
Self Driving Car Toy Using Machine Learning and Convolutional Neural Networks

Shenoy Akshay Rohidas¹, Felicita Fernandes², Ghanshyam G. Shet³,

Ramesh Nayak⁴

Professor⁴

Department of Information Science Engineering

Canara Engineering College

Email ID: shenoyakshay97@gmail.com

Abstract

The autonomous car and unmanned ground vehicle is a vehicle that is capable of sensing its environment and navigating without human input. Some believe that autonomous vehicles have the potential to transform the transportation industry and cleaning up the environment. Levels of Autonomous car: No-Automation (Level 0) - The driver (human) controls it all. Function specific automation (Level 1) - Some control functions such as the electronic stability control or charged brakes is automated. Combined function automation (Level 2) - At least two main control functions such as the adaptive cruise control in combination with lane centering are automated. Limited self-driving automation (Level 3) - Under certain traffic and environmental conditions, the driver cedes full control of all safety-critical functions and rely heavily on the vehicle to watch for any changes in the conditions requiring transition to driver control. Full self-driving automation (Level 4) vehicle is intelligently designed to monitor roadway conditions and act solo and performing all safety-critical driving functions for an entire trip (a fully driverless level). The working of an Autonomous car can be viewed in three stages; they are: The sensing unit of an autonomous car consists of various sensors such as Lidar, Infrared, Cameras, etc. The signals from the sensing unit are sourced to the Logical processing unit, which is responsible for the decision making, user interface, etc. The Mechanical Control System is the unit which regulates the metrics of car. The most important aspect of any autonomous car is the

Artificial Intelligence that drives it, it is the element that replaces the human factor.

Keywords: - *Machine Learning, Convolutional Neural Networks, Deep Learning.*

INTRODUCTION

The future is ultimately unknown, yet planning requires predictions of future needs. Many decision-makers and practitioners wonder how autonomous vehicles will affect future travel demands, how this should affect planning for roads, parking and public transit systems, and whether policies should encourage or restrict their use interests in the industry, based on the experience with electronic innovations such as digital cameras, smart phones and Internet. Their analysis often overlooks significant implementation requirements and the costs.

Although vehicles can now operate autonomously under specific conditions, many technical problems must be solved before they can operate autonomously under all normal conditions, and many years before such vehicles are then adequately tested, approved for general commercial sale, and affordable to most travellers. Motor vehicles last much longer and the cost much more than personal computers, cameras or telephones, so new

technologies generally requires many years to penetrate vehicle fleets. System failures by camera, telephones and Internet can be frustrating but are seldom fatal, system failures by motor vehicles can be very frustrating and deadly to the people and other road users. Autonomous driving can induce additional vehicle travel which can increase the traffic problems. As a result, autonomous vehicles are likely to take longer to develop and provide smaller net benefits than the optimists predict.

This report explores these issues. It investigates, based on the experience with previous vehicle technologies, how quickly the self-driving vehicles are likely to be developed and deployed, critically evaluating their likely benefits and costs, and discusses their likely travel impacts and their implications for planning decisions such as the optimal road, public transit supply.

ALL VEHICLES vs SHARED VEHICLES

Autonomous vehicles can provide various benefits and imposes various costs.

• ***Reduced Stress, Improved Productivity and Mobility***

Autonomous vehicles may provide various benefits and impose various costs. On the other hand, self-driving vehicles can introduce new problems and discomforts. Grush suggests that travellers will experience “high anxiety,” if they fear that

their vehicle cannot reach a desire destination. To minimize cleaning and vandalism costs, self-driving taxis and buses will have “hardened” interiors, minimal accessories, and security cameras. Demand response sharing will reduce security (passengers may need to share some space with strangers), and reduce the travel speed and reliability since each additional pick-up or drop-off will impose a few minutes of delay to other passenger, particularly in the sprawled areas with dead-end streets. (*See Table: 1*)

Table: 1

All Vehicles	Shared Vehicles
<ol style="list-style-type: none"> 1. Sensors (optical, infrared, radar, laser,etc). 2. Automated controls (steering, braking, signals, etc.) 3. Software, servers and power supplies. 4. Wireless networks. Short range system for vehicle to vehicle communications, and long range systems to access to maps, software upgrades and road reports. 5. Navigation. GPS systems and special high quality maps. 	<ol style="list-style-type: none"> 1. Frequent cleaning and repairs 2. Dispatching and fleet management. 3. Business administration and insurance. 4. Business profits. 5. Security. 6. Empty vehicle-miles to pick up and drop off passengers

Autonomous vehicles may provide independent mobility for non-drivers, including the people with disabilities, adolescents, and others or who cannot or should not drive. This can provide benefits to those travelers, reduce burdens on their family members and friends, and in some cases increase their access to the education and employment opportunities, increasing the economic productivity. Some affluent non-drivers living in the sprawled areas might have purchased personal autonomous vehicles, and urban non-drivers are likely to use the autonomous taxis. Optimistic predictions of autonomous vehicle benefits may also cause some communities to reduce support for public transit services which might reduce mobility options for the non-drivers.

