Identifying Distracted Driving through Gaze Tracking

Examining Sociotechnical Causes Behind the Failure of DriveWell

A Thesis Prospectus
In STS 4500
Presented to
The Faculty of the
School of Engineering and Applied Science
University of Virginia
In Partial Fulfillment of the Requirements for the Degree
Bachelor of Science in Computer Science

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Summer 2024

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

The leading cause of deaths in the United States (US) is, not surprisingly, car crashes. Each year, our nation sees over 6 million passenger car accidents. In the past year, road accidents have unfortunately claimed the lives of 38,000 individuals (Darrigo, 2024). Many drivers have a tendency to blame external situations for their accidents, however, the truth is 98% of all accidents are caused by human error (Backer, 2023). This statistic becomes especially devastating when considered in conjunction with the fact that 25% of all car accidents were caused by texting and driving (TaD) or other forms of driver distraction (Hard Wolf, 2023). This equates to over 1.5 million, easily avoidable car accidents. Anti-TaD campaigns have historically shown to be unsuccessful. As Mi Ae Lipe in 2019 puts it, "It has been proven repeatedly in study after study that this is not just a matter of willpower or character but of physiological incentive, because using our devices trigger our brains to reward us by releasing tiny amounts of dopamine, that feel-good neurotransmitter."

Considering this evident failure, I propose the development of an algorithm capable of tracking the driver's gaze through an interior camera and ensuring that he or she is staying alert while driving. The moment the driver appears to be distracted and is gazing elsewhere, such as a cellphone, the driver will be alerted via an incessantly repeating, loud noise similar to a seatbelt warning, forcing the driver to remain engaged. As this technical project is heavily dependent on the adoption of this technology by the user, understanding the driver's needs and psychology is vital to the success of this project. Therefore, I will draw upon the science, technology, and society (STS) framework of user configuration to thoroughly analyze how this project can best be implemented in the real-world. I will also use this framework to show how a gamified solution to TaD, DriveWell, failed to gain traction due to its misunderstanding of user needs.

Addressing both technical and social aspects of distracted driving is important to understand the most effective solution to the problem at hand. Because the challenge of TaD is socio-technical in nature, it requires attending to both its technical and social aspects to accomplish successfully. This paper will be divided into two sections: first, a technical solution to fight distracted driving, and second, an social analysis of the failure of DriveWell.

Technical Project Proposal

Texting and driving has become a rampant issue in the past decade. According to the CDC, this form of distracted driving, alone, causes over 400,000 injuries and takes the lives of over 3,000 individuals every year (CDC, 2024). Despite a rather common understanding of the dangers of texting and driving, many humans believe that they are more skilled than the average driver and can get away with it, especially given past success. They do not realize that you can drive the length of an entire football field completely inattentively, by just sending one text within 5 seconds, while driving at 55mph (NHTSA, 2024). This is further corroborated by the fact that drivers who text and drive are 23 times more likely to be involved in an accident (USDoT, 2010).

To address this growing problem, the government has tried enforcing legal consequences against drivers who text while driving. Currently, 48 out of 50 states have either heavy fines or strict laws against using a cellphone while driving. Despite this widespread regulation, legal consequences have only caused a mere 3% reduction in texting and driving caused traffic fatalities (Roswald, 2021). Various organizations have also led social movements to raise awareness about the growing issue. Campaigns such as the NHTSA's *Put The Phone Away or Pay* or EndDD have helped create a general understanding of the statistics behind texting and driving. However, little has been done to successfully mitigate the actual action.

This is largely due to the fact that most drivers still do not really believe that texting and driving can truly harm them, or worse, cause them to harm someone else. In a recent study by the Society of Risk Analysis, 68% of research participants acknowledged that they would need a lot more convincing to truly believe in the risks (SRA, 2018). Overconfidence in their own skills, a fear of missing out from the digital world, and past success are usually major reasons behind these drivers' mentalities.

The flaw behind these movements is that they aim to change the driver's mentality towards texting and driving by raising awareness or imposing heavy penalties. However, this method has clearly not been successful. The aim of this technical project is to create a method of accurately determining when a driver is driving distracted and preventing the action as it occurs through loud sounds or even slowing down the car if the action persists. This solution is more effective as it will train the driver out of the action similar to how the seatbelt warning chime in modern vehicles has effectively trained drivers to always drive with the seatbelt on (IIHS, 2024).

Identifying when a driver is texting and driving is rather difficult given the wide variety of possible circumstances. My technical solution involves placing a camera on the interior of the car that is capable of tracking the driver's gaze. This live feed is passed to a machine learning model trained on detecting when a driver is attentive and gazing upon the road versus when a driver is inattentive and gazing elsewhere.

