IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.102 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 13, Issue 3, March 2024

DOI: 10.17148/IJARCCE.2024.133113

AI IN MEDICINAL PLANT DISCOVERY AND HEALTH CARE

K Shramitha Shetty[1], Lahari Acharya[2], Riya Miranda[3], V Lahitha[4], Dr.Sreeja Rajesh[5]

Department of Information Science & Engineering, Mangalore Institute of Technology & Engineering, Moodabidri[1-4]

Associate Professor, Dept. of Information Science & Engineering, Mangalore Institute of Technology & Engineering, Moodabidre, India[5]

Abstract: Ayurveda, an ancient Indian system of medicine rooted in the Vedas, has gained global attention for its holistic approach to health. India is well-known for offering an optimal environment that supports a wide variety of medicinal plants. The various components of these plants play a crucial role as key elements in crafting natural remedies. Fascinatingly, numerous medicinal plants thrive in our own backyards or along sidewalks. Identifying and differentiating between these plants is nearly impossible for someone without proper training. The manual process of identifying plant species is both challenging and time-consuming, exacerbated by a lack of expertise in the field. This challenge is especially evident in the accurate classification of medicinal plants, where the process can be intricate and perplexing. To overcome these challenges, this project aims to harness the capabilities of machine learning for the automatic detection of medicinal plants. This approach aims to streamline the identification process, minimizing the reliance on manual labor. The automation of this crucial task not only targets improved efficiency and accuracy but also strives to make it more user-friendly for individuals with diverse levels of expertise. Incorporating Convolutional Neural Networks (CNNs), identified as optimal for the project, the AI algorithm specializes in image classification, particularly suitable for the diverse shapes, colors, and textures of plant leaves. CNNs not only identify the plant but can also extract crucial information on its medicinal properties and practical applications through training on labeled datasets. This innovative fusion of AI and Ayurveda holds immense potential to revolutionize healthcare. Empowering individuals to actively engage in their well-being, the project aims to provide access to the expertise of Ayurveda practitioners, fostering a healthier and sustainable future for all.

Keywords: Medicinal plants, Machine learning, Image processing, Convolutional neural Network, feature extraction, plant recognition

I. INTRODUCTION

In the exploration of medicinal plants, the quest for identifying and harnessing their therapeutic potential stands as a pivotal endeavor. Across centuries, traditional systems of medicine like Ayurveda have relied on the profound knowledge of botanical diversity and their healing properties. However, the manual process of identifying medicinal plants often proves cumbersome and error-prone, especially in distinguishing between closely related species.

In addition to Convolutional Neural Networks (CNNs), various other AI models such as Inception Networks, Residual Networks (ResNets), MobileNets, DenseNet, VGGNet, and Xception have been employed for image classification tasks. While each model offers distinct advantages and applications, the preference for CNNs in our project underscores their efficacy and versatility in analyzing botanical imagery.

CNNs have emerged as the cornerstone of image classification due to their ability to automatically learn and extract hierarchical features from raw pixel data. Their architecture, inspired by the visual cortex of the human brain, comprises convolutional layers that detect local patterns and spatial relationships, followed by pooling layers that down sample feature maps to capture essential information efficiently.

Within our model architecture, we employ various layers including Dense, Dropout, Flatten, Conv2D, MaxPool2D, and Batch Normalization, each serving distinct functions in enhancing the model's performance.

The utilization of CNNs and associated layers enables our system to analyze real-time leaf images uploaded by users, swiftly identifying plant species and providing comprehensive insights into their medicinal properties. By automating this process, we mitigate reliance on expert knowledge and expand accessibility to plant identification, particularly in remote areas.

DOI: 10.17148/IJARCCE.2024.133113

Moreover, our project extends beyond mere identification, encompassing features aimed at enriching users' understanding and engagement with medicinal plants. Alongside species recognition, our system offers insights into geographic distribution, medicinal properties, and practical applications of identified plants. This holistic approach not only empowers individuals to make informed decisions about their health but also contributes to the conservation and sustainable utilization of medicinal plant resources.

In summary, our project amalgamates the rich heritage of traditional medicine with the transformative potential of AI, fostering a synergistic relationship between ancient wisdom and modern technology. Through the convergence of machine learning, computer vision, and botanical knowledge, we endeavor to revolutionize the exploration and utilization of medicinal plants, paving the way for a healthier and more sustainable future for all.

II. RELATED WORKS

1. Recognition of Ayurvedic Medicinal Plants from Leaves: A Computer Vision Approach

The paper presents an automated system for identifying ayurvedic medicinal plant species in the Western Ghats region of India, utilizing computer vision and machine learning techniques. By combining Speed Up Robust Feature (SURF) and Histogram of Oriented Gradients (HoG) features, extracted from leaf images, with a k-Nearest Neighbor (k-NN) classifier, the system achieves impressive accuracy metrics. With an average accuracy of 99.6%, along with high precision, recall, and F-measure values, the system effectively recognizes plant species based solely on leaf images. The study also suggests future directions, including expanding the dataset, exploring alternative classifiers, and optimizing feature combinations. This research marks a significant advancement in automated plant species identification, with implications for botanical research and healthcare applications.

