Rice Quality Analysis Using Image Processing Techniques

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Introduction

Rice quality is nothing but the combination of physical and chemical characteristics. Grain size and shape, chalkiness, whiteness, milling degree, bulk density and moisture content are some physical characteristics while amylose content, gelatinization temperature and gel consistency are chemical characteristics of rice. The paper presents a solution of grading and evaluation 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. In this technique we find the endpoints of each grain and after using caliper we can measure the length and breadth of rice. This method requires minimum time and it is low in cost.

Traditional Method

The traditional methods used for grain size and shape measurement are dial micrometer, grain shape tester and graphical method, but these methods are very time consuming. In dial micrometer and grain shape tester we can measure length and breadth of single grains at a time. The outcome of this analysis is also relative, time consuming, having variable results and costly. So it requires high degree of accuracy to satisfy customers need and to overcome limitations of manual inspection new and advanced method is proposed which is image processing techniques.

Image processing Method

The image processing technique is used for counting the number of rice seeds and classifies them on the basis of length, breadth and length - breadth ratio. Length is the average length of rice grain while breadth is the average breadth of rice grain and length-breadth ratio is calculated as:

$$\mathbf{L/B = [(Avg.\ length\ of\ rice) / (Avg.\ breadth\ of\ rice)]*100}$$

Steps Involved:

In first pre-processing step image registration takes place and noise is removed from the image by using filter. Shrinkage algorithm used for segmenting the touching kernels which is second step. In third step we perform edge detection to find out the region of boundaries. In fourth step rice seed measurement is done and in the same step length, breadth and length-breadth is also measured. In the fifth step of the algorithm rice is classified according to its size and shape

A. Image pre-processing

Filter is applied to remove noise which occurs during the acquisition of image. Filter also sharpens the image. Threshold algorithm is used to segment the rice grains from the black background.

B. Shrinkage morphological operation

Erosion is applied to separate the touching features of rice grains without losing the integrity of single feature. Dilation process follows erosion process. The goal of dilation is grow the eroded features to their original shape without rejoining the separated features

C. Edge detection

Edge detection helps to find out the region of boundaries of rice grains. We use canny algorithm to detect the edges.

D. Object measurement

Measurement indicates the count of rice grains. After getting the count of rice grains, edge detection algorithms applied on the image and outcome of the applied algorithm is we get endpoint values of each grain. We use caliper to join the endpoints and measure the value of length and breadth of each grain. After getting the value of length and breadth we can calculate length-breadth ratio.

E. Object classification

Classification requires all standard, measured and calculated results. The standard database for rice size and shape measurement is referred from laboratory manual on rice grain quality, Directorate of Rice Research, Rajendranagar, Hyderabad. The classification of rice grains as per the standard database is shown in following tables. Table 1 indicates classification of rice grains on the basis of length and length-breadth ratio.

Long Slender (LS)	Length 6 mm and above, L/B ratio 3 and above
Short Slender (SS)	Length less than 6 mm, L/B ratio 3 and above
Medium Slender (MS)	Length less than 6 mm, L/B ratio 2.5 to 3.0
Long Bold (LB)	Length 6 mm and above, L/B ratio less than 3
Short Bold (SB)	Length less than 6 mm, L/B ratio less than 2.5

