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Utilizing Deep Learning for the Identification and Suitability of Medicinal Plants in Disease Treatment

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Abstract:

Introduction: The production of medications in the Ayurvedic, folk, and herbal medicine sectors depends on the precise identification of medicinal plants. Every plant species has special qualities that add to its healing benefits. Characteristics that help identify therapeutic plants include One of the main ways to identify a species is by its leaf shape, which can differ greatly between species. Broad, narrow, lobed, and compound leaf shapes and their arranged on the stem offers important identifying cues. The health and species type of the leaves can be determined by their color on both the upper and bottom surfaces. Species, maturity, and environmental factors can all influence color variations.

Objectives: Analyse feature vectors from both the upper and lower surfaces of a green leaf, alongside various morphological characteristics, to determine the optimal combination of features that enhances the identification accuracy and the usability.

Methods: In this study, The initial stage, known as image acquisition, is taking pictures of plant leaves, typically using a camera or a pre-defined data set. The analysis will make use of the Leaf Image Dataset. To train the model, this dataset contains pictures of both healthy and sick leaves. Pre-processing is used to standardize the format, improve image quality, and eliminate noise. Training and testing are the two sections of the dataset. To automatically extract significant information from the photos, CNN (Convolutional Neural Network) is used. It is very good in image analysis. Metrics like accuracy, precision, recall, and F1-score are checked to evaluate performance. Lastly, the health statuses of the plant and suitable cures or treatments for the illness are recommended.

Results: By employing this technique, the system displays an image of a plant leaf together with its scientific name, local name, qualities, and the ailment it treats, as well as whether the leaf is a member of the medicinal plant or not. Because of its many compelling benefits, such as strengthening feature propagation and promoting feature reuse, which boost efficiency and reduce valuation loss, the Dense Net type of Convolutional Neural Network (CNN).the model is trained using Keras.

Conclusions: The recommended method identifying herbs particularly for those who are unable to use pricey analytical equipment. This study examines various plant identification techniques and weighs the benefits and drawbacks of each.

Keywords: *CNN, Plant Identification*

1. Introduction

There are thousands of plant species in the globe, many of which are useful for medicine, some of which are in danger of going extinct, and some of which are dangerous to humans. Plants are the foundation of all food chains in addition to being a vital resource for humans. The production of herbal, ayurvedic, and traditional medicines primarily uses medicinal plants. Herbal plants are plants that can be utilized as natural alternatives to treat llnesses. Approximately 80% of people worldwide still rely on conventional medicine. Herbal plants, on the other hand, are plants that contain characteristics in their leaves, stems, or roots. They can be utilized as basic materials to create both traditional and modern medications.

The forest is frequently home to these therapeutic plants. There are several ways to identify different kinds of herbal plants, and one method is to use the leaves to identify the plant. It is essential to properly analyze and categorize plants in order to preserve plant species. Herbal remedies from various Indian systems use combinations of a tiny subset of these plants, totaling 1500. In particular, 500 of these species are used in commercial Ayurvedic remedies. While the remaining plants are grown on agricultural land, more than 80% of the plants utilized in ayurveda formulations are gathered from wastelands and forests. It has been discovered that over 8000 plants with Indian origins have therapeutic properties.

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Traditionally, Ayurvedic doctors would personally select the therapeutic herbs and make the medications for their patients.

Few practitioners still adhere to this technique now. With an annual revenue of over Rs. 4000 crores, the production and distribution of

Ayurvedic medications has grown into a booming sector. Over 8,500 licensed producers of Ayurvedic medicines may be found in India. The commercialization of the Ayurvedic industry has raised concerns about the quality of the raw ingredients used to make Ayurvedic medications. Today, women and children who are not professionally trained in selecting the correct therapeutic herbs gather the plants from wild areas.

2. Objectives

This study suggests an effective way to categorize ayurvedic botanicals [2]. We think that our solution will bridge the knowledge gap between the general public and Ayurvedic practitioners. Our study's primary goals are to: • Identify the medicinal plant using an image

• To outline the characteristics of therapeutic plants

• To determine the cures for illnesses

• To determine the accuracy of various algorithms used on the dataset.

3. Review Literature

This article (Ajra, H. et al. 2020) proposes a leaf classifier based on optimization approach (LCOT) to classify different Hibiscus plant species using a variety of leaf features. The article explains the image processing algorithms used to recognize leaf features.The study's goal was to find out if automatic recognition might be used to accurately identify medicinal plants (G. Mukherjee et al., 2021). A new database of medicinal herbs is presented in this study, which contains pictures of ten categories of medicinal and one category of non-medicinal species. Then, using the MobileNetV3 architecture, a model for the economical, dependable, and efficient classification of medicinal plants was proposed. The study (Malik OA, et al. 2022) suggests a technique for the automated, real-time identification of plant species, particularly for Borneo-native medicinal herbs. To overcome the recognition difficulty, an enhanced Efficient-Net-B1 model was trained and evaluated on both publicly available and privately owned plant species datasets. The suggested model outperformed the traditional model on test data by more than 10% in both datasets.

