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Detection of Different Paddy Diseases Using Image Processing Technique

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Abstract- The main objective of this research is to develop a prototype system for diagnosing paddy diseases, which are Blast Disease (BD), Brown-Spot Disease (BSD), and Narrow Brown-Spot Disease (NBSD). This paper concentrates on extracting paddy features through off-line image. The methodology involves image acquisition, converting the RGB images into a binary image using thresholding based on local entropy threshold and Otsu method. A morphological algorithm is used to remove noises by using region filling technique. Then, the image characteristics consisting of lesion type, boundary colour, spot colour and broken paddy leaf colour are extracted from paddy leaf images. Consequently, by employing production rule technique, the paddy diseases are recognized about 95.2 percent of accuracy rates. This prototype has a very great potential to be further improved in the future.

Keywords - Feature extraction, color segmentation, paddy leaf diseases and production rule.

1. INTRODUCTION

The main objective of this Paper is to develop a prototype system for diagnosing paddy diseases, which are Blast Disease (BD), Brown-Spot Disease (BSD), and Narrow Brown-Spot Disease (NBSD). This Paper concentrates on extracting paddy features through off-line image. The methodology involves image acquisition, converting the RGB images into a binary image using thresholding based on local entropy threshold and Otsu method. A morphological algorithm is used to remove noises by using region filling technique. Then, the image characteristics consisting of lesion type, boundary colour, spot colour and broken paddy leaf colour are extracted from paddy leaf images. Consequently, by employing production rule technique, the paddy diseases are recognized about 95.2 percent of accuracy rates. Paddy plantation is one of the most crucial agriculture activities in agricultural countries. Paddy is also one of the cereal crops and staple food to many people in the world including India as well as Asian countries. Paddy plantation is still threatened by many factors that make paddy-rice production become slow and less productive. It leads to hardly achieve the target of 10 tons per hectare for the national needs. One of the main factors is paddy disease. A disease is an abnormal condition that injures the plant or causes it to function improperly. Diseases are readily recognized by their symptoms – associated visible changes in the plant. There are a lot of paddy disease types, but this research focuses on three paddy diseases that have the same symptoms, which are Blast Disease (BD), Brown-Spot Disease (BSD), and Narrow Brown-Spot Disease (NBSD). BD is caused by the fungus Pyriculariagrisea. This fungal disease is estimated to cause production losses of Rs 55 Crores each year in South and Southeast Asia. BD is a deadly disease of rice plants and it has white spread distribution in more than 80 countries. The losses are even higher in East Asia and other more temperate rice growing regions around the world. Most conspicuous symptoms of the disease occur on leaves and glumes of maturing plants. Traditionally, paddy farmers determine the type of disease as manual. The disease is visually detected by expert formers. Although paddy farmers are being trained by agricultural experts to recognize paddy diseases, but errors might occur to determine the type of diseases and control.

However, this method is strenuous and time arresting.The advent of computer technology offers great potential to automate the process. This study aims to develop a prototype system to automatically and correctly detect and classify the paddy diseases with BSR, BBS and PBR using image processing technique.This method for diagnosing paddy diseases can be simplified as Fig.1. This process involves several tasks, such as image acquisition and collection, image segmentation and pre-processing, shape feature extraction and colour feature extraction, and paddy diseases classification based on lesion description.

