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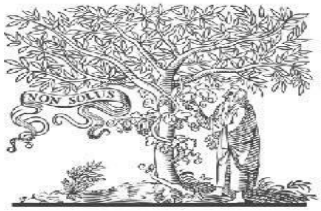

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Title **Predict and analysis of plant disease and Nutrient Deficiency identification system using Conventional Neural Network and Machine Learning Algorithm**

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Paper Authors **K. Kumara Swamy, Dr.Sumaiya Samreen**

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Predict and analysis of plant disease and Nutrient Deficiency identification system using Conventional Neural Network and Machine Learning Algorithm

[1]K. Kumara Swamy,
Assistant Professor, Department of Information Technology,
Malla Reddy Engineering College for Women,
Maisammaguda, Hyderabad-500100
Email: kankala.kumar24@gmail.com

[2]Dr.Sumaiya Samreen
Professor, Department of Information Technology
Malla Reddy Engineering College for Women,
Maisammaguda, Hyderabad-500100
Email:sumaiyasamreenriaz@gmail.com

Abstract— **Agricultural merchandise are the number one need for every us of a. If plant life is infected via sicknesses, this impacts the use of this agricultural production and its financial sources. This paper affords a system that is used to classify and come across plant leaf diseases using deep gaining knowledge of strategies. The used images were received from (Plant Village dataset) internet site. In our work, we've got taken specific kinds of plant life; consist of tomatoes, pepper, and potatoes, as they are the maximum common sorts of flora in the international and in Iraq in particular. These statistics Set contains 20636 photos of plants and their sicknesses. In our proposed machine, we used the convolutional neural community (CNN), via which plant leaf sicknesses are labeled, 15 classes had been classified, which includes 12 training for illnesses of various flowers that were detected, inclusive of microorganism, fungi, etc., and three classes for wholesome leaves. As a end result, we acquired first rate accuracy in training and testing, we have got an accuracy of (98.29%) for schooling, and (ninety eight.029%) for checking out for all information set that have been used**

Keywords—Plant leaf disease, Deep Learning, CNN algorithm

I. INTRODUCTION

Agriculture is the mother of all civilizations. The focal point is on improving productivity without considering the environmental results that have seemed inside the degeneration of the surroundings. Plant illnesses are very crucial as this may especially imply both the great and amount of plant within the development of agriculture. Generally, the sicknesses of flora include fungi, microorganism, viruses, moulds, and many others. Farmers or specialists normally recognize plants ailment and analysis them with naked-eyed [1]. Nevertheless, this technique may be time-consuming, expensive, and incorrect, therefore, detection and class of plants sicknesses the use of deep getting to know technique presents quick and appropriately technique. Photographic pictures of symptoms of plant contamination are utilized for detection of plant disorder and for observe, coaching and evaluation, and so forth. [2, 3, 4]. Using computer image processing and deep getting to know technology [5, 6] that is to get a short and accurate detection; research show that deep getting to know strategies are effective strategies for classification of plant illnesses [7]. Number one impels were made to beautify dependability, correctness, and accuracy of picture analysis for detecting and classify plant infection [8]. An automated system aimed toward supporting diagnose plant illnesses via the presence and visible signs of the plant may be of massive help to freshmen inside the growing process and certified specialists as an infection diagnostic verification device.

The researchers used Visualization strategies [9] to extract plant sickness illustration from skilled CNN [10]. There are numerous researchers had been completed every yr within the developing a part of picture processing and laptop vision [11]. In these paintings, we advocate a system that detects and classifies vegetation illnesses the use of a machine getting to know approach. Our paintings in deep getting to know [12], and based on CNN [13]. The records set [14] that became taken from global records set that's (Plant Village) [15] consists of several of the vegetation. We will limit our work to unique styles of plants for their repute within the world in preferred and in Iraq specially. The paper is dependent as follows: segment II displays at the influential paintings that has been achieved in a area into consideration. Segment III clarifies the method proposed and the technique utilized in tandem with the ranges taken to gain the preferred results. The results and interpretation of the advised, technique is blanketed by using phase IV. Phase V presents the paper's conclusion and the scope for destiny works.

