Vellore Institute of Technology

(Deemed to be University under section 3 of UGC Act, 1956)

School of Computer Science and Engineering

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Prepared for:

Image Processing

(CSE-4019) – PROJECT COMPONENT

Quality analysis and classification of Rice Grains

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We also express gratitude towards all those who have directly or indirectly contributed to the successful completion of the project.

Place : Vellore

Date : 28.05.21

1. EXECUTIVE SUMMARY

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.

TABLE OF CONTENTS

2. 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.

2.1 OBJECTIVE

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

2.2 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 thistechnique 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.

2.3 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.

3. LITERATURE REVIEW

SL. NO	***Title of Paper***	***Authors***	***Year of Publication***	***Dataset Used***	***Methodology Proposed***	***Pros and Cons***	***Future work possible***
1	Rice Quality Analysis Based on Physical Attributes Using Image Processing Technique .	Namita Patel,Hardik Jayswal, Amit Thakkar	2017 2nd IEEE International Conference On Recent Trends In Electronics Information Communication Technology , May 19-20, 2017, India	RGB IMAGE	Classifying rice grains into three categories small seed, medium seed and long seed based on the parameters: area, major axis length,minor axis length;eccentricity.Methodology consists of preprocessing of image(conversion from rgb to grayscale and then to binary),morphological operations(dilation and erosion),edge detection,object measurement, classification of rice grains	**Pros**:Canny edge detection is used which gives better results than prewitt and sobel edge detections.**Cons**:But the quality analysis of the rice grains is not done. The amout of dust which can also be present in the rice grains is also not considered. Noticing the precise quality is difficult.	A future extension to this work is to apply different classification techniques for better classification of seeds. Possibility of adding more parameters for better classification.

2	Identification And Quality Testing Of Rice Grains Using Image Processing And Neural network	Mr. V.S.Kolkure,Ms. B.N.Shaikh	International Journal of Recent Trends in Engineering & Research (IJRTER) (2017).	640 x 480 JPEG image	A model of quality grade testing and identification is built which is based on appearance features such as area, major axis length, minor axis length, aspect ratio, the morphological and color with technology of computer image processing and neural network.The work process system consists of image preprocessing,image segementation, image feature extraction(color, area, major axis,minor axis length,aspect ratio),neural network	**Pros**:Unknown rice grain features can be known using the image processing model combined with neural networks.**Cons:**Explicity the rice grains have not been classified into categories to distingush them based on the features extracted using the model.Noticing the precise quality is difficult.	Explicitly categorizing the rice grains quality by classifiying them into groups.Also rice grains can contain dust which has its own features.Dust can also be used for classification.

3	Rice Sample Segmentation and Classification Using Image Processing and Support "Rice Sample Segmentation and Classification Using Image Processing and Support	Nagoda, Nadeesha, and Lochandaka Ranathunga	2018 IEEE 13th International Conference on Industrial and Information Systems (ICIIS), pp. 179-184. IEEE, 2018.	3966 x 2976 two images. One is the rice grains image with background. Second image is the background image.	Rice sample is a combination of full rice, broken rice, damaged rice, paddy, stones and foreign objects.. A rice sample need to classify in to these six groups in order to identify rice quality. This paper provides an approach to separate and classify objects of rice sample based on color and texture features with the help of image processing and machine learning techniques. The methodology consists of Gray scale conversion, noise reduction, binarization, morphological operations are applied on the acquired images. Contours of the objects are estimated by	**<u>Pros:</u>**The proposed method provides better results than manual and traditional methods. Because it is accurate and cost effective. This approach requires less time than manual process and also it gives better algorithmic efficiency because of light weighted algorithms and feature vectors utilized. **<u>Cons:</u>**But the stone object identification gives less accuracy.	For further research, stone identification accuracy can be improved by specially designing further validation step in the approach.

					using contour detection.		
4	Assessment of quality of rice grain using optical and image processing technique.	Parveen, Zahida, Muhammad Anzar Alam, and Hina Shakir.	2017 International Conference on Communication, Computing and Digital Systems (C-CODE),pp. 265-270. IEEE, 2017.	d rice grain images from HP Scan jet G2410 with black background. Then saved in JPEG format.	Image processing algorithm to grade the rice on the basis of length, width, area and area of chalky and also worked on the color detection on the rice grain.Methodology consists of image acquisition , image preprocessing, edge detection, color and chalky detection ,classification.	**Pros**:It is concluded that some rice are better on the basis of their length, some are better on the basis of their width while some can be termed good in quality on the basis of their area and area of the chalky.**Cons** :It is not essential that all features can be present in the rice	For further research, the moisture content in the rice grain can also be added to grade the overall quality of the rice grain.

						grain .	
5	Low Cost Solution for Rice quality analysis using Morphological parameters and its comparison with Standard measurements	Ali, Syed Farooq, Halima Jamil, Razia Jamil, Iqra Torij, and Saira Naz.	2017 International Multi-topic Conference (INMIC), pp. 1-6. IEEE, 2017.	103 rice grains were scanned using HP Scanjet G3110 scanner with a resolution of 300 dpi.It contains total of 8 images obtained by placing the rice grains on the scanner.	Rice quality is determined by different parameters including width, length, area, number of large, medium, small and broken rice. In recent years, there has been an increasing trend in automation of rice quality parameters. State of Art Software named Satake RSQI10A Grain Scanner is being used in this regard in various rice mills in Pakistan including Amir Rice Mill. The main aim of this paper is to provide a low cost software product that mimics all the features and	**Pros:**Software provides a low cost solution for rice industry by imitating the state of art Satake RSQI10A Grain Scanner that is being extensively used in rice industry of Pakistan including Amir Rice Mill Sheikhupura . The accurate results and low cost of our software add more confidence in its future use as a replacement of SatakeRSQI	The future directions could be to apply machine learning algorithms and techniques to intelligently classify different types (nations) of rice including Basmati, Kernel and Super Kernel.

					functionalities of this state of art software.	10A Grain Scanner.**Cons:** Does not consider any other impuritiespresent.	
6	A Computer Vision Approach for Grade Identification of Rice Bran	Devraj Vishnu, Gunjan Mukherjee, Arpitam Chatterjee	2017 Third International Conference on Research in Computational Intelligence and Communication Networks (ICRCICN)	Sample images collected from rice mills	This paper uses a 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	**Pros:**Uses Neural networks. So, it can be more precise under difficult circumstances.**Cons:** Needs quality images and also high processing machines.	The work can further be extended to the classification using classifiers, more robust feature extraction, inclusion of prediction models, etc.

					raw rice bran are ranging from (16~18%)		
7	Analysis and Identification of Rice Granules Using Image Processing and Neural Network	Pratibha, Nikhade, More Hemlata, M. Krunali, and S. T. Khot	International Journal of Electronics and Communication Engineering. ISSN 0974-2166 Volume 10, Number 1 (2017)	The samples of Basmati rice grains collected from stores	This paper uses the 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	**Pros**:Algorithm is light weighted and more efficient in terms of time complexity. **Cons:**It detects stones with same dimension and colour	The model needs to use more features like colour and brightness to differentiate between stones and rice grains that have similar features.
8	Rice Grain Classification using Fourier Transform and Morphological Features	Teresa Mary Philip and H. B. Anita	Indian Journal of Science and Technology, Vol 10(14), April 2017	The dataset for the work was collected from retail rice outlets across Karnataka	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	**Pros:**Uses two layers of classification one is naive Bayes tree and second is sequential minimal optimization .**Cons:** Images suffer from number of environment	The scope of this work can be further enhanced by making use of photographic images for classification as the current system suffers from a number of environmental constrains

					spatial features.	al constraints.	
9	Rice Quality Analysis Using Image Processing Techniques	Bhagyashree Mahale, Prof. Sapana Korde	International Conference for Convergence of Technology - 2017	640 x 380 JPEG Images	Rice seeds are randomly placed on black background for image acquisition. Image is acquired and stored for further analysis. In first pre-processing step image registration takes place and noise is removed from the image by using filter. Shrinkage algorithm is used for segmenting the touching kernels which is the second step. In the third step they perform edge detection to find out the region of boundaries. Then rice seed measurement is done where length, breadth and other parameters are	Requires minimum time; cost is less and gives better results compared with manual results or traditional methods.**Cons:**Classification is done only based on length/breadth ratio and sometimes this might not give the expected results.	For quality analysis, maximum number of parameters are to be measured by image processing techniques. Expansion on this work can target to design such a system which can classify rice grains on the basis of each parameter which can used to enhance the quality of rice. The cost of such system should be less and minimize time requirement for quality analysis.

					measured. In the fifth step of the algorithm rice is classified according to its size and shape		
10	Standardization for Export Quality of Oreochromis niloticus and Chanos chanos based on Quality Index Method using Integrated Image Processing Algorithms	Flordeliza L. Valiente, Danielle Jaye Agron	Received July 15, 2019, accepted July 29, 2020, date of publication August 27, 2020, date of current version August 26, 2020	Farmed Bangus and Tilapia typical fish	The prototype design concept is shown , the major components of the prototype are Conveyor Belt, Illumination, and Camera. The conveyor belt is used to transport the sample fish along. A camera is fixed mounted above and located at the middle of the conveyor ramp to capture images of the fish, the images will be send to the computer to be analyzed in MATLAB image processing. A	This research provided the fish farmers and sellers an efficient way to verify and ensure for consumers that the fishes are of high quality. The study yield 97% accuracy based on International Standards.	A more in-depth study of visual sensory assessment would provide the necessary guidelines in developing such progress and also help the farmers.

