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CASE STUDY ON THE IMPLEMENTATION OF THE AUTONOMOUS DRIVING SYSTEMS

ABSTRACT

This paper presents the basics of autonomous vehicle as well as technologies that enable a vehicle to be self-driving. Taking into the consideration the fact the major causes of traffic accidents are by human errors, with the application of intelligent vehicle systems would be a great help to go to the "zero vision" of life losses in traffic accidents. According to traffic accident statistics, 75% or more of fatal accidents have been caused by human factors such as: lack of attention, stress, loss of orientation, fatigue, health condition, etc. In 24% of cases unexpected behaviors causes traffic accidents and only 0.7% of them are due to technological failures. For this reason, the potential of driver assistance and active safety systems that support the driver in complicated traffic situations is much higher when compared to passive safety. From this perspective it can be seen that with the construction of a self-driving vehicle, 75% of cases of fatality are likely to have a significant decrease in the percentage of life-loss in total number of traffic accidents. On the other side technological errors that affect the occurrence of fatal accidents may have a slight increase but all this based on the prejudice that in future there will be more vehicles with intelligent systems failures that may occur in disfunctional system.

Keywords: Self-driving Vehicles, Assisting Systems, Automated Systems, Tesla, Google

1. INTRODUCTION

In the last 25 years robotic vehicles, commonly known as intelligent vehicles, became an important part of service in the field of robotics. It is estimated that more than one billion passenger vehicles traveling on the world's roads today. With such traffic it is clear that there are many situations where drivers do not react fast and properly. In many cases, the driver is not able to react, that is why automated system applications are included in the vehicles. These automated systems will perform various tasks that the driver faces when driving a vehicle. An intelligent vehicle is defined as a vehicle equipped with perception devices that enable the automation of driving tasks such as: the following safe lane, avoidance of obstacles, overcoming slow traffic, anticipating and avoiding dangerous situations and defining of the road. The overall motivation for intelligent vehicle development is in providing road safety, adaptation and efficiency. Current research on intelligent vehicles is focused on actual legal conditions. Therefore, mainly due to legal issues is not the ultimate goal of the research teams to build a fully

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autonomous vehicle. The automotive industry itself sees its role in overseeing and system assistance. Moreover, the world's transport authorities are not oriented to handle autonomous vehicle systems, but in particular are focused on reducing vehicle fuel consumption, expanding the road network, increasing road and vehicle life. It is known worldwide the development of intelligent vehicles has social, environmental and economic benefits. Intelligent vehicles can predict driving scenarios and respond in case of dangerous situations, which can avoid accidents caused by human errors up to 90%. Ultimately, this leads to the saving of human lives. Experiments on the autonomous vehicle dating by the year 1920. The first research that has shown good results has been developing since 1950, and work has continued since that time. The first autonomous vehicle appeared in 1980 at the Navlab Carnegie Mellon University, while another project was developed in 1984 by Mercedes Benz and EUREKA Bundeswehr. Another one is developed by University of Munich "Prometheus Project" in 1987. Since then, many large companies and research organizations have developed and worked on prototypes of autonomous vehicles, including Mercedes-Benz, General Motors, Continental, Autoliv, Nissan, Renault, Toyota, Audi, Volvo, Tesla motors, Peugeot, Google etc. [5 and 11]. In 2015, many states such as Washington DC, Virginia, California, have allowed autonomous vehicle testing on public roads, while so far the vehicles have been tested on regular roads without snow and with regular traffic, but Ford has tested its vehicles on snow-covered roads that has shown good success.

2. RESEARCH SIGNIFICANCE

Autonomous vehicles, also known as AV, or informally as robot vehicles or self-driving vehicles, are motor vehicles that can move independently (i.e., any person to sit at the driver's seat and not necessarily all functions in real time driving are on the so-called Vehicle Automation System). AV is vehicles that are not needed to be driven by a driver, also referred to as robot vehicles. This kind of vehicle has the ability to perform all the functions that a person does while driving a vehicle. They themselves detect the traffic environment, when the "driver" is only required to choose a destination and does not have to carry out any operation while driving. Main aim of this paper is oriented in elaboration on function of autonomous vehicle (AV), respectively: its technical characteristics, integral components, applied technology, and main operating systems that enable the application of intelligent or automated systems that AV is self-driving. Another aim is the comparison of two AV developed by the two giant companies, Google and Tesla.

Autonomy levels: A classification system based on six different levels (ranging from driver assistance to fully automated systems) which was published by Association of Automotiive Enginners (SAE) in 2014. This classification system is based on the amount of driver intervention and the necessary attention, instead of the vehicle's capabilities, while these are closely related to each other and consists of:

- **Level 0:** The automated system does not have a vehicle control but can do warnings.
- **Level 1:** The driver must be ready to take control at any time. The automated system may include features such as vehicle speed control-Adaptive Cruise Control (ACC), automated parking assistance, and assitance to keep the vehicle in the lane.

