Prospectus

Design and Construction of a Disinfection Robot
(Technical Topic)

The Role of Automation in the Development of Public Transportation and Parties Involved
(STS Topic)

By

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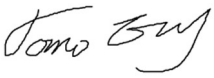
On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

Signed: 

Technical Advisor: 

STS Advisor: _____

Introduction

The overall common topic of both my technical and research topic is automation. Automation has been used for decades to streamline repetitive tasks. A machine can often do a simple task more efficiently and precisely than a human. There is a concern for safety which will be addressed in the cases below. But a major concern seems to be that machines will take jobs that had otherwise been performed by humans. As early as 1983, Bainbridge argues that this is not the case. She argues that "industrial processes may expand rather than eliminate problems with the human operator." That is to say that if a problem should arise with an automated system, an operator must now be more highly trained and skilled in order to solve a problem. Even though this was decades ago, today, Rauch "viewed operator performance as multidimensional" requiring nuanced experience and skill (2017). Even if one worker's job can be entirely replaced by automation, the worker would not need to face unemployment. A company ends up dynamically reorganizing to give the worker a new task that is not fulfilled by automation (Shestakofsky, 2017). The role of the worker does not disappear, it changes.

Technical Topic

Specifically, for the technical topic, my team and I are developing a semi-autonomous robot to disinfect surfaces that may be infected with COVID-19. As news to almost no one, COVID-19 is a highly infectious, potentially deadly virus that can be spread indirectly from person to person through surface contact. Even early in the pandemic when little was known about the virus, the World Health Organization suspected this due to its similarity to other viruses of a similar type (2020). This led to a demand for a disinfection

method that minimizes human interaction. The method we chose to use was ultraviolet (UV) light disinfection.

UV light has been shown to kill COVID-19. With variations in intensity of the light, a surface can be disinfected in as little as five minutes (Choi, 2021). But of primary importance, as should be with all things engineering, is safety. UV radiation can cause skin cancer (Raeiszadeh, 2020). Therefore, it is of utmost importance that this robot act alone and at the least semi-autonomously. So, our goal is to have this robot sense when a human is near, through something like a motion sensor or heat sensor (or both), and at least turn the UV lights off when a human is in the proximity.

Funding for the robot came from the Unites States Military more specifically the U.S. Navy. The goal is to put the robot on a naval ship so that it can disinfect each room. Since this is still a new development, we are working incrementally towards this goal based on previous attempts. Before us, a robot was developed that was somewhat large and could barely fit through a standard doorway. We hope to refine previous work so that the robot will be able to easily move through a building. This could be used in such buildings as military hospitals or other high traffic places such as office buildings. Future design and development will help the machine navigate the narrow corridors of a ship.

Automation, in this case, has admittedly removed the human from a task. This is, however, in the name of human safety. For the same reason machines are used to disarm bombs and the same reason that there are rovers on Mars, robots are sent to places where it is dangerous for a human to step. And one last point, the process of building a robot can be reiterated so that the implementation of the system could extend beyond the original

design. This could be used in nearly any building such as schools or any private business. The robot would create a robust system that would extend across many social boundaries.

STS Topic

My STS topic proposal involves the implementation of automation into a public transportation network. As mentioned above, automation can make routine tasks more efficient. A more efficient public transportation system could lead to a more robust transportation system and extend it to many who need it. According to a study in Hobart, Australia, the highest demand for public transportation is on the edges of urban centers (Currie, 2004). An efficient, automated system could extend already existing networks to these areas of need.

Brandtner address the issue more specifically in the frame of employment. "Unfilled job vacancies can coexist with qualified jobless workers, in sizable part because of a basic spatial mismatch (2019)." Despite the availability of jobs, the physical disconnect between one's home and potential place of employment is an issue. For many people, if there is not both available transportation near home and available transportation near work, then the pool of job opportunity shrinks, and chances of unemployment increases.

In a more nuanced study in 2017, Tyndall conducted a study on transit in New York City. After Hurricane Sandy, there was flooding and interruption to the transportation to a particular part of the city. Tyndall concludes that "there is compelling evidence that a sudden decrease in public transportation triggered a significant hardship for the job market prospects of affected workers." Without access to transportation that had already existed, employees that depended on it suddenly found that their job security was in jeopardy.

The argument of this paper is not to say that infrastructure ought to be immune from natural disaster, although that would be a worthwhile goal. It is instead to say that public transportation is insufficient to provide social opportunities for many who would benefit from it. This is where the role of automation could help expand a transportation system to fulfill demand.

There are many modes of transport but the focus here is automation and specifically on autonomous vehicles. There are a few reasons for this. First is economics. For other modes of transit, such as trains, there is huge infrastructure cost. From the acquisition of land to the laying of track, to the trains themselves would prove to be a huge financial burden on whomever would have to pay.

Second, autonomous vehicle can be applied buses and cars which would have similar implementations. These vehicles would be operated by similar driving mechanisms in order to operate. Development of just a few autonomous vehicles could be extended to nearly all types of road vehicles with a little modification.

And third, autonomous vehicles would minimize the cost of new infrastructure. They would use an infrastructure that is already in place (at least in the United States), that is, the already existing road network. There would be no need to build train tracks, stations and depots. Using the infrastructure that already exist would reduce the financial burden on whomever will shoulder it.

There is still wariness about the use of autonomous vehicles on public roads. According to some studies, autonomous vehicle could potentially save 30,000 lives per year. Also, if there should be an accident with an autonomous vehicle, the seriousness of the accident with respect injury or death are lower than those of human controlled vehicles

(Tettamanti, 2016). This type of automation is the same reason it has been implemented in manufacturing. Automation can make routine tasks more efficient and less prone to error.

I plan to use Act-Network Theory to examine the potential combination of autonomy and public transportation. There will be an investigation of human actors involved such as owners, operators, and users of the system. I will examine the incentive of owners, the possible career change of operators, and the social mobility of users. I suspect that the overall implementation of such a system would benefit more than it would harm. I plan to conclude this by finding more detailed case studies of those who work directly with automation and those areas who live in areas that need more transportation options.

Conclusion

Automation is used to make human task more efficient and to ensure that they are done more safely. It also helps to expand the capabilities of an organization and can lead to more innovation. This should be extended to the field of public transportation. An automated transit system would be more reliable and could potentially extend it beyond its existing boundaries. This would increase access to people that currently need reliable transportation. Future research will be on employees of public transportation systems such as drivers and operators. Though, generally automation leads to change rather than elimination of jobs, there is no evidence that I found that necessitates that this extend into the transit industry.

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