2. Ayurvedic Plant Leaf Classification using Image Processing Techniques and SVM

The paper introduces a machine learning-based approach for identifying Ayurvedic leaf types using shape, color, and texture signatures. Employing Support Vector Machine (SVM) for leaf classification, the system utilizes features such as area, perimeter, aspect ratio, and statistical measures obtained from 210 images representing seven different medicinal plant species. Through a dataset division of 140 training samples and 70 testing samples, the proposed method achieves an impressive accuracy of 96.4% in leaf classification. By leveraging SVM and a combination of features, the system effectively reduces the time and manual effort required for Ayurvedic species recognition, showcasing high classification performance and potential for promoting medicinal herb cultivation.

3. The analysis of plants image recognition based on deep learning and artificial neural network

The paper explores the use of artificial intelligence and machine vision, focusing on plant leaf recognition for enhanced plant classification and protection. Using deep learning, specifically the backpropagation algorithm, the study achieves a high average recognition rate of 92.48% across 50 plant leaf databases. The backpropagation neural network outperforms other methods in terms of recognition time and accuracy, showcasing its practical applicability. The study suggests future research directions, emphasizing the need for a unified plant leaf database and standardized evaluation criteria for plant species identification systems. In summary, the paper covers the model, features, dataset, performance metrics, and highlights implications for future research in plant leaf recognition.

4. Identification of medicinal plant using hybrid transfer learning technique

The paper "Identification and Classification of Medicinal Plants Using Deep Learning Approaches" employs a hybrid transfer learning model, incorporating principal component analysis (PCA), to address the challenges of accurately identifying medicinal plants crucial for Ayurvedic treatments. The Convolutional Neural Network (CNN) architecture, specifically designed for plant leaf information, utilizes a grayscale channel for improved feature extraction. The study relies on a dataset sourced from Mendeley Data, encompassing 30 different species of medicinal plants from the Indian sub-continent. The dataset organization follows the scientific or botanical names of the species, and each species is represented by 1,500 images. Dataset division involves a thoughtful rotation and tilting of leaf images to optimize deep learning and machine learning benefits. Performance metrics, particularly the accuracy of the hybrid transfer learning model, are evaluated through extensive experimentation, comparing the proposed approach with well-known pre-trained models like VGG16, Resnet50, InceptionV3, Xception, DenseNet121, and MobileNetV2. The study demonstrates that the PCA Based VGG16 hybrid model achieves a notable accuracy of approximately 95%, surpassing the comparative models. The paper identifies the computational challenges associated with deep learning models and suggests potential future directions, including the incorporation of additional images and layers for further enhancement of the system's performance.

IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.102 ⁒ Peer-reviewed & Refereed journal ⁒ Vol. 13, Issue 3, March 2024

DOI: 10.17148/IJARCCE.2024.133113

5. Identification of Ayurvedic Medicinal Plants by Image Processing of leaf samples:

The paper proposes a methodology for identifying Ayurvedic medicinal plants using image processing techniques. The model utilized in the study primarily employs Support Vector Machine (SVM) algorithms for classification. Features crucial for plant identification include geometric features (solidity, eccentricity), color features (mean, standard deviation), texture features (derived from GLCM), and shape features (determined via an erosion technique). The dataset comprises 32 species of plant leaf images, augmented for diversity. However, no standardized dataset was available. The dataset is divided into training and testing sets, each consisting of 64 samples. Performance metrics indicate an impressive accuracy rate of 96.667%, demonstrating the effectiveness of the proposed methodology in accurately identifying Ayurvedic medicinal plants.

6. The Implementation of CNN on Website-based Rice Plant Disease Detection

The literature survey in the paper provides a comprehensive overview of studies focused on rice plant disease detection using Convolutional Neural Networks (CNNs). These studies collectively emphasize the critical role of accurate disease detection in agricultural management for optimizing crop yield and ensuring food security. Notably, researchers consistently report high accuracies ranging from 90% to over 95% when employing CNNs, underscoring the efficacy of deep learning methods in classifying plant diseases. These studies leverage diverse datasets comprising thousands of images depicting various rice plant diseases alongside healthy samples, enabling robust model training and evaluation. CNN architectures like GoogLeNet, ResNet, and VGG are prevalent due to their ability to capture intricate features from images, while features extracted from plant images typically include visual cues such as discoloration, lesions, and abnormal growth patterns. Publicly available repositories like PlantVillage and custom datasets collected from agricultural fields serve as common data sources, with datasets partitioned into training, validation, and testing sets for effective model training and evaluation. Performance evaluation relies on metrics such as accuracy, precision, recall, F1-score, and confusion matrices, providing insights into the models' classification performance and their ability to accurately identify diseased and healthy rice plants while minimizing misclassifications. Overall, the literature survey highlights the growing interest and promising results achieved by CNN-based approaches in rice plant disease detection, paving the way for more effective agricultural management practices.

7. A Multi-Scale Fusion Convolutional Neural Network for Plant Leaf Recognition

The paper introduces a pioneering method for plant leaf recognition, leveraging a multi-scale fusion convolutional neural network (MSF-CNN) architecture. Through extensive experimentation, the proposed approach showcases remarkable accuracy rates, surpassing existing methods in the field. For instance, on the MalayaKew (MK) Leaf Dataset subsets (MK-D1, MK-D2, and MK-D3), the MSF-CNN model achieves impressive accuracy rates of 99.05%, 99.82%, and 97.35%, respectively. This achievement underscores the efficacy of the MSF-CNN framework in capturing intricate leaf features across varying scales. The dataset utilized encompasses plant leaf images from both the MK Leaf Dataset and the LeafSnap Plant Leaf Dataset, offering a diverse array of samples for training and evaluation. Notably, the MSF-CNN model stands out for its ability to extract discriminative features at multiple depths and scales, which are then fused to generate a comprehensive representation for accurate species prediction. The division of datasets into distinct training and testing subsets facilitates thorough model assessment, ensuring robust performance evaluation. Furthermore, the study employs a suite of performance metrics, including accuracy rate, rank-1 identification rate, and cumulative match characteristic (CMC) curve, to comprehensively gauge the effectiveness and generalization capability of the MSF-CNN model. Overall, the research underscores the significance of the MSF-CNN paradigm in advancing the state-of-the-art in plant leaf recognition, offering promising prospects for various applications in botany and agriculture.