II. RELATED WORK

This segment describes the special structures for detecting the illness in plant leaf the use of deep studying strategies. Prajwala TM, etc, all designed a machine to discover and classify diseases in tomato leaf, by means of implements, a slight distinction of the CNN layout named LeNet [16]. The principle objective of this studies is to discover a way to the problem of detecting tomato leaves ailment using the perfect method while utilizing minimal computational resources to produce consequences that are similar, to state-of the-art techniques. Neural network systems use an automated extraction of capabilities to help differentiate the input image into several instructions of illness. This gadget has received an usual accuracy of 94-95 %, showing even below unfavorable conditions the viability of the neural network approach. Atabay, proposed paintings depending on deep residual mastering approach [17]. CNN is carried out to categories tomato plant leaf images dependent on the obvious effects of diseases. In addition to switch learning as a compelling methodology, training a CNN from scratch utilizing the Deep Residual gaining knowledge of strategy exams. To do that, design of CNN is proposed and carried out to a subset of the Plant Village dataset, consisting of tomato plant leaf picture. The consequences show that the proposed layout outflanks VGG fashions, pre- skilled at the photograph net dataset, in each exactness and the time required for re-schooling, and it tends to be utilized with a widespread computer. In these preceding Works, there is an opening the researchers

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Used only one plant, which is the tomato plant, so it is straightforward to detect illnesses in it. Unlike our work, there are 3 sorts of plants. There could be a detection here only for diseases and no longer a type of plant kinds. Malvika Ranjan, et al, affords a usually visual determination system that requires accurate judgment and scientific strategies further [18]. The bad leaf photo is stuck. HSV capabilities are derived due to the coloration segmentation. Artificial Neural community, (ANN) is then educated, to perceive samples which can be ill and wholesome the overall performance of the ANN class is 80 % higher than others method in accuracy. As for the loophole of this work, it is a bit accuracy, that is 80%. This accuracy, using the neural community, is few and includes a few detection mistakes for plant leaf illnesses. Kawasaki et al. Suggested the CNNs approach that is used to differentiate nutritious cucumbers from diseased cucumbers by means of utilising pics of leaves [19]. They recognized dangerous viral infections with CNN in this survey: MYSV ((melon yellow spot virus)) & ZYMV ((zucchini yellow mosaic virus)). They used facts set incorporates of 800 snap shots of leaves of cucumbers (2 hundred with ZYMV, three hundred with MYSV, or three hundred with healthful leaves). The statistics set changed into enlarged the use of rotational variations on snap shots. Researchers recommended CNN structure which includes ninety-six M for this multi-category function. 3 convolutional layers, pooling layers, and normalization layers. The activation method used on this gadget is the characteristic Rectified Linear Unit (ReLU). The precision acquired in this evaluation is 94.9 %.

III. THE PROPOSED SYSTEM

In this part, we present a computer vision system, to identify plant leaf diseases system. The proposed system consists of several steps. Fig. 1 shows the main structure of the proposed system.

