A PROJECT REPORT

ON

"FRUIT SORTING AND GRADING BASED ON IMAGE PROCESSING"

Submitted to

UNIVERSITY OF MUMBAI

In Partial Fulfilment of the Requirement for the Award of

BACHELOR'S DEGREE IN
COMPUTER ENGINEERING

BY

Shaikh Ashraf Tahir Parveen Bano	**15CO35**
Sayyed Asim Farooque Najma	**16DCO71**
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UNDER THE GUIDANCE OF
PROF. Mubasshir Khan

DEPARTMENT OF COMPUTER ENGINEERING
Anjuman-I-Islam's Kalsekar Technical Campus
SCHOOL OF ENGINEERING & TECHNOLOGY
Plot No. 2 3, Sector - 16, Near Thana Naka,
Khandagaon, New Panvel - 410206

2019-2020

AFFILIATED TO

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CERTIFICATE

This is certify that the project entitled

"Fruit Sorting and Grading based on Image Processing"

submitted by

Shaikh Ashraf Tahir Parveen Bano	**15CO35**
Sayyed Asim Farooque Najma	**16DCO71**
Shaikh Mehvash Samir Fauziya	**16DCO75**

is a record of bonafide work carried out by them, in the partial fulfilment of the requirement for the award of Degree of Bachelor of Engineering (Computer Engineering) at ***Anjuman-I-Islam's Kalsekar Technical Campus, Navi Mumbai*** under the University of MUMBAI. This work is done during year 2019-2020, under our guidance.

Date: / /

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At last we must express our sincere heartfelt gratitude to all the staff members of Computer Engineering Department who helped us directly or indirectly during this course of work.

Shaikh Ashraf Tahir Parveen Bano

Sayyed Asim Farooque Najma

Shaikh Mehvash Samir Fauziya

Project I Approval for Bachelor of Engineering

This project entitled *" Fruit Sorting and Grading based on Image Processing¨* by ***Shaikh Ashraf Tahir Parveen Bano,Sayyed Asim Farooque Najma,Shaikh Mehvash Samir Fauziya*** is approved for the degree of ***Bachelor of Engineering in Department of Computer Engineering.***

Examiners

1. .....
2. .....

Supervisors

1. .....
2. .....

Chairman

.....

Declaration

We declare that this written submission represents our ideas in our own words and where others ideas or words have been included, We have adequately cited and referenced the original sources. We also declare that We have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in our submission. We understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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ABSTRACT

In recent years, automated machine vision based technology has become more potential and important in many areas like Agricultural Sector and Food Processing Industry. Grading and Sorting of the fruit is one of the most important process, but this procedure is mostly carried out manually which is not efficient as it tends to human error. An automatic fruit quality inspection system helps in speed up the process improve accuracy and efficiency and reduce time.

In our project we have two main module, Grading Module and Sorting Module. In Grading process, is carried out by capturing the fruit image using camera and this image is interpreted using image processing various techniques.The Sorting process is done by sorting the fruits based on Color. With the help of this two module we will detect the defected fruits. We will be doing Size detection based on binary image of fruits.

The Main aim of the our system is to Sort and Grade the variety of Fruits by using different Image Processing Techniques and also by using Neural Networks(Sequential Neural networks).Image Processing Techniques like converting color image to gray scale image so with the help of thresholding we can get the amount of color the image would be having like RGB color and canny edge detection for detecting the edge of fruits and also neural network that can to changing input; so the network generates the best possible result without needing to redesign the output criteria.with help of this techniques we can make the the sorting and grading process more efficient than the manual work.It will improve the quality as well as it will take less time.

Keywords: :Fruits, OpenCV, Contours,Image Processing, Edge Detection,Color Detection, Canny Edge Detection, Neural Network,Camera.

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Chapter 1

Introduction

Image processing is a process of converting an image into a digital form. This process is generally done to perform some functions or operations on the image to get an enhanced image or may be to extract some meaningful information out of it.

In simple terms, image processing is the processing of various algorithms on an image to get the results according to our requirements. If we take a real-life example, most of us have used the Adobe's Photoshop or Microsoft's Picture Manager or Google's Picasa. These are some of the software which provides a user interface to apply various functions to process the images and uses some basic image processing algorithms.

An automatic fruit quality inspection system helps in speed up the process improve accuracy and efficiency and reduce time.In our project we have two main module– Grading Module and Sorting Module.In Grading process, is carried out by capturing the fruit image using camera and this image is interpreted using image various processing techniques.The Sorting process is done by sorting the fruits based on Color. With the help of this two module we detect the defected fruits. We will be doing Size detection based on binary image of fruits.The Main aim of the our system is to Sort and Grade the variety of Fruits by using different Image Processing Techniques. Image Processing Techniques like converting color image to gray scale image so with the help of thresholding we can get the amount of color the image would be having like RGB color,canny edge detection and Neural Networks(Sequential Neural Network) for detecting the edge of fruits with help of this techniques we can make the the sorting and grading process more efficient than the manual work.It will improve the quality as well as it will take less time.

1.1 Purpose

The main purposes of our project are :-

- Visualization – Observe the objects that are not visible.

- Image Sharpening and restoration – To create a better image.
- Image Recognition – Distinguish the various objects in an image
- Image Retrieval – Seek for the image of interest.
- Measurement of pattern – Measures various objects in an image.
- Neural Network - A neural network is a series of algorithms that endeavors to recognize underlying relationships in a set of data through a process that mimics the way the human brain operates.Neural networks can adapt to changing input; so the network generates the best possible result without needing to redesign the output criteria
- Sequential Neural Networks -Neural Networks sequentially build high-level features through their successive layers. We propose here a new neural network model where each layer is associated with a set of candidate mappings.

Basically the purpose is to provide the best quality of product in market which satisfies the customer needs and get rid of manual work which takes more time.

1.2 Project Scope

The scopes of the research project are listed as the following:

- Fruit is chosen as the analysis material for this fruit sorting system.
- Algorithms are developed based on the size and color of Fruit.
- Algorithms are designed by using Neural Network and OpenCV.
- Analysis is based on the data of image.
- Inputs is given to robotic arm to sort the fruits

1.3 Project Goals and Objectives

1.3.1 Goals

- To provide the best quality of fruits.
- To reduce the manual work.
- To make sure the fruits are best.

1.3.2 Objectives

- To design and develop an algorithm for fruit classification based on shape and color. Classification based on Shape and Color will help to provide the perfect sorting and grading of fruits.
- To evaluate the system performance for fruits sorting and classification in term of accuracy.As their are many manual system available in market but it much more time consuming then the Automated System.
- To optimize the system performance by manipulating the illumination, thresholding value and distance of camera.The Threshold value plays an important role for the Color Module for RGB where we will take average of R,G,and B and for shape the Edge Detection will provide proper shape and size of a fruit.
- With neural networks, we seek to minimize the error.

1.4 Organization of Report

- Chapter 1 : Here we have explained important terminologies like Introduction which includes concept like use of system, Problem definition and current system, Purpose of project(reason because of which we decided to build this System), Scope of project, Goal and Objective.
- Chapter 2 : Here, we have discuss 3 different papers for our project.
- Chapter 3 : We have discussed the requirement analysis of a project under which we have mentioned various terminologies like members and their capabilities, their roles and responsibilities, various assumptions that are made and constraints faced along with the Project Management Approach, Project Budget And Complete Timeline.
- Chapter 4 : In this chapter, we have mentioned the overall description that includes project perspective, features of the product and the environment that is required to operate the system.
- Chapter 5 : In this chapter, we have mentioned the system design that includes functional requirements, non-functional requirements, system architecture design, sub-system development and system integration.
- Chapter 6 : This chapter includes implementation of our project where we have discussed various modules that we have mentioned earlier in more depth.
- Chapter 7 : We have shown various test cases and results along with the analytic discussion. This chapter contains the expected and actual results of our system.

- Chapter 8 : This chapter include the screenshots of our project.
- Chapter 9 : Here we have concluded the the whole project with its future scope and limitation followed by references.

Chapter 2

Literature Survey

2.1 Orange Sorting by Applying Pattern Recognition on Colour Image

The objective of this paper is to provide Automated Grading based on Pattern Recognition.this paper proposes the research work for automated grading of Oranges using pattern recognition techniques applied on a single color image of the fruit. This research is carried out on 160 Orange fruits collected from varied geographical locations in Vidarbha Region of Maharashtra. System designed can automatically classify an Orange fruit from this region, given its single color image of 640 480 pixel resolution, taken inside a special box designed with 430 lux intensity light inside it, by a digital camera.Only 4 features are used to classify oranges into 4 different classes according to the maturity level and 3 different classes as per size of oranges.

2.1.1 Advantages of Paper

a. It is provide the maturity levels.

b. It provides efficiency.

c. Use of different pattern recognition techniques.

2.1.2 Disadvantages of Paper

a. Blue color is least significant hence can be neglected.

2.1.3 How to overcome the problems mentioned in Paper

a. We will use this information and make a system which will predict the size of fruits

2.2 Automated Sorting and Grading of Vegetables using Image Processing

The computer vision based system for automatic grading and sorting of agricultural products like strawberry and brinjal based on maturity level is presented in this paper. The application of machine vision based system, aimed to replace manual based technique for grading and sorting of fruit and vegetable. The manual works obtained problems in maintaining consistency in grading and uniformity in sorting. To speed up the process as well as maintain the consistency, uniformity and accuracy, a prototype computer vision based automatic grading and sorting system is developed. The proposed method is implemented by k-means clustering segmentation and color detection process with strawberry and brinjal. Feature extraction for various features like Entropy, Mean and standard deviation are calculated. The main aim of the proposed system is to sort and grade the variety of vegetables like strawberry and brinjal is implemented using image processing techniques.

2.2.1 Advantages of Paper

a. It provides consistency.

b. It uses different feature extraction.

2.2.2 Disadvantages of Paper

a. It has used various maturity level.

2.2.3 How to overcome the problems mentioned in Paper

a. We will use this information and make a system which will provide more accuracy.

2.3 Automated Fruit Grading System

The quality of the fruits is important for the consumers and become the requirement from the suppliers to provide fruits with high standards quality. So, in the past few years, fruit grading systems have established to fulfil the needs of the fruit processing industry inspection. Besides that, the process of fruits involves several steps that can generally be classified into grading, sorting, packaging, transporting and storage. The grading are considered as the most important steps towards the high standard of quality. Two kinds of fruits have been inspected in this project; namely are apple and mango. A prototype of an automated fruit grading system is designed and developed in this paper to detect the defects on of the surface of fruits. The

system is capturing the fruit's image using camera and the fruits are placed onto of a rotating desk.

2.3.1 Advantages of Paper

a. It focuses on grading, to provide the high standard of quality

2.3.2 Disadvantages of Paper

a. As their is the use of camera and rotating disk may be due to failure of mechanism it can stop working for movement

2.3.3 How to overcome the problems mentioned in Paper

a. We will use this information and make a system where we will avoid the light so to get the perfect image of the fruit

2.4 Technical Review

Our system is basically based on Neural Networks which involves :

a. A camera for capturing the images,

b. Predictive causal analytics.

c. Prescriptive analytics

For the Front End: Open CV , Python .For the Back End: Machine Learning , Mysql.

