Q-CURVE APPROACH FOR QUALITY ANALYSIS OF INDIAN ORYZA SATIVA SSP INDICA(RICE)

Chetna V. Maheshwari

G..H. Patel College of Engineering. And Technology, Vallabh Vidyanagar, (India).

ABSTRACT

Quality assessment of grains is a very big challenge since time immemorial. The paper presents a solution for quality evaluation and grading of Rice industry using computer vision and image processing. The paper reviews quality evaluation and grading techniques of different varietal Oryza Sativa L.(rice) in food industry . In this paper basic problem of rice industry for quality assessment is defined and with the help of proposed method quality assessment is done via computer vision. Image analysis and processing there is a high degree of quality achieved as compared to human vision inspection. This paper proposes a method for counting the number of Oryza sativa L (rice seeds) with long seeds as well as small seeds using image processing with a high degree of quality and then quantify the same for the rice seeds based on combined measurements.

Keywords- Machine Vision; Computer Vision; Quality Control; Image Processing; Image Analysis; Oryza Sativa L. (Rice Seeds); ISEF Edge Detection; Combined Measurements; Chalkiness

I INTRODUCTION

The agricultural industry is probably too oldest and most widespread industry in the world. In this hi-tech uprising, an agricultural industry has become more intellectual and automatic machinery has replaced the human efforts[1]. In India to overcome the need of ever-increasing population it is necessary to make advancement in agricultural industry. Due to automation need of high quality and safety standards achieved with accurate, fast and cost effective quality determination of agricultural products[2]. Quality control is of major importance in the food industry because after harvesting, based on quality parameter a food product has been sorted and graded in different grades. Traditionally quality of food product is defined from its physical and chemical properties by human sensory panel which is time consuming, may be varying results and costly[3].

Machine vision is one of the important advanced technological field where significant developments have been made[4,5].Machine vision attempts to impersonate. sensory perception of human beings viz. vision, touch, smell, taste, hearing etc. Efforts are being geared towards the replacement of traditional human sensory panel with automated systems, as human operations are inconsistent and less efficient [6]. Scientists have successfully endowed computers with machine vision by digital cameras and machines[7]. Extreme research is in progress all over the country on application of electronic eye and nose in food, beverage and agricultural industry [8,9].Many

IJARSE

industries have come up with the same but its quite costly.

Oryza Sativa L(Rice) is a vital worldwide agriculture product. It is one of the leading food crops of the world as more than half of the world's population relies on rice as the major daily source of calories and protein[8]. Rice (Oryza sativa L*)* is cultivated in several countries such as India, China, Indonesia, Bangladesh and Thailand which are considered as the major producers. India is the world's 2nd largest producer and consumer country of rice for a very long time.

This paper presents a solution to the problem faced by Indian Rice industry. Section 2 discusses the Particular problem of quality evaluation of Basmati Rice seed (Oryza sativa *L).* Section 3 talks about the materials and methods proposed for calculating parameters for the quality of rice seeds (Oryza sativa *L).*The proposed system and proposed algorithm for computing Rice seed (Oryza sativa *L)*with long seed as well as small seed being present in the sample is also discussed in the same section. Section 4 discusses results based on quality analysis. Section 5 discusses the quantification for the quality of rice seeds based on image processing and analysis. Section 6 provides the conclusion of the proposed process.

II PROBLEM DEFINITION

In agricultural industry quality assessment of product is main problem. Nowadays, the quality of grain seed has been determined manually through a visual inspection by experienced technicians. So it requires high degree of accuracy to satisfy customer need of high level of quality as well as correctness for a non-destructive quality evaluation method which is proposed based on image processing [10].

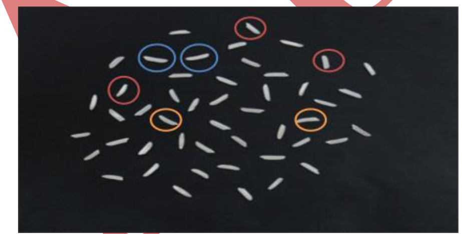


Figure 1. Rice seed with and without foreign elements

Basmati rice(Oryza sativa L) seed contains foreign elements in terms of long seed (blue circle) as well as small seed (red circle) along with normal seed(orange circle)as shown in Fig 1. These seeds are having very much importance in quantifying quality. At the time of processing these seeds are removed. Proper removal of this seed is necessary if it is not so then it creates degradation in quality of rice seed. This paper proposes a new method for counting the number of Basmati rice (Oryza sativa L) seeds with these foreign elements as shown in Fig 2 using computer vision non destructive technique based on combined measurement techniques to quantify the quality of Basmati rice(Oryza sativa L) seeds.

