

FUTURE OF AUTOMOBILE TECHNOLOGY

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Abstract - Autonomous vehicles are future vehicles which are told to be driverless, crash avoiding and more efficient. In this paper we will review about the main sensor technology, driving systems used in autonomous vehicles and hardware used in autonomous vehicles. AV uses passive sensors and active sensors. Sensors include RADAR, LiDAR, CAMERA, ULTRASONIC SENSORS. For diving system AV uses drive by wire technology. Hardware used is NVIDIA.

Key Words: Autonomous Vehicles, DSRC, RADAR, LiDAR, NVIDIA, RSU.

1. INTRODUCTION

An autonomous vehicle is a vehicle capable of sensing its environment and it can operate without human involvement. It is told that in 10 years. Autonomous vehicles will be the norm and autonomous vehicle can generate an annual revenue of \$7 trillion by 2050. In roads almost 94% of road crashes occur due to human error. Almost 3700 people have been killed globally and 410 people are killed in India daily due to vehicle crashes. Autonomous vehicles work by computer vision, sensor fusion, localization, path planning and controlling. In 2014 Society of Automotive Engineers (SAE) classified autonomous vehicles to six different levels that is from level 0 to 5. Level 0 is no automation, level 1 is driver assistance, level 2 is partial automation, level 3 is conditional automation, level 4 is high automation and level 5 is full automation. From level 0 to 2 the human monitors the driving environment and from level 3 to 5 the automated system monitors the driving environment. With the widespread adoption of AV can reduce 90% of vehicle crashes.

2. SENSORS USED

Every vehicle has 60 to 100 sensors on board, other than these sensors autonomous vehicle has active and passive sensors. Active sensors send out energy in the form of waves and looks for the objects based on the information back. The active sensors in AV are RADAR, LiDAR, ULTRASONIC SENSORS etc., The passive sensors simply take in information from the environment without emitting any wave. RADAR (Radio Detection and Ranging) it transmits electromagnetic energy and the energy reflects back to it. In AV radar is found in two variants 77GHz for long range sensing and 24GHz for short range sensing. It works best at detecting object made of metals. It has limited ability to classify object but can accurately tell the distance to the detected object. It is mounted on bumpers, with two sensors on front and two in rear. Navitech-radar

360 is used in AV. LiDAR (Light Detection and Ranging) emits laser beam hits object in the environment and bounces back to photodetector. It creates 3D image of environment and sense almost everything in the environment. CAMERA works on basis of AI. Cameras are placed on front, rear, right and left of the AV and are combined to create a 360degree view. Cameras works with the help of classifier, optical flow and artificial intelligence. ULTRASONIC SENSORS is used as parking sensors. It is ideal for providing additional sensing capabilities to support low speed use. Its range is only few meters. GPS (Global Positioning System) is used to find the position of the vehicle with the help of satellites. CENTRAL COMPUTER it is the brain of the vehicle. It receives information from various components and helps to direct the vehicle.

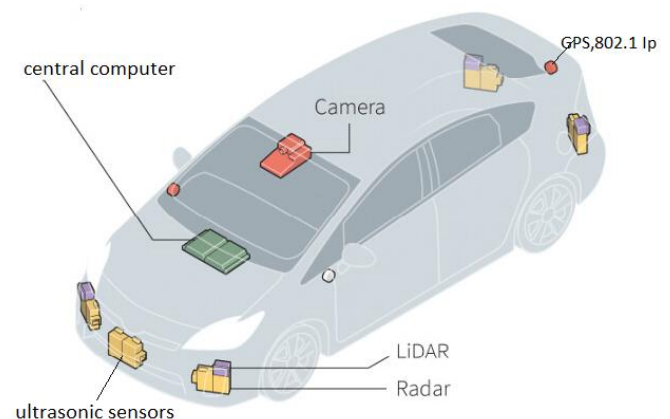


Fig-1: sensors used in autonomous vehicles

3. DEDICATED SHORT RANGE COMMUNICATION

DSRC permits AV to communicate with other vehicles and infrastructure. It is a two-way short to medium range wireless communication. It enables data transmission. DSRC operate in 75 MHz of bandwidth at 5.9 GHz. In AV there are two ways of communication V2V (vehicle to vehicle) and V2I (vehicle to infrastructure). V2V communication enables vehicle to wirelessly exchange information about their speed, location, etc., DSRC combined with GPS we can produce low cost V2V. The range of V2V is more than 300m. V2V technology employ visual and audible alerts to warn the driver.

