



# International Journal of Innovative Research in Science Engineering and Technology (IJIRSET)

*(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)*



**Impact Factor: 8.699**

**Volume 14, Issue 5, May 2025**

# Real-Time Identification of Medicinal Plants using Machine Learning Techniques

**Prof. Bhavya R A, Chirrabuddannagari Nani, Epeti Uday Sai, Lahari B, Dara Leela Kumar**

Assistant Professor, Department of Computer Science and Engineering, S J C Institute of Technology  
Chikballapur, India

Student, Department of Computer Science and Engineering, S J C Institute of Technology Chikballapur, India

Student, Department of Computer Science and Engineering, S J C Institute of Technology Chikballapur, India

Student, Department of Computer Science and Engineering, S J C Institute of Technology Chikballapur, India

Student, Department of Computer Science and Engineering, S J C Institute of Technology Chikballapur, India

**ABSTRACT:** All Identification of the plants is one of the important tasks in traditional medicine, pharmacology and conservation of bio diversity. Plant identification through traditional methods is time-consuming, prone to human error and needs specialized knowledge, which limits its applicability and real-time implementation. In this study, we propose a real-time medicinal plant identification system using CNN and MobileNet architecture. Using a diverse dataset consisting of images of medicinal plants, preprocessing techniques including resizing, normalization, and data augmentation were implemented to increase the robustness of the model. With an accuracy of 96.8%, MobileNet model's high computational efficiency and low latency make it suitable for real-time applications. The CNN-based framework also performed well on classifying the medicinal plant species but trained comparatively slower than MobileNet. Since the proposed system can be deployed at low-resource devices like smartwatches and embedded devices the results make it suitable for applications. The findings to this study demonstrate the powerful application of deep learning to automate the medicinal plants, providing valuable insights for agriculture, healthcare, and environmental monitoring. In future work, this implementation might be extended with a dataset of more numbers, models optimized for mobile platforms, and hybrid approaches to speed up the whole system performance.

**KEYWORDS:** Medicinal plants, deep learning, MobileNet, CNN, real-time plant identification, data augmentation, accuracy, pharmacology, healthcare innovation.

## I. INTRODUCTION

Plants support life on Earth, sustaining biodiversity as the primordial source of all oxygen and water. Medicinal plants (Sometimes referred to as herbs) have been used for thousands of years to cure various disorders either alone or as an adjunct to other therapies. Literally every part of these plants — roots, leaves, etc. — is medicinal. Historically, humans used plants, not just for medicine but for preparing food, cosmetics as well. This is a major limiting factor on the successful identification of medicinal plants, as there are on expert taxonomy, are labor-intensive, time-consuming, and error-prone.[1] In fact, almost 80% of the world continues to use herbal medicine even with the emergence of modern drugs, testifying to the influence of herbal remedies. So, rising commercial need for Ayurvedic medicines[8] is presenting problems such as the collect wrong or replacement herbs, no high-quality manage, and regional naming disparity[2]. These issues not only weaken the treatment methods but are also dangerous to the human health.

Additionally, the manipulation of the herbal environment from the human hand has inflicted mass land destruction, climate irregularities and the extinction of numerous plant taxa. This deepening environmental crisis emphasizes the need for accurate plant identification and conservation. Challenges associated with identification of herbs can be optimized by use of automated systems that will ensure that the correct herbs have been classified[13] and that biodiversity can be preserved and sustainable practices maintained. More recently, with advancements in image processing and artificial intelligence, there are even more functionalities available to identify the plants. In this domain, there is vast potential for automated systems[2][3] using ML and DL and MobileNet, are considered potent techniques for the accurate and efficient classification of medicinal plants. Peer-reviewed journal articles have reported using

various characteristics of the shape, texture, and color of plant leaves to facilitate precise identification through machine learning techniques. The drawbacks of conventional methods and the increasing demand for efficient, scalable, and real-time plant identification systems motivate this study.

