The Impact of Autonomous Vehicles on People's Use of Vehicles and the Possible Environmental Pollution

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Abstract. This paper gives the introduction and impact analysis of autonomous vehicles (AVs). The intention of inventing AVs is to facilitate people's life and to reduce the waste of recourses. It brings several impacts to public society from environmental and other perspectives. Research finds that as the application of AVs is boosting, the vehicle miles traveled (VMTs) of self-driving cars keep increasing. This phenomenon was affected by a few reasons: expanded user groups, increased public transportation, and some personal factors. Furthermore, considering the environmental impacts such as the relationship between energy consumption, life span, and frequency of use. By discovering the negative impact of AVs on humans and the whole society, some of these impacts are listed, like it reduces the labor force and causes radiation to the human body. It is undoubtful that AVs have brought many improvements to human life, it contains drawbacks due to the immature technology and short development period, but protocols and technology advancements will help to minimize these drawbacks as this technology is getting more mature.

Keywords: Autonomous vehicles (AVs); vehicle miles traveled (VMTs); energy consumption and life span; labor force; radiation to humans.

1. Introduction

Autonomous vehicles (AVs) are a kind of new technology that is developing now. As smart artificial intelligence technology is adopted in the self-driving car, combined with machine learning (ML), the AVs' positive effects are clearer now. Self-driving technology utilizes sensors and actuators, which can connect with other machines and electric devices on this road. Attaining the instantaneous road information and inducing the barriers. If the level of automation is higher than level 4 (include), the car is dominantly driven by the computer system in the vehicle, it depends on the current progression of tech and also the domestic law related to AVs. For sure, it brings tremendous positive effects to the global, and in this paper, analyzing the cause and details of these impacts are done. For instance, from the perspective of social benefits, it increases the number of people who can use vehicles. This huge progression might give the credit to the developed smart artificial intelligence [1].

However, this change is linked with a few negative aspects such as pollutant emissions. Due to the boosting of the frequency of use, the car will emit more harmful substances to the surroundings. Furthermore, the large number of electric devices which are used in AVs than conventional vehicles can cause harmful radiation to the human body. So far, researchers try to focus on the impacts on society and the environment in order to minimize such negative impacts due to the immature technology and short research period. In the following paper, the research goal is to consider and analyze these positive aspects and the drawbacks of the AVs, try to fairly think about these factors together, and compare the extent of impacts of each effect.

2. Autonomous vehicles (AVs) mediated social and individual benefits

With the development of technology, more and more people try to focus on technology which can improve people’s life. An invention was developed in the transportation industry, which might tremendously impact the whole world's transportation prospects if it is well-developed. Autonomous vehicles (AVs) are a type of new technology which mainly relies on the computer system inside the

car to finish the artificial intelligence work when traveling on the road. Since this technology is not widely used in many countries now, there are several potential impacts that it might bring to transportation technology in the future; the following passage considers a few potential impacts. If AVs are adopted in real-life transport systems on a large scale, they can bring many effects which facilitate human society in several ways: increasing the use of vehicles around the globe and providing the driving opportunity to a variety of people.

2.1. Expanded user group

A person must pass the AV testing and have the skills to drive the autonomous car if it is needed to be driven by humans. These rules largely limit the number of people who can drive AVs. However, As the level of autonomy of the AVs increased when mature technology was developed, there were fewer strict limitations for the drivers of AVs. So, AVs give more people a chance to drive on the road. In most countries, the aging of the population has become a major phenomenon, especially in those well-developed countries like China and America. In 2020, 17% of the population aged 65 and above in the United States entered an aging society (Huaxia Industrial Economy Research Institute). This bodes that AVs can boost the transportation industry by letting older and even younger people drive on public roads, which endures more people to drive by using the technologies in Avs [2].

The self-parking system is another beneficial factor that facilitates the use of vehicles. Parking is always a headache when people are driving cars, and also it increases the limitation of driving them. Once younger and elderly people use this, it can avoid several problems caused by lack of skills. Furthermore, the computing technology in AVs can calculate the whole unit of cars in one road and then reduce the space between each car, finally reducing the congestion and traffic jam, which also increases the road capacity and give more people to drive on the road.

People will tend to use AVs instead of public transportation with further developed advanced AV systems. Some research shows that AVs raise the vehicle miles traveled (VMTs) by 15% to 59% [3]. Since AVs provide more opportunities to a variety of people, people find that AVs can provide a comfortable trip with a wider area and more privacy through personal driving systems with closed spaces. This leads to the phenomenon that there is an increase in the number of people who take AVs every day, especially for people with special characteristics who lack driving skills.

