Image Segmentation based Methodology for Classification of various Seed varieties.

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Abstract

The main objective of this research is to develop a methodology for identifying different varieties of paddy seeds using morphological features. Morphological features are powerful tool which could separate the different varieties of seeds. Three varieties of paddy seeds are taken that are classified according to their morphological feature range. Image of paddy seeds was acquired by a canon digital IXUS 132 camera. Images were stored in jpg format for further analysis Contour based feature extraction and traversal of seeds are carried out. This methodology consist of several steps image acquisition, segmentation using mean shift segmentation that is based on color merge over the space, binarization using otus's threasholding method, feature extraction and classification. Six morphological features are extracted from paddy seed images and they are area, diameter, major axis, minor axis, compactness, roundness. All three verities that are classified in this paper vary according to all morphological features. More numerical results are presented in this paper.

Keywords: *Contour, Morphology. Segmentation, Binarization, Feature extraction, classification.*

1. Introduction

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 is one of the most important cereal grain crops. It constitutes the world's principle source of food, being the basic grain for the planet's largest population. For tropical Asians it is the staple food and is the major source of dietary energy and protein. In Southeast Asia alone, paddy is the staple food for 80% of the population. During grain handling operations, information on grain type and grain quality is required at several stages before the next course of operation can be determined and performed. Harper et al.(1970) emphasized the heritability of morphological characters in nature. Measurement of some characters such as color, texture, or some of morphological features are simple, but the information which get in this way is subjective and so is not reliable. Therefore, searching a method which solves this problem

is necessary. Digital image analysis is using image analysis software; with accurate, rapid and objective potential is much reliable method which gets a lot of information from a digital image. Also, reviewing the literatures supported the importance of this technique in agricultural research. Zayas et al. (1986) used some of shape parameters for identification of wheat varieties. Recognition of cultivars seeds using imaging program was reported by Travis and Draper (1985). Neuman et al., (1987) discriminated durum wheat cultivars with accuracy of 96%. Symonsand Fulcher (1988) calculated the morphological features of Canadian wheat cultivars. Automatic discrimination of autumn cereals including oats, rye, barley and weed species was reported by Westerlind (1988). Afsharibehbahanizadeh et al. (2011) used image processing technique to indicate different physical properties in various plant densitiesand Draper (1985). Neuman et al., (1987) discriminated durum wheat cultivars with accuracy of 96%. Symonsand Fulcher (1988) calculated the morphological features of Canadian wheat cultivars. Automatic discrimination of autumn cereals including oats, rye, barley and weed species was reported by Westerlind (1988). Afsharibehbahanizadeh et al. (2011) used image processing technique to indicate different physical properties in various plant densities. paddy is one of the most important crops which widely grown in different regions of the world. So the present study was conducted to extract the morphological features in seven different types of paddy seeds and estimation of features diversity in these cultivars.

1.1 Morphology and Classification

Morphology is a branch of bioscience dealing with the study of the form and structure of organisms and their specific structural features.[This includes aspects of the outward appearance (shape, structure, colour, pattern) as well as the form and structure of the internal parts like bones and organs. This is in contrast to physiology, which deals primarily with function. Morphology is a branch of

life science dealing with the study of gross structure of an organism or taxon and its component parts. Most taxa differ morphologically from other taxa. Typically, closely related taxa differ much less than more distantly related ones, but there are exceptions to this. Cryptic species are species which look very similar, or perhaps even outwardly identical, but are reproductively isolated. Conversely, sometimes unrelated taxa acquire a similar appearance as a result of convergent evolution or even mimicry. A further problem with relying on morphological data is that what may appear, morphologically speaking, to be two distinct species, may in fact be shown by DNA analysis to be a single species. The significance of these differences can be examined through the use of allometric engineering in which one or both species are manipulated to phenocopy the other species.

1.2 Plant Morphology

Plant morphology or phytomorphology is the study of the physical form and external structure of plants. This is usually considered distinct from plant anatomy ,which is the study of the internal structure of plants, especially at the microscopic level. Plant morphology is useful in the visual identification of plants.

1.2.1 A Comparative Science

A plant morphologist makes comparisons between structures in many different plants of the same or different species. Making such comparisons between similar structures in different plants tackles the question of *why* the structures are similar. It is quite likely that similar underlying causes of genetics, physiology, or response to the environment have led to this similarity in appearance. The result of scientific investigation into these causes can lead to one of two insights into the underlying biology:

1. **Homology** - the structure is similar between the two species because of shared ancestry and common genetics.

