Thesis Project Portfolio

Ultrasonic Automated Watering System

(Technical Report)

Corporate Transparency and Consumer Trust in Household Digital Assistants

(STS Research Paper)

An Undergraduate Thesis

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Audrey Swart

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Department of Electrical and Computer Engineering

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Sociotechnical Synthesis

Digital voice assistants and smart speakers such as the Amazon Alexa have become a staple in many of our lives. We use them to play music, hear the news, and even tell us jokes. What we rarely think about is what it really means to have microphone-enabled products in our homes. My technical project involved creating such a product, except instead of a smart speaker, it was an ultrasonic plant watering system. Regardless of the form of the technology, having a microphone in your home is an exercise in trust. The general problem underlying both my technical and STS research is the difficulty in making household microphone-enabled devices (HMEDs) that are trustworthy. This problem matters because privacy is important and we should be empowered to make informed decisions about the technologies we choose to trust and why.

The problem investigated by my STS research is that large technology companies like Amazon use selective transparency as a tactic to gain consumer trust, while failing to make consumers explicitly aware of how their data is used. I examined analyses of Amazon's privacy statements and data use, as well as what information is on their own website. Amazon claims Alexa is trustworthy because it doesn't record private conversations, it only listens for its wake word. Additionally, they emphasize that privacy is a core company value. But despite this, data from Alexa devices is used to covertly target advertisements towards consumers. I also examined a selection of research papers discussing the broader ideals of transparency and trust, and I found that anthropomorphization is a major avenue through which trust is formed in smart speakers. This phenomenon combined with selective transparency contributes to Amazon fostering misinformed trust from the public.

The problem addressed by my technical work is the difficulty in keeping up with houseplant care. Some plants have needs that are more nuanced than a static watering schedule, and it's also easy to sometimes be forgetful as a plant owner. My teammates and I examined new research that plants make ultrasonic sounds, and these sounds become more frequent when a plant is dehydrated. We used this research to develop a microphone system that can detect plant sounds and automatically distribute water to a plant. Therefore, our solution to the problem was an HMED. We claim our device is trustworthy for a consumer to have in their home because it's entirely unrelated to personal data – it physically filters out all sounds except those at ultrasonic frequencies, well above the frequency of any noise a human could make. However, similarly to smart speaker devices, the bottom line is that there is no way for consumers to verify the HMED is only recording what it claims to.

My STS research offers a partial solution to the general problem because it provides an avenue for consumers to critically evaluate where they place their trust and what factors might be affecting its formation. I believe that I achieved all I set out to do in regards to my STS research, but the vastness of the issue at hand means there is much left to be investigated by future researchers. For example, how should large technology companies navigate the level of transparency they have with consumers? Is there any way to make HMEDs verifiably trustworthy? My technical research provides an example of one way to attempt to make a trustworthy HMED, but the project did not come to full fruition due to time constraints. We were able to verify our design worked using digitally simulated ultrasonic sounds, but we were unable to verify it with actual houseplants. Continuing this work would involve creating an experimental setup to listen for live plant sounds over a long period of time, and most likely refining the design based on the nature of the sounds.

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