APPEARANCE MODIFIER FOR REMOTE DIGITAL VIDEO COMMUNICATION AND HOW THE STARTUP ENVIRONMENT INFLUENCES ENGINEERS PRODUCTS, PRACTICES, AND ETHICAL DESIGN

EFFECTS OF THE STARTUP ENVIRONMENT ON TECHNOLOGY EXTRAPOLATED FROM THE EFFECTS EXERTED ON STARTUP ENGINEERS AND MANAGERS

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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

The technical topic, as assigned by the Dept. of Electrical & Computer Engineering and as constructed in the capstone design project, is the implementation of a moving ring light that uses head-tracking data generated from the user. This project was created due to the current online environment facilitated by social distancing during the coronavirus pandemic. The lack of exposure to other people meant that the presentation of individuals was not only limited to their appearance but the quality of their video capture. Suddenly on top of personality or appearance, new variables like lighting, webcam quality, and webcam tracking became just as relevant. This device was created in order to improve the quality of the video capture such that each individual isn't represented poorly in an online environment.

The technical subject of the STS prospectus and the technical topic for the Dept. of Electrical & Computer Engineering is not related. The subject that will be researched in the STS Prospectus is an exploration of how engineers during the design process develop harmful misconceptions towards the effects of their products. This dissonance between the impact the product has on stakeholders and the engineer's impression of its use is detrimental to developing technology that benefits the people it affects. To better understand the extent of this, several engineering design projects within a local startup will be studied along with a personal autoethnography account of design experiences as an engineer in Medlock LLC. This research will also include how ethical reflections may be neglected that contribute to these misconceptions, whether it's from cultural or environmental causes. The extent of these external influencers will be identified, categorized, and given relevant context to better understand the cause of this dissonance.

TECHNICAL TOPIC

Due to COVID-19, there has been an unprecedented increase in those working from home. However, the current increase in remote work is not an isolated incident. Global Workplace Analytics (2020) found that between 2005 and 2018 there was an increase of 173% in regular remote working. The increase in remote work has outpaced the growth of the workforce by 11%, indicating that a growing portion of jobs are remote, with an estimated 56% of employees whose work could be completed remotely (Global Workplace Analytics, 2020). Thus, remote work is expected to remain a not-insignificant portion of the workforce.

However, even when working from home, appearance bias is still an issue in the virtual workplace. Thus, it is in an employee's best interest to take steps to protect themself from the effects of appearance bias when on camera in virtual meetings. According to Zoom Video Conferences (2020), the optimal lighting of one's face is with the primary light positioned "in such a way that it sits above you and points just above your head. You do not want the majority of the light to hit you, but you want just enough to make your face a bit more brilliant on-screen." By utilizing good lighting, an employee can improve the perceived appearance, minimizing the negative effects of appearance bias caused by the Halo/Horns Effect (Mahajan, 2007).

The Automated Ring Light is a device for providing direct illumination to the user's face as they move about their workstation. Positioned behind the primary monitor, it will track the user's movements via a sensor on a headset and move left and right and rotate as needed to keep the ring light directly focused on the user from any angle they work at. In the age of video conferencing and the prevalence of appearance-based judgments in the workplace, this device aims to present the user at their best to co-workers, clients, and managers. This issue does not affect men and women equally, however. "Where attractiveness is a highly desirable trait for women,

attractiveness is thought to be less important for the traditional male role" (Wong & Penner, 2016). This leads to a disparity where, for women, "the perception of beauty seeps so deeply that external appearance simply equals aptitude and professionalism," and men seldom have their looks conflated with their professional abilities (Leibu, 2014). This device aims at allowing the user to tackle this unnecessary hurdle.

However, one projected issue with the Automated Ring Light is that it does not attempt to solve the problem of appearance bias. Instead, it plays into appearance by instead aiming to improve the presentation of the user. By doing so, the Automated Ring Light perpetuates appearance bias. In a way rather than addressing the cultural problem of people being unfairly judged on presentation, we are creating a product that improves the user's presentation due to the cultural issue they face. This leads to more people conforming to bias expectations, which further normalizes the bias (Mahajan, 2007).

