

Self-Driving Cars: Ethical Analysis

Abdelrahman Ahmed

6 September 2017

Table of Contents

1. Introduction	3
2. Ethical Analysis	4
2.1. Ethical Concerns	4
2.1.1. Unemployment	4
2.1.2. The Trolley Problem	5
2.1.3. Vulnerability	7
2.2. Stakeholders	8
2.2.1. Automakers	8
2.2.2. Government	8
2.2.3. Car Owners	9
2.2.4. Individuals Employed as Drivers	9
2.3. Ethical Views of Stakeholders	10
2.4. Personal Views	11
3. Industry Codes of Ethics	12
3.1. Application to Self Driving Vehicles	13
3.2. Comparison of Codes of Ethics	13
4. Conclusion	14
5. References	15

1. Introduction

Autonomous vehicles are gradually becoming a reality through improvements in existing autonomous systems and technological advances in computer vision techniques. Their introduction will have significant benefits to our society, economy, and environment. Human error is the main cause of many traffic accidents, causing millions of casualties every year. Removing the potential for human error has been a major influence in the drive to develop autonomous vehicles (MV & Jaswal 2015). In addition to reducing accidents, the introduction of autonomous vehicles will have an impact on the environment. They will be electric and more efficient, thus reducing fuel consumption and toxic emissions. Autonomous vehicles will also open the possibility for people with disabilities to travel without assistance. They will also aid in the reduction of traffic congestion through improved cruise control, automating public transportation and ride-sharing services. Despite all of these benefits, there are many ethical and reliability concerns surrounding the introduction of autonomous vehicles. Autonomous vehicles face the trolley problem in inevitable accidents, where they may have to make a decision of whose safety to prioritise. Would autonomous vehicles be utilitarian and minimise overall harm, or would they prioritise the safety of their owner and passengers over others? There are also concerns about the massive loss of employment for people relying on vehicles to make a living, such as truck and bus drivers. In addition to this, experts question their security and reliability as autonomous vehicles are computerised, and would inherit the current security issues facing personal computers; worsened by a

possibility of having vehicle-to-vehicle communication network that may be vulnerable as well.

2. Ethical Analysis

2.1. Ethical Concerns

The large investments and technological advances in autonomous vehicle technology distort the fact that there are still many ethical concerns associated with autonomous vehicles. Society as a whole will need to address these issues as autonomous vehicles become more mainstream. This section will identify the key ethical issues associated with autonomous vehicles, and provide justifications for these concerns.

2.1.1. Unemployment

Over the years advances in technology and automation have led to a massive loss of jobs in different areas, such as telecom, manufacturing and publishing, and autonomous vehicles will not be any different. It is expected that it will have a significant impact on employment and the economy, leaving millions of individuals currently employed as vehicle drivers without a job (Balakrishnan 2017).

Balakrishnan (2017) reported that Goldman Sachs found as autonomous vehicle saturation peaks, drivers in the United States will expect to see job loss at a rate of 300,000 a year, or 25,000 a month. This includes truck drivers, bus drivers, taxi

drivers and employees of ride-sharing services, such as Uber. In addition to that, it will likely have some adverse effects on peripheral jobs such as car repair shops and gas station attendants.

One can argue that technology does not just eliminate jobs, but also creates new jobs in different fields. This, however, will require a significant amount of investment to retrain and re-employ the individuals who have lost their jobs. These concerns have also renewed the discussions about Universal Basic Income (UBI), a form of social security where individuals receive payments on a regular basis independent of any other income. This would allow individuals who have lost their jobs to have a safety net while they work towards retraining and re-entering the workforce (West 2015).

2.1.2. The Trolley Problem

The trolley problem is a thought experiment in ethics, and has been a major topic of discussion in the ethics of autonomous vehicles. Suppose that an autonomous vehicle is moving towards five pedestrians. The vehicle can either stay on course and kill them, or swerve into a wall, killing its passenger or another pedestrian (Greene 2016). Bonnefon, Shariff and Rahwan (2016) conducted a series of survey experiments to explore this ethical dilemma, and found that people generally approve of utilitarian cars, which would minimise overall harm. However, respondents were not eager to drive or own a car that may sacrifice them for the greater good. They also found that people are even less comfortable when family members or children are on board, or when the number of lives saved by swerving is larger than original five individuals.

