Prospectus

Novel Coronavirus Decontamination Robot

(Technical Topic)

Theory of Technological Politics on Implicit Racism Embedded in the Design of Facial Recognition Software

(STS Topic)

By

Hannah Clark

17 October 2020

Technical Project Team Members: Erin Dubas, Dan Helmus, Charlie Kellas, Cynthia Okoye, Connor Wynkoop

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: ________________ Hannah Clark ______________________

Approved: ____ Date _________________________

Benjamin Laugelli, Department of Engineering and Society

Approved: ____ Date _________________________

Tomo Furukawa, Department of Mechanical and Aerospace Engineering

Introduction

The Coronavirus pandemic has swept the world and currently has been contracted by over forty-one million people across the globe. The virus is highly contagious and can be transmitted through direct, indirect or close contact with droplets or tiny droplet nuclei called aerosols, produced by an infected individual (WHO, 2020). The primary way in which a person contracts Covid-19 is through these droplets being expelled from one human directly to another through talking, sneezing or coughing (WHO, 2020). The secondary way that the virus spreads is when these droplets land on and contaminate surfaces, which results in an indirect transmission of the virus when an uninfected individual touches a surface with these droplets and then touches their eyes, mouth or nose (WHO, 2020). These droplets can persist on infected surfaces for a few hours up to a few days and are not easy to remove (WHO, 2020). The frequency of indirect transmission makes eliminating these particles from surfaces a crucial step to preventing the spread of Covid-19. To eliminate the droplets from surfaces, I am designing a semiautonamous coronavirus decontamination robot that will use UV lights to disinfect surfaces.

However, to do this successfully, it is important to be aware of the science, technology and society (STS) implications of this project, which is apparent through analyzing the theory of technological politics. It is crucial to be aware of who technology is designed for and subsequently, who it excludes. This is an important consideration for the safety features of the semi autonomous robot which are imperative for its design. The UVC lights that the robot uses to disinfect surfaces can cause burn-like reactions on the skin and eye injuries when humans are exposed to it (FDA, 2020). This means, for the robot to be safe, its cameras must be able to recognize if a human is in the room and turn off all of its systems in their presence. But cameras may not recognize all skin colors and human figures equally. A failure to account for these limitations in designing this robot would result in a robot that may harm the people it is designed to protect.

To design the robot in a way that is effective and safe for all people, both social and technical factors must be examined. The technical process required to do this includes creating a mobile, semi autonomous robot that can fit through doorways and safely disinfect a variety of surfaces for coronavirus. While the STS framework of technological politics is used to examine implicit racism embedded in the design of facial recognition software.

Technical Problem

A prevalent method for contracting the coronavirus is through infected individuals expelling droplets and aerosols that land on surfaces. These fomites, or infected surfaces, are particularly dangerous in high occupancy facilities -- especially at hospitals where Covid-19 patients are being treated (WHO, 2020). Expelled particles can linger for up to 2 to 3 days on some fomites ("72 Coronavirus", 2019). Historically surfaces have been cleaned by humans typically using disinfectant sprays but these are becoming less popular as robots grow more autonomous (Zilgalvis, 2020). Disinfection robots are particularly advantageous for cleaning coronavirus because they are faster, cost effective in the long term and eliminate human error when cleaning (Zilgalvis, 2020). The current most popular method of disinfection for robots is using UVC lights. This method kills contaminants on surfaces and in the air by "disrupting the outer member of microbes" (Conte, 2020).

One of the world's leaders in coronavirus decontamination is Blue Ocean Robotics' subsidiary, UVD Robots ("A Quantum", 2020). Their current design is a semi autonomous robot that utilizes UVC lights in a central tube and it is capable of moving around a room, disinfecting it ("A Quantum", 2020). This design capitalizes on the thin design of the robot's body to be able to maneuver in and decontaminate small spaces ("A Quantum", 2020). A second prevalent design is the mobile coronavirus decontamination UVC robot developed by the University of Virginia (UVA) (Samarrai, 2020). This larger robot improves on the design of its competitor with the addition of an arm that also houses a UVC light that is used to decontaminate hidden surfaces (Samarrai, 2020).