2. **Convergence** - the structure is similar between the two species because of independent adaptation to common environmental pressures.

Understanding which characteristics and structures belong to each type is an important part of understanding plant evolution. The evolutionary biologist relies on the plant morphologist to interpret structures, and in turn provides phylogenies of plant relationships that may lead to new morphological insights.

2. Methods and Material

In this paper, a new approach for classification of paddy seeds varieties using image processing techniques is presented. The block diagram shown in Fig. 1 illustrates the procedure for recognition and classification of paddy seeds.
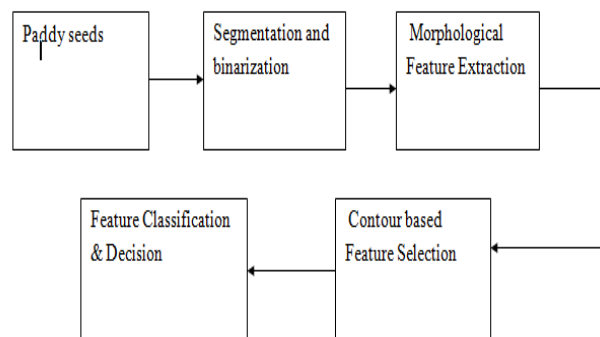

Figure 1:Procedure for classification of seed varieties

2.1 Image Acquisition

Image of paddy seeds was acquired by a canon digital IXUS 132 camera. Images were stored in jpg format for further analysis (Fig. 2For each variety, the measurements were conducted for 20 seeds of paddy. Using image processing techniques it was possible to easily extract the morphological features of seed varieties .

2.2 Mean Shift Segmentation

Image segmentation subdivides an image into different parts or objects and is the first step in image analysis. The image is usually sub divided until the objects of interest are isolated from their background. Mean Shift segmentation uses a color merge (over a scale that depends on the similarity) of the colours to one another in order to segment images. This approach is based on minimizing the total energy y in the image; here energy is defined by a link strength, which is further defined by colour similarity. Mean shift finds the peak of a colour-spatial (or other feature) distribution over time. Mean-shift segmentation finds the peaks of color distributions over space. Given a set of multidimensional data points whose dimensions are (x, y, blue, green ,red), mean shift can find the highest density "clumps" of data in this space by scanning a window over the space. However, that the spatial variables (x, y) can have very different ranges from the color magnitude ranges (blue, green, red). Therefore, mean shift needs to allow for different window radii in different dimensions. In this case we should have one radius for the spatial variables (spatial Radius) and one radius for the color magnitudes (color Radius). As mean-

shift windows move, all the points traversed by the windows that converge at a peak in the data become connected or "owned" by that peak. This ownership, radiating out from the densest peaks, forms the segmentation of the image

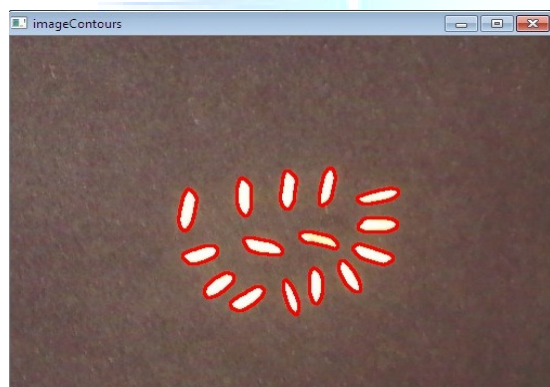Figure2:Original image(PR114.PUSA44.HKR127)

Figure 3: Segmented Image(PR114.PUSA44,HKR127)

2.3 Binarization (Otsu's Method)

Otsu,s method is used to perform histogram shape based image threasholding or the reduction of gray scale image to binary image.The algorithm assume that the image to be thresholded contains two classes of pixels or bi-modal histogram eg forground and background then calculates the optimum threshold separating those two classes so that their combines spread is minimal. A measure of region homogeneity is variance (i.e., regions with high homogeneity will have low variance). Otsu's method selects the threshold by minimizing the within-class variance of the two groups of pixels separated by the thresholding operator. It does not depend on modelling the probability density functions, however, it assumes a bimodal distribution of gray-level values (i.e., if the image approximately fits the constraint, it will do a good job).

