Semi-autonomous ambulances: threats to society or life-saving innovations?

Semi-Autonomous Ambulances: Threats to Society or Life-Saving Innovations?

To what extent can we apply artificial intelligence to the dispatching of driverless ambulances to respond to a life-threatening medical condition, under the assumption that there will be someone monitoring the vehicle’s progress?

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Introduction

For every minute that passes after a person goes into cardiac arrest, his or her chance of survival drops by ten percent. In instances like this, it is essential to find the quickest route to a victim and stabilize him or her before

it is too late. In our innovative and industrious society, designs for more efficient and effective methods of transportation are being perfected each and every day. With so many more resources available at our fingertips, we have begun to delve into the realms of impossibility – artificial intelligence. Artificial intelligence refers to the ability of technology to become " self-aware".

To be considered as " self-aware," a system must be able to make decisions beyond the capacity of its programming. Currently, artificial intelligence is being tested in special, non-commercialized cars for recreational use. However, the increasing ability of software being able to recognize and learn from its own mistakes begs the question as to whether artificial intelligence could – and should – be used for more critical purposes.

For a person with a medical emergency, seconds can mean the difference between life and death. These seconds are usually lost to preparation time and human error, leading to fatalities. However, if we were able to utilize this technology to the dispatching of driverless ambulances, would this effectively and safely eliminate the time lost? While at the present autonomous vehicles can be very risk-prone, further investment into this technology could be beneficial because it would largely do away with the human factors causing a slower arrival time to the scene.

How Self-Driving Vehicles Work

In order to address whether or not this technology can and should be incorporated into emergency vehicles, we must first consider how an autonomous vehicle works. In order to navigate the road safely, a person

must be able to interpret light signals, pass effectively, acknowledge other drivers and pedestrians, and make turns. For an autonomous vehicle, the same rules of the road apply.

Sign Reading

When a person learns to drive, he or she is taught the meanings of different signs and traffic lights they may encounter and what to do when approaching them. In the same sense, an autonomous vehicle has specific algorithms telling it what to do in specific scenarios. Since the vehicle cannot " see" as a human can, it uses cameras and laser sensors in order to detect these signs. For example, let us suppose that the cameras detect a stop sign. The car will slow down and come to a complete stop at the sign. Then, it has to make a decision. If the cameras and sensors do not detect a car coming from either direction, the car will continue along its predefined route; otherwise, it will remain stopped until no other threats are present.

In addition, artificial intelligence can detect when another vehicle has its hazard lights on. In order to determine whether it is safe to move around the stalled car, the vehicle must examine the road behind and beside it for oncoming cars. If the sensors detect another car, pedestrian, or object in the same path of motion, the car will wait; otherwise, the car will continue.

A difficulty arises with the ambiguity of a decision. When a person approaches a yellow light, he or she has two possible choices: try to make to through the light or stop. With an autonomous car, however, these decisions become more difficult. Since there is no means of weighing one action

against another in specific scenarios, the car risks making the wrong decision and crashing [1] .

In an emergency vehicle, there can be no room for error; therefore, the technology needs to be refined to the point where the cameras can effectively scan the sign quickly and efficiently.

Passing

When passing another car on the road, one must determine if there is enough distance between the cars in the lane next to them to determine whether a safe passage can be made. In the same sense, the cameras on an autonomous vehicle must determine whether it is safe to move over a lane based on a predefined distance. Generally, this is ~3-4 seconds between you and the car you want to pass in front of.

Additionally, autonomous vehicles are preprogrammed with " City Knowledge." This technology allows automobiles to recognize when and where certain deliveries will be made and thus move around halted delivery vehicles [2] .

As an emergency vehicle, an ambulance automatically receives the right-of-way. Using the " City Knowledge" technology, the system would find the fastest route to the nearest hospital; a critical feature when there is a limited amount of time.

Acknowledging Drivers/Pedestrians

In order to be permitted on the roadways, an autonomous vehicle must have an awareness of others. This means that it abides by the same rules as a

regular car and is able to safely integrate on roads. In order to be able to drive with other automobiles, a self-driving car must have a safe following distance. The car is programmed with a minimum two-second following distance [3] that it must follow at all times; that way, the risk of a careless fender-bender collision is reduced.

The presence of pedestrians is another critical factor to consider while driving. A pedestrian is always given the right of way, regardless of if their actions are breaking the law. To prevent a collision, a driver must look at the potential crosser's gestures and direction in order to decide whether he or she is going to wait or cross the street. As of now, artificial intelligence does not have the capacity to make these snap judgments. Instead, the cameras on the car focus on the knees of the person. If the knees are pointed away, it is safe to go ahead; if not, then the car will wait [4] .