4. Methods

A novel technique for identifying medicinal plants using photos of the leaves taken from various perspectives has been put forth. A collection of pictures of medicinal plant leaves served as the basis for the project. To increase the recognition rate of green leaves, several morphological feature combinations of texture and shape have been found. By employing this technique, the system displays an image of a plant leaf together with its scientific name, local name, qualities, and the ailment it treats, as well as whether the leaf is a member of the medicinal plant or not.

Data Collection

The Indian Medicinal Plant Datasets collection contains preconfigured photos of medicinal plants, which we used for this. These photos are kept in a free-flowing environment with various backgrounds. The 80 directory of leaves from medicinal plants are included in this dataset. There are perhaps 100 or more files with photographs of leaves taken from various perspectives in each directory. Research uses a dataset of about 10,000 photos of all leaves.From the dataset, at least 70 leaves from 80 distinct medicinal plants were extracted shown in figure 1.

Fig.1 Sample of **dataset** of leaves

Properties of Plants

Table 1.Local and Botanical name with the uses of medicinal plant

S. No	Local Name	Botanical Name	Uses of medicinal Plant
1	Aloevera	Aloe barbadensis miller	Treat skin injuries (burns, cuts insect bites, and eczemas) and digestive problems.
2	Betel	per betle	Stimulant, an antiseptic, and a breath-freshener
3	Castor	Ricinuscommunis	Constipation, dry eye childbirth, and to empty the colon before a colonoscopy.
4	Ekka	Calotropis	stomach issues, toothaches, cramping, and joint discomfort,
5	Ginger	Zingiberofficinale	inflammatory diseases vomiting, rubella, Atherosclerosis, tuberculosis, and cancer
6	Honge	Hai	treat skin diseases, piles ulcers,diabetes, rheumatism tumors, and wounds.
7	Tecoma	Tecomastans	diabetes, digestive problems control of yeast infections, as powerful diuretic, vermifuge and tonic.

Work flow of proposed model

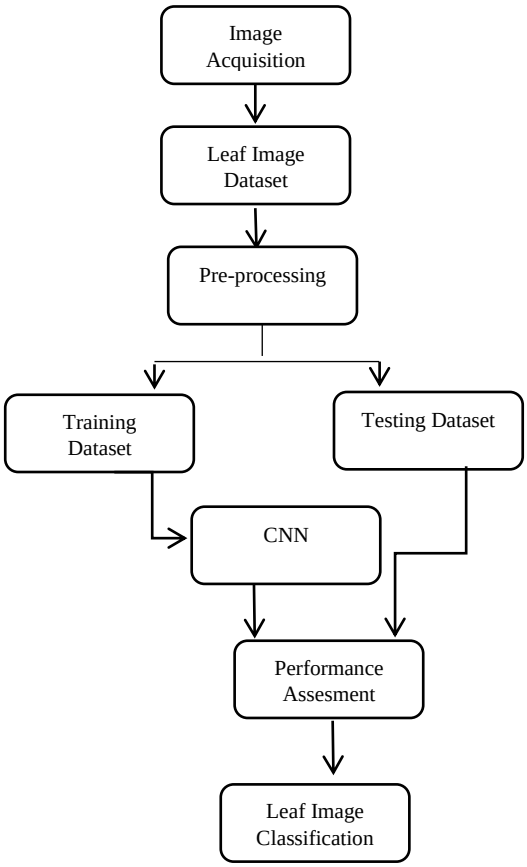


Fig.2 work flow of proposed work

5. Results

Software

The program used is Python 3.9, and Jupyter Notebook is the IDE. The model is trained using Keras. This high-level neural network library uses back propagation and epochs to train the deep learning model. Epochs entail grouping the data into batches and training them through iterations, ensuring that the training process achieves the highest accuracy and the least amount of loss. The CNN type utilized is called DenseNet, and Tensorflow is the library used for DenseNet's numerical computations. It is an open source software library that offers several application interfaces and uses dataflow graphs to carry out computations. Softmax is the output activation function used in the last layer of the CNN, while ReLU is the input activation function used in the first layer.