2. EXISTING SYSTEM

2.1. Introduction

Early work on image retrieval can be traced back to the late 1970s.Text-based image retrieval uses traditional database techniques to manage images. Through text descriptions, images can be organized by topical or semantic hierarchies to facilitate easy navigation and browsing based on standard Boolean queries. However, since automatically generating descriptive texts for a wide spectrum of images is not feasible, most text-based image retrieval systems require manual annotation of images. Obviously, annotating images manually is a cumbersome and expensive task for large image databases, and is often subjective, context-sensitive and incomplete. As a result, it is difficult for the traditional text-based methods to support a variety of task-dependent queries. In the early 1990s, as a result of advances in the Internet and new digital image sensor technologies, the volume of digital images produced by scientific, educational, medical, industrial, and other applications available to users increased dramatically. The difficulties faced by text-based retrieval became more and more severe. The efficient management of the rapidly expanding visual information became an urgent problem. This need formed the driving force behind the emergence of content-based image retrieval techniques. In 1992, the National Science Foundation of the United States organized a workshop on visual information management systems to identify new directions in image database management systems. It was widely recognized that a more efficient and intuitive way to represent and index visual information would be based on properties that are inherent in the images themselves. Researchers from the communities of computer vision, database management, human-computer interface, and information retrieval were attracted to this field. Since then, research on content-based image retrieval has developed rapidly. Since 1997, the number of research publications on the techniques of visual information extraction, organization, indexing, user query and interaction, and database management has increased enormously. Similarly, a large number of academic and commercial retrieval systems have been developed by universities, government organizations, companies, and hospitals.

2.2. Content Comparison Techniques

2.2.1. Color reclamation

Color is the most broad used optic content for image reclamation. Its three dimensional values make its discrimination potentiality superior to the single dimensional gray values of images. Before selecting an appropriate color description, color space must be determined first. Retrieving images based on color similarity is achieved by computing a color histogram for each image that identifies the proportion of pixels within an image holding specific values.Each histogram bin is partitioned into two types, i.e., coherent, if it belongs to a large uniformly-colored region, or incoherent, if it does not. Another method called color correlogram expresses how the spatial correlation of pairs of colors changes with distance.

2.2.2. Texture Reclamation

Texture is a widely used and intuitively obvious but has no precise definition due to its wide variability. Visual texture in most cases is defined as a repetitive arrangement of some basic pattern. This repetition may not be random. However, a texture pattern normally has some degree of randomness due to randomness in basic pattern as well as due to randomness in the repetition of basic pattern. To quantify texture, this randomness is measured by some means over a small rectangular region called window. Thus, texture in an image turns out to be a local property and depends on the shape and size of the window .Identifying a patch in an image as having uniform texture or discriminating different visual textures obeys the law of similarity.

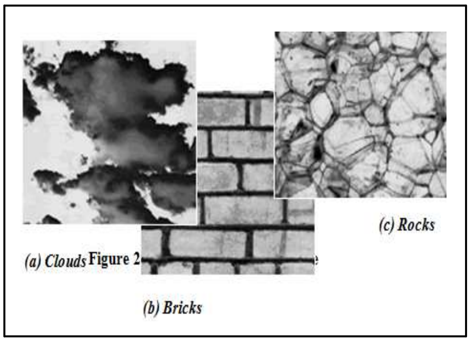

Fig.1. Different types of texture

They have a tendency to be best when connected to surfaces that are extremely normal. Measurable systems, including Fourier force spectra, co-event networks, shift-invariant foremost part examination (SPCA), Tamura characteristic, Markov irregular field, fractal model, and multi-determination separating methods, for example, Gabor and wavelet change, describe surface by the factual circulation of the picture power.

2.2.3. Shape Reclamation

Shape may be defined as the characteristic surface configuration of an thing; an outline or contour. It allow an thing to be imposing from its ambient by its outline Shape representations. Which are divided into two types , a.Boundary-based,
b. Region-based.

Boundary-based shape representation (Fig 2.3) only uses the outer edges of the shape. This is done by describing the considered region using its external characteristics; i.e., the pixels along the object boundary. Region-based shape representation uses the entire shape region by describing the considered region using its internal characteristics; i.e., the pixels contained in that region

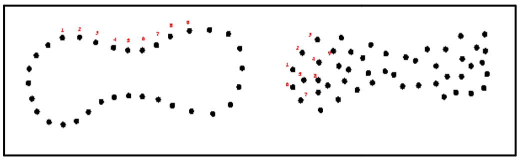

Fig.2.Boundary-based & Region-based shape representation

3. PROPOSED APPROACH

The methodology for diagnosing paddy diseases can be simplified as Fig 1. This process involves several tasks, such as image acquisition and collection, image segmentation and pre-processing, sh extraction and colour feature extraction, and paddy diseases classification based on lesion type, boundary colour, spot colour and broken paddy leaf colour. The Fig 1.shows the flow diagram of the proposed work.

