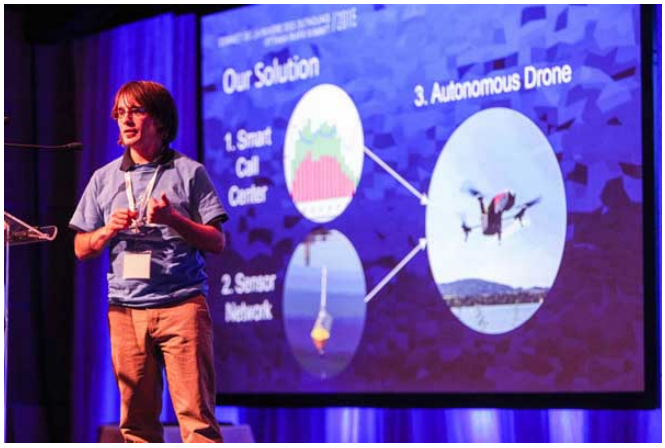
How emerging technologies can monitor environment, prevent disasters

30 June 2015, by Nina Haikara



PhD candidate Alberto Camacho at the Ottawa River Summit, AquaHacking 2015. Credit: AquaHacking/de Gaspé Beaubien Foundation

Their goal was to show how emerging technologies can help Canada's lakes, rivers and freshwater sources – starting with the Ottawa River.

Their solution: a system they call Drone River.

"Drone River can help the people responsible for the care of the river to monitor its quality in real time," says University of Toronto PhD candidate Alberto Camacho. He describes the project as consisting of three components: a call centre that processes calls automatically and gathers information from social media such as Twitter; a sensor network deployed along the river; and a number of drones distributed along the river.

"When our system detects a problem in the river, it sends a drone to autonomously inspect the affected area, take pictures, videos, samples of water and deploy extra sensors if necessary," says Camacho. "This information is sent to experts, speeding up the process of solving the problem in the river and preventing major disasters."

Camacho and Patricio Córdova, a graduate student in U of T's master of science in applied computing program developed and pitched Drone River for AquaHacking 2015. The recent event brought together computer enthusiasts, developers and digital professionals to focus on a series of concerns defined by the Ottawa River community.

"AquaHacking was an opportunity to explore new emerging technologies to solve a challenging problem," says Córdova.

Below, writer Nina Haikara talks with the pair about Artificial Intelligence, Drone River and the Internet of Things.

How did you develop your idea?

Camacho: I spoke with several experts in the conservation of the Ottawa River about the current problems they face.

They identified three major areas of concern: insufficient human resources to respond to phone calls reporting problems with the river, complex legislation relating to river conservation, and challenges associated with inspecting inaccessible or unpopulated areas of the river.

I knew that all of these problems could be addressed using existent artificial intelligence (AI) and drone technologies. All we needed to do was to demonstrate that such a solution was feasible, effective and reliable.

Córdova: We developed a working prototype using web services and a commercial drone.

The call centre is an automated and centralized web service that gathers information about the state of the river from text messages, phone calls, and tweets that contain relevant information. The

call centre analyzes this information in order to identify problems in the river and locate them.

We propose the installation of solar-powered base camps along the waterway. Each base camp gathers information from the sensors deployed in the river, and sends this data to the cloud through cellular networks for real-time analysis.

Whenever a problem is detected, a drone near the affected area is sent automatically to inspect the river. The drone can fly autonomously, and take pictures, videos, take samples of water, or deploy more sensors in the water to better understand the problem. The drone was programmed to fly from the base station to a simulated river, descending close to water level, and then returning to the base station.

Did your current research influence your project for Aquahacking?

Camacho: Absolutely. For me, artificial intelligence is the key factor that adds value to our solution. My research focuses on AI planning and the Internet of Things and consists of finding the best strategies to solve a task. AI makes it possible to design systems that make intelligent decisions and interact with the environment autonomously.

Córdova: Not at all. I am currently completing an applied research term at Riva Modeling Systems where my work is related to data visualization on maps. However, my main interest is solving any relevant problems using technology, which is why I chose the applied computing program.

In this case the problem was monitoring the water quality of a river and reacting fast to possible pollution cases. For me, drones and sensors seemed to be the most efficient technology for open space usage, so the challenge was to research what is the state of the art in the field, what is the best technology available and what we need to do to implement it.

Why do you think technology-based solutions are needed to support waterway conservation?

Córdova: After our presentation, one of the attendees to the summit approached us and said that our project would "take him out of the business" since his job is to take measurements of the river's water quality manually and our solution is more efficient.

My answer to him was that our goal was not to replace people, but to help them do their tasks more efficiently. There is still the need for expertise to determine things like what areas of the river have to be inspected, what clues to look for, and several other layers of knowledge that are gathered only after years of work that AI applications cannot fully understand yet.

Camacho: Our experts identified insufficient human resources as a challenge to the conservation of the Ottawa River. Our solution addresses this challenge, allowing limited human resources to be used for key decision making and commonsense reasoning, relegating machines and computers to some of the more mundane or repetitive tasks like water monitoring or sifting through social media posts. Using technology-based solutions makes it possible to increase the coverage of the areas monitored, to identify problems in real time, and to respond to them faster than can be done with existing resources.

Have you participated in other hackathons or technology-based competitions?

Camacho: I was the runner-up in the IBM SportsHack 2014. Previously, I won the Indra Future Minds 2011, an international case study competition, and was the runner-up in the National Engineering Competition in Spain.

Córdova: The last competition I participated in was the Microsoft Imagine Cup in 2013, an international contest in which students develop solutions in three categories. My team competed in the World Citizenship category after developing a network that geo-localizes social causes and tries to find donors and volunteers to contribute to them. We were chosen to represent my home country, Ecuador, in the world finals. In the finals we won

the Facebook award, worth $25K, for our usage of the Facebook Open API to spread the word about the causes.

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