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# Leaf Disease Detection and Remedy Recommendation Using CNN

**Dr.B.Srinivas Rao sir, PROFESSOR (Ph.d From the University of Bhopal)**
**DEPARTMENT of CSE,**
**bsrgriet2015@gmail.com**

**M. Snehith varma ,BTech, Department of CSE,(18241A05F9) mssnehithvarma86@gmail.com**

**J.Sandeep Kumar,BTech, Department of CSE,(18241A05E2)**
**sandeepjupally5301@gmail.com**

**S.Anil Reddy, BTech , Department of CSE,(18241A05H0)**
**anilchinna7744@gmail.com**

**B.Varun Tej , BTech, Department of CSE,(18241A05C6)**
**varuntejbondhi@gmail.com**

**ABSTRACT: People's lives and economic well-being are influenced by agriculture. In terms of GDP, it employs a large number of people and accounts for a significant portion of it. Crop losses are caused in large part by diseases, which are common and unavoidable. Agricultural yields are reduced each year due to poor disease control, which can have a significant impact on the quality, quantity, and productivity of the crop. There is a great deal of value in detecting leaf disease using an automated method such as image processing. Convolutional Neural Networks (CNNs) are the most commonly used deep learning classification technique. An artificial intelligence (AI) classification system that uses a neural network is referred to as a neural network classification system (NNCCS).**

## 1. INTRODUCTION

There are a large number of farmers in India that grow a wide variety of crops. Agriculture is the key industry and the primary source of employment for most people. In terms of agricultural output, India is second only to the United States. A large number of individuals are either directly or indirectly reliant on the agriculture sector's output. To ensure the long-term viability of the country, it is essential to produce high-quality agricultural products. There are a number of variables that can affect crop productivity.

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As the world's population grows, political unrest persists, and the weather changes, the agricultural business is scrambling to find new and improved ways to produce more food. Many farmers are leaving agriculture in favor of other employment because of a lack of productivity and industrialisation. With today's advanced farming technology, we can significantly boost crop yields while lowering the cost of production and enhancing the quality of food. Temperature, humidity, and light conditions must be monitored and controlled in order to produce crops that are more productive and of higher quality.

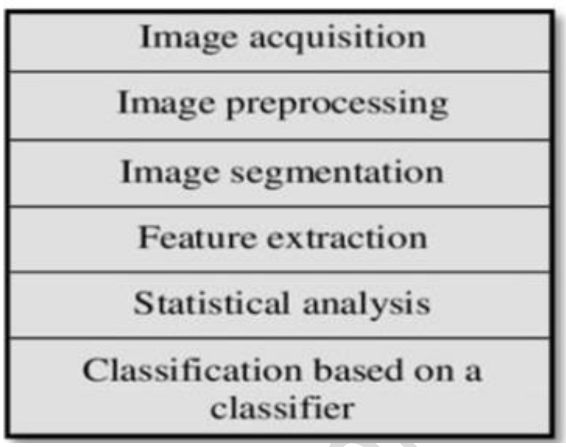


Fig.1: Modules in DL model

Leaf disease is another big danger to food security. It degrades product quality and lowers harvest yields. Diseases in leaves are spread by microorganisms such as insects, pests, fungi, bacteria, and viruses. The entire plant is harmed when they consume the top and bottom of the leaf. There must be an early detection of leaf diseases for future agricultural losses to be avoided. In turn, this boosts the economy by increasing food yields, which in turn helps farmers. It is critical to determine the health of the plant. The illness can be identified by looking at the diseased leaves. Patches of irregularly shaped black pigment form on the leaf's surface, and fungus can grow in these patches if they are humid. Initially, these spots are minor, but with time, they spread to cover the entire leaf, causing it to decay. A precise window of time must be allowed for the accurate detection of leaf diseases, i.e., at the initial stage, before the basic functions of plants, such as pollen transport and fertilizer absorption are compromised.

