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April 23, 2020

Applications of AI in the Automotive Industry: Driverless cars

This paper will discuss the applications of artificial intelligence in the automotive industry, specifically in terms of the approach, availability, and accuracy of the driverless cars--that is, cars that require no human driver to operate the machinery of the vehicle. This paper is divided into the following sections: (1) an introduction and understanding of this application of artificial intelligence, (2) how it uses subsets of artificial intelligence, such as machine learning and computer vision, to operate, (3) arguments or problems discussed for this particular implementation of artificial intelligence, and, finally, (4) a conclusion to summarize previous sections and present the expectations of driverless cars.

A self-driving car, or driverless car, is a highly advanced automobile that is adept at both perceiving its surroundings and moving cautiously and safely with little human input. In some cases, no attentive human input is required for correctly operating these vehicles

AI encapsulates a variety of technologies—from machine learning to natural language processing—that allows computers, engines, or any other machines to sense, comprehend, act and learn. In this particular case, for artificial intelligent cars, companies are employing two particular subsets of artificial intelligence to create the availability of driverless vehicles: machine learning and computer vision.

Perhaps at the origin of these highly advanced cars is computer vision. Computer vision equips computers to understand and adapt to the visual world it sees around itself. Using both deep learning models and digital images captured from cameras and videos, it can operate as a complete sensory apparatus to the automotives, one that concurrently takes in the environment around the vehicle and analyzes it for conceivable threats, obstacles, and other relevant situations that a driver would need to react to while driving. These tasks are classified into 4 sub-tasks: (1) the detection of an object, (2) the identification of an object or recognition object classification, and (3) the object localization and prediction of movement. One way to exemplify how these tasks work is by analyzing rear cameras and sensors. It immediately detects the distance the car is away from another object and alerts the driver when coming into close contact with that object, in some cases the car even automatically stops the car for the driver. Computer vision works the same way, except it is applied to the entire car and not just the rear of the car.

Further, this computer vision application is based on machine learning; therefore, artificial intelligent cars also require a thorough integration of machine learning, which is the study of computer algorithms that improve automatically through experience. The algorithms can be classified as unsupervised and supervised algorithms, with the differentiating factoring being how each of the algorithms learn. The supervised algorithms utilize a training dataset to learn and will continue to learn until they reach a particular level of confidence, resulting in the minimization of the probability of error. In contrast, the unsupervised algorithms attempt to acquire value from the accessible data. This means that within the data that is available, an algorithm is able to find a relation so that it can detect the patterns or divide the data into groups that vary on the amount of similarity between them. The supervised algorithms can be sub-categorized into regression, classification and dimension reduction, meanwhile the unsupervised algorithms can be sub-categorized into association rule learning and clustering. The following paragraph discusses the definitions as it applies to this paper in the following paragraph.

Keeping the information and terms discussed above in mind, it is understandable that the machine learning algorithms are more generally named and divided into four classes: decision matrix algorithms, cluster algorithms, pattern recognition algorithms and regression algorithms. A decision matrix involves the utilization of a list of values and/or information that allow the machine to methodically classify and interpret relationships between the sets of said values and information, being used in AI cars for decision making purposes (when a car needs to turn or brake). Sometimes, the images acquired by the system are not clear and it becomes difficult to locate and detect objects. The clustering algorithm is specially designed in finding the structure from data points. It describes the class of methods and class of problems like regression. Regression algorithms are effective at predicting events. The regression analysis determines the relation between multiple variables and analyzes the effects of these variables on varying scales. This analysis is mainly done using the following three metrics: the shape of the regression line, the type of dependent variables, and the number of independent variables. The images, captured using a camera or radar play an important role because they aid in developing an image-based model for selection and prediction. Clustering algorithms and regression algorithms are beneficial in situations where the machine misses the object or where there is discontinuous data, very few data points or low-resolution images, producing an inability to categorize and report it to the system. The pattern recognition algorithm works exactly as one would expect: it recognizes patterns in data from the object, and captured by sensors or camera, to be used for future use. One of these categories of the machine learning algorithms can be used to achieve two or more subtasks. Simply put, these cars are equipped and encoded with knowledge required to operate a vehicle, *in addition to*, the availability to adopt. Just like us, we pass the driving test--ensuring we have the skills needed to correctly drive--and improve, and get better over the course of time; except, in this case, these machines are highly advanced technologies that have the ability to adapt and learn faster than humans ever could.

Moreover, there have already been trials of this application along with actual implementations already available to the consumer. To exemplify, ridesharing services, such as Lyft and Uber, have already begun testing these driverless vehicles in a range of cities. In other cases, Tesla has two autopilot packages already available for purchase: Autopilot and Full Self-Driving Capability. Employing computer vision technology, it uses 8 external cameras, a radar, 12 ultrasonic sensors and a powerful onboard computer to have this feature. It is important to note that Autopilot claims to be an advanced driver assistance system that is to be employed to *enhance* safety and convenience while driving, not replace the driver altogether. Nonetheless, the applications of this technology are not only being tested but widely used for some companies.

There are, however, contestments to this application of AI. The two main arguments that are brought up in discussing AI in cars are as follows: (1) the possibility of computer error/malfunction, which also involves considering human error, as it is humans themselves that are programming these highly intelligent machines, and (2) the inevitability of unhuman like experiences, as predicted with the "tech lash" situation visible in our society today. Many people fear accidents will occur with these machines on the road. Besides, the technology failing, overall people worry the use of these cars will result in a non genuine and non organic experience. In both cases, using this technology more will allow for these challenges to become either unnoticeable or non existent.

Despite the arguments discussed above, these vehicles are promising to offer a safer driving experience than the experience deriving from our situation today, which we alone are responsible for. Gone will be the days where the most common causes of accidents and misfortunes occur due to human mistakes, such as distracted driving (e.g., texting, eating, talking, grooming, etc.), drunk driving, and reckless driving (e.g., speeding, tailgating, changing lanes too quickly, acting aggressive, etc.). Moreover, new, external sources can improve the accuracy of AI and offer valuable insights, equipping the machine with knowledge and experience to operate the vehicle better than any other human is capable of. In conclusion, the future of this application of AI guarantees a new generation of security and comfort in the roads, where driving experience is embellished by precise and adapted computers.

Resources:

https://www.accenture.com/us-en/services/ai-artificial-intelligence-index?src=SOMS

https://arxiv.org/abs/1604.07316

https://www.huffpost.com/entry/top-15-causes-of-car-accidents_b_11722196

https://medium.com/neuromation-blog/how-computer-vision-can-change-the-automotive-industry-b8ba0f1c08d1

https://www.kdnuggets.com/2017/06/machine-learning-algorithms-used-self-driving-cars.html