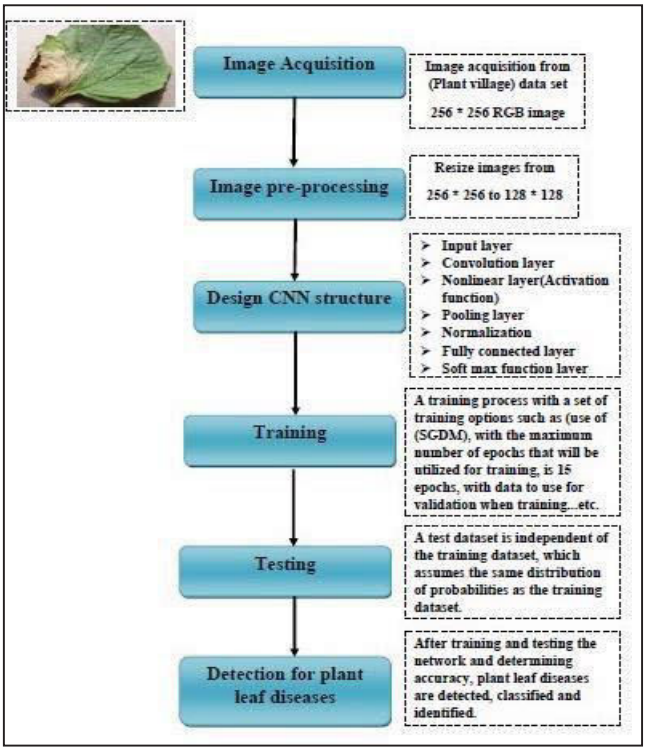

Fig. 1. General Diagram for Plant Leaf Diseases Detection and Classification System

As in the Fig. 1, which shows the construction of our proposed system for detection and classification of plant leaf diseases, the first stage in it is the stage of image acquisition.

A. Image acquisition (Dataset)

The plant leaves disease photos were acquired from the (Plant Village) treasury from internet site (www.Plantvillage.Org). The accrued dataset incorporates of round 20636 pix relating to 15 distinct instructions as proven in Fig. 2. The dataset accommodates photos of all foremost types of leaf diseases that would influence the three types of plant its tomato, pepper, and potato crops which have been chosen because it is of the most well-known kinds of flora in the world in fashionable and in Iraq especially. Every of the downloaded pictures relates to the RGB coloration space by the default and turned into saved in the uncompressed JPG shape.

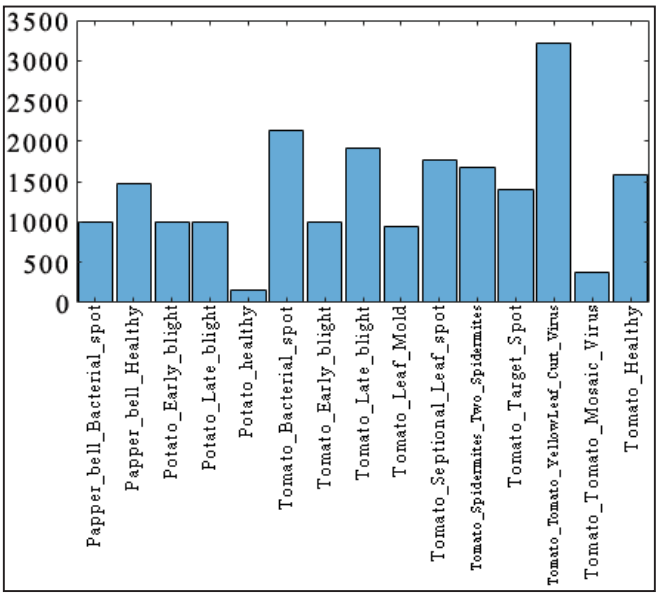

Fig. 2. Crops and their Disease that been used as a Dataset

B. Image Pre-processing

To speed up the schooling manner and acquire the model testing calculation realistic, the pictures inside the dataset is resized to 128 x128 resolutions. The manner of optimizing both the enter or purpose variables facilitates to speed up the train processing. At the same time as maintaining the integrity of the information within the image from loss.

C. CNN Structure Design

CNN is a completely famous method in deep studying in which a couple of layers are robustly skilled. It has been discovered to be effective and is additionally the most widely utilized in numerous packages of pc imaginative and prescient. CNN can be applied to assemble a computational shape that operates on unorganized photograph inputs and transforms them into the ideal output classes for class. In our work, a shape has been constructed for this set of rules. This structure is made from numerous layers as shown in Fig. Three, which illustrates the architecture that we used to assemble the CNN.