3.1. Image Acquisition

In this process, it is preparation process to obtain paddy leaf images. The RGB colour images of paddy leaf are captured using a Nokia 3G Mobile Phones, with pixel resolution 240 x 320. The digitized images are about 255KB size each. Those images are cropped into a smaller image with dimension of 109x310 pixels. They have collected about 94 data samples. It consists of three types of paddy diseases as shown in Fig.2. Images are stored in BMP format. The prototype uses Mat lab Image processing library.

3.2. Image Segmentation and Pre-Processing

The segmentation and Pre-Processing task are the initial stage before the image is used for the next process. The main objective of this process is to obtain the binary image with less noise or noise free. In order to achieve high accuracy, an appropriate silhouette should be obtained. An occurrence matrix is generated from the input image in accordance with probability distribution needed for entropy measures. The local entropy is defined as follows:

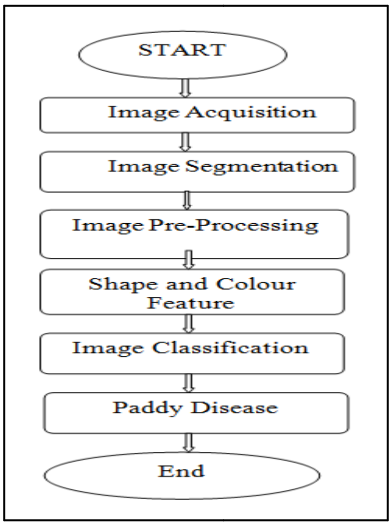

Fig.3. Flow diagram of the proposed work

$$H = -\sum_{i=1} p_i \log P_i \qquad (1)$$

$$p_i = \frac{ai}{a1 + a2 + \ldots\ldots + an} \qquad (2)$$

Where H is local entropy value, pi is the probability distribution, and *a1 + a2 + …… + an* are the brightness levels in the windows located at the central pixel. Note that the name 'local entropy' does not refer to a locally generated threshold, but the name originally given to the method.

3.3. Feature Extraction Using Texture Analysis

As the image of paddy disease, several of disease varieties had different lesion shape and lesion colour, hence the shape and colour feature of disease spot were extracted for study. The image analysis focused on the shape feature extraction and colour based segmentation.100 data image samples consist of 20 images of each lesion type are analyzed to obtain the value of width and height of the lesion. Based on experiment the constant values are set. In content-based image retrieval systems (Figure 3.1), the visual Contents of the Image in the database are separated and portrayed by multi-dimensional peculiarity vectors. The peculiarity vectors of the pictures in the database structure a gimmick database. To recover pictures, clients furnish the recovery framework with illustration pictures or outlined figures. The framework then changes these cases into its interior representation of gimmick vectors. The likenesses/removes between the peculiarity vectors of the inquiry illustration or portrayal and those of the pictures in the database are then computed and recovery is performed with the support of an indexing plan. The indexing plan gives a productive approach to hunt down the picture database. Recent retrieval systems have incorporated users' relevance feedback to modify the retrieval process in order to generate perceptually and semantically more meaningful retrieval results.

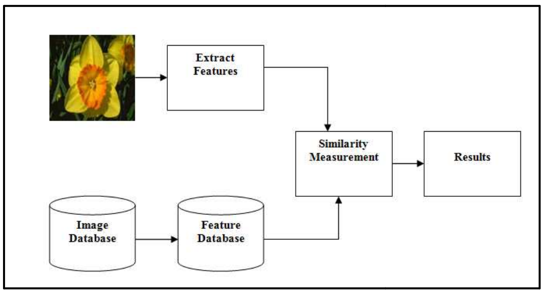

Fig.4.Content Based Image Retrieval System

3.4. Images

A computerized picture is made out of pixels which can be considered little specks on the screen. An advanced picture is a direction of how to shading every pixel. An average size of a picture is 512-by-512 pixels. Later on in the course you will see that it is helpful to let the measurements of the picture to be a force of 2. For instance, 29=512. In the general case we say that a picture is of size m-by-n on the off chance that it is made out of m pixels in the vertical bearing and n pixels in the flat heading.

