IDENTIFICATION OF AYURVEDIC MEDICINAL LEAVES USING DEEP LEARNING

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***Abstract*—Ayurvedic medicine is an ancient kind of medicine. In the last few years, it has regained prominence. Ayurvedic botanicals are used to make medicines used in this therapeutic approach. These plants come in a wide range of types and must be distinguished from many other plant varieties found in nature. It is exceedingly difficult for an ordinary man to identify locally available medicinal herbs without sufficient knowledge. This presentation will present a new technique for recognizing Ayurvedic medicinal plants leaf using convolutional networks (CNN) and photos of leaves.**

Computer vision and the computer technology that supports it has advanced to the point that it may now be employed in a variety of fields. Image classification is one of its uses, which recognizes images more precisely than traditional methods. All the necessary information and steps used throughout the implementation process are described in the paper. All the essential steps like gathering images to create a database, training the models are described in detail. The deep neural network method that we used gives a more accurate classification than other classification methods. The advantage also lies in its simplicity, there is no need of preprocessing the images to extract features and then provide them to the model. A deep convolutional neural network can indeed be fed raw images as input. We don't need to extract visual attributes because neurons extract and store them as images transit through multiple levels in a deep neural network, allowing for accurate leaf classification. As a result, leaves are sorted and displayed via deep learning and a web app. The Deep learning technique that is being used in this paper is a Convolutional neural network.

***Keywords*—Convolutional Neural Networks (CNN), Deep learning, Ayurvedic medicinal plants, Image pre-processing, Rectified Linear Units.**

I. INTRODUCTION

Ayurvedic medicine has its origins in India. Ayurveda is a sort of alternative medicine that follows procedures developed from ancient Ayurvedic traditions. Ayurveda therapies and practices have been adapted into general wellness applications and, in some circumstances, medicinal use in nations other than India.

People's lifestyles nowadays are vastly different from those of the past. There has been a significant increase in the number of illnesses and diseases. As a result, people's reliance on allopathy has skyrocketed. People have begun to turn to homeopathy and Ayurveda after understanding that modern medicines have numerous negative side consequences on health. People have begun to believe in at-home remedies and natural remedies in recent years. To accomplish so, you must first learn how to use appropriate tools. The software we're working on will assist users in recognizing ayurvedic plants and learning about their advantages. This will assist them in adequately utilizing various plants. Plants used for medicinal purposes fall into a spectrum of disciplines. It's really difficult to distinguish between them. As a result, you will find that this technology makes your job easier. According to a survey of the literature, up to 80% of Indians use traditional medicine, which encompasses Ayurveda. According to various sources, Ayurveda is the most widely used kind of medicine, with 75 to 80 percent of the people using it.

Because of advances in the development of computer vision and the computing capability of computer hardware, using deep learning for many applications is getting easier. It can do complex tasks since it is a neural network inspired by the human brain. The human brain inspires neural networks, which are made up of neurons. Each node connected, and one of its outcomes is used as an input for the neurons in the following layer. Neurons have several layers. The three levels of a neural network are the input layer, the hidden layer, and the output layer. Multiple layers can be hidden within a single layer. A simulation is conducted at each neuron layer to glean data from the input. A Neural net with a group of neurons and layers is known as a deep neural network. Deep learning is capable of completing more complicated tasks than traditional neural networks. Deep learning for classification reduces the necessity for visual feature extraction, which was previously required. Deep learning performs some computation on an image and extracts features from it since it is a form of a matrix that contains the RGB value of an image.

II. METHODOLOGY AND IMPLEMENTATION

This section will walk you through the full process of acquiring photos for the dataset and classifying them. The entire procedure is broken down into stages and thoroughly described.

A. Dataset

The dataset is the most crucial aspect of any Deep Neural Network or Object Recognition project. A solid dataset provides a lot of information about the data. Photographs for this project were produced by clicking on photographs of a variety of medicinal plants discovered in the area with patience. Then, using a python script that applied the comparison technique, all redundant photographs in the dataset were eradicated. The name, size, and date of the photographs are used in the script's contrast enhancement.

Following the removal of duplicate photos, the next stage is to categorize photographs in different classes based on their types. Datasets for training, testing, and validation are all created. And each dataset includes all of the distinct forms of medicinal leaves. The training dataset is often used to train the model, the test dataset is used to test the trained model, and the validation dataset is used to ensure that the output is correct. There are three different types of leaves collected: Neem, Tulsi, and Hibiscus.