					GUI display must be released after a few seconds, the quality assessment procedure is done on the sample and the result of whether it passed the standards will be noted then it would be moved to the desired container, the Bangus sample is separated to a different bin container from Tilapia samples		
11	DoFP-ML: A Machine Learning Approach to Food Quality Monitoring Using a DoFP Polarization Image Sensor	MAEN TAKRURI1 , (Senior Member , IEEE), ABUBAKAR ABUBAKAR	Received July 13, 2020, accepted July 31, 2020, date of publication August 17, 2020, date of current version August 26, 2020	f 225 DoFP images for 5 five apples. 80% of the dataset (180 images corresponding to four apples) is utilized to train and validate the system	The proposed system uses Machine Learning Systems namely, Support Vector Regression (SVR) and Gaussian Process Regression (GPR), to estimate the age of apples and determine if they are fit for consumption even before the external rot appears on the fruit. Initially, the	Experiments on real data showed that the proposed DoFP-ML system is capable of estimating the age of apples with an accuracy of up to 92.57%. Polarization angle keeps on changing based on the given situation.	To study the possibility of using the proposed system on other fruits and vegetables, with the aim of generalizing it into a comprehensive non-invasive and nondestructive solution for determining the shelf life of food items. This will help big stores to

				using 5-fold cross validation method	reconstructed images namely, Degree of Linear Polarization (DoLP) and Angle of Polarization (AoP), are generated from the polarization image and their respective correlations with the actual age of apples (in days) are established.		properly manage their stored food items.
12	Assessment of Quality of Rice Grain using Optical and Image Processing Technique	Engr. Zahida Parveen, Dr. Muhammad Anzar Alam	2017 International Conference on Communication, Computing and Digital Systems (C-CODE)	Rice grains	Apply Morphology Opening,Apply Morphology Erosion and Reconstruction, Apply Morphology Closing Operation,Apply Extended-Maxima-Transform, Superimposed Regional Maxima on the Original Image,Compute the Area of Chalky.	The main pros are some rice are better on the basis of their length, some are better on the basis of their width while some can be termed good in quality on the basis of their area and area of the chalky. However the main con is it is not essential that all features can be present in	.For further research, the moisture content in the rice grain can also be added to grade the overall quality of the rice grain.

						the rice grain .	
13	Detection of Quality in Orange Fruit Image using SVM Classifier	Hardik Patel,Rashmin Prajapati	Proceedings of the Third International Conference on Trends in Electronics and Informatics (ICOEI 2019)	Five type of defect in orange fruit	Input orange image is given to the system.Apply Pre-Processing task of using Median Filter .Hybrid Segmentation method (Color + K means) is apply on Image. After that Color, Shape and Texture Feature is extract and given to the Classifier. Classifier classify the image and give the type of Defect name.	It is also observed that the SVM classification result changes when we change training/testing Ratio. So making theory is used for combining features and combine color and cluster based methods for actual part segmentation. This system is batter works for orange fruit defects classification and can be improved	In futere use of image processing and combining two or more classification system would give batter output for fruit industry.

						for other fruits	
14	Grain Quality Detection by using Image Processing for public distributionAn Automated Tomato Quality Grading using Clustering based Support Vector Machine	Deepika Sharma, Sharad D. Sawant	International Conference on Intelligent Computing and Control Systems ICICCS 2017	Raisin grains	The process starts before the customer encounters the food grains. It's an initial process in food industries. Henceforth, the cost is decided for each type of grain. In this system, images of wheat and rice samples are taken by a camera and then it's given to the image processing unit. All these food grains are run along a conveyor belt and the images are captured randomly of different samples.	This system is fully automated in food industry and gives cost effective solution. Also it is relaxed, reliable and less time consuming. The results found are more accurate.	The results of this project can me made into an mobile application so that farmers can access and store data in mobile for future trained machine learning models.

15	Fruit Disease Classification and Identification using Image Processing	Flordeliza L. Valiente, Danielle Jaye Agron,Aarti Manjramkar	Proceedings of the Third International Conference on Computing Methodologies and Communication (ICCMC 2019)	Apple Fruit image samples	different types of diseases of apple fruit namely, Rot, Scab and Blotch in order to verify and validate the given approach. For the fruit disease recognition and categorization automatically we have experimentally approved the importance of clustering method (K-means clustering algorithm) used for the segmentation of disease and for training and classification multi-class support vector machine is used as a classifier.	Experimental outcomes show that the given solution can significantly support automatic identification and classification of apple fruit diseases. Based on our experiments, the more precise outcome for the classification of apple fruit disease has been achieved. 96.07% average classification accuracy achieved by using ISADH+GLCM and 96.29% average classification accuracy achieved by using ISADH+CLBP+ZM	Further work incorporates consideration of combination of different features to enhance the output of the proposed method.

						features combination .	

4. PROJECT DESCRIPTION AND GOALS

4.1 DESIGN APPROACH

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

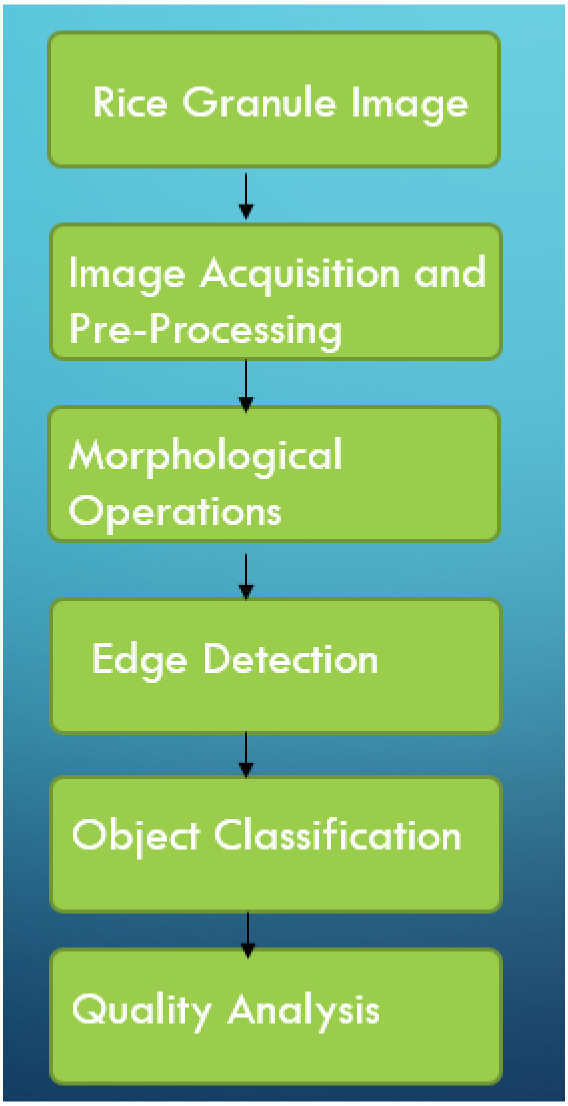
Measurement indicates the count of rice grains. After getting the count of rice grains, edge detection algorithms applied on the image and outcome of the applied algorithm is we get endpoint values of each grain. We use calliper to join the endpoints and measure the value of length and breadth of each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

SLENDER	Aspect ratio>=3 and aspect ratio<3.5
MEDIUM	Aspect ratio>=2.1 and aspect ratio<3
BOLD	Aspect ratio>=1.1 and aspect ratio<2.1
ROUND	Aspect ratio>=0.9 and aspect ratio<1
DUST	Aspect ratio>3.5

4.2 SYSTEM ARCHITECTURE DESIGN



4.3 CODES AND STANDARDS

```
#RICE_QUALITY_DETECTION_USING_IMAGE_PROCESSING AND DATA VIZUALIZATION
 #IMPORTING DATASETS
import dash
import dash_core_components as dcc
import dash_html_components as html
import plotly.graph_objects as go
from plotly import subplots
import pandas as pd
import plotly.express as px
import numpy as np
from dash.dependencies import Input, Output, State
import cv2
import PIL.Image as image
from io import BytesIO
import base64
from matplotlib import pyplot as plt
app = dash.Dash(__name__)
#project explanation
text1="""
            Rice is favorable and high consumed cereal grain in Asian countries.
   It can be easily found all over the world. Many value 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.

""""

text2=""""

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.

""""

text3=""""

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.

""""

text4=""""

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 digital image processing technique which are pre-processing, enhancement, and display, information extraction.

"""

text5="""

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 are 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.

