

Autonomous Driving Technology and Privacy Issues

Peng Yu, 46635884

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Introduction

The concept of self-driving cars was first proposed at the New York World's Fair in 1939, but it could not be widely used due to the inability to provide effective data support for the self-driving system. In 1977, the Japanese proposed to transfer the technology to the computer's camera system to process road images. This is the first practice to link data with an automatic driving system. In 1987, the Germans proposed to use VaMoR as a sensor to provide more accurate data.¹ In recent years, semi-automatic driving has been widely used. With the advent of the big data era, huge data clusters make automatic driving become possible.²

A question that follows is how to balance the conflict between data privacy and technological development? Because the data for autonomous driving technology comes from the driver. When people drive a car, the autonomous driving system collects a large amount of data. Data can be mainly divided into three categories, driver and passenger data, location data, and sensor data. When autonomous driving is put on the market, the challenge the company faces is how to use data while not infringing on users' data privacy. This article will discuss autonomous driving from three domains in ethics, law and technology.³

¹ "Pittsburgh's History with Self-Driving Cars." *Automotive News* 91, no. 6769 (2017).

² Stanchev, Peter, and John Geske. "Autonomous Cars. History. State of Art. Research Problems." In *Distributed Computer and Communication Networks*, 1–10. Cham: Springer International Publishing, 2016.
https://doi.org/10.1007/978-3-319-30843-2_1.

³ Hacker, Philipp. "Personal Data, Exploitative Contracts, and Algorithmic Fairness: Autonomous Vehicles Meet. the Internet of Things." *International Data Privacy Law* 7, no. 4 (2017): 266–86.
<https://doi.org/10.1093/idpl/ix014>.

Ethics

An autonomous car is a vehicle capable of sensing its environment and driving autonomously without human involvement. The Society of Automotive Engineers (SAE) currently defines 6 levels of driving automation ranging from no automation, driver assistance, partial automation, conditional automation, high automation to full automation.⁴ A fully autonomous vehicle is self-aware and capable of making its own choices by relying on sensors, actuators, complex algorithms, machine learning systems and powerful processors to execute software. The self-driving technology collects data about the environment outside the vehicle through the sensors, radar, thermal imaging devices, cameras and light detection placed around the car. The autonomous driving system collects massive amounts of information every second, with the purpose of making the system "smarter" through the collection of data.⁵ A data set of automatic driving containing travel data such as current location, potential destination, time, date, and speed with additional information of the passengers, can provide various benefits. This data may help the users in traffic planning such as quickly guiding them to home, workplace and favourite restaurants. The ultimate goal is to provide customers with better services. Meanwhile, personal information such as the user's home location, on-road driving behaviours and speed may be unintentionally collected. These are sensitive data and valuable to governments, insurance companies and private investigators, highlighting the privacy implication of data collection and use. Third-party collection and use of data may expose the users and the passengers to privacy concerns. This is because the data collected by the automatic driving program reveals where they go and what they are doing. However,

⁴ Ding Zhao, Henry Lam, Huei Peng, Shan Bao, David J LeBlanc, Kazutoshi Nobukawa, and Christopher S Pan. "Accelerated Evaluation of Automated Vehicles Safety in Lane-Change Scenarios Based on Importance Sampling Techniques." *IEEE Transactions on Intelligent Transportation Systems* 18, no. 3 (2017): 595–607. <https://doi.org/10.1109/TITS.2016.2582208>.

⁵ Collingwood, Lisa. "Privacy Implications and Liability Issues of Autonomous Vehicles." *Information & Communications Technology Law* 26, no. 1 (2017): 32–45. <https://doi.org/10.1080/13600834.2017.1269871>.

the users may not know that their personal information about the autonomous vehicle has been collected and stored. The collection and use of unknown data is an ethical dilemma.⁶

Automatic vehicles have the potential to prevent traffic accidents as a result of human errors as the system takes control of the vehicle. However, some car crashes may be unavoidable because it involves ethical decisions in cases that it is difficult for automatic vehicles to make.⁷ For example, the automatic system may avoid hurting several passengers by adjusting direction to sacrificing a pedestrian walking on the road or harm its own passenger to save more passers-by. In the domain of ethics, the algorithms of the automatic driving systems need to address complicated problems. It needs to consider the potential risks, uncertainties, blame assignment and expected outcomes that may take place in a traffic accident. For instance, is it a better solution for the automatic driving vehicle to avoid a speeding motorbike by swerving into the opposite lane? It is an ethical dilemma to anticipate that who deserves the greater probability of survival. Who needs to take the responsibility for this accident, the wrecker or the algorithm of the automatic driving system? Although these scenarios are unlikely to occur with the advanced autonomous driving technology. Automatic driving programming needs to take distributing harm into consideration and include decision-making rules in algorithms about what to do in such potential events.⁸