2.4.1 Advantages of Technology

a. Open CV : Python is a library of Python bindings designed to solve computer vision problems.OpenCV-Python makes use of Numpy, which is a highly optimized library for numerical operations with a MATLAB-style syntax. All the OpenCV array structures are converted to and from Numpy arrays. This also makes it easier to integrate with other libraries that use Numpy such as SciPy and Matplotlib.

b. Python : Python is a high level, interpreted and general purpose dynamic programming language that focuses on code readability.It has fewer steps when compared to Java and C.It was founded in 1991 by developer Guido Van Rossum.It is used in many organizations as it supports multiple programming paradigms.It also performs automatic memory management.

2.4.2 Reasons to use this Technology

a. Machine Learning : Machine learning is an application of artificial intelligence(AI) that provides systems the ability to automatically learn and improve from experience without being explicitly programmed. Machine learning focuses on the development of computer programs that can access data and use it learn for themselves

b. Neural Networks : A neural network is a series of algorithms that endeavors to recognize underlying relationships in a set of data through a process that mimics the way the human brain operates. ... Neural networks can adapt to changing input; so the network generates the best possible result without needing to redesign the output criteria.

c. Sequential Neural Networks : Neural Networks sequentially build high-level features through their successive layers. We propose here a new neural network model where each layer is associated with a set of candidate mappings. When an input is processed, at each layer, one mapping among these candidates is selected according to a sequential decision process. The resulting model is structured according to a DAG like architecture, so that a path from the root to a leaf node defines a sequence of transformations. Instead of considering global transformations, like in classical multilayer networks, this model allows us for learning a set of local transformations. It is thus able to process data with different characteristics through specific sequences of such local transformations, increasing the expression power of this model w.r.t a classical multilayered network. The learning algorithm is inspired from policy gradient techniques coming from the reinforcement learning domain and is used here instead of the classical back-propagation based gradient descent techniques. Experiments on different datasets show the relevance of this approach.

Chapter 3

Project Planning

3.1 Members and Capabilities

Table 3.1: Table of Capabilities

SR. No	Name of Member	Capabilities
1	Shaikh Ashraf Tahir Parveen Bano	Coding
2	Sayyed Aasim Farooque Najma	Coding
3	Shaikh Mehvash Samir Fauziya	Coding

Work Breakdown Structure

3.2 Roles and Responsibilities

Table 3.2: Table of Responsibilities

SR. No	Name of Member	Role	Responsibilities
1	Shaikh Ashraf Tahir Parveen Bano	Team Leader	Coding
2	Sayyed Aasim Farooque Najma	Member	Coding
3	Shaikh Mehvash Samir Fauziya	Member	Coding

3.3 Assumptions

a. Data provided should be true.

b. The sorting and grading would be 100 percent.

3.3.1 Constraints

a. Details of the fruits should be maintained.

b. Pre-processing is done.

3.4 Project Management Approach

We have use Agile Methodology for the development of the project.AGILE methodology is a practice that promotes continuous iteration of development and testing throughout the software development life cycle of the project. Both development and testing activities are concurrent unlike the Waterfall model.Agile methodology is often compared with the waterfall model in the software development industry. However, agile approach is considered to be better. It uses an incremental approach where a sample prototype is discussed with the customer.The idea is to maintain product's quality in the entire phase of development.

Fig. Agile Model

3.5 Ground Rules for the Project

a. Show up on time and come prepared.Be prompt in arriving to the meeting and in returning from breaks.

b. Stay mentally and physically present.

c. Contribute to meeting goals.

d. Let everyone participate.

e. Listen with an open mind.

f. Think before speaking.

g. Stay on point and on time.

h. Attack the problem, not the person.

3.6 Project Budget

a. Open CV - Open Source

b. Python - Open Source

c. No Budget Cost.

Chapter 4

Software Requirements Specification

4.1 Overall Description

4.1.1 Product Perspective

The project is basically based on the sorting,grading and prepossessing of the data set and providing the proper quality of fruits.As we have collected the data set of different fruits.The details of the fruits will be feeded in the system.We will provide this system to the users which will be having the data of the fruits. We have design two modules Sorting and Grading.In Grading process, is carried out by capturing the fruit image using camera and this image is interpreted using image various processing techniques.The Sorting process is done by sorting the fruits based on Color.And with neural network that endeavors to recognize underlying relationships in a set of data through a process that mimics the way the human brain operates.With the help of this two module we will detect the defected fruits. We will be doing Size detection based on binary image of fruits.

4.1.2 Product Feature

The system will make easier for the Farmer and different users so sort and grade the fruits very easily.This system will reduce the manual work and time of farmers and different users.It will the best quality of fruits.

4.1.3 User Classes and Characteristics

The users of the system will be the Farmers and Industry Workers.They will be using our software for detecting the fruits.This will make their work more easy and efficient.

4.1.4 Operating Environment

The environment in which the system will operate should be Open CV and the platform on which the software will run can be any browser. Further the required

specification the system will need are :

a. Proper Data Set.

b. Neural Network.

4.1.5 Design and Implementation Constraints

The major challenge that will hurdle the development of the system is required the clean and huge amount of data set and dealing with Neural Network.With the help of accurate data set the system will pre-process the data which will than sort and grade and provide the immediate output. The another constraints is that the user should know how to use the system.So that they can provide the accurate report of fruits.

4.2 System Features

The features of the system is to do sorting and grading of fruits and provide the good quality of fruits.

4.2.1 System Feature

a. Provide accuracy.

b. Immediate Sorting and Grading.

Description and Priority

a. Provide Accuracy : To maintain the accuracy the system should provide with the accurate data set .So that the data can get pre-process and can sort and grade the fruits.

b. Immediate Sorting and Grading : With the help of immediate sorting and grading we will get the best quality of fruits as early as possible.

c. Neural networks can adapt to changing input; so the network generates the best possible result without needing to redesign the output criteria.

Stimulus/Response Sequences

a. The user need to log in in to the system.

b. All the images will be available in the system.

c. Lastly it will provide the best quality of fruit

Functional Requirements

REQ-1. The user need to log in in to the system.

REQ-2. The system should give accurate image to the objects.

REQ-3. Gathering the data.

REQ-4. Handling missing data

REQ-5. Taking your data further with feature extraction.

REQ-6. Deciding which key factors are important. ...

REQ-7. Splitting the data into training testing sets.

REQ-8. Server should respond quickly.

4.3 External Interface Requirements

4.3.1 User Interfaces

The software provides good graphical interface for the user any administrator can operate on the system, performing the required task such as update, viewing the details.

4.3.2 Hardware Interfaces

a. 4 GB Ram.

b. 500 GB Hard Disk Minimum.

4.3.3 Software Interfaces

a. Operating System : Window,Linux.

b. Front end : Open CV , Python.

c. Back end : Neural Networks,Machine Learning ,API's :- Keras, TensorFlow.

4.3.4 Communications Interfaces

a. Proper internet connection.

4.4 Nonfunctional Requirements

4.4.1 Performance Requirements

The system must be interactive and the delays involved must be less.When we connecting to the server the delay is because the data is stored or manage online very safely and securely.The data is reliable to the user to see this data very correctly. Authentication,Quick Response by server,Accurate Annotation.

4.4.2 Safety Requirements

Backups is the major safety requirement if due the catastrophic failure, such as the disk crash,the recovery method restores a past copy of the database.Database Security applying Statistical Method.

4.4.3 Security Requirements

The major security requirements for the system will be the safeguarding of the user data from any kind of exploit. In order to protect the user data, high security and authentication is required for better security.

Chapter 5

System Design

5.1 System Requirements Definition

Our system is a web-based application. The complete system is trained to annotate image automatically. The images are store in database.The System will be secured.

5.1.1 Functional requirements

a. The user need to log in in to the system.

b. The system should give accurate images of the objects.

c. Server should respond quickly.

Use-case Diagram

Use case diagrams are usually referred to as behavior diagrams used to describe a set of actions (use cases) that some system or systems (subject) should or can perform in collaboration with one or more external users of the system (actors). Each use case should provide some observable and valuable result to the actors or other stakeholders of the system. The below figure shows the Use Case diagram of our system which contains the following component:

a. Capture Image.

b. Image Processing.

c. Grading.

d. Sorting.

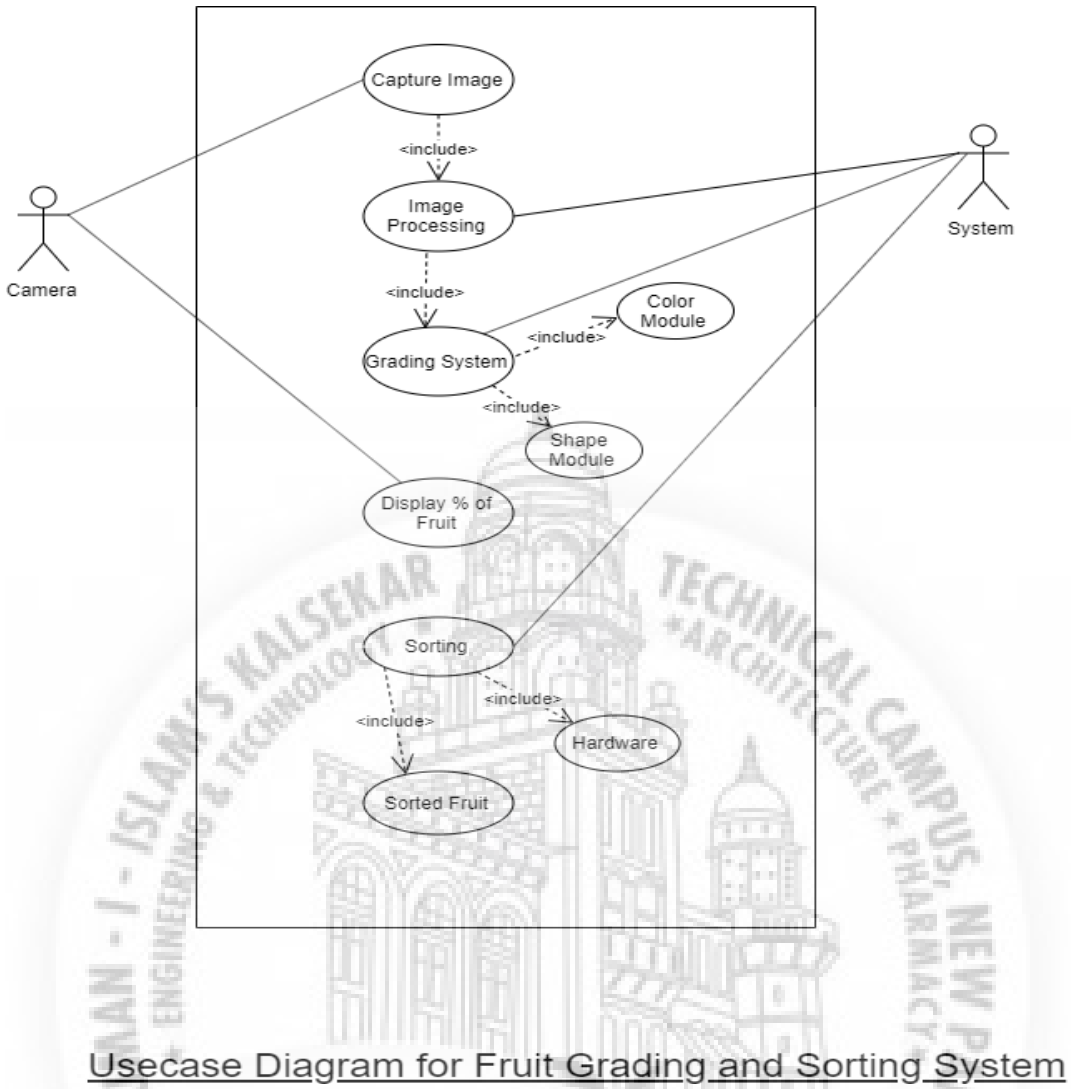


Figure 5.1: Use Case Diagram

Data Flow Diagram

A data flow diagram (DFD) is a graphical representation of the ”flow” of data through an information system, modelling its process aspects.A DFD is often used as a preliminary step to create an overview of the system without going into great detail, which can later be elaborated. DFDs can also be used for the visualization of data processing.