There are 1600 photos for training, 400 photos for testing, and 300 photos for validation in each of the three-leaf categories.

B. Image processing

Image processing is a term that refers to image operations at the most basic level of analysis, where both the input and output are frequency pictures. Pre-processing is a technique for improving image data by removing unwanted distortions or increasing specific visual aspects that are important for later processing. Reducing low-frequency ambient noise, leveling the magnitude of individual pixel values, picture intensity changes, removing reflections, and masking areas of photos are all examples of preprocessing procedures. Pre-processing techniques that take advantage of the treated pixel's surroundings. Focus on improving the interpretability or comprehension of information in photos for human viewers as well as provide better input for other automated image-processing processes using image enhancement. Image processing includes noise reduction as a crucial aspect. Any high-frequency constituent in an image is referred to be noise.

For noise, reduction and filtering, we employ a Low Pass filter. Image filtering is a technique for minimizing the effects of camera noise, erroneous pixel values, and missing pixel values, among other things. The photos are now ready to be utilized as input for the algorithm after being preprocessed.

C. Neural Network training

Deep learning can be understood in the context of Machine learning. It's a field devoted to computer algorithms that learn and evolve on their own. Machine learning utilizes simpler principles, but deep learning uses artificial neural networks (ANN), which are designed to replicate how humans analyze and learn. Maximum throughput formerly limited the sophistication of neural networks.

Advances in big data analytics have enabled denser, more complicated neural networks, enabling computers to monitor, comprehend, and respond to complex events faster than humans. Image categorization, computer vision, and speech recognition have all benefited from deep learning. It can solve any pattern recognition challenge without the assistance of a human. Feature extraction, which employs an algorithm to automatically create relevant features of data for learning, training, and comprehension, is another part of deep learning.

Convolutional neural networks (or ConvNets) are a form of complex neural network used in deep learning to evaluate visual vision. They've also called space invariant artificial neural networks (SIANN) because of their shared weights architecture, and translation invariance properties. Among the applications are Video and Image recognition, Recommendation systems, Natural language processing(NLP), Image classification, medical diagnosis, and fiscal time series forecasting.

Multilayer perceptrons are CNN versions that have been regularised. Multilayer perceptrons are typically fully connected neural networks, with each neuron of a particular layer coupled with all neurons of the next layer. Because of their "full connectedness," these neurons are susceptible to data overfitting. A frequent way to regularisation is to add some type of magnitude validation of weights to the loss function. CNN tries a different approach to regularisation: they use the hierarchical structure in data to piece together more complicated patterns from smaller, simpler patterns. As a result, CNN's are at the bottom of the connection and complexity scale.

Convolutional layers, Max-Pooling layers, and Fully linked layers are among the CNN architecture's building blocks. A typical design comprises one or more completely linked layers followed by a stack of many convolutional layers and a pooling layer.

- A convolutional layer is an important part of the CNN architecture that extracts features using a combination of linear and non - linear techniques, including convolution and activation functions. In convolutional layers, a parameter sharing strategy is utilized to limit the number of free parameters.
- A layer of neurons known as the non-linear layer performs multiple activation roles. These functions introduce nonlinearities, which are desirable in multi-layer networks. Other very prevalent activation functions are sigmoid, tanh, and ReLU. When contrasted to other features, since neural

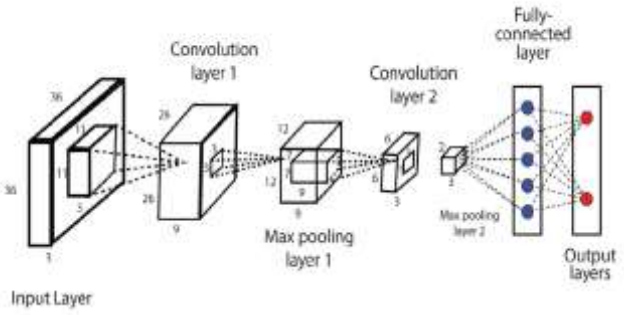

Figure 1[14]: CNNs model

networks train multiple times quicker, Rectified

Linear Units (ReLU) are preferred. Saturating nonlinearities are replaced using Rectified Linear Units (Re LU). This activation function enhances accuracy by learning the parameters of rectifiers overtime at a cheap computing cost.

