IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

ISO 3297:2007 Certified ⁜ Impact Factor 8.102 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 12, Issue 6, June 2023

DOI: 10.17148/IJARCCE.2023.12644

PLANT LEAF DISEASE DETECTION USING DEEP LEARNING

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Abstract: Agriculture must complete a huge effort that involves finding plant diseases. This is something that the economy is extremely dependent on. Due to the prevalence of plant illnesses, finding infections in plants is a crucial task in the agriculture industry. To detect illnesses in the leaves, and plant must be continuously examined. This constant inspection of the plants is labor-intensive and time-consuming since it involves many people. Simply said, some sort of deliberate strategy must be used to monitor the plants. The detection of Program-based diagnosis of diseases makes it easier to identify damaged leaves as well as save time and labour. The suggested method can more correctly categorise diseased plants by identifying their symptoms.

Keywords: In order to extract features from and categorization in plants disease species, CNN and deep learning techniques are used.

I. INTRODUCTION

India is a predominantly agricultural nation, and a country's status in the globe depends on its economy, which in the majority of cases is dependent on agricultural production. In India, farmers can choose from a vast variety of crops to cultivate to get the best yield possible depending on the environment. Then, crop diseases also had an impact on production. Crop diseases are brought on by infections, nutrient deficiencies, fungus, etc. Early disease detection allows for effective treatment and eventual recovery. A specialist is needed to identify the illness, define the course of treatment, and offer advice on prevention. Finding the plant disease is a difficult task. It calls for expertise and familiarity with plant diseases. Accurate descriptions of plant disease symptoms are also necessary. A system known as an Expert System, which possesses knowledge and expertise, can be relied upon by a person.

II. RELATED WORK

Using a variety of machine learning techniques, K. Muthukannan as well as associates identified leaf detect illnesses and classified based on the groups assigned for them of sick leaves. By examining the shape and image texture information of the sick leaf, Vector the quantization method Learning and Feed Forward Neural Networks, in addition to Radial Basis Function Networks used to distinguish unhealthy plant leaves. The simulation demonstrated the effectiveness of the suggested system. an arrangement utilising machine learning for enhancing agricultural the Indian economy's quality may be created with the aid of this initiative. [1].

Malvika Ranjan and colleagues' work on plant leaf disease detection begins with image capturing. From the results of segmentation, HSV properties and other color-related information are gathered, also using an artificial neural network. After that, By selecting feature values for the (ANN) that accurately differentiate between the healthy and the unwell samples. The current work proposes a technique for swiftly and accurately identifying cotton leaf diseases by integrating visual data processing with methods and Ann [2].

Syafiqah Ishakais and colleagues' research, Classification of Leaf Disease Using Artificial Neural Networks, gathers and evaluates data from images of leaves to determine if they are healthy or unwell. using image processing methods in medical facilities. to gather data and extract photos using an optimal algorithm extraction of characteristics using segmentation, contrast, and methods of processing image. An A synthetic neural network was employed to examine the test outcomes. The framework of the building uses a classification scheme for healthy and unhealthy leaves. RBF and multilayer perceptrons, which have several layers and feed forward, are two similar ideas. RBF performs better than the MLP network, according to the experiment's final findings [3].

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Srdjan Sladojevic and colleagues created a novel technique called Plants Classifying Images Integrated Deeply Convolutional Neural Network (CNN) Recognition of Crop Diseases. how to create a model for crop illnesses identification system using convolutional networks and deep learning to classify plant images.

The strategy adopted and the creative setup procedure make it possible for the system to be quickly and easily set up. Possessing the ability to recognise crops depending on their environments, and the model created can tell apart between healthy leaves and thirteen various plant illnesses. The whole process of using this sickness detection model is discussed in depth all during the research, starting with the collection of photos to build a professional-evaluated database in agriculture. a Caffe platform for deep learning. CNN was deep-learned using the invention of the Berkley Vision and Learning Centre. The accuracy of the developed model was tested experimentally for several class tests, and the average range was between 91% and 98% and 96.3% [4].

CNN and modelling in order to separate diseased plants, adversarial network were applied. Some others, such as Emanuel Cortes, used a publically available dataset of various sorts that included 86,147 photos of healthy and diseased plants to train semi-supervised algorithms and a deep learning network to detect 57 different crop species and disease status. The RS-net was a successful experiment using unlabeled data. With a detection rate of 1e-5. fewer than 5 epochs during the training phase, it was able to get a better score [5].

