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Automatic Rice Panicle Length Measurement Using Image Processing

[1]Prabira Kumar Sethy and [2]Antariksha Anupam

[1]Department of Electronics, Sambalpur University, Odisha, India

[2]Department of Electronics and Communication Engineering, SUIIT, Sambalpur University, Odisha, India

E-mail: [1]prabirsethy.05@gmail.com , [2]antariksha.anupam@suiit.ac.in

ABSTRACT

Rice is the main food crops that all human consumes in all over the world, especially in Asian countries, it is consumed by more than half of the world population. Therefore, accurate yield estimates are extremely important for ensuring safety of rice production and providing a continuous supply. In general, the length of the panicles is measured manually, after some selected samples are removed from the plants. The problem with this method is that, for the data to be statistically significant, a large number of samples have to be measured, which can be tedious and tiresome. Moreover, the panicles tend to have a curvature, instead of being straight, adding more difficulty to the measurement task. This paper presents a new method based on digital image processing techniques such as color transformations and mathematical morphology, to provide estimates for the lengths of rice panicles that have been removed from the plant. The length of rice panicle determines the number of grains it can hold, and consequently rice yield; therefore, it is one of the most important factors assessed in yield related research. However, the conventional method of measuring panicle length is still a manual process that is inconsistent, subjective and slow. The results shown in this method estimates the panicle length successfully with 10% of error for approximately 20cm length panicle.

Keywords:*CMYK; panicle length; rice; morphological operation, principal axis detection.*

1. INTRODUCTION

Rice is considered as one of the most important food crop all over the world. Therefore, crop losses in the developing countries like India, China, and Japan etc. which run to billions of dollars negatively affect the country's economy and nutritional standard because almost 70% of the population of India depend upon it. There are several studies where the author report [1][2][3][4][5] that the yield estimation and diseases in rice crop has significant correlation with panicle length. Therefore, accurately estimating yields of crops is extremely important for ensuring safety of rice production and continuous supply. Due to the progress of technology, industries and peoples are using newer technologies rather than using old techniques. There is growth in number of people who consume rice as food, therefore demand is increasing as a result bagging and packaging of rice is becoming steadily automated. This paper presents the use of image processing for accurate estimation of panicle length and thereby estimating the yield. The length of rice panicle enables us to determine the number of grains panicle can hold, and consequently allow us to predict rice yield; thus it is considered as one of the essential yield factors used to calculate rice yields. Fig.1 shows the suggested system of measuring rice panicle length.

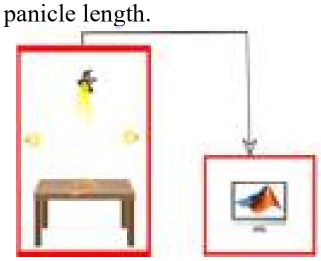

Figure 1. System overview.

2. RELATED WORK

Chenglong Huang et al.[7] proposed a method for estimating yield of rice crop. The methodology dubbed "Smart-PL", was developed for the automatic measurement of rice panicle length based on dual-camera imaging. Cameras with a long-focus lens and a short-focus lens were utilized to capture both a detailed image and a complete image of the rice panicle, respectively. Specific image processing algorithms were exploited, to analyze the neck image for neck identification and the whole-panicle image for path extraction. Subsequently, co-registration was used to identify the neck location in the whole-panicle image, and a resampling method was used to search for the path points between the panicle neck and the tip. Finally, the panicle length was calculated as the sum of the distances between each adjacent path point. To evaluate the accuracy of this prototype, six batches of rice panicles were tested. The results showed that the mean absolute percentage error (MAPE) for the system was about 1.23%, and the automatic measurements had a good agreement with manual measurements, regardless of panicle type. To evaluate the efficiency of this prototype, 3108 panicle samples were tested under continuous-measurement conditions, and the measuring efficiency was approximately 900 panicles per hour, 6 times over manual method. In conclusion, the system automatically extracts panicle length while providing three advantages over the manual method: objectiveness, high efficiency and high consistency. Jayme Garcia Arnal Barbedo et al [8] proposed a method for automating the process of estimating panicle length, they created a whole machine-vision-based facility to measure some yield-related traits in rice, and however those do not include panicle length. The proposed method is mainly based on image processing techniques such as color transformations

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and mathematical morphology. It also includes extensive specialist knowledge to guarantee the accuracy of the estimates. As will be seen along the text, the method is capable of providing estimates at least as good as those manually obtained. Also, this approach has the ability of providing estimates for several panicles at once, either by processing several image files in a single batch, by processing images containing a large number of panicles, or both.

