The Impact of Autonomous Vehicles on Cities

Zijun Luo[1,a,*]

[1]*Sussex Artificial Intelligence Institute Zhejiang Gongshang University, Zhejiang Gongshang University, Hangzhou, Zhejiang, China, 310000*

a. zl383@sussex.ac.uk
corresponding author

Abstract: Autonomous vehicles are a double-edged sword, bringing happiness and convenience to people's lives but also silently creating various crises and bad effects. The purpose of this article is to explore and analyze the implications of autonomous vehicles, with a focus on their impact on cities, as they are and will be massively linked to smart city systems and operate on urban roads. In this paper, the author has analyzed the findings and data from many past literature and research sources and summarized them based on his own research and ideas. The findings of this article show that the positive impacts of self-driving cars are mainly in the areas of ease of travel and self-driving car fleets. The negative impacts are mainly reflected in three different aspects: safety hazards, environmental pollution and energy consumption. Of course, self-driving cars have different impacts in various fields, and these impacts need to be explored by more researchers.

Keywords: autonomous vehicle, city, urban sustainability, positive & negative impact

1. Introduction

As technology continues to advance and develop, artificial intelligence technology has gradually become an important tool for human life and work, and this technology will certainly become an indispensable tool for human beings in all aspects of life in the future. As one of the most important application scenarios for AI technology, autonomous driving technology has been advancing rapidly in recent years, with technology levels changing rapidly and reaching L4(high automation), a level created by The-Society-of-Automotive-Engineers. Studies have shown that humans will reach the highest level of L5(full automation) within the next decade or so. As autonomous driving technology continues to improve, it is bound to spread to everyone's lives on a large scale. So we must be sensible and consider the impact of autonomous vehicles on people, especially in urban life. The author of this article has read and analyzed a lot of literature and research materials on self-driving cars, summarizing and reflecting on the current social reality. The research on self-driving cars helps human beings to travel safer and better and improves the level of human technological development. It constantly makes technology serve life. As the research related to self-driving cars continues, it will bring a lot of labor demand as well as a lot of wealth to society. This all contributes to the further good development of human society.

2.   Bringing Benefits to Cities

One of the main advantages of autonomous vehicles is that they improve road safety by eliminating the human element, significantly reducing the fatality rate from traffic accidents by 80-90% [1]. The majority of road safety accidents are actually avoidable due to the fact that humans are not able to concentrate as fully as machines without doing anything that is not against the rules of the road. As time spent driving increases, people become progressively more tired and their concentration and reaction time decrease. But these problems do not occur at all with autonomous vehicles in the current world context. Autonomous vehicles do not get tired or distracted and have advanced sensing and communication technologies that allow the vehicle to take over all key safety control functions [2].

2.1.   Convenient Transportation

Each autonomous vehicle can communicate and coordinate with each other, and the overall planning of a smart city system will go a long way to alleviating the serious traffic congestion in the city. Autonomous vehicles can effectively use the Internet of Things technology to plan traffic routes in real time to reach their destination as quickly as possible. To avoid congestion due to disorderly traffic on urban roads, humans need to use tools such as road signs and traffic lights to direct traffic, and this has the effect of significantly reducing the efficiency of traffic movement. Autonomous driving technology will inform every car in motion of the current and future traffic conditions at a junction to avoid traffic, thus eliminating the need to wait in place and waste time to significantly improve traffic flow.

One research study proved that 67% of the respondents said they would use the time not driving to enjoy the scenery along the road outside the car window; 55% thought they could use this time to communicate and chat with friends or colleagues; 54% would choose to use it to communicate with their families; and 51% would use it to take care of work [2]. It is much easier for passengers to ride in a car than for the driver to keep an eye on the road and an ear to the ground. This is why many people choose to take the car rather than drive themselves. We can also deduce from this that, with the development of autonomous driving technology, people will no longer need to operate their vehicles when travelling, and that vehicles will be able to automatically adjust their travel routes according to the smart city system to avoid the risk of traffic congestion in time.

