Automatic Leaf Parameter Monitoring and Analysis of Irrigation System in Agriculture using Machine Learning Technique

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Abstract- India is a country where most of the people rely on agriculture for leading their lives. There for quality and quantity of each crop is important to have better income. But it may be effected if a disease is caused to a plant. Hence it is necessary to detect and analyses the disease as early as possible. Accurate exposure and recognition of crop disease thus plays an important role in adequately regulating and preventing disease for feasible agriculture and food preservation. So detection and diagnosis of disease at the right time is essential to the farmer. This paper proposes a simple and creative method which is useful in the leaf disease detection and selection of fertilizers using artificial neural network. This system involves different concepts related to image processing such as image acquisition, image preprocessing, feature extraction, artificial neural network based training, classification, diagnosis and treatment by using Support Vector Machine (SVM). Different texture features of some leaves are used as database for performing the operations. Here we can get the disease name and also the fertilizer which is precise for that disease. It gives better performance compared to other processing system. In this proposed method ATMEGA 8 and front end GUI is used for displaying the values of each parameter. Image processing is used to detect leaf diseases. Analysis of proposed method is done by plotting graph of different parameter with respect to time. From graphical analysis farmer can provide nutrient and water through drip irrigation for improving and increasing the crop production.

Key Words: Crop diseases, Statistical movements, Computer vision, Image segmentation, GLCM, SVM, Diagnosis.

I. INTRODUCTION

Plant disease cause reduction in both quality and quantity of the food crops. Another reason for reduced production is the presence of pest. In present situation there are different concepts of image processing technology adapted in order to identify the plant disease. One of the dominant problem for agronomist is to reduce and destroy the progress of pests affecting the crop yield. The common pests like fungus, slugs, gnats, flies, snails, caterpillars etc. were most commonly seen in the plant disease. Majority of agriculturist are used to identify pest systemically over examination by just their eyes but this access is high and it takes some time.

The techniques of digital image processing have been organized in the agriculture field in order to analyze the purposes in different agricultural applications like plant recognition, crop yield approximation, soil quality estimation etc. Feature extraction method of neural network with GLCM approach was also established in order to detect the crop disease. The extraction of texture feature is carried out by both using GLCM. The literature survey says that the existing systems will not offer preventive measures since most of them focus on classification of crop disease. In order to overcome such problems, a system is proposed that will provide disease name and suitable fertilizer for that disease. Also features such as texture will also be extracted using Gray Level co-occurrence Matrix (GLCM) and first order statistical moment's method. GLCM is a matrix representing the frequency of one gray level existing in a stated structural linear relationship with another gray level within the area of observation. In order to calculate the texture features the contents of this GLCM matrix can be used, by observing the measure of difference in intensity at the pixel of interest.

II. RELATED WORK

Detection of leaf disease and also the spread of diseases in plants has long been an issue of concern in agriculture sector for crop quality management. Some already developed systems with in the area of detection of leaf disease and the level of diseases is shown below.

Akanksha rastogi sopra et, al[1**]** offered algorithm for leaf disease identification and classified using digital image processing and machine vision technology. System is functioned in two parts. In initial part, recognition of plant based on feature of leaf is prepared and in the second part, classification of disease present in the leaf and grading of disease is carried out on the basis of the amount of disease present in the leaf. This system is based on Machine Vision Technology and Artificial Neural Network (ANN) and it is useful for automatically detecting plant leaf, leaf disease and also categorizing them. However from this it is not possible to detect the fertilizer which is apt for the disease. Here the

system covers almost all possible viral diseases for cucumber and executes less diagnostic limitations during image acquisition. This system uses Euclidean distance technique and K means clustering technique for segmentation of picture to divide the leaf area, disease area and background area of the input leaf image for calculating the percentage infection of the disease in the leaf and to classify them into different categories.

