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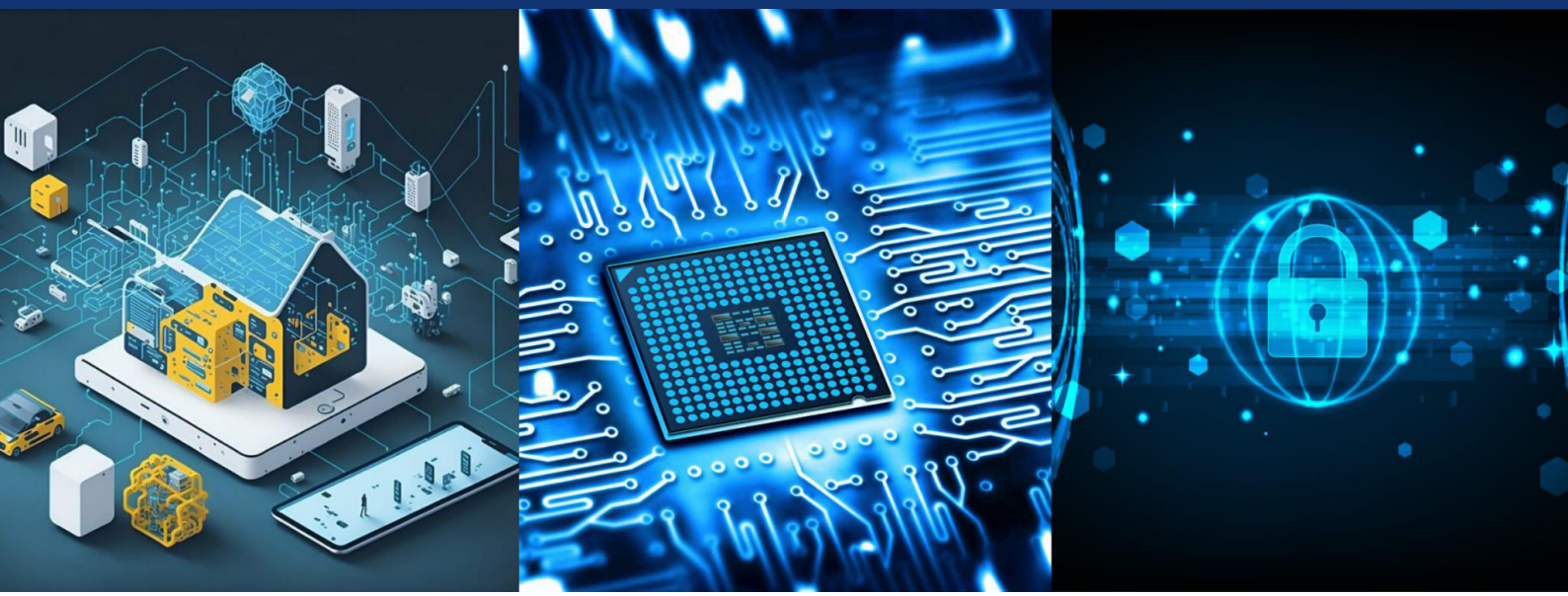