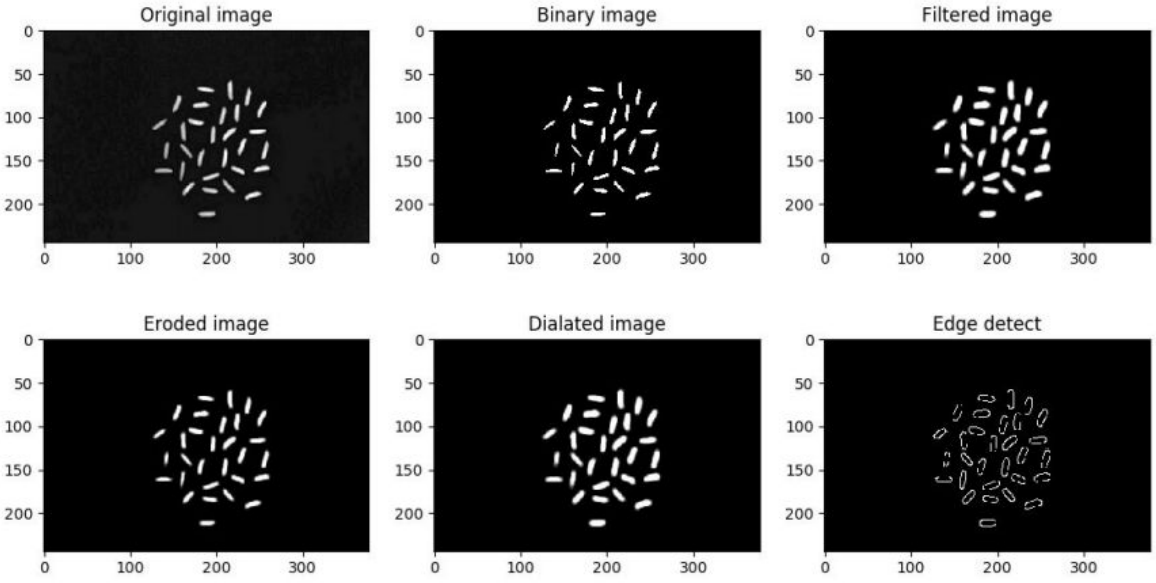
TABLE 2

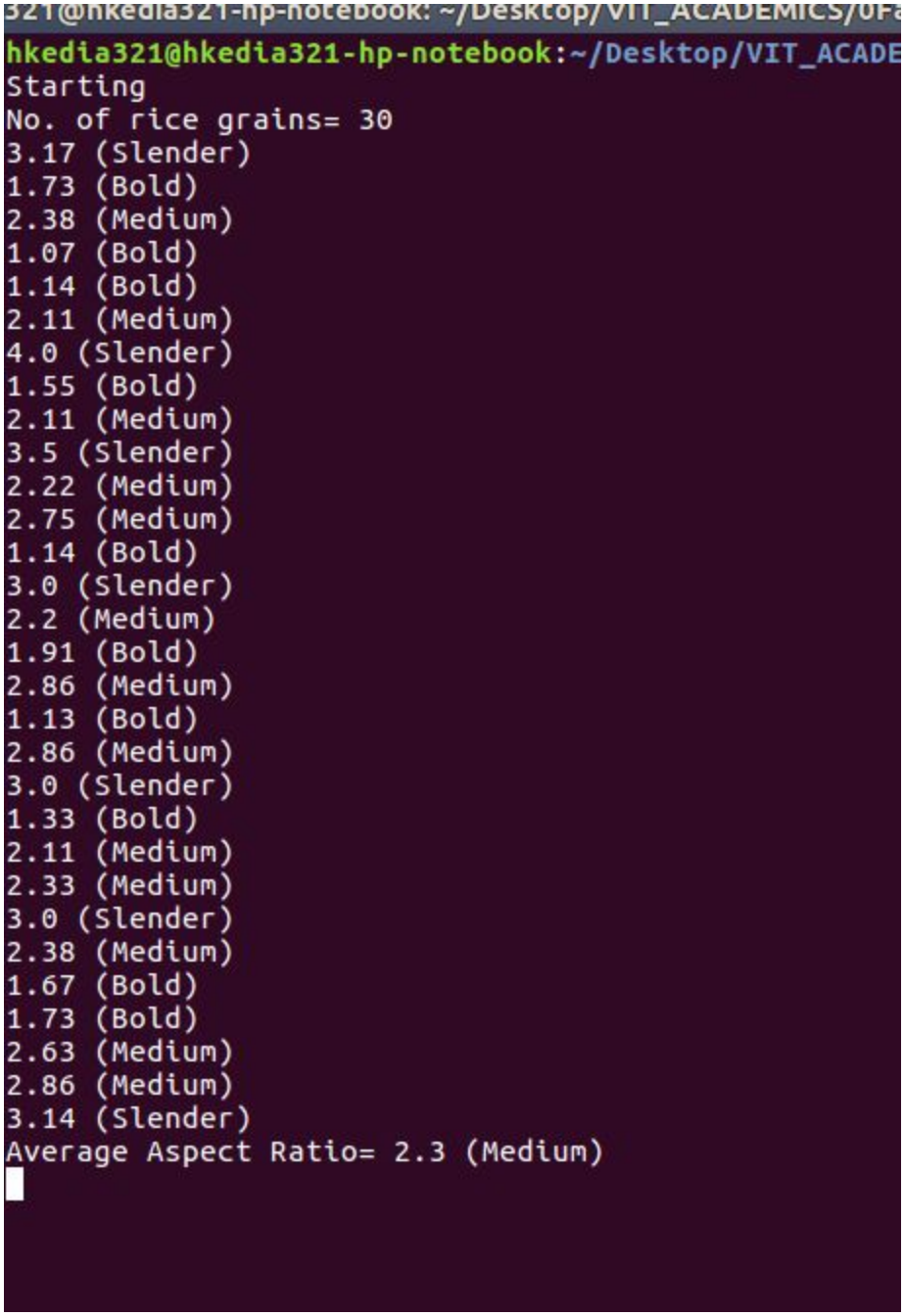
Python code

```
import cv2
import numpy as np
from matplotlib import pyplot as plt

def get_classificaton(ratio):
        ratio =round(ratio,1)
        toret=""
        if(ratio>=3):
                toret="Slender"
        elif(ratio>=2.1 and ratio<3):
                toret="Medium"
        elif(ratio>=1.1 and ratio<2.1):
                toret="Bold"
        elif(ratio<=1):
                toret="Round"
        toret="("+toret+")"
        return toret
#rnjn
print "Starting"
img = cv2.imread('rice.png',0)#load in greyscale mode

#convert into binary
ret,binary = cv2.threshold(img,160,255,cv2.THRESH_BINARY)# 160 - threshold, 255 - value
to assign, THRESH_BINARY_INV - Inverse binary

#averaging filter
kernel = np.ones((5,5),np.float32)/9
dst = cv2.filter2D(binary,-1,kernel)# -1 : depth of the destination image


kernel2 = cv2.getStructuringElement(cv2.MORPH_ELLIPSE,(3,3))

#erosion
erosion = cv2.erode(dst,kernel2,iterations = 1)

#dilation
dilation = cv2.dilate(erosion,kernel2,iterations = 1)

#edge detection
edges = cv2.Canny(dilation,100,200)

### Size detection
```

```
_,contours,hierarchy = cv2.findContours(erosion, cv2.RETR_EXTERNAL,
cv2.CHAIN_APPROX_SIMPLE)
print "No. of rice grains=",len(contours)
total_ar=0
for cnt in contours:
        x,y,w,h = cv2.boundingRect(cnt)
        aspect_ratio = float(w)/h
        if(aspect_ratio<1):
                aspect_ratio=1/aspect_ratio
        print round(aspect_ratio,2),get_classificaton(aspect_ratio)
        total_ar+=aspect_ratio
avg_ar=total_ar/len(contours)
print "Average Aspect Ratio=",round(avg_ar,2),get_classificaton(avg_ar)
#plot the images
imgs_row=2
imgs_col=3
plt.subplot(imgs_row,imgs_col,1),plt.imshow(img,'gray')
