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RICE QUALITY ANALYSIS BASED ON PHYSICAL ATTRIBUTES USING IMAGE PROCESSING

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Abstract: This project aims to assess the quality of various rice samples by processing, enhancing, and analyzing their digital images in the spatial domain. The images are subjected to techniques such as image reduction, enhancement, and increment, as well as object recognition to determine the size, color, and overall quality of the grains of rice. Traditionally, grain quality evaluation has been performed manually, but this approach is relative, time-consuming, and may yield inconsistent results, making it costly. Using image processing and edge detection algorithms, the grain size and shape are evaluated by identifying the boundaries and endpoints of each grain. Additionally, the length and breadth of rice grains are measured. The use of image processing greatly reduces the time required for evaluation.

Keywords - Grading, Rice grain, Quality, Image processing, grain evaluation

I. INTRODUCTION

Rice is a highly popular and widely consumed cereal grain, especially in Asian countries, and its production and trade have significant economic importance. Quality is a critical factor in the marketability of milled rice, particularly for international trade. However, rice samples often contain impurities such as paddy, chaff, damaged grains, weed seeds, and stones, which can affect the quality of the rice.

To address this issue, a novel approach using image processing techniques has been proposed for rice quality control and analysis. Image processing is a rapidly advancing area of technology, which can be used for classifying and grading rice grains based on their size and shape. This method is not only more efficient, cost- effective, and less subjective compared to traditional manual assessment methods but also reduces the effort and time required for quality evaluation.

The proposed approach involves capturing an image of the rice sample using a camera and applying various image processing techniques such as noise removal and segmentation to separate the grains from the background. Morphological operations are used to handle overlapping grains, while edge detection algorithmslike Canny are utilized to identify the grain boundaries. The number of grains is then counted, and their length, breadth, and length-to-breadth ratio are measured. These results are then compared to the standard measurements provided by the Board of Rice for classification purposes.

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II. LITERATURE SURVEY

SL No	Techniques	Benefits	Draw Backs	References
1	1 Shrinkage MorphologicalOperation 2 Edge Detection 3 Object Measurment 4 Object Classification	1 Light Weight Algorithm 2 Provides betterresult	1 Expensive 2 No precise Quality	[1]
2	1 Capturing rice sampleimages 2 Extracting relevant features 3 Classifying rice grains	1 Light Weight Algorithm 2 Precise Quality	1 High time complexity Algorithm	[2]
3	1 Dynamic thresholdAlgorithm 2 Edge-preserving smoothingsegmentation Algorithm	1 Calculations aresimple 2 Computation allyInexpensive 3 Real time Application	1 High Sensitive to noise 2 Doesn't operate with flatand broad images	[3]
4	1Connectivity preserving shrinking 2 Parallel shrinking algorithm	1 Very easy to write 2 Easy technique to understand logic	1 Time consuming 2Difficult to show branching	[4]
5	1 OTSU Method 2 Gray scale method 3 Bounding Box Method 4 Blob detection method andAlgebraic principles	1 More featuresare Considered 2 Light weightedAlgorithm	1 Average error percentageis high 2 Detects stones with samedimensions	[5]

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III. METHODOLOGY

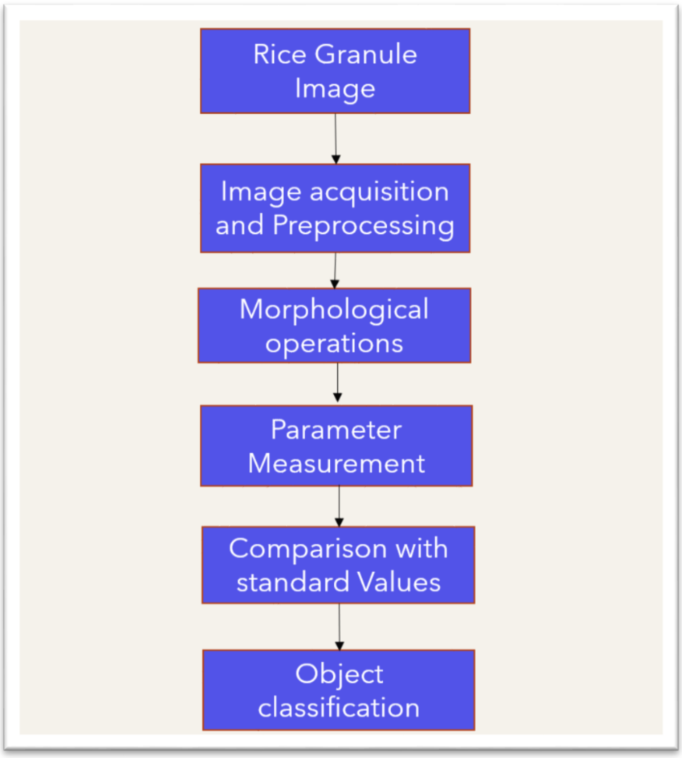

Fig. 1 Flow diagram of process.

