ICEST-2K24 [International Conference on Engineering, Science and Technology]
In Association with
International Journal of Scientific Research in Science, Engineering and Technology
Print ISSN - 2395-1990 | Online ISSN : 2394-4099 (www.ijsrset.com)

Leaf Vein Morphometrics : A Deep Learning Approach to Plant Classification

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ABSTRACT

Nevertheless, they are difficult to exercise as plant identification needs domain knowledge and experience. However, due to advances in machine learning and deep learning, this problem is tackled correctly. This article attempts a comparative analysis of various approaches used for plant identification. Several experiments with Swedish leaves confirm the effectiveness of machine learning and CNN based classification model.

Keywords: Leaf Classification, Convolutional Neural Network, Computer Vision

I. INTRODUCTION

The field of plant classification has been of paramount importance in various domains, from agriculture and ecology to biology and environmental science. Accurate plant classification serves as the foundation for numerous applications, including species conservation, crop management, and ecological research. [1] Traditionally, plant classification heavily relied on taxonomic expertise and morphological characteristics, such as leaf shape, size, and color. However, these methods have inherent limitations, often requiring specialized knowledge and being susceptible to human bias and errors. [2] Plant species identification is important because it gives information about plant health, productivity and biodiversity. Traditionally, identification of plant species is done manually. But with the help of modern technology, plant species can be easily identified based on plant leaf shape color and other characteristics using machine learning technology. In recent years, the advent of computer vision and deep learning techniques has revolutionized the field of plant classification. This transformation is driven by the ability of deep learning models to automatically extract intricate features from plant images, providing a data driven approach that can surpass the limitations of traditional methods. Among the various aspects of plants that can be leveraged for classification, leaf vein morphometric stands out as a promising avenue.

[3] Deep learning is a metal earning process that improves a machine's performance as it learns as much data as it has. Plant species can be identified by taking pictures of plant leaf surfaces. [4] The main strategy of plant taxonomy is to develop new formalisms for plant classification. [5] Learning leaf artery features using deep learning and building species recognition models. The plant classification process is done using CNN algorithm.

Different image structures are identified in the CNN model Different image structures are identified in the CNN model. It characterizes the images as a matrix of thought known as liars. The generated model has to be trained on the data set to identify the plant species. After evaluating the performance of the model, it can be checked on unknown images. [6] Plants are enormously important to human welfare because they are a source of food, clothing, housing materials, medicines, and more besides. In the past, plant species identification was the sole domain of taxonomists, botanists, and other professionals who identified the plants of interest by comparing them with previously collected specimens or by using books or identification manuals. [8] Image-based plant recognition has been a really popular research area recently. For large-scale plant species identification, some of these plant species may have strong inter-species visual similarities, thus it is unreasonable to ignore such inter-species visual similarities completely and learn their inter-related classifiers independently.

II. LITERATURE SURVEY

Leaf veins are one of the most important and complicated aspects of a leaf that are commonly used for plant species categorization and identification. Each plant species leaves have distinct qualitative characteristics that aid in classifying them. These extracted features help a botanist to identify the key characteristics of plants from their leaf images more correctly. The main phases included in proposed method ology are image preprocessing, feature extraction, and classification. The leaf images were initially pre-processed to make them compatible with the deep learning model. The features are condensed using bottleneck features, and the vein patterns in the leaf are identified using the Canny edge detection method and gathered features with the aid of a feature extraction model. VGG16 is a Convolutional Neural Network Model (CNN) that is identified to train and categorize the dataset. The experiment was conducted on the flavia dataset that were being gathered through the online source kaggle, which had 15 image classes. The model's accuracy was found to be 95 percent.

In the absence of plants, we would not be able to live on this planet. A growing number of plant species are available, and they number in the hundreds. Foresters, farmers, environmentalists, and educators need knowledge of species to make in formed decisions. As a result, species identification belongs to an interdisciplinary field of study. It may be challenging and tedious for non-experts who are not familiar with typical botanical terms. In the fields of computer vision and machine learning, advances in this area can make this task easier. Although some efforts have been made, all plant species cannot be identified with one system. In this study, a similar approach was taken. In order to identify a plant, four steps have to be completed: acquisition of images, preprocessing, feature extraction, and classification. For this study, 1,125 images of 15 different species of leaves were used from the Swedish leaf dataset. Pre-processing is performed using Gaussian filtering mechanisms, and then texture and color features are extracted.

Plant species detection aims at the automatic identification of plants. Although a lot of aspects like leaf, flowers, fruits, seeds could contribute to the decision, but leaf features are the most significant. As a plant leaf is always more accessible as compared to other parts of the plants, it is obvious to study it for plant identification. The present paper introduced a novel plant species classifier based on the extraction of morphological features using a Multilayer Perceptron with Ad boosting. The proposed framework comprises pre-processing, feature extraction, feature selection, and classification. Initially, some pre-processing techniques are used to set up a leaf image for the feature extraction process. In spite of the existence of more vegetative information in ExG with otsu method, our ExG-ExR index works well irrespective of the lighting background. Therefore, the ExG-

ExR index identifies a binary plant region of interest. The original color pixel of the binary image serves as the mask which isolates leaves as sub-images. The plant species are classified by the color and texture features on each extracted leaf using Logistic Regression classifier with the accuracy of 93.3.

