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FROM MORPHOLOGY TO MACHINE LEARNING: ARTIFICIAL INTELLIGENCE IN PLANT IDENTIFICATION AND SYSTEMATICS

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Abstract:

A Plant identification and systematics have mostly been about looking at how plants look and comparing their features. This old-school way set the groundwork for how we classify plants, but it takes a lot of time and you really need an expert to do it right. The availability and expertly of plant taxonomist is becoming a difficult task for the botany workers. Now days it becomes more essential to prepare new taxonomist or develop an alternative system for plant identification. Now, with AI—especially machine learning and deep learning—things are changing fast. Using image recognition, computer vision, and analysing genetic data, we can identify species much quicker and more accurately. This paper talks about how we moved from just looking at plant shapes to using AI for systematics. It covers the methods, where this tech is used, the pros and cons, and what might come next. Mixing computer smarts with botany is shaking up how we study biodiversity and work on conservation.

Keywords: *Artificial Intelligence, Plant Identification, Systematics, Deep Learning, Computer Vision, Taxonomy.*

Introduction

Plant systematics is all about studying plant diversity and how different species relate to each other. Traditionally, people identify plants by looking at things like leaf shape, flower patterns, and reproductive parts. This method has been key for a long time, but it's tricky because it depends on the expert's judgment, and plants can look different depending on their environment.

AI means computers doing tasks that usually need human thinking. In plant taxonomy, AI mostly shows up as machine learning and deep learning. These let computers find patterns in big sets of data—like pictures or DNA—and then classify plants. Machine learning and deep learning have made it possible to handle huge amounts of data and spot complex traits in plants. For example, deep learning models like Convolutional Neural Networks (CNNs)

have gotten really good at recognizing plant species from photos (1, 2). This is changing how we identify plants and study their relationships.

AI applications in plant taxonomy

Artificial intelligence has lots of application in plant taxonomy such as Image-Based Species Identification, Herbarium Digitization and Data Extraction, Genomic and Phylogenetic Analysis and Automated Field Data Collection

Image-based species identification

AI systems, especially deep learning models like Convolutional Neural Networks (CNNs), can identify plant species from photographs of leaves, flowers, or fruits. (2, 3). These models are trained on thousands of labelled images so they learn to recognize subtle patterns that might be difficult for humans to notice.

The smartphone applications such as PlantNet, LeafSnap, PlantSnap, INaturalist and Google lens are used for the plant identification.

Applications in plant systematic

Artificial intelligence–based plant identification systems have become valuable tools in plant systematics. They help in the quick and accurate recognition of plant species, reducing the time and effort required for traditional manual identification. These systems support biodiversity assessment by enabling researchers to collect and analyze large amounts of data from different regions efficiently (2). They also assist in conservation planning by identifying rare or threatened species and mapping their distribution. Furthermore, AI tools are useful in detecting and monitoring invasive species, which helps in taking timely control measures (3). Citizen science platforms such as PlantNet, LeafSnap and iNaturalist use automated identification features to involve the general public in documenting plant diversity (4, 5). In this way, automated systems not only support large-scale ecological monitoring but also make plant identification more accessible to non-specialists.

Advantages of use of AI

The use of artificial intelligence in plant identification offers several important benefits. It makes species identification faster and more efficient while maintaining high accuracy. These systems can handle large amounts of data and help reduce mistakes that may occur in manual identification (3). Mobile-based applications also make plant identification easy and accessible to researchers, students, and the general public (6). Such tools are especially useful in biodiversity-rich regions where trained taxonomic experts and resources may be limited (5).

Challenges and limitations

Despite its many benefits, AI-based plant identification systems have several challenges and limitations. These systems require large and properly labelled datasets for accurate training, which are not always available. They often perform better for common or well-documented species and may show bias when dealing with rare or less-studied plants. Their accuracy can also decrease when images are of poor quality or taken under unfavourable conditions. In addition, newly discovered or poorly described species are difficult for AI models to identify correctly (7). There are also ethical concerns related to data sharing and ownership of biological information. Therefore, although AI is a powerful tool, it cannot replace the knowledge and experience of trained taxonomists and should be used to support and complement traditional methods.

