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Plant Leaf and Disease Detection by Using HSV Features and SVM Classifier

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Abstract:
Agricultural productivity is that thing on which Indian Economy highly depends. This is the one of the reasons that disease detection in plants plays an important role in agriculture field, as having disease in plants are quite natural. If proper care is not taken in this area then it causes serious effects on plants and due to which respective product quality, quantity or productivity is affected. Detection of plant disease through some automatic technique is beneficial as it reduces a large work of monitoring in big farms of crops, and at very early stage itself it detects the symptoms of diseases means when they appear on plant leaves. This paper presents an algorithm for image segmentation technique used for automatic detection as well as classification of plant leaf diseases and survey on different diseases classification techniques that can be used for plant leaf disease detection. Image segmentation, which is an important aspect for disease detection in plant leaf disease, is done by using genetic algorithm.

Keywords: SVM classifier, HSV features, NN Classifier, GA Process, Artificial Neural Network

I. INTRODUCTION

The existing method for plant disease detection is simply naked eye observation by experts through which identification and detection of plant diseases is done. For doing so, a large team of experts as well as. Continuous monitoring of experts is required, which costs very high when farms are large. At the same time, in some countries, farmers don't have proper facilities or even idea that they can contact to experts. Due to which consulting experts even cost high as well as time consuming too. In such condition the suggested technique proves to be beneficial in monitoring large fields of crops. And automatic detection of the diseases by just seeing the symptoms on the plant leaves makes it easier as well as cheaper. This also supports machine vision to provide image based automatic process control, inspection, and robot guidance .Plant disease identification by visual way is more laborious task and at the same time less accurate and can be done only in limited areas. Whereas if automatic detection technique is used it will take less efforts, less time and more accurately. In plants, some general diseases are brown and yellow spots, or early and late scorch, and other are fungal, viral and bacterial diseases. Image processing is the technique which is used for measuring affected area of disease, and to determine the difference in the color of the affected area. Here we are analyzing the features of different leaves affected by different diseases .The database is collecting of four different leaves affected by four diseases those are black rout, fungal, powdery mildew, scorch and normal leaves. These are the diseases which can affect the plants easily and they can spread to entire crop or farm. So we are selected these four diseases for the classification in our project. We are classifying these leaves based on their features by using NN classifier. For the first we will perform whether the leaves are affected by the diseases or not by using SVM classifier then if it is affected by any disease then we again classify by using NN classifier to classify which disease has effected to particular leaf.

II. PROBLEM ANALYSIS

Now-a-days, in modern agricultural system, numerous computational methods have been developed to help farmers or agronomists to monitor the proper growth of their crops. The basic problems regarding with crop is on the field, a fast and accurate recognition and classification of the diseases is required by inspecting the infected leaf images also recognize the severity of the diseases. There are two main characteristics of plant-disease detection machine-learning methods that must be achieved, they are: speed and accuracy. The damage diagnosis of different crops and vegetables has traditionally been done manually. Several efforts have been made to use image processing systems to automate the process through this research work.

III.PROPOSED METHOD:

To identify the affected area, the images of various leaves are taken with a digital camera or similar device. Then to process those images, various image-processing techniques are applied on them to get different and useful features required for later analyzing purpose. Plants are traditionally recognized by manual matching of the plants features such as leaves, flowers, and bark. In view of the large number of plant species available, the manual approach to plant classification is slow and prone to human error. There are several techniques which are currently being employed to build computer-based vision systems using features of plants extracted from images as input parameters to various classifier systems. In this paper, a

technique to argument already existing techniques of plant leaves identification system is described. The main contribution of this paper is to increase the classification speed and accuracy of the existing systems by incorporating Genetic Cellular Neural Networks for image segmentation. In the existing works summarized in Table 1, there is need to improve the accuracy of the classification model. One way to do this is do employ efficient image segmentation techniques. Once the images are efficiently segmented, the features subsequently generated may help improve the classification accuracy of the system. In this paper, a new classification model involving SVM, genetic algorithm (GA) and neural networks (NN) was employed to develop a computer based vision system for automatic identification of plant species.