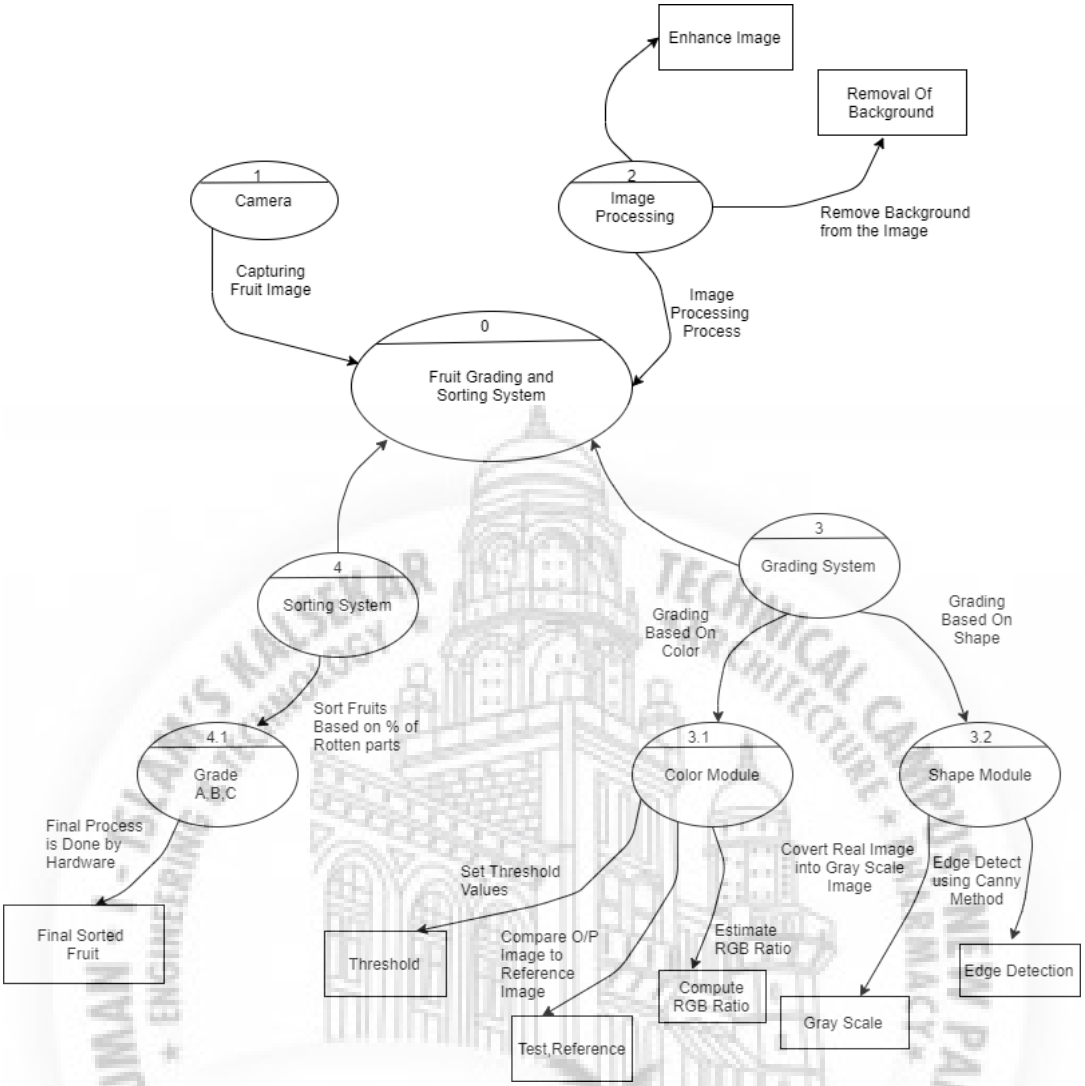


Figure 5.2: Data Flow Diagram

5.1.2 System requirements (non-functional requirements)

The system should have high performance and low failure rates. The hardware and software should be able to transmit/receive data from databases.The immediate report generation is depend on the two test.

Performance Requirement

a. Authentication.

b. Quick Response by server.

c. Accurate Annotation.

Algorithm to Color Detection

STEP-1. Start.

STEP-2. Read the input color image using imread function.

STEP-3. Read the input pixel of color image in three different planes (RGB) and store it into three variable r,g and b.

STEP-4. Read the small region of fruit to detect color of fruit.

STEP-5. Store in different variable r1, g1, b1.

STEP-6. Calculate the mean of r1,g1,b1 and store into variable r2,g2,b2.

STEP-7. Compare the value with Threshold.

STEP-8. if g2¿threshold, Color detected is green.

STEP-9. if r2¿threshold, Color detected is red.

STEP-10. End.

Algorithm to Value Threshold Algorithm

Value Threshold Algorithm is used to segment the object and remove the background. Threshold cut off value is decided by taking mean of the four pixels values near four corners in the image, coding is This segmented image of fruit object extracted is scanned and only four key features are extracted. These features are Tot pixel,Ravg,Gavg and Bavg

a. Tot pixel“pixel in Obj–¿This is total number of pixels in the segment example fruit.

b. Ravg“pixel Rs - Tot pixel–¿Arithmetic mean of Red color in the fruit.

c. Gavg“pixel Gs - Tot pixel–¿Arithmetic mean of Green color in the fruit.

d. Bavgpixel Bs - Tot pixel–¿Arithmetic mean of Blue color in the fruit.

5.2 System Architecture Design

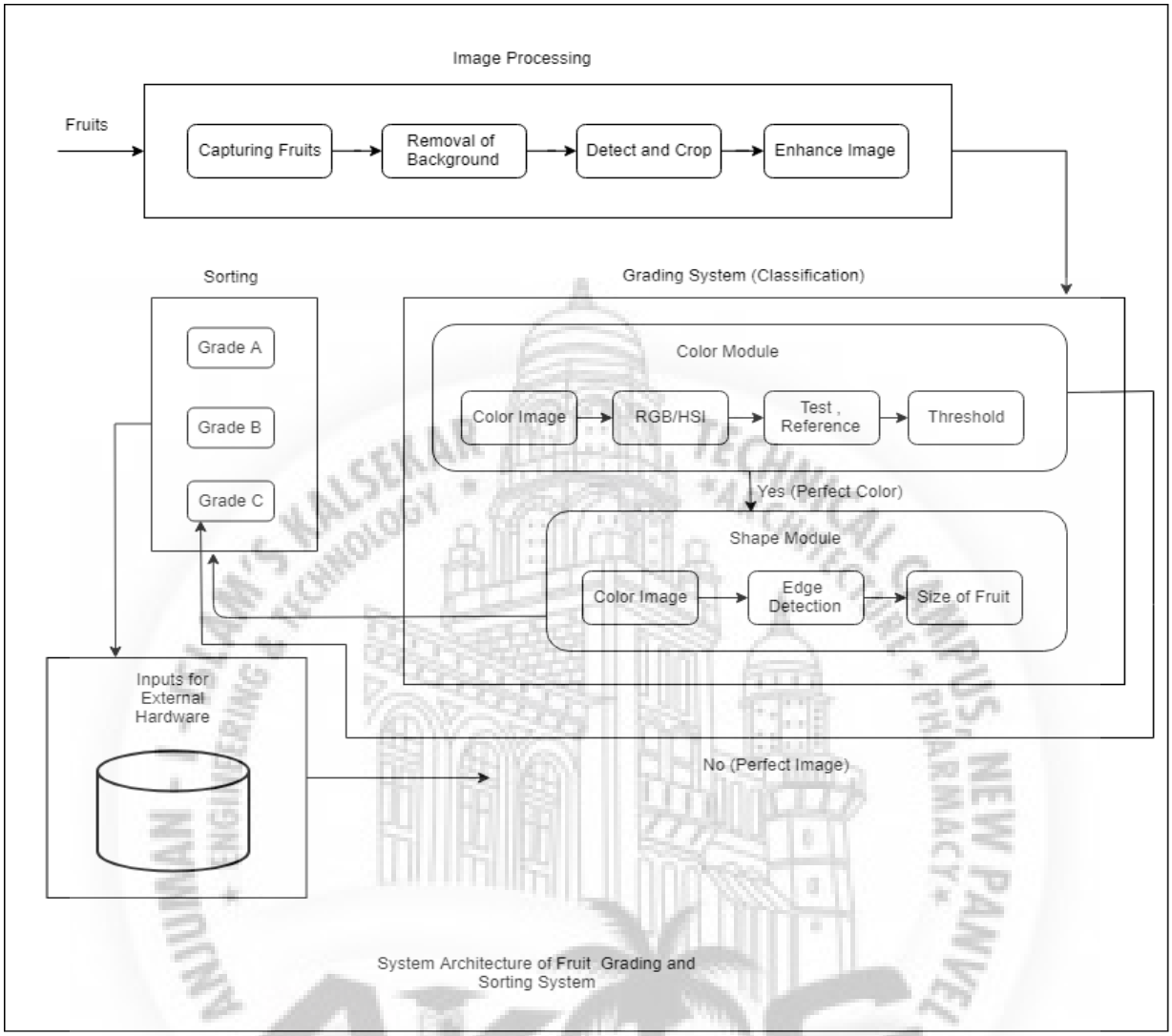


Figure 5.3: System Architecture Design

5.3 Sub-system Development

In our project,we have two important module Grading and Sorting.For grading and sorting of fruits we need best pictures of the fruit so the camera also play an important role in our project.With help of pictures we can grade and sort fruits.

5.3.1 Module 1 - Image Processing

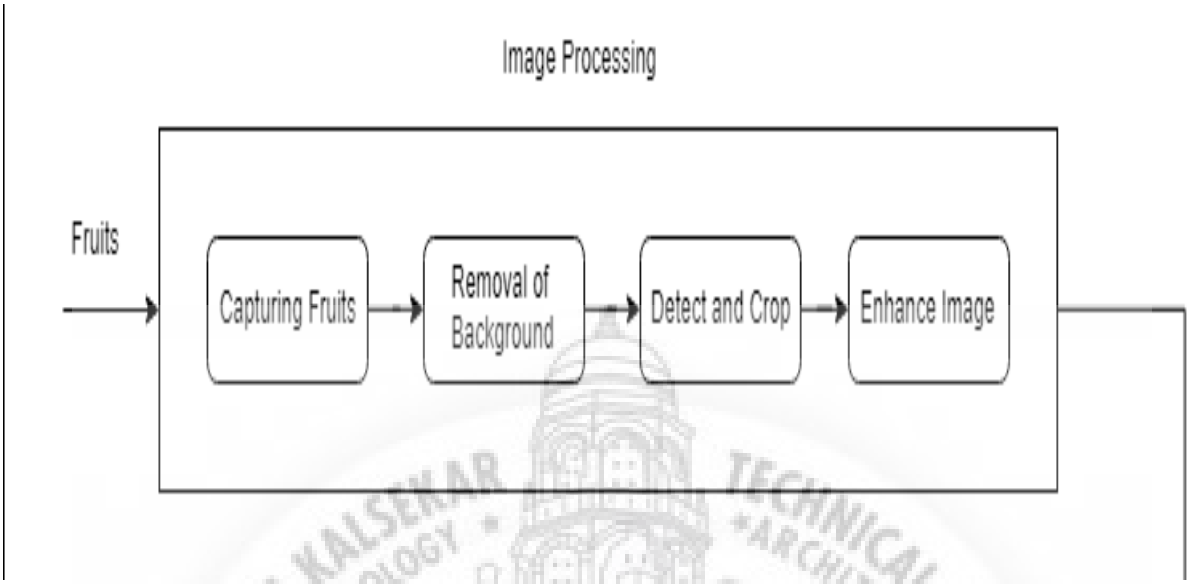


Figure 5.4: Image Processing Module

In our project,Firstly the camera will capture the image of the fruit.The the RGB image is converted to Grayscale image,after that conversion of RGB to grayscale we get the binary value of image which makes easy to work with.As you can see in above figure first capture the image then removal of background mean we have to remove the sound by enhancing the image,so that we get the clear image.

