WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Ayurvedic Herb Identification Using Deep Learning

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ABSTRACT:

The Ayurvedic Herb Identification Project has introduced a web-based platform designed to create ease in the identification and learning of Ayurvedic herbs. Users can upload images of herbs, which are then correctly identified and followed by relevant detailed information on medicinal importance, growth condition, and care instructions. Personalized cultivation recommendations are supplied based on environmental characteristics to assist even in the effective growing of herbs. Furthermore, the platform brings in an interactive chatbot within it for the common user who might have questions regarding Ayurvedic herbs, uses, and cultivation methods. This process will be a great move toward making Ayurvedic knowledge even more accessible to novices and experienced practitioners alike in terms of sustainable practices and holistic wellness. By herb identification, educational resources as well as an AI-powered assistant, the initiative enhances engagement and thus encourages the use of natural remedies in everyday living.

KEYWORDS: Artificial Intelligence, Convolutional neural network, Deep Learning, Herb Identification, Medicinal plants

I. Introduction

Communication plays a vital role in sharing knowledge, fostering connections, and promoting well-being. However, identifying and understanding Ayurvedic herbs can be challenging, especially for those unfamiliar with their characteristics and benefits. The **Ayurvedic Herb Identification Project** addresses this challenge by providing an intuitive platform that simplifies herb identification and learning.

This project integrates **herb recognition, personalized recommendations, and interactive assistance** to make Ayurvedic knowledge more accessible. Users can **upload images of herbs**, which are analyzed to provide accurate identification along with detailed information on medicinal properties, growth conditions, and care instructions. Additionally, a **chatbot** feature enhances user engagement by answering queries related to Ayurveda, herbal remedies, and cultivation practices.

With a focus on user accessibility and ease of interaction, the platform bridges the gap between traditional Ayurvedic wisdom and modern technology. By delivering **accurate, informative, and user-friendly insights**, it empowers individuals to explore herbal medicine, promote sustainable practices, and embrace natural wellness in their daily lives.

II. Problem Statement

Identification and understanding of the Ayurvedic herbs are not quite easy for the individual because of the unavailability of many resources, limited knowledge about plants as well as poor skills in distinguishing the herbs. Conventional ways of herbal identification are popularly dependent on books, experts, or a wealth of field knowledge, which makes it very tedious and untraveled for most people. The user might face a lot of challenges in getting proper information regarding the medicinal properties, requirements for giving the herb such a usage-for its cultivation.

In the very effort, this project aims to bring a digital solution to the can upload images of herbs for identification and derive detailed profiles from them along with personalized recommendations for cultivation based on environmental conditions.- They can even get access to an AI-powered chatbot that assists users in answering questions related to Ayurvedic herbs, their benefits, and other modes of growing these plants. They aim to fill that gap between traditional Ayurvedic knowledge and modern technology, making herbal learning and identification more accessible, accurate, and user-friendly.

III. Literature Survey

[1] R.D.T.N. Rajarathna and V.G.T.N. Vidanagama, “Ayurvedic Leaf Recognition: A Classification and Comparison of CNN Architectures”, Wayamba University Research Congress (2023) The present research investigates the capabilities of Convolutional Neural Networks (CNN) in classifying Ayurvedic medicinal leaves, and as such, VGG16, ResNet-50 and DenseNet121 architectures were implemented and tested on a dataset comprising of

Jackfruit, Lemon, and Mango as well as Betel comestible leaves. An added challenge was that, the dataset which was used for storing pictures of such leaves was uploaded on the Google drive service and was enhanced using augmentation techniques for training purposes. Models were fine-tuned using weights which had previously been trained on ImageNet and trained on Google Collab Pro for 50 epochs with resultant accuracy metrics suitable for use in Ayurvedic applications. Strengths: High Accuracy: Image classification deep learning networks VGG16, ResNet50, DenseNet121 offers a great level of accuracy on leaf identification. Data Augmentation: This allows increasing the dataset size which enhances the model performance. Drawbacks: Narrow Focus: Learns only four classes of leaves and so it cannot be applied in a larger context. Dependence on Cloud Services: Google Drive along with Collab are cloud based services and thus an internet connection is a necessity limiting its offline use.

[2] I.A.M. Zin, Z. Ibrahim, D. Isa, S. Aliman, N. Sabri, and N.N.A. Mangshor, "Herbal Plant Recognition Using Deep Convolutional Neural Network", Bulletin of Electrical Engineering and Informatics , Vol. 9, No: 5| October 2020. This research employs deep Learning techniques, particularly Convolutional Neural Networks (CNNs) for the classification of herbal plants by their leaves and employs an enhancement technique called data augmentation. This technique which includes admixture of resizing images, flipping images and rotating images is aimed at minimizing the challenges because of the likeness of different species. Owing to the trials on the ready special purpose modified database of Malaysian herbs leaves, the system received a 99 perfect mark; hence a testament of the ability of CNNs in expediting plant recognition. Strengths: Enhanced Performance: This practical experience in plant identification, particularly within herbal databases containing such plants, explains the near perfect 99 percent accuracy that has been recorded with the application of CNNs. Data Augmentation: Certain alterations including, but not limited to, changes such as resizing, flipping and rotating images have been included which in turn strengthens the model towards real life variations of the leaves and hence readies the model for various shapes of leaves. Drawbacks: Limited Database Scope: In this instance, the design adopted is primarily based on a custom made database of malaysian herbs. This poses serious limitations on the models applicability to other herbs beyond this geographical area. Challenges associated with the usability of CNNs: Resources required for training the CNNs are hige= efficient therefore ordinary users with personal computers may not be able to effectively use them.

