# Fruit Maturity Detection using Matlab image processing

## Project Report

*Submitted in partial fulfillment of the requirements for the degree of*

## Bachelor of Technology

in

## Electronics and Communication Engineering

*by*

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**Under the guidance of**

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**SENSE**

**VIT, Vellore.**


May, 2020

# DECLARATION

I hereby declare that the thesis entitled "Fruit Maturity Detection Using Matlab Image Processing" submitted by me, for the award of the degree of *Bachelor of Technology in Electronics and Communication Engineering* to VIT is a record of bonafide work carried out by me under the supervision of Dr.Ravi Kumar C V.

I further declare that the work reported in this thesis has not been submitted and will not be submitted, either in part or in full, for the award of any other degree or diploma in this institute or any other institute or university.

Place : Vellore

Date:15/4/2020

**Signature of the Candidate**

B.DeviPrasanna(16BEC0914)

Bokka Sampreethi(16BEC0875)

# CERTIFICATE

This is to certify that the thesis entitled "Fruit Maturity Detection Using Matlab Image Processing" submitted by B.Devi Prasanna (16BEC0914) & Bokka Sampreethi (16BEC0875), **SENSE**, VIT University, for the award of the degree of *Bachelor of Technology in Electronics and Communication Engineering*, is a record of bonafide work carried out by him under my supervision during the period, 10. 12. 2019 to 30.05.2020, as per the VIT code of academic and research ethics.

The contents of this report have not been submitted and will not be submitted either in part or in full, for the award of any other degree or diploma in this institute or any other institute or university. The thesis fulfills the requirements and regulations of the University and in my opinion meets the necessary standards for submission.

Place : Vellore

Date :

**Signature of the Guide**

**Internal Examiner**

**External Examiner**

Thanikaiselvan V

SENSE

# ACKNOWLEDGEMENTS

At the outset, we shall present our sincere gratitude to our guide,
Dr.Ravi Kumar C.V whose invaluable support and assistance has been the primary reason for successful completion of this work. Without his constant guide at every step, this endeavor would have remained a distant dream. We could also acknowledge the help of other faculty and students as a collective, who albeit not directly involved, had set in forth a series of positive increments in our academic growth in college, which culminated in our pursuit of this project. Lastly, but no less importantly, we would thank the authors of the innumerable papers and books that we had to peruse in order to carry this thesis through to the end.

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# Executive Summary

The ability to identify the fruits based on quality in food industry which is most important technique and the realization of automatic fruit sorting machine in order to reduce the work of human and also time consuming. Automatic methods of the classification of a ripen and unripen fruits helps the food industries for the export of fruits to the various places. An effective classification approach based on Support Vector Machine (SVM) algorithm for early fruit maturity detection .The dataset contains 24 samples of strawberry with four stages of maturity level. Gabor wavelet scheme based on SURF knuckle print recognition is used to get the better accuracy of extracted pictures. Color information is actively used for fruit ripening process. In our model, the filters are applied to three channels based on k means clustering layer. The experimental results validate that the proposed method effectively recognizes different types of fruits. This project provides the percentage of fruit maturity in the yield using Gabor wavelet and SVM technique.

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# List of Abbreviations

| | |
|---|---|
| GLCM | Gray level co-occurrence matrix |
| SVM | Support Vector Machine |

# 1. INTRODUCTION

## 1.1 Objective:

Agriculture is one of the biggest economic sectors and it plays the significant job in economic development of our nation. In our nation the ever-expanding population, misfortunes associated with preparing and the expanding request of products of high quality with great appearance, there is a requirement for the development of accurate, quick and focused quality determination of food and agrarian items like fruits and vegetables. While evaluating is done dependent on the general quality highlights of a fruits by thinking about
various traits like shape, size, shading and so forth. Association is important for the quality assessment of developed produce like fruits and vegetables. Fruits play an important role in keeping the body healthy and have a few advantages. Fragrance and taste of the fruits are determined by its development level. Owing to lack of storage facilities in developing nations like India, gigantic amount of fruits is wasted. Subsequently, there ought to be a strategy to decide the development level of collected harvest. Gathered fruits are regularly expended following 4 to 5 days of timespan. A few number of fruits must be expended inside brief timeframe period where as some assortment of fruits can be devoured following 10 days in the wake of reaping. Damage present in the fruits may likewise fluctuate dependent on fruits . A damage is perceptible to unaided eye though nuisance or bug harm may not be obvious to unaided eye. Manual picking of products of the soil them as indicated by development and damage done might be tedious and may not get ready for sending fruits to customer inside stipulated time. Thinking about these elements preprocessing techniques can be applied to decide development and recognizing damage done. Organic product development location has numerous strategies. Picture handling and sensor-based strategies are most famous at this point. In this paper we are utilizing picture handling method utilizing MATLAB.

Fruit is grown as it is has many vitamins and necessary nutrients for human bodies .Fruits, commonly consumed in daily diets, are a major source of anti-oxidants. There are a seasonal fruits and their availability is limited during certain seasons. Fruits find numerous uses in both fresh and processed forms. Processed forms include jam, paste and juice. Export of these processed products of fruits yield more income for the country.

To overcome this problem, image processing method in industries has to become a major issue in recent years. Using MATLAB software as a tool in image processing.

We can find the quality of Fruits using various algorithms. Finally after collecting lot of trained data bases, we have proposed certain range. With these ranges we can identify the quality of Fruits, whether it is ripen or not. `

This evaluating framework primarily includes of some reenactment procedure to actualize implement image pre-processing, Histogram equalization, Color detection, segmentation, extracting grading characteristic, desktop application of the project is developed using MATLAB GUIDE. The Image noise is characterized as unmistakable pixels which are not comparative in appearance with the neighborhood pixels. Over segmentation happens for the most part because of essence of the noise and insignificant fluctuation which produces non real minima. In preprocessing stage noise impact is expelled from unique picture to make it smooth. That noise can be removed with the help of filters

like median filter, Wiener channel and Adaptive channel. After the preprocessing subsequent stage is to execute the histogram adjustment. Segmentation process was finished by implies bunching division. characterization was finished by different features like entropy, standard deviation and mean dependent on the development level of fruits.