5.3.2 Module 2 - Grading

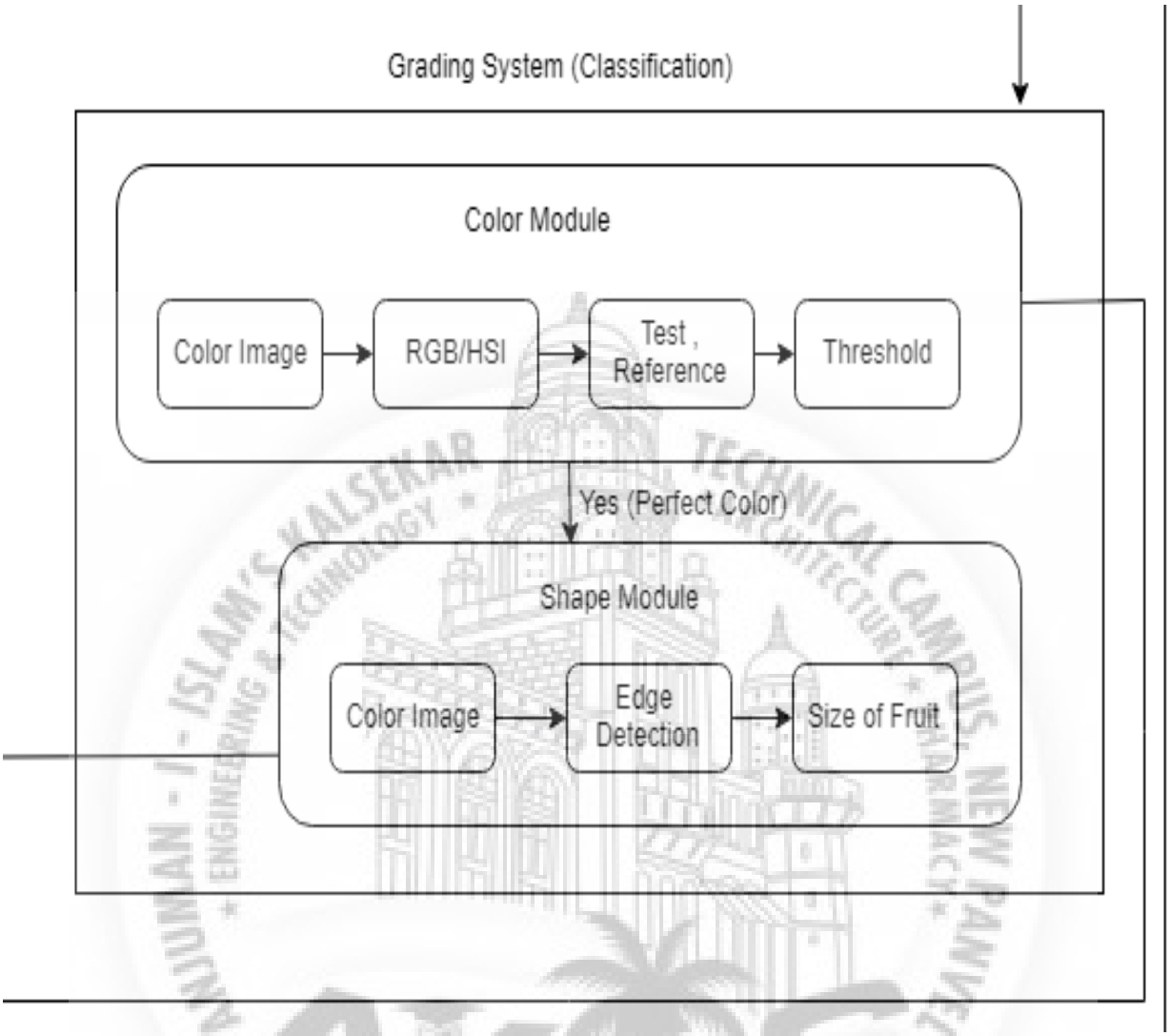


Figure 5.5: Grading Module

In our project, we have two important module grading and sorting.In above figure you can see the grading system.In grading system we have two sub modules Color Module and Shape Module.In color module we take the image which we have converted in binary form,after by setting the threshold value we get the image grade with perfect color.In shape module,in which we are going to detect the edge of the fruits.We are using canny edge detection for the edge once both the condition is satisfied we say that the image has been graded.

5.3.3 Module 3 - Sorting

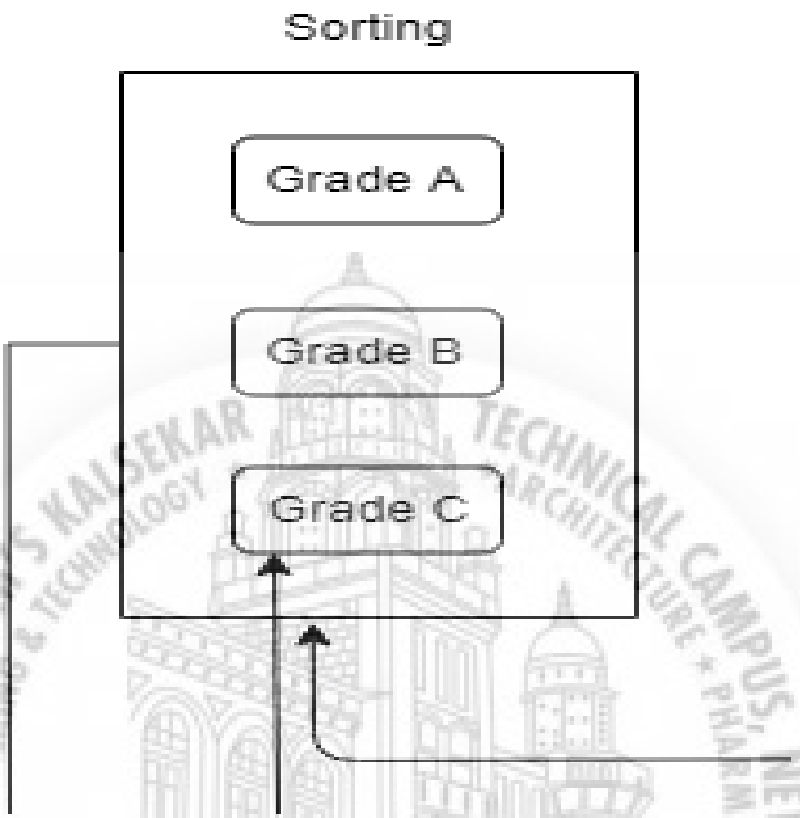


Figure 5.6: Sorting Module

The Second most important module of the project is Sorting Module,in this module the sub color module playes an important role with the help of color we can sort the fruits.Like the fruit is ripe or not and on the bases of that we can sort the fruits.

5.3.4 Module 3 - Neural Networks

Neural networks are an interconnected collection of nodes called neurons or perceptrons. Every neuron takes one piece of the input data, typically one pixel of the image, and applies a simple computation, called an activation function to generate a result. Each neuron has a numerical weight that affects its result.

