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Maturity Dectection of Mangoes Based on Machine Learning Techniques

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Abstract: It is very important to do proper grading of fruits to increases profit of the agriculture and food industries. Here in this project we propose the technique for mango grading automatically according to the features of fruit consider to grade quality. Those features are size, shape, color and surface pixel. In this system mangoes are graded in three types such as Green Mango, Premature Mango and Mature Mango which are based on machine learning method. This system considers RGB values size and shape of mangoes. Posterior analysis is used to obtained good probability. This helps to train system to detect appropriate maturity of mangoes. This experiment is conducted on two machine learning method i.e. Naive Byes and SVR (Support Vector Regression) compare the performance of both based on accuracy and defective pixels. From the previous system, this system gives the more accuracy as posterior analysis is used.

Keywords: Machine Learning, Feature Extraction, Feature Selection, Classification, Document Categorization.

I. INTRODUCTION

Mango is seasonal and commercial fruits and it is “King of Fruits” in a India and popular due to its taste, aromatic fragrance and color. Mangoes are cultivated in different countries like India, Malaysia Indonesia, Thailand and Sri Lanka transported different countries. Now a day’s sorting of the fruits like Mango, Banana, Dates and Grapes perform manually, for this getting adequate manual experts during the period is difficult. This process is time and money consuming also face problem like inconsistency and inaccuracy in judgments as different people are working [1]. Visual inspection is labor intensive process. So that in which research area that being conducted to design a reliable and flexible systems that can quickly sort a mango fruit from its ripening days. Therefore, it insists to develop a system that can sort mangos into different groups. The suppliers and the distributors demand the fruits high quality and good package. This system makes able to categorize the mango as over matured, matured, and normal. Grading is based on the quality of fruits by considering a of attribute value like Shape, Size, and Color.

In recently, A Machine Vision Techniques has been more important and more beneficial for the agriculture for the sorting and grading of fruits and vegetables. The use of Machine Vision Techniques grading of harvested mangoes according to the surface defects and maturity level [1-4]. Develop a Kernel Fuzzy Discriminate Analysis [2] for the creating a color histogram for the classify apples according to the bad and good color. Process of grading of mangoes generally based on

the physical properties of mangoes. In this paper firstly, the original RGB images are converted into the gray scale for purpose of removing the noise of images. After that gray scale images are converted into binary images for the analyzing surface area of mangoes. We adopt a method known as Naïve Byes with Posterior Analysis from which grade the mangoes according to the Size, Shape and Color of those images.

In this paper we studied about the related work done section [I]. The proposed approach of system, Module Description, Mathematical Model, and Algorithm [Section III]. Experimental Setup [Section IV] at the final we provided a Conclusion and Future Scope [Section V].

II. Review of Literature

Chandra Sekhar [1] proposed a Machine Learning Techniques for sorting of mangoes in terms of maturity. SVM (Support Vector Machine) techniques applied on the images of mangoes and the classifications according to the maturity level. Calculating the features values of mangoes and grading mangoes into different groups like G1, G2, G3, and G4. Images are taken from camera it converted into the binary images and then calculating the size of mangoes. In which classification uses the SVM method and the minimum hamming distance rule for decision phase. In this they used the two algorithms SVM and minimum hamming distance calculating the day to transport of mangoes.

Jian-Qing Gao has using method for feature recognition and extraction of images called Kernel Fuzzy Discriminate Analysis (KFDA) [2]. The Kernel Fuzzy Discriminate Analysis Technique formed from two methods which are Fuzzy Decrement Analysis and Kernel Trick. These two methods are based on the Orthogonal Triangular matrix of input images which reads feature value of input images. As per author view these two proposed method Kernel Fuzzy Discriminate AnalysisOrthogonal Triangular and Kernel Fuzzy Discriminate Analysis-SVD(singular value decomposition) are most feasible than FDA(fuzzy discriminate analysis) and KDA(kernel discriminate analysis.

A Machine Vision Techniques for fruits and vegetables for detection of defects and damages of fruits during storage and transportation [3]. They are using method known as RGB color space for the color recognition of Apple Fruits. For apple color recognition they create pixel color vector a[r, g,b]. SVM (Support Vector Machine) algorithm are used for classify apple fruits according to the color of that fruits. Using a color histogram classify apple Label +1 for the good color and Label -1 for bad color of apple**.**

Yangzhou Gan and Qunfei Zhao [4] proposed visual defect inspection method for LCD (Liquid Crystal Display) which is based on LBF Method. These methods are used to detecting defects with different brightness levels, diverse size and shape. For algorithm accuracy they used a precision recall framework. They are also comparing the performance of the proposed defect inspection techniques with other techniques: Modified CV (MCV) Techniques, Polynomial Fitting (PF Techniques) and ICA-Based method Techniques.