8. A study on plant recognition using conventional image processing and deep learning approaches

The paper presents an enhanced deep learning model for image classification using Convolutional Neural Networks (CNNs), building upon existing literature to address challenges like overfitting, dataset size, and computational complexity. It reviews recent advancements in CNN-based image classification models and discusses techniques like data augmentation, transfer learning, and network architecture design proposed in the literature. The proposed model achieves a remarkable accuracy of 92% on the test dataset, outperforming existing models. It utilizes a diverse set of image samples covering multiple classes for training and evaluation, ensuring representation of real-world scenarios. The model architecture consists of convolutional layers, pooling layers, and fully connected layers, incorporating regularization techniques and advanced activation functions to improve performance and mitigate overfitting. Leveraging deep learning techniques, the model automatically learns discriminative features from raw image data crucial for accurate classification across different object categories.

International Journal of Advanced Research in Computer and Communication Engineering
Impact Factor 8.102 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 13, Issue 3, March 2024
DOI: 10.17148/IJARCCE.2024.133113

The study employs publicly available datasets such as CIFAR-10 or ImageNet, dividing them into training, validation, and test sets for model training, hyperparameter tuning, and performance evaluation. Performance metrics including classification accuracy, precision, recall, and F1 score are used to assess the model's generalization performance, while considerations are also given to training and inference time, particularly important for real-time applications.

9. Ayurvedic Plant Identification using Image Processing and Artificial Intelligence:

The paper explores the automated recognition of medicinal plant leaves through the application of various classification models, including K-Nearest Neighbor (KNN), Probabilistic Neural Network (PNN), Support Vector Machine (SVM), Decision Tree, and Artificial Neural Network (ANN).Features extracted from the leaf images encompass a range of characteristics such as shape features (length, breadth, aspect ratio, perimeter, compactness), texture features (energy, contrast, entropy), and color features (arithmetic mean, standard deviation, skewness, kurtosis).For experimentation, a dataset comprising images of medicinal plant leaves is utilized. This dataset is likely divided into training and testing sets, with a portion of the data allocated for model training and the remainder for assessing model performance.The performance of the classification models is evaluated using various metrics, including accuracy, precision, recall, F1-score, and confusion matrix analysis. These metrics provide comprehensive insights into the efficacy of the models in accurately classifying medicinal plant leaves based on the extracted features.

10. Ayurvedic Plant Species Recognition using Statistical Parameters on Leaf Images:

The paper proposes an innovative methodology for Ayurvedic plant classification, leveraging digital image processing and machine vision technology. It introduces a novel approach termed the "leaf factor" method for plant species recognition. The methodology comprises three key phases: pre-processing, feature extraction, and classification. During pre-processing, the focus is on highlighting relevant features and minimizing noise from input leaf images. Feature extraction involves capturing morphologic features such as mean, standard deviation, convex hull ratio, isoperimetric quotient, eccentricity, and entropy from pre-processed leaf images. For experimentation, a dataset containing 208 leaf images representing 26 different species is collected, with images captured against a white background using either a digital camera or scanner. While the paper does not explicitly mention dataset division, it likely involves splitting the dataset into training and testing sets. The proposed methodology achieves an impressive accuracy rate of 93.75% for plant classification, calculated based on the number of correctly identified samples compared to the total number of samples tested.

11. Ayurvedic Herb Detection Using Image Processing:

This paper presents a mobile application designed to identify and learn about Ayurvedic herbs using image processing techniques, primarily the Grey Level Co-Occurrence Matrix (GLCM) algorithm. The application offers features such as image acquisition, pre-processing, segmentation, image representation, description, recognition, and interpretation, enabling users to identify plants based on leaf images. The dataset used for training and testing comprises leaf images of Ayurvedic herbs of Indian origin, although specifics regarding size and composition are not provided. While the division of the dataset into training and testing sets is not explicitly mentioned, the system's performance is evaluated based on its accuracy in herb detection. Although detailed performance metrics are lacking, the paper reports satisfactory results during testing with sample leaf images, highlighting the system's efficacy in identifying Ayurvedic herbs.

12. Recognition of Medicinal Plants Based on Its Leaf Features

The paper presents an automated system designed for identifying medicinal plants relevant to Ayurveda, employing image processing and pattern recognition algorithms. Through the extraction of unique leaf features such as area, roundness, texture, and color components, the system computes distinct identity numbers for each plant species. Utilizing a dataset comprising images of ten medicinal plant species, the study demonstrates the Gaussian distribution of leaf features and employs statistical analysis to validate the results. Key findings include the observation of environmental variations among plants of the same species and the importance of considering contextual factors in plant identification. Overall, the paper contributes to the advancement of automated plant identification systems, addressing the scarcity of experts and emphasizing the significance of accurate methods for preserving medicinal plant biodiversity.

