

Passenger Management on Autonomous Buses for Public Transport

Social Influences on the Regulation and Development of Safety in Autonomous Vehicles

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By

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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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INTRODUCTION

How can autonomous vehicles be designed and regulated to ensure safety and public acceptance?

With the rapidly increasing adoption of autonomous vehicles (AVs) in our society, concerns of safety, reliability, and public trust are becoming paramount. Autonomous vehicles are said to have many benefits including increased driver safety, lower traffic congestion, environmental benefits, and more (Othman, 2022, Moody et al, 2020). However, many of these benefits are only fully realized once AVs have become fully integrated into our society. Before this can occur, many difficult technical challenges, such as reliable navigation and passenger safety and management, must be overcome. Alongside this, society's evolving perception of AVs influences the expectations and regulatory standards for this technology, which directly pressure designers and policymakers to align AVs' technical standards with public values. This means that having a better understanding of how the public's perception of AVs affect development is critical to ensuring the advancement of safety and reliability in AV technology.

This topic is significant because the public's perception of AVs and the pressure of their influence play a pivotal role in the technology's acceptance. With new technologies and services such as robotaxis and autonomous buses emerging, the public's perception on their safety and reliability will have drastic effects on how the technology is developed and whether or not it will be widely accepted (Othman, 2021).

To better understand this relationship, this paper will look at how the public's perception of AV technology has changed as the technology has been developed and how that development in turn has shaped the public's perception. The technical focus of this paper is on the development of sensor systems and algorithms that can be used to facilitate the management of

passenger flow on autonomous buses for public transportation. The STS project will examine the mutual shaping of the public's perception of AVs and the regulation and development of AVs to gain a greater understanding of the impact of the societal forces on the development of AV technology.

Technical Research Project: Passenger Management on Autonomous Buses for Public Transport

How can sensor systems on autonomous buses reliably detect, track, and manage passenger flow at each stop?

One of the most important aspects of the public's perception on autonomous vehicles is safety. However, there are many other factors to consider when accounting for public opinion, including public expectations for a technology. For example, commuters expect a bus to stop at designated locations to pick up and drop off passengers, an operation that is straightforward with a human operator. When the bus is autonomous however, this operation is much more complex and if not executed correctly, may worsen public perception of autonomous vehicles (Deb et al, 2018).

As of today, many different organizations have provided solutions for autonomous passenger management, with machine learning models being the most commonly proposed solution. However since autonomous buses are only just emerging, there are no widespread or generally accepted systems for autonomous passenger management (Nasir et al, 2018, Li et al, 2023). In order to address this problem, I will primarily use cameras and photo-recognition of human activity both outside the bus when observing people at bus stops as well as inside to ensure proper service is provided to all commuters. Based on the data from the cameras, I will

create or modify existing video/image recognition software that will identify common passenger behaviors, such as waiting at bus stops, entering or exiting the bus, and remaining seated. I will do this by using machine learning models that can recognize and classify human behaviors, training the model on video and photo datasets so that it can recognize the common behaviors of bus passengers.

This software will be a basis for the management of passenger flow during stops and for other potential features such as emergency recognition, accessibility accommodations, and data collection. In conjunction with this software, I will devise a system to facilitate the bus's knowledge of when there is a passenger waiting at a bus stop or wanting to exit the bus to increase reliability. The end result of this project should be a software that can detect and track passenger flow during bus stops to ensure the efficient and reliable service for all passengers.

STS Research Project: Social Influences on the Regulation and Development of Safety in Autonomous Vehicles

How has public perception of autonomous vehicles impacted the regulation and development of safety in autonomous vehicles?

The rapid development and introduction of autonomous vehicles (AVs) represents the potential start of a major technological shift and has many significant social implications. As AV technology progresses, public perception will play a large role in shaping new regulations and design standards of AVs, especially concerning safety (Thomas et al, 2020). Public trust in AV safety directly impacts regulatory decisions and will influence both the pace and scope of AV development and adoption. This project aims to analyze how societal values and perceptions

influence the regulation and development of AV safety to better understand how this relationship affects the speed, scale, and efficiency of AV adoption. Analysis of this relationship and its impact will be done through the key components of the Social Construction of Technology (SCOT) framework: relevant social groups, interpretive flexibility, problems & conflicts, closure & stabilization, and wider context.

