependent variables.

II. LITERATURE SURVEY

XU Qian, et. al. [1] [2014] have proposed a positioning algorithm. The method involves macroscopic path alignment & microscopic precise placement that is focused on map-matching & environmental awareness for the autonomous cars. This paper has focused on study of real time positioning of autonomous cars, and has presented an algorithm which is completely based on map matching and environmental perception.

Xue-Mei Chen, et. al. [2] [2017] have proposed to use a rough set method to extract decision making under complex & active urban environment. This method of rough set deals with large data and fast operation. Vehicle dynamics was simulated with a dynamical 6-DOF model, which is based on MATLAB / Simulink to acquire experimental data. The authors have used equidistant discretization approach for reducing the influence of data discretization.

Kichun Jo et. al. [3] [2015] proposed a design and development platform for autonomous cars, based on distributed architecture of the system. This development approach has enabled the development and design of autonomous cars with some benefits like reduction in computational complexity, fault tolerant characteristics and system modularity. The case study of this development methodology is also addressed by introducing the autonomous driving system implementation process.

Claudiu Pozna, **Csaba Antonya** [4] [2016] have discussed the major cultural facets related to autonomous cars and have proposed a control architecture which has following levels; strategical level, tactical level, and operational level. The task of strategical level is to create an interface between users and autonomous cars; task of tactical level is to solve circumstances which are likely but they are not predicted in the previous level; the last operational level uses the task that is defined from tactical level and then read the sensors, control the autonomous car's actuators etc.

Branislav Kisačanin [5] [2017] has discussed the latest developments in the autonomous driving arts and science. Author has discussed the new software & hardware solutions for the development and implementation of computationally increasingly challenging Deep learning networks used in autonomous cars. Author has illustrated how the tools are being used

Betina Carol Zanchin et. al. [6] [2017] have explained the fundamental definitions of an autonomous cars. They have presented a discussion over the classification and instrumentation of self-driving cars to encourage the community that is interested to intensely understand the field. With the rise of autonomy, the number of sensors tends to increase, sensors used in various features and rates will help improving the car's environmental sensing.

Mochamad Vicky Ghani Aziz, et. al. [7] [2017] have discussed that the problem of autonomous car research requires numerous subjects to be discussed in more detail like deep learning, computer vision, the fusion sensor, locating and controlling until path planning. The findings of the implementation of the Cipollarang (located in Indonesia) toll road detection algorithm as part of the automobile system are discussed herein. In Python Language the entire application process can be detected with a precision of more than 90 percent. The results have shown that this algorithm need some parameters to be implemented to allow parameters to be modified during day and night.

Manju Bisht, et. al. [8] [2017] have presented a detailed analysis of the current societal problem of autonomous vehicles. This paper has raised questions about its effect on our environment and the effects on our society in turn. This paper summarises the flaws, concerns and the strange autonomous car area, and raises a question as to why we should search for a secure future beyond them. Authors have concluded that the infrastructure for autonomous vehicles is still at its prototype. It is extensively tested in the car industry as well as outside and is expected to have a perceptive environment effect, traffic flow and performance.

Abdur R. Fayjie[9] [2018] in this paper have addressed the deep enhanced learning of autonomous navigation and the avoidance of autonomous cars, applied to a virtual car urban environment with the Deep Q Network. Two types of sensor data i.e. camera sensor and laser sensor in front of the vehicle are used for the approach as input. It also designs a concept of high-speed car that is cost-effective and able to use the same algorithm in real time. This paper has established the reward function and the behaviour of the agent (car) to maximize the positive reward and train the neural network. Authors have also talked about our sensor fusion method: Lidar and Camera data concatenation.

Qing Rao and Jelena Frtunikj [10] [2018] have presented the possibilities and obstacles for integrating deep neural network learning in automated cars. Authors have also addressed the challenges of behavioural safety throughout the progress of deep learning tactics in autonomous vehicles. The challenges include the monitoring of training and testing data completeness, tracking the safety requirements in the programs during software advancement and the implementation of transfer learning in various area.

Takafumi Okuyama [12] [2018], in their paper have examined the findings of a simulation of an autonomous car in a simplified setting, comprising only lane markings and static barriers. In this article, authors have proposed a simulation analysis of a autonomous driver studying in a simplistic setting consisting of a lane and static barriers only. In the simulated environment, we used a Deep Q Network to train the agent in simulated environment.

III. CONCLUSION

The field of autonomous cars will have a drastic impact in the transportation sector in coming years. As suggested by various reviews, artificial intelligence related technologies such as machine learning and deep learning prove to be quite promising and relevant in order to understand and analyse the robotic behaviour of these embedded applications. The perception control and decision-making abilities of autonomous cars are the major areas of research by the scientific community. Deep neural networks can be extensively used for object detection and classification on the typical road traffic scenarios.

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