International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 09 Issue: 06 | June - 2025 SJIF Rating: 8.586 ISSN: 2582-3930

An Automatic System for Medicinal Plant Identification Using ResNet- CNN

[1]Mrs.B.Mamatha
Assistant Professor, Dept of Computer Science and Engineering
Vignan's Institute of Management and Technology for Women, H
mamathavmtw@gmail.com

[2]Sankeerthana Machika
UG Student ,Dept of Computer Science and Engineering
Vignan's Institute of Management and Technology for Women
sankeerthanamachika@gmail.com

[3]Priyanka Sama
UG Student Dept of Computer Science and Engineering
Vignan Institute of Management and Technology for Women,
samapriyanka55@gmail.com

[4]Harshitha Dubakka
UG Student Dept of Computer Science and Engineering Vignan Institute of Management and Technology for Women,
dubakkaharshitha@gmail.com

***Abstract*—Medicinal plant classification is crucial to preserve traditional knowledge and formulate natural medicine with fewer side effects. Here, we propose an automatic medicinal plant classification using deep learning techniques. Our approach utilizes convolutional neural networks (CNNs) to classify over different types of medicinal plants based on leaf images in an efficient manner. The model classifies different medicinal plants based on leaf images. The image processing system uses the threshold method in order to remove unwanted pixels to have a clean dataset to be processed by the CNN. The model not only categorizes plant species but also offers elaborate information regarding their medicinal benefits, making it easy for users to determine the indigenous medicinal application of plants. Moreover, the model examines combinations of plants to propose possible synergies among various medicinal plants to assist in herbal medicine preparation. It offers knowledge on how combining certain plants can increase therapeutic efficacy, leading to a more effective and synergistic natural medicine. This system is anticipated to fill the knowledge gap on medicinal plants and their uses by modern generations and therefore promote the use of traditional remedies in contemporary healthcare practices.**

Keywords—Medicinal Plants, Plants identification, ResNet (Residual Neural Network), Feature Extraction.

I. INTRODUCTION

Medicinal plants have been used for centuries to treat various ailments, and their accurate identification plays a crucial role in traditional medicine, pharmaceutical research, and biodiversity conservation. However, manual identification of these plants based on morphological characteristics such as leaves, flowers, and bark can be time-consuming, error-prone, and requires expert knowledge. With the advancement of technology, deep learning-based image classification offers an efficient and reliable solution for automatic plant recognition.

This project proposes an automatic system for medicinal plant identification using a Convolutional Neural Network (CNN) architecture, specifically ResNet (Residual Network). ResNet is well-known for its superior performance in image classification tasks due to its ability to train very deep networks without the vanishing gradient problem. By leveraging the power of ResNet-CNN, the system can learn complex patterns and features from plant images, enabling it to accurately classify various species of medicinal plants.

The main objective of this system is to support botanists, researchers, and healthcare professionals by providing a user-friendly and accurate tool for medicinal plant identification. This not only reduces dependency on manual methods but also promotes the preservation and understanding of plant-based traditional knowledge through technology.

II. LITERATURE REVIEW

Nasiri et al. [1] used a CNN model along with a technique called Global Average Pooling. This method helped the model focus better on important features of plant images and also reduced overfitting, which is a common problem in deep learning. Their work showed how combining CNN with pooling techniques can improve accuracy in identifying different medicinal plants.

Paulson and Ravishankar[2], explored how deep learning methods can be used to identify medicinal plants more accurately than traditional techniques. They found that CNNs are very effective when trained on large sets of plant images and can learn even small details in the leaf structure, helping in better classification.

Grinblat et al. [3], presented a unique idea where they used the vein patterns in leaves to identify plants. Their deep learning model was trained to recognize the shape and structure of veins, which is a key feature in many plant species. This approach showed that using specific leaf features can give very good results.

Hu et al. [4], introduced a multi-scale fusion CNN model that could look at both large and small details in leaf images. By combining information from different levels, their model was able to recognize leaves more effectively, even when the patterns were very fine or complex.

Kumar and Rathore [5], provided a review of many deep learning models used in plant identification. They discussed the strengths of models like ResNet and highlighted the importance of having proper datasets. Their review helped me understand which models work well and why ResNet is a good choice for building an accurate plant identification system.

Lee and Hong[14], provided a detailed survey on plant recognition using machine learning methods**.** They explored how different algorithms like Support Vector Machines (SVM), Decision Trees, and especially deep learning models are being used to classify plant species. Their study showed that while traditional machine learning methods work well with small datasets, deep learning models like CNNs perform better when dealing with large and complex image data. This paper helped me understand the overall progress in plant identification systems and the shift towards deep learning approaches due to their higher accuracy.

