Efficient Prediction Model for Detection of Black Spot and Downy Mildew Diseases in Rose Flowers

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Abstract: Flower also known as bloom or blossom often believed as natural item to show the love, peace, affection and complement. Among various countries in the world, India has fourth largest production of flowers. It is also found that rose flowers are the most preferable flower by people to exchange their feelings on different events. However, rose flower plants suffer from different diseases. The reasons for these diseases are the occurrence of bacteria, viruses or fungi in these plants. Every farmer wants to get an increase in flower production and concentrate more on the detection of disease, if any, in the early phase of plant growth. This paper proposes an approach based on image processing and machine learning to correctly detect the plants which are affected by a particular disease. We have used a dataset of digital images that contains a large set of healthy and unhealthy images of rose plants. We have used color threshold algorithm in order to segment leaf from its background. We have used image processing methods to extract a set of features and develop various classification models. In this work, we have used recall, precision and accuracy parameters for performance evaluation. We have performed various experiments by considering different ratios of training and testing samples on original and augmented datasets. From all experiments, it is found that the precision, recall and accuracy of proposed approach is highest for random forest-based prediction model and lowest for SVM based prediction model in detection of flower plant diseases. In summary, we have achieved the 98.57% accuracy for the detection of Black Spot and Downy Mildew diseases in rose flowers

Keywords: Black Spot and Downy Mildew Disease, Rose Flower, Segmentation, Machine Learning.

1. INTRODUCTION

Nowadays, the requirement of specific type of flower is increasing on the specific days such as valentine day, Birthday, father's day, Mother's day, New Year etc. Agriculture experts have found various factors such as accessibility the nutrient for specific flower plants, water availability, seed quality, and soil type may affect the flower production [1]. Every farmer wants to get an increase in flower production and concentrate more on the detection of disease, if any, in the early phase of plant growth. It is found that flower plants suffer from various diseases. The disease symptoms are reflected on leaves and according to the symptoms a particular disease is identified. These diseases occur due to bacteria, viruses or fungi in these plants. Researchers have found that around 30-40% of flower crops are destroyed due to these diseases. When farmers got that their plants infected by some disease, they used some pesticides or did other treatments. Some farmers are capable of detecting disease manually. But sometimes they fail to detect accurately and result in loss in their crops. To overcome this problem, researchers are working in this direction and have proposed many approaches to detect the disease in an initial state, so the necessary action can be taken at that time to prevent crop loss. Researchers have proposed image processing [2], machine learning or deep learning based [3-7] many approaches for detection of different kinds of plant diseases.

2. DISEASES IN GARDEN ROSE FLOWERS

Among the various flowers, roses are the most demandable flower by the people. The demands of rose flowers become very high at various occasions such as valentine day or during festival days. On the other side, the garden flowers suffer from different kinds of diseases due to many different causes. Some flower plants show the same symptoms on the leaves, however, suffered from different kinds of diseases. Therefore, specific disease identification is required by examining leaves and stems for proper treatment. Therefore, diseases in rose plants affect the yield as well as beauty of rose flowers [8]. The brief details of commonly rose diseases are discussed in the following section.

Black Spot: It is a common disease that occurs due to diplocarpon rosae fungal on leaves of rose flowers. Due to this black round spots are seen on the leaves. It may be seen as black-to-brown spots with diffuse borders. Because of this disease, the

plants internal development is affected and produces dirty leaves. Figures 1 show the pictures of Block Spot disease on rose flower leaf.

Figure 1: Black Spot Fungal Disease on Rose

Powdery Mildew: It is a fungal disease which creates a white powder coating on the flower plant's leaves, steams and on the flower itself. Due to this flower leaves may twist and change their color initially into yellow then in brown. This disease becomes worse in humid or warm season. Generally, zinnias, snapdragons, and verbena flowers plants are affected by this kind of fungal disease. Figure 2 shows the picture of Powdery Mildew disease on rose leaf.

Figure 2: Powdery Mildew on Rose Leaf

Rust: It is a fungal disease that occurred due to the Phragmidium mucronatum and P. tuberculatum fungus. It creates faint yellow spots to green spot on rose leaves's upper surface and yellow to orange pimples on the lower surface of rose's leaf. Figure 3 shows the picture of Rust on rose leaf.

