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# A Review of Infected Part Detection of Apple Fruit Using Various Segmentation Techniques in MATLAB

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## ABSTRACT

Diseases in fruits have become a major factor leading to less productivity as well as poor quality in agricultural sector. It has been a necessity to inspect the plant during its growth period as well as at the time of fertilization. In this paper, image processing techniques have been used for detection of diseases in fruits and classification has been performed using neural network pattern reorganization toolbox in MATLAB. The proposed method consists of K-Mean clustering for image segmentation and Speeded up Robust Features (SURF) for feature extraction. The combined study of image processing and clustering technique gave a turning point to the defected part segmentation in fruits to calculate percentage of infection in fruit. The increasing awareness towards quality of food has opened new opportunities of research in this area. In this review I'll show implementation of various algorithms in MATLAB.

***Keywords:-***Apple fruit segmentation, K-means, Clustering, Infected part and detection etc.

## I. INTRODUCTION

### IMAGE PROCESSING

Image processing is a method to perform some operations on an image, in order to get an enhanced image or to extract some useful information from it. It is a type of signal processing in which input is an image and output may be image or characteristics/features associated with that image. Nowadays, image processing is among rapidly growing technologies. It forms core research area within engineering and computer science disciplines too.

Image processing basically includes the following three steps:

- Importing the image via image acquisition tools;
- Analyzing and manipulating the image;
- Output in which result can be altered image or report that is based on image analysis.

There are two types of methods used for image processing namely, analogue and digital image processing. Analogue image processing can be used for the hard copies like printouts and photographs.

Image analysts use various fundamentals of interpretation while using these visual techniques. Digital image processing techniques help in manipulation of the digital images by using computers. The three general phases that all types of data have to undergo while using digital technique are pre-processing, enhancement, and display, information extraction.

### IMAGE SEGMENTATION

Image segmentation is useful in many applications. It can identify the regions of interest in a scene or annotate the data. The author categorized the existing segmentation algorithm into region-based segmentation, data clustering, and edge-base segmentation. Region-based segmentation includes the seeded and unseeded region growing algorithms, the JSEG, and the fast scanning algorithm. All of them expand each region pixel by pixel based on their pixel value or quantized value so that each cluster has high positional relation. For data clustering, the concept of them is based on the whole image and considers the distance between each data. The characteristic of data clustering is that each pixel of a cluster does not certainly connective. The basis

method of data clustering can be divided into hierarchical and partitioned clustering. Furthermore, we show the extension of data clustering called mean shift algorithm, although this algorithm much belonging to density estimation. The last classification of segmentation is edge-based segmentation. This type of the segmentations generally applies edge detection or the concept of edge. The typical one is the watershed algorithm, but it always has the over-segmentation problem, so that the use of markers was proposed to improve the watershed algorithm by smoothing and selecting markers.

## II. TYPES OF SEGMENTATION

1. Threshold based segmentation. Histogram thresholding and slicing techniques are used to segment the image. They may be applied directly to an image, but can also be combined with pre- and post-processing techniques.
2. Edge based segmentation. With this technique, detected edges in an image are assumed to represent object boundaries, and used to identify these objects.
3. Region based segmentation. Where an edge based technique may attempt to find the object boundaries and then locate the object itself by filling them in, a region based technique takes the opposite approach, by (*e.g.*) starting in the middle of an object and then "growing" outward until it meets the object boundaries.
4. Clustering techniques. Although clustering is sometimes used as a synonym for (agglomerative) segmentation techniques, we use it here to denote techniques that are primarily used in exploratory data analysis of high-dimensional measurement patterns. In this context, clustering methods attempt to group together patterns that are similar in some sense. This goal is very similar to what we are attempting to do when we segment an image, and indeed some clustering techniques can readily be applied for image segmentation.
5. Matching. When we know what an object we wish to identify in an image (approximately) looks like, we can use this knowledge to locate the object in an image.This approach to segmentation is called matching.

## III. ALGORITHMS

### A. K-MEANS CLUSTERING ALGORITM

The food image processing using clustering is an efficient method. Clustering technique classifies the objects into different groups, or more specifically, partitioning of a data set into clusters (subsets), so that the data in each cluster (ideally) shares some common trait - often according to some defined distance measurement. Data partitioning is a usual technique for the analysis of statistical data, which is used in many areas, including machine learning, image analysis, pattern recognition, bioinformatics and data mining. The computational task of partitioning the data set into k subsets is often referred to unsupervised learning. There are many approaches of clustering designed for a wide variety of purposes. K-means is a typical clustering algorithm.. K-means is generally used to determine the natural groupings of pixels present in an image. It is attractive in practice, because it is straightforward and it is generally very fast. It partitions the input dataset into k clusters. Each cluster is represented by an adaptively changing center (also called cluster center), starting from some initial values named seed-points. K-means clustering computes the distances between the inputs (also called input data points) and centers, and assigns inputs to the nearest center. K-means method is an unsupervised clustering method that classifies the input data objects into multiple classes on the basis of their inherent distance from each other.

