Preventing Radiation Drone Crashes: Avoiding Collisions and Following Terrain

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Introduction and Motivation

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

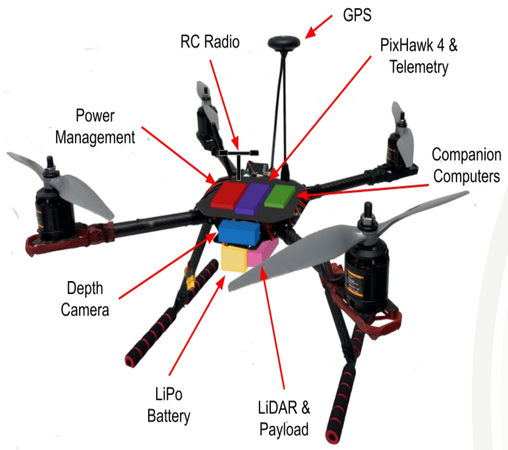

Figure 1: UM iRAD-Lite

Technical Approach

Collision Avoidance

Hardware

- Raspberry Pi 4B, Intel RealSense Depth Camera D435, Pixhawk 6x flight controller

Software

- Python, Pixhawk PX4, Robot Operating System 2 (ROS2) Libraries

Steps

- 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

Figure 2: Raspberry Pi, Pixhawk Flight Controller, Intel Depth Camera

Terrain Following

Hardware

- Garmin LiDAR-Lite Optical Distance Sensor, Pixhawk 6x flight controller

Steps

- 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

Figure 3: Garmin Optical Distance Sensor

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

Conclusion

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

Next Steps

- 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

Mission Relevance

- Applications in monitoring and response
- Opportunities for student research
- STEM education in nuclear engineering

Expected Impact

- Systems that allow widely available drones to navigate safely in autonomous mode for radiation mapping

MTV Impact

- Student research and support
- Presentations (14)
- Publications (future)

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