```
"""
text6="""
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.
"""
#classification of rice particals
def get_classification(ratio):
    ratio =round(ratio,1)
    toret=""
    if(ratio>=3 and ratio<3.5):
        toret="Slender"
    elif(ratio>=2.1 and ratio<3):
        toret="Medium"
    elif(ratio>=1.1 and ratio<2.1):
        toret="Bold"
    elif(ratio>0.9 and ratio<=1):
        toret="Round"
    else:
        toret="Dust"
    return toret

#initialisig the values
classification = {"Slender":0, "Medium":0, "Bold":0, "Round":0, "Dust":0}
```

```
avg = {"Slender":0, "Medium":0, "Bold":0, "Round":0, "Dust":0}


#load in greyscale mode
from IPython.display import display, Image
img = cv2.imread("rice.png",0)
display(Image(filename='rice.png'))


#histogram part of the image
import cv2
import numpy as np
from matplotlib import pyplot as plt


img = cv2.imread('rice.png',0)


hist,bins = np.histogram(img.flatten(),256,[0,256])


cdf = hist.cumsum()
cdf_normalized = cdf * hist.max()/ cdf.max()


plt.plot(cdf_normalized, color = 'b')
plt.hist(img.flatten(),256,[0,256], color = 'r')
plt.xlim([0,256])
plt.legend(('cdf','histogram'), loc = 'upper left')
#plt.show()
```

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

```
#counting impurities
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_classification(aspect_ratio))
    classification[get_classification(aspect_ratio)] += 1
    if get_classification(aspect_ratio) != "Dust":
        total_ar+=aspect_ratio
    if get_classification(aspect_ratio) != "Dust":
        avg[get_classification(aspect_ratio)] += aspect_ratio

#getting the average value
avg_ar=total_ar/len(contours)

#setting the values for classification of rice
if classification['Slender']!=0:
    avg['Slender'] = avg['Slender']/classification['Slender']
if classification['Medium']!=0:
    avg['Medium'] = avg['Medium']/classification['Medium']
if classification['Bold']!=0:
    avg['Bold'] = avg['Bold']/classification['Bold']
if classification['Round']!=0:
    avg['Round'] = avg['Round']/classification['Round']
```

```
#saving different types of images
cv2.imwrite("img.jpg", img)
cv2.imwrite("binary.jpg", binary)
cv2.imwrite("dst.jpg", dst)
cv2.imwrite("erosion.jpg", erosion)
cv2.imwrite("dilation.jpg", dilation)
cv2.imwrite("edges.jpg", edges)

#histogram part for the edge part of the image
import cv2
import numpy as np
from matplotlib import pyplot as plt

img = cv2.imread('edges.jpg',0)

hist,bins = np.histogram(img.flatten(),256,[0,256])

cdf = hist.cumsum()
cdf_normalized = cdf * hist.max()/ cdf.max()

plt.plot(cdf_normalized, color = 'b')
plt.hist(img.flatten(),256,[0,256], color = 'r')
plt.xlim([0,256])
plt.legend(('cdf','histogram'), loc = 'upper left')
```

```
#plt.show()


#converting rgb to bgr
def readb64(base64_string):
    sbuf = BytesIO()
    sbuf.write(base64.b64decode(base64_string))
    pimg = image.open(sbuf)
    return cv2.cvtColor(np.array(pimg), cv2.COLOR_RGB2BGR)


#updating the image
def update_image(pic):
    img = readb64(pic)
    img = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)
    classification1 = {"Slender":0, "Medium":0, "Bold":0, "Round":0, "Dust":0}
    avg1 = {"Slender":0, "Medium":0, "Bold":0, "Round":0, "Dust":0}
    #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_ar1=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_classification(aspect_ratio))
        classification1[get_classification(aspect_ratio)] += 1
        if get_classification(aspect_ratio) != "Dust":
            total_ar1+=aspect_ratio
        if get_classification(aspect_ratio) != "Dust":
            avg1[get_classification(aspect_ratio)] += aspect_ratio
    avg_ar1=total_ar1/len(contours)
```

```
    if classification1['Slender']!=0:
        avg1['Slender'] = avg1['Slender']/classification1['Slender']
    if classification1['Medium']!=0:
        avg1['Medium'] = avg1['Medium']/classification1['Medium']
    if classification1['Bold']!=0:
        avg1['Bold'] = avg1['Bold']/classification1['Bold']
    if classification1['Round']!=0:
        avg1['Round'] = avg1['Round']/classification1['Round']
    cv2.imwrite("img1.jpg", img)
    cv2.imwrite("binary1.jpg", binary)
    cv2.imwrite("dst1.jpg", dst)
    cv2.imwrite("erosion1.jpg", erosion)
    cv2.imwrite("dilation1.jpg", dilation)
    cv2.imwrite("edges1.jpg", edges)
    return classification1,avg1,avg_ar1


#displaying image
def get_image(path):
    img=image.open(path)
    # Constants
    img_width = 710
    img_height = 550
    scale_factor = 0.5
    fig = go.Figure()
```

```
fig.add_trace(
    go.Scatter(
        x=[0, img_width * scale_factor],
        y=[0, img_height * scale_factor],
        mode="markers",
        marker_opacity=0
    )
)
fig.update_xaxes(
    visible=False,
    range=[0, img_width * scale_factor]
)
fig.update_yaxes(
    visible=False,
    range=[0, img_height * scale_factor],
    scaleanchor="x"
)
fig.add_layout_image(
    dict(
        x=0,
        sizex=img_width * scale_factor,
        y=img_height * scale_factor,
        sizey=img_height * scale_factor,
        xref="x",
        yref="y",
```

```
            opacity=1.0,
            layer="below",
            sizing="stretch",
            source=img)
    )
    fig.update_layout(
        width=img_width * scale_factor,
        height=img_height * scale_factor,
        margin={"l": 0, "r": 0, "t": 0, "b": 0},
    )
    fig.show(config={'doubleClick': 'reset'})
    return fig


#average aspect vs classification plot
def get_plot1(classification = classification, avg = avg, avg_ar = avg_ar):
    fig = subplots.make_subplots(rows=1,cols=1,specs=[[{"type":"bar"}]],
shared_xaxes=True)
    print(list(classification.keys()))
    print(list(classification.values()))
    plot1 = go.Bar(x=list(classification.keys()), y=list(classification.values()),
name="Particles")
    plot2 = go.Bar(x=list(avg.keys()), y=list(avg.values()), name="Avg. Aspect Ratio")
    fig.add_trace(plot1,1,1)
    fig.add_trace(plot2,1,1)
    fig.add_shape(
```

```
        type="line",
        x0=0,
        y0=round(avg_ar,2),
        x1=5,
        y1=round(avg_ar,2),
        line=dict(
            color="LightSeaGreen",
            width=4,
            dash="dashdot",
        ),
    )
    fig.update_layout(
        width = 600,
        height = 350,
        margin = {"l": 5, "r": 5, "t": 30, "b": 5},
        title = "Average Aspect Ratio Vs Classification",
        template = "plotly_dark"
    )
    return fig

#quality annalysis
def get_plot2(classification = classification):
    fig = subplots.make_subplots(rows=1,cols=1,specs=[[{"type":"pie"}]])
    rice = sum(list(classification.values())) - classification['Dust']
    dust = classification['Dust']
```

