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Python based Expert System for Mango crop Disease Detection using Random Forest

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Abstract
Agriculture is one of the major contributions in Indian economy. In rural India 70% of the people are depending on Agriculture. The Andhra Pradesh state is also agro based and stands to be top in our country. Mango is an important crop that generate substantial revenue to farmers through domestic consumption and through the exports to other countries.As Mango crop is contributing more economy, proper care should be taken for the quality production. Proper Disease Detection in mango crop is necessary to increase the productivity and Quality. Hence, in this study various images of Mango leaves with different diseases are considered for the study. An expert system is developed using python to detect the disease occurred to the mango plant. Random Forest Classifier is used to classify the disease infected mango leaves images. The expert system is able to detect the particular disease occurred successfully with high accuracy.

Keywords: *Disease Detection, Mango Plant, Expert System, Random Forest.*

I. INTRODUCTION

Mango is the national fruit and one the important fruit crops in India and it is exported to various countries. Mango has rich medicinal values and it is also used in Ayurvedic medicines. In addition to its delicious taste mango is rich in Vitamin A and C. The mango tree is hardy in nature and requires low maintenance cost. Andhra Pradesh is having larger area of mango crop when compared with other states in India. Fresh mangoes and pulp are the major item in the Agro-exports from India. Mainly mangoes are exported from India to the countries such as USA and Middle East countries. In this way Mango crop is contributing major portion in the Indian Agro-economy. Hence, proper care and effective disease management is necessary [1].

Usually disease identification in mango plant are carried out by the farmers. Farmers can able to identify the diseases by monitoring the leaves, steams, flower and fruits continuously. Disease identification of mango plants in small scale is very easy. But for large scale mango crop disease identification by the farmers is complex and error prone. Therefore, automated disease detection is necessary for increased productivity and quality of mangoes.

In this study an Expert system which can detect the most commonly occurred diseases in mango plant is developed. The proposed system can identify the disease such as Bacterial Canker, Mango Anthracnose, Mango Malformation, Oidium Mangiferae, Powdery Mildew and Sooty Mould efficiently. The proposed system is developed using Python and various Image Processing and Artificial Intelligence libraries.

II. LITERATURE REVIEW

Several researchers contributed their research for the automatic identification of the diseases and health of mango plant using various Image Processing Techniques and Artificial Intelligence Techniques. Some of the works done are reviewed in this section.

Shripad S.Veling et.al [2] used an improved Fuzzy c-mean Clustering algorithm, FRFCM to

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segment the images of mango leaves and fruit. After segmentation the texture features are extracted using GLCM method. Finally Support Vector Machine (SVM) is used to classify the data and the health status of the mango leaf and fruit is identified.

Nabodip Sutrodhor et.al [3] developed a methodology called Mango Leaf Ailment Detection (MLAD). In the proposed methodology the input image is preprocessed using k-means clustering algorithm. From the disease affected region 13 features (Color and Shape) are extracted. Neural Networks and Support Vector Machine are used to classify the data.

Priyadharshini M. K et.al [4] developed a Convolution Neural Network to identify the disease using leaf images. With low computational power the images are classified efficiently. It takes longer time to train but it works more efficiently than the traditional methods.