## 1.2 Motivation:

Agriculture is a field which has undergone constant and rapid changes. These changes are often attributed to newer farming techniques, impact of technology and the way farmers view farming. Often changes in the outlook of the society also influence farmers to adopt new and improved farming methods which are sustainable. Conventional farming practices due to certain deficiencies are paving the way for organic farmers. The study explores the different motivating factors which influence the farmers to switch from conventional farming to organic farming methods which are sustainable. Factors such as concern for the environment, moral and social responsibility, and economic considerations are studied through a qualitative research method. One of the most fertile belts of Central Kerala has been taken for this study.Results show that subjective norms have less impact on any farmer who chooses to switch, and that farmers give high importance to soil health and soil fertility than the moral, economic and social concerns. Contrary to a widespread belief,

farmers also suggest that cost of farming has very little influence on them when they chose organic farming over conventional farming. This paper further explores certain unexpected results like the influence of the nature of crops and demand in the motivation to switch.

## 1.3 Background:

Agriculture is a key source of livelihood. Agriculture provides employment opportunities for village people on large scale in developing country like India. India's agriculture is composed of many crops and according to survey nearly 70% population is depends on agriculture. Most of Indian farmers are adopting manual cultivation due to lagging of technical knowledge. Farmers are unaware of what kind of crops that grows well on their land. Farming Systems in India are strategically utilized, according to the locations where they are most suitable. The farming systems that significantly contribute to the agriculture of India are subsistence farming, organic farming, and industrial farming. Regions throughout India differ in types of farming they use; some are based on horticulture, ley farming, agroforestry, and many more. Due to India's geographical location, certain parts experience different climates, thus affecting each region's agricultural productivity differently. India is very dependent on its monsoon cycle for large crop yields. India's agriculture has an extensive background which goes back to at least 9 thousand years.

## REVIEW OF RELATED LITERATURES

### A.Volume and maturity of fruit lime

In year 2015 , an IEEE paper on Estimation of volume and development of sweet lime organic product utilizing picture handling calculation was approved by Poshit Raj Gokul, Shoraya Raj, Poornapushpakala Suriyamoorthi. This paper depicts picture handling strategies to perceive volume and development of sweet lime fruit[1]. Volume of the sweet lime is resolved with the assistance of sweep of foods grown from the ground of sweet lime is resolved with the assistance of RG proportion.

### B.Fruit maturity detection using neural network and odour sensor

In year 2015, an IEEE paper on Fruit development location utilizing neural system and odour sensor was approved by Hiroshi Kinjo, Naoki Oshiro and Sam Chau Duong[2]. This paper portrays the idea of odour sensor to distinguish development of maturity of fruit. This paper presents brisk development identification strategy in less time utilizing the rising sign of odour sensor arrange.

### C.Fruit grading utilizing external appearances

Choi et al[3] has utilized picture handling technique with ccd camera for preparing the shade of natural product pictures. Shade of natural product shading picture is utilized for preprocessing, division for surrenders discovery. Close to Infrared spectroscopy has been utilized for estimating inside characteristics of organic product. Developed natural products have high assimilation rates contrasted with ready organic products. Size, shape and volume of organic products likewise has

been taken by the creator. A superior precision in the yield is accomplished.

**D.Fruit maturity recognition using direct colour mapping**

In year 2011, an IEEE paper on, "Rapid Color Grading for Fruit Quality Evaluation Using Direct Color Mapping," was approved by lee,Archibald and xiong[4]. This paper portrays the grading of organic product is identified utilizing colour evaluating thresholds .in this paper they have utilized pre-chosen shades important to figure one of a kind set loads for shading transformation.

**E. Orange reviewing framework utilizing choice tree order.**

Wajid et al[5] has gathered RGB colour pictures of oranges. Water shed strategy has been utilized to section the pictures to give more pixilation for better outcomes. Arrangement techniques, for example, credulous bayes, neural system and choice tree have been looked at. Choice tree grouping has given an accuracy of 93%

**F. Maturity reviewing of peach organic products**

Matteoli et al [6]recognized evaluating of organic products development by utilizing the solidness dependent on the tissue of natural product by methods for multivariate recovered techniques accomplished with spectrometer and has treated them with a development fluffy classifier. Fiber optic spectrometer is utilized for estimating reflectance from the fruits. Fluffy logic classifier is utilized to characterize final stage.

**G. Apple reviewing technique dependent on feature combination**

Weixing Zhu , et.al [7](2011) has anticipated the grading apples upheld its element i.e., fusion of size, structure and colour. during this paper, Background Propagation (BP) neural system and Dempster Shafer (D-S) critical hypothesis ought to improve the accuracy of the grading of apples. BP organize classifier is utilized to develop the principal probability task (BPA) by joining the classifiers yields. At long last, D-S combination ought to be acclimated succeed a definitive grading result. it's a great

deal of higher reviewing than single element extraction.

## PROJECT DESCRIPTION AND GOALS

### MATLAB:

MATLAB (matrix laboratory) is a multi-paradigm numerical computing environment and proprietary programming language developed by Math Works. MATLAB allows matrix manipulations, plotting of functions and data, implementation of algorithms, creation of user interfaces, and interfacing with programs written in other languages. Although MATLAB is intended primarily for numerical computing, an optional toolbox uses the MuPAD symbolic engine allowing access to symbolic computing abilities. An additional package, Simulink, adds graphical multi-domain simulation and model-based design for dynamic and embedded systems. MATLAB users come from various backgrounds of engineering, science, and economics.

MATLAB helps you take your ideas beyond the desktop. You can run your analyses on larger data sets, and scale up to clusters and clouds. MATLAB code can be integrated with other languages, enabling you to deploy algorithms and applications within web, enterprise, and production systems.

