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Image Based Disease Detection and Solution Prediction in Plant Leaves

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Abstract:- Deep structured learning simply called deep learning is an artificial neural network based representation technique which is based on the machine learning models. The training dataset can be used by deep learning neural networks for learning. Different objects can be distinguished and differentiated by these trained networks. The three levels of learning models are 1)that take direct feedback called Supervised learning, 2)that takes no feedback called Unsupervised learning and 3)that uses a reward system called Reinforcement learning. Deep learning combined with image processing has several applications in the current and also in the future era. Higher level features are extracted progressively from the input using the machine learning algorithms. The lower layer features are identified by the image processing techniques. Thus the two technologies become useful in identifying diseases in plants. The main intention of this paper is to detail the technologies that ought to be the part of a disease detection application that can contribute to the agricultural sector. The automatic detection of diseases and pathological parts present within the leaf pictures of plants through the advancement of technology helps the farmers to extend the production level. Image processing techniques are used to classify diseases and quick diagnosis can be carried out as per the disease.

Keywords:- *Deep learning, Image processing, Artificial Neural network.*

I. INTRODUCTION

Classifying and identifying the plant leaf diseases are of economic importance in the agricultural industry.. Early information on plant health and disease detection can facilitate the control of the disease. Any abnormal condition that alters the appearance or function of a plant makes it diseased. Generally there are three forms of plant diseases: 1)Bacterial plant disease; 2)Viral plant disease and; 3)Fungal plant disease.

The database plays the most crucial role in image detection.The larger the database the more accurate the results are. The image database consists of diseased and healthy plants, and this dataset serves as the root for the model to classify between diseased and healthy leaves.

So the application can help farmers do cultivation without the help from experts , a platform where we could process the images of plant leaves and analyse their diseases, and predict the solutions[1].

This paper mainly focuses on the methods and technologies such as deep learning, image processing techniques and other neural network models that are used in detecting the diseases affected in plant leaves.

The traditional way of identifying plant diseases consumed a lot of time and at the same time, it was not applicable to large areas. This case necessitated the need for an automatic detection technique that required less time and also less effort. Some general diseases that are seen widely among the plants are identified and their images are collected to form the dataset that can be used to predict the disease and solution. Colour difference and texture are the main characteristic features that can be used from a quantitative point of view= by the image processing technique. For identifying and analysing the disease, image segmentation can be performed by using the K-means algorithm. Thematic maps for classification purposes can be created from multiband raster images using the image processing methods. The image classification is of two types 1)Supervised and 2)Unsupervised. Disease detection and classification of agricultural products with the help of modern machines have become important in our world.This paper presents a review on existing reported techniques as well as our proposed method useful in detection of disease.

We are able to observe the diseases in leaves, stems, roots and even fruits. Here we consider the leaves for identifying the diseases and for giving them suitable interceptions.

II. BACKGROUND

Plants that have economic values must be diagnosed faster for avoiding economic losses in the agricultural industry worldwide. Two problems can undermine this goal: 1)the permanent monitoring of the entire area farming by people able to detect the disease is , in most cases not feasible; 2)in many cases the person who detects the symptoms does not have the knowledge necessary to identify its cause[1].

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Although there are systems that are used as solutions that exploit the current technologies to diagnose the diseases, most of them face accuracy issues due to the specification issues of the systems, as they are lagging behind in holding the huge database.

Most methods proposed so far are dedicated to identify a few diseases, lacking therefore the ability to handle the wide range of disorders that may affect any species of plant. The few methods attempting to consider a broader range of diseases have relatively high error rates[1].

In the previous years identifying a disease was only done by people who were experienced, but nowadays as the number of variety of diseases has increased with drastic change in climatic condition it is hard to predict. So image processing techniques are used for identification of plant disease which makes it easier.

The largest part of the dataset comprises tomato leaf in the paper which can be identified by Computer vision methodology. The images can be converted into different forms by normalisation techniques based on certain Threshold Algorithms. RGB colour indices are mostly given as threshold values. K-means clustering algorithm can be used to differentiate between the ripe and unripe tomatoes and according to their tall order along with this differentiation a number of hierarchical clusters are also formed. The K-means algorithm is lagging behind since it is found to be iterative and non-deterministic in nature.

III. PROPOSED METHOD

Image classification has created a boom in the era when it is combined with the deep learning models. The various plant diseases can be analysed with the deep convolutional neural network. A large dataset has to be fed during the training so that it could be able to predict the disease with utmost accuracy.

