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Leaf Disease Detection Using Fuzzy Logic

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ABSTRACT: Agricultural productivity is something on which 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 is quite natural. If proper care is not taken in this area then it causes serious effects on plants, due to which respective product quality, quantity and/or productivity is affected. For instance a disease named little leaf disease is a hazardous disease found in pine trees in United States. Detection of plant diseases through some automatic technique is beneficial as it reduces the tedious work of monitoring in big farms of crops, and at very early stage itself it detects the symptoms of diseases i.e. when they appear on plant leaves. This paper presents an algorithm for image segmentation technique which is used for automatic detection and classification of plant leaf diseases. Image segmentation, which is an important aspect for disease detection in plant leaf disease, is done using genetic algorithm. It uses fuzzy logic for detection of plant disease. The parameters are skewness, extract mean and extract deviation. A test image is taken and compared with database image and then dissimilarity is calculated with extracted parameters.

KEYWORDS: Extract Mean, Extract Deviation, fuzzy logic, GLCM feature extraction, Image segmentation.

I. INTRODUCTION

Agriculture is an important source of income for Indian people. Farmers can grow variety of crops but diseases hamper the growth of crops. One of the major factors responsible for the crop destruction is plant disease. Diverse plants experience the ill effects of various diseases. The primary piece of plant to look at the sickness is leaf. The real classes of plant leaf ailments depend on viral, parasitic and microscopic organisms. The diseases of leaf can diminish both the quality and amount of products and their further development. The simple strategy to identify the plant diseases is assistance with the help of farming master knowing about plant ailments. Be that as it may, this manual location of plant sicknesses takes parcel of time and is an arduous work. Henceforth, there is a requirement for machine learning strategy to identify the leaf illnesses. Computer can assume a major part to build up programmed techniques for the discovery and order of leaf diseases. There can be different example acknowledgment and picture handling methods that can be utilized as a part of the leaf sickness identification. The leaf infection recognition and order of leaf illnesses is the way to keep the horticultural misfortune. Distinctive plant leaves bear diverse sicknesses. There are diverse sorts of techniques and classifiers to recognize plant leaf sicknesses. Programmed identification of plant infections is a vital errand as it might demonstrate valuable in checking expansive field of harvests, and consequently naturally identify ailments from side effects that show up on plant clears out. Thus automatic detection of plant disease with the help of image processing techniques provide more accurate and guidance for disease management. Comparatively, visual identification is less accurate and time consuming. Hence, it is required to design and develop a machine learning method to detect disease.

Following be the cotton plant description

- Cotton is a soft, fluffy staple fiber that grows in a boll, or protective capsule, around the seeds of cotton plants of the genus *Gossypium*.
- Cotton is the king of fibres, usually referred as white gold.

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- Current estimates for world production are about 25 million tones annually. China is the largest cotton production in world
- The United States are the largest exporter for many years.



Fig 1.1 cotton flower

The brief discussion about the further topics is described in this section. The next section, section II describes about the prior and related work. In this section a summary of related work is described elaborately with the demerit and accuracy obtained by the method used. Section III describes about the proposed methodology. In this section the methodology used procedure Section IV shows the experimental results obtained and discussion by the method used. Accuracy and Conclusion is explained in Section V. This section clearly portrays the drawback of the proposed system, gives a brief description about the work to be carried out in future.

II. RELATED WORK

Sachin D. Khirade and et al [1]: Identification of the plant infections is the way to keeping the misfortunes in the yield and amount of the agrarian item. This paper likewise examined some Feature extraction and order systems to separate the highlights of contaminated leaf and the grouping of plant infections. The utilization of ANN techniques for characterization of infection in plants, for example, self-arranging highlight outline, proliferation calculation, SVMs and so forth can be proficiently utilized. We can precisely recognize and group different plant maladies utilizing picture preparing method.

Prof. Sanjay, B. Dhaygude et al [2]: the use of surface measurements for distinguishing the plant leaf ailment has been clarified. Firstly by shading change structure RGB is changed over into HSV space in light of the fact that HSV is a decent shading descriptor. Concealing and expelling of green pixels with pre-processed edge level.

Amandeep Singh, Maninder Lal Singh et al [3]: the most critical test looked amid the work was catching the quality pictures with greatest detail of the leaf shading. This was taken care of by utilizing a Nikon made D5200 camera which served the undertaking extremely well. Second test confronted was to dispose of light conditions as from begin to the finish of paddy edit season, brightening changes a ton notwithstanding when the picture getting time is settled. However the answer for this is variable client characterized thresholding and making essential changes in accordance with the shades of LCC.

Mr. Pramod S. landge, Sushil A. Patil et al [4]: In this the authors propose and tentatively assess a product answer for programmed recognition and grouping of plant illnesses through Image Processing. Ranchers in provincial India have insignificant access to rural specialists, who can review trim pictures and render counsel. Postponed master reactions to questions frequently achieve agriculturists past the point of no return. This paper tends to this issue with the target of creating picture handling calculations that can perceive issues in crops from pictures, in view of shading, surface and shape to consequently recognize maladies or different conditions that may influence harvests and give the quick and precise answers for the agriculturist with the assistance of SMS. The outline and execution of these advancements will incredibly help in specific concoction application.