Bonnefon, Shariff and Rahwan (2016) also discuss the aspect of liability and responsibility in such inevitable scenarios. Should the driver or automaker should be held accountable? These factors will need to be considered as a key part in the regulation of autonomous vehicles. Building safe and ethical autonomous systems is one of the biggest challenges in artificial intelligence, and as these systems become more common, it becomes an urgent and important issue that needs to be addressed (Bonnefon, Shariff & Rahwan 2016). While it is difficult to reconcile moral values and personal self-interest, public opinion and social pressure may change as discussions progress.

The National Highway Traffic Safety Administration (NHTSA) in the United States have begun to formally address this problem by initially categorising the levels of autonomous vehicles for automakers to follow. They have also requested that automakers become more transparent about their ethical design principles by providing safety assessments, which address ethical considerations and other safety concerns (Lin 2017).

2.1.3. Vulnerability

Researchers in recent years have demonstrated that it is possible to hijack brakes, engines and other components of an individual's car remotely, making the security of autonomous systems an important ethical and safety concern that needs to be addressed by automakers. Autonomous vehicles are equipped with computers, sensors and, in some cases, Internet connectivity, which leaves them vulnerable to

cyber attacks. As it is difficult to isolate the different components of the vehicle, once the car network is attacked, the perpetrator is able to control almost any component of the vehicle (Simonite 2016).

Evtimov et al. (2017) conducted experiments designed to fool the sensors of autonomous vehicles, rather than hacking into the vehicle. By identifying how a self-driving car recognises objects, cars and road signs, the researchers managed to use printable stickers on road and street signs which results in the vehicle misidentifying them. They found the stickers to work in most conditions and subtle enough to not be noticed by police officers or drivers. While these stickers can distort the speed-limit recognition systems for example, the authors stated that using contextual information from the environment and location can aid the car in making the correct identification (Evtimov et al. 2017). The possibility of cyber attacks as well as physical attacks demonstrate the vulnerability of autonomous vehicles, and the importance of safety in their development as well as their regulation.

2.2. Stakeholders

Autonomous vehicles will have a large impact on society, and will directly and indirectly affect a large number of people. In this section, key stakeholders that will be directly affected by the rise of autonomous vehicles are identified and their perspectives are described.

2.2.1. Automakers

Automakers are the companies responsible for the design, development, manufacturing and selling of autonomous vehicles. The motivation behind autonomous vehicles stems from the fact that human error is the biggest factor in traffic accidents. Automakers have continued to build and improve autonomous systems that aid the driver, such as cruise control, in order to rely less on the driver and also make them more comfortable. These systems have been gradually developing and will eventually become fully independent of the driver. Automakers will need to guarantee the safety of the autonomous vehicle, and safeguard it against possible hacks and other tampering. They will also play a major role in addressing the trolley problem by implementing an ethical framework the autonomous vehicle can operate in, and abiding by government regulations.

2.2.2. Government

The government acts as the legislative and regulatory body for autonomous vehicles. They will be concerned with the major ethical issues identified, as they prioritise the welfare and safety of citizens by looking at the trolley problem and the vulnerability of vehicles. Furthermore, they will need to deal with the unemployment situation. The government will also need to protect the interests of the state and citizenry by keeping the automakers in check and ensuring there is a competitive market and proper regulation.

2.2.3. Car Owners

Individuals who use their cars for commuting or other purposes, but do not rely on vehicles for employment, are the main target audience of autonomous vehicles. While there are some who enjoy driving, the vast majority of people, specifically younger individuals, are enthusiastic about the introduction of autonomous vehicles (Bonneton, Shariff & Rahwan 2016). Car owners will be concerned about the security of their vehicle and personal privacy, as well as how the vehicle behaves in certain conditions, especially in accidents where casualties may be unavoidable.

2.2.4. Individuals Employed as Drivers

Individuals employed as drivers include truckers, taxi drivers, bus drivers and drivers employed by ride sharing and hailing services such as Uber and Lyft. These individuals are concerned with the loss of their jobs as autonomous vehicles become more common. They are unlikely to see the benefits of autonomous vehicles from their perspective, and will rely on government support to re-enter the workforce.