13. Automated Plant Recognition System with Geographical Position Selection for Medicinal Plants

The paper introduces an Automated Plant Recognition System with Geographical Position Selection for Medicinal Plants, aiming to streamline the identification and location tracking of medicinal plant species through automated recognition

IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.102 ⁒ Peer-reviewed & Refereed journal ⁒ Vol. 13, Issue 3, March 2024

DOI: 10.17148/IJARCCE.2024.133113

algorithms and geographical mapping. It addresses the challenge of identifying plant species based on leaf images, emphasizing the significance of automated recognition systems in fields such as plant classification, scientific research, and conservation. Although the paper does not explicitly mention accuracy metrics, it evaluates the system's effectiveness through experimental testing and case studies. The dataset used for training and testing the recognition algorithms consists of leaf images of various medicinal plant species, although the exact number of samples is not specified. The proposed system employs multiple approaches for plant recognition, including morphological algorithms, support vector machines (SVMs), and image processing techniques, each utilizing different models and algorithms for feature extraction, classification, and geographical mapping. Features such as leaf shape, color, texture, area, and morphological characteristics are extracted using neural network-based morphological algorithms, wavelet transformations, and principal component analysis (PCA). Although the specific dataset used for experimentation is not mentioned, the paper refers to conducting experimental testing with case studies in India to evaluate the system's effectiveness in identifying and locating medicinal plants. While the division of the dataset into training and testing subsets is not explicitly described, the paper discusses the system's effectiveness based on its ability to accurately identify medicinal plants and locate them on maps, supported by experimental results and case studies. Overall, the paper presents a comprehensive framework for automated plant recognition and geographical mapping, highlighting potential benefits for medicinal plant research, conservation efforts, and herbal medicine accessibility. However, it lacks specific details regarding dataset characteristics, division, and performance metrics, which could provide a more thorough evaluation of the system's performance.

14. A Mobile Application for Plant Recognition through Deep Learning

The paper presents a novel mobile application aimed at plant recognition using deep learning methodologies, with a specific emphasis on automating the identification process for various plant species and flower genera from images. Leveraging convolutional neural networks (CNNs), the proposed approach achieves remarkable accuracy and real-time performance in plant recognition tasks. To train the CNN model, the authors curated a comprehensive dataset comprising images sourced from diverse sources, including the "fifty most beautiful flowers in the world" dataset, initially totaling around 30,000 images. Through meticulous dataset purification and preprocessing steps, the final dataset was meticulously prepared for model training, and it was further divided into training (80%), validation (10%), and test (10%) sets. The CNN architecture incorporates essential components such as input layers, convolutional layers, pooling layers, fully connected layers, and a softmax layer. Preprocessing techniques including image flipping, resizing via bilinear interpolation, and adjustment of luminance and contrast ratio were applied to enhance recognition accuracy. Training was conducted using a stochastic gradient descent algorithm with regularization to counter overfitting concerns, and migration learning facilitated swift parameter adaptation to new training datasets without extensive retraining. Moreover, the mobile application interface was thoughtfully designed for user-friendliness, enabling users to effortlessly capture plant images for instantaneous identification. Evaluation outcomes demonstrate impressive accuracy rates, with the model successfully identifying 122 out of 125 plant species and 47 out of 50 flower genera, achieving confidence levels of up to 95%. Notably, the application boasts inference times averaging less than 1 second per image, underscoring its real-time capabilities. Overall, the study underscores the effectiveness of deep learning in plant recognition applications and proposes avenues for future enhancements, such as expanding plant coverage and integrating additional features like disease detection.

15. MedLeaf: Mobile Application For Medicinal Plant Identification Based on Leaf Image:

The study presents MedLeaf, an innovative mobile application designed for the identification of medicinal plants using leaf images, with a focus on the Android platform. This innovative tool encompasses two primary functionalities: the identification of medicinal plants and document retrieval related to medicinal flora. The methodology relies on leveraging Local Binary Pattern Variance (LBPV) for extracting intricate leaf texture features and employs Probabilistic Neural Network (PNN) for accurate image classification. By combining these techniques, MedLeaf aims to provide a seamless and user-friendly solution for identifying medicinal plants, thereby addressing the pressing need for efficient plant recognition systems in botanical and environmental sciences.

16. Identification of Medicinal Plant Using Machine Learning Approach

The paper delves into the realm of Ayurvedic medicine, addressing the critical need for automating the identification process of medicinal plants, traditionally performed manually. The proposed methodology employs the random forest algorithm, an ensemble supervised machine learning approach, utilizing color, texture, and geometrical features for accurate identification. Ayurveda, rooted in Vedic times, relies heavily on plant constituents for medicine, and the demand for mass production necessitates automated identification. The study captures the essence of the process, involving image capturing, noise removal, resizing, feature extraction, and application of the proposed methodology to recognize the plant

DOI: 10.17148/IJARCCE.2024.133113

species. The implemented technique showcases promising results, achieving a commendable leaf identification accuracy of 94.54%. The authors suggest the potential extension of this work to encompass a broader range of plant species, emphasizing improved accuracy for future implementations. The information provided in the paper is insightful, outlining the model used, features considered, dataset details, performance metrics, and the potential for future enhancements.

