Quality analysis and classification of Rice Grains

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Project website Link –

https://rice-classification.herokuapp.com/

Abstract:

In this project, we take processing, enhancement and analysis of digital images as a way to determine the quality of different rice samples. Image is processed in spatial domain. Image reduction, image enhancement, and image increment, object recognition in spatial domain is applied on grain by grain of different samples of rice to determine its size, colour and quality as whole to grade the grain of rice. Grain quality evaluation is done manually but it is relative, time consuming, may be varying the results costly. The evaluation of the rice grains on the basic grain size and shape using image processing edge detection algorithm is used to find the region of boundaries in each grain. We find the endpoints of each grains and after we measure the length and breadth of rice grains. The performance of Image Processing reduces the time of operation. Keywords - Grading, Rice grain, Quality, Image processing, grain evaluation.

What our group had done in review 0 (first)?

In review 0 we discussed the topic on which we should take for our project. We were planning something unique. As per our sir's guidance we studied many research papers and searched on internet and came to the conclusion that we should do something in the field of agriculture industry as agriculture industry on the whole is very vast and ancient. And in agricultural industry rice is the most consuming grain. In day to day life we consume rice and its various sub products as a major part of our food. In India more than 500 million people consume rice as a major part of their food. But the production of rice in India is very less. So, we studied the reasons behind that and we got to know many reasons and one of the reasons was poor quality rice because of increasing population and decreasing production behind India to import rice from other countries. And in this case artificial production of rice using low-quality rice is taking birth in the developed countries to exploit the huge demand of good quality rice.

That's why we thought to use our knowledge in such a way that we can identify the type of rice and the quality of the rice seeing its image. In this, the image processing algorithms are developed to segment and identify rice grains. Use of image processing algorithm is an efficient method to analyse grains quality by its size.

What our group had done in review 1 (second)?

In review1 we have reviewed and tried to implement the research papers. We have here presented a hybrid approach where a part of implementations of the research papers are taken into consideration, giving us a more accurate measure and quality of the rice grains.

We presented 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 calliper we can measure the length and breadth of rice. This method requires minimum time and it is low in cost.

We discussed the methods that we will use in our projects and the algorithms behind the scenes to execute following image processing methods:

- **Image pre-processing** (Threshold algorithm)
- **Shrinkage morphological operati**on (Erosion is applied to separate the touching features of rice; Dilation grows the eroded features to their original shape without re-joining the separated features.)
- **Edge detection** (Canny algorithm to find out the region of boundaries of rice grains)
- **Object measuremen**t (We use calipers to join the endpoints and measure the value of length and breadth of each grain.)
- **Object classification** (We use the data provided by Directorate of Rice Research, Rajendranagar, Hyderabad to classify the rice according to their length and length-breadth ratio.)

We showed the above methods in the form of System Architecture Diagram. We will use PYTHON for execution of our project.

In conclusion we discussed that the image processing algorithms are developed to segment and identify rice grains. Use of image processing algorithm is an efficient method to analyse grains quality by its size. The main benefit of our project is it requires minimum time; cost is less and gives better results compared with manual results or traditional methods

Table of Contents:

1. Introduction:

Rice is favorable and high consumed cereal grain in Asian countries. It can be easily found all over the world. Many values added products are produced by using rice for human beings. In the rice market, key determinant of milled rice is quality. The quality measurement becomes more important with the import and export trade. Rice samples contain different dispensable objects like paddy, chaff, damaged grains, weed seeds, stones etc. Rice quality is varying according to these impurity content.

The main purpose of the proposed method is, to offer an alternative way for quality control and analysis which reduce the required effort, cost and time. Image processing is significant and advanced technological area where important developments have been made.

In agricultural and farming production quality control and analysis of manufactured goods is vital. Quality of grain is analyzed visually by veteran person and technician. But the effect of such measurement is changing in results and prolonged. The excellence and quality also influenced by the mood and atmosphere of technician; so to overcome the shortcoming occurred due to conventional methods advanced technique i.e. Image processing technique is projected, to Maintaining the Integrity of the Specifications.