2.4 Morphological feature extraction

The following morphological features were extracted from images of Paddy seeds,

Area: the number of pixel inside and including the paddy seed boundary.

Perimeter: It calculates the distance around the boundary of Paddy seed..

Major axis length: it is the distance between the end points of the longest line that could be drawn through the Paddy Seed.

Minor axis length: it is the distance between the end points of the longest line that could be drawn through the Paddy seed while maintaining perpendicularity with a major axis.

Aspect ratio: the ratio of major axis length to the minor axis length.

Elongation: the ratio of minor axis length to major axis length.

Roundness= 4∏ × Area/Perimeter	**(1)**
Aspect Ratio= Major Axis/ Minor Axis	**(2)**
Compactness= Perimeter2/Area	**(3)**
Elangation= Minor Axis/ Major Axis	**(4)**
Feret Diameter= _(4× Area/ ∏)	**(5)**

2.5 Contour Based Feature Selection

Seed variety	Min area	Min diameter	Major axis	Minor axis	Compactness	Roundness
PR114	324.5	41.7	11	12	0.43	0.18
PUSA44	586.5	51.0	16	36	0.45	0.20
HKR127	312	42.7	15	16	0.46	0.21

Seed variety	Max area	Max diameter	Major axis	Minor axis	Compactness	Roundness
PR114	578.5	55.9	51	49	0.51	0.26
PUSA44	772.5	69.4	60	65	0.53	0.28
HKR127	558.5	53.4	48	48	0.52	0.28

Table 1:Minimum to Maximum range of features

After extracting morphological features, a min to max range of each feature is calculated for each seed variety.

This range helps to classify the seed varieties according to their feature selection range. Three varieties of seeds are take. They are (PR114,PUSA44,HKR127)Each feature of a particular variety vary between a range of minimum to maximum.Six morphological features (Area,Diameter, Major axis,Minor axis,Compactness,Roundness) vary between a minimum to maximu range for each seed of a particular variety.

3. Results

Three different varieties of paddy seeds (PR114, PUSA44.HKR127) are classified according to their feature selection range. The results indicated that there were significant differences between the cultivars in morphological features which measured.The random three seeds are classified according to maximum feature matching range. The more varierty feature matches,the more possibility of that particular variety.

Possible classification of first seed(1)			
Area (411.5)	PR114		HKR127
Diameter (42.80)	PR114		HKR127
Major axis (32)	PR114	PUSA44	HKR127
Minor axis (15)	PR114		HKR127
Roundness (0.27)		PUSA44	HKR127
Compactness(		PUSA44	HKR127

Table 3:Possible classification of seed 1

Seed	variety
1	HKR127

Table 4:final classification of seed 1

Seeds	Area(pixels)	Diameter(pixels)	Major axis	Minor axis	compactness	Roundness
1	411.5	42	32	25	0.52	0.27
2	310.5	42	15	36	0.43	0.23
3	587.0	51	38	26	0.52	0.24

Table 2:Three random seeds from a mixture of 15 seeds

Possible classification of seed(2)			
Area(310)	PR114		
Diameter(42.0)	PR114	PUSA44	HKR127
Major axis(15)	PR114		HKR127
Minor axis(36)	PR114	PUSA44	HKR127
Compactness(0.43)	PR114	PUSA44	HKR127
Roundness(0.23)	PR114	PUSA44	

Table 5:Possible classification of seed 2

Seed	variety
2	PR114

Taable 6:Final classification of seed 2

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Possible classification of seed(3)			
Area(587)		PUSA44	
Diameter(51.0)	PR114	PUSA44	HKR127
Major axis(38)	PR114	PUSA44	HKR127
Minor axis(26)	PR114	PUSA44	HKR127
Compactness(052)		PUSA44	HKR127
Roundness(0.24)		PUSA44	HKR127

Table 7: Possible classifications of seed 3

Seed	variety
3	PUSA44

Table 8: Final classification of seed 3

4. Conclusion

These results emphasized that the features extracted by image analysis could facilitate many agricultural programs such as application of them in automated detections in machine vision systems, discrimination of cultivar seeds from each other. Studies on correlation of morphological features of seeds with other parts of plant and finally the correlation of these features with physiological characters of plant could recommend.

Acknowledgement

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