The Figure 1 depicts the architectural model for the application that analyse, detects the disease and then predicts solutions for the identified disease. Here users register with a new account and then login to their account with the newly created one. And then they can upload the picture of the diseased leaf for verification. After scanning the image, proper output with the solution will be displayed.

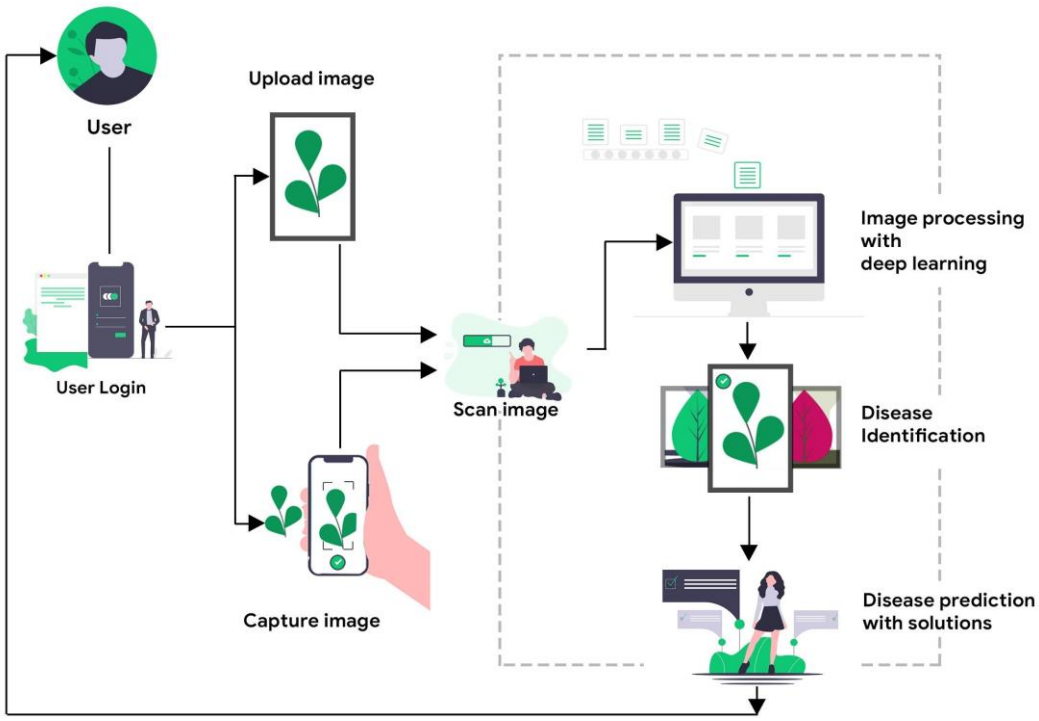

Fig 1:- Architecture diagram

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The disease detection follows certain basic steps as depicted in Figure 2.

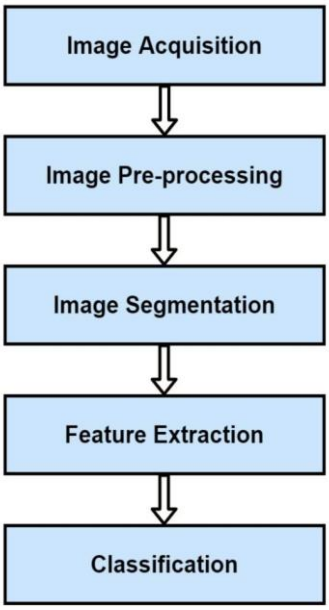

Fig 2:- Basic steps in Image processing

- **Image Acquisition:**To find the the disease associated with plant, we take a picture of the leaf of the plant and is then uploaded into the system.
- **Image Preprocessing:** The input image data is improved to remove noise or distortions before moving on to the next phase.
- **Image Segmentation:** Image segmentation is the process through which we partition the image into multiple segments that can be defined as super-pixels.It helps us to analyse the image easier.ktu
- **Feature Extraction:** It extracts the shape information contained in an image to identify the pattern it is classified into. Feature extraction is another form of dimensionality reduction.
- **Classification:** This phase is responsible for categorising the pixel information in a digital image.

Since the rapid detection of diseases can help in the increase of production rate of plants,the accurate and fast prediction of disease with a solution can have a good impact on the agricultural industry.

The larger the database the more accurate the results are. The image database consists of diseased and healthy plants,when we train this deep neural network we can identify the disease of the plant.

