National Geographic Explorers Connect the Okavango Delta to the IoT

Drones capable of detecting illegal logging in the Amazon Rainforest. Sensor networks to help research the dwindling honeybee population. Smart solar-powered waste collection. This is all happening today thanks to the Internet of Things. In addition to new technologies, the open-source movement has made it possible to share hardware designs, software and even data-making it easy for anyone to aid the global effort to preserve the ecosystems we depend on.

This summer, a team of National Geographic explorers are taking a 1,000 mile journey down the Okavango River in an effort to collect environmental data, discover new species and measure the heartbeat of one of the most remote wetlands in the world. And it's all being done with Internet connected devices.

Into the Okavango's Mission
The Okavango Delta, located in Botswana, is one of the last pristine wetland wildernesses in the world. It's protected as an UNESCO World Heritage Site, but farther upstream its water supply in Angola and Namibia is still susceptible to human interference.

National Geographic's Okavango Expedition assembled a team of scientists and engineers to collect data along the Okavango River so that conservation efforts can be more effective, raise awareness and ensure that this remote wildlife sanctuary can be enjoyed for generations to come.

The delta itself stretches a vast 15,000 square kilometers, so the team of researchers needed to find a way to efficiently gather data across the entire area. Since this is such a remote location, additional considerations needed to be made like weatherproof equipment, power sources, and how to network the sensors.

Connecting Across the Delta

Shah Selbe, the expedition's lead technologist and conservation engineer at Conservify, created a wireless sensor network that significantly reduces the amount of manual labor required by the team to collect environmental data. Now, they no longer have to use pH strips or manually check sensor readings and record data onto paper. The wireless network completely automates the recording of data, collects more of it, and is more accurate.

Steve Boyes, National Geographic Emerging Explorer, put it best saying, "Shah took us from little strips and pieces of paper – writing down the water quality as we go down – to environmental sensor platforms… We're going to be measuring the literal heartbeat of that wilderness in real time for the world to see."

Shah and team built a wireless sensor network using components you probably have sitting on your desk right now. A Raspberry Pi running a Python script is the center of each network. This central hub processes the data generated from multiple remote nodes and acts as a Wi-Fi gateway. Data is directly uploaded to the web server using JSON. In some especially remote locations, the remote Arduino nodes send data using the Twilio API over a cellular network.

Each of the nodes consist of an Arduino, XBee, and multiple sensors. The XBee ZigBee network makes it possible to connect over long distances since data packets can hop between neighboring nodes until they reach the central coordinator. For power, the remote nodes rely on a solar panel and a 6600 mAh battery.

There were a variety of sensor deployed throughout the delta. The main goal is to gather data related to water quality so sensors for water chemistry like pH, dissolved oxygen, salinity, and conductivity make up a bulk of the data collected. The team is also trying to better understand flood dynamics by monitoring flow rate, water level, and turbidity.

On the surface, sensors measure air temperature, humidity, barometric pressure and in the future the team plans to add sensors to detect radiation and other air pollutants.

In addition to the environmental data collected by the sensors, the team is streaming GPS location, research observations, wildlife sightings, photos, and more in real-time on their website.

Rolling out the wireless sensor network and collecting data is just phase 1 of the project. All of the data will be made available to the public through the website's API. Continuously monitoring the delta will enable the team to detect even the smallest changes in water quality. The design and code used in the project will also be open sourced so the conservation effort can reach and preserve as many marine habitats as possible.

Over the next few years, the team plans to build out the network by adding sensors to the headwaters and other locations across the delta to gain an even more comprehensive understanding of the river and its surrounding environment.

Tags: Africa, Arduino, Conservation, Data, National Geographic, Raspberry Pi, Shah Selbe, wireless sensor network, xbee