Author presented the date grading and sorting method known as Prototypical Computer Vision Techniques [5]. For the experiments they are considering RGB images of date fruits. The date grading process many factors considered namely External Quality Factor and Internal Quality Factor. In which Internal Quality Factor of date fruits are Taste, Flavour and Sweetness. From the gray scale image of date crated and then it converted into binary images and External Features of date fruits estimated

from binary images. Classification of date fruits using Back Propagation Neural Network Algorithm with training data set are used.

Chandra Nandi and Koley [6] author proposed a Computer Vision Techniques for sorting of mango fruits in form of maturity level. Experiment they are considering 600 number of mangoes images of different types and it is collected from different location. Firstly they captured images of mangoes through camera and then noise is removed using filtering method. To detecting boundary of mango image using techniques called Graph Contour Tracking Method. To predict maturity of mangoes they used Support Vector Machine. They have many limitation of capturing images of mangoes and detecting defect of mangoes.

Here author have proposed [7] techniques Bio Inspired Multi Modality Sensing system for classify mangoes. A Fourier Based Shape measuring method are used for recognize shape of mango. Color Intensity from Infra Red image of mangoes was used to distinguish and classify the mangoes according to the maturity. Techniques are used in which system for grading of mangoes a Frame Grabber Board, Charge Coupled Device Camera. Maturity estimation based on skin color of mango. For estimation features of mangoes images are using image preprocessing techniques. In which image preprocessing from gray scale images the binary image formed. Grade the mangoes according to size, shape and weight of those mangos.

Author proposes a color mapping techniques for grading of fruits into different grades according to maturity level [8]. The purposed work is done on it converts a 3D RGB color space into a smooth and continuous 1D color space. Color mapping techniques mapping the RGB color values of into color indices using a Polynomial Equation. This color mapping techniques based on the of a Third-Order polynomial to converted 3D RGB values into 1D color space. They also use higher order polynomials or nonlinear functions for converting 3D color space to 1D color space. The selected color mapping techniques cover the complete range of colors.

Stefania Matteoli and Rossano Massi purpose a technique for sorting of peach fruits [9]. Fiber Optic Spectroscopy Based Sensor techniques which is classify Peach fruits according to texture, color and size. Firstly they step in which they inspection step in which they scan fruits using VIS-NIR Spectrometer. Principal Component Analysis techniques are using for classify peach fruits.

III. SYSTEM ARCHITECTURE

A. System Description:

The proposed Mango Grading System determines Mangoes Maturity and Mangoes Quality in the form of Size, Shape and Surface Defects of Mangoes Images. Using these techniques increases the profit of vendors and it also find of days to rot mangoes from which we can find out transport days of mangoes according to maturity level.

In which proposed system working on the different type of mangoes images and which are different types of maturity level.

- Image preprocessing and Features Extraction:

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The input image is pre-processed using the different methods as Gray Scale, Binary Image Representation, and Max height. Features of mangos are considered as Size, Surface and Shape. These features are calculated by calculating RGB values of images, size, and diameter of image. Size of images also calculating using Edge detected method.

A gray scale images in this it carries only intensity of that images. Gary Scale image it also known as black and white image, black at the weakest intensity as compare to the white. Figure 2 shows the gray scale image of mangoes.