Furthermore, another projected issue is the anticipated high cost of the device. This could potentially bring concerns about possible class discrimination. Considering the intersectionality of appearance bias and class bias, it is pertinent to also consider the relationship between those who are perceived as "more attractive" and higher average salaries (Bartlett, 1994). The combination of a high price along with the Automated Ring Light contributing to potential appearance bias, while helping minimize the effects of appearance bias for an individual, could result in further expanding and enforcing the effects of appearance bias in the workplace as a whole.

STS PROSPECTUS

Introduction

From Summer 2019 to Summer 2020, I worked at a biomedical startup Medlock LLC where I oversaw the development of two products designed to track the consumption of controlled substances for a patient. One product tracked the consumption of medication in the form of pills, while the other tracked the consumption of Suboxone strips designed to treat Opioid Use Disorder (OUD). During the development of both products, I had the opportunity to observe a team of engineers undergoing all stages of the design process. Each iteration of the device we produced solved a multitude of functional problems that arose from the feedback we received; all changes were meant to improve the user experience. This feedback was the fuel that drove the engine of growth and allowed us to design an effective product that can succeed economically outside of the lab.

However, our startup was in a unique situation regarding our limitations in what data we can obtain in each of our medical trials. We found that through the development of both devices, the only way to generate feedback was to interview the doctors and patients who interacted with the product directly. Other methods of data acquisition relating to the trial were ineffective due to the trial's short period of only one month. Data relating to patient drop-off, behavioral patterns, and opioid abuse could not be generated for each iteration. Therefore, in order to rapidly improve the products, we used interviews to supplement the design process. These interviews were thought to be informative; however, the quality of the feedback was more variable to bias than initially thought.

The engineering team within the startup was mostly composed of undergrad engineering students or recently graduated engineering students. Within the team there was a sense of naïveté regarding the expectations in the feedback we would receive. Often many engineers experienced a university education that defined the design process through outlining design constraints and creating a solution to meet the specified constraints. This design process, as we understood it, was based on an objective set of parameters that allowed for problems to be clearly defined and solved. However, once we were independent of any authority to provide us with constraints, it became difficult to define objective constraints to build and refine from.

In absence of these methods, we began to base shared experiences among the patient population or doctors as objective fact rather than subjective impressions. This led to a dissonance between what the designers understood were the effects of their product and the reality of how the product affected the population. This dissonance continued to go unnoticed due to the feedback of the medical clinics and the impression of positive patient interaction being prioritized over everything else. Rather than focusing on the utility of the product, we focused on the impression of the product, which we assumed were one and the same. Any objective data we accumulated independent of interviews was also subjected to the imperfect interpretation of the engineering team.

In addition to this, the environment the engineers worked in had a profound effect on cultivating this dissonance. Due to the small size of the startup, there was little to no organizational oversight to the engineering team, which resulted in many design decisions not receiving ethical examination. Often short deadlines made each iteration receive little consideration beyond the utility or functionality of the device. No ethical frameworks were implemented, nor was any ethical research done in preparation for the device's medical trial. This lack of internal accountability may

have contributed to this dissonance, and as a result may be relevant to how subjectivity can remain unchecked during engineering design.

Ultimately, the experiences gained from designing two products at Medlock LLC began to raise many questions regarding the effectiveness of formal engineering design education in practice. The biases experienced by the engineering team resulted in a systemic dissonance that affected the actual utility of the device. Any ethical framework or ethical research that could've negated this dissonance remained unused. This topic demands research to potentially understand how and why ethical oversight in engineering design in practice may be neglected. Using this knowledge, it may be possible to modify the idealized engineering design education in order to account for the social, cultural, and technical influencers that may cause this neglect and dissonance.

Research Question

This research project will focus on exploring the essence of this broad question. Do engineers possess a bias towards the technology they design that skews the impression of its effects? However, in order to better refine the research objectives better the following additional questions will be asked. These questions are made with a specific focus on understanding the extent and cause of the observed dissonance between the impression of engineers and the actual effects of the technology they design.

To begin the research, an important step that must be taken is validating that the research topic exists beyond the subjective context it was discovered in. Therefore, the question "Do engineers in design corroborate the existence of this bias or have they experienced the effects of this bias in the past?" is especially relevant. By answering this question, it will provide a foundation

of understanding that will allow the other questions to build on. In an attempt to answer this question, it is anticipated that along with confirming the hypothesis of the proposed research it will also be the first step towards creating points of contact for interviews.