```
    values = [rice, dust]
    labels = ["Rice", "Dust"]
    plot1 = go.Pie(labels=labels, values=values, hole=.3)
    fig.add_trace(plot1,1,1)
    fig.update_layout(
        width = 600,
        height = 350,
        margin = {"l": 65, "r": 5, "t": 60, "b": 50},
        title = "Quality Analysis",
        template = "plotly_dark"
    )
    return fig

#
app.layout = html.Div([
            html.Div([
                        html.Div([
                                    html.Img(
                                                src="logo.jpg",
                                                style={"height" : "40px", "width" : "40px", "border-
radius":"20px"}
                                    )
                        ],style={"float":"left","padding" : "5px 0 5px 50px"}),
                        html.Div(
                                    children="Classification and Quality Analysis of Rice",
```

```
                    style={"float":"left","padding" : "10px 0 10px 10px","font-size": "17px", "font-weight" :"600"}
                ),
                html.Div([
                    html.Div([html.A("Home",href="#home")], style={"float":"left","padding":"0 10px 0 10px","align-items": "center","font-size": "15px", "font-weight" :"600"}),
                    html.Div([html.A("About Project",href="#about-project")], style={"float":"left","padding":"0 10px 0 10px","align-items": "center","font-size": "15px", "font-weight" :"600"}),
                    html.Div([html.A("About Us",href="#about-us")], style={"float":"left","padding":"0 10px 0 10px","align-items": "center","font-size": "15px", "font-weight" :"600"}),
                    html.Div([html.A("Source Code",href="#bottom")], style={"float":"left","padding":"0 10px 0 10px","align-items": "center","font-size": "15px", "font-weight" :"600"}),
                ],style={"float":"right", "padding": "10px 50px 10px 0px"})
            ],className="nav"),
            html.Div([],style={"height":"50px"},id="home"),
            html.Div([
                html.H1(children="Visualisation of Results", style={"text-align":"center", "margin":"0", "padding-bottom" : "20px", "color" : "whitesmoke"}),
                html.Div([
                    html.Div([
                        dcc.Graph(figure=get_plot1(),id="graph1"),
```

```
html.P("Original Image", style={"margin":"0","padding-bottom":"10px"})
], style = {"display": "block", "justify-content": "center", "align-items": "center", "padding":"0 20px 0 20px"}),
html.Div([
dcc.Graph(figure=get_plot2(),id="graph2"),
html.P("Binary Image", style={"margin":"0","padding-bottom":"10px"})
], style = {"display": "block", "justify-content": "center", "align-items": "center", "padding":"0 20px 0 20px"}),
], style = {"display": "flex", "justify-content": "center", "align-items": "center", "text-align":"center"}),
html.Div([]),
html.Div([
html.Div([
dcc.Upload([
'Drag and Drop or ',
html.A('Select a File')
],
style={
'width': '100%',
'height': '60px',
'lineHeight': '60px',
'borderWidth': '1px',
'borderStyle': 'dashed',
```

```
'borderRadius': '5px',
'textAlign': 'center'
}, id="upload-image"),
], style = {"display": "block", "justify-content": "center", "align-items": "center", "padding":"0 20px 0 20px"}),
], style = {"display": "flex", "justify-content": "center", "align-items": "center", "text-align":"center", "width" : "100%"})
],style = {"color":"black", "padding" : "20px 0 20px 0", "color" : "whitesmoke"},id='plots'),
html.Div([
html.H1(children="Images", style={"text-align":"center", "margin":"0", "padding-bottom" : "20px"}),
html.Div([
html.Div([
dcc.Graph(figure=get_image("img.jpg"),id="img"),
html.P("Original Image", style={"margin":"0","padding-bottom":"10px"})
], style = {"display": "block", "justify-content": "center", "align-items": "center", "padding":"0 20px 0 20px"}),
html.Div([

dcc.Graph(figure=get_image("binary.jpg"),id="binary"),
html.P("Binary Image", style={"margin":"0","padding-bottom":"10px"})
```

```
], style = {"display": "block", "justify-content": "center", "align-items": "center", "padding":"0 20px 0 20px"}),
html.Div([
dcc.Graph(figure=get_image("dst.jpg"),id="dst"),
html.P("Dust Image", style={"margin":"0","padding-bottom":"10px"})
], style = {"display": "block", "justify-content": "center", "align-items": "center", "padding":"0 20px 0 20px"})
], style = {"display": "flex", "justify-content": "center", "align-items": "center", "text-align":"center"}),
html.Div([]),
html.Div([
html.Div([

dcc.Graph(figure=get_image("erosion.jpg"),id="erosion"),
html.P("Erosion", style={"margin":"0","padding-bottom":"10px"})
], style = {"display": "block", "justify-content": "center", "align-items": "center", "padding":"0 20px 0 20px"}),
html.Div([

dcc.Graph(figure=get_image("dilation.jpg"),id="dilation"),
html.P("Dilation", style={"margin":"0","padding-bottom":"10px"})
```

```
                    ], style = {"display": "block", "justify-content": "center", "align-items": "center", "padding":"0 20px 0 20px"}),
                    html.Div([
                        dcc.Graph(figure=get_image("edges.jpg"),id="edges"),
                        html.P("Edge Detection", style={"margin":"0","padding-bottom":"10px"})
                    ], style = {"display": "block", "justify-content": "center", "align-items": "center", "padding":"0 20px 0 20px"})
                ], style = {"display": "flex", "justify-content": "center", "align-items": "center", "text-align":"center"})
        ],style = {"color":"black", "background-color" : "lightsteelblue", "border-radius":"40px 40px 40px 40px", "padding" : "20px 0 20px 0"},id='images'),
        html.Div([
            html.H1(children="About Project", style={"text-align":"center"}),
            html.P(children=text1),
            html.P(children=text2),
            html.P(children=text3),
            html.P(children=text4),
            html.P(children=text5),
            html.P(children=text6),
        ],style = {"color":"white", "padding":"10px 50px 10px 50px"},id="about-project")
])

#app callback
```

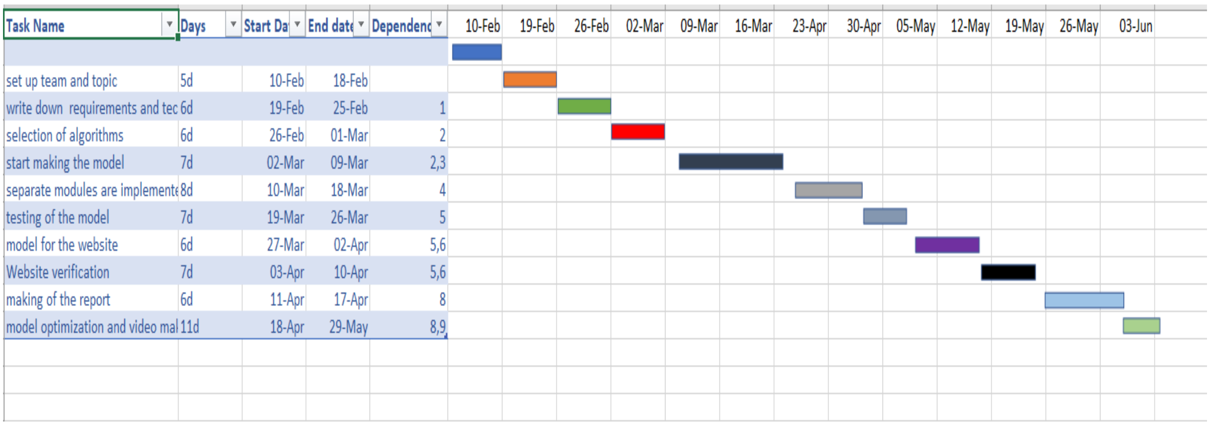
```
@app.callback([Output('img', 'figure'),
                Output('binary', 'figure'),
                Output('dst', 'figure'),
                Output('erosion', 'figure'),
                Output('dilation', 'figure'),
                Output('edges', 'figure'),
                Output('graph1', 'figure'),
                Output('graph2', 'figure')],
               [Input('upload-image', 'contents')])

