Snow Depth Sensor Analysis & Quality Assurance via on-site imagery

NDSU | COMPUTER SCIENCE

Capstone 2024

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Sponsor: NDAWN (North Dakota Agricultural Weather Network)

The Need

- NDAWN collects and provides weather information in the North Dakota region
- Over 150 stations with snowstakes (shown in the bottom right corner) and cameras to measure snow depth
- Computerized reading of the snowstakes would make snow depth collection very efficient as opposed to manual entry.

The Goal

- Our goal was to design a system that would scrape the images each day, process them using optical character recognition, and output the results to a JSON file.

Technical Information

Scraping

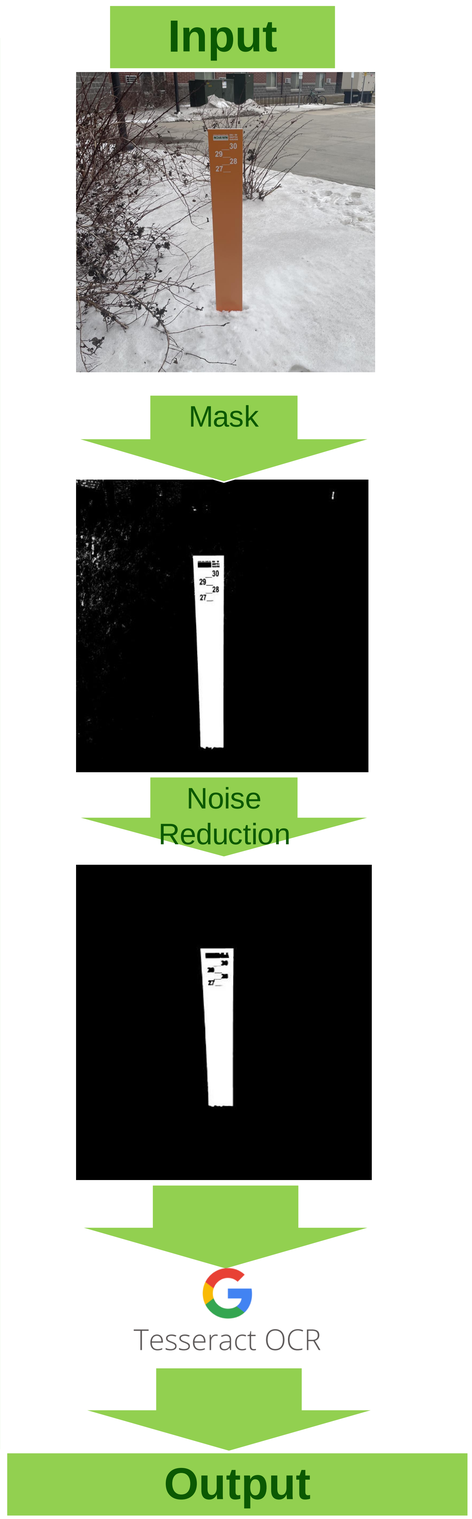
- Scraping the NDAWN website daily brings in the image and the file name to be used in the JSON output

Tesseract/OpenCV

- Tesseract is an open-source OCR that we employ within our project.
- OpenCV (Open Computer VIsion) is a Python library that we used to help locate the snowstake within the image.
- For best results we use the following steps to pre-process the images:
  - Mask image based on color range – blaze orange stakes are the best here due to the small range of colors when accounting for snow reflection
  - Erode image – making the white part smaller to reduce noise
  - Dilate – returning white parts of the image to their original size. Because the noise was reduced, it does not interfere with this step.

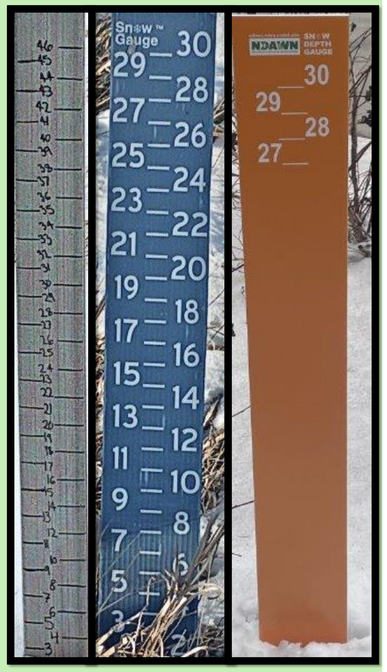
JSON

- Output to a JSON file to include station name and depth as fields. If there is an error, then the fields are the station name and the error..



Snowstakes & Roadblocks

- Initially the snow stakes were in either the handwritten form or the blue form (right)
- The hand-written stakes didn't really work at all, except for manual review
- The blue ones have two main issues.
  - Shadows on the snow become a similar color to the stake
  - When eroding noise, the numbers being so close to the edges makes them erode as well
- The orange stakes fix these issues



Three generations of snowstakes – from worst on left to best on right