IV. BLOCK DIAGRAM:

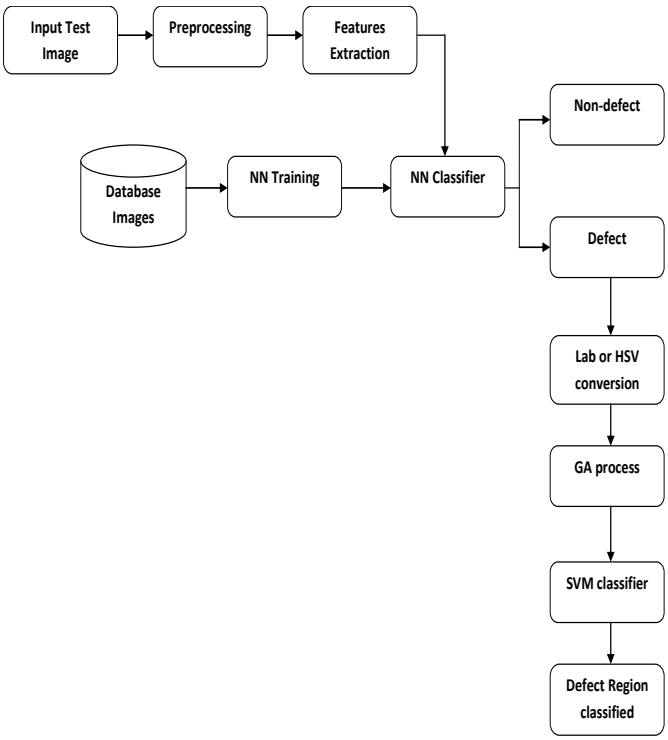


Figure.1. block diagram

The methodological analysis of the present work has been presented pictorially in Block diagram. The work commence with capturing images using cameras or scanners. These images are made to undergo pre-processing steps like filtering and segmentation. Then different texture and color features are extracted from the processed image by using Genetic algorithm. Finally, the feature values are fed as input to the NN classifier to classify the given image.

Input Image: The sample is captured from the digital camera and the features are then stored in the database.

Preprocessing:

Image pre-processing is a prophase relative to feature extraction and image recognizing. The images which have input are always not satisfactory regardless of what image acquisition devices are adopted.

Features Extraction Process

- **Energy:** It is a gray-scale image texture measure of homogeneity changing, reflecting the distribution of image gray-scale uniformity of weight and texture. **E=∑∑p(x, y) ^2 P(x, y) is the GLC M**

- **Contrast:** Contrast is the main diagonal near the moment of inertia, which measure the value of the matrix is distributed and images of local changes in number, reflecting the image clarity and texture of shadow depth.

I=∑∑(x-y)^2 p(x,y)

- **Entropy:** It measures image texture randomness, when the space co-occurrence matrix for all values is equal, it achieved the minimum value.
S=∑∑p(x, y) log p (x, y)

- **Correlation Coefficient:** Measures the joint probability occurrence of the specified pixel pairs.

$C=\sum\sum((x- \mu x)(y-\mu y)p(x , y)/\sigma_x\sigma_y))$

- **Homogeneity:** Measures the closeness of the distribution of elements in the GLCM to the GLCM diagonal.

H = ∑∑ (p(x , y)/(1 + [x-y]))

Genetic algorithm

In the field of artificial intelligence, a **genetic algorithm (GA)** is a search heuristic that mimics the process of natural selection. This heuristic (also sometimes called a met heuristic) is routinely used to generate useful solutions to optimization and search problems. Genetic algorithms belong to the larger class of evolutionary algorithms (EA), which generate solutions to optimization problems using techniques inspired by natural evolution, such as inheritance, mutation, selection, and crossover.

Methodology

Optimization problems

In a genetic algorithm, a population of candidate solutions (called individuals, creatures, or phenotypes) to an optimization problem is evolved toward better solutions. Each candidate solution has a set of properties (its chromosomes or genotype) which can be mutated and altered; traditionally, solutions are represented in binary as strings of 0s and 1s, but other encodings are also possible. The evolution usually starts from a population of randomly generated individuals, and is an iterative process, with the population in each iteration called a generation. In each generation, the fitness of every individual in the population is evaluated; the fitness is usually the value of the objective function in the optimization problem being solved. The more fit individuals are stochastically selected from the current population, and each individual's genome is modified (recombined and possibly randomly mutated) to form a new generation. The new generation of candidate solutions is then used in the next iteration of the algorithm. Commonly, the algorithm terminates when either a maximum number of

generations has been produced, or a satisfactory fitness level has been reached for the population.

Training Process:-

The first artificial neuron was produced in 1943 by the neurophysiologist Warren McCulloch and the logician Walter Pits. An Artificial Neural Network (ANN) is an information processing paradigm that is inspired by the way biological nervous systems, such as the brain, process information. Neural networks are a kind of *black box* where data is entered and the network "figures out" the necessary juxtapositions required drawing a reasonably accurate conclusion; the operations are organized into a multilayered feed forward network with four layers:

- Input layer
- Hidden layer
- Pattern layer/Summation layer
- Output layer

Table.1. Architecture of PNN

Plant Species	No. of Images Used For Training	No .of Images Used for Testing	Accuracy For SVM	Accuracy For NN
BEANS	10	10	74.66	87.6711
COTTON	10	12	75.25	83.6977
GAUVA	8	10	74.12	87.622
LEMON	9	10	75.32	88.54
MANGO	8	9	76.55	86.12