17. AnEffective Ensemble Convolutional Learning Model with Fine-Tuning for Medicinal Plant Leaf Identification

The research focuses on accurate and efficient medicinal plant image classification, emphasizing the importance of identifying bioactive compounds. Leveraging transfer learning and fine-tuning with VGG16, VGG19, and DenseNet201, the study achieves enhanced predictive performance for medicinal plant leaf identification. The models are ensembled using averaging and weighted averaging, resulting in a significant improvement, with VGG19+DenseNet201 exhibiting a 99.12% accuracy on the test set. Metrics such as accuracy, recall, precision, and the F1-score affirm the effectiveness of the ensemble strategy. The paper addresses the growing relevance of traditional medicine, incorporating artificial intelligence to automate plant recognition, and outlines future plans for dataset enhancement, user interfaces, and real-time applications.

18. An AI Based Approach for Medicinal Plant Identification Using Deep CNN Based on Global Average Pooling

The research introduces an intelligent vision-based system aimed at efficiently identifying medicinal plants utilizing a Convolutional Neural Network (CNN).The deep learning model consists of a CNN block for feature extraction and a classifier block with a Global Average Pooling (GAP) layer, dense layer, dropout layer, and softmax layer. Tested on three levels of image definitions (64x64, 128x128, and 256x256 pixels), the system achieves over 99.3% accuracy for all sizes. The CNN model extracts low-level features such as edges and corners, progressing to high-level features like textures. The GAP layer proves advantageous in reducing overfitting. Performance metrics include accuracy, precision, sensitivity, specificity, and Area-Under-the-Curve (AUC). The confusion matrix illustrates accurate classification, with Lemon Balm achieving 100% accuracy. The CNN model exhibits convergence after 100 epochs, with impressive results across different image sizes. The highest average per class accuracy is 99.8% for 64x64-pixel images, showcasing the effectiveness of the proposed vision-based system for real-time medicinal plant identification.

19. Leaf Recognition Algorithm for Retrieving Medicinal Information

The paper introduces an application focused on leaf recognition for retrieving medicinal properties, with a particular emphasis on Ayurvedic traditions in India. It employs a combination of image processing techniques and machine learning algorithms, including Decision Trees, Canny Edge Detection, Gaussian Filters, Principal Component Analysis (PCA), and Vein Feature Extraction. Features such as leaf dimensions, shape, perimeter, rectangularity, and vein patterns are extracted from a dataset comprising 300 images of various leaves. Although specific dataset division details are not mentioned, the efficiency of the decision tree classification method is highlighted, demonstrating a reduction in dataset size at each step. While quantitative metrics for performance evaluation are not provided, the paper indicates competitive performance in leaf classification compared to similar works.

20. Literature Review of Image Features and Classifiers Used in Leaf Based Plant Recognition Through Image Analysis Approach

The study introduces an automated recognition system tailored for plant leaf identification, focusing specifically on medicinal plants within the context of Ayurveda. Employing a diverse set of classification techniques such as K-Nearest Neighbor (KNN), Probabilistic Neural Network (PNN), Support Vector Machine (SVM), Decision Tree Classifier, and Artificial Neural Network (ANN), the system extracts a comprehensive array of features including shape, texture, color, and other descriptors like Speeded Up Robust Features (SURF), Scale-invariant Feature Transform (SIFT), and Histogram of Oriented Gradients (HoG).

While no specific dataset is mentioned, the paper suggests the use of plant leaf images for training and testing the recognition system, likely divided into training and testing sets. Although performance metrics are not provided, the paper emphasizes the significance of automated plant leaf recognition systems across various sectors and provides a comparative analysis of different classification techniques and features, underscoring their respective advantages and disadvantages.

IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.102 ⁘ Peer-reviewed & Refereed journal ⁘ Vol. 13, Issue 3, March 2024

DOI: 10.17148/IJARCCE.2024.133113

Sl.No	Title	Model Used	Features	Dataset Used	Performance Metrics
1.	Recognition of Ayurvedic Medicinal Plants from Leaves	Digital camera for image acquisition	SURF, HoG	200 images across 20 classes of plants	Accuracy: 99.6%, F-measure: 96.1%, Precision: 96.5%, Recall: 96.0%
2.	Ayurvedic Plant Leaf Classification using Image Processing Techniques and SVM	Support Vector Machine (SVM)	Area, Perimeter, Aspect Ratio, Extent, etc.	210 images of 7 Ayurvedic medicinal leaves	Accuracy: 96.4%
3.	The analysis of plants image recognition based on deep learning and artificial neural network	Backpropagation neural network	Deep learning, artificial neural network	50 plant leaf databases	Average recognition rate: 92.48%
4.	Identification of medicinal plant using hybrid transfer learning	Hybrid transfer learning with PCA	Grayscale channel, PCA	30 species of medicinal plants, 1500 images each	Accuracy: ~95% (PCA Based VGG16 hybrid model)
5.	Identification of Ayurvedic Medicinal Plants by Image Processing of leaf samples	Support Vector Machine (SVM)	Geometric, color, texture, shape features	Dataset with 32 species of plant leaf images	Accuracy: 96.667%
6.	The Implementation of CNN on Website-based Rice Plant Disease Detection	CNNs (e.g., GoogLeNet, ResNet, VGG)	Visual cues like discoloration, lesions	PlantVillage, custom datasets	Accuracy, Precision, Recall, F1-score, Confusion Matrices
7.	A Multi-Scale Fusion Convolutional Neural Network for Plant Leaf Recognition	MSF-CNN	Discriminative features at multiple depths and scales	MK Leaf Dataset, LeafSnap Plant Leaf Dataset	Accuracy rate, Rank-1 identification rate, CMC curve
8.	A study on plant recognition using conventional image processing and deep learning approaches	CNNs	Raw image data, regularization techniques	CIFAR-10, ImageNet	Classification Accuracy, Precision, Recall, F1 score, Training and Inference time