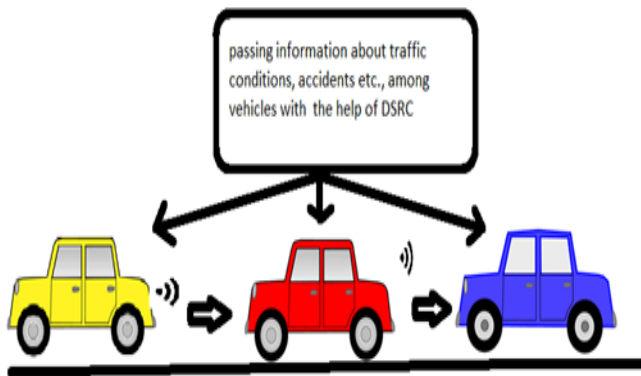


Fig-2: vehicle to vehicle communication

V2I communication consist of Roadside Units (RSUs) and Onboard Units (OBUs) that have transceivers and transponders. The RSU engages OBUs of travelling vehicles via DSRC technology in order to acquire the necessary traffic information for time, speed and location of the vehicle. The DSRC Roadside Units occasionally approximates the Start of Congestion and travel time after acquiring the data. The information is then broadcasted to all the vehicles that are in coverage range by DSRC roadside unit.

4. DRIVE BY WIRE

In drive by wire we can replace all the mechanical components in autonomous vehicle to electrical wires. It works with the help of sensors and passes the recorded data to the central computer. The central computer further gives information to the steering and breaking system of the vehicle which is controlled by sensors.

4.1 Steering System

The steering system in AV works by drive by wire technology. This technology can remove the mechanical components and can be replaced by wires. It works by giving torque and assist torque in steering. This system makes the steering much more accurate than the conventional system. The steering system contains two main parts the steering wheel and the feedback actuator. It can term as noncontact type as there is no mechanical connection between the sensors and steer wheels.

4.2 Throttling System

The throttle system in AV works by drive by wire technology. It will be electronic throttle and the mechanical components will be replaced with sensors. The information from the sensors will be passed to the central computer and the electrical impulse activates the actuator for precisely required amount of time which releases specific amount of fuel and air into the engine cylinder. The throttle valve position is send back to the central computer and feedback is processed in the central computer and necessary corrections are done from information from various sensors.

4.3 Braking System

The braking system in AV works by brake by wire technology. The brake will be controlled by electrical means. The technology replaces traditional components such as pumps, hoses, etc., with sensors and actuators. It has a small electric motor near the wheels that generate braking pressure. The DC electric motors on the wheel produces the breaking pressure. The break by wire technology is still under construction and testing.

5. ARTIFICIAL INTELLIGENCE

AI is the ability of a computer program or machine to think learn and make decision. It was found by John McCarthy. With AI we are getting computer program and machine to do what humans do. Artificial intelligence software in the car is connected to all the sensors. AI stimulates decision making process using deep learning and controls actions in driver control systems. The artificial intelligence in the autonomous vehicle makes the vehicle to think like humans. With the help of artificial intelligence in Autonomous vehicle the vehicle can sense different objects in the environment such as humans, buildings, animals etc., The artificial intelligence also helps drive by wire technology to help the vehicle to direct by itself.

6. HARDWARE & 5G TECHNOLOGY

NVIDIA DRIVE AGX is an AV computing platform that serve as the brain for AV. NVIDIA DRIVE AGX delivers high performance and energy efficient computing for functionally safe AI- powered self-driving. For level 2+ and level 3 AV NVIDIA DRIVE AGX Xavier is used which deliver 30 trillion operations per second. For level 4 and level 5 AV NVIDIA DRIVE AGX PEGASUS is used which has the power of two Xavier. It processes the data from different sensors such as cameras, Lidar, radar etc., It also execute for the safe drive of the vehicle. It also controls the artificial intelligence. NVIDIA is developed such that a single chip can control numerous systems in autonomous vehicles.

5G is the fifth generation mobile network. It is designed to connect everyone and everything together including device, machines and objects. 5g guarantee ultralow latency and high reliability. It has high data rate transfer from vehicle to everything. (V2X). 5G technology allow us to leverage the full potential of advanced technologies such as AI and Internet of Things.

7. CONCLUSION

The major advantage of AV is it decreases the no of accidents that is it prevents human errors from happening by controlling the vehicle. It can lessen the traffic jams by communicating well with one another. It enables stress free parking by dropping the person at destination and directly heading to the vacant parking spot. It also helps in accessibility of transportation by senior citizens and disabled persons will have difficulty in driving. The AV assist towards save and accessible transportation. AV will be highly expensive as it has high technology and

equipment used in it are expensive however this may lower down giving way to the average earner people to have one. AV due to numerous technologies used are prone to hacking. Non-functioning of sensors can also happen in drastic weather conditions.

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