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Vol. 7, Issue 6, June 2018

III. METHODOLOGY

Fig. 3.1 shows the block diagram of the system. A digital camera or any other optical instrument for recording or capturing images, may be used for obtaining the image of the leaf. After obtaining the photo, the image is resized. The resized image is then filtered using median filter. After filtering, image segmentation is performed on the image. Otsu's model is used for this purpose. This is followed by the process of feature extraction and classification. The classification step makes use of the fuzzy classifiers.

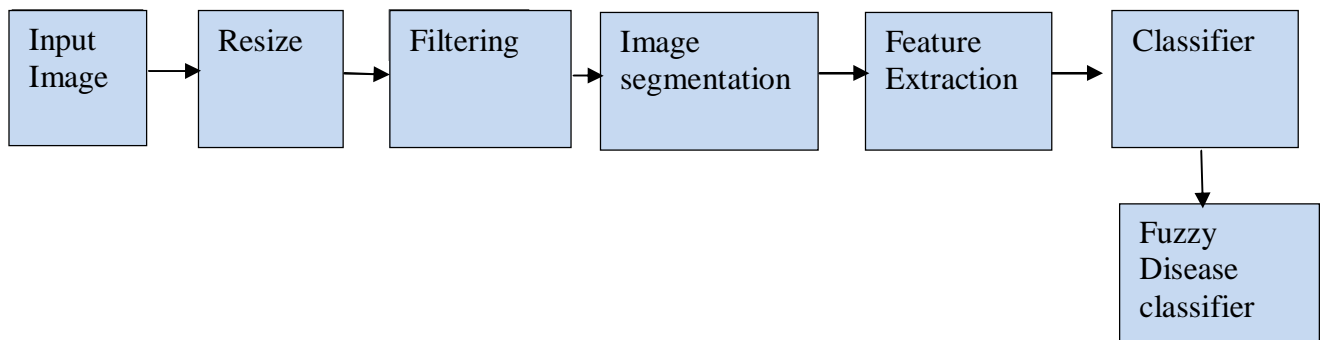


Fig. 3.1Block Diagram of the system

The block by block explanation of the system is given below.

1. Take image from leaf database
2. Pre-processing

Image pre-processing typically denotes a processing step transforming a source image into a new image which is fundamentally similar to the source image, but differs in certain aspects, e.g. improved contrast. According to the above definition, pre-processing results in changing the brightness of individual image pixels. This step includes the physical transformation of the RGB and the gray scale image. Image pre-processing typically denotes a processing step transforming a source image into a new image which is fundamentally similar to the source image, but differs in certain aspects, e.g. improved contrast. According to the above definition, pre-processing results in changing the brightness of individual image pixels. This step includes the physical transformation of the RGB and the gray scale image and resizing of the image. In that pre- processing image have been taken 320*220 pixel size for all data set.

3. Filtering:

In signal processing, a filter is a device or process that removes some unwanted components or features from a signal. Filtering is a class of signal processing, the defining feature of filters being the complete or partial suppression of some aspect of the signal. Most often, this means removing some frequencies or frequency bands. There are many type of filtering Median filtering, Gaussian filtering, low pass filtering, high pass filtering. In this paper use Median filtering technique use.

Median Filter: -

It is a nonlinear type of digital filter which is used to remove the noise from the signal and image. It is used to enhance the quality of the signal. The advantage of the median filter it gives the precise output and it preserves edges while removing noise. Median filtering is one kind of smoothing technique, as is linear Gaussian filtering.

4. Image Segmentation:-

Image segmentation is a crucial process for most image analysis consequent tasks. Especially, most of the existing techniques for image description and recognition are highly depend on the segmentation results. Segmentation splits the image into its constituent regions or objects. In that image segmentation technique by using otsu thresholding method detect the disease. First level of segmentation only detect defected area of leaf then second level of segmentation detect the leaf disease part.

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Vol. 7, Issue 6, June 2018

5. Feature extraction:-

In machine learning, pattern recognition and in image processing, feature extraction starts from an initial set of measured data and builds derived values (features) intended to be informative and non-redundant, facilitating the subsequent learning and generalization steps, and in some cases leading to better human interpretations. Feature extraction is related to dimensionality reduction.