Dedicating highway lanes for the autonomous vehicle platooning might reduce the capacity for human-operated traffic, making travelers in the human-operated vehicles worse off.

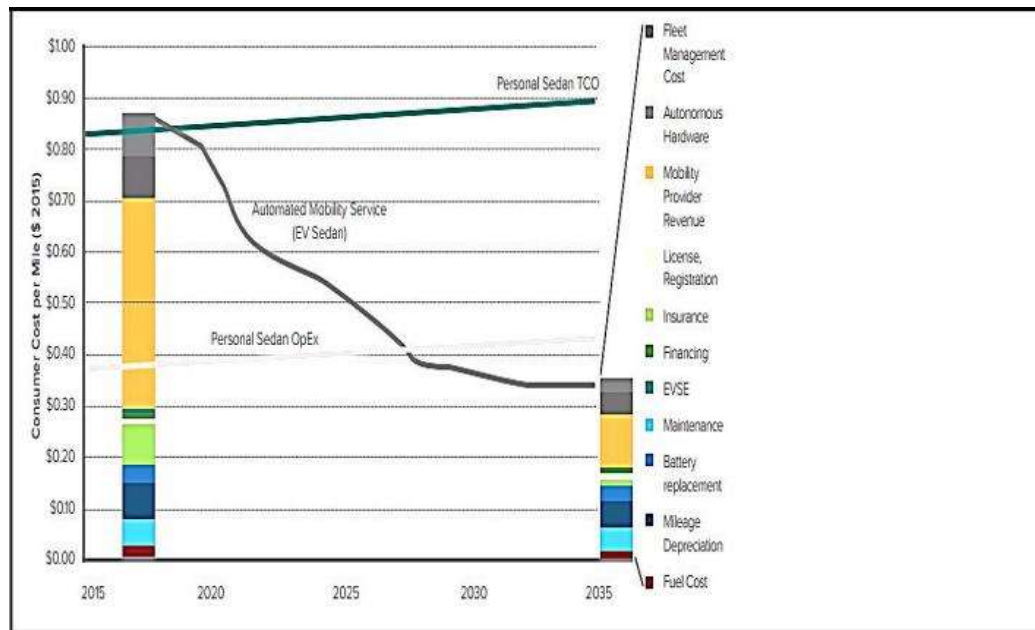
Ownership and Operating Costs

Autonomous vehicles may require additional equipment and services summarized in the box. Such technologies can add around thousands of dollars to vehicle purchase prices and around

hundreds of dollars of annual fees. For example, the package of optional electronic features such as remote starting, high beam assist, adaptive cruise control and top view camera typically increases the new vehicle prices by more than \$4,900, and navigation and security services, such as On Star and Tom Tom, costs \$300-700 per year.¹ Since failures could be fatal, autonomous driving system needs robust, redundant and abuse-resistant components maintained by the specialists, similar to the aviation service standards, further increasing costs.

Advocates argue that these additional costs will offset by insurance and the fuel cost savings, but that seems to be very unlikely. For example, if the autonomous driving cuts liability insurance costs in half, the \$200-600 average annual savings is just 4-9% of estimated additional costs. Additional equipment and larger vehicles is to serve as the mobile offices and bedrooms are likely to increase rather than reduce energy consumption. Electric vehicles have a very low fuel costs, in part because they are currently paying no road user fees comparable to the vehicle fuel taxes, imposing cost-recovery fees on electric vehicles will increase their operating costs 5-10% per vehicle-mile.²

Exhibit 3 Automated versus Personal Car Costs (Johnston and Walker 2017)



Some studies estimate lower costs (Keeney 2017). For example, Kok, et al. (2017) predict that shared, electric autonomous vehicles operating costs will be less than 10¢ per mile, so their use will often be free, funded through advertising, but such estimates ignore significant costs such as vehicle maintenance and cleaning, business profits, empty vehicle-travel, insurance (based on optimistic assumptions of autonomous vehicle safety), and roadway costs (they assume that electric vehicles should continue to pay no road user fees), and so are probably underestimates.

