A Review Paper on Self-Driving Car's and its Applications

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Abstract— In the near future 2020 Google X plans to launch a product called Google car, which is a fully automatic car with no steering wheel or pedals and it operates with the help of a Smartphone. The project team of Google had used a varied range of vehicles to develop the Algorithm for the driverless car. The project was led by Sebastian Thrun (Stanford Artificial Intelligence Laboratory and co-inventor of Google Street view) and 15 other developers at Google. In the starting stages the project was kept a top secret and all the testing and development of the Google car was done at the Headquarters of Google. In 2012 the world was first introduced to the concept of Driverless cars when Google started the road testing of their various range of prototype cars on the streets of America. A special series of laws called 'robotic car law' has been passed in the various states of America to allow the operation of the prototypes of these Google cars on public roads.

Key words: Google X, Google Car, Artificial Intelligence, Google Street View

I. INTRODUCTION

Google car consist of $150,000 in equipment including a $70,000 LIDAR system and a range finder mounted on top of the car Velodyne 64-beam laser. This laser helps the car software to generate a detailed 3D map of its environment. The software of the car is designed to follow all the road safety measures and traffic rules. Google has been field testing these cars with the help of professional drivers at the driving seats and a Google developing engineer at the back seat of the car. With the help of the different scenarios faced by the Google car on the America streets the software team of Google makes changes in the security protocols of the Google car.

Most of the components of Google car have been perfected. The software is able to recognize the traffic signs and register them in a common database using Google Maps, Google Street View and GPS. The GPS software component records the signs and direction of travels from each area. Each car participating in the traffic using this software will register the new signs and signals detected and will modify the confidence and the degree of recognition for other users. Another software component is able to recognize the Demarcation lines present between lanes. It uses 3 cameras to calculate the exact position of the car on the road, where the sidewalks are to propose a new direction even in the absence of traffic signs for the next seconds. A part of the software uses Artificial Intelligence to recognize other car fingerprints from webcam images.

Google car field testing has been going on for a few years now and during this field testing has faced many difficulties. According to the Google the Google car has faced 20 accidents while the field testing but the Developer's claims that the cause of these accidents was due to Human negligence of road safety.

II. DRIVERLESS CAR DIAGRAM

In the following diagram you can see the design of Google Car. The car contains two cameras designed so as to be able to spot the different lanes from left and right. Another camera is placed in front of the driver's seat in order to spot the traffic lanes and the different traffic signs as if viewed by a normal driver. The 3D radar, called also Rangefinder or LIDAR, is placed at the top of car to create a 3D model, including a real-time model of the environment. All the 3D information from the surrounding environment and traffic lanes and the traffic signs will be processed by the master software in order to calculate the collisions and the optimal car's path.

The Artificial Intelligence calculation is done by 3 different laptops. These laptops are synchronized under the supervision of Master Software. The Master software component will quantify all of the processed data by all the components and it will be able to turn the steering wheels and control acceleration in order to maintain the car on the street/ road.

