SELF-DRIVING CARS

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INTRODUCTION

This report will explain various aspects of self-driving cars. These aspects include the origins of autonomous vehicles, the technology driving them, the business and insurance implications they create, and the pros and cons of implementing such vehicles on the roads today.

HISTORY OF SELF-DRIVING CARS

Over the past decade, the interest and intrigue in autonomous cars have soared dramatically. From being used in experiments and tests in controlled environments, autonomous cars today can functionally navigate the uncertain roads and streets of even the busiest cities. This report will explain the attraction of self- driving cars and review the history behind it.

ADVANTAGES OF SELF-DRIVING CARS

Since the idea of autonomous vehicles came out, self-driving cars have attracted so much attention due to three main reasons: safety, mobility, and traffic congestion reduction. Road traffic injuries are the leading cause of death for individuals aged 15 to 29 (World Health Organization). Some of the leading causes of traffic accidents are speeding, driving under the influence, and distracted driving; all of which are human errors. In fact, over 90 percent of traffic accidents are a result of human error (Anseth 2015). Self-driving cars can eliminate these human errors and greatly reduce the number of traffic related injuries and deaths. Autonomous cars can also increase mobility for those who cannot drive, for example people with disabilities or senior citizens. Lastly, if

implemented correctly, self-driving cars can greatly reduce congestion. To prove this let's take look at highways; if self-driving cars were the only vehicles on the highway, then they can all be automated to drive at the same speed which theoretically can eliminate congestion caused by deceleration, acceleration, merging, lane changes, etc. This will let people get to their destinations much quicker which in turn will also reduce traffic. If self-driving cars can tackle these issues of safety, mobility, and congestion reduction, then its potential is limitless.

HISTORY (1939 – 2006)

The history of self-driving cars dates back to 1939 when General Motors revealed a concept for an autonomous vehicle; but it wasn't until the 90's when mobile computing and machine learning was introduced that the idea began to take shape. However, even with this advancing technology, the idea of self-driving cars was not grabbing enough interest. This all changed with the introduction of a new competition that pushed autonomous cars to its limits. The DARPA Grand Challenge, an off road race across a desert, put the spotlight on self-driving cars and propelled the idea forward. Numerous teams, with their own automated vehicles, participated in the competition, which tested each car's durability and adaptability to various different environments and terrains. The first year of the competition saw a lackluster performance as the autonomous cars were only able to complete 7 miles of the 150 mile course. The following year saw multiple cars complete the course which was won by a team from Stanford University (Anseth 2015). Although the cars that participated in this competition were far from being street

safe, they were the start of a research renaissance that has led to the progress we see today.

RECENT HISTORY (2006 – TODAY)

Several years after the introduction of the Grand Challenge, reputable companies all over the world started projects for their own autonomous cars. One of the more notable companies to do so was Google in 2009. With themes from the DARPA challenges in mind, Google created their own self-driving cars which over the years have racked up more than 700,000 miles on public roads (Anseth 2015). After Google's success, many automotive companies embarked on their own projects to develop the next best autonomous car. Today, companies like Tesla and Lucid offer a full line of cars that have autonomous driving features. Considering the rapid growth of autonomous cars over the past 10 years, which is showing no signs of slowing down, it is safe to assume that self-driving cars is the future of the automotive industry.

The popularity for self-driving cars has been on a steady rise. They have the potential to greatly reduce traffic accidents, transport anyone who is unable to drive to their destination (ex. senior citizens, disabled), and reduce traffic congestion. The industry for autonomous cars has grown so much over the past years; even today it has only just begun to hit its strides and is on a path to dominate the automotive market in the coming years.

TECHNOLOGY

Google is in the process of developing a car capable of driving to a given destination without requiring a driver behind the wheel. In fact, this car doesn't need a wheel at all.

With a combination of sensors, GPS tracking, cameras, and machine learning software, the self-driving car is able to see its surrounding area, adjust for surprises on the road, and adapt over time through its own driving experiences and through simulations. This is done with the help of machine learning software and a complex map system of the area created by Google.

HARDWARE

There is a lot of advanced hardware used in combination to make this car capable of maneuvering obstacles and understanding its surroundings. Laser Illuminating Detection and Ranging (LIDAR) is used to map the car's surrounding area in 3D. It essentially "sees" its surroundings with the help of the LIDAR. This device sits at the top of the car and constantly rotates 360 degrees while using a laser to estimate distance between itself and objects in its surroundings.

While LIDAR is great for mapping the surround area, it lacks the ability to adjust in real time to surrounding vehicles' speed. Distance sensors are added to front and rear bumpers in order to accurately measure the distance of obstacles on the road. This is done through the use of radars. These radars can tell if something is too close and the car adjusts accordingly. A video camera is used in conjunction with the LIDAR and distance sensors in order to detect traffic lights and any moving objects on the roads. (Jiang, Petrovic, Ayyer, Tolani, & Husain 2015) On top of that, there are even sonars used in some of the prototypes in order to assure that the car breaks and avoids obstacles properly.

Machine learning is used to simulate all possible events that could occur on the road.