In their paper, " Utilising Soybeans to Detect Crop Disease CNN," Serawork Wallelign and the others examined this problem. CNN's capacity to spot crop issues from pictures of leaves. Images captured in the local natural surroundings are shown in this research. The Le-Net architecture is used to develop the model, which categorises the illnesses impacting soybean plants. 12,673 samples of evaluated green images, including images of wholesome leaves, were taken from the plant village collection. These samples were divided into four categories. The pictures were recorded in an unorganised setting. The developed model has a classification rate of 99.32%, demonstrating its accuracy. Using a major convolutional neural network, significant traits and plant illnesses may be recognised from photographs obtained in the wild [6].

A Real-Time Detection of Pests and Diseases in Tomato Plants deep learning-based in this paper, Alvaro Fuentes and colleagues investigate three different detector types, referred to collectively as "deep learning meta-architectures": the Area-based R-CNN, the Faster Region-based CNN Single Layer Actions and Convolutional Neuronal Networks (R-FCN) Multi box Detector (SSD).

We will merge all of these meta-architectures using a network that utilises "deep feature extractors" like Residual and VGG net. We provide a technique in both the local and global scalable category labelling and feature extraction, and we illustrate the efficacy of deep morpho and feature extractors. Throughout, train to decrease false positives and increase accuracy. On our big dataset of tomato illnesses and pests, which comprises complex representations pests and illnesses, including a variety of extra-class and between-class variables, including infection position and standing within the facility [7], our systems have been thoroughly tested and trained[7].

Utilising deep learning, Prasanna Mohanty and associates created a deep convolution neural network that they used to recognise14 different plant species and 26 diseases. The accuracy of the model that was held out on the test set was 99.35 percent, proving the value of this tactic. The model still has a 31.4% accuracy rate. in spite of this. assessed using a selection of pictures obtained from reliable web sources, such as pictures shot in settings other than those used for instruction. Despite the fact that this accuracy is significantly greater than the 2.6% one that is chosen at random, the total accuracy must be improved by using a bigger collection of training data [8].

Using segmentation, and categorization of features from acquired leaf pattern data, Ashwin Dhakal and associates created a model to recognise plant leaf diseases. Good Leaf, Bacterial Spot, and Late Blight, and Yellow Leaf Curl Virus consist of the four classifier labels that were utilised. In the neural network, the obtained properties are added after 20 iterations. An accuracy rating of 98.59 percent was achieved by the top neural network-based topology utilised to forecast plant disease [9].

S. Khirade and associates used automated image processing methods and the backpropagation neural systems to circumvent the challenges of plant disease diagnosis various methods to identify plants in 2015 the developer created writers using leaf photographs. Otsu's thresholding was used to separate the contaminated leaf segment, followed by boundary methods for spot detection and detection. To identify diseases of plants, they use extracted properties including colour, texture, and form edges, among others. The BPNN method is used to classify and recognise plants [10].

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Peyman Moghadam and associates established the usefulness of spectral imaging for the detection of plant diseases in 2017. This study made use of the short-wave infrared (SWIR) and vision and near-infrared (VNIR) spectra. The authors developed the Clustering using K-means in the spectral domain approach using leaf segmentation.

They were able to remove the hyperspectral pictures' grid. suggested a way for removing grids. The index's precision of vegetation in the VNIR spectral band was 83 percent, whereas 93% of the spectrum's data were accurate. Although the recommended approach proved effective, it needs to be used with a first hyperspectral camera bringing 324 spectral bands to boost accuracy. The remedy's price is too high [11].

Using variable including hue, mean, uniformity, and SD and edges, entropy, variance, and correlation, SM Sharath and company a finding of bacterial blight system technique for Pomegranate plants in 2019. Take cut, for example, where the authors divided the image's interest region using segmentation. The Canny edge detector was being used to extract the edges of the pictures. Since the authors were able to effectively develop a technology that can predict the fruit's level of infection [12].

