Use of Digital Image Processing for Grain Counting

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Abstract: In many areas of industry, counting of different types of objects is an integral part. Particularly agriculture industries, in which objects like spice, seeds or grains and other structures have to be evaluated based on their quality. Digital image processing can be used for quality evaluation and grading of agriculture food in industry. One of the major step in quality assessment of grains is counting of grains, which normally accomplished either manually or using expensive commercial equipments[1]. We propose a simple method based on image processing for grain counting. The proposed method converts the input image into a format such that the number of grain can be counted based on the components present in the enhanced image. Proposed method is implemented in Matlab 7.9 software.

Keywords: median filter; image processing; erosion; binary image; Matlab.

I. INTRODUCTION

Images contain different types of objects and structures which may convey information. Counting involves estimating the number of objects in an image. Counting arises in many real-time applications such as counting grains in agriculture industry, counting cells in microscopic images, counting of number of people and number of vehicles on road etc. In the agriculture industry, one of the major step in the quality evaluation of grain seeds is to determine their count. Existing methods for counting involves a large amount of hardware which also adds to the cost or manual counting which is time consuming and may give erroneous results. Now counting can be done with the technique involving digital camera and simple image processing method based on matlab. And hence automated grain counting could be performed with ease. The rapid development of computer vision and pattern recognition technology, computer vision detecting technology has been used in the quality detecting and count of grains[2]. In this paper, we proposed a simple matlab based method for grain counting which involves capturing of dispersed grains image at first. This method is based on morphologic operations used in digital image processing, in order to make its implementation simple and to keep the computational burden low.
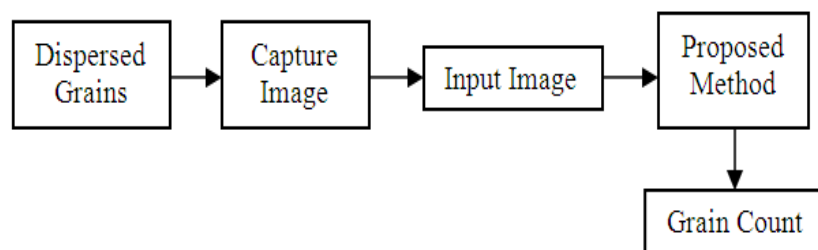

Fig.1 Workflow for Grain counting

The system workflow of grain counting is shown in the Fig.1. Firstly, the grains are dispersed without overlapping and no conglutinations among grains. We then acquire grains image. We used 8 megapixel camera to capture the image, which gives good quality images. This image will be processed by proposed method to provide grain count.

II. METHODOLOGY

According to our proposed method, first image of different grains are acquired with a colour Digital Camera as shown in Fig.2.

In Fig.2, images of dried white peas and green peas with different grain counts are shown. Here the grains are dispersed on black background so that the image of grains can be separated from the background. Captured images are stored in JPG format. In Matlab, captured image is read by the imread() function. The images acquired are colour images, so it is converted into grayscale image. The colour information is not necessary for further processing as it does not carry any useful information[3]. Matlab function converts the colour image to grayscale image by eliminating the hue and saturation information while retaining the luminance.

Images are normally corrupted by noise during image acquisition process. Noise may get add to original image due to different factors. The noise interference in images might affect the results for some processing that worsen the quality of original image. Therefore, the image denoising process should be performed on the image before applying other image processing methods [5]. In proposed method we used median filtering which is nonlinear filter. Median based filtering is the popular method to remove unwanted noise level from corrupted images. This is because of their simplicity and capability to preserve edges.

Fig.2 Original Captured Images

Determination of grain count from grayscale image is difficult task in image processing. It is necessary to differentiate the grain and background in grayscale image. One way to achieve this is to change the grayscale image into a binary image. From binary image, individual grain can be identified. The centre of these individual grains is then marked to get exact grain count. Thresholding is used to convert the grayscale image to a binary image. Binary image has two colors white and black. When the gray level of pixel is greater than the threshold, that white color pixel is related to grain and conversely black means pixel related to background. We need to find a threshold that is representing good value to separate the two different gray levels.

In Fig.2 we can see many of the grains are conglutinated. This may causes an error in grain counting if the conglutination among grain is not separated. Image erosion is most basic image processing operation typically applied on binary images. Image erosion process erodes away or eliminates boundaries of region of foreground pixels which are white pixels related to grains and makes it shrink towards centre. The erosion process takes two inputs. The first is the image which is to be eroded and second is a structuring element. The shapes and sizes of structuring element are selected according to the type of grain. Usually used shapes are diamond, disk, line, square, etc. In this paper we used disk structuring element.

For counting of grain from binary image, we need to identify which foreground pixels corresponds to which grain. In binary image the value 0 in each location is related to the background pixel. Value 1 represents foreground object here grain in binary image. The Matlab function bwlabel() is used to count the grains. Furthermore label is displayed graphically on each grain. Centroid of each grain is computed and text string of count is superimposed on top of the image at centroid locations.

