TREE DETECTION FROM LIDAR IMAGES VIA DEEP LEARNING

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1 Introduction

This is a project in which we utilize image processing and deep learning to detect whether the trees planted for use and processing in various sectors have grown to the size that they could be chopped without the assistance of people, i.e. utilizing technology.
The process of tree detection begins by preprocessing the LiDAR data, which typically includes removing noise, filling in gaps, and creating a 3D point cloud of the data.

2 Research Objective

1. Preprocessing LiDAR data to remove noise, fill in gaps, and create a 3D point cloud of the data.
2. Extracting features from the point cloud that are indicative of trees, such as height, shape, and location.
3. Implementing and training deep learning models.
4. Evaluating the performance of the deep learning models to accurately identify and locate trees in LiDAR images.
5. Testing the developed system on different LiDAR images.
6. Optimizing the system.

3 Releated Literature

Various studies have shown that deep learning can be used to improve the accuracy and robustness of tree detection from LiDAR images.
For example, a study by Wang et al. (2020) proposed a deep learning-based method using 3D LiDAR point clouds. They used a 3D CNN and achieved an accuracy of 92.6% in detecting trees.

4 Design

4.1 Realistic constraints and conditions

We used a dataset from selected locations in Slovakia. We primarily used the Python to process, label, and visualize dataset. There were no problem and any affair about sustainability, ethics, health, safety, and social, environmental and political issues.

4.2.Cost of the design

We process and visualize our dataset using the Python programming language, its libraries and several visualization tools. Since we developed these using our own computers, no extra cost was required.

4.3.Engineering Standards

ISO/IEC/IEEE 26514:2022 Systems and software engineering — Design and development of information for users
ISO/IEC/IEEE 12207:2017 Systems and software engineering — Software life cycle processes
ISO 28902-1:2012 Air quality — Part 1: Ground-based remote sensing of visual range by LiDAR

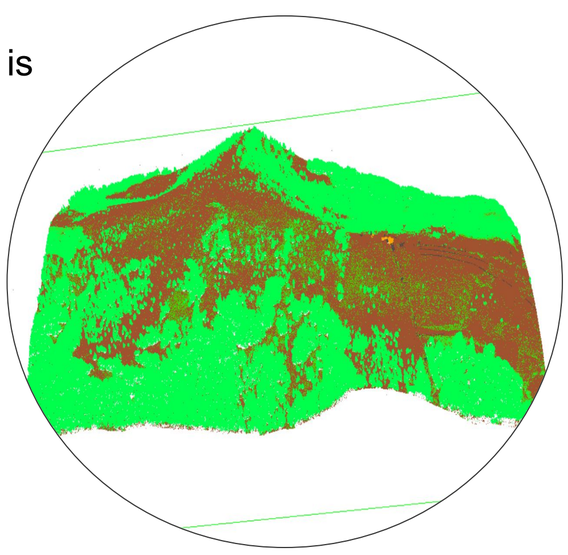
4.4 Details of the design

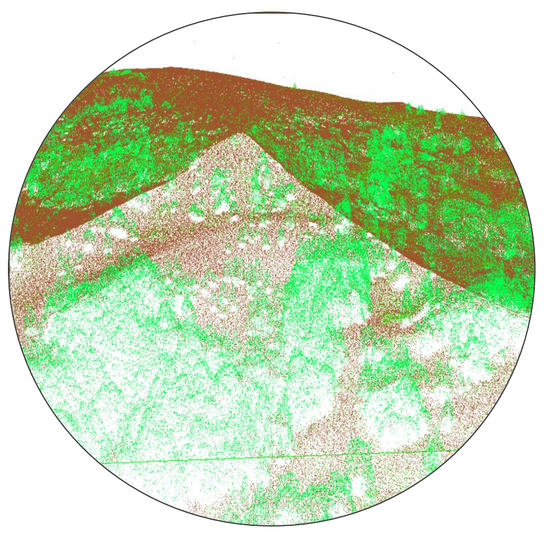
We took into account the resources from which we can obtain the most accurate results. As a result of the study, we found our LiDAR data, which was the most significant condition. We will continue the part that we train deep learning in second semester project. This term, we worked on creating, pre-processing, visualizing and labeling the dataset for "trees" that would be used to train a model.

5 Methods

5.1Data Pre-processing Methods

1. Point cloud segmentation is a preprocessing step that is used to divide the LiDAR data into smaller segments
2. Ground filtering is a preprocessing step that is used to separate ground points, in order to focus on the above-ground objects.
3. Feature extraction is a preprocessing step that is used to extract relevant information as the height, shape, and location of trees.
4. Data cleansing is a preprocessing step that is used to remove these unwanted data points, in order to improve the accuracy of tree detection.





5.2. Data Visualizing Methods

1. 3D scatter plots are a simple and effective way to visualize point cloud data by plotting each point in 3D space
2. 3D surface plots has helped to visualize the shape and structure of the objects in the data, such as the trees.
3. Color-based visualizations are used to display the point cloud data using different colors, based on a specific feature of the data.

5.3. Data Labeling Methods

Data labeling is the process of annotating or classifying the data, in order to provide a label or a class for each data point. The labeled data is then used to train machine learning models. We have read our LAS files to achieve the classifications of our data to label the “High Vegetation and Low Vegetation” class for our tree detection. We did that manually and converting the LAS files to matrices for the classification numbers of corresponding to “trees”.

6 Results and Discussion

We divided our project into two phases. The first session was spent preparing our dataset for the deep learning section of the project, which we discussed in greater detail above. Despite some problems faced when creating our dataset throughout this period of time, we were able to complete it as a consequence of our study.

7 Conclusion

In summary, this project aims to use image processing and deep learning techniques to automate the process of detecting trees in LiDAR images. As a result of, we were able to acquire a LiDAR dataset, which was a crucial step in starting the project. We used data labeling and visualizing techniques to provide accurate labels for our point cloud data in order to train machine learning models. These are going to be used in the second term to develop our deep learning model to detect trees in our dataset and hopefully other datasets which are needed to be detected.

8 Acknowledgement

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