**Advantages**

- Develop the computational codes easily.
- Debug easily.
- Use a large database of built in algorithms.
- Process still images and create simulation videos easily.
- Call external libraries.
- Perform extensive data analysis and visualization.

**APPLICATIONS:**

- **General Applications**

  Example models illustrating general applications

- **Automotive Applications**

  Model and simulate automotive systems using Simulink® and other MathWorks® products

- **Industrial Automation Applications**

  Example models illustrating industrial automation applications

- **Signal Processing**

  Model signal processing and communications systems using DSP System Toolbox™ software

## EXISTING SYSTEM

In existing system, the picture preprocessing process is utilized to make the pictures into resized to diminish the color file. the obtained picture is in RGB format which is a real color format for a picture. In the Feature Extraction Stage, two feature extraction techniques are utilized. The first concentrates the shape and color features. While, the subsequent component extricate technique utilizes the Scale Invariant Feature Transform (SIFT). In the Classification Stage the calculation utilized is the Random Forests (RF) algorithm to classify the fruit picture so as to perceive its name. In the current strategy the methods utilized are:

1)SIFT highlights.
2) Random Forest (RF).

**Disadvantages of existing framework are**: Feature extraction strategy isn't accurate algorithm won't predict it accurately.

**PROPOSED SYSTEM :**

In the proposed framework we use support vector machine (SVM)[10], for compelling arrangement of fruits. The proposed algorithm uses:1) K-means clustering[9]. 2) Gabor wavelet[11].3)support vector machine (SVM). In preprocessing stage, the picture color record is diminished. The noise is removed using median filter. Then the images are processed using k-means clustering. At that point the pictures are processed using k-means clustering. the clustered picture is utilized in the feature extraction. In the feature extraction we use speeded up robust feature algorithm based plan, called Gabor wavelet is utilized to improve accuracy in less range of time. Gabor wavelet gives an exactness of 97% in the yield. Order is finished utilizing SVM.

The advantages of this prosed framework are:

- Based on k-implies clustering, segmentation and arrangement can be effectively performed. Thus time utilization will be less.

- SVMs are a lot quicker than multilayer perceptron systems and accurately predict target likelihood score.

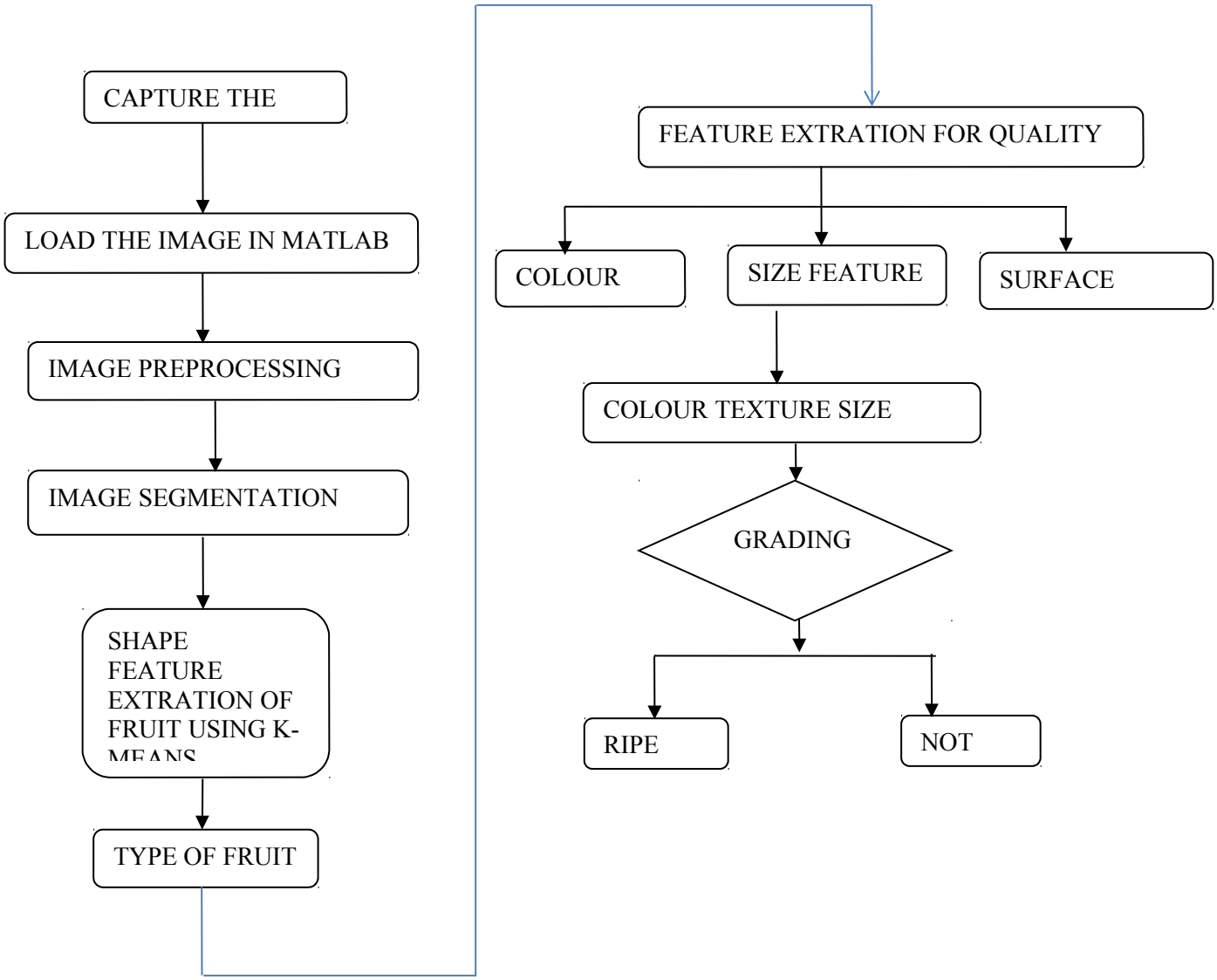
**PROPOSED ALGORITHM:**

- **K-Mean Clustering**
- **GLCM**
- **SVM**

**ADVANTAGES:**

- Based on k-means clustering the segmentation and classification can be easily performed. Hence time consumption will be less.
- SVMs are much faster than multilayer perceptron networks and accurately predict target probability score.

