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CNN Based Leaf Disease Identification and Remedy Recommendation System

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ABSTRACT: Agriculture is one field which has a high impact on life and economic status of human beings. Improper management leads to loss in agricultural products. Farmers lack the knowledge of disease and hence they produce less production. Kisan call centers are available but do not offer service 24*7 and sometimes communication too fail. Farmers are unable to explain disease properly on call need to analysis the image of affected area of disease. Though, images and videos of crops provide better view and agro scientists can provide a better solution to resolve the issues related to healthy crop yet it not been informed to farmers. It is required to note that if the productivity of the crop is not healthy, it has high risk of providing good and healthy nutrition. Due to the improvement and development in technology where devices are smart enough to recognize and detect plant diseases. Recognizing illness can prompt faster treatment in order to lessen the negative impacts on harvest. This paper therefore focus upon plant disease detection using image processing approach This work utilizes an open dataset of 5000 pictures of unhealthy and solid plants, where convolution system and semi supervised techniques are used to characterize crop species and detect the sickness status of 4 distinct classes.

KEYWORDS: CNN, leaf disease, Classification, deep learning, remedies.

I. INTRODUCTION

System analysis is the process of separation of the substance into parts for study and implementation and detailed Examination. It must be needed to keep the structured approach, which can be classified into four stages. The first is the investigation and understanding of the current physical system. It is a process of planning a new business system or replacing an existing system by defining its components or modules to satisfy the specific requirements. Before planning, you need to understand the old system thoroughly and determine how computers can best be used in order to operate efficiently. The next stage is to determine how the current system is physically implemented. The third step is the required logical system. Finally the required system can be developed.

Health of human beings depends on the type of food they consume. If the food is unhealthy, it certainly leads to poor nutrition and emergence of several types of health issues. Thus, having good crop productivity depends on healthy plants. Any type of disease in plants yields unhealthy crops. Hence, detection of plant disease forms basic and most important step in yielding good crops.

The aim of this paper is to help the farmers to protect his farm from any kind of pests and disease attacks and eliminate them without disturbing the decorum of the soil and untouched parts of other plants. Mostly in India, farmers use manual monitoring and some apps which have huge database limitations and are only bound to detection part. Since,Prevention is better than cure, this paper aims at detection ofattack of pests/diseases in future thereby making farmer to prevent such attacks.

II. RELATED WORKS

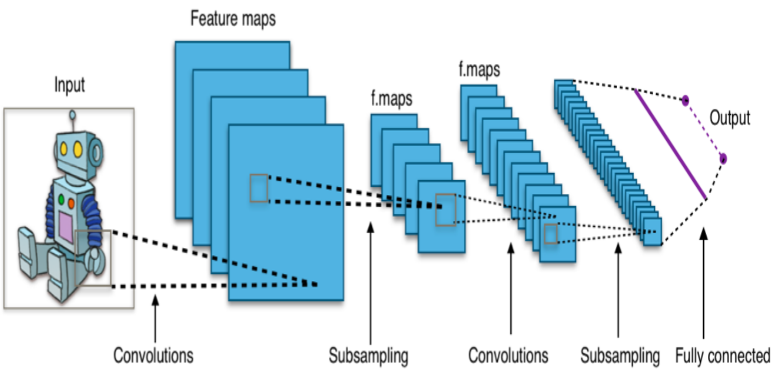
For the purpose of image-based identification which includes, training phase to evaluation phase where the performance of classification algorithms are evaluated, it is necessary to have huge data sets. Hence, the source of data is collected from PlantVillage website. The images thus collated are labeled with four different categories-bacterial spot , yellow leaf curl virus , late blight and healthy(in order to differentiate healthy leaves from affected ones). Subsequently, there is a need to enhance the dataset by adding the images that are augmented. This paper further train the network to learn features that differentiates one class from other. Correspondingly, a database comprising of more than 5000 images are used to train and around 1000 images are further used to validate the same.

Several samples of images are collected from plant village which are spread across in several formats having varying levels of resolutions and hence the variations in quality. Thus, to acquire a reasonable feature extraction, the final images are used as input data for classifier which are then pre-processed to achieve consistency.

III. METHODOLOGY

Convolutional Neural Networks have a different architecture than regular Neural Networks. Regular Neural Networks transform an input by putting it through a series of hidden layers. Every layer is made up of a set of neurons, where each layer is fully connected to all neurons in the layer before. Finally, there is a last fully-connected layer — the output layer — that represent the predictions.

