Autonomous Aerial Remote-Sensing Drone

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Problem Statement

Grand Lake St. Mary's has been a community gathering place for many years. Being a focal point for many restaurants, businesses, parades and boat races; like many lakes across the Midwest. This lake was the location of the first offshore oil rig; however, like many other lakes in the Midwest the quality of the water in Lake St. Mary's has declined over the years due to a rapid increase in algae. This increase of algae has caused the EPA to place a recreational ban on the lake multiple times in the last 10 years preventing people from being allowed to use the lake for boating, fishing or hunting activities. Given the severe increase of algae, an understanding on how and where it forms needs to be improved. Currently, there is no effective way to monitor the algae and see where the worst spots of the algae are forming in the lake. Therefore, we are designing and building a cost-effective, and fast acting algae monitoring system to serve as an early warning system for those responsible for the care of the lake.

Objectives

Create an unmanned aerial vehicle with either remote or autopilot functionalities

Capture images that can be pieced together to create a map displaying heavy concentrations of algae

Fly high in the air, yet remain stable enough for clear and accurate pictures

Focus Areas

Fly in the air, through remote flight, up to 100 feet above the lake.

Be able to discern blue-green algae from other plant life and water.

WebODM

Conceptual Design

This is a CAD model of our drone that we used to layout and modify the design of our drone design and components. It initially was made of plywood and slightly heavier than our second design, that included a carbon fiber frame.

Also shown is our CAD model for our gimble. This is an important piece, as it holds the camera in place and if it is loose or break, the picture quality will decrease, or we could lose the camera into the lake.

Testing

We tested the thrust capabilities of our motors by attaching one to a pull gauge and ran the motor at full power. At max power, we were able to get 758g of force from the motor.

Budget

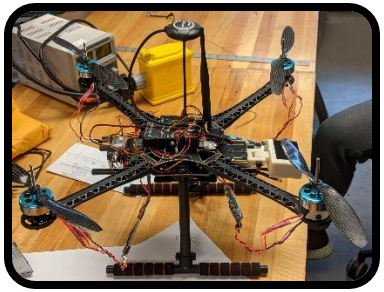
Initial budget was $1000. The most expensive item in our budget was the NDVI camera.

		Name	Costs
Required	Camera	MAPIR Survey 3	$600.00
	"Controller"	PixHawk	$94.90
	Photo Software	WebODM	$57.00
	128 GB Micro Sd	Sandisk 128 GB Micro SD	$19.99
	Drone Frame	Readytosky S500	$46.96
	Motors and Propellers	Spare from Campus	0
	Electrical Speed Controller	Aikon AK32PIN	$0.00
	Remote and Reciever	Turnigy iA6C PPM/SBUS 8CH	$0.00
		Turnigy Evolution Digital Mode 2 AFHDS 2A Radio Control System w/TGY-iA6C Receiver Black	$0.00
	Battery		$0.00
	Total Cost (Max is 1000)		$818.85
	Left for Spare Parts		$181.15

Fabrication

Fabrication included screwing down and fitting together our frame. Ensuring everything had a snug fit and stable. Any unsteadiness or deflection could cause the drone to wobble about or be off center, causing the drones to work more and cause the picture quality to be blurry or out of focus.

With the frame assembled, printed out and mounted a gimble, for our camera, onto the front of the frame for ease of access and a clear view for pictures.



Conclusion

Starting from the ground up, we designed and built a drone that is able to distinguish blue-green algae from the surrounding lake life while being able to remain above the lake by a desired height. It is able to be remote controlled or automated for the user's preference and can be used on the move, if needed.

Photo from the Times Bulletin