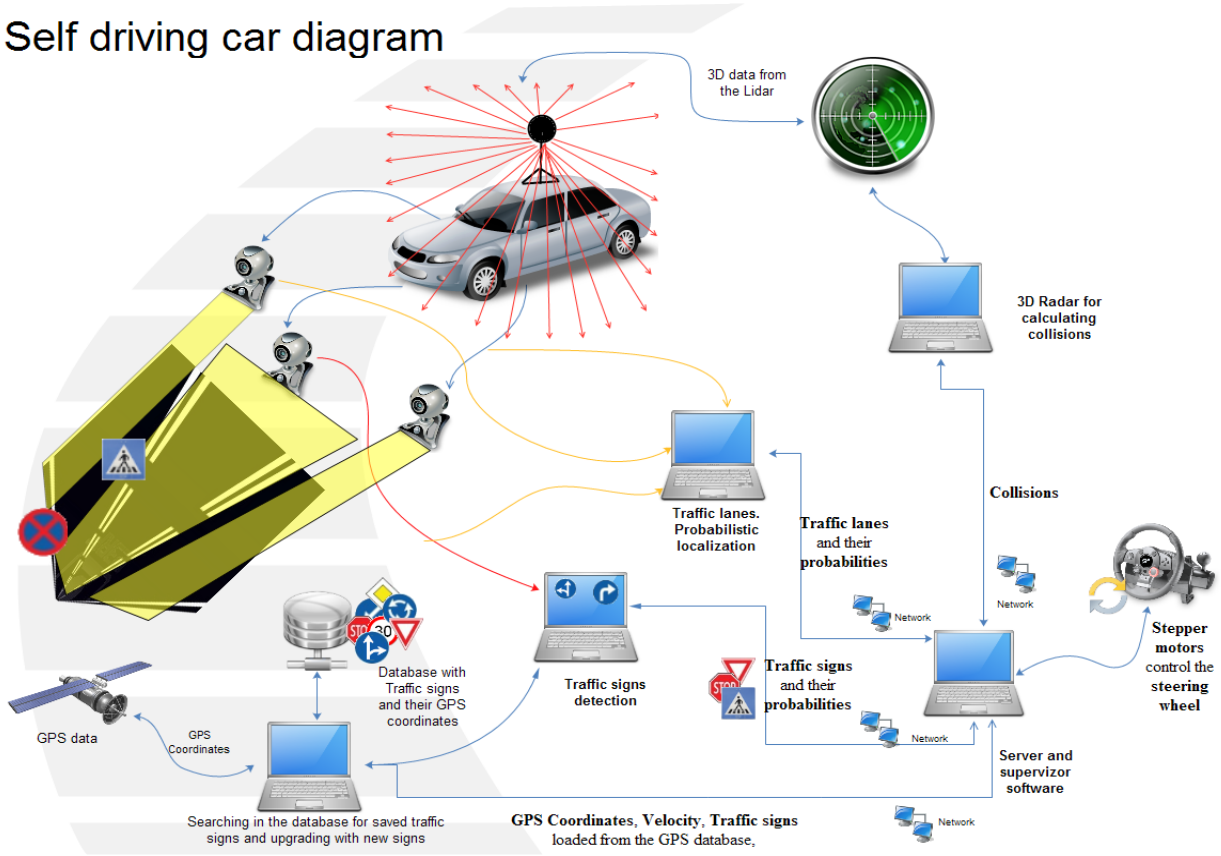

Fig. 1: Self driving car diagram

III. TECHNOLOGIES USED IN DRIVERLESS CARS

Every Google Car has LIDAR radar fitted at its top which performs a full 3 full 360 degree rotations per seconds. LIDAR is a technology that measures distance to a reflecting object present at the surroundings of the Google car by emitting timed pulses of laser and measuring the time taken between emission and reception of reflected pulses. This information is used to calculate the ranges, distances, objects. In this manner, LIDAR is similar to radar (radio detecting and ranging), except that it works on discrete pulses of laser light. The 3-D coordinates (e.g., x, y, z or latitude, longitude, elevation) of the target objects are calculated from 1) the time difference taken by laser pulse when emitted and returned, 2) the angle at which the pulse was "fired," and 3) the exact location of the sensor on or above the surface of the Earth. The measured data is fed into the processors installed in the Google car at the software creates a real time virtual 3D environment that is actually present around the car. The software of the car is now programmed to operate according to the details of this 3D environment.

IV. HISTORY OF SELF-DRIVING CARS

In 2004, the Advanced Research Projects Agency of Google launched its Challenger series, a multimillion-dollar competition for self-driving vehicles, giving robot cists scattered all across American universities and companies a fair chance to go toe-to-toe. A rivalry was developed between Stanford and Carnegie Mellon University, which traded the top spots in the first two years and a prize was awarded. The early Challenges resembled the science fiction films more than a government research experiment—and Google took note of the showmanship of the participants. Sebastian Thrun, the leader of Stanford's winning team, who took a break from the university in 2007 to lead the Google Street View project, later founded the company's self-driving-car project named as Google car. Rather than letting the researchers to compete for grants, equipment's, funding, and all the other trials of university research, Google just hired the best from Stanford, Carnegie Mellon, and other universities, and gave them access to the company's collection of computational power and data. Google's autonomous vehicle is still years away from perfection and widespread use: it faces both technical and regulatory hurdles. In September, for example, the state of California began enforcing new laws requiring autonomous vehicles to allow drivers to drive in an emergency condition, and Google engineers said that they will modify its test cars to comply with the regulations and the new laws. Still, the Google car provides lesson about how science fiction can turn into a reality. In a sense, Google's car is more of a parts-assembly project than it is a new vision for human transport. The company's real achievement was bringing together researchers and the scientist with existing technologies under one project.

V. APPLICATIONS OF SELF-DRIVING CARS

1) Drivers have more time for everything: Self-Driving car could free as much as 50 minutes a day for people, who will be able to spend traveling time working, relaxing, and accessing entertainment. The time saved by users every day might

add up globally to one billion hours. It could also create a large pool of value; potentially generating global digital-media revenues of 5 billion dollars per year for every additional minute people spend on the mobile Internet while in a car.

2) Accident rates drop: By midcentury, the use of self-driving vehicle can make the car crashes in the United States to fall from 2nd to 9th place in terms of their lethality ranking among accident types. Today, car crashes have an enormous impact on the economy. For each person killed in a motor-vehicle accident on an average 8 is hospitalized, and 100 are treated and released from emergency care. The overall annual cost of road crashes to the economy of U.S.A was $212 billion in 2012. Taking that year as an example reducing accidents by up to 90 percent would have potentially saved about $190 billion.
3) New mobility models emerge: While Google is developing autonomous vehicles, a variety of other transport-mobility inventions are already on the road. Many of these take the form of pay-per-use models such as car sharing, carpooling, and car rents from city to city. These plays are attracting investments and showing impressive growth rates. The e-hailing model has seen strong growth given both annual investment funding and market penetration.
4) Parking becomes easier: Google car could change the mobility behavior of consumers and hence reducing the need for parking space in the U.S.A by more than 5.7 billion square meters. Many factors would contribute to the reduction in parking space. For e.g., self-parking Google car do not require door space for dropping off users when parked, allowing it to occupy parking spaces that are 15 percent tighter.

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