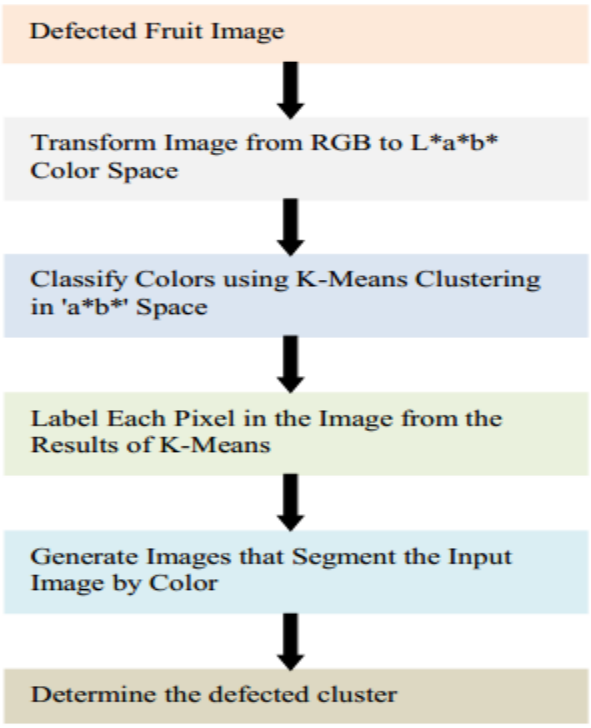



**Figure 1: Flow chart for Fruits defect segmentation.**

**Figure 2: Variety of infected fruits**

## B. FUZZY C-MEANS ALGORITHM

Fuzzy C-means algorithm has some steps discussed as

**Image Segmentation**

Segmentation is generally the first stage in any attempt to analyze or interpret an image automatically. Segmentation bridges the gap between low-level image processing and high-level image processing. Some kinds of segmentation technique will be found in any application involving the detection, recognition, and measurement of objects in images.

**Clustering**

Clustering is one of the widely used image segmentation techniques which classify patterns in such a way that samples of the same group are more similar to one another than samples belonging to different groups. There has been considerable interest recently in the use of fuzzy clustering methods, which retain more information from the original image than hard clustering methods.

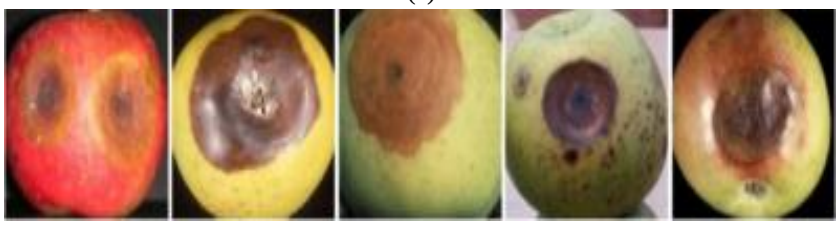
**Histogram**

Histogram is a plot between number of pixel and pixel intensity. To plot the histogram, bar graph can be used. The histogram code operates by first reading the greyscale value at the first entry and coming up with pixel intensity between 0 and 255. In scientific experiments, histograms are useful in characterizing the spread of data from repeated trials and for determining the probability of given measurement.

**Fuzzy C-means Algorithm**

Fuzzy C-means algorithm is widely preferred because of its additional flexibility which allows pixels to belong to multiple classes with varying degrees of membership. Fuzzy C means is a method of clustering which allows one pixel to belong to one or more clusters. Fuzzy C-means (FCM) is a clustering technique which differs from hard K-means that employs hard partitioning. The FCM employs fuzzy partitioning such that a data point can belong to all groups with different membership grades between 0 and 1. FCM is an iterative algorithm. The aim of FCM is to find cluster centers (centroids) that minimize a dissimilarity function.

(a)



(b)

(c)

**Figure: 3 Sample images from the data set infected with (a) apple scab, (b) apple rot, and (c) apple blotch diseases.**

### C. K-Nearest Neighbor

This method has training and testing sets. In the training phase, from a given set of training images features are extracted and used to train the system using the K-nearest neighbor classifier. In classification phase a given test fruit image is segmented and then the same features are extracted which are used for training the system for classification purpose. These features are queried to K-nearest neighbor classifier to label an unknown fruit. The block diagram of the method is given in Figure 4.