3.5 MODLES OF THE PROPOSED SYSTEM

3.5.1. General Description

The Paper will be developed in three types of modules such that the output can be visual in three manners.

- Color Feature Extraction and Reclamation
- Texture Feature Extraction and Reclamation
- Integration and sorting

3.5.2 Color feature extractions and retrieval

The color feature based image retrieval includes the following steps:
1. Feature Extraction
2. Histogram Computation
3. Similarity Matrix Computation
4. Dissimilarity Computation
5. Sorting Images in ascending

3.6 Module Block Diagram

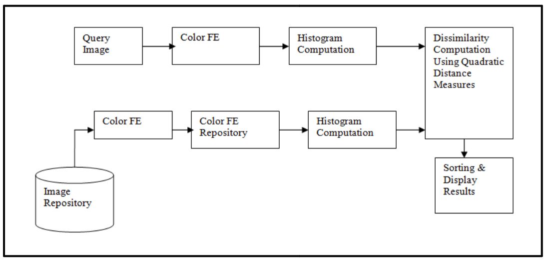

Fig.5.Color Feature Extraction Block Diagram

3.6.1. Feature Extraction

The shading peculiarities vector of question and database pictures are figured in HSV shading space. Thus our proposed system incorporates HSV mapping to acquire the shading guide histogram.

3.6.2. Histogram Quadratic (cross) Distance

There are several vector of question and database pictures are figured in HSV shading space. Thus our proposed system incorporates HSV mapping to acquire the shading guide histogram.

3.6.3. Dissimilarity Computation

Let ***h*** and ***g*** represent two color histograms. The Euclidean distance between the color histograms ***h*** and ***g*** can be computed as :

$$d^2(h,g) = \sum_A \sum_B \sum_C (h(a,b,c) - g(a,b,c))^2 \quad (3)$$

In this distance formula, there is just correlation between the indistinguishable canisters in the separate histograms. Two separate canisters may speak to perceptually comparative hues however are not thought about transversely. All containers contribute similarly to the separation.

3.6.4. Breed Images in increasing order

The applicant images are sorted out based on the disparate and exhibit in increasing manner.

3.7. Texture Representation

Texture gives a rich wellspring of data about the common scene. For creators, a composition adds extravagance to a configuration. For PC researchers, a composition is appealing not just in light of the fact that it is an imperative part in picture investigation for tackling an extensive variety of connected distinguishment, division and blend issues; additionally it gives a key to comprehension fundamental components that underlie human visual discernment.

3.7 .1. TEXTURE FEATURES

In many machine vision and image processing algorithms, simplifying assumptions are made about the uniformity of intensities in local image regions. Be that as it may, images of genuine protests frequently don't display areas of uniform intensities. The examples can be the consequence of physical surface properties, for example, unpleasantness or situated strands which frequently have a material quality, or they could be the aftereffect of reflectance contrasts, for example, the shading on a surface. For ultimate arrangement purposes, what concern us are the measurable methods of portrayal. This is on account of it are these procedures that outcome in processing surface properties.which are

a. Co-occurrence Matrix
b. Tamura Texture
c. Wavelet Transform

3.7.2 CO-OCCURRENCE MATRIX

At first proposed by R.M. Haralick, the co-occurrence matrix illustration of texture features explores the grey level spatial dependence of texture. A mathematical definition of the co-occurrence matrix is as follows:

- Given a position operator ***P(i,j)***,
- let ***A*** be an n x n matrix
- Whose element ***A[i][j]*** is the number of times that points with grey level (intensity) ***g[i]*** occur, in the position specified by ***P***, relative to points with grey level ***g[j]***.
- Let ***C*** be the ***n* x *n*** matrix that is produced by dividing ***A*** with the total number of point pairs that satisfy ***P***. ***C[i][j]*** is a measure of the joint probability that a pair of points satisfying ***P*** will have values ***g[i]***, ***g[j]***.
- ***C*** is called a co-occurrence matrix defined by ***P***.