- **Level 2:** The driver is responsible for detecting objects and events and intervening if the automated system does not respond properly. The automated system executes actions such as acceleration, braking and steering. The automated system can be deactivated immediately after receiving the driver's control.
- **Level 3:** Inside the knowledge, limited environments (such as highways), the driver can be sure to draw his attention away from driving responsibility.
- **Level 4:** The automated system can control the vehicle in all environments, except such as bad weather. The driver must enable the automated system only when he is convinced to do so. When activated, driver attention is not required.
- **Level 5:** In addition to defining the destination and starting the system, no human intervention is necessary. The automated system can drive any vehicle where it is legally.

3. FUNDAMENTALS OF THE AUTONOMOUS VEHICLE FUNCTION

In order the autonomous vehicle to orient itself, a system of localization, perception, vehicle control, planning and management system are needed. In the the following figure are presented their fundamental functions.

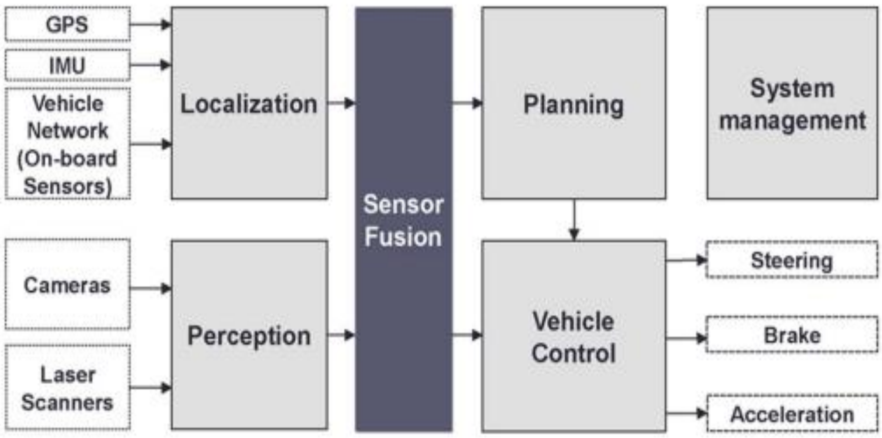

Figure 1. Fundamental functions of autonomous vehicle [1]

- **Perception** is a process that senses perceive the surrounding environment of autonomous vehicles by using different types of sensor techniques such as radar, camera, LIDAR.
- **Localization** finds the position of autonomous vehicles using the techniques of the global positioning system (GPS) and road map [2].
- **The Planning Function** determines the behavior and motion of autonomous vehicles based on the information received from the perception and localization function.
- **Vehicle Control** the control function follows the desired command from the planning function starting with the direction, acceleration, and braking of autonomous vehicles. Control of the vehicle is an essential function for the conduct of autonomous vehicles along the planned trajectory, and must be accurate for safe driving in various driving conditions. The functional scheme is given by Figure 2.

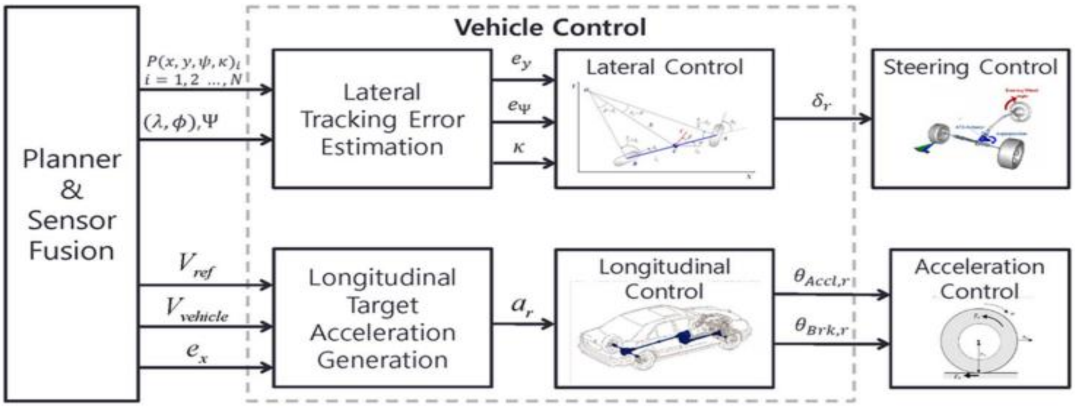

Figure 2. Control of autonomous vehicles [1]

- **The management system** for the development and operation of an autonomous vehicle, the management system is essential for overseeing the entire autonomous system of driving a vehicle. The management system for the development and operation of an autonomous vehicle is essential for overseeing the entire autonomous system of driving a vehicle, Figure 3.