plt.title("Original image")

plt.subplot(imgs_row,imgs_col,2),plt.imshow(binary,'gray')
plt.title("Binary image")

plt.subplot(imgs_row,imgs_col,3),plt.imshow(dst,'gray')
plt.title("Filtered image")

plt.subplot(imgs_row,imgs_col,4),plt.imshow(erosion,'gray')
plt.title("Eroded image")

plt.subplot(imgs_row,imgs_col,5),plt.imshow(dilation,'gray')
plt.title("Dialated image")

plt.subplot(imgs_row,imgs_col,6),plt.imshow(edges,'gray')
plt.title("Edge detect")

plt.show()
```

Output


Original image
Binary image
Filtered image
Eroded image
Dialated image
Edge detect
0
50
100
150
200
0
100
200
300



Thus, as we can see the average Length/Breadth ratio of the rice is 2.3, and the quality is “medium”.

Conclusion

The image analysis algorithms are applied on image in which rice grains are randomly placed and spread in one layer. If the error occurs like touching kernels shrinkage operation works efficiently for separating the connecting part from point touching kernels. Edge detection is performed to find out the region of boundaries and endpoints of each grain; and then after that using caliper length and breadth can be measured. After getting the values for length and breadth, length-breadth ratio is to be calculated.

In this study, the image processing algorithms are developed to segment and identify rice grains. use of image processing algorithm is an efficient method to analyze grains quality by its size. The main benefit of proposed method is it requires minimum time; cost is less and gives better results compared with manual results or traditional methods. *We have successfully executed all the steps proposed.* Last two steps include calculating the size of the grains and then classifying them according to the Table provided.