#updating the outputs
def update_output(list_of_contents):
    if list_of_contents is not None:
        ind = str(list_of_contents).find(",")
        cla,av,av_ar = update_image(list_of_contents[ind:])
        return get_image("img1.jpg"), get_image("binary1.jpg"), get_image("dst1.jpg"), get_image("erosion1.jpg"), get_image("dilation1.jpg"), get_image("edges1.jpg"), get_plot1(cla, av, av_ar), get_plot2(cla)
    else:
        return get_image("img.jpg"), get_image("binary.jpg"), get_image("dst.jpg"), get_image("erosion.jpg"), get_image("dilation.jpg"), get_image("edges.jpg"), get_plot1(), get_plot2()

#hosting the website
if __name__ == '__main__':app.run_server(debug=False)
```

5. SCHEDULE TASKS AND MILETSTONES

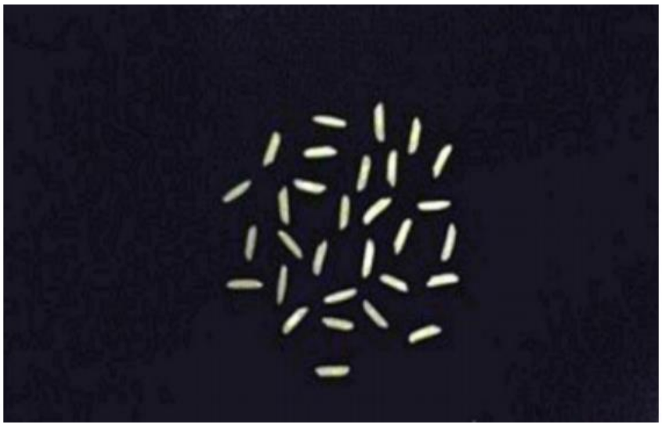
Gantt Chart



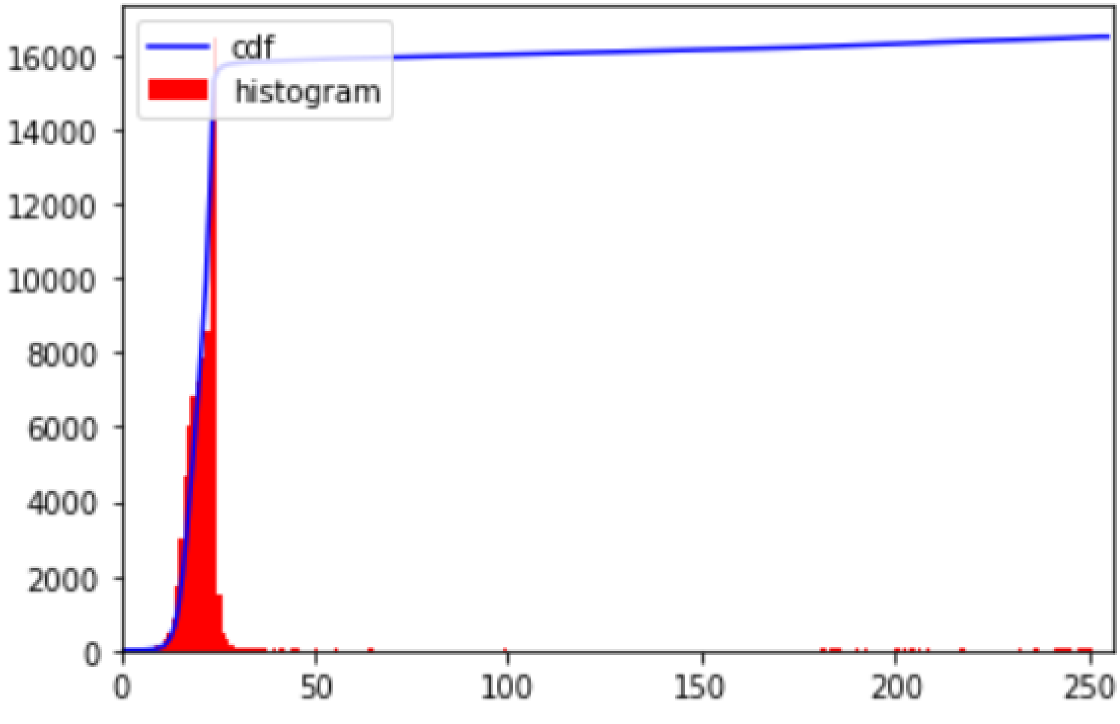
Task Name	Days	Start Da	End date	Dependenc