Thereafter by confirming the existence of this bias, the next question that should be focused on is the extent of its existence. The question, "Is this bias shared among all engineers working on the technology?" is necessary to gauge the relevancy and prevalence of this question in engineering. In particular, this question determines if the extent of this bias is based on an individual or group basis. This question intends to narrow down the possible origin or influences that contribute to these subjective biases in design. Another clarifying question that will be asked that also determines the scope of this bias is the question, "Which design environments share this bias?" This question serves to determine possible patterns present in the environment depending on which environments share it.

Once the prevalence and extent of this bias is better understood the next question to ask is, "Does environmental stress, such as a lack of time and resources, contribute to engineers neglecting ethical or objective reflections during the design process?" These external influencers have been anticipated to affect this bias and mandate to be studied in order to confirm their relevancy. The last clarifying question to be asked after this is to determine if these environmental influences affect the prevalence of this bias. Therefore the question, "Does a lack of ethical examination contribute to engineers developing a bias towards the effects of their technology?" will be asked. This research will outline the scope and context of this dissonance through individual case studies personally experienced. Through these case studies patterns and experiences relating to this dissonance will be used to approximate what parts of the design process it affects.

Literature Review

To better understand the context this research, various sources are shown here that relate to past studies that explore issues with engineering design. Present in the paper written by Steverson (Steverson 2013) is an account of how unethical decisions may manifest out of necessity in a startup environment. The ethical violations made within startup environments are diverse in effect and context. Within the research paper written by Steverson et al. presents an example of one of these ethical violations. There is a phenomenon of "legitimacy lies" in startups wherein the presentation of products or services is purposefully altered due to existing pressures in startup environments.

The extent of these alterations often involves willfully misleading the financers of the organization or relevant stakeholders about the startup's performance or product effectiveness. These lies are ethical violations made with the conscious intent to reduce the risk present within the startup. Often these lies are made of necessity among those in leadership positions to compensate for the lack of established reputation for newly created startups. This lack of reputation creates a barrier towards gaining legitimacy, which can prevent the startup from allocating resources necessary to improve the quality of their products or services.

In addition to the existing research towards environmental effects on ethical violations, the research paper created by Vakkuri et al. (Vakkuri 2020) recorded several case studies of startup companies neglecting implementing ethical frameworks or making socially informed ethical decisions regarding the product or service they were developing. In particular, the startups were software-based, made frequent use of artificial intelligence, and were within the biomedical industry. Among these startups, four shared qualities relevant to the case study. All startups shared agile development methods with a focus on developing multiple prototypes to be tested. In addition

to the short time between prototypes, the startups experienced notable time pressure and scarce resources.

To examine these startups, Vakkuri et al. (Vakkuri 2020) provided a research framework based on the ART principles of AI ethics. This framework consists of three places of focus within a case study of ethics. These are Accountability, Responsibility, and Transparency. Transparency is first prioritizing basic understanding of the system being studied. This includes understanding who made which decisions, which allows accountability to be developed. From accountability, designers within a system are liable to explain and justify their decisions to external stakeholders. The last category, responsibility, is more abstract and relates to the attitude or moral obligations relative to responsibility.

From each interview, they discovered a shared psychology that was present between all startups. These lines of thinking reflected a lacking presence of ethical accountability in the studied organizations. It also reflected how each engineer exempted themselves from making ethical design decisions. Based on these findings, they thereafter categorized each conclusion under three distinguished types: accountability, responsibility, and transparency. They determined that the developers felt responsible for problems strictly relating to the development of the product rather than the effects of the product itself. While each of these developers expressed ethical concerns, due to the time and resource constraints, there were little to no ethical frameworks implemented to tackle these concerns. While all people within these startups acknowledged transparency and ethical decisions were a goal, there was no formal effort to pursue these goals. This and other common patterns emerged to explain why these organizations possessed a performance-based culture that didn't consider the consequences of their design decisions.

