LUNDS TEKNISKA HÖGSKOLA | PRESENTED 2019-08-27

Master's Thesis LiDAR Pedestrian Detector and Semi-Automatic Annotation Tool for Labeling of 3D Data

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Pedestrian Detector using LiDAR and AI

Erik Andersson, Roy Andersson

LiDAR has been a fast growing technology recent years, mainly because of its use in autonomous vehicles and for mapping of terrains. In this project a pedestrian detector was created using a LiDAR and machine learning.

A LiDAR (Light Detection and Ranging) is a sensor that uses a laser to measure the distance to different objects. It does so by sending out a laser pulse and measuring the time it takes for the pulse to return to the sensor. This is done thousands of times every second. The output from the LiDAR is a point cloud which is depicted in the image below. Because the LiDAR uses distances, the point cloud is actually a 3d mapping of the environment. The goal is to detect pedestrians in this point cloud. This is done by using something called machine learning. Machine learning which basically is a method for letting a computer learn by itself by showing point clouds of pedestrians and non-pedestrians while telling the algorithm which is which. The machine learning algorithm is fed a cluster of points and should hopefully be able to tell the user whether the cluster is a human or not.

When using machine learning there is a need for large amounts of data to train the algorithm. This project also included the development of a semi-automatic annotation tool which is used to gather and label data as either a pedestrian or a non-pedestrian. By using this tool it's possible to gather rather large amounts of data in a very short time span. The alternative to this tool would be to manually cut out each cluster and to label it (this can take up to two minutes for every cluster). The tool created in this project is able to gather hundreds of clusters in a single minute!

The algorithm extracts features from the clusters, the features can be simple things like the height or width of the object. These features is the information that is fed to the machine learning algorithm and is what it uses to decide what kind of object a cluster is. After the algorithm has been trained with the data gathered, a recording from the LiDAR is fed to the algorithm and it is able to detect humans within about 20m from the LiDAR. The algorithm is however not perfect and can in some cases show false positives (e.g. mark an object like a bush as a pedestrian). To remove these false positives it is required to gather more data and to train the algorithm on this new data as well (like showing the algorithm point clouds of the tree and telling it that it's not a pedestrian). The process of training a machine learning algorithm is almost never-ending and it's difficult to create the perfect classifier.

The proposed method shows rather promising results as the algorithm generally detects humans if there are any in the scene (along with some false positives). There are however restrictions with the technology and it's easy to miss pedestrians that are obstructed or people in unusual positions which the algorithm hasn't been trained on.

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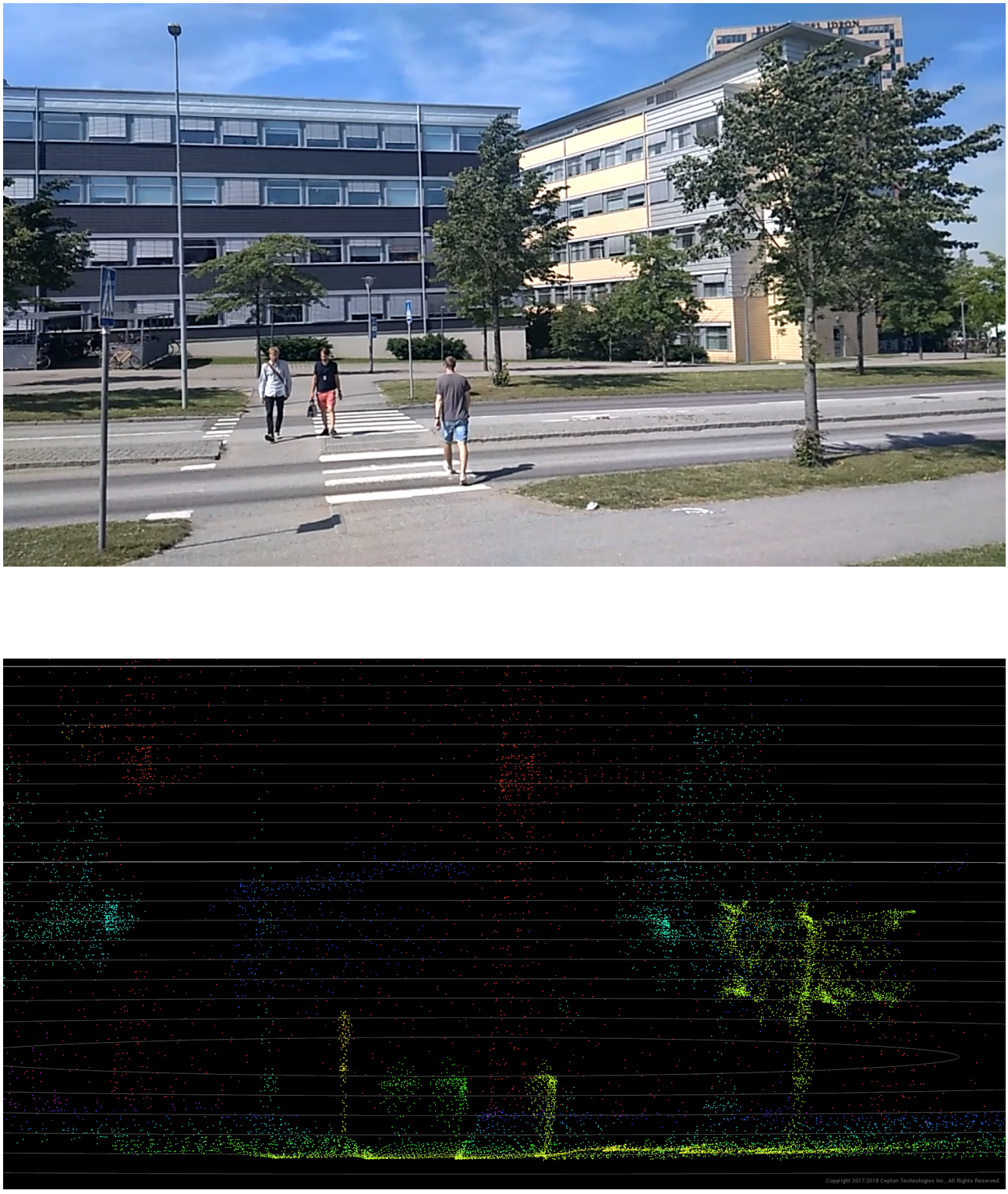

Figure 1: The point cloud of the scene in the image above.