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2018 Uber Autonomous Vehicle Crash

Abstract

In Tempe, Arizona in 2018, a series of unethical decisions and poor engineering choices culminated in the first recorded fatality involving a self-driving car. The vehicle belonged to Uber, and was meant to be out for testing with an operator at the wheel for emergencies. When a pedestrian wheeling a bicycle crossed the street in front of it, both the software and the operator failed to stop the car before it collided with and killed the pedestrian. In the aftermath of the incident, it was revealed that the human operator of the car was distracted by her phone and was unaware of the pedestrian. As a result, she was charged with negligent homicide. Despite evidence showing that the software guiding the vehicle was at least partly at fault, Uber was resolved of criminal liability for the incident. When examining the details of the crash through the lens of deontology, it is evident that the actions of both the driver and Uber failed to obey the Categorical Imperative and should be viewed as ethical failures. Following the incident, Uber suspended testing for a year while stricter regulations were put in place. Instead, Uber should have been more proactive rather than reactive, holding themselves to stricter safety standards than required by law. Moving forward, autonomous vehicle engineers and operators must learn from Uber's mistakes as self-driving cars begin to become integrated into society.

Background

In 2018, Uber began the process of testing their self-driving cars in real-world conditions. At the time, these vehicles were considered to have “Level 2” automation, meaning that the vehicle was capable of steering and accelerating in simple situations, but a human driver was needed to take control in more complex scenarios. Ultimately, engineers hope to achieve “Level 5” automation, which entails a completely driverless vehicle that can operate in all situations and environments (Synopsys, 2022). One site for this testing process was the city of Tempe, Arizona, chosen due to the state’s relatively lax regulations on autonomous vehicle testing compared to other options (Levin, 2020). One night in March 2018, an Uber operator named Rafaela Vasquez engaged in a night-time test. During the test, a pedestrian named Elaine Herzberg crossed the street in front of the autonomous vehicle with a bicycle. Neither Rafaela nor the software hit the brakes, and the resulting collision killed Elaine. This incident is believed to be the first pedestrian fatality caused by a self-driving car (Levin, 2020).

The legal investigations that followed the incident determined that Rafaela was distracted by her phone while at the wheel, and was unaware of the vehicle’s surroundings. As a result, she failed to play her role as the safety fallback for the vehicle’s software, directly leading to the collision. Due to these findings, Rafaela was charged with negligent homicide, while Uber remained free of any criminal consequences (Conger, 2020). Despite the lack of legal action directed towards the corporation, further investigations showed that Rafaela may have ended up taking the fall for a much larger issue, stemming from the prioritization of innovation over safety and poor engineering decisions.

Uber was first blamed for an “inadequate safety culture” that resulted in Rafaela getting distracted on the road (Conger, 2020). Investigations by the National Transportation Safety Board concluded that Uber should have developed some procedure to monitor autonomous

vehicle operators and keep them focused on their task (Porter, 2020). In addition, Uber was faulted for decisions made during the development of the vehicle's software. For instance, during the design of the vehicles, it was discovered that certain scenarios would trigger false alarms, resulting in the vehicle taking extreme measures to avoid a collision that would never have happened. To create a smoother experience, engineers decided to delay emergency actions until the vehicle verified the hazard was real. This delay, combined with the sensors failing to identify Elaine, prevented the vehicle from braking to soften the collision (Lee, 2019).

In the aftermath of these investigations, Uber pulled their self-driving cars from testing. Toward the end of the year, they reintroduced them with much stricter regulations on testers, most notably, the presence of a second safety operator (Porter, 2020). However, many experts have argued that Uber should never have been allowed to operate with such a lack of concern for public safety in the first place. Much of this blame has been placed on the state of Arizona, which explicitly promoted fewer regulations in order to attract more self-driving cars. Regardless of who is responsible for enforcing these regulations, the fact that a fatality had to occur for safety measures to be implemented shows that there exists multiple failures throughout the system as a whole.

The Engineering Failure

Taking into account how new of a technology self-driving cars are, issues with their software should be expected. This is especially true considering the extreme unpredictability of the typical driving environment. However, when these issues are capable of taking lives, engineers should be expected to do better than Uber during the time of the incident. Without even looking at potential preventative measures like automated monitoring of the driver, plenty of Uber's software enabled the incident.