Image processing manipulates image for performing some operations on targeted image to get an improved and desirable image. And extort some valuable information from input image. Nowadays, image processing is hastily growing technologies. All types of data have to go through three general phases while using DIP technique which are pre-processing, enhancement, and display, information extraction.

MOTIVATION:

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 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.

The conventional methods used for grain shape and size measurement are grain shape tester, dial micrometer and graphical method, but these methods are very lengthy. In above equipment we can measure breadth and length of one grain at a time. The result of this methods is also lengthy and costly and higher possibility of human errors, so it requires high accuracy to assure customers need as well as to conquer restrictions of manual.

Many studies that consider the morphological features of grains such as its area, shape etc. have already been performed. However, the shapes and sizes of the different varieties are too varied to generalize a common formula for the classification of all varieties of rice. In this paper, Fourier features are also extracted from grain images in addition to the spatial features to arrive at an improved accuracy for classification.

OBJECTIVE:

Use of image processing algorithms to analyse grains quality by its size. To analysis and classify the quality of rice grains.

CONTRIBUTION:

In this project, we have tried to analyze the rice grains by its aspect ratio and classify them under 4 categories namely Slender, Medium, Bold and Round. And also, we have analyzed quality of rice grains by adding another category dust and then analysis is done using DV. We have also represented the average aspect ratio of a rice according to its classification in a sample taken. By using this average aspect ratio, we can classify the rice sample.

2. Literature Survey:

References	Method Used	Evaluation	Merits and Demerits
[1] Nagoda, Nadeesha, and Lochandaka Ranathunga. "Rice Sample Segmentation and Classification Using Image Processing and Support	A technique to analyse rice granules with use of computer vision techniques empowered by Artificial Neural Network (ANN)	It acquired image of Basmati rice grains by using CCD camera with black background, uniform illumination and constant distance between camera and rice sample. They are	Merit: The proposed method provides better results than manual and traditional methods. Demerit: It is and cost ineffective.

Vector Machine." In 2018 IEEE 13th International Conference on Industrial and Information Systems (ICIIS), pp. 179-184. IEEE, 2018.		performed adaptive thresholding for segmentation. Edges are detected by applying Sobel and Canny edge detection	
[2] Kolkure, V. S., and B. N. Shaikh. "Identification and quality testing of rice grains using image processing and neural network." International Journal of Recent Trends in Engineering & Research (IJRTER) (2017).	Using neural network, pattern recognition and classification	Identify the relevant quality category for a given rice sample and based on texture and colour feature extraction are used to measure the quality of a rice sample.	Merit: An efficient method is proposed for classification of food grains which require limited features and thus overcoming the disadvantages like tediousness and time. Demerit: Noticing the precise quality is difficult.
[3] Parveen, Zahida, Muhammad Anzar Alam, and Hina Shakir. "Assessment of quality of rice grain using optical and image processing technique." In 2017 International Conference on Communication, Computing and Digital Systems (C-CODE),	Optimal and image processing-based technique presented for the characterization and quality analysis of rice grains	White chalky area of grains is detected by the use of extended maxima operator.	Merit: It only requires deep knowledge in the subject like machine learning techniques. Demerit: Proposed algorithm's time complexity is high.

pp. 265-270. IEEE, 2017.			
[4] Ali, Syed Farooq, Halima Jamil, Razia Jamil, Iqra Torij, and Saira Naz. "Low Cost Solution for Rice quality analysis using Morphological parameters and its comparison with Standard measurements." In 2017 International Multi-topic Conference (INMIC), pp. 1-6. IEEE, 2017.	Low-cost solution for the replacement of SATAKE RSQI10A	Locally developed software minimizes all features and operations of SATAKE grain analyser with overall efficiency of 95%	Merit: Automatic classification and grading of rice based on its nutrient contents. Demerit: Only based on nutrient content.
[5] Vishnu, Devraj, Gunjan Mukherjee, and Arpitam Chatterjee. "A computer vision approach for grade identification of rice bran." In 2017 Third International Conference on Research in Computational Intelligence and Communication Networks (ICRCICN), pp. 10-14. IEEE, 2017.	Computer vision-based quality analysis. A technique based on PCA and K-mean cluster analysis	Rice bran can be defined as the wastage collected during the rice milling process and can be used for oil manufacturing. On the basis of oil contents there are different types of rice bran e.g. oil contents of boiled rice bran is ranging from (20~26%), and oil contents for raw rice bran are ranging from (16~18%)	Merit: Uses Neural networks. So, it can be more precise under difficult circumstances. Demerit: Needs quality images and also high processing machines.