IJARSE

Figure 2. Foreign elements in the sample

III MATERIALS AND METHODS

In this section we discuss the proposed algorithms. Here we have used different varietal samples of Basmati rice. we define quality based on the combined measurement technique. we use area, major axis length, minor axis length and eccentricity of rice seed for counting the number of Basmati rice (Oryza sativa L) seeds with long seeds, normal seeds as well as small seeds.

3.1 System Description and Operating Procedure

A schematic diagram of the proposed system is in Figure 3.In our proposed system there is a camera which is mounted on the top of the box at point 1 in Fig 3. The camera is having 12 mega pixels quality with 8X optical zoom. After capturing images of rice seed by camera is stored for further processing. To evade problem of illuminance and for good quality of image, we used two lights at point 2 and 3 as in the Fig 3. We can also use butter paper for uniform distribution of light on the tray. In our system box contains opening which can be seen at point 4. At point 5 which is a tray in which rice seeds will be inserted for capturing an image[17].

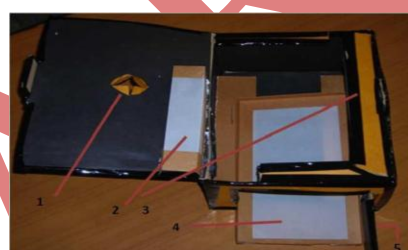


Figure 3. Proposed Machine Vision System For Analysis Of Seed

The simplicity of operation of system can be concluded from the operating procedure detailed in Table 1.

Table 1 Operating procedure for proposed system

Sr. No	STEPS
1	Spread the samples of seeds uniformly on the Tray to avoid overlapping of seeds
2	Capture image of seeds
3	Process and analysis of digital image in computer
4	Display number of normal rice seeds, long rice seeds and small seeds.
5	Repeat above steps for 10 to 15 samples

3.2 Proposed Algorithm to Detect Rice Seeds With Long and Small Seeds

According to our proposed algorithm first capture image of sample spread on the black or butter paper using camera.

Table 2 Proposed Algorithm

Sr. No.	STEPS
1	Select the region of interest of the rice seeds
2	Convert the RGB image to gray images
3	Apply the edge detection operation
4	Calculate the parameters of the rice seeds
5	Compute the histogram of the parameters of rice seeds and find out the threshold ranges.
6	Display the count of normal, long and small rice seeds on screen.

This image is color image so we covert it in to gray scale image as the color information is not of importance. The identification of objects within an image is a very difficult task. One way to make straightforward the problem is to use optimal edge detector, ISEF, for extracting edges of gray scale image. This phase identifies individual object boundaries and marks the centre of each object for further processing. Thresholding is used to convert the segmented image to a binary image. The output binary image has values of 1 (White areas) for all pixels and 0 (black) for all other pixels.

3.3 ISEF Edge Detection

The edge can be detected by any of template based edge detector but Shen-Castan[12]Infinite symmetric exponential filter based edge detector is an optimal edge detector like canny edge detector which gives optimal filtered image[13]. First the whole image will be filtered by the recursive ISEF filter in X direction and in Y direction. Then the Laplacian image can be approximated by subtracting the filtered image from the original image. For thinning purpose apply non maxima suppression as it is used in canny for false zero crossing. The gradient at the edge pixel is either a maximum or a minimum. Now gradient applied image has been thinned, and the problem of Streaking can be eliminated by thresholding with Hysteresis. Finally thinning is applied to make edge of single pixel. The ISEF algorithm is given inTable3.