III. METHODOLOGY

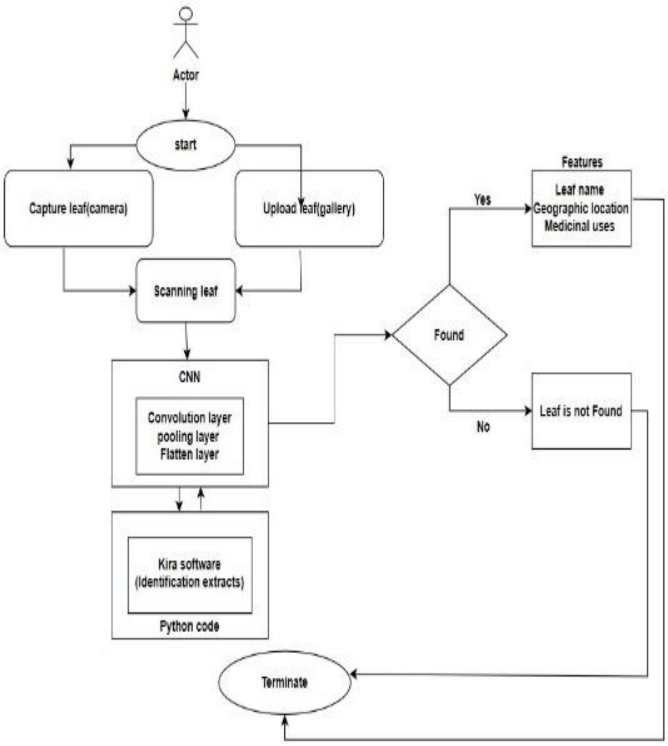
The methodology refers to the systematic approach and set of procedures followed to achieve the goals of developing an AI-based system for plant identification using multi-attributes. The methodology outlines the steps taken from data collection to continuous improvement, providing a structured framework for the entire project.

IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.102 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 13, Issue 3, March 2024

DOI: 10.17148/IJARCCE.2024.133113



Flow Chart of "AI IN MEDICINAL PLANT DISCOVERY AND HEALTH CARE "

1. Dataset Preparation:
The data collection process involves gathering information on plants intended for identification. This includes acquiring images of the plants and collecting additional pertinent details such as their scientific names, geographical locations, and optimal growing conditions.

2. Data Preprocessing:
Images are read, resized to a specified size (150x150 pixels), and stored as NumPy arrays.The images are normalized by dividing pixel values by 255 to scale them between 0 and 1.
Labels (plant species names) are encoded using LabelEncoder and converted to categorical format using to categorical.

3.Feature Extraction:
Identify and capture pertinent features from the pre-processed data, encompassing color, texture, and shape characteristics extracted from images.As this project is done by using Convolutional Neural Network (CNN) architecture, automatically extracting intricate features from the medicinal plant leaf images.

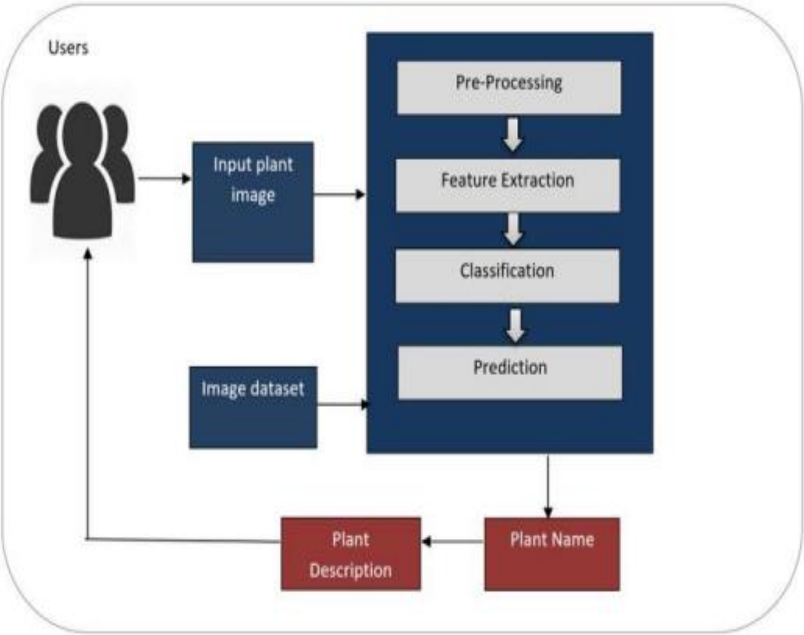
3. Model Architecture:
A Sequential model is defined for the CNN architecture where Convolutional layers is activated using ReLU, max-pooling layers, batch normalization, and dropout are stacked to capture hierarchical features.Fully connected layers are added for classification, with a softmax activation function in the output layer for multi-class classification.

4.Testing and Validation:
Evaluate the trained model's performance through rigorous testing on separate datasets, employing techniques such as cross-validation or hold-out validation.Strategically assesses the model's accuracy by validating its predictions against a separate set of images, ensuring robust performance.