Distributing harm is the ethical dilemma that needs to be considered, aiming to minimise harm in a traffic accident. Therefore, the manufacturers will need to embed ethical principles into the algorithms that can guide automatic vehicles to make the best ethical decision in situations of unavoidable harm. With the development of technology, millions of cars will be endowed with autonomy. It seems difficult to

⁶ Sixian Li, Junyou Zhang, Shufeng Wang, Pengcheng Li, and Yaping Liao. "Ethical and Legal Dilemma of Autonomous Vehicles: Study on Driving Decision-Making Model Under the Emergency Situations of Red Light-Running Behaviors." *Electronics (Basel)* 7, no. 10 (2018): 264. <https://doi.org/10.3390/electronics7100264>.

⁷ Ibid, i.

⁸ Bonnefon, Jean-François, Azim Shariff, and Iyad Rahwan. "The Social Dilemma of Autonomous Vehicles," 2015. <https://doi.org/10.1126/science.aaf2654>.

design algorithms that can reconcile ethical factors with the maximisation of personal interests. Thus, it is urgent for the manufactory to consider how to avoid the ethical dilemma in terms of automatic driving technology.⁹

To sum up, this part has discussed the ethical dilemma including privacy concerns and unavoidable harm associated with autonomous driving technology. It is incumbent for the developers to address ethical issues that may occur while using automatic driving in our daily life. The automatic driving programming needs to develop well-justified frameworks, accepted principles, and guidelines for algorithms to maintain public safety, aligning with the ethics of the general public.¹⁰ coming from a problem, that is, autonomous driving technology cannot quantify responsibilities morally, and ethics cannot provide a solution to this dilemma. This is what I am going to talk about next, legal tools and technical tools.

Legal

Based on the two ethical dilemmas mentioned above, I will give a legal solution and possible solutions from a legal perspective. Law, as a tool that can determine right and wrong, must be implemented under the premise of ensuring fairness and justice. This is also the reason why problems that cannot be solved on the moral level can often be answered in the law.

Autonomous driving needs to collect massive amounts of data to train AI, and it will inevitably infringe on the privacy of users.¹¹ I found some relevant regulations from the description of privacy principles in Australian law. Firstly, Australia requires

⁹ Johnsen, Annika, Niklas Strand, Jan Andersson, Christopher Patten, Clemens Kraetsch, and Johanna Takman. *Literature Review on the Acceptance and Road Safety, Ethical, Legal, Social and Economic Implications of Automated Vehicles*, 2017.

¹⁰ Fleetwood, Janet. "Public Health, Ethics, and Autonomous Vehicles." *American Journal of Public Health* (1971) 107, no. 4 (2017): 532–37. <https://doi.org/10.2105/AJPH.2016.303628>.

¹¹ Ibid, i.

Australian Privacy Principles (APP) entities to manage personal information in an open and transparent manner.¹² In other words, after autopilot operators collect user information, all data usage must be open and transparent. This regulation ensures that even if customer sensitive data is collected, there will be no data abuse. At the same time, the supplementary regulations also mention that entities must comply with the Australian Privacy Principles or inquiries and complaints of such codes. That means customers can complain about the abuse of their sensitive data to protect their data security. Secondly, the legal regulations also mention that APP entities must have clear privacy policies, and all users have the right to understand their privacy policies.¹³ Prior to using autonomous driving technology, the users are informed to read the information that how the data will be collected, stored and used in the future. The autonomous driving technology can only be permitted to use after signing the agreement of the company's privacy policy. Finally, the legal regulations also define the rules in regards to handling sensitive information. If the APP entity is an organization, the entity may not collect personal information unless the information is reasonably necessary for one or more functions or activities of the entity.¹⁴ It is clearly stated that entities shall not collect sensitive information from users for any reason other than training AI. This ensures that the user's data will not be misused or maliciously disclosed.

