Enhancing 3D Map Generation from Satellite Imagery Using R-CNN

K. Girnius, A. Gadeikytė, E. Butkevičiūtė

Faculty of Informatics, Kaunas university of technology

ABSTRACT

This study provides a detailed analysis of methods for processing satellite images to generate 3D maps, addressing key technical challenges and recent advancements in the field. Satellite imagery plays a crucial role in applications such as environmental monitoring, urban planning, and disaster management. However, converting 2D satellite images into precise 3D models remains a complex task due to issues like data quality, resolution, and the limitations of current techniques.

TRAIN DATASET

1. Data from OpenStreetMap, including object types such as buildings, roads, etc. Image size 1500 x 1500 px.

2. Assign unique colors to objects based on their type (e.g., green for buildings, blue for water).

3. Process prepared images and generate corresponding JSON annotations.

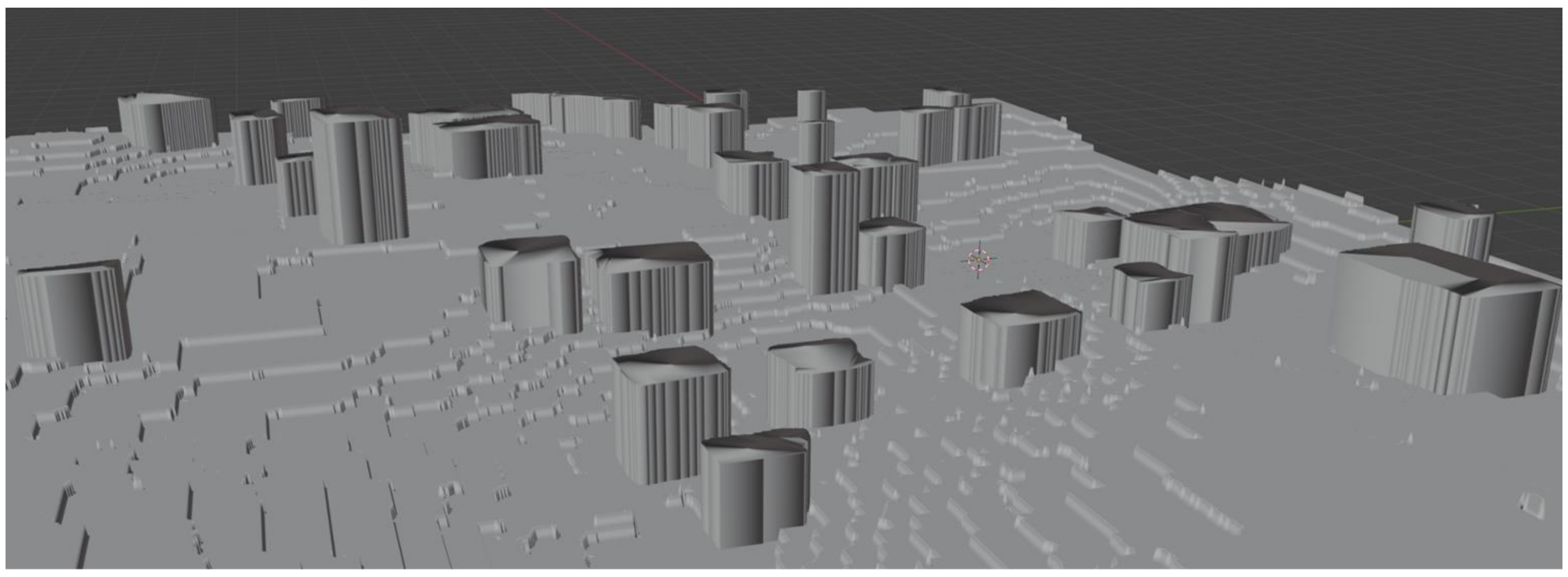
This study was conducted using Qgis 3.32 Lima Software [1], TensorFlow machine-learning framework [2], and Blender Software [3].

PROJECT DESCRIPTION

The aim of this work is to investigate a region-based convolutional neural network model for object detection and classification of satellite images.

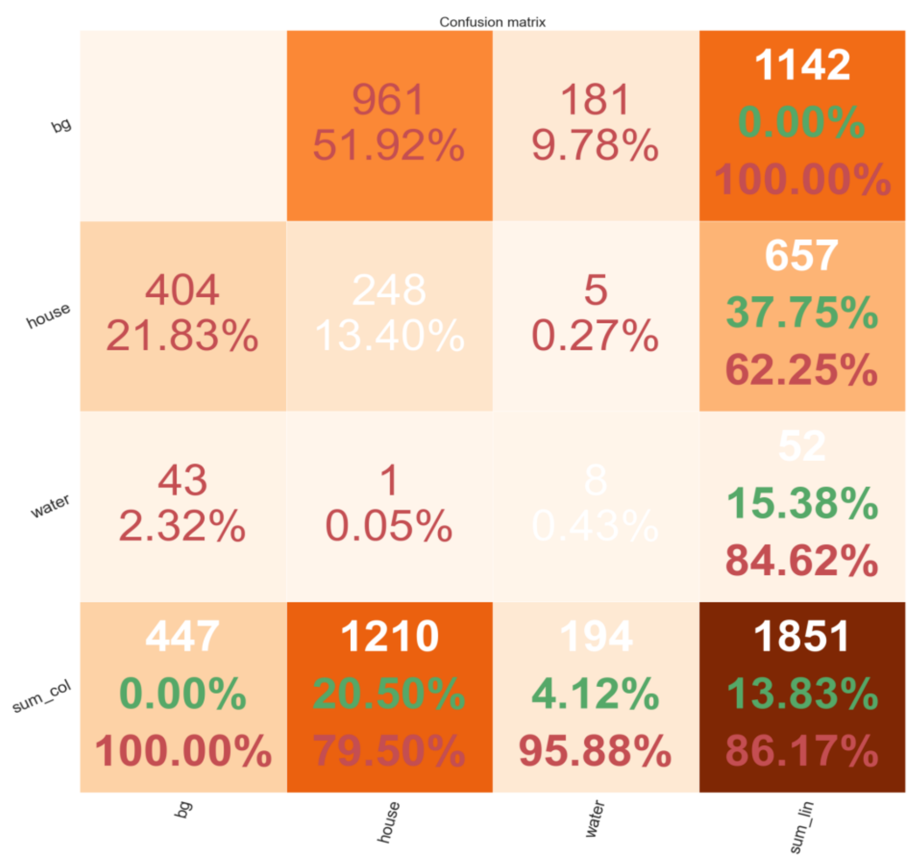
The study achieved a Precision-Recall (PR) curve with an Average Precision (AP) score of 0.974 at an Intersection over Union (IoU) threshold of 50%, after training for 30 epochs on both a manually annotated dataset of cities of Lithuania and the "Manually Annotated High-Resolution Satellite Image Dataset of Mumbai for Semantic Segmentation". The research shows that with enhanced algorithms and optimized processing techniques, satellite imagery can be transformed into highly accurate, large-scale 3D maps more efficiently.

GENERATED RESULT



RESULTS

Model results are displayed by highlighting objects in satellite images, with bounding boxes and labels indicating confidence scores to identify buildings and other features. A 3D terrain model image with different heights and structures represents detected objects such as buildings and demonstrates successful satellite imagery processing and 3D map generation.



CONCLUSIONS

The project demonstrated a cost-effective method for generating 3D maps using the Mask R-CNN machine learning model [4] in combination with terrain elevation images. Future improvements include performance optimizations, training the model with a larger dataset of satellite images, and expanding object detection capabilities.

REFERENCES

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