State of Knowledge on the Use of Webcams for Ecological Applications

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SECOORA Southeast Coastal Ocean Observing Regional Association

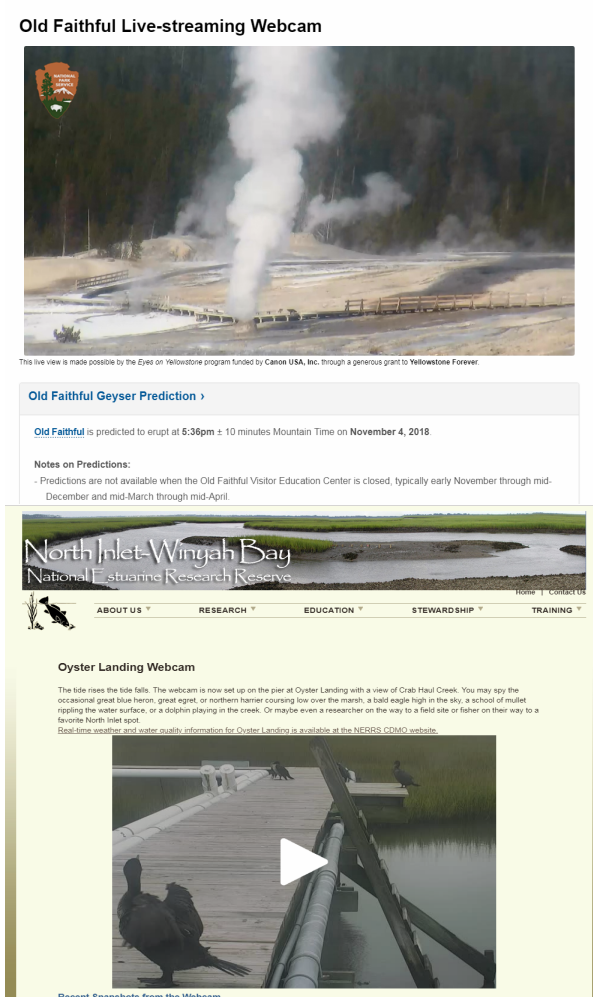
IOOS Integrated Ocean Observing System

Application

- How are you applying the web camera data?
  - A somewhat rigorous, but certainly not exhaustive, literature search coupled with very limited personal contacts found:
    - Not much “knowledge” was found in the literature.
    - While the use of remote sensing technologies to address ecological applications are extensive and diverse, the use of webcams is currently limited.

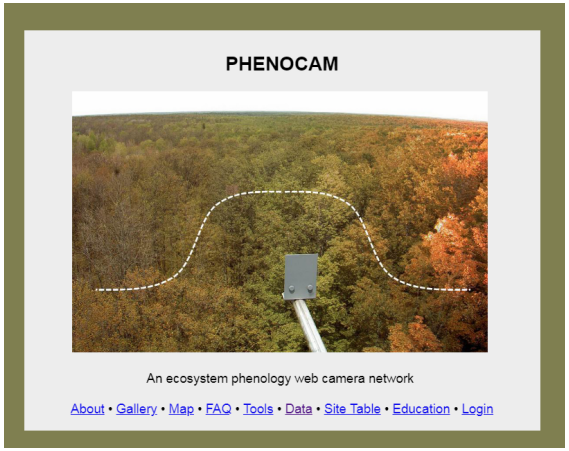
Application

- How are you applying the web camera data?
  - Most identified webcam applications are for qualitative or ‘’for you enjoyment” viewing:
    - The National Park Service maintains a series of webcams providing real-time ‘views’ of parks. (E.g. https://www.nps.gov/yell/learn/photosmultimedia/webcams.htm?sf174893829=1)
    - A number of NERRS reserves maintain webcams for viewing wildlife, tidal stages, vegetation, etc. (E.g. http://www.northinlet.sc.edu/webcam/index.html)



Application

- How are you applying the web camera data?
  - A few applications were quantitative in nature:
    - Phenocamnetwork (https://phenocam.sr.unh.edu/webcam/) is a network of webcams with automated image processing to remotely quantify the phenology of plant communities. If you install an appropriate camera and connect it to the web, the network will do all the image analysis, data processing, data-hosting, etc.
    - National Park Service Air Quality Network (https://www.nps.gov/subjects/air/webcams.htm) is an agency approach to evaluating air quality conditions and trends allows the National Park Service Air Resources Division (ARD) to provide specific air quality information for over 350 national park units.



Application

- How are you applying the web camera data?
  - Research-project specific applications include:
    - Quantifying changes in forested extent for an alpine tree line ecotone
    - Monitoring fall leaf color changes
    - Calculating normalized snow indices
    - Tracking invasive species
    - Bacterial source tracking
    - Assessing impacts of boat wake on marsh slumping
    - Monitoring fish passage
  - Research efforts are underway to assess the use of webcams for:
    - Assessing water quality conditions including HAB formation
    - Counting / tracking things in the water

Web Camera Set Up

- Considerations include:
  - Type of communication to camera
    - Hard-wired (best case scenario) or via wireless, radio, etc.
  - Bandwidth limitations and associated loss/gain of resolution
  - How remote is camera and associated logistics of servicing
  - Power
  - Vandalism
  - Capturing and then posting unwanted / inappropriate imagery

Management of Data

- Considerations for data management:
  - Access protocols and data usage limitations
  - Storage costs
  - Format
  - Data catalog to include search keywords or attributes that might be common across cameras and the access to their collected video/data.
    - That would be helpful if a developer or programmer wanted to search across a network of cameras for camera(s) with a specific or similar setup, utility, access, etc. to a possible application profile.

Data Analysis

- Image analyses techniques and tools include:
  - Amazon Rekognition allows you to automatically identify objects, people, text, scenes, and activities, as well as detect any inappropriate content.
  - TensorFlow™ is an open source software library for high performance numerical computation. Its flexible architecture allows easy deployment of computation across a variety of platforms (CPUs, GPUs, TPUs), and from desktops to clusters of servers to mobile and edge devices.
    - The video link to the Folly Beach camera object detection used openly/freely available 'tensorflow' code from tensorflow.org, using one of many task-specific machine learning models.

Challenges and Roadblocks

- What are your top challenges and roadblocks you face?
  - When using AI techniques, such as Tensor Flow, the hardware needed to train and run the processing can be expensive.
  - Usually high performance is gained from using high end graphics cards(GPUs) and the prices of these can be cost prohibitive.
  - The training data itself can be time consuming to format in a consistent manner.
  - Depending on the camera focus and resolution, the applications that could be developed are in the domain of automating a manual/visual object identification/tracking task which might be tedious or unfeasible by a person, but possible and cost-effective using machine learning/visual pattern matching.
  - Related to the development of this process is whether this object id and tracking process can, could or should be shared at other similar locations for the same individual site and/or combined.