Both of these designs contain valuable components but fall short by not being able to disinfect all fomites and by not being able to maneuver in tight spaces. The absence of an arm on the Blue Ocean's robot means that it is not able to disinfect certain high touch surfaces outside of the robots line of sight such as the backs of computers. On the other hand, the UVA robot has a larger, and heaviver base to counteract the weight of the arm. The aforementioned design makes it challenging for the robot to fit in small spaces and through doorways which on average can be as small as 30 inches across which is the same length as the UVA robot's smallest horizontal dimension ("What size", 2019). The added weight on this robot also makes it slower, less efficient and therefore cost more money to operate. With the current designs, operators must choose between a more efficient and nimble robot that will leave some infected surfaces uncleaned or a thorough robot that is less efficient, cannot fit in tight spaces or through some doorways.

The goal of the technological project is to design a coronavirus robot that utilizes the arm design incorporated on the UVA robot while also maintaining the maneuverability and efficiency of the Blue Ocean model. To accomplish this, the UVA robot design will be adapted and given a smaller horizontal dimension to optimize the number of spaces it can maneuver in. The placement of the UVC lights will also be reevaluated to maximize the efficiency of each tube while the robot is in use. Additionally, the robot will be given additional cameras to increase safety and remove any blind spots. To test this design, CAD, or computer aided design software, will be used to create and test the durability of the robot's frame by analyzing the stresses on each component. The robot's electrical system will be tested through visually seeing the robot move and the UV light turn on. The software will be tested through trial and error to determine how to optimize the robot's set path and safety features. Finally, the most efficient design for both UV light placement and software will be selected by comparing the time each design iteration takes to disinfect a set room. The performance of the robot will be compared to the previous model created by UVA of this robot in terms of efficiency, size, and weight.

STS Problem

The Hewlett-Packard (HP) MediaSmart computer was released in 2009 and included many new high tech features including a face-tracking software which was designed to track a user's face and keep it in the center of the camera frame (Staff, 2009). The software was developed to use an algorithm that "measures the difference in intensity of contrast between the eyes and the upper cheek and nose" to determine when a face is present (Staff, 2009). From HP's perspective, the face-tracking software was created to make it easier to see and track a user's face to make filming with the webcam easier ("HP notebook", 2020). However, only looking at the tracking software from the perspective of HP leads to a misguided understanding of this technology. Shortly after the computer's release, a video of a black and a white coworker testing out the face-tracking software was posted on YouTube (Zamen, 2009). When the white woman, Wanda Zamen, enters the camera's sight the software tracks her face exactly as expected (Zamen, 2009). But as the black man, Desi Cryer, enters the camera's line of sight and moves his face around the screen nothing happens (Zamen, 2009). The face-tracking software does not follow him or react in any way to the presence of his face (Zamen, 2009). This video has received over 3 million views from customers around the world and highlights the unintended political work HP's face-tracking software is doing and its inadvertent effects on racial power dynamics (Zamen, 2009). Awareness about the uses and shortcomings of this product will help HP understand the political consequences of their designs.

I believe that it is imperative for producers to form a better understanding and work to eliminate racial bias that is often integrated into facial recognition software. By doing this, we can help prevent racial bias in designs that intentionally or unintentionally marginalizes users with darker skin tones. To examine this inequity, I will use the STS Framework of Technological Politics to determine the impact of implicit racism embedded in the design of facial recognition software. Technological politics refers to how a technology reflects and shapes social relations of power and privilege either intentionally or unintentionally resulting in the benefit of one group over another (Winner, 1980). This theory will strengthen the understanding that although new technological advancements in camera recognition can create many benefits to society, we must account for who these advancements exclude through unintentional bias present in the designs of these softwares. In this case, the HP MediaSmart computer's facial-tracking software was designed for people with white skin and in doing so, the group of users with darker skin was implicitly told that this product was not created for them. To make this argument I will analyze HP press releases, as well as a YouTube video depicting two users interfacing with the software.