set up team and topic	5d	10-Feb	18-Feb	
write down requirements and tec	6d	19-Feb	25-Feb	1
selection of algorithms	6d	26-Feb	01-Mar	2
start making the model	7d	02-Mar	09-Mar	2,3
separate modules are implemente	8d	10-Mar	18-Mar	4
testing of the model	7d	19-Mar	26-Mar	5
model for the website	6d	27-Mar	02-Apr	5,6
Website verification	7d	03-Apr	10-Apr	5,6
making of the report	6d	11-Apr	17-Apr	8
model optimization and video mal	11d	18-Apr	29-May	8,9

6. PROJECT DEMONSTRATION

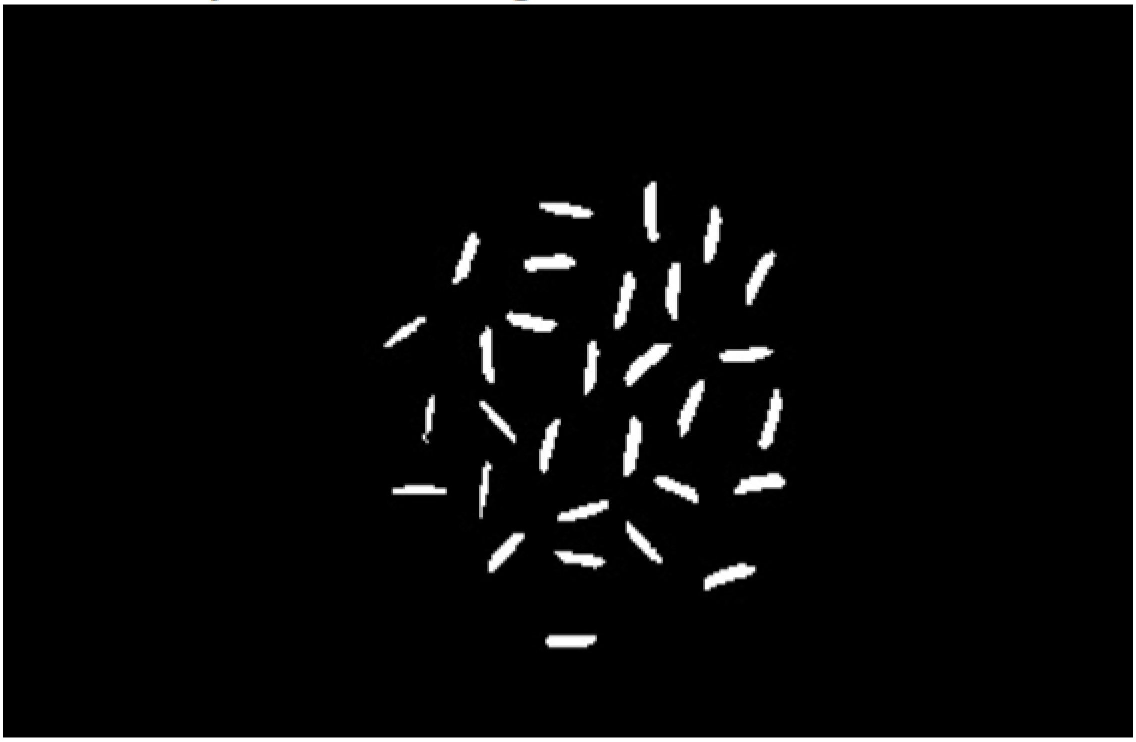
INPUT IMAGE



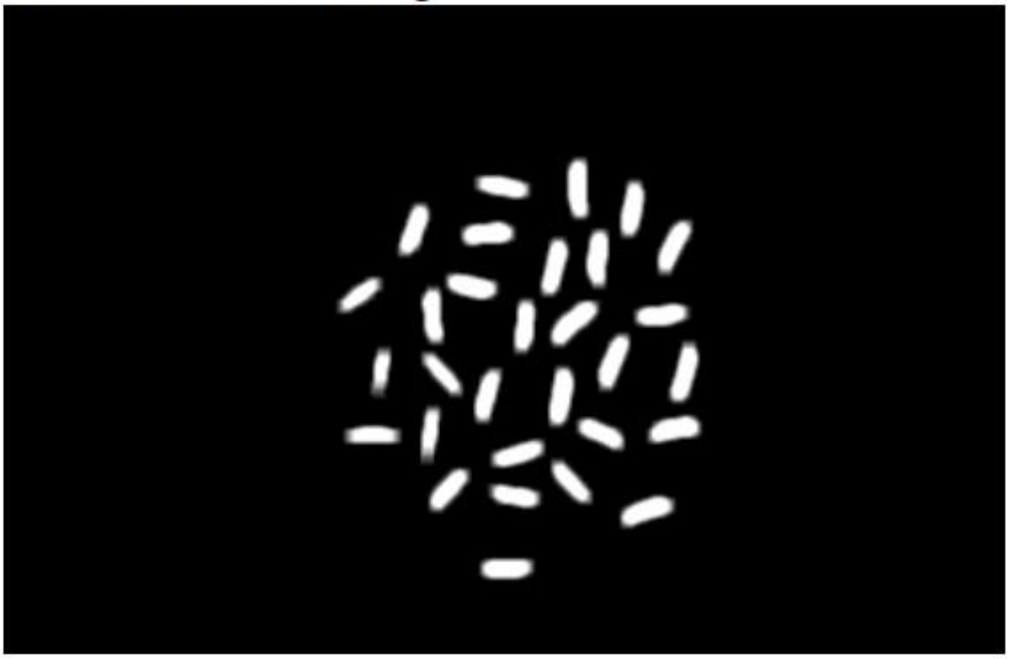
HISTOGRAM BEFORE PROCESSING



The binary form of image



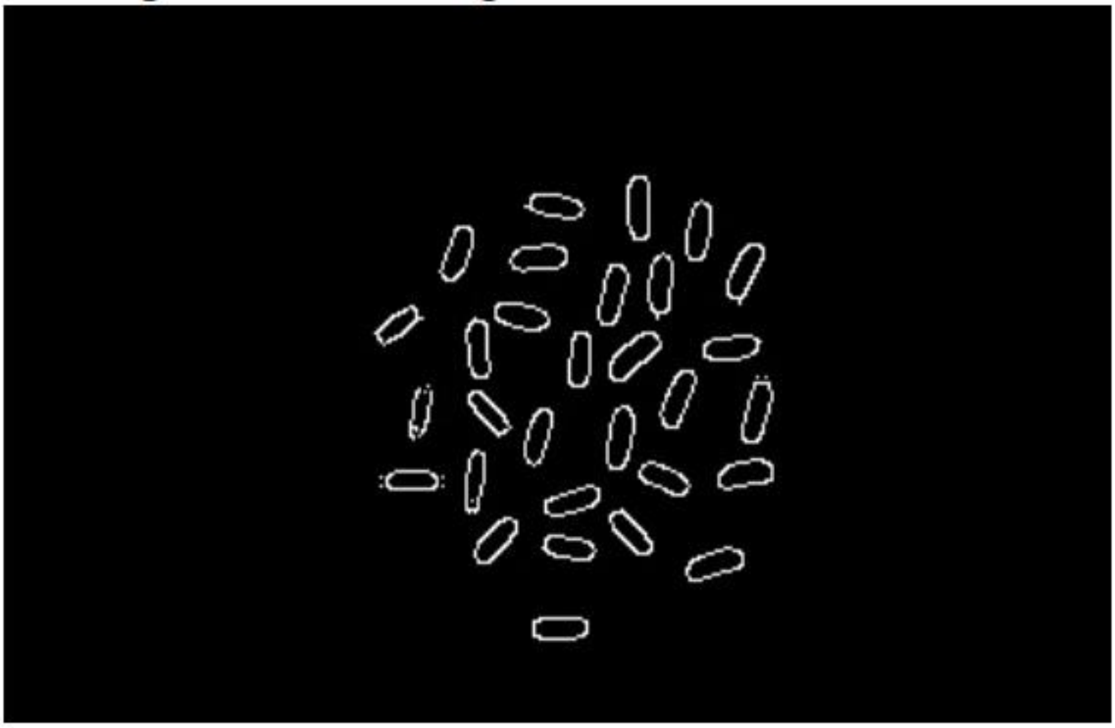
The dust form of image

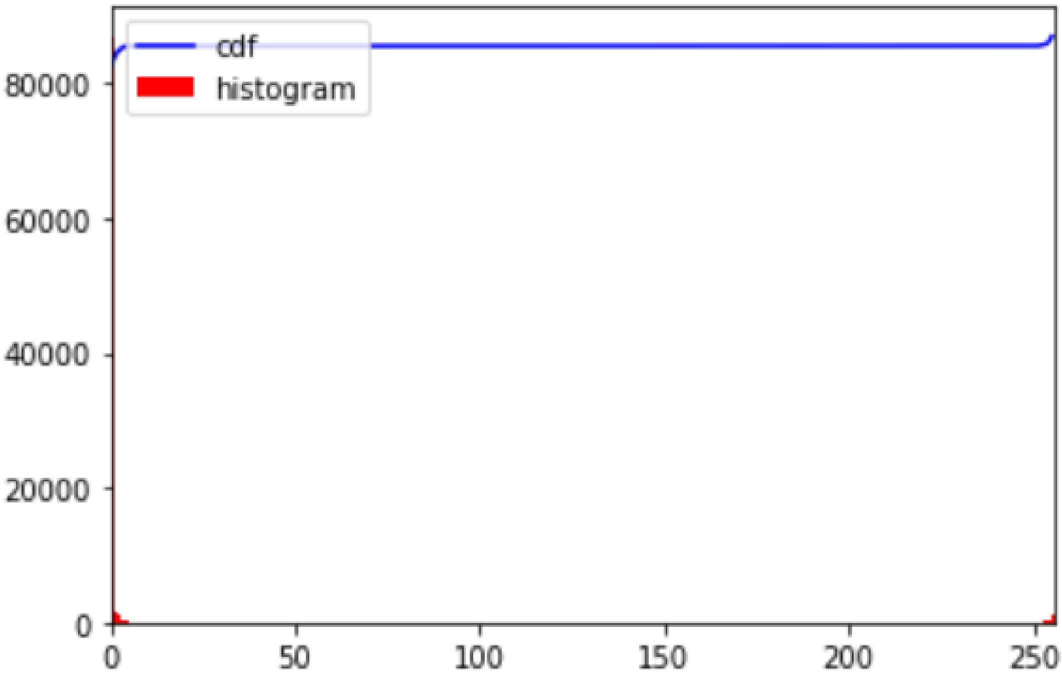


The erosion form of image

The dialation form of image

The edges form of image





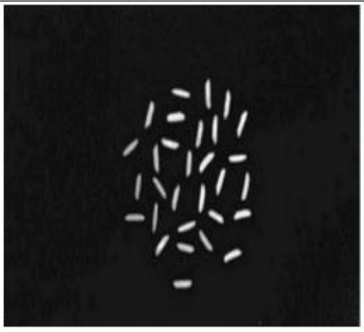
