Prospectus

Building a Communications Management System for the Staunton Makerspace
(Technical Topic)

Programming Autonomous Vehicles to Balance Driver Safety and Public Appeal with the Moral Responsibility to Minimize Fatalities
(STS Topic)

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

It goes without saying that communication is a vital part of everyday life. Communication can make or break successful teams and organizations, and as technology evolves, it has taken on a new meaning in the past few decades. Today, we are surrounded by numerous means of communicating, and while this variety of outlets offers plenty of convenience, it also comes with the downside of making communications harder to keep organized. This is especially true for smaller groups who may rely on multiple forms of contact for communication but are without a way to consolidate their messages. The Staunton Makerspace, a fast-growing location for 3D-printing, woodworking, and other projects, is facing such a dilemma, as their membership uses several methods to communicate. My team's goal is to not only provide a more uniform form of communication, but to also consolidate all of their current forms of communication into a single web application. With this application, my team will create a universal communication platform to aid the growth and organization of the Staunton Makerspace.

My STS topic does not share very much in common with my technical capstone project, but it can be noted that the driving force behind the project – communication – still has a large effect on it. As our society inches closer to welcoming in autonomous vehicles (AVs), there are many very important questions to be answered. There is clearly a wide range of potential benefits, from reducing accidents to increasing efficiency of vehicles, but AV developers have done little to alleviate any of the public's concerns. These concerns include some important details like pricing, design, and the actual ability of AVs to drive better than humans, but these problems should all be answered in the coming years. What's more important to many eventual buyers is the car's programming, which, due to the nature of AVs, will be responsible for all

decisions, taking the human element out of driving. And if ever a situation arises where a difficult decision must be made, the code must exist to decide it, whether the driver would agree or not. As a group, autonomous vehicle manufacturers must find a way to balance several huge issues: saving lives, preserving morality, and maintaining enough public appeal to convince people to put their lives in an unbiased algorithm's hands.

Technical Topic

The Staunton Makerspace has a technologically diverse community of members. They have technologies including 3-D printers, woodworking tools, and electronics stations, meaning enthusiasts and professionals alike are drawn to it. Before this project, the leaders of the Makerspace contacted members using emails and a Slack channel. This was a fairly slow operation for them, as they had to log into many different accounts. After logging in and sending a message, there is no guarantee that the members will actually view their messages. Many members do not check these methods, and the leadership wishes to create a better system to effectively communicate with all members of the Makerspace. This communication barrier lowers participation in the Makerspace and leaves many members uninformed, and our team has been tasked with removing this barrier by creating a uniform communication system for the Staunton Makerspace.

Since the Makerspace provides a physical location that members go to, we are developing a "smart bulletin board" that will automatically show members both general and user-specific information once they scan their RFID chips to enter into the facility. This solution will provide all members with a centralized location to view any messages they would have from leadership or other members. With the added benefit of having a physical location that all members use, all

members of varying technical abilities and strengths will be able to view their own specific messages. This will help leadership and general members better share correspondence within the Makerspace community.

Our goal in this project is to develop a highly available, cloud-hosted web application for the Staunton Makerspace to enhance their communication abilities. In essence, our team desires to bring the notifications that need to be seen by each user directly to them, thereby reducing the amount of effort required to stay informed. In order to ensure that our product meets our clients' expectations, we worked directly with them to develop a list of important system requirements that our team will continue to work on. Our team has been given several minimum requirements which must be met by the end of this semester. These include allowing users to use our system to send messages to other individuals, the entire membership of the makerspace, or members of specific guilds. We must also make a display mode that the makerspace can use to show notifications to members as they enter the building via a key fob. This display mode will be used in a kiosk near the entrance, so notifications must be clearly visible and kept relatively short. Our team also has desired requirements, which must be met by the end of next semester. The most significant of these is the task of displaying messages from all of the makerspace's preexisting forms of communication, such as Slack and email, as additional notifications. Our system must also allow for users to create accounts and then subsequently log in to view personal messages without having to look at the kiosk display.

In addition, we have a set of optional requirements, and these requirements do not all have to be met by the end of the project. These include the ability for users to view information about their status in various guilds and current machine certifications, as well as giving users the ability to edit their guild membership. Another optional requirement is to be able to let users set

notification preferences for the display mode, and we also plan on showing various general notifications - and potentially a ticker for praising members - on the display when someone isn't entering the building. We expect to meet most, if not all, of these optional requirements in addition to our minimum and desired requirements, and we have already begun completing the first few minimum requirements.

STS Research Topic

Perhaps the best way to properly explain the ethical dilemma that AVs are facing is to examine the case of the so-called "trolley problem" (Nyholm & Smids, 2016). In this hypothetical scenario, a person is tasked with either allowing 5 people to die by doing nothing or acting immediately to save those 5 people but ultimately killing 1 person who was not initially in any trouble. This exact scenario is very unlikely to actually occur, but in a world where possibly billions of self-driving cars may soon share the road, some variation of this issue is bound to happen (Bonnefon et. al, 2016). As a human, you may be forgiven for making such a rapid decision, but an AV's manufacturer must make this decision far in advance and be ready to deal with the consequences.