Zhao and Gong [15], focused specifically on the role **of** deep learning in plant image recognition**.** They reviewed several CNN-based models and explained how these models can learn patterns such as leaf shape, color, and texture from images. The paper also discussed various challenges like background noise, variations in lighting, and similarity between species. From this review, I learned that using deeper models such as ResNet can help address these challenges by capturing more

International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 09 Issue: 06 | June - 2025 SJIF Rating: 8.586 ISSN: 2582-3930

detailed features, making them suitable for tasks like medicinal plant identification.

III. METHODOLOGY

A. Dataset

The images of leaves of medicinal plants will be the data for this task. Variability in the data will be present to train a strong model to classify correctly. The data will be different types of medicinal plants with leaf shape, size, color, and texture variation. The images will be captured under different light sources and directions to mimic real-world scenarios. Rotation, scaling, and flipping data augmentation techniques will be used to augment the data and enhance the model's ability to generalize. The data will be carefully curated to be high-quality data with the appropriate labels of respective plant species. Reliability and performance in the trained model will be ensured through careful curation.

B. Model Architecture

A ResNet-based Convolutional Neural Network model will be utilized in this research. ResNet with residual connections has the capability of avoiding the vanishing gradient issue, and deeper networks are achieved with improved performance in image classification. The model to be used will be ResNet depending on the data set size and compute resources available. The model will be trained to efficiently extract features from leaf images and classify them into the respective medicinal plant species. In addition, techniques such as data augmentation and fine-tuning of hyper parameters will be applied to improve model generalization and accuracy. This ensures the system remains robust even when identifying plants from varied environmental conditions or image qualities.

C. Proposed Backbone Framework

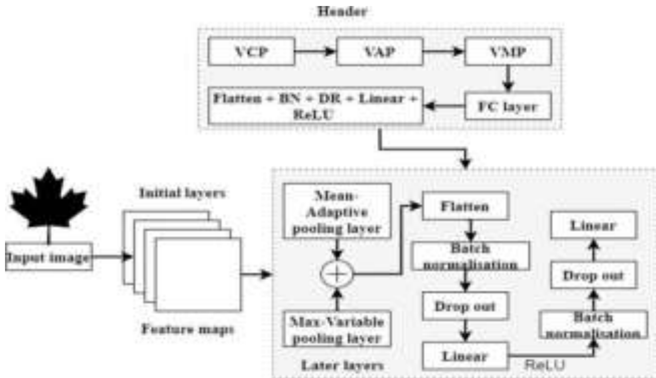
The proposed backbone structure is a ResNet-style Convolutional Neural Network architecture, which uses the residual connection to prevent vanishing gradients and enable training deeper networks. The structure will include multiple convolution layers with batch normalization and ReLU activation to acquire discriminative leaf features from input leaf images. Max-pooling layers are added at positions where down sampling of the spatial size and the computational requirement are necessary, with minimal information loss.

Convolutional layers will learn appropriate features from the input images, and the pooling layers will reduce spatial dimensions and computationally expensive loads. The fully connected layers will project the learned features to target plant species. The ResNet model will be trained on herbal plant identification task.The last layer to be specified in the backbone architecture will be dense layers that perform the classification task, projecting the input leaf image to the respective medicinal plant species. The specification of the backbone architecture, the number of layers and the number of filters per layer, will be determined empirically and optimized to perform optimally with the given dataset.

Additionally, data augmentation techniques such as rotation, flipping, and scaling will be applied during training to improve the model's generalization capability and robustness against variations in leaf orientation, size, and background. This will ensure the model performs well not only on the training data but also in real-world scenarios where leaf images may be captured under diverse conditions.

IV. SYSTEM ARCHITECTURE

RESNET



The system architecture for the automatic identification of medicinal plants is thoughtfully designed to handle the complete pipeline—from input image acquisition to the final classification output. It starts with the user or system providing a clear image of a medicinal plant leaf, which serves as the primary input. These images may vary in lighting, background, and orientation, reflecting real-world conditions. To ensure consistency and enhance learning, the image first passes through a preprocessing module where it is resized, normalized, and cleaned. This step also includes data augmentation techniques like rotation, flipping, and scaling, which help create more training examples and improve the model's ability to generalize across different leaf patterns.Once preprocessed, the image enters the feature extraction stage powered by a ResNet-based Convolutional Neural Network. ResNet is chosen for its efficiency and reliability in deep image classification tasks, especially due to its residual learning mechanism that enables deeper network construction without the problem ofvanishing gradients. The convolutional layers in the ResNet model work by detecting edges, textures, shapes, and other fine-grained details that are unique to each plant species. These features are passed through several residual blocks, allowing the model to retain important information while learning more complex patterns at deeper levels.