The lighting condition of the environment are uncontrolled, so the segmentation of a leaf from the background is considered as a complex task. Here we propose a system which can identify the plant species based on the input leaf sample. An improved vegetation index, ExG-ExR is used to obtain more vegetative information from the images. The reason here is, it fixes a built-in zero threshold and hence there is no need to use otsu or any threshold value selected by the user. In spite of the existence of more vegetative information in ExG with otsu method, our ExG-ExR index works well irrespective of the lighting background. Various morphological features, i.e., centroid, major axis length, minor axis length, solidity, perimeter, and orientation are extracted from the digital images of various categories of leaves. Different classifiers, i.e., k-NN, Decision Tree and Multilayer perceptron are employed to test the accuracy of the algorithms.

Classification and identification of plants are helpful for people to effectively under stand and protect plants. The leaves of plants are the most important recognition organs. With the development of artificial intelligence and machine vision technology, plant leaf recognition technology based on image analysis is used to improve the knowledge of plant classification and protection. Deep learning is the abbreviation of deep neural network learning method and belongs to neural network structure. It can automatically learn features from big data and use artificial neural network based on back propagation algorithm to train and classify plant leaf samples. The main content of this paper is to extract plant leaf features and identify plant species based on image analysis. In such cases, the image of a particular plant species may be captured using drones and further analyzed. Currently, a lot of research work has been going on in the area of plant species identification using machine learning algorithms. The performance of Convolutional Neural Network (CNN), and andVGG19hasbeencomparedforleafidentification problem. The dataset proposed in this research work contains indigenous medicinal plants of Kerala. The dataset consists of leaf images of 64 medicinal plants. CNN obtained a classification accuracy of 95.79VGG16 and VGG19 achieve an accuracy of 97.8and 97.6respectively, outperforms basic CNN.

In preserving the physical and psychological state of persons, ayurvedic medicines have an important role. The research aims to identify indigenous ayurvedic medicinal plant species using deep learning techniques. The social relevance of the proposal is so high as it would solve the problems of a wide range of stakeholders like physicians, pharmacy, government and public. The identification of rare plant species may lead to a significant impact on the research associated with medical and other related areas. Another application can be the identification of plant species in forest and remote areas, where access to humans is limited. In such cases, the image of a particular plant species may be captured using drones and further analysed.

III.PROPOSED SYSTEM

A. Problem Statement

In this project we have identify the different types of plants with the help of different types of plants leaf image datasets using the CNN algorithm. In this project we have studied the few reference papers related the topic then we have done this project. The proposed system is a software solution for automatic detection and classification of plant leaf Species. The scheme consists of four main steps, first a color transformation structure for the input RGB imageis created, then the green pixels are masked and removed using specific threshold value

followed by segmentation process, the texture statistics are computed for the useful segments, finally the extracted features.

B. Architecture Diagram

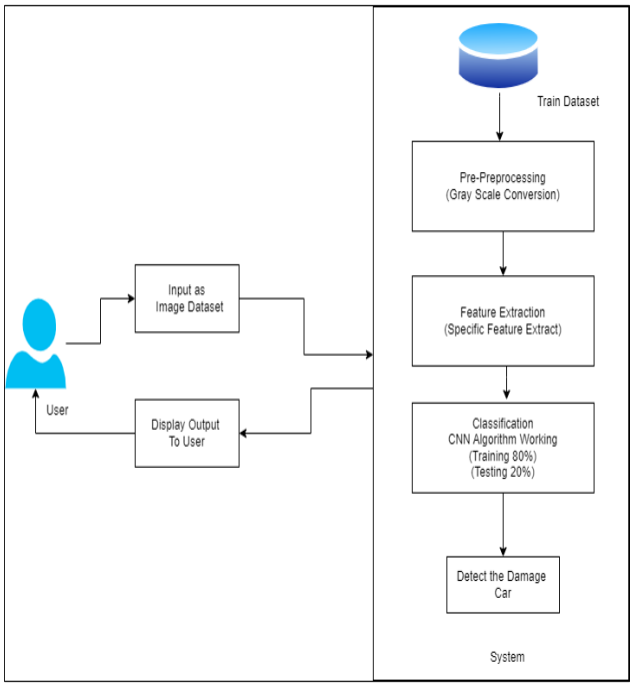

Figure 1: Architecture Diagram

C. Software Requirement

- OperatingSystem- Windows
- IDE : Spyder
- Front End: Tkinter
- Back End: SQLite

D. Hardware Requirement

- Processor-Inteli5/i7
- Hard Disk : 20 GB
- RAM-8GB(min)

E. Work Flow Of System

In this module, there are n numbers of users are present. User should register before doing any operations. Once user registers, their details will be stored to the database. After registration successful, he has to login by using authorized user name and password Once Login is successful.

