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Defect Detection in Fruits and Vegetables using K Means Segmentation and Otsu's Thresholding in Matlab

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Abstract---*It will take more time to examine the large quality of fruits and vegetables manually and accuracy will be less. This process is based on detection the defect in the fruits and vegetables using image processing in Matlab software. The external defect is the surface image of the fruits and the vegetable is processed .The detection is done by using K means clustering algorithm and Otsu's thresholding method. The K means clustering is computationally faster compared to other clustering algorithms. To subtract the background in the fruits and vegetables image, the most efficient technique used is Otsu's thresholding. This method subtracts the background under partial effects like occlusion, cropping, noisy and blurry images, so this results in good accuracy in extracting fruits and vegetables. In this we can identify the faulty fruits and vegetables and the defected spot can be identified.*

***Keywords*—K means clustering algorithm, Otsu's thresholding, Matlab software.**

I. INTRODUCTION

Food industry is one of the commercial industry. There is rapid growth in population in India. This population growth affects the quality of food. There is raising demand for the good quality food due to the increasing population. In agricultural industry, the detection of defects in fruits and vegetables is a vital task , as for the great demand for high-quality fruits and vegetables in the market. The traditional manual estimation of quality of fruits and vegetables is time consuming process and it requires more human power and there will be some human error. To reduce the human error and to speed up the process some methodologies for automation is introduced. Estimation of fruits based on skin color and tree grown food size is now computerized by machine vision and some programmed framework for reviewing the pieces of fruits for defects is still in examination stage.

The different imperfections in the fruit's and vegetable's skin is more helpful to analyze the defects in the fruits and vegetables. There were lots agriculture related software developed to check the quality of the products. As we know that the agriculture is the backbone of Indian economy. So there will be dent in GDP of Indian economy, if there is major loss in the agriculture.

In this process, we utilizes image processing technique to detect the defects in fruits and vegetables. To obtain the effective information, the given image is converted into digital image in the image processing technique.

In image processing, the given input is processed and output is generated. This technique is used for image recognition, recognition of pattern, image sharpening and image retrieval. The digital images are four types, they are indexed image, binary image, true color image and grayscale image. To extract the required information from the digital image, there is various phase to be follow. The image processing phases are pre-processing, segmentation, feature extraction and classification.

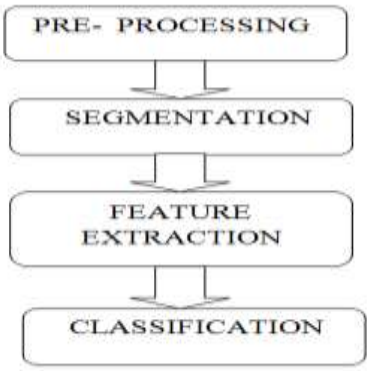


Fig 1 Phases of image processing

II. LITERATURE SURVEY

The authors Mukesh Kumar Tripathi, Dhananjay D. Maktedar [4] used the accurate technique to segment the fruits and subtract the noisy background. The algorithm used is Otsu's thresholding algorithm. By using this method the required data is effectively extracted from the given image. Even the data can be acquired from the blurry image more efficiently. This proposed method was experimentally proved that the Otsu's threshold will provide the more accurate information from the given fruit and vegetable images.

The authors Nikhil Pandey, Suraj Kumar and Raksha Pandey [6] used different algorithm to detect the diseases in the fruits and vegetables in the earlier stage

before harvesting. Some of the methodology used in this paper is Computer Vision, Machine Learning, SVM, CNN, Deep Learning and algorithm used is Thresholding, K-means clustering. This algorithms are accommodated in the smartphone for the regular monitor and diseases will be detected.

The authors Siddhika Arunachalam, Harsh H. Kshatriya and Mamta Meena [5] used image processing technique to detect the diseases in the fruit from processing the surface image of the fruit. To classify the defected fruits from fresh fruits ,this proposed method used pre processing, segmentation, edge-detection and feature extraction. The main objectives of this method is to identify the defect in the surface from the RGB images. This proposed methodology is used in supermarkets to automate the sorting process of fruits from the set of different fruits.

The authors Van Huy Pham and Byung Ryong Lee [3] used hybrid algorithm depends on split and merge approach to segment the image for fruit defect detection. First the image is split into region using k means clustering and minimum spanning tree is used to iteratively combine same regions to generate fresh homogenous ones. This technique provides the good result compared to other methods.

III. PROPOSED METHOD

In the proposed system we have used k means clustering algorithm and Otsu's thresholding to detect the defect in the fruits and vegetables by processing the surface image of the fruits and vegetables.

3.1 Pre-Processing

The input image used here is an colored image and it contains noise, this noise produces the blurring effect in the image during processing, so to avoid this effects we are going for pre-processing.

3.2 Filtering

To improve the visual quality of image we are going for filtering process and also it reduces the noise. By this filtering we can detect the edge more effectively.

