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Leaf Disease Detection UsingDeep Learning

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Abstract: ***Agriculture is the most important sector among all, as it supplies food to people. As the food demand is increasing in our daily life and the population is increasing there is need of increasingin the food production also. The main issue nowadays is that diseases that are causing the food production to reduce. So our main aim is identification of the disease of the plants in early stage so that we can do the early diagnosis and protect crops from the harmful diseases. By doing this we can avoid the damage of crops and also can reduce the loses that farmers suffer from damage of crops. Here we are using image processing technique to identify the disease of the crops so that we can cure the diseases of the crops in early stage.***
Here we are using Deep learning algorithms like Convolutional neural networks (CNN) for our project that is leaf disease detection. CNN is the best algorithm for image processing as it greatly increases the performance of our model. Nowadays deep learning is the current trend as it solves the most complicated problems easily and can get the highest accuracy.
Keywords: Deep learning, Leaf disease detection, CNN, Early diagnosis.

I. INTRODUCTION

A. Problem Definition

Agriculture, being a important contributor to the world's economy, it is the main source of food, income, and employment. In India, as in other low- and middle-income countries, where an enormous number of farmers exist, agriculture contributes 18% of the nation's income and boosts the employmentrate to 53%. In the past years agriculture sector provides the highest growth of economy. It not only helps in economic growth but also provides food which is an important factor. It is our duty to protect thecrops from the harmful diseases that are being spread. So our project's main theme is to detect the diseases that are causing damage to the crops by doing this we can do the earlydiagnosis and can protect the plants. Here we are using one of the methods calledimage processing for the detection of plant disease because it is one of the most effective method of deep learning techniques where we can detect the disease using images of the leaves of the plant. Nowadays there are many diseases that farmers also don't know what are the causesof that disease in this case our model is mostreliable to detect the disease and to prevent it from damaging the crops. We are using one of the deep learning algorithms for our model i.e. Convolutional neural networks (CNN) this is one of the effective algorithms for image processingmany of the researches used this convolutional neural network algorithm for their models so that they can get the better performance and high accuracy. Convolutional neural network is one of the of deep learning methods which has become dominant in various tasks and isattracting interest across a variety of domains, including radiology.

B. Objective of the Project

Our main objective of the project is detection of diseases in plants as they are the vital source of energy we need to protectthem. Early diagnosis of plant diseases using automatic detection techniques can improve the quality of food production and minimize economic losses. In recent years, there are many areas where we used deep learning techniques for problem solving.
There are many diseases that are spreading among the plants which are destroying the crops, so to detect them and to and preventing them is our main objective of this model. Moreover it is our goal to create anautomatic detection system for detection of diseases in the plants using image processing by implementing convolutional neural networks.

II. LITERATURE SURVEY

There are many researches that are done on different plant leaves they are as follows.

1) Ranjan, Malvika, and others "Detection and classification of leaf disease using artificial neural network." International Journal of Technical Research and Applications 3.3 in 2015 they proposed a model for detection of leaf disease usingartificial neural network.
2) There is another paper which took apple tree leafs as there sample and This paper outlines a method for accurately identifying apple leaf diseases. Building enough unhealthy photos and unique architecture ofa deep CNN based on AlexNet are required to identify apple leaf infections.

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3) Pooja V et al. 2017[29] proposed a framework where machine learning techniques are used for classification & disease detection & uses tools for image processing. first It will capture the damagedor infected region in the leaf image and thenit detects the disease.

4) Tran, T. T., Choi, J. W., Le, T. T. H. and Kim, J. W.: In 2019 these people took the tomato plat leaves for sample and done there research to detect the diseases that occur for the tomato leaf.

5) Uğuz, S. and Uysal, N.: Classification ofolive leaf diseases using deep convolutionalneural networks. This is also one of the deep learning model here they took olive leaf for the disease detection and done thereresearch.

6) Sharath, D. M., et al. "Image-based plant disease detection in pomegranate plant for bacterial blight." In 2019 they done their research on pomegranate plant for thedisease detection using image processing

7) Oppenheim, D. and Shani, G.: Potato Disease Classification Using Convolution Neural Networks(2017).

III. PROPOSED SYSTEM

A. Existing System

The current approach for detecting plant disease is simple naked eye observation by plant experts, which can be used to detect and identify plant diseases. In these circumstances ,the suggestedtechnique is useful for tracking vast fields of crops. Furthermore, in some nations, farmers lack adequate facilities or are unwarethat they can contact experts.AS a result, consulting experts is not only more expensive but also moretime consuming. In those circumstances, the suggestedtechnique for tracking a large number of plants would be useful.

