NATIONAL CONSORTIUM FOR REMOTE SENSING EDUCATION, RESEARCH, AND APPLICATIONS

IndianaView

PROJECT FACT SHEET

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Deep learning-based tree detection and species identification

***Yunmei Huang*, Purdue University (huan1643@purdue.edu); Emily M Griffin, Purdue University; Charles C Wamer, Purdue University; Rado Gazo, Purdue University; Songlin Fei, Purdue University**

Overview: The goals of this study are building an inclusive image dataset that contains tree species in Indiana and training models that can detect tree bark and identify species. This study provides a tree species identification (TSI) model using tree bark images for industrial application.

Introduction: Information at the species level is necessary for biodiversity and precision forestry management. However, recognizing different tree species takes a lot of time and is difficult on a large scale. TSI is a non-trivial procedure involving understanding and examining the physical characteristics of trees such as their leaves, bark, and flowers. Forest practitioners and professionals often use bark's features for TSI, due to their relatively stable, and accessible attributes, which have less seasonal variation than a tree's fruits, leaves, and flowers[1]. In this project, we trained two artificial intelligence models to detect tree bark and identify species to improve the efficiency of TSI.

Method: With the assistance of experts, we used smartphones to collect images of tree bark in Indiana. We trained two models: one for species classification, and the other for tree localization. For tree localization, we adopted U-net[2] architecture while for classifying species ResNet18[3] architecture was employed. A hand-labeled dataset was built for the tree localization experiment.

Preliminary Result:

Several key outcomes from the current progress:

- We constructed a diversified tree bark image dataset from a variety of backgrounds, illuminations, and distances. 6472 images among 39 species were used in this dataset.
- During tree classification, the highest accuracy is 46% among 39 species.

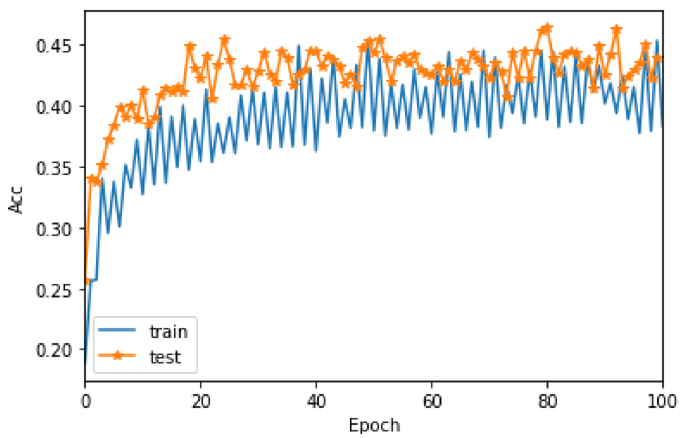

Figure 1. The overall accuracy rate of tree identification among 39 species.

Future Work: Based on the current dataset and results, two limitations we need to overcome to improve the model's performance: imbalanced image numbers for various species and relatively low accuracy. To solve these issues, we plan to collect more images to build a balanced dataset and to get more hand labels to improve models' performance. Lastly, these models' architectures will enable the identification of tree species based on canopy images captured by drones.

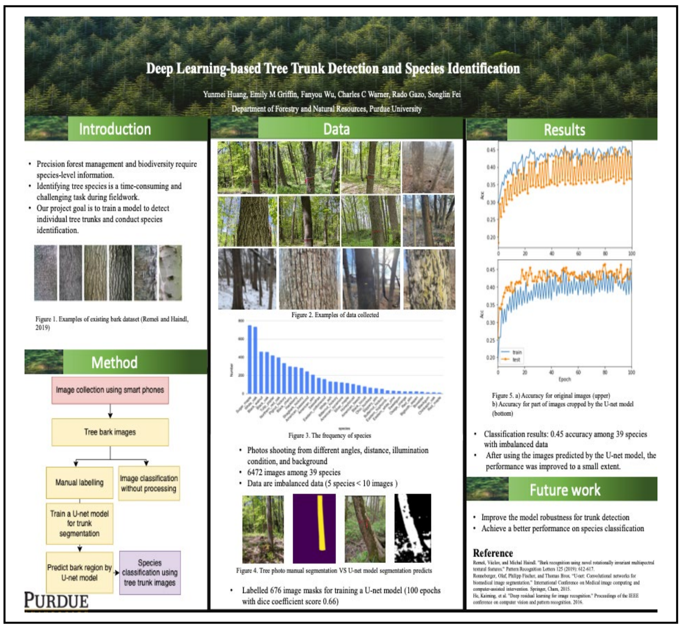

Figure 2. Poster presented at the Digital Forest retreat Purdue University, on August 8, 2022.

FOR FURTHER READING:

[1]Bertrand, Sarah, et al. "Bark and leaf fusion systems to improve automatic tree species recognition." Ecological Informatics, 2018.

[2]Ronneberger, Olaf, Philipp Fischer, and Thomas Brox. "U-net: Convolutional networks for biomedical image segmentation." International Conference on Medical image computing and computer-assisted intervention. Springer, Cham, 2015.

[3]He, Kaiming, et al. "Deep residual learning for image recognition." Proceedings of the IEEE conference on computer vision and pattern recognition, 2016.