Semantic Segmentation of Refuge Islands in Aerial Images and Comparison with OpenStreetMap

Student

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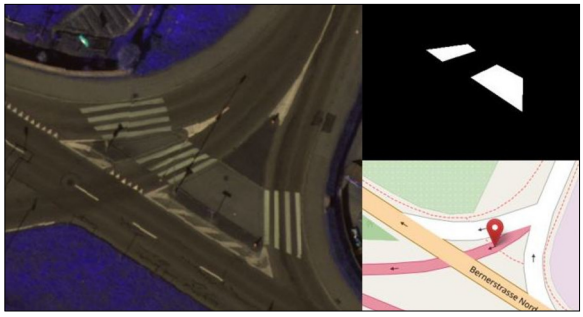
Introduction: Thanks to advances in the machine learning domain, it is now possible to process large amounts of data efficiently. Consequently, there is great potential to apply these technologies in areas where data is sometimes still processed or reviewed manually. For instance infrastructure object-detection in satellite or aerial imagery. This project is about the detection and localization of refuge islands in the north eastern region of Switzerland, based on 1. high-resolution aerial images of 2019 from Swisstopo and 2. current island objects from OpenStreetMap (OSM).

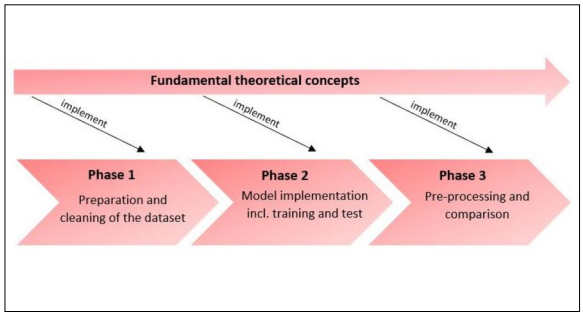
Approach: Based on computer vision theory, an already existing machine learning model is extended and trained based on the two inputs. The project contains three main phases (see fig.3). First, the training dataset is cleaned and prepared to make sure the later used artificial neural network is fed with useable data and correct labels. Phase 2 contains the whole training and testing processes of the model. By the end of this step, the model will have produced predictions for a subset of the data on whether there are refuge islands located on these images. In phase 3, the coordinates of the predicted objects are extracted. Subsequently, the locations are compared with all already mapped pedestrian refuge islands in OSM.

Result: First, a training set has been generated by manually labeling images containing refuge islands. Then a machine learning model in the form of a convolutional neural network has been implemented using Python, a Jupyter Notebook, and the deep-learning library Fastai. The result of this work is a computer-aided method for object segmentation of refuge islands in aerial images. This can be further used to support the verification process on OSM. Due to the correct preparation of the orthophotos, as well as a suitable configuration and targeted training, the model used, is now able to reliably recognize pedestrian islands. The model achieved an object accuracy of 92% and an F1 score of 0.95. The subsequent comparison of the model predictions showed that all 623 refuge islands included in the test set are already correctly mapped in OSM.

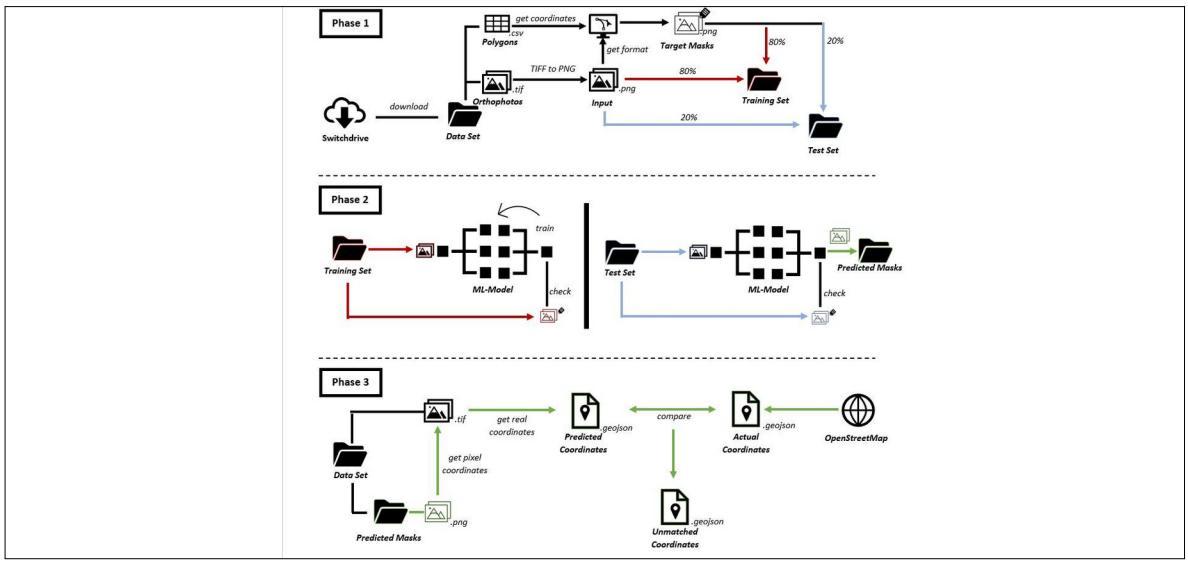
Aerial image as input for the neural network and the derived binary mask (top right). OSM localization (bottom right).
Own presentment



Direct application of the acquired concepts throughout the three main phases of the practical part of the project.
Own presentment



Data flow diagram showing the conversion and creation of data from the source dataset to the comparison with OSM.
Own presentment



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Subject Area
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