Thesis Portfolio

The Agroflight Soil Sensing Drone
(Technical Report)

Undoing Environmental Damage with Digital Agriculture
(STS Research Paper)

An Undergraduate Thesis
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Bachelor of Science, School of Engineering

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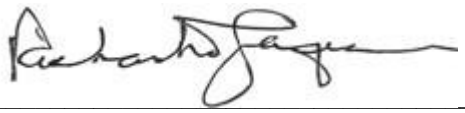
Approved  Date 05 May 2022

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Sociotechnical Synthesis

The sphere of agricultural technology is beginning to shift to include digital electronics to sense, track, and predict crop yields. Following this wave, our team's technical project was a soil sensing drone. The Soil Sensing Drone is a quadcopter fixed with a soil sensor that reads nitrogen, phosphorous, and potassium levels. Digital technology for farming can mitigate environmental damage – this movement has been coined the Digital Agricultural Revolution. The Soil Sensing Drone built for my technical project is a direct contributor to the next era of farming, saving farmers costs and reducing environmental harm.

The Soil Sensing Drone helps farmers better understand their fields by performing assisted flight missions across a field to sample NPK nutrient levels. The drone lands, inserts a sensor into the ground, and reports the data back to a central hub. The soil nutrition data will be used to create a high-resolution map of an agricultural field's nutrient concentrations, which would help farmers deploy fertilizers more locally. This helps save farmers costs for fertilizers. Furthermore, these data can be used to feed predictive agricultural models to estimate the crop yield that will be produced at the end of the growing season. Overall, the Soil Sensing Drone helps farmers be more efficient and better understand their crops' value.

My STS research focuses on how digital technology for farming can mitigate environmental damage. The Green Agricultural Revolution that occurred in the 1970s introduced a plethora of chemical products that help boost crop production. However, these products, which include fertilizers and pesticides, have a blowback effect where they damage agricultural soil, which actually reduces crop production long-term. Furthermore, fertilizers pollute surrounding ecosystems, to the extent that their effects accelerate climate change. Digital products deployed include sensors, drones, and AI models. Though farmers are implementing this technology to

reduce costs, engineers and sustainability experts are looking to the digital revolution to begin undoing the harms of the green revolution. Using fewer chemicals and more precise farming techniques will not only reduce environmental pollution but will also help restore the damaged soil and produce more crops.

The Soil Sensing Drone is a direct contributing product to the Digital Agricultural Revolution. My STS project led me to understand which technologies were being successfully implemented in digital agriculture. It also led me to understand which metrics are important for farmers to understand and keep track of. My technical project group could not have created product requirements for the drone without first understanding why digital farming is important and the ethical implications of designing this product. Completing my technical project gave me the insight into how engineers are using critical thinking skills along with cutting edge technology to make agriculture more precise. Combining these projects gave me a wholistic view of digital farming – a successful engineer should have a dual understanding of the technical and ethical issues they face when designing a product for it to be successful.