To optimize the survival of the passenger, an automated ambulance must move as quickly as possible while still being safe. In essence, it may not have time to wait for careless pedestrians. Emergency vehicles are the only vehicles with the right-of-way over pedestrians; however, there is no excuse for hitting a person on the road. Therefore, it is essential that this technology is improved to analyze body language the way a human would before it can be considered to be released to the public.

Turns

In order to make a turn, one must first ensure that there are no potential safety threats. A self-driving car uses its laser technology to scan the road for any oncoming cars. If there are no cars that would interfere, the vehicle

will complete the turn; otherwise, it will wait until the road is clear [5] . If a car is stopped at a red light and is making a right turn, it must search for a “ No turn on red” sign. If there is no such sign and there are no other vehicles coming, it is safe to make the turn. If conditions are unsafe or a sign prohibiting the act of turning on red is present, then the car will wait.

Machine Learning

It is impossible to foresee every possible scenario. Therefore, in order to avoid a collision, the vehicle requires a method to relate new input to prior instances. This method is called machine learning, or Deep Learning. [6] For this to work, programmers must first provide input in the form of basic commands. From this input stream, the AI is able to detect patterns based on repetitive action.

By analyzing these patterns, the system is able to change up existing software as well. An instance of this can be found within the company DeepMind. In this company, video game programmers have constructed a game of Breakout that was able to improve its playing ability over time. This was due to a built-in neural network: a system of algorithms that keeps track of the result of the ball hitting the various bricks [7] . By continually playing the game, the network was able to recognize that hitting a brick would make it disappear, and that hitting all the bricks would allow the game to end. In the same sense, this neural network can be used in semi-autonomous cars. This would especially come in handy in special scenarios. For example, it is normally acceptable to turn right on red. The sensors would gather input

from other cars turning right on red and would use that data to determine that the action is permissible.

This technology has major faults, however. If a sign were to read “ No Turn On Red” and the light was red, the network may be confused on what to prioritize. The system had been hard coded to obey the signs; yet, it has taken on the idea that it is okay to turn right on red. Since the AI has fallen into this routine, it would likely turn at the red light regardless of whether or not a sign is detected. This can result in a collision with another car or pedestrian, inflicting heavy penalizations on the company running the car.

How close are we to developing the necessary technology?

In order to be considered fully autonomous, a vehicle must be able to perform all functions safely without the need for human intervention. The level of autonomy ranges from zero to five, with zero through three requiring a high level of human involvement and five requiring no intervention aside from someone entering the desired destination [8] . Ideally, a self-driving ambulance would be at a level five standard as to decrease the time necessary to arrive at the scene. However, in their current state, self-driving vehicles are not up to par with these regulations. In order to maximize the safety of the patient inside, a person must be present to check on the vehicle’s progress and to step in when necessary.

There have been many instances of these vehicles being tested on open roadways. On one account, Google has had “ more than 200 miles of ‘ computer-led’ driving. [9] ” Aptiv has conducted over five-thousand miles of testing using self-driving taxis [10] . Apple is currently testing sixty-six self-

driving minivans [11] . From these three examples, a trend emerges: different vehicles are being tested for the same AI capabilities. This tactic helps bring comfort to those wary about getting in a vehicle without an official driver. By promoting the successful attempts and the multi-purposefulness, these companies are assuring consumers that the technology can be safe and helpful.

While signs of progress point to a possibility of using this technology in more extreme circumstances in the future, companies need to continue testing this software and eliminating any potential malicious bugs that could pose a threat to safety. Otherwise, a small virus can quickly escalate into a life-threatening cataclysm.

Human Factors Slowing Down Reaction Time

One of the most difficult issues to counteract is the inability for EMS services to reach remote rural areas quickly. Since there is no hospital nearby, a rescue can take several minutes to be initiated – by this time, there is only a slim possibility that the patient survives [12] . When preparing to reach a certain destination, it is the driver's responsibility to plug in the location to the GPS and determine the quickest route to reach the patient. If the vehicle is autonomous, however, it would make these decisions at a much quicker rate using the " City Knowledge" technology [13] . This would allow artificial intelligence to analyze which roads are normally subjected to heavy traffic and therefore avoid unnecessary delays.

A call of emergency can come at any time of the day or night. Medics can be rushed off with little energy but the adrenaline of getting to the scene in

time. According to the article “ sleep,” sleep is defined as “ a normal, reversible, recurrent state of reduced responsiveness to external stimulation [14] .” When someone is sleep-deprived, his or her response time mimics that of a person in a state of slumber. Since a call can come in at any time, there is a chance that the driver will have had very little sleep. When on the roadways, this can be just as dangerous as driving intoxicated: a person can no longer make judgments quick enough to be able to react well in a life-or-death situation. Since this technology can never get “ tired,” its implementation could help prevent further damage to the patient and casualties of those helping out.