In the research paper presented by Ibo van de Poel (Poel 2001), he explores ethical aspects present in the engineering design process. He particularly focuses on common ethical issues and visible shortcomings of the current approach to engineering ethics. Ibo van de Poel examines these issues by providing ethical insights to a case study on the design of alternative refrigerator coolants following the ban of CFC 12. A ban that eventually resulted in the adoption of the expensive and patentable HFC 134a coolant. HFC 134a was the coolant that was picked in contrast to the flammable yet environmentally friendly HFC 152a coolant. While the HFC 134a coolant was expensive it also had unique manufacturing requirements that could be easily patentable. This patentability was prioritized over the HFC 152a coolant which while being cheap easy to manufacture was unpatentable.

During the design process in picking a new coolant the was little regard given to the ethical implications of their decision. In fact, the extent of their ethical decisions was determined solely by government regulations. Present in the psychology among these engineering design teams was a notion that the role of making decisions with respect to the safety, health, and the environment was the role of external regulation by government agencies. Often any relevant ethics were incorporated into the design only implicitly or considered purely technical. In the case of the refrigeration coolant, the criteria to ethically determine which chemical would be chosen wasn't based on any ethical framework or the environment the product would exist in. Rather all ethical decisions were based on the ASHRAE Safety Code for Mechanical Refrigeration. From these regulations' requirements were made that provided the framework for making the design decision on which coolant to use.

Proposed solutions to improve the ethical awareness of engineers have mixed results. Attempts to divide the ethical and technical aspects with design have proved insufficient.

Engineers not taking an active part of making ethical decisions results in a lack of technical expertise necessary to make a decision that benefits all stakeholders. While engineers generally follow norms and rules in work, there lacks a normative framework that is consistent with the unique demands each engineer faces. Furthermore, even if there was an existing framework, most engineers operate as employees in organizations. This means the extent of their ethical reflection is limited by their employer's management.

Ibo van de Poel proposes two systemic issues and potential solutions. One is to include the affected stakeholders in the decision-making process itself, and the other is to allocate ethical responsibilities to each person within an organization such that the ethical design decisions are made independent of individual volition. These modifications would encourage or mandate those in the organization to reflect on ethical decisions out of necessity. Such a system would be made to minimize undesirable consequences from the designed technology.

In another paper presented by Ibo van de Poel et al. (Poel 2008) four case studies are conducted regarding how different design processes result in different ethical decisions. Two involve implementations of normal design and two implementations of radical design. Normal design entails a design process in which engineers use a regulative framework to make ethical decisions. These include design processes limited by legislation and regulations implemented by external organizations that relate to minimum requirements for sustainability, pollution, and safety. In contrast, radical design doesn't have a regulative framework that can be applied to guide or shape ethical decisions. Ibo van de Poel et al. showcases the difference between how the two design processes approach ethical decisions in engineering design.

Present in normal design between the two products being built, one of which was a chemical pipe and the other a bridge, both engineers used the established safety standards to help

guide parts of the design process. However, depending on the extent of the regulations and the established culture of responsibility within the organization, the engineers did not focus on safety regulations that they weren't liable for. This includes construction safety standards, which were seen as the duty of contractors rather than the engineers.

The other two case studies involved the use of radical design for lightweight automobiles and lightweight trailers. In contrast to normal design, the radical design approach constructed their ethical decisions around norms they created during the design process. Due to the unique circumstances of the design, there was no regulative framework that could be easily applied. These norms were supplemented in absence of that and were often based in experience relating to the work at hand. Therefore, these ethical decisions were largely made on intuition and based on professional engineering culture or company culture. This presented an issue for the trailer design case study, as they notably neglected traffic safety without regulative oversight.

In the paper by Friedman et al. (2003), several case studies of Value Sensitive Design are presented along with the description of Value Sensitive Design (VSD). Value Sensitive Design is a practical approach to making informed ethical decisions by incorporating the values of relevant stakeholders into the design process. It is composed of three stages which are, conceptual, empirical, and technical. During the conceptual stage designers examine the values of stakeholders and determine how the technology may negatively or positively affect these stakeholders. The next stage, the empirical stage, involves the logistics and the extent of these values that stakeholders have. During the empirical stage designers examine which values should be prioritized and how these values can be practically included in the design process. The final stage, called the technical stage, involves examining how the technology's existing properties may impact the values of the

relevant stakeholders. Additionally, it also seeks to incorporate the knowledge found in the previous stages into the technology itself.