Disadvantages of Existing System

- Only humans are capableof predicting diseases.
- The procedure is extremelyslow
- Consumption of time isalso very high

B. Proposed System

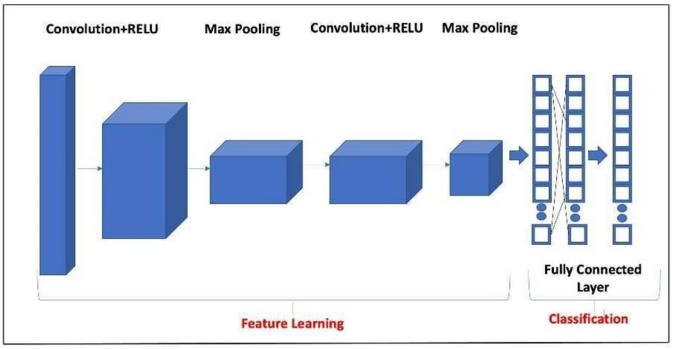
This study is focused on the identification of plant diseases. The plants which are mostly consumed are taken into consideration. It aims for providing a solution at early stage and hence observation from leaves for the identification of diseases is crucial. For any plant disease it is known that leaves are major regions where initial symptomswere found.

Hence considering the images of leaves , the methodology used Convolutional Neural Network to train with infected and healthy plant images.

The train dataset is used to train the model (CNN) so that it can identify the test imageand the disease it has CNN has different types that are Dense, Dropout, Activation, Flatten, Convolution2Dand Maxpooling2D.

After training the model successfully, the software can identify the disease detection contained in the dataset.After successful training and preprocessing , comparisionof the test image and trained model takes place to detect the disease detection.

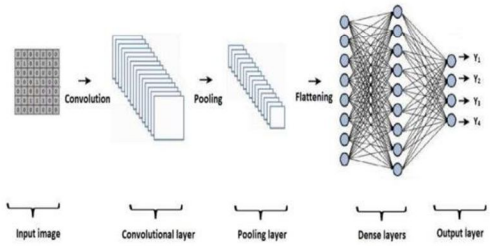
C. Architecture



A convolution neural network is made up of input layers, hidden layers and an outputlayer. In a feed forward neural network, these middle layers are being addressed as hidden layers because the inputs being fed to hidden layers and output generated fromthem are masked by activation function and final covolutional. In CNN ,the hiddenlayers are most essential as they perform convolutions. This Convolution layer does most heavy lifting. The output from these layer is termed as Feature map which givesus the important information of the image.

Following these CNN consists of layers like Pooling layers, fully connected layers and normalization layers which will help to process the image and provide results moreaccurately. The primaryapplication of pooling layer is to reduce the computational cost by dccrcasing thc sizc of convolvcdfcaturc map. Thc fully conncctcd layer comcs bcforc thc output laycrwhich consists of wcights andbiases and all the mainmathematical computation takes place in this layer. In these layer, the main function that is classification takes place. These layers along with additionalfeatures like dropout and Activation function makes the model more efficient.

D. Method and Algorithm Convolution Neural Network



A Convolutional Neural Network has three layers: a convolutional layer, a pooling layer, and a fully connected layer.

1) Convolutional Layer

Produces an activation map by scanning pictures several pixels ata time using a filter. Fig shows the internal working of the convolutional layer.

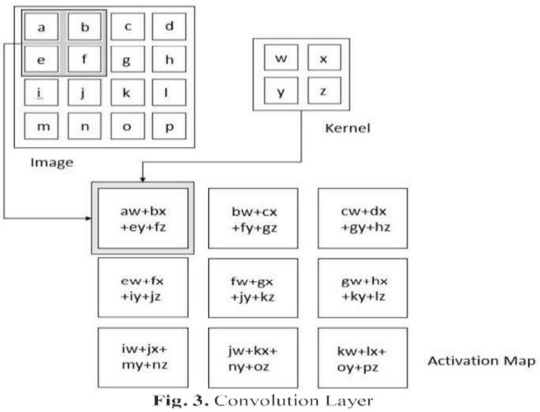
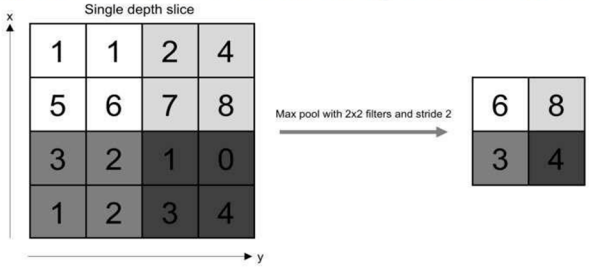


Fig. 3. Convolution Layer

2) Pooling Layer

Pooling layer : reduces the amount of data created by the convolutional layer so that it is stored more efficiently.



