

Justin Nguyen
Professor Elisa Warford
Writing 340
Illumin Assignment
April 28th 2014

Autonomous Vehicles: Are We Ready For a New Type of Transportation?

Engineers around the world have been working on autonomous driving technology and they believe it will be the next generation of transportation. Despite the many challenges engineers face, we have come as close, as many cars have been out there for testing such as the “VaMP” and the “Google Car” were introduced [1] [3]. With a combination of advanced technologies today, the autonomous car has become more promising, and which might change how we commute from point A to B in the future.

Introduction

The autonomous vehicle is no longer far away from reality since the same technology has been used very broadly with military drones or commercial aircraft. The idea that your car could be summoned and take you to your destination within a click on a remote control might sound like stories in science fiction. However, this idea has now been developed into a real world system. Google has made this new mode of transportation more promising and closer to reality by introducing the Google Car. Unlike drones and aircraft, Google has designed this technology specifically for commercial use. It is just like the sedan we drive everyday but with some extra built-in equipment.

History of Autonomous Vehicle Technology

The idea behind the technology is not new. In 1961, Stanford University introduced the Stanford Cart (Figure 1.1). This autonomous vehicle was a simple four-wheel cart equipped with a video camera and controlled by a remote through a long wired cable [1]. The autonomous vehicle's features have improved concurrently with its supplemental technology such as the camera lens, motion sensors, robotics, software programs, and tracking devices. The rapid technological

advancement in this century has allowed engineers to further advance and transform this idea into a real world applications. The second notable experiment was from Bundeswehr University Munich in 1980 (Figure 1.2). The German aerospace engineers were credited for the advanced driverless car (UniBW car) with eight built-in 16-bit Intel microprocessors, two cameras, sensors, and software that supported it to move at a speed of 90 km/h for 20 kilometers [1].

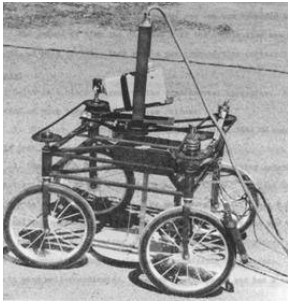


Figure 1.1 Stanford Cart in 1961 [10]



Figure 1.2 UniBW car in 1980 [11]

The testing distance has been constantly increasing overtime, and in 1995, Mercedes’ “VaMP” was able to travel up to 1600 km around Europe (Figure 1.3) [1]. The vehicle could to track up to twelve surrounding cars simultaneously. In 2004, the United States government took the initiative by funding the project Demo I, II, and III to improve this technology [2]. Since then, the Defense Advanced Research Projects Agency (DARPA) has held Grand Challenge competitions for driverless cars to encourage engineers to participate and continue to develop the autonomous driving technology [2].

So where are we with this technology today? In 2011, Google introduced its autonomous Google Car with complete and advanced features (Figure 1.4) [3]. The car is equipped with sophisticated technology equipment such as high-resolution camera, radar’s censor, laser, and a global positioning system (GPS). With these features, the vehicle can handle more complex test drives. The car has driven up to 300,000 kilometers in suburban areas, metropolitan city traffic, busy highways, and mountain roads [4].



Figure 1.3 The “VaMP” in 1995 [11]



Figure 1.4 The Google Car in 2011 [5]

How Do Autonomous Cars Work?

The autonomous car requires several important technologies (Figure 2.1). The newest technology is the LIDAR (Light Detection and Ranging) located on the roof of the car. It is a 360 degree rotating sensor that detects lights, ranges map and distances. LIDAR is not a new technology; it was used for submarine detection from aircraft in 1960 [14]. It can detect range as far as 60 meters. The motion sensor will detect moving objects in a large range. The rear-view mirror has a mounted video camera that is used to detect close range objects like pedestrians, bicyclists, and as well as traffic lights. The car has four automotive radar sensors, three under the headlights and one in the back. The radar sensors will help determine the distance between the car and other objects. Currently, automotive industry already implements these sensors for their products. They are used to support many vehicle features like automatic car parking and automatic braking. Finally, another sensor is attached on the left wheel of the car to locate the position of the car based on the GPS [4].