## FLOW CHART

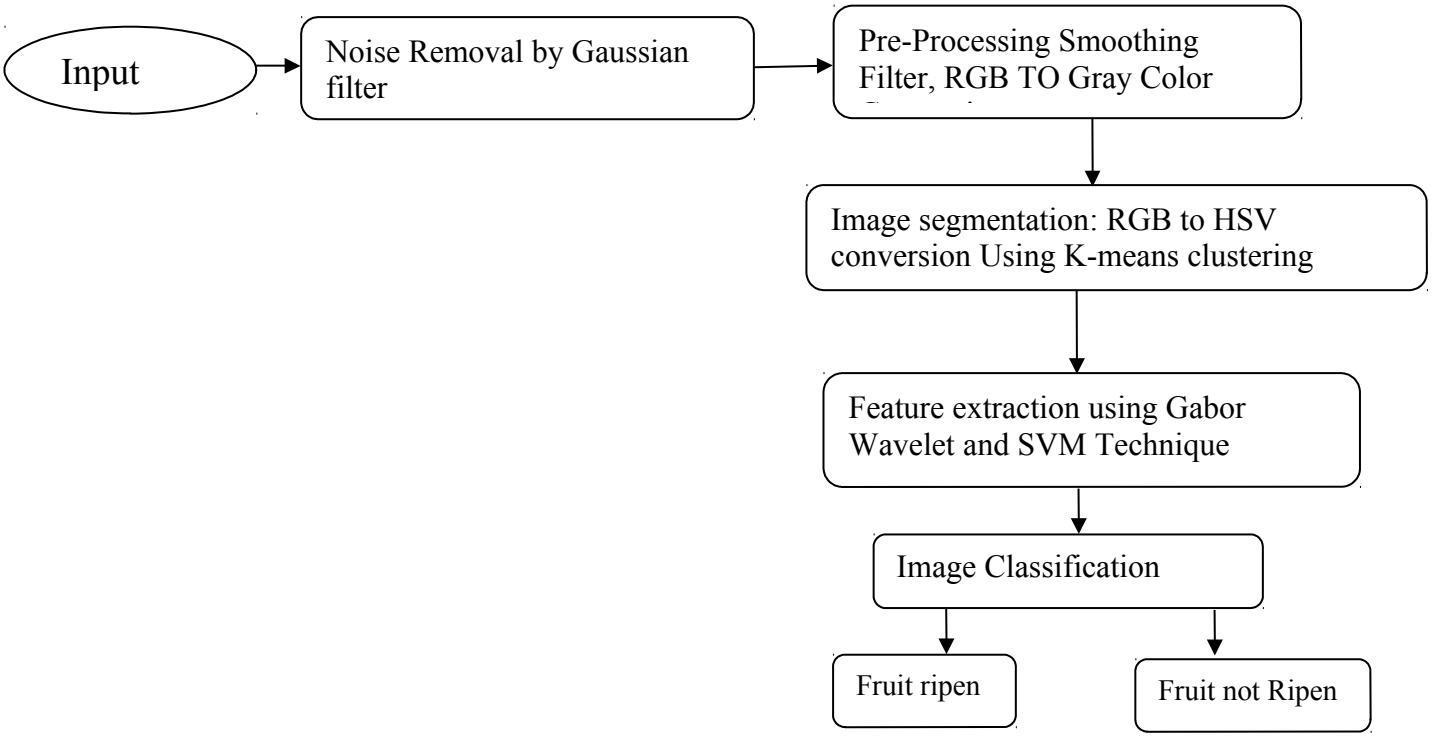



**Flow chart for the Fruit Ripening detection using MATLAB**

## TECHNICAL SPECIFICATION

**PROPOSED CONCEPTS:**

- **Image Clustering**
- **K-Mean Clustering**
- **Gabor Wavelet and SVM**



# DESIGN APPROACH AND DETAILS

## 4.1 Design Approach / Materials & Methods

### A. IMAGE ACQUISITION

In this step the image is given as the input to the system. The input can be of any popular format. Normally any input image has lot of noise associated with them.

### B. IMAGE PREPROCESSING

In this rule, Image noise is characterized as distinct pixels which are not comparative in appearance with the neighborhood pixels. Over segmentation happens principally because of quality of the noise and unimportant fluctuation which produces non real minima. The pre-processing stage is to smooth the original picture by removing the noise effect and upgrade the picture quality of the fruit, using median filter. Median filter is very effective and robust than mean or average filters in light of the fact that an single unrepresentative pixel esteem in neighborhood influences less to the median value. This Median channel gives perhaps the nearest values as an output pixel and consequently it doesn't make new impractical values close to the edges and preserves sharp edges.

The fundamental techniques discovered are,

1. RGB to gray conversion.
2. Binary conversion.
3. Noise reduction.
4. Contrast stretching
5. Histogram equalization
6. Background elimination.

## C. IMAGE SEGMENTATION

Picture division is the way toward making picture into numerous sections. In this procedure Means clustering division is used. The reason for K-means clustering segmentation is segmenting the defected part of fruits and good part of fruits then find the mean of each cluster.

### i) K MEANS CLUSTERING

K-Means is a least-squares subdividing strategy that isolates an collection of objects into K groups. The algorithm repeats more than two stages:

1. Calculate the mean of each cluster.
2. Calculate the separation of each point from each cluster by calculating its good ways from the relating cluster mean. Allocate each point to the cluster it is closer to.
3. Repeat over the over two stages till the summation of squared inside gathering mistakes can't be brought down any longer. The over three stages were executed to fruits by utilizing image processing method.