Ms.Pooja pawaar et, al[2] presents algorithm for detecting crop disease early and exactly. Image processing techniques and artificial neural network are used to develop this system. It consist of different concepts related to image processing such as image acquisition, image preprocessing, feature extraction, creating database and classification using ANN. In this, database is a collection of many texture features of leaves. The system involves collecting leaf samples of diseased cucumber crop. Process is implemented to find cucumber crop disease and also deliver treatment for the detected disease. Two cucumber crop diseases namely powdery mildew and downy mildew are considered for this work. The first order statistical moments and GLCM are used to extract texture features. System provides classification correctness of only 80.45% not 100%. This can be used in more than one crop of diverse types. For a different crop type, the system has to choose those features only that can categorize their crop diseases precisely.This system offers a new practical plant-disease recognition system, for this it takes about 7,520 cucumber leaf images comprising images of leaves that infected by different viral diseases and healthy leaves. The leaves were photographed on site under only one requirement that, each image must contain a leaf roughly at its center, thus providing them with a large variety of appearances, although partial of the images used in this experiment were taken in bad conditions. Here the classification is done on the basis of conventional neural networks and attained an average of 82.3% accuracy under the four-fold cross validation strategy. The system covers almost all possible viral diseases of cucumber and imposes less diagnostic restrictions during image acquisition. In all these related works disease name is available but not able to get the fertilizers name which is suitable for that disease. To overcome this we introduced new system of leaf disease detection and choice of fertilizers using ANN.

III. PROPOSED METHOD

Betel vine plants are infected by a variety of diseases in the complete plantation without any premature warning of the diseases. The aim of this work is to detect and classify foot rot, leaf rot and powdery mildew diseases in the variety of betel vine plants (leaves) in an earlier stage using digital image processing techniques. The architecture of the proposed system is shown in fig.1. This describes each processes in the system and the method involved in it.

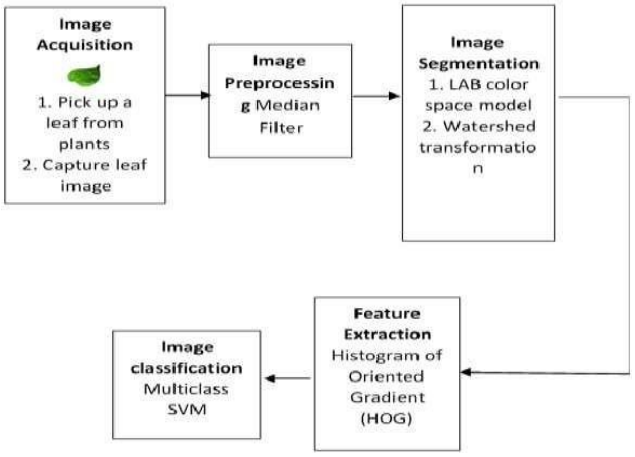


Fig.1 Architecture of the proposed system

A. Module Description of Proposed Technique

The main objective of this proposed methodology is detection of leaf disease and fertilizers that is appropriate for the specific disease. For this we are using artificial neural network. For experimental analysis mango and lemon leaves are treated and these have two kinds of diseases. The proposed method is shown in figure1.

The modules within the current work are given below,

- Image acquisition
- Image preprocessing
- Color transformation
- Image segmentation
- Feature extraction

- Classification

1) Image pre-processing: In image pre-processing the operations on images at the lowest level of abstraction is done. These operations don't increase image information content however they decrease it if entropy in an information measure. The aim of pre-processing is to enhance the image information that suppressed by undesired distortions or enhances some relevant image features for further processing and analysis task. The improvement includes filtering that removes the noise and process the image efficiently. The filtering is completed by using median filter. The median filter is operated by arranging all the pixel values from the window into numerical order, and then replacing by middle pixel value. The original image and is shown in figure 3 and figure 4.

Fig.2 Original image

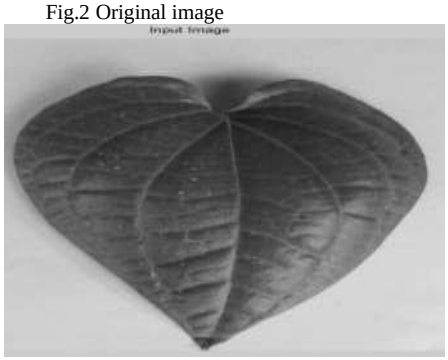
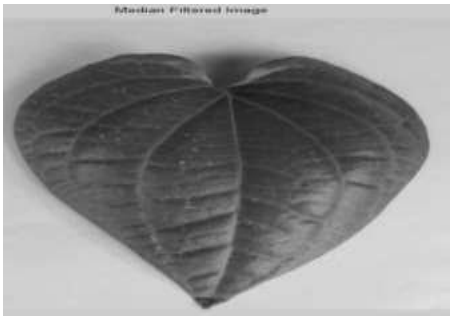