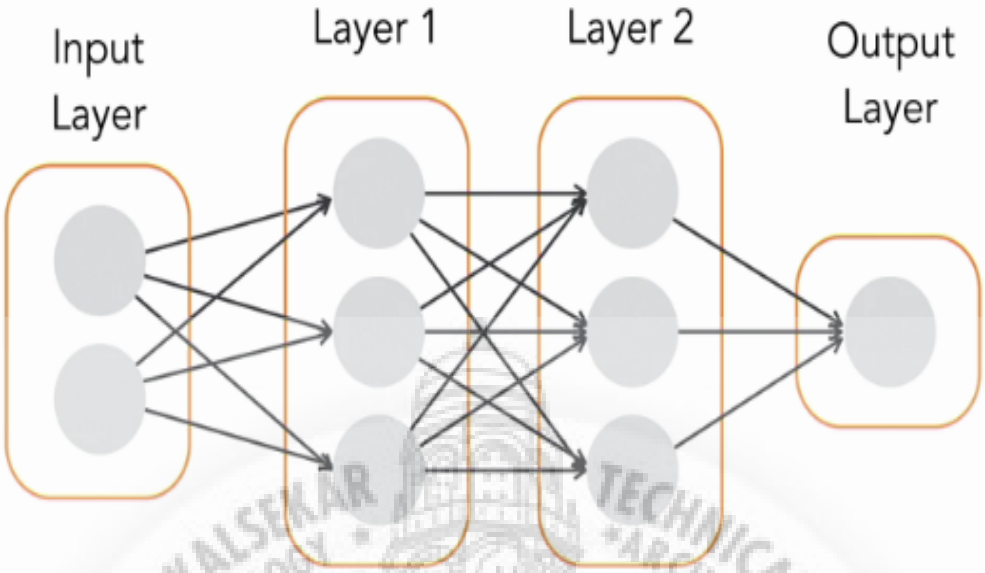


Figure 5.7: Sequential Neural Network

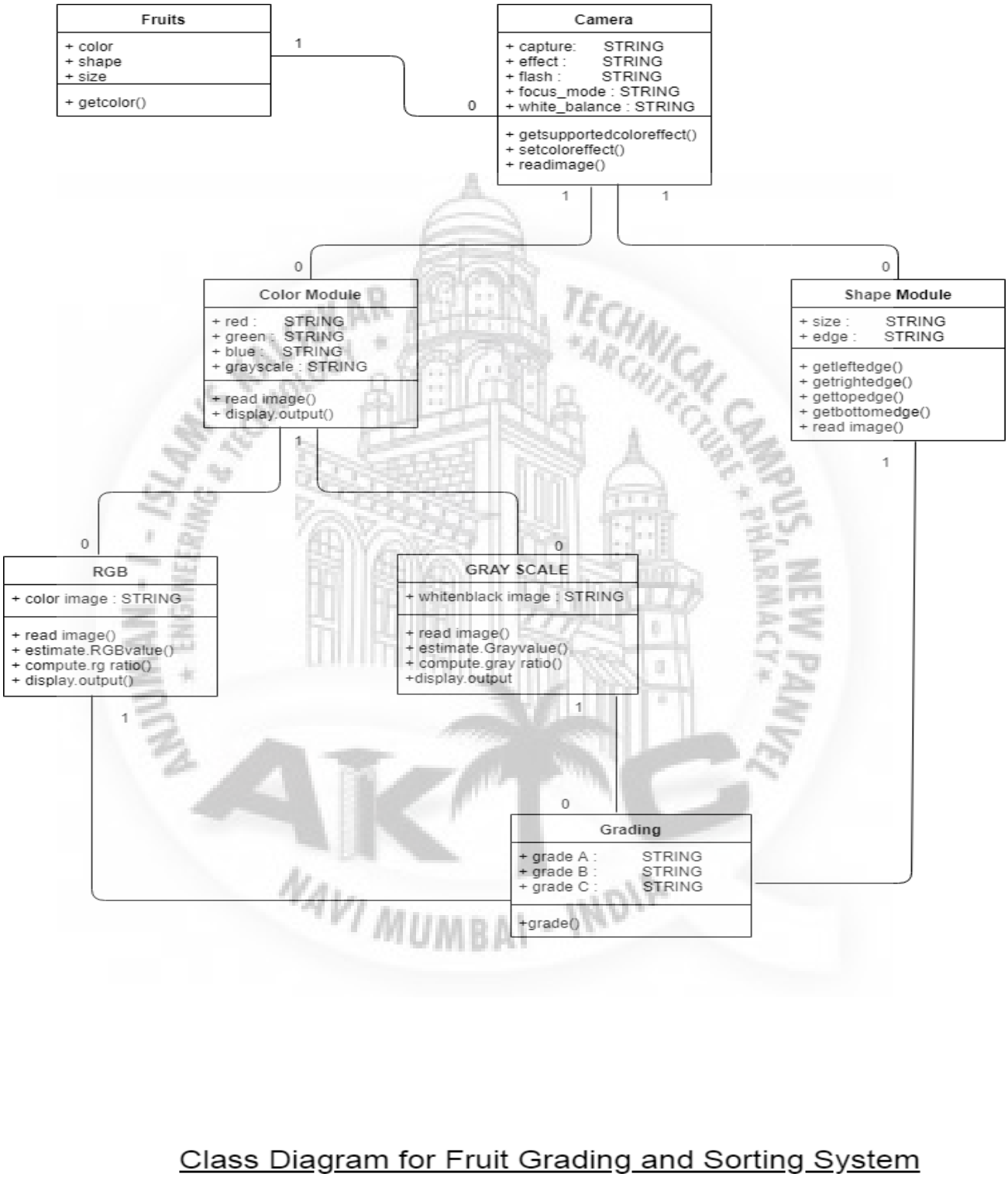
Sequential Neural Network - Sequential is the easiest way to build a model in Keras. It allows you to build a model layer by layer. Each layer has weights that correspond to the layer the follows it. We use the 'add()' function to add layers to our model. We will add two layers and an output layer.For most deep learning networks that you build, the Sequential model is likely what you will use. It allows you to easily stack sequential layers (and even recurrent layers) of the network in order from input to output

The basic steps to build an image classification model using a neural network are:

1. Flatten the input image dimensions to 1D (width pixels x height pixels)
2. Normalize the image pixel values (divide by 255)
3. One-Hot Encode the categorical column.
4. Build a model architecture (Sequential) with Dense layers.

5.4 Systems Integration

5.4.1 Class Diagram



Class Diagram for Fruit Grading and Sorting System

Figure 5.8: Class Diagram

A class diagram in the Unified Modeling Language (UML) is a type of static structure diagram that describes the structure of a system by showing the system's classes,

their attributes, operations (or methods), and the relationships among objects.
The below figure shows the class diagram of our system which describe the relationship between the modules of system and the major components are:

1. Fruits.
2. Camera.
3. Color Module - RGB,Gray Scale.
4. Shape Module.
5. Grading .

5.4.2 Sequence Diagram

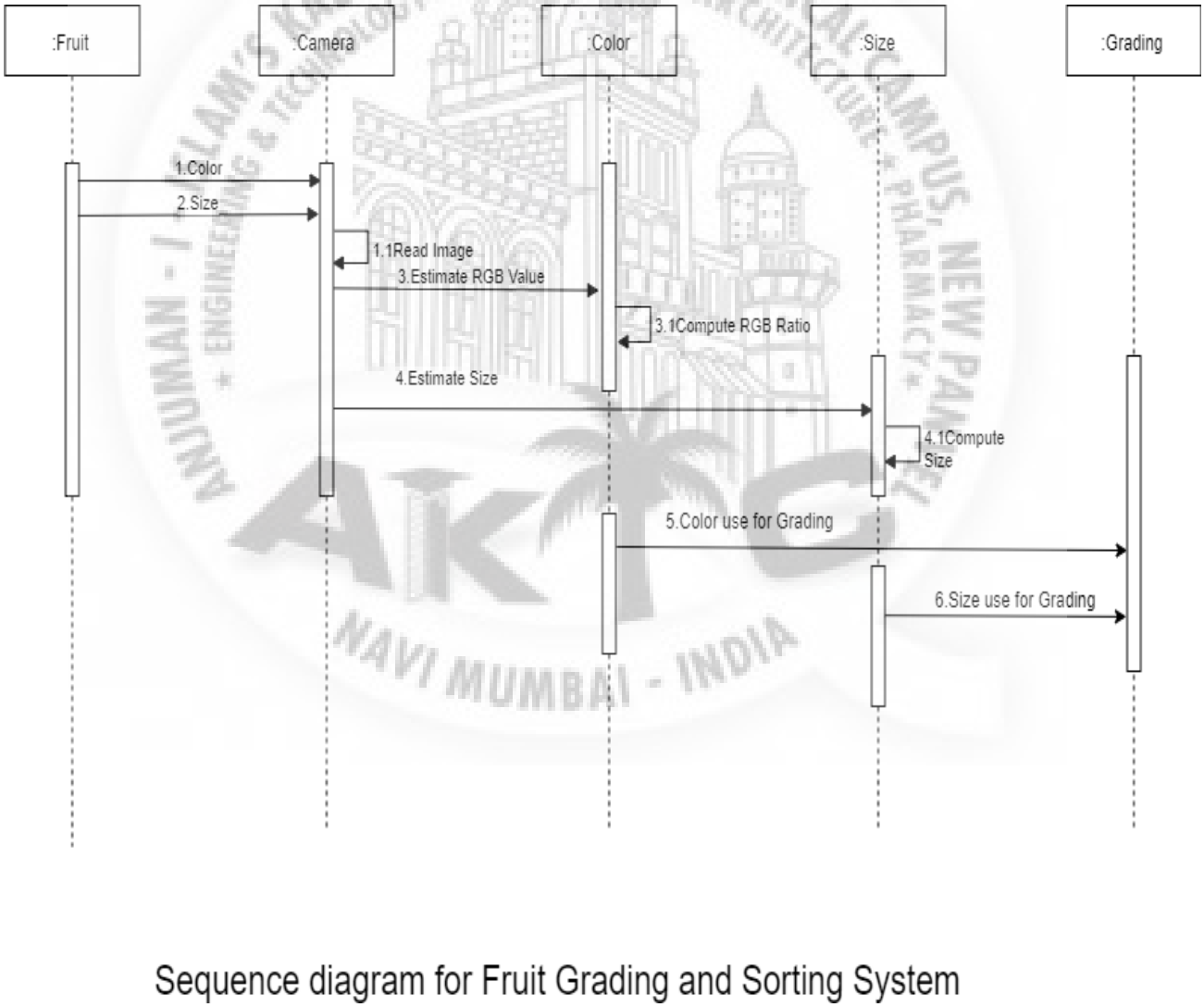


Figure 5.9: Sequence Diagram

A sequence diagram is an interaction diagram that shows how objects operate with one another and in what order. It is a construct of a message sequence chart. The below figure describe the Sequence Diagram of our system.

5.4.3 Component Diagram

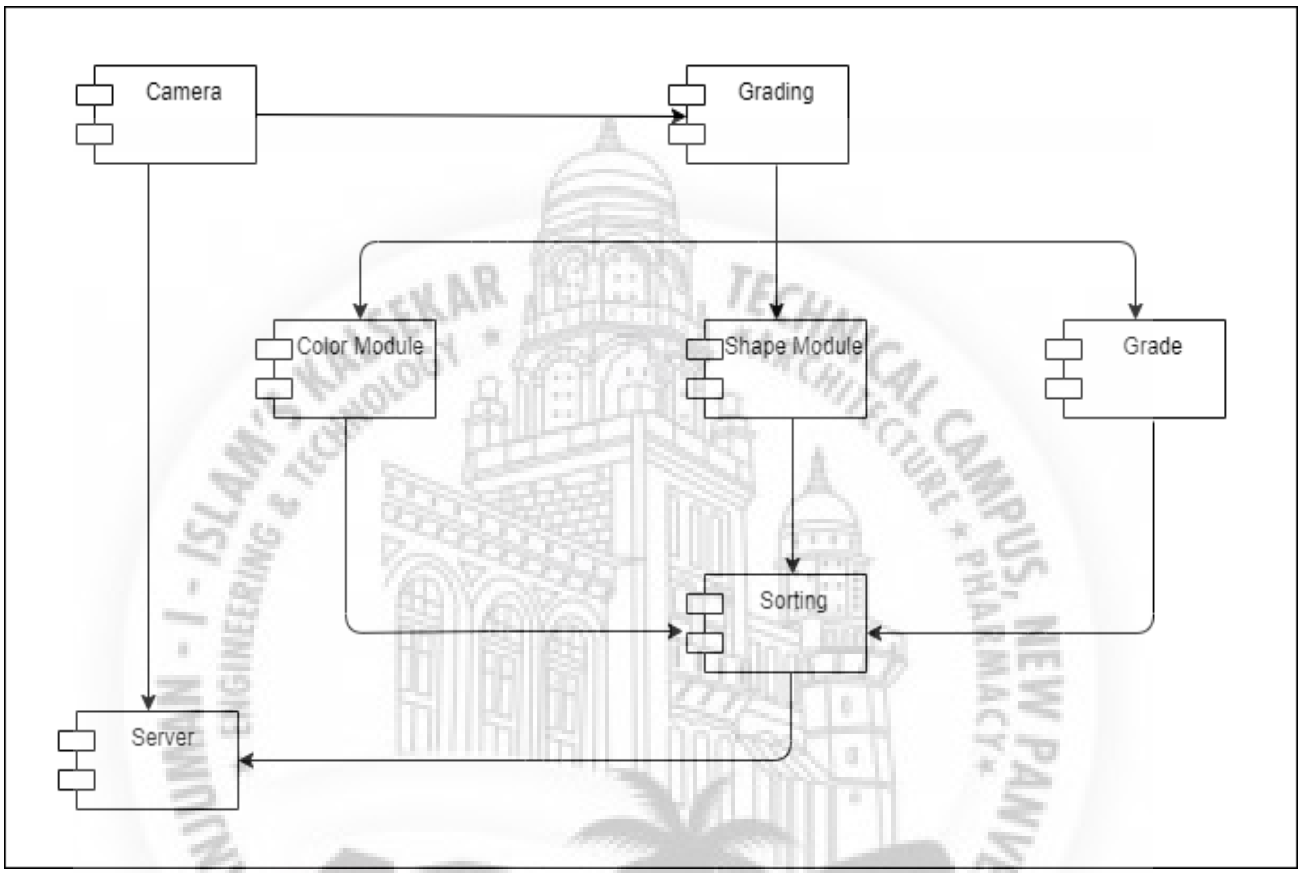


Figure 5.10: Component Diagram

A component diagram, also known as a UML component diagram, describes the organization and wiring of the physical components in a system. The below figure describe the Component Diagram of our system.