## 2. LITERATURE REVIEW

### *2.1 Automated leaf disease detection in different crop species through image features analysis and One Class Classifiers:*

It is shown that using Local Binary Patterns (LBPs) for feature extraction and One Class Classification for classification, it is possible to automatically identify crop diseases on a variety of leaf sample photos from a variety of crop species. The One Class Classifier for each plant health condition, including healthy, downy mildew, powdery mildew, and black rot, is used in this proposed methodology. The algorithms developed on grape leaves have been tested in a wide range of crops, with excellent applicability. It is possible to identify ambiguous data samples as belonging to one or more of several criteria using an original technique that proposes resolving conflict between One Class Classifier classifier. The 46 plant-condition combinations evaluated yielded a 95 percent overall success rate.

### 2.2 Pattern recognition for crop diseases using K-Means clustering and artificial intelligence:

Farmers rely on crops as much as they rely on bread and butter. Economic output from agricultural activities is the primary source of India's economic

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growth. As a result of our research, we can support farmers. By implementing an automated agricultural inspection, Farmer may be able to provide better and more precise output. The quality of the various products can be improved. In agriculture, it's critical to be able to predict which crop will be afflicted. We are indirectly contributing to the improvement of crop quality through this work. The Indian economy will benefit from a recognition system based on machine learning. The paper will present a method for classifying and identifying various plant diseases.

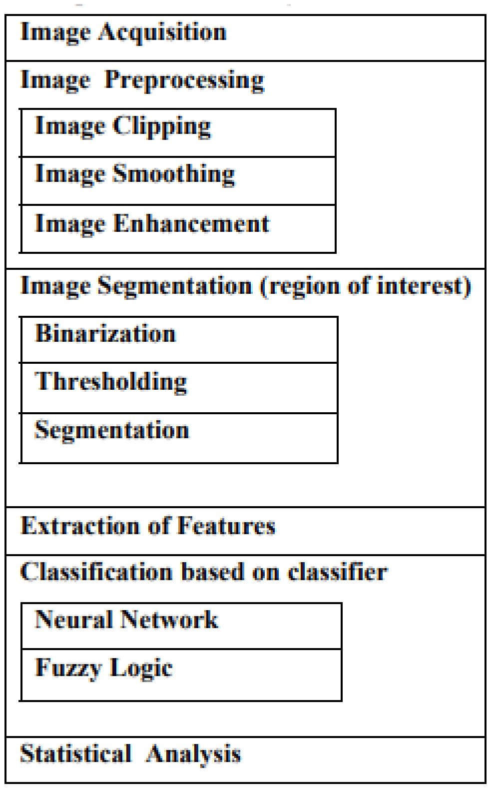


Fig.2: Digital image processing

Crop color digital analysis is critical. It's now becoming more and more popular by the day. It's also one of the most cost-effective options available. Because color changes are a useful sign of crop health, efficiency, and survivability. Visual scales and low-cost crop colors can then be used to measure it.

A method for detecting the disease-causing Yellow Vein Mosaic Virus in okra leaf photos by extracting the veins from the leaves and utilizing a Naive Bayesian classifier

Tropical, subtropical and warm-temperature zones all over the world grow Okra, or Abelmoschus esculentus (L) Moench. Easy cultivation and adaptability to varied moisture conditions make it a common crop in India. Insects, nematodes, and viruses can all cause illness in crops, therefore it's important to protect the harvest from these threats. Yellow Vein Mosaic Virus (YVMV) is the most common okra disease, and it is spread by white flies (Bemisiatabaci). Image processing, K-means and a Naive Bayesian classifier were used to detect and categorize the presence of YVMV illness in okra leaf. The proposed method was tested on 79 photos of sick and healthy okra leaves. As the intensity of the YVMV infection increases, so do the four classes of leaf images that can be used as input: Highly Susceptible, Moderately Susceptible, Tolerable, and Resistive. Using just 10 features, the proposed method has a success rate of 87%.