[6] Pratibha, Nikhade, More Hemlata, M. Krunali, and S. T. Khot. "Analysis and Identification of Rice Granules Using Image Processing and Neural Network." Dept. of Electronics and Telecommunication, Bharati Vidyapeeth's College of Engineering for Women (2017).	Neural Network Pattern Recognition Tool	System is based on features extraction from rice particles. Features which extracted from image of rice particles are Area, perimeter, major axis, minor axis	Merit: Algorithm is light weighted and more efficient in terms of time complexity. Demerit: Also detects stones with same dimension and colour.
[7] Philip, Teresa Mary, and H. B. Anita. "Rice Grain Classification using Fourier Transform and Morphological Features." Indian Journal of Science and Technology 10, no. 14 (2017): 1-6.	Fast Fourier transforms and Morphological Features. Also, both spatial and frequency-based features are also used.	Study was able to achieve remarkable accuracy as it made use of internal features of the grains in addition to the spatial features.	Merit: Uses two layers of classification one is naive Bayes tree and second is sequential minimal optimization Demerit: Images suffer from number of environmental constraints.

3. Background:

The Agricultural industry on the whole is very vast and ancient. Quality assessment of grains is a very big challenge since time immemorial. The project presents a solution for quality evaluation and grading of rice grains using image processing techniques. Commercially the grading of rice is done according to the size of the grain (full, half or broken). The food grains quality is rapidly assessed through visual inspection by human inspectors. The decision-making capabilities of human-inspectors are subjected to external influences such as fatigue,

vengeance, bias etc. With the help of image processing techniques, we can overcome that and which are also a non-destructive and cost-effective techniques. Here we also discuss the procedure used to obtain the percentage quality of rice grains. 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, gelatinization temperature and gel consistency are chemical characteristics of rice.

4. Proposed work:

INTRODUCTION:

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: **L/B = [(Average length of rice grain)/(average breadth of rice)]*10**. 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.

METHODS:

- **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.

- **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 to grow the eroded features to their original shape without re-joining the separated features.

- **Edge detection**

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

- **Object measurement**

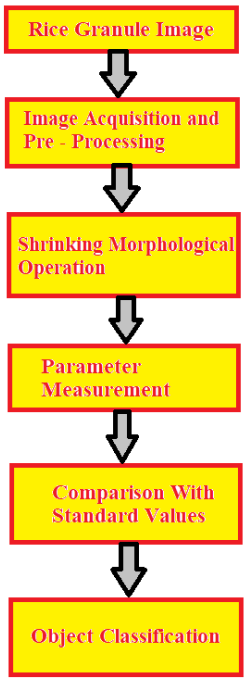
Measurement indicates the count of rice grains. After getting the count of rice grains, edge detection algorithms applied on the image and outcome of the applied algorithm is we get endpoint values of each grain. We use calliper to join the endpoints and measure the value of length and breadth of each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