The self-driving car of the future will have the independence to make route plans, charge itself, and also clean the vehicle when the owner does not need it. When the vehicle is ready to drive itself, each family will simply upload their family member's individual journey plan to the autonomous system, and the vehicle will adjust its own optimal route to ensure that each family member arrives at the intended location on time. At this point, what each family really needs is a scooter as a means of getting around. AI self-driving cars with greater autonomy will also be a relief for the size of urban sites. There will no longer be a need to build a lot of parking spaces in congested cities, which will save a lot of land for different activities such as real estate development [3]. This also leads to an increase in the size of the city, and the urban effect becomes more and more apparent.

2.2.   Facilitating Further Technological Exploration and Development

Self-driving cars may also increase the demand for travel [3]. Autonomous vehicles appear to hold the promise of increasing the capacity of existing roads and intersections. As people's demand for travel increases, the frequency of use of vehicles also increases, which promotes the use of shared autonomous vehicles. Sharing autonomous vehicles will not only save families money on private cars but will also improve the efficiency of car use and people's travels, removing many unnecessary hassles caused by private cars. According to surveys, many people believe that in the future, people

will not own private cars but instead will move to car sharing [1]. Autonomous vehicles will be the best vehicle of choice for car sharing.

Shared self-driving cars can be considered an upgraded version of the current shared online vehicles. Only instead of a real-life driver, there is self-driving technology with superb computing power and aided by smart city systems. Driving on city roads will also become safer, easier, and faster. Users simply place an order online in advance and enter the destination they want to go to, and then big data technology will automatically match them with the nearest self-driving car to fulfill that order. Shared autonomous vehicles can be both the only direct point-to-point mode of transport for people travelling on a daily basis and an important link to the public transport system at both origin and destination. Firstly, shared self-driving cars could arrive directly at the user's demand and take them to their destination in the most efficient way possible, which would have the effect of saving time and convenience. But this approach would undoubtedly leave the public transport system in a state of collapse with no one riding. So this has given rise to a more innovative mode of travel that combines shared self-driving cars with public transport systems. Self-driving cars can improve traffic safety and efficiency, reduce emissions, and improve travel comfort. When combined with public transport, the benefits of sustainability may be amplified due to shared travel [4]. This new model will also significantly reduce the cost of travel for people and can also significantly stimulate and advance the development of the shared self-driving car industry and public transport systems. Of course, the benefits that self-driving cars will bring to cities go far beyond this. This new mode of travel will dramatically change people's perceptions of travel, creating a positive attitude rather than a fear of hassle. At the same time, the full realization of self-driving cars will require a highly developed level of science and technology, which will facilitate further technological exploration and development in every way. The realization of more advanced artificial intelligence technology and its ability to serve humanity better [5].

3. The Potential Damage to Cities Caused by Autonomous Vehicles

As technology has continued to develop in recent years, self-driving cars have become more and more visible to the public, and with the impact they have on humans. Since almost half of the population thinks that self-driving cars are equivalent to new energy vehicles, they take it for granted that self-driving cars are environmentally friendly. The truth is not as simple as they think. In fact, research shows that as self-driving technology continues to advance these vehicles will become more and more polluting to the environment, not only emitting large amounts of greenhouse gases but also causing more waste of resources. What's more, autonomous vehicles have the potential to cause damage to smart city facilities if the technology is not strictly managed and gets out of hand [6].

3.1. Safety Hazards

Another major hazard that self-driving cars pose to cities is safety. In a self-driving car, people are putting their lives in the hands of computers. So the safety of the computer technology involved will be a major concern. Self-driving cars, as a form of motorized transport, can reduce driver stress, aid safe transport, reduce congestion, be as reliable and perform as conventional vehicles, and provide freedom of movement and a comfortable ride [2]. But the safety, reassurance, and reliability of autonomous vehicles cannot be compared to the reliability of conventional vehicles. Driverless cars bring with them a sense of insecurity and the fear that people will not be able to intervene in the event of a breakdown in the technical system, which would be very dangerous. Also of concern is the safety of the artificial intelligence technology at the heart of autonomous driving technology. If autonomous vehicles are to become widespread in urban society, safe and reliable technology is the first requirement. Only when that technology is mature enough to ensure adequate safety can it be rolled

out. And we need artificial intelligence technology that assists humans, provided that the logic is such that the technology does not pose any threat to humans as it continues to evolve.