Potential Malfunctions/Difficulties

While a self-driving ambulance would open up opportunities to help in more areas, it is subject to many difficulties. For one, it may encounter vehicles that are too expansive to see around. In this instance, the car would stop and wait for the car to move. If that vehicle happens to be stalled for a long time, however, people behind the car will become impatient. In an ambulance especially, this can be extremely dangerous. Aside from road rage, this situation is also hurting the patient himself/herself. By stalling behind a stopped vehicle, the ambulance would be wasting precious seconds that could have been used to save someone’s life.

Another setback for artificial intelligence, in general, is the fact that it is incapable of making flash judgments like a human is. When looking for pedestrians, an autonomous car examines the knees. At times, however, the knees are not enough. In 2018, a pedestrian was hit with a semi-autonomous vehicle. Although she followed the crosswalk and assumed the car would

stop for her, she was killed [15] . A person is normally able to look into the body language of a pedestrian and, by referring to teachings and prior experience, determine whether or not that person is going to cross. Artificial intelligence, however, does not have prior experience to rely on; one cannot teach a car what not to do by running into human beings. Therefore, the technology relies fully on how it has been programmed. Since the decisions the car makes are irreversible without human intervention, a sudden decision of a person or animal to cross the street almost guarantees destruction. For a vehicle that is meant to save victims, this cannot be acceptable.

In addition, artificial intelligence is not yet able to recognize and correct its own mistakes. A few weeks ago, I was merging onto the road. I was expecting the car to let me into the lane, but he remained in the same position when I started to merge over. Automatically, I realized a mistake I made – I did not look behind me far enough. I then proceeded to wait until the car had moved ahead, made sure that no other cars were posing a threat, and entered the highway. A semi-autonomous car, on the other hand, is unable to make this distinction. Since the car is not preprogrammed with every potentially catastrophic scenario it will ever face, it does not follow a specific plan of evasion. If something were to happen beyond the scope of its code, the car will likely continue along its planned route, causing a collision.

The potential for system malfunction or manipulation is also an overbearing concern for many. As the capabilities of the software increase, so does the number of loopholes to interfere with the system. Unfortunately, by

incorporating autonomous capabilities to a vehicle, the creator increases the risk for a malicious attack. A system failure can be just as deadly. If a car were to suddenly malfunction in the middle of a highway, the cars behind and around it may not have enough reaction time to prevent a disaster. If there is no human to intervene and pull off into a safe area, this situation is futile; there is no avoiding a collision.

Cost Factor

As the demand for self-driving vehicles increases, the price will continue to skyrocket. Currently, the technology is valued at hundreds of thousands of dollars [16] . With the amount of equipment necessary for an ambulance to operate, it is unlikely that most companies will be able to afford such a luxury.

A possibility to combat this in a regular car is installing the software into an existing vehicle. An instance of this occurred when a college student was able to turn his Honda Civic into a semi-autonomous vehicle using seven-hundred dollars worth of equipment and software he found online [17] . While this proves to be a more cost-effective solution, one must consider the consequence of retrieving software: the source may or may not be reliable. Not only could the software online be filled with encrypted malware, but there is a possibility that it may not even be functional. In addition, there are very few people with the knowledge of how to program this type of software. In order to ensure the safety of those inside the vehicle, multiple computer programmers would have to be hired to search for errors and install the software into the vehicle. This is simply not feasible. An ambulance needs to

be prepared quickly and efficiently. By downloading semi-autonomous capabilities, one is rendering that ambulance unusable for the duration it takes to program the artificial intelligence. In a situation where all the ambulances are needed, this could prevent EMT services from reaching a patient in time.

In the long term, this solution may be more expensive than purchasing a self-driving ambulance. Since EMT professionals are most likely not trained in programming or networking, they would have to pay for the salary of the workers and technicians, as well as the materials needed to upkeep the maintenance of the vehicle. With a shortage of vehicles to deploy and a potential for malware in the code, this is not an acceptable opportunity.

To subsidize this cost, ambulance companies will have to increase their patients' bills. While this is a feasible solution for the company, the patients are faced with an overwhelming cost. Even without this new technology, the cost of an ambulance ride is exorbitant. In one instance, a man named Roman Barshay was billed $3, 660 for a four-mile ambulance ride. This fee was to cover the staff on board and the ride over. If self-driving capabilities were to be added to an emergency vehicle, the trip would become unavailable to the everyday person.