The first case study presents an implementation of Value Sensitive Design for cookies in web browsers. Value Sensitive Design was used in order to determine how to modify how websites used and allocated user data. This application of Value Sensitive Design was made with a particular focus to improve transparency relative to the user. In the conceptual stage they explored and dissected what it meant to inform users their data was being used. Follow this in the empirical stage they explored among the users, who were stakeholders, if they valued privacy and if so how they valued privacy. In the concluding technical stage they constructed an interface to track, refine, and delete cookies from various websites based on the values outlined from the conceptual and empirical stage. The other case studies explored similar approach to different types of technologies.

In the excerpt written by Friedman et al. (Friedman 1996) common biases that arise in the design of computer systems that negatively impact users are articulated and listed. These biases were separated into three categories that related to the sociological context these bias originate from. These were Preexisting Bias, Technical bias, and Emergent bias. Preexisting biases are defects present in the design that originate from social institution, conventional practices, and attitudes. Often these biases originated prior to the creation of the technology itself and deeply reflects the common culture the designer or design team are exposed to. Additionally, personal biases of the designer independent of society can also be projected into the technology. Common examples of preexisting biases manifesting in technology are devices assumes or favors males more than females.

Technical bias in contrast is independent of societal biases the designers are exposed to, rather these biases arise from technical issues encountered during the design process. These include limitations of computer tools, limitations of and application of available algorithms, and the limits of human comprehension towards complex systems. These biases limit the utility of the system and presents unintentional effects that influence users. As an example, the invention of the graphical user interface (GUI) resulted in many visually impaired members of the computing community to become alienated and out of touch with new technology in the community.

The last category of bias present in technology is emergent bias. Emergent bias is a phenomenon in which the technology that was created has different effects or uses overtime depending on changing societal knowledge, user population, or cultural values. An example of this manifesting was the international distribution of education software that was originally developed in the United States. Educational products meant to facilitate learning in US classrooms were adapted to other countries. The new international users had different cultural backgrounds, which impacted the effects of the learning activities present in the software. While some competitive activities worked well for United States students in cultures that focused on group cooperation the effectiveness of the activity lessened.

The paper presented by Cummings is an application of Value Sensitive Design that details the ethical design decisions in creating a command and control supervisory display for the Tomahawk missile. In the conceptual investigation, the designers explored fundamental human values relating to the use of weapon systems and the ethical implications of waging warfare while minimizing unintended harm. Engineers do not decide in the design process to wage ware, but they do have the power to wage it humanely. Basing off established law and historical records they justify the ethical necessity in optimizing the interface of weapons of war. The essence of this

justification is that by improving the accuracy and accessibility of the platform of the Tomahawk missile, they reduce the chance of it accidentally striking unwanted targets.

Within the technical stage they adapted the value of not harming non-combatants. To manifest this value, they determined that the interface should be adapted such that it allows the user to quickly make course corrections to a launched Tomahawk missile. In addition, they also determined the user should have quick accessibility to handling failures in mid-flight. Based on these requirements, a decision support tool was created that helped users understand the state of the Tomahawk missile. This support tool took on the form of a matrix so the user could quickly view the status of multiple Tomahawk missiles at once. This matrix considered various important variables such as target priority and time criticality. Both of these variables allow for the user to make a better decision regarding correcting for course changes.

Finally, present in the empirical stage is an investigation into which values in design should be prioritized over others. The primary value, as outlined in the conceptual stage, was a system that could discriminate between targets. It was determined that excessive automation might cause an increase of failures that will result in improper targeting. Therefore, a human-in-the-loop design was experimented with. From these experiments, it was determined that the level of automation did improve faster decisions among test subjects but did not improve correct decisions. Therefore, they decided to implement an automation level that allowed the computer to help narrow down decisions while ultimately leaving the rest of the decision-making process to the user.

This case study provides a fascinating insight to applying value-sensitive design that is not found in other case studies. It showcases the versatility of the ethical framework while providing an interesting insight into how they researched and implemented technology with stakeholder

values. The methodology of the empirical stage, including the detailed description of the testing, provides an insight into how value-sensitive design may be used in the future.

the paper presented by Salvo (Salvo 2001) goes over potential implementations of user-centered design in which he details the existing methodology behind it along with the new variations of it. In particular, this paper details the change from observing user to participating with users in order to better understand how they interact with a developing technology. In user-centered design there are various communication methods that allow engineers designing the technology to receive feedback. User participation offers a unique communication method that encourages two-way communication, and thus an increased amount of transparency to stakeholders. During this communication Salvo discusses dialogue ethics as a means of ensuring users participate effectively in the design process.