Table 3 ISEF algorithm

Sr.No.	Steps
1	Apply ISEF Filter in X & Y direction
2	Apply Binary Laplacian & Non Maxima Suppression Technique
3	Find the Gradient
4	Apply Hysteresis Thresholding
5	Thinning

IJARSE

(a) (b) (c)

Figure 4. Rice seed with and without foreign elements

(a) (b) (c)

Figure 5. After edge detection operation rice seed without and with foreign elements

In Fig.4(a) normal rice seed of good quality is shown, while Fig. 4(b) and Fig. 4(c) contains an image of a long seed and small seed. After applying the Edge detection operation, we get images of Fig. 5(a) ,(b) and (c) respectively.

3.4 Parameter Calculation

Here we are extracting four parameters area, major axis ,minor axis length and eccentricity for differentiating normal rice seed from long seed as well as small seed.

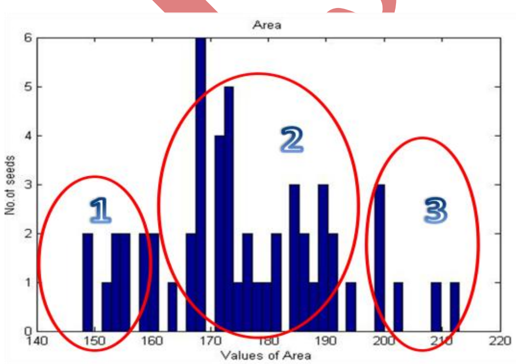
“The area A of any object in an image is defined by the total number of pixels enclosed by the boundary of the object.”

“The major axis length N of an image is defined as the length (in pixels) of the major axis of the ellipse that has the same normalized second central moments as the region.”

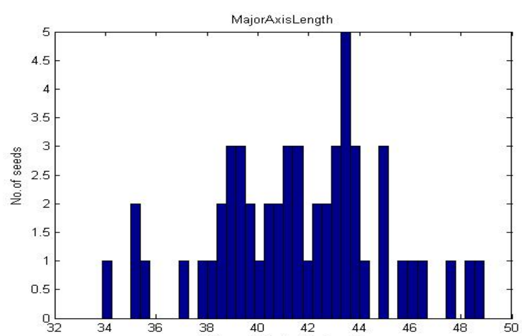
“ The minor axis length M of an image is defined as the length (in pixels) of the minor axis of the ellipse that has the same normalized second central moments as the region.”

“The eccentricity is the ratio of the distance between the foci of the ellipse and its major axis length. The value is between 0 and 1.”

For Area calculation, we define area of a normal seed is **A**, area of long seed is **B** and area of small seed is **C**. Area **A** is having a normally less value then area B and area **C** is having a less value than area **A**. Use of Vernier caliper for quality evaluation by human inspector can be replaced by Major axis, Minor axis calculation. For eccentricity calculation a long seed is having bigger value than the normal seed and small seed.

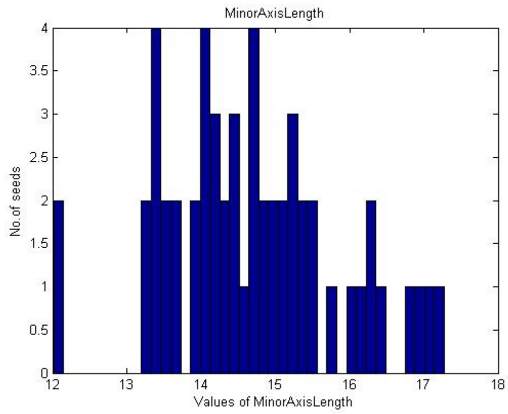


(a) area

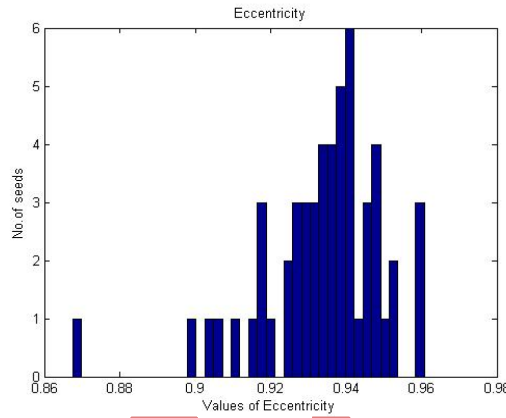


(b) Major Axis

IJARSE



(c) Minor axis



(d) Eccentricity

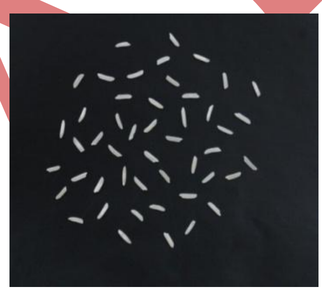
Diagram for histogram for area, Major axis length ,Minor axis length and Eccentricity calculation computed from sample is shown in Fig. 6 (a) to (d).