Garima Shrestha and associates used a convolutional neural network to detect plant disease in 2020. The authors were successful in classifying 12 plant diseases with an accuracy rating of 88.80 percent. The experiment made use of a collection of 3000 high-resolution RGB images. In this network, the third convolutional layer block and the pooling layer are both present. As a result, the network ultimately costs a lot of money. Because there are so many false negative predictions, F1 score for the model is 0.12, which is a very low number [13].

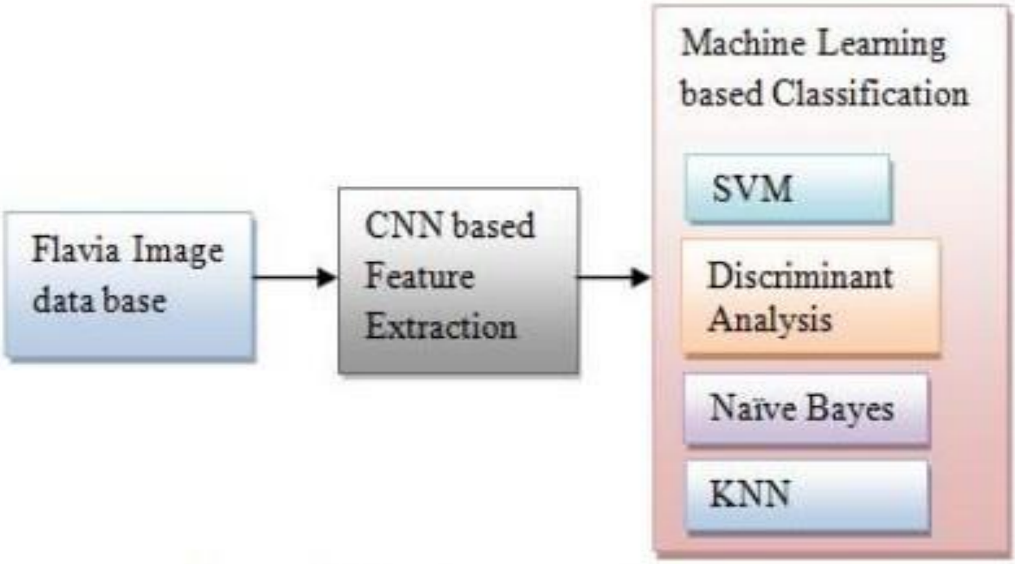

Figure 1: The implemented system

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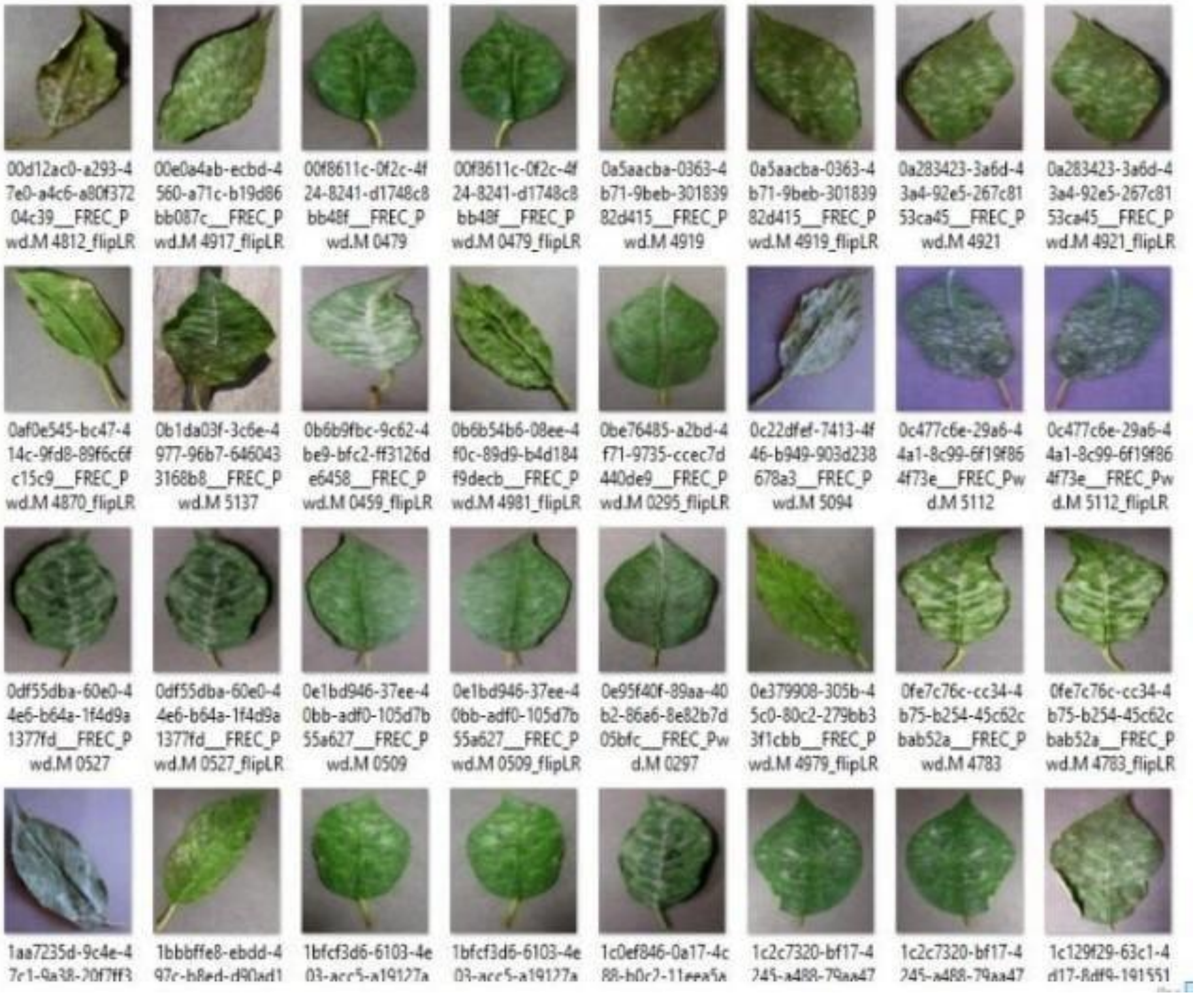