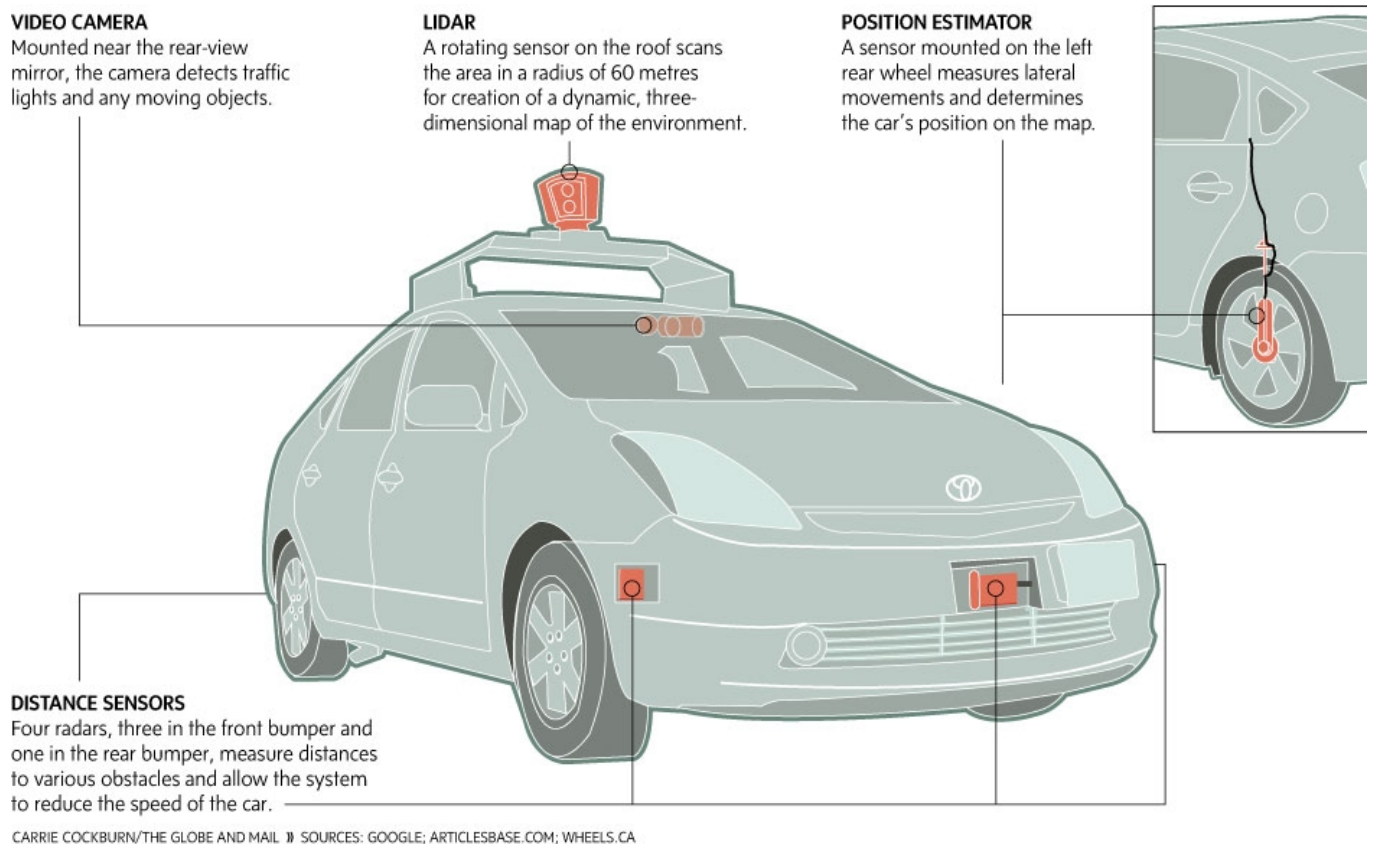


Figure 2.1 Autonomous Car Technologies [12]

Benefits of Autonomous Driving

Some wonder how much time a driver spends in traffic. Statistically, an American spends approximately thirty-eight hours a year, and a Californian alone spends nearly eighty-two hours a year in traffic [6]. As people become busier, twenty-four hours a day is simply not enough. We cannot afford to spend so much time in traffic. Autonomous cars can solve the problem by allowing people to share cars. In other words, people can share a car when it is not in use, whether it is parked at school, office, restaurant, or shopping mall. Since the autonomous car can reach the destination by itself, it can be summoned electronically through any device that can connect to Internet such as smart phones or computers. For example, a family of four would not need to own four vehicles or parents would not need to leave work to give other family members a lift. They could just go to work with the car and leave it for other family members if they need it to commute to other places. Of course they could always summon it back if there is any urgent business. The idea of sharing a car makes life easier because carpooling often time can be problematic since people need to commute to work and to school to different destinations and at various times. Furthermore, public transportation might not be the most convenient option for everyone. Autonomous cars can reduce number of cars on the road, therefore can significantly reduce traffic especially at rush hours. The alternative is taking public transportation, however, the opportunity cost can be high such as waiting on a cold rainy day for a bus or waking up at six in the morning to catch the right train.