5.4.4 Deployment Diagram

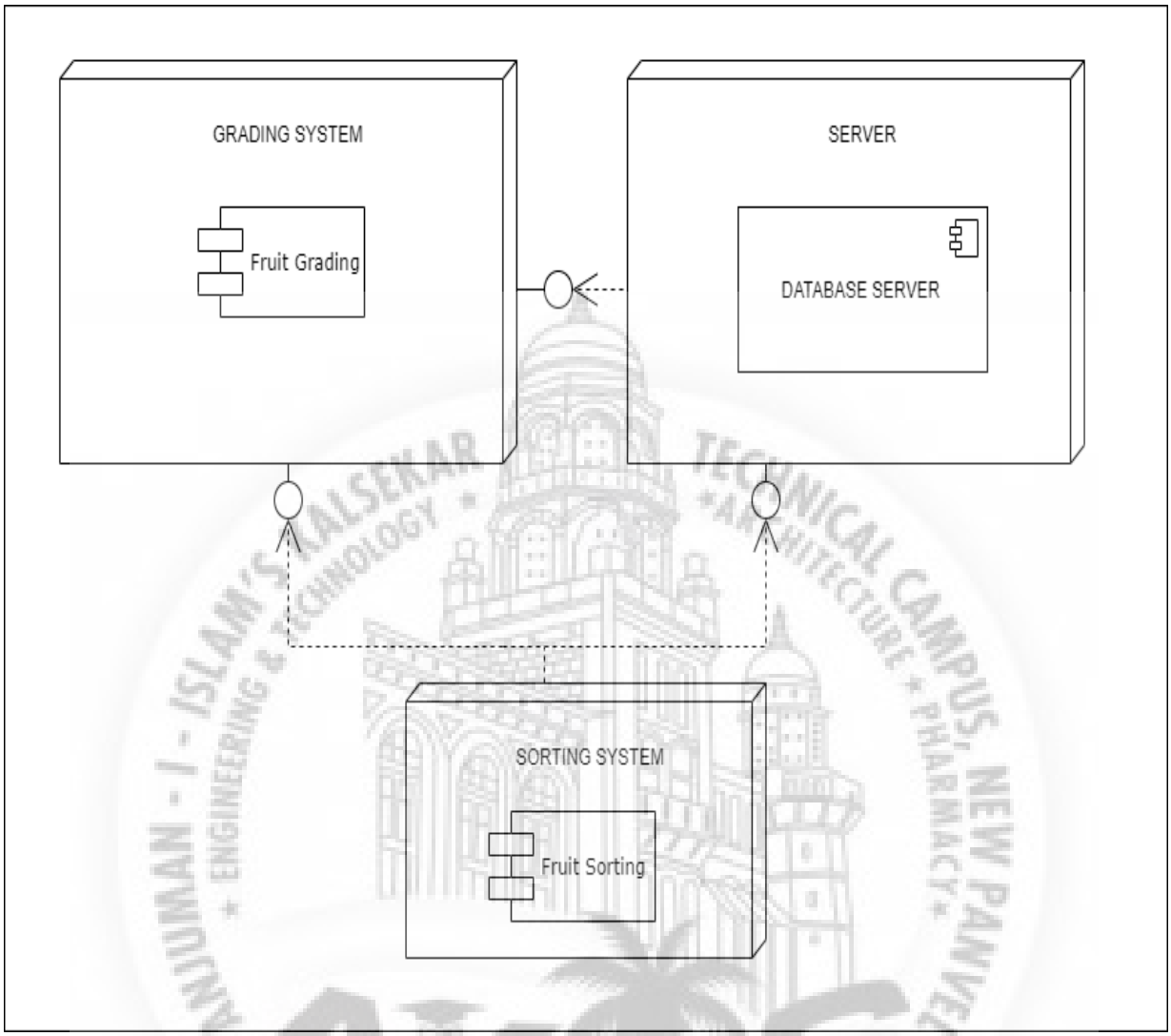


Figure 5.11: Deployment Diagram

Deployment diagram is a structure diagram which shows architecture of the system as deployment (distribution) of software artifacts to deployment targets. The below figure describe the Deployment Diagram of our system.

Chapter 6

Implementation

6.1 Grading and Sorting

Figure 6.1: Output Diagram

```
from __future__ import division
from keras.preprocessing.image import ImageDataGenerator
from keras.models import Sequential
from keras.layers import Conv2D, MaxPooling2D
from keras.layers import Activation, Dropout, Flatten, Dense
from keras import backend as K
import numpy as np
from keras.preprocessing import image
import io
import os
```

```
import random
import time
from copy import deepcopy
import cv2
import pickle
kernelOpen=np.ones((5,5))
kernelClose=np.ones((20,20))
# img = cv2.imread('appletest.jpg')



# <=========================================COLOR MODULE
    ==========================================>
# <=========================================MODULE STARTS
    ==========================================>


# <----------------------capture image through camera---------------------->

# <----------------------code starts---------------------->
# i=time.strftime("%d-%m-%y_%H-%M-%S")
# camera = cv2.VideoCapture(0)
# return_value, img = camera.read()
# cv2.imwrite('all.jpg', img)
# del(camera)
# frame=img


# <----------------------code ends---------------------->

#take image locally

# <----------------------code starts---------------------->
img = cv2.imread('all.jpg')

# <----------------------code ends---------------------->

edge_img=deepcopy(img)


# finds edges in the input image image and
# marks them in the output map edges
thresh = cv2.Canny(edge_img,50,100)
thresh = cv2.dilate(thresh, None, iterations=1)
thresh = cv2.erode(thresh, None, iterations=1)

# find contours in the edge map
contours, hierarchy = cv2.findContours(thresh, cv2.RETR_TREE, cv2.
    CHAIN_APPROX_SIMPLE)

max_contA=cv2.contourArea(contours[0])
max_cont=max(contours,key=cv2.contourArea)



# disable this line of code when taking image locally and enable when camera is
    used

#<----------------------code starts---------------------->


```

```
# for i in range(len(contours)):
#         x,y,w,h=cv2.boundingRect(max_cont)
#         cv2.rectangle(edge_img,(x,y),(x+w,y+h),(0,0,255), 2)
# croppedk=frame[y:y+h,x:x+w]


# #<----------------------code ends---------------------->


# Display the fruit
# cv2.imshow('Edges',edge_img)

frame=edge_img

# converting BGR to HSV
hsv = cv2.cvtColor(frame, cv2.COLOR_BGR2HSV)

# define range of red color in HSV
lower_red = np.array([0,50,50])
upper_red = np.array([10,255,255])

# create a red HSV colour boundary and
# threshold HSV image
redmask1 = cv2.inRange(hsv, lower_red, upper_red)

# define range of red color in HSV
lower_red = np.array([170,50,50])
upper_red = np.array([180,255,255])

# create a red HSV colour boundary and
# threshold HSV image
redmask2 = cv2.inRange(hsv, lower_red, upper_red)

redmask=redmask1+redmask2
maskOpen=cv2.morphologyEx(redmask,cv2.MORPH_OPEN,kernelOpen)
maskClose=cv2.morphologyEx(maskOpen,cv2.MORPH_CLOSE,kernelClose)

maskFinal=maskClose
# cv2.imshow('Red_Mask:',maskFinal)


cnt_r=0
for r in redmask:
  cnt_r=cnt_r+list(r).count(255)
print ("Redness ",cnt_r)

lower_green=np.array([50,50,50])
upper_green=np.array([70,255,255])
greenmask = cv2.inRange(hsv, lower_green, upper_green)
# cv2.imshow('Green_Mask:',greenmask)
cnt_g=0
0
for g in greenmask:
  cnt_g=cnt_g+list(g).count(255)
print ("Greenness ",cnt_g)

lower_yellow=np.array([20,50,50])
upper_yellow=np.array([30,255,255])
yellowmask = cv2.inRange(hsv, lower_yellow, upper_yellow)
# cv2.imshow('Yellow_Mask:',yellowmask)
cnt_y=0
```

```
for y in yellowmask:
  cnt_y=cnt_y+list(y).count(255)
print ("Yellowness ",cnt_y)


#Calculate ripeness
tot_area=cnt_r+cnt_y+cnt_g
rperc=cnt_r/tot_area
yperc=cnt_y/tot_area
gperc=cnt_g/tot_area
rslt1=rperc>gperc+yperc


#Adjust the limits for your fruit
glimit=0.3
ylimit=0.2



# if rslt1 == rperc>gperc+yperc:
#   prediction2 = "Medium Ripeness"
# else:
#   prediction2 = "High Ripeness"

# print(prediction2)

if rslt1 == gperc>glimit:
  prediction2 = "Low Ripeness"
elif yperc>ylimit:
  prediction2 = "High Ripeness "
elif cm:
  prediction2 = "Medium Ripeness"
# else:
#   print ("Medium Ripeness grade a")
print(prediction2)

# <==========================================MODULE ENDS
   ==========================================>
# <==========================================COLOR MODULE
   ==========================================>


# <==========================================MODULE
   3==========================================>
# <==========================================MODULE STARTS
   ==========================================>



img_pred = image.load_img('D://college project/final year/22-04-2020/all
   integrated/all.jpg',target_size=(150, 150))
img_pred = image.img_to_array(img_pred)
img_pred = np.expand_dims(img_pred, axis = 0 )



# load the model from disk
loaded_model = pickle.load(open("trainedm3.sav", 'rb'))
rslt2 = loaded_model.predict(img_pred)

print(rslt2)
```

```
185 if rslt2[0][0] == 1:
186   prediction1 = "Rotten_Apple"
187 else:
188   prediction1 = "Nice_Apple"
189
190 print(prediction1)
191
192
193
194 # <=========================================MODULE ENDS
    ==========================================>
195 # <=========================================MODULE
    3==========================================>
196
197 # <=========================================EDGE MODULE
    ==========================================>
198 # <=========================================MODULE STARTS
    ==========================================>
199
200
201 edges = cv2.Canny(img,600,600)
202 img = cv2.imwrite('a.jpeg', edges)
203 img_pred = image.load_img('D://college project/final year/22-04-2020/all
    integrated/a.jpeg',target_size=(150, 150))
204 img_pred = image.img_to_array(img_pred)
205 img_pred = np.expand_dims(img_pred, axis = 0 )
206
207 # load the model from disk
208 loaded_model = pickle.load(open("trainededge.sav", 'rb'))
209 rslt1 = loaded_model.predict(img_pred)
210 print(rslt1)
211
212 if rslt1[0][0] == 1:
213   prediction2 = "edge is not right"
214 else:
215   prediction2 = "Proper edge"
216
217 print(prediction2)
218
219
220
221 if (rslt2 + rslt1) + rslt1:
222   print("grade B")
223
224 else:
225     print("grade A")
226 # <=========================================MODULE ENDS
    ==========================================>
227 # <=========================================EDGE MODULE
    ==========================================>
228
229 # Wait for any key to close
230 while True:
231   k = cv2.waitKey(5) & 0xFF
232   if k==27:
233     break
234 # De-allocate any associated memory usage
235 cv2.waitKey(0)
236 cv2.destroyAllWindows()
```

6.2 Edge Detection

We will be detecting the edge with the canny edge detection.

