3D Plant Model Reconstruction Using Deep Learning

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1. INTRODUCTION

In the industry of computer graphics and computer vision, 3D models are the most common information carrier. Based on image 3D reconstruction is a very important research question, from the graphics and computer vision researchers in the field of machine learning to the exploration of this field for many years. At the same time, through the image of three dimensional reconstruction in robot navigation, visual perception to understand 3D object recognition, environment modeling, and other fields has important significance, also for industrial manufacture Intelligent control and healthcare industries bring a wide range of applications. Although our final goal is to achieve 3D plant reconstruction, it is easy to extend the same logic to other 3D reconstruction missions. The basic principle has two steps. Firstly, we prepare point cloud datasets in which there will be enough plants in each group. Then we use the point completion network to reconstruct the 3D incomplete model.

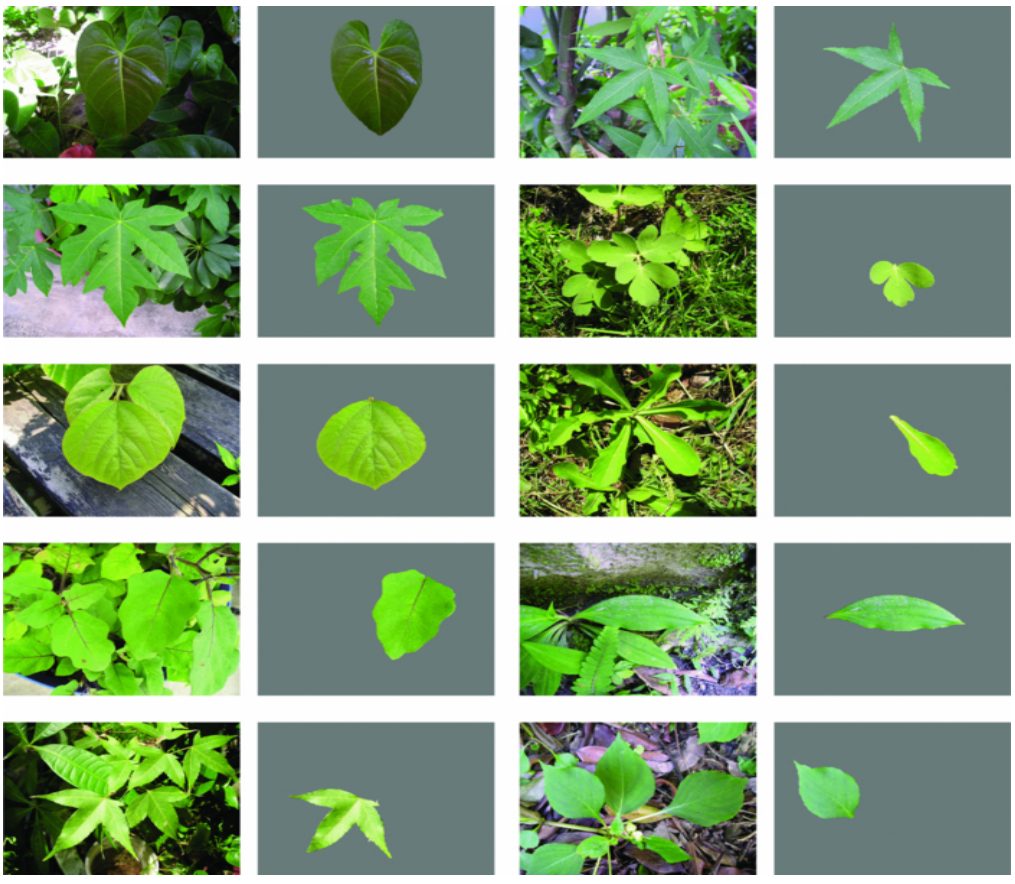

Figure 1. We observe the plants from online photos and create the synthetic data via VLab

