UAV For Safety – BUMBL

[**B**owlin **U**pdyke **M**eza **B**eekman **L**ord]

Mechanical Engineering - Electrical and Computer Engineering

Students: Blake Beekman, Michael Bowlin, Austin Lord, Jonathan Meza, Lauren Updyke
Advisors: Dr. The Nguyen and Dr. Daniel Bukofzer

FRESNO STATE
Lyles College of Engineering

Abstract

The goal of this project is to design and implement an unmanned aerial vehicle (UAV) that provides security through the use of infrared video monitoring and storage while maintaining a "close to the user" flight pattern. BUMBL is a compact quadcopter, standing only 2.5 inches tall with arms folding into a 7.75 x 7.75 in² area, making it a practical and convenient size for portability. BUMBL is a prototype UAV with a 3-D printed frame using ABS plastic, an electrical system capable of 15-minute flight time, and a mobile app with GPS tracking capabilities that uses GPS data to autonomously keep the UAV within a set distance to the user. BUMBL achieves personal security by having live streaming of the immediate surroundings available to the user's mobile device.

Specifications

Dimensions: 7.75 x 7.75 x 2.5 in³ and 2.5 lbs.
Optics: 1080p Infrared-Sensitive Cameras
Power: 2 batteries – 3 cell (11.1 V) and 1000 mAh
Flight: Autonomous and Manual Mode
Memory: 1 GB RAM and 150 Mbps throughput

Prior Art

Lily Specifications:
Dimensions
- 10.3 x 10.3 x 3.2 in³
- 2.8 lbs.

Flight:
- 20 min. flight time
- 100 ft. range

Sprite Specifications:
Dimensions
- Height: 13.2 in
- Diameter: 3.8 in.
- 2.6 lbs.

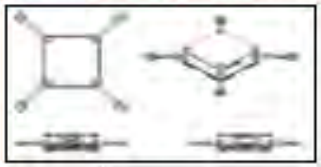
Flight:
- 10-12 min. flight time
- 2 km. range

Detailed Design – Electrical Eng.

The RC controller sends commands to the RC receiver onboard the UAV, which is directly connected to the flight controller. The flight controller sends commands to the four electronic speed controllers (ESCs) in order to control the four motors.

Quad X is the configuration for this UAV, as shown above.

Detailed Design – Mechanical Eng.

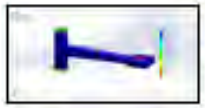


Detailed Design – Electrical Eng.

The Raspberry Pi acts in place of a manual RC remote control for autonomous flight by:
- Receiving data via Wi-Fi
- Interpreting the GPS positions of both the UAV and user's mobile device
- Calculating and relaying a target location/directional heading to the flight controller

Detailed Design – Mechanical Eng.

Stress Results:
Maximum: 4.679e+00 MPa
Maximum: 6.78.6e+00 psi



Factor of Safety Results:
Minimum: 0.421

Mode 3 Frequency Results:
Frequency: 2465.8 Rad/sec
Frequency: 23546.66 RPM

Detailed Design – Computer Eng.

- Code is written in Python and JavaScript to interface with Raspberry Pi
- Raspberry Pi sends commands to the flight controller
- Autonomous commands include arming motors, takeoff, altitude hold, and landing

Detailed Design – Computer Eng.

A server on the Pi allows it to receive GPS coordinates from a mobile device, giving it the ability to generate waypoints and navigate the flight controller autonomously; in this way, the Raspberry Pi acts as the brain for the craft. The image above shows the app connecting to Pi, obtaining security tokens, and receiving GPS coordinates.

Testing

Manual Flight Test with Trainer Frame

Autonomous Flight Test

BUMBL Wi-fi network

Conclusion

BUMBL compares well with its biggest UAV competitors, the Lily and Sprite, due to its original design and extraordinary features, which include its ability to fold into the size of small textbook, a sustainable 15 minute flight time, and video streaming through the utility of four infrared-sensitive cameras. BUMBL is equipped with both Manual and Autonomous flight capabilities, and uses a "close to the user" flight pattern. BUMBL truly achieves personal security by providing the user this data through a GPS connection between the UAV and a mobile device. After being put through rigorous Manual and Autonomous flight testing, BUMBL has proven that it is ready to move onto Beta Prototype Testing. BUMBL will soon provide both security and portability for its user.

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