Intelligent Surveillance Unmanned Aerial Vehicle

Andrew Gallagher (ME), Steven Guayaquil (RBE/ECE), Ben McIntyre (RBE), Arianna Niro (RBE), Antonio Puzzi (ME), Arman Uygur (ME)
Advisor: Dr. Taşkin Padir

Abstract

Surveillance is critical for military, law enforcement, and search and rescue operations. Recently, unmanned aerial vehicles (UAVs) have grown in popularity and are an excellent resource that can be utilized for surveillance missions. Since there are many drones capable of this, this project sought to create a surveillance UAV that was autonomous, inexpensive, and easy to manufacture. The drone was designed as a quadrotor that houses two cameras and a wireless transmission system. It was also designed to be able to carry a payload for future developments.

Manufacturing

- Lightweight, Affordable 3D Printed PLA
- Robust, Laser Cut Delrin Exterior
- Rapid Assembly with Basic Tools

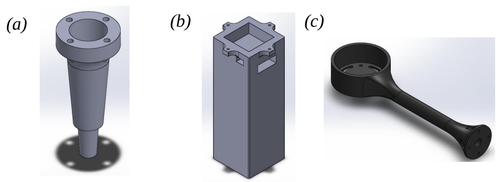

Figure 1: (a) Leg Assembly (b) Battery Housing (c) Motor Arm

Electronics & Propulsion

- Four 1.2kg Thrust Motors for Lift
- Four Counter Rotating 10x4.7 inch Propellers
- Two 2500mAh Lithium Polymer Batteries for Compact Power
- 16MHz and 700MHz Microprocessors
- Satellite GPS and Inertial Measurement Unit for Position Estimation

Figure 2: (a) Propeller (b) ESC (c) Motor (d) Battery

System Design

Figure 3: Final Prototype

- Aerodynamic Hull Top
- Sturdy Hull for Mounted Electronics
- Externally Attached Arms for Easy Replacement
- Effective Electronics System

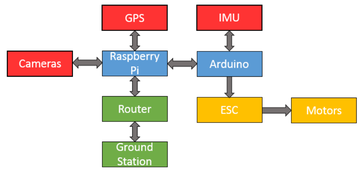

Figure 4: System Circuit

Project Specifications

Specification	Goals	Met?	Comments
Altitude	100 ft.	Not Met	Not stable enough to attempt reaching max. height
Weight	2 kg	Met	Entire drone approximately 1.8 kg
Payload	0.5 kg	Met	Max. thrust capacity of 4 kg allows for 0.5 kg payload
Size	< 4 ft^3	Met	Total size approximately 3.52 ft^3 (0.1 m^3)
Cost	< $1000	Met	Total cost approximately $490
Imaging	2 Streamed Cameras	Conditionally	Networking problems with ground station
Weather Protection	Waterproof	Not Met	Exposed openings throughout entire drone
Drop Test	10 ft.	Conditionally	Undamaged sensor module; damaged landing gear and rods
Landing Device	Impact Reducing	Conditionally	Impact reduction partially accomplished by 4 spring legs
Communications	Real Time Control	Not Met	Networking problems with ground station
Position and Orientation	GPS and IMU	Met	Fully operational location sensing and attitude control

System Tests

- Drop Tests to Assess Structure Capabilities
- Multiple Flight Tests to Ensure Stability
- Electronics and Sensor Testing to Guarantee Proper Performance

Figure 5: Axial Stability Test

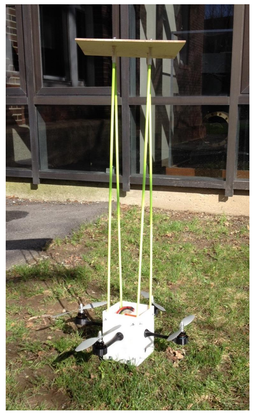

Figure 6: Altitude Stability Flight Test

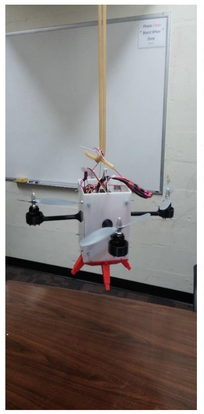

Figure 7: Orientation Stability Flight Test

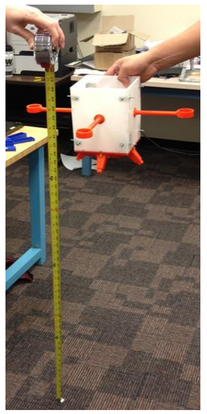

Figure 8: Three-Foot Drop Test

Software

- Stable Controls Simulation
- Fast Communication Between Microprocessors
- Simple Graphics User Interface
- Autonomous Attitude Stability
- 200 Hz Data Transmission Speed

Figure 9: Graphic User Interface

Conclusions and Future Work

- Cost Efficient Drone Capable of Flight
- Nonlinear Stability Control Updates Necessary
- Heavier Payload Potential
- Vision System Upgrades
- Make Future UAVs Smaller and Lighter
- Further Weatherproof Development
- Potential for Swarm Technology

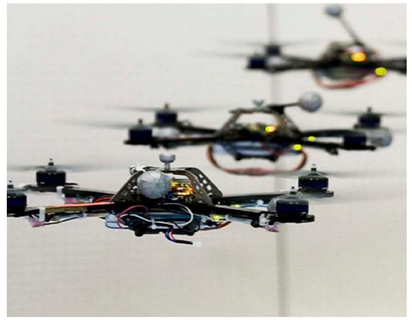

Figure 10: Swarm of Drones