[3] P. B. R. Pushpa, M. N. Megha, and A. K. B. Amaljith, "Comparison and Classification of Medicinal Plant Leaf Based on Texture Feature" , International Conference for Emerging Technology (INCET), Belgaum, India. Jun 5-7, (2020). This study presents a solution to the problem of identifying and classifying textures of medicinal plants automatically. The textured images of the plants are processed in a series of image processing steps such as enhancement, feature extraction, and classification techniques to identify the plants. Smartphone images of leaves are subjected to texture feature extraction using wavelet transform, Gray Level Difference Matrix (GLDM), and Gray Level Co-occurrence Matrix (GLCM). A K-Nearest Neighbor (KNN) classifier is used and the classification achieved an accuracy of 60%. In the opinion of the authors, better resolutions of images would carry better accuracy in the future classification. Strengths: This research method provides a variety of texture extraction techniques (wavelets, GLDM or GLCM), providing a wider perspective on analyzing the textures in plant leaves. International Journal of Research Publication and Reviews Vol ( ) Issue ( ) (2021) Page 000 The method is feasible and simple to use since it employs images obtained using a smartphone which can be easily adopted in the field. Weaknesses: With a classification accuracy of only 60%, the system's effectiveness and the reliability are considerably limited. Relying only on KNN classifier may not be the best; classification could be further improved by more sophisticated techniques such as CNNs.

[4] S. Kavitha, T. Satish Kumar, E. Naresh, Vijay H. Kalmani, Kalyan Devappa Bamane, Piyush Kumar Pareek, "Medicinal Plant Identification in Real-Time Using Deep Learning Model", 8 October (2023). In this research, they designed a deep learning model based on MobileNet to recognize six medicinal plants with an accuracy of 98.3%. The model was embedded in a mobile application in which processing of plants' images is done in the cloud to enable a real-time plant identification service, thus providing an easy to use application for botany and health care. Strength: Responsive Web: The lightweight structure enables in-the-field recognition on smartphones. Increased Data: Enhances model generalization with the mere availability of few samples. Drawbacks: Few Species: The model can only recognize 6 plant species in its trained dataset. Network Requirement: It is based on cloud computing, therefore suitable for use over the net only.

[5] Nidhi Tiwari, Bineet Kumar Gupta, Abhijityaditya Prakash, Kartikesh Tiwari, Sami Alshmrany, Arshad Ali, Mohammad Husain, Devendra Singh, "Developing A Neural Network-Based Model for Identifying Medicinal Plant Leaves Using Image Recognition Techniques", Journal of Advanced Zoology, Vol. 44, Issue S-5 Year 2023 In this research, the image processing techniques using neural networks are used along with the proposed CNN models of AlexNet ResNet to profile the medicinal herbs. Identification accuracy of 96.82% was reached with the best performance coming from the 5-layer CNN architecture. The aim of this research is to create a mobile or online application that will aid in the identification of species, provide information on plants that have medicinal value, and contribute to the conservation of endangered plant species. Advantages: Illustrious CNN Models with Their High Accuracy: 5 layers of CNN have been capable of attaining a high accuracy of 96.82% suggesting its efficiency in the classification process of medicinal plants. Redundancy and Derivative: The model minimizes the long and grueling process of manually identifying a plant and the expertise of botany. Disadvantages: Hardware Demand: Implementing ResNet and AlexNet for the training of deep neural network illumination structures is very powerintensive which makes it hard to afford and impractical operation in real-time. Restricted Memory: Out of the entire dataset, only 30 plant species have been included in the model making it difficult to expect a wide range of changes when the model is used on other medicinal plants.

[6] A. Fauzi, B. Soerowirdjo, and E. Haryatmi, "Herbal Plant Leaves Classification for Traditional Medicine using Convolutional Neural Network" , IAES International Journal of Artificial Intelligence (IJ-AI) Vol. 13, No: 3| September 2024 This study focuses on the use of Convolutional Neural Networks for identification of medicinal plant leaf images. Thus, a Custom Database was built that with 1,000 tree leaves picture which were gathered from four groups, such as Gulma siamo, Piduh, Sirih and Tobacco and trained a CNN model composed of 6 convolution layers, ReLU and Softmax output layers attaining 98.74% accuracy with auxilliary data augmentation (as opposed to 91.43% accuracy without auxilliary data augmentation). Strengths: Excellent Precision: 98.74% with data augmentation, up from 91.43% without it. Accurate Classification: The classification is exact across

different variety of plant species. Data Augmentation: Enhanced robustness, strategies for generalization, and overfitting mitigation Drawbacks: Small Dataset: Only 1,000 pictures of 4 species are available leading to poor generalizability Image Quality Dependability: The algorithm may be less accurate when the images are low in quality. Power Hungry: Training for 100 epochs is quite resource-intensive.

