

pros & cons of autonomous vehicle

Design Research Seminar

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Approval

This Design Research Seminar titled 'Pros & Cons of Autonomous Vehicle' by Rishi Soman is approved in partial fulfilment of the requirements for Master of Design Degree in Mobility & Vehicle Design.

Prof. G G Ray (Project Guide)

Declaration

I declare that this written submission represents my ideas in my own words and where others' ideas or words have been included, I have adequately cited and referenced the original sources. I also declare that I have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in my submission. I understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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1. Abstract

This report explores the positive and negative impact of autonomous vehicles on transportation systems and its effects on human lifestyle.

2. What is an autonomous vehicle?

An autonomous vehicle is a vehicle that is capable of sensing its environment and navigating without human input.

3. What is the difference between autonomous & automated?

This Today's vehicles have a lot of systems automated, such as automatic gears, wipers, climate control, emergency braking, automatic parking and cruise control to name a few. These automatic systems are incapable of performing under uncertain conditions and also heavily rely on human supervision and human intervention when it comes to governance.

Autonomy means the freedom from external control or influence; the right to self-govern. Autonomous vehicles are implied to perform under significant uncertainties in its working environment and also be able to compensate for any system failure without human intervention.

4. Why autonomy?

Autonomous vehicles can greatly reduce road accidents, congestion, fuel consumption and load on infrastructure. Autonomy opens the doors to shared vehicle, greatly reducing the cost of mobility. Differently abled or older individuals can freely access autonomous vehicles without the requirement of a driver's license, made possible by autonomous driving.

Self driving cars have always been a part of science fiction, beckoning a probate future where mankind is relieved from chores like driving and instead spend the time travelling on work or entrainment.

5. Brief history of autonomous vehicles

Development of self driving vehicles have been going from as far back as 1920s. The first self-sufficient and truly autonomous cars appeared in the 1980s, with Carnegie Mellon University's Navlab and ALV projects in 1984 and Mercedes-Benz and Bundeswehr University Munich's Eureka Prometheus Project in 1987.

Companies like Audi, General Motors, Ford, Nissan, Toyota, Volvo, Rinspeed, Tesla and Google have all demonstrated prototype autonomous vehicles capable of traversing through existing road traffic conditions. As of February 2016, Tesla offers an autopilot feature which lets the Model S drive by itself without any human interventions on select highways.

6. Classification of autonomous vehicles

For encouraging development of autonomous vehicles, the United States of America's National Highway Traffic Safety Administration (NHTSA) has proposed a formal classification of autonomous vehicles. They are as follows:

Level 0

The driver completely controls the vehicle at all times

Level 1

Individual vehicle controls are automated, such as automatic braking and electronic stability control.

Level 2

At least two controls can be automated in unison, such as adaptive cruise control in combination with lane keeping.

Level 3

The driver can fully cede control of all safety-critical functions in certain conditions. The car senses when conditions require the driver to retake control and provides a “sufficiently comfortable transition time” for the driver to do so. (For example, the Tesla Model S.)

Level 4

The vehicle performs all safety-critical functions for the entire trip, with the driver not expected to control the vehicle at any time. As the vehicle would control all functions from start to stop, including all parking functions, it could include unoccupied cars.

7. Safety of autonomous vehicles

“Self driving cars can never completely eliminate accidents”

Upwards of 1 million people die every year in road accidents. In India, 10,16,295 people died in road accidents from 2003 to 2011. Averaging 1,00,000 deaths every year just in India. Human error is the cause of most of these accidents. Accidents cause immense grief and financial burden to the affected family and the society.

Self driving cars can never completely eliminate accidents, but they can greatly reduce them. Computers don't get tired or drowsy, nor do they have emotions or drinking habits. Autonomous cars have extremely short reaction time, they measure their environment thousands of times every second, which is way faster than any human could react. Infrared cameras give autonomous cars great visibility even in poor visibility conditions like during a blizzard. Autonomous cars will be able to talk to surrounding cars wirelessly, relaying realtime traffic information or in case of a sudden braking, the car behind will be warned beforehand.

Road safety can be improved and in some ways, accurately predicted with the arrival of autonomous vehicles. The death toll related to road accidents will be greatly reduced, something that we have come to accept as part of daily life.

8. Changes in legislations

United States and European Union are at the forefront of Autonomous vehicle development. The state of Nevada in United States is a hotbed for testing autonomous vehicles. Companies including Google, Mercedes-Benz, Volvo, General Motors and Ford have prototype autonomous cars running on Nevada roads along with regular traffic. These prototypes require dual control which can be fully autonomous or operated manually by an operator. Regulations require a licensed operator to be in the test car always ready to take over the control at any given moment.

Friendly legislations have encouraged automotive manufacturers to test their prototypes in real world conditions but always under human supervision. Due to liability issues in case of an accident, no manufacturer is testing an unmanned vehicle on public roads as of February 2016.

9. Pros of autonomous vehicles

Creating more free time

Self driving vehicle provides the occupants more time that can be used for socialising, entertainment or productive activities otherwise spent driving the vehicle. The occupants are relieved from taxing navigation and driving.

Improved safety

Traffic collisions caused by human error such as drowsiness, distraction, aggressive driving and intoxication can be completely avoided.

Reduced emissions and increased efficiency

Autonomous vehicles are programmed to take the most efficient route and restrained driving style ensures a reduced fuel consumption both in case of IC engine and electric vehicles. Since the vehicles have way quicker reflexes than humans and inter car communication, the speed limit for autonomous vehicles can be increased.

Relieved traffic congestion

Autonomous vehicles need less safety gap from the car in front, thereby increasing the number of vehicles on road which relieves traffic congestion.