3.3 K Means Clustering Algorithm

Algorithm
Step 1: The input image is given.
Step 2: The clusters are formed.
Step 3: RGB image is converted into gray image.
Step 4: Changing the 2-D image into 1-D array of length "r×c".
Step 5: Intensity range is calculated.

Range = [(Max value) - (Min. value)]
Step 6: Centroid value is calculated.
Centroid 1 = Range/No. of clusters
Centroid 2 = (2 × Centroid 1)
Step 7: The first intensity and the other centroid values difference is calculated.
Step 8: Based on minimum value cluster group is formed on the intensity values.
Step 9: Repeat 1& 2 for all the other values of intensity 1 & 2 is repeated
Centroid 3 = (3 × Centroid 1)
Centroid n = (n × Centroid 1)

3.3 Background Subtraction

To extract the required portion from the image we have to subtract the background in the image. Here we subtracted the background by using the Otsu's Thresholding.

3.4 Feature Extraction

In feature extraction the defected portion in the fruits and vegetables will be extracted by RGB masking the image.

3.5 Classifying the Fruits and Vegetables

In this step we are classifying the defected fruit from the fresh fruits. The status of the fruits will be displayed in the comment window for our reference.

IV. FLOW CHART AND ALGORITHM

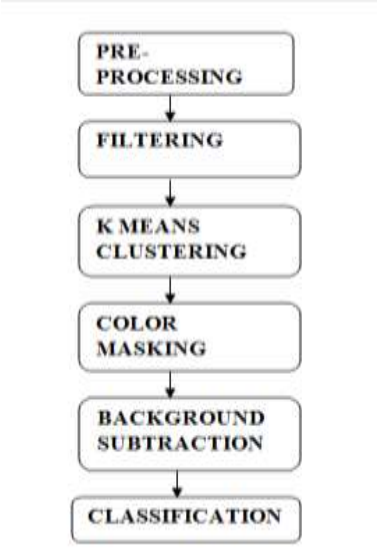


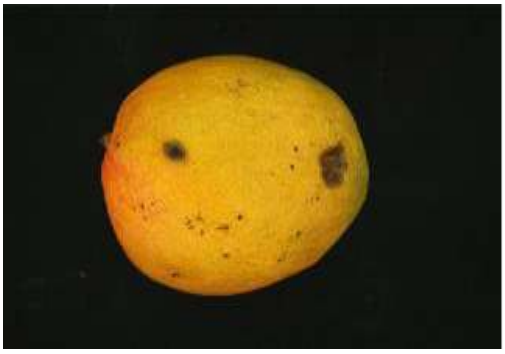
Fig 2 Flow chart

Algorithm:
Step 1: Input the fruit image.
Step 2: Pre-process the original image RGB.
Step 3: Filter the image to remove noise.
Step 4: The image is segmented using k means clustering algorithm.

Step 5: Subtract the background from the clustered images.
Step 6: Color masking is done using RGB color band.
Step 7: Apply the condition and display the result.

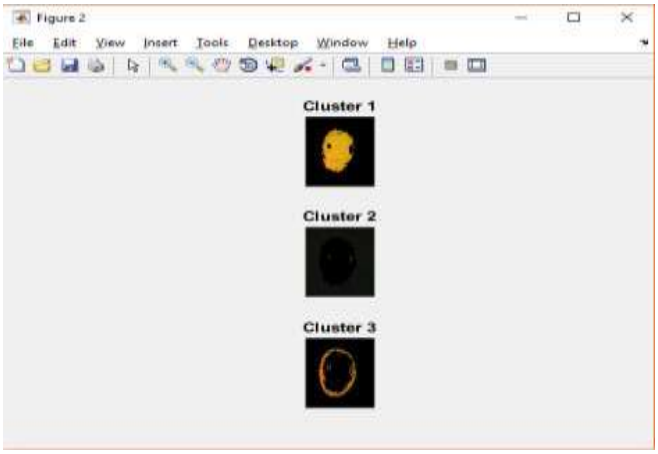
V. RESULT AND DISCUSSION

In matlab we get the input as color image and display it in the output screen. The input fruit image is pre-processed to eliminate the unwanted data to achieve good quality of image. Pre-processed image is converted to binary from RGB.



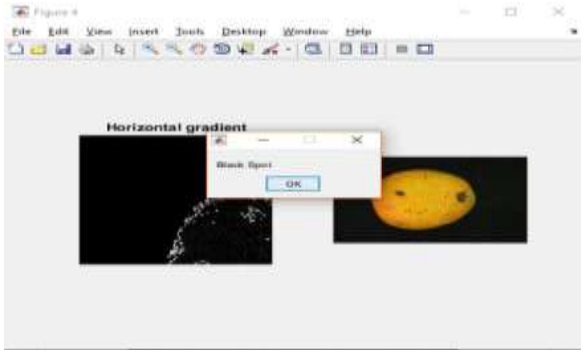
(a)

Segmentation is carried out to highlight the defected portions in the fruit. This segmentation is done using k means clustering algorithm. The image split into different clusters and merge the portion with similar intensity. Then the background subtraction is done.