To address the ethical dilemma in unavoidable harm related to automatic driving, it is significant to divide the proportion of respondents in autonomous driving accidents at the legal level. Currently, South Australia has enacted laws that driverless vehicles are allowed to conduct realistic road experiments.¹⁵ It can be seen that the government of South Australia is very cautious about autonomous driving technology. All autonomous vehicles need to be tested on closed roads in accordance with

¹² Australian Government, "Australian Privacy Principles", OAIC, *Office of the Australian Information Commissioner*, 2014, <https://www.oaic.gov.au/privacy/australian-privacy-principles>, ii.

¹³ Ibid, ii.

¹⁴ Ibid, ii.

¹⁵ Society of South Australia, issuing body Law. Bulletin. Adelaide: Law Society of South Australia, 1991.

experimental guidelines. They need to request further instructions from the exemption bill, law and standard in order to evaluate the road value based on the test results possibility. For vehicles to be evaluated as qualified to drive autonomously on the road, insurance needs to be purchased, stipulated by the law. Drivers using unmanned driving need to pay valuable insurance for the vehicle and themselves. At the same time, there are strict restrictions on the exemption time for vehicles. In addition, for any accidents caused by the driver's use of autonomous driving during the exemption period, the driver shall bear the responsibility and impose a fine on it. If the circumstances are serious, the driver will also be prosecuted. In view of the fact that the current automatic driving is more assisted driving, the driver has the ability to manually stop the accident. The driver has to assume legal responsibility if the accident has taken place and caused harm to public health. From this, we can find that Australia takes a conservative attitude towards the popularization of autonomous driving technology, and the car owner is mainly responsible for the partially exempted experimental autonomous driving technology. However, I believe that with the maturity of autonomous driving technology, the law will also make adaptive changes. It is understandable that the current autonomous driving technology is not recognized and trusted by the law due to its uncertainty.

Next, I will discuss the two issues at the technical level. The main purpose is to analyse how to deal with ethical dilemmas and to discuss legal restrictions from the technical level, thereby exploring more possibilities for the development of autonomous driving technology.

Technical

The current immaturity of autonomous driving technology has led to severe ethical and legal restrictions. I think there are a few reasons that accounted for the immature autopilot technology. First of all, the autopilot technology is not advanced enough

because it mainly uses a pattern recognition method to complete a task, which is not enough to solve complex commands. The second issue is that the sensors of autonomous driving technology are often meaningless to collect data. the data will be collected continuously since the car owner activates the system. However, the collected data is often invalid because the automatic driving program is not competent to correlate the data together and produce judgements while driving. The third is the interaction of current driverless technology with other cars while driving, which is unsafe. There is a risk of data leakage and attack.¹⁶ Below I will give an example and demonstrate each of these three points.

Regarding the first point, autonomous driving technology is not smart enough. I think it is mainly reflected in three points. First, the autonomous driving technology will only learn rules mechanized, rather than adapt to changes. For example, weather forecast data collected by autonomous driving shows that it will rain today, and the road needs to be slowed down when the road is wet and slippery. But in fact, it didn't rain today, and the slow driving of autopilot is meaningless at this time. A smarter AI should combine the collected information with the actual situation sensed by the current sensors, and jointly give the results of the analysis. If it is different, everything should be based on the real-time data collected by the display sensor. This can also solve the problem of pedestrians running through the red light mentioned earlier. When the sensor returns the result that there is a pedestrian, even though it is currently a green light, an emergency brake should be used to avoid hitting the pedestrian. When such technology becomes possible, the full application of autonomous driving technology will be possible. The second autonomous driving technology does not know whether the data is sensitive data or collectable data. As mentioned earlier, the suppliers of autonomous driving technology have their own privacy policies, so the AI also needs to meet legal requirements according to privacy policies. The data should not be collected unintentionally. For some sensitive information but need to be

¹⁶ Maurer, Markus, Barbara Lenz, and J. Christian Gerdes. *Autonomous Driving : Technical, Legal and Social Aspects*. Cham: Springer Open, 2016. <https://doi.org/10.1007/978-3-662-48847-8>, iii.

learned, the data can be temporarily stored. The data can be completely deleted after a certain period of time.¹⁷ In this way, infringement of user privacy can be avoided. The last manifestation of not being smart enough is that the current automatic driving has a set of incomplete auxiliary driving rules. When automatic driving is popularized and all vehicles are automatic driving, there needs to be an AI that can completely replace humans to drive.