Figure 3: Rust Disease on Leaf of Rose Leaf

Botrytis Blight: It is also known as Gray Mold. It is a common fungal disease that occurs in flowers due to the Botrytis cinerea fungus. The effects of this disease are seen on flower petals, buds or on leaves in cool or rainy season. It appears on dying leaves and flowers. It begins with gray or white growth on flowers generally seen early in the morning, soon spreading to the stalks and causing plants to become dry and brittle. Figure 4 shows the picture of Botrytis Blight on rose leaf.

Figure 4: Botrytis Blight Disease on Leaf of Rose

Downy Mildew: It is a fungal disease that occurred due to Downy mildew is caused by the fungal-like organism. It looks similar to black spot disease but has different behavior. The many treatments being used to control the black spot disease are not useful to control the downy mildew. Due to this disease leaves have angular brown, red or purple lesions. The high humidity and cool weather is a favorable environment for this disease. Figure 5 shows the picture of Downy Mildew on rose leaf.

Figure 5: Downy Mildew Disease on Leaf of Rose

Among the above discussed diseases Powdery mildew and black spot diseases are the most common diseases on rose flower plants [4].

The main objective the main objective is to develop a rose flower's diseases detection system to help the farmers in identifying rose diseases in crop production early stages to avoid any kind of losses. The next objective is to review the existing approaches developed by various researchers to detect the rose flower's diseases. The final objective is to extract a set of features from leaves of rose plants and build prediction models to correctly detect the plants which are affected by a particular disease.

The rest of paper is organized as follows: In section 3, is discussed the literature review of existing approaches. Section 4 discusses the flow chart in detail of the proposed approach. The results and analysis are discussed in section 5. Finally, we have concluded our work in section 6.

3. LITERATURE SURVEY

Nowadays, plant disease detection based on machine learning techniques is becoming a rising field of computer vision in agriculture. Due to good accuracy in disease detections, these approaches are becoming popular. Researchers have given various approaches for plant disease detection by using different algorithms such as decision tree, artificial neural network (ANN), support vector machine (SVM) etc. In this chapter, we have discussed the previous work proposed by various researchers.

Nishkala and Bhavaya [8] proposed an approach to detect rose leaf disease. Firstly, they performed the segmentation on the rose images and found pixel distribution using k-means clustering algorithm. They build the model using CNN algorithm; however classes present in the dataset was not mentioned.

S. Minaei, M. Jafari , and N. Safaie proposed and developed a system for the detection of Powdery mildew and gray mold diseases in Rose flower using infrared and visible images. They also proposed a spraying system for prevention of diseases on specific sites. Authors in paper [10] developed Convolutional Neural Network Model for identifying rose flower diseases. They have used VGG16 Architecture to develop prediction model. They have achieved an accuracy of 90.26% in classification of various rose diseases. Authors in paper [11] propose an Image processing and machine learning based technique for rose plant disease detection. Authors in papers [12] and [13] used Support Vector Machine (SVM) and K-Nearest Neighbors (KNN) algorithm respectively. In paper [14], authors proposed an approach to detect four different types of rose plant diseases with minimum 93% accuracy.

4. PROPOSED APPROACH

The flow chart of the proposed approach is shown in figure 6. In this work, we have considered two datasets (i.e. original and augmented datasets) of three different categories i.e. leaf with Black Spot & Downy Mildew diseases and healthy rose leaf images, for analyzing the performance of proposed approach. Because Block Spot and Downy Mildew diseases are considered the most serious disease among the various diseases in rose plants. Rose black spot disease occurs due to fungus and affects the plant strength. The downy mildew disease is caused by Peronospora sparsa and harms greenhouses, nursery and all other placed rose plants. The original and augmented datasets contain 917 and 4342 images respectively. These images are collected from Mendeley data available for downloading at **https://data.mendeley.com/datasets/7z67nyc57w** [9]. In our data set all images are RGB color format. RGB denotes the red, green and blue color contribution for each pixel. The intensities of green, red and blue color are used to determine the color of each pixel. In a 24-bit format, each color values are represented by 8 bits each. Basically, feature extraction is an important step in building machine learning based prediction model. In the previous step, we obtained segmented images. Next, we again converted the segmented images into RGB color images as this is necessary to perform the feature extraction. Further, we have extracted a set of features from segmented images. We have extracted color, shape and texture features to quantify the plant images. The other extracted features are contrast, energy, entropy, variance,