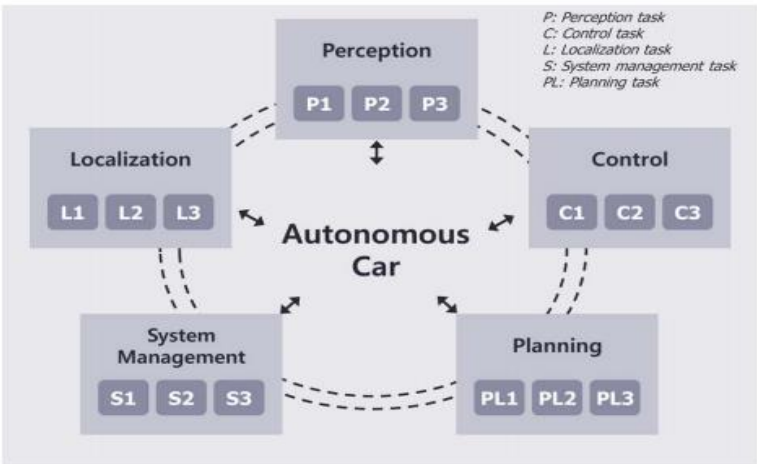

Figure 3. Functional components of the self-management system [2]

3.1. Technologies Used in Autonomous Vehicles

Today there are technologies that enable a autonomous vehicle. Active security systems are commercial, and those that are available today represent a basic level of autonomous vehicle. For the full functionality of autonomous vehicle, there is no need for more hardware. Software and testing is where much work needs to be done. Autonomous vehicles use sophisticated algorithms to decode data obtained from sensory hardware to determine the course of action to be taken and how to execute those actions. To carry out these actions, a lot of testing will be needed to make sure that every possible scenario which is taken properly.

The hardware is not a drawback. Today there is much of the technology required to build fully autonomous vehicles, and many prototypes are built and are fully functional and also already being tested. Active safety systems which provide a basic level of self functioning have been on sale for several years and begun to enter into the world market. For full autonomous capabilities, the vehicle constructors need only to work harder in the direction for the development of active safety systems. The software will be "secret sauce" for the full operation of AV. Most of the work on the development of AVs that is happening today seems to revolve around software. AV use highly sophisticated algorithms to interpret sensor data coming from hardware for it. The softwares should perform the following tasks to:

- Interpret everything in the surrounding of AV,
- Anticipate future events and necessary reactions,
- Guide the various hardware components of AV to carry out the necessary actions.

To perform these actions, it needed an exponential growth in the quantity and sophistication of the necessary software for achieving full autonomous capabilities. This is probably the biggest change in the functionality of autonomous vehicles.

Practical considerations are the main constrains. When engineers ask questions about hardware and software that are needed to provide full autonomous capacity in labs, long time will be up to commercial implementation. The reasons are the result of practical considerations. There are two levels of practical considerations:

- Solving non technical issues related to responsibility and regulations and
- Ensuring that hardware and software can perform calculations for almost every possible scenario while driving.

3.2. Hardware Components

Camera: There must be at least monovision camera, which means to have only one source of vision. Monovision cameras are very simple and inexpensive devices and used to understand a generally basic infrastructure environment such as lane markings, speed limit signs, etc. The next phase is stereovision cameras, which use two sources of vision, similar to human sight, Figure 4.

Figure 4. Views provided by cameras [3]

Radar: It is a system that detects objects using radio waves to determine the radius, height, direction, or speed of objects. Vehicle sensors- radars are responsible for the detection of objects around the vehicle and detecting dangerous situations (potential collisions), Figure 5. There are two types of radar: long-range radar and short-range radar.