Fig.3 Median filtered image



In order to perform median filtering, initially window is moved and every pixels enclosed by the window are shorted. After then median is computed and this value is allotted to center pixel. If the number of elements in K*K window is odd, middle value is allotted as median value, else average of two middle values is given as median value.

- It involves K binary SVM classifiers, a single classifier for each class.
- Each SVM is trained to separate one class from the rest of the classes.
- A hyper plane is determined for each class, considering that class as positive (+1) class and the remaining classes as negative (-1).
- Repeat the procedure until all classes are separated from the rest of classes.
- A sample is tested for each classifier and is assigned to the class that corresponds to the SVM with the highest output value. The multi class classification in one versus all method.

Multiclass Support Vector Machine Classifier is employed to classify the betel leaf diseases. The gradient features are obtained from the database. Diseased and non-diseased betel leaves are trained and in the testing, the gradient values of untrained betel leaf are given as input to the classifier. In this problem, the classified results belongs to four categories such as foot rot, leaf rot, powdery mildew and no disease. If the given values are near to any of these classes, then the classifier identified that untrained betel leaf belongs to that class.

If the given values are near to the foot rot category, then the classifier identified that betel leaf belongs to foot rot diseases.

Fig.4 Classifier Output for Foot Rot Diseases

Fig.5 Classifier Output for Leaf Rot Diseases

Fig6 Classifier Output for Powdery Mildew Diseases

If the given values are near to the leaf rot class, then the classifier identified that betel leaf belongs to leaf rot diseases as shown in Fig.7. If the given values are near to the powdery mildew class, then the classifier identified that betel leaf belongs to powdery mildew diseases. If the given values are near to the powdery mildew class, then the classifier identified that betel leaf belongs to powdery mildew diseases as shown in Fig 8.

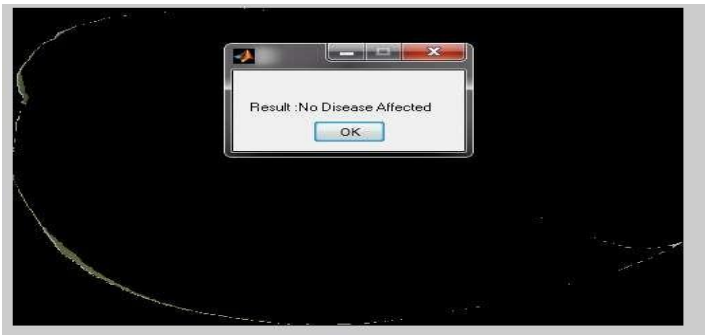


Fig. 7 Classifier Output for Healthy leaves

Multiclass SVM classifier is used to identify whether the betel leaf is affected or not and also to identify the type of diseases. The experimental result for healthy betel leafs.

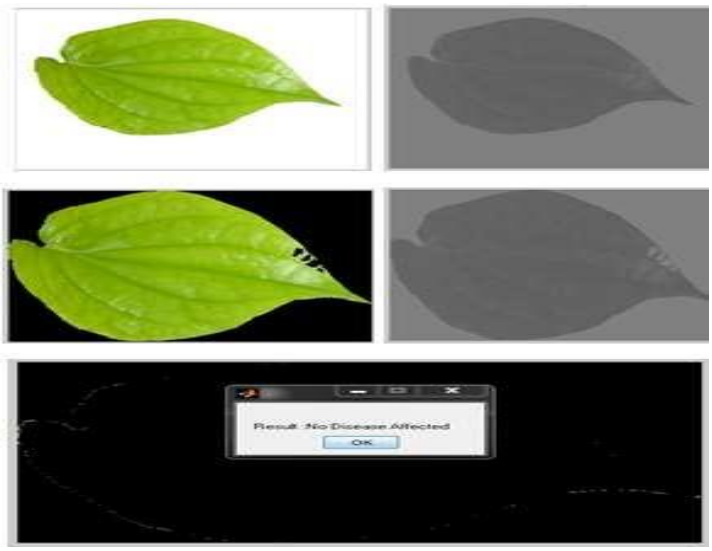


Fig. 8 Experimental result for healthy betel leaf

The experimental result for diseased betel leaf .

