

Integrated Sensors with Drones for Water Quality Surveys

Unmanned Aircraft Systems (Drones) for Collecting Water Samples

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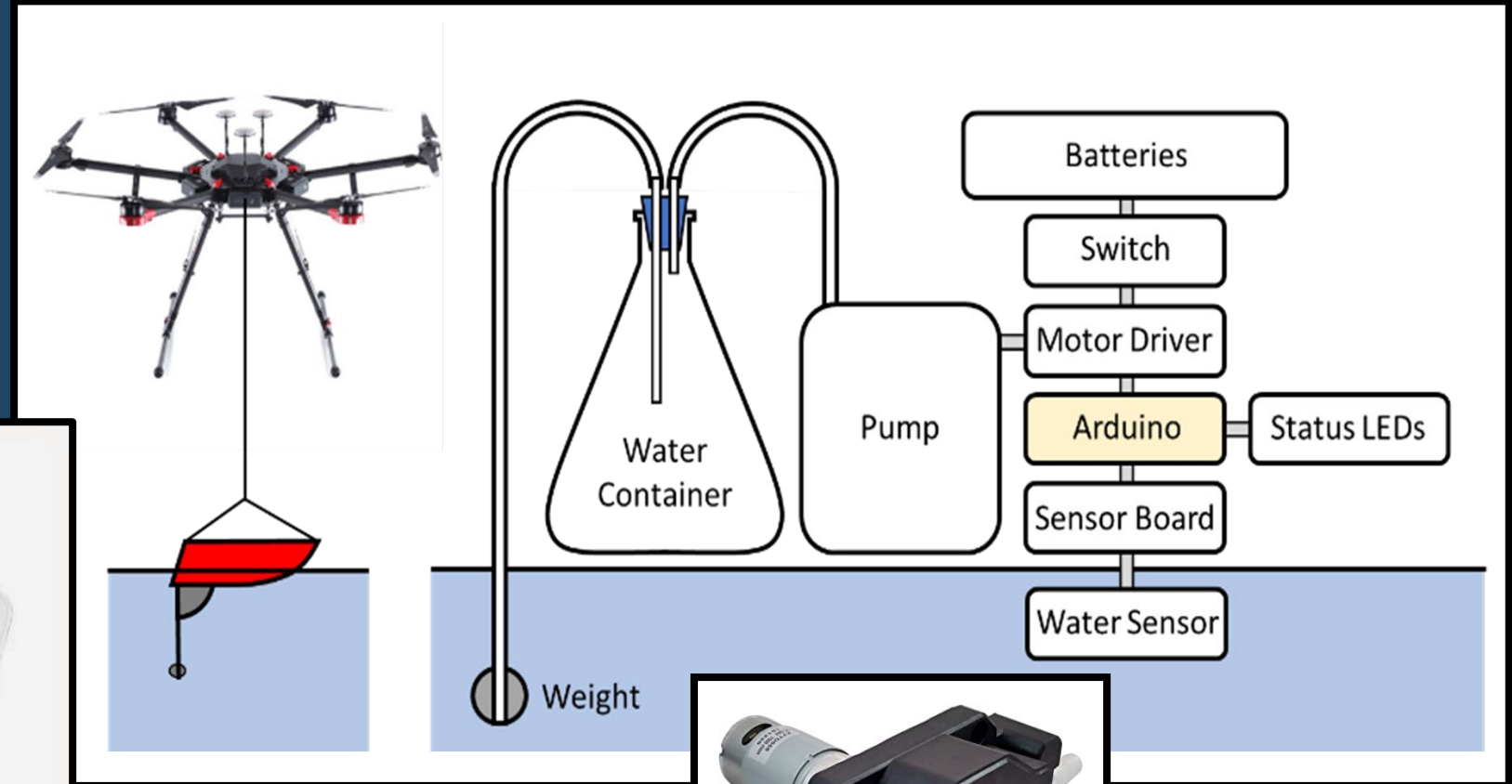
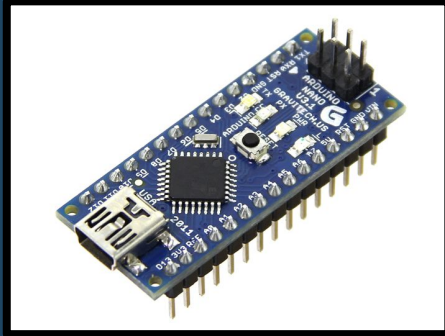
Goal:

Develop and field a water sampling drone

Challenges:

- Collect water without cross-contamination with other samples
- Collect samples from 12 to 48 inches below the surface
- Large water samples of 1 liter per sample must be collected
- Choppy water and currents where samples are to be collected
- Must be able to operate in modestly windy conditions
- Limitations of altitude hold resolution (plus-or-minus 1 meter typically)
- Payload capacity of the vehicle
- Autopilot must be capable of flying to a specific location and height to collect samples
- Vehicle and payload must be able to take-off and land from a boat or from the shore
- Quick turn-around time between samples
- Time and location of samples must be logged

Schematic of the Unmanned Aircraft System



UF Water Institute Symposium
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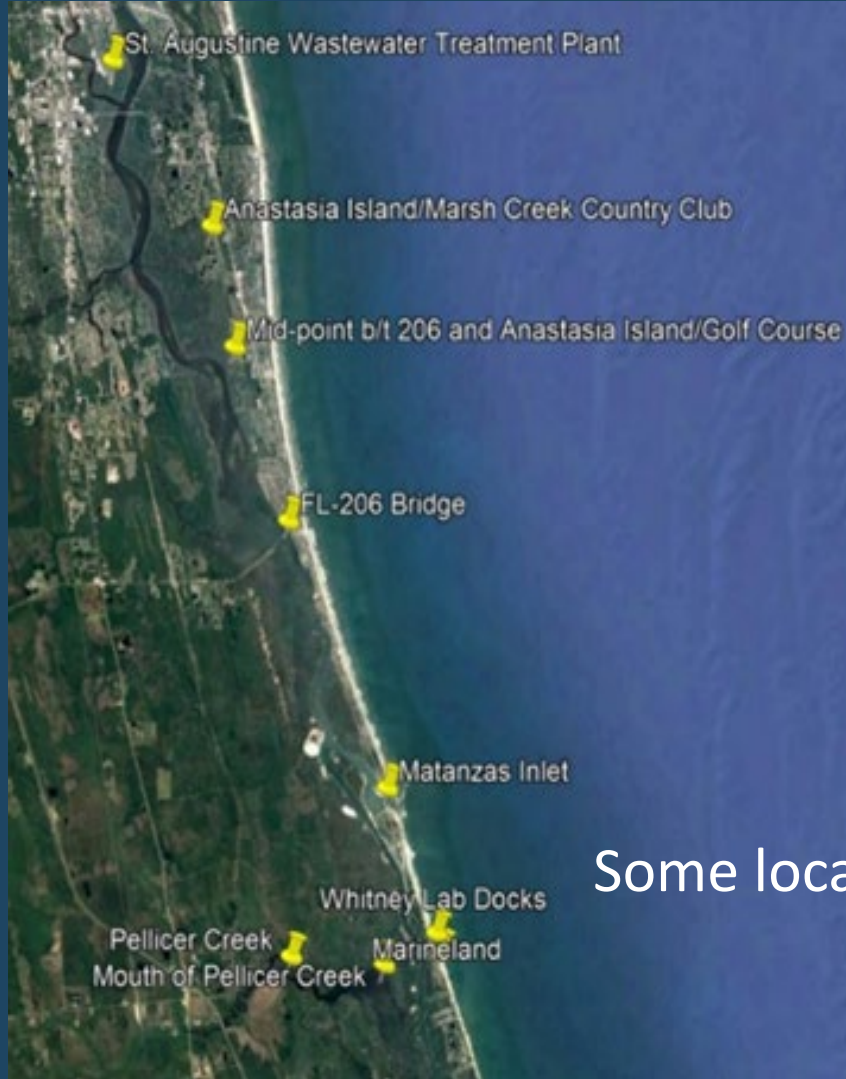
System in Action