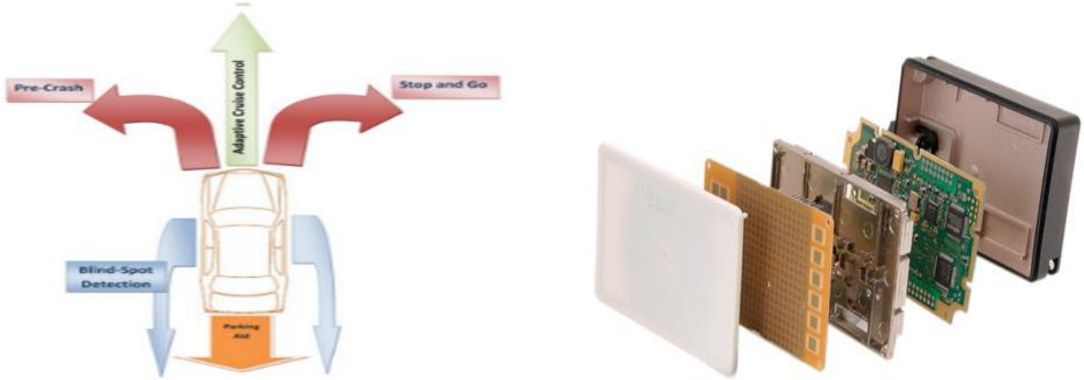

Figure 5. Radar

LIDAR. LIDAR uses a combination of laser reflecting/light (LI) and radar (DAR) to create a 3D map of the vehicle environment. LIDAR is widely used in seas, archaeological applications. LIDAR technically does not detect a moving object but creates a quick 360° series of profiles and compares them to each other and stores it in a database to detect changes (e.g., movement), Figure 6.

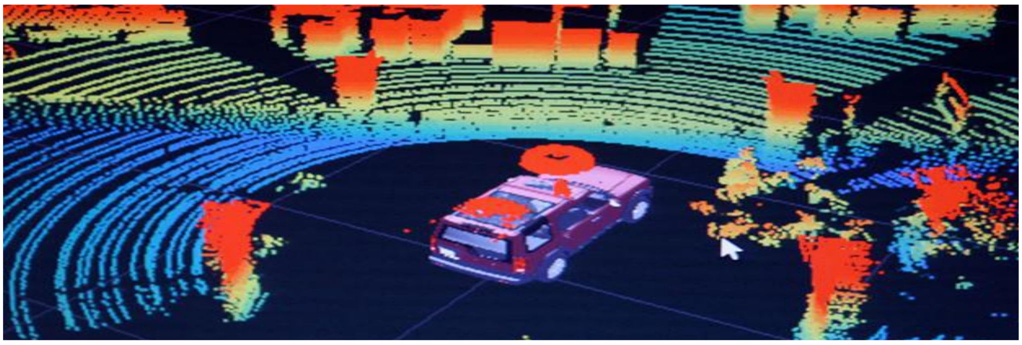

Figure 6. Map created by LIDAR [3]

Sensor: While the camera, radar and LIDAR are used to detect obstacles and monitor the environment, sensors are widely used to understand what happens to the vehicle itself. Sensors of all types are already widely used in vehicles, including acceleration sensors, pressure sensors, light sensors, parking sensors, and so on.

GPS: GPS antenna is only a visible part of a highly precise system positioning. The most commonly used navigation systems allow raw positioning based on satellite data, Figure 7.

Human interface with vehicle: It can be one of the most sophisticated and complex systems within an AV. Human interface with vehicle refers to the combination of in-vehicle systems, including the information /entertainment system, the instrument panel, and controls that act as an interface between the vehicle and the human, Figure 8. However, this function should also be aware of the internal vehicle environment in case of emergency situations.

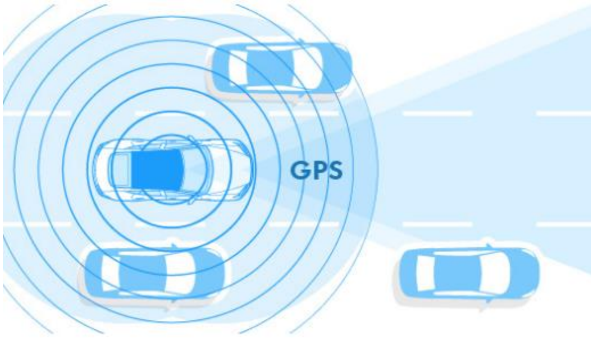

Figure 7. GPS

Figure 8. Human interface with the vehicle [3]

Controller Domain: It is considered the "brain" of the autonomous vehicle system. It acts as a crossover between the input and output systems in the vehicle, taking different signals from the camera, the radar and the sensors, to determine what action to take and then communicate with the power transmission or braking components, acceleration, deceleration etc., to execute the necessary actions, Figure 9.

Motion control/Actuator/Mechatronic units: Once the control domain has decided what action to execute, based on the data received from the sensing units, it passes instructions to the mechatronic units actuators), who physically control the steering components, such as steering wheel, acceleration, deceleration, braking, suspension and so on, Figure 10.