3. PROPOSED METHODOLOGY

The length of panicle of rice crop is measured using the following steps:
Step-1: Sample Collection
Step-2: RGB to CMYK Color Space conversion.
Step-3: Extraction of Yellow Channel.
Step-4: Binarized by thresholding.
Step-5: Morphological Closing.
Step-6: Detection of Principal Axis.
Step-7: Estimation of Panicle Length using Curve fitting.

3.1 Sample Collection

The number of samples used in development of algorithms has 6 images. The images were captured after being removed from respective plants using a 13 mega pixel Smartphone camera, with image have of - 465 X 621 pixels. The length of the panicle is measured from Panicle base to the extremity of top most branches.

a b c d e

Figure 2. Samples of Rice Panicle.

3.2 RGB to CMYK Conversion

The images were stored using the RGB color model. This format is appropriate for storage and visualization purposes, but it is usually not suitable for more sophisticated manipulations. After an extensive study considering the most used color models, the third channel(yellow) of the CMYK (cyan, magenta, yellow, and key)model was deemed the most suitable. After the color transformation, the pixel values are rescaled to span the entire range of values (0 to 255).

3.3 Binarized by Thresholding

The image is then Binarized by thresholding value of 0.4, that is, all pixels above this value are made equal to 1, and all others are made equal to zero. This operation separates the panicles from the background. In order to remove debris and spurious elements, objects that are smaller than 1% of the largest object in the image are eliminated**.**

3.4 Morphological Closing

Next, a closed image is obtained from the Binarized one by applying a morphological closing, using as structuring element a disk whose radius is 1% of the size of the largest side of the image. Holes that may arise inside the objects are filled. This closed image has as main objective to aggregate each panicle into a single continuous object. This is necessary because, in the thresholding process, some very thin parts of some branches may not be detected, which in practice may disaggregate a single panicle into multiple objects.

3.4 Detection of Principal Axis

After morphological closing the image process through skeletonization & thinning operation and then determine the Euclidean distance so, that the central pixel of each row of the image is only considered to detect the principal axis.

3.5 Panicle Length Measurement

The length of the panicle is not detected straightforward by considering the top and bottom pixel of image as the panicle are not like straight line but have certain curvature. By use of curve fitting tool we generate the second degree polynomial equation as below.

Linear model Poly2:
c(x) = p1*x^2 + p2*x + p3
Coefficients (with 95% confidence bounds):
p1 = 5.592e-09 (-4.007e-06, 4.018e-06)
p2 = -3.409e-05 (-0.005342, 0.005274)
p3 = 480.5 (479, 482)

From polynomial equation the length is measured by use of below equation.

$$Length=\int\sqrt{1+}\,[(c'(x)]^{2}dx$$

And the range of integration is the both extremities of the curve c(x).

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4. RESULT AND DISCUSSION

The panicles presented in the fig.2 were measured manually prior to the image capture by use of thread and measuring tool i.e. tape. These measured manual lengths of panicle were used for comparison with the length measured by the algorithm and estimate the performance of the Algorithm.

