PROJECT ON

"PLANT LEAF DISEASE DETECTION SYSTEM"

Introduction

- Diseases and pests are the major problems of the agriculture. These require careful analysis and timely treatment to protect the crops from massive loss.

- Automatic detection of plant leaf disease is an essential topic for research as it may prove benefits in observing a large field of crop and thus automatic detection of disease from an indication that appear on a plant leaf. Moderately visual identification is less accurate and time-consuming than image processing identification[4].

- This automated system is designed to overcome the problems of manual techniques. The image could be captured using a regular digital camera or high-resolution mobile phone camera. That image is given as an input to the system for gaining the leaf attribute.

- The system consists of several steps like segmentation, attribute extraction, identification. The dataset that we used in the training of the model was taken from Kaggle. This data set was further trained and tested as per the Convolutional Neural Network (CNN). The average highest accuracy expected from this project is 98%, and we expect to reach more than this from this project.

- This project will aim to provide a free of cost application to the farmers located even in the most remote locations of the country, with an easy hands-on user interface.

Problem

- Diseases are the natural factor that can cause some severe effects on plants, which ultimately reduces productivity.

- The naked eye observations of experts are the primary approach used in observation for the detection of plant diseases. But, this needs continuous monitoring of experts.

- When there is a large farm, this approach might be prohibitively expensive.

- In some developing countries like India, farmers may have to go long distances to contact specialists, this makes consulting specialists too expensive, and a time-consuming farmer is unaware of non-native diseases. These can be a severe problem in some cases because this may lead to severe effects for the plants and the crop of the farmer.

Proposed Solution

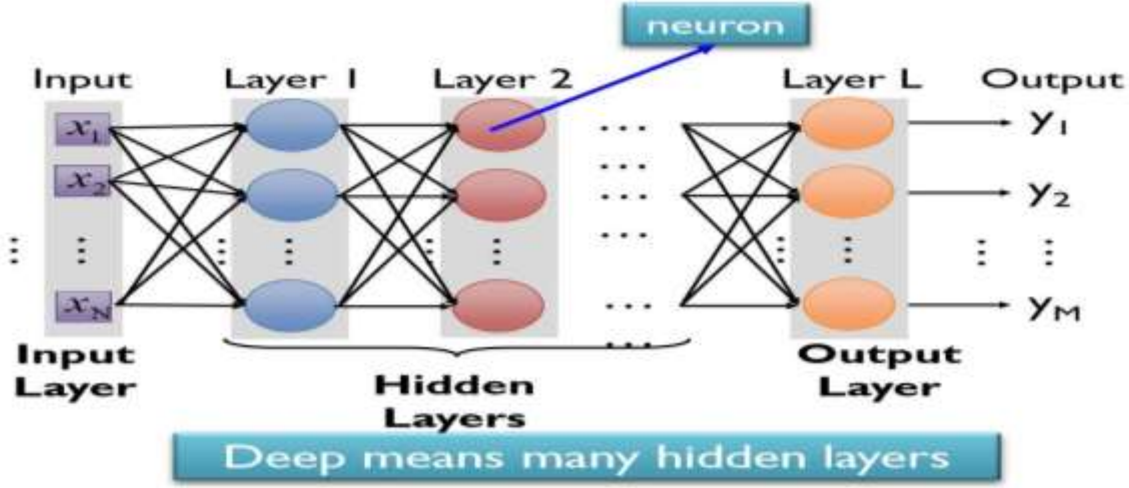
In the prototype model of the proposed system, we applied the concepts of deep learning and image preprocessing to develop a backend algorithm for our model that will help us to recognize the plant's disease and thus suggest the concerned person(farmer) about the possible solutions in the form of fertilizers.

We have classified the steps to the solution into following phases :
1. Phase 1 (Back End)
2. Phase 2 (Front End)
3. Phase 3 (Implementation)

1. PHASE 1 (THE BACK END)

- **Methodology**:

A Convolutional Neural Network (CNN) is a specific type of artificial neural network that uses perceptron, a machine learning unit algorithm for supervised learning to analyze data. CNN consists of convolutional layers, which are sets of image filters convoluted to images along with other layers (e.g., pooling). In image classification, feature maps are extracted through convolution and other processing layers repetitively, and the network eventually outputs a label indicating estimated classes. On the given dataset, we apply the CNN algorithm to optimize the weights and filter parameters in the hidden layers to generate features suitable to solve the classification problems. The parameter in the neural network are optimized by back-propagation and gradient descent approach to minimize the classification error.



