**Final Lit Review**

**Members:**

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**The literature review for the final report consists of reading and summarizing 5 or more published papers on the project topic. While the internet can serve as a good source of information, the DePaul Library also has extensive holdings, most of them available electronically.**

**Your summary should include the following information:**

**A complete citation (helpful for putting together a bibliography and for finding the paper again if you lose track of it)**

1. Kumar, Neeraj, et al. “Leafsnap: A Computer Vision System for Automatic Plant Species Identification.” *Computer Vision – ECCV 2012 Lecture Notes in Computer Science*, 2012, pp. 502–516., doi:10.1007/978-3- 642-33709-3\_36

[<https://neerajkumar.org/base/papers/nk_eccv2012_leafsnap.pdf> ]

1. Lee, Sue Han, et al. “Deep-Plant: Plant Identification with Convolutional Neural Networks.” 2015 *IEEE International Conference on Image Processing (ICIP)*, 2015, doi:10.1109/icip.2015.7350839.

[<https://arxiv.org/pdf/1506.08425v1.pdf>]

1. Suwais, Khaled, Alheeti, Khattab, and Dosary, Duaa. “A Review on Classification Methods for Plants Leaves Recognition” 2022. International Journal of Advanced Computer Science and Applications (IJACSA), 2022

**[**<https://thesai.org/Downloads/Volume13No2/Paper_11-A_Review_on_Classification_Methods.pdf>**]**

1. Kadir, Abdul, et al. “Leaf Classification Using Shape, Color, and Texture Features.” *Leaf Classification Using Shape, Color, and Texture Features*, July 2011, pp. 225–230.

[<https://arxiv.org/ftp/arxiv/papers/1401/1401.4447.pdf>]

1. Yang, Kunlong, Zhong, Weizhen, Li, Fengguo. “Leaf Segmentation and Classification with a Complicated Background Using Deep Learning.” 2020. *A Review of Imaging Techniques for Plant Phenotyping 2014*

[ <https://www.mdpi.com/2073-4395/10/11/1721/html>]

**An overview of the methodology of the paper (details not needed; they will be in the paper, will be common knowledge or can be found in the paper’s references)**

**Applied Methods:**

**[1]** In this project, they implemented Nearest Neighbor, and Color Segmentation.

**[2]** – Methods that were proposed are convolutional neural networks (CNN), deconvolutional networks (DN) which is a visualization technique.

**[3]** – They implemented methods such as the Leaf Recognition, Leaf Features, Feature Extraction, Image Processing, and Support Vector Machines (SVM), and Convolutional Neural Network (CNN).

**[4]** – They used PNN (Probabilistic Neural Network) which is a neural network, Feature Extraction, Fourier descriptors of PFT (Polar Fourier Transform)

**[5]** – The illustrated methods in this paper are, Deep Learning, Image Segmentation, Mask R-CNN, and VGG16.

**An overview of the results (no need to reproduce graphs, charts, or tables – a high-level review is good)**

* The manual verification stage as the user explores the images and textual descriptions of one of the results to confirm it as the correct match, (j) labeling the correct match, (k) the addition of that leaf to the user’s collection for future reference, and (l) a map view showing where that leaf was collected. **[1]**
* This paper studied a deep learning approach to learn discriminative features from leaf images with classifiers for plant identification. From the experimental results, they justified that learning the features through CNN can provide better feature representation for leaf images compared to hand-crafted features. Moreover, they demonstrated that venation structure is an important feature to identify different plant species with performance of 99.6%, outperforming conventional solutions. This is verified by analyzing the internal operation and behavior of the network through DN visualization technique. **[2]**
* In this research, they have made an effort to study and analyze the latest researches in the field of leaves classification and recognition. They have provided helpful insight on the process of leaves classification using different features of leaves. These features are discussed and analyzed thoroughly, and their efficiency in enhancing the recognition and classification process is presented. **[3]**
* The results from this project depicts that based on the dataset, 40 plants per species were used to train the network, and 10 plants per species were used to test performance of the system. In this case, PNN classifier is adjusted by using smoothing factor as equal 0.05. **[4]**
* In this paper, the Mask R-CNN model and the VGG16 model are used to segment and classify leaf images with multiple targets and a complicated background. More than 4000 images were used for model training and testing. The results show that the average ME of segmentation is up to 1.15% using the Mask R-CNN model, and the average classification accuracy is up to 91.5% using the VGG16 model. This shows that the Mask R-CNN model and the VGG16 model could reliably be used in the segmentation and classification of leaf images with a complicated background. **[5]**

**Strengths and weaknesses of the paper, with particular emphasis on your project. Strengths acknowledge the good work others have done; weaknesses create the space and reason for your own work. If your project implements something others have already done, focus on similarities and differences, rather than strengths and weaknesses.**

**[1]**

**Strength:**

Leaf snap was developed to greatly speed up the manual process of plant species identification, collection, and monitoring.

**Weakness:**

Without visual recognition tools such as Leaf snap, a dichotomous key (decision tree) must be manually navigated to search the many branches and seemingly endless nodes of the taxonomic tree.

**[2]**

**Strength:**

It is found that venations of different order have been chosen to uniquely represent each of the plant species. Experimental results using these CNN features with different classifiers show consistency and superiority compared to the state-of-the art solutions which rely on hand-crafted features.

**Weakness:**

The contributing factor of the misclassification seems to be the condition of the leaves, where the samples are noticeable affected by environmental factors such as wrinkled surface and insect damages.

**[3]**

**Strength:**

An important role introduced by plants to maintain the ecological balance of the earth by providing us with breathing, shelter, fuel and medicine. With the development of machine learning, image processing, mobile devices, computer software, and hardware, it is possible to present an efficient and quick automated system to manage, recognize and understand a plant species

**Weakness:**

Many biological and environmental factors affect leaves to be damaged. So, many characteristics of a damaged leaf will be not useful to provide identifying signals. Therefore, a recognition system that depends on such characteristics may lead to unreliable and inconsistent outcomes.

**[4]**

**Strength:**

Twelve textures features are extracted from lacunarity. The result gives 93.75% of accuracy, which is slightly better than the original work that gives 90,312% of accuracy. Polar Fourier Transform (PFT) are very useful to capture shape of a leaf.

**Weakness:**

Dispersion (irregularity) is another feature suggested by Nixon & Aguado [22] to deal with an object that has irregular shape such as the leaf. The fractal dimension is not a good texture descriptor. Images are not really fractals, i.e. they do not exhibit the same structure at all scales.

**[5]**

**Strength:**

Plant identification is usually by their floral parts, fruits, and leaves. Flowers and fruits are not suitable for plant identification as they appear for a short interval. Classification of the plant has great significance to explore the genetic relationship of plants and explain the evolution of plants.

**Weakness:**

Urbanization and biodiversity loss have made plant classification a significant problem for many professionals such as agronomists, gardeners, and foresters. However, considering the great number of species, plant identification is a fairly difficult task, even for botanists.