2.3. Ethical Views of Stakeholders

Automakers will likely adopt consequentialism¹, as they aim to have their vehicles minimise harm as much as possible. However, it will be difficult to reconcile consequentialism with the interests of their customers, where their customers may be unwilling to own a car that may sacrifice them for the greater good.

¹ Consequentialism: right or wrong is dependent on a comparative assessment of each act's consequences (Mooney 2016)

Government will likely adopt justice ethics² to ensure that both the consumers and automakers are treated fairly, and are able to benefit from the introduction of autonomous vehicles. They would also ensure that there is fairness in the automotive industry, and avoid monopolies with a more competitive market.

Car Owners will likely adopt relativism³, as they will influence and be influenced by public opinion and government regulation which will decide what society deems acceptable.

Individuals Employed as Drivers will most likely adopt absolutism⁴, as they will view the autonomous systems as a threat from their perspective as they have a right to be employed and their introduction will significantly harm them by affecting their livelihood and employment.

2.4. Personal Views

Unemployment issues are not exclusive to autonomous vehicles. In reality, improvements in technology has helped create more jobs than it has destroyed in the last 144 years by increasing demand for labour in sectors that are the source of these improvements, as well as boosting employment in knowledge intensive sectors.

² Justice ethics: the duty to fairly treat the parties involved, and to equally distribute the risks and benefits (Mooney 2016)

³ Relativism: ethics and morality are not absolute, instead defined by culture and society (Mooney 2016)

⁴ Absolutism: a single ethical truth exists, implying a single perspective as to what is right or wrong (Mooney 2016)

Innovation in technology has reduced production expenses, increased disposable income and eliminated repetitive and dangerous tasks. These improvements have also resulted in an increase in employment in jobs involving care and nursing (Stewart, De & Cole 2015). It is an ethical responsibility to ensure that individuals in society have equal opportunities, and guarantee that individuals that have lost their jobs have access to the necessary resources to retrain and re-enter the workforce.

The trolley problem is an important thought exercise that should be addressed as autonomous vehicles become more mainstream. Implementing an ethical framework for autonomous vehicles to follow will require support and cooperation between automakers, regulators and the public. This may in itself be a difficult task as 'before we put our values into machines, we have to figure out how to make our values clear and consistent' (Greene 2016, p. 2).

The safety and security of autonomous systems is one of the most pressing concerns. As researchers have successfully demonstrated they are able to hack into cars, or fool their sensors and recognition systems, which not only affects future autonomous vehicles, but also affects production cars that are on the road right now.

In my view, autonomous vehicles will bring more benefits than harm, by reducing human-caused traffic accidents, congestion and pollution. By adopting consequentialism for all ethical concerns identified, autonomous vehicles will have an overall positive benefit to society. They will eliminate traffic accidents caused by human error and minimise overall harm the vehicle may cause in certain conditions.

The technology will continue to advance, and as society moves to a complete autonomous system, these unavoidable accidents will be less likely over time. This is inline with the automaker's perspective as they aim to produce vehicles that would minimise as much harm as possible.

3. Industry Codes of Ethics

In this section, three reputable codes of ethics and conduct in the Information Technology industry are examined in relation to autonomous vehicles: Australian Computer Society (ACS), Association for Computer Machinery (ACM) and British Computer Society (BCS).

3.1. Application to Self Driving Vehicles

The three codes of ethics strive for developing systems that improve the quality of life, and emphasise the importance of recognising and minimising the harmful effects of such systems. The codes also advise professionals to disclose any conflicts and be transparent about the issues concerning these systems. The three codes will likely be in favour of measures that will address the trolley problem that minimise overall harm in order to guarantee the safety and well-being of individuals.

Ethical and safety concerns will always be a part of the project management process, and it is essential to recognise and disclose them, and explore all options to mitigate them. The benefits of introducing autonomous vehicles outweighs the issues concerned with them, as it will dramatically reduce accidents caused by human

error, traffic congestion and pollution. Therefore, the three codes of ethics will most likely approve of the development and use of autonomous vehicles.

3.2. Comparison of Codes of Ethics

The three ethical codes of conduct share many similarities. One important and shared aspect is the moral imperative. The ethical codes stress the importance of contributing to society and human well-being, and giving the public interest precedent over personal and private interests. Therefore, the codes would agree that autonomous vehicles must be implemented in a socially responsible way, where they can enhance the quality of life and avoid harmful effects to welfare and health (ACM 1992, ACS 2014, BCS 2015).

