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Traffic Congestion Solution: Autonomous Vehicles

During the last couple of decades, populations of megacities have been growing at unprecedented rates. In fact, in 2008 50% of the human population were living in urban cities; it was 3% in 1800 ("Urbanization and The Megacity"). It is projected that by 2050, two-thirds of the human population will be calling urban cities home ("Urbanization and The Megacity"). As a chain reaction byproduct of population densities rising, unparalleled traffic congestion has been taking place in urban cities. This problem has left plenty of researchers and engineers wondering what can be the solution for traffic congestion. Some people have been advocating for urban sprawl as the solution to traffic congestion, and others have been calling for the idea of walkable cities, also known as "Car-free cities". However, the possible solution lies in technology. Technology has been the revolutionary answer to seemingly unsolvable problems, ones like traffic congestion. Autonomous Vehicles, or "self-driving cars", may just be the solution to never-ending traffic congestion. To prove so, the root cause of traffic congestion, the possibility of autonomous vehicles being the solution, and the possible limitations of autonomous vehicles will be discovered entirely.

To solve traffic congestion, the reason behind it must first be discussed. The basic problem is primarily human-centered; it lies behind human behavior (Frank). Human behavior can be the reason in the sense that some humans might make decisions that create congestion in originally congestion "free" situations (Frank). Probing deeper, it can be the reason for traffic congestion because of distracted or drowsy driving ("What Causes Traffic Congestion?"). A distracted driver

might make an unexpected last-minute break that results in a ripple effect (“What Causes Traffic Congestion?”). This one mistake can be the reason for slow traffic in that lane for hours (“What Causes Traffic Congestion?”). Then, a “phantom traffic jam” appears, because as drivers get past that point in the lane they will have to slow down, but there will appear to be no reason for the congestion. Even worse, the progressive slowing down of the incoming cars might be the reason that cars at the end of the ripple effect stop moving entirely. Then, the lag and reaction time between braking and accelerating in humans creates even more congestion. The idea of traffic congestion caused by humans is even much simpler than the process discussed above. It is the lack of adequate and sufficient driving training (“What Causes Traffic Congestion?”). Most countries require drivers to go through a process to test their understanding of the rules on the road, not necessarily how to merge onto a freeway or to use the accelerator instead of last-minute braking to deal with stop-and-go traffic (“What Causes Traffic Congestion?”). Ideally, if all drivers went through adequate safety training before driving, it is arguable that some traffic congestion could be prevented. However, to say that the solution for traffic congestion is to change human behavior completely is illogical. Thus, the possible hidden solution might be entirely removing humans and adding autonomous vehicles to the driving equation.

To prove how self-driving cars can prevent traffic congestion, a team of researchers used a video game-style interface to control simulated cars on made-up roadways (Hutson). The researchers repeated the experiment for several situations: cars driving around a figure eight with a central intersection, cars driving on several lanes and merging onto one, and cars traversing a Manhattan-like grid with traffic lights at each crossing (Hutson). In each situation, the researchers also varied the number of cars that were controlled by artificial intelligence that learned by the process of trial and error (Hutson). For example, in some simulations they had included only one

car controlled by AI out of 14 cars, in some, they had half of them; and in others, all of them were AI controlled (Hutson). The results of these experiments were shocking and they helped in illustrating how autonomous vehicles can be the answer to traffic congestion. In the figure eight situation, replacing one of the 14 human-driven cars with an autonomous vehicle doubled the average speed of the vehicles (Hutson). In the merge situation, replacing 10% of the human-driven cars with a self-driven one increased the average flow of traffic, sometimes increased the average flow by 50% (Hutson). Keeping a buffer distance between each other to decrease the probability of forcing themselves to break is the way that self-driving cars increased the flow of traffic (Hutson). Hence, it can be proven through experiments that autonomous vehicles can be utilized as a means of cutting down traffic congestion.

The technology behind how autonomous vehicles cut down traffic is the interesting part, and it demonstrates how advanced and smart artificial intelligence has become. There are a couple of adaptations that the computer controlling the car makes, some of them by itself and some with the surrounding environment (Sielicki). First, vehicle to vehicle communication, where autonomous vehicles are connected on a network to communicate with one another (Sielicki). Instead of humans communicating with each other using signs and honks, cars can talk to each other using this network. This kind of communication can allow cars to share road conditions like traffic flow, speed, and direction (Sielicki). Moreover, a self-driving car can tell another self-driving car that is going to merge onto its lane, which might help the process be more efficient and might eventually decrease the probability of an accident occurring (Sielicki). The U.S Department of Transportation believes that the vehicle-to-vehicle communication technology can reduce up to 80% of the severity of non-impaired car crashes (Sielicki). As a result, this will make drivers experience a more predictable traffic flow pattern, which in turn decreases the number of traffic