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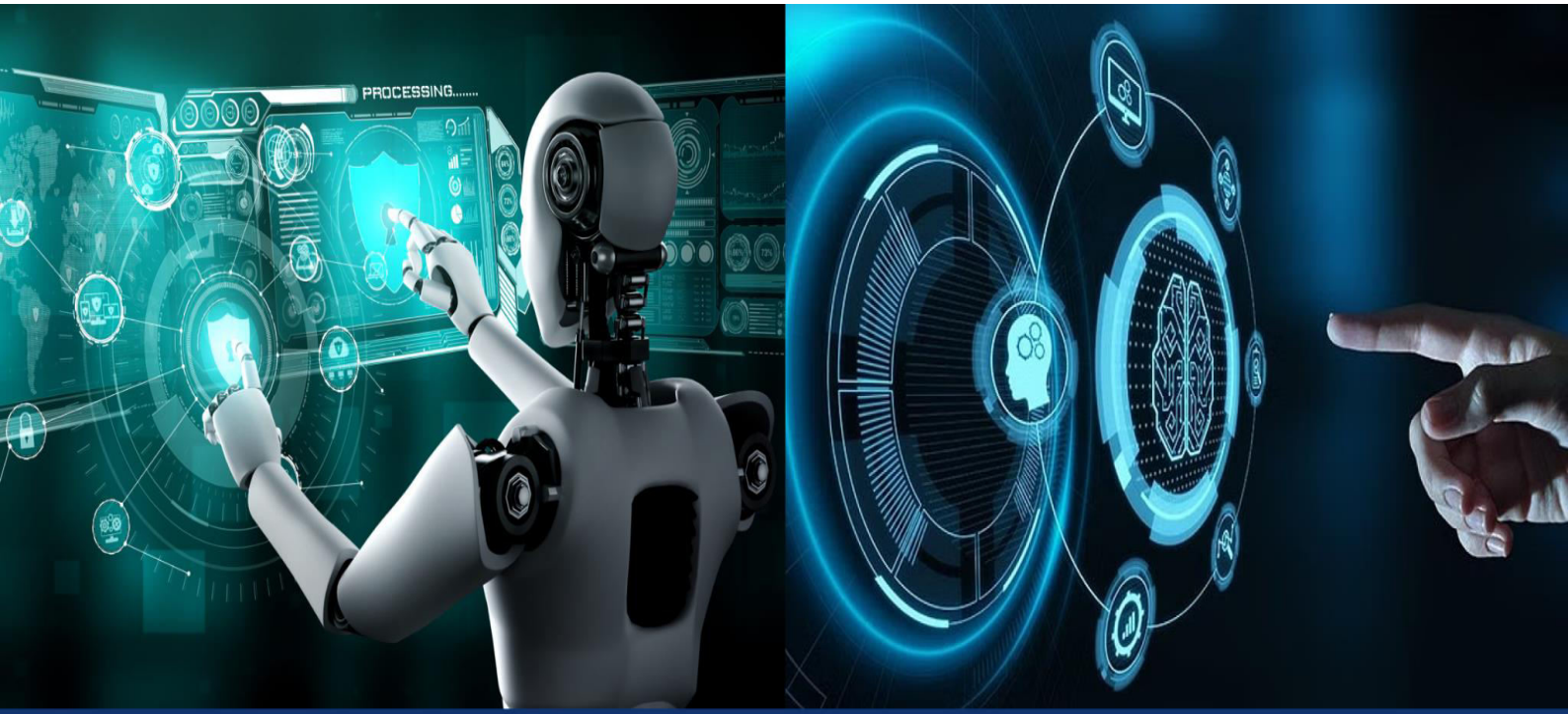

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Herbo Vision: Advanced Herbal Plant Recognition Using Convolutional Neural Networks

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ABSTRACT: Medicinal plants play a vital role in traditional healthcare systems, and their accurate identification is essential for preserving their medicinal value. Our Project Herbo Vision is a deep learning-based framework that utilizes Convolutional Neural Networks (CNNs) for the precise classification plant leaves. The model is trained on the Indian Medicinal Leaves Image dataset, incorporating image preprocessing techniques such as rescaling, augmentation, and normalization to improve classification accuracy. To ensure accessibility, the trained model is integrated into a Flask web application, enabling users to upload plant leaf images for real-time identification. In addition to classification, the system retrieves botanical names, medicinal properties, and traditional uses, providing comprehensive insights into each identified plant. This approach enhances efficiency, accuracy, and user-friendliness, making medicinal plant identification more accessible to researchers, herbal practitioners, and Ayurveda enthusiasts. By leveraging deep learning, Herbo Vision significantly improves upon traditional methods, offering a robust and intelligent solution for medicinal plant classification, ultimately contributing to botanical research, Ayurveda, and herbal medicine applications.