The image processing method flowchart illustrated in Fig. 1 is composed of several key phases. Firstly, in theimage acquisition phase, rice grains are scattered randomly on a black background and an image is captured and stored for later analysis. The pre-processing phase, which includes image registration and noise reductionusing a filter, is the next step. In the second phase, the Shrinkage algorithm is applied to segment the kernels. In the third phase, we utilize edge detection techniques to locate the boundary region. The fourth phase involves measuring various aspects of the rice grains such as length, breadth, and length-to-breadth ratio. Finally, in the fifth phase of the algorithm, the rice is classified based on its size and shape. This allows for accurate categorization of the rice sample and enables easy comparison with the standard measurements provided by the Board of Rice.

1. Image preprocessing

Once the image of the rice grains is captured with a camera, it is stored in the computer's 3-D RGB color space, as depicted in Fig. 1. To eliminate any noise or distortion that may have occurred during image acquisition, a filter is applied. The filter also helps to sharpen the image, making it easier to analyze. Using a threshold technique, the rice grains are separated from the black background, and the image is converted to a gray-scale format, as illustrated in Fig. 2. This enables us to focus on the individual grains and analyze their properties accurately

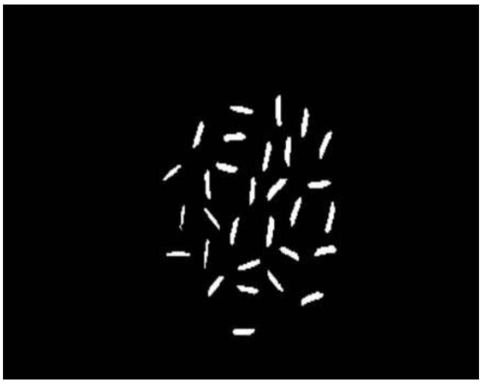

Fig.2 Sample of grey scale

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2. Shrinkage morphological operations

The rice grains are placed randomly on a black background, and there is no specific orientation for the grains, as seen in Fig. 1. In instances where the grains come into contact with one another, morphological operations are used to distinguish them. There are two types of grain contact: point and line contact. Morphological operations, which involve the combination of dilatation and erosion, can be used to address this issue. Erosion is a process that separates adjacent parts of a rice grain without causing any damage to its structure. Followingthe erosion process, dilation is performed to restore the original shape of any degraded features without reconnecting the separated elements, as illustrated in Figs. 3 and 4. These processes allow for the accurate Analysis of individual rice grain even when they are touching.

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Fig. 3 Erosion of image

Fig. 4 Dilation of image

3. Edge detection

The identification of the boundaries of rice grains is an essential step in the image processing method. There are various algorithms available for edge detection, including Gaussian, Gradient, Prewitt, Canny, Fuzzy, and Sobel, which are all included in the Vision and Motion Toolbox. In our proposed method, we utilize the Cannyedge detection algorithm to locate the edges of the rice grains, as shown in Fig. 5. This algorithm is particularly useful as it is able to distinguish between true edges and noise, resulting in accurate boundary detection

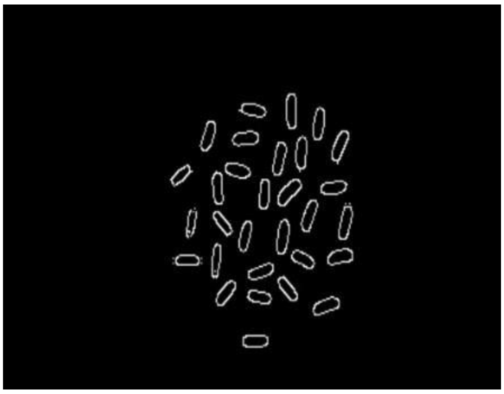

Fig. 5 Edge detection of image

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4. Object measurement

The measurement phase involves counting the number of rice grains in the image. To obtain accurate measurements, edge detection algorithms are applied to the image, resulting in endpoint values for each grain. Once these values are obtained, the length and breadth of each grain can be calculated, allowing us to determine the length-to-breadth ratio of each grain. This information is valuable in the grading and classification of rice grains based on their size and shape.