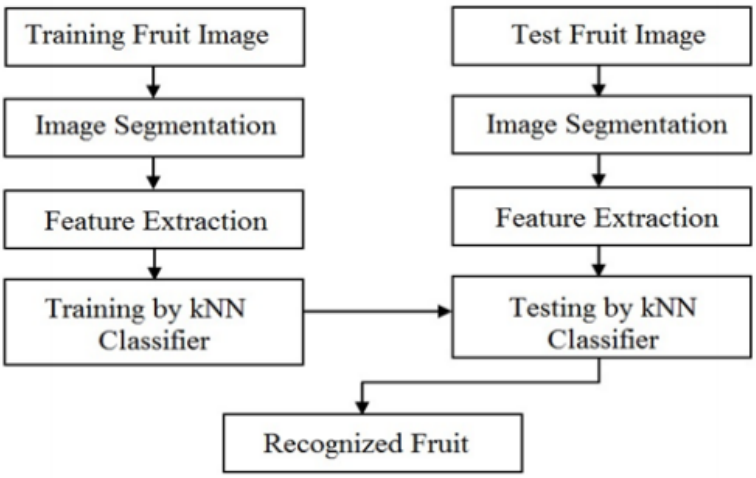
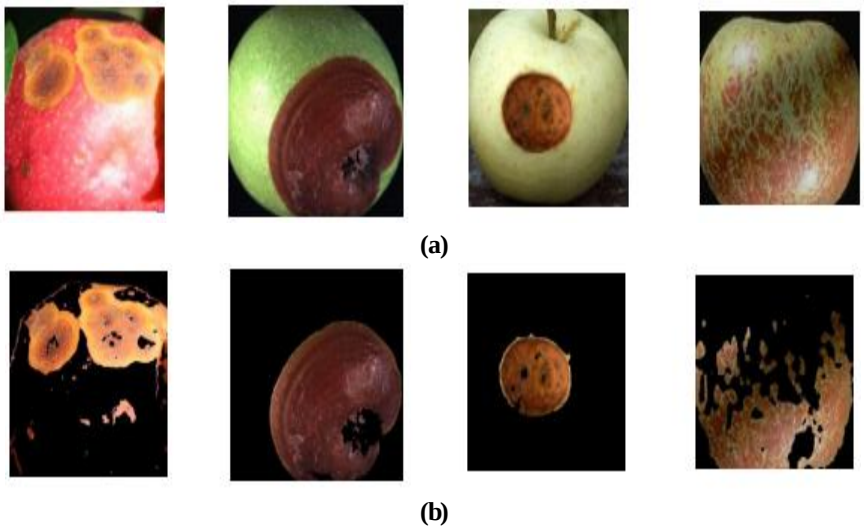



**Figure 4: Block Diagram of Methodology**



**(a)**

**(b)**

**Figure 5: Some defect segmentation results (a) Images before segmentation, (b) Images after segmentation**

## IV. RELATED WORK

Shiv Ram Dubey et al (2013) presented the proposed approach used K-means clustering technique for segmenting defects with three or four clusters. The proposed approach is able to accurately segment the defected area of fruits present in the image. K-means based defect segmentation approach. Shiv Ram Dubey et al (2014) This author has proposed approach is composed of mainly three steps: In the first step defect segmentation is performed using K-means clustering technique.In the second step features are extracted. In the third step training and classification are performed on a Multiclass SVM. CLBP feature shows more accurate result for the identification of apple fruit diseases and achieved more than 93% classification accuracy. P. Pandiyammal et al (2015) presented automated inspection of agricultural products, fruits in particular, is an important process as it reduces human interaction with the inspected goods, classify generally faster than humans and tend to be more consistent in classification. Experimental results suggest that the algorithms are able to segment the defects 93% accuracy. Ridhuna Rajan Nair (2015) proposed approach used improved k-means clustering and segmentation technique. Considering the wide range of application in the small scale and the large scale industries of the proposed system, we can conclude that the proposed system is more feasible with less time complexity and dependency. J.Ramprabhu et al (2015) presented The system proposed here is a display model. In this paper, a framework for the defect segmentation of fruits using images is projected and valued. For a large scale production the number of cameras and length of conveyor system can be modified according to our requirements in future. VaniAshok et al (2015) presented proposed approach used K-Means clustering and Fuzzy C-Means clustering to segment defects in apple images. Experimental results suggest that the algorithms are able to segment the defects more accurately. The major drawback of K-Means is that, there may be a skewed clustering result if the cluster number estimate is incorrect. It is overcome to certain extent in the proposed method by determining the number of clusters using the histogram of the image. The image is also pre-processed to remove noise.

## V. CONCLUSION

Image processing based approaches are proposed and evaluated in this paper for classification and grading of apple fruit images. We collected the database of different images from previous papers and researches. Various image processing techniques are reviewed here. K-means clustering is the best algorithm for clustering. Fuzzy c-means clustering is also good algorithm for clustering.

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