Demonstration of Sampling Capabilities



Spring Break (March 2020) Water Sampling Trip



Site	Site ID	Latitude	Longitude
St. Aug. Wastewater Treatment Plant	WWTP	29.87720N	81.30367W
St. Aug. Wastewater Treatment Plant DEEP	WWTP-DEEP	29.87720N	81.30367W
Anastasia Island Country Club	AICC	29.83314N	81.30404W
Mid-point	MDPT	29.81107N	81.28106W
FL 206 Bridge	FL206	29.76860N	81.25815W
Matanzas Inlet	MAIN	29.71160N	81.23291W
Whitney Lab Docks	WLDO	29.669249N	81.216506W
Marineland spray field outflow	MALA	29.66780N	81.21643W
Mouth of Pellicer Creek	MOPC	29.66431N	81.22892W
Pellicer Creek Mid-reach	PECR	29.66260N	81.26837W
Pellicer Creek Mid-reach DEEP	PECR-DEEP	29.66260N	81.26837W

Some locations will be sampled from land and others via boat



Conclusions

- The basic system has been developed and tested
- We have lots of testing to expose deficiencies in the design
- Spring sampling trip is next week
- Modify things as needed to make the system robust
- Future work on automation
- Work to integrate the sampling drone with full-field imaging drones

Please visit poster #51

**Andrew Ortega, “Collecting Water Samples with Drone (sUAS)
for Water Quality Surveys”**



In Situ Detection Platform for Monitoring Water Contamination

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Water and its Importance

- Surface water
 - Lakes
 - Rivers
 - Coastal areas
- Importance of surface water quality
 - Safe recreational environment
 - Water supply for
 - Drinking
 - Aquaculture
 - Agriculture



Florida Lakes,
Rivers and
Water Resources

State-of-the-Art of Monitoring Water Contamination

- EPA: *E. Coli* and enterococci are the best indicators of contamination in marine and fresh water
- Culture Methods
 - EPA 1603: membrane filtration/culture (2 hr at 35°C + 22 hr at 44.5°C)
 - IDEXX Colilert:¹ total coliforms, 1 cfu/100 mL in 24 hours
 - Fluidion:² most probable number (MPN), 2-12 hr (depending on concentration)
- DNA Methods
 - EPA 1611: TaqMan® qPCR, 3-4 hr, in lab
 - LAMP:³ Magnetic-beads-based DNA + LAMP (30+30 min), 10-100 CFU/mL