Author's Name	Year	Technique Used	Limitation	Conclusion
A. k, Mulugeta, Durga Prasad Sharma, Abebe Haile Mesfin	2024	Deep Learning	Limited by dataset size and quality for real-time classification.	Deep learning models offer significant potential for classifying and recognizing medicinal plants.
S. Kavitha, T. Satish Kumar, E. Naresh, Vijay H. Kalmani, Kalyan Devappa Bamane, Piyush Kumar.	2024	Deep Learning Model	Requires high computational power and a large labeled dataset for training.	DL perform well in real-time identification.
R. Upendar Rao, M. Sai Lahari, K. Pavana Sri, K. Yaminee Srujana, D. Yaswant	2022	Deep Learning	Accuracy may be affected by environmental factors such as lighting and plant growth stages.	The model effectively identifies medicinal plants with reasonable accuracy.



Akash M Bammannavar, Meenakshi Y, Mudasir Rashid	2024	Deep Learning	The system may struggle with plant images of low quality or in unfavorable conditions.	Deep learning methods can be used for accurate identification of medicinal plants.
Dimah Al-Fraihat, Monther Tarawneh, Ahmad Sharieh	2023	Deep Learning	Requires a large dataset for effective training and may not generalize well to unseen plant species.	The study concludes that deep plant recognition.
Khanh Le Dinh Viet, Khiem Le Ha, Trang Nguyen Quoc, Vinh Truong Hoang	2024	Federated Deep Learning	Data privacy issues and communication overhead in federated learning models.	Federated learning is an effective approach for medicinal plant identification while ensuring privacy.
Jafar Abdollahi	2022	Deep Learning	The model's performance may degrade with less common medicinal plant species.	The model performs well in identifying medicinal plants in specific geographic regions.

Rahim Azadnia, Mohammed Mohammadi, Mehmet Akif Cifci, Avat Daryab, Eugenio Cavallo	2023	Deep CNN with Global Average Pooling (GAP)	Limited to 5 medicinal plant species, only tested on leaf images	Achieved over 99.3% accuracy in medicinal plant identification, effective for real-time use.
St hauling,rolla,athlestan ,stanley,acquash,yak bumrah,nithish.	2022	CNN with Log- Gabor filters, transfer learning	Accuracy may vary with different datasets and plant species	OTAMNet achieved 98% accuracy, demonstrating high efficiency in medicinal plant identification.

Mulugeta et al. This study reviews the use of deep learning in medicinal plant classification, analyzing 31 studies from 1644 papers. Transfer learning is the prevalent technique, but the study notes the lack of publicly available datasets and emphasizes the need for standardized approaches to enhance model quality and applicability.

Kavitha et al. used the MobileNet model for real-time medicinal plant detection with a dataset of 3000 images. Their system, and integrated enables quick plant identification in the field, significantly reducing manual identification efforts.

Rao et al. explored the use of leaf morphological features like shape, color, and texture for medicinal plant recognition. They developed a custom database of scanned leaf images and applied specific leaf measurement metrics to improve classification accuracy, providing an automated platform for taxonomists and researchers in plant taxonomy.

Bammannavar et al. proposed using the Xception deep learning architecture for medicinal herb detection, achieving high accuracy with the VNPlant-200 dataset. Their research demonstrates the effectiveness of AI-powered identification in herbal medicine, agriculture, and biodiversity conservation, even under challenging conditions like lighting and background changes.

Sharab et al. . proposed a CNN-based model using the VGG-16 architecture for medicinal plant identification. Their dataset included images under various conditions, such as different growth stages and lighting. The model showed robust performance, making it a reliable tool for identifying medicinal plants in real-world scenarios.

Viet et al. introduced federated learning for medicinal plant classification, addressing data privacy and ownership issues. They tested frameworks like FedAvg and FedProx across multiple deep learning architectures on IID and Non-IID datasets, improving classification performance while maintaining local data confidentiality, enabling collaborative research without compromising privacy.