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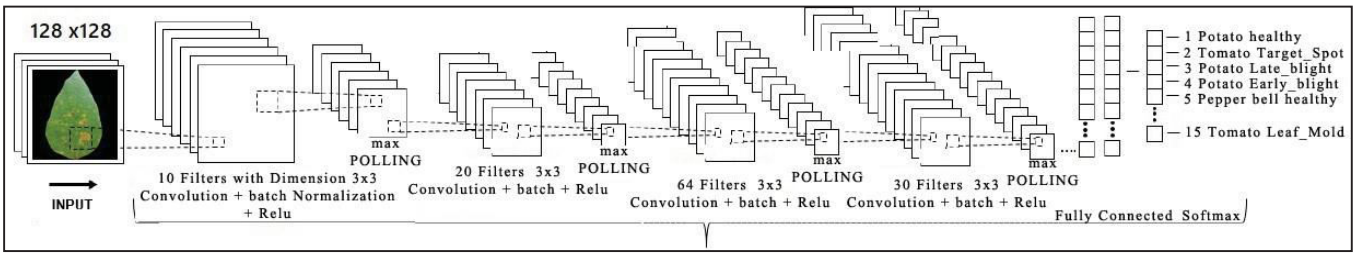

Fig. 3. CNN Model Architecture

1. Input Layer

The input layer contains the input images and their pixel values.

2. Convolution Layer

A CNN makes use of one-of-a-kind kernels, in the convolution layers to convert the complete object as well as the premier function maps, creating specific characteristic maps. In our studies, we've used four convolution layers, in the first convolutional layer, we used 10 filters which have a top and width of 3 with padding man or woman arrays 'equal'. The padding applied to the input alongside the rims. The 'equal' method Padding is set in order that the output size is similar to the enter size. Inside the 2nd convolutional layer, we used 20 filters that have a height and width of three with padding character arrays 'equal'. In the 0.33 convolutional layer, we used sixty-four filters that have a height and width of 3 with Padding character array 'equal' and in the fourth convolutional layer, we used 30 filters that have a peak and width of three with Padding character array 'equal' as shown in Fig. 3.

3. Pooling Layer

A pooling layer is frequently following a convolutional layer and may be applied to depreciate the scale of feature maps and parameters of the community. Pooling layers also are invariant in interpretation, alike to convolutional layers because their calculations recall neighboring pixels. The most widely used processes are average pooling and max pooling. In our studies, we used a max-pooling layer.

4. Non-Linear Layer

A non-linear transformation is carried out to the input with the aid of the CNN, the item of which is to categorise the capabilities inside per hidden layer. In CNN shape we use Rectified linear gadgets (ReLU). Rectified linear units are normally used as non- linear transformation. This form of layer executes a simple operation with a threshold in which any enter price smaller than zero is ready to zero.

5. Fully Connected Layer

The information arrives at the closing layer of the CNN, that is the fully linked node, later a great deal generation of the prior layers. Within the neighboring layers, the neurons are linked immediately to the neurons inside the related community as shown in fig.3.

6.Normalize Layer

In our proposed gadget we use a batch normalize layer. Batch normalization layer shape normalizes any channel through a mini-batch. This will help to lower sensitivity to records versions.

*7.*Softmax Layer

The network's performance can be hard to interpret. It's miles normal to complete the CNN with a softmax characteristic in type troubles. After extracting values of 15 instructions of plant illnesses within the absolutely linked step, a Softmax could be made for them, so that the magnificence can be selected in every manner and consistent with the capabilities that were extracted thru the preceding layers that the pics of plant sicknesses went through it. In this layer, the correct elegance of disorder is decided by making use of the Softmax characteristic.

D. Training

Training a network is a technique of acquiring kernels in convolution layers and weights in completely linked layers that reduce differences on a schooling dataset among output predictions and wonderful floor truth labels. In our art work, we used 70% of the information for schooling, through this diploma simply so the community that has been built learns via extracting skills from plant leaf disorder images a good way to examine from the ones abilities for each picture to be outstanding on its basis.

E. Testing

The testing is a dataset utilized to provide an impartial very last design fit assessment on the education set of information. In this stage, we use the groups that were educated within the preceding step that changed into trained in CNN, and the features have been extracted by using getting to know the community while the information set passes from plant leaf diseases on this community, we used 70% of the facts for trying out.

F. Detection for Plant Leaf Diseases

After the previous operations, plant species diseases are detected and classified according to three types of plants, namely tomatoes, peppers, and potatoes. All results, detection and classification will be presented in the next section.