CNN based Feature Extraction Using Convolutional Neural Networks (CNN) to extract features used in this approach to retrieve the more precise features. These characteristics resemble the leaf's diameter, length, width, area, and perimeter.The Flavia data collection is used to provide the CNN with training images. The hand-crafted features of the earlier systems performed far worse than the CNN-based approach. The figure displays the CNN architecture**.**

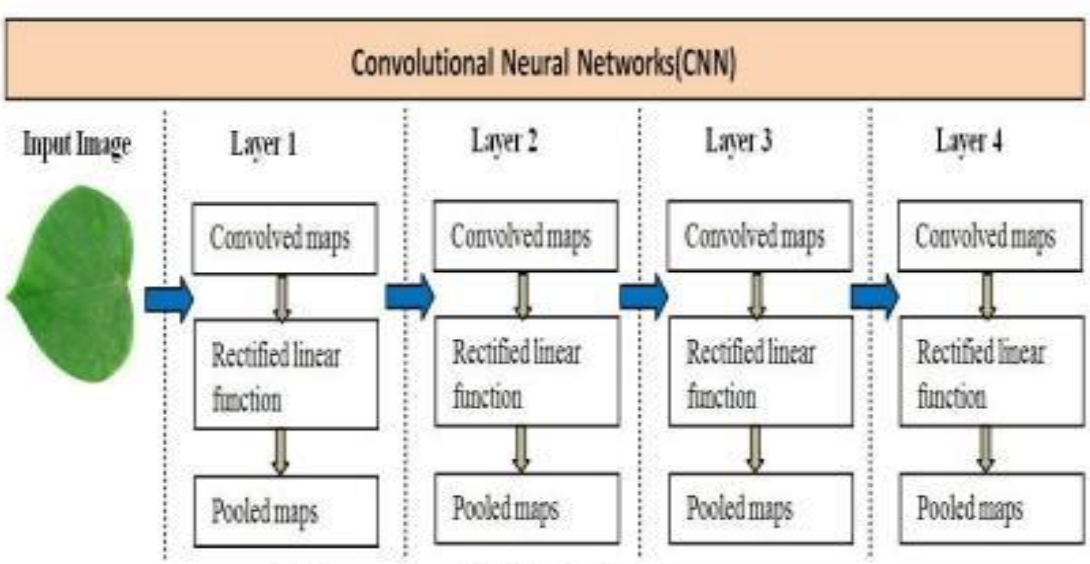

Figure 2: CNN Architecture

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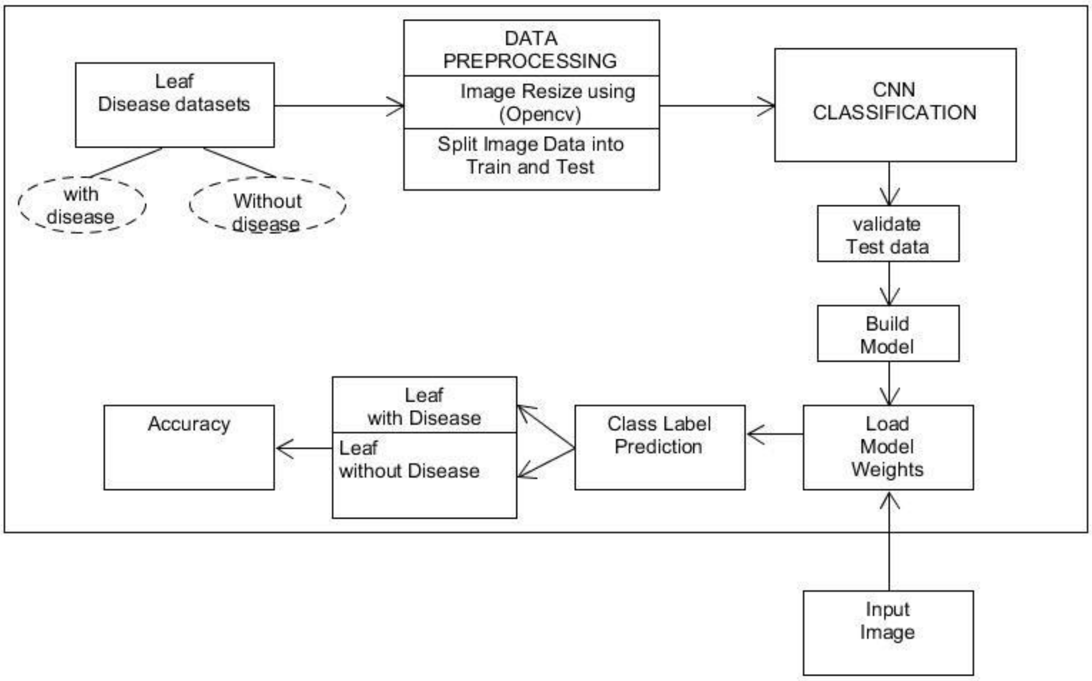
The Flavia dataset, which included 1800 leaves for the training images, was utilised to construct the CNN method in order to extract characteristics from 32 distinct species. In this case, we employed a 4-Layer CNN model. The network layers are listed below. Depicts the CNN design. The Input Layer This layer receives the vector of the input data set (p). It measures 5 by 1. Radial Basis Layer (ii) The vector distance (n) between the weight vector and the vector p is computed in this layer. It is used in the form of the dot product. ni = || || || || pi (1) Radial basis (ni) is equal to exp (-ni 2). where i is the vector's row number. iii) A few traits of the Radial Basis Layer If ni=1, then the output weights of the competitive layer's competitive function will send their values to the competitive function if pi and i are the same. Competitive Layer (iv) d = n.*Mi is the output vector. From d, the competitive function C is computed. C is equal to 1 and 0 only at the greatest element of d. It serves as the index when looking up the plant's scientific name. ii. Classification using machine learning. The process of automatic plant recognition ends with classification. The several Artificial neural networks (ANN), support vector machines (SVM), K-nearest neighbour (KNN), and naive bayes (NB) are examples of machine learning techniques. can be used to execute this classification procedure.

An isolating hyper plane describes SVM classification. The following training data set, which is divided into two classes, D = (x1, y 1), (x2, y 2). (x k, y k), xi Rm, yi [+1, -1] (4) + b = 0 (5), makes it simple to understand the concept of SVM classification. If the separation error is "0" and the distance function is maximal, the set of vectors is said to be separated by the hyper plane in the ideal case. ANN is now the most used research technique in the field of machine learning. This idea of an ANN is comparable to the network of neurons in the human brain. Neuronal density and hidden layers affect ANN performance. A feed-forward neural network with one hidden layer was employed in this implementation. The system employs the Scaled Conjugate Gradient function by default throughout the training phase.