Simulations of expected road obstructions such as traffic, pedestrians, and weather are

done to prepare the car for actual events. Google has made software that is essentially

California's road system with accurate simulations. By mapping each road that the cars

will drive on, they can create ultra-precise digitization of the terrain. The car integrates all

of the data from the sensors, sonars, and the LIDAR to build a map of the car's position.

Algorithms are then used to process this data. The map system is used in conjunction

with GPS satellites, inertial measurement units, and a wheel encoder to determine the

car's actual speed. (Patkar, Long, & Clark 2015)

A lot of little things are needed to make sure that the car drives properly. Each individual

piece of hardware plays an important role in determining positioning on the road, as well

as potential obstacles. The software then takes all of that information and uses algorithms

to determine current position, speed, and the distance of surrounding objects. If the car is

too close to a given object, it will apply its break. This technology is incredibly complex

and certain challenges still remain such as weather and object identification. Google has

estimated that the self-driving car will be ready by 2020, so they still have plenty of time

to overcome these challenges.

BUSINESS AND INSURANCE

As the market for self-driving cars continues to grow and adapt, so does everything that

goes with the modern perception of cars. In addition to a fundamental shift in the way

that cars are used and viewed there will also be changes to the corporate landscape that

makes up all the different extra things that cars are required to have. Cars will have new features that weren't available or feasible in conventional user operated cars. Cars will be made up of increasing amounts of computers and software and they will become increasingly autonomous. However, no market must adapt more than the automotive insurance industry.

IMPLICATIONS ON THE INSURANCE INDUSTRY

An industry that is valued at close to $200 billion will be forced to radically change as the frequency of accidents goes down. Estimates state that accidents may decrease by as much as 90% by the time self-driving cars become commonly accepted and used(Jiang, Petrovic, Ayyer, Tolani, & Husain 2015). A loss of 90% of claims would destroy the insurance industry if they don't adapt. If they don't make major changes to their policies and models their industry could go from $200 Billion to $20 Billion almost overnight. This may end up being done by increasing premiums by increasingly large margins, but even if the insurance industry does increase premiums it wouldn't save them. Self-driving cars will destroy the industry unless they enact major policy changes. The most prevalent change would be that accidents would no longer be under user error as the user has no input on the cars action. The liability would then fall to the car manufacturer who would then be responsible for the damages, loss of life, etc. The insurance policy would no longer be on a car to car basis, but rather by the manufacturer. This could end widespread car ownership as it would then become much more cost effective for the manufacturer to deal in subscriptions rather than sales and for people to subscribe to a service in which the cars come to them when they need to go somewhere. This would make regulation of

the cars easier as well as allowing the manufacturers to build in the cost of liability into a subscription fee. This action would still require an enormous effort for the insurance industry, as they would need to completely rewrite their policy information as well as their business model. The advent of self-driving cars is a new industry and it opens new markets and possibilities, but while it creates new areas for business it also destroys others.

IMPLEMENTING SELF-DRIVING CARS

It was not until quite recently that autonomous cars have become such a popular topic. They have always been just an idea, and the possibility of them being implemented in everyday life seemed much farther away. Recently many car companies have announced that they have begun designing and creating autonomous vehicles. They plan to start implementing them in everyday use in the coming decades.

POTENTIAL PROS AND CONS

Advocates have said that affordable autonomous vehicles can greatly reduce traffic, parking, accidents, pollution and so many other problems. While some reports contemplate that the saving will be amazing and everyone will benefit, there are other reports stating that the costs will be more than the benefits/savings. Since 90% of vehicle accidents are human error, it is speculated that self-driving cars would decrease accidents by 90% (Litman 2017). Many advocates say this is wrong because when people get comfortable they become less cautious. They stop wearing their seat belts and become less aware of their surroundings. Also, mixing normal cars with self-driving cars can also be dangerous because the people driving cars become less cautious because they believe

their surroundings are safe. All these problems could make autonomous cars even more dangerous and could cause even more accidents.

As of now the technology needed to implement autonomous cars can be up to tens of thousands of dollars. As they become mass produced however, the price can go down substantially. Since the system softwares have to be 100% reliable since it could easily become fatal if the system fails, a large amount of money and time needs to be invested in these softwares. Installation, testing and other factors can make this aspect of autonomous vehicles quite expensive. Just like the airbag, hybrid vehicles and GPS systems, it took awhile for them to be mass produced and used regularly but now they are all used all the time. Autonomous vehicles will become the same as them, it will just take some time getting used to and working out all the problems as they come.

Self-driving can also negatively impact the economy. These cars take away the need for taxi services, Uber/Lyft drivers and car repair companies. Many people make a living off of these jobs so this could potentially ruin their lives (Litman 2017). For every pro, there is also a con. Even though there are many cons and the process of self-driving cars being in everyday life will be very slow, it will happen no matter what. Self-driving cars are the future and we must progress with time. Hybrid cars have been around for about 15 years now and they are still not as common as one would think. It will take decades for autonomous cars to become apart of everyday life, as well as all the small changes and fixes that need to occur once they start becoming more common. Everything must be analyzed since technology is the only thing being relied on. All problems must be fixed before people use the vehicles or there could be many fatalities.

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