KEYWORDS: Herbal Plant Recognition, Convolutional Neural Networks (CNNs), Indian Medicinal Leaves Image Dataset, Flask Web Application, Plant Identification

I. INTRODUCTION

Medicinal plants play a crucial role in traditional medicine, offering numerous therapeutic benefits. However, manually identifying these plants can be time-consuming and error-prone, requiring expert knowledge. To address this challenge, this research utilizes deep learning to develop an automated medicinal plant identification system. A Convolutional Neural Network (CNN) is trained on the Indian Medicinal Leaves Image Dataset to classify different medicinal plants with high accuracy. Additionally, a Flask-based web application is implemented, allowing users to upload images and receive predictions along with medicinal information.

The primary objective is to develop an efficient deep learning model that enhances accessibility to medicinal plant knowledge. By leveraging CNN optimization and data augmentation, the system improves classification accuracy, aiding botanists, researchers, and herbal medicine practitioners. This approach bridges the gap between traditional plant identification methods and modern technology, making medicinal plant recognition more accessible and reliable.

II. LITERATURE SURVEY

Several studies have explored the identification of medicinal plant leaves using deep learning and machine learning techniques. [1] Bhargavi Jahagirdar et al. (2021) used CNNs for Indian medicinal leaf classification, achieving high accuracy and demonstrating the potential of deep learning for plant identification. [2] S. Praveena et al. (2024) proposed a CNN-based model that not only classifies medicinal leaves but also provides medical recommendations based on their properties, showcasing the practical applications of AI in healthcare. [3] S. Kavitha et al. (2024) introduced a real-time plant identification model that integrates pre-trained CNNs with an image processing pipeline, allowing for fast and efficient classification, making it suitable for mobile and web applications. [4] Adibaru Kiflie Mulugeta et al. (2024) conducted a systematic review of deep learning architectures such as CNN, ResNet, and Inception, highlighting their strengths and limitations in medicinal plant classification, emphasizing the importance of architecture selection. [5]

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Ravina Kolekar et al. (2024) employed machine learning classifiers like SVM and Random Forest for medicinal leaf identification, later extending their work to Ayurvedic plants using CNNs, which significantly improved accuracy. [6] Ravina Kolekar et al. (2024) further extended their research to Ayurvedic leaves using CNNs, enhancing classification accuracy. [7] Rohan Kumar Verma et al. (2024) focused on enhancing feature extraction using advanced CNN architectures like VGG16 and MobileNet, improving classification performance across different plant species. [8] K. Karthika et al. (2024) explored various machine learning models such as decision trees, k-NN, and SVM, emphasizing the importance of dataset quality, preprocessing, and feature selection for robust model performance. [9] Mukherjee G et al. (2021) developed a CNN-based vision system capable of identifying species and maturity stages of Neem, Tulsi, and Kalmegh leaves, demonstrating CNNs' ability to differentiate between growth stages. [10] Azadnia R et al. (2022) proposed a deep CNN model utilizing global average pooling, which improves accuracy while reducing model complexity, making it a more computationally efficient solution. Collectively, these studies demonstrate that CNNs, particularly with transfer learning, outperform traditional methods, enabling real-time applications and AI-driven solutions in medicinal plant identification. Future research can focus on expanding datasets, improving model generalization across diverse environments, and integrating explainable AI techniques to enhance the interpretability and trustworthiness of classification models.

III. PROBLEM STATEMENT

Identifying medicinal plants accurately is crucial for traditional medicine, pharmaceutical research, and biodiversity conservation. However, manual identification is time-consuming and requires expert knowledge, making it inaccessible to the general public. Existing plant classification methods often suffered from low accuracy, limited scalability, and lack of additional medicinal information. Moreover, many deep learning-based models focus solely on image classification without integrating a user-friendly interface for practical applications. This project aims to develop an automated medicinal plant identification system using Convolutional Neural Networks (CNNs). The model will classify plant species based on leaf images and provide detailed medicinal properties and uses. Additionally, a Flask-based web application will be implemented, allowing users to upload images and receive real-time predictions, making medicinal plant identification accurate, accessible, and informative.