IV. Experiment Results

The experiments are performed on MATLAB R2018b; RAM 4 GB and processor core(TM) i5_4300U CPU @ 2.50 GHz. We train the network and save the trained network so that the training process is not repeated and so the time taken for training is provided, after which the network is also tested by testing data and showing the accuracy. In the last stage, through which the diseases of plant leaves are detected and

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classified, a random selection is made for any image, here we have chosen an example of the potato plant paper after loading it to the system and choosing the network that was trained and press the Detection button, the disease and the type of the affected plant will be revealed as in the Fig. 4 that illustrates the detection and classification process using the CNN algorithm for Late blight disease, to the potato plant leaf.

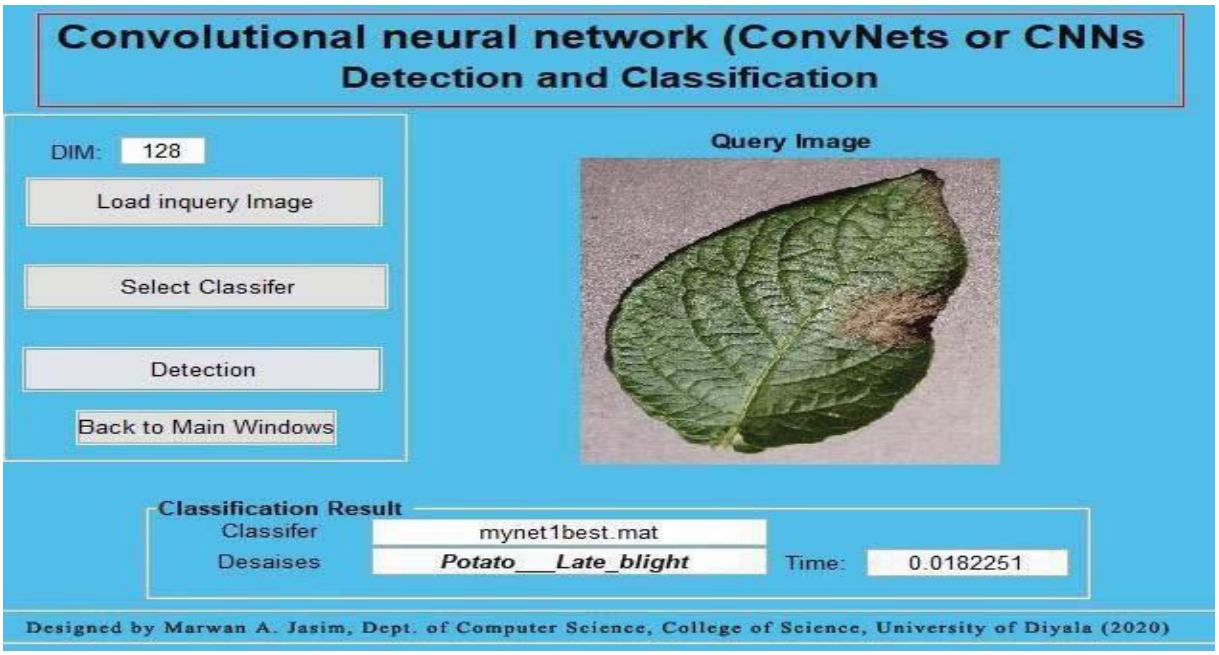

Fig. 4. CNN detection and classification

The process of calculating the accuracy was performed to be displayed later in the confusion matrix according to TABLE I and like "(1)" and "(2)" through which the accuracy is calculated for each class and the total accuracy is calculated for all classes.

TABLE I. CONFUSION MATRIX TABLE

		Predicated	
		Positive	Negative
Actual	Positive	a	b
	Negative	c	d

The reason for the difference in accuracy between the classes, despite the proximity of this accuracy, is due to the data set, the difference in these images, the difference in the capture process, as well as the lighting, as well as the difference in the number of pictures for each class in the data set. This greatly affects the accuracy of each class.

In the network training process as in Fig. 5, which illustrates the training process and shows the loss function that occurred during the training of the network and also explains the training options used, such as epochs and iterations, as in the following figure.

