Crack Detection in Paddy using Image Processing Techniques

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Abstract— In this paper a method is proposed to find cracks in paddy. X ray image of a single paddy is acquired and processed using image processing techniques to assess the quality of a paddy without dehusking. There by eliminating manual, laborious, ineffective process of quality asses of rice granules. On the acquired X ray image of paddy image pre-processing techniques such as de-noising, edge detection, dilation and region of interest (ROI) extraction, feature extraction are performed to detect cracks. There by deciding the quality of paddy. Condition of paddy determines its quality and price.

Index Terms— Edge detection, feature extraction, histogram, image de-noising, image cropping, ROI, X-ray image.

1 Introduction

India is the second largest country in the production of rice. India contributes about 20% for world rice production. Processing of paddy to rice takes many stages like harvesting, classification, packaging, transport, processing, preservation and selling, etc. There is a possibility of paddy getting damaged in any of these stages. Humidity in paddy should be 7-14% at room temperature for good quality of paddy. Rapid change in the temperature of the atmosphere also affects the physical state of the paddy. Before processing, quality of paddy is examined in the industry. Quality of paddy is an important factor to decide its price. Crack in paddy decreases its quality. Paddy husk is a thick layer around rice kernel due to which rice cracks are not visible to naked eyes. The current method of crack detection in paddy is done by manually dehusking, and examining kernels under light. This method is laborious, time consuming and subjective. Automation of the process makes the system more efficient.

While processing the rice about 14% loss occurs due to breakage of rice kernels. To reduce this loss an automatic system is implemented. 'Jaya' variety of paddy is considered for experiments in this paper.

2 Literature Survey

Liu Guangrong [1] proposed a method to find the chalk degree of rice. The rice image has been extracted from background with an optimal threshold value. After this extraction the chalk has been defined through contrast-ribbon approximation. The chalk has been extracted from the rice. Chalky grain has been defined by calculating area ratio of chalk and the whole rice. Then chalky area ratio and chalky grain rate have been calculated. After this automatic detection of rice chalk degree has been realized.

Dollawat Ngampak and Punpiti Piamsa-nga [2] proposed a method to evaluate the broken rice grains. In this method, a grain image is converted into grayscale, passed to Gaussian filter to eliminate noises and enhance the edge contrast of broken rices using morphological opening. Then the image is filtered by Otsu 'method and features are extracted. Major axis length and minor axis length, which are maximum length and max mum width of each rice grain, respectively, are extracted to classify broken grains according to the features extracted.

Mahale et.al, [3] proposed a method to sort rice based on quality by grading and evaluating the of rice grains on the basis of grain size and shape using image processing techniques. Specifically edge detection algorithm is used to find out the region of boundaries of each grain. Depending on the morphological measures rice is classified.

C Karunakaran, et.al, [4] proposed a method to sort the infested wheat kernels by acquiring the x ray images at different stages of wheat life using neural networks using the non-parametric classifier and BPNN.

3 Problem Definition

The objective of the paper is to develop an automated system using image processing techniques to detect cracks in paddy without de-husking and hence to asses quality of rice grain. This system would contribute in improving the automation in rice milling industries.

4 Methodology

To detect cracks in the paddy, a system is developed by acquiring x-ray image of rice and processing the image with steps as shown in fig 1.

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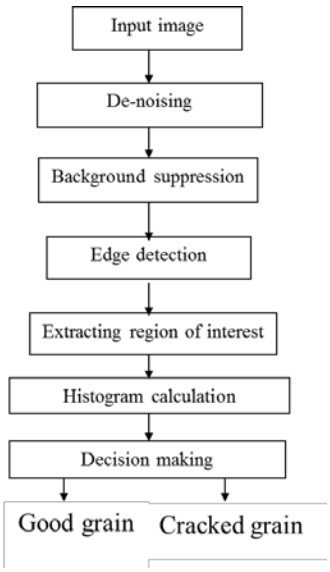

Fig 1 Flow chart of the algorithm used to find cracks in rice.

4.1 Input image

X ray image of paddy is acquired with digital Dental X ray machine placing a paddy kernel against the sensor. X rays are passed through the paddy with an exposure time of 4.6 mili seconds. Digital X ray machine used in experiments is MyRay RXAC. It is designed with non-variable voltage and current parameters of 70kVp and 08mA respectively.