Architecture of PNN

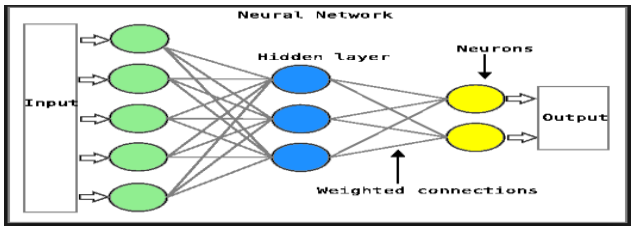


Figure.2. Architecture of Neural Network

V. EXPERIMENTAL RESULTS

After mapping the R, G, B components of the input image to the threshold image, the co-occurrence features are calculated. The co-occurrence features for the leaves are extracted and compared with the corresponding feature values stored in the feature library. The classification is first done using the Minimum Distance Criterion. The leaf images are divided into training and testing set, where 5% of the leaf images from each group are used to train the system and the remaining images serves as the testing set. The classification gain obtained by SVM is 86.77%. The detection accuracy is improved to 95.74% by NN classifier. The training and the testing sets for each type of leaf along with their detection accuracy is shown in from the results it can be seen that the detection accuracy is enhanced with SVM classifier.

Table .2. Comparison of results by support vector machine and NN classifiers

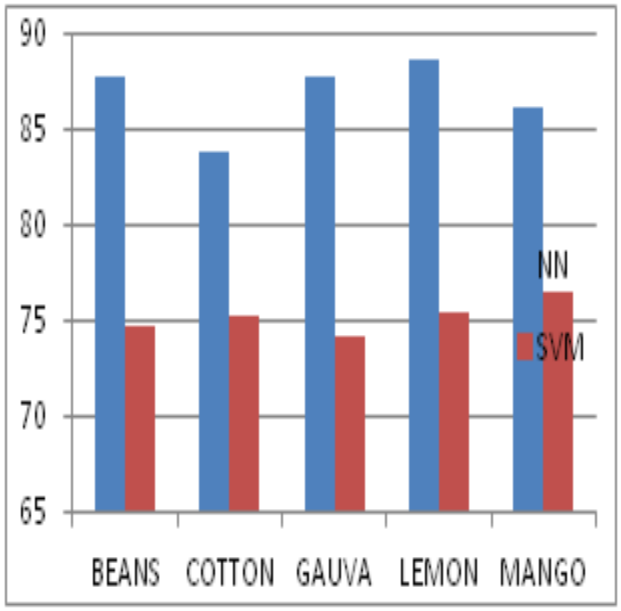


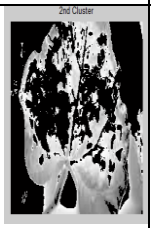
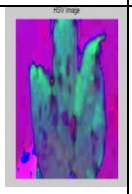
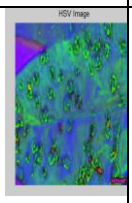
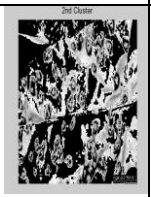
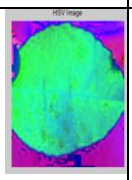
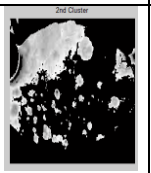
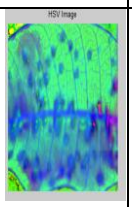
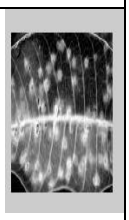
Figure.3.Comparison graph of results by NN classifier and support vector machine

Table 2 Detected diseased region of various leaves, the acquired leaf images are converted into HSI format. The co-occurrence features like contrast, energy, local homogeneity, shade and prominence are derived from the co-occurrence matrix. With these set of co-occurrence features the plant diseases are detected. Samples of leaves with various diseases like early scorch, yellow spots, brown spots, late scorch, bacterial and fungal diseases as a sample, a rose leaf that is infected by bacterial disease is given as input to the algorithm. Color transformation structure on the input image is performed. Then the green pixels are masked and removed using a specific threshold value. Then the R, G, B components are mapped to the threshold image.

VI. CONCLUSION:

This paper gives the executed results on different diseases classification techniques that can be used for plant leaf disease detection and an algorithm for image segmentation technique used for Automatic detection as well as classification of plant leaf diseases has been described later. Banana, beans, jackfruit, lemon, mango, potato, tomato, and sapota are some of those ten species on which proposed algorithm was tested. Therefore, related diseases for these plants were taken for identification. With very less computational efforts the optimum results were obtained, which also shows the efficiency of proposed algorithm in recognition and classification of the leaf diseases. Another advantage of using this method is that the plant diseases can be identified at early stage or the initial stage.

Table.3. plant species

Plant species	Input image	HSV Image	Clustered image	R plane image
Beans				
Cotton				
Gauva				
Lemon				
Moang				

VII. FUTURE ENHANCEMENT:

To improve recognition rate in classification process Artificial Neural Network, Bayes classifier, Fuzzy Logic and hybrid algorithms can also be used.

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