IV. OBJECTIVES

A. User-Friendly Interface
The web application, built using Flask, provides a simple and intuitive platform where users can upload leaf images and get instant results.
B. High Accuracy
The CNN model processes images efficiently, providing fast and reliable identification of plant species.
C. Detailed Medicinal Insights
Along with classification, users receive medicinal properties, botanical names, and uses of the identified plant.

V. PROPOSED SYSTEM

The proposed system developed an Avanced Herbal plant Recognition system using Convolutional Neural Networks (CNNs). This system will classify plants based on leaf images and provide detailed medicinal properties, uses, and botanical information through an integrated Flask-based web application. The model is trained on the Indian Medicinal Leaves image dataset, ensuring high accuracy and robustness in classification. The web application will allow users to upload plant images and receive predictions, making it accessible to researchers, students, and traditional medicine practitioners. To improve performance, the system will use image preprocessing techniques, data augmentation, and an optimized CNN architecture. The user-friendly interface will ensure easy access to medicinal plant information, making identification fast, efficient, and reliable.

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VI. METHODOLOGY

6.1 Dataset Collection & Preprocessing

The Indian Medicinal Leaves Image dataset contains approximately 6900 images of various medicinal plant leaves. Images are resized to 256x256 pixels and normalized to improve model performance. Data augmentation techniques like rotation, zoom, shear, and flipping are applied to enhance model generalization and prevent overfitting.

6.2 Model Development

A CNN model is designed with three convolutional layers, each followed by a max-pooling layer to extract important features. The Flatten layer converts these features into a one-dimensional vector, processed by a Dense layer for classification. The final softmax activation function assigns the image to one of plant classes.

6.3 Model Evaluation & Optimization

The model is trained for 20 epochs and evaluated using accuracy and loss metrics on both training and validation datasets. Hyperparameter tuning is performed by adjusting the learning rate, batch size, and number of filters to optimize performance while avoiding overfitting.

6.4 Integration with Flask Web Application

A Flask-based web application allows users to upload an image for plant identification. The trained CNN model processes the image and predicts the plant species. The web application is designed to be user-friendly and accessible on various devices.

6.5 Medicinal Information Retrieval

Once the plant is identified, its botanical name, medicinal properties, and traditional uses are retrieved from the Medicinal Plants Info dataset. This feature helps users understand the medicinal benefits of the identified plant.

6.6 Deployment & Testing

The system is thoroughly tested with diverse plant images to ensure high accuracy and reliability. The model is deployed along with the Flask application, ensuring smooth functionality in real-world conditions. Feedback from users is incorporated for further improvements.