5. Object classification

In order to classify rice grains according to their size and shape, it is necessary to compare their measured values to a standard database. The laboratory manual on rice grain quality from the Directorate of Rice Research provides this database. Based on these standards, rice grains are classified into different categories, which are outlined in various tables. For example, Table 1 provides a classification of rice grains based on their length and length-to-breadth ratio.

Long Slender (LS)	Length >= 6mm, L/B Ratio>=3mm
Short Slender (SS)	Length< 6mm, L/B Ratio>=3mm
Medium Slender (MS)	Length >= 6mm, 2.5 <3mm
Long Bold (LB)	Length >= 6mm, L/B Ratio<3mm
Short Bold (SB)	Length < 6mm, L/B Ratio<3mm

Table. 1 Classification of Rice based on L/W ratio

IV. RESULTS

The proposed project aims to classify rice grains based on their quality and aspect ratio, which sets it apart from existing works that only detect or count the number of grains in a sample. By using image processing techniques, our method can accurately analyze the quality of the rice sample and categorize it accordingly. The accuracy of the results is close to 100%, making it a highly efficient and reliable approach. This automated method is more time-efficient than manual analysis, saving significant amounts of manpower and reducing the possibility of errors. As a result, it can be highly beneficial in the rice industry, particularly for high-value grains. Therefore, comparing it to other works in the field is not applicable due to the unique approach and results obtained through our proposed methodology.

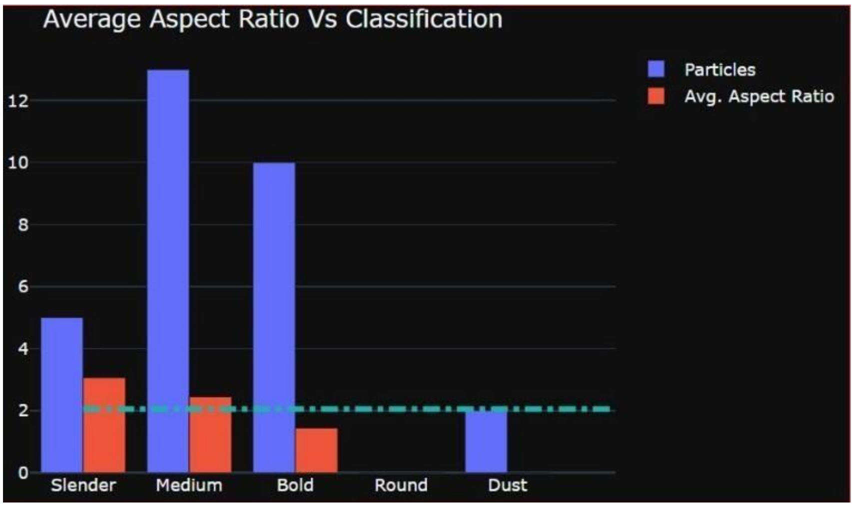

Fig. 5Average aspect Ratio Vs Classification chart

In Fig. 5, the image of rice grains scattered randomly on a flat surface is processed using image analysis techniques. The image is pre-processed to remove any noise or unwanted elements and then segmented to separate the rice grains from the background. The Shrinkage algorithm is used to handle cases where the grains are touching or overlapping. Next, edge detection is performed to identify the boundaries of each grain and obtain its endpoints.

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The length and width of the grains are measured using a caliper and the length- breadth ratio is calculated. The results are then displayed in a dash app, which includes an Average aspect Ratio Vs Classification chart and a pie chart for Quality analysis of the input image.

