Testing the Waters: Engineering an Innovative Method of Water Health Analysis, Year II

Cardwell, John (School: Breck School)

Natural and anthropogenic sources pollute lakes and rivers worldwide, endangering freshwater supplies. To address waterrelated problems, physical sampling and data collection are required. Current methods of manual water quality evaluation are time-inefficient and expensive. The focus of this research was to design a remotely operated system to monitor the health of lakes and rivers. It consisted of two parts: 1) a quadcopter drone to collect aerial imagery, and 2) a remote-controlled watercraft to collect physical samples and electronic data. Aerial photos captured using a DJI Mavic Air 2 drone were analyzed for color, and drone video was used to 3D render topographic maps. The drone was also used to document progression of an algae bloom. A portable remote-controlled watercraft was fitted with a water-sampling system. This system utilized 1) vacutainers (traditionally used for blood collection); 2) an attachment chain fitted with 3D printed vacutainer retention; and 3) a linear actuator articulating a needle to puncture. A prototype vacutainer sampling system was constructed in year one, but the design was refined in multiple areas: 1) the mounting plate was completely redesigned; 2) a second plate was added to properly tension the chain; and 3) a more effective puncture mechanism was implemented. To the authors' knowledge, the remote-controlled miniwatercraft engineered in this study is the first to employ vacutainers in water collection. When ultimately operated in concert, the mini-watercraft/drone system could gather detailed, comprehensive data on physical and chemical aspects of a body of water, facilitating economical management of limited freshwater supplies.