Examples for the operator ***P*** are: "***i*** above ***j***", or "***i*** one position to the right and two below ***j***", etc.

This can also be illustrated as follows… Let t be a translation, then a co-occurrence matrix C_t of a region is defined for every grey-level *(a, b)* by [1]:

$$C_t(a,b) = card\{(s, s+t) \in R^2 | A[s] = a, A[s+t] = b\} \quad (4)$$

Here, $C_t\ (a,\ b)$ is the number of site-couples, denoted by $(s,\ s + t)$ that are separated by a translation vector t, with a being the grey-level of s, and b being the grey-level of $s + t$.

For example; with an 8 grey-level image representation and a vector t that considers only one neighbor, we would find at first the co-occurrence matrix is constructed, based on the orientation and distance between image pixels. Then meaningful statistics are extracted from the matrix as the texture representation.

	0	1	2	3	4	5	6	7
0	0	0	0	0	0	0	0	0
1	0	1	2	0	0	0	0	0
2	0	1	0	2	0	0	0	0
3	0	0	1	1	0	0	0	0
4	0	1	0	0	1	0	0	0
5	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0

Fig.6.Classical Co-occurrence matrix

Haralick proposed the following texture features:

1. Angular Second Moment
2. Contrast
3. Correlation
4. Variance
5. Inverse Second Differential Moment
6. Sum Average
7. Sum Variance
8. Sum Entropy
9. Entropy
10. Difference Variance
11. Difference Entropy
12. Measure of Correlation 1
13. Measure of Correlation 2
14. Local Mean

Hence, for each Haralick texture feature, we obtain a co-occurrence matrix. These co-occurrence matrices represent the spatial distribution and the dependence of the grey levels within a local area. Each ***(i,j)*** th entry in the matrices, represents the probability of going from one pixel with a grey level of '***i***' to another with a grey level of '***j***' under a predefined distance and angle. From these matrices, sets of statistical measures are computed, called feature vectors.

3.8. GLCM

This appendix describes the specific computational procedures used for the extraction of image features. *Gabor function and wavelets.* Following Manjunath and Ma (1996), we employed Gabor filters to extract textures of different sizes and orientations (i.e. Gabor-based texture feature). A Gabor filter (Fig. 5) is defined by a two-dimensional Gabor function, $g(x, y)$:

$$g(x,y)=\left(\frac{1}{2\pi\sigma_x\sigma_y}\right)\exp\left[-\frac{1}{2}\left(\frac{x^2}{\sigma_x^2}+\frac{y^2}{\sigma_y^2}\right)+2\pi jWx\right] \tag{5}$$

Where σ_x and σ_y denote the scaling parameters of the filter in the horizontal (x) and vertical (y) directions, and W denotes central frequency of the filter. The Fourier transform of the Gabor function $g(x, y)$ is defined as:

$$G(u,v)=\exp\left[-\frac{1}{2}\left(\frac{(u-W)^2}{\sigma_u^2}+\frac{v^2}{\sigma_v^2}\right)\right] \tag{6}$$

Where $\sigma_u = 1/2\pi\sigma_x$ and $\sigma_v = 1/2\pi\sigma_y$.