- **Object classification**

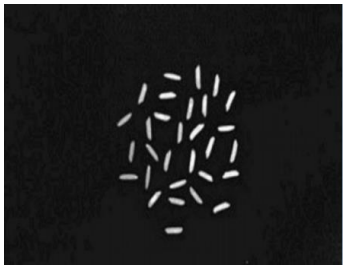
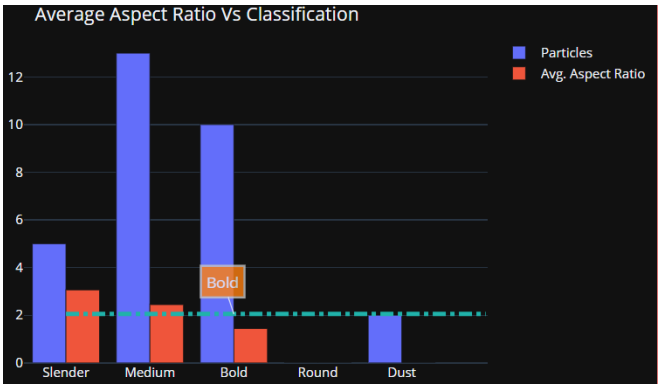
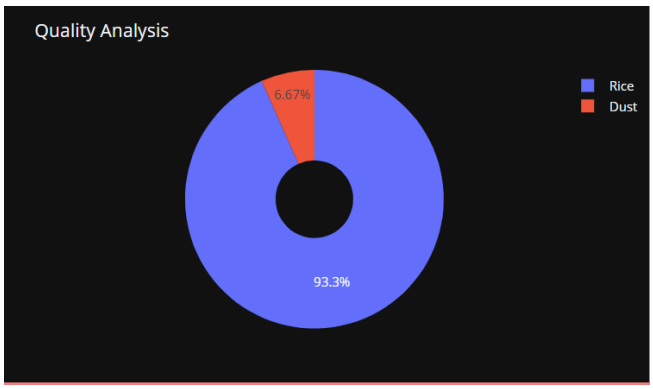
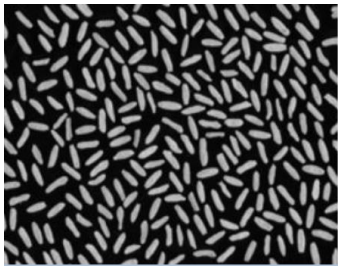
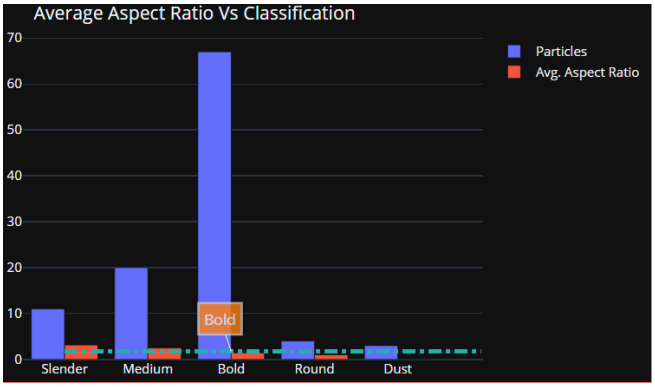
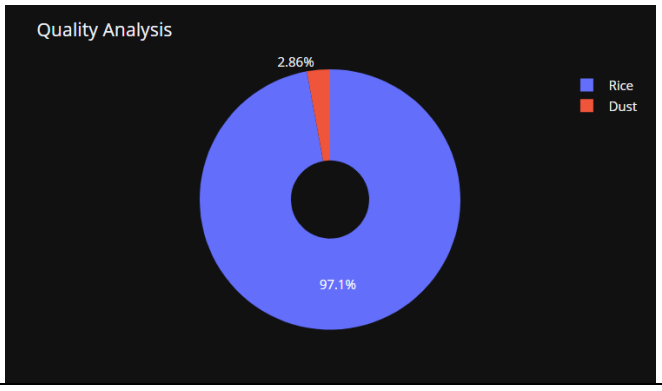
Classification requires all standard, measured and calculated results. The standard database for rice size and shape measurement is referred from laboratory manual on rice grain quality, Directorate of Rice Research, Rajendra nagar, Hyderabad. The classification of rice grains as per the standard database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