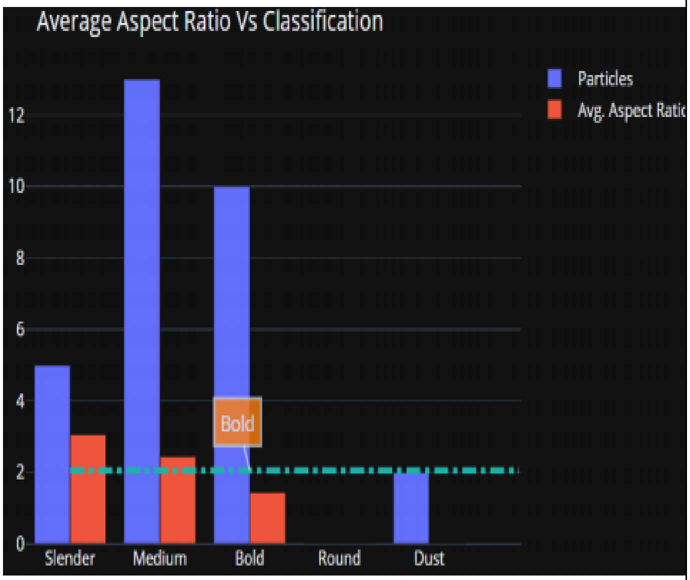
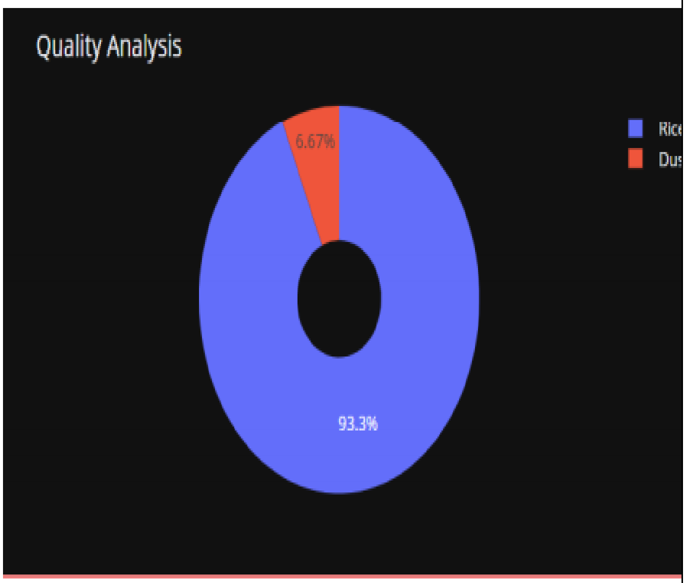
7. PROJECT COST ANALYSIS

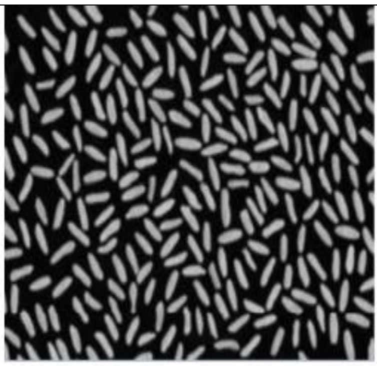
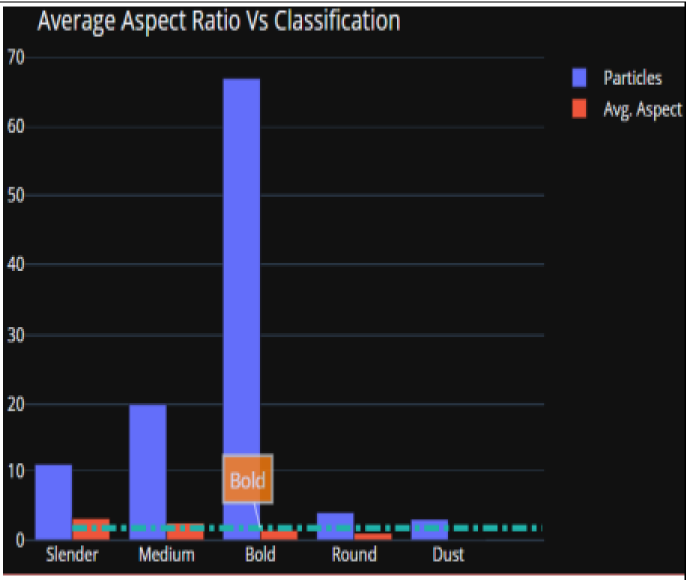
This project aims in reducing the total amount of physical labour required to classify rice grains and to analyse the rice grains based on their quality. Machine Learning and Python Flask have been used to achieve the objectives of this project.

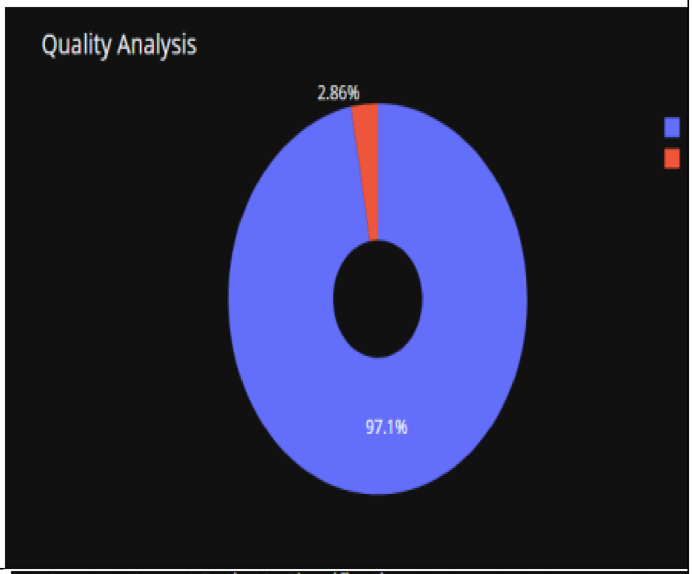
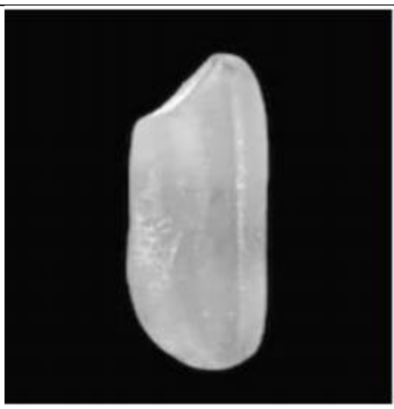
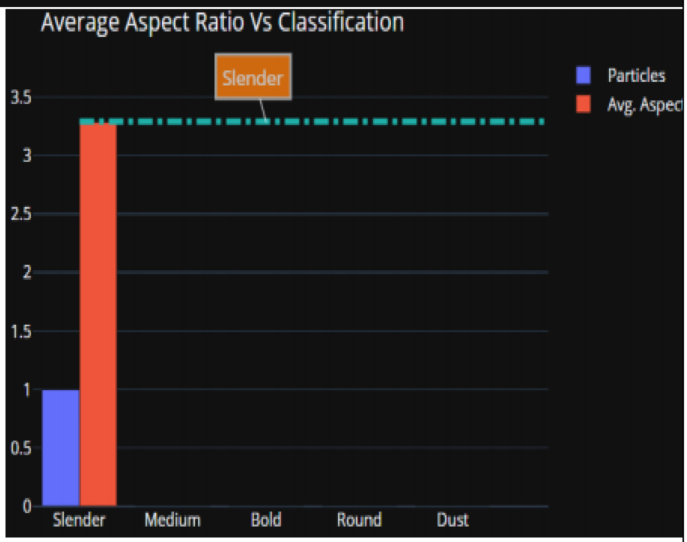
At the end of the project we are successful in developing a website which can take input in the form of rice images and classify the rice grains and as well as determine the quality of the rice grains.

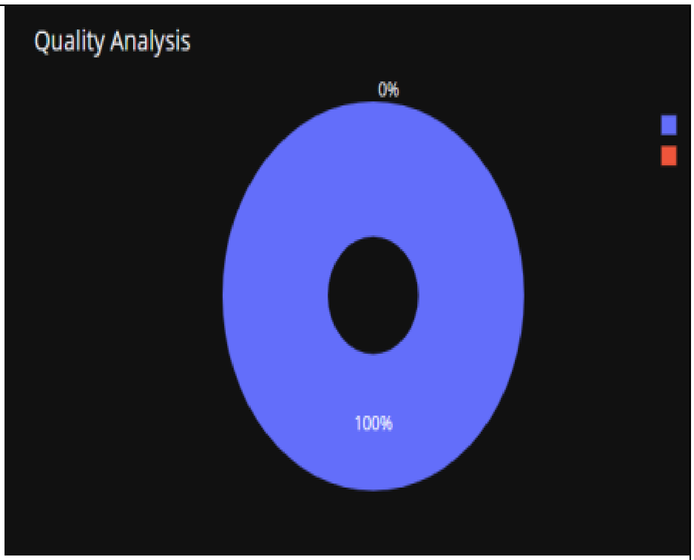
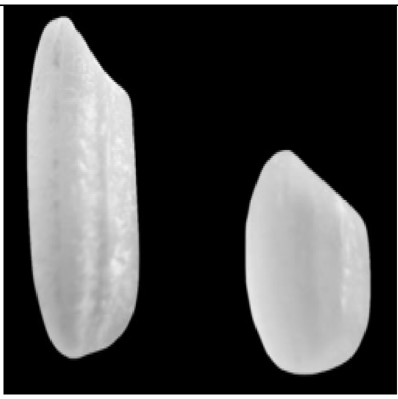
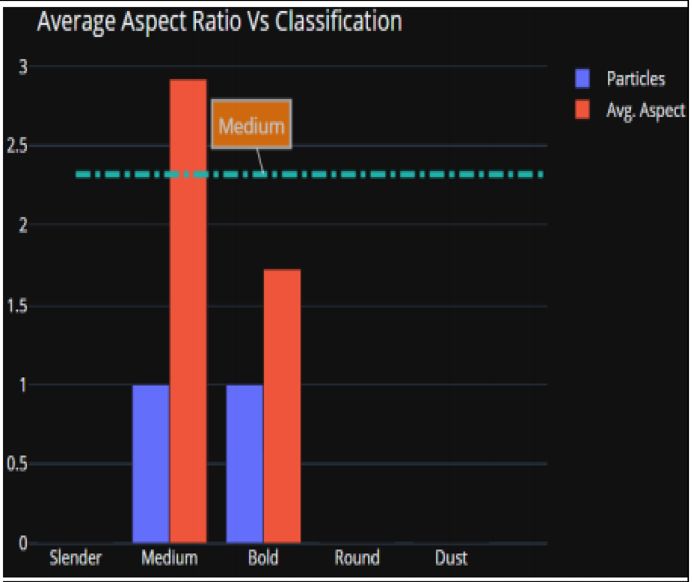
