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Infected Fruit Part Detection Using K- Means Clustering Segmentation Technique

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***Abstract*— Nowadays, overseas commerce has increased drastically in many countries. Plenty fruits are imported from the other nations such as oranges, apples etc. Manual identification of defected fruit is very time consuming. It presents a novel defect segmentation of fruits based on color features with K-means clustering unsupervised algorithm. We used color images of fruits for defect segmentation. Defect segmentation is carried out into two stages. At first, the pixels are clustered based on their color and spatial features, where the clustering process is accomplished. Then the clustered blocks are merged