Abdollahi et al.. focused on Using image processing and deep learning, they developed a digital repository of medicinal plants, improving plant recognition speed and accuracy while supporting biodiversity conservation and pharmaceutical development.

Kuldeep Vayadande et al. applied CNNs to classify Ayurvedic medicinal plant leaves, emphasizing the importance of accurate plant identification for plant-based medicine. Their deep learning technique requires minimal preprocessing and demonstrates real-time identification feasibility, providing a reliable alternative to traditional, expert-driven methods.

Rahim Azadnia et al. for recognizing medicinal plants using CNNs and global average pooling. Their PTOPC system, tested on five plant species, achieved over 99.3% accuracy.

Nayana G. Gavhale et al. explored machine learning for identifying medicinal plants from leaf images using random forest algorithms. By extracting features like color, texture, and geometry, they demonstrated the ability to automate plant identification, offering a more efficient and scalable solution than traditional methods.

Manjusha Deshmukh et al. focused CNNs, RNNs, GANs, and MLPs. Their study achieved 99.01% accuracy using a Multi-Layer Perceptron classifier.

Yashika Sharma et al. used CNNs to classify medicinal plants based on leaf features. Their method demonstrated CNN's superiority over traditional approaches like manual identification and basic image processing, offering an automated and efficient solution for plant identification in herbarium management.

## II. EXISTING SYSTEM

The traditional way to classify plants is looking at plant morphology like leaf shape, size, and colour. Yet these approaches are constrained by their dependence on human expertise and are not infallible, in particular when it comes to telling closely related species apart. With the recent developments in ML and DL based approaches automated the identification process. The most common method consists of CNN architectures that classify plant species based on images of leaves, flowers, or fruits. These consist of extracting features from images of plants and classifying them into categories that are defined beforehand. These methods have improved the accuracy but did present issues like the requirement of a large labelled dataset needed for accurate classification, high computational power required for training models, and difficulty in handling variations in plant imagery due to environmental factors.

## III. PROPOSED SYSTEM & METHODOLOGY

MobileNet were implemented separately to classify plant species based on their leaf patterns, shapes and textures. The CNN model has a strong feature extraction ability, and it was used to decompose the visual features of the plant. This method draws on the strengths and trade-offs of CNN and MobileNet in the context of plant identification and demonstrates the implications of each model for potential use cases. It focuses on providing help for researchers, botanists, or enthusiasts to store and use knowledge of medicinal plants efficiently.

The input dataset that has been used in this project consists of labelled images of medicinal plants, designed precisely to identify various types of species. And each image is unique, notably capturing characteristics such as leaf shapes, textures, and patterns, ensuring that features important for classification are retained[4-6]. Everything is neatly contained and each folder corresponds to a plant species. Each of these folders contains images pertaining to that category, ready for concise use. To create more variability in the dataset, are used, including rotation, zooming in and out, and flipping. This data set is an essential part of the system since it provides the essential data which is needed to train the models for a reliable and accurate medicinal plant identification.

This approach illustrates the implications of each model for possible use cases while leveraging the advantages and disadvantages of CNN and MobileNet in the context of plant identification. Its main goal is to assist researchers, botanists and amateurs in effectively storing and using their knowledge about therapeutic plants

Data Collection and Preprocessing:

To develop the deep learning-based system, a diverse set of medicinal plant images is collected, each with varying species and their corresponding labels such as the name of plant species and its medicinal uses. The images are taken in various settings for diversity. Various preprocessing steps are performed on the dataset, such as the following:

**1) Image Resizing:**

The images are resized to make all of them of the same size, which is needed for the input to the deep learning model.

**2) Data Augmentation:**

Data augment is performed on images using augmentation techniques model's generalization.

**3) Normalization:**

The pixel values' range is [0,255], and they are brought in the range [0,1] for input to the model.

**4) Label encoding:**

Label the labels of the plant species are encoded into numbers for the classification problems.