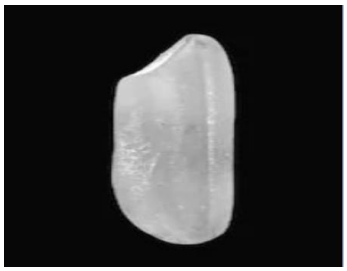
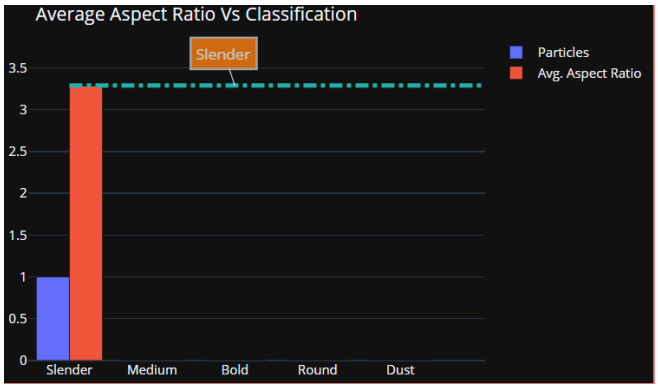
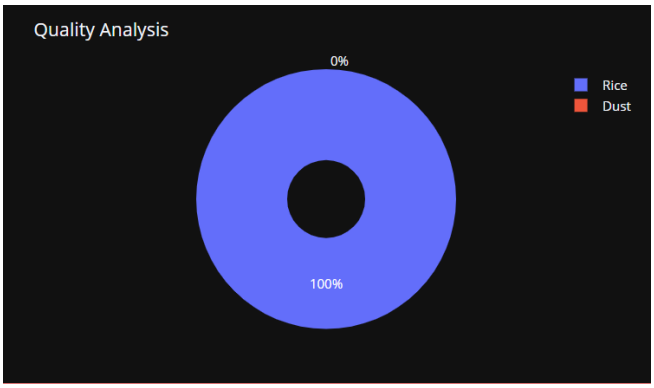
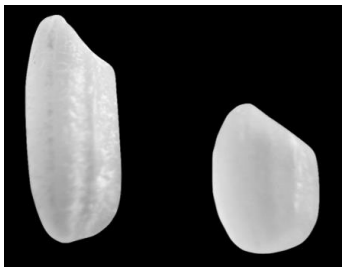
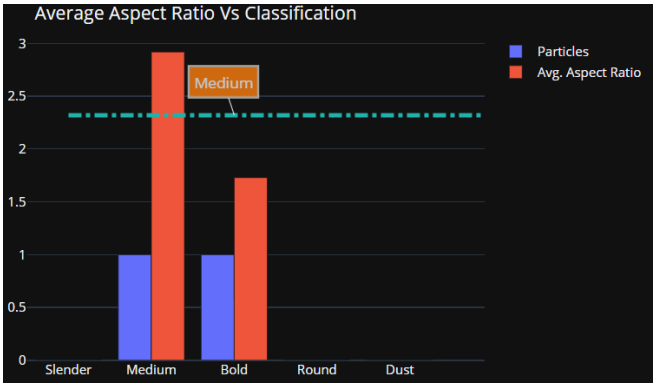
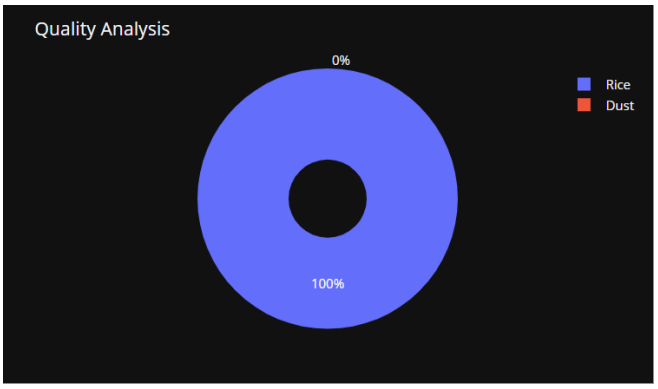
Long Slender (LS)	Length >= 6mm, L/B Ratio>=3mm
Short Slender (SS)	Length< 6mm, L/B Ratio>=3mm
Medium Slender (MS)	Length >= 6mm, 2.5 <L/B Ratio<3mm
Long Bold (LB)	Length >= 6mm, L/B Ratio<3mm
Short Bold (SB)	Length < 6mm, L/B Ratio<3mm