Figure 6 Histograms of parameters for Basmati rice seeds

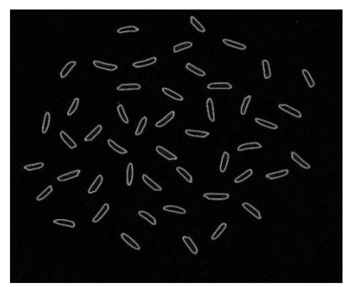
IV RESULT ANALYSIS

Classification of Rice Seeds can be done based on assessment of parameters like Area, Major axis, Minor axis and eccentricity. The original image, gray scale image and Image after performing edge detection operation is shown in Fig 7 (a) to (c)

(a) RGB image



(b) Gray-scale



(c) Edge detected image

Figure 7 Images of one of the sample of Basmati Rice seed

Table 4 shows intended parameters value based on histogram for normal seeds, long seeds and small seeds respectively. Table 5 and Table 6 shows calculated parameters value and percentagewise calculated parameters value based on histograms.

IJARSE

Sr No.	Area	Major Axis Length	Minor Axis Length	Eccentricity	Sr No.	Area	Major Axis Length	Minor Axis Length	Eccentricity
1	164	38.42	14.38	0.9277	26	188	46.04	15.36	0.9428
2	172	40.57	14.92	0.9299	27	174	40.68	13.96	0.9392
3	179	41.36	13.44	0.9456	28	200	43.37	12.08	0.9604
4	169	42.73	13.70	0.9478	29	199	48.90	13.93	0.9586
5	161	39.15	14.25	0.9313	30	152	36.94	13.29	0.9329
6	167	39.26	14.19	0.9321	31	186	42.38	17.07	0.9150
7	154	37.75	13.58	0.9330	32	173	41.48	13.42	0.9466
8	191	43.56	14.79	0.9412	33	156	39.04	13.62	0.9366
9	168	40.28	15.25	0.9251	34	172	41.27	14.69	0.9344
10	209	46.60	14.44	0.9523	35	174	44.21	14.22	0.9465
11	148	35.15	15.33	0.8992	36	202	48.34	14.61	0.9532
12	178	40.93	15.19	0.9285	37	213	43.49	16.37	0.9261
13	169	42.70	14.70	0.9388	38	177	42.90	13.43	0.9497
14	175	42.22	16.04	0.9251	39	184	45.07	14.27	0.9482
15	154	33.87	16.84	0.8675	40	181	44.83	15.27	0.9402
16	176	41.87	14.11	0.9415	41	172	39.98	14.61	0.9301
17	181	43.73	15.14	0.9380	42	199	46.58	15.74	0.9411
18	173	41.69	15.53	0.9271	43	174	43.01	15.44	0.9333
19	189	45.06	14.22	0.9488	44	184	41.39	16.28	0.9193
20	158	35.20	14.06	0.9167	45	166	39.39	16.26	0.9110
21	188	46.04	15.36	0.9428	46	185	43.25	15.16	0.9364
22	189	43.93	14.80	0.9414	47	160	39.26	13.48	0.9392
23	190	45.54	14.43	0.9484	48	195	43.30	14.81	0.9390
24	169	39.76	13.99	0.9360	49	191	43.64	17.27	0.9184
25	155	38.15	13.34	0.9368	50	187	43.31	12.01	0.9602

Table 4 Analysis for Several Seed Available In One Sample

Sample	Normal	Long	Small	Total
1	53	2	2	57
2	52	2	1	55
3	54	1	4	59
4	53	1	2	56
5	54	1	1	56
6	53	1	2	56
7	52	1	2	55
8	49	3	7	59
9	52	2	3	57
10	53	2	1	56
11	52	1	3	56
12	45	2	3	51
13	50	1	3	54
14	51	1	6	58
15	44	2	7	53

