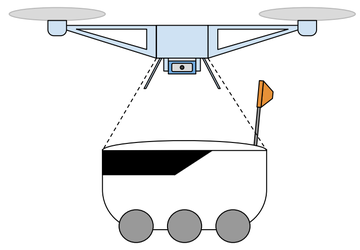
Raytheon UAS Showcase

UTDesign II: Spring 2022



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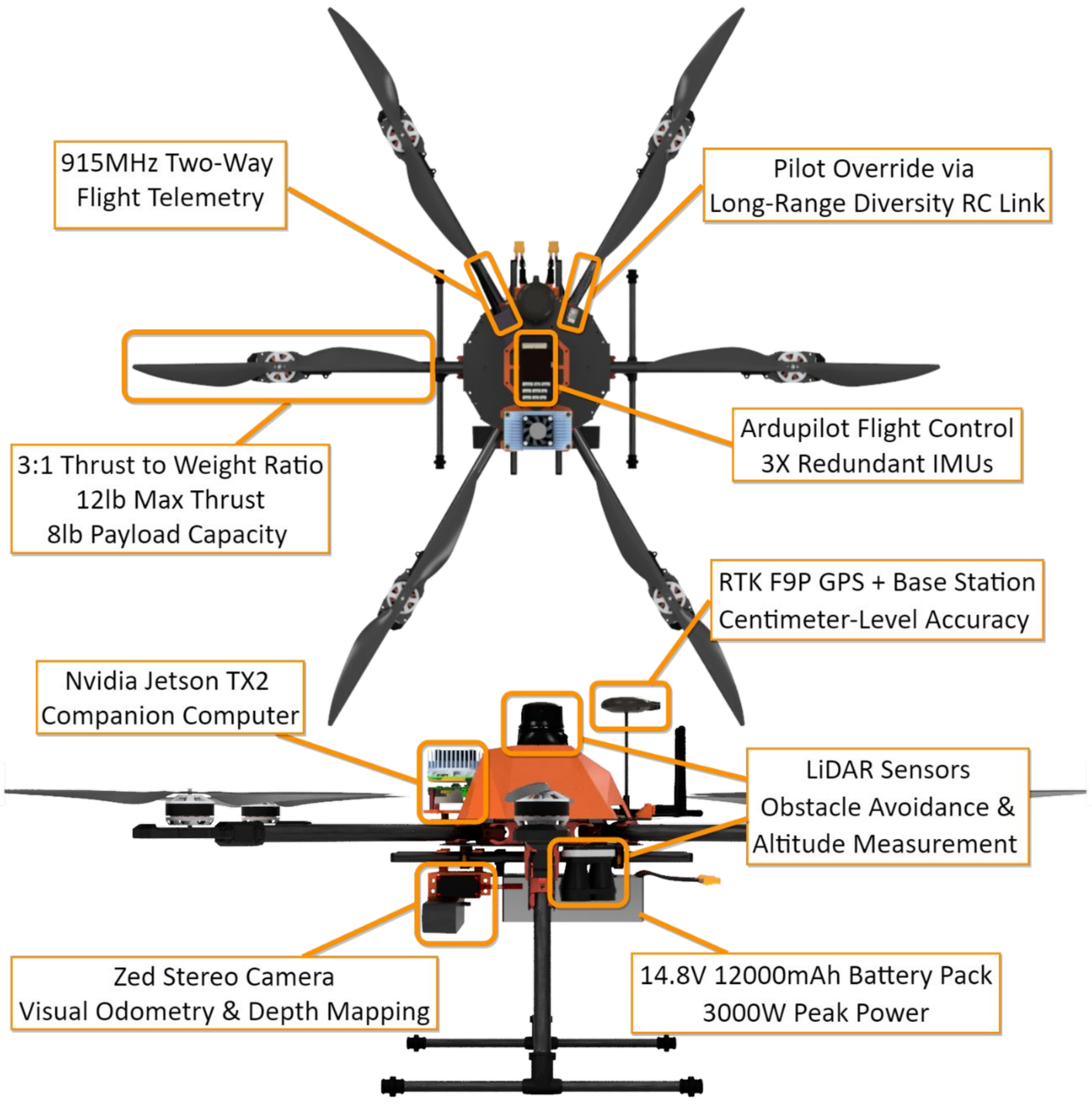
Project Overview

The Unmanned Aerial System (UAS) Innovation Showcase is an intramural competition between universities in partnership with Raytheon Technologies. Our drone's performance is judged based on time, accuracy, speed, and adaptability of our system as it completes a series of 4 unique challenges. Our drone is a hexacopter utilizing RTK GPS, stereo cameras, and LIDAR sensors to detect and navigate around obstacles. To combine components and make flight plans, the drone uses a Jetson TX2 and ArduPilot firmware. The hexacopter uses the various sensors to recognize and land on passive markers for autonomous navigation, obstacle identification, and obstacle course navigation.

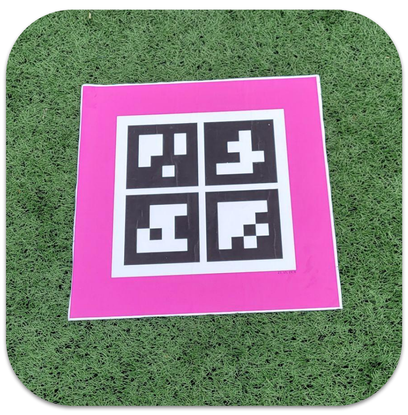
Temoc Air



Design Specifications

Final Hexacopter Build

Showcase 2
Aruco Markers being detected with OpenCV



Showcase 3 & 4
Obstacles

Design Challenge

Our autonomous system must be robust and quickly adaptable to a new environment.

Solution

Eliminating the complexity of a machine learning model and building out a robust sensor and computer vision based solution lets us combine obstacle avoidance systems and target scanning algorithms for a simple and adaptable system.

Ethics Statement

All of the source code, design, and ideas are unique and original to our team. Safety is the top priority for our drone so we have implemented numerous failsafes and stoppages in case of unintended actions from the drone. Manual failsafes were also added to prevent injuries and damages. All software used was either open-source or used with the appropriate licensing.

Conclusion

The drone is ready to compete in all four challenges at the competition against other Texas Universities on April 23rd. Our drone will be judged on its ability to complete the challenge and the speed in which it can complete the challenge in comparison to the other drones at the competition.

Approaches:

- **Showcase 1 >** Take off to target altitude and then land at 30-yard line
  - Use RTK GPS to precisely land 30 yards away from the end zone line
- **Showcase 2 >** Autonomous logo tracking and precision landing
  - Use computer vision to find our logo's shape and color
    - High contrast border to detect logo at a distance
  - Estimate geolocation of these points of interest (POI)
  - Check points of interest for Aruco markers to identify logo for descent
- **Showcase 3 >** Traverse through obstacle course autonomously
  - Using Ardupilot built-in object avoidance integrated with a 350° LiDar to detect and safely navigate through the obstacle course using GPS
- **Showcase 4 >** Traverse through an obstacle course autonomously without GPS in an indoor facility
  - Object detection and obstacle avoidance through Zed camera captured image depth map processing
  - Navigation utilizing ZED visual positional tracking

Performance Metrics

Time, precision, staying within elevation limits, positional tracking, safe landing, and object avoidance.