Boreal Ecosystem Recovery & Assessment
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INTERNET OF THINGS TEAM FALL 2018: *BOREAL FOREST ENVIRONMENT MONITORING USING IOT*

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Project summary

The boreal forest ecosystem of Alberta is increasingly affected by human development related to natural-resource extraction, pipelines, roads and seismic lines. It's urgent and necessary to understand and monitor environmental conditions in the boreal area. However, it is difficult to collect continuous temporal observations in boreal regions due to its remote location, traffic inconvenience, the cold weather in winter. The objective of this research is to design, develop, test, and demonstrate a low-cost, low-power, and long-range IoT (Internet of Things) monitoring system that will collect ground biophysical data (e.g. micro-climate) in the boreal forest area. Firstly, we designed and developed a sensor-network system based on existing commercial off-the-shelf open-source hardware, software, and open standards architecture. Secondly, we deployed a small-scale alpha version WSN (Wireless Sensor Network) which had eleven devices in three different sites to test the possibility and reliability of the architecture. Thirdly, we revised our design based on the lessons we learned from the field deployment. Then, we present our current new design and implementation IoT system which consists of 20 nodes.

Progress to date

This year we focus on integrating LoRaWAN (Long Range Wide Area Network) into our design. The purpose of using LoRaWAN is to provide a reliable transmission network as well as to increase sensing coverage for our WSN in the boreal area. We enhance our design and use Seeeduino LoRaWAN as our sensing node. Each node has a temperature/humidity sensor, and a light sensor to track the surrounding micro-climate, as well as the LoRa module to transmit data from the field to the cloud. From our current test, the gateway can receive messages up to 6 km in open area, where buildings and trees are not blocking line of sight from the sensing node. For boreal forest area, where multiple trees are in the way, the gateway can receive data at an average of 1 km far away from the node.

Our next step is building a geospatial cloud platform to store, analyze, visualize and share field data before April 2019 as well as deploying a large-scale sensing network (100 sensing nodes) in the boreal area for one month in 2019 summer.

Management implications

1. A WSN can offer continuous temporal observations to describe and understand boreal area environmental conditions that either cannot be directly measured by traditional remote-sensing technologies or are too costly to obtain through conventional field surveys.
2. The advent of the IoT and the availability of powerful and inexpensive hardware, together with the development of open standard stacks, make the Internet-connected WSNs largely adopted for environmental monitoring.
3. LoRaWAN network can help us build a low-cost, mobile, and secure bi-directional communication system in a remote area with increasing the monitoring area
4. The end-to-end geospatial cloud platform will streamline the process to collect, communicate, share, and analyze field data, and enable government, businesses, and citizens to share, collaborate, and access the information generated from the project via a unified web-service API.

Geographic location

The geographic area of this research will take place in Barrier Lake Field Station which is located in the Kananaskis Valley, 80 kilometres west of Calgary.