Boreal Ecosystem Recovery & Assessment
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INTERNET OF THINGS TEAM FALL 2018: *AUTOMATICALLY PREDICTING MICRO-CLIMATES USING DYNAMIC TIME WARPING*

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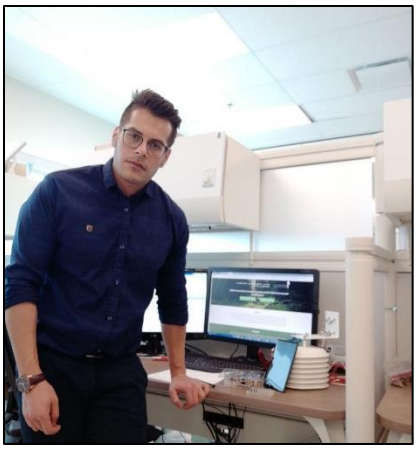

Project summary

Microclimate is a climatic condition confined to a relatively small area. Microclimates are affected by many factors, such as temperature, humidity, wind, frost, heat balance, evaporation, the nature of the soil and vegetation, the local topography, latitude, elevation, and season. The low-cost and low-power sensors including temperature, light, humidity, and wind sensors can easily measure different environmental parameters and identify microclimates. Although microclimates can be identified by designing and deploying a sensor network in the study area, it needs human intervention in different fields. The first human intervention is for assessing the energy supply of each measuring sensors. Applying the solar power system as a source of energy for measuring sensors can extend their lifetime from several days to several weeks and result in reduce human intervention. Analyzing time series provided by sensor measurements and identify microclimates is the second field of human intervention. This type of intervention can be addressed by proposing a cloud-based mechanism to gather all the measurements and then analyze time series on the cloud environment. In this study we are going to propose a low-cost, and secure bi-directional communication network, LoRaWAN Network, and apply Dynamic Time Warping algorithm to automatically predict microclimates with the lowest level of human interaction.

Progress to date

The main objective of this research is following the proposed architecture based on open hardware and open standard OGC SensorThings to develop a low-cost geo-sensor network for automatically identifying microclimates in terms of temperature, light, humidity, and wind changes in the boreal-forest regions of Alberta. I started working on this project in October 2018. Thus far, I searched about the functionality of different sensors, conducting a literature review and applying DTW for microclimate modeling, and analysing the data to find dynamic patterns. I have a plan to used a proposed wireless sensor network used to collect large and highly accurate environmental data in the next following weeks.

Management implications

The boreal-forest regions of Alberta are under increasing pressure from human development related to natural-resource extraction. Roads, seismic lines, well sites, cut blocks, mines, pipelines, and other elements of human footprint exert cumulative environmental effects which may affect microclimates in this region. Automatically predicting microclimates in this region can be considered as the underlying knowledge for environmental engineers and decision makers. In this study, we will analyze the time series by applying the Dynamic Time Warping algorithm. Also, we will try removing the need for human intervention by using a solar power system as our energy resource and using an implemented low-cost wireless sensor network based on open hardware solutions and open standard OGC SensorThings.

Geographic location

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