Autonomous Aerial Remote-Sensing Drone

Team Members: Jared Bettinger, Brittany Brookhart, Shane Hemmelgarn, Blake Stephens, Kierstyn Neumeier
Advisor: Dr. Stephen Jacquemin
Wright State University Lake Campus Engineering

Problem Statement

Since 2009 Grand Lake St Mary's has been struggling with harmful algal blooms of Cyanobacteria. These HABs have catastrophic effects on both local environment and economy. Expensive satellites or physically collecting water samples for testing are often used to detect algae, which can be very time-intensive.

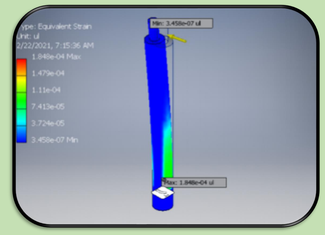
Objective

By using a UAV, along with a hyperspectral camera and photogrammetry software, early detection of HABs is possible. This advancement has the potential to cut both time and cost of testing. By surveying over the lake and its watershed, we can pinpoint the blooms early, and take measures to reduce the severity of the outbreak, which in return increases lake health and tourism.

Our Objectives:
Create a monitoring system for algae blooms
UAV capable of complete autonomy
Remote Sensing
Initial budget goal of $1,000

Focus Areas

- Construct a drone based on specific deliverables
- Achieve autonomous flying capabilities
- Program flight planning software
- Program photo analysis software to capture, analyze, and detect agal blooms
- Perform engineering analysis
  - Thrust
  - Power
  - Center of Gravity
  - Riser FEA
  - Motor and Propeller
  - Flight Plan



Conceptual Design

For the design of our drone, we decided to go with a quadcopter style design consisting of four propellors and four motors in a square shape. For the camera, we chose to go with an NDVI RGB camera because according to our research this would yield the best results when using the photogrammetry software for analyzation. WebODM is the photogrammetry software chosen and Mission Planner is the flight planning software chosen. Multiple different sensors were budgeted for as well in order to allow the drone to be fully autonomous (GPS, Lidar, etc.).

Budget

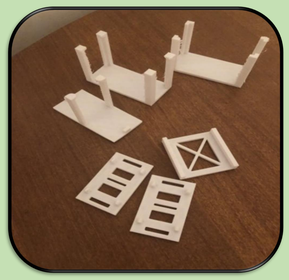
Our senior design group created a budget for the different components used to construct the drone.

The total cost for fabrication was $1658.

Hobby King	Quantity	Price(total)
ZIPPY Compact 8000mAh 4S1P 30C Lipo Pack w/XT90	1	72.48
Hobby King Quadcopter Power Distribution Board Lite	1	0.92
Turnigy MultiStar 30A BLHeli-S Rev16 V3 ESC 2~4S (C	4	42.24
OpenDroneMap		
WebODM Photogrammetry Software	1	57.00
AgroCam		
AgroCam Geo NDVI (single camera NDVI)	1	380.00
Lightware		
LW20/C(100m)	1	279.00
IR-Lock		
IR-LOCK Sensor - with Short Range LEDs	1	125.00
Amazon		
HEX Technology Pixhawk 2.1 Cable Set	1	20.89
Cube Orange (ADS-B) Full Bundle with RFD900x Telemetry	1	581.00
ReadyTosky S500 Quadcopter	1	46.96
Crazepony 4pcs Brushless Motor DX2205 2600KV	1	30.99
Valefod 6 Pack LM2596 DC to DC High Efficiency Voltage Regulator 3.0-40V to 1.5-35V Buck Converter DIY Power Supply Step Down Module	One 6 pack	10.99
OliRC 2pcs Male XT90 XT-90 to Female XT60 XT-60 Connector Adapter(C95-2)	1	9.99
Risers	8	-
Camera Gimbal	1	0.52
Propellers	4	-
	Total:	1,657.98

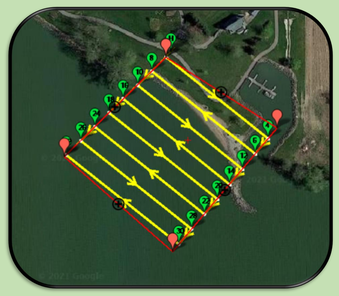
Fabrication

For the fabrication of this drone, we chose to build from the ground up in order to achieve compatible efficiencies. By personally selecting the components, we were much less limited by manufacturer standards. Due to the growth of the drone hobbyist community, parts are much easier to source than previous years. After completing calculations for necessary specifications, adequate parts were ordered.



Testing

We have conducted thrust tests to verify that our motors and propellers are able to create enough thrust to lift our drone. The test was very rudimentary being that we had a limited budget. Along with the thrust test we tested the drone's capability of taking photos along its flight path. We used a set flight plan in which the drone took enough photos for the software to stitch together.



Conclusion

To conclude, the motive of this project is to design and construct a drone with the main purpose of autonomously collecting a series of photos from a pre-determined location. The photos taken from the drone will then be analyzed using a software in order to detect early stages of algal blooms on bodies of water. If an algal bloom can be noticed early enough, then preventative actions can be taken to stop the bloom before it grows, leading to a prevention of the devastating effects that can happen when a bloom gets out of control.