Autonomous Vehicles: A Technology with Many Problems and Few Solutions

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Autonomous Vehicles: A Technology with Many Problems and Few Solutions

Numerous times now, the proposed release date for autonomous vehicles has been delayed. The companies developing this technology always promise to have a consumer-ready product by a specified date. By the time that date arrives, they postpone it for another few years or decades. The reason for these unexpected delays is the difficulty of creating this technology. Currently, semi-autonomous features are available on high-end cars such as Tesla. However, the goal for some companies such as Waymo, owned by a parent company of Google, is full autonomy. This goal would involve a driver never having to touch the wheel. Current attempts to reach full autonomy include a combination of precise 3D maps for an area, sensors to understand the surroundings, and artificial intelligence to make decisions. Several of the largest companies constantly compete to create the first fully-autonomous vehicle. No matter what approach they take, the result is never as good as a human driver. Not only is the technology expensive and challenging to create, but negative media coverage gives the public and legislators fear. Although numerous setbacks limit the development and release of self-driving cars, autonomous vehicles are still viable due to several temporary solutions that can be implemented.

Current Technology

Although technology is currently advancing at unprecedented rates, the needed technology for self-driving cars is far from ready. Computers can provide consistency and precision to the basic mechanics of driving. However, the data collection and decision-making needed are too complicated for the current state of artificial intelligence. For instance, pedestrians and drivers alike use body language in communication. A computer cannot read or give body language ("plan to make self-driving cars speak human," 2016). Without being able to

read or give body language, both the computer and the humans on the road will be confused. Another issue involves decision-making for new situations. Although self-driving cars have shown fairly accurate responses for common scenarios, the primary source of accidents is from uncommon situations not used in the training data (Hao, 2017). Since not every situation can be planned for, an approach in which a self-driving car can make decisions on its own, rather than base decisions on previously trained situations, would be necessary. However, for an advancement of this magnitude, the foundation for artificial intelligence would have to be recreated entirely. Although this would take a substantial amount of time, it is essential for these cars to integrate with humans safely.

Even merely collecting data on a car's surroundings creates new problems. A self-driving car can effortlessly determine the difference between two areas with different surrounding buildings and landscape. However, in areas that have few buildings and little differences in the surrounding environment, such as bridges, current artificial intelligence can quickly get confused (Muoio, 2016). In such situations, the autonomous vehicle may not even know where it is driving, which could make it miss critical objects such as stop signs. Although there are other sensors that get this information such as GPS or vision sensors in the case of the stop sign, more information is better. To make things worse, frequent disruptions such as puddles or snow can also create confusion (Luehrs, 2018). With such small disturbances creating uncertainty, it is clear that other new obstacles would engender confusion as well. In order to fix this issue, autonomous vehicles must recognize their surroundings and not become confused by slight differences on the road. In current testing, self-driving cars usually misperceive something a bit over every 10 thousand hours. However, it usually takes about a million hours to get into an

accident (Hao, 2019). Although confusion does not always result in catastrophe, certain situations, such as failing to recognize a stop sign and thus not stopping, will almost always cause an accident. (Broussard, 2018). The current approach is to make small workarounds and specific changes for every new problem that arises. However, no matter how long this approach is used, more problems will always arise. For computers to drive on the sporadic roads shared with humans, artificial intelligence must become much smarter.

With human lives at stake, cybersecurity is now more critical than ever. Similar to how current technologies are still combating new cyberattacks, autonomous vehicles will also have to quickly address flaws in cybersecurity (Garfinkel, 2017). Even if companies make cybersecurity their main priority, history has shown that hackers will still find vulnerabilities. If a hacker remotely took over a car, they could kill the passenger as well as any human drivers or pedestrians on the road. With the current state of security, this issue will be impossible to prevent and could easily hurt the adoption of this technology as a whole. In addition to remote hacking, GPS jammers, available for only around $50, can stop the use of GPS for any nearby piece of technology. This machine can make a vital component of the self-driving car no longer work properly (Broussard, 2018). This problem shows why it is essential to have backup components to a self-driving car: a critical component, such as the GPS, might stop functioning. These problems also show that proper security is essential. Although it is impossible to prevent all hackers, proper security will be especially crucial for this technology.

High Costs

Autonomous vehicles require a combination of expensive equipment with programming that has higher stakes than any other existing software. This combination makes it unsurprising

that only a few of the largest companies are competing in this race to release the first consumer-usable self-driving car. The Harvard Business Review estimates that each testing vehicle currently costs around $250,000 to $300,000 (Oliver et al., 2018). Only a few companies are willing to use ample resources on what is said to be a possibly unsolvable problem, which explains why development is so slow. Even for companies that have more than enough resources such as Google, the technology needed to solve this problem is unprecedented. For smaller companies, and even larger ones that envision making a profit off of this research, quality standards must be lowered. Also according to the Harvard Business Review, companies will only make a profit if there is an unusually high passenger use time compared to the time it takes to drive to passengers. As a result, companies may end up cutting down on safety costs (Nunes & Hernandez, 2019). The thought of these companies making compromises with safety for profits is concerning. Even with the most expensive technology of the time, the autonomous vehicle will have an unacceptable accident rate. If companies are cutting corners, this accident rate will be much worse. This role of money for an already challenging technological problem makes the situation much worse.