Prediction takes place by

- Recognizing infected leaf
- Measuring the affected area
- Finding the shape of the infected region
- Determine the color of infected region
- Determining the size and shape of the leaf.

As soon as the conclusion takes place the solution is given with it . The different stages through which the leaf is processed are

- Image Acquisition
- Image Preprocessing
- Image segmentation
- Feature extraction

The process is simple: the diseased plant leaf is scanned and by image processing we compare it with the data set and detect the diseases.The solution is provided for the detected disease.

A. Deep Learning

Artificial neural networks mimic the human brain, so we can say that deep learning neural networks which are a sub-branch also follow the human brain. Explicit programming is not necessary in deep learning models. The reason for the hype of the technology in the present situation is the high processing power and the amount of data that we are dealing with.

The hundred billion neurons connected to each neighbouring neuron that are present in the human body is similar to the deep learning neural network. In a multilevel neural network the layer that receives input is called input layer and those that give out output are called output layer and layers hidden are called as hidden layers as can be seen in fig.3.

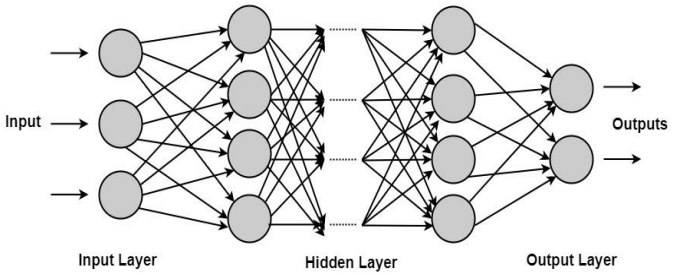

Fig 3:- Multilevel structure of a neural network

Deep Learning models, with their multi-level structures, as shown in Figure 3, is used to extract information from input. CNNs take advantage of GPU for computation and thereby reduce computation time.

Deep learning comes under artificial intelligence (AI). Deep learning has the ability to classify, recognize, detect and describe. The reason for the importance of deep learning can be understood from the graph depicted in Figure 4 .

The graph indicates the performance to data quantity ratio. The red line indicates that with traditional algorithms there was a poor performance rate for applications while with improved algorithms related to deep learning methods the performance shows a crucial increase, indicated by the blue line.

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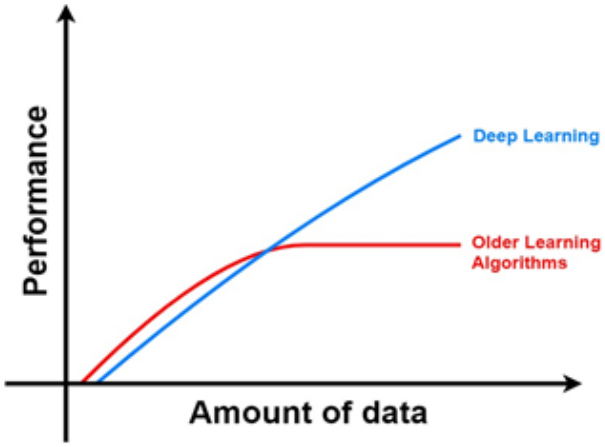

Fig 4:- Importance of Deep learning

Complex perception tasks can be easily calculated with maximum accuracy using the deep learning models. The multiple levels present in the deep learning neural network can be used for conversions and extraction of features. The main advantage of deep learning is its set of functions than allow networks used by traditional learning methods. A deep architecture is more ideal than a shallow one.

B. Convolutional Neural Network

All sorts of graphical information can be pertained using deep learning neural networks. Shift invariant or space invariant are the other names of CNN by which it is known. They are popularly used in image and video recognition, recommender systems, image classification and so on.

When the versions of multilayer perceptrons are regularized they can be called CNN. Multilayer perceptrons are those networks which are fully connected. In CNN each neuron in one layer is connected to all neurons in the next layer. This property leads to overfitting data. When magnitude measurements of weight are added to the loss function this results to the regularization of CNN. CNNs have a different view towards regularization. They use the advantage of the hierarchical pattern in data and assemble more complex patterns using patterns which are smaller and simpler. Therefore,CNNs are on the lower extreme when it comes to connectedness and complexity.

