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EXPLORING THE SAFETY QUOTIENT IN SELF DRIVING TECHNOLOGY BY EMPLOYING SELECTED PARAMETERS OF EFFICIENCY, COST & ETHICS TO ANALYSE A PROTOTYPE OF A FEASIBLE VERSION OF AUTONOMOUS VEHICLES

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The need for having sustainable transportation is growing day by day. Humans are putting their best effort to carve out the best transportation model and get rid of the existing models which are becoming a threat to the earth. Travelling from one point to the other surely fulfills the demand of an individual but it poses a threat to the society. The economic conditions of the individuals are steadily increasing and so are their demands. The demand of owning a car and traveling individually is everyone's dream. Thus Single Occupancy Vehicle (SOV) driving is increasing at an unprecedented rate. There are many cons associated with SOV: pollution of all forms (air, noise etc.); huge traffic congestion; travel delays etc. Vehicle accidents are the greatest concerns of the society and are majorly caused due to human errors. Over 85% of the accidents are due to human errors. Above all, cars consume too much of valuable resources in the form of petrol, diesel etc. which take years to get renewed. The rise in the number of cars causes increased use of resources in different forms of money, natural resources, human resources etc. For instance, transforming petrol and diesel powered vehicles to electric drive helps reduce transportation-related carbon emissions, but does little to lessen congestion or automobile fatalities. Hence there is a much need of switching to different transportation models so as to increase the sustainability of the transportation for future generations.

Self Driving Cars could serve as one of the viable models of transportation and feed the requirement of a better future. Self-driving vehicles (autonomous vehicles) - are vehicles with the capacity of sensing its environment and navigating without human input. A couple of meanings could illustrate this kind of vehicles: "autonomous" (which is more popular) and "automated" (which is more appropriate). "Automated" connotes control with a machine, while "autonomous" connotes performing alone or individually. Self-driving cars utilize an assortment of systems to recognize their environment, for example, radar, laser light, GPS, odometry and PC vision. Propelled control frameworks translate tangible data to recognize proper route ways, and also hindrances and significant signage. Autonomous autos must have control frameworks that

are equipped for breaking down tactile information to recognize distinctive autos on the road. The potential advantages of self-sufficient vehicles incorporate diminished versatility and framework costs, expanded wellbeing, expanded portability, expanded consumer loyalty and decreased wrongdoing. Self-driving vehicles are anticipated to build activity stream; give upgraded portability to youngsters, the elderly, crippled and poor people; soothe explorers from driving and route errands; bring down fuel utilization; fundamentally diminish requirements for parking spot; lessen wrongdoing; and encourage plans of action for transportation as an administration, particularly by means of the sharing economy. This demonstrates the tremendous troublesome capability of the rising innovation.

The numbers of motor vehicles are exponentially increasing all over the world resulting in multitudes of problems. As of 2015, there are 263.6 million vehicles registered and the number of cars sold in the US stood around 7 million in 2016. Considering the conversion of these vehicles to autonomous vehicles could definitely create a large impact and far-reaching implications.

Switching over autonomous vehicles could affect a multitude of parameters or issues like cost, safety, environment and public opinions. These are some of the factors of major concern associated with self-driving cars. These are the factors responsible for deciding the option of switching over autonomous vehicles in future. There are many more factors which could impact the decision of adopting it like the ethical issues and dilemmas which are inhibiting the implementation of self-driving cars and creating a lot of skepticism amongst people. Also, ethical dilemmas associated with the self-driving cars would be dealt further.

COST MEASURES

Undoubtedly, it can be said that the cost of development of the autonomous vehicle is very much large and not affordable for the general public. And therefore most work is done upon to make it affordable which could enhance the sustainability of the car and succeed in the easy implementation of it.

Currently considering the cost of the car it is said that the price is around $250,000. Considering the Google's subsidiary parent company ' Waymo' which is an autonomous car development company, has developed driverless car worth $150,000 out of which the LIDAR system costs $75000. They are working on the LIDAR System to make it cost effective. There are many companies working on to make the LIDAR System cost efficient like Quanergy, Velodyne LiDAR, LeddarTech etc.

According to Waymo's chief executive officer, it was told that the team is working upon to reduce 90% cost of LIDAR system (Bloomberg) and making it more effective at times of rain, fog, and snow. Also, the cost is covered by Velodyne HDL -64E, which comprises 64 lasers and

64 diodes to scan the world. If the 90% reduction in LIDAR System becomes true, it would be one of the most successful achievements and the price of the car would drop significantly, making it more affordable and sustainable.

SAFETY CONCERNS

Safety reasons stand as one of the parameters to implement autonomous vehicles as a better transportation model. Over 37, 461 deaths have occurred due to motor vehicle accidents (Census) and the rate is expected to grow with years. The primary goal of developing self-driving cars is to minimize human errors and reduce these accidents. It is stated that there are 88% accidents due to human error (Oporty, 2016).