In addition to high development costs, the cost for autonomous vehicles to work across the entire nation is simply too high for any company. According to the MIT Technology Review, companies currently use hand-made 3D maps to navigate areas for testing (Woyke, 2018). As a result of the time necessary to create each one, building 3D maps for the entire United States is unrealistic. Although most urban areas will likely have 3D maps, rural areas might not (Patel, 2018). It is merely cost-ineffective to create maps for rural regions, having fewer people for a

larger area. These cost limitations overall limit the consumer market to only a few cities and thus can aid in forcing companies to economize essentials such as safety.

Public Fear

For autonomous vehicles to continue developing and to sell in the future, the public must come to accept this new technology. Although almost anyone would purchase a cheap and safe self-driving car, this is not an accurate description of the current state for these vehicles. Currently, autonomous accident rates are higher than human accident rates, and even then, the errors that computers make are unacceptable. Human error is from making bad decisions such as drinking and driving or merely human flaws such as tiring or losing concentration. When a computer makes an error, on the other hand, it is a much larger one that should not exist for a piece of technology that lacks all of these human flaws (Grucza, 2018). With this expectation, accidents involving self-driving cars receive ample scrutiny. This scrutiny is shown through a Tesla autopilot crash in 2016 receiving more media coverage than the 40,200 other fatal accidents of that year (Goldhill, 2017). For people to trust these new vehicles, the media must lower their expectation level while this new technology is in testing. An American Automobile Association poll found that seven in ten Americans are scared to use self-driving cars (Narayanan, 2019). This fear is likely a result of negative media coverage that portrays autonomous accidents as a significant source of all accidents. To add onto this difficulty in gaining public support, society has contradicting views in terms of how a self-driving car should act in an emergency. Research shows that people support a self-driving car that will sacrifice the passenger if it means that multiple pedestrian lives are saved. However, when deciding whether to buy a car, people will want their car to protect them as the passenger, even if it means that

multiple pedestrians die (Goldhill, 2017). When bringing up this situation, there is no best choice for self-driving car manufacturers in terms of public support because a person's choice would depend on whether they are the passenger or the pedestrian. In order for people to become accepting of self-driving cars, autonomous vehicles must become as perfect as possible to prevent negative media coverage and have this controversial decision be rarely applicable.

Governmental Factors

Similar to the setbacks from social concern, highly publicized accidents also impact the concern of lawmakers. However, unlike the public, which can protest through not purchasing autonomous vehicles, lawmakers can directly limit the testing and release of self-driving cars. This governmental power means that it is especially important to have the support of lawmakers and politicians (Herrmann et al., 2018, p. 172). With such a dominant role that lawmakers play in this process, as more publicized accidents occur, laws will likely get stricter. If the law limits these vehicles to the point that they cannot test on public roads at all, companies would be forced to test under unrealistic conditions in closed environments. Although an autonomous vehicle may perform excellently under these conditions, they could still perform poorly under real and unpredictable conditions. This leads to a problem upon release. The only way to speedily give the government and public a level of safety would involve releasing large numbers of their cars on public roads at once (Araya, 2019). If these cars were previously only tested under closed environments, this level of safety testing would result in a high amount of risk to the public. However, if the companies were to have been testing their cars on public roads over a gradual process and fixing potential issues, the process of release or even just a safety level would be

much less risky. How lawmakers respond to efforts in making self-driving cars could affect the overall risk that autonomous vehicles have on society upon large scale deployment.

In addition to legal limitations, the government limits autonomous vehicles through the poor quality of current roads. The Department of Transportation estimates that 65% of roads in the United States require work (Truett, 2016). No matter how advanced this technology becomes, artificial intelligence will always struggle to sense a car's surroundings without severe changes to current roads. Not only is road repair needed in terms of more clear lines, but roads lack advancements that could be made by the government to encourage autonomous innovations. If the government were to add technology around roads that enable communication between autonomous vehicles and surrounding infrastructure, self-driving cars could be much more reliable (Oliver et al., 2018). Companies are doing what they can to make self-driving cars a reality, but the government must contribute to this effort as well by updating roads and surrounding infrastructure.