9. Pros of autonomous vehicles

Increasing access for everyone

Since a self driving vehicle wouldn't require any driving or navigational input from the driver, it would not matter if the occupant were under age, over age, unlicensed, blind, disgraced, intoxicated or impaired.

Reduced need for new infrastructure

Autonomous vehicles can park into tighter parking spots. Traffic police will not be required. Better traffic flow can be maintained as less safety gap is required.

Travel time dependability

A methodical and predictable driving pattern ensures autonomous vehicles will provide a dependable travel time.

Productivity improvement

Autonomous vehicles free up the cabin space due to the removal of steering wheel and other driver interface, thereby improving the ergonomics of the cabin. Occupants need not be forward facing or even sitting. Occupant can assume a relaxed position letting them rest or concentrate on productive activities.

Reduce number of vehicles

Autonomous cars can be used on a shared basis. Rather than self owned vehicles, transportation as an on-demand-service will be a much more efficient and economical mobility solution.

10. Cons of autonomous vehicles

Liability

In case of a regular car accident, the driver is the soul responsible party. With autonomous cars, the manufacturer of the device/software become the liable party. This is one of the biggest obstacle in the implementation of autonomous vehicles.

Uncertain adoption period

Due to tricky liability, legislature, resistance from individuals to forfeit control of their vehicles, the adoption period for autonomous vehicles is uncertain.

Loss of driving related jobs

Self driving vehicles make driving jobs obsolete. There will be considerable resistance from driver's union, delaying adoption of self driving cars.

Reliability of hardware and software

The computer administrating the autonomous car could be compromised via hacking, jamming, virus or even simple sabotaging the sensors.

10. Cons of autonomous vehicles

Loss of privacy

Sharing of location and vehicle information through vehicle to vehicle and vehicle to infrastructure communication could mean loss of privacy.

Communication gap

Nonverbal cues or gestures by policemen, pedestrians or cyclists could be tricky for an autonomous vehicle to understand.

Elevated demand on wireless communication infrastructure

Vehicle to vehicle, vehicle to infrastructure, GPS location services of numerous autonomous vehicles put elevated demands on wireless communication infrastructure.

Ethical problems

Ethical problems in situations where an autonomous car's software is forced during an unavoidable crash to choose between multiple harmful courses of action.

11. Ramification of the automobile industry

Adaptation of autonomous vehicle will be significantly transformative challenging for the automobile industry. Consumers will shift their interest from performance vehicles to vehicles that will be more comfortable to be driven in.

Automobile manufacturers could be selling mobility as a service instead of selling the vehicle as is. This drastic change in the business model will put more emphasis on the experience design of the vehicle. Automobile industry landscape will be drastically transformed with the arrival of autonomous vehicles.

12. Reluctance of automotive manufacturers

The technology for autonomous vehicle exists today. Manufacturers have been testing prototypes that have been successful in autonomy. Yet, autonomous vehicles seem like at least a decade away from everyday reality. Automotive manufactures like Mercedes-Benz, BMW, Audi, Volkswagen are showing reluctance in even committing themselves into manufacturing autonomous vehicles for the future. These are few of the hurdles automotive manufactures have to face to make autonomous vehicles a reality.

Liability is one of the biggest hurdles facing the full deployment of autonomous vehicle by automobile manufacturers. All blame will be on the manufacture in case of fatality involving an autonomous vehicle. And accidents will happen however sophisticated the vehicle is. No manufacturer wants to be first responsible for a fatality caused by their design.

Technological hurdles like reliability of software, hardware, communication, sensors et al. over the long run will be addressed with the advancement of technology. At the same time, current regulations in most counties don't permit a driverless vehicle. An internationally formed regulatory board could help standardise autonomous vehicles. A universal regulation across various nations would make it easier for manufacturers to design autonomous vehicles.

9. Reluctance of automotive manufacturers

“If control must be sacrificed for safety, safety is no longer a selling point.”

Autonomous vehicles are inherently safer than human drivers by multiple folds, thereby greatly reducing accident related fatalities. But from an automotive manufacturer stand point, it creates a paradoxical business model. If control must be sacrificed for safety, safety is no longer a selling point.

Human beings have learnt to drive a vehicle. However bad we are at it, it's human psychology to have control over outcome. There will always be a few who would want to drive their own vehicle, since they've become accustomed to the task of driving. Manufacturers fear this and this could be one of the biggest reasons why manufacturers are reluctant to introduce autonomy.

Tesla and Volvo are the only two manufacturers, as of February 2016, to publicly announce their plans for future autonomous vehicles. Tesla has already introduced their Autopilot software update, which is capable of automatic throttle and steering input on highway conditions. Volvo will roll out a fleet of 100 autonomous cars in Swedish public roads with goals of testing in harsh weather conditions in 2017. Volvo's Vision 2020 project intends to eliminate all fatalities in a Volvo car by the year 2020. Tesla is a low volume manufacturer, so it can take up the risky task of educating the public about autonomy with incremental updates to their Autopilot software.

Automotive manufacturers are still stuck up in these issues, but optimistic signs from Tesla and Volvo will show the way for other heavyweight manufacturers.

13. Conclusion

Autonomous vehicles are an inevitable outcome of technological advancement and a dream for a utopian future. With ever-changing climate conditions due to pollution and depleting fossil fuel, the quest for a cleaner and efficient modes of transportation has lead to autonomous sharable vehicles running on electric power.

There will be hurdles along the way as mentioned in this report, but autonomous vehicles seem much more closer to reality than ever before.

It's only time until Autonomotive Singularity will arrive, the day the last person gets into a car and relinquishes all input other than destination.

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