flow jams (Sielicki). The second technology that self-driving cars use is called platooning (Sielicki). It is a futuristic feature of autonomous vehicles that allows self-driving cars to move together close to each other safely, a practice that is usually done by bikers (Sielicki). Platooning can help with making traffic flow more efficient in a couple of ways; it reduces the amount of aerodynamic drag that a car is exposed to and decreases fuel consumption and emissions (Sielicki). Besides, it can make traffic flow more steadily and reduces congestion by fitting more cars on the road (Sielicki). The third technology is adaptive cruise control, which is a revamped form of traditional cruise control that is more technologically advanced and user-friendly (Sielicki). Traditional cruise control is a handy feature if the driver is lucky enough to find a road that has relatively little traffic. However, with adaptive cruise control, the dimension has changed completely, because autonomous vehicles can sense traffic themselves and adjust accordingly without any input from the driver (Sielicki). Adaptive cruise control uses sensors and laser to read the traffic flow of the surrounding vehicles and modifies the cruise control accordingly (Sielicki). If self-driving cars were implemented and adaptive cruise control was included, traffic would flow steadily at an even speed and the number of unexpected braking would decrease (Sielicki). The last technology that can be possibly embedded in autonomous cars is the intuitive automotive assistant (Sielicki). It is a feature that is related to the network system that the cars are connected to. Before starting a trip, the self-driving car knows where the most traffic is and which routes are more efficient; this way traffic can be less congested when cars take different routes (Sielicki). Upcoming technologies may even be able to predict future congestion and avoid routes where possible congestion is going to happen. Thus, it can be suggested that with vehicle-to-vehicle communication, platooning, adaptive cruise control, and intuitive automotive assistant autonomous vehicles can be a method of cutting off traffic congestion.

Despite the calculated benefits of autonomous vehicles and how they can be a solution to travel congestion, there has been heated debate about whether it is ethical or not to implement them in day-to-day life. It is quite unethical to give computers the power to make decisions regarding people's destiny (Lau). A case where a self-driving car decides on whether which human should live and which should die is the trolley problem. The trolley problem is where a self-driving driving car has five people to hit on its original path and one person to hit if it switches routes, so algorithmically the car goes to the other lane. In this case, it is arguably unethical to leave the decision of who lives and who dies to a computer, in which the answer is already pre-determined (Lau). Some people argue that random decisions are better than pre-determined ones (Lau). Even worse, who would be responsible for a car crash if it were to happen? The manufacturer, the algorithm maker, the software, or the car driver? Other people may also argue that self-driving cars are unethical because humans should not allow companies, governments, and policymakers to make decisions on their destiny (Lau). In this case, the developer of the autonomous vehicle designed the product according to their definition of ethics, their standards, and how they would react in a certain situation. Also, governments and policymakers set rules regarding how and how not to use autonomous vehicles, which makes them an additional influence on the users (Lau). Thus, it is arguable that the implementation of self-driving cars is unethical for plenty of people.

Adding to that, autonomous vehicles have other limitations that can be measured quantitively and that are not only hypothetical. As it stands right now, self-driving cars are extremely expensive because they are stacked with rare high-quality technological equipment making it an unaffordable product for the casual user (Prince). Until now, most companies have not released a price on self-driving cars, but most are expected to be sky-high prices (Prince). Furthermore, the infrastructure of autonomous vehicle licensing has not yet been placed (Prince).

Frankly, most policymakers do not know how self-driving cars are going to change the way transportation and mobility are, so they still do not have proper policies in place for them (Prince). Therefore, if self-driving cars were to be utilized without a proper infrastructure of policies regarding them, public safety would be at high risk (Prince). Moreover, Raffi Krikorian, the engineering director of Uber, has stated that self-driving cars struggle to go over bridges (Muoio). That is because self-driving cars were designed to compare what they are seeing to what is supposed to be there, and bridges usually do not have pedestrians or buildings so they cannot compare anything (Muoio). Besides, autonomous vehicles do not possess the ability to function in extreme weather conditions and on roads where lanes are not structured clearly (Muoio). This makes self-driving cars extremely limited in the sense that they only properly function in a few parts worldwide. Elon Musk, the CEO of Tesla, vented about the problem that driverless cars cannot change lanes and properly function when they cannot clearly distinguish lanes on the road (Muoio). This loops back to how limited the current global infrastructure might be for self-driving cars. Hence, it can be suggested that autonomous vehicles are highly impractical due to plenty of quantifiable reasons.

To conclude, traffic congestion is a problem that has been lying around for years with no clear-cut solution. Arguably, what causes traffic congestion is mainly human behavior. Thus, what happens if we completely remove humans and implement self-driving cars. Experiments have shown that this might be the perfect solution to traffic congestion and plenty of technologies support this claim. However, the full implementation of autonomous vehicles is admittedly a high-risk decision due to the ethical and experimental limitations of them. On the other hand, amidst the plenty of limitations of self-driving cars, there appear to be opportunities rooting out of them. The possible solution to most measurable limitations lies in designers perfecting the surrounding

environment for autonomous vehicles to function. All in all, are autonomous vehicles the most perfect imperfect solution to never-ending traffic congestion?

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