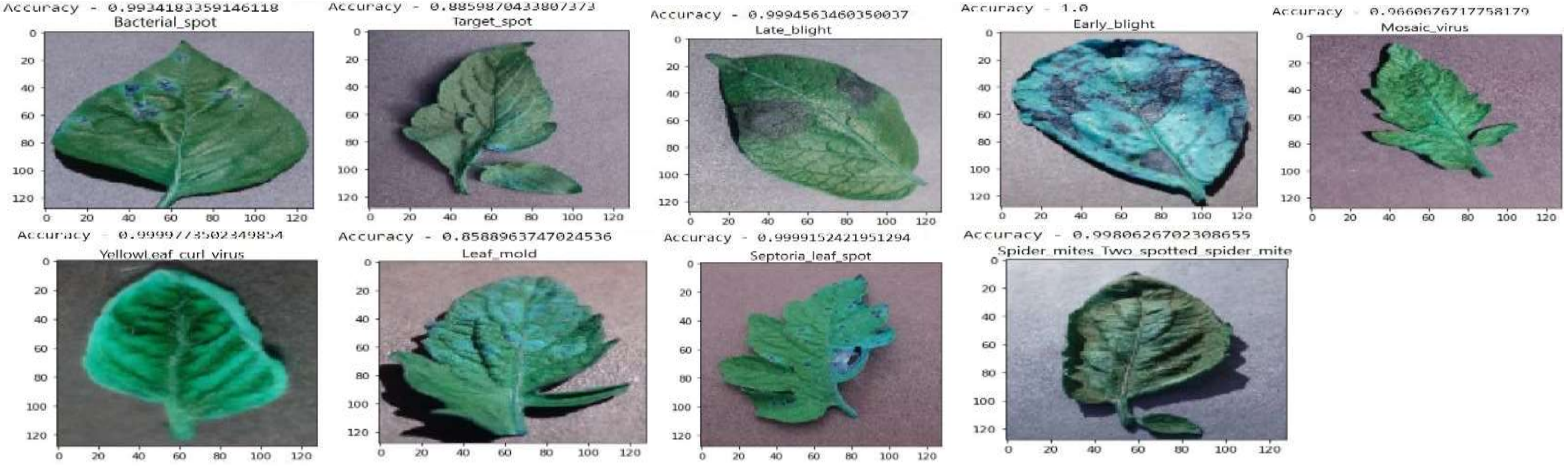
- **Working:**

In this, we apply image processing techniques for the detection of plant leaf diseases. The proposed methodology applied in this work, in which we followed the image preprocessing, segmentation, feature extraction, and sample images, was trained by CNN. In this system, the available images for the training of the model were taken from the Kaggle dataset named Plant Village. A total of 54305 image samples in the form of images were used in the form of 256X256 pixels. The diseases studied were of 34 class diseases, which are found in crops. The preprocessing step is to improve image data by removing background, noise, and also suppress undesired distortions. It improves image features for processing and analysis. The image stored in RGB format is resized to 256X256. Image enhancement is carried out to increase the contrast.

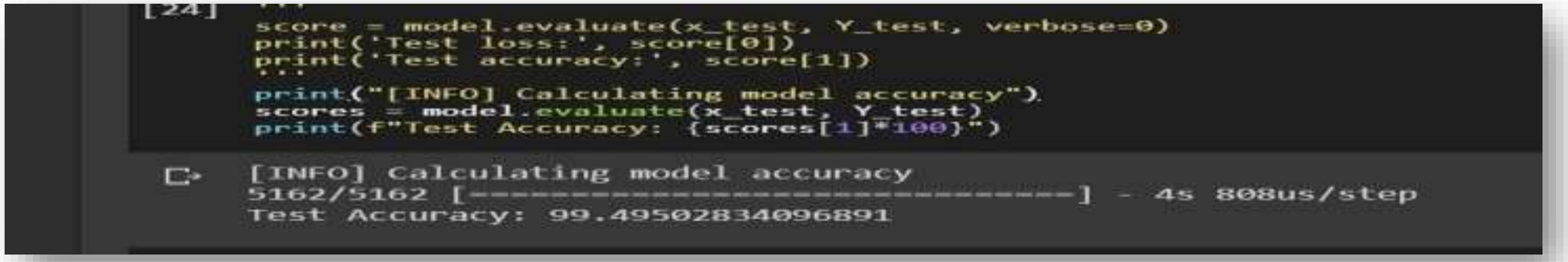
The following are the plant and their related disease types that are being covered under this project:

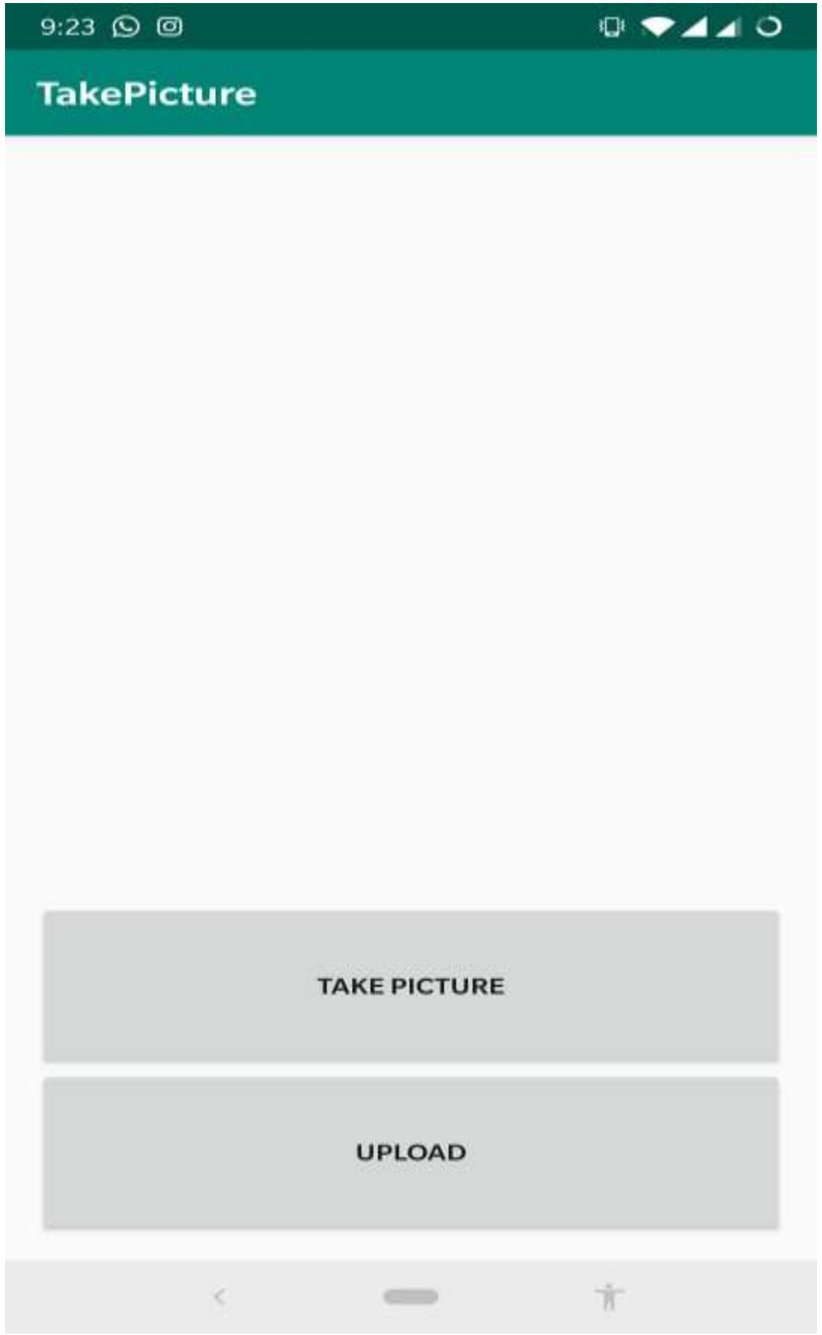
Plant/Crop	Diseases	Fertilizers(Examples)
Apple	Scab, Black rot, Cedar apple rust	fixed copper, liquid sulfur or liquid lime sulfur during rainy springs, etc.
Blueberry	Bacterial leaf scorch, leaf rust, Septoria leaf spot	Granular nitrogen-rich fertilizer, Fungicide, etc.
Cherry	Powdery mildew	Neem oil is a plant-based insecticide that also works as a fungicide, etc.
Grape	Black rot, Esca(Black Measles), Leaf blight(Isariopsis leaf spot)	Copper Fungicide Spray or Dust, Citrus, Fruit & Nut Orchard Spray
Orange	Sooty mould, Powdery mildew	Neem oil is a plant-based insecticide that also works as a fungicide, etc.
Peach	Bacterial spot	Oxytetracycline, Copper provides a third alternative for bacterial spot, etc.
Pepper	Bacterial spot, Early blight	Oxytetracycline, Copper, etc.
Potato	Late blight, Early blight	Nitrogen in nitrate form, Potassium, etc.
Raspberry	Mosaic, Fire Blight	Insecticidal Soap or Neem Oil, etc.
Soybean	Anthracnose, Bacterial blight, Brown spot	Ecofit, Neem Oil, etc.
Corn	Common rust	Fungicides, fluxapyroxad+pyraclostrobin, etc.
Strawberry	Leaf scorch	apply protective foliar fungicide, etc.
Tomato	Bacterial spot, Early blight, Late blight, Leaf Mold, Septoria leaf spot, Spidermites two spotted spider mite, Target spot, Mosaic Virus, Yellow leaf curl virus	Nitrogen in nitrate form, Potassium, etc.