As people can travel from places to places faster, autonomous cars can also improve the safety on the road and reduce accidents. Safety has been a huge concern of all the drivers today. There are approximately 37,000 deaths and more than 2.35 million of injuries on average resulting from all kinds of traffic accidents annually in United States (Figure 3.1) [7]. The autonomous car aims to cut this number as much as possible. Most of the car accidents will end up with a costly result for driver whether it is lives, damages on the vehicle or the auto insurance fee. There are several reasons people can trust in this technology. Unlike humans, robots cannot be distracted while driving whether they travel at day time or night. Also, the Lidar sensor detects any object nearby while humans have to take their eyes off the road to observe. Lastly, human cannot react as fast as the radar sensor. Some might raise the question that as to what would happen if something went wrong with the software. Autonomous driving technology leaves the option for the driver to take control of the vehicle anytime.

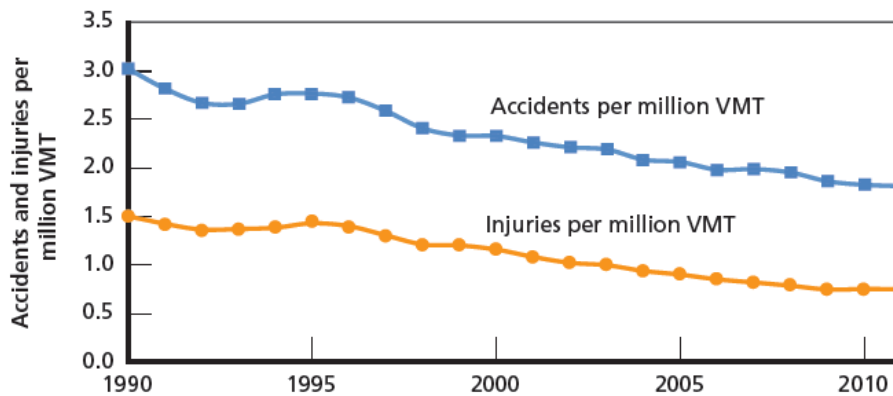


Figure 3.1 U.S. Roadway accidents and injuries per million vehicle miles traveled [3]

Challenges to Face

Despite the advantages that autonomous cars can bring into the table, the statistic from Cisco’s survey shows that just a little more than 50% of consumers would trust driverless cars and the number of consumers who would let kids ride them is even lower (Figure 3.2) [8]. This raises the question about reliability of the software and the responsibility once accidents happen. Does the software provider have to be accountable for the accident or is the driver who does not intercept fast enough to take control of the vehicle?

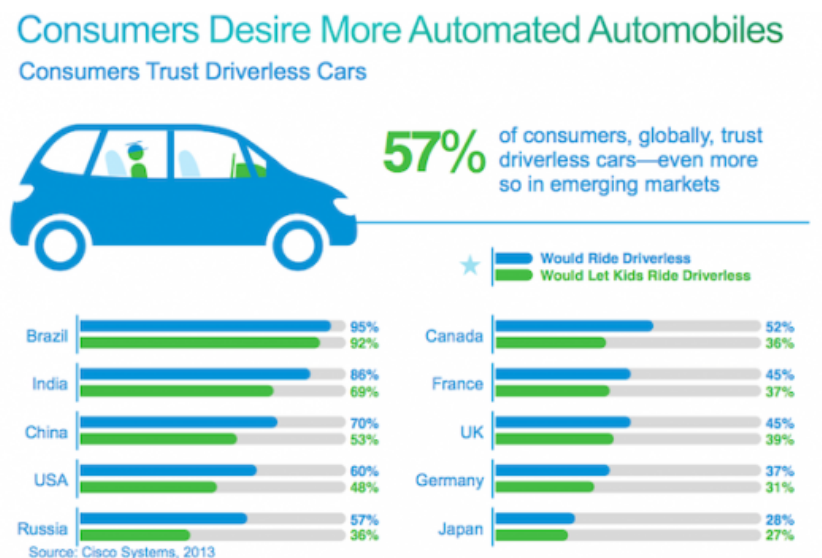


Figure 3.2 Desire to have an automated car [13]

From the consumer's perspective, car enthusiasts will probably be reluctant to give up driving their own vehicles. The car's appearance does not look attractive, as it has to carry a huge sensor on the roof and other visible parts on the exterior. Heavily relying on the autonomous driving GPS, the driver will lose driving skill and sense of direction. In other words, it will stop them from developing a part of their brain, which helps mental mapping the world [9]. Finally, it will come down to the cost of the unit as well as maintenance. Embracing all the latest technology will result in a high cost of frequently maintenance to guarantee the safety.