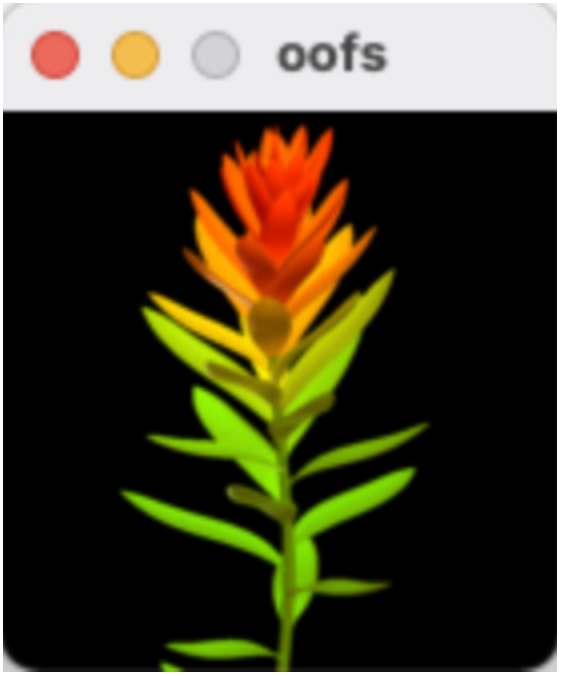

Figure 2. Synthetic plants sample from VLab

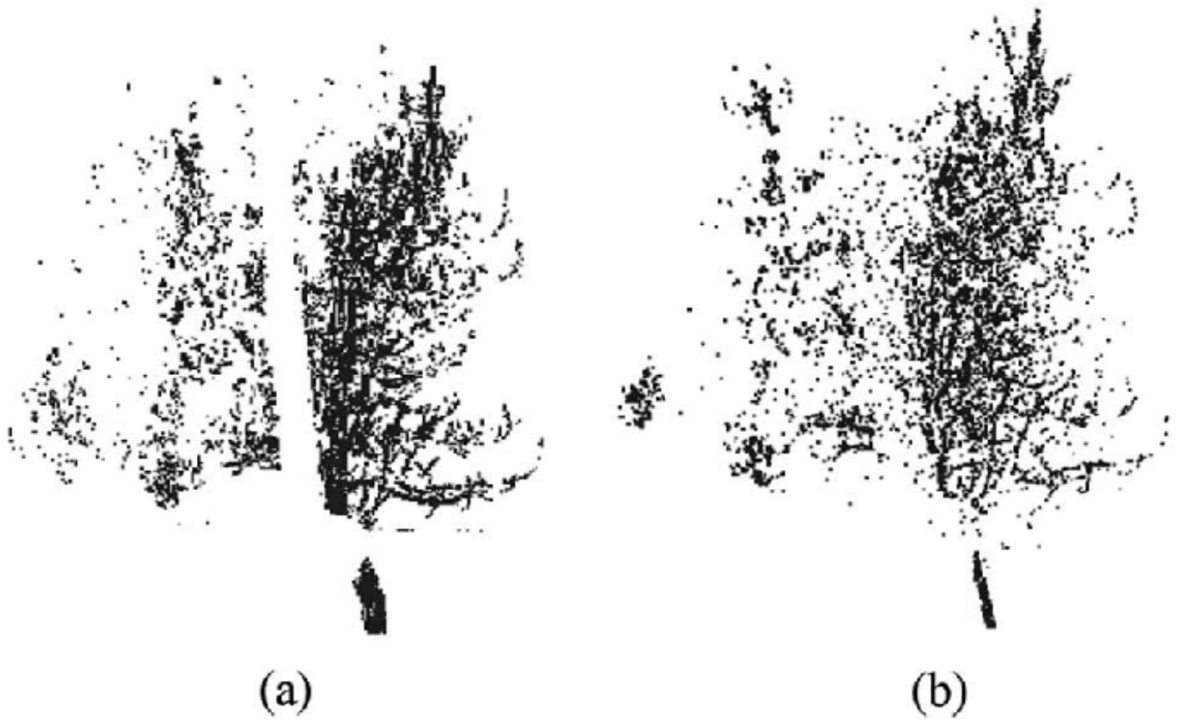

Figure 3. [1] The optimization of an incomplete tree point cloud. (a) The raw point cloud. (b) The optimized point cloud.

2. PROPOSAL

2.1 Prepared Dataset

In this project, we use 3D point cloud models as datasets to train the neural network. The training dataset will be generated from Vlab. We will draw the skeleton for each group and we will try to simulate real world plants as much as possible. For the neural network to have enough to train, we will use normal distribution to produce around 1000 random shape plants in each group. After producing enough plants in the training dataset for each group, convert them to 3D point cloud models to be the general input of our neural network.

2.2 Neural Network

Point cloud is one of the commonly used data representation forms in 3D stereo vision. A point cloud is a collection of points in a given coordinate system. In general, points in these sets contain three-dimensional coordinates, colors, and so on. In some complicated cases, it also includes normal vectors, time, intensity, classification, etc. In nature, any object can be represented by a point cloud. Combining point clouds with neural networks is an effective method for object reconstruction[2][3][4].
As for the neural network, we will research and implement 5-6 point completion networks.
Currently, after we have made the proper datasets, we will mainly research point completion networks on the following types: VRC-Net[5], GAN[6], GR-Net, PF-Net[7], MSN-Net[8] and MSPCN[9]. Once we have implemented 5 networks, we will train the network with our datasets prepared. The input of the network will be an incomplete model and the output model will be the reconstruction 3D model. Last, we will write a report to compare the reconstruction quality and give a result of performance of each neural network.

3. TIMELINE

Phase	Task	Start and End Dates
1	Prepare a large dataset. Research and select best deep-learning models for our dataset	Oct. 10 - Oct. 20
2	Implement 5 deep-learning models and train the models	Oct. 20 - Nov. 25
3	Change the parameter for better results. Write the report	Nov. 25 - Dec. 06

Figure 4. Project Timeline

As shown in Fig 4, we plan to prepare the large dataset and research for the neural network for the next two weeks, and after that, we implement the neural network properly and train it with datasets for 4 weeks. In the last two week, we will write reports for the performance of our neural network model and find out how to increase its performance.

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