3.2. Energy Consumption

Basically, all existing human activities require energy supplies, and human energy reserves are indeed limited. In the field of mobility, existing cars consume petrol, which is used as a raw material. The reserves of oil on the planet are very limited, and with the constant exploitation of this energy by mankind, they are already significantly reduced and will soon be exhausted. If mankind does not change the mode of travel and reduce or even eliminate the use of petroleum as a fuel for cars, then mankind will face a serious energy crisis and environmental hazards. If new electric vehicles become the vehicle for self-driving cars and indeed all cars in the future, the energy needed to get around will become relatively clean and accessible. Electricity, as a renewable energy source, can be created and produced in many ways. The current source of human energy for electricity is mainly through the burning of fossil fuels for thermal power generation, which will be depleted when fossil fuels are about to be exhausted. As cities continue to grow in size, the demand for electricity will only increase. City planners will need to meet the normal domestic and commercial electricity needs of the city's residents as well as the growing fleet of shared self-driving cars. The demand for energy will be enormous [7]. It is time to think of more effective solutions to the energy problem and to create or discover new and more efficient energy sources.

3.3. Environmental Pollution

This is a problem that cannot be ignored today and will continue to be a major problem in the future. The massive emissions of carbon dioxide and other harmful gases will also continue to affect the human environment. Many people think that new energy vehicles are the only vehicles for autonomous vehicles, but the problem is not that simple. Autonomous driving technology is an advanced technology that can be universally applied to all types of vehicles and is universally applicable, while new energy electric vehicles are simply the best vehicle to meet all the requirements of autonomous vehicles. Most of the vehicles in today's society require petrol as a fuel supply [8]. To replace most of the vehicles in society with new energy electric vehicles would be a long and arduous process. The development of autonomous vehicles in this process will also be a joint development of traditional energy vehicles and new energy electric vehicles. The damage to the environment caused by conventional energy vehicles will be enormous and immeasurable. This situation will be significantly improved when new energy electric vehicles are able to completely replace traditional energy vehicles, but their environmental impact cannot be ignored.

Firstly, in autonomous driving scenarios, higher traffic speeds due to significantly increased road capacity will lead to lower greenhouse gas emissions. However, over time, increased travel demand will lead to increased greenhouse gas emissions [3]. Also as mentioned above, self-driving cars will significantly increase the demand for travel, increasing the desire to travel by car. This in turn will inevitably lead to an increase in greenhouse gas emissions. In the face of the current serious environmental pollution problem, we should pay considerable attention to it. We need to optimize our autonomous vehicles, reduce pollution, and maintain the environment of our planet [9].

4. Discussion

Overall, in the context of current times, the negative effects of self-driving cars slightly outweigh the positive ones. In the long run, however, the benefits and positive aspects of self-driving cars will only increase in the near future, far outweighing the negative effects of today. Society should not stop or abandon research into the development of high technology just because of the current negative effects,

and we should look at the long term. When technology matures, it will bring considerable rewards and benefits to mankind. Currently, autonomous driving technology is flourishing with the support of governments in all countries. Companies are investing more and more in this technology. It is believed that autonomous driving technology will become an important technological tool for mobility in the near future. Technology is now becoming more widespread in society, with more people being able to understand and access self-driving cars.

There are, of course, many limitations to the development of self-driving cars. The current state of technology does not allow for the safe and reliable implementation of this technology. We are currently facing the most difficult technical bottleneck in this technology and need to continue to research and develop the technology to its full potential. There is also a level of trust in society. The public and large companies need to have enough trust in self-driving cars to feel comfortable paying for this technology. With the support of governments and with a strong and active push from companies, many civilized people should agree that the benefits and dividends of autonomous driving technology for the environment are incalculable. At the same time, however, as various factors remain uncontrollable, scientists and even the general public should take a moment to properly re-examine such technologies. Instead of being the driving force behind the destruction of the urban environment, autonomous driving technology should be an environmentally friendly transport technology that facilitates fast travel. In recent years, as smart city systems and autonomous driving technology have been combined and optimized, many factors will gradually reduce the negative effects of intelligence and full automation. For example, orderly driving, environmentally friendly vehicle materials, recyclable energy, and efficient rechargeable batteries. What's more, strict supervision by the relevant authorities is essential. When self-driving technology really matures, it will lead to a new way of life and an almost entirely new modern society.