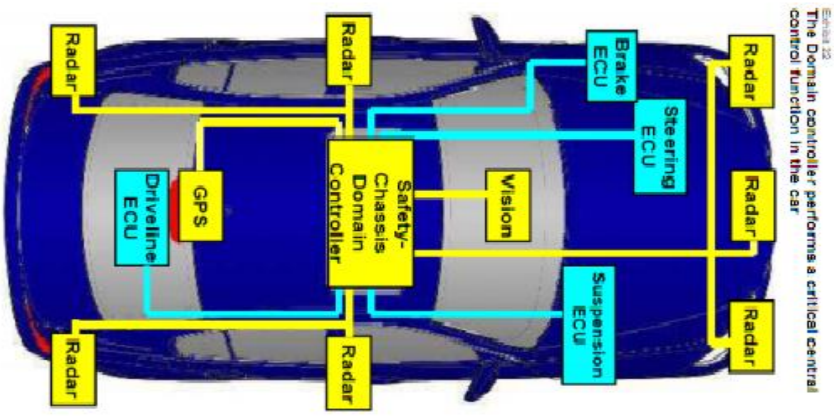

Figure 9. Controller domain [3]

Figure 10. Automatic steering wheel

3.3. Obstacle Detection Algorithms

Here the algorithms are used to classify objects that have obstacles by using the filtering and detection algorithms. Here an obstacle is an object which hinders or comes in way of the robot planned motion.

Some of the obstacle detection algorithms used:

- Edge-Detection Algorithm-used to detect edges of objects.
- Motion-Detection Algorithm-used to detect any changes in object position.
- Tracking Algorithm-used for object tracking [4].

3.4. Motion Planning Algorithms

Here the algorithm is used to find a shortest and optimal path to reach the target destination by avoiding all the obstacles. These algorithms use the concepts of Graph Theory. Some of the commonly used motion planning algorithms:

- Dijkstra Algorithm-computation cost is less.
- A* (star) Algorithm-fast and optimal path is found.
- Rapidly Exploring Random Tree Algorithm-uses spanning tree concept.
- Probabilistic Roadmap Algorithm-uses probability distribution concept.

Apart from the above mentioned algorithms, statistical techniques are used for prediction, approximate and optimization of sensor data using filter, as the sensor data have error and lack of precision [4].

4. RESULTS AND DISCUSSION

4.1. Self-driven Vehicle From Google

Google has been testing autonomous vehicle since 2009. In May 2014, Google announced plans for a self-driven vehicle that had no wheel or pedal, and unveiled a fully functional prototype in December that year, and had planned to test on the streets of San Francisco in early 2015. Google's self-driving vehicle has a target to carry two people from one country to another without any human interaction. The vehicle is called by a smart cell phone to get to the destination location of the user. There is no pedal or manual control, just a start button and a large red button for emergency stop.

4.2. Technologies Used by Google

Google's robotic vehicles have invested around $150.000 on devices, including a $70.000 LIDAR system mounted on the upper part of the Velodyne 64-beam laser car. The automotive self-driving function of Googles is based on the following: GPS/digital maps, Lidar, Camera, Sensor, Radar, Automatic steering, Auto parking, Security, Figure 11.

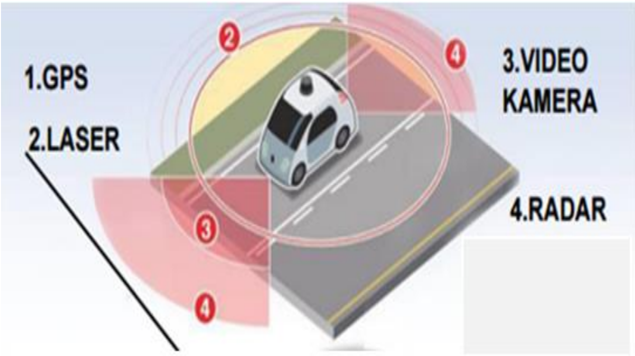

Figure 11. Technologies used from Google

Devices on vehicle: Within the car are altimeters, gyros, to determine a very accurate position of the vehicle. This provides very accurate data on vehicles to operate safely. Software can recognize objects, people, cars, marked streets, traffic signs and traffic lights, obeying road rules and avoiding many unpredictable hazards, including cyclists and pedestrians. Self-driven vehicles can also detect road works and safely move around them.

4.2.1. Self-driven Vehicles from Google

Self-driven vehicle analyzes the situation when there are works on roads, bicycles, pedestrians, other objects, Figure 12.