Following feature extraction, the information flows into a series of fully connected layers. These layers act as the decision-making part of the model, taking the extracted features and mapping them to specific plant classes. The final dense layer outputs the predicted class label, which corresponds to the name of the medicinal plant. Optionally, this can be accompanied by a confidence score or even a brief description of the plant and its medicinal use, which adds informative value to the end user.

Overall, the architecture is built to be robust, efficient and scalable, ensuring accurate classification while remaining user-friendly.

V. IMPLEMENTATION

A. Proposed System

The system implemented uses a ResNet-based CNN model to recognize medicinal plants from leaf images. The system takes an image of the leaf as an input and returns the predicted plant species as output. The system is insensitive to the changes in lighting, orientation of the leaf, and background.

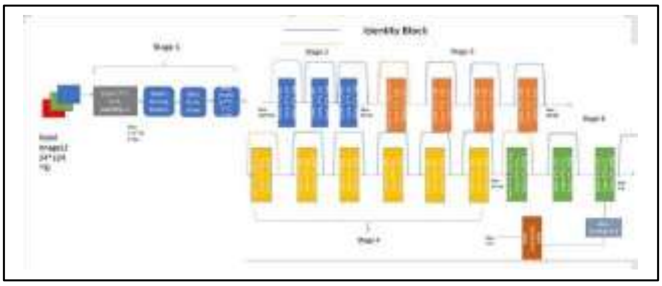


Fig. 5.1. Proposed System Architecture.

B. Model Training and Optimization

The ResNet model will be trained on the well-selected dataset of medicinal plant leaf images. Training will consist of tuning the model's parameters to reduce the difference between predicted and actual species of plants. Stochastic Gradient Descent or Adam will be trendy optimization algorithms utilized. The model's performance will be measured using accuracy, precision, and recall. Cross-validation will be utilized to make the model generalize to unseen data.

C. Software and Hardware Requirements

The deployment will leverage deep learning libraries like TensorFlow. Effective training of models is highly recommended to use a GPU.

VI. RESULTS

Figure 6.1: Homepage of the medicinal plant classification

This is the homepage of the Medicinal Plant Classification App. Users can upload an image of a plant using the "Choose File" button and click "Upload and Classify" to identify the plant.

Fig6.2: Neem Leaves with Medicinal Uses

The image shows the output of the Medicinal Plant Classification App identifying the plant as **Curry Leaves**. In the wet state, it helps treat diarrhea, diabetes, and morning sickness, while in the dry state, it is beneficial for hair and skin health.

Fig 6.3 :Classification Result-Alovera with high prediction

The image displays the Classification from the Medicinal Plant Identification App. It identifies the plant as Aloevera with a high confidence level of 99.54%**.** The interface also provides an option to go Back to Home for uploading another image or restarting the process.

Fig 6.4: Tulasi plant with medicinal uses

The ResNet CNN model was trained on a varied dataset of several classes of medicinal plants with a large number of images per class. The model was trained a number of times with robust learning capacity. Although it was able to perform well while training, there was a significant variation in performance when tested on unseen data, indicating possible areas of improvement. The outcome demonstrates that deep learning methods are capable of identifying medicinal plants, but further tuning could improve overall consistency. Comparison: Weighted KNN and ResNet CNN Both the Weighted KNN model and the ResNet CNN model were compared to assess their performance in medicinal plant classification. The Weighted KNN model, even though simple and straightforward to implement, was unable to be used on high-dimensional image features and therefore performed poorly with respect to accuracy. The ResNet CNN model, on the other hand, employed deep learning techniques to extract complex patterns and therefore there was a huge boost in classification performance. While the Weighted KNN model was unable to handle complex variations in features, the ResNet CNN model had improved generalization and accuracy. The results of the comparison indicate the superiority of deep learning compared to the traditional machine learning techniques in medicinal plant classification.

VII. CONCLUSION

The system for medicinal plant identification using leaf images provides a simple yet effective platform for classifying plant species. By applying deep learning techniques such as ResNet, the system ensures accurate classification and offers valuable medicinal information for each identified plant. The web-based interface enables users to upload images easily and receive instant results.

This project contributes significantly to the fields of botanical science, traditional medicine, and environmental conservation by promoting awareness and understanding of medicinal plants. The integration of AI in plant identification supports students, researchers, physicians, and agriculturalists in utilizing medicinal plants more efficiently.

VIII. FUTURE SCOPE

In the future, this medicinal plant identification system can be improved by expanding its image database to include a greater variety of plant species from different regions. This will increase the system's ability to correctly identify a broader range of medicinal plants, making it more reliable and applicable worldwide.