2.2. Individual emotional benefits

When people are taking traditional cars that do not have self-driving systems, they need to focus on the road's current condition and get ready to do the next step when driving on the public road. Staying focused for a long time can have detrimental effects on the human body, like the nervous system, or cause high blood pressure. In addition, after working for a whole day, people's minds must be exhausted and was accumulated tons of stress, so when meeting the traffic congestion and traffic jam on the way from work is tolerating the human body. On the contrary, AVs give people more freedom. Autonomic driving allows people to relieve the pressure caused by work and traffic congestion, which means they do not need to keep their minds and do whatever they want. Having fun, finishing work assignments, talking with friends, or even sleeping are all the privileges that self-driving cars give to people. So, more and more people are choosing AVs because of this huge advantage.

2.3. Improved communication efficiency

As mentioned in the previous passage, AVs daily commuting process relies on the computer system inside the car, which is one of the most transparent advantages of AVs. According to a few experiments by (Maxime Gue´riau and Ivana Dusparic) analyzing the CAVs (connected autonomous vehicles), AVs can bring traffic efficiency by reducing traffic congestion as a benefit to many people.

Unlike the manual manipulating of cars, AV's artificial intelligence is entirely controlled by the computer system. It can strictly follow the intellectual system inside the car. Some people may break the traffic rules like running a red light to solve an emergency. To realize an entirely self-driving

system, the AVs must reach the level of autonomous driving of 4, the level where people can release their hands and mind and give themselves to the Avs [4]. The strategy of intelligent driving systems is generally conservative, which, combined with high-precision handling, greatly reduces congestion and the possibility of accidents at busy intersections.

To be specific, AVs can connect to each other through the systems, which can realize synchronization when traveling. In traditional driving, the acceleration of different vehicles is out of sync, which means if there is only one car has delayed the acceleration, all the car units on this road will be impacted by it, and then a traffic jam is formed. The advantage of self-driving cars is that they can sense changes in road conditions ahead. In self-driving cars, the spacing between the car and the car is larger, and acceleration and deceleration are determined through a series of calculations. When the traffic is dense, the self-driving car will keep a certain distance to reduce the number of sudden braking, thereby reducing the impact on the vehicle behind.

3. Challenges and problems on public issues with the implementation of AVs

Based on the advantage that AVs can calculate the most reasonable routes and save energy through the onboard computers, many people believe it is one of the future environmentally friendly travel tools. But none of this can hold without considering the frequency of use. With the increased frequency of energy-saving vehicles, their energy consumption will increase exponentially. It should be admitted that AVs are not as economical as people think. The main factors depend on powerful onboard computers and AVs themselves. The underlying logic is that based on the conclusion of this paper's previous research, AVs will greatly increase the frequency of use, even if The secondary energy consumption is very low, and the total energy consumption of the two in a certain time will become a considerable number.

First of all, there is no doubt that new energy vehicles consume less energy than traditional cars - but the new energy vehicles and self-driving vehicles cannot be generalized. The powerful computer function of self-driving means sacrifice in another field, that is, the inevitable energy consumption generated by computers.

According to a report released by the Sustainable Systems Center of the University of Michigan in 2018, computers in AVs account for 41% of energy consumption [5]. This means that AVs may fall into an embarrassing dilemma - the vehicles themselves emit fewer harmful substances, but more electricity consumption leads to increased pollution in upstream industries. In addition, with the emergence of commuter management, the need to choose to live in urban areas has decreased. It means that more people are willing to accept long commutes. After all, the people who drive are not themselves). The total driving distance will increase significantly in AVs. The rebound effect on AVs will occur in many ways. First, the future development of AVs will improve people's willingness to drive and increase urban traffic, thus increasing energy consumption. With the optimization of their energy efficiency, more people will choose AVs, which is also a reflection of the rebound effect - combined, AVs are higher than ordinary cars. The energy consumption of Western energy vehicles, which are put into computers, will cause a lot of energy consumption [6].

In addition, another problem of AVs must be considered, which is also based on the increasing frequency of use, that AVs will have a shorter service life than traditional cars, increasing energy consumption in the macro field.