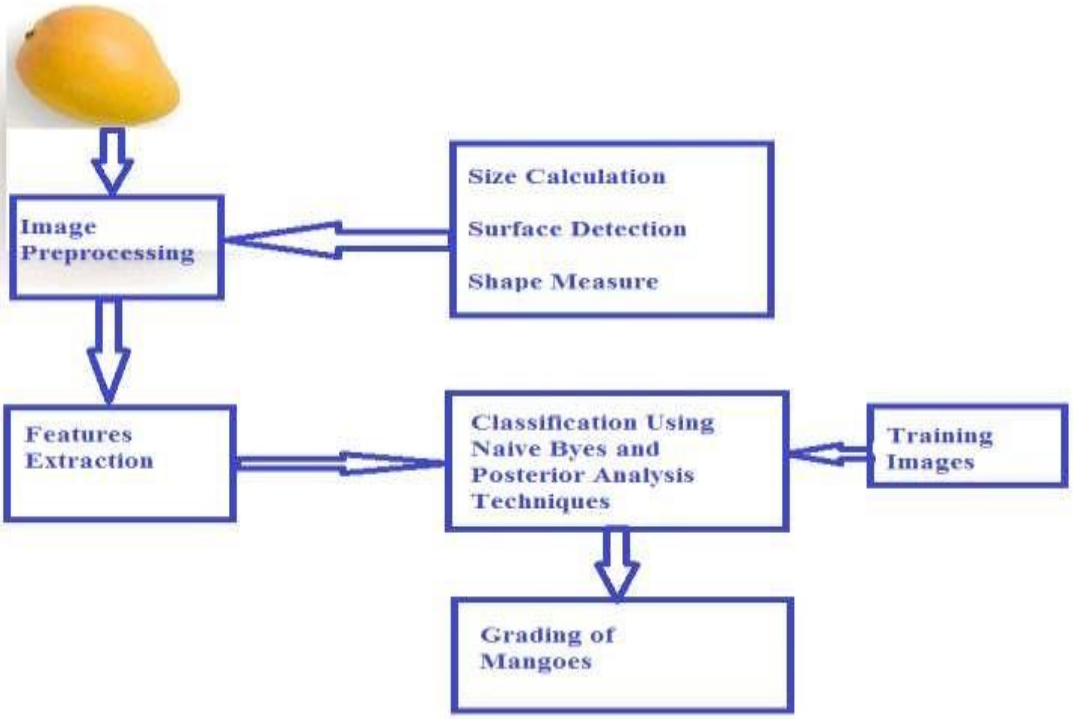

Figure1: System Architecture

Binary images are crated from threshold value of a gray scale or color image for the separating an object in the image. The colours of mango image are white which is referring to the foreground color and background colors of images are black.

Shapes of mangoes are calculating using Edge Detection method. Figure 3 shows that Edge detection of mango image.