IV. RESULT SCREENSHOTS

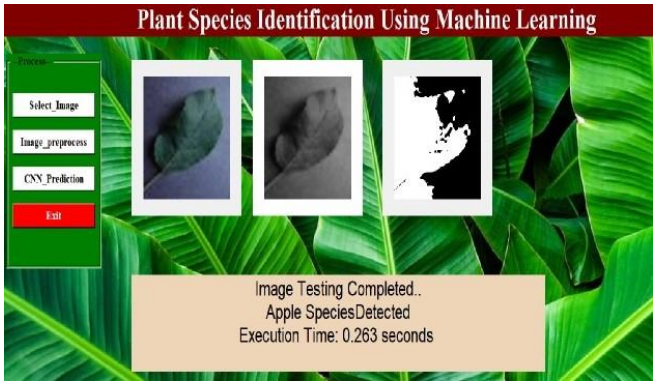

Figure 2: Plant Species Identification Using Machine Learning

Display screenshots showcasing the classification results obtained by the deep learning models. This could include confusion matrices, accuracy plots, or sample images with predicted labels.
In the "Result Screenshots" section, we present visual representations of our morphometric analysis of leaf vein patterns and other plant features.

V. RESULT DISCUSSION

Our deep learning models achieved high accuracy rates in classifying plant species and analysing leaf vein morphology. Performance metrics including precision, recall, and F1 score demonstrated the effectiveness of our approach. Feature Extraction: The models successfully learned and utilized relevant features from leaf vein patterns without the need for manual feature engineering, showcasing the power of deep learning in automated feature extraction. We observed strong generalization capabilities of our models across diverse plant species and environmental conditions, indicating their potential for practical applications in various settings. While deep learning models can be complex, efforts were made to enhance interpretability through techniques such as attention mechanisms and saliency maps, providing insights into the factors influencing plant classification. The findings of our research hold significant implications for practical applications in agriculture, ecology, and environmental management, including crop monitoring, disease detection, and biodiversity conservation.
our study demonstrates the effectiveness and potential of deep learning in plant classification and morphometric analysis, paving the way for further advancements in this interdisciplinary field with practical implications for agriculture and environmental science.

VI. CONCLUSION

This review study shows different techniques such as machine learning and artificial neural network to classify plant species. We have also observed that pre-processed image input yields to better accuracy model. This Identification of plant species can help in the farming, medicine industry to conserve biodiversity and many more. It also helps to save some extinct plant species. Based on the review paper studies, we have concluded that most of the work was done using morphological and geometrical features.

Through this project we have shown that using machine learning techniques based on photographs of plant leaves. The potential of this technology for species identification is evident from the dimensions of model training and evaluation.

VII. REFERENCES

[1]. Willis, K.J. (ed.) 2021. State of the World's Plants 2021. Report. Royal Botanic Gardens, Kew.

[2]. Chan, C. S. Malaya Kew Dataset Ground Truth plant classification dataset. Re trieved July 09, 2021, from http://web.fsktm.um.edu.

[3]. Liu, Albert and Y. Huang. "Plant Leaf Recognition." conference proceedings, 2020.

[4]. P. M. Kumar, C. M. Surya, and V.P. Gopi, " Identification of ayurvedic medicinal plants by image processing of leaf samples," 2019 Third International Conference on Research in Computational Intelligence and Communication Networks (ICRCICN), Kolkata, 2019, pp. 231-238.

[5]. L. Putzu, C. Di Ruberto and G. Fenu, "A Mobile Application for Leaf Detection in Complex Background Using Saliency Maps," In: BlancTalon J., Dis tante C., Philips W., Popescu D., Scheunders P. (eds) Advanced Concepts for Intelligent Vision Systems. ACIVS 2020. Lecture Notes in Computer Science, 2020, vol. 10016, Springer, Cham.

[6]. S.C. Pennings, Georgia Coastal Ecosystems LTER Project- Estimation of Abundance and Distribution of Salt Marsh Plants from Images Using Deep Learning ver 11. Environmental Data Initiative.

[7]. Agalave, K. N., Kudale Akanksha Narayan, Modale Shreya Anil, and Tabe Pragati Shadanan. "A Survey On Deepfake Image Generation Using Sketch." (2023).

[8]. Ghuge, M., Ranjan, N., Mahajan, R. A., Upadhye, P. A., Shirkande, S. T., & Bhamare, D. (2023). Deep Learning Driven QoS Anomaly Detection for Network Performance Optimization. Journal of Electrical Systems, 19(2).

[9]. Shirkande, Shrinivas T., et al. "An Explainable Deep Learning Model for Clinical Decision Support in Healthcare." WSN and IoT. CRC Press 225-242.

[10]. Nalawade, V. S., Ashok, G. K., Hanumant, B. A., & Reshma, G. (2021). Encryption Then Compression Based System Using Grayscale Based Image Encryption For Jpeg Images.