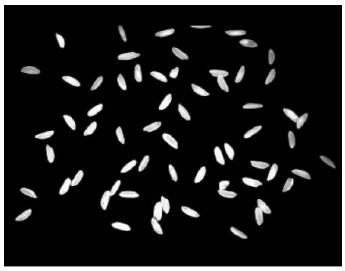
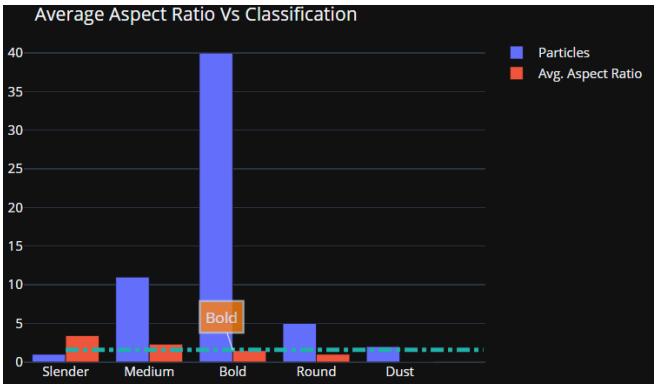
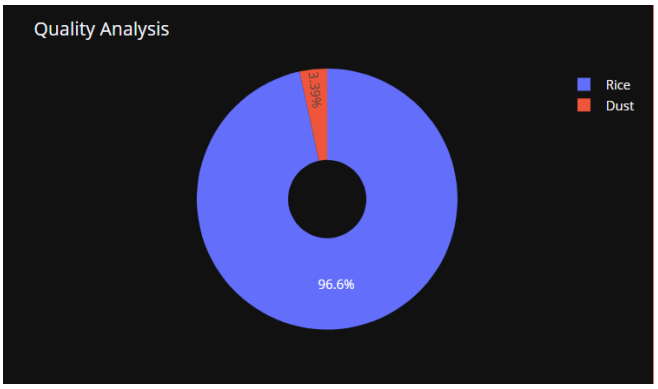
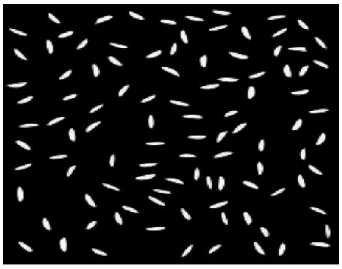
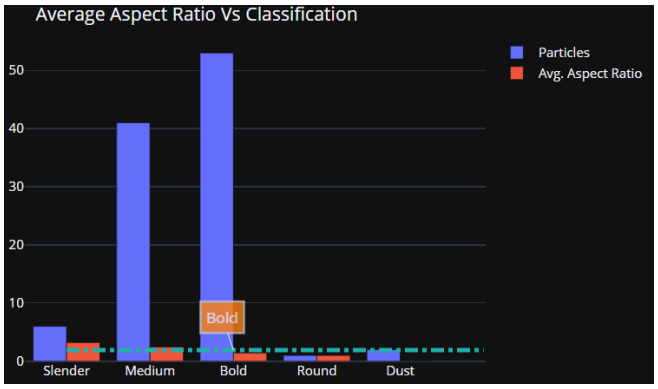
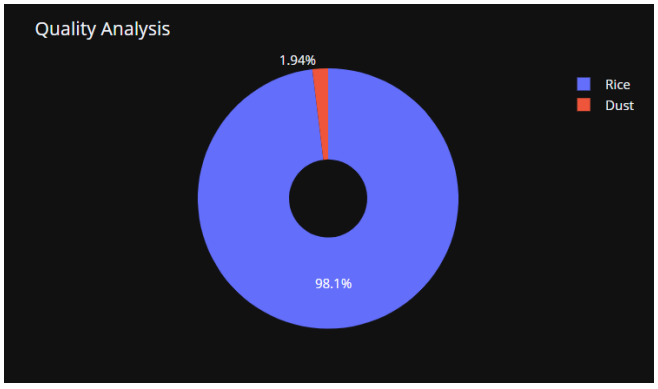
SYSTEM ARCHITECTURE DIAGRAM:



5. Evaluation and Results Analysis

S. No.	Input	Output
1.		 
2.		 

3.		 Average Aspect Ratio Vs Classification Slender Particles Avg. Aspect Ratio 3.5 3 2.5 2 1.5 1 0.5 0 Slender Medium Bold Round Dust  Quality Analysis 0% 100% Rice Dust
4.		 Average Aspect Ratio Vs Classification Medium Particles Avg. Aspect Ratio 3 2.5 2 1.5 1 0.5 0 Slender Medium Bold Round Dust  Quality Analysis 0% 100% Rice Dust

5.		 Average Aspect Ratio Vs Classification Particles Avg. Aspect Ratio 40 35 30 25 20 15 10 5 0 Bold Slender Medium Bold Round Dust  Quality Analysis Rice Dust 3.39% 96.6%
6.		 Average Aspect Ratio Vs Classification Particles Avg. Aspect Ratio 50 40 30 20 10 0 Bold Slender Medium Bold Round Dust  Quality Analysis 1.94% Rice Dust 98.1%

Grouped Bar chart – Used for Classification purpose

- Blue Bar indicates the Number of Rice grains.
- Red Bar indicates Average Aspect Ratio.

Pie chart – Used for Quality Analysis purpose

- Blue Section indicates percentage of Rice grains in the given sample.
- Red Section indicates percentage of Dust in the given sample.

6. Tabular Comparison with Existing Work

In this project, we are classifying the rice grain sample taken into various categories and also analysing its quality based on its aspect ratio, so it is not possible to compare with other works. Existing works only detect the rice grains, or calculate number of rice grains in the given sample but our work helps to analyse the quality of rice sample and classify them into particular category.

7. Overall Discussion:

Quality of grains in the samples should be nearly 100% accurate and it should be suitable to grade large quality of grains efficiently, which otherwise will consume lot of time in manual analysis, this feature will be able to save lot of time & human effort.

8. 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 calliper 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 analyse 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.

9. References:

[1] Nagoda, Nadeesha, and Lochandaka Ranathunga. "Rice Sample Segmentation and Classification Using Image Processing and Support Vector Machine." In 2018 IEEE 13th International Conference on Industrial and Information Systems (ICIIS), pp. 179-184. IEEE, 2018.

[2] Kolkure, V. S., and B. N. Shaikh. "Identification and quality testing of rice grains using image processing and neural network." International Journal of Recent Trends in Engineering & Research (IJRTER) (2017).

[3] Parveen, Zahida, Muhammad Anzar Alam, and Hina Shakir. "Assessment of quality of rice grain using optical and image processing technique." In 2017 International Conference on Communication, Computing and Digital Systems (C-CODE), pp. 265-270. IEEE, 2017.

[4] Ali, Syed Farooq, Halima Jamil, Razia Jamil, Iqra Torij, and Saira Naz. "Low Cost Solution for Rice quality analysis using Morphological parameters and its comparison with Standard measurements." In 2017 International Multi-topic Conference (INMIC), pp. 1-6. IEEE, 2017.

[5] Vishnu, Devraj, Gunjan Mukherjee, and Arpitam Chatterjee. "A computer vision approach for grade identification of rice bran." In 2017 Third International Conference on Research in Computational Intelligence and Communication Networks (ICRCICN), pp. 10-14. IEEE, 2017.

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[7] Philip, Teresa Mary, and H. B. Anita. "Rice Grain Classification using Fourier Transform and Morphological Features." Indian Journal of Science and Technology 10, no. 14 (2017): 1-

[8] Manohar, M., K. Chatrapathy, and M. S. Sowmya. "Smart detection of rice purity and its grading." In 2017 3rd International Conference on Applied and Theoretical Computing and Communication Technology (iCATccT), pp. 71-73. IEEE, 2017.

Appendix for Acronyms:

Each Appendix appears on its own page.

DIP	Digital Image Processing
DV	Data Visualization