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3) *Fully Connected Layer*

a) *Fully Connected Input Layer:* The preceding layers output is flattend and turned into a single vector which is used asan input for the next stage.

b) *The First Fully Connected Layer:* ADDS weights to the inputs from the feature analysis to anticipate the proper label.

c) *Fully Connected Output Layer:* Offers the probability for each label in the end.

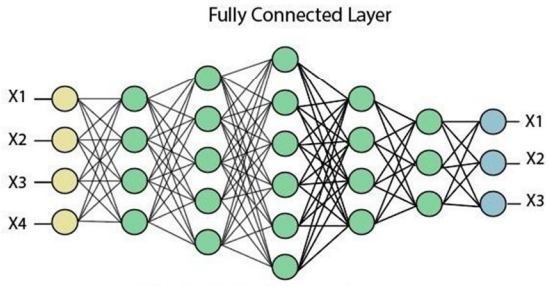


Fig. 5. Fully Connected Layer

E. Preprocessing

The input image captured is preprocessed by following steps. After reading the image the next step is to resize the image. The resizing of the image is vital because the images obtained from the dataset will be of different sizes which in turn would bedifficult to process through the model .Therefore, we must make sure that a base size is set for all images and then fed in to our algorithms. Then we try to remove the blur by reducing the noise. In the next step , we are going to segment the image, separating the background from foreground objects and we are going to further improve our segmentation with more noise removal. The preprocessing step helps to reduce the unwanted section and focuses on the main object in the image.

F. Feature Extraction

Features are patterns of an object in an image which will help to identify the desired result. Features include different types of properties such as corners, edges, regions of interest points, ridges,etc. This method will be most useful when the dataset is large and because of this technique it is possible to reduce the number of features without losing anyimportant or relevant information. So, by this processing gets easier. It will be able to extract complex features compared to traditional feature extractors where CNN are able to express the image in much more detail and more efficient. These large datasets have multiple different variables. These variables require high computing resources in order to process them. So, Feature extraction identifies the best feature from those big datasets, thus effectively reducing the amount of data.Ideally, these features are relatively easy toprocess, but still are able to describe the actual dataset with accuracy. The CNN layers helps us to extract features from an image. The amount of redundant data will be significantly eliminated with the help offeature extraction.

IV. RESULTS

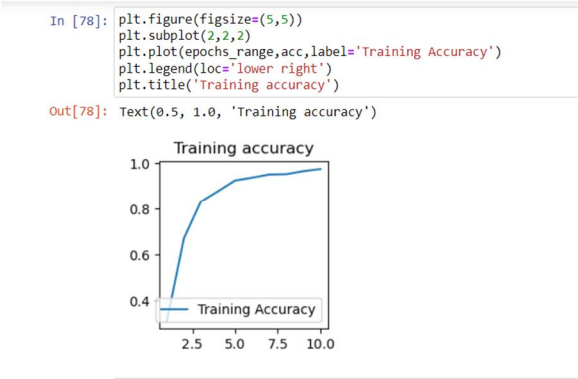


Fig 4.1: training accuracy of the model

This is the training accuracy of our model , the
Graph shows the accuracy.

```
In [84]: plt.subplot(2,2,2)
         plt.plot(epochs_range,acc,label='Training loss')
         plt.plot(epochs_range,acc,label='validation loss')
         plt.title('Training loss')
Out[84]: Text(0.5, 1.0, 'Training loss')
```

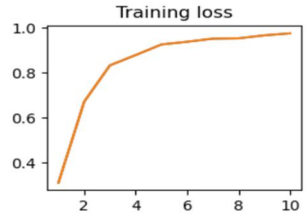


Fig 4.2: training loss of the model.

We got the highest accuracy for our model that is 97%. We took mango leaf sample for detection of disease in the mango leaf.

