Quadcopter Drone Platform for Vision-Based Search and Exploration

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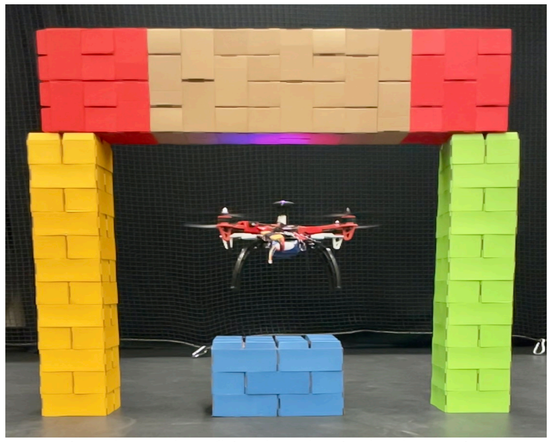
Introduction

Quadcopter drones are versatile flight platforms

Their ability to hover and operate in confined spaces makes them well-suited for indoor flight operations

Their stable flight profile allows them to host a variety of sensor instruments such as depth sensing cameras and lidar



A quadcopter drone flying through a simulated constrained environment obstacle, displaying the vehicles controllability

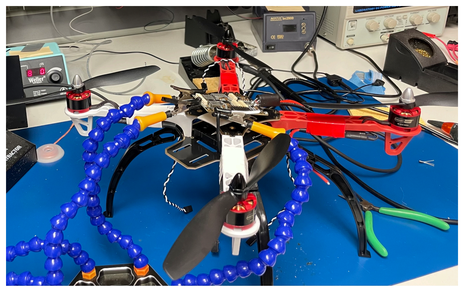
Project Goal

The goal of the project is to develop a quadcopter drone platform that can be used for vision-based search and exploration.

Design and Assembly

The drone was created with a modular design to allow for customization

Individual procurement of components and in-house assembly keeps the cost of the drone low

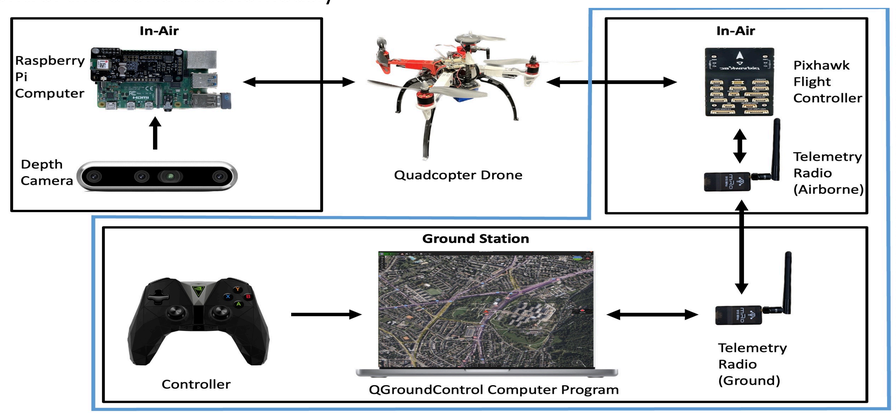


Soldering the engine speed controller power leads to the power distribution board

Flight Control

Current drone setup requires an operator to control the drone via gaming controller and a computer

Drone platform allows for future integration of sensors and computers that can control the drone autonomously

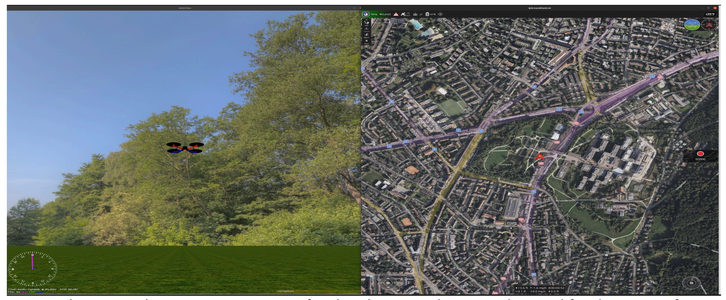


Flowchart Illustration of the drone control network

Software-In-The-Loop Simulation

Software-In-The-Loop Simulation (SITL) allows users to virtually model and test drone components

We modeled our Pixhawk Flight Controller using a SITL flight simulator



SITL drone simulation using JMAVSIM for the physics and QGroundControl for drone interface

Flight Testing

Drone was tested for flight stability, responsiveness, and ease of control

Balance testing using a harness

Scan for footage of drone test flight

Research Application

Drone can be used as platform for research experiments involving:
-Vision-based search and exploration
-Flight control systems [1]
-Ergodic exploration [2]
-Active learning and optimal control [3]

Results

Our team successfully designed, constructed, and tested a customizable quadcopter drone platform for application in scientific research experiments

Final design of the quadcopter drone

Drone in flight

Acknowledgements

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References

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2. Dong, D., Berger, H. & Abraham, I. Time Optimal Ergodic Search. Preprint at http://arxiv.org/abs/2305.11643 (2023).
3. Abraham, I. & Murphey, T. D. Active Learning of Dynamics for Data-Driven Control Using Koopman Operators. *IEEE Trans. Robot.* **35**, 1071–1083 (2019).