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Introduction to Autonomous Driving

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Introduction

Automobile companies the world over are making autonomous driving their top priority as they work to make driving safer. Autonomous cars rely on sensors, actuators, complex algorithms, machine learning systems, controllers, and powerful processors to execute software. RADAR, optics, LiDAR, GPS, processors, and wheel speed sensors all work together to create safer driving conditions.

The backbone of these autonomous cars is artificial intelligence (AI). The software in these vehicles uses groundbreaking machine learning (ML) algorithms, which train on the data generated by the cars' sensors, learning from them and evolving.

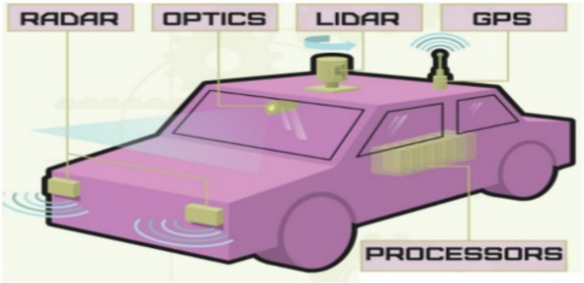
Autonomous vehicles are very closely associated with industrial IoT. This paper discusses the concept of creating datasets for autonomous driving ML algorithms and how organizations can profit from this technology. It highlights the processes and technologies used to create training data sets and the various industries that can greatly benefit from it.

What is Autonomous Driving?

An autonomous vehicle or self-driving car operates without human intervention.

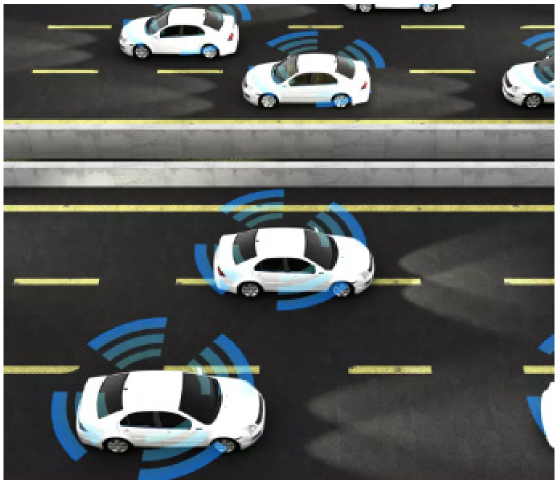
Using a fully-developed autonomous programming mechanism with sensors all around it, the car detects its surroundings and any other vehicles around it in the same way as a human driver.

Driveless cars depend on various kinds of data on the back end to function seamlessly on the road.



Various function-specific software drive end devices like sensors, actuators, and controllers (such as those pictured above), which run on electronic control units. Machine learning software is also part of this set.

This is how an automated car senses its surroundings (at right).

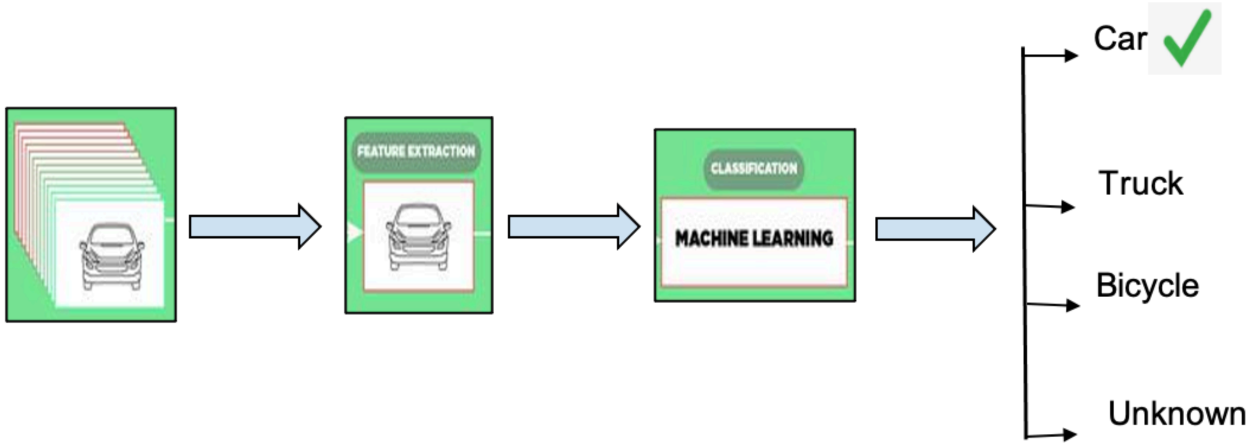


One of the main tasks of any machine learning algorithm in a self-driving car is the continuous rendering of the surrounding environment and the prediction of possible changes to those surroundings. We can divide these tasks into four sub-tasks:

- Object detection
- Object identification or recognition
- Object classification
- Object localization and prediction of movement

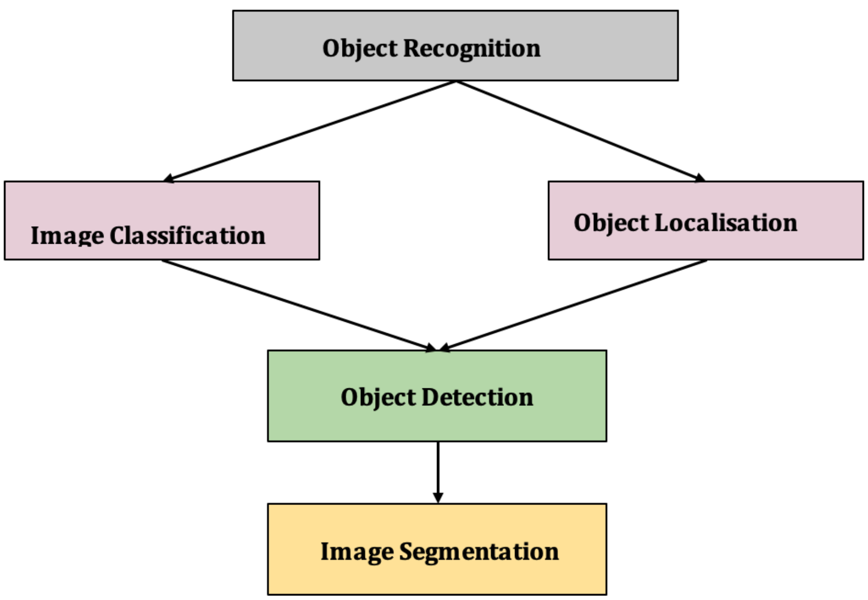
Object detection: During the task at hand, a self-driven algorithm uses data sets that provide information about the environment through the LiDAR and camera. Using the information from these sensors, objects are detected. Usually, sensors detect objects using a combination of feature-based modeling and appearance-based modeling.

Object Recognition: Object recognition is the technique of identifying an object present in images and videos. It is one of the most important aspects of machine learning, data mining, and deep learning processes. This trains machine learning algorithms to identify nearby objects just like a human being does.

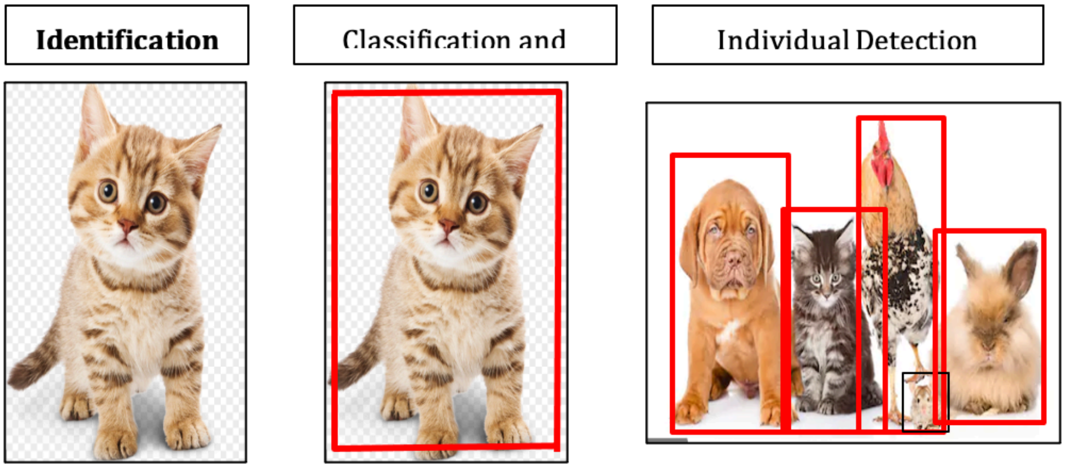


Object/Image Classification and Localization: In image classification, algorithms consider an image as an input, process it, classify it, and send an output. For example, an image of a cat can be classified as a class label "cat," or an image of a dog can be classified as a class label "dog" with a degree of probability.