According to a report by ScienceAlert, driverless cars could reduce traffic fatalities up to 90%. Also considering the article published by The Atlantic, Self Driving Cars could save 300,000 lives per decade in America. Similarly, many reports claim that autonomous cars could bring the fatality rate significantly and would prove boon to humanity.

EFFICIENCY

Self Driving cars or autonomous vehicles are still undergoing development so as to carve out the best model of it which would feature affordability, self-sufficiency, safety, ecological and many more viable features.

Driverless vehicles could suffice the need of each individual, be it a child or an old person or a person with any physical disability. Many people are also dependent on other people to commute between places, so self-driving cars could possibly solve this issue too. The need to get the best driver could be easily resolved by a driverless car. Also, the user can work easily or communicate with the fellow passengers while traveling in a driverless car.

Many more things could be sorted out with autonomous vehicles like the problem of traffic congestion and parking system. Smart parking system could be a result of driverless car and hence would make roads more organized and much better. Considering the reaction time of electronic stuff, the autonomous vehicle could highly prove beneficial at times of accidents etc. The use of mapping could help autonomous vehicle commute between places without creating any haphazard and user doesn't have to remember routes to travel.

Imagination has no limits and so the benefits of self-driving cars. Diving deep into the future and possibly imagining of situations where driverless cars could be useful seems pretty interesting. Taking kids from one place to another without parents, use of driverless cars as ambulances etc. could be the future uses of the driverless car. A user can send the driverless car to pick up things and bring them back. The list of imaginations would however not come to an end. So talking

about the efficiency of driverless cars, estimation in percentage could be very much difficult to determine.

VIEWPOINT OF PUBLIC

The driverless cars are undergoing a huge lot of changes in terms of all parts used in the car like the sensors, photodiodes etc so as to make navigation and mapping of the environment more and more precise so as to avoid any kind of disruptions in future. However, the opinion from the public is one of the strongest factors which would decide to bring driverless cars on the roads. According to the survey published in Quartz, only 44 % people would want to ride in a driverless car. Also, it is stated that the biggest fears centered on a general lack of trust in the technology- a reluctance to cede control to a robot – and more specific safety concerns (Quartz Media LLC, 2016).

Public opinions matter a lot in the implementation of the autonomous vehicles. The main reasons Americans say they would not ride in a driverless car are lack of trust, safety concerns, technology immaturity, the potential for hacking etc. The level of hesitancy to trust a computer, especially to drive, is supported by many pieces of evidence which drops the enthusiasm of adopting autonomous cars; still implementing driverless cars is a dream for everyone.

ETHICAL CONCERNS

Ethical issues have always been of major concern and have created skepticism to implement self-driving cars. There are many dilemmas associated with autonomous vehicles which are yet to be answered. The question "How should a car be programmed if it encounters an unavoidable accident? " One of the most debated problems is the Trolley problem. Taylor, a professor of philosophy at Stanford quoted that "Everyone is saying how driverless cars will take the problematic human out of the equation. But we think of humans as moral decision makers. Can artificial intelligence actually replace as moral agents?" This question leads to the most debatable "Trolley problem".

The 'Trolley Problem' (or the 'Trolley Dilemma') consists of a series of hypothetical scenarios developed by British philosopher Philippa Foot in 1967. The trolley problem is a well thought hypothetical issue. Considering the general form of the trolley problem: "Assuming that there is a runway trolley" i.e. moving down the railway tracks. Ahead, on the tracks, assume that there are five workers who could be killed if the trolley continues on the same course. Let say Sam is standing some distance off in the train yard, next to a lever. If Sam considers pulling the lever, the trolley would move to a different set of tracks. However, he notices that there is one person tied up on the side track. Then Sam has two options to opt for:

a. Stand still and the five people are killed.

b. Or Pull the lever, so that the pulley is diverted to an altogether different track.

So what could be the most ethical decision?

Similar are the different ethical dilemmas like the fat villain, the loop variant, footbridge dilemma etc.

Researchers are constantly trying to carve out the best possible solution and solve the underlying ethical dilemmas. However, more research has to be done so as to reach to the solutions and bring out a better world for the driverless cars to be implemented.

Having looked into certain parameters which would certainly determine to decide whether driverless cars would be the new future and how much time it would take to be implemented. Be that as it may, from what has been depicted it is genuinely simple to see that the non-mechanical issues will probably be an obstruction towards the reception of autonomous vehicles than the innovative ones. The prototypes are in development each second and each day something magical is happening so as to bring out the best model of driverless cars.

However, the cost has a big role to play and public opinion is the strongest factor to decide the future of autonomous vehicles.