(b)

The fruit is checked whether it is affected or not by extracting the feature. The output will display the type of the defect in the output screen.



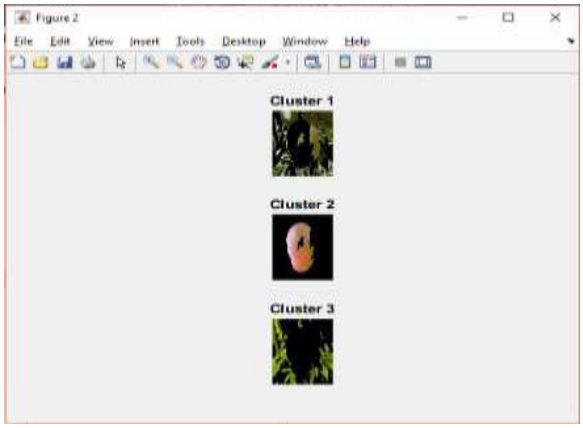
(c)

Figure 3. dark spots (a) Given image, (b) separate cluster, (c) output display

The mango fruit is given as a input image. The preprocessing is done and input image is displayed.

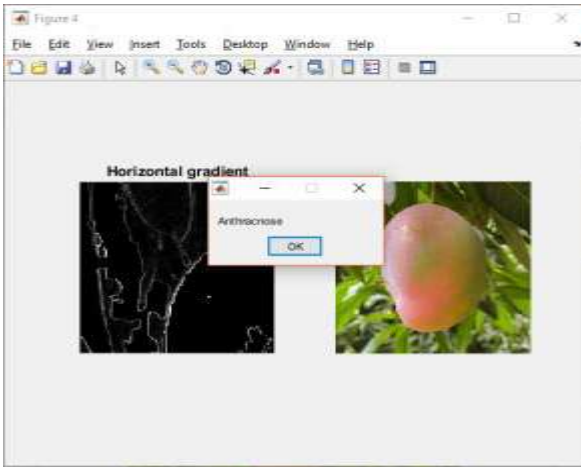
(a)

The image clustering is done using split and merge algorithm and background is subtracted.



(b)

The result of the processing is displayed in the output screen.

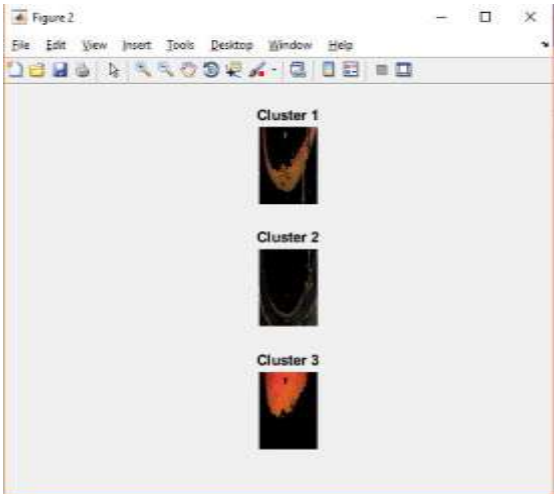


(c)

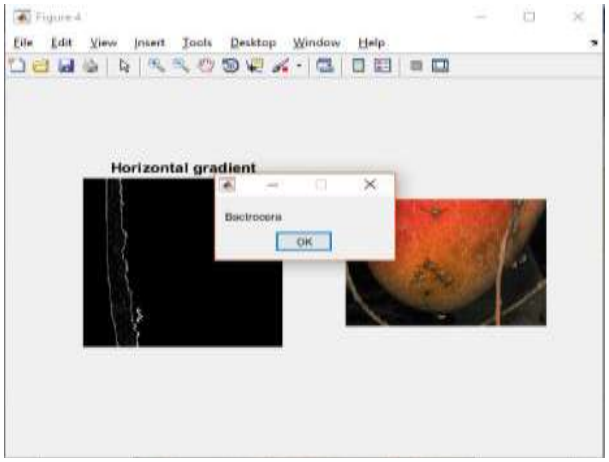
Figure 4. Anthracnose (a) Given image, (b) separate cluster, (c) output display

The bacterial infected mango fruit is taken as a input image to process.

(a)



(b)



(c)

Figure 5. Bactrocera (a) Given image, (b) separate cluster, (c) output display

CONCLUSION

This paper introduced the system image processing method to determine the faulty in the fruits and vegetables by processing the surface image of fruits and vegetables. This paper introduced the split and merge segmentation algorithm with the effective background subtraction technique Otsu's thresholding algorithm. The affected parts in the fruits and vegetables were identified and spread the fresh items from the defected ones. Through this system process the three different types of defects in fruits and vegetables. The proposed algorithm, sorting of fruits can be done based on quality. This system reduces the man power and the percentage of human error can be decreased. In future we plan to modify the algorithm to detect more than three defects and also the system will have a good prospect of application in fruit size detecting and grading areas.

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