Fig.9 Experimental result for diseased betel leaf

The results are evaluated by using the Evaluation metrics sensitivity and specificity and demonstrated that the existing method with 82.35% accuracy and the proposed method can improve the betel leaf disease detection with 95.85% accuracy.

IV. PERFORMANCE EVALUATION

In the evaluation metrics, confusion matrix is evaluated to make decision that may be created by classifier. Consider a confusion matrix shown in Table 1, where TP, FN, FP, TN are as follows

TP (True Positive) represents the quantity of healthy leaves are correctly classified,

FN (False Negative) refers to the quantity of unhealthy leaves are misclassified as healthy leaves, FP (False Positive) expresses the quantity of healthy leaves misclassified as unhealthy leaves, TN (True Negative) refers the quantity of diseased leaves are correctly classified.

TABLE 1 CONFUSION MATRIX

		Predicted	
		Healthy	Diseased
True	Healthy	TP	FP
	Diseased	FN	TN

TABLE 2 WATERSHED TRANSFORMATION

WATERSHED TRANSFORMATION ALGORITHM			
		Predicted	
		Healthy	Diseased
True	Healthy	8	1
	Diseased	0	11
COLOR SPACE MODEL			
		Predicted	
		Healthy	Diseased
True	Healthy	3	6
	Diseased	0	11

The confusion matrix for the existing algorithm i.e., color space model and proposed algorithm i.e., watershed transformation are given below. Here we have 30 number of betel leaf. In that 20 are using for testing data and 10 for training data. For testing images, based on the True records and Predicted records the TP, TN, FP, FN values are calculated for all. According to the confusion matrix, a set of metrics commonly evaluated by using the evaluation metrics are sensitivity and specificity.

V. RESULT ANALYSIS

Based on the confusion matrix of existing and proposed work, the sensitivity, specificity and accuracy are calculated. In the following graph, sensitivity, specificity and accuracy values for the proposed work and existing are plotted based on Table2. In the X- axis the existing algorithm (Color Space Model) and the proposed (Watershed Transformation) algorithm are plotted and in the Y- axis their values are plotted.

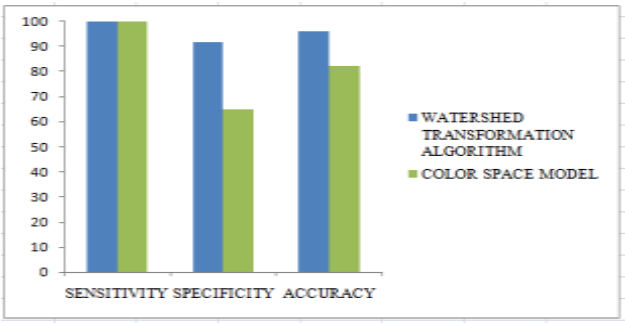


Fig. 10 Graphical results of sensitivity, specificity and accuracy

VI. CONCLUSION

The proposed technique classifies the diseases affected in betel leaf such as foot rot, leaf rot and powdery mildew. The color transformed images are segmented using watershed transformation algorithm. After that, a channel is extracted from l*a*b color transformed pictures (RGB to l*a*b). The gradient feature value of betel leaf images are obtained using HOG method based on the outlines of the betel leaf. Multiclass Support Vector Machine classifier classifies the betel vine diseases using gradient feature values of the leaf images. The Multiclass SVM classifier and watershed segmentation are the recent techniques involved in this research. From the performance analysis of the accuracy values the watershed transformation algorithm could detect betel leaf diseases competently about 95.85 % of accuracy rate. Through the performance evaluation, it can be concluded that the proposed solution is feasible and is capable to attain far better

classification result than the prevailing.

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