For texture analysis

1. Contrast:

It returns a measure of intensity contrast between pixel and its neighbourhood over the whole image. Contrast will be zero for a constant image. It is given by,

$$\text{Contrast} = \sum (\text{abs}(i - j))^2 * P(i, j) \quad (1)$$

2. Dissimilarity

$$\text{dissi} = \sum (\text{abs}(i - j) * P(i, j)) \quad (2)$$

3. Energy:

It returns the sum of squared element in GLCM. It is also called as uniformity or uniformity of energy or angular secondary moment. Energy is one for a constant image.

$$\text{Energy} = \sum (P(i, j)^2) \quad (3)$$

4. Homogeneity

It returns a value that measures the closeness of the distribution of element in GLCM to GLCM diagonal. It ranges from [0 1]. Homogeneity is 1 for a diagonal GLCM. It is given by

$$\text{Homogeneity} = \sum (P(i, j)(1 + \text{abs}(i - j))) \quad (4)$$

5. Entropy

Frist order entropy is dependent on the homogeneity of the image. Homogeneity lowers the entropy of an image.

$$\text{Entropy} = \sum (P(i, j) * \log(i, j) + eps) \quad (5)$$

Colour Movement

1. Skewness

Skewness is measure of symmetry or more precisely, the lack of symmetry a distribution or data set, is symmetric if it is looks same to the right and left of the centre of point.

2. Extract Kurtosis

A positive kurtosis image would have a fairly uniform distribution of gray levels but not too many at the external values while a negative kurtosis image would have mid-level gray levels that are fairly dominant and another wise uniform distribution.

3. Extract Mean

When feature are defined in terms of local neighbourhood operation applied to an image one can use feature extraction by the extracting mean.

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Vol. 7, Issue 6, June 2018

4. Extract standard deviation

The Standard deviation reveals something about the contrast of image in particular bin.

6. Classification

Here, we are using the fuzzy logic for the classification purpose. In recent years, the number and variety of applications of fuzzy logic have increased significantly. The applications range from consumer products such as cameras, camcorders, washing machines, and microwave ovens to industrial process control, medical instrumentation, decision-support systems, and portfolio selection.

In this phase of classification, extraction and comparison of co- occurrence features for the leaves with corresponding feature value are stored in the feature dataset.

Fuzzification is method of translating crisp value into linguistic value. Each input need to undergo fuzzification for the fuzzy controller to translate the input into output. In order to fuzzify a value, a membership function needed. Defuzzification is method of translating the linguistic value back into crisp value. The measurement of success of classification is done by using the classification gain and following eq. (6) is used for calculation:

$$\text{Gain (\%)} = \frac{\text{No of classification}}{\text{Total no of test images}} * 100 \quad (6)$$

IV. EXPERIMENTAL RESULTS

The GLCM technique is applied for extracting the feature of leaf. The dataset is created 57 infected leaf which is include Alternaria, Cerespora and Gery mildw.

Step 1: Take leaf image from database



Fig. 4.1 Leaf

Step 2: Resize the leaf image



Fig. 4.2 Resize Leaf

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Vol. 7, Issue 6, June 2018

Step 3: Apply the filtering process

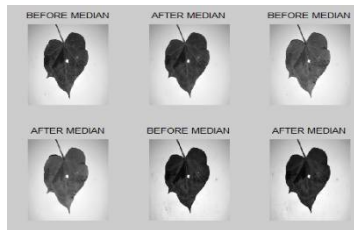


Fig. 4.3 Leaf Filtering

Step 4: Segmentation of leaf image

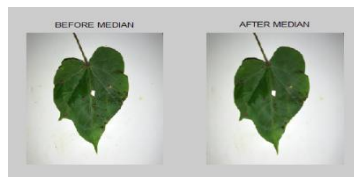


Fig. 4.4 Leaf Segmentation

Second level of segmentation

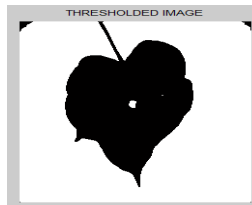


Fig. 4.5 OTSU's Thresholding

Apply fuzzy classifier

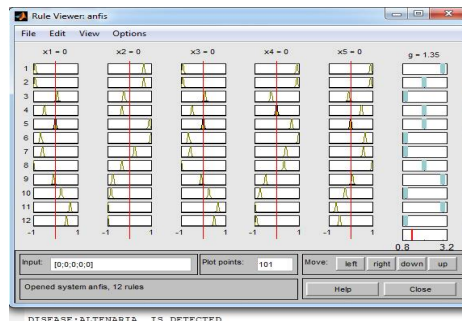


Fig 4.6 Alternaria Disease

Below table shows that accuracy of leaf disease detection.

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Vol. 7, Issue 6, June 2018

Table 5.1 Leaf Disease Detection

Name of Disease	Disease is Detected	Disease not Detected	Total
Alterneria	18	1	19
Cerespora	17	3	20
Grey Mildew	14	4	18

$$Accuracy = \frac{TP_1 + TP_2 + TP_3}{TotalImage} \quad (1)$$

v. CONCLUSION

This project focusses on an image processing technique that has been used for detection of plant diseases. 57 images of leaves are tested. The system uses the Otsu's method for segmentation purpose. The feature extraction parameters used are mean, standard deviation, entropy, extract standard deviation, extract kurtosis, skewness. The system gives higher accuracy as compared to the techniques used in the past. By using Fuzzy Logic it gives an accuracy of 88% for detection of leaf diseases.

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