What is most significantly missing from the trolley problem is of course the risk associated with the passengers of an AV. The trolley problem poses no danger to the person making the decision, but if a vehicle must choose between killing its passenger or killing 10 people, this becomes an entirely different issue. According to a study of respondents from Amazon's Mechanical Turk, 76% agree that AVs should sacrifice their passenger in this case, but they only scored their likelihood to buy such an AV at 19 out of 100, signifying a hesitation to actually adopt such a morally correct vehicle (Bonnefon et. al, 2016). It also appears as though

drivers care far more about the "perceived usefulness" of AVs and trust in them than they do about the potential convenience AVs could bring (Choi & Ji, 2015 p.698). This idea of easier driving was a huge factor behind the rapid development of autonomous driving technologies, largely driven by DARPA's initial push 2 decades ago (Bimbraw, 2015), but the public is reluctant to buy AVs for that reason alone.

Recent development setbacks and accidents haven't done anything to alleviate the public's general hesitation at the idea of self-driving cars. A recent crash in Tempe, AZ in 2017 led to a wave of angry public responses, ultimately forcing Uber to suspend their AV test program despite the fact that the AV involved was seemingly obeying traffic laws at the time (Bissell, 2018). Another survey from 2014 showed findings that agreed with this trend of distrust, stating that drivers were "very concerned" about riding in fully autonomous vehicles (Schoettle & Sivak, 2014 p. 12). Drivers were also found to be unlikely to buy an AV for a price any higher than non-AVs, and would expect to spend their time in an AV watching the road anyway if they'd even be willing to ride in the first place (Schoettle & Sivak, 2014 p. 17). Manufacturers aren't exactly giving the public any reason to change their opinions, either. Waymo and other manufacturers recently asked that the NHTSA quickly remove the restriction that cars must include a wheel and pedals to drive, despite not having self-driving cars that are currently safe enough for this change (Hawkins, 2019). This suggests that there is a massive disconnect between the goals of AV manufacturers and what the public wants.

On the issue of making the right ethical choice, it seems as though this dilemma is best examined through the lens of virtue ethics as opposed to utilitarian ethics. Virtue ethics is primarily concerned with doing what a person would feel is the most morally correct, while utilitarian ethics takes a purely material look at our actions. Here, the utilitarian solution is to just

kill as few people as possible, but this is hardly an easy solution to sell to an already distrustful public. Instead, a more innately human solution is needed, and AV manufacturers must agree to be held accountable for any decision that is made that does not have a bias for minimizing fatalities. In truth, no ethical framework can be used to fully encompass the goals of AV algorithms, and perhaps the best agreement we can come to is a deontological approach. This field of ethics consists of a set of ethical rules that cannot be violated (Goodall, 2014), and while the vast amount of possible ethical considerations in AV accidents is too big to create a ruleset for, it represents a more humane way of looking at it than pure utilitarianism.

As for the problems associated with public distrust, I will point out some of the clear shortcomings of AV manufacturers. Their behavior and actions have hindered the social construction of technology (SCOT) for developing AVs. SCOT is a framework based on the idea that various relevant social groups can use the interpretive flexibility of technology to help it meet their desires, ultimately moving technological development forward, and this can be easily applied to the initial development of the automobile (Kline & Pinch, 1996). Unfortunately, AV manufacturers seem to want to remove any capability for humans to drive their vehicles, a move which not only makes development seem very one-sided but also potentially magnifies the problems AVs may face. The threats of security, hacking, and cooperation with other vehicles on the road – especially in a transitional period where only a portion of cars on the road are AVs – are even larger issues when the failsafe of human override is removed (Koopman & Wagner, 2017). As it currently stands, there is very little interpretive flexibility in AVs, as drivers and users are given little control of the vehicle, if any. It seems as though the only thing any relevant social groups can do is decide whether or not to buy them – clearly there needs to be more communication between manufacturers and the public.

Research Question and Methods

I intend to analyze these issues by addressing the question: How can AV manufacturers and the general public agree on a policy for making AVs both ethical and desirable? Many studies explore what people want in their AVs and what they expect from the companies that make them, and I will conduct a survey to see if I find similar results or not. The questionnaire will include both ethical questions (such as what the participant thinks the AV should do in different ethical dilemmas) and public perception questions (such as what they would want in an AV for them to buy it). I will also collect data by using interviews with both peers and older individuals, and these will involve a very different set of questions where the answer is more descriptive. The main benefit in doing both a survey and interviews is that the survey data will primarily gather data on general opinions on different factors in buying or trusting AVs, while the interview data will allow me to dig deeper on a few of these issues and hear peoples' personal opinions.

I plan on analyzing these results using deontological ethics to get a clearer (and more up-to-date) idea of what the public expects in AVs and how they should make decisions that require an ethical choice. I also want to use these results to determine which form of ethics could be used as the best course of action for AV programming – deontological ethics may not be what the public perception supports. I should be able to compare my data to the results from pre-existing surveys to see if my findings agree or if public opinion has changed. This should also indicate how effective public opinion has been in shaping AV technology, and if SCOT has become relevant in this field. I also expect to see exactly what people have to say about where they draw the line for vehicle ethics, and these results can help me identify a potential balancing point between desirability and morality.

Conclusion

My team and I are working on a communication management system for the Staunton Makerspace to aid them in their growth and to help keep their communications in one place. This project's requirements will be completed in two-week sprints over the next several months: minimum requirements will be complete by the middle of December, and desired requirements (along with most of the optional requirements) will be done by the middle of April, or whenever our final sprint ends. I additionally will be working to determine how best AV manufacturers can balance public appeal and ethical considerations. I plan on having a survey ready to send out sometime in February, and I will likely collect information from the survey and conduct my interviews in March. With this information, I hope to find trends that could lead to making the public trust AVs and helping AV companies find the most balanced ethical algorithms that the public would support.

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