- A total of 54305 images are used for training the system. Training is the process by which the system learns the input parameter and classifies the input images into different classes. In this first from an infected plant, the leaf is loaded by opening the directory with the help of the OS module and then saves those images in a list with the help of an OpenCV. Those images are loaded in a pixel format. The classification of infected plant leaf's performance depends on various classification techniques that have been analyzed for the 54305 input leaf images. From these 997 are of bacterial spot, 1,000 are of early blight, 1,000 are of late blight, and so on. In CNN the percentage of correct classification of infected plant is shown below:-



Model accuracy:



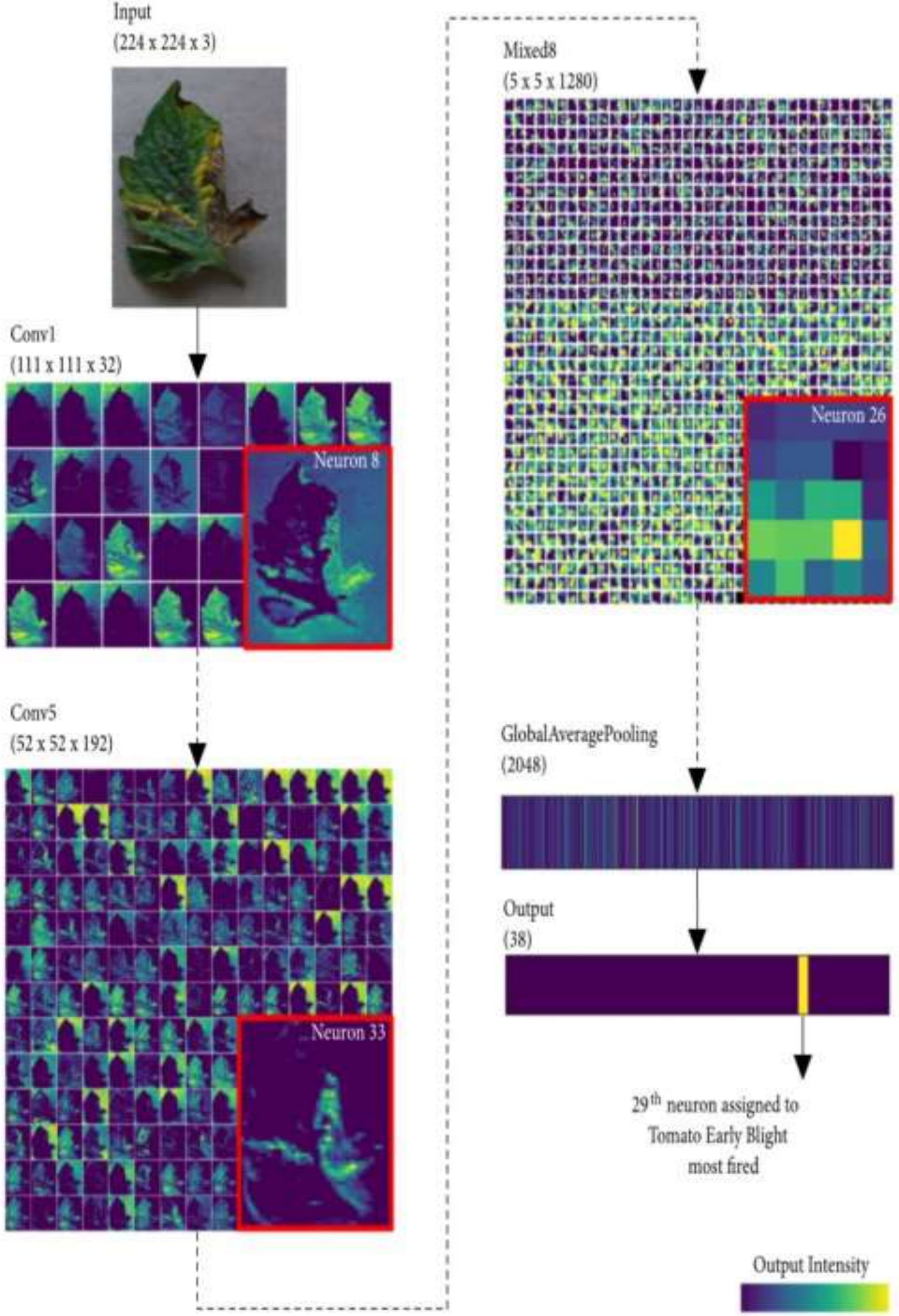


2. PHASE 2 (THE FRONT END)

- For the front end of our proposed project, we are developing an app that will provide a user interface for the ordinary users (farmers) of the model, to blend the algorithm being used to predict the plant's diseases with the real day to day scenario.

- Using this application, the farmers will be able to upload the images of the crop/leaf. On the simple click of a button, it will predict for him/her if their plant/ crop is healthy or not, and if it is unhealthy, it will also suggest to them the fertilizers that may be used or any other solutions if possible.

- In this way, the project will aim at providing a better and easily accessible solution to the farmers for their problems at their doorstep.



3. Phase 3 (Implementation)

- The implementation phase focuses on the central aspect of how does the working of this project is mentioned in terms of the output and solutions provided as per the input.

- In the initial stage when the entire work is being done at the worksheet where the algorithm is developed, the input after the training of the model is done, is given in the form of testing data, where after the input (an image of the infected leaf), after analyzing it and putting it in the algorithm, the model predicts it to be healthy or unhealthy, if unhealthy, it predicts it's disease and also tells the accuracy of the prediction.

- For the user end, the output shall be provided on the app developed with the suggestion of fertilizers which can cure the plant.

Implication

The implication of our project is designed to be free of cost and readily available to the targeted users, i.e. the farmers so that they do not have to face the same problems that they had to earlier. They do not have to suffer the complexities of the system, and it's bureaucracy and are easily able to get solutions to their problems regarding their crops. The Implication part has been put down into two stages of implication:

Stage One:

- Today is an age of high-speed internet and technology, where everyone more or less has access to smartphones. Keeping this in mind, we aim at bringing the app developed for the disease detection on Google Play Store, which is a leading platform of getting hands on the applications that are helpful for the chores of daily life.

- Our app will be available on this platform free of cost for the farmers, from where they can easily install it, and then can use the app to know their crop's disease and get solutions to cure it, given the user-friendly the interface of this app.

Stage Two:

- Keeping another scenario in mind as well, where the farmer from the remotest locations of our country is not capable of having access to smartphones or the internet. We have a plan of reaching out to the Kishan Help Centres or Agricultural Deptt. of India so that their officers can be told about our app and asked to use it for solving the cases related to crop diseases using our app, whenever such a case is reported in their area.

- In this way, the farmers will not have to spend their time and money on travelling to these centres with a sample of their crop to be tested. Instead, these representatives from these centres will come to them and using the app, will be able to tell them the solutions or answers that they need. All this will be done free of cost, as there will be no experts advice and testing needed. All the work shall be done by the app, that too, with high accuracy and minimum time.

Conclusion and Future Work

- Human life is completely dependent over plants and agriculture and yield of crops play a very important role in deciding the overall development and growth of the human race, for this purpose, there is an urgent need to solve the issues and problems that are related to plants and agriculture.

- Therefore we in this project are aiming to create a model that will help in the monitoring and well keeping of the agricultural plants from the various diseases by analyzing them thoroughly of crops.

- In future, we will extend our database since as we increase the training data, the accuracy of the system will be higher.

- We also try to make the application as user-friendly and time-saving as possible so that even a 10-year-old child may be able to use it effectively.

- We also plan to develop a system within the app in future that will predict and tell the farmers the best crop/plant that may be grown on their land as per the soil conditions.

References

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[4] Vijai Singh, A K Mishra, “Detection of plant leaf diseases using image segmentation and soft computing techniques”, Information Processing in Agriculture Volume 4, Issue 1, March 2017