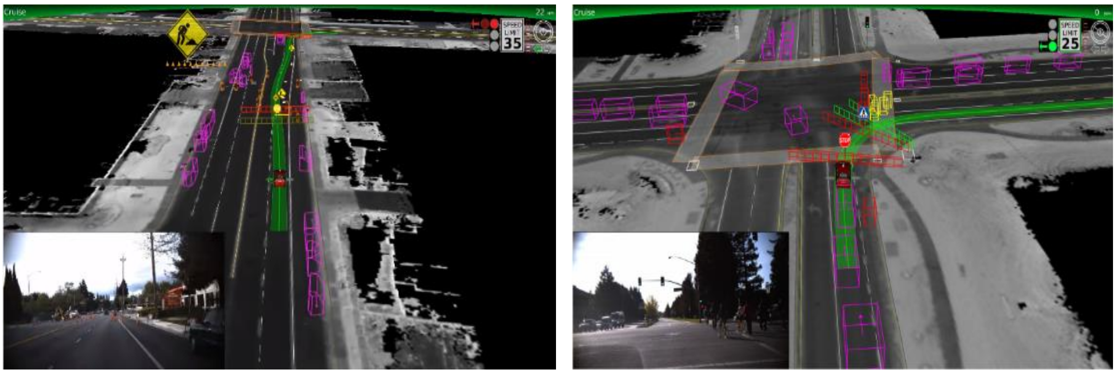

Figure 12. Recognition of road works and appearance of pedestrians, cyclists, other road vehicles [12]

Other actions from self-driven from Google: Keeps a safe distance with the front vehicles, Figure 13 a) and b), identifies traffic lights and stops when the red light is on the traffic light, identifies heavy vehicles, recognizes the police cars, and the school bus.

Figure 13. a) Keeping the safety distance; b) Stops in front of the traffic light [13]

Figure 14. a) Identification of heavy vehicles; b) Recognition of the police cars [14]

Google's self-driven vehicles also identify heavy vehicles, Figure 14 a), and recognition of police cars by recognizing the lights located above the car, Figure 14 b). Also, Google's self-driven vehicle makes recognition and discovers the school buses, and permits the bus connection to the traffic lane, giving priority to crossing.

4.3. Self-driven Vehicles from Tesla with the Possibility of Autopilot

The autopilot provides driver assistance. All Tesla vehicles manufactured since the end of September 2014 are equipped with a camera mounted on the top of the glass, looking ahead. The Radar (provided by Bosch), the front and rear bumper sensors, offer a 360^0 protective zone around the car. This enables vehicles to detect traffic signs, lane markings, obstacles and other vehicles. In addition to controlling, speeding, and lane exit warning, a "the Tech Package of $2500" option that will allow this system to provide semi-autonomous driving (called Call) and Parking Capability (called Autopark). These features are activated through software updates since October 15, 2015. Technology has been developed in partnership with the Israeli company Mobileye. In July 2016, Mobileye and Tesla ended their business connection. The autopilot system version 8 uses the radar as the primary sensor instead of the camera.
The autopilot has the following functions:

- **Autosteer:** Autosteer carries the car in the current lane and engages in controlling traffic-conscious speed to maintain the driving speed, Figure 15. Using a range of measures, including steering angle, driving norms and speeds to determine operation, the AutoSteer option helps assisting the driver on the road, making driving experience easier. Tesla requires drivers to remain committed and aware when Autosteer is activated. Drivers should hold their hands on the wheel.

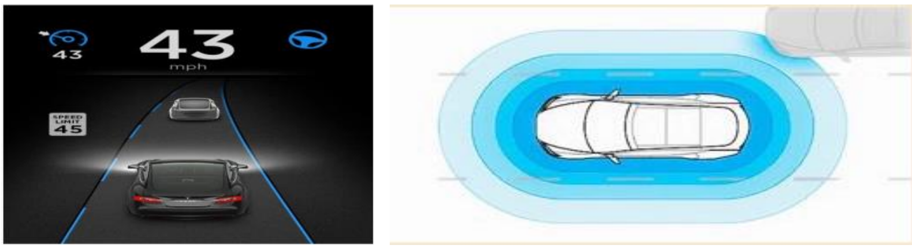

Figure 15. The Autosteer function

Constraints: This function does not work when the vehicle moves at speeds of over 90 miles per hour, so users have to choose between driving safely and without hands, either fast and with driving effort. The autosteer will warn the drivers to remind them to put their hands on the wheel. If the driver does not do so, the car will eventually come to a stop at which point the risk lights will be activated. The company warns that the autosteer does not work reliably on sharp-curved roads or where there are no signs or unclear signs of the lane (as is often the case with roadworks, snow, etc.). Performance will change in rain, snow or fog conditions. The panel, however, will notify the driver to take the lead when necessary.

Automatic Lane Change-How it works: When this function is enabled, the vehicle will automatically begin changing the lane when the driver activates the return signal, Figure 16.

