Autonomous UAV Navigation in a GPS Deprived Environment

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Purpose

Unmanned aerial vehicles, such as drones and quadcopters, rely heavily on GPS for navigating an environment. Indoors, GPS is often diminish to the point of unusability, making indoor navigation difficult.

We seek to identify and implement various systems which enable an unmanned aerial vehicle to navigate autonomously in GPS-deprived environments, such as indoors.

The Team

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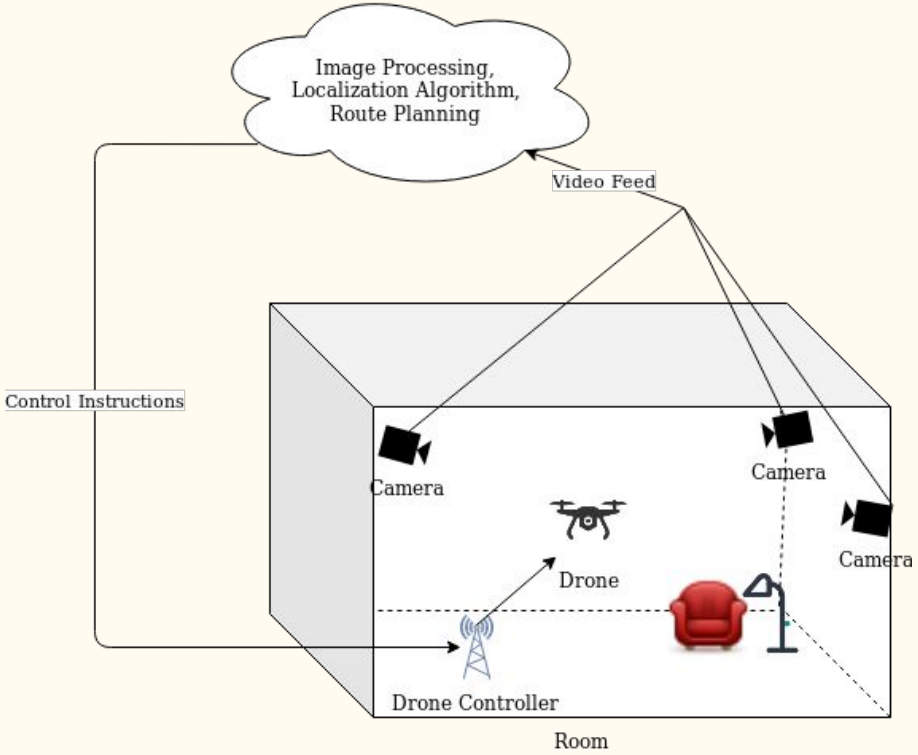
Abstract

Unmanned aerial vehicles rely principally on GPS for localization and navigation, so GPS-deprived environments pose a major challenge. We seek to explore and implement various strategies for automating UAV flight without access to GPS. The first strategy entails the use of many fixed cameras placed in the environment, which identify the location of the UAV through the fusion and analysis of their individual camera feeds. The second strategy uses WiFi signals obtained from numerous access points and analyses the relative signal strengths to localize the UAV. These strategies will be used simultaneously to achieve robust localization.