IV. Working

Technologies Used:

Python: For developing the recognition algorithm and backend server.

Django – For handling the backend, database management, and user authentication. For capturing and processing video frames from the webcam.

OpenWeather API – For providing personalized cultivation recommendations based on environmental conditions.

HTML/CSS/JavaScript: For designing and interacting with the web interface.

MobileNetV2 – A deep learning model used for herb classification and identification.

System Architecture:

The system architecture depicts the systematic structure by a system for the identification of herbs through Ayurveda. It defines how the various components create a coherent user experience. Architectural relations will establish the hardware, software, data storage, and communication frameworks whose design serves as a blueprint for development, implementation, and maintenance.

This system is basically organized in a client-to-server model in which the users use a front-end interface that communicates with a back-end AI engine. When the image of an herb is uploaded by the user, it is sent to the server for processing through various AI modules before the results of identification are returned to him. More particularly, this starts when the user clicks or uploads an image of the herb through the web based application interface. The image is sent to the Django backend, which performs preprocessing for quality enhancement and dimension normalization.

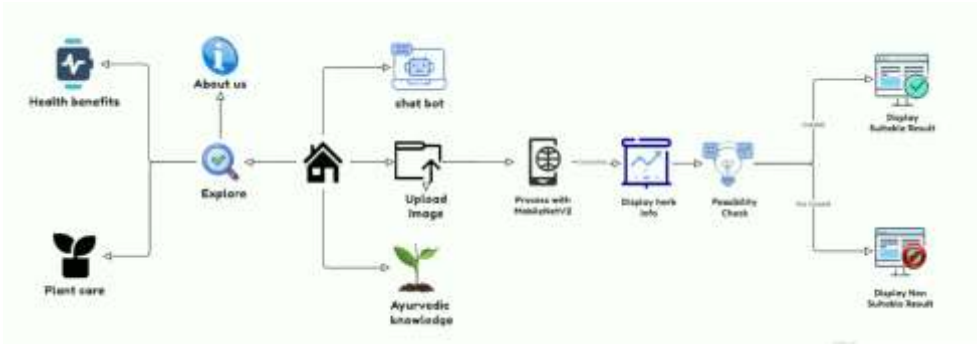
The preprocessed image goes to MobileNetV2 for feature extraction, which is creating a digital signature of the visual characteristics of the herb. This signature is then matched against a trained model to derive herb species identification along with the confidence score. The system, then, queries the database concerning the further information of the identified herb-from the medicinal properties, growing requirement, and Ayurvedic use to weather API integration, which compares ideal growing conditions to the local environment of the user in the determining of cultivation suitability. Finally, all results are prepared and sent back to the UI for display, covering identification as well as practical recommendations.

Design and Implementation:

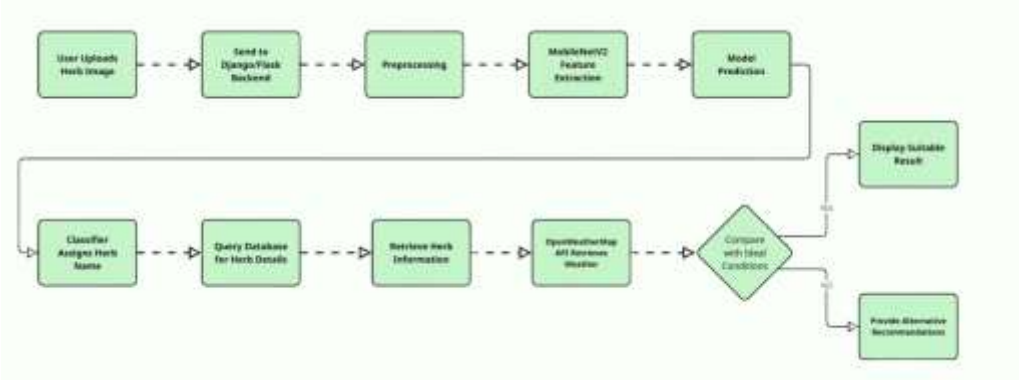
1. **Image Upload** This essential feature allows the users to choose pictures of the herb through their devices. The module also compresses the images well before sending them to the Django backend for preprocessing and analysis. Hence, the functionality is available even for limited bandwidth connections.
2. **Herb Identification** Herb Identification is the major feature which processes uploaded images on our open-source AI system. MobileNetV2 architecture extracts visual features from images to be matched against the trained model to identify the herb with a confidence score. The classifier gives a name which will fire queries against the database to return detailed information, including medicinal properties and Ayurvedic uses.
3. **Exploration** Exploration module consists two important sections- Health Benefits and Plant Care. Users are free to view this repository of knowledge for knowing about medicinal applications and cultivation requirements for some herbs in our database without uploading images.
4. **Personalized Recommendations** Through the OpenWeather API, assuming a linking of local environmental conditions with those ideal for growing certain herbs-thus assessing an herb as beneficial for cultivation-the system further presents other suitable herb recommendations according to the user's locality in case the conditions are not that favorable.
5. **Interactive Assistance** The chatbot feature addresses the conversation help for querying aspects regarding the herbs which gives how to identify them, describes their uses in various traditional systems of medicine, and provides guidance for their cultivation all in a simple and understandable tone.