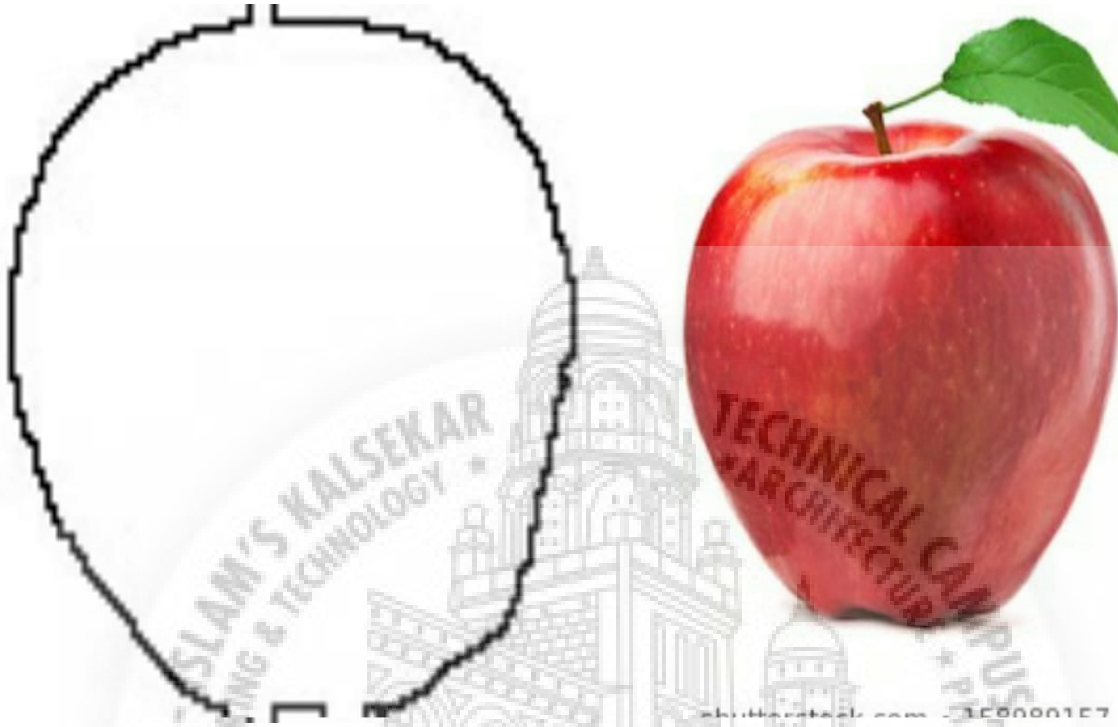


Figure 6.2: Edge Detection

```
from keras.preprocessing.image import ImageDataGenerator
from keras.models import Sequential
from keras.layers import Conv2D, MaxPooling2D
from keras.layers import Activation, Dropout, Flatten, Dense
from keras import backend as K
import numpy as np
from keras.preprocessing import image

import pickle


#dimensions of our images
img_width, img_height = 150, 150

train_data_dir = "D://college project/final year/22-04-2020/all integrated/edge/train"
validation_data_dir ="D://college project/final year/22-04-2020/all integrated/edge/test"
nb_train_samples = 2000
nb_validation_samples = 200
epochs = 80
batch_size = 40

if K.image_data_format() == 'channels_first':
  input_shape = (3, img_width,img_height)
else:
  input_shape = (img_width,img_height, 3)

train_datagen =   ImageDataGenerator(
```

```
  rescale=1. / 255,
  shear_range=0.2,
  zoom_range=0.2,
  horizontal_flip=True)

#This is the augmentation configuration we will use for testing:
#only rescaling
test_datagen = ImageDataGenerator(rescale=1. /255)

train_generator = train_datagen.flow_from_directory(
  train_data_dir,
  target_size= (img_width, img_height),
  batch_size=batch_size,
  class_mode='binary')

validation_generator = test_datagen.flow_from_directory(
  validation_data_dir,
  target_size=(img_width,img_height),
  batch_size=batch_size,
  class_mode='binary')


model = Sequential()
model.add(Conv2D(32, (3, 3), input_shape = input_shape))
model.add(Activation('relu'))
model.add(MaxPooling2D(pool_size= (2, 2)))

model.summary()

model.add(Conv2D(32, (3, 3)))
model.add(Activation('relu'))
model.add(MaxPooling2D(pool_size= (2, 2)))

model.add(Conv2D(64, (3, 3)))
model.add(Activation('relu'))
model.add(MaxPooling2D(pool_size= (2, 2)))

model.add(Flatten())
model.add(Dense(64))
model.add(Activation('relu'))
model.add(Dropout(0.5))
model.add(Dense(1))
model.add(Activation('sigmoid'))

model.summary()

model.compile(loss='binary_crossentropy',
              optimizer='rmsprop',
              metrics=['accuracy'])

#This is the augmentation configuration we will use for training

model.fit_generator(train_generator,
  steps_per_epoch= nb_train_samples // batch_size,
  epochs=epochs,
  validation_data=validation_generator,
  validation_steps=nb_validation_samples // batch_size)

model.save_weights('first_try.h5')

img_pred = image.load_img('D://college project/final year/22-04-2020/edges
```

```
    module/new/a.jpeg',target_size=(150, 150))
img_pred = image.img_to_array(img_pred)
img_pred = np.expand_dims(img_pred, axis = 0 )


# Save the trained model into pickle file i.e trained.sav
pickle.dump(model, open("trainededge.sav", 'wb'))

rslt = model.predict(img_pred)
print(rslt)
if rslt[0][0] == 1:
  prediction = "edge is not right"
else:
  prediction = "Proper edge"

print(prediction)
```

6.3 Color Module

If the Fruit is Rotten or Nice.

Figure 6.3: Deployment Diagram

```
from keras.preprocessing.image import ImageDataGenerator
from keras.models import Sequential
from keras.layers import Conv2D, MaxPooling2D
from keras.layers import Activation, Dropout, Flatten, Dense
from keras import backend as K
import numpy as np
from keras.preprocessing import image

import pickle


#dimensions of our images
img_width, img_height = 150, 150

train_data_dir = "D://college project/final year/22-04-2020/all integrated/module3/test"
validation_data_dir ="D://college project/final year/22-04-2020/all integrated/module3/train"
nb_train_samples = 1000
nb_validation_samples = 100
epochs = 40
batch_size = 20

if K.image_data_format() == 'channels_first':
  input_shape = (3, img_width,img_height)
else:
  input_shape = (img_width,img_height, 3)

train_datagen =   ImageDataGenerator(
  rescale=1. / 255,
```

```
  shear_range=0.2,
  zoom_range=0.2,
  horizontal_flip=True)

#This is the augmentation configuration we will use for testing:
#only rescaling
test_datagen = ImageDataGenerator(rescale=1. /255)

train_generator = train_datagen.flow_from_directory(
  train_data_dir,
  target_size= (img_width, img_height),
  batch_size=batch_size,
  class_mode='binary')

validation_generator = test_datagen.flow_from_directory(
  validation_data_dir,
  target_size=(img_width,img_height),
  batch_size=batch_size,
  class_mode='binary')


model = Sequential()
model.add(Conv2D(32, (3, 3), input_shape = input_shape))
model.add(Activation('relu'))
model.add(MaxPooling2D(pool_size= (2, 2)))

model.summary()

model.add(Conv2D(32, (3, 3)))
model.add(Activation('relu'))
model.add(MaxPooling2D(pool_size= (2, 2)))

model.add(Conv2D(64, (3, 3)))
model.add(Activation('relu'))
model.add(MaxPooling2D(pool_size= (2, 2)))

model.add(Flatten())
model.add(Dense(64))
model.add(Activation('relu'))
model.add(Dropout(0.5))
model.add(Dense(1))
model.add(Activation('sigmoid'))

model.summary()

model.compile(loss='binary_crossentropy',
              optimizer='rmsprop',
              metrics=['accuracy'])

#This is the augmentation configuration we will use for training

model.fit_generator(train_generator,
  steps_per_epoch= nb_train_samples // batch_size,
  epochs=epochs,
  validation_data=validation_generator,
  validation_steps=nb_validation_samples // batch_size)

model.save_weights('first_try.h5')

img_pred = image.load_img('D://college project/final year/22-04-2020/all
    integrated/1.jpg',target_size=(150, 150))
```

```
img_pred = image.img_to_array(img_pred)
img_pred = np.expand_dims(img_pred, axis = 0 )


# Save the trained model into pickle file i.e trained.sav
pickle.dump(model, open("trained.sav", 'wb'))

rslt = model.predict(img_pred)
print(rslt)
if rslt[0][0] == 1:
  prediction = "rotten_apple"
else:
  prediction = "Nice_apple"

print(prediction)
```

Chapter 7

System Testing

7.1 Test Cases and Test Results

Test ID	Test Case Title	Test Condition	System Behavior	Expected Result
T01	Camera	Captures	Captures the image of fruits	Successful
T02	Keras	Neural Network	Neural Network	Executed
T03	Tensorflow	Library	Library we use	Work Fine

7.2 Sample of a Test Case

Title: Login Page – Authenticate Successfully on gmail.com
Description: A registered user should be able to successfully login at gmail.com.

Precondition: the user must already be registered with an email address and password.

Assumption: a supported browser is being used.

Test Steps:

1. Navigate to gmail.com
2. In the 'email' field, enter the email of the registered user.
3. Click the 'Next' button.
4. Enter the password of the registered user
5. Click 'Sign In'

Expected Result: A page displaying the gmail user's inbox should load, showing any new message at the top of the page.

Actual Result:

Write here description
upload the image of result

7.2.1 Software Quality Attributes

1. AVAILABILITY :-The system should not be down, Whenever the user uses the system the specific data should be available to the user.
2. CORRECTNESS :-As the system tags the object present in image should be satisfied by the user. If user is searching for an image so system should provide relevant image.
3. MAINTAINABILITY :- The administrator will manage and maintain the database of the system. He will also maintain the user data.
4. EXTENSIBILITY :-The system is capable of being modified by changing some modules or by adding some features to the existing system.

Chapter 8

Screenshots of Project

8.1 Sorting and Grading

8.2 Edge Detection

Chapter 9

Conclusion and Future Scope

9.1 Conclusion

Our system will provide an Automatic Fruit Grading System , which will save time, effort and provide better accuracy than the Manual Sorting.The techniques contains, the Color Detection and Edge Detection.Color Detection is used to identify the defected part with the Threshold level.Edge Detection is used for finding the boundaries of objects within images.Our System consists of Mechanical Part such as DC motor,Arduino, Computer and Software such as image processing in Python using OpenCV.We are going to design this System to meet the demands in Grading Fruits operation compared to manual grading.

In our System, we have one Important Module which is GRADING Module in which we have two sub Modules A)Color Module and B)Shape Module.The Color Module is further divided into RGB and Gray-Scale. In Color Module we will Capture an Image it will detect the number of Pixels of RGB an image is having by using the Threshold. In shape Module we will be focusing on the Edges of the Fruits so that we can get the accurate shape of the Fruit.These is how our system is going to work and will provide the Best Image. In addition, since there will have some kind of fruits with same color such as Tomato and apple so, there will be having some misclassificaton.

9.2 Future Scope

In Future we can enhance the work by making is all by manual free with the help of robot and machines which will make the work more efficient and accurate.

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Achievements

1. Publications
   (a) *Grading and Sorting of Fruits Based on Image Processing*; Ashraf Shaikh,Aasim Sayyed,Mehvash Shaikh,Iconic Research And Engineering Journals, 27-01-2020 of published (https://irejournals. com/paper-details/1701868)
2. Project Competitions
   (a) *Grading and Sorting of Fruits Based on Image Processing*; Ashraf Shaikh,Aasim Shaikh,Mehvash Shiakh, 6th National Level Project Exhibition cum Poster Presentation , 13 March and 2020 of attend(Venue : Universal College of Engineering, Vasai,Palghar-401208.)