From a economy point of view, the autonomous car could have several effects. Once drivers become unnecessary, there will be no demand for driving professionals in the transportation service. Many truck drivers will lose their jobs or possibly receive lower salaries. If autonomous driving truly provides the best safety, the insurance companies will have to adjust their system to keep customers. They need to assure who would be responsible if the crash happens in many different situations. Lastly, the insurance rate will have to decrease, which might put the company out of business.

Conclusion

The autonomous driving technology has been simply a great idea for more than half of a century, but it has been transformed to real world use ever since the development of the Stanford cart in 1961. Engineers continue to improve and create new ways to incorporate the vast functionality of the autonomous car to make it more suitable for wide commercial use. The development now is focused on the chicken and egg issue to convince the other 43% of the world to believe that autonomous car is the future's transportation despite many challenges it is facing right now. If it is successfully developed to meet all the requirements, it will have a great impact on our daily lives, and most importantly, our daily commute on the road.

References

- [1] Tom Vanderbilt. (2012, February 6). Autonomous Cars Through the Ages [Online]. Available: <http://www.wired.com/autopia/2012/02/autonomous-vehicle-history/>
- [2] _____. Autonomous Cars. Robotic Magazine (Online). Available: <http://www.Autonomouscars.com/>

- [3] J. M. Anderson, N. Kalra, K. D. Stanley, P. Sorensen, C. Samaras, and O. A. Oluwatola, “Autonomous Vehicle Technology,” in A Guide for Policymakers, Transportation, Space, and Technology Program (RAND) [Online]. Available: http://www.rand.org/content/dam/rand/pubs/research_reports/RR400/RR443-1/RAND_RR443-1.pdf
- [4] Erico Guizzo. (2011, October 18). How Google’s Self-Driving Car Works [Online]. Available: <http://spectrum.ieee.org/automaton/robotics/artificial-intelligence/how-google-self-driving-car-works>
- [5] Evan Ackerman. (2010, October 13). Google’s Autonomous Car Takes To The Streets [Online]. Available: <http://spectrum.ieee.org/automaton/robotics/artificial-intelligence/googles-autonomous-car-takes-to-the-streets>
- [6] Adam Werbach. (2013, February 6). The American Commuter Spends 38 Hours a Year Stuck in Traffic (Online). Available: <http://www.theatlantic.com/business/archive/2013/02/the-american-commuter-spends-38-hours-a-year-stuck-in-traffic/272905/>
- [7] _____. Annual United States Road Crash Statistics (Online). Available: <http://www.asirt.org/KnowBeforeYouGo/RoadSafetyFacts/RoadCrashStatistics/tabid/213/Default.aspx>
- [8] _____. (2013, May 15), Driverless Cars: 5 Main Advantages, in Induct Mag (Online). Available: <http://induct-technology.com/magazine/2013/05/15/driverless-cars-5-main-advantages/>
- [9] Leon Neyfakh. (2013, August 18). Do our brains pay a price for GPS? (Online). Available: <http://www.bostonglobe.com/ideas/2013/08/17/our-brains-pay-price-for-gps/d2Tnvo4hiWjuybid5UhQVO/story.html>
- [10] Les Earnest. (2012, December). Stanford Cart (Online). Available: <http://www.stanford.edu/~learnest/cart.htm>
- [11] Jurgen Schmidhuber. Prof. Schmidhuber’s highlights of robot car history (Online). Available: <http://www.idsia.ch/~juergen/robotcars.html>
- [12] _____. (2011, December 28). Google scores yet another win (Online). Available: <http://arabiangazette.com/google-scores-win/>

[13] Marc Carter. (2013, May 20). Half of the World's Consumers Trust Autonomous Cars, According to a New Study (Online). Available: <http://inhabitat.com/half-of-the-worlds-consumers-trust-autonomous-cars-according-to-a-new-study/>

[14] What is Lidar. Available: <http://www.lidar-uk.com/what-is-lidar/>