**Procedure of K-Means Algorithm:**

1. The informational collection ought to be isolated into K number of clusters and data points need toward be apportioned to every one of these clusters haphazardly.
2. The good ways from data point to each cluster is determined using Euclidean separation which is only the separation between two-pixel points and is given as follows: Euclidean Distance=$\sqrt{((x1-x2)^2 + (y1 - y2)^2)}$ where (x1, y1) and (x2, y2) are two pixel points.
3. The data point which is closer to the cluster to which it has a place with ought to be left for what it's worth.
4. The data point which isn't close by to the cluster to which it has a place with ought to be then moved to the close by cluster.

5. Repeat all the above strides for whole data points. 6. When the clusters are steady, clustering process should be halted.

**FEATURE EXTRACTION:**

The element extraction is used to quantify the development level and influenced some portion of fruits. Feature extraction is a system of capturing visual substance of a picture of fruit. Feature extraction system is to speak to crude picture in its diminished structure to advance the dynamic procedure, for example, design clasiffication. Entropy, Mean and Standard deviation are used to separate slope includes in. A component is extricated so as to permit a classifier to recognize infected part, riped fruit and not riped fruits. Various features are separated from this procedure and essentially used features are:
Shape. 2. Size. 3. color. 4. Texture.

**GABOR WAVELET:**

In this feature extraction we use Gabor wavelet system to show signs of improvement accuracy in the output picture. A Scheme dependent on (SURF) Speeded up Robust Features algorithm was proposed using knuckle print recognition. The outcomes indicating the recognizable proof taking normal time of 0.106s which is less time yet giving a accuracy of 97%.

It is based on SURF knuckle print recognition is used to get the better accuracy of extracted pictures. A preprocessing stage using picture dealing with to set up the fruit product pictures dataset to diminish their shading document is presented. The fruit picture features are then extracted.

Texture features are using on the different wavelet strategies. Wavelet conversion is one of the most famous techniques used for the time-frequency transformations. The wavelets transform decomposes an into signal into low frequency and high frequency component utilizing a filter. Wavelets can be separated into various basic functions for picture compression and recognition. Gabor wavelet used to various techniques however improve the effectiveness of low and nature of

various pictures in Gabor.

**SUPPORT VECTOR MACHINE:**

- The binary classifier that utilizes the hyper-plane that is likewise called as the choice limit between two of the classes is called as Support Vector machine (SVM).

- Some of the issues of pattern recognition like texture classification, uses of SVM. Mapping of nonlinear input data to the direct information gives better classification in high dimensional area in SVM.

- The marginal distance is maximized between entirely different categories by SVM. Entirely different kemels are used to partition the categories. SVM is a binary classifier that decides the hyper plane in partitioning two categories.

- The boundary is maximized between the hyper plane and furthermore two categories. The samples that are closest to the margin are chosen in choosing the hyper plane are known as support vectors.

- In order to recognize the ripening stage of banana based on the values of L*, a* and b*, support vector machine (SVM) acted as classification method. SVM was a set of supervised learning method that analyzes data and recognizes patterns. SVM was an especially useful method for data classification. An SVM model was a representation of the examples as points in space, mapped so that the examples of the separate categories are divided by a clear gap that was as wide as possible. The standard SVM took a set of input data, and predicted, for each given input, which of two possible classes comprises the input, making the SVM a non-probabilistic linear classifier.
- SVM was one of the most robust and accurate methods. For a two-class linearly separable learning task, SVM can found a hyper plane that could

separate two classes of given samples with a maximal margin.

- Multiclass classification is likewise done, either by using one-to-one or one-to many. The maximum output capacity function will be chosen as the winning category.

- This SVM classification is a lot quicker than multilayer observation and gives an accuracy of 97%.

**4.2 Codes and Standards:**

```
opengl('save','software')
clc;
close all;
clear all;
%choose the file to be processed
[filename,pathname] = uigetfile({'*.jpg;*.bmp;*.png'},'Select file');
% Read the image
I = imread([pathname,filename]);
% Resize the image for simpler computation
I = imresize(I,[640 640]);
figure,imshow(I);
title('Input Image');
% Find the size of the input image
[m n o] = size(I);
% If the input is RGB convert it to Grayscale
if o == 3
   gray = im2double(rgb2gray(I));
else
   gray = im2double(I);
end
% Preprocessing Stage : Removing the noise
filtering = medfilt2(gray);
```

```
figure,imshow(filtering);
title('Noise Removed Image');
% Image enhancement
enhancement = imadjust(filtering);
figure,imshow(enhancement);
title('Enhanced Image');
  %Segmentation
cform = makecform('srgb2lab');
lab_he = applycform(I,cform);

ab = double(lab_he(:,:,2:3));
nrows = size(ab,1);
ncols = size(ab,2);
ab = reshape(ab,nrows*ncols,2);

nColors = 3;
% repeat the clustering 3 times to avoid local minima
[cluster_idx, cluster_center] = kmeans(ab,nColors,'distance','sqEuclidean', ...
                                 'Replicates',3);

pixel_labels = reshape(cluster_idx,nrows,ncols);
figure;
imshow(pixel_labels,[]), title('image labeled by cluster index')

segmented_images = cell(1,3);
rgb_label = repmat(pixel_labels,[1 1 3]);

for k = 1:nColors
   color = I;
   color(rgb_label ~= k) = 0;
   segmented_images{k} = color;
end
```

```
[SOrder insort]=sort(cluster_center(:,1));
Seg1=segmented_images{insort(end)};
Seg2=segmented_images{insort(end-1)};

figure;
subplot(311);imshow(Seg1);
subplot(312);imshow(Seg2);
title('ROI');

%% Feature Extraction
% Detect SURF Features
feature1 = detectSURFFeatures(enhancement);
% Extract the detected SURF features
[features, valid_corners] = extractFeatures(enhancement, feature1);
% Extract PHOG Features
bin = 3;
angle = 360;
L=3;
roi = [1;300;1;300];
p = anna_phog(enhancement,bin,angle,L,roi);
p = p';
% Find Gabor Wavelet Features
[meanAmplitude, msEnergy] = gaborWavelet(enhancement, 4, 6); % 4 = number of
scales, 6 = number of orientations
gabor_features = [meanAmplitude msEnergy];
% Feature reduction
feature1_reduction = pca(features);
feature1 = [mean(feature1_reduction) p];
% Combining the features
final_features = [gabor_features];

% CLASSIFICATION
```

```
load svm_trained.mat
load type_id.mat
features_test(isnan(final_features))=0;
for digit = 1:numel(svm_trained)
   predictedLabels(:,digit) = svmclassify(svm_trained(digit), double(final_features));
end
[~,position] = find(predictedLabels==1);
if ~isempty(position)
   if length(position)>1
      final_pos=position(1);
   else
      final_pos=position;
   end
   if final_pos <= 3
       msgbox ([type_id{final_pos}]);
      msgbox([' Image is under category of NOT RIPE FRUIT ']);

   elseif final_pos>=4
      msgbox ([type_id{final_pos}]);
      msgbox('  Image is under category of RIPE FRUIT');
   end
else
   msgbox('unable to predict....train again or try with different samples... ');
end
```