Convolutional networks are similar to biological processes where the connectivity of the neuron resembles the visual cortex of animals. In the receptive field, the stimuli will be getting a response from the individual cortical neurons.The entire receptive field tends to get overlapped by receptive fields of different neurons. Compared to other image classification algorithms, CNN uses less pre-processing This means that the network learns the filters which in traditional algorithms were found to be hand-engineered. CNN can be used without prior knowledge and human effort in feature design which is considered as a major advantage.

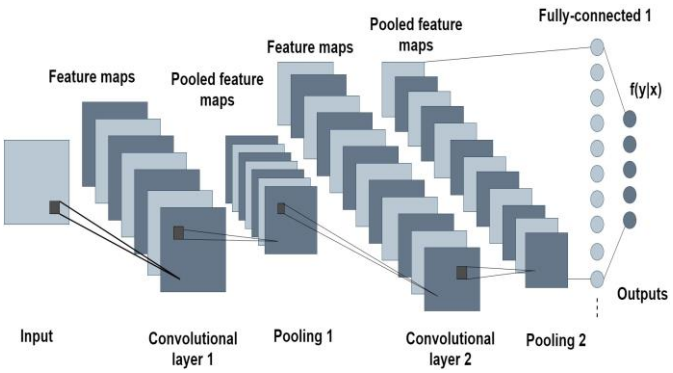

Fig 5:- A simple Convolutional Neural Network Architecture

Mathematical operation called convolution which is employed by the network is indicated by the term “Convolutional Neural Network”. Convolution can be called an advanced kind of linear operation. Instead of general matrix multiplication, they are using convolutions to each one of their layers.

Input, output and multiple hidden layers are the layers found in a typical convolutional neural network. A series of convolutional layers can be found in a typical hidden layer. RELU layer is considered to be the activation function, which is followed by pooling layers, fully connected layers and normalization layers, whose all are referred as hidden layers, because activation function and final convolution will be masking their inputs and outputs.

The layers are sometimes referred to as convolutions. Sliding dot product or cross-correlation is what we call them mathematically. Specific Index points are affected by the weights due to the indices in a matrix which are considered as a major significance.

Convolution layer, Rectified Linear Unit (ReLU) layer, Pooling layer and Fully connected layer are the four main layers found in CNN.

The sequential data cannot be handled by CNN. This was one of the drawbacks found in CNN.

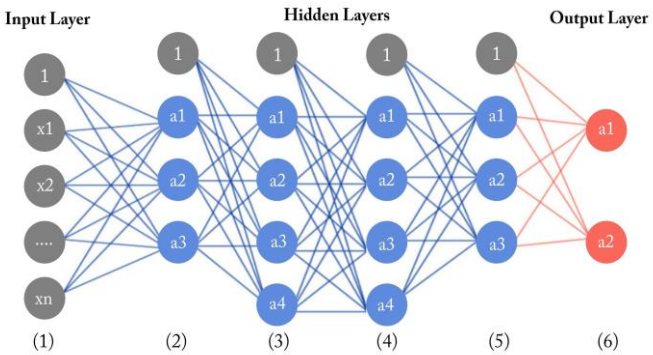

Fig 6:- Convolutional Neural Network

C. K-Nearest Neighbors Algorithm

KNN can be called as a supervised learning algorithm.For resolving classification and regression problems in machine learning, K Nearest Neighbour Algorithm is used. Data available will be used by KNN and with the help of similarity measures (e.g. distance function) they are able to classify new data points. Classification can be determined by majority vote to its neighbors. The input found in classification and regression has examples of k closest training and the output relies on whether KNN uses classification or regression.

- In classification, the output can be called as a class membership. The class which is common among its k nearest neighbours has been assigned with objects that are classified by a plurality vote .The class of a single nearest neighbor will be assigned with an object, provided k=1.
- An object's property value in regression can be called as an output. The average of the values of k nearest neighbors will be considered as its values.

KNN is mainly used in problems which are related to recognition of patterns. The nearest neighbour algorithm was one of the few algorithms which were used to rectify travelling salesman problem.

The nearest neighbor method is applied to each of the seven representations of the measured data. One advantage of using the nearest neighbor method is that the institution of interest can be found at the center of the most similar institutions available.

IV. CONCLUSION

Our software approach can help those people to do cultivation, without seeking the help of personal experts and laboratory analysis that require huge expenses to be met with. The software can not only predict the disease, it can also recommend solutions for those diseases.

The use of deep learning with a large database increased the accuracy of the prediction.This will help in the rapid detection of diseases in turn help in the fast diagnosis of diseases in plants of economic interest and hence will ensure food security and avoid losses caused by various diseases.

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