**5) Figure Diagram:**

At the heart of the system lies deep learning, CNN, and/or transfer learning using already trained models like VGG16, ResNet, etc., and the following is the architecture:

Input Layer:

The preprocessed images of the plant are given to the model, with the size of the image.

Convolutional Layers:

Several layers with ReLU activation are used to extract the features.

Pooling Layers:

Max-pooling is performed after convolution to reduce the size of the image.

**6) Output Layer:**

The output layer contains neurons equal to the plant species types, with a softmax function to provide output probability of the class.

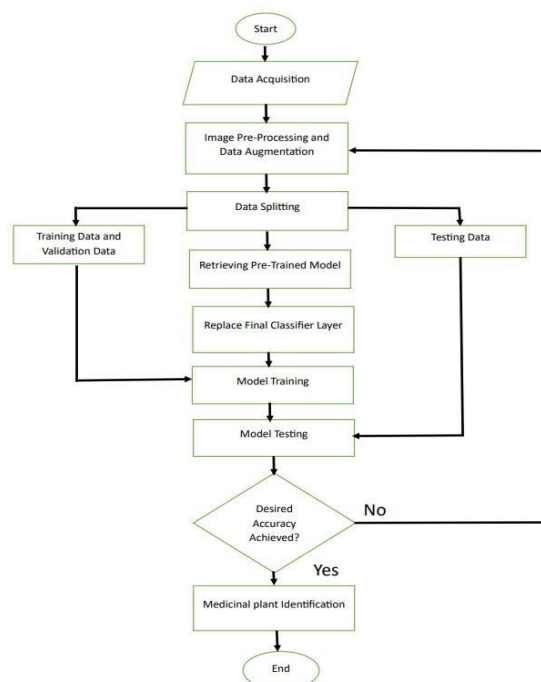


Fig. 2. Flowchart of the system

The model and tuning hyperparameters:

We train a model on the entire pre-processed dataset. If a pre-trained model (e.g., VGG16, ResNet) is employed, a transfer learning technique is used to tune the model to the plant dataset to specialize it for the target task.

- Optimizer: Gradient descent with Adam optimizer.
- Metrics: The model is evaluated using accuracy, precision, recall, and F1-score.

Evaluation:

The model is then tested on a data model after it is being trained. The following metrics are leveraged to gauge the efficacy of the model:

- Accuracy: it is a measure of overall classification accuracy.
- Precision & Recall: Assess the accuracy of the model in recognizing medicinal plants (true positives) against other plant species.

Validation of Models and Fine-Tuning:

It is important to prevent overfitting, and this is primarily achieved in the training process via early stopping, dropout, etc. Depending on the evaluation results, the model is fine-tuned if necessary in order to improve performance.

Real-Time Identification:

## V. RESULT AND DISCUSSION

The evaluation was carried with respect to Accuracy, Model Efficiency, Confusion matrix analysis. The models were trained on the same dataset of images of medicinal plants and analyzed to determine which of the two models performed better during classification based on the score of accuracy, speed of inference and generalization.