The halting criteria are based on the minimal gradient. KNN can also be used to identify different plant species. The KNN algorithm is based on feature space distance measurements. The KNN classifier first identifies the k nearest neighbours, and then labels the sample depending on the weight of the neighbours. A statistical method is the Bayesian classifier. It carries out the classification using the probability idea.Precision of Bayesian Due to its conditional independence of Bayesian probability, the classifier approach is less effective. .RESULT OF SIMULATION The 10 distinct plant species listed are used in the experiment. The classification report (Precision, Recall, F1-Score & Support) obtained using the suggested technique is shown . The metrics employed in the classification procedure are listed below. I. The proportion of accurately predicted positive observations to all expected positive observations is known as precision. Precision (P) equals TP / (TP + FP). True Positives (TP) False Positives (FP) ii. The proportion of positives that are correctly detected is known as recall. Recall(R) = (TP+FN)/TP False Negatives (FN) iii. The harmonic mean of recall and precision is calculated to provide the F1-Score. F1-Score is equal to 2*(R*P)/(R+P) Support is determined by the quantity of each class's occurrences.

III. METHODOLOGY



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Collection datasets:

- From kaggle.com, we will gather datasets for the prediction.
- The data sets include numerous Classes.

Data Preprocessing:

- We'll apply a couple image pre-processing procedures to the selected data as part of data pre-processing.
- Image resizing
- Additionally, data dividing into testing and training groups

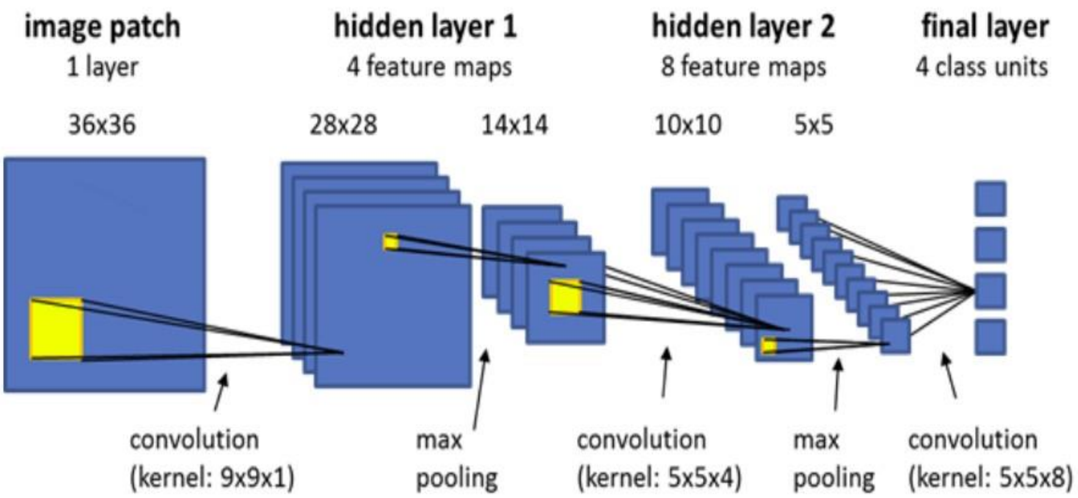
Data Modelling:

- Split train data is fed into the CNN algorithm to help with training.
- The programme analysed the learned plant image data after receiving test data
- Accuracy is determined

Build Model:

Once the data has been trained and is demonstrating a high accuracy rate, a model file needs to be built.

IV. IMPLEMENTATION



Convolutional Neural Networks have the following layers:

- Convolutional
- RELU Layer
- Pooling
- Fully Connected Layer

Step1: Convolution Layer:

Convolutional neural networks apply a filter to an input and then generate a feature map that depicts the characteristics in detail that have been found in the input.

Step2: RELU Layer

Every negative value from the filtered photos is eliminated and that layer are substituted with a zero. To prevent the values from adding up to zero, it is happening.

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Rectified Linear unit (RELU) Transform functions only activate a node if the input value exceeds a predetermined threshold. The output changes from zero while the data is below zero to something else whenever the data exceeds a threshold. It is correlated linearly with the dependent variable.