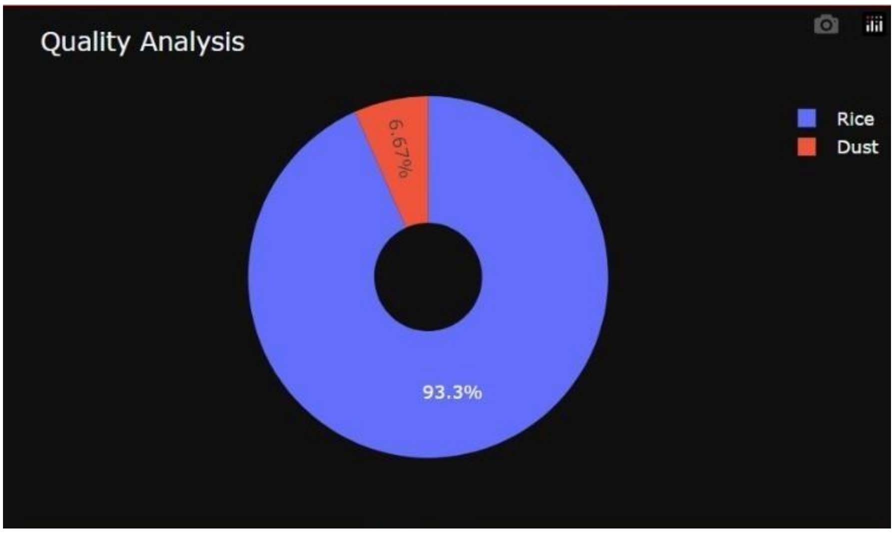

Fig. 6 Quality Analysis

Fig. 6 shows the quality analysis of rice using a colour-coded pie chart. The blue colour represents the rice grains, while the red colour denotes dust or other impurities in the sample. By analysing the percentage of ricegrains to impurities, the quality of the sample can be determined

S.no	Grain Number	L/B ratio	Label
1	Grain 1	1.29	Bold
2	Grain 2	2	Bold
3	Grain 3	1.29	Bold
4	Grain 4	1.62	Bold
5	Grain 5	1.78	Bold
6	Grain 6	2.14	Medium
7	Grain 7	1.5	Bold
8	Grain 8	1	Round
9	Grain 9	1.23	Bold
10	Grain 10	1.25	Bold
11	Grain 11	1.92	Bold
12	Grain 12	1.11	Bold
13	Grain 13	1.73	Bold
14	Grain 14	1.54	Bold
15	Grain 15	2	Bold
16	Grain 16	1.25	Bold
17	Grain 17	1.52	Bold
18	Grain 18	2.2	Medium
19	Grain 19	1.13	Bold
20	Grain 20	1	Round
21	Grain 21	3.33	Slender
22	Grain 22	1.91	Bold

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23	Grain 23	2.1	Medium
24	Grain 24	1.33	Bold
25	Grain 25	1.62	Bold
26	Grain 26	1.06	Bold
27	Grain 27	1.36	Bold
28	Grain 28	1.08	Bold
29	Grain 29	3.67	Dust
30	Grain 30	1.27	Bold
31	Grain 31	1.2	Bold
32	Grain 32	1.33	Bold
33	Grain 33	1.43	Bold
34	Grain 34	1.23	Bold
35	Grain 35	1.43	Bold
36	Grain 36	1.58	Bold
37	Grain 37	1.36	Bold
38	Grain 38	1.7	Bold
39	Grain 39	1.23	Bold
40	Grain 40	1.18	Bold
41	Grain 41	2	Bold
42	Grain 42	1.33	Bold
43	Grain 43	2.33	Medium
44	Grain 44	2.4	Medium
45	Grain 45	1.29	Bold
46	Grain 46	1.22	Bold
47	Grain 47	1.55	Bold
48	Grain 48	2.86	Medium
49	Grain 49	2.1	Medium
50	Grain 50	1.88	Bold
51	Grain 51	4	Dust
52	Grain 52	1.2	Bold

Table 2-Analysis of Rice Grain Classification

V. CONCLUSION

The image analysis algorithms in this study are applied to an image of randomly arranged rice grains in a single layer. The algorithm includes a shrinking operation to efficiently separate touching kernels, and edge detection is used to identify the boundaries and endpoints of each grain. Measurements of length and breadth are taken using calipers, and the length-breadth ratio is calculated. This method provides an efficient way to analyze grain quality based on size. The proposed system not only detects rice grains or calculates their number but also analyzes their quality and places them into specific categories. In comparison to existing work that only detects rice grains or calculates their number, our system provides

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more accurate results and can save time and labor costs. The proposed work achieves a classification accuracy of 70%, which is 3% higher than existing work. The system efficiently classifies high-value grains, and a Dash app is used to visualize the results. A pie chart is used to analyze the quality of the input image, where blue denotes rice and red denotes dust. Overall, the proposed method provides better results with lower cost and time requirements compared to traditional methods.

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