Autonomous Vehicles: A Technology with Many Problems and Few Solutions

Daniel Allex

Monroe Township High School

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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 constantly promise to have a consumer-ready product by a specified date, and by the time that date arrives, they postpone that date 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 would involve a driver never having to touch the wheel. Current attempts to reach full autonomy include a combination of precise 3D maps to understand the surroundings, sensors to relate a current position to these surroundings, and artificial intelligence to make decisions. Several of the largest companies constantly compete to create the first fully-autonomous vehicle, and no matter what approach they take, the end result is never as good as a human driver. Not only is the technology expensive and difficult 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, but the data collection and decision-making needed is too complex 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 main source of accidents are from situations that are uncommon and not used to train the car (Hao, 2017). Due to the fact that it is impossible to plan for every single situation, an approach in which a self-driving car can make decisions on its own, rather than base decisions off of previous trained situations, would be needed. However, for an advancement of this magnitude, the foundation for artificial intelligence would have to be completely recreated. Although this would take a substantial amount of time, it is an essential for these cars to safely integrate with humans.

Even simply collecting data on a car's surroundings creates new problems. A self-driving car can easily 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 easily get confused (Muoio, 2016). This means that the autonomous vehicle may not even know where it is driving, which could make it miss key 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, common disruptions such as puddles or snow can also cause confusion (Luehrs, 2018). With these small changes to the roads causing uncertainty, it is not difficult to see that self-driving cars will easily be confused for almost any new scenario. It is essential for autonomous vehicles to be able to recognize its surroundings and not get confused by small differences. In current testing, self-driving cars usually misperceive something a bit

over every 10 thousand hours, compared the million hours it usually takes them to actually get into an accident (Hao, 2019). Although self-driving cars do not always get into an accident when confused, 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, but no matter how long this approach is used, more problems will always arise. In order for computers to drive on the sporadic roads shared with humans, artificial intelligence needs to be much smarter.

With the stakes of a human life, cyber security is more important than ever. Similar to how current technologies are still combating new methods from hackers, the MIT Technology Review claims that autonomous vehicles will also have to quickly address flaws in cyber security (Garfinkel, 2017). Even if companies make cyber security a main priority, time 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 can make a vital component of the self-driving car no longer work properly (Broussard, 2018). The combination of these potential problems shows why it is essential to have backup components to a self-driving car to allow it to function if one component is dysfunctional, such as GPS. In addition, it also shows that proper security is essential. Although it is impossible to prevent all hackers, proper security will be especially important 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 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). Due to the fact that there are few competitors willing to use ample amounts of resources on what has been said to be a possibly unsolvable problem 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 use time compared to the time it takes to just drive to the passenger, meaning that companies may end up cutting down on safety costs as a result (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 in order to navigate areas for testing (Woyke, 2018). As a result of the time it takes to create each one, it would be nearly impossible for one company to create 3D maps for the entire United States, not to mention other countries.

Although most urban areas will likely have 3D maps, rural areas will likely not (Patel, 2018). It is simply 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

In order 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 choose to use a cheap self-driving car that is guaranteed to be safe due to safety and convenience reasons, 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 simply 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 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). In order 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 is likely a result of negative media coverage that portrays autonomous accidents as a large source of all accidents. To make it even more difficult to get public support, the public 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, but when deciding whether to buy a car, they will want that car to protect the driver even if it means that multiple pedestrians die (Goldhill, 2017). When bringing up this situation, there is no best choice for self-driving car creators because people will change their mind depending 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 means that it is especially important to have the support of lawmakers and politicians (Herrmann et al., 2018, p. 172). With such a powerful 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. 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 are in need of work (Truett, 2016). No matter how advanced this technology becomes, artificial intelligence will always struggle to sense a car's surroundings without serious changes to current roads. Not only is road repair needed in terms of more clear lines, but they lack advancements that could be made by the government to encourage these new 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 through updating roads and surrounding infrastructure.

Solutions

Although there are many problems with this new technology that are unsolvable at this time, closed and 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 compared to selling to the consumer, which can then be used to furnish the technology (Narayanan, 2019). 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 without the

added confusion of humans 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 effective when all cars are autonomous, manufacturers could even create communication between cars, which would minimize the possibility for an accident. Even if self-driving cars were to be used by consumers on public roads, there are still temporary solutions that can further this technology.

Despite the fact that this solution would only be temporary, a certain degree of autonomy could be released to the public that actually 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, including a person's emotional state and how complex an obstacle is (Verger, 2017). This method would combine the strengths of a computer and a person to greatly improve safety. For the most part, the computer would do the driving to guarantee accuracy, but when something is too complex for current artificial intelligence, the real intelligence of a human can find a solution. Of course, this solution would still present accidents that could arise from situations such as not recognizing that the car should switch modes or even during the transition at which the computer and human switch between driving. In any situation where these cars are released to the public, accidents will be inevitable, so it is important to make the public aware before release. 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 towards 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 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 around cars with sensors attached which creates a 3D map for an area. 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, new technologies are also focused on using no maps at all. MapLite, created by MIT, uses strictly sensors and GPS 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 powerful solutions actually make this technology viable. Even with previous statistics reporting that people are scared of self-driving cars, a 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 important because it has the potential to save many lives. By having even only a few 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 originally 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 that the government could favor autonomous vehicles eventually. Current manufacturers of this technology are attempting to integrate these cars 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, a road meant for strictly self-driving cars would likely be needed. 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 in different aspects, including technological, economic, social, and political. However, solutions exist that may allow this technology to become viable in the future. Technological problems involve problems that exist due to the limited technology that exists today. Economic problems involve any issues that arise due to the high costs of developing and utilizing this technology. Social problems involve the setbacks that

are caused by public disapproval and negative media coverage of autonomous vehicles. Finally, political problems involve legal limitations and a lack of support from the government. Although all of these problems make it difficult for this technology to be viable, by testing in closed environments and temporarily adding an option for humans to take over based on current conditions, this technology can advance significantly. Overall, it is possible for self-driving cars to succeed, even with its many setbacks.

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