An analytical study of Self-Driving vehicles and Public perception with special reference to Pune region

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Abstract

Automated vehicles (AVs) are scheduledour roadways shortly. They might begin to pose problems and issues that most of us in public have not yet encountered or even witnessed till date. The present work tries to explore various aspects of automated vehicles can be included in designing of the product and communicated to potential consumers in a way to be understood by the general public.

The arrival of driverless autonomous vehicles (AVs) represents a unique opportunity for a fundamental change in urban mobility if public authorities and common man using their own private transport take an active role to integrate AVs into an effective transport network.

This paper tries to study the perceptions of potential Indian consumers specifically related to the benefits of AVs as an effective transport, extent of partial acceptance of consumers under specific conditions & perceived dangers in riding an automated vehicle.

Key words: Automated vehicles, Futuretransportation infrastructure,Advanced Driver Assistance Systems

Introduction

Inspired form nature that bats avoid hitting obstacles with echolocation as they fly through complete darkness without bumping into cave walls or other obstacles, the concept of autonomous cars have travelled a long way from science fiction / fantasy to on road reality. Though it seems that technology emerged virtually overnight, the path to self-driving vehicles has been a tedious and laborious.

Inventors in 1925 demonstrated a radio-controlled car, driven through the streets of Manhattan without anyone at the steering wheel. Seventy seven years later in 2002, Defense Advanced Research Projects Agency announced its challenge, offering researchers from top research institutions a $1 million prize if they can build an autonomous vehicle able to navigate 142 miles through the Mojave Desert.

Starting in 2009, Google began developing its self-driving car project, now called***Waymo***, in secret. In 2014, it revealed a prototype of a driverless car without any steering wheel, gas pedal or brake pedal, thereby being 100 percent autonomous and announced that its autonomous cars had collectively driven 300,000 miles under computer control without one single accident.

Google's self-driving car system has been officially recognised as a driver in the US, paving the way for the legalization of autonomous vehicles. The government agency admitted to classify Google's artificial intelligence system as the driver of its cars.

Federal government had responded with a $4 billion plan to roll out self-driving cars within a decade. The UK government has also announced an investment of £20 million in eight driverless car projects.

The automotive AI market was valued at $783 million in 2017 and expected to reach close to $11k million by 2025, at a CAGR of about 38.5%. IHS Market predicted that the installation rate of AI-based systems of new vehicles would rise by 109 % to 2025, compared to the adoption rate of 8% in 2015.

AI-based systems will come as a standard package in new vehicles especially in the two categories mentioned below:

1. Enhanced human-machine interface, including speech recognition and gesture recognition, eye tracking and driver monitoring, virtual assistance and natural language interfaces.
2. Advanced Driver Assistance Systems (ADAS) and autonomous vehicles, including camera-based machine vision systems, radar-based detection units, driver condition evaluation and sensor fusion engine control units (ECUs).

The human perspective of driving a car is to use sensory functions such as vision and sound to watch the road and the other cars on the road.

Industry intends building autonomous vehicles that drive themselves, and wants them to drive like human drivers. Hence it needs to develop designs to provide these vehicles with the sensory functions, cognitive functions (memory, logical thinking, decision-making and learning) and executive capabilities that humans exercise to drive vehicles. The automotive industry is continuously evolving to achieve exactly this over the last few years.

According to the world's leading research and advisory company Gartner, by 2020, 250 million cars will be connected with each other and the infrastructure around them through various V2X (vehicle-to-everything communication) systems. As the amount of information being fed into IVI (in-vehicle infotainment) units or telematics systems grows, vehicles will be able to capture and share not only internal system status and location data but also the changes in its surroundings, all in real time. Autonomous vehicles are being fitted with cameras, sensors and communication systems to enable the vehicle to generate massive amounts of data which, when applied with AI, enables the vehicle to see, hear, think and make decisions just like human drivers do.