The Ayurvedic Herb Identification application is an important step towards transforming the indigenous herbal wisdom into new technology. Bringing together advanced AI with simple interfaces, the application actually allows individuals to accurately identify herbs, to know their properties, and how best to utilize that in practical situations for health and wellbeing.

Frontend Architecture: Intuitive User Experience

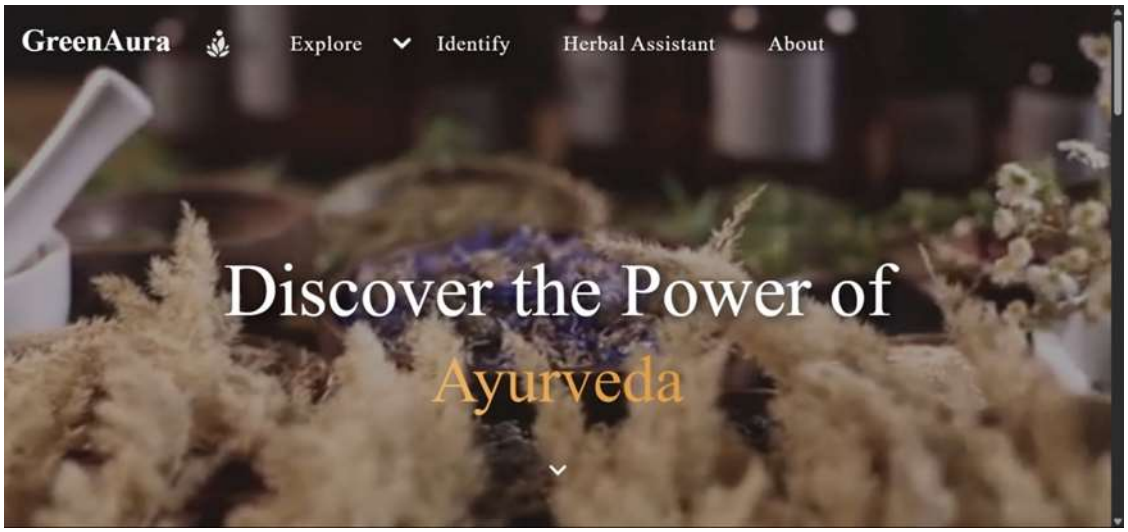


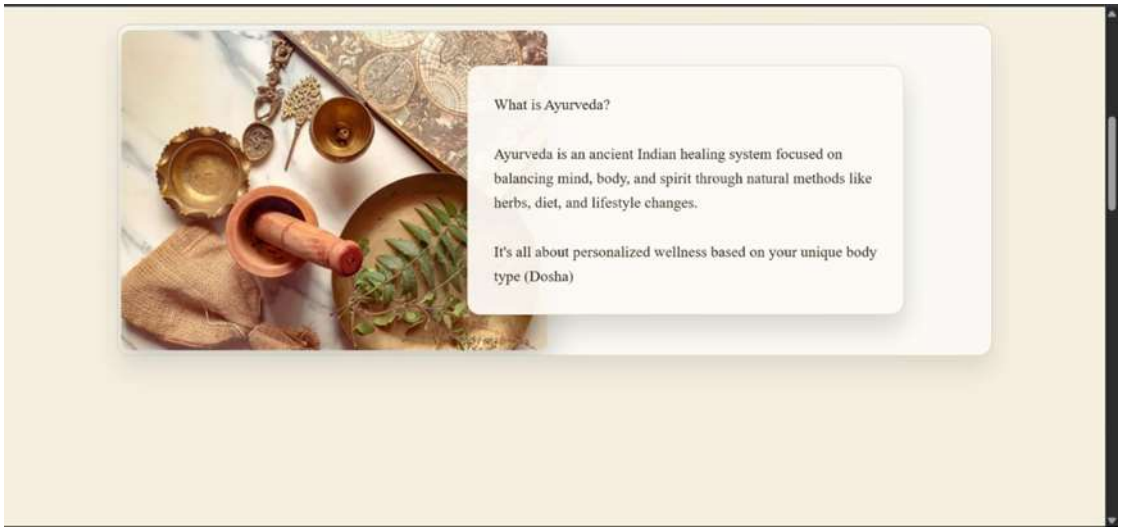
Backend Architecture: Robust AI Infrastructure



V. Output:

Home Page:





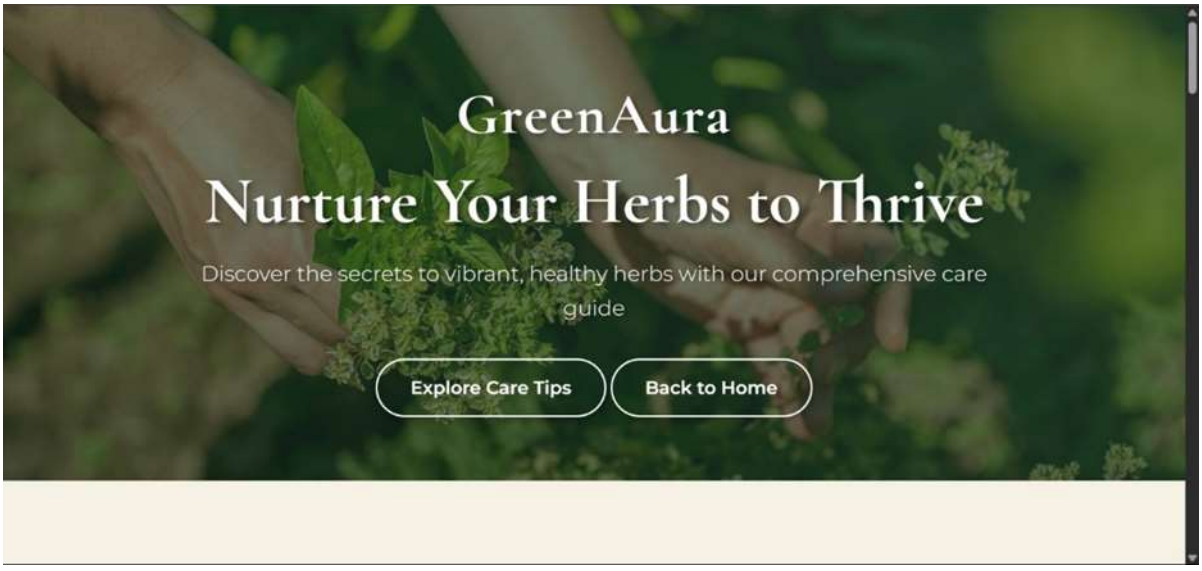
Explore Section :

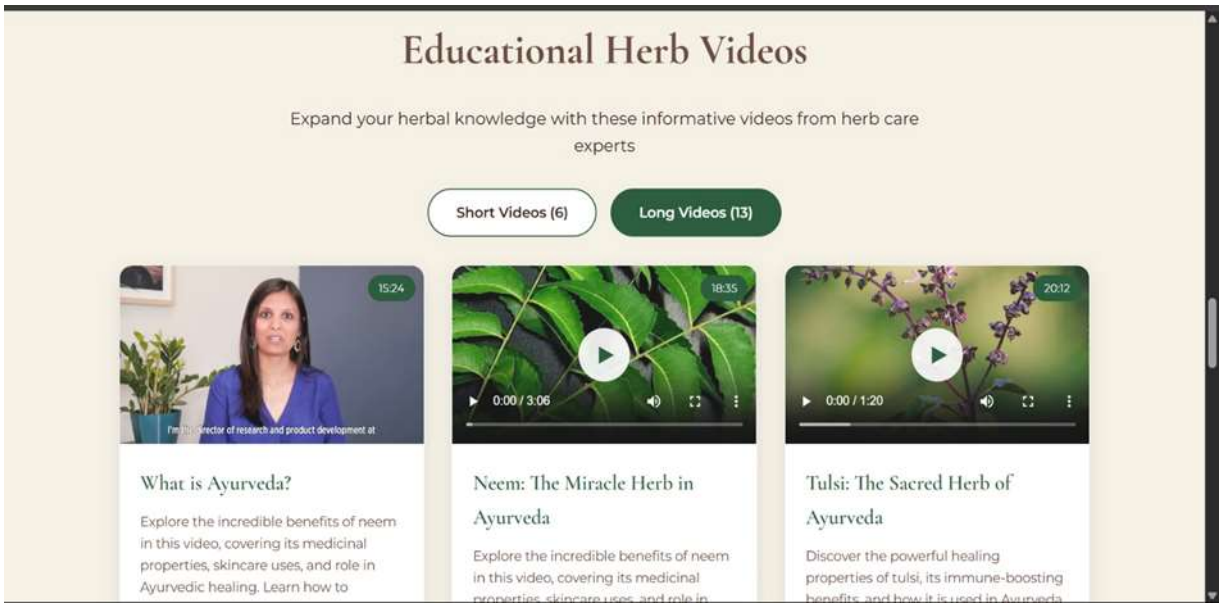
1. **Health Benefit**


Uses in Daily Life
Herbal teas and infusions
Supplements and capsules
Spices in daily cooking
Smoothies and tonics