In addition, we divided the training data set we used in our work 15 epochs and for each epoch, 112 iterations and the number of iterations was 1680 divided by 15 epochs. As shown in Fig. 5.

In the classification with the CNN algorithm, we obtained a high accuracy of the performance was shown in the confusion matrix for each class that was classified in training data. At the top of the matrix, rate the overall performance accuracy of the training data which (98.29) appears as in Fig. 6. Also the rate the overall performance accuracy of the test data that we obtained was calculated (98,028) and the accuracy of each class in the testing process as in Fig. 7 that shows the confusion matrix for the accuracy of the performance of the test data.

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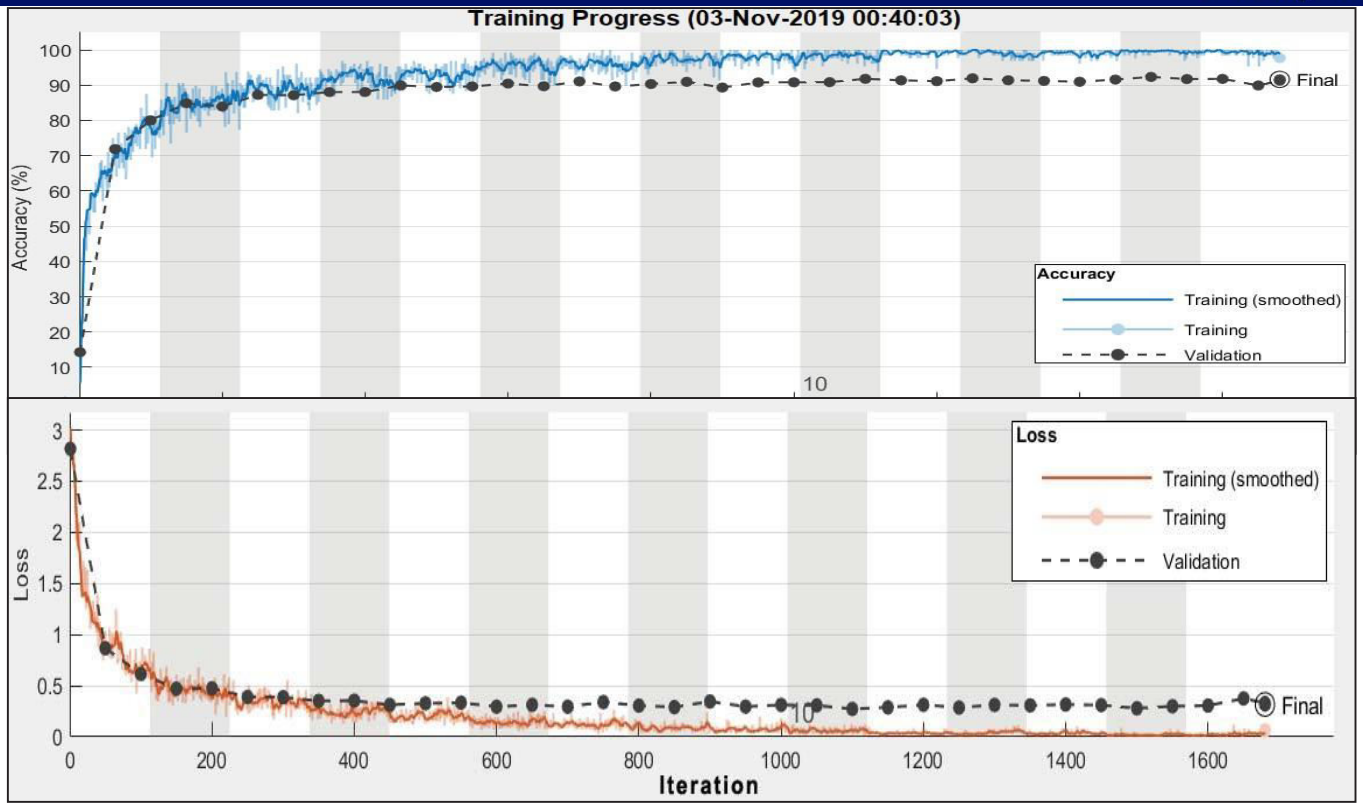