Plant disease detection using RGB and grayscale images: a comparative study

Aims/Background: Digital image processing is utilized in a wide range of sectors, including medicine and biology, to analyze diverse applications. It has been proven possible to identify plant diseases using a wide range of image kinds. Grayscale and RGB images are examined and contrasted in this study, and the results are presented.

Statistics/Methodology: We used image processing techniques such as pre-processing, segmentation, and clustering to inspect and analyze RGB and Grayscale images for leaf diseases. Results/Finding: Color plays an essential role in determining the severity of disease in infected leaves. These photos were processed using a median filter to improve contrast, as well as a segmentation algorithm that was able to detect the sick areas. The results show that the RGB image provides a clearer and more noise-free image than the Grayscale image, which is ideal for detecting sick leaves.

SVM-based disease detection for grape leaves:

When it comes to fruit crops, grapes are one of India's most popular. Fruit, stem, and leaf infections caused by a variety of diseases reduce grape productivity. Diseases of the leaf are typically caused by microorganisms such as bacteria, fungus, and viruses among others. Fruit production is hampered by illnesses, which can be difficult to regulate. Without a good diagnosis of the ailment, the correct treatment can't be applied at the right time. One of the most commonly utilized techniques for detecting and classifying plant leaf diseases is image processing. SVM classification is used in this paper to assist in the detection and categorization of grape leaf diseases. Segmentation by K-means clustering is used to locate the sick area, and then color and texture features are extracted. Finally, the type of leaf disease is determined using classification techniques.

2.6 Image-based disease detection using deep learning:

Food security is threatened by crop diseases, yet identifying them quickly is difficult in many countries due to a lack of adequate infrastructure. Smartphone-assisted disease detection has been made possible thanks to recent breakthroughs in computer vision made possible by deep learning, which is becoming increasingly widespread around the world. We train a deep convolutional neural network to identify 14 crop types and 26 illnesses from 54,306 photos of damaged and healthy plant leaves (or absence thereof). To prove that this strategy is viable, the model achieved an accuracy rate of 99.35 percent on the test set that was held out. On the whole, training deep learning models on increasingly huge and publicly available image datasets provides a clear route for smartphone-aided crop disease diagnosis on a worldwide scale.

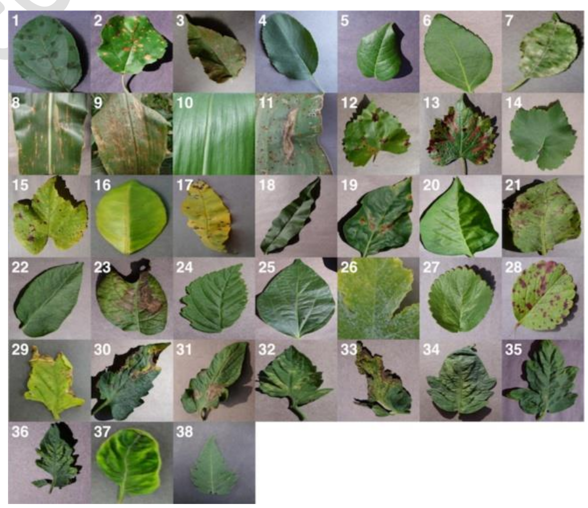

Fig.3: Leaf pictures from the PlantVillage dataset, which represents every crop-disease pair utilized in the study.

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### 3. IMPLEMENTATION

[4][5][6]] Human-level accuracy has been achieved using generic object recognition in the last few years. Leaf diseases may now be detected early and accurately using a camera and image processing integrated with machine learning, an automated expert system [9][12]. Deep learning is extensively utilized because it enables the computer to discover the best features on its own, without the need for human intervention. Computational model: Neural Network In the human brain, it resembles the activity of neurons. The primary goal of a neural network is to eliminate the need to manually create feature vectors.