METHODOLOGY

This part mainly focuses on providing a brief outline of how the research has been conducted and what factors were considered to drive to the conclusion of it. A hypothesis would be established which would be tested upon to drive the result out of it. Based on the preliminary research, certain parameters were established as test points determining the future of autonomous vehicles. The most influential factors were a. Cost of producing driverless cars

b. Safety associated with it

c. Public opinions and Ethical concerns

The research also draws light upon the ethical concerns associated with driverless cars and how they could be solved upon so as to carve out a bright future for driverless cars.

This part will additionally talk about the procedures utilized as a part of deciding these key impacts, and also how information was gathe0red and dissected. Our technique clung to the means sketched out in the conventional logical strategy – leading preparatory research/perceptions, building up a theory, performing foundation look into, planning a test, directing the investigation, examining the outcomes, and framing a conclusion in view of the examination. The accompanying areas of this section will abridge each of these means in the request in which they were performed.

HYPOTHESIS

There are many questions which would be answered through this research but the focus would be on answering the following questions:

- Are people ready to switch over the driverless car and how easily they would adopt them?
- What do people envision about self-driving technology and how could they establish the belief in it?
- What are the ethical dilemmas which bother public and how it could be solved?

There are several other questions that are of concern and should be answered but the aforementioned questions are the fundamental questions which need to be answered.

APPROACH

To test our hypothesis and find out the answers to the research questions, I looked into various surveys published in several recognized magazines, publications, scholarly articles etc. to arrive at the conclusion of the answers to the proposed questions.

The reason to stick to the surveys of different publications was that people weren't much aware of the self-driving cars and so they couldn't fully express themselves about the autonomous vehicles. Also, a lot of research has been done to gather the public perceptions in regard to the self-driving cars and has been published by several companies like Wyamo (Google), Tesla, BMW etc. As these companies are working on to bring the most affordable form of driverless cars, so they are constantly researching about the market and its demand in future. The research uses several of the surveys of these companies to answer the questions.

RESULTS & CONCLUSIONS

Answers to Research Questions

Are people ready to switch over the driverless car and how easily they would adopt them?

It is very difficult to confirm or establish the fact that people would adopt driverless cars easily. People's opinion highly predicts that it is very difficult to believe in autonomous vehicles and so adopting them is a very crucial decision. Gathering information from various sources, the ratio of people willing to have driverless cars on roads to those who are not willing is roughly one is to one i.e roughly 50% of people are interested in having driverless cars on roads. Talking about the reason for the highly numbered disinterested people in self-driving cars is many and the list seems unending. Some of the reasons associated with it are Safety, Cost, and lack of belief in autonomous vehicles. Cost is definitely a big factor to look upon which highly influences the

success of self-driving cars. Currently, the manufacturing cost of autonomous vehicles is too high and therefore its affordability is very low and so the researchers are trying hard to make it less expensive. Considering the safety factors associated with autonomous vehicles, it is definitely safe to travel in it but then the ethical dilemmas associated with self-driving cars come into play. So there is a need to answer the daunting ethical questions and provide solutions too. But people definitely believe in the advantages of autonomous vehicles which gives a hope of implementation of autonomous vehicles in near future.

What do people envision about self-driving technology and how could they establish the belief in it?

Self Driving Technology is an altogether out of the box technology which captivates human intelligence to drive vehicles. This captivation of human intelligence is what scares people and what creates skepticism among people on how can a machine be equal to human intelligence. Hence it is difficult for people to understand the in-depth of this technology and so people fail to rely on it. However, establishing belief in self-driving technology could only bring autonomous vehicles on roads and more the time it takes people to believe in it more lately the technology would be turned on roads. Also in order to establish belief on self-driving technology, it is thought that until and unless it is not brought on the real roads and made to drive in harmony with driver-vehicles, people won't believe into it.

What are the ethical dilemmas which bother public and how it could be solved?

The most debatable problem which exists on self-driving technology is the ethical issue which is one of the strongest reasons why people doubt self-driving technology. The list of ethical issues continues and is eventually growing with time. But the need is to essentially answer these questions with priority and definitely look for a solution to it. Talking about the most debatable question "How should a car be programmed if it encounters an unavoidable accident?" is still left unanswered. Other issues like 'Trolley Problem' is also debated a lot. In order to solve these existing dilemmas researchers are trying to establish some laws which could give a base solution to these ethical issues to an extent. Answering these ethical issues is definitely a difficult task to perform but solutions to them have surely come up. However, the ethical dilemmas would remain a constraint in the path of self-driving technology.

Self-driving technology would definitely be the next technology which would bloom like other technologies. Public perception is a strong factor which would decide when this technology would arrive and how successful it would be in future. Autonomous vehicles are being well researched throughout and would be the most efficient model of transportation in future.