Dialogue ethics is described as a way to create an identity during an exchange that results in one party being acutely aware of the humanity of the other. From this shared identity, an understanding of what the person needs is illuminated. In addition, this mutual participation allows a beneficial relationship to form between two parties. By humanizing each member of the community, a relationship can be created in which a technology that would be potentially harmful to the community could be refined with their input. Furthermore, participatory design could also be applied in a workplace environment between laborers and employers during the design process. This implementation of participatory design was created by Pelle Ehn with a specific focus towards creating a more democratic workplace that allows for diplomatic exchanges. In addition to this, various modifications of this basic framework are discussed, detailing the historical and social context each exist in.

In the paper by Devon et al. (Devon 2004), they discuss a different application of social ethics with a focus towards the structure and process of the organization the ethical decision exists in. This is opposed to the individual perspective which is based around action and consequences. Devon et al. presents multiple case studies that involve ethical decisions and reflects on it by applying their new perspective. One case study examined was a reflection on the challenger space shuttle disaster. Devon et al. examines the structural errors in the organization that contributed to the disaster. In particular, Devon et al. notes that there were poor communication channels towards informing the astronauts the risks each launch would have. In addition, Devon et al. examines the disaster of the Hyatt Regency hotel from as an organizational failure rather than a failure on the engineer who designed the suspended platform. Devon et al. suggests that failure in design is inevitable, but failure to review designs isn't. Therefore, the negligence of the disaster may be viewed as a structural failure.

From these case studies Devon et al., generalizes how to apply social ethics towards the design process. These include multiple steps that involve planning the product and defining the task the design fulfills. From these examinations the structure of the design process is created with a specific focus on designing a structure that fosters both active and passive responsibility. This includes a structure that encourages individuals to have explicit accountability while also maintaining a culture of cooperation.

The paper written by McGinn (McGinn 2003) is a collection of studies relating to the difference in ethical views in design between senior engineers and engineering students. This paper provides context to how engineers of different experience understand and interpret ethical dilemmas. In engineers with less experience ethical issues are determined based if the action would have a non-trivial effect on people. Ethical decisions often only related to experiencing harm rather

than bestowing benefit. In addition, unexperienced engineers also equate ethics to morals, and in absence of universally understood morals among engineers resulted in different interpretations of ethical dilemmas. To add to this, engineers without experiences possessed a reliance on their subjective conscience to determine their decisions during these dilemmas. These studies provide helpful insights into the thinking of different groups of engineers and may give context to the thinking in student based or graduate startups.

STS Framework

In order to record and ascertain information relative to the groups being interviewed and other interactions by using a methodology called autoethnography. Autoethnography is way to communicate experiences accumulated during studying a culture or group of people. It uses the literary style of autobiography in order to convey the subjective experiences or abstract concepts observed during studying a group. Rather than dismissing the subjectivity present in sociology autoethnography embraces it and grounds all information as relative to the experiences of the author. This methodology for recording and communicating information for this study was chosen due to the authors deep involvement in one of the startups being reviewed.

In addition, Value Sensitive Design will be used to better understand the context of the products produced by Medlock LLC exist in. This will include analyzing the values through the conceptual stage of Value Sensitive Design by referencing past interviews by patients along with performing new interviews with existing clinical contacts or patients. From these interviews shared values in the patient population will emerge along with other values of other relevant stakeholders. This includes doctors who participated in past trials along with other clinicians who were involved with the distribution of the experimental products. Following this these values along with the evaluation on which values are more important will be determined in the empirical stage. This

includes carefully examining the information obtained along with performing additional interviews to clarify these values.

From an understanding of the values the technology and its design will be evaluated to determine how it conflicts or encourage the values present in the stakeholders. This includes examining how it modifies human behavior during its use and what intentions were present in the design itself. From these examinations the product will be understood such that the intentions and expectations of those who participated in designing the device can be compared to.