1. IDEXX brochure

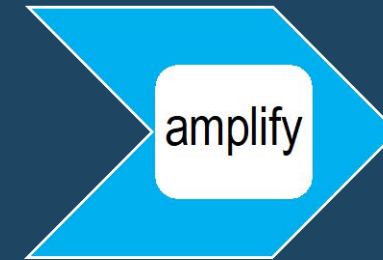
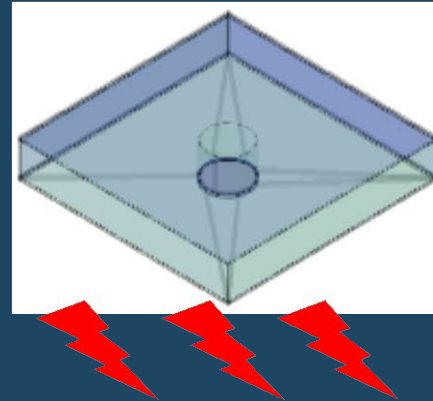
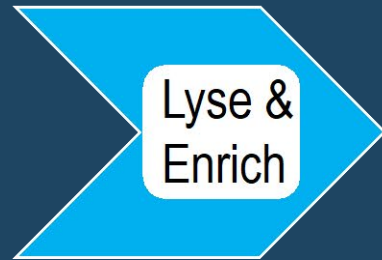
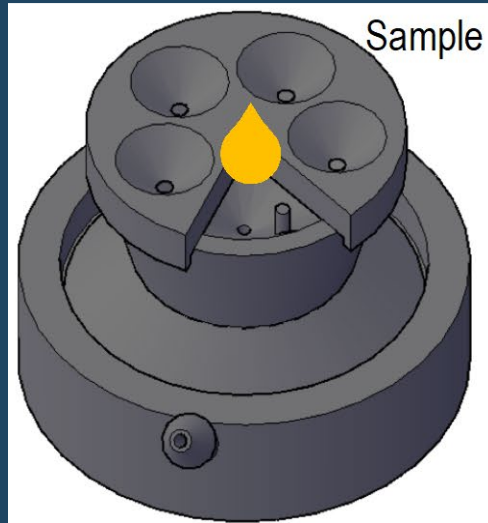
2. Angelescu, et al., *J. App. Microbio.* 2018, 126, 332-343.

3. Lee, et al., *Water Res.* 2019, 160, 371-379.

qPCR: quantitative polymerase chain reactions
LAMP: Loop-Mediated Isothermal Amplification

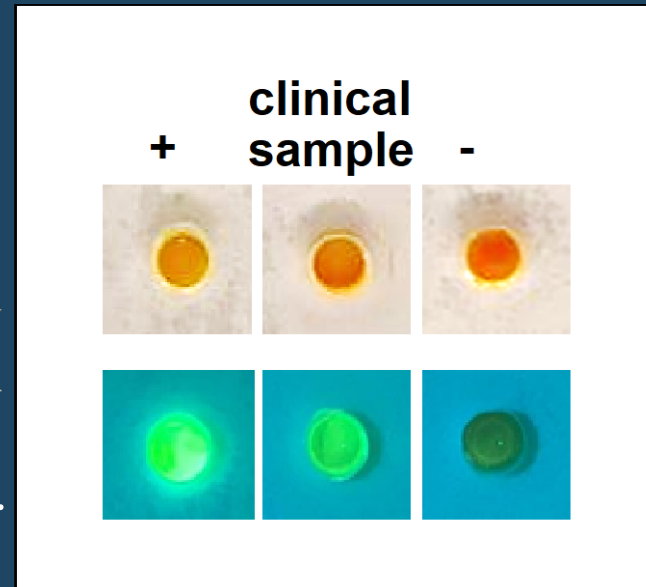


in situ Detection Platform

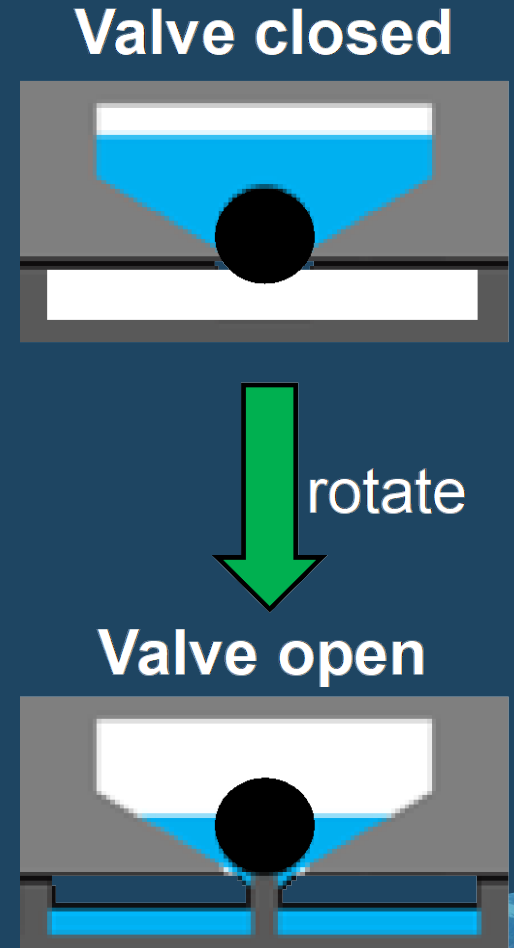
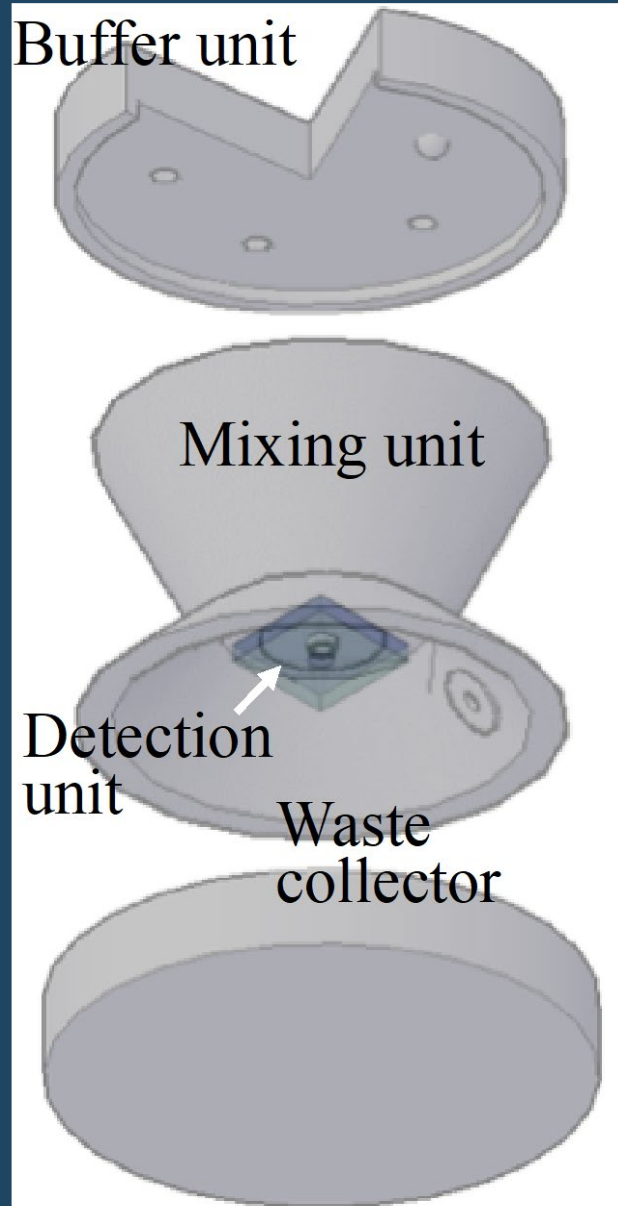


de-identified urine sample from
a Zika patient in Venezuela,
2016; the ZIKV presence had
been confirmed by RT-PCR

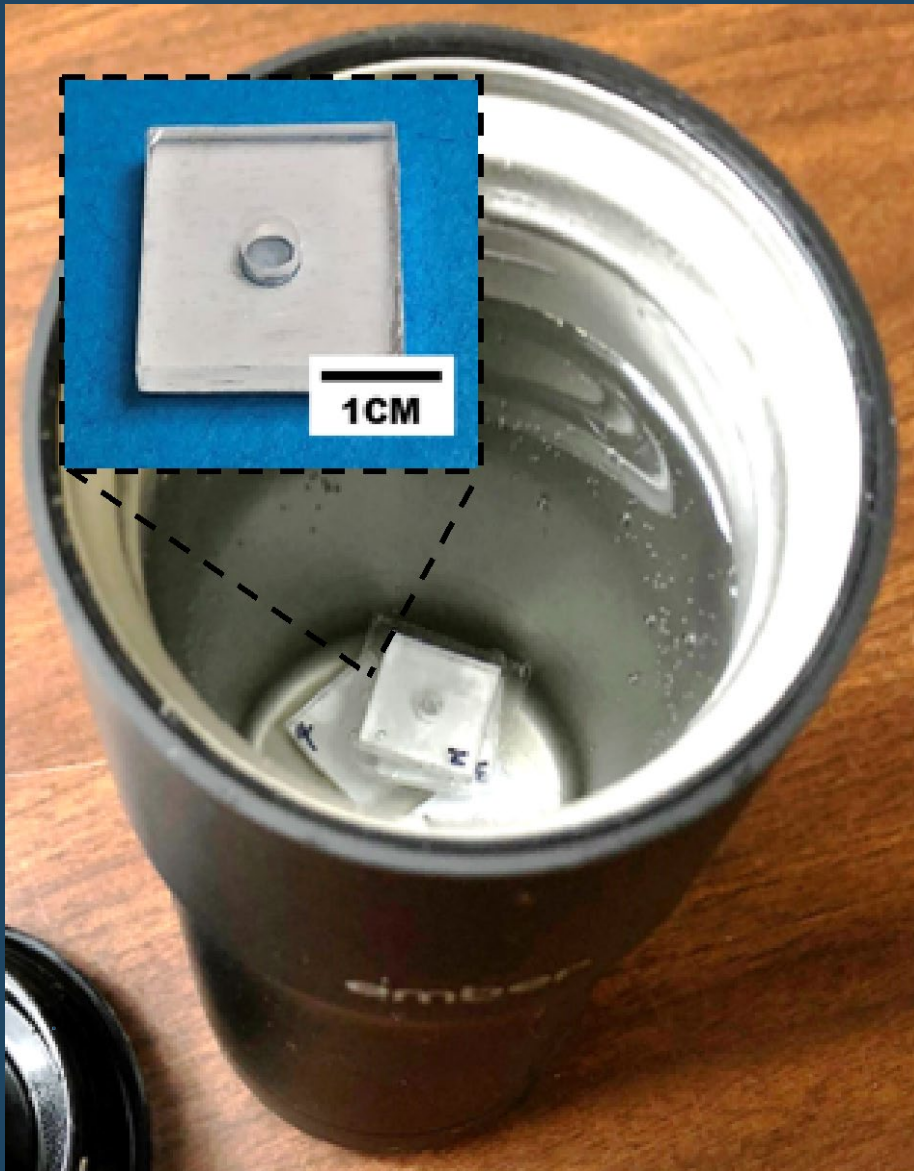
Jiang, et al. *Angewandte Chemie I. E.*, 57, 2018, 17211–17214.



Sample Preparation and Valve-Enabled Procedure



Detection Unit and LAMP



negative
control

1 mL water
spiked with
E. coli

positive
control



E. Coli Detection

- Demonstrated detection of *E. Coli* spiked in 1 mL water in the device
 - DH5-alpha
 - K12 MG1655
 - TOP10 Chemically Competent
- Established a process of ~1 hour for DNA enrichment, amplification, and detection (much faster than 1-2 day culture methods)

negative
control

DH5-alpha *E. coli* spiked in 1 mL water



DNA concentration equivalent to ~30 *E. coli* bacteria

Conclusion

- Designed and built in situ detection system for monitoring water contamination
- Demonstrated the detection of 3 *E. coli* strains using LAMP
- Future plans
 - Test water samples collected during Hurricane Dorian
 - Integrate with a drone for water quality survey

Please visit poster #52

Carlos Manzanas, “Miniaturized Platform for *in situ* Detection of *E. Coli* in Water Samples”



Acknowledgement

- Students
- Postdocs
- Collaborators

◆ Funding