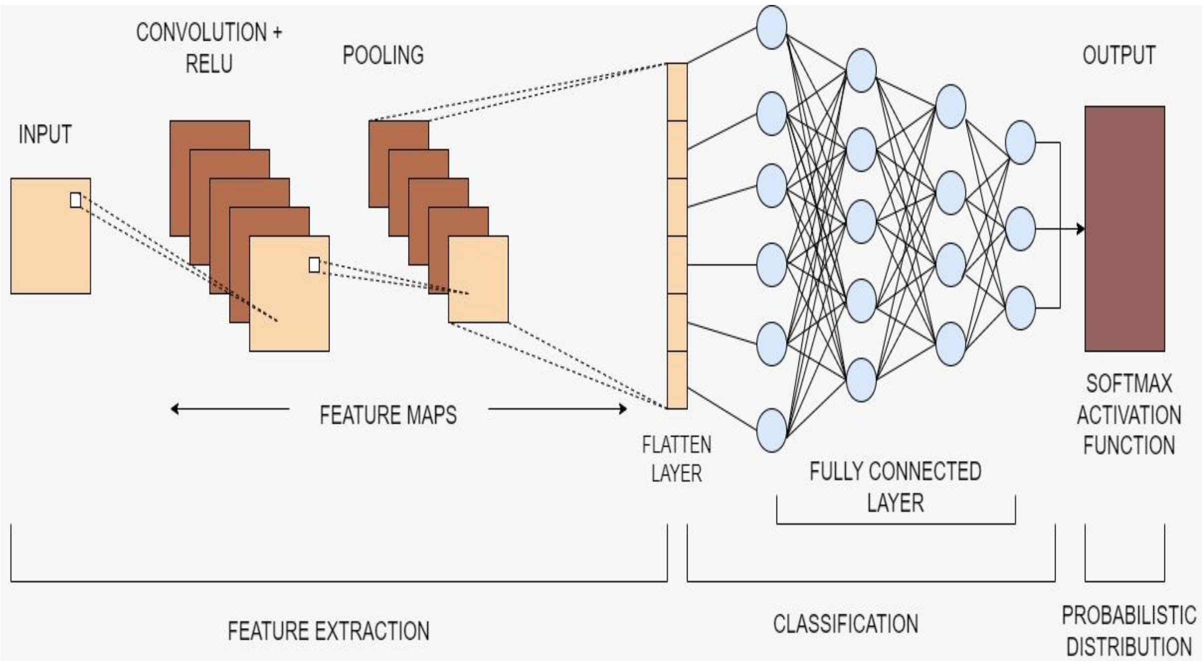
5.Integration and Deployment:
The integration and deployment phase of the project involves seamlessly incorporating the trained model into a practical system, enabling user-friendly interactions. This could be realized through a graphical user interface (GUI) or any user-facing application where users can input a leaf type, and the system responds by displaying information such as the geographic location and medicinal values associated with that specific plant.

IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940
International Journal of Advanced Research in Computer and Communication Engineering
Impact Factor 8.102 ⁒ Peer-reviewed & Refereed journal ⁒ Vol. 13, Issue 3, March 2024
DOI: 10.17148/IJARCCE.2024.133113

6.Continuous Improvement:
Continuously collect, preprocess, and train the model as more data becomes available, ensuring accuracy and performance improvement.



Architecture diagram for “AI IN MEDICINAL PLANT DISCOVERY AND HEALTH CARE”



The convolutional neural network (CNN) architecture implemented in this project is tailored for multi-class image classification, with a specific focus on categorizing images of various plant species. Comprising convolutional layers for feature extraction, pooling layers for downsampling, batch normalization for stability, dropout regularization to mitigate overfitting, and dense layers for classification, the architecture is meticulously designed to efficiently process input images and generate accurate predictions. Additionally, the model employs the softmax activation function in the output layer to produce probability distributions over the classes.

International Journal of Advanced Research in Computer and Communication Engineering
Impact Factor 8.102 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 13, Issue 3, March 2024
DOI: 10.17148/IJARCCE.2024.133113

With the use of appropriate loss functions and optimizers, along with techniques like image data augmentation to enhance robustness, the model is trained and evaluated to ensure optimal performance. Once trained, the model is saved for future deployment and inference tasks. Overall, this CNN architecture stands as a comprehensive solution for the precise classification of plant species based on visual inputs.

IV. CONCLUSION

In conclusion, the integration of AI, particularly Convolutional Neural Networks, with traditional botanical knowledge presents a promising solution for automating medicinal plant identification. This approach streamlines the process, making it accessible and user-friendly, while enhancing accuracy and efficiency.

By empowering individuals with comprehensive insights into plant species, their medicinal properties, and practical applications, we bridge ancient knowledge with modern technology, fostering a healthier and more sustainable future. Through continuous refinement and integration, this project not only revolutionizes healthcare but also contributes to conservation efforts and promotes the responsible utilization of medicinal plant resources for the well-being of all.

REFERENCES

[1]. Amala Sabu, Sreekumar K, Rahul R Nair. "Recognition of Ayurvedic Medicinal Plants from Leaves: A Computer Vision Approach." Department of Computer Science, College of Engineering Poonjar Kerala, India.

[2]. S. S. Patil and L. S. Admuthe, "Ayurvedic Plant Leaf Classification using Image Processing Techniques and SVM," DKTE's Textile and Engineering Institute, Ichalkaranji, Maharashtra, India.