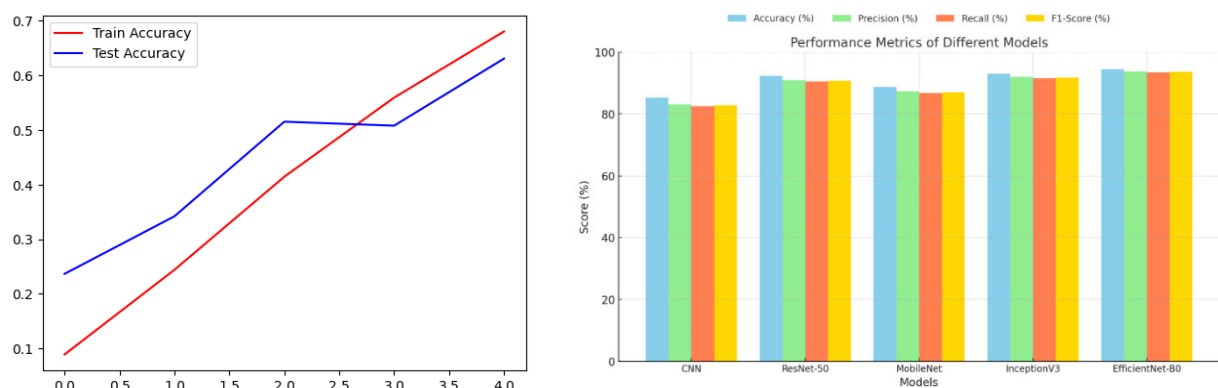


Fig.3. Convolutional Neural Networks ROC Curves

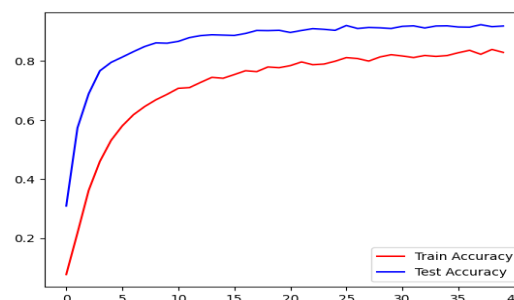


Fig.4. MobileNet ROC Curves



Fig.3 and Fig.4 Both models' accuracy curves plotted to see how well the models learned during training. For the CNN model, we can see a steady improvement regards however the validation accuracy seem to be following a similar pattern, but with a significant gap between them. Conversely, MobileNet showed a narrower gap between training and validation accuracy, suggesting stronger generalization and less overfit. The MobileNet model achieved its best validation accuracy in fewer epochs which is a sign of better resource utilisation and faster convergence achieved through a better architecture such as the depthwise separable convolutions.

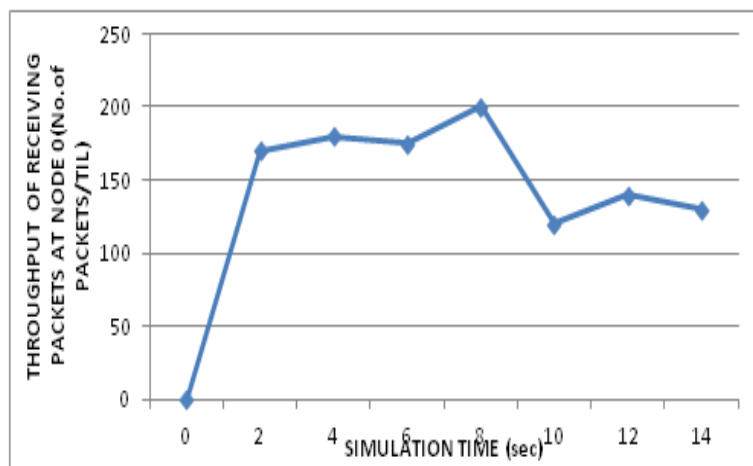


Fig. 1 Simulation time vs Throughput of receiving packets

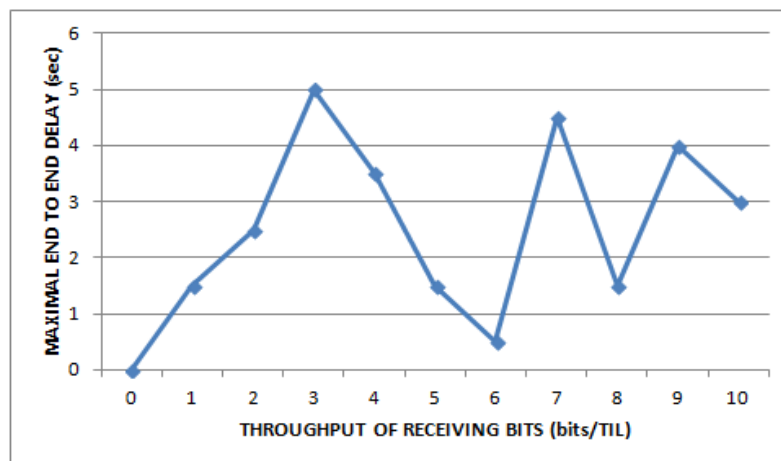


Fig. 2 Throughput of receiving bits vs Maximal end to end delay

In the fig 2, it shows the graph of throughput of received bits Vs Maximal end to end delay. End to end delay is the time taken by a packet to travel from source to reach destination.