Training the dataset

The accuracy and loss are computed for each epoch of training the 3657 images in the dataset. The number of times a learning algorithm views the entire dataset is called an epoch. An complete dataset is only transmitted through the neural network once, forward and backward, throughout an epoch. Accuracy is the proportion of accurate predictions to all predictions, whereas loss is the total of the model's errors. Training process through back propagation shown in figure 3.

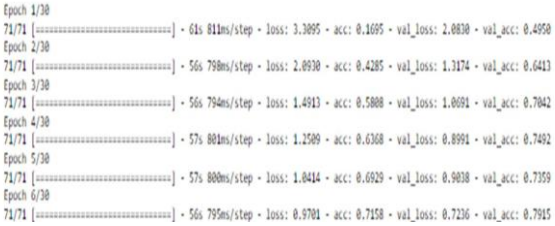


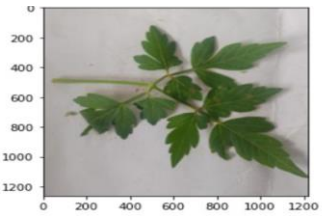
Fig. 3 The process of training by backpropagation

Input and Output

The program is executed after the path containing the image from the test data is provided. Along with the output image, the leaf's scientific and local names are shown, as well as the characteristics of the leaf or the illness it treats.output shown in figure 4 and the result of classification is shown in table 2.

Output

Local name – Balloon vine
Scientific name – Cardiospermumhalicacbum
Uses – treats nervous disorders and stiffness in limbs
Confidence 96.72%



Local name – Bamboo
Scientific name – Cardiospermumhalicacbum
Uses –Fever, Reposetorydisorder,Digestive disorder
Confidence 99.81%

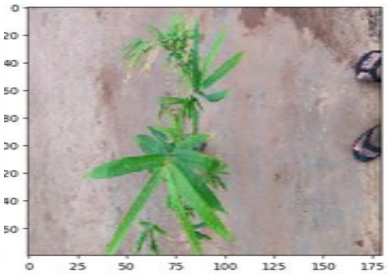


Fig.4 Output of medicinal plan

Table2. Result of classification

Plant name	precision	Recall	F-Score	Support
Aloevera	0.98	0.81	0.95	182
Betel	0.93	0.90	0.91	176
Castor	0.89	0.78	0.88	167
Ekka	0.94	0.92	0.90	173
Ginger	0.95	0.88	0.93	180
Honge	0.89	0.78	0.85	169
Tecoma	0.90	0.84	0.81	179

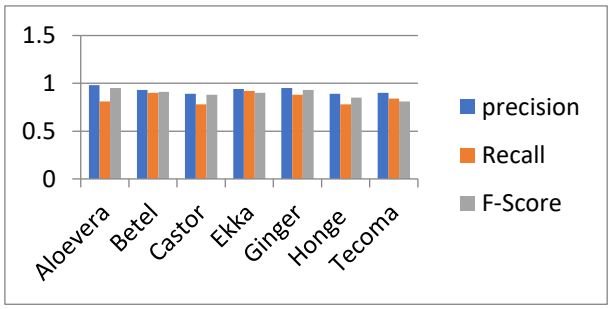


Fig.5 graphical representation of classification

Table 2 shows the classification result where highest score of precision is 0.98 and recall is 0.90 and F-score 0.95. the graphical representation of this result is shown in figure 5.

Graph of Training and Validation Accuracy

Following training, a graph is produced showing the relationship between training accuracy, validation accuracy, and 30 epochs. In this case, training accuracy is represented by the red line and validation accuracy by the blue line. The following formula is used to determine accuracy shown in figure 6.

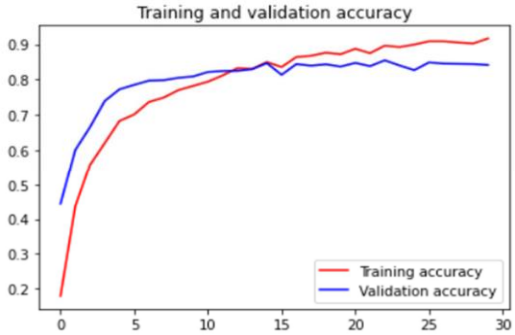


Fig 6.epochvs accuracy graph

Conclusion

Plants are necessary for human survival. Herbs, particularly, are employed by indigenous populations as folk medicines from old period. Herbs are typically recognized by clinicians based on decades of intimate sensory or olfactory experience. Recent improvements in analytical technology have made it much easier to identify herbs depending on scientific evidence. This helps a lot of individuals, particularly those are not used to recognising herbs. additionally for time-consuming methods, laboratory-based analysis necessitates expertise in sample healing and data explanation. As a result, a simple and reliable method for identifying herbs is required. Herbal

identification anticipated to benefit from the combination of computation and statistical examination.

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