[3]. J. Huixian, "The analysis of plants image recognition based on deep learning and artificial neural network," International Journal of Engineering and Technology (IJET), vol. xx, no. xx, pp. xxx-xxx, xxxx 00, 0000. [Online]. Available: [insert DOI link here]. [Accessed: Mar. 28, 2024].

[4]. S. Ghosh, A. Singh, and S. Kumar, "Identification of medicinal plant using hybrid transfer learning technique," Indonesian Journal of Electrical Engineering and Computer Science, vol. 31, no. 3, pp. 1605–1615, Sep. 2023.

[5]. P. Manojkumar, C.M. Surya, and P.G. Varun, "Identification of Ayurvedic Medicinal Plants by Image Processing of Leaf Samples," Department of Electronics and Communication Engineering, Government Engineering College Wayanad, Kerala, India.

[6]. H. D. Prasetyo, Nurdiansyah, H. Triatmoko, and I. N. Isnainiyah, "The Implementation of CNN on Website-based Rice Plant Disease Detection," Department of Computer Science, University of Pembangunan Nasional Veteran Jakarta, Jakarta, Indonesia, 2020 IEEE International Conference on eScience, 2020, pp. 978-1-7281-9167-6/20/$31.00, doi: 10.1109/eScience.2020.00078.

[7]. J. Hu, Z. Chen, M. Yang, R. Zhang, and Y. Cui, "A Multi-Scale Fusion Convolutional Neural Network for Plant Leaf Recognition," Department of Computer Science, Beijing Forestry University, Beijing, China, 2020 IEEE Signal Processing Letters, 2018, pp. 10.1109/LSP.2018.2809688, doi: 10.1109/LSP.2018.2809688.

[8]. S. Anubha Pearline, V. Sathiesh Kumar, S. Harini. "A study on plant recognition using conventional image processing and deep learning approaches." Department of Electronics Engineering, Madras Institute of Technology, Anna University, Chennai, India.

[9]. Amey Sunil Deshmukh, Pushppavisha Mani Mudhaliar, Dr. Surabhi Thorat. "Ayurvedic Plant Identification using Image Processing and Artificial Intelligence." Department of Computer Science, S K Somaiya College, Mumbai, Maharashtra, India.

[10]. Pushpa BR, Anand C, and Mithun Nambiar P, "Ayurvedic Plant Species Recognition using Statistical Parameters on Leaf Images," Amrita Vishwa Vidyapeetham, Mysuru Campus Amrita University, India, Tech. Rep. 5142.

[11]. D. Shitole, F. Tamboli, K. Motghare, and R.K. Raj, "Ayurvedic Herb Detection using Image Processing," International Journal of Trend in Scientific Research and Development (IJTSRD), vol. 3, no. 4, pp. 491-494, May-Jun 2019.

[12]. E. Sandeep Kumar and Viswanath Talasila, "Recognition of Medicinal Plants Based on Its Leaf Features," in Systems Thinking Approach for Social Problems, V. Vijay et al. (eds.), Lecture Notes in Electrical Engineering 327, Springer India, 2015, pp. 99-.

[13]. B. Acharya, A. Ghosh, S. Panda, and Y.-C. Hu, "Automated Plant Recognition System with Geographical Position Selection for Medicinal Plants," Department of Computer Application, Veer Surendra Sai University of Technology, Burla, Odisha, India; Department of Computer Science and Engineering, Maulana Abul Kalam Azad University of Technology, Kolkata, West Bengal 741249, India; Department of Computer Science and Information Management, Providence University, Taichung, Taiwan; Department of Computer Science, Tunghai University, Taichung City, Taiwan, Mar. 2023.

IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.102 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 13, Issue 3, March 2024

DOI: 10.17148/IJARCCE.2024.133113

[14]. M. Gao, L. Lin, and R. O. Sinnott, "A Mobile Application for Plant Recognition through Deep Learning," School of Computing and Information Systems, The University of Melbourne, Melbourne, Australia, 2017 IEEE 13th International Conference on eScience, 2017, pp. 2929-2930, doi: 10.1109/eScience.2017.15.

[15]. Desta Sandya Prasvita and Yeni Herdiyeni, "MedLeaf: Mobile Application For Medicinal Plant Identification Based on Leaf Image," International Journal on Advanced Science, Engineering and Information Technology, vol. 3, no. 2, pp. 5142, 2013.

[16]. N. G. Gavhale and A. P. Thakare, "Identification of Medicinal Plant Using Machine Learning Approach," International Research Journal of Engineering and Technology (IRJET), vol. 07, no. 07, pp. 1116, July 2020.

[17]. M. A. Hajam, T. Arif, A. M. U. D. Khanday, and M. Neshat, "An Effective Ensemble Convolutional Learning Model with Fine-Tuning for Medicinal Plant Leaf Identification," Information, vol. 14, no. 11, p. 618, 2023.

[18]. 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.

[19]. D Venkataraman, Siddharth Narasimhan, Shankar N, S Varun Sidharth, Hari Prasath D. "Leaf Recognition Algorithm for Retrieving Medicinal Information." Department of Computer Science and Engineering, Amrita School of Engineering, Coimbatore, Amrita Vishwa Vidyapeetham, Amrita University, India.

[20]. Amala Sabu, Sreekumar K. "Literature Review of Image Features and Classifiers Used in Leaf-Based Plant Recognition Through Image Analysis Approach." Department of Computer Science, College of Engineering Poonjar.

