Indoor Autonomous Drone Navigation with Aruco Markers

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Summary

The intent of this project is to demonstrate the use of aruco markers as waypoints for indoor drone navigation. Using a DJI Tello, paired with a laptop, and given a map with aruco markers strategically placed, we can process data sent from the Tello and create programs that can send commands to the drone. After marking no-fly zones and designating waypoints, we can find the best possible path to a given node for maximum efficiency

Introduction

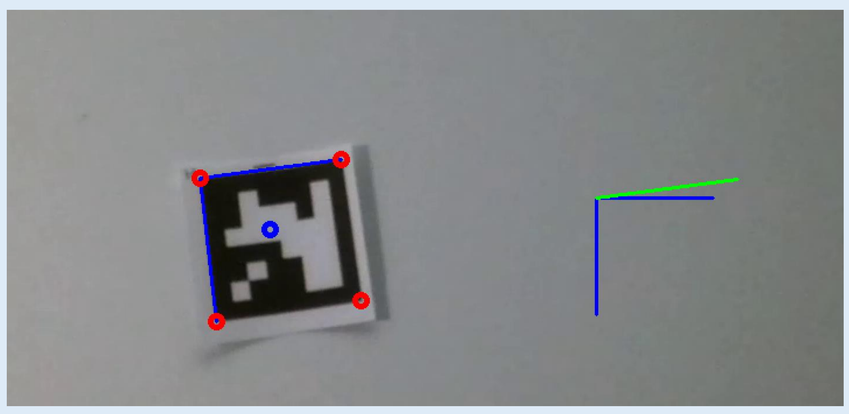
- Drones increasingly used in missions to collect data, transport items, disaster management, security purposes, and much more.
- It would be very useful if drones could complete their missions without any control from a user.
- This project explores the idea of indoor drone navigation using computer vision and Aruco markers for path-planning and localization

Methods

- Created application utilizing OpenCV to recognize aruco markers.
- Calculated pixel location of center marker and error calculation for PID controller
- Created aruco following application to test PID controllers
- Developed path-planning GUI based on idea that locations are connected waypoints with weights representing distance
- Receive angle and speed data from drone and use to calculate actual distance traveled and visualize path

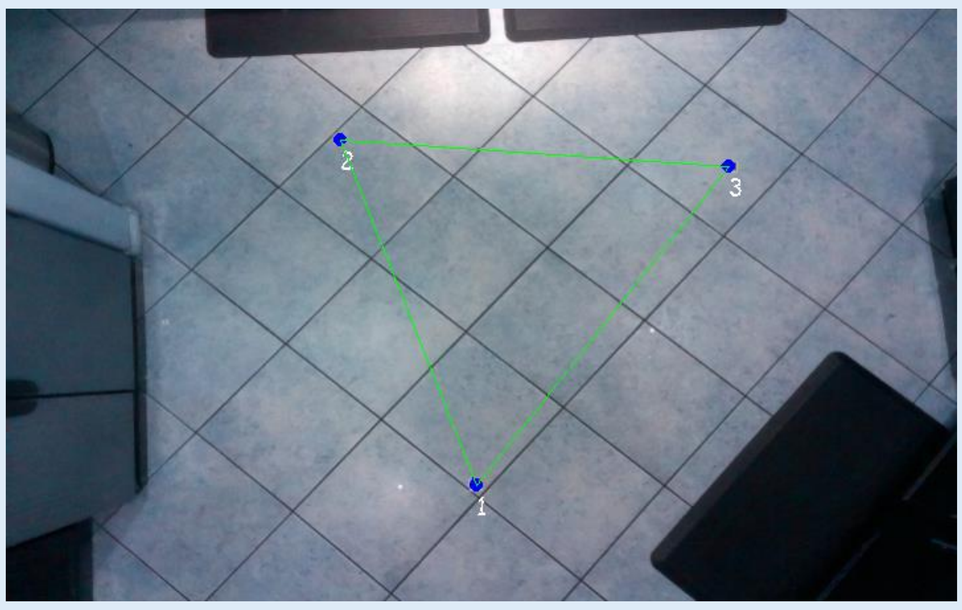
PID Controllers

- Drone sends video stream to computer
- Recognize aruco marker and perform calculations to find center of marker
- Find angle offset
- Get error of marker center and center of camera to center drone over marker, use similar process for angle error
- Send commands to drone to adjust motor speeds to center on marker



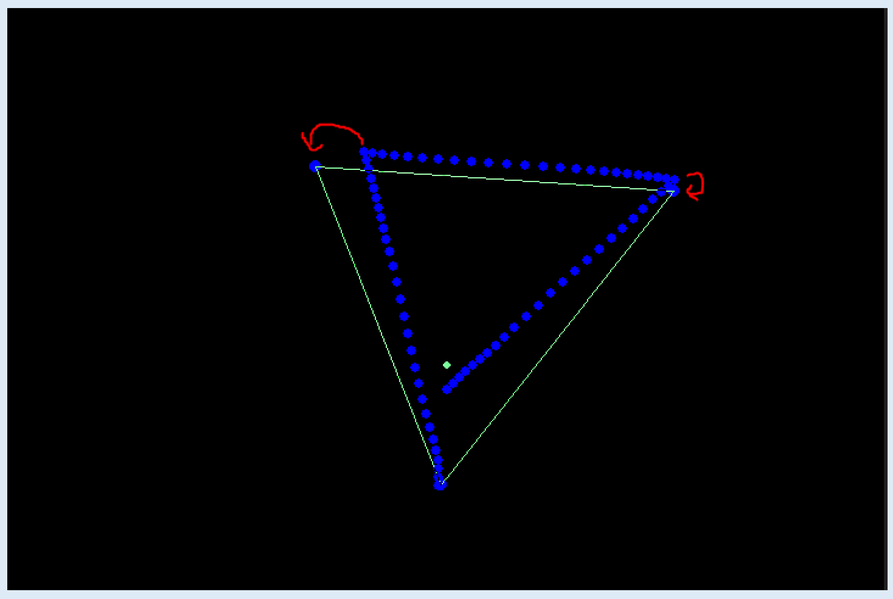
Path-Planning GUI

- User provides map (aerial view of location)
- Place drone on initial marker and connect to laptop
- Mark no-fly zone and create waypoints
- Enter target location and drone will fly to desired node using best possible path
- Once at desired node, drone will center on marker



Visualization

- Capture drone IMU data (angles, speed)
- Plot the drone movement
- We can see the drone actual path vs the calculated path



Green: Calculated path
Blue: Actual path taken
Red: PID controller starts to center over marker

Results

This project demonstrates the possibility of accurate indoor drone navigation. The more aruco markers placed, the higher the precision of movement across an indoor space. With this method of navigation, there is no need for high-cost sensors such as lidar, or high-cost processors for more intense image processing to perform SLAM

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