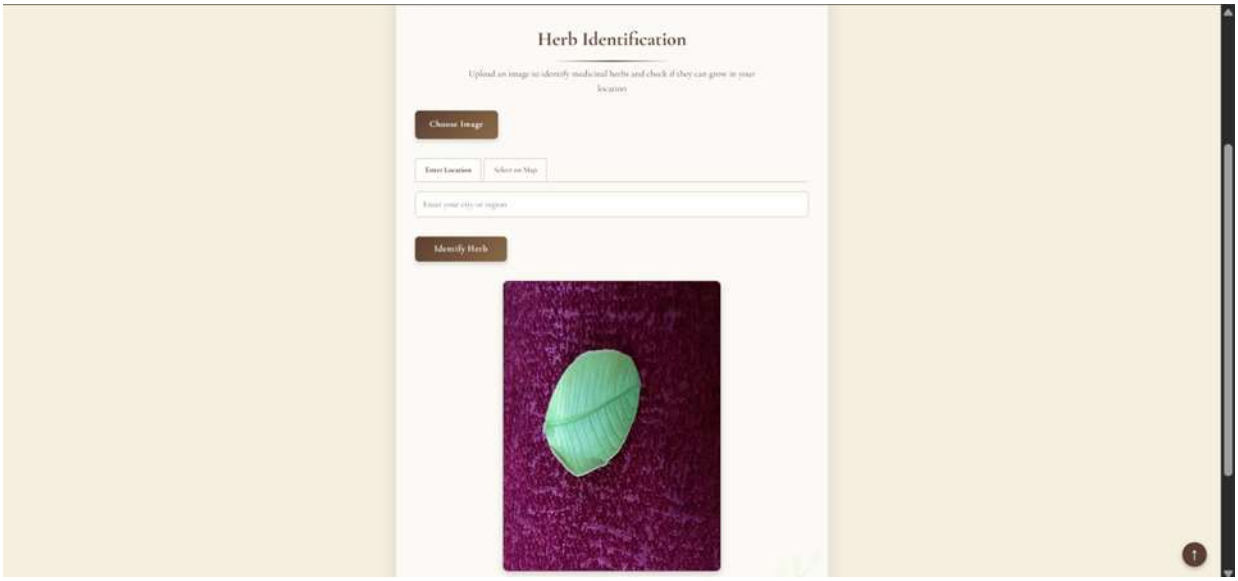

Explore Ayurvedic Immune-Boosting Herbs
Ashwagandha
Description: Known for its adaptogenic properties, Ashwagandha helps reduce stress and improve immunity.
Benefits:
Manages stress
Boosts energy levels
Supports overall immunity
Uses:
Adaptogen for stress relief
Enhances vitality
Used in herbal supplements
Amla (Indian Gooseberry)
Description: Amla is rich in Vitamin C and antioxidants, supporting immune health.
Benefits:
Boosts immunity
Promotes healthy skin
Supports digestion
Uses:
Rich in Vitamin C
Used in herbal tonics
Included in beauty products

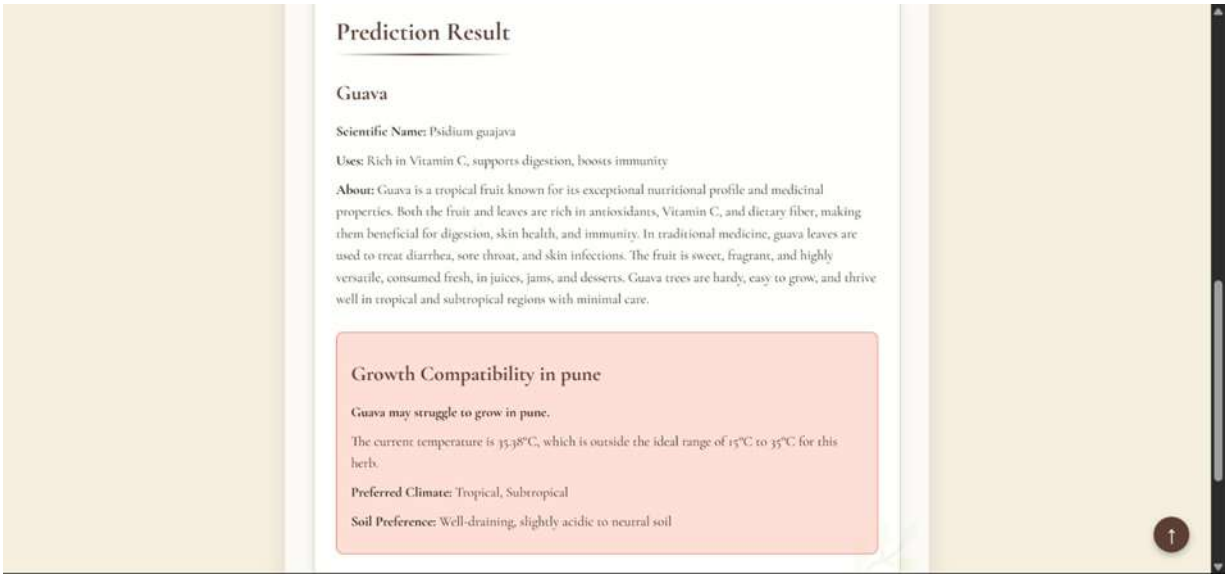
Plant Care:


GreenAura
Nurture Your Herbs to Thrive
Discover the secrets to vibrant, healthy herbs with our comprehensive care guide
Explore Care Tips
Back to Home

