

**Thesis Project Portfolio**

**Up in Frames: AgroFlight**

(Technical Report)

**Social Implications of Drone Technology on Migrant Farm Workers**

(STS Research Paper)

An Undergraduate Thesis

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

University of Virginia • Charlottesville, Virginia

In Fulfillment of the Requirements for the Degree

Bachelor of Science, School of Engineering

**Gabriel Mallari**

Spring, 2022

Department of Electrical and Computer Engineering

## **Table of Contents**

Sociotechnical Synthesis

Up in Frames: AgroFlight

Social Implications of Drone Technology on Migrant Farm Workers

Thesis Prospectus

## **Sociotechnical Synthesis**

### **Introduction**

In the agricultural industry, farmers need to collect soil nutrition data in order to manage fertilization and predict crop yield. The sampling process involves penetrating the soil with a 12-inch soil sampler, sending the samples to a laboratory for analysis, and receiving the results within a couple of weeks. For large farms, this is an extremely arduous and time-consuming task. With the evolution of smart farming technologies, there's greater pressure for farmers to adopt these technologies to optimize output. For my technical project, we built a semi-autonomous soil testing drone that collects real-time soil nutrition data and displays it on a ground station desktop application. The goal of this project is to automate the soil testing process and streamline the analysis process. Once drones are developed to perform manual labor tasks like watering, seeding, pesticide spraying, and similar tasks, it's predicted that the demand for migrant farm labor will decrease. For my STS research project, I conducted a case study to better understand the potential social impact of drones on the migrant farm worker population and how this technology could be used to marginalize an already vulnerable population in the United States. Through this project, I aim to develop a multifaceted understanding of the consequences of the technology I develop.

### **AgroFlight: Soil Testing Drone**

Drones are increasing in popularity in the agricultural sector and can perform autonomous flight for surveying, mapping, pesticide application, infrastructure inspection, and stockpile management. Soil sampling and testing was an application that our team saw very few people

attempt, so we wanted to explore the novel applications of drone technology. My technical project, called AgroFlight, involved collaborating with 4 engineering students to develop a soil testing drone. It's split into three primary parts: the flight and probe system, the flight computer, and the ground station application. The flight and probe system describe the physical components of the drone. The frame was 3D printed and incorporated landing gear that enabled the drone to deploy a soil sensor to perform measurements at the user's will. The flight computer is a logic device that relays flight instructions as well as collects data to send to the ground station. The ground station application is a graphical user interface used to monitor drone flight and display soil data. These functions enable the drone to perform regular and repeatable soil sensing flights and create a map of soil nutrition over a large area.

### **Drone Impact on Migrant Workers**

The agriculture industry is experiencing a Digital Revolution, an era defined by the increased integration of automated technologies into various industries. This includes technologies such as smart tractors, smart greenhouses, and other Internet of Thing's devices. Agricultural drones, especially, have the potential to not only revolutionize the future of farming, but also the labor market. There is increased concern that farming drones could potentially cause migrant farm workers lose their jobs and negatively impact their economic stability. Migrant farm workers are workers who are hired during peak harvest seasons to perform manual labor. These workers come from ethnically and socioeconomically diverse backgrounds with most being of Mexican descent. My STS research project involves analyzing a series of historical texts, research papers, and current labor policies to describe how these workers are marginalized and how drone technology could propagate this issue. This includes examining the origins of the migrant farm

worker system and how the system was developed to exploit these workers. Similar research conducted in Rwanda will be analyzed to learn more about the sociotechnical imaginaries of farm workers in response to their country's drone implementation initiative. Drawing on the parallels of their worker's concerns about their job security in response to drone integration, I will evaluate the National Farmworker Jobs Program (NFJP), a government program that addresses these concerns. This will help provide a better understanding of the experiences of these migrant farm workers and provide a framework of potential improvements to mitigate their economic concerns.

## **Conclusion**

Drone technology has the potential to revolutionize how farms operate, but it's important to consider the unintended consequences. AgroFlight, a drone used to perform soil testing, could be expanded to perform jobs normally done by migrant farm workers. Unfortunately, these workers don't have the educational or technical background to operate this technology, and are predicted to lose their jobs to this technology. Drones don't only affect the agriculture industry; it also impacts other industries that are slowly integrating robotics to automate work performed by their blue-collar workers. The ongoing struggles of the migrant farm workers will continue once technological displacement becomes a reality, so we as engineers must understand these unintended social consequences in addition to their benefits.