Citrus Canker Disease Detection Using Genetic Algorithm in Citrus Plants

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Abstract: India is an agricultural based country which cultivates many varieties of plants for food. Plants leaves disease detection and solution are important for increasing quality and quantity of the agricultural products. Genetic algorithm is used to find out the optimal solution and used to solve problems in disease detection. Genetic algorithm is efficient searching method based on natural selection and genetics. Genetic algorithm is used to find out the optimal solutions based on natural selection and genetics. The proposed approach gives an idea about how to detect citrus canker disease in citrus plants such as lemon, orange, grapes and gets an optimal solution using various image processing tools. Citrus plants such as lemon, orange and grapes are mainly affected by citrus canker disease which affects the fruit production to these plants. Citrus canker disease identification and solution is important for increasing the quality and quantity of the production of these plants.

Keywords: *Citrus canker, Citrus plants, Genetic algorithm, Image processing, optimal solution.*

I. INTRODUCTION

Biological sciences use images for collecting information which are used as data for various processing. Plant leaves diseases reduce both quality and quantity of agricultural products. Plant leaves diseases detection and solution is an important for reducing leaves disease level and improving quality and quantity of agriculture products. The proposed system considers the citrus canker disease of citrus plants and gives the solution using genetic algorithm.

In India, Citrus plants are the most popular fruit trees grown in the home landscape. Citrus plants such as lemon, orange are a long duration crops which are affected by a number of diseases like bacterial spot, citrus canker. Citrus canker is the important disease in citrus plants which appears as spots on the leaves. Citrus canker is a bacterial disease that causes premature leaves and fruits of citrus plants. Initially, the infected leaves have white spongy spots and that will turn gray or brown later. The spots have oily margins or yellowish ring (lesions), can be seen on both sides of the leaves. This disease can be detected in groves by the appearance of lesions.

Citrus canker was discovered in 1910 in Florida. Citrus Canker originated in the area of Southeast Asia- India and has spread to citrus growing areas in several countries (Japan, South and Central Africa, Bangladesh. This is a significant threat to all citrus-growing regions.

(a) Lemon Leaf   (b) Orange Leaf

Figure 1: Initial stage of Citrus Canker

(a) Lemon Leaf   (b) Orange Leaf

Figure 2: Final stage Citrus Canker

This paper has been proposed to detect the citrus canker disease of citrus plants (Lemon and Orange) and find out the optimal solution.

II. RELATED WORKS

Detection of plant leaves diseases have grown immensely over the past decade in biological area. Various methods have been devised that are used to study plant diseases using Image Processing methods. The methods studied are aimed at increasing throughput & reducing computations arising from human experts in detecting the plant diseases [1].

The image processing can be used in biological applications for following purposes:

1. To identify and detect diseased leaves and fruits.
2. To detect level of affected area by diseases.

3. To find shape of diseased affected area.
4. To determine colour of affected area
5. To determine size & shape of fruits.

Plant disease detection based on the infected images of various plants. They used image growing, image segmentation techniques to detect infected parts of the plants [4].

Citrus canker is common disease in citrus based plants which appears in leaves and fruits. First, it affects the leaves of the plants and spread to fruits [2]. Citrus canker is bacterial disease which is serious problem in citrus plants [3]. The disease identification is important to improve quality and quantity of the fruits of citrus plants. The proposed method describes the steps which is used to detect the citrus canker disease in citrus plants.

III. PROPOSED METHODOLOGY

First, the images of various affected canker diseased lemon and orange leaves are captured using a digital camera. Then various image processing techniques are used to detect the disease and Genetic algorithm are applied to get optimal solution of the canker disease.
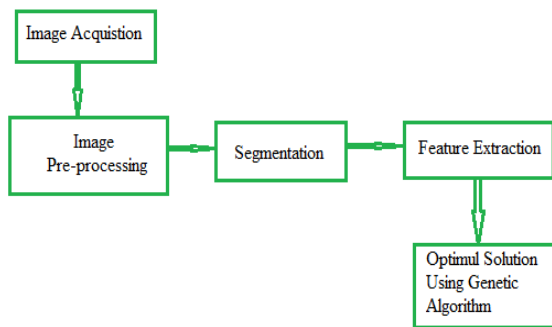

Figure 3: Steps - Canker Disease Detection and Optimal Solution

The procedure of the proposed system:
1) Image acquisition
2) Image pre-processing
3) Image segmentation
4) Computing the texture features
5) Optimal solution using genetic algorithm

1) Image acquisition

Citrus Canker disease detection starts with image acquisition. The images are captured using a digital camera with required resolution and the images are saved in the image processing supported format such as JPEG, TIF, BMP, PNG etc.