Because it saves both labor and time, CNN is frequently employed for image identification [13][14]. For the classification task, CNN does not employ hand-made features but rather optimizes and creates the hidden layer's filter parameters and weights. Different layers of CNN are used to identify, detect, categorize, and predict diseases. As a result of the faster treatment and more precise results, it has less of a negative impact on harvest. Increased agricultural output and productivity are achieved with minimal outlay of resources. Chemicals used on the plants are being minimized. Smaller areas can be better monitored by utilizing different methods for layer- and neuron-based visualisations together.

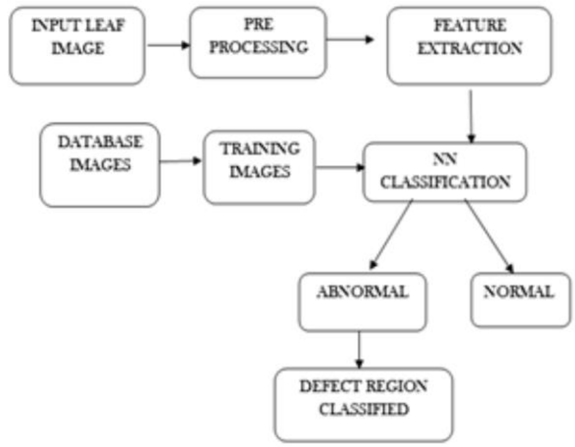


Fig.4: System architecture

A class of feed-forward neural networks known as convolutional neural networks can handle data in several dimensions. Perceptrons constitute layers in feed-forward neural networks. The first layer receives inputs, and the last layer produces outputs. The so-called secret layers are not connected to the rest of the world. Layer-specific perceptrons are interconnected, but not with those of the same layer. Constantly, new information is fed upwards from one layer to the next. The quality of the features essential for effective prediction isn't sacrificed in the process of making images easier to analyse using CNN. In order to accurately classify leaf diseases, images are used as input. Using these photos as a starting point, an image filter called a convolution layer extracts the information. The pooling layer derives the feature values from the retrieved features. Convolution and max pooling can be used to gain additional information from images that are more complicated. The output of the previous layer is converted into a single vector, which is then used as the input for the following layer by a fully connected layer. A convolution and other layers repeatedly extract feature maps, and the network eventually outputs a label that indicates an expected class. As depicted in

Fig. 3, the steps needed to implement the CNN model for leaf disease detection. Each step is significant in and of itself.

STEPS:

1) To do feature extraction, obtain the input leaf image, preprocess it, and then convert it to an array.

Make that the database of leaf photos has been properly sorted and preprocessed.

3) Use the CNN classification technique to train the model on practice photos.

When comparing the preprocessed test image with the trained model, the leaf is either identified as normal or abnormal, as seen below in step 4.

5) If the leaf has a flaw, the sickness and treatment are visible.

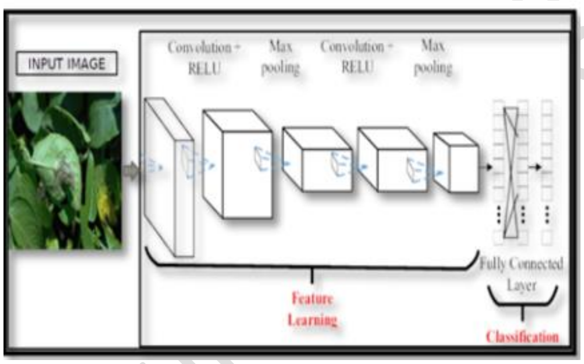


Fig.5: Internal structure of the CNN model

The CNN is trained using the Keras python package and the Tensorflow backend framework. It was utilized to improve Adam Optimizer's performance. Training and testing data are sent as inputs to model.fit generator. The number of epochs is also passed. In order to accurately fit the dataset of leaves collected, carefully segregated, and inspected by agricultural professionals and independently validated for distinct leaf diseases, CNN has been fine-tuned. The trained model is compared with the test image to forecast the disease. Using gradient descent and back-propagation algorithms, adjust the network parameters to reduce classification error.