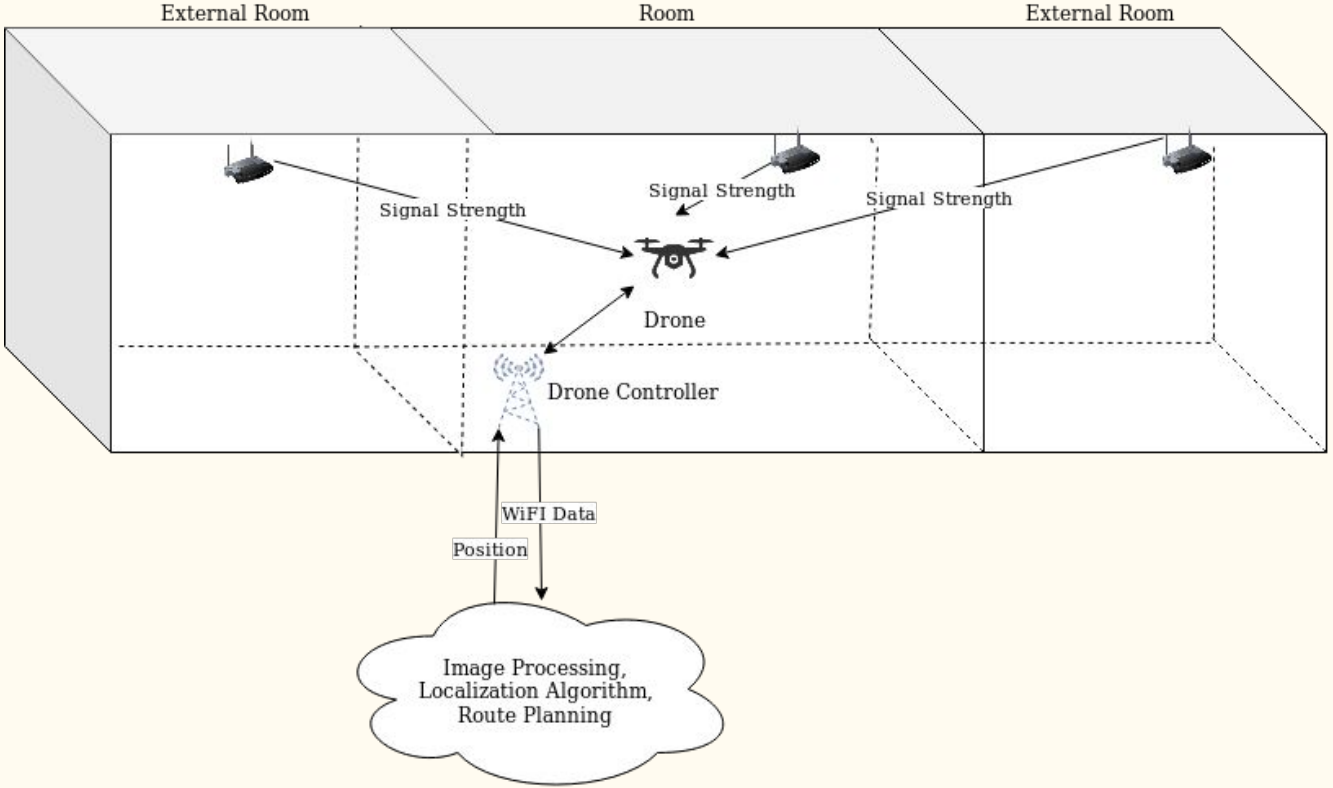
User Stories

- As a drone operator, I would like to be able to automate the flight of my drone even if GPS signal is weak or non-existent.
- As a drone operator, I would like to have better tools to fly and automate the flight of my drone.
- As a drone I would like to be to fly indoors, without the need for a GPS signal to guide me.

Design Diagram - Camera Localization



Design Diagram - WiFi Localization



Project Constraints

- Operating without access to GPS
- Ensuring public safety while UAV is operating
- FAA Drone Pilot License
- Only DJI Drone supported
- Drone-server connectivity required
- Susceptible to interference and jammers
- Focus on civilian and rescue operations

Current Project State

- Remote control of DJI drone
  - DJI Mobile SDK
  - Custom software to transmit controls and low latency video to PC over network
- Camera localization in progress
- WiFi Heat Mapping case study in progress

Expected Accomplishments

By the end of this semester, we expect to accomplish a full case study on both external camera and wifi localization.

The end of our project, we expect to have a system in place for controlling the drone with localization data. After that we will be able to allow the drone to navigate autonomous through hallways, and rooms.

Project Timeline and Milestone

- Now
  - Automatic remote control (take off, move forward) of drone from a PC
- Next
  - Drone localization and mapping case studies
- Later
  - Autonomous flight and and navigation

Who is doing what on the project

Joseph

- Visual Localization (RGB Cameras)

Tanner

- Non-Visual Localization (WiFi)

Matt

- Drone control and sensor feedback (SDK/API)

Expected Demo at Expo

Due to the nature and legal limitations of flying the drone, we will likely only be able to present videos and not an in person demonstration of our project.

We hope to have examples of a drone navigating through an unknown environment, without GPS, but with various other localization methods.