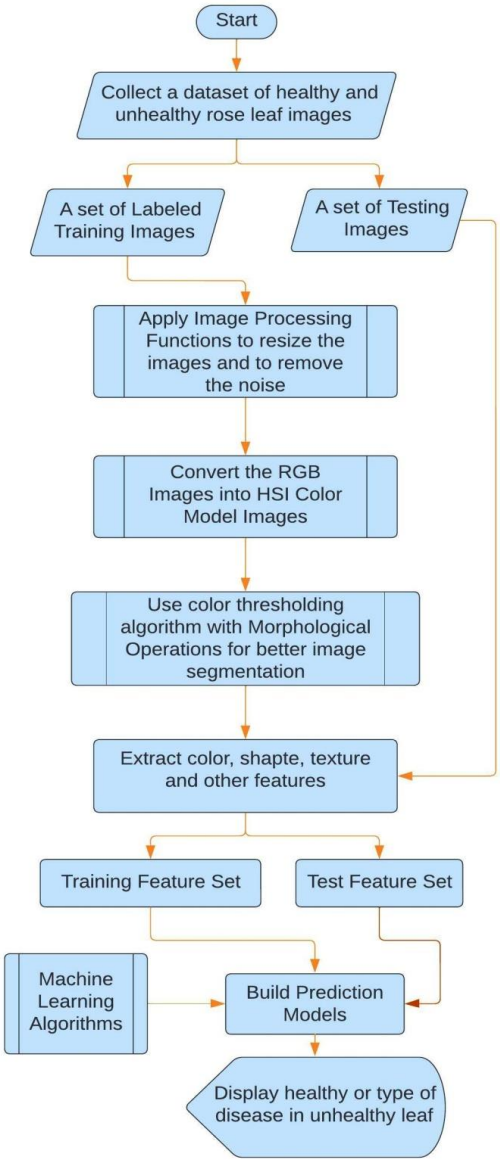

Figure 6: Proposed Approach

5. EXPERIMENTAL RESULTS

To evaluate the performance of the proposed approach, two datasets (i.e. original and augmented datasets) of three different categories i.e. leaf with Black Spot & Downy Mildew diseases and healthy rose leaf images have been used. The original and augmented datasets contain 917 and 4342 images respectively. We have applied various preprocessing techniques images for various purposes. We divide this data dataset into training and testing dataset by taking 70%, 80%, 90% images in training and remaining images in the testing dataset in the different experiments. We have developed various models by using Nearest Neighbor classification (KNN), Support Vector Machine (SVM), Naïve Bayes and Random Forest machine learning algorithms.

Table 1: Performance of Model Prediction Models based on Augmented Dataset

Machine Learning Classifier	Precision (%)	Recall(%)	Accuracy (%)
NB	82.34	82.36	81.42
SVM	80.81	80.09	79.04
KNN	94.3	94.4	93.92
Random Forest	98.5	98.7	98.57

Table 1 shows the performance of prediction models on augmented dataset by considering 80% images as training samples and 20% images as testing samples. From this table, we can see that the accuracy of Naïve Bayes, SVM, KNN and Random Forest based prediction models are 81.42%, 79.04%, 93.92% and 98.57% respectively. The precision of Naïve Bayes, SVM, KNN and Random Forest based prediction models are 82.34%, 80.81%, 94.3% and 98.5% respectively. It also can be seen the recall of Naïve Bayes, SVM, KNN and Random Forest based prediction models are 82.36%, 80.09%, 94.4% and 98.7% respectively. These show the accuracy, precision and recall values of Random Forest based prediction model are highest and SVM prediction model is lowest in detection of flower plant diseases. There is a minor difference in the accuracy, precision and recall values of NB & SVM based prediction models.

6. CONCLUSION AND FUTURE WORK

In this paper, an approach is proposed for detection of Black Spot and Downy Mildew Diseases of Rose Flowers using Machine Learning and Image Processing Techniques. We have used color threshold algorithm in order to segment leaf from its background. In this work, morphological operations as well as edge detection techniques are also used. We have used image processing methods to extract a set of features and develop various classification models. From the results, it can be seen that the precision, recall and accuracy of the proposed approach is highest for random forest-based prediction model and lowest for SVM based prediction model in detection of flower plant diseases. In summary, we have achieved the 98.57% accuracy for the detection of Black Spot and Downy Mildew diseases in rose flowers.

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