For the second point, the sensor collects various invalid information, wasting storage resources and consuming invalid learning. For example, we learned the word "apple" today by understanding the spelling and its pronunciation. There is no need to repeat this study every time when we confront the same apple but it is necessary to learn when we come across a different apple that is red or yellow where also applies to automatic driving. In a condition involving traffic lights, AI generally learns to stop at a red light and continue to drive at a green light. If the signal light is out of power, but AI thinks there are lights here, so AI sensors are only needed at this time. Fully open, to conducting a comprehensive study of the situation without signal lights, to facilitate the future to deal with similar situations. The advantage of this is that a large amount of invalid information can be filtered out, which greatly saves the space for storing data and the time for invalid learning. The greater advantage is that to a certain extent, it also reduces the false collection of some unconsciously sensitive information.¹⁸

The last is the interaction between different autonomous driving AIs. During the driving of the autonomous vehicle, the sensor will recognize nearby vehicles by collecting and identifying the other's vehicles. For example, a narrow road can only hold two small cars or one large car at the same time. The autonomous driving AI needs to recognize whether the opposite vehicle is a large vehicle or a small vehicle, so as to make a judgment to continue driving or stop to prevent crash accidents.¹⁹ If it

¹⁷ Ibid, iii.

¹⁸ Ibid, iii.

¹⁹ Bigelow, Pete. "Autonomous Robots Deliver in College Town; Yandex Showcases Self-Driving Road Tech on Sidewalks in Deli Pilot." *Automotive News* 95, no. 6986 (2021).

is an ambulance or a police car driving on the road, AI should recognise that it must stop or give way to the ambulance or patrol wagon. In the process of vehicle interaction, the sensor will inevitably collect some sensitive information about the opponent's vehicle. It's difficult to determine whether it is good or not. For example, if the opponent's vehicle is a small car whereas we are currently driving a large vehicle, the larger vehicle should have the priority to go first. If there is a pregnant woman in the opponent's car about to give birth. From an ethical consideration, giving way to a small vehicle may save two lives. As a result, an ethical dilemma appears again because AI is not smart enough to consider these factors. It is not about the law, but it fails to consider ethical factors. Another situation is that in the process of vehicle interaction, the sensor may shoot and transmit the high-definition photo of the other driver. According to Australian law, it is illegal to shoot by the sensor as long as the photo is not maliciously disclosed. But what if the collected information is used maliciously? The disclosure of such sensitive information will become uncontrollable.

From a technical perspective, at this time, autonomous driving companies often choose to use hypothesis verification methods to deal with. The so-called hypothesis verification is to make a hypothesis on the current situation, called H_0 . In the current situation, our hypothesis is that the sensor will not leak or abuse the collected sensitive information. After that, the company needs to apply statistical methods to sample from a large amount of data. Under normal circumstances, we think that a small probability event will not happen, but if information abuse or information leakage occurs during the sampling and detection process, it is considered that the sensitive information captured by the sensor will be leaked or abused.

To summarise, automatic driving is faced with numerous challenges in terms of ethical dilemma and legal consideration. The application of technology can solve these problems to the greatest extent. Considering the safety issues, technology tends

to give priority to solving legal requirements because this determines whether autonomous driving technology can be legally used. On the ethical level, requirements are often difficult to judge. For example, when there is traffic congestion on the way driving to work in the morning. We sometimes choose to let other cars pass courteously whereas the driver will beckon to show gratitude. This customary habit is often not understood by AI. AI's processing logic is single and only follow instructions to complete the task without considering the ethical factors. Therefore, involving ethical considerations in artificial intelligence is the next realistic challenge that needs to be overcome in the future.

Conclusion:

I think the application of autonomous driving technology is inevitable. This is a double-edged sword. The unprecedented development of technology will inevitably bring controversy and contradictions. After the second industrial revolution, the widespread popularity of automobiles has also brought about a lot of moral and legal disputes. As the stability and safety of automobiles are comprehensively improved, new ethical standards will gradually be formed in ethics. The law will build a complete set of laws and regulations to protect human rights. When we are facing the third industrial revolution, it is now the information revolution. The main feature is the explosive growth of data, making various fields full of unknown possibilities. In my opinion, autonomous driving technology is a typical embodiment of the information revolution, not only improving at the technical level but also continuing to explore the potential for a better future. Meanwhile, data may expose people to privacy concerns. Data security and human privacy are always the priority issues that need to be considered because any technology ultimately serves people.