Constraints: This function works only when the autosteer is enabled and only for one lane change, so drivers who want to quickly go through some lanes should have to activate the function for each lane change. The vehicle will not change the lane if you notice any other vehicle on the other lane, so they avoid an accident. It is not able to monitor the vehicles backwards and so it is always required by drivers to look back at the blind spot for rapidly coming vehicles behind it.

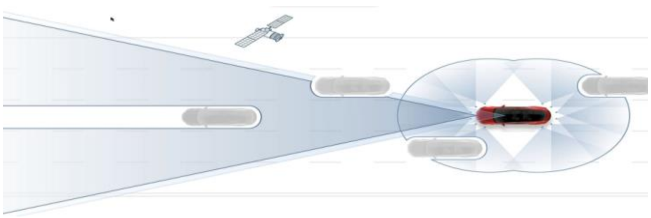

Figure 16. Lane change and radar coverage, camera, and ultrasonic sensor.

Autopark: Teslas models can now park themselves in parallel, eliminating the need for drivers to take care about complex and difficult parking maneuvers. When driving at low speeds around the cities, a "P" will appear on the instrument panel when Tesla detects a parking space, Figure 17. The Autopark Guide will appear on the touch screen along with the rear side display of the vehicle with cameras, once the car park is activated, it will start to park itself by checking the direction and speed of the vehicles.

Figure 17. Tesla with the Autoparking option

4.4. Comparison of self-driven Google vs Tesla Vehicles under Development

Self-driven vehicles by Google, based on NHTSA autonomy functions, are somewhere between level 3 and 4 of autonomy, Figure 18. Autonomy based on Tesla is at level 2 of autonomy, Figure 19. While in the classification of SAE - The Automotive Engineers Association, Google, can say it is in the middle of level 4 and 5, while Tesla is in the middle of level 2 and 3. Google and Tesla are indisputable pioneers in the development of self-driving technology. But while driving Google cars have been developing for the best part of the last decade, Tesla has made great strides overnight and has effectively taken on the leading role (semi-autonomous) vehicle behavior on the market model S or X model and model 3. Google and Tesla, each company set off radically different routes to achieve their common goal of fully autonomous vehicles by 2020. There are two main ways that Google and Tesla differ in their approach towards construction of autonomous vehicles:

- Selection of computer vision technology and
- Maneuvering vehicles - or lack thereof.

Figure 18. Self-driven vehicle from Google and its inside view

Figure 19. Automobile from Tesla, inside view

4.5. Computer Vision

The camera and radar or LIDAR, required for any self-driving vehicle, of course, are the ability to see the road ahead (and all around), as well as road lanes, pedestrians, other vehicles, traffic lights, STOP signs, traffic cones, animals in the streets, beasts and all other types of world variables. This is no easy task. In fact, this is too complex. There are two schools of thought to give the machine a vision. One way is to use a camera and radar system and the other way is LIDAR. Google decided to use LIDAR, while Tesla included cameras and radar. In simple terms, here is the difference between them. The LIDAR system can provide accurate information on the height and distance of the objects. The use of optics and radar sensors in vehicles from Tesla believes that passive optic sensors and a radar system can do the same thing as Google's LIDAR system. Tesla has equipped vehicles with 12 long-range ultrasonic sensors that provide a 360-degree view of the car. In addition, each car has a radar system ahead. The integration of these components together helps the Tesla autopilot system.

Google is also using the LIDAR system that not only creates a 360-degree model around the car, but also anticipates pedestrian and vehicle movements nearby. On the other hand, the Tesla autopilot system uses forward cameras that are manufactured by Mobileye. These cameras can accurately capture the location as well as the curbs and road markings of the lane that help keep the vehicle on its lane and make basic lane changes. While the technology of both companies is tremendous, they will work in different directions and outcomes. The Tesla autopilot system is free and will prove to be useful for initial purposes and automation of 90% of the car within just a few years. However, 10% of other car scenarios are quite difficult to implement.

LIDAR: This is a costly system that will eventually need to be changed if Google wants to make it affordable to consumers. However, Google is working to eliminate the need to drive a car from drivers; while Tesla is working on securing some of the daily driving we need to do. From this perspective, LIDAR may be the right choice at the end.

Vehicle Control: Drivers or passengers. To begin, let's define the spectrum of autonomous cars in two different points: a completely autonomous car without a driver, a machine that does not allow any direct human control.

Example 1: Google. The driver manages the autopilot activated in vehicle. Vehicles that use an aviation-inspired autopilot where the driver is usually charged with car monitoring and management, but can take manual control if desired and when needed or desirable.