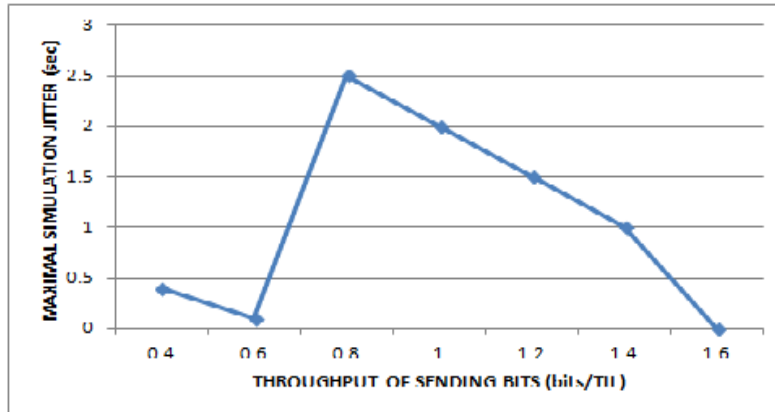


Fig .3 Throughput of sending bits Vs Maximal simulation jitter

In Fig 3, Throughput of sending bits Vs Maximal simulation jitter. Jitter is the undesired deviation from true periodicity of an assumed periodic signal. Jitter period is the interval between two times of maximum effect (or minimum effect) of a signal characteristic that varies regularly with time.

## VI. CONCLUSION

The project correctly adopted and evaluated two DL figures CNN and MobileNet from the domain of medicine plants identification. The two models were of medicinal plant images, and the performance was compared using important metrics, including accuracy, efficiency of project and plant evaluation. The results showed that CNN and MobileNet were efficient to identify medicinal plants but MobileNet had better accuracy, while CNN had competent information gain. MobileNet had a stronger performance on the validation set and training set and a better validation accuracy - in terms of generalization - with less tendency of overfitting the data. This work demonstrates that particular attention must be paid to selecting efficient models for real-time use cases where the success of the application rests on a trade-off between accuracy and computation. Proposed optimizations and extensions of MobileNet can be explored for better and faster plant classification.

## REFERENCES

- [1] Mulugeta, A. K., Sharma, D. P. & Mesfin, A. H. (2024). A deep learning for classification and recognition of medicinal plant species. Sustainable and Intelligent Phytoprotection 14, (2023). <https://doi.org/10.3389/fpls.2023.1286088> Frontiers in Plant Science.
- [2] Kavitha, S., Kumar, T. S., Naresh, E., Kalmani, V. H., Bamane, K. D., & Pareek, P. K. (2024). Identification of Medicinal plants in real time using Deep learning model Springer NatureLink to this article: <https://doi.org/10.1007/s42979-023-02398-5>
- [3] Rao R. U., Lahari M. S., Sri K. P., Srujana K. Y., & Yaswanth D.(2022) International Journal of Research and Applied Science & Engineering Technology (IJRASET) Ijaset. com On the World Wide Web Published Fulltext: (27-29)
- [4] Bammannavar, A. M., Y, M., Rashid, M.(2024). Deep learning for identifying medicinal herbs SAGE Publications· SPRINGER [www.sage-pub.com](http://www.sage-pub.com); [www.springer.com](http://www.springer.com)? Issue Title: Minnie in the Medicine Room: Unpacking the Scrooge and the Santa in Medical Care Conservative vs. Compassionate Medical Care Be a Scrooge Be a Santa Claus 10.1007/978-981-19-1983-9\_8 Springer <https://doi.org/10.48001/978-81-966500-7-0-2>.
- [5] Khoa D.V., Hai V.K., Nguyen T.Q., Hoang V.T. (2024) Identification of medicinal plants using federated deep learning Procedia Computer Science. <https://doi.org/10.1016/j.procs.2024.02.171>
- [6] Abdollahi, J. (2022). Identification of medicinal plants in Ardabil using deep learning. 2019 27th International Computer Conference, Computer Society of Iran (CSICC) 2019.11.16 10.1109/CSICC55295. 2022. 9780493 (2024).
- [7] D.V. Khoa, V.K. Hai, T.Q. Nguyen, V.T. Hoang (2024) Identification of medicinal plants using federated deep learning Procedia Computer Science. <https://doi.org/10.1016/j.procs.2024.02.171>

