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Identification of Plant Leaves Disease Detection and Optimal Solution Using Genetic Algorithm

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Abstract – Genetic algorithm (GA) is a powerful searching technique that is used to solve problems in many different ways. Genetic Algorithm (GA) is efficient search method based on principles of natural selection and genetics.GA is used to find out the optimal solutions among the search space with the operators like selection, crossover, mutation, etc. This work presents the methodology for detecting plant leaf diseases and the way for getting optimal solution of leaf disease detection using genetic algorithm.

Keywords: Genetic algorithm, color conversion, Image processing, leaf disease, optimal solution.

I. INTRODUCTION

Images are important data and information in biological sciences. Plant leaf diseases reduce both quality and quantity of agricultural products. Plant leaf diseases detection and solution is an important for reducing leaf disease level and improving quality and quantity of agriculture products. The proposed system gives solution for leaf disease using genetic algorithm.

Disease management is a challenging task. Mostly diseases are seen on the leaves or stems of the plant. Plant leaf colour is also commonly used as an indication of health status of plants.

Diseases in leaves cause major production and economic losses in agricultural industry. Monitoring of health and detection of diseases in leaves is critical for agriculture. This is report a machine vision system for the identification of the leaves diseases, from coloured images. Diseased regions shown in digital pictures were enhanced, segmented, and a set of features were extracted from each of them. First the captured images are converted into preferable and clear format for the operation. Grayscale images or binary images are preferable format for plant leaves diseases detection because of they have only the intensity information. So it is easy for operation. Image segmentation is used to extract the diseased portion of the plant leaf. The image segmentation is used in the image about the disease regions and the normal regions in the leaves.

In plant leaf disease detection, numbers of images are generated for the experiment. These images can be required for further analysis of plant diseases detection. Here image processing plays important role for analysing and detecting plant diseases. The image processing can be used in agricultural applications for following purposes:

1. To detect diseased leaf, stem, fruit, etc.
2. To find shape of affected area.
3. To determine colour of affected area
4. To determine size and shape of fruits.
5. To find the disease level.

In case of plant the disease is defined as any impairment of normal physiological function of plants, producing characteristic symptoms. This paper has been proposed to detect the plant leaf diseases and find out the optimal solution.

II. PROPOSED METHODOLOGY

This work focuses the overall view and implementation steps of plant leaves disease detection. First, the images of various affected leaves are captured using a digital camera. Then various image processing techniques and Genetic algorithm are applied to detect and get optimal solution the plant leaf disease.

The procedure of the system is:

1) Image acquisition using digital camera
2) Convert the input image from RGB to Grayscale format
3) Image pre-processing
4) Image segmentation
5) Computing the texture features
6) Classification based on a classifier
7) Finding the optimal solution using genetic algorithm

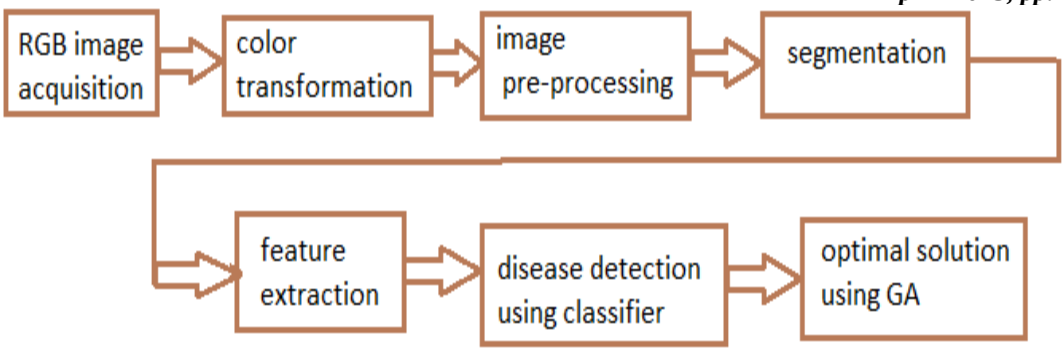

Fig. 1 steps involved in leaf disease detection and optimal solution

1) Image Acquisition

The plant leaf disease detection begins with image acquisition. The images are captured using a digital camera with required resolution for better quality. The images should be saved in the same format such as JPEG, TIF, BMP, PNG etc.