Table 5 Result Analysis of Various Samples Based On Algorithm

IJARSE

Sample No.	Total seed	Normal seed%	Long seed%	Small seed %
1	57	88	7	5
2	55	85	6	9
3	59	85	8	7
4	56	86	9	5
5	56	90	5	5
6	56	88	7	5
7	55	87	9	4
8	59	84	8	8
9	57	88	5	7
10	56	86	5	9
11	56	86	7	7
12	51	92	4	4
13	54	83	9	8
14	58	86	5	9
15	53	90	6	4
	Average	**87**	**7**	**6**

Table 6 Result Analysis Of Various Samples Based On Percentage Value

Sample No.	Normal seed	Long seed	Small seed	Total seed
1	50	4	3	57
2	47	3	5	55
3	50	5	4	59
4	48	5	3	56
5	50	3	3	56
6	49	4	3	56
7	48	5	2	55
8	49	5	5	59
9	50	3	4	57
10	48	3	5	56
11	48	4	4	56
12	47	2	2	51
13	45	5	4	54
14	50	3	5	58
15	48	3	2	53

Table 7 Result Analysis of Various Samples Based On Human Sensory Evaluation Panel

IJARSE

Sample No.	Total seed	Normal seed%	Long seed%	Small seed %
1	57	92	4	4
2	55	94	4	2
3	59	91	2	7
4	56	95	2	3
5	56	96	2	2
6	56	95	2	3
7	55	94	2	4
8	59	83	5	12
9	57	92	3	5
10	56	95	3	2
11	56	92	2	6
12	51	88	4	8
13	54	92	2	6
14	58	88	2	10
15	53	83	4	13
	Average	**91**	**3**	**6**

Table 8 Result Analysis Of Various Samples Based On Percentage Value Of Human Sensory Evaluation Panel

We compare the results with ground truth data. Table 7 shows values calculated based on Human Sensory Evaluation Panel for normal seeds, Long seeds and Small seeds of various sample. Table 8 shows the percentagewise calculated value based on Human Sensory Evaluation Panel for the same.

V CLASSIFICATION OF SEED

For finding out the number of normal rice seeds, long rice seeds and small rice seeds we compute thresholds values using the histograms of Figure 6 (a) to (d) for area, minor axis length, major-axis length and eccentricity as mention in Table 9.

Table 9 Computed Threshold Values

Parameters	Small Rice	Normal Rice	Long Rice
Area (a)	140-160	160-210	210-250
Major Axis Length (b)	35-42	42-55	55-70
Minor Axis Length (c)	10-15	15-20	20-25
Eccentricity (d)	0.8-0.9	0.9-0.96	0.96-0.99

The quality Q, of Rice seeds is not having any particular formula for quantification and assessment. The quality factor Q depends on foreign materials. If these parameters increase percentage wise in the bulk of Rice seeds then as a result the quality Q would decrease. Hence the quality factor Q is inversely proportional to Rice seed with foreign

IJARSE

materials. So the Q factor can be defined as

$$Q = \frac{c}{x_1 + x_2}$$

Assuming *C* to be 100, Q Table can be prepared defining various Q values on the basis of two parameters x1 and x2. For instance if one consider x1 to be 11% and x2 to be 1% the quality factor Q would be 9.09. This particular instance predicts the grade of Rice seeds to be "A" as seen from the Figure 8. The top most ellipse represents Grade A normal seeds, the red color filled area represents grade B which comprise of higher percentage of long seeds .The bottom most encircled area is grade C for small seeds.

X2 \ X1	1	5	9	13	17	21	25
1	50	16.6666	10	7.1428	5.5555	4.5454	3.8461
5	16.6666	10	7.1428	5.5555	4.5454	3.8461	3.3333
9	10	7.1428	5.5555	4.5454	3.8461	3.3333	2.9411
13	7.1428	5.5555	4.5454	3.8461	3.3333	2.9411	2.6315
17	5.5555	4.5454	3.8461	3.3333	2.9411	2.6315	2.3809
21	4.5454	3.8461	3.3333	2.9411	2.6315	2.3809	2.1739
25	3.8461	3.3333	2.9411	2.6315	2.3809	2.1739	2

Figure 8: Q Curves According To Equation

VI CONCLUSION

This paper proposed a method for quantifying the quality of Rice seeds. We are calculating area, major axis length, minor axis length and eccentricity for counting normal seed and foreign element in terms of long as well as small seed for a given sample.