Example 2: Tesla with autopilot. Simply put, Google believes in a completely free world without human drivers, fully autonomous cars without drivers. On the contrary, Tesla, repeatedly and powerful, believes that self-driving machines should use a system inspired by autopilot aviation, ie, the driver manages the autopilot, while Google cars evade any part of the interface between the driver and the car. Teslas cars still have steering wheel, brake pedals, and gas. On the other hand, Tesla with the chance of autopilot tries to provide an imperfect and temporary solution, while the Google system is literally designed to allow a passenger (driver) to enter a vehicle and fall asleep in the "wheel". Tesla expects drivers to be alert, attentive, and ready to go into action when asked at a moment's notice to take control of the vehicle. To be open, then, Google is applying a binary solution to the problem, while Tesla is more analogous, the driver is neither completely in control nor completely sleepy, which is unusual if the issues were over running and reading instead of running and sleeping, we can call it "confused driving". Google has been testing autonomous automobiles since 2009, and has accumulated 1.8 million miles of self-directed public roads. Its latest prototype has no pedals, brakes and steering wheel. All this driving has led to no more than two minor crashes, including at least one accident that led to injuries. With all of its progress, the company has not yet formalized when its cars will be available for sale, only if they come out with a full-function self-driving vehicle in all conditions in 2020, or how they will distributed, so be sold. Cars from Tesla are already semi-autonomous in its autopilot mode, which allows Model S, X and 3 to accelerate, curb, change lane, and even park. Drivers have entered 130 million miles of autopilot, collectively giving Tesla a massive amount of data to improve its system. Tesla automobiles can be upgraded by upgrading the software, just like smart phones. But the concern is that the Tesla system makes the drivers very weak, especially since a car in the autopilot function was involved in the first known fatality of a self-driving vehicle. Tesla has stated that the company will have a completely autonomous vehicle in operation by the end of 2017, but this may take longer until 2020.

4.6. The Issue of Atmospheric Conditions

One of the concerns about the ability of an autonomous car to be effective in a wide range of circumstances is whether it can be trusted in bad weather. True, in heavy rain, fog or snow conditions, autonomous car cameras will "struggle" to get popular models or objects, while radar systems can become "confused". In such cases, an autonomous car may not be able to work. However, there are several things to keep in mind:

- This happens only in case of really extreme weather, where visibility falls at very low distances, similar to conditions when there is a high snowfall. Then it can be said that the driver's (human) ability to look may be better than autonomous cars in such circumstances and safer driving of vehicles and the best course of action.

Vehicle-to-vehicle communication makes it possible to drive autonomous cars in bad weather conditions and make driving safer than in a manual way. The car knows exactly where the other cars are located that are on the road and at different speeds and the different driving styles will not pose any problems. Autonomous vehicles will be difficult to run improperly in bad atmospheric conditions, causing less accident in bad atmospheric conditions. In the end, driving can possibly be done as other types of transport, including air traffic, if the weather conditions are so bad that even a car with advanced stereo and infrared beam and long distance radar will not be able to see, this is probably too dangerous for a vehicle to control itself.

5. CONCLUSION

The main purpose of this paper is to study the functioning of self-driving vehicles, those technologies and functions that enable the application of intelligent or automated systems, enabling a car to be self-driven. Self-driving vehicles in the near future will be safer, more comfortable, will not need a driver as they will drive themselves and try to get zero life-loss from accidents. With the application of intelligent vehicle systems, you can achieve greater driving safety while providing greater assistance to the driver. Telematics technologies such as GPS etc. are also of great importance. For the operation of automotive without a driver, technologies already exist, hardware components have enough. Software and roadside testing are the issues to be solved that include learning the real-life behavior and the problems faced by drivers every day. These issues need to be regulated until the car market without a driver. Automated systems such as vehicle speed control, parking, traffic signal warning and vehicle holding assistance, etc., are now available in new vehicles that are in use. These automated systems are the basis for building an automated, robotic, and self-driven automobile. For the construction of a self-driving car many companies are working from Mercedes Benz, BMW, Volvo, Honda, Google, Tesla and others.

In this paper, we have featured two self-driven vehicles developed by Tesla and Google, and we have noticed that the self-steering pedal and steering wheel completely autonomous by Google is being tested and expected to be fully operational by 2020, as well as the car with the autopilot option from Tesla, which has self-driving functions only on highways unlike Google. Tesla vehicles are now on sale with the autopilot option and Tesla is expected to build a self-propelled vehicle by 2020. Self-driving vehicles built up so far, almost all are not functional under tough weather conditions until the year 2020 and have warned many construction companies to build self-driven vehicles. For them to come up with fully autonomous functional automobiles is expected to be solved and this issue. With the introduction of self-driven vehicles in the market, expectations are that there will be no loss of life from traffic accident; reduce environmental pollution globally, as all these vehicles are planned to be electric etc.

NOTICE

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