

# **THESIS PROJECT PORTFOLIO**

## **Pancake Printer**

(Technical Report)

## **Cyber-Physical Systems and the Rise of Consumer E-Waste** (STS Research Paper)

An Undergraduate Thesis

Presented to the Faculty of the School of Engineering and Applied Science  
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Bachelor of Science, School of Engineering

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Todd DeLong, Department of Electrical and Computer Engineering

#### CYBER-PYSICAL SYSTEMS AND THE RISE OF CONSUMER E-WASTE

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#### PROSPECTUS

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This thesis is comprised of a technical component developing a pancake printer and an STS component investigating the causes for a lack of citizen participation in e-waste recycling. These topics were approached together because working in a field that creates luxury technologies that are prone to rapid disposal can cause ethical challenges in a world where sustainability is becoming higher priority for much of the world. As an actor involved in the system, I want to be able to keep improving technologies, but it comes with drawbacks. It is important to consider the impacts of these technologies on the environment and work to change the societal systems that surround them in order to create space for the technologies to progress while preventing harm.

The technical component followed the development of a in home pancake printer kitchen appliance. The device allows users to customize their breakfast experience. The design is built around a 3D printer chassis that controls the motion and dispenses the batter. The customizability is introduced with a mobile app. The mobile app allows the user to upload a photo of their choosing to be turned into a pancake. This is then converted into five versions of line art with varying clarity that the user can select as the final image. The image is then translated into a series of coordinates that move the dispenser and draw the image with the batter. This project was designed to showcase the array of embedded development, from low level hardware design to high level mobile development and image processing.

The STS component consisted of an investigation of the societal landscape surrounding e-waste management. Governments, corporations, and individuals all play a distinct role. The most significant reasons found for a lack of participation in e-waste recycling programs were lack of access to services and consumers' perceptions of usefulness. Governments and corporations can work together to solve both of these problems to increase consumer

involvement in programs by creating more points of access e.g. increasing frequency and location of collection and by promoting efficacy of services, respectively.

By combining these topics, I have expanded the options for green engineering programs. Previously, much of the research surrounding reducing e-waste has focused on increasing product lifecycles and limiting consumer disposal of items, with little focus on the final stage of e-waste. Looking into this issue provides a way to increase jobs and avoid limiting consumer choice while still prioritizing environmental concerns. Further research could be conducted into consumers' responses to different types of persuasive techniques concerning improving recycling practices to help find the most effective solutions for governments and corporations to pursue.