Solutions

Although there are many problems with this new technology that are unsolvable at this time, temporary solutions can overall advance the technology. For instance, autonomous vehicles do not have to be released to the consumer first. If this technology came into the logistics and transportation business first, their investments would more quickly turn into profits, which can then be used to furnish the technology (Narayanan, 2019). By not starting with the consumer market, businesses could choose to limit where these vehicles drive and give specific and purposeful tasks. Even if self-driving cars do not get used by businesses first, the Harvard Business Review claims that creating separate roads strictly for autonomous vehicles could be a

great start (Oliver et al., 2018). This would allow the technology to continue advancing while also giving the technology a realistic application of these cars interacting with each other. Especially useful when all cars are autonomous, manufacturers could even allow cars to communicate, which would minimize the possibility of an accident. Even if self-driving cars were to be used by consumers on public roads, there are still other temporary solutions that can further this technology.

Even though this solution would only be temporary, a certain degree of autonomy could be released to the public that still improves safety. IBM is working on a system in which the computer and the person switch off between driving the car depending on who is currently better suited to be driving, taking a person's emotional state and an obstacle's complexity into account (Verger, 2017). This method would combine the strengths of a computer and a person to improve safety significantly. For the most part, the computer would do the driving to guarantee accuracy. However, when something is too complicated for current artificial intelligence, the real intelligence of a human can find a solution. Of course, this system would not stop all accidents. For instance, a car might transition between drivers when it should not or even fail to recognize that it needs to switch modes. In any situation where these cars are released to the public, accidents will be inevitable, so it is vital that the public is aware that accidents can still happen. By informing the public that they should expect accidents while also explaining the benefits of this technology in how it will be safer overall compared to the current system, people will be more accepting of this new technology (Herrmann et al., 2018, p. 402). After society accepts these partly-autonomous vehicles, companies would be able to have realistic testing at a lower risk. Every time a human must take over, the car manufacturers would be able to solve that

specific problem, with the goal of the computer doing more of the driving in the future. This analysis would not only allow the vehicles to become more accurate, but it would also help with social acceptance.

Several companies present solutions to the long and expensive process of creating 3D maps. One approach is from the company Mapper, which hires people to drive cars with sensors attached in order to create a 3D map for an area based on collected data. This one company is combining these individual maps to eventually be a giant map service such as Google Maps for self-driving cars (Woyke, 2018). Not only does this fix the problem where only large cities get 3D maps, but it also means that smaller car and technology companies with access to this map database can compete with larger companies that are currently part of this competition. Even if this technology still does not allow rural areas to get access to 3D maps, other technologies are attempting to use no maps at all. MapLite, created by MIT, uses sensors and GPS strictly in navigating its surroundings (Patel, 2018). Of course, the technology is not as perfect as cars that have the additional resource of a 3D map, but it opens an opportunity for self-driving cars in rural areas. These companies will expand the market of autonomous vehicles by not only allowing more companies to get involved but also allowing self-driving cars to be used in more areas.

Viability

Despite the many setbacks for this technology, the few robust solutions make this technology viable. Even with previous statistics reporting that people are scared of self-driving cars, a different survey found that 48% of people would consider giving up ownership of their car for an autonomous alternative (Accenture, 2019). Although this is still less than half of car

owners, it is a good sign that some with fear would still consider purchasing a self-driving car. The success of this technology is crucial because it has the potential to save many lives. By having even only a petite percentage of the worst drivers use autonomous vehicles, accident rates can significantly lower (Sensiba, 2019). Although it may seem difficult to remove drivers from the road, this situation was similar to how cars were introduced to the road. Originally, roads were primarily for pedestrians where people expected laws to force cars to avoid pedestrians. However, lawmakers decided to make it necessary for pedestrians to avoid cars instead (Goldhill, 2017). Similarly, people currently expect the old system of human-driven cars to have the priority when it is possible for the government to favor autonomous vehicles eventually. Current manufacturers of this technology are attempting to integrate these cars on roads with current human-driven ones. However, if it can be found that using this technology strictly is safer than roads consisting of only human drivers or a mix of human and autonomous drivers, this idea of no longer allowing humans to drive is a possibility. To demonstrate this safety, the government would first need to introduce a road that is meant for self-driving cars strictly. Although this technology still has numerous challenges to overcome, history and surveying shows a possibility for even roads consisting of only autonomous vehicles.

Conclusion

Autonomous vehicles have many problems including the necessary technology, money, social acceptance, and political leniency. However, solutions exist that may allow this technology to become viable in the future. Current technology limits the creation of autonomous vehicles because even the best data collection and artificial intelligence result in accidents. The technology cannot develop as fast as it can because high costs allow only the largest companies

to get involved. Even when companies develop what they consider ready for the market, society plays an influential role that can reject the new technology. Finally, the government plays an even more dominant role, having the power to limit the development and release of this technology. Although all of these problems make it difficult for this technology to be viable, by testing in closed environments and adding temporary features, this technology can advance significantly. Overall, it is possible for self-driving cars to succeed, even with its many setbacks.

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