The method proposed in the paper gives a direction of certification of quality of rice seeds based on non destructive machine vision based technique. Traditionally quality evaluation and assessment is done by human sensory panel which is time consuming, may be variation in results and costly.

For quality analysis more parameters can be calculated to make more accurate results.

ACKNOWLEDGEMENT

The author expresses their gratitude to Mr.H.N.Shah the owner of Shri Krishna Rice and Pulse Mill, Borsad for the system model as per the requirements desired by the image processing group.

IJARSE

REFERENCES

[1] Abdullah MZ, Fathinul-Syahir AS, Mohd-Azemi BMN, "Automated inspection system for color and shape grading of star fruit (Averrhoa carambola L.) using machine vision sensor," *Transactions of the Institute of Measurement and Control*, 27 (2), 65-87,2005.

[2] M. Kurita and N. Kondo, "Agricultural product grading method by image processing (part 1)- effectiveness of direct lighting method," J.SHITA 18(1): 9-17,2006.

[3] Kavindra Jain, Chintan K. Modi, Kunal Pithadiya, "Non Destructive quality evaluation in spice industry with specific reference to Riceum Cyminum L (Rice) seeds," International Conference on Innovations & Industrial Applications, Malaysia, (IEEE) 2009.

[4] Blasco J, Aleixos N, Molt E, "Machine vision system for automatic quality grading of fruit," *Biosystems Engineering*, 85 (4), 415-423,2003.

[5] Du C-J, Sun D-W, "Learning techniques used in computer vision for food quality evaluation: a review,." Journal of Food Engineering, 72(1), 39-55,2006.

[6] Chetna Maheshwari,Kavindra Jain,chintan Modi, "Novel approach for Oryza sativa L.(Rice) based on machine vision technology," PEPCCI, National Conference,ISBN No.-978-93-81286-06-7,2012.

[7] Ballard, D. A., & Brown, C. M. " Computer vision.", Englewood Cliffs, NJ, USA: Prentice-Hall ,1982.

[8] Tadhg Brosnan, Da- Wen Sun, "Improvng quality inspection of food products by computer vision-a review," *Journal of Food Engineering* 61,pp. 3–16,2004.

[9] Xiaopei Hu, ParmeshwaraK.M.,DavidV."DevelopmentOf Non Destructive Methods To Evaluate Oyster Quality By Electronic Nose Technology". Springer Science Business Media, LLC,2008.

[10] Gunasekaran Sundaram,Kexiang Ding, "Computer vision technology for food quality assurance,". Trends in Food Science and Technology, 7, 245-256,1996.

[11] Rohit R. Parmar, Kavindra R.Jain, Dr.Chintan K.Modi, "Image Morphological operation based quality analysis of coriander seed (Coriandrumsatavum L.)," ETNCC (International Conference on Emerging Trends in Network and Computer Communications),2011.

[12] Shen Castan, Sian Zhao,"A Comparitive study of Performance of Noisy roof edge detection "5th International conference on Computer analysis of Images and Patterns, volu.179,pp 170-174

[13] Canny J,"A computational approach to edge detection." IEEETransactions on Pattern Analysis and Machine Intelligence, 8 (6), 679-698,1986.

Chetna V. Maheshwari

Graduated in Electronics & Communication Engineering from the Government Engineering College, Modasa,North Gujarat University, Gujarat, India in 2001. She has done her Master's in Communication Engineering from G H Patel College of Engineering and Technology(GCET), V. V. Nagar Gujarat Technological University(GTU) in 2012. She is working as a Assistant Professor in G H Patel College of Engineering and Technology(GCET),Vallabh Vidyanagar, Gujarat, India. She has published several National & International Conference Papers as well as international Journal paper based on Edge detection, Machine Vision and Image processing.

IJARSE