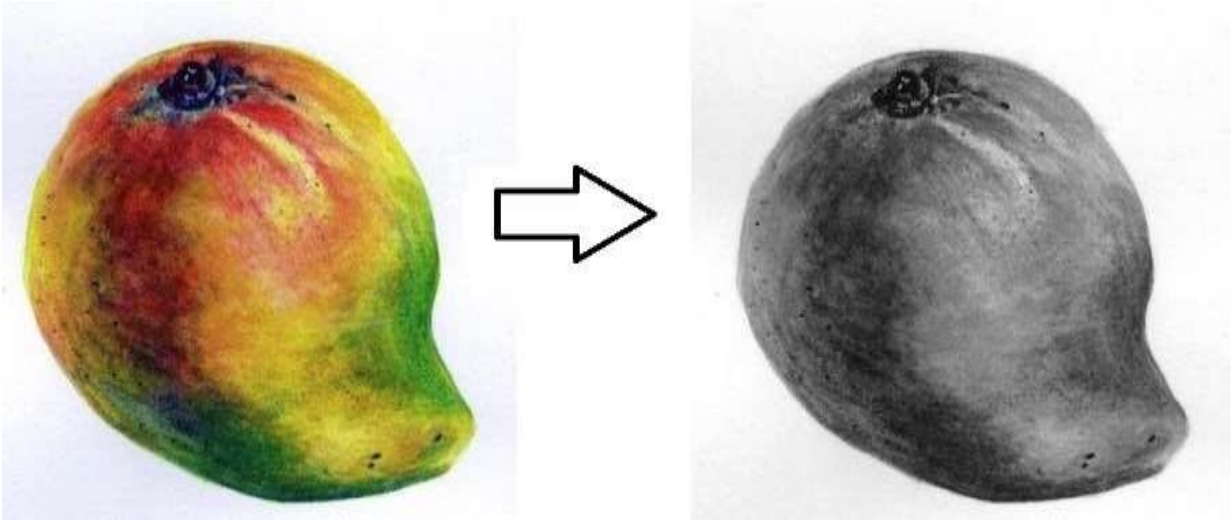

Figure2: Gray Scale Image of Mango

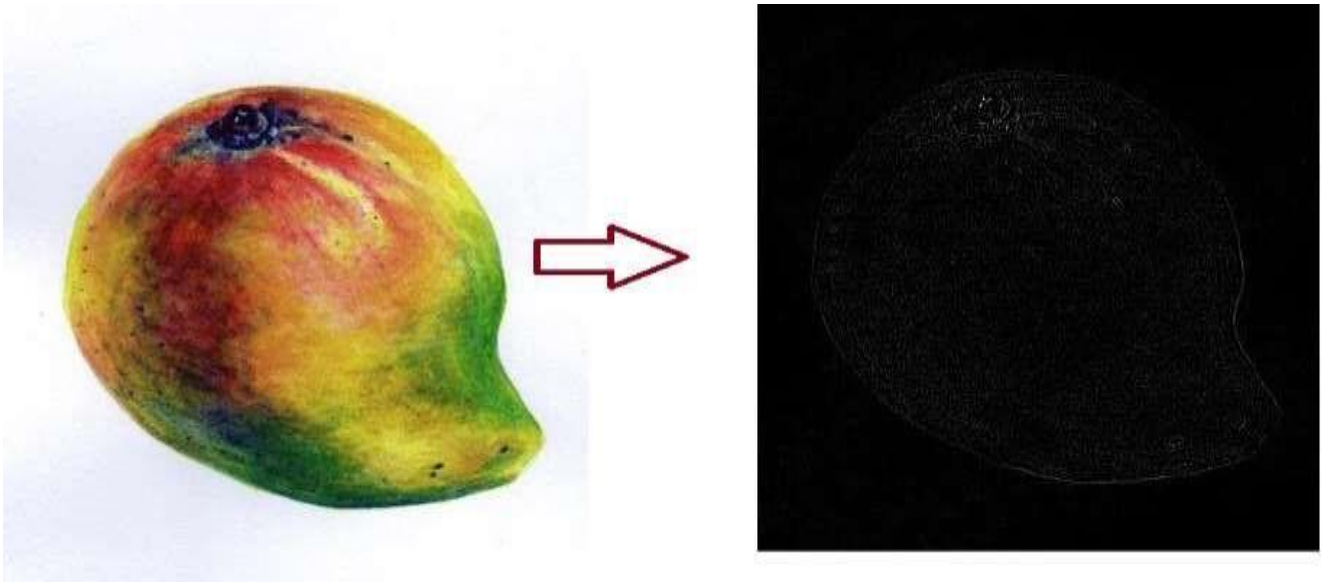

Figure 3: Edge Detection of Mango Image

- Naive Byes for classification(With training data) and Posterior Analysis techniques:
  Naive Bayes (NB) is a very simple algorithm. This can be seen in steps to resolve the posterior probability calculation. Components in NB are as follows this point below:

$$Posterior = \frac{Likelihood * Prior}{Evidance} \qquad 1.1$$

  Following steps are involved to accomplish classification:

- Prior Probability :
  Prior probability as value for a certain class is calculated from experience of previous events. The more data the past is used, then the values of the prior probability, the better and sometimes the prior probability value is used to determine the classification result when the some prior probability values between classes.
  Examples: P (Class-1) P(Class-2).....P(Class-n)
  Where n specifies the number of classes and i = 1, 2, 3 ...n.

- Conditional Probability:

Conditional probability is a probability values that has a requirement previous events and events into the conditions are a particular class, such as the ith class "Class-i" meaning a requirement that the incident is an event that happened occurs first, followed by the emergence of other events, such as the incident of "Criteria-1", "Criteria-m", where m denote the number of feature or criteria or parameter. So to it write conditional probability variable i.e. P(Criteria-1|Class-i) * P(Criteria-2|Class-1) * P(Criteria m | Class-i) Marginal Probability(evidence):

Evidence is the probability of single occurrence of one or a set of features Evidence "P (Criteria-1, Criteria-2, Criteriam)" can be calculated by summing the result of "likelihood * prior" that run on all existing classes.

- Posterior Probability:
  Posterior probabilities have almost similar characteristics with conditional probability and conditional probability is the opposite of the sequence of events from the point of view.
- Grading of image :
  Finally, after applying all logic and algorithms we get graded image of mangoes.