5. Conclusion

In an urban environment, autonomous vehicles can have a number of beneficial effects: Firstly, they can make travelling more convenient and efficient, so that people no longer have to worry about the fatigue and boredom caused by long hours of driving. When autonomous vehicles are combined with smart city systems, they will greatly improve the efficiency of city operations, significantly reduce traffic jams and other situations, and improve people's well-being; Secondly, as technology continues to advance, autonomous driving fleets will eventually be realized. However, every coin has two sides. Firstly, environmental pollution is the main threat we face, with CO_2 and greenhouse gas emissions increasing with every mile travelled, especially before new energy trams have completely replaced fuel cars as the only vehicle for autonomous vehicles. Secondly, massive energy consumption, city expansion, and the constant use of autonomous vehicles will result in a huge demand for energy; third, autonomous driving technology will rely heavily on safe and reliable artificial intelligence technology, which must be strictly enforced so that it does not get out of control and harm humans. When it comes to the impacts of autonomous vehicles, what needs to be done to amplify the positive impacts and minimize or even eliminate the negative impacts on the environment. Firstly, the national government should enact more reasonable and strict laws and regulations to regulate the relevant technical standards. Secondly, at the corporate level, we should strictly comply with the relevant regulations and ethical constraints, and continue to improve our technology to develop and manufacture more efficient autonomous vehicles. Finally, at the individual level, everyone should use self-driving cars in accordance with the regulations, be aware of the negative impacts while improving their quality of life, as well as promote all kinds of green and low-carbon travel to reduce the workload of autonomous vehicles. This article is based on a summary of the analysis of literature related to self-driving cars and the current situation in society. Due to the constant updating and publication of various materials, there may be missing or unrealistic ideas or data. The author needs

to constantly read this new literature, summarize and correct errors and deficiencies in the article in a timely manner. Future research may be more oriented towards the practical analysis and exploration of specific implementation methods for self-driving cars.

References

[1] Townsend, R. M., Atkinson-Palombo, C., Terbeck, F., & Garrick, N. (2021). Hopes and fears about autonomous vehicles. Case Studies on Transport Policy, 9(4), 1933-1942. (2021).

[2] Acheampong, R. A., Cugurullo, F., Gueriau, M., & Dusparic, I. Can autonomous vehicles enable sustainable mobility in future cities? Insights and policy challenges from user preferences over different urban transport options. Cities, 112, 103134. (2021).

[3] Nadafianshahamabadi, R., Tayarani, M., & Rowangould, G. A closer look at urban development under the emergence of autonomous vehicles: Traffic, land use and air quality impacts. Journal of transport geography, 94, 103113. (2021).

[4] Poinsignon, F., Chen, L., Jiang, S., Gao, K., Badia, H., & Jenelius, E.Autonomous Vehicle Fleets for Public Transport: Scenarios and Comparisons. Green Energy and Intelligent Transportation, 100019. (2022).

[5] Patel, R. K., Etminani-Ghasrodashti, R., Kermanshachi, S., Rosenberger, J. M., & Foss, A. Exploring willingness to use shared autonomous vehicles. International Journal of Transportation Science and Technology. (2022).

[6] Silva, Ó., Cordera, R., González-González, E., & Nogués, S. Environmental impacts of autonomous vehicles: A review of the scientific literature. Science of The Total Environment, 154615. (2022).

[7] Rafael, S., Correia, L. P., Lopes, D., Bandeira, J., Coelho, M. C., Andrade, M., ... &Miranda, A. I. Autonomous vehicles opportunities for cities air quality. Science of the Total Environment, 712, 136546. (2020).

[8] Abe, R. Preferences of urban rail users for first-and last-mile autonomous vehicles: Price and service elasticities of demand in a multimodal environment. Transportation Research Part C: Emerging Technologies, 126, 103105. (2021).

[9] Margarida C, Claudio G. Driving Information in a Transition to a Connected and Autonomous Vehicles Environment: Impacts on Pollutants, Noise and Safety, AIIT 2nd International Congress on Transport Infrastructure and Systems in a changing world (TIS ROMA 2019), 23rd-24th September 2019, Rome, Italy. (2020).