2) Image pre-processing

Image pre-processing is a technique which is used to get an enhanced image that is more useful to a human observer. Pre-processing includes various techniques like image resize, filtering, morphological operations etc. The initial captured lemon or orange leaves images are resized to a fixed resolution. Since the images may be captured from the fields, it will have unavoidable noises that might be appeared on the captured images. They must be removed for further image analysis and disease detection. Filters like Gaussian, median, Linear, Low pass, High pass filters etc. can be used to remove the image noise which will be selected depends upon the noise level of the images. When the leaves images noises are removed, the quality of the images will be improved. Finally we get the enhanced leaves images. The next process is to extract leaf disease region in the image using image segmentation method.

3) Image segmentation

Image segmentation is the process to partition the images into multiple segments. Here the citrus canker diseased leaves images are partitioned using segmentation. Segmentation is used to segment the interest portion of the leaves images. There are various techniques are used for image segmentation such as clustering methods, compression based methods, histogram-based methods, region growing methods, etc. At the end of the segmentation process, the diseased portions of the leaves are extracted.

4) Feature extraction

In plant leaves diseases detection, features of the leaves are unique characteristics and play a fundamental role in classification. In this approach, leaves image features usually include colour, shape are considered for disease detection. Here leaves diseased portion texture features like Contrast, Energy, Local homogeneity, Cluster shade and cluster prominence are computed using color Co-Occurrence method. After the texture features extraction, find out the stage of the disease. Plant leaves colour is used as an indication of health status of plants. According to the leaves color and result of texture features, the disease level can be identified.

5) Finding the optimal solution using genetic algorithm

An evolutionary optimization algorithm is a type of genetic algorithm which is used in biological evolution. Genetic algorithms are direct, parallel, stochastic method for global search and optimization. The evolutionary algorithms use the three main principles of the natural evolution:

1. Reproduction
2. Natural selection
3. Diversity of the species

They are maintained by the differences of each generation with the previous. Genetic Algorithm works with a set of individuals, representing possible solutions of the task. The selection principle is applied by using a criterion, giving an evaluation for the individual with respect to the desired solution.

The steps involved in genetic algorithm are as follows:

1. Initialize a population of random solutions
2. Determine best solution in population
3. Loop
   - select two parents from population
   - make two children from the parents
   - place children into population
   - make and place an immigrant into population
   - check if a new best solution exists
4. End loop
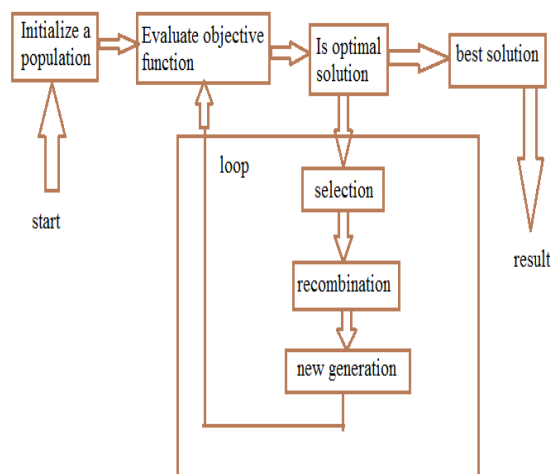5. Return best solution found

Figure 4: Computational Methodology of Evolutionary Algorithm

At the beginning of the computation a number of individuals (the population) are randomly initialized. The objective function is evaluated for these individuals. The first/initial generation is produced. If the optimization criteria are not met the creation of a new generation starts. Individuals are selected according to their fitness for the production of offspring. Parents are recombined to produce offspring. All offspring will be mutated with a certain probability. The fitness of the offspring is then computed. The offspring are inserted into the population replacing the parents, producing a new generation. This cycle is performed until the optimization criteria are reached.

CONCULSION

Genetic algorithms are simple and powerful search and optimization procedures that are widely used in various applications. Genetic algorithms can provide a number of potential solutions to a given problem. The final result is selected by the user based on the requirements of the application. First the sample leaves images are acquired and segmented into multiple parts. Then color and textures features are extracted to detect the disease of the leaves and find out optimum solution using genetic algorithm.

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