Fig. 2 Original Colored RGB Images

2) Convert the input image from RGB to Grayscale format

First, the RGB images of plant leaves are converted into Grayscale representation. Grayscale images are the preferred format for image processing. During the image processing computations, the grayscale image pixels are stored in binary format. It is easy for understanding and matrix values are represented by intensities. The matrix elements have the values corresponding to brightness or darkness of the pixel. There are two ways to represent the brightness of the pixel. One is double class (or data type) which assigns a floating value between 0 and 1 to each pixel. The value 0 represents black and the value 1 represents white. The other class is called uint8 which assigns an integer value between 0 and 255 to each pixel. The value 0 represents black and the value 255 represents white. The class uint8 only requires 1/8 of the storage compared to the class double. But, many mathematical functions can only be applied to the double class.

Here the conversion method converts the true color images RGB to grayscale by eliminating the hue and saturation information while retaining the luminance.

This method is to match the luminance of the grayscale image to the luminance of the color image. To convert any color to a grayscale representation of its luminance, first obtain the values of its red, green, and blue (RGB) primaries in linear intensity encoding and luminance is calculated as a weighted sum of the three linear-intensity values. Grayscale conversion can be performed using the following function:

$$y = f(x)$$

Here, x is the original input data and y is the converted output data. The function f(x) converts RGB values to grayscale values by forming a weighted sum of the *R*, *G*, and *B* components:

$$f(x) = 0.2989 * R + 0.5870 * G + 0.1140 * B$$

Fig. 3 Converted Grayscale Images

3) Image pre-processing

Image pre-processing is a technique which is used to create an enhanced image that is more useful or pleasing to a human observer. Pre-processing uses various techniques like image resize, filtering, segmentation, morphological operations etc. The initial captured plant leaves images are resized to a fixed resolution to reduce the computational burden. Since images may be captured from the fields it will be unavoidable that some noise might appear on the captured images. They must be removed for further image analysis. Filters like Gaussian, median, Linear, Low pass, High pass filters etc. can be used to remove the image noise. Once the leaves images have been enhanced, the next process is to extract leaf disease region in the image. This can be achieved by image segmentation.

4) Image segmentation

Image segmentation is the process of partitioning the digital image into multiple segments. Here the plant leaf portion is partitioned using segmentation. Segmentation should stop when the objects of interest in an application have been isolated. There are various techniques for image segmentation such as clustering methods, compression based methods, histogram-based methods, region growing methods etc. At the end of the segmentation, the diseased portion of the sugarcane leaf is extracted.

5) Feature extraction

Features play a fundamental role in classification. In image processing, image features usually include colour, shape and texture features. Here sugarcane leaf diseased portion texture features like Contrast, Energy, Local homogeneity, Cluster shade and cluster prominence are computed using color Co-Occurrence method.

6) Classification based on a classifier

Once the leaves texture features are extracted, next step is to find to which stage the disease is. Plant leaf colour is also commonly used as an indication of health status of plants. According to the leaf image color and result of texture features, the disease type and disease level can be identified.

7) 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 (GA) are direct, parallel, stochastic method for global search and optimization. The evolutionary algorithms use the three main principles of the natural evolution: reproduction, natural selection and diversity of the species, 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:

- Initialize a population of random solutions
- Determine best solution in population
  - 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
  - end loop
- return best solution found

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.

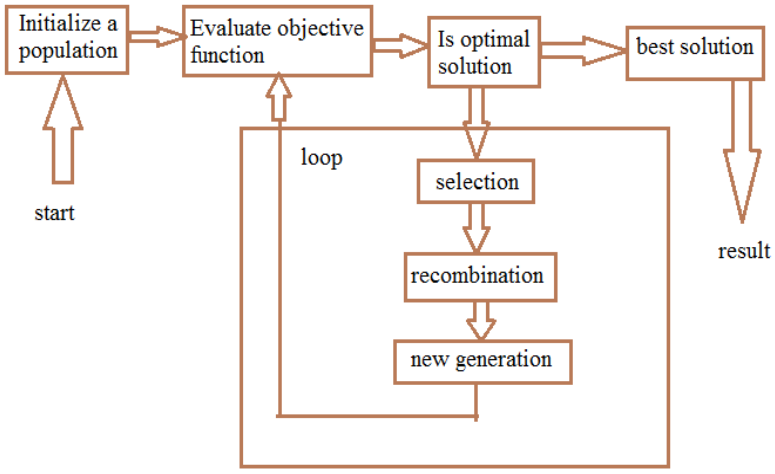

Fig. 4 structure of evolutionary algorithm

III. CONCULSION

Genetic Algorithms are simple and yet powerful search and optimization procedures that are widely applicable. Genetic algorithms can provide a number of potential solutions to a given problem. The final choice is left to the user.

First the sample leaves images are acquired then color and textures features are applied to extract useful features and detect the disease of affected leaves image samples using a classifier and find out optimum solution using genetic algorithm.

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