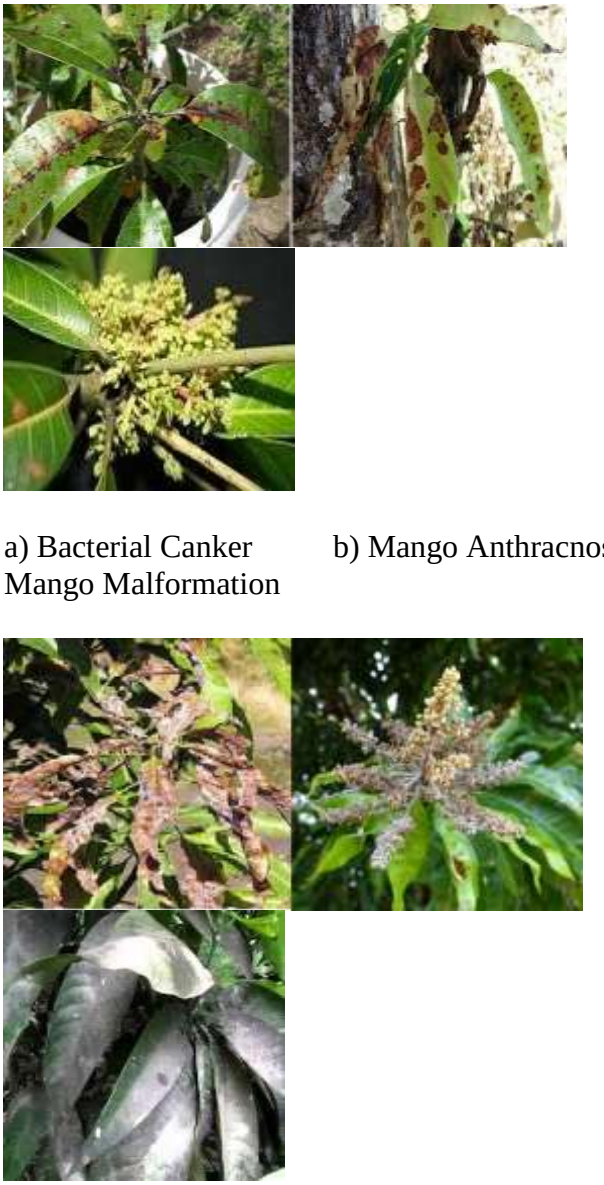
Jayaprakash Sethupathy et.al [5] identified and classified the diseases of mango leaves. K-means algorithm is applied for the disease segmentation, and SVM classifier is used for the disease classification. Leaf shape based disease identification has been performed in this study. Disease identification is carried out using the OpenCV libraries and Leaf shape based disease identification is carried out using MATLAB.

III. MATERIALS AND METHODS

In this section the dataset used for the study and the techniques applied are presented. The implementation details are also discussed in this section.

Dataset

42 images of mango leaves infected with six types of diseases like Bacterial Canker, Mango Anthracnose, Mango Malformation, Oidium Mangiferae, Powdery Mildew and Sooty Mould are acquired from the regional mango farms. Collected sample images of mango leaves based on the disease are presented in the figure 1.



a) Bacterial Canker b) Mango Anthracnosec) Mango Malformation

d) Oidium Mangiferae e) Powdery Mildew
f) Sooty Mould

Fig 1.Sample images of mango leaves in the dataset

In figure 1 sample images of mango leaves related to the six types of diseases are presented. Different images related to the same disease are collected to get better training and classification accuracy.

Implementation Details

Powerful scientific environment Spyder is used for

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the implementation of the expert system using Python version 3.7. Qt Designer application is used to build GUI. Tkinter GUI library is also used along with the packages imutils, numpy, mahotas, cv2 and PIL.

IV. EXPERT SYSTEM FOR THE DISEASE DETECTION OF MANGO CROP

The proposed expert system for the disease detection of mango crop consists of stages such as Image Pre Processing, Feature Extraction, Training and Disease Detection.

Image Processing

In the Image Preprocessing stage the RGB color mango leaves image is converted in to Grayscale image. The figure 2 represents the image preprocessing phase.

Fig 2. Image Preprocessing phase

Feature Extraction

Texture features of the selected image are extracted in this phase. 19 features are extracted for the selected image. The Feature Extraction phase is presented in the figure 3.

Fig 3. Feature Extraction phase

Training

In the training phase 75 % of the images among 42 images related to different types of disease infected mango leaves are trained using Random Forest Classifier. Remaining 25% of the images are used for the testing phase. Figure 4 represents the training phase.

