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1 Introduction

1.1 Project statement

Drone Energy Delivery is a proof of concept for the use of a quadcopter as a means for energy transportation. We will be using a quadcopter or “Drone” to bring a charger to a location where the energy is needed. We will accomplish this by configuring a quadcopter to automatically travel to and accurately land at a location or node using a server for direct control. The drone will then use on board charging equipment and batteries to recharge the node. After the node is sufficiently charged to the amount desired by the server, the drone will then leave and return to a home base where it can then be recharged.

1.2 Purpose

We are using this project to prove that a system of power delivery by drone is possible and potentially feasible. Use cases for this would be situations like far away temperature probes or simple arrays of sensors located in a hard to reach area. The power consumption of these sensors is not high, and the cost of running power to that location would be extreme. The drone can then bridge this gap, allowing the usage of cheap and easily accessible energy at one location to be transported to another.

1.3 Goals

By the end of senior design, we hope to create a system that allows the transfer of energy from a home base station to a node. The node will consist of a basic power draw, a landing area, and a battery to be charged. The home base will consist of a source of energy to charge from, control server, and a landing pad. The drone will have a charging setup with a battery and a visual sensor for enhanced landing capability.

For our short term goals, we are creating a an app that will allow us to send the drone to a certain gps location to show we have the ability to automate control over the drone. We further hope to automatically land the drone onto a node with image recognition.

2 Deliverables

We will deliver both software and physical products.
For software, we will create an Android app that will control the drone. The app will be run autonomously from a computer using an Android emulator. The app will be written in Java, using the SDK provided by the drone manufacturer, DJI. The SDK provides methods for controlling and getting data off of the drone. We will control the drone using Waypoint Missions, which are provided in the SDK. When the drone arrives at the landing pad, it will take pictures of

the pad, which the app will retrieve from the drone. We will then use a library, OpenCV, to process the images and realign the drone for landing.

We will create a system of contacts on the drone, base station, and node. These contacts will be connected to circuits on the drone and node. When the contacts meet, the circuits will be closed and connected. The contacts on the node will be used to charge a battery from energy delivered by the drone. The contacts on the drone will be connected to a two way circuit; one that can charge a node, and one that can receive charge from a base station. The base station will contain a circuit that charges the battery on the drone.

Finally, we will create landing pads. There will be two types, one for the node and one for the base station. The only difference will be the circuit on each. The pads will have a unique pattern on them, so the app using OpenCV can identify the pad, and align the drone with it. The pattern will be specific in one direction so the drone can turn around and face the right way when landing on the pad, so the circuits connected to the contacts can be properly aligned and closed.

3 Design

Include any/all possible methods of approach to solving the problem. Discuss what you have done so far. What have you tried/implemented/tested etc. We want to know what you have done.

We will use DJI's SDK to control the flight of our drones via a mobile device.

- We have not tested any code yet, but have downloaded the SDK and went through the tutorial app to understand some basics of working with the SDK.

We will use a central server emulating a series of android devices to control each drone.

- We have not tried running any server based android device yet.

We will make contact with, and deliver power to the battery on our destination node

- We have not started implementing any prototypes yet. We are still in the research phase.

3.1 System specifications

Detail any specifications given and/or assumed about the project.

1. The operational range of our deliverable will be no more than 20 meters, the area of a large indoor room
2. Charge time for each node should be no more than 20 minutes

3.1.1 Non-functional

List and explain the non-functional requirements of the project.

1. Well documented code
2. Adherence to all Drone flight regulations

3.1.2 Functional

List and explain the functional requirements of the project.

1. Stable flight and navigation for each drone
2. Obstacle avoidance while in flight
3. Precise landing onto node
4. Networked communication between each drone and node
5. Efficient energy transfer between payload and node

3.1.3 Standards

Discuss the standard protocols that you follow in your lab or for writing code. Are these approved by standard organizations like IEEE, ABET etc. Will any of your practices be considered unethical by such organizations? Discuss how standards are applicable to your project.

1. We have not settled on a coding standard

3.2 PROPOSED DESIGN/METHOD

We will build an android application to control a DJI drone equipped with an energy delivering payload. We will design and build the energy payload as well as the energy receiving receptacle for each node.

3.3 DESIGN ANALYSIS

We recently were able to do the first first test flight of the drone that was delayed for legal reasons. We then started work on making a app to send the drone to needed location. Image processing was also started so that the drone would auto land on the node. Next semester after having the drone able to fly back and forth from the location we will work on the charging the node with a battery on the node

4 Testing/Development

4.1 INTERFACE specifications

The hardware included in our project will include: The drone, whatever device we use to act as the server, the beacon to track the drone if lost,and the node(battery).

The software we will use will strictly be through the DJI Android SDK.

4.2 Hardware/software

The drone itself will be used to test the software seeing on how a major part of the autonomous flight is reliant on the software. A battery tester may be needed in order to test whether or not the node that needs charging has been charged.

4.2 Process

We first test flew the drone once we were able to. We then started work on making a app to send the drone to needed location. Image processing was also started so that the drone would auto land on the node. Next semester after having the drone able to fly back and forth from the location we will work on the charging the node with a battery on the node.

5 Results

List and explain any and all results obtained so far during the testing phase. Include failures and successes. Explain what you learned and how you are planning to change it as you progress with your project. If you are including figures, please include captions and cite it in the text.

We have not yet begun to test the drone due to legal issues regarding our ability to fly the drone outside. We have researched various areas of the drone such as tracking the drone, preexisting frameworks for drone controllers, type of drone required, methods of transferring energy from our drone to a node, and methods of charging batteries.

6 Conclusions

Summarize the work you have done so far. Briefly re-iterate your goals. Then, re-iterate the best plan of action (or solution) to achieving your goals and indicate why this surpasses all other possible solutions tested.
The goal is to transfer energy from a home base to a node station. The drone will autonomously charge a battery from the home node then fly to the node land and charge the node. Short term will be to have some way to automate control of the drone. Even more short term then that is being able to fly the drone first.

7 References

List any references used in the document. These are an essential part of your review so far.

8 Appendices

If you have any large graphs, tables, or similar that does not directly pertain to the problem but helps support it, include that here. This would also be a good area to include hardware/software manuals used. May include CAD files, circuit schematics, layout etc. PCB testing issues etc. Software bugs etc.