Convolutional Neural Networks are a bit different. First of all, the layers are organised in 3 dimensions: width, height and depth. Further, the neurons in one layer do not connect to all the neurons in the next layer but only to a small region of it. Lastly, the final output will be reduced to a single vector of probability scores, organized along the depth dimension.



Feature Extraction: Convolution:

Convolution in CNN is performed on an input image using a filter or a kernel. To understand filtering and convolution you will have to scan the screen starting from top left to right and moving down a bit after covering the width of the screen and repeating the same process until you are done scanning the whole screen.

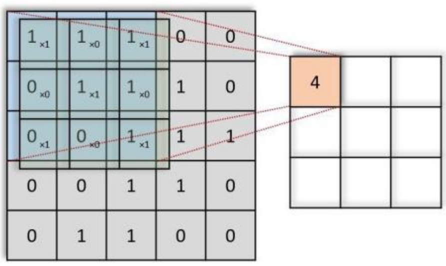
1	1	1	0	0
0	1	1	1	0
0	0	1	1	1
0	0	1	1	0
0	1	1	0	0

Input

1	0	1
0	1	0
1	0	1

Filter / Kernel

The filter (green) slides over the input image (blue) one pixel at a time starting from the top left. The filter multiplies its own values with the overlapping values of the image while sliding over it and adds all of them up to output a single value for each overlap until the entire image is traversed:



Similarly we compute the other values of the output matrix. Note that the top left value, which is 4, in the output matrix depends only on the 9 values (3x3) on the top left of the original image matrix. It does not change even if the rest of the values in the image change. This is the receptive field of this output value or neuron in our CNN. Each value in our output matrix is sensitive to only a particular region in our original image.

IV. SYSTEM ARCHITECTURE

The below block diagrams explains the architecture of the proposed system (Fig 3.1 Architecture Diagram and Fig 3.2 Flow Diagram):

