ECE4872 Project Summary

Project Title	Drones for Tree Trimming
Team Members (names and majors)	Darrell Fambro (Computer Engineering) Tyler Bryant (Electrical Engineering) Nikhil Patel (Computer Engineering) Keith Liang (Electrical Engineering) Matthew Ramberger (Electrical Engineering)
Advisor / Section	James Kenney
Semester	2021/Spring Circle: Either Intermediate (ECE4871) or Final (ECE4872)
Project Abstract (250-300 words)	Florida Power and Light (FPL) is the largest energy company in the United States, serving more than 5.1 million customer accounts or more than 10 million people across the state of Florida. The problem of increased outage service times and safety of workers as a result of unsafe circumstances with tree branches around service wires have become an heightened issue and FPL is determined to produce a solution. To further address this critical issue, FPL is currently leveraging drones for detailed investigations of overhead facilities. Continuing this innovation, this project aims to leverage drones in the trimming of branches and debris surrounding FPL service wires. By completing a research and development investigation on this specific drone technology, the aim was to determine the best approach for creating a piloted drone capable of completing basic tree and debris clearing missions on FPL service wires and sites in an easy and safe manner. Through a complex process of drone design, investigation of best practice for cutting tree branches, and various weather simulations, this project leveraged drones to trim tree branches and debris. By using drones instead of having to deploy a crew with equipment to reach and remove foliage, FPL will produce a more cost effective method of transmission line maintenance. Thus, producing a drone in the most cost effective manner was an important objective of this project. It aimed to gradually eliminate the average amount of service interruptions that customers experience; as well as provide a safe alternative to exposing workers to dangerous environments.

Project Title	Drones for Tree Trimming
List **codes** and **standards** that significantly affect your project. Briefly describe how they influenced your design.	The FAA under Part 107 regulates the use of drones to below 400 feet in altitude and below speeds of 100 mph. Given the scope of the project, these restrictions will not be a factor in our design. A drone operator is required to have Section 333 Exemption or Aircraft Certification, Certification of Authorization, Aircraft Registration and Markings, and a Pilot Certificate. Due to the drone not being functional, these standards did not affect our design.
List at least two significant **realistic design constraints** that applied to your project. Briefly describe how they affected your design.	The main two realistic design constraints were the weight that the drone can carry and how much you could see when cutting branches. Weight affected our design a lot since the drone provided by FPL, the DJI Inspire, could only carry a payload of up to 3 lb. This means we can only add 3 lb of weight to the drone. This rules out some of the hardware we could have used otherwise, limiting our options and making us design to be as light as possible. The other main constraint is vision. The branches being cut could sometimes be 50 feet away. A tool like a lopper only has a 1 ½ to 2 ½ inch gap for cutting branches. Even though the DJI Inspire has a camera attached to it, it would be very hard to cut branches using a standard lopper. Thus, we had to be mindful of what tool we used and it's position in the camera's field of view in order to make effective operation feasible for the drone pilot.
Briefly explain two **significant trade-offs** considered in your design, including options considered and the solution chosen.	The Ryobi cutting tool was a big trade-off between weight and efficacy in our design. If we were to attach a heavier cutting implement to the drone, it would be able to cut branches fast and without much trouble. However, we would need to sacrifice weight in other areas in order to not exceed our 3 lb limit. Heavier cutting implements are also generally not as safe. Other tools are safer, but not as good at cutting branches. The Ryobi cutting tool was ideal here, being light but easy to use, giving us weight headroom for other things. Another trade off is how the tool is powered. A chainsaw, portable bandsaw, or reciprocating saw could potentially be turned on manually while the drone is still on the ground. This would be easier to set up but could potentially be more dangerous depending on how it is attached. A tool like a lopper would require a motor to be attached along with some metal to hold the lopper in place. This would however allow the tool to be powered remotely only when a branch needed to be cut. Safety was a top concern here, so option two, specifically using the Ryobi pruning shears is the preferable solution, as it gave more control.
Briefly describe the **computing aspects** of your projects, specifically identifying **hardware-software** tradeoffs, interfaces, and/or interactions. *Complete if applicable; required if team includes CmpE majors.*	Onboard computer(s) are absolutely necessary on the end effector that will allow the drone to trim tree branches. The manual and autonomous aspects of control need to be managed by these computer(s), in such a way that is reliable and responsive in real-time. In addition, a processor was needed to interface between the human user and tree trimming extensions. This means pulling communications data from a wireless communications module and translating them into commands in real-time. The major tradeoff here is between power and performance. As drones are powered by batteries, they only have limited flight time before a recharge is needed. We didn't want to reduce this to under 10 minutes. A high performing processor would be able to handle all of our needs, but at the same time would require more power and reduce flight time. Thus, the goal was to choose a power efficient processor at some determined minimum performance specification.

Project Title	
Leadership Roles (ECE4871 & Forecasted for ECE4872) (NOTE: ECE4872 requires definition of additional leadership roles including: 1.Webmaster 2. Expo coordinator 3. Documentation	Semester 1 Darrell - Document Editor Tyler - Director of Communications Nikhil - Software Lead Keith - Hardware Team Lead Matthew - Testing Team Lead Semester 2 Darrell - Webmaster Tyler - Expo Coordinator Nikhil - Software Team Lead & Documentation Coordinator Keith - Design Team Lead Matthew - Testing Team Lead
International Program: Global Issues (Less than one page) (Only teams with one or more International Program participants need to complete this section)	N/A