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(Campus Director)

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Grading and Sorting Of Fruits Based On Image Processing

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Abstract- ***In recent years, automated machine vision based technology has become more potential and important in many areas like agricultural sector and Food Processing Industry. Sorting and Grading of the fruit is one of the most important process, but this procedure is mostly carried out manually which is not efficient as it tends to human error.An automatic fruit quality inspection system helps in speed up the process improve accuracy and efficiency and reduce time. The Grading process is carried out by capturing the fruit image using camera and this image is interpreted using image various processing techniques.The sorting process is done by sorting the fruits based on Color and Shape parameters. Then image processing is done Defected fruit is detected Size detection is based on binary image of Fruit Sorting is done based on color and grading is done based on size.***

The Main aim of the proposed system is to Sort and Grade the variety of Fruits by implemented Image Processing Techniques.By using Image Processing Techniques we can make the the sorting and grading process more efficient than the manual work.It will improve the quality as well as it will take less time.

Indexed Terms- Fruits, Arduino, Software, Python, Open CV, Contours, Robotic Arm, Rally, Image Processing,Edge Detection,Color Detection,Canny edge Detection, Neural Network, Camera.

I. INTRODUCTION

To design and develop an algorithm for fruit classification based on shape and color.Classification based on Shape and Color will help to provide the perfect sorting and grading of fruits.To evaluate the system performance for fruit sorting and classification in term of accuracy and precision.As their are many manual system available in market but it much more time consuming then the Automated System. To optimize the system performance by manipulating the illumination, thresholding value and distance of camera.The Threshold value plays an important role for the Color Module for RGB where we will take average of R,G,and B and for shape the Edge Detection will provide proper shape and size of a fruit. In this paper we are using different types of Fruits like Apple, Orange, Strawberry, and so on.The quality of the fruits is important for the customers and become the requirements from the supplies to provide fruits with high quality.The grading are considered as the most important step to achieve the high quality standards.Generally , the fruits quality depends upon parameter such as SIZE, COLOR, SHAPE, and INTENSITY, but Color and Size is the most important factor for Grading and Sorting of fruits.Color is very important in the sorting of fruits but due to the similarity of colors between some of the fruits, the size also help in solving problems.Different types of algorithm and classifier are available to extract features of the fruits so that we can provide the exact result about the fruits

II. LITERATURE REVIEW

A. Orange Sorting by Applying Pattern Recognition on Colour Image.

The objective of this paper is to provide Automated Grading based on Pattern Recognition.This paper proposes the research work for automated grading of Oranges using pattern recognition techniques applied on a single color image of the fruit. This research is carried out on 160 Orange fruits collected from varied geographical locations in Vidarbha Region of Maharashtra. System designed can automatically classify an Orange fruit from this region, given its single color image of 640 480 pixel resolution, taken inside a special box designed with 430 lux intensity light inside it, by a digital camera.Only 4 features are

used to classify oranges into 4 different classes according to the maturity level and 3 different classes as per size of oranges.

- Weaknesses: Blue color is least significant hence can be neglected.
- How to Overcome: We will use this information and make a system which will predict the size of fruits.

B. Automated Sorting and Grading of Vegetables using ImageProcessing Description.

The computer vision based system for automatic grading and sorting of agricultural products like strawberry and brinjal based on maturity level is presented in this paper. The application of machine vision based system, aimed to replace manual based technique for grading and sorting of fruit and vegetable. The manual works obtained problems in maintaining consistency in grading and uniformity in sorting.To speed up the process as well as maintain the consistency, uniformity and accuracy, a prototype computer vision based automatic grading and sorting system is developed. The proposed method is implemented bykmeans clustering segmentation and color detection process with strawberry and brinjal.Feature extraction for various features like Entropy, Mean and standard deviation are calculated. The main aim of the proposed system is to sort and grade the variety of vegetables like strawberry and brinjal is implemented using image processing techniques.

- Weaknesses : It has used various maturity level
- How to Overcome: We will use this information and make a system which will provide more accuracy.

C. Automated Fruit Grading System.

The quality of the fruits is important for the consumers and become the requirement from the suppliers to provide fruits with high standards quality.So, in the past few years, fruit grading systems have established to fulfil the needs of the fruit processing industry inspection. Besides that, the process of fruits involves several steps that can generally be classified into grading,sorting, packaging, transporting and storage. The grading are considered as the most important steps towards the high standard of quality. Two kinds of fruits have been inspected in this project; namely are apple and mango.A prototype of an automated fruit grading system is designed and developed in this paper to detect the defects on of the surface of fruits.The system is capturing the fruit's image using camera and the fruits are placed onto of a rotating desk.

- Weaknesses: Capturing of fruit and Focusing on fruit.
- How to Overcome: We will use this information and make a system where we will avoid the light so to get the perfect image of the fruit.

III. SURVEY ON EXISTING SYSTEM

In this research is carried upon, the classification of the fruits based on the types of defects. Two types of fruits are being chosen for this project that are apple and mango. Then, mangoes are divided into two groups that are ataulfo and normal mango. Apples are divided into two groups also that are winesap and normal apple. Firstly, the camera captures the image of the surface of fruits and will analyze the types of defects of the fruits. The system was tested by using a samples of apples and mangoes. Firstly, the fruit is brought manually to the rotating desk which is connected to the shaft of the 12V DC motor. The DC motor is then set by Arduino to rotate 180° twice for each of the fruits in order to be able to detect the defects of the whole lateral surface of fruits. Then, the camera will capture the image and show the analyzed image at the Graphical User Interface (GUI). We can then observe

Fig. 1. System setup

the surface defects and decay of fruits through GUI. This system consists of mechanical part such as rotating desk that act as a place for inspection;

electrical parts such as DC motor, Arduino, computer and software such as image processing in OPENCV. after fabrications. In this project, camera from laptop is positioned to detect the lateral surface of the fruit. The sample of fruits are brought to the rotating desk for grading. The DC motor is used to rotate the desk which allow the camera to capture the lateral surface of the fruits

A. Equations

The DC motor required for rotating desk holding fruits has to be chosen based on the following considerations:

- Maximum weight of fruit sample is considered to be less or equal to 1.0kg
- Weight of rotational desk is = 0.3kg
- Torque of DC motor= 0.784N.m
- Weight of fruit sample + weight of rotating desk = 1.0kg
- + 0.3kg
- Radius of DC-Motor = 1.8cm

Torque needed to turn the rotating desk and sample of fruit

$=1.8cmx1.3kg = 2.34kgcm = 2.34kgcmx_{\gamma} = 0.23N.m$ (1)

IV. PROPOSED SYSTEM

In our system, we are going to work on both the software as well as hardware. Our system will help to provide the Grading and Sorting of fruits based on parameters (size, color, shape, intensity) we have two most important module 1.Grading Module, 2.Sorting Module

The Following Sorting Module is divided in two sub parts: RGB Module and Gray Scale Module.

RGB Module: In the RGB model, an image consists of three independent image planes, one in each of the primary colours: red, green and blue. Specifying a particular colour is by specifying the amount of each of the primary components present.

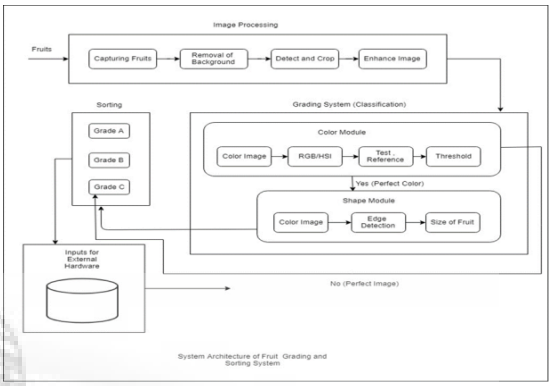

Fig. 2. System Architecture

Gray Scale Module: A gray scale (or graylevel) image is simply one in which the only colors are shades of gray. The reason for differentiating such images from any other sort of color image is that less information needs to be provided for each pixel. In fact a 'gray' color is one in which the red, green and blue components all have equal intensity in RGB space, and so it is only necessary to specify a single intensity value for each pixel, as opposed to the three intensities needed to specify each pixel in a full color image

The Following Grading Module is Shape Module.

Shape Module: In Shape Module, the important detection is an Edge Detection from which we can get the accurate shape of the Fruits.In edge detection, we find the boundaries or edges of objects in an image, by determining where the brightness of the image changes dramatically. Edge detection can be used to extract the structure of objects in an image detection uses an approach where the intensity variations occur in the image points is declared as the edge. It is a series of actions used to identify the points in an image where clear and defined changes occur in the intensity. This series of action is necessary to extract the image related information e.g. image sharpening, enhancement and object location present in the image

ALGORITHM: Color Detection Algorithm

- Step 1: Start.
- Step 2: Read the input color image using imread function.

- Step 3: Read the input pixel of color image in three different planes (RGB) and store it into three variable r,g and b.
- Step 4: Read the small region of fruit to detect color of fruit.
- Step 5: Store in different variable r1, g1, b1.
- Step 6: Calculate the mean of r1, g1, b1 and store into variable r2, g2, b2.
- Step 7: Compare the value with Threshold.
- Step 8: if g2¿threshold, Color detected is green.
- Step 9: if r2¿threshold, Color detected is red.
- Step 10: END.

V. HARDWARE MODULE

Irrespective of any reference papers, we thought of something new which can be implemented using some old methods which we can say re usability in terms of power. As you can see in the above image of our hardware section, we are using multiple motors in our project not just because of the main function but also to generate energy from the previously used energy. As we know Electricity can be generated by using magnetic flux and dc motor already contains the magnet and the magnetic flux Hence when one motor is rotated the rotation

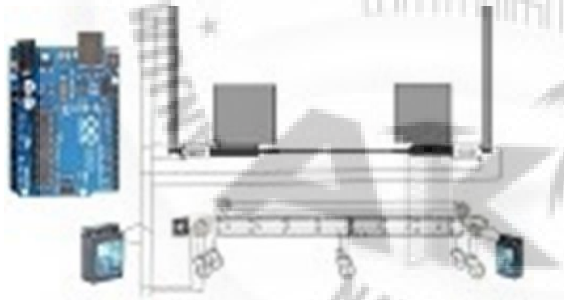

Fig. 3. Hardware Setup.

part is connected to another motor which makes it rotates too and this rotation initiates the magnetic flux by which energy is generated and this energy can be later used in the project, looking it as an industrial perspective the machines can still run even when there is no Electricity. And it also decrease the power consumption.

VI. CONCLUSION

Our system will provide an Automatic Fruit Grading System, which will save time, effort and provide better accuracy than the Manual Sorting. The techniques contains, the Color Detection and Edge Detection. Color Detection is used to identify the defected part with the Threshold level. Edge Detection is used for finding the boundaries of objects within images. Our System consists of Mechanical Part such as DC motor, Arduino, Computer and Software such as image processing in Python using Open CV. We are going to design this System to meet the demands in Grading Fruits operation compared to manual grading.

In our System, we have one Important Module which is GRADING Module in which we have two sub Modules A)Color Module and B)Shape Module. The Color Module is further divided into RGB and Gray-Scale. In Color Module we will capture an Image it will detect the number of Pixels of RGB an image is having by using the Threshold. In shape Module we will be focusing on the Edges of the Fruits so that we can get the accurate shape of the Fruit. These is how our system is going to work and will provide the Best Image. In addition, since there will have some kind of fruits with same color such as Tomato and apple so, there will be having some misclassification

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