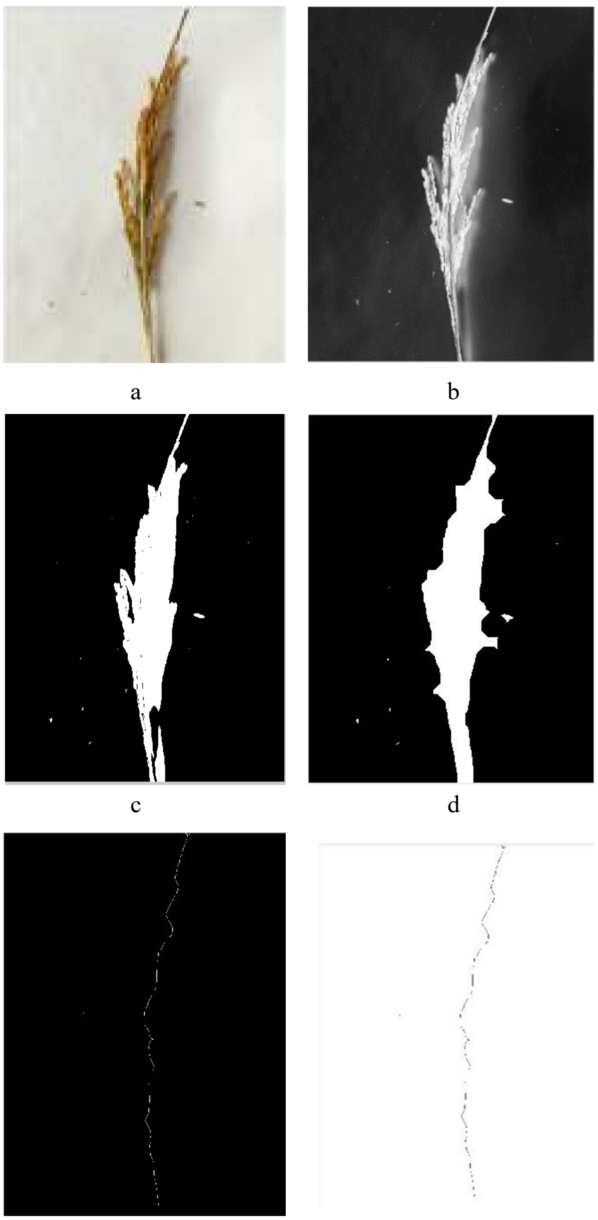

Fig.3. (a) Original Image (b) Yellow Channel of Image.(c) Binarize Image (d) Morphological Closing Image.(e) Image after skeletonisation & thinning opeartion.(f) Principal axis of Image.

Fig.3 show the different steps to detect the principal axis . Here Fig.a show the Original Panicle image, Fig.b show the yellow channel image,Fig.d is the binarize image with thresholding value of 0.4, fig.d is the mophological closing image to fill the vacant portion of the image,fig.e is the image after skeletonization & thinning operation. Finally fig.f is the principal axis which one is the results of central white pixel in each row of image.

Table.1. Performance Analysis of Algorithm.

Sample Image	Manual Measurement (in Cm)	Algorithmic Measurement (in Cm)
Fig.2 (a)	20	20.8824
Fig.2 (b)	21	21.0936
Fig.2 (c)	22	21.1242
Fig.2 (d)	21.5	23.2488
Fig.2 (e)	20.5	19.5663
Fig.2 (f)	22.5	24.7753

Table.1 shows the length of panicle measure manually and by algorithm. Here for our demonstration we have taken 6 number of panicle image and all are measured manually prior to process through algorithm. And from Table.1 we imply that our algorithm successfully measured the length of panicle but with error, e≤ 2cm for approximately 20cm length panicle.

5. CONCLUSION

This paper presents an automatic method to measure rice panicle lengths using digital image processing techniques. The proposed algorithm is capable of providing estimates at 10% of error for 20 cm length of rice panicle i.e. it is ~ 90% accurate in estimating the length of panicle.

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AUTHOR PROFILES

Prabira Kumar Sethy has received his Master of Technology degree in Communication Engineering from IIT(ISM) Dhanbad. He has been working as Assistant Professor in Sambalpur University, Odisha, India. His research interest is Image Processing. He has published more than 20 no. of Publication in International Journal and Conferences.

Antariksha Anupam is a BTech student of Sambalpur University.He is doing his project work in area of image processing.