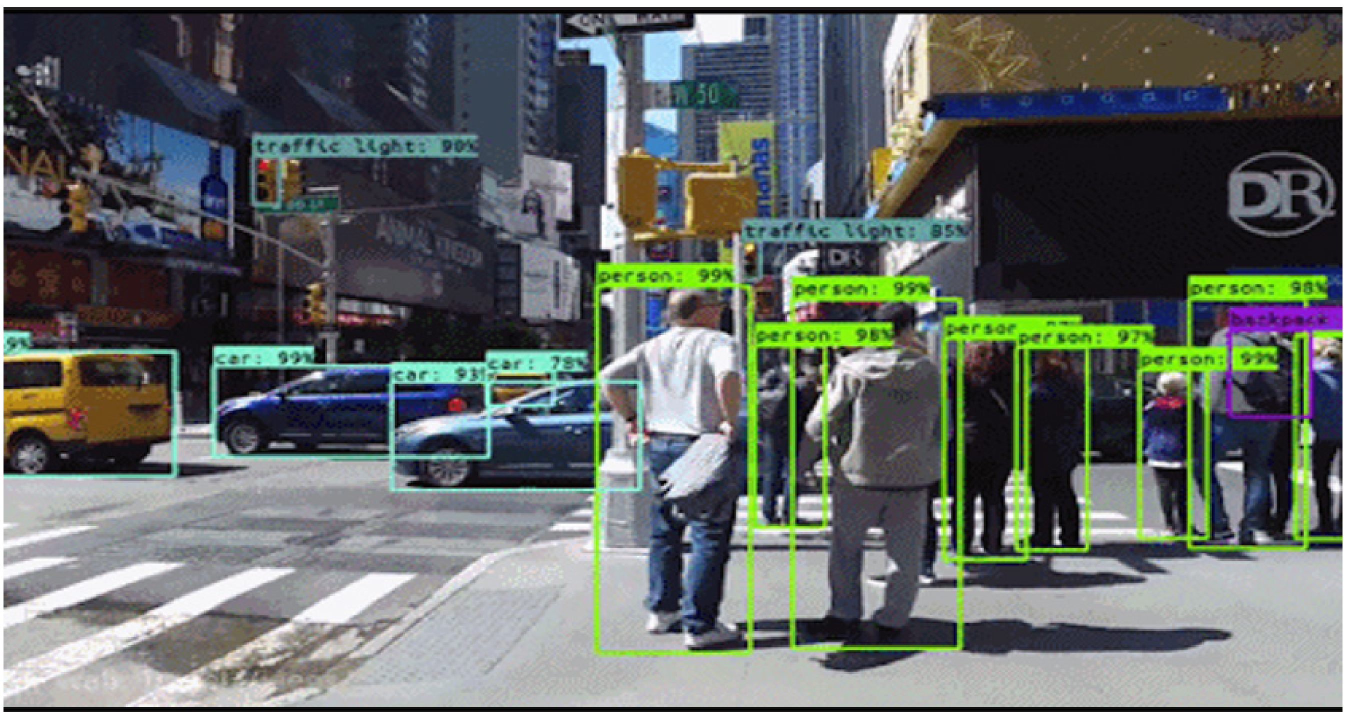
In some cases, we can simply mention the whole labeling part as just an animal, bird, or any specific object. This algorithm locates the presence of an object in the image and represents it with a bounding box. It takes an image as input and outputs the location of the bounding box in the form of position, height, and width.



