Enabling Autonomy for Intelligent Radiation Awareness Drone-Lite: Open-Source Terrain Following and Collision Avoidance Software using PX4 Autopilot

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Introduction

- Intelligent Radiation Awareness Drone Light (iRAD-Lite) will navigate autonomously
- Autonomy requires safety considerations
- Primary safety goals: avoiding collisions and following terrain

▲ Aurelia X4 commercial drone, one of the iRAD fleet

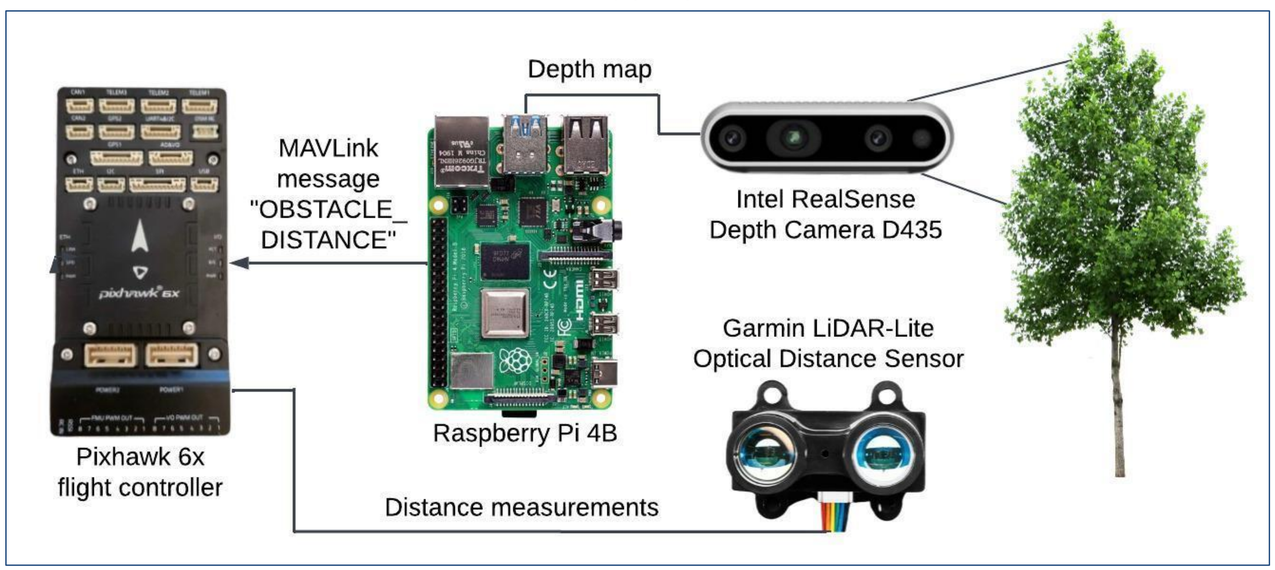
Methods and Materials

Terrain Following

- Connect sensor to flight controller via I2C
- Pixhawk uses measurements from sensor and internal height estimations to enable drone to maintain constant height above ground

Collision Avoidance

- Software: Python, Pixhawk PX4, Robot Operating System 2 (ROS2) Libraries
- Process depth camera data via Raspberry Pi program
- Transmit output of Raspberry program to Pixhawk via MAVLink messaging protocol
- Pixhawk flight controller determines appropriate action to avoid collisions



▲ Collision avoidance and terrain following dataflow

Results

- Modification of pre-existing collision avoidance software for compatibility with iRAD-Lite and ROS2 is reasonable approach
- Open-source PX4 collision avoidance software was community-modified for ROS2
- Global planning is superior to local planning because it optimizes travel by taking the known environment and the drone's ultimate goal into account when avoiding collisions
- Lightweight and compact Garmin sensor chosen for terrain following has I2C capability which allows for simple implementation

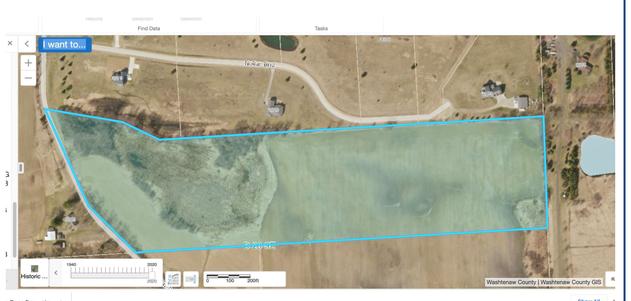
Conclusions

- Implementation of collision avoidance and terrain following enable safe autonomous navigation for iRAD-Lite and Pixhawk-controlled drones

Future work

- Complete collision avoidance and terrain following implementations
- Pair collision avoidance software with intelligent navigation software undergoing development
- Test using Gazebo flight simulation software
- Flight test: netted outdoor drone testing facility and farmland with barns, swamp, fencing, and woods

▲ University of Michigan M-Air flight facility



▲ Plot of land to be surveyed by iRAD systems

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