Another enhancement involves enriching the database with more plant-related information such as medicinal uses, chemical compounds, and traditional applications. This will transform the system into a valuable reference tool for students, researchers, and professionals in the fields of botany, Ayurveda, and natural medicine.

To make the system more user-friendly and inclusive, multilingual support can be added. This will allow users to interact with the system in their native languages, helping preserve indigenous knowledge and making the tool accessible to people from diverse linguistic backgrounds.

Additionally, developing a mobile application can greatly improve usability. Users will be able to identify plants in real time using their smartphone cameras. Including offline features will also ensure that the system remains functional in areas with limited or no internet connectivity, making it ideal for fieldwork and rural usage.

IX. REFERENCES

[1] Nasiri, A., Omid, M., & Alimardani, R. (2022). An AI-Based Approach for Medicinal Plant Identification Using Deep CNN Based on Global Average Pooling. *Agronomy*, 12(11), 2723.

[2] Paulson, J., & Ravishankar, M. (2021). Identification of Medicinal Plants Using Deep Learning Techniques. *Journal of Computational and Theoretical Nanoscience*, 18(5), 1545–1550.

[3] Grinblat, G. L., Uzal, L. C., Larese, M. G., & Granitto, P. M. (2016). Deep Learning for Plant Identification Using Vein Morphological Patterns. *Computers and Electronics in Agriculture*, 127, 418–424.

[4] Hu, G., Wu, Y., & Yang, J. (2020). A Multi-Scale Fusion Convolutional Neural Network for Plant Leaf Recognition. *IEEE Access*, 8, 68822–68830.

[5] Kumar, P., & Rathore, V. S. (2021). Identification of Medicinal Plants Using Deep Learning: A Review. *Materials Today: Proceedings*, 47, 5105–5110.

[6] Zhang, S., Wu, X., You, Z., & Zhang, L. (2018). Leaf Image Based Plant Species Recognition Using Extreme Learning Machine. *Multimedia Tools and Applications*, 77(14), 18333–18347.

[7] Wäldchen, J., Rzanny, M., Seeland, M., & Mäder, P. (2018). Automated Plant Species Identification—Trends and Future Directions. *PLoS Computational Biology*, 14(4), e1005993.

[8] Barbedo, J. G. A. (2016). A Review on the Use of Machine Learning in Plant Disease Detection and Diagnosis. *Computers and Electronics in Agriculture*, 131, 10–23.

[9] Rekha, N., & Raja, K. B. (2019). Identification of Medicinal Plants Using Machine Learning Techniques. *International Journal of Engineering and Advanced Technology*, 8(6), 1410–1414.

[10] Kadir, A., Nugroho, L. E., Susanto, A., & Santosa, P. I. (2011). Performance Improvement of Leaf Identification System Using Principal Component Analysis. *International Journal of Advanced Science and Technology*, 44, 113–124.

[11] Wu, S. G., Bao, F. S., Xu, E. Y., Wang, Y. X., Chang, Y. F., & Xiang, Q. L. (2007). A Leaf Recognition Algorithm for Plant Classification Using Probabilistic Neural Network. *IEEE International Symposium on Signal Processing and Information Technology*, 11–16.

[12] Kumar, N., Belhumeur, P. N., Biswas, A., Jacobs, D. W., Kress, W. J., Lopez, I. C., & Soares, J. V. B. (2012). Leafsnap: A Computer Vision System for Automatic Plant Species Identification. *European Conference on Computer Vision*, 502–516.

[13] Shoaib, M., & Mujtaba, G. (2020). Plant Species Identification Using Traditional and Deep Learning Approaches: A Review. *International Journal of Advanced Computer Science and Applications*, 11(5), 569–577.

[14] Lee, Y., & Hong, S. (2021). A Survey of Plant Recognition Using Machine Learning Methods. *Sensors*, 21(22), 7583.

[15] Zhao, S., & Gong, W. (2021). A Review of Deep Learning in Plant Image Recognition. *Multimedia Tools and Applications*, 80(18), 27753–27777.

[16] Zheng, H., Sun, S., & Ji, Y. (2019). Plant Leaf Identification Using a Convolutional Neural Network. *International Journal of Pattern Recognition and Artificial Intelligence*, 33(10), 1950029.

[17] D. Chetia, S. K. Kalita, P. P. Baruah, D. Dutta, and T. Akhter, "Identification of Traditional Medicinal Plant Leaves Using an Effective Deep Learning Model and Self-Curated Dataset," *arXiv preprint arXiv:2501.09363*, Jan. 2025