One of these issues is that the self-driving car was not programmed to consider the possibility of jaywalkers (Gonzales, 2019). While driving, Uber's autonomous vehicles attempt to classify any detected objects into one of numerous known categories. Since Elaine did not cross the street at a crosswalk, the vehicle had trouble classifying her as a pedestrian. In the moments before the collision, Elaine and her bicycle were classified as "other object", "vehicle", "bicycle", "unknown", and "bicycle" again. At no point did the software detect her as a pedestrian (Lee, 2019). Under normal circumstances, this would not have been as much of an issue as it ended up being. Regardless of what the object in the vehicle's way is, it should still stop to avoid a collision. The problem originates from the software's reaction to this information. When the vehicle detects and classifies an object, it attempts to use past information to construct a prediction for how the object will move and if the object is a threat to the vehicle. However, every time the vehicle reclassified Elaine, it did not maintain any of her positional data from prior to the reclassification. As a result, it perceived Elaine as a motionless object that would not come into the vehicle's trajectory. By the time Elaine was actually in the vehicle's way, it was 1.2 seconds before the eventual collision, far too little time for the car to come to a stop (Lee, 2019).

Even if the car was unable to stop, it should have still hit the brakes to reduce the damage the collision caused. Instead, the car was undergoing a function called "action suppression." During development, engineers found that the car was reacting to false stimuli on the road, causing it to behave sporadically. To remedy this, engineers decided to implement "action suppression," which forced the vehicle to verify detected hazards before acting upon them. This fix essentially disabled the car's ability to swerve or hard brake for hazards that posed an immediate threat (Lee, 2019). Even worse, reports state that it is possible that this change was made to improve the passengers' experience in the face of an incoming test drive with Uber's

new CEO (Bort, 2018). Although swerving was later reintroduced into the software, hard braking was still locked behind the action suppression mechanism at the time of the incident, preventing the car from taking steps to possibly save Elaine's life (Levin, 2020).

Ethical Analysis

In order to determine exactly what went wrong and how it can be fixed in the future, an ethical analysis of the incident must be taken into account. In this case, Kant's formulation of deontology will be used. Deontology focuses on the actions that led to the situation in order to judge morality. In Kant's formulation, these actions must follow an absolute set of rules, meaning any action should theoretically be able to be classified as either right or wrong. According to Kant, an action has moral worth only if it is done with respect to the Categorical Imperative. This means that for an action to be moral, the actor must be able to rationally think that, given the same general situation, all others should act in the same way. In addition, people must abide by the humanity principle, which states that, since people have free will, it is wrong to suppress others' free will by using them as a means to an end. Since this disaster was caused by a culmination of many decisions, it is possible to highlight the ethical failures that resulted from Rafaela and Uber's actions through the lens of deontology.

Before starting with Rafaela, it should be noted that, since the case is still ongoing, some of the facts are not yet fully clear. For the purposes of this analysis, both sides of the story will be given the same weight. The main fact that is confirmed about the situation is that Rafaela was distracted by her device at the time of the collision, as well as for a significant portion of the drive. When the incident first occurred, prosecutors claimed that Rafaela was watching a TV show on her personal phone at the time of the crash, leading to Rafaela being found guilty for negligent homicide (Conger, 2020). In this case, Rafaela would have been acting by the maxim

"prioritize personal satisfaction over others' needs." This clearly fails to obey the Categorical Imperative because if all people were to act in this manner, it would be impossible to function cooperatively as a society, since everyone would be acting only on their interests. In addition, it fails to satisfy the humanity principle, since the free will of others is being used as a means to bring about the satisfaction of a single person. According to Rafaela's attorneys, the prosecution had actually lied in their original case. They claim that Rafaela was not distracted by a TV show on her personal phone, but was actually following Uber's company policy by tracking work-related communications on her work phone (Biscobing, 2022). If this were the case, then it should still be argued that Rafaela was still violating the Categorical Imperative. In more general terms, she was acting by the maxim "prioritize the will of authority over others' needs" by allowing her assignment from Uber to override basic safety measures. Again, this maxim cannot be universalized, as it would create an imbalance of power in the world, allowing those with authority to have nearly limitless power. This also appears to break the humanity principle, as Rafaela is making the decision to compromise the safety of pedestrians around her for the sake of completing her duties as an Uber tester. As seen from this analysis, regardless of what Rafaela was doing on her device, she was clearly acting without regard for the Categorical Imperative, and was therefore acting unethically according to deontology.