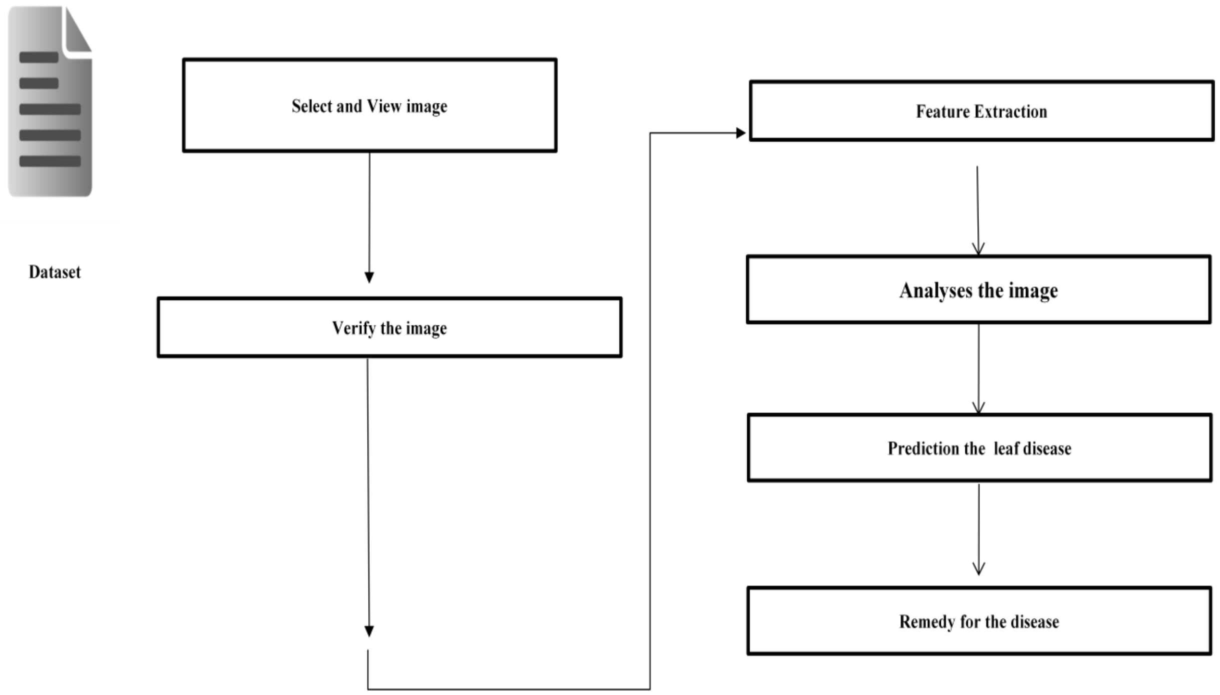


Fig 3.1 system architecture

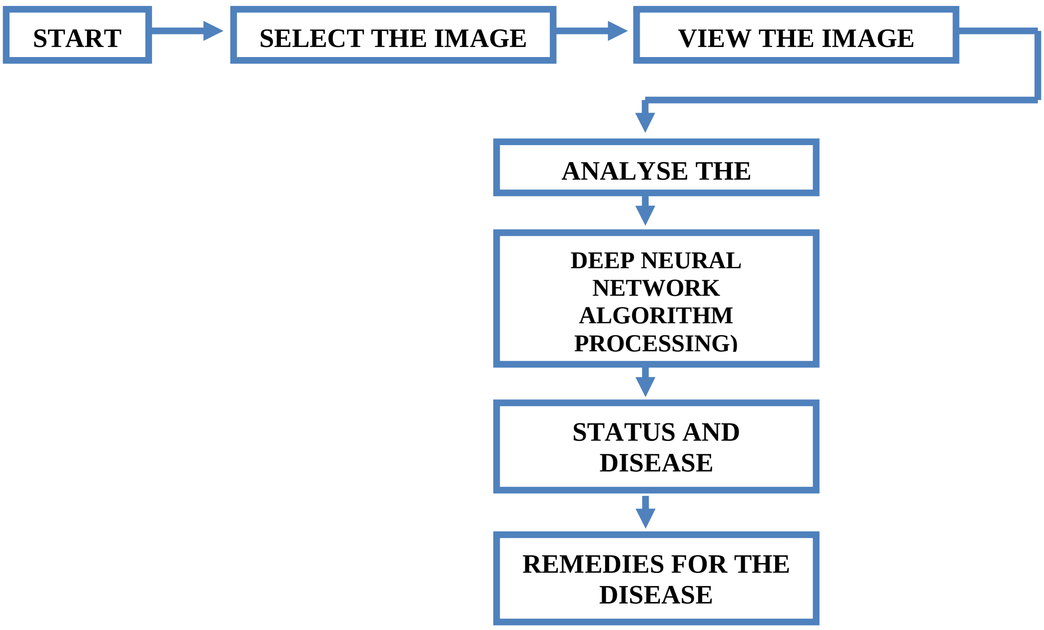


Fig 3.2 Flow Diagram

V. RESULT

The dataset is divided into 70% for the training, 10% for validation and 20% for testing. Different models with different architectures and learning rate are tested. The parameters of the network like the kernel size, filter size, learning parameter were selected by trial and error. Table 1 depicts classification results from different models using different architectures

	Architecture	Validation accuracy	Test accuracy
Grayscale	[3X3, 4X4]	77.60%	78.74%
	[5X5,5X5]	70.20%	70.07%
	[3X3, 4X4]	77.20%	78.67%
	[3X3, 2X2]	77.60%	77.87%
Color	**[3X3,4X4, 1X1]**	**89.30%**	**88.20%**
	[3X3,2X2,2X2]	89.50%	86.90%
	[3X3,4X4,3X3]	89.90%	88.00%
	[3X3,4X4]	88.00%	85.50%
	[3X3,2X2]	87.30%	85.30%
Segmented	[5X5, 3X3]	**87.40%**	**86.00%**
	[3X3,4X4]	87.60%	85.90%
	[3X3,2X2]	87.00%	85.50%

From the result, the classification accuracy from the color images is better than the gray scale and the segmented images. This shows the color feature is important to extract important features for classification

VI. CONCLUSION AND FUTURE WORK

Convolution neural network is used to detect and classify plant diseases. The Network is trained using the images taken in the natural environment and achieved 99.32% classification ability. This shows the ability of CNN to extract important features in the natural environment which is required for plant disease classification.

Image classification, Image Categories, Feature Extraction, and Training Data is carried out. The whole development of algorithm is done in Python tool. Using several toolboxes like Statistics and Machine Learning toolbox, Neural Network Toolbox and Image Processing Toolbox the outputs as of now are the training data in form of image categories, image classification using K-Means clustering and moisture content along with predicting of withstanding.

In future it is proven that we can implement this by the real time cloud like firebase in android. This will result to yield a better performance and results for the convenient of the user. Our application can be further developed as an android and iOS application so that the user can use the application easily wherever they are, using their mobile phones or any of their handhelds and it will be more than a user-friendly application.

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