VII. USE CASE DIAGRAM

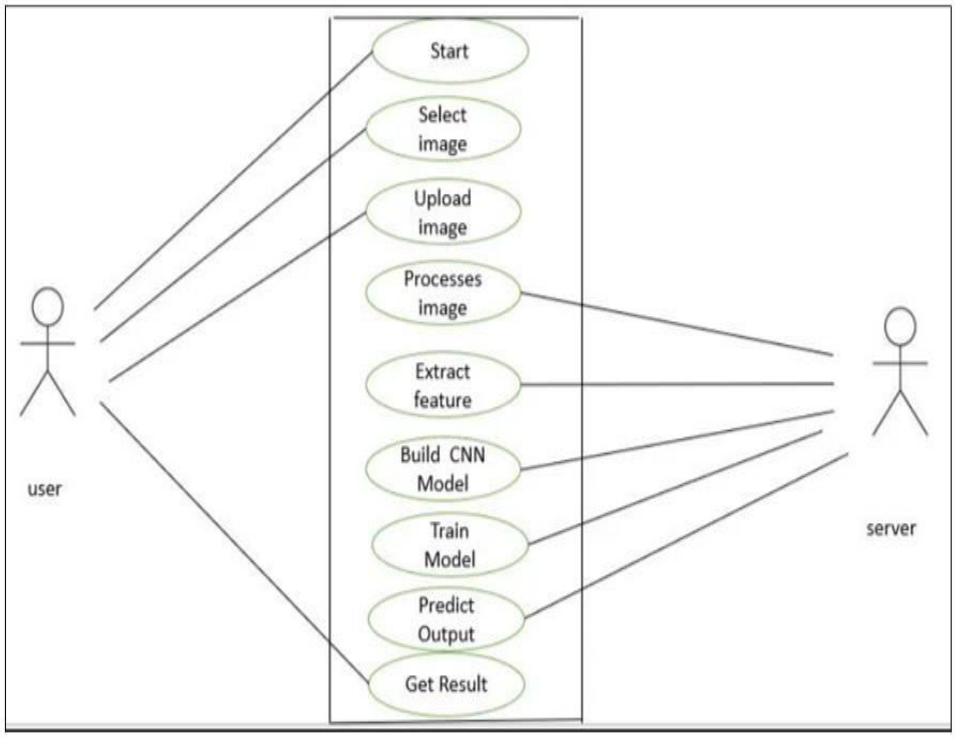

FIGURE 1. Use case diagram

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VIII. SYSTEM ARCHITECTURE

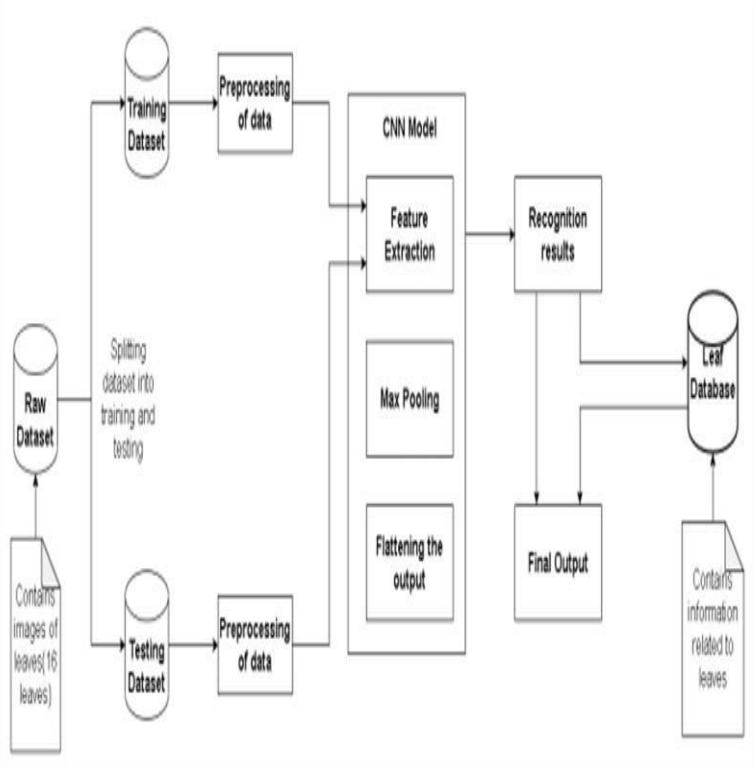

FIGURE 2. System Architecture

IX. RESULTS AND DISCUSSION

The medicinal plant identification system achieved 98% accuracy, demonstrating its effectiveness in classifying medicinal leaves. The model was tested on a diverse set of plant images, and its predictions were highly reliable.