# SCHEDULE, TASKS AND MILESTONES

| Task | Duration(days) | Start Date | End Date |
|---|---|---|---|
| Gathering research papers | 21 | 10-12-2019 | 31-12-2019 |
| Proposal preparation and submission | 20 | 1-01-2020 | 20-01-2020 |
| Literature survey and problem study | 26 | 25-01-2020 | 20-02-2020 |
| Existing system | 15 | 21-02-2020 | 7-03-2020 |
| Proposed system | 15 | 8-03-2020 | 23-03-2020 |
| Coding | 25 | 24-03-2020 | 18-04-2020 |
| System Testing | 7 | 19-04-2020 | 25-04-2020 |
| Bug Fixes if any | 02 | 25-04-2020 | 27-04-2020 |
| Improvements | 03 | 27-04-2020 | 30-04-2020 |
| Final testing | 02 | 30-04-2020 | 02-05-2020 |
| Research Paper writing | 10 | 29-03-2020 | 06-04-2020 |
| Acceptance | 14 | 06-04-2020 | 20-04-2020 |
| Publishing | 10 | 20-04-2020 | 30-04-2020 |

## PROJECT DEMONSTRATION

The ability to identify the fruits based on quality in food industry which is most important technique and the realization of automatic fruit sorting machine in order to reduce the work of human and also time consuming. Automatic methods of the classification of a ripen and unripen fruits helps the food industries for the export of fruits to the various places. An effective classification approach based on Support Vector Machine (SVM) algorithm for early fruit maturity detection .The dataset contains 24 samples of strawberry with four stages of maturity level. Gabor wavelet scheme based on SURF knuckle print recognition is used to get the better accuracy of extracted pictures. Color information is actively used for fruit ripening process. In our model, the filters are applied to three channels based on k means clustering layer. The experimental results validate that the proposed method effectively recognizes different types of fruits. This project provides the percentage of fruit maturity in the yield using Gabor wavelet and SVM technique.

Initial process is to give the input image to the system. By using the image preprocessing techniques mentioned above the fruit has to be diagnosed whether it was ripen or not ripen .Once the preprocessing is done the image has to be segmented and feature extraction is to be done to show signs of improvement accuracy in the output picture. A Scheme dependent on (SURF) Speeded up Robust Features algorithm was proposed using knuckle print recognition. Here we have used algorithms like K means clustering for segmenting the image once the preprocessing is done. Then we have used Gabor wavelet method for the feature extraction. These values are compared with the trained data and the fruit name is classified by SVM classifier. Then the name of the fruit is identified. Ten by using binary image affected amount of pixels are calculated . This project provides the percentage of fruit maturity in the yield using Gabor wavelet and SVM technique.

## RELATED WORK

From the study on various types of techniques for maturity prediction some of them are illustrated as below, Literature survey includes various techniques and work done related to maturity of different fruit, proposed a new color mapping concept of converting 3-D color spaces to 1-D color indices for automated color grading. An effective and user-friendly color mapping concept for automated color grading that is well suited for commercial production. This color mapping method assigns colors of interest specific to a given application to calculate a unique set of coefficients for color space conversion. The cost effective maturity grading system for one of the most popular fruit strawberry was done using a novel setup utilizing inexpensive material and image processing algorithms to identify the six important stages of strawberry ripening had been presented. All algorithms were first designed and developed using Simulink, a part of MATLAB on a 2.5 GHz CPU with an overall 97% accuracy was achieved. The two techniques had been used which are color image segmentation. Four images of a single fruit had been captured from four different directions and separate desired part from each image using color image segmentation. calculate the RGB value segmented part and gave input to k-means clustering, Gabor wavelet and Support vector machine gives output whether the fruit ripe or not. The same logic applied for remaining 3 fruit, these 4 input were applied to Gabor wavelet and Support vector machine which states whether the fruit ripe, over-ripe or not. fruit quality extraction in terms of its shape, size and ripen stage.The prediction of maturity level has been performed from the video signal collected by the CCD camera placed on the top of the conveyer belt carrying strawberries. Segmented image frames from the video signal have been corrected and processed to extract various features, which were found to be more relevant for the prediction of maturity level. Recursive feature elimination technique in combination with SVM based classifier has been employed to identify the most relevant features among the initially chosen 27 features. lastly, the optimum set of reduced number of features have been obtained and used for sorting of the strawbrries into four different classes according to the maturity level from least mature to over mature. identification of fruits based on quality in the food industry which is the most

important technology in the realization of automatic fruit sorting in order to reduce the work of human and time consuming. This work presents a hierarchical grading method applied to the fruits, in this work the identification of ripen or not ripen fruits is focused on the methods using MATLAB. First extract certain features from the input fruit image, later using different method like thresholding, segmentation, k-means clustering. From the proposed range identification can be done, the ripen or not ripen fruits. The ripeness of the fruit is based on different color intensity and size. This system uses a computer, a CCD camera and MATLAB software to analyze it and interpret output images. To improve image quality the collected images are converted to color space format (HSV). Matlab software and its image processing toolbox have been used in this analysis.