Most supporters of AVs have hope for its future that it can work in the field of online carpooling. And through its powerful computing power, it can calculate the most suitable route and passengers along the way, forming a real-time traffic network that can be self-corrected. For AVs, most would agree that a driverless car is going to be used in a similar rides Haring manner and be on the road quite a lot. . The future of AVs in the field of carpooling is not only widely recognized but also often regarded as evidence of the energy-saving potential of AVs. However, the lifespan of cars needs to be considered. According to today's statistics, the average age of traditional cars in the United States is 11.6 years, while the mileage is 150,000 miles. Statistics on Uber and Lyft carpool drivers show

that they have an average of 1,000 miles per week, which means that this type of car can only be used for three years. As mentioned above, AVs with carpooling will also attract people to increase the frequency of commuting, which means that they will be scrapped and replaced more frequently than traditional cars. Moreover, on the other hand, driverless cars can never run 24 hours a day as most people dream of [7]. Even if manual driving costs are saved, AVs still need to be maintained and charged. This means that it is not the perfect means of transportation in the eyes of many people, but it will cause excessive waste and waste. After three years of service life, AVs will face the problem of scrapping and recycling. The challenge of managing end-of-life vehicles is also increasing. In order to recover valuable metals and treat harmful substances, Tuo Zhang and his group carried out relevant tests. However, due to the harmful components of some metals, this process is undoubtedly complex and labor-intensive. Even without considering the cost of recycling, such a high-intensity iterative update will pollute the environment - based on its production process. In order to extract metals used to make AVs, the use of non-sustainable extractors will cause air pollution and damage to ecosystems, and as the demand for related resources increases in the future, it will also have a negative impact on mineral mining. To sum up, the career prospects of AVs are not completely optimistic. Under the influence of a series of factors, it will have a negative impact on the environment based on its short lifespan, complex recycling procedures, and a large demand for resources.

By combining the research on the systems and application fields of AVs, it is found that in addition to reducing direct emissions of exhaust gases, as a product downstream of the industrial chain, it has to indirectly or directly affect the environment. From energy consumption, which is avoided by most relevant companies, to enter the market to production and recycling, the future of AVs cannot be seen only as "new energy vehicles that do not require driver-on operation". More importantly, it will affect the psychology of consumers in its own form (as the second point of the rebound effect) and the mode of operation of the market (the fourth point of the rebound effect). This complex interaction process will fundamentally change the transportation market. The slight energy savings for a single car are not worth mentioning in the whole market. When looking at it from a macro perspective, AVs' changes in the future are huge and eye-catching [8]. Any small feature will become an important factor that cannot be ignored when it is enlarged. And before the production measures, recycling measures, and operation policies related to it are introduced, any of its advantages should not be exaggerated - because a loophole in SLR has been missed, which will become a huge hidden danger that is difficult to erase in the future.

4. AVs' negative impact on human

4.1. Impact on people and public safety

Although the developed self-driving car brings lots of progress to humans, it might contain some drawbacks. AVs are not commonplace in our real life because the technologies used in the AVs are not mature and highly developed. For instance, when the driving conditions are not ideal, like when encountering a storm, fog, or some emergency events are happening, the systems such as navigation and road detectors used in AVs may not behave as normal, and are out of control by the computer system. These factors and impacts will certainly lead to uncontrollable car crash accidents [9].

This also leads to another vital problem, the liability of the accident. It is vague to consider and judge who will be responsible for the liability when self-driving crashes happen. The immature technology and related policy of self-driving cars may make the problems solving in court to be difficult.

4.2. Radiation in the electric car

Almost every AV is an electric car, which means it also needs some energy to produce the electricity inside the car, like the devices people need to drive the car and do the searching tasks. For instance, laser radar, which is used to detect the routine and the barrier on the road, can produce radiations that have detrimental effects on the human body. The reason for setting it as an electric car

is that it is easier for computers to drive. When generating electric devices, a harmful magnetic field is produced by these devices. By replacing the mechanical systems with electric devices, extra radiation production is one of the problems which cause negative impacts on the human body, mainly including microwave radiation emission.

More specifically, AVs may cause radiation injuries to people outside the vehicle, like motorcyclists and bike riders. By using radar and laser, AVs can produce microwave radiation to surroundings. If it's on a wide road and the speed of the vehicle is high, more energy is used to generate electricity, which produces more radiation. The worse scenario is that there is a unit of AVs and siege the motorcyclist inside of them, the overlay of the radiation can cause cancer and other diseases to the rider [10].

Past experience suggests that technological development may also create more jobs in the short term. But blue-collar workers face a high risk of becoming obsolete after 2035, according to the study. This is a huge shock to the labor market. Driverless cars will put drivers out of work, just as horses do carriages.