## 4. ALGORITHM

**CNN:**

The reader is expected to be familiar with neural networks. Artificial Neural Networks are excellent in Machine Learning. Image, audio, and word classification are all examples of tasks where artificial neural networks are applied. LSTM and Convolution Neural Networks are both used for picture classification, whereas Recurrent Neural Networks and Convolution Neural Networks are used to predict word sequences. Let's go over the basics of a neural network again before getting into the Convolution Neural Network. Normal Neural Networks have three layers: the input, the output, and a hidden layer.

Layers of data to be entered: Essentially, this is the layer where we feed our model with data. There are exactly as many neurons in this layer as there are in our data (number of pixels in the case of an image).

The input from the input layer is fed into the hidden layer. Depending on our model and data size, there may be several hidden layers. As the number of characteristics increases, so does the number of neurons in each buried layer. A nonlinear network's output is generated by multiplying the previous layer's output by the layer's learnable weights and biases, then applying an activation function to the resulting matrix.

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A logistic function such as sigmoid or softmax is used to translate the output of each class into a probability score for each class in the output layer.

Using the model's output, we can next calculate the error using an error function, such as cross-entropy or square loss error, among others. This phase is referred to as "feedforward." After that, we use the derivatives to retrace our steps back to the model. Backpropagation is a technique used to reduce the amount of data that is lost.

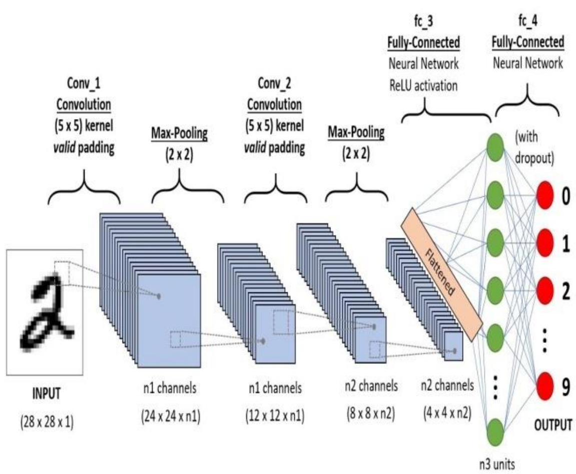


Fig.6: CNN architecture

**Step by Step Procedure:**

Step 1: Choose a Dataset. ...

Step 2: Prepare Dataset for Training. ...

Step 3: Create Training Data. ...

Step 4: Shuffle the Dataset. ...

Step 5: Assigning Labels and Features. ...

Step 6: Normalizing X and converting labels to categorical data. ...

Step 7: Split X and Y for use in CNN.

## 5. EXPERIMENTAL RESULTS

For example, it can identify between 12 different types of damaged leaves and their healthy counterparts in the image using the model that was designed for this task alone. The pesticide to be employed as a cure is displayed after the treatment, i.e., the pesticide, is successfully detected with a high level of confidence. As a preventative measure, this treatment helps to keep the disease at bay. Flask was used to integrate the pickle model into the remedy suggestion system. Leaf illnesses can be diagnosed more accurately and quickly using the proposed CNN methodology, compared to current methods.


Fig.7: Home screen.