After the successful attempt to provide high-speed connectivity across India by means of high-speed bullet trains wherein, the government had taken assistance from governments from France, Spain, China, Japan and Germany to complete these project, next target for Indian government on the technological frontier can be to promote production and usage of private fully automated and electrically driven vehicles and to go for a strong public transportation system using fully automated and electrically driven vehicles to reduce noise and air pollution in its attempt to go green. Specifically in Pune having the highest no of two wheelers in India, can fully automated and electrically driven vehicle public transport be an answer to reduce the pollution**?**

Official Statements in favor of automated cars

Automated vehicles open up possibilities for saving lives, saving time and saving fuel. Automated vehicles promise to move people and goods more efficiently than we are moving them today --*Antony Foxx (Department of Transportation head).*

The act of driving is too dangerous for humans and will be outlawed as soon as self-driving cars are proven to be safer. All electric vehicles manufactured by Musk will be fully autonomous within two years. -- *Billionaire Tesla founder Elon Musk*

Research Problems and Objectives of the study (Problems in acceptance of cars)

1) Today's "safety drivers" — the humans who sit idle behind the wheel in case the artificial Intelligence fails to what extent and how effectively will they be able to control the vehicle?

2) Educated people understands that autonomous vehicles are amazing but to what extent will they accept the automated system to fully take control of a passenger vehicle with no human behind the wheel?

3) The recognition of Google's autonomous computer as a driver would require an amendment regardinga legal basis for establishing liability in the event of accidents involving self-driving cars proving a major obstacle in getting the cars insured for driving on public roads.

4) Few companies like Udelv, Nissan, Waymo, Zoox have made arrangements possiblefor remote monitoring to be done from call center-like cubicle farms. What would be the acceptability of general public as a response ?

5) Can autonomous vehicles be successfully utilized for a public transport system specifically in developing countries like India by getting acceptance of general people ?

6) What prime requirements are to be fulfilled and communicated in order to get acceptance in India ?

Statement of Hypothesis

Hypothesis 1: Males are more likely to be interested in using a self-driving car compared to females.

Hypothesis 2: Number of years of driving experience is inversely related to acceptance to self-driving cars being safer to have on roads.

Research methodology

Research design:	Descriptive research
Research instrument:	Questionnaire
Sample size:	500
Sampling system:	Convenience

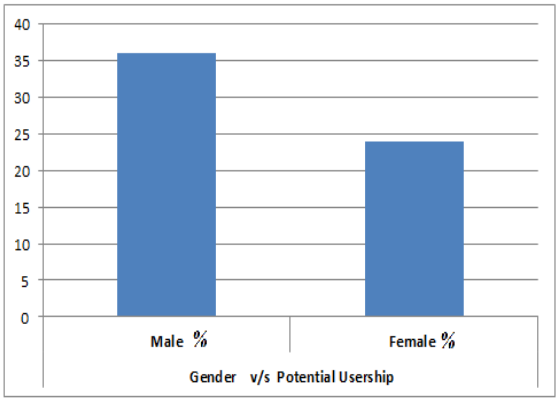
A survey was carried out using Google Forms that was posted publically on Facebook,Twitter andLinkedIn and sent through E-mail and What's App. Google Forms was selected because data is easily collected for analysis and there are no restrictions on the number of responses. Respondents were encouraged to share the survey with others. The survey was posted online for one month with the link being reposted once a week.

Finding & Analysis

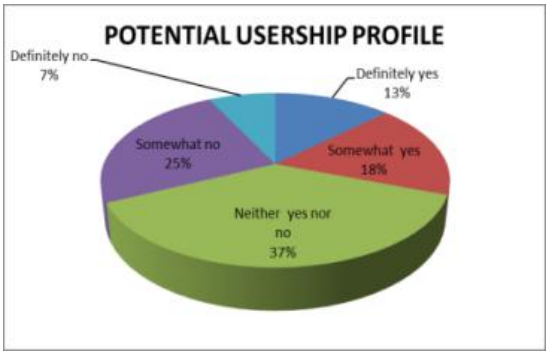
Q.1 Would you consider riding in a vehicle with autonomous/self-driving capabilities?