Fig.5. Training Progress (Accuracy) and Loss Function

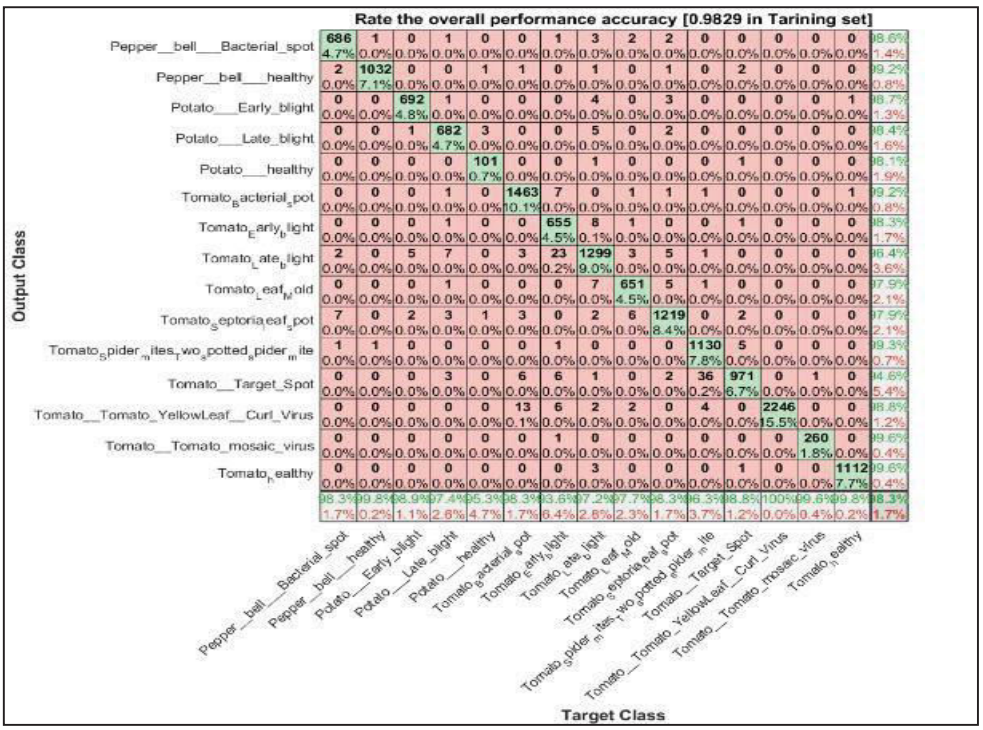

Fig. 6 performance accuracy of the training data

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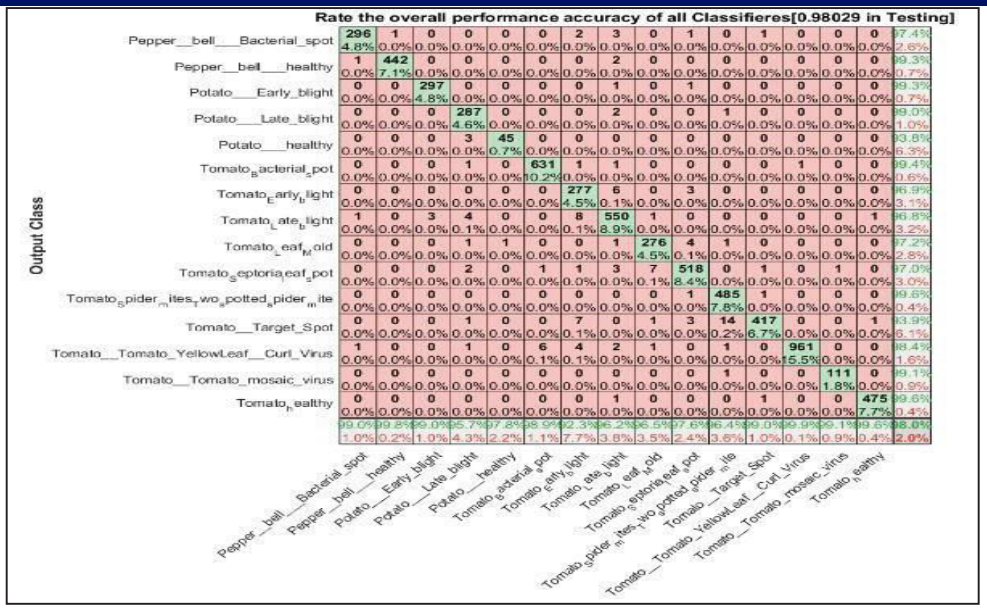