This technical solution can be divided into two subprojects. First, is capturing and tracking the user's gaze. For demonstrative purposes, the user's laptop will be used to mimic the camera placed on the interior of the driver's vehicle. This live feed will be captured using the OpenCV Python library. On top of this, certain Python libraries, yet to be decided, will be used to identify and follow the user's gaze. Second, is creating a machine learning model capable of

detecting whether a user's gaze is attentive or distracted. Once trained, the model will be able to take in the camera feed as input and actively detect when the driver is focused or not.

Initial training data for this model will be obtained from MPIIGaze or EYEDIAP. These are large, publicly available datasets used to train models in gaze estimation. The value of this technical solution will be demonstrated when the model is able to accurately detect when the user is not paying attention and produces a large warning sound in response.

STS Project Proposal

DriveWell is an AI-driven telematics platform created by Cambridge Mobile Telematics in 2010 (Cambridge Mobile Telematics, 2023). This platform has the ability to connect to various Internet of Things (IoT) devices, including phones, dash cams, sensors, the car itself, and etc. It can then aggregate all the data it collects from these sources, fuse them with contextual data, and ultimately create a unified view of driver behavior. The fundamental concept behind DriveWell is gamification. After aggregating and analyzing all the data it has access to, DriveWell constructs a holistic driver score. This score is based on a variety of factors including amount of time on the phone while driving, acceleration patterns, collisions, speed, and etc. (DriveWell, 2024).

Based on the technology's purpose and operation, it seems as though DriveWell has been designed for the general public. It is commercially available and ready to download by anyone. Moreover, according to the mission statement of Cambridge Mobile Telematics, "Its mission is to make the world's roads and driver's safer."

However, Cambridge Mobile Telematics fails to realize that the gamification aspect of their technology does not have universal appeal. The users of this technology, which are ultimately the everyday drivers, would not find joy in gamifying their daily driving. There are

two key reasons why. First, there is no real incentive for drivers to try and score lower than their peers. For example, consider Netradyne, a company serving AI technology to regulate fleet driver safety. They follow a similar model to DriveWell by providing each driver with a score based on their safe driving. However, drivers in each fleet typically have a monetary or promotional incentive by their hiring companies to score higher than their fellow fleet drivers. (Netradyne, 2024). This is not applicable to daily drivers in the real-world. Second, many drivers would likely be concerned that insurance companies may eventually start using the driving score as an influential factor on their insurance rates, which is something DriveWell has already considered doing (Cambridge Mobile Telematics, 2023).

As aforementioned, the core idea behind DriveWell is building a community of drivers that all help each other drive safer by gamifying the act of driving. While the technology behind DriveWell works perfectly in a technical sense, it has failed to gain traction in the public domain. This can be explained by one of the fundamental STS concepts. The success of a technical project can never be independently defined by the effectiveness of its underlying technology. Various social factors play just as much of a role when it comes to widespread public adoption of the project. The designers of DriveWell made bold assumptions that gamifying driving would be a fruitful way of delivering their technology to the world. I argue that these assumptions are inherently flawed and incorrect.

My argument draws on the framework of user configuration, created by British sociologist, Steve Woolgar (Woolgar, 1980). This framework examines how product creators envision their users and design systems to shape user behavior and experiences. In the case of DriveWell, the designers configured their users as individuals who would find gamified driving scores engaging and motivating. This configuration overlooked the broader context of daily

driving habits and the lack of tangible incentives for most drivers. The misalignment between the designers' vision and the actual needs and preferences of everyday drivers resulted in poor adoption of the technology.

To support my argument, I will explore case studies of gamified applications in different industries to reveal how a lack of real incentives in a gamified system results in failures. One primary corroborating evidence that I will take into consideration is Nike FuelBand. Nike FuelBand was a wearable fitness tracker that tried to motivate users to workout by earning “Fuel points” and associated leaderboard rankings (Muoio, 2017).

Conclusion

In summary, my technical project will deliver an innovative system that tracks driver gaze using interior cameras and machine learning to detect and alert distracted driving in real time. This design aims to directly reduce instances of texting and driving, potentially saving lives by preventing accidents before they happen. Meanwhile, my STS research will use the user configurations framework to explain how various social factors influence the adoption of such technical solutions, specifically through the case study of DriveWell. Insights from this research, such as the importance of user incentives and the psychology behind driver behavior, will be crucial in refining and effectively implementing my technical solution. Together, these projects address the sociotechnical challenge of distracted driving by combining a robust technological intervention with a nuanced understanding of the social dynamics at play, ultimately aiming to create safer roads and reduce the devastating impact of car crashes.

Word Count: 1848 words

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