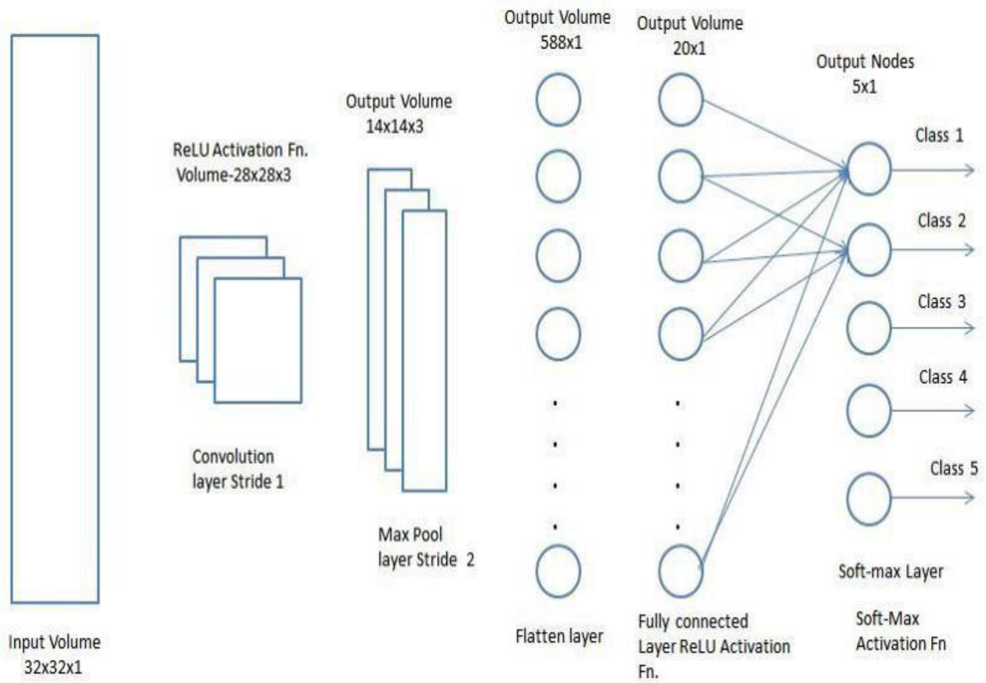
Step3: Pooling Layer

We reduce the size of picture stack in the layer. After travelling through the activation layer, pooling is completed.

We do by implementing the following 4 steps:

- Select a window size (often 2 or 3).
- Choose a stride (typically two).
- Glance at your filtered photographs as you move your window.
- Take the highest value from each window.

Step4: Fully Connected Layer



The network is said that it's totally linked when all neurons on the highest layer is linked to all of the others in levels below and below. This replicates higher-level thinking, which takes into consideration all feasible paths from the input to the outcome. Then passing the reduced image after being converted to one files and a vector that has there are two stages of convolution, which is RELU, and pooling, take the reduced image and place it into the only list.

V. RESULT AND ANALYSIS

The project's goal is to create a completely automated image classification system that can positively detect a specific illness that affects various plant species. We used algorithms that work well at every level of detection in this effort to do disease prediction on several plant species for the first time. Our method offers a lower percentage of false positives and a comparably higher predictability.

About 70% of the entries in the training dataset and 30% of the entries in the test set were used for training. According to the table below, CNN's algorithm provides greater accuracy. We are aware that when trained on larger datasets, convolutional networks are capable of learning features.

98% network-wide accuracy as a parameter was attained.

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PARAMETER	CNN ALGORITHM	ACCURACY
Currently classified instances	We take 70% of training and 30% of testing dataset	**98%**
Classified Incorrectly instances	We take 70% dataset for training and 30% for testing	**2.0%**

VI. CONCLUSION

For the feature extraction and categorization of plant disease species, we employed CNN and deep learning techniques. The various machine learning algorithms are Naive Bayes (NB), SVM, KNN, and ANN. For this strategy, we have taken into account the Flavia dataset. These data sets are used for testing and training purposes. It has been able to achieve 98% accuracy. Precision, recall, F1-score, and help are all evaluated for every performance metric. Furthermore, the accuracy thresholds for training and validation are relatively comparable. During training, small, grayscale pictures are used. It is potential to use colour picture classification for plant disease recognition in future study.

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