STS Framework: Social Construction of Technology

The SCOT framework emphasizes that technology is not developed in isolation but is instead a result of social, economic, and political forces (Pinch & Bijker, 1984). The major concepts of SCOT allow us to analyze how public perception has affected the development of AV safety. This framework is also especially useful in regards to AVs as it allows us to explore the complexities of regulating a technology that directly interacts with the public and has significant social implications.

Social Groups

In considering the influence of public perception on the development and regulation of AV safety, the relevant social groups are as follows: Designers and manufacturers, the general public, policymakers, and watchdog groups.

Designers and manufacturers first and foremost want to be monetarily profitable and create a successful business model surrounding AVs. However, designers also want to advance the technology as far as possible in the name of innovation and technological progress. However, as these manufacturers and designers are almost always part of commercial business, they are limited by their goal of monetary gain (Law, 2023).

The general public includes a wide variety of people with many differing views, including those who view AVs as technological progress and generally safer, with others viewing it as risky and prone to failure (Raine & Funk, 2022). However, the general public trust in AV safety is a critical aspect of influence on AV regulation and design. Policymakers include the regulatory agencies on the federal, state, and local level who play a critical role in determining safety standards of AVs. The policies they create are influenced both by public perception of AVs and the promise of safe innovation in the form of AV technology.

Finally, watchdog groups are groups that advocate for the safety and privacy of the general public, raising concerns about safety, ethics, and privacy in regard to AV technology. These watchdog groups play a critical role in influencing regulating bodies and questioning manufacturer and design decisions of AVs in the name of safety.

Interpretive Flexibility and Problems & Conflicts

As AVs are a newly emerging technology, different social groups have assigned different meanings to AV technology. According to manufacturers and designers, AVs represent a fundamentally safe technological innovation that will have a number of benefits including increased safety, reduced emissions, and reduced traffic congestion. However, the general public and watchdog groups, AVs pose a significant safety concern in the form of potential accidents, unpredictability of machine learning models, and decision making in ethical dilemmas. While technological innovation and improved safety can slowly improve public perception, any incident or accident involving AVs can dramatically worsen public perception almost instantly (Othman, 2021).

On the other hand, regulators and policymakers face the challenge of making regulations for a new and developing technology where they must define the standards of safety in an unprecedented field . To them AVs are a challenging new technology where they must find the balance between technological progress and public safety (Brodsky, 2016).

Closure & Stabilization

Closure and stabilization within the SCOT framework is when relevant social groups consider their problem with the artifact, in this case AVs, to be solved, leading to a more stable and widely accepted form of the technology. In regards to AVs, this closure could occur when safety standards and regulations are formed and widely accepted and both the general public and manufacturers can agree that AVs are a safe technology. However, since AVs are still a relatively new technology and regulations haven't been fully formed, closure and stabilization have not been reached as of 2024.

Wider Context and Conclusion

The final tenant of the SCOT framework addresses wider context. The regulation of AVs is deeply intertwined with and influenced by public perception, showing how social forces shape technological development. Public trust, industry lobbying, and regulatory caution contribute to the mutually shaping relationship between society and AV technology that affect the design and regulation of AVs. This project contributes to the broader understanding of how social forces influence the regulation and designs of emerging technologies, emphasizing the importance of public perception on the scope and scale of AV acceptance and adoption in today's society.

Methodology

I plan on utilizing a qualitative methodology, analyzing artifacts such as media coverage and polls on public perception of AVs, regulatory documents and congressional hearings, and AV designs to examine how public perception shapes AV regulation and design. Sources such as news articles, government reports, statements from manufacturers, and design documents will be analyzed to identify general public perception of AVs and how that influences the designs and regulations of AVs.

I also plan on exploring case studies of AV incidents to understand how they affect public perception and whether they have any effect on AV policy in the long term. An example of these case studies includes incidents involving autonomous vehicles with clear impacts on public perception and consequently direct responses from relevant social groups. By examining these case studies over time, I aim to identify how public perception has impacted the regulation and development of safety in autonomous vehicles.

Conclusion

By the end of this research project I aim to discover the extent to which public perception influences the development of AV safety technology. While my preliminary research suggests a strong correlation between public perception and AV safety development, I hope that by the end of my research I can come to a firm conclusion on the scale of their mutually shaping relationship. In regards to the technical portion of my project, I hope to gain a better understanding of how autonomous systems interact with an unpredictable environment to better promote safety, efficiency, and consistency while also finding and/or providing solutions to relevant problems with autonomous buses. Both of these projects will contribute to the overall

problem of how we can design autonomous vehicles to ensure safety and public acceptance by exploring AV safety technology and its mutually shaping relationship with public acceptance.

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