In this scenario, Uber made numerous decisions that must be analyzed. Of course, the primary topic for discussion is the decisions they made during their engineering process. Hundreds of decisions would have been made that led to the design of the vehicle during the time of the crash, however, the one at the center of controversy was the decision to use action suppression. As stated previously, action suppression was designed to verify the existence of hazards prior to responding to them in an effort to improve the passengers' experience (Lee,

2019). By approving this decision, Uber is acting under the maxim of "prioritize comfort over safety." If the world operated under this maxim, it would be impossible to trust nearly any engineering innovation, as safety would never be the main priority. Therefore, this decision absolutely violates the Categorical Imperative. Furthermore, it is possible that engineers made this decision in order to impress their new CEO on a test drive (Bort, 2018). In this case, they would be acting under the maxim "impressing authority is more important than safety." This maxim also violates the Categorical Imperative, since it would create a world where authorities would be the focus of attention, and everybody else would be subject to terribly unsafe living conditions. This action also violates the humanity principle because the engineers are taking free will away from users and pedestrians by removing safety measures in an effort to impress their CEO. In addition to mistakes made by their engineers, Uber's relationship with Rafaela should also be subject to analysis. This incident saw Uber walk away with no criminal case while Rafaela shouldered the entirety of the legal ramifications. Essentially, Uber allowed Rafaela to take the fall for a series of unethical decisions by everyone involved (Levin, 2020). This decision follows the maxim that "others can be blamed to save yourself." Obviously, this maxim cannot rationally be universalized, as it would create a world where nobody could be held responsible for their actions, so it fails the Categorical Imperative. It also fails the humanity principle, as Rafaela is being used by Uber to dodge legal consequences of their failures.

Recommendations

This collision was a result of a series of engineering and ethical failures that compromised the safety of users and those around them. From an engineering perspective, developers should never have been allowed to enable action suppression as a measure to improve the experience of the ride. While allowing the software to continue responding to false alarms

would be dangerous in its own way, simply suppressing emergency measures was doomed to fail. Programmers should know that, when it comes to critical systems, redundancy is key to making sure things go smoothly. Instead of stripping away safety mechanisms, engineers should have been working on ways to limit the number of false alarms that were triggered, either by improving the sensors on the vehicles or the software running hazard detection. While it would have taken longer to fix the issue in this way, it would have preserved the safety provided by these emergency systems.

From an ethical perspective, the burden of responsibility still needs to fall on Uber. Despite thousands of campaigns, drivers are distracted by their devices for around 10% of time on the road, leading to distracted driving being responsible for 27% of crashes annually (Covington, 2022). Regardless of if Rafaela was watching a TV show or attending to work-related matters, she was still driving distracted, and there will be many other users that do the same. While autonomous vehicles still need human assistance, Uber needs to be proactive in deterring human operators from becoming distracted. This could be done through an automated system that warns the driver if it detects that they have lost focus on the road. Uber also needs to work on building a culture that prioritizes safety over all else. This is absolutely necessary considering they are developing a product that could seriously endanger lives if tested before undergoing thorough safety checks. Mistakes like action suppression and misidentification should never have made it onto public roads, and should have been resolved in-house.

Conclusion

The biggest takeaway from this accident should be that self-driving cars are dangerous machines that require a high degree of vigilance to succeed. Every point of failure leading to this crash originated from a trade-off that sacrificed safety for something much less important. In

order to be technically sound and ethical, safety must have the highest priority in every decision-making process. The only way this can happen is if Uber and all related regulatory agencies are held responsible for these failures. In the direct aftermath of the incident, Uber made good strides in improving their company's safety culture and establishing stricter safety standards. This includes expanding testing to cities that were previously thought to have overly strict regulations (Porter, 2020). Regulatory agencies have also done a good job responding to incidents such as these. Following legal investigations, the NTSB did a good job holding Uber accountable for the poor engineering decisions they made, and offered recommendations that forced Uber to rethink their reckless approach (Gonzales, 2019). After numerous other crashes, the NHTSA also stepped in and forced manufacturers to provide the data generated from those crashes (Boudette, 2022). This was a good first step in making sure these companies are held accountable in the eyes of the public and will continue to promote safety within the industry.

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