Avionics Considerations for a Student-designed 2-kg Payload-capable Radiation Detection Drone

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Introduction and Motivation

- Autonomous radiological surveying systems reduce dose for radiation workers
- Commercial systems are often expensive and lack customization
- Using open source software and hobbyist hardware, Intelligent Radiation Awareness Drone Lite (iRAD-Lite) provides an inexpensive radiation surveying for a variety of applications

Technical Approach

- Emphasis on component availability, minimizing cost, and maximizing payload mass
- 2:1 thrust to weight ratio for improved maneuverability and flight time
- LiDAR sensor and depth camera allow for collision avoidance and terrain holding
- Open source PX4 autopilot runs on selected Pixhawk flight controller to allow autonomous flight

Mission Relevance

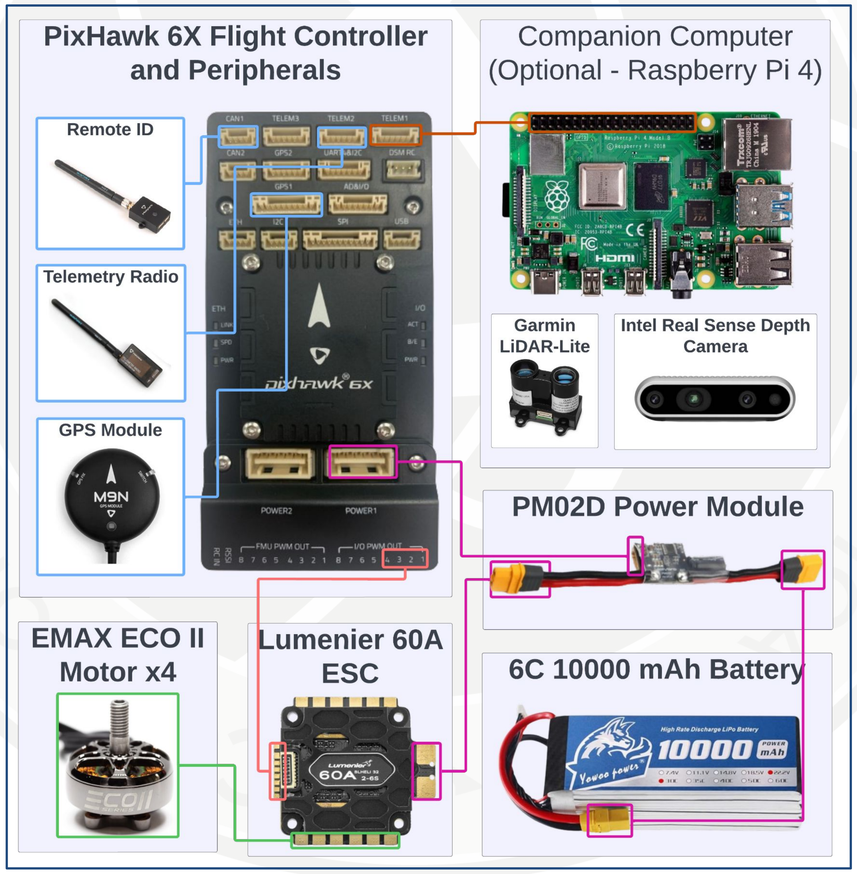
- Applications in monitoring and emergency response
- STEM/Nuclear Engineering outreach and education
- Reduces dose while performing radiological survey

Expected Impact

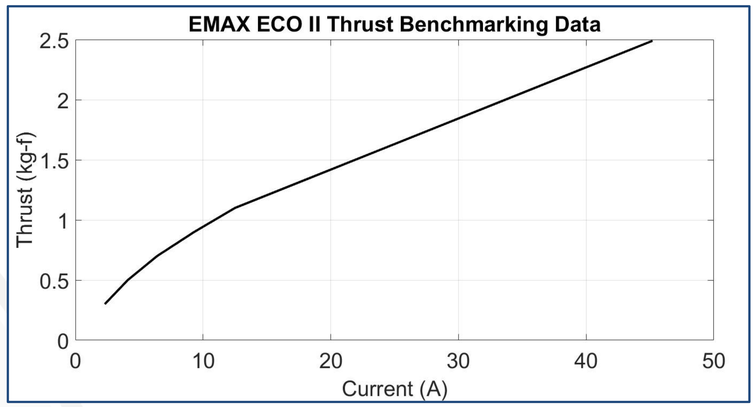
- Affordable drone platform for remote radiological survey and source localization
- Open source design for outreach and education
- Scalable for multi-drone survey methods
- Compatibility/customization for unique applications

Results

- The avionics support a total mass budget of roughly 4 kg while maintaining a 2:1 thrust to weight ratio
- Motor testing shows that each motor can provide maximum thrust of 2 kg-f at ≅30 A
- Approximately 15 minute flight time while hovering
- Total cost of about $1700, while similar commercial drones can cost over $3500, albeit including the frame
- iRAD-Lite utilizes a 3D-printed frame to allow for low cost development and easy repairs



▲ Avionics system wiring/component diagram



▲ Motor benchmark data with 7” propellers (provided by manufacturer)

Conclusions

- Hobbyist drone parts provide a sufficient platform for robust, inexpensive design
- Complete drone with 3D printed frame cheaper than similar commercial drone platforms
- Quadcopter configuration reduces cost and increases power efficiency

Next Steps

- Flight testing with 3D printed frame
- Integration with detection payload, navigation algorithms, collision avoidance, and terrain holding
- BLHeli 32 configuration and current limiting

MTV Impact

- Undergraduate Student Support
- Presentation and publication opportunities
- Networking and internship opportunities

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