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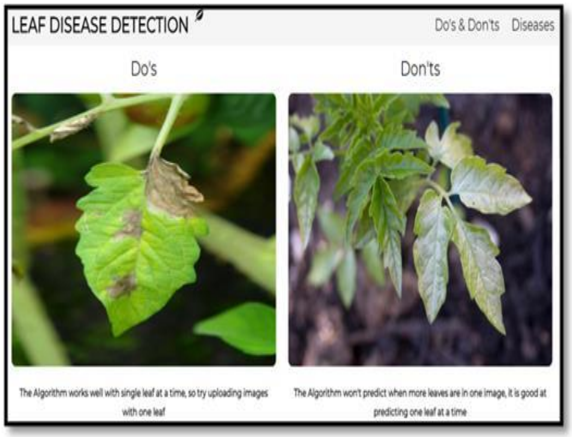


Fig.8: Upload image

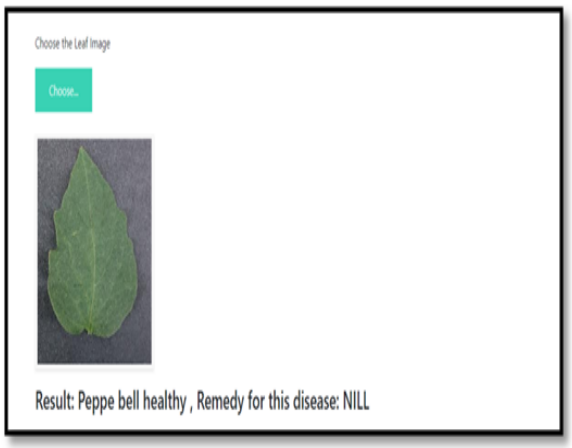


Fig.9: Detection result

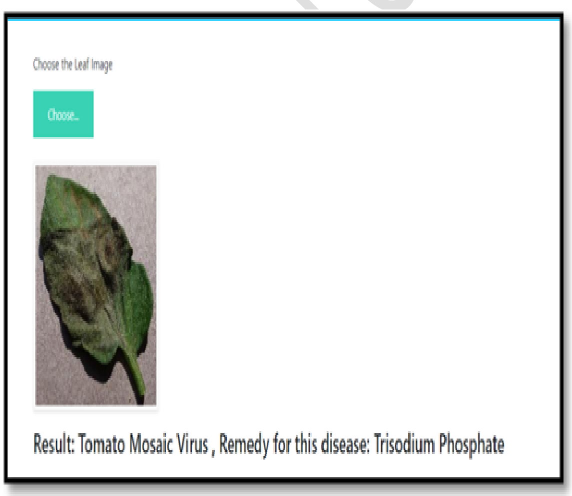


Fig.10: Another detection result

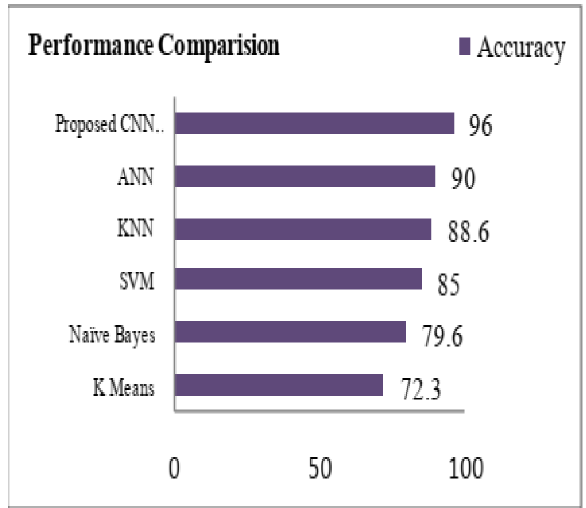


Fig.9: Comparison graph

## 6. CONCLUSION

The primary objective is to effectively identify and detect leaf diseases while also considering the advantages that farmers will derive. Using neural networks, a model of the human brain can be generated. There were very few models that could be trained in this manner prior to the invention of neural networks. Python's CNN model has a 96 percent accuracy rate for detecting leaf disease automatically. Increased accuracy and speed can be achieved with the use of a graphics processing unit (GPU). The proposed approach eliminates the need for an exorbitantly priced domain expert. In addition to accurately predicting leaf illness, it also offers a treatment that may be used to speed up the recovery of the plant's health. An airborne surveillance and live video coverage of huge agricultural fields may be done using this technology, which reduces the amount of manual work and time required. The model is fed data from photos taken by a high-resolution camera mounted on the drone. The cost is prohibitive for small-scale farming, but it is essential for large-scale farming.