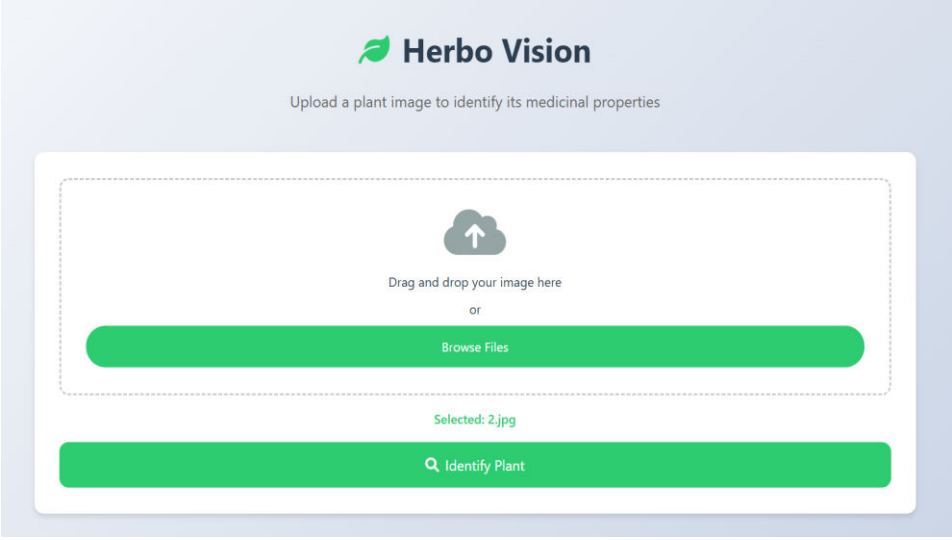

FIGURE 3. Home Page

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The above Figure shows a user interface of "Herbo Vision," an application for identifying medicinal plants from uploaded images. It includes an upload section, a "Browse Files" button, and an "Identify Plant" button to identify plant images.

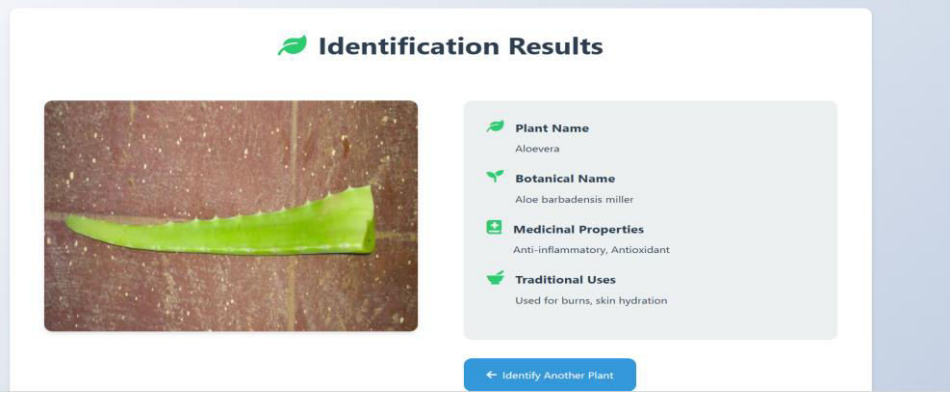

FIGURE 4. Result Page

The above Figure shows the "Identification Results" page of the Herbo Vision application. It identifies the plant as Aloe Vera (Aloe barbadensis miller) with medicinal properties like anti-inflammatory and antioxidant benefits. Traditional uses include treating burns and skin hydration, with an option to identify another plant.

TABLE 1. RESULTS

Plant Name	Botanical Name	Medicinal Properties	Uses
Aloevera	Aloe barbadensis miller	Anti-inflammatory, Antioxidant	Used for burns, skin hydration
Amla	Phyllanthus emblica	Rich in Vitamin C, Immunity booster	Boosts immunity, improves digestion
Bamboo	Bambusoideae	Antibacterial, Antioxidant	Supports bone health, digestion
Betel	Piperbetle	Antiseptic, Digestive aid	Helps in digestion, oral hygiene
Bhrami	Bacopa monnieri	Cognitive enhancer, Neuroprotective	Improves memory, reduces anxiety

X. CONCLUSION

The proposed Herbal Plant Recognition System effectively recognizes various medicinal plants using deep learning techniques. By utilizing a CNN model trained on the Indian Medicinal Leaves Dataset, the system achieves an impressive 98% accuracy in plant identification. The integration of a Flask-based web application ensures a user-friendly interface for seamless image uploads and retrieval of medicinal information. The system provides valuable insights into the botanical names, medicinal properties, and traditional uses of identified plants, aiding researchers, herbal practitioners, and the general public. Future improvements may include expanding the dataset, enhancing model efficiency, and integrating real-time mobile applications for wider accessibility.

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