Conclusion

The technical report will provide a novel design for a coronavirus decontamination robot that will optimize mobility, cameras, and UV light software and placement to create a more efficient and safe robot. The improvements made will focus on a smaller base for the robot to maneuver on, more cameras to increase safety, and more efficient placement of UV lights, including on an arm so the robot can disinfect a wider variety of surfaces, including outside its line of sight. The STS research paper will explore the concept of technological politics by analyzing the controversy that arose from the HP MediaSmart face-tracking software and how designers benefit from understanding unintentional racial bias in their facial recognition softwares.

The technical report and the STS report will each help fix the socio-technical problem of designing a robot that is both safe and effective for all people. The technical component will help with the design of a robot that is better at maneuvering through tight areas, has a greater efficiency and increases the safety of people who work in that space. The purpose of the STS paper focuses on increasing understanding of the implicit racism that is embedded in the design of facial recognition software.

Word count 1774

References

72 Coronavirus statistics you might not know. (2019). Retrieved October 21, 2020, from https://www.everlywell.com/blog/covid-19/coronavirus-statistics/

A quantum leap for disinfection robots globally. (2020, September 10). Retrieved October 21, 2020, from https://www.uvd-robots.com/blog/a-quantum-leap-for-disinfection-robots-globally

Conte, D., Leamy, S., Tomonari, F. (2020). Design and map-based teleoperation of a robot for disinfection of COVID-19 in complex indoor environments. Retrieved October 14, 2020, from https://docs.google.com/document/d/1a3Qa3qNn7exv-Tm6HfQYtpjG1ZGsVkN65h3CVVAj4zc/

HP notebook PCs - using HP MediaSmart software webcam feature. (2020). Retrieved November 12, 2020, from https://support.hp.com/us-en/document/c02002284

Samarrai, F. (2020, June 05). Mechanical engineers develop Coronavirus decontamination robot. Retrieved October 21, 2020, from https://news.virginia.edu/content/mechanical-engineers-develop-coronavirus-decontamination-robot

Simon, M. (2009, December 23). HP looking into claim webcams can't see black people. Retrieved October 21, 2020, from http://www.cnn.com/2009/TECH/12/22/hp.webcams/

Staff, C. (2009, December 22). HP responds to claim that face-tracking software is racist. Retrieved October 21, 2020, from https://www.crn.com/news/components-peripherals/222002954/hp-responds-to-claim-that-face-tracking-software-is-racist.htm

Transmission of SARS-CoV-2: implications for infection prevention precautions. (2020, July 9). Retrieved October 21, 2020, from https://www.who.int/news-room/commentaries/detail/transmission-of-sars-cov-2-implications-for-infection-prevention-precautions

UV lights and lamps: ultraviolet-C radiation, disinfection, and Coronavirus. (2020, August 19). Retrieved October 23, 2020, from https://www.fda.gov/medical-devices/coronavirus-covid-19-and-medical-devices/uv-lights-and-lamps-ultraviolet-c-radiation-disinfection-and-coronavirus

What size door is right for your entry? (2019, August 09). Retrieved October 21, 2020, from https://www.pellabranch.com/blog/global-blogs/average-size-entry-door/

Winner, L. (1980). Do artifacts have politics?, *Daedalus 109* (1), 121–136.

Zamen, W. (Producer). (2009, December 10). *HP computers are racist* [Video file]. Retrieved October 21, 2020, from https://www.youtube.com/watch?v=t4DT3tQqgRM

Zilgalvis, P. (2020, March 19). Danish disinfection robots save lives in the fight against the Coronavirus. Retrieved October 21, 2020, from https://ec.europa.eu/digital-single-market/en/news/danish-disinfection-robots-save-lives-fight-against-corona-virus