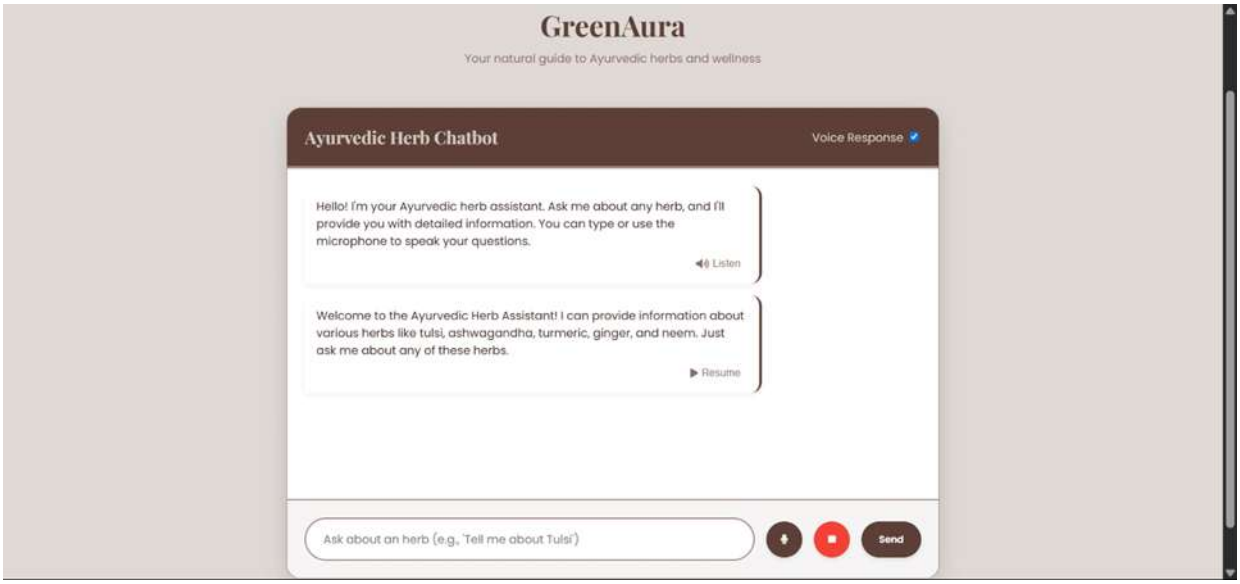


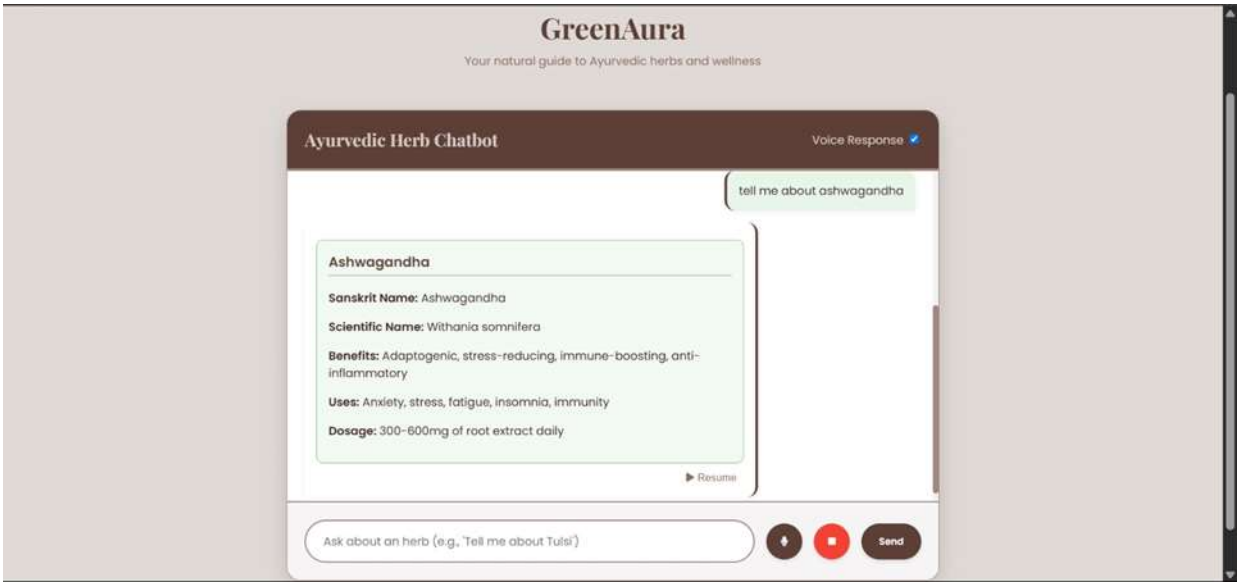
Identify Section:



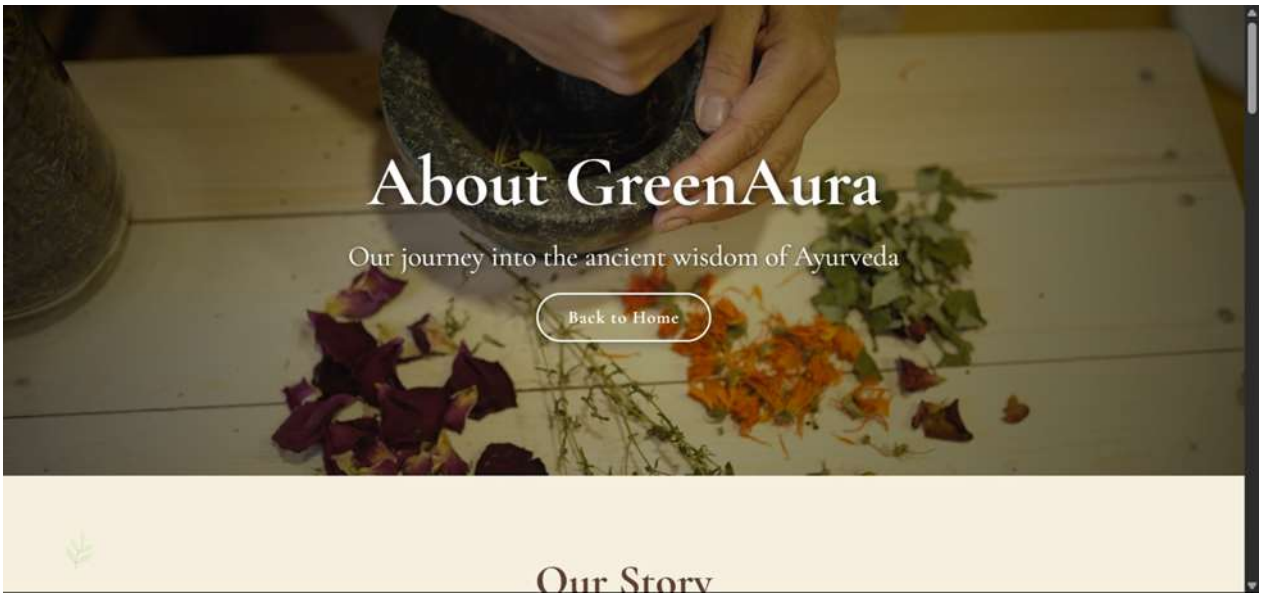


Chatbot Section:





About Section:



Outcome:

The Ayurvedic Herb Identification Project has been successful in providing an intelligent yet user-friendly platform for a highly specialized identification of herbs and dissemination of Ayurvedic knowledge. This system accurately identifies multiple Ayurvedic herbs with an image analysis technique with 98.03% accuracy, providing users with detailed knowledge about their medicinal uses, growth requirements, and mode of application. The inclusion of an interactive chatbot improves the overall experience by delivering instant answers to questions pertaining to herbal remedies, farming, and practices of Ayurveda.

VI. Conclusion

There are various directions in which the project may be further improved and developed. For instance, the herb identification database may be improved by including rare plant species and those endemic to specific geographic regions. The training data set on the image data set could be enriched in order to enhance MobileNetV2 model identification under diverse light situations and at different growth stages. Further enhancement to run its performance on low-end devices, combined with research into offline functionality, may further improve the application and enable its use in remote areas with inadequate internet connectivity. Furthermore, environmental APIs other than the weather could be integrated into the application for more precise cultivation recommendations based on soil conditions and local biodiversity. Being an open-source project, contributions from the community can expand the Ayurvedic knowledge base, enhance algorithms for identification, and help bring forward features like seasonal herb calendars or regional growing guides. On-the-ground research and development into plant recognition techniques fused with traditional Ayurvedic knowledge may birth more avenues for innovation and enhancement of the system, thereby making ancient wisdom on herbs readily available through present-day technology. There are several avenues for further enhancement and development of the project. One potential area of improvement is the expansion of the recognition capabilities to support more complex gestures and sign language. Additionally, integrating user authentication and personalization features could enhance the user experience and make the system more adaptable to individual preferences. Furthermore, optimizing the performance of the recognition algorithm and exploring real-world applications, such as assistive technology for individuals with disabilities, could broaden the project's impact and relevance. Continued research and development in the field of gesture recognition could unlock additional opportunities for innovation and refinement of the system.

VII. Future Scope

Enhanced Recognition Capabilities: In this regard, the system will be improved to be used for identification of herb species at various stages of growth, during various seasonal conditions, and from partial plant specimens, such as single leaves or roots. Such an application would, therefore, become more versatile for users having little botanical specimens.

Advanced Environmental Analysis: Integration of more environmental APIs apart from weather data would allow one to recommend cultivation practices in a more holistic manner, such as considering soil composition, sunlight exposure patterns, and compatibility with the local ecosystem.

Multilingual Support: Making the application multilingual would help open up access to traditional Ayurvedic knowledge for a large range of communities worldwide, thus preserving the system of ancient wisdom across cultural barriers.

Augmented Reality Features: Allowing AR functionality would let users visualize how herbs would grow in their respective spaces before actual cultivation while providing an interactive identification overlay when they are out exploring nature.

Community Contribution System: A moderated online platform to share verified information about local varieties of herbs, their cultivation practices, and their traditional uses would be a valuable addition to the knowledge base.

Offline Functionality: Improving the app to function with little or no connectivity would help in areas where knowledge of traditional herbs is most needed and relevant.

Integration with Health Tracking: With suitable medical knowledge and regulatory approval, the system could eventually give recommendations on personalized herbs derived from user health profiles and traditional Ayurvedic principles.

Seasonal Calendars and Notifications: Implementation of calendars for planting, harvesting, and preparation with notifications would increase the practical usage of the identification system.

Cross-Platform Development: Transitioning from web-based to native mobile applications will improve the performance of the system while allowing a tight integration with the device cameras.

Educational Modules: A series of structured learning paths about Ayurvedic principles and uses of herbs will transition the tool away from an identification system and into an educational platform in its own right.

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