COMP39/9900 Computer Science/IT Capstone Project
School of Computer Science and Engineering, UNSW

Project Number: P29

Project Title: AI-Driven Shoreline Mapping for Coastal Monitoring

Project Clients: Jonathan Chan

Project Specializations: Software development; Artificial Intelligence (Machine/Deep Learning, NLP); Computer vision.

Number of groups: 3

Background:

With rising sea levels, more intense storm events and increased coastal development, effective coastal management is integral to preserving and protecting vulnerable communities and ecosystems in low-lying coastal areas.

A key metric for informing coastal management and answering challenging questions such as "Where is the coastline most vulnerable?" or "How effective is this artificial reef?" is beach width variability. The primary means of measuring beach width variability involves extracting the shoreline positions (the sand-water interface) from images, such as satellite images, phones and fixed cameras.

Current tools for extracting shoreline positions from images are based on simple image processing techniques, are specific to image types and require manual intervention, restricting the potential for extracting shorelines from images in near real-time and from the extensive archive of coastal images. With recent advances in AI, neural networks and image segmentation, there's potential for a powerful tool for extracting shorelines from all types of images. If developed, this tool would greatly enhance the data accessible to coastal scientists and practitioners, leading to more informed coastal management.

The goal if this project is to have a single and robust AI drive solution to effectively extract shorelines from images.

Requirements and Scope:

The scope of this project is to develop a robust AI-driven tool for automatically mapping shoreline positions from various image sources, including satellite images, phone images, and fixed camera images. The tools could be used by people with different backgrounds and from anywhere in the world, so it is important that the tool is simple and user-friendly. It is understood that some machine learning tools and packages that could be incorporated into the solution require specific hardware.

The group will be provided with an extensive dataset comprised of images and mapped shorelines for model training and validation. The group will then design and implement their own solution to extract shoreline positions from images.

The group needs to ensure the tool can handle images from various sources with different resolutions and qualities. The group will initially begin by developing a tool to work on oblique aerial images and following this the group will incorporate satellite imagery.

The solution should be simple and easy to use, requiring minimal user input besides some

hyperparameter tuning and a user-defined image source and output directory.

Required Knowledge and skills:

Experience programming in python would be preferable, but not essential.

Expected outcomes/deliverables:

A robust tool for mapping shorelines on different image sources (fixed cameras, phone cameras and satellite images).

- Documentation for deployment
- A user guide.
- A report containing a summary of the options that were explored, a diagram of the system architecture, justification for the chosen architecture, a summary of model hyperparameter tuning and a summary of the overall model performance for different image sources.

Supervision:

Jonathan Chan

Additional resources:

Existing tools for shoreline extraction from:

1. Oblique aerial images: https://github.com/simmonsja/cnn-shoreline-detect
2. Satellite images: https://github.com/kvos/CoastSat
3. Phone images: https://github.com/Coastal-Imaging-Research-Network/CoastSnap-Toolbox