Table no. 1* :*Acceptance to ride the automated vehicle v/s Gender distribution

Gender v/s Potential User ship		
Gender	Male	Female
Total Respondents	**278**	**222**
Definitely yes	42	23
Somewhat yes	58	30
Total positive	100	53



Alternative	Responses
Definitely Yes	65
Somewhat Yes	88
Neither Yes or No	187
Somewhat No	123
Definitely No	37



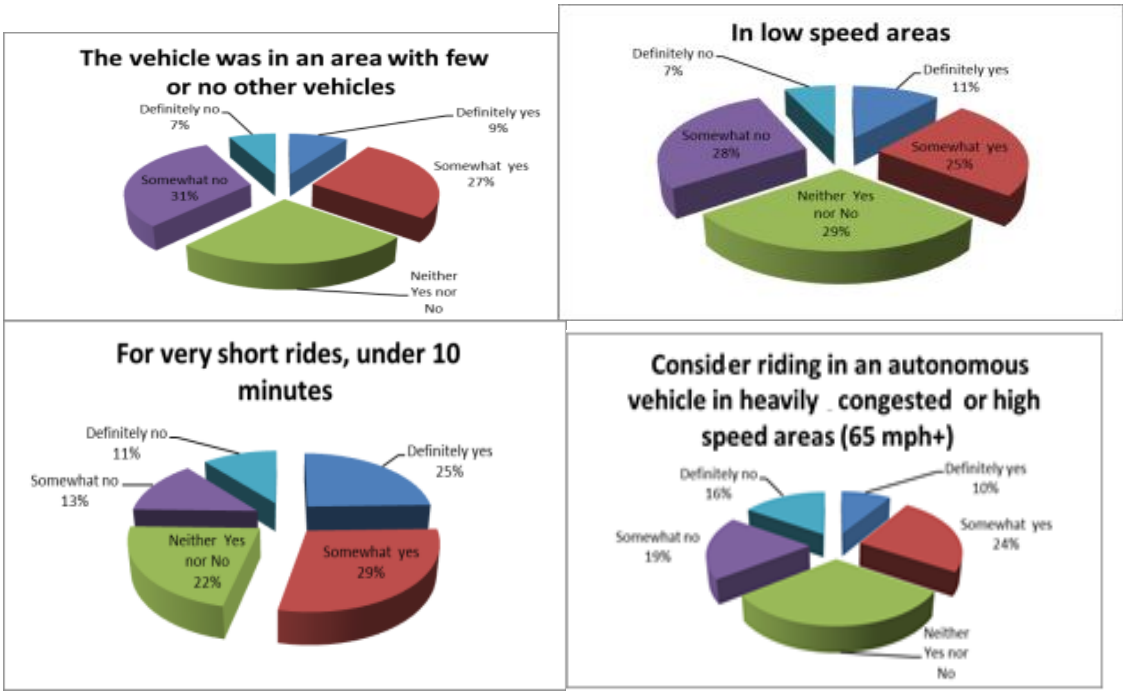
Hypothesis 1

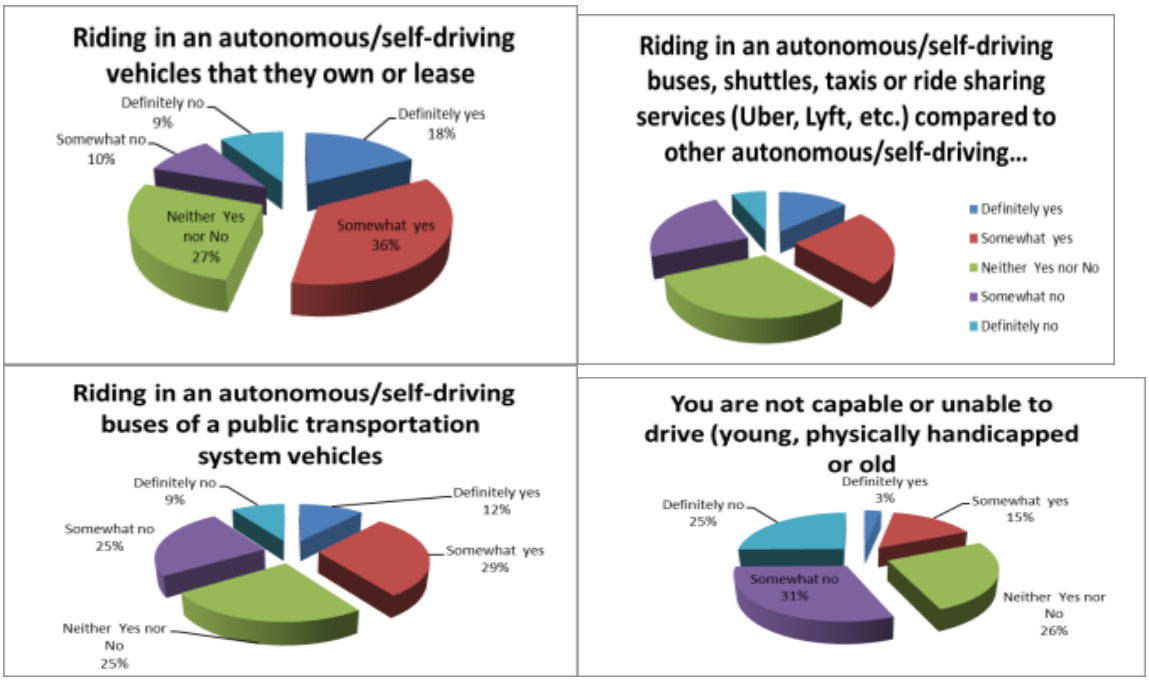
H_1: Males are more likely to be interested in using a self-driving car compared to females.
H_0: Males are less likely to be interested in using a self-driving car compared to females.

The % male respondents interested inusing a self-driving car were found out to be 36 % in comparison to 24 % of female male respondents. Hence the null hypothesis is rejected and the alternative hypothesis is accepted.Automated vehicle manufacturers have to take this fact while designing of the vehicle and target the male customer as a potential customer for their product.

Q.2 Under what conditions would you consider riding in a vehicle with autonomous/self- driving capabilities.

Figure no 2 :Acceptability of respondents for riding under different conditions