Gabor filters transformed the animal faces $I(x, y)$ into $X_{mn}(x, y)$:

$$X_{mn}(x,y)=\int I(x_1,y_1)g_{mn}{}^*(x-x_1,y-y_1)dx_1dy_1 \tag{7}$$

Where * denotes the complex conjugate. Assuming that the local regions are spatially homogeneous, we can use the mean, u_{mn}, and standard deviation of these regions, σ_{mn}, as textural features.

$$\mu_{mn}=\iint |W_{mn}(xy)|\,dxdy$$
$$\sigma_{mn}=\sqrt{\iint (|W_{mn}(xy)|-\mu_{mn})^2\,dxdy} \tag{8}$$

Using 24 Gabor filters defined at six orientations and four sizes, the two textural features (u_{mn} and σ_{mn}) derived from Equations 1 to 5 result in a 48-dimensional feature vector (24 × 2 = 48). We then employed principal component analysis (PCA) to reduce these high-dimensional feature vectors into one dimension (i.e. the one corresponding to the largest variance).

5. EXPERIMENTAL RESULTS

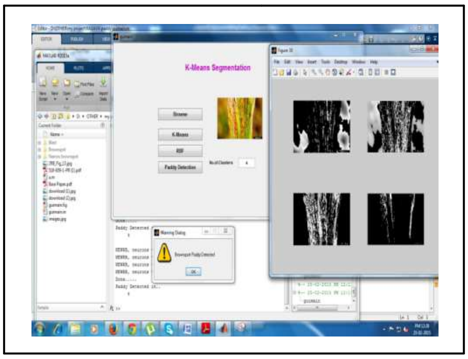

Fig.7.Output screen

Fig.8.Browsing the path of input file

Fig.9.Selection of input Input image

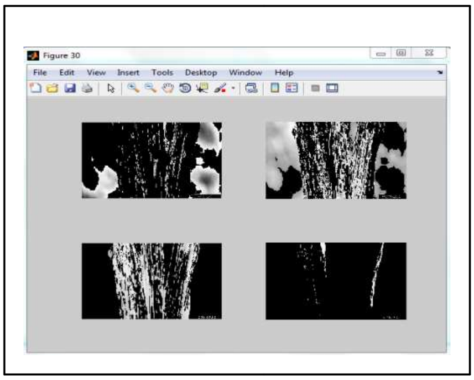

Fig.10.k-means clustering

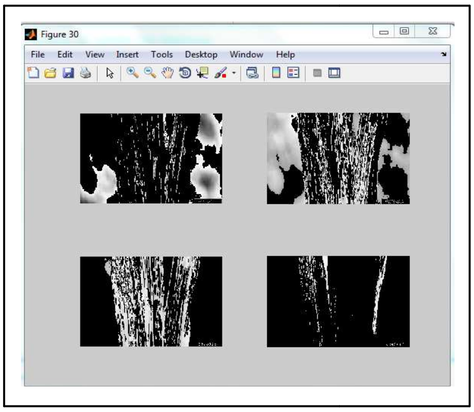

Fig.11.RBF of clusters

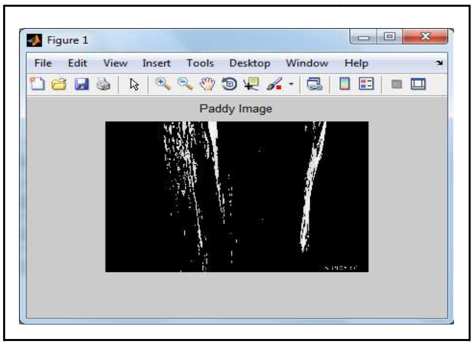

Fig.12.Occurrence of specific pady cluster

Fig.13.Type of pady detected

5. CONCLUSION

A system for diagnosing paddy diseases, including BD, BSD and NBSD mainly based on IDL application system. Four characteristics of lesion type, boundary colour, spot colour, and broken paddy leaf colour were tested for used to establish the classification system. The ratio of height and width of the lesion spot provided a unique shape characteristic for determining the type of the lesion. Two threshold methods have been applied to get the best result in diagnosing ninety-four paddy leaf images. The best accuracy of two methods that used Local entropy threshold is about 94.7%. Different intensity values and less prone to illumination, thus Otsu method is disabled to perform segmentation task accurately.

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