These can be compared with other modes' costs (AAA 2017; Litman 2009). Automobiles currently have about \$3,600

in fixed expenses (financing, depreciation, insurance, registration fees, residential parking and scheduled maintenance) and \$2,400 in variable expenses (fuel, oil, tire wear and paid parking), and is driven about 12,000 annual miles, which averages about 50¢ per mile, of which about 20¢ per mile is operating expenses (automobile cost estimates published by the automobile associations are somewhat higher because they focus on newish vehicles with full insurance). Human-operated taxis generally cost \$2.00-\$3.00, ride-hailing (Uber and Lyft) about \$1.50-2.50, and conventional public transit 20-40¢ per mile.

- **Traffic Safety**

Optimists claim that, because human error contributes to 90% of crashes, autonomous vehicles will reduce crash rates and insurance costs by 90% (Fagnant and Kockelman 2013; Kok, et al. 2017; McKinsey 2016), but this overlooks additional risks these technologies can introduce (Fung 2015; Hsu 2017; Kockelman, et al. 2016; Koopman and Wagner 2017; Ohnsman 2014):

- **Hardware and software failures.**

Complex electronic systems often fail, and even small vehicle operating system failures - a false sensor, distorted signal, or software error - can have catastrophic results. Self-driving vehicles will certainly have failures that contribute to crashes; the question is their frequency compared with human drivers.

- **Malicious hacking.** Self-driving technologies can be manipulated for amusement or crime.

- **Increased risk-taking.** When travelers feel safer they tend to take additional risks, called offsetting behavior or risk compensation. For example, if autonomous vehicles are considered very safe, fewer passengers may wear seatbelts and other road users may take greater

risks. Pedestrians may become less cautious (Millard-Ball 2016). Toyota Research Institute Director Gill Pratt describes this as “over-trusting” technology (Ackerman 2017).

- **Platooning risks.** Many potential benefits, such as reduced congestion and pollution emissions, require platooning (vehicles operating close together at high speeds on dedicated lanes), which can introduce new risks, such as human drivers joining platoons and increased crashes severity.

- **Increased total vehicle travel.** By improving convenience and comfort autonomous vehicles may increase total vehicle travel and therefore crash exposure (Trommer, et al. 2016; WSJ 2017) providing more affordable alternatives to higher-risk drivers. Efforts to reduce higher-risk driving, such as graduated driver’s licenses, special testing for senior drivers, and anti-impaired driver campaigns, can be more effective and publicly acceptable if affected groups have convenient and affordable mobility options.

- **External Cost**

Advocates claim that autonomous driving will reduce external costs including traffic

congestion, energy consumption, pollution emissions, and roadway and parking facility costs, although those benefits are uncertain (Eddy and Falconer 2017). To be more space and energy efficient autonomous vehicles require dedicated lanes for platooning (Exhibit 7). This is only feasible on grade separated highways. Autonomous vehicles can increase congestion, energy, pollution and roadway costs. If they strictly follow traffic laws and maximize caution, such as speed limits and optimal spacing between vehicles, they will often delay other road users. Because passengers tend to be more sensitive to acceleration than drivers and some passengers will rest or work, many users may program their vehicle for more gradual acceleration and as medium risk, and wild animals, such as kangaroos, as high risk. In addition, children sometimes dress in animal costumes, and adolescents in zombie variations. Most drivers can understand such risks. If I say, "Watch out for a group of teenagers in zombie kangaroo costumes," you could probably understand the threat since you too were once a playful youth, but a computer would be flummoxed: that situation

Self driving car is the future of world of cars easily.

Self-driving technologies requires additional equipment, and vehicle manufactures are likely to market seats that turn into beds and mobile offices, which can increase energy consumption and emissions. Autonomous vehicles may require higher roadway maintenance standards, such as clearer line painting and special traffic signals. Autonomous driving can reduce parking facility costs by allowing vehicles to park further from destinations, but most users will probably want their vehicles available within five or ten minutes, and so must park within a mile or two.

DEVELOPMENT AND DEPLOYMENT

Many current vehicles have Level 1 and technologies such as cruise control, hazard warning and automated parallel parking. Tesla's Autopilot offers automated steering and acceleration in limited conditions, but deployment was delayed after it caused a fatal crash in 2016 (Hawkins 2017).