III. PROPOSED ALGORITHM

According to proposed algorithm first sample grains are spread on the black background and image is captured by colour digital camera. Further the captured image is processed by Matlab based method. Fig.3 shows flowgraph for proposed method.
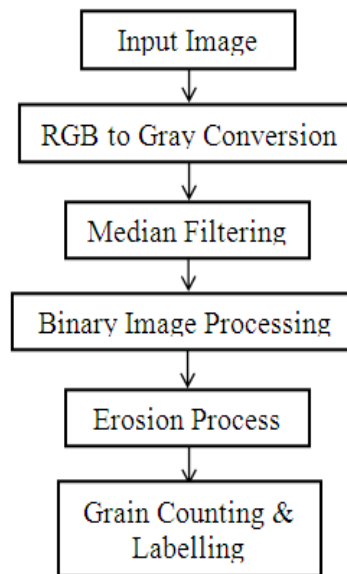

Fig.3 Flowgraph

Here the captured image is colour image so covert it in to gray scale image because the colour information is not of importance for our analysis. For efficient counting of grains this grayscale image is converted into a binary image and morphological operations are then used on these binary images. Thresholding is used to convert the segmented image to a binary image. Then the grains touching each others are identified and separated by erosion process. This phase identifies individual grain boundaries and marks the centre of each grain for further processing. The grains are counted and labelled at the end.

IV. RESULT ANALYSIS

Taking image of dried white peas shown in Fig.1 as original image and fig.4 is gray scale image. Fig.5 shows an image after performing operation to convert into binary image.
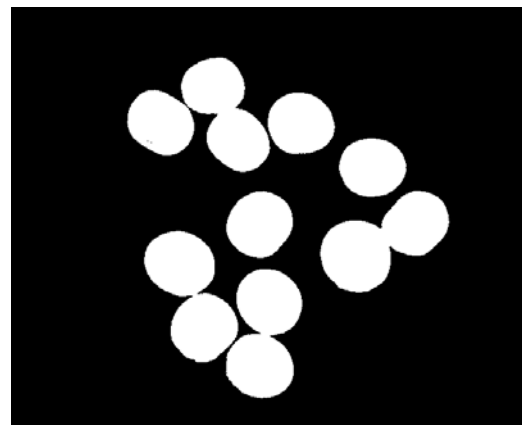

Fig. 4 Grayscale image
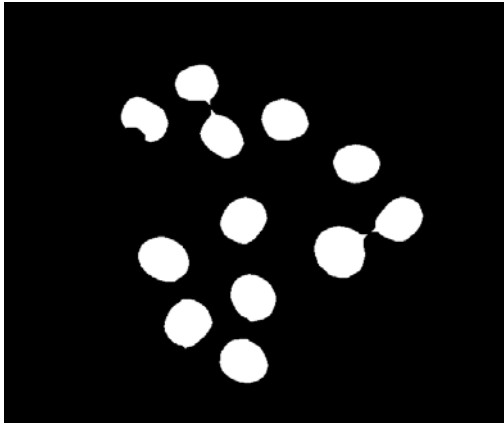
Fig. 5 Binary image
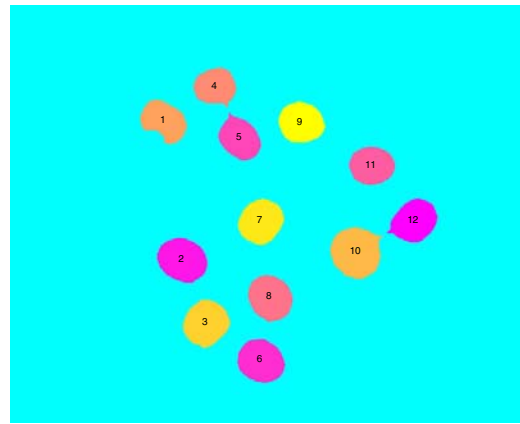
Fig. 6 Eroded image

Fig. 7 Labelled image

Fig 6 shows eroded image wherein conglutination among grain is separated using disk structuring element. From Labelled image in Fig.7, we get measured count of grains.

TABLE I.   Experimental Result

Grain Type	Actual Number	Measured Number
White Peas	12	12
White Peas	187	187
Green Peas	221	221
Green Peas	85	85
Green Chick Peas	337	336

The experimental results are given in Table.1. Here images of different sample grains are processed by proposed method. The actual count and measured count of different grains are compared.

V. CONCLUSION

Image processing based on Matlab is effectively used to determine count of different grains. Traditionally grain counting is done manually or may involve costly electronic systems. This can be replaced by proposed system. The developed method is quick and low cost as there are no costly equipment and software. Good accuracy has been achieved in experimental results. It has been observed that for bigger grains the counting accuracy is more. Size of disk structuring element has more effect on accuracy. Smaller the grain is, less the size of disk structuring element should be. Accuracy can be increased by separating conglutination among the grains.

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