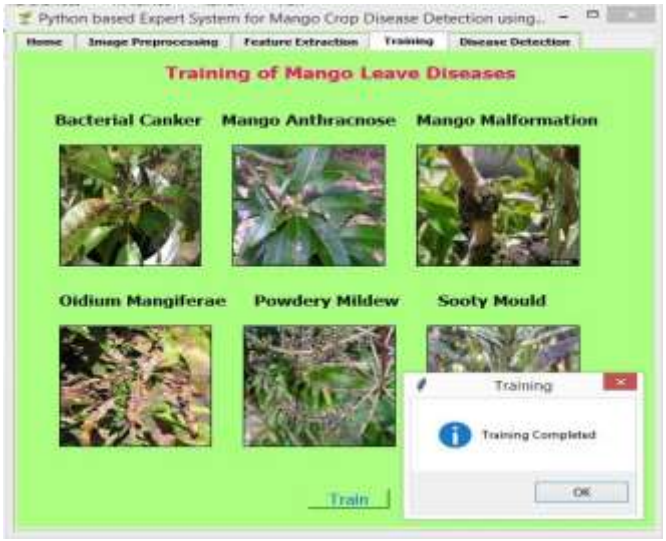

Fig 4. Training Phase

Disease Detection

In this phase test images are selected and the disease of the mango leaves is identified accurately. Figure 5 presents the results of disease detection.

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Fig 5. Disease Detection results

V. RESULTS

The proposed python based expert system for the disease detection of mango crop is used to preprocess the mango leaves images, extract the textures features and to train the model. The trained RF based model is tested with the mango leaves images with the six diseases mentioned in the section 3.

The accuracy of the model is evaluated for the each disease. The results are presented in the table 1.

Table 1: Testing Accuracy of the proposed model

Disease name	Testing Accuracy
Bacterial Canker	83.33%
Mango Anthracnose	83.33%
Mango Malformation	77.77%
Oidium Mangiferae	77.77%
Powdery Mildew	**100%**
Sooty Mould	85.71%

The results of the proposed expert system for the disease detection is represented diagrammatically in figure 6.

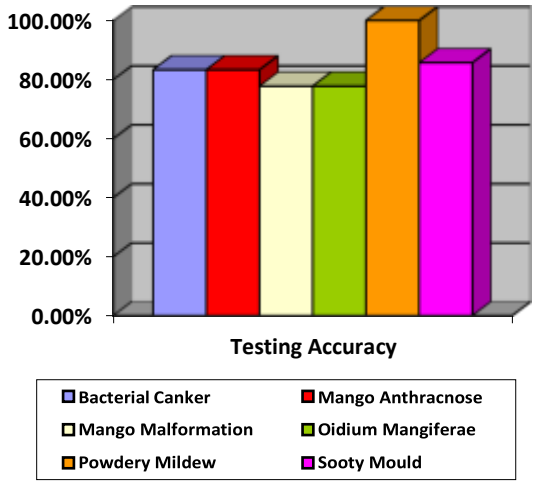

Fig 6. Comparison of testing accuracies of the results.

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The proposed python based expert system is able to detect the diseases of mango crop efficiently with higher accuracy. The proposed system is able to identify the Powdery Mildew disease with 100% accuracy. Sooty Mould disease is identified with 85.71% accuracy. The diseases such asBacterial Canker and Mango Anthracnose are detected with 83.33%. Mango Malformation and Oidium Mangiferae diseases are identified with less accuracy 77.77% compared with other diseases detection.

VI. CONCLUSIONS

Python based Expert System for Mango crop disease detection is proposed in this study. The proposed expert system uses Random Forest classifier to classify the image dataset into six classes related to six diseases of mango plant such as Bacterial Canker, Mango Anthracnose, Mango Malformation, Oidium Mangiferae, Powdery Mildew and Sooty Mould. The proposed system is able to detect the all the diseases with higher accuracies. Among the six diseases, the Powdery Mildew disease is identified with 100% accuracy. The remaining diseases are detected with less accuracies than that of Powdery Mildew disease. If more number of mango leaves images with diseases are added to the training dataset can improve the accuracy of the proposed system.

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