4.2 De-noising

The acquired image is filtered with the median filter. Median filter is used to smoothen the image. With the median filter the sharp or high intensity variation of the pixel values are brought down to nearby neighbor pixel value. A window of size 3×3 is set and all the pixel values p1, p2, p3, p4, p5, p6, p7, p8 and p9 in the window are replaced by the median value of the window are shown.

p_1	p_2	p_3
p_4	p_5	p_6
p_7	p_8	p_9

Fig 2 A 3×3 window, for median filter with pixel values.

To get the median value over all the pixel values of the window

- All the pixel values are arranged in ascending order.
- Middle value of pixels is selected and replaced all the other pixel values by this selected value.
- If there are even numbers of pixels then the average of the middle two pixels is computed and all other pixel values are replaced by the median value.

4.3 Background suppression

To remove the noise and sharpen the image, a threshold is set to reduce the risk of background edge detection which is out of interest. After subjected to mean filtering, background of image is suppressed with a threshold value of 15 to decide the pixel intensities. Rice kernel in the image is enhanced by suppressing the background. By thresholding the pixel values cracks in rice kernels are made intense.

4. 4 Edge detection

After removing denoising and background suppression edges are extracted using canny edge detection.

The algorithm of canny edge detection works in following 5 steps.

- Smoothing: removes noise with the help of Gaussian filter which gives the blurring effect.
- Finding gradients: The edges should be marked where the gradients of the image has large magnitudes using partial derivatives.

$$Magnitude, M(x,y) = \sqrt{g_x{}^2 + g_y{}^2} \quad \text{.....(1)}$$

$$Angle, \alpha(x,y) = \tan^{-1}\left[\frac{g_y}{g_x}\right] \quad \text{.....(2)}$$

Where g_x and g_y are horizontal and vertical gradient vectors respectively.

- Non-maximum suppression: Only local maxima should be marked as edges.
- Double Thresholding: A higher and a lower threshold values are set. The pixel values crossing thresholds are marked as edges and connecting edges respectively.
- Edge tracking by hysteresis: Final edges are determined by suppressing all edges that are not connected to a very certain edge.

By canny edge detection algorithm edges of the image will be more predominant.

4.5 Extracting region of interest

Contour points of input image which are the sources of finding region of interest are extracted. Contour gives the boundary points of the input image. From these boundary points a rectangular region of the rice kernel is extracted which excludes the edges of the rice kernel. Size of the region of interest varies depending on the variety of the paddy taken.

The extracted region of interest is scanned for edges and lines. If there exist any edges or lines in the rice image, then it

is considered as a crack in the rice kernel. If there are no edges or lines in the extracted region then the rice kernel is considered as having no cracks.

4.6 HISTOGRAM PLOTTING

To find whether the extracted region is having cracks or not, histogram of the interested region is calculated. Depending on the values of the histogram decision is made about the quality of the paddy. Maximum and minimum value of the histogram is calculated. Depending on the maximum value and the minimum value of the histogram, decision is made as the rice has no crack or rice is having crack.

5 RESULTS

Experimental results of the proposed algorithm are shown in the images below.

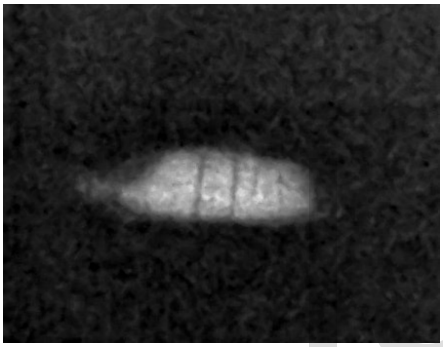

Fig 3 Digital X- ray image of paddy having cracks.

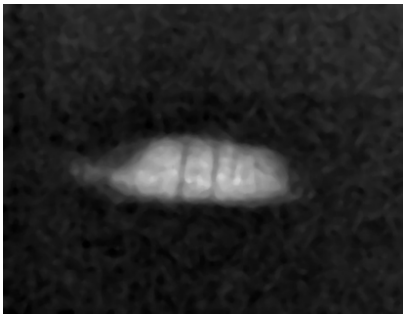

Fig 4 Image of rice kernel after a

Fig 5 Result of canny edge detection

Fig 6 Extracted region of rice having cracks.

6 CONCLUSION

In our contry normally the equality of paddy is asessed manually by de-husking. This process is subjective, time consuming and labourious. To overcome these limitations, this paper proposes an image processing technique to asses the quality of paddy automatically. This automated process is more efficient and economical to rice milling industries.Dental X-ray machine is used to aquire images of rice kernel as it emerges less radiation there by preventing any possible damages to rice kernel.

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