Acceptance for riding an autonomous/self-driving vehicle was found to be maximum under 3 conditions as follows:-

1. For very short rides, less than 10 minutes. The probable reason might be that respondents considered the risk associated with the vehicle for a long ride.
2. Riding in vehicles that they own or lease. The probable reason might be that respondents considered familiarity with the own vehicle a major factor to reduce perceived risk.
3. Riding in buses of a public transportation system vehicle. The probable reason might be that respondents perceived themselves to be comparatively more safe being in a bigger transportation vehicle

Q.3 To what extent these potentialdangers due to malfunctioning of the features do you expect from the automated vehicles

Major dangers in perceived of the automated vehicles were Computer system malfunctions, especially if they cause the vehicle to crash (49%) and Sensors not operating optimally in certain weather conditions or at night (56%). Automated vehicle manufacturers have to take this fact while designing the vehicle.

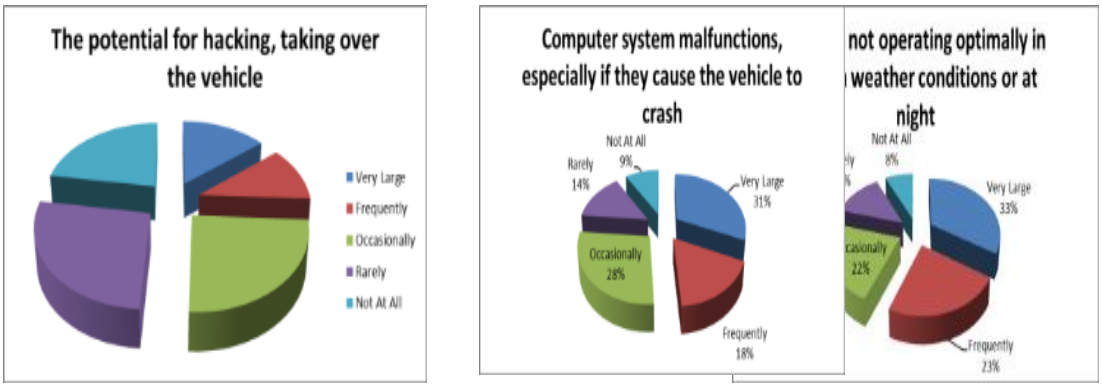


Figure no 2* :*Perceived potential dangers due to malfunctioning of automated vehicles