# RESULT & DISCUSSION

## A. IMAGE PRECPROCESSING:

In this process, by the below figure.1, firstly the picture is enhanced to smoothing. While gathering picture numerous data is gathered which include noise. The output of pre-processing is appeared here for strawberry fruit

Input image → enhanced image

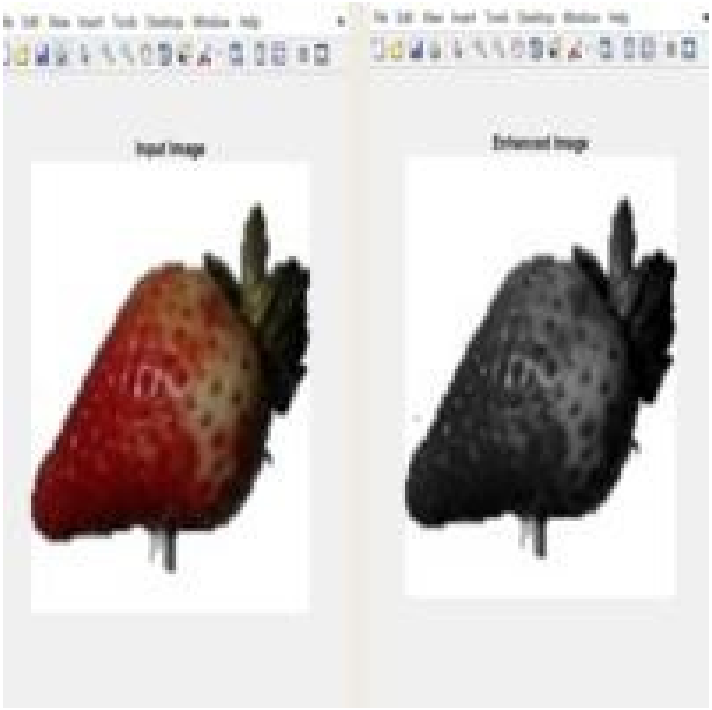



**Figure:1**

## B. NOISE REMOVAL OF THE ENHANCED IMAGE:

From the below figure.2 we proposed a technique of salt and pepper noise elimination for color pictures using median filter giving the reconstruction of an picture so as to acknowledge result with least loss of data.

Median filter or morphological filter methods are used to remove the noise.

The figure shows the output of noised removed image**:**


**Figure:2**

## C. IMAGE SEGEMENTATION

The enhanced image is segmented using k-means clustering algorithm. The clustered image with label index is formed during this process

The figure:3 represents the clustered form:


**Figure:3**

## D. REGION OF INTEREST:

The clustered image is used for feature extraction using Gabor wavelet method. The Region of Interest (ROI)is extracted using clustered picture. After the region of interest, the ROI classification is done using SVM. The final output of the fruit image is classified under the category of ripe or not ripe.

**The figure:4 shows the final output:**


**Figure:4**

## E. REGION OF INTEREST:

The clustered image is used for feature extraction using Gabor wavelet method. The Region of Interest (ROI)is extracted using clustered image. After the region of interest, the ROI classification is done using SVM. The final output of the fruit image is classified under the category of ripe or not ripe.

Here are some results obtained using this SVM technique

**Figure:5**

## METHODOLOGY :

**Block Diagram:** For this paper, strawberry of different locality were collected; to determine the maturity of the fruit we follow the method one by one as shown in below block diagram. In this we first take an RGB input of fruit. After then divide this into R channel and G channel which further converted to R mask and G mask images of fruit. Taking intermediate mask from the R mask and G mask then using this intermediate mask different feature vectors were calculated. Classification was done into four stages which are

1) Pre-mature fruit

2) Early-mature fruit

3) Mature fruit

4) Over-mature fruit

After classification 24samples of strawberry had to be trained using b-back-propagation algorithm. Completion of feature training feature testing was done and lastly using the above arrangement decision was taken whether the fruit is mature, early mature, mature or over mature,