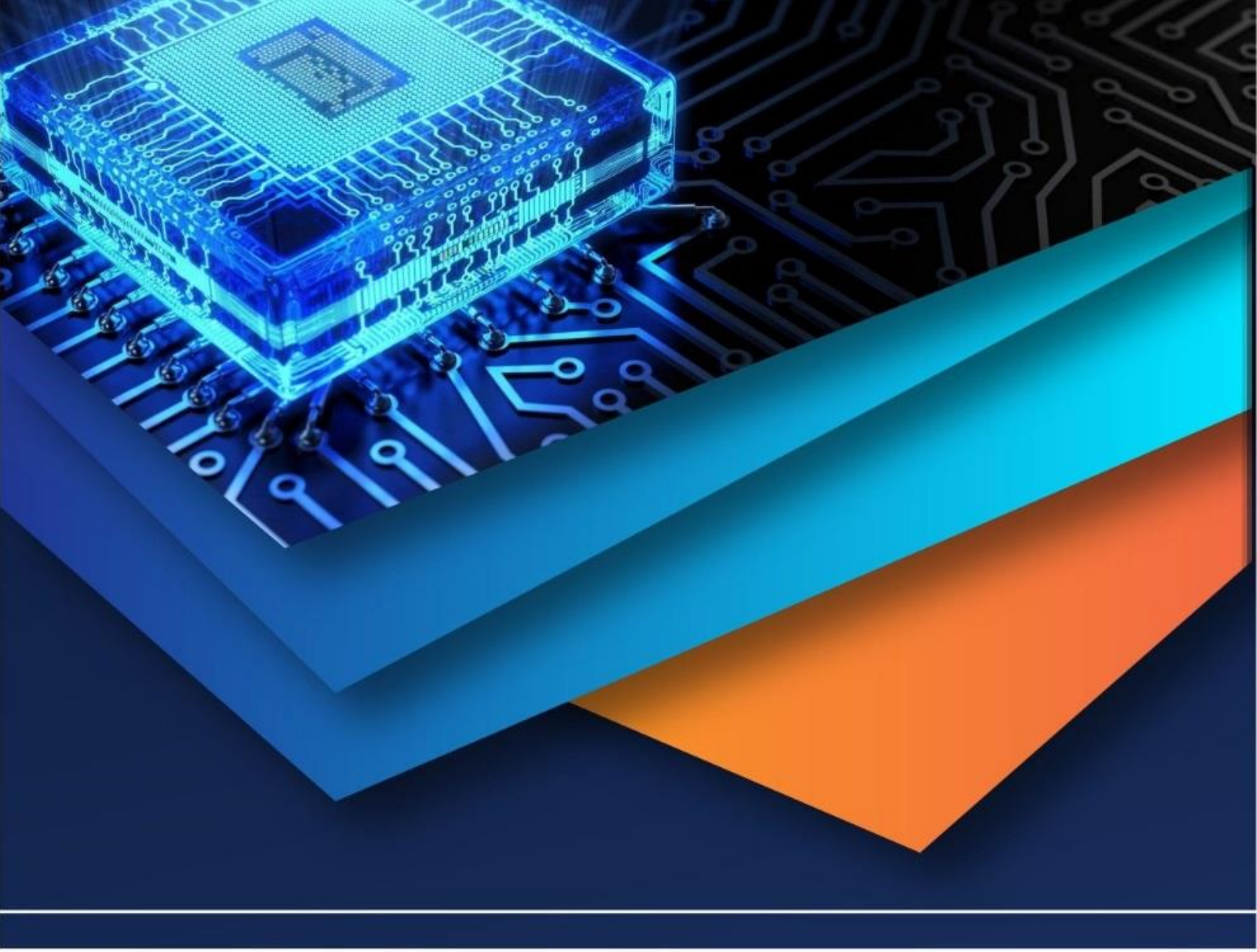
V. CONCLUSION

Our main aim of this model is welfare of the agriculture sector so that we can prevent the plants by getting infected from various types of diseases using the convolutional neural networks using image processing technique. By proper knowledge of the disease we can cure the maximum number of disease that plants suffer. This paper presents a basic overview of the concept of Convolutional neural networks and to build a automatic detection system for detection of leaf diseases. our main aim is to get the high accuracy and a model at low cost thereby building a model which is robust and reliable. Here we used deep learning technique which is used to solve the complex problems and by doing this we want to increase the production of agriculture sector. By using this model we achieve the following.

1) Detection of leaf disease with highest accuracy.
2) With low cost.

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