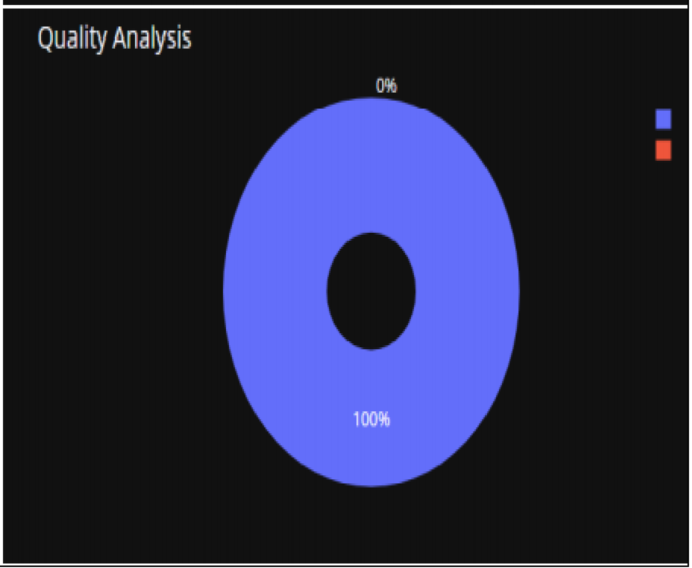
This is an efficient approach and as well as a cost-efficient approach.

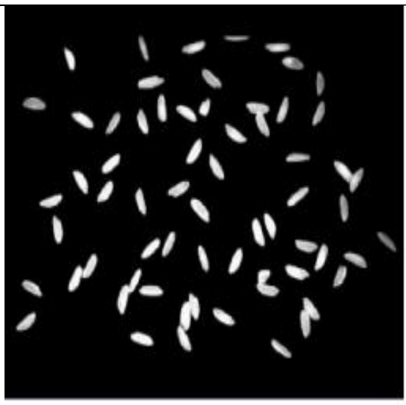
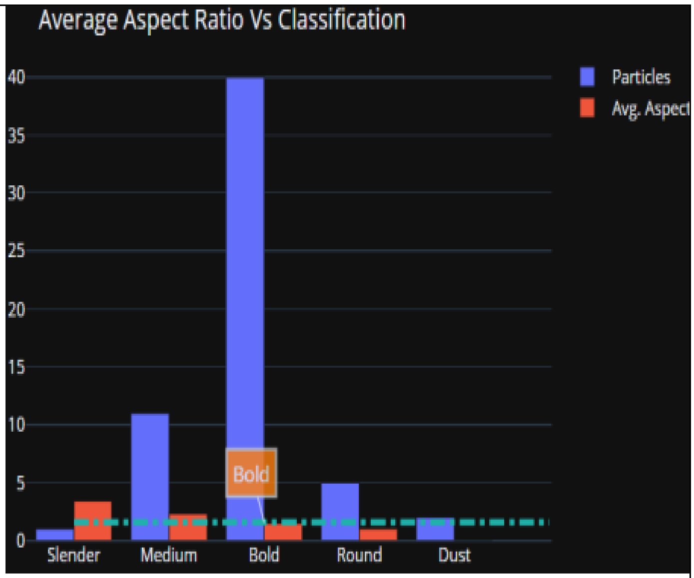
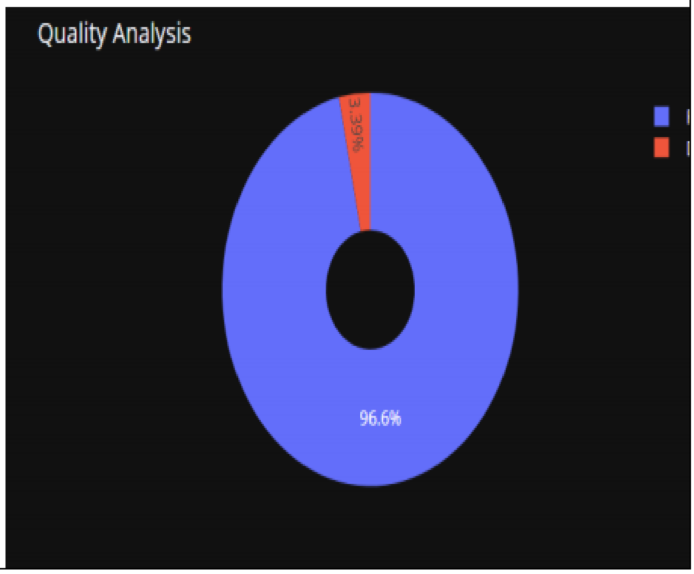
8. RESULTS AND DISCUSSION

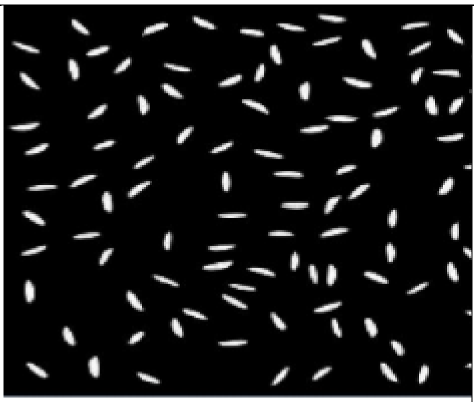
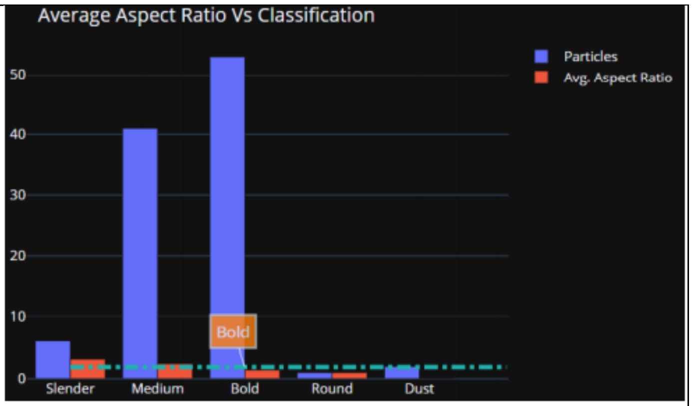
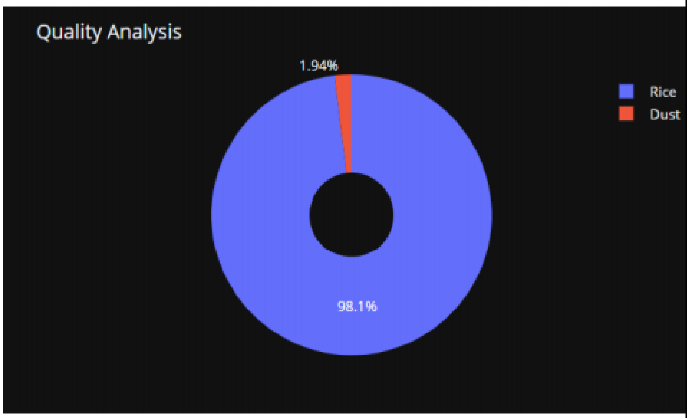
S.NO	INPUT	OUTPUT
1		 

<table>
<tr>
<td>2</td>
<td></td>
<td>


</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>
</td>
</tr>
</table>

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

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

6		 

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.

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.

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

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.