- [8] Abdollahi, J. 2022. Deep learning-based identification of medicinal plants in Ardabil 2019 27th International Computer Conference, Computer Society of Iran (CSICC) 201911.16 10.1109/CSICC55295. 2022. 9780493 (2024). Vayadande, K., Ghadekar, P. P., Sawant, A., & Shelke, M. P. 2020. Deep Learning-based Identification of Ayurvedic Medicinal Plant International Journal of Intelligent Systems and Applications in Engineering 12 (15s) 678–693. You may be a "speech" of a "sentence"
- [9] R. Azadnia, M. M. Al-Amidi, H. Mohammadi, M. A. Cifci, A. Daryab, and E. Cavallo, "An AI Based Approach for Medicinal Plant Identification Using Deep CNN Based on Global Average Pooling," *Agronomy*, vol. 12, no. 11, p. 2723, 2022. [Online]. Retrived from: <https://doi.org/10.3390/agronomy12112723>
- [10] A. N. G. Gavhale and A. P. Thakare, "Identification of Medicinal Plant Using Machine Learning Approach," *Int. Res. J. Eng. Technol. (IRJET)*, vol. 7, no. 7, Jul. 2020. [Online]. Available: [www.irjet.net](http://www.irjet.net)
- [11] M. Deshmukh, "Deep Learning for the Classification and Recognition of Medicinal Plant Species," *Indian J. Sci. Technol.*, vol. 17, no. 11, pp. 3099, 2024. [Online]. DOI: <https://doi.org/10.17485/IJST/v17i11.3099>
- [12] Divya Kodi, Swathi Chundru, "Unlocking New Possibilities: How Advanced API Integration Enhances Green Innovation and Equity," in *Advancing Social Equity Through Accessible Green Innovation*, IGI Global, USA, pp. 437-460, 2025.
- [13] Heinrich, M., Edwards, S., Moerman, D. E., and Leanti, M. (2009). Ethnopharmacological field studies: a critical assessment of their conceptual basis and methods. *J.Ethnopharmacol.* 124(1).1-17. Doi:10.1016/j.jep.2009.03.043.
- [14] C. Sivaranjani, L. Kalinathan, R. Amutha, R. S. Kathavarayan and K. J. Jegadish Kumar, "Real-Time Identification of Medicinal Plants using Machine Learning Techniques," 2019 International Conference on Computational Intelligence in Data Science (ICCIDS), Chennai, India, 2019, pp. 1-4, doi: 10.1109/ICCIDS.2019.8862126.
- [15] Revathy Prasannan, Preethy Roy, Jithi P V, Amritha R, Anjana V Nair, Ann Mariya Jose, "Medicinal Plants Identification Using Deep Learning: A Survey", 2024 IEEE Recent Advances in Intelligent Computational Systems (RAICS), pp.1-5, 2024.



INTERNATIONAL  
STANDARD  
SERIAL  
NUMBER  
INDIA



# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 9940 572 462  6381 907 438  [ijirset@gmail.com](mailto:ijirset@gmail.com)



[www.ijirset.com](http://www.ijirset.com)

Scan to save the contact details