- A pooling layer reduces the number of learnable parameters by performing a conventional residual block's operation on the feature maps, reducing their in-plane dimensionality, and introducing linearity to minor shifts and distortions. Although like convolution processes, filter size, stride, and padding are hyper-parameters in pooling operations, none of the pooling layers have learnable parameters. Convolutional networks integrate the outcomes of neuron clusters using local or global pooling layers. Overlapping pooling is a good way to cut down on overfitting.

After multiple, convolutional and max-pooling layers, fully connected layers are used to execute elevated reasoning in the neural net. In a conventional (non-convolutional) artificial neural network, neurons in such a fully connected layer are connected to all activations in the preceding stage. As a result, their activations may be estimated using an affine transformation and a bias offset.

When a picture is fetched to the model, the Convolution layer applies a filter to the picture and performs convolution (Sum of the product of filter value, and each pixel value). The depth of the filter is also known as its size. The depth of the filter determines the output size of the convolution layer. Convolution is accomplished by sliding a stride-valued filter over the image. Each layer's neurons store image features, and each layer's neurons store different picture features.

Padding is used to keep edge information intact. After convolution, the picture is passed into the pooling layer, which performs pooling. Layer images flow to the fully linked layer after pooling, where the image matrix is transformed to a 1D array. We don't have to minimize the image's resolution for analysis in CNN because multiple layers and filters do it for us. After you've received the pooled featured map, you'll need to flatten it. The entire pooled feature map matrix is flattened into a single column, which is then supplied to the neural network for processing. The flattened feature map is then put through a neural network after flattening. The input layer, the fully linked layer, and the output layer make up this step. In ANNs, the fully connected layer is identical to the hidden layer, except it is fully connected in this case. The anticipated classes are found in the output layer.

Depth, stride, and zero paddings are hyper-parameters that affect the size of the convolutional layer's output volume.

- ❏ The size of the output layer determines the number of neurons in the layer that relate to a certain area of the input volume. These neurons will all learn how to trigger various input qualities.
- ❏ Stride determines how the filter will are dispersed around the spatial dimensions (width and height) of the image. There are many overlapping receptive fields between the columns, as well as a lot of output, as a result of this. Higher strides, on the other hand, cause the receptive fields to overlap less, resulting in a decreased output volume with reduced spatial dimensions.
- ❏ The act of adding zeros to the dimensions of images in order to preserve information that is at risk of being lost is known as zero paddings.

III. RESULTS AND DISCUSSION

We will present our findings utilizing a variety of machine learning models, including Deep Convolutional networks. The results achieved by training them with only original photographs will not be examined, despite the fact that ConvNet(CNN) is known to gain features when trained on larger datasets. After increasing the parameters of CNN in the 110th training cycle, an accuracy of 96.8% was obtained, compared to 95 percent without optimization. Extremely accurate results were acquired with a relatively low loss after the 25th training iteration, and the balance inaccuracy and loss were carried out with high precision after the 51st iteration. After the model had been trained, it was independently evaluated and verified in each class. The obtained results should be compared to some other outcomes, as advised by good practice standards. No one has used our image database yet, despite the fact that it was created during our research. Therefore we analyzed CNN's outcomes with those of other Machine Learning models, and one of the KNN models' outcomes was 86 percent. As a result of the rigorous testing, deep learning algorithms produced better output in cases like pattern recognition, image classification, and object detection.

In this work, a novel strategy to identifying Ayurvedic medicinal Plant leaf categorization was investigated using deep learning approaches. The ultimate recognition rate is 96 percent, although the result can range from 92 percent to 97 percent based on the results. People in our digital era have access to the internet, but many do not have access to adequate medicine or health care. This CNN (Convolutional neural network) application aims to provide individuals with knowledge about Ayurvedic plants that can be discovered locally so that they can use them more effectively.

A future goal for this project is to launch it as a product, and we've already integrated the CNN model with a web application that allows users to click on a photo of any plant leaf and the app will tell them whether that's an ayurvedic plant or not, as well as provide information on its features and functionality. Continuing this research, the researcher wished to raise awareness about the effects of Ayurvedic plant use and to provide health care using Ayurvedic plants to someone who does not really have access to healthcare.

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