Fig.7. Confusion Matrix for CNN Performance Accuracy for Testing Data

TABLE II. ACCURACY OF EACH CLASS WITH THE OVERALL ACCURACYOF THE TRAINING AND TESTING STAGES

No	Class Name (Plant Diseases)	Accuracy in CCN Training	Accuracy in CCN Testing
1	Pepper bell Bacterial spot	98.60	97.60
2	Pepper bell healthy	99.20	99.30
3	Potato Early blight	98.70	99.30
4	Potato healthy	98.10	93.30
5	Potato Late blight	98.40	99.00
6	Tomato Target Spot	94.60	93.90
7	Tomato_mosaic_virus	99.60	99,10
8	Tomato Yellow Leaf_ Curl Virus	98.80	98.40
9	Tomato Bacterial spot	99.20	99.40
10	Tomato Early blight	98.30	96.90
11	Tomato healthy	99.60	99.60
12	Tomato Late blight	96.40	96.80
13	Tomato Leaf Mold	97.90	97.20
14	Tomato_Septoria leaf spot	97.90	97.00
15	Tomato Spider mites	99.30	99.60
16	Rate overall accuracy of the training for CNN	98.29	
17	Rate overall accuracy of the testing for CNN	98.029	

It should be noted here that the confusion matrix is a global and approved view and the reason for its lack of clarity here is just the large numbers of classes used, to clarify the results more we will display them in the form of a table. As in TABLE II, this shows the accuracy obtained in the test and examination stages for each class, as well as the total accuracy of all classes in the two mentioned stages.

In TABLE III we showed a comparison of the proposed system with some work related to our work. It clarifies the things that have been compared, including the algorithms used for each of the related work and the algorithms used as we have shown in the table are the CNN algorithm and the ANN algorithm. Also, among the things that within the comparison are the comparison with the quantities of the data set used in related work and in relation to our work, we have proven that our work has used more types and numbers of images than other related work, and the most important thing has been proven that the overall accuracy in our work is the highest accuracy compared to other related work as shown in the following table.

TABLE III. A COMPARISON BETWEEN THE PROPOSED SYSTEM VS. THE RELATED WORK

Author(s), Year	Ref. No.	Algorithm (classification)	Dataset size (Images Number)	Accuracy
Prajwala TM, 2018	[16]	CNN	18160	94_95%
. Habibollah Agh Atabay , 2017	[17]	CNN	19742	96.78_97.53%
Malvika Ranjan ,2015	[18]	ANN	Not Mentioned	80%
Kawasaki and et al,2015	[19]	CNN	800	94.9%
Our proposed system	-	CNN	20636	98.029%

V. CONCLUSIONS

Given the significance of agriculture and flora inside the complete global and in our united states of america, Iraq, and due to many plant diseases, that exist nowadays, these studies proposed a strong methodology to hit upon and classify these diseases with accurate and fast outcomes based on laptop facilities and deep gaining knowledge of strategies. We carried out this work to attain the outcomes via the use of CNN algorithm. We acquired high results over ninety-eight%, and this caused very correct and rapid detection of the sort of disease and the type of plant that incorporates this ailment via the leaf of that plant. Fifteen unique classes are labeled as plant illnesses consist of extraordinary flowers, the world over well-known, and crucial in our united states of America, Iraq, are tomatoes, potatoes, and peppers. Diverse learning charges and optimizers ought to too be carried out as a part of destiny paintings to experiment with the proposed machine. Also,

we aspire to increase many different types of plants with other types. Use multiple techniques and create an expert system that detects and classifies plant leaf diseases.

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