5. Conclusion

After a series of arguments above, this paper concluded that AVs cannot simply be seen as a solution to a series of problems that human beings face in transportation. As an industry with a huge market prospect in the future, AVs will have an all-round impact on human society from the social impact and technological impact. Therefore, it needs to be put in perspective, and it needs to be analyzed more carefully from different aspects. It is irrational to exaggerate the advantages of AVs for the sake of the benefits brought by the future blue ocean market or to fear that AVs, as an emerging technology, may cause more negative impacts on society. This paper first discusses the advantages of AVs for enterprises and individuals. On the one hand, it expands the user market. On the other hand, it brings users a better experience and improves efficiency in daily life. However, the direct effect of this advantage can actually become the disadvantage of AVs - based on the power consumption of onboard computers, a higher frequency of use will lead to exaggerated energy consumption and environmental pollution. And the touted future model of AVs, automated ridesharing, has been called into question by its short lifespan and complex recycling process. In addition, there is much talk about the impact of AVs on the human body and their impact on the labor market - this is a problem that almost every new technology adopted must face, but even today, people must carefully consider whether AVs will have a serious negative impact on the job market.

The most important underlying logic in this paper’s entire argument about the prospects of AVs is that what appears to be an advantage can have negative effects in other ways. Such as saving manpower and affecting the labor market, higher frequency of use and more pollution generation, better service mode, and shorter service life. These factors interact with each other, which makes it impossible to estimate the impact of AVs on the future society from a single perspective - Because the difference in outcomes between the different possibilities is too large. In conclusion, this paper suggests that even if AVs do have a bright future, researchers still need to do a more comprehensive analysis of its possible ripple effects. In the future, people should be fully prepared to embrace new technologies, do a good job of supporting relevant policies, and forecast the direction of development. Nevertheless, the future of AVs is optimistic- even as the paper discusses the touted and undeserved merits of AVs, these problems are not obstacles to the development of new technologies. The ultimate hope is that through this series of investigations, the government can eventually bring AVs into people's lives naturally. And until that day, by continuing to develop the technology to reduce the current shortcomings. In this process, sound policies and more research are very necessary, perhaps a combination of technicians and sociological researchers. But all in all, AVs will be fully developed in the next decades with the support of various fields.

References

[1] Alexandros Nikitas Alexandra-Elena Vitel Cornelu Cotet, Autonomous vehicles and employment: An urban futures revolution or catastrophe? Cities Volume 114, July 2021, 103203

[2] Daniel J. Fagnant, Kara Kockelman. Preparing a nation for autonomous vehicles: opportunities barriers and polict recommendations for capitalizing on self-driving vehicle. Transportation Research Part A 77: 167-181, 2015.

[3] Shinpei Kato, Eijiro Takeuchi et al. An Open Approach to Autonomous Vehicles. IEEE Trans. November/ December 2015.

[4] Hörl, Sebastain; Ciari, Francesco; Axhausen, Kay W. Recent perspectives on the impact of autonomous vehicles. Arbeitsberichte Verkehrs- und Raumplanung 1216. 2016-09

[5] Wilko Schwarting, Javier Alonso-Mora and Daniela Rus. Planning and Decision-Making

[6] for Autonomous Vehicles. Annu. Rev. Control Robot. Auton. Syst. 2018.1: 8.1–8.24

[7] David Rojas-Rueda, Howard Frumkin and Haneen Khreis. Autonomous Vehicles and Public Health. Article in Annual Review of Public Health April 2020.

[8] M. Guériau and I. Dusparic, "Quantifying the impact of connected and autonomous vehicles on traffic efficiency and safety in mixed traffic," 2020 IEEE 23rd International Conference on Intelligent Transportation Systems (ITSC), 2020, pp. 1-8, doi: 10.1109/ITSC45102.2020.9294174.

[9] Möller, Jasmin & Daschkovska, Kateryna & Bogaschewsky, Ronald, 2019. "Sustainable city logistics: rebound effects from self-driving vehicles," Chapters from the Proceedings of the Hamburg International Conference of Logistics (HICL), in: Jahn, Carlos & Kersten, Wolfgang & Ringle, Christian M. (ed.), Digital Transformation in Maritime and City Logistics: Smart Solutions for Logistics. Proceedings of the Hamburg International Conference of Logistics, volume 28, pages 299-337, Hamburg University of Technology (TUHH), Institute of Business Logistics and General Management.

[10] Taotianchen Wan and Yikai Wang, The Hazards of Electric Car Batteries and Their Recycling 2022 IOP Conf. Ser.: Earth Environ. Sci. 1011012026