Table 1: AI application use for plant identification

Sr. No.	Name of App	Identification	Nature of Working	Compatible for	Accuracy Reported by Producer	Charged /Free/ Free with add
1	**PlantNet**	Allow user to upload photograph and helps in identifying plant species	Utilizes large database for plant identification	Android & ios	Less than 100%	free
2	**LeafSnap**	Identify plant on the base of image of leaf	Used Machine learning models trained with large database of image	Android & ios	90%	Free with adds
3	**PlantSnap**	Identify plant by taking photo	Provide instant identification using its extensive plant database	Android & ios	90%	free
4	**INaturalist**	Provide a platform where AI helps identify plant specimen from user shared photograph.	Have integration of both human input and AI to improve identification accuracy	Android & ios	95%	free
5	**Google lens**	Google Lens is an image recognition technology developed by Google; the plant photograph can be captured with camera or can provide direct image to identify	It brings up relevant information related to objects it identifies using visual analysis based on a neural network	Android & ios	Not given	Free
6	**Flora Incognita**	Identify plant by taking photo	Use large database for plant identification	Android & ios	90 %	Free
8	**Obsidentify**	Identify plant by taking photo Europe or the Dutch Caribbean	Utilizes large database for plant identification	Android & ios	Not given	Free

Conclusion

The transition from morphology-based taxonomy to AI-driven plant identification marks a significant paradigm shift in systematic biology. Several ai based applications are helpful for identifying plants in the basis of photographs of flowers, leaf etc. Although it helps in plant identification but it's not be hundred percent reliable because of the input photograph, available database and unrecorded plants species. While traditional morphological methods remain foundational, machine learning and deep learning technologies enhance efficiency, scalability, and accessibility. AI does not replace taxonomy but strengthens it, offering powerful tools for biodiversity conservation and ecological research. The integration of computational intelligence with botanical science will continue to redefine plant systematics in the coming decades.

References

1. Lee, S. H., Chan, C. S., Wilkin, P., & Remagnino, P. (2015). Deep-plant: Plant identification with convolutional neural networks. In *2015 IEEE International Conference on Image Processing (ICIP)* (pp. 452–456). IEEE. https://doi.org/10.1109/ICIP.2015.7350839
2. LeCun, Y., Bengio, Y., & Hinton, G. (2015). Deep learning. *Nature, 521*(7553), 436–444. https://doi.org/10.1038/nature14539
3. Khaoula, L., Bouaziz, B., & Mahdi, W. (2022). Deep learning approaches for plant species identification: A review. *Ecological Informatics, 69*, 101678.
4. Kumar, N., Belhumeur, P. N., Biswas, A., Jacobs, D. W., Lopez, I., & Soares, J. V. B. (2012). Leafsnap: A computer vision system for automatic plant species identification. In *Proceedings of the 12th European Conference on Computer Vision (ECCV 2012)* (pp. 502–516). Springer. https://doi.org/10.1007/978-3-642-33712-3_36
5. Carranza-Rojas, J., Joly, A., Goeau, H., Mata-Montero, E., & Bonnet, P. (2018). Automated identification of herbarium specimens at different taxonomic levels. In *Multimedia tools and applications for environmental & biodiversity informatics* (pp. 151–167). Springer International Publishing.
6. Seeland, M., Rzanny, M., Boho, D., Waldchen, J., & Mäder, P. (2019). Image-based classification of plant genus and family for trained and untrained plant species. *BMC Bioinformatics, 20*(1).
7. Simpson, M. G. (2010). *Plant systematics* (3rd ed.). Academic Press.
8. Joly, A., Goeau, H., Kahl, S., Deneu, B., Servajean, M., Cole, E., Picek, L., de Castaneda, R. R., Bolon, I., Durso, A., Lorieul, T., Botella, C., Glotin, H., Champ, J., Eggel, I., Vellinga, W. P., Bonnet, P., & Müller, H. (2020). Overview of LifeCLEF 2020: A system-oriented evaluation of automated species identification and species distribution prediction. In *Lecture notes in computer science* (pp. 342–363). Springer International Publishing.

Websites

1. https://floraincognita.com/
2. https://identify.plantnet.org/
3. https://leafsnap.com/
4. https://lens.google/
5. https://obsidentify.en.uptodown.com/android
6. https://plantsnap.com/
7. https://www.inaturalist.org/