Below is how it works:



This is how sensors identify and detect on-road attributes:



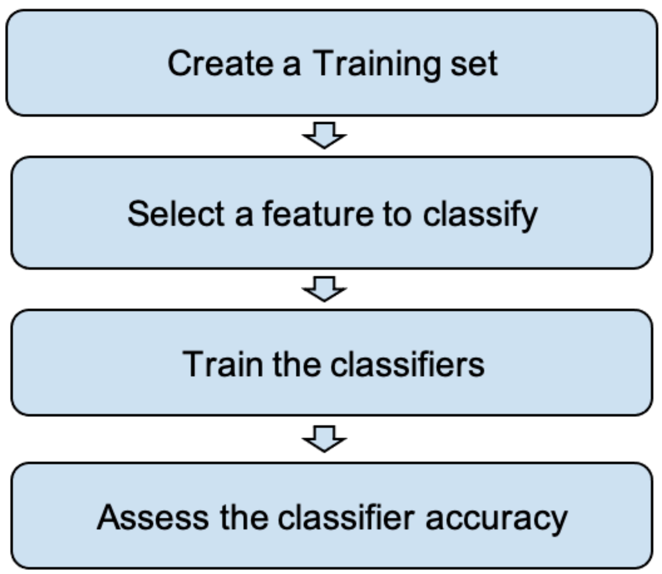
How Does Autonomous Driving Data Set Creation Work?

The data set is composed of high-resolution sensor data collected by autonomous cars in a wide variety of road conditions.

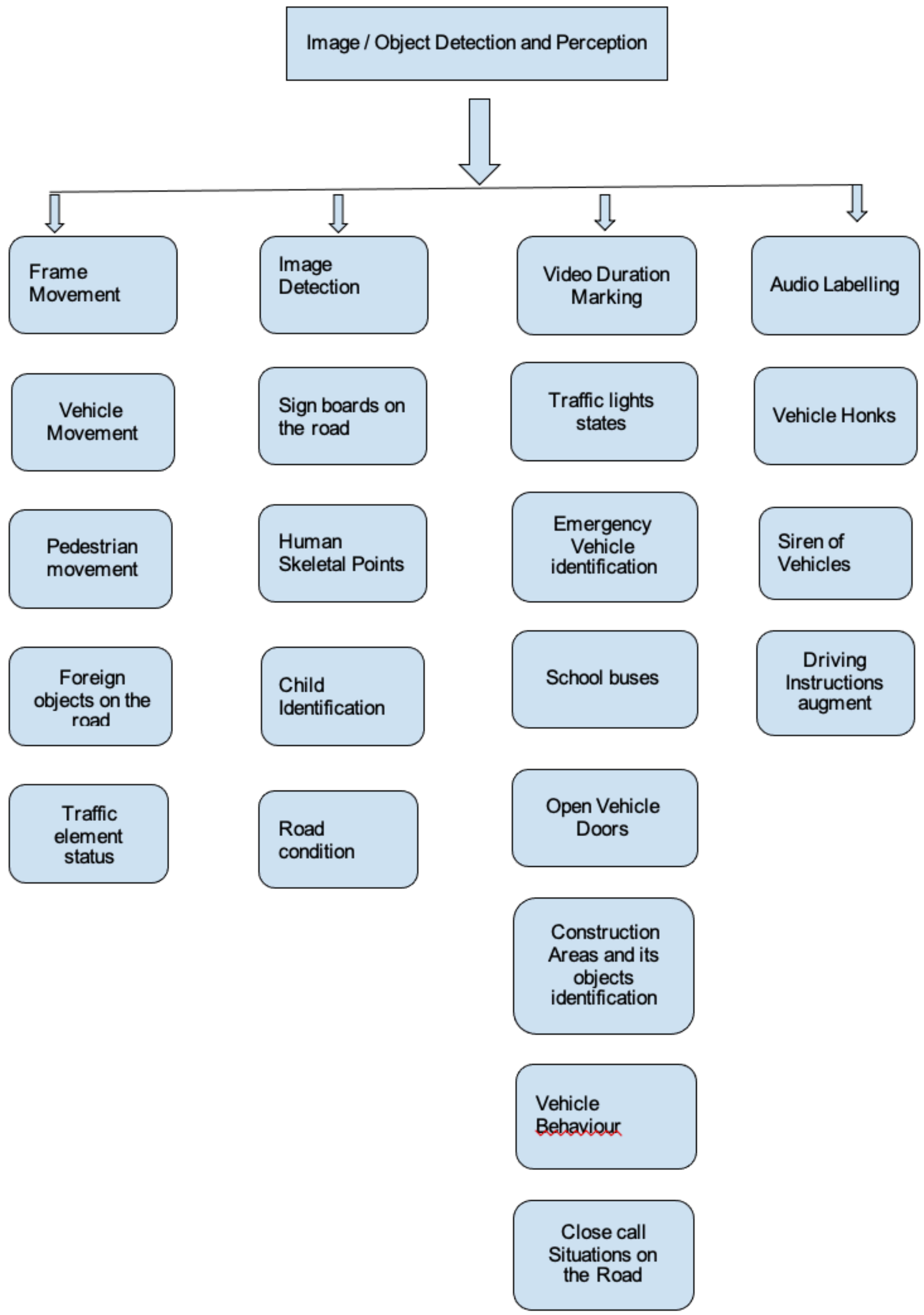
One well-known autonomous car has eight sensors. The most noticeable is the rotating roof-top LiDAR, a camera that uses an array of 32 or 64 lasers to measure the distance to objects. It then builds up a 3D map at a range of 200m, letting the car “see” potential hazards. The vehicle also sports another set of “eyes” with a standard camera pointing through the windshield. This camera looks for nearby objects (such as pedestrians, cyclists, and other motorists), reads road signs, and detects traffic lights.