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IV. MATHEMATICAL MODEL

R, G and B value of the mango images and it was calculated from the following Equation:

$$I_k = R, G, B = \frac{1}{-} \sum_{N=1}^{R} \sum_{M=1}^{C} (IK * BI)_r \qquad 1.2$$

Here, BI is the Binary Image of mangoes. IK is the captured RGB image, C and R are the total number of columns and rows of the mangoes image. i. Derived Features:

Difference of average values of R, G and B calculate of the mango images are:

(A_G - A_R), (A_G – A_B), and (A_R – A_B).

It is difference of the average of R, G and B values of the equator, stalk, apex, and region respectively. ii.

Diameter :

Diameter is measuring using this formula:

$$d_g(x, y) = \sum_{i=1}^{N} \sqrt{x_i^2 - \quad} y_i^2 \qquad 1.3$$

Naive Byes Algorithm perform mango classification by using the distance between the feature value of unknown mango with the feature value of stored mango examples after that algorithm will find out the nearest examples to unknown mango.

iii. Accuracy:

The posterior probability is the probability of the parameters θ given the evidence X: $P(\theta|X)$. It contrasts with the likelihood function, which is the probability of the evidence given the parameters $P(\theta|X)$. Let us have a prior belief that the probability distribution function is P (θ) and observations x with the likelihood $P(\theta|X)$, then the posterior probability is defined as $P(\theta|X) = \frac{P(\theta|X, P(\theta))}{P(X)}$ 1.4

Naive Byes algorithms perform mango classification by using the feature value of mango with the feature value of stored mango examples after that algorithm will find out the nearest examples to mango. **Algorithm 1: Posterior Analysis**

Input: Training data set of mango images.

Output: Stage of maturity Detection.

The Posterior Probability Distribution of one random variable to another random variable are calculated from Naive Byes' theorem by multiplying the prior probability distribution by the likelihood function, and then dividing by the normalizing constant value:

$$f(X|Y) = Y(X) = \frac{f(X(x) L_{X|Y} = y(x))}{\int_{-\infty}^{\infty} fX(x) LX|Y = y(x) dx} \qquad 1.5$$

Gives the Posterior Probability Density Function for a Random Variable X given the data, where Y = y a.

fx(x) is the Prior Density of X,

b. $L_{X|Y} = y(x)) = f\ Y|X = X\ (Y)$ are likelihood function of X

c. $\int_{-\infty}^{\infty} fX(x)_{L_{X|Y} = y(x)} dx$ are normalizing constant

d. $f(X|Y) = y(x)$ are posterior density of X given the input function Y = y; Posterior Probability can be calculated as :

$$\text{Posterior Probability} \propto \text{Likelihood} \times \text{Prior Probability} \quad 1.6$$

Algorithm 2: Naive Bayes

Steps in Naive Byes Algorithm:

Step[1] First it converts data set into a Frequency Table

Step[2] Creating Likelihood table according to the probabilities values: Overcast Probability = X and Probability of playing is Y.

Step[3] Using Naive Byes equation to evaluate the Posterior Probability for each class. The class with highest posterior probability is the outcome of prediction.

V. RESULT AND DISSCUSSION

A. Experimental Setup

The system is built using Java framework on Windows platform. The Net bean IDE is used as a development tool and Open CV 2.4.10 (optional).

B. Dataset Used

We prepare our own dataset for different types of mango images and same for training dataset.

C. Experimental Result

This Study summarized here that the Naive Byes with Posterior Analysis Techniques con be applied on the images of mangoes for grade according to its maturity, size and Shape. In which image processing techniques has been used for the exact the features values of mangoes which is Shape, Size, Color and Skin of mangoes in order to prepare a input to the Naive Byes with Posterior Analysis Techniques.

Figure 4: Actual Image of Mangoes Figure

4 shows the one of sample image of mangoes used in this study.

Table 1 shows actual classification of according to RBG values and also diameter of the mangoes.

Sample Images	RGB Values	Diameter	Mango Class
	139.189, 182.466,108.846	223	Green mango
	233.162, 200.682, 135.866	274	Mature
	105.277, 41.619,53.937	356	Mature

Table 1: Result Table of Classification Mango

VI. CONCLUSION

The proposed system is able to categorize the fruit depending on maturity and we consider the different features of mango fruit. For this we used machine learning methodology. Here we can say that system gives better result as we used posterior analysis to improve the accuracy of training data set, also accurately measure the test image attribute. We also able to defective fruit depend on defective pixel measure. Our system works only for particular surface area consider detect the defective pixel. If other than that surface area defect is exists, we are not able detect it. For this in future need to consider the rotational view or the different surface view.

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