Thus, upon discovering the dissonance between the effects on the product on the relevant stakeholders the engineers who built it along with the clinicians who tested it will be interviewed. These interviews will help illuminate the context of this dissonance along with the mentality of the engineers had that may contributed to it. In particular, a focus will be made on understanding shared biases among these people and categorizing them. By accumulating these biases and also providing context towards why they may have been left unchecked an understanding towards ethical neglect can be built.

During the interviews a focus on a participatory communication will be used. This includes actively partaking in the conversation during the interview and creating a dialogue rather than asking a set of pre-defined questions. This is in hopes to generating a more detailed and honest account of each individual regarding the potentially negative effects of the product they helped to create. Also as noted by the research paper detailing the methodology of participatory communication, by mutually understanding the intentions of both parties in a conversation any hostility that may arise from this question will be minimized. The humanity of each person will be laid bare and foster an honesty that will greatly help the research efforts.

Timeline

The following is an abridged timeline detailing the steps taken during the research project. The timeline will be separated into multiple weeklong intervals that require a certain amount of work to be performed prior to the date. These deadlines are planned around the end of the work week on Friday. From February 1st, 2021 to February 5th, 2021 all old interview logs and data relating to the products produced by of Medlock LLC will be obtained. This includes past interviews with patients, doctors, and clinicians who participated in the process of testing the built products. From this information each dataset and interview will be categorized and reviewed in order to determine its relevancy.

From February 6th 2021 to February 12th 2021 multiple old contact within the startup and working with the startup will be contacted for a basic questionnaire. During this questionnaire their availability and consent towards asking question relevant to this research project will obtained. From February 19th, 2021 to March 5th, 2021 there will be multiple interviews with the people contacted to the previous week. The content of these interviews relates to their past work or involvement with the product produced by the startup. In addition, questions relating to their interest during the study will be asked including expectations, wants, and intentions behind their decisions.

From March 6th to March 19th the two products created from Medlock LLC will be evaluated to determine how they benefit or harm the stakeholders who took place during this study. This analysis of the technology's affects will be aided with a detailed description and record of its design along with the input from the engineers that worked on the device itself. From this information the effects and initial intentions of the engineers will be better understood. Any visible

conflict between the intent of the device along with its observed or anticipated effects will be revealed from applying Value Sensitive Design methodology towards the products.

From March 20th to April 2th additional interviews will be performed towards the engineers relating to the conflicts between intentions of the engineers and the effects of their product. From these interviews a personal account will be recorded with the intention to determine how the expectations and environment the engineers worked in contributed to these conflicts not being understood sooner. A methodology similar to the one Vakkuri et al., will be applied during these interviews. From April 3rd 2021 to April 16th 2021 all the information obtained with the interviews will be complied and distilled. During this time period there will be a focus to understand why these conflicts may have arisen and what potential causes contributed to them. A summary of the research and the implications from the information generated will be recorded and analyzed.

From April 17th 2021 to April 30th the draft of the research paper detailing the findings, interpretations will be finalized. Thereafter the information contained in the paper will be examined by other peers and the engineers that participated in the interviews. The findings will be discussed and a conclusion detailing the interpretations from all parties will be recorded.

Conclusion

Based on established research into known issues with engineering design this research will continue to understand the why ethical decisions or frameworks may be neglected in practice. This will be done by better understanding how the environment affects engineers in making ethical decisions. This includes stress, time, and lack of organizational oversight. In addition, using the established research methodology present in the literature review for conducting interviews will

be used to generate relevant information. This methodology is based on communication models and will take on a more involved participatory approach.

All research will be performed using autoethnography to record and communicate the subjective experiences in researching the various groups of people relevant to the research. These groups include the engineers within the startup and the relevant stakeholders that were affected by the technology created by Medlock LLC. From these interviews' biases present in the engineering team will be categorized and identified. Thereafter any conflicts between the technologies affects and the stakeholders' values will be evaluated, and potential reasons behind this visible dissonance will be explored. To identify these conflicts Value Sensitive Design will be used to understand the technology and the values the stakeholders possess. The identified conflicts will then be confirmed either by interview or evaluating past interviews.

The hope of this research project is to provide a better understanding about how practical implementations of engineering design may unintentionally neglect important ethical examinations that affect people's lives. By better understanding this, future educational resources towards teaching engineers can be improved and optimized for the unique challenges each engineer may face in practice. Furthermore, better insights into how organizations can neglect ethical decisions will be illuminated.

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