We deal with each attribute that a sensor captures and use it for creating a training set.

The hierarchy is as follows:



We segregate all of the available aspects that may affect autonomous cars’ behavior attribute-wise and work them queue-wise to classify them as a data set.



Each of the attributes mentioned above are generic training classifier data sets for autonomous cars. These are the factors that affect the self-driving car's path on the road.

The Impact of our Work on Driverless Cars

We give inputs to the AI sensor algorithms so that autonomous cars can identify the real-world objects in their paths, creating a precise graph image for the vehicle. Any inaccurate information fed to AI may result in close calls or accidents on the road.

For example, the sensors of a self-driving car can identify a motorcyclist and their gestures. It then either slows down or speeds up, giving space to the biker and avoiding a collision.

We create these kinds of data set instructions at the queue level. Any incorrectness in this input leads to unwanted close call situations on the road.

Why Autonomous Driving?

Automation can help reduce the number of collisions by significantly minimizing driver error. Higher levels of autonomy also have the potential to reduce risky and dangerous driver behaviors. Below are a few related benefits.

Benefits of Autonomous Driving

1. Reduced traffic accidents

The number of deaths caused by road accidents is alarming. With the advent of autonomous vehicles, we can mitigate driver error to the maximum extent and create safer driving conditions. Sensors around the autonomous vehicle help it identify other cars around it so that software can access the speed and control functions to avoid close calls or risky situations.

2. Reduced traffic congestion

Fewer crashes mean fewer roadway backups. Driverless vehicles can maintain a safe and consistent distance between cars, reducing the number of stop-and-go waves that produce road congestion.

3. Environmental impact

Fewer traffic jams save fuel and reduce greenhouse gases caused by unnecessary idling. A self-driving car can move faster and more safely than a car driven by a human, decreasing traffic congestion. These vehicles have built-in adaptive control mechanisms and can automatically shift into electric mode to save gas. We reduce emissions because automated systems accelerate and brake smoothly. The algorithms also are programmed to choose the most fuel-efficient route.

4. Cost savings

This can have a major impact. Fuel efficiency improves as your car can communicate with other vehicles and control its speed more accurately. Fewer accidents means reduced insurance costs, and organizations can consider better health care plans.

Autonomous vehicles will obey all laws, which enables owners to avoid all kinds of traffic fines.

Driverless cars can save time, and we can be more productive. Sharing an autonomous vehicle would be cheaper than owning a car.

Conclusion

In the future of public transportation, self-driving vehicles will undoubtedly be a game-changer.

Organizations would be smart to take advantage of any opportunities in autonomous driving as they become available. Boosting productivity, increasing fuel efficiency, and reducing traffic snarls, autonomous vehicles will change the nature of our cities, roads, and the way we live our lives.

About the Author

Sankeerthana Pullabhotla has been an associate team lead of CE at GlobalLogic for six years and has worked for three years in machine learning (content management). She holds a double master's degree in English and Psychology from IGNOU.

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