Q.4 To what extent do you agree on the potential benefits of using autonomous vehicles

Table no. 2* :*Acceptance on the potential benefits of riding the automated vehicle

Sr no	Statement	Strongly Agree	Somewhat Agree	Neither Agree Nor Dis Agree	Somewhat Disagree	Strongly Disagree	Total
1	Increasing safety & lower accident rates	227	123	68	48	34	500
2	Lower insurance rates	112	134	141	68	45	500
3	Being able to travel while drowsy	320	67	45	23	45	500
4	Reduced traffic congestion	234	102	98	43	23	500

Table no.3 : Driving experiencing V/ s Increasing safety & Lower accident rates

Acceptance to increasing safety & lower accident rates	Strongly agree	Somewhat agree	Neither agree nor Dis agree	Somewhat disagree	Strongly	Total
Below 5years	98	28	7	5	6	144
5 years-10 years	58	25	21	7	6	117
10 y-15 y	44	42	31	22	3	142
15years and above	27	28	9	14	19	97
Total	227	123	68	48	34	500

Hypothesis 2

H_1: The number of years of driving experience is inversely related to acceptance to self-driving cars being safer to have on roads.

H_0: The number of years of driving experience is not related to acceptance to self-driving cars being safer to have on roads.

When the acceptability considering Increasing safety & Lower accident rates by the consumers were tested for cross tabulation & co-relation against driving experience groups, a weak negative co-relations Pearson's co=relation coefficient R = - 0.364 was obtained in which negative co-relation indicated that the acceptability of Increasing safety & Lower accident rates to purchase furniture decreases with increasing Driving experiencing. Hence the null hypothesis is rejected and the alternative hypothesis is accepted.

Automated vehicle manufacturers have to take this fact while designing of the vehicle and target the less experienced drivers as a potential customer for their product.

Demographic profile:

Age	**Below 25**	**25-40 --**	**40-60**	**60 and Above**
	126	**234**	**95**	**45**

Monthly Income	**Below 15000**	**15000-50000**	**50000-100000**	**100000 and Above**
	26	**222**	**185**	**67**
Education status	**Below matric**	**Undergraduate**	**Graduate**	**Post Graduate & Above**
	45	**154**	**221**	**80**
Driving experiencing(in years)	**Below 5**	**5-10**	**10-15**	**15 and Above**
	144	**117**	**142**	**97**
Marital status	**Married**	**Unmarried**	**Divorced**	
	189	**288**	**23**	
Gender	**Male**	**Female**		
	278	**222**		

Conclusions & Suggestions

The percentage of male respondents interested in using a self-driving car was found out to be 150 % greater than percentageof femalerespondents. Automated vehicle manufacturers will have to design the vehicle so as to target the male customer market as a major potential customer for

their product.Acceptance for riding an autonomous/self-driving vehicle was found to be maximum under conditions as

- For very short rides, less than 10 minutes.
- Riding in vehicles that they own or lease.
- Riding in buses of a public transportation system vehicle.

The probable reason might be that respondents considered the risk associated with the vehicle for a long ride, familiarity with the own vehicle a major factor to reduce perceived risk &perceived themselves to be comparatively more safe being in a bigger transportation vehicle.

Automated vehicle manufacturers will have to promote the vehicles through advertisements which would try to change their attitude towards perceived risks while riding the automated vehicle not only in these situations mentioned but otherwise also to make automated cars a more comprehensive option of public and private transport in future. .

Major dangers in perceived of the automated vehicles were Computer system malfunctions, especially if they cause the vehicle to crash (49%) and Sensors not operating optimally in certain weather conditions or at night (56%). Automated vehicle manufacturers have to take special attention to these factswhile designing the vehicle.

When the acceptability considering increasing safety & lower accident rates by the consumers were tested it was found that the acceptability of increasing safety & lower accident rates to purchase furniture decreases with increasing driving experiencing. Automated vehicle manufacturers have to take this fact while designing of the vehicle and target the less experienced drivers as a potential customer for their product.

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