### 7. FUTURE SCOPE

It is possible to create a voice-activated smartphone application that illiterate farmers may easily utilize. Expanding the model to include the diagnosis of more leaf diseases would be advantageous. Expansions, such as displaying the proportion of the leaf that is damaged, are possible.

### REFERENCES

[1] Pantazi, Xanthoula Eirini et al. "Automated leaf disease detection in different crop species through image features analysis and One Class Classifiers." Comput. Electron. Agric. 156 (2019): 96-104.

[2] Badnakhe, Mrunalini R. and P. Deshmukh. "An Application of K-Means Clustering and Artificial Intelligence in Pattern Recognition for Crop Diseases." (2011).

[3] D. Mondal, A. Chakraborty, D. K. Kole and D. D. Majumder, "Detection and classification technique of Yellow Vein Mosaic Virus disease in okra leaf images using leaf vein extraction and Naive Bayesian classifier," 2015 International Conference on Soft Computing Techniques and Implementations (ICSCTI), Faridabad, 2015, pp. 166-171, doi: 10.1109/ICSCTI.2015.7489626.

[4] Padmavathi, K & Thangadurai, K.. (2016). "Implementation of RGB and Grayscale Images in Plant Leaves Disease Detection – Comparative Study." Indian Journal of Science and Technology. 9. 10.17485/ijst/2016/v9i6/77739.

[5] Padol, Pranjali B. and A. A. Yadav. "SVM classifier based grape leaf disease detection." 2016 Conference on Advances in Signal Processing (CASP) (2016): 175-179.

[6] Mohanty, Sharada & Hughes, David & Salathe, Marcel. (2016). "Using Deep Learning for Image-Based Plant Disease Detection." Frontiers in Plant Science. 7. 10.3389/fpls.2016.01419.

[7] Singh, Vijai & Misra, A.K.. (2016). "Detection of Plant Leaf Diseases Using Image Segmentation and Soft Computing Techniques." Information Processing in Agriculture. 4. 10.1016/j.inpa.2016.10.005.

[8] Pawar, P. et al. "Cucumber disease detection using artificial neural network." 2016 International Conference on Inventive Computation Technologies (ICICT) 3 (2016): 1-5.

[9] Halder, Monishanker & Sarkar, Ananya & Bahar, Habibullah. (2019). "Plant Disease Detection by Image Processing: A Literature Review." SDRP Journal of Food Science & Technology. 3. 534-538. 10.25177/JFST.3.6.6.

[10] Khirade, Sachin D. and A. B. Patil. "Plant Disease Detection Using Image Processing." 2015 International Conference on Computing Communication Control and Automation (2015): 768-771.

[11] Kulkarni, Anand & K, Ashwin. (2012). "Applying image processing technique to detect plant diseases." 2. 3661-3664.

[12] Gavhale, Ms & Gawande, Ujwalla. (2014). "An Overview of the Research on Plant Leaves Disease detection using Image Processing Techniques." IOSR Journal of Computer Engineering. 16. 10-16. 10.9790/0661-16151016.

[13] Wallelign, Serawork et al. "Soybean Plant Disease Identification Using Convolutional Neural Network." FLAIRS Conference (2018).

[14] Xie, Xiaoyue et al. "A Deep-Learning-Based Real-Time Detector for Grape Leaf Diseases Using Improved Convolutional Neural Networks." Frontiers in plant science vol. 11 751. 3 Jun. 2020, doi:10.3389/fpls.2020.00751

[15] S. Phadikar and J. Sil, "Rice disease identification using pattern recognition techniques," 2008 11th International Conference on Computer and Information Technology, Khulna, 2008, pp. 420- 423, doi: 10.1109/ICCITECHN.2008.4803079