Approval Amongst the Populace

Currently, the majority of people are wary of the effects that could be imposed. According to a study referenced by Lauren Sigfusson, 56% of the people surveyed stated that they were not comfortable riding in a self-driving vehicle due to safety concerns [18] . In order to create an autonomous

emergency vehicle, or even to release semi-autonomous cars to the general public, more testing is needed. As more and more successful endeavors are recorded, people will become more willing to accept this new technology as a way of life.

Not all people are deterred by the potential consequences, however. Steve Mahan, a man with 95% vision loss, consented to be a test subject for Google. He became the first person to ride in a self-driving car, along with a few Google executives that supervised him. Surprisingly, his actions did not hint a bit of worry; rather, he appeared quite enthusiastic.

In addition, over forty-five companies have made investments in the success of self-driving technology. In some instances, significant progress has already been made. Amazon, for example, patented autonomous lane-switching technology in 2016 [19] . This technology allows for the vehicle to examine the conditions in the lane next to it and, if it is far enough ahead of the car behind it, far enough behind the car in front of it, and not in the path of any oncoming cars, it will switch over; otherwise, the car will wait until these conditions are true. The biggest advancement relating to a non-recreational vehicle would be the success of a semi-autonomous bus from Yutong. Yutong is a bus company based in China. Since starting its research into autonomous vehicles in 2012, the company has been successful in “ navigat[ing] a bus in an inter-city road [20] .” Not only does this result bring the confidence that vehicles of this size are able to be controlled effectively, but it also exemplifies the notion that AI can be used in a public service vehicle.

Need for Human Intervention

Some companies, in order to emphasize the importance of human involvement, code for lights on the wheel to flash when the driver has been looking away for too long [21] . Currently, there is a necessity for humans to be behind the wheel. Autonomous vehicles are still in the beginning phases of testing, so there are still lots of kinks to be worked out before humans can safely leave the picture. Additionally, there is a high potential for the software to be manipulated. If a person is at the wheel, however, they can regain control of the car and avoid a catastrophic collision. Ideally, a person should never have to intervene; however, until the security is bolstered and the issues in the programs are addressed, humans need to be prepared behind the wheel.

Other Ways AI Can Be Used

While a semi-autonomous vehicle would aid in transportation to the hospital, it cannot be responsible for everything. Therefore, another useful consideration for this technology would be in making phone calls. When an emergency arises, EMS needs to alert the hospital of the type of situation and the doctors needed for a procedure. This step is crucial to complete as quickly as possible. When the goal is to keep the patient stabilized, a second away can make the difference between life or death. An AI server can be pre-programmed with an array of different symptoms linking to different diseases. By pinpointing this disease using information from the paramedics, the server would be able to search for the diagnosis and contact all medical personnel necessary – all within a span of mere seconds. For example, a

victim of a car accident will be approached by a team of pulmonologists, neurologists, cardiologists, and specialized surgeons.

Conclusion

Although the technology behind it is still underdeveloped and costly, a self-driving ambulance could benefit those on the trembling bridge between life and death. As artificial intelligence continues to make new advances in the medical field, new possibilities are opened to its applications. Robots have been used around the globe to assist humans in their work. They never tire, are more precise than humans, and can perform calculations at a much faster rate. In some instances, they have been used to perform surgeries. The doctor’s hand movements are programmed into the robotic arm. With a magnified view of the body and a minuscule insertion point, the robot is able to perform surgeries with a higher degree of accuracy than a medical professional [22] . In the same manner, robots could be used to analyze patients, diagnosed possible conditions based on an array of predefined symptoms, and stabilize the patient. This would especially be useful for conditions that are unsafe for humans to enter. Rather than send out medical personnel and risk losing more lives, the driver can deploy a robot medic to search for and retrieve the patient.

However, as the revelation of this technology is rather recent, the feasibility of this step forward is too low. The strongest, most-effective advancements and the ones built up through baby steps. If too much is added too quickly, the risk of a systematic gremlin will soar. In this case, there is a possibility of confusion between the two different AI servers: a combination of tasks that could lead the system to shut down. Additionally, since many diseases and

injuries have similar symptoms, there is the potential of misdiagnosing the patient. If a robot gives the patient the wrong type of treatment, it risks making the condition worse. As for now, it is better to make progress gradually with a system that can be controlled manually if necessary but will ultimately decrease the time it takes to deliver a patient.

An argument can be made that a semi-autonomous ambulance would take away the jobs of medical personnel. On the contrary, it still takes the same number of employees in either case to maximize safety. The driver will remain to ensure a smooth transition. While he or she is not required to drive the vehicle, he or she must be there to plug in the location and be ready to take over if necessary. In a situation of life and death, each second matters. By perfecting upon and using artificial intelligence to speed up the process of reaching and stabilizing the patient, we will be able to reach situations that were previously unreachable and provide better medical care for all.

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