TRAVEL IMPACTS

Many costs and benefits will depend on how autonomous vehicles affect total vehicle travel, which will depend on how they impact users' travel experience, costs and mobility options. As described

previously, autonomous vehicles can increase mobility by non-drivers, such as people with disabilities and adolescents. In a typical community they represent 10-30% of residents, but many have relatively low travel demands, and are now, when picking up or dropping off passengers, or when waiting to be summoned; it will often be cheaper for a car to drive around than to pay parking fees. Shared autonomous vehicles are likely to reduce vehicle ownership but increase travel per vehicle (Sivak and Schoettle 2015b). With current policies these factors are likely to increase total vehicle travel.

Convenience:-Motorists often keep items in their vehicles, including car seats, tools, sports equipment and emergency supplies.

Speed and Reliability:- Under optimal conditions taxis can arrive in less than five minutes of a summons, but often take much longer, particularly during busy periods, for special vehicle types (such as a van to carry multiple passengers or a wheelchair), and in suburban and rural areas.

Costs Vehicle sharing is generally cost effective for motorists who drive less than about 6,000 annual miles. People who live in suburban and rural areas, who usually

commute by car, or who for other reasons drive high annual miles will probably choose to own a personal vehicle.

Status Many people take pride in their vehicles and their driving ability, and so may prefer to own private vehicles, and have the option of driving.

POTENTIAL CONFLICTS AND SOLUTIONS

There are potential conflicts between user and community goals in autonomous vehicle design and programming. For example, if programmed to maximize sleeping passengers' comfort they may reduce traffic speeds, and if programmed to protect occupants they may increase crash risk to other road users. Some benefits (reduced congestion and possibly pollution emissions) require that autonomous vehicles have dedicated lanes. This will raise debates about the fairness, pricing, regulations and enforcement of these requirements. There are also potential conflicts in transportation system planning and management.

By increasing vehicle travel demand and vehicle traffic speeds, and displacing public transit, autonomous vehicles could exacerbate traffic congestion, sprawl-related costs, and mobility inequity. For

example, if parking is priced but roads are not, it will be cheaper for autonomous vehicles to driving continuously on urban streets rather than pay for parking, exacerbating congestion and pollution problems. Some experts argue that autonomous vehicles eliminate the need for conventional public transit services, but high capacity transit will still be needed on major travel corridors and they can support public transit by improving access to stops and stations (ITF 2014; TRB 2017). In response, public interest organizations have developed guidelines for efficient and equitable implementation of emerging mobility technologies and services (Kaohsiung Eco Mobility Festival 2017). These policies are recommended to maximize benefits (Schlossberg, et al. 2018; TRB 2017):

Test and regulate new technologies for safety and efficiency.

- Require autonomous vehicles to be programmed based on ethical and community goals.
- Efficiently regulate and price roads and curb space to prevent congestion.
- Favor shared and higher-occupant vehicles over lower-occupant vehicles on public roads.

- Support high capacity public transit on major travel corridors.
- Reduce parking requirements to take advantage of shared vehicles.
- Efficiently price development to prevent inefficient sprawl.
- Take advantage of more efficient vehicle traffic to redesign streets and public spaces for efficiency and livability.

CONCLUSION

Recent announcements that manufactures will soon sell self-driving cars raise hopes that autonomous vehicles will quickly solve many transportation problems. Advocates predict that by 2030, such vehicles will be sufficiently convenient and affordable to displace most human-operated vehicles, reducing driving stress and tedium, providing independent mobility to non-drivers, and be a panacea for congestion, accident and pollution problems. However, there are good reasons to be skeptical. Most optimistic predictions are made by people with financial interests in the industry, based on experience with other disruptive technologies such as personal computers, digital cameras and smart phones. There is

considerable uncertainty concerning autonomous vehicle benefits, costs and travel impacts. Advocates claim that they will provide huge social benefits, but many of their claims are speculative and exaggerated. Advocates often ignore significant costs and risks, rebound effects (increased vehicle travel caused by faster travel or reduced operating costs), and potential harms to people who do not to use the technology. Benefits are sometimes double-counted, for example, by summing increased safety, traffic speeds and facility savings, although these often involve trade-offs.

Platooning benefits require dedicated autonomous vehicle lanes. These issues will probably generate considerable debate over their merit and fairness.

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