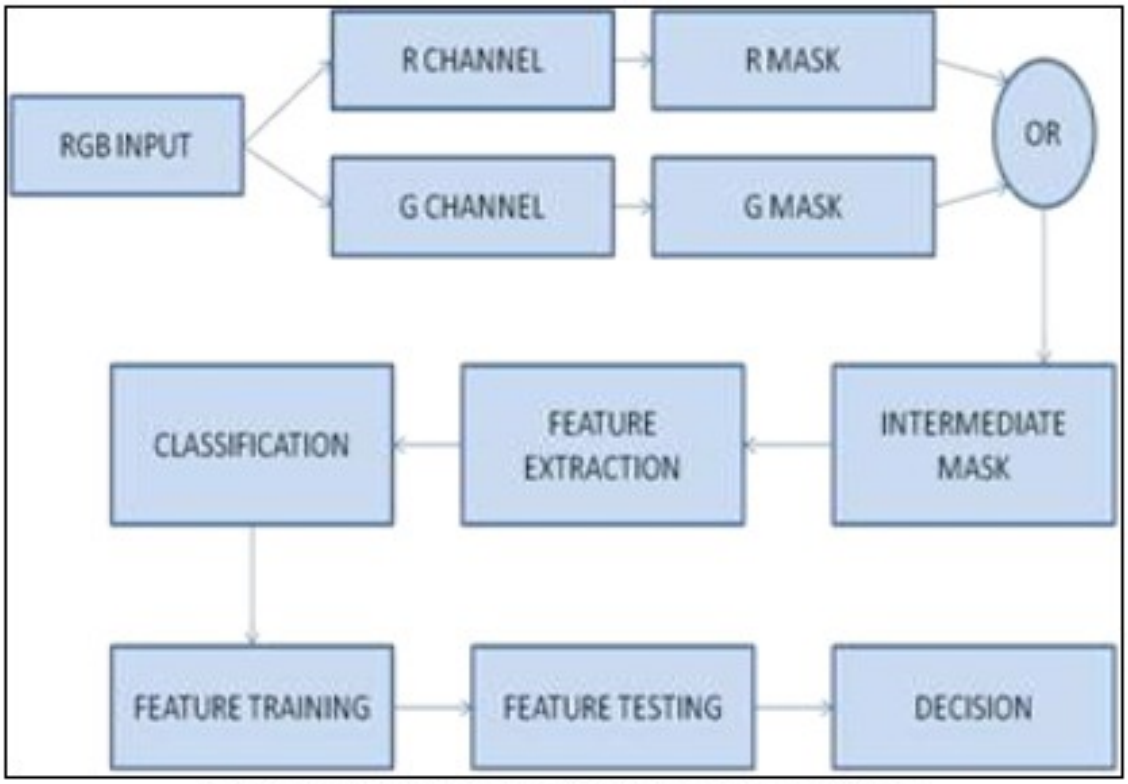



Fig. 3.1: Block Diagram for Maturity of Fruit Detection

**Acquisition of Fruit Images:** Including the strawberry fruit data in the form of digital images before processing it is called as acquisition of images which is in the RGB format. To improve the processing speed these images are resized it into proper size of original image. The four samples of strawberry stages shown in below


Fig. 3.2: Input Image Of Strawberry Fruit

**Convert to Red Channel:** The RGB color model is an additive color model in which red, green, and blue light are added together in various ways to reproduce a broad array of colors. The name of the modelcomes from the initials of the three primary colors, red, green, and blue. The main purpose of the RGB color model is for the sensing, representation, and display of images in electronic systems, such as televisions and computers, though it has also been used in conventional photography. R channel are separated from the RGB colour images.

**Convert to Green Channel:** Similarly the G channel also separated from the RGB

images of strawberry fruit.

**Convert to Red Mask and Blue Mask:** Masks allow hiding part of a layer to display the layer(s) underneath. This gives the ability to adjust and construct in a highly controlled way to create the perfect photo. Masks are entirely non-destructive making them extremely flexible tools. Masks can be edited or deleted at any point in workflow and at any later time. The blue and red channels are first binarized to generate blue and red masks. For each pixel in the image, the corresponding value in the blue mask is set to 0 if the value of the blue channel is high (blue background), otherwise it is set to 255 (fruit).

**Intermediate Mask:** First, blue does not occur naturally in strawberry. Second, blue is one of the three channels in the RGB color space, making it easier to filter than colors that require multiple channels to represent. Fruit is segmented from the blue background by creating masks corresponding to the fruit area using the blue and red channels. The new color mapping method is then used to remove areas of shadow and increase the accuracy of the mask. Adding the R mask and G mask together, intermediate colour indices is obtained from the blue background by creating masks corresponding to the fruit area using the blue and red channels. The new color mapping method is then used to remove areas of shadow and increase the accuracy of the mask. Adding the R mask and G mask together, intermediate colour indices is obtained.

**Feature Extraction:** Feature extraction is defined as gathering the input data objects into a set of features. The features extracted will help to extract the relevant information from the input data in order to perform the feature matching .Using this we can reduce the representation input size instead of the full size input. The feature analyses of strawberry include extraction of color features. In this study, 24 features common in this field were extracted and applied which are given below.

**Feature vector of strawberry fruit:**

| | | | |
|---|---|---|---|
| *mean* | *r_m= Mean(R)* | *g_m= Mean(G)* | *b_m= Mean(B)* |
| *normalised* | *Rt1=R/(R+G+B)* | *Gt1=G/(R+G+B)* | *Bt1=B/(R+G+B)* |
| *difference* | *r_g=R-G* | *r_b=R-B* | *b_g=B-G* |
| *varience* | *v_r=Var(R)* | *v_g=Var(G)* | *v_b=Var(B)* |
| *skewness* | *skew_r=Skewness(R)* | *skew_g=Skewness(G)* | *skew_b=Skewness(B)* |
| *kurtoisis* | *kor_r=Kurtosis(R)* | *kor_g=Kurtosis(G)* | *kor_b=Kurtosis(B)* |
| *mean* | *mean_rg=Mean(r_g)* | *mean_rb=Mean(r_b)* | *mean_bg=Mean(b_g)* |
| *varience* | *v_rg=Var(r_g)* | *v_rb=Var(r_b)* | *v_bg=Var(rb_g)* |

**Feature Training:** Feature training method includes collection of large number of trained features of clustered values of mature and pre-mature fruits. More number of collecting trained features gives more accuracy. In this method, the number of closest code vectors for each training vector is identified and is stored as the corresponding cluster density. The cluster densities for all training vectors are computed and are sorted according to their maturity stages i.e premature, early mature, mature or over-mature. From the sorted list, strawberry are identified and grouped as their maturity level. This maturity level is saved and loaded in MATLAB for feature testing.

## Importance of maturity indices:

- Ensure sensory quality (flavour, colour, aroma, texture) and nutritional quality.
- Ensure an adequate postharvest shelf life. •
- Facilitate scheduling of harvest and packing operations. •
- Facilitate marketing over the phone or through internet.

## FUTURE SCOPE

Here we may also connect this to an app on mobile phone where it will be easy for the farmers to click pictures and this can be used as data set to find the ripen fruit without any delay.

## CONCLUSION

This paper discusses an approach which is easily accessible and inexpensive of fruit maturity detection using SVM. SVM classification is much faster than multilayer perceptron network. Gabor wavelet method used for feature extraction gives an accuracy of 97% after the classification done using SVM.SVM classification results are better for K-means algorithm compared to different types of algorithms. This technique takes less time and gives better accuracy than existing methods. The results in this paper will help in automatic classification of various fruits in food industries for enhancing the fruit quality and maturity automatically.

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