AUTONOMOUS VEHICLES

REIMAGINING THE POSSIBLE I 2022 ENGINEERS WEEK

Introduction

Government data identifies driver behavior or error as a factor in 94 percent of crashes, and autonomous vehicles can help reduce driver error.

Benefits of AVs:

i. *SAFETY:* Vehicle safety promises to be one of automation's biggest benefits. Higher levels of automation, referred to as automated driving systems, remove the human driver from the chain of events that can lead to a crash. Higher levels of autonomy have the potential to reduce risky and dangerous driver behaviors.
ii. *MOBILITY:* Seniors and people with disabilities, like the blind, are capable of self-sufficiency, and highly automated vehicles can help them live the life they want.
iii. *ECONOMIC AND SOCIETAL BENEFITS:* AVs can help avoid the costs of crashes, including medical bills, lost work time and vehicle repair. In a fully automated vehicle, all occupants could safely pursue more productive or entertaining activities, like responding to email or watching a movie.
iv. *ENVIRONMENTAL:* Fewer traffic jams save fuel and reduce greenhouse gases from needless idling. Fewer crashes or fender benders mean fewer roadway backups. AVs maintain a safe and consistent distance between vehicles, helping to reduce the number of stop-and-go waves that produce road congestion.

Levels of Automation: Society of Automotive Engineers (SAE) describes Levels of automation as seen in the table below. Level 5 is considered a fully autonomous vehicle.

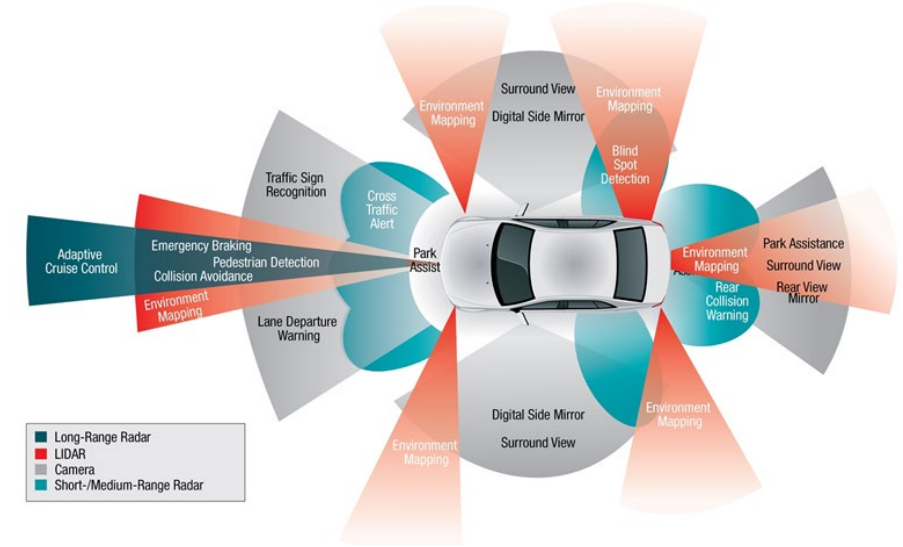
Levels of Automation

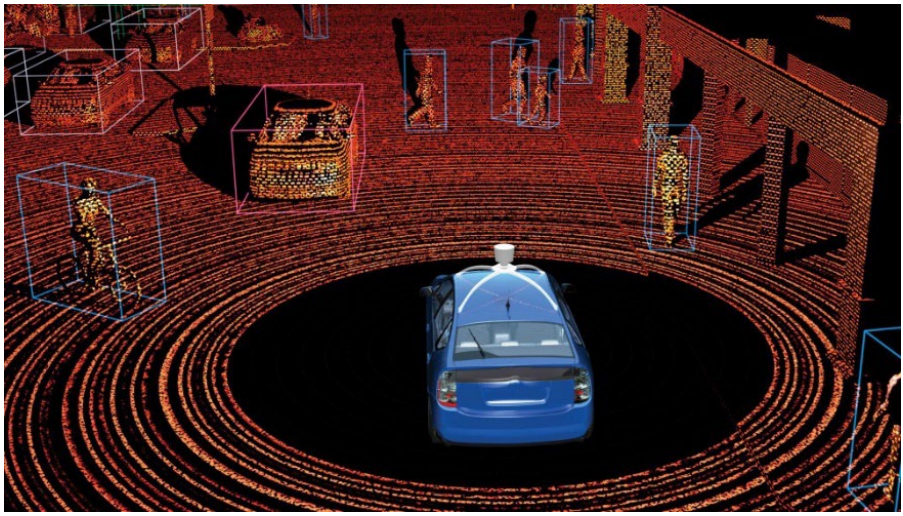
Level 1	Basic assistance (ABS, ESP, cruise control etc)
Level 2	The car accelerates, steers and breaks on its own monitored by the driver
Level 3	The driver doesn't have to keep their eyes on the road in certain situations
Level 4	The car drives itself in almost all situations without the driver's help
Level 5	Full autonomy, no driver needed

Sensors used in Autonomous vehicles

The following are some major sensor components used in Autonomous Vehicles:

LIDAR: Stands for Light Detection and Ranging, is a remote sensing method that uses light in the form of a pulsed laser to measure ranges (variable distances) to the Earth. This technology is used to scan roads and buildings. With a LIDAR scan, we generate a cloud point (literally a dataset of points) which can be loaded and used to represent the real world. The following picture shows data points generated by a LIDAR detector.





RADAR: Is a detection system that uses radio waves to determine the range, angle, or velocity of objects. Radars are one of the simplest sensors in an autonomous vehicle, the distance they reach is short but they are relatively cheap when compared to LIDAR. Currently, many vehicles already use Radar technology for collision prevention during parking.

GPS: We generally understand what GPS means. When activated in cell phone, GPS allows use of Maps or any other geolocation-dependent functionality. The official definition states:

The **Global Positioning System** (**GPS**), is a satellite-based radio navigation system owned by the United States government and operated by the United States Air Force. It is a global navigation satellite system (GNSS) that provides geolocation and time information to a GPS receiver anywhere on or near the Earth where there is an unobstructed line of sight to four or more GPS satellites.

CAMERA: A camera is an important sensor in autonomous vehicles. It allows them to identify objects and people in the real world. Autonomous vehicles use Cameras for object detection and object identification based on advances made in the field of Computer-vision and Machine learning techniques, particularly in convolutional neural networks.

4D IMAGING RADAR: The traditional sensors discussed above add significant weight to autonomous cars and is a subject of concern for car manufacturers. 4D imaging radar sensors can address this challenge by replacing various single-function sensors while also proving to be safer than traditional radar or light detection and ranging (LiDAR)

Autonomous Vehicles Operating Today

BEEP – provides multi-passenger, electric, autonomous shuttle that operates at several locations including May Clinic – Jacksonville; Lake Nona, Fl; HART, Tampa; Yellowstone, WY and several others.

Several autonomous delivery robots are operating in selected areas. The robots are deployed by several companies such as Starship Technologies, Nuro, Udelv, Kiwibot, Amazon Scout etc.

Future Trends

Toyota's Research Institute made a Toyota Supra drift without input from the driver on a two-mile stretch of Thunderhill Raceway in Willows, California. This was achieved using advance technologies and computers controlling everything: steering, throttle, clutch, and the sequential transmission.

This research has some real-life applications in pushing driver assistance forward; controlling a drift is akin to controlling a car's inputs whenever you're in a limited-traction situation, which requires precise input controls to avoid a collision.

To watch video of this cool research project, click the following link: https://youtu.be/MfU5_gzqPaM