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NUSwan: Robot Swans for Highly Advanced Water Monitoring

A researcher placing a NUSwan in Padang Reservoir for advanced water monitoring. Credits: NUS Environmental Research Institute

Assistant Professor Dr Mandar Chitre and his team of researchers from NUS Environmental Research Institute (NERI) developed

robot swans that conduct highly advanced water monitoring. They recently tested this new technology at Singapore's Padang Reservoir. The robot swans move around areas of interest in water bodies and send data wirelessly via cloud computing. Operators and programmers can remotely control the robot swans. This invention is potentially a new paradigm for freshwater testing in Singapore and around the globe.

We conducted an interview with the NUS team behind the robotic swans, also known as NUSwan. Read our conversation below for exclusive insights into this new ground-breaking technology!

Researchers using a remote to control a NUSwan. Credits: NUS Environmental Research Institute

Describe NUSwan and share the different compounds NUSwan measures.

This is a research project by NUS to develop and test a new generation of the Smart Water Assessment Network, named NUSwan. The team is testing the capability of NUSwan in continuous monitoring of water quality at reservoirs and providing real time data collection. NUSwan could potentially be

used to monitor the levels of different physical and biological compounds (e.g. pH, dissolved oxygen, turbidity, chlorophyll) and at a much improved resolution. It also allows operators or researchers to tailor the sampling strategy based on varying site conditions. This allows stakeholders to quickly and efficiently interpret evolving situations and activate appropriate responses where necessary. The NUSwan platform is designed to be extendable – new sensors and actuators can be added on demand to increase its sensing capability.

Can you tell us more about the team leading the research on NUSwan? We understand your research team collaborates with the Public Utilities Board (PUB). How did this collaboration come about? Who in PUB do you work with, and how did this collaboration with PUB enable the success of NUSwan?

NERI and the Tropical Marine Science Institute (TMSI), which have been working closely in many research areas, decided to have a research team that incorporate engineers and chemists from the two institutions to jointly develop a prototype. Although the initial funding came from NERI, we are indeed delighted that our national water agency, PUB, was interested in further supporting the development of this New Smart Water Assessment Network (NUSwan) Project that is made up of a fleet of robotic swans capable of continuously monitoring our reservoirs.

How did the idea of creating robotic swans for water monitoring develop?

Four years ago, Professor Ong Choon Nam, Director of NERI, approached Professor Mandar on the idea of using our STARFISH (Small Team of Autonomous Robotic “Fish”) autonomous underwater vehicles (AUVs) for monitoring fresh water bodies

such as rivers, lakes and reservoirs. So far, there were no systems that are low cost, friendly to the environment, cover a wide range of parameters and for routine monitoring of water quality. Although STARFISH AUVs could be used for the monitoring, they were over-engineered for this task and would not provide a cost-effective solution. A robot swimming at the surface would be a better solution and offer higher accuracy. Additionally, a robot that blended with the environment, in line with PUB's ABC initiative, would be nice. The idea of NUSwan was thus born.

Does your team face competition from other developers of similar monitoring systems?

Existing freshwater monitoring over a large area can be laborious, and typically involves taking a boat to fixed sampling locations for collection of grab samples and take in-situ measurements. Fixed online stations provide limited coverage. It would be too costly to deploy a large number of them for extensive spatial sampling. Hence to reduce reliance on manpower and increase efficiency in water quality monitoring, we are constantly looking into developing new technology with improved capabilities. Scientifically, the NUSwan test drives a new paradigm of freshwater monitoring, one that is persistent and interactive, and is potentially able to monitor the dynamics of water quality over space and time at an affordable cost. It would be expensive to do similar monitoring manually or using AUVs (Autonomous Underwater Vehicle).

Researchers collecting data from NUSwans which send data wirelessly. Credits: NUS Environmental Research Institute

What other projects would your team be working on in the future?

The NUSwan Project is in its test-bedding stage, where several NUSwans run missions regularly at the test sites in Singapore, and the data collected during test bedding is validated against the data from other traditional monitoring methods. The NUSwan evolves continuously, and acquires new sensors and capabilities. Recently, a team at NUS managed to develop a prototype for phosphate monitoring in freshwaters. We hope to integrate phosphate sensing capability to NUSwan in the future.

Click here (http://news.nus.edu.sg/images/resources/news/2015/2015-07/2015-07-03/ROBOT-cnaonline-3jul.pdf) to read more about NUSwan!

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