While the three codes of ethics agree that one should avoid harm to others, the ACM specifically mentions the obligation practitioners have to report dangers, and if necessary to “blow the whistle” in circumstances where the reported issues were ignored by superiors. However, the ACM does emphasise the importance of thoroughly assessing incidents and seeking advice as unwarranted reporting can be harmful in itself (ACM 1992).

The similarities between the three codes of ethics are most likely due to the fact that these societies belong to developed western countries that share fundamental values, such as equality and human rights. However, areas of conflict or differences are likely to occur due to different working environments and cultures.

4. Conclusion

The ethical concerns associated with autonomous vehicles must be addressed and managed in order for society to fully reap the remarkable benefits that they will generate in the coming years. Societies will need to collectively agree on what moral and ethical values should be implemented in autonomous vehicles. The automakers should take the necessary actions to guarantee the safety and security of autonomous vehicles before they hit the road. Following the NHTSA lead, more governments around the world should be involved in regulating autonomous vehicles as well as guaranteeing equal opportunities and a safety net for those who have lost jobs due to automation and innovation in technology.

5. References

ACM - see Association for Computing Machinery

ACS - Australian Computer Society

Association for Computing Machinery 1992, *ACM code of ethics and professional conduct*, ACM, New York, viewed 31 August 2017, <<http://ethics.acm.org/code-of-ethics>>.

Australian Computer Society 2014, *ACS code of professional conduct*, ACS, Sydney, viewed 31 August 2017, <https://www.acs.org.au/content/dam/acs/rules-and-regulations/Code-of-Professional-Conduct_v2.1.pdf>.

Balakrishnan, A. 2017, 'Self driving cars could cost America's professional drivers up

to 25,000 jobs a month, Goldman Sachs says', *CNBC*, 22 May, viewed 31 August 2017, <<https://www.cnbc.com/2017/05/22/goldman-sachs-analysis-of-autonomous-vehicle-job-loss.html>>.

BCS - see British Computer Society

Bonnefon, J.F., Shariff, A. & Rahwan, I. 2016, 'The social dilemma of autonomous vehicles', *Science*, vol. 352, no. 6293, pp. 1573-1576.

British Computer Society 2015, *BCS code of conduct*, BCS, Swindon, England, viewed 31 August 2017, <<http://www.bcs.org/upload/pdf/conduct.pdf>>.

Evtimov, I., Eykholt, K., Fernandes, E., Kohno, T., Li, B., Rahmati, A. & Song, D. 2017,

'Robust physical-world attacks on machine learning models', *arXiv*.

Greene, J.D. 2016, 'Our driverless dilemma', *Science*, vol. 352, no. 6293, pp. 1514-1515.

Lin, P. 2017, 'Here's how Tesla solves a self-driving crash dilemma', *Forbes*, 5 April, viewed 25 August 2017, <<https://www.forbes.com/sites/patricklin/2017/04/05/heres-how-tesla-solves-a-self-driving-crash-dilemma/#63fbbf1b6813>>.

Mooney, G. 2016, 'Introduction to ethics', *UTS Online Subject 31272*, PowerPoint presentation, UTS, Sydney, viewed 31 August 2017, <https://online.uts.edu.au/bbcswebdav/pid-2223362-dt-content-rid-9816921_1/xid-9816921_1>.

MV, R., Jaswal, A.K. 2015, 'Autonomous vehicles: the future of automobiles', *Transportation Electrification Conference, IEEE*, Chennai, India, pp. 1-6.

Simonite, T. 2016, 'Your future self-driving car will be way more hackable', *MIT*

Technology Review, 26 January, viewed 04 September 2017,
<<https://www.technologyreview.com/s/546086/your-future-self-driving-car-will-be-way-more-hackable/>>.

Stewart, I., De, D. & Cole, A. 2015, *Technology and people: the great-job creating machine*, Deloitte, United Kingdom.

West, D.M. 2015, 'What happens if robots take the jobs? The impact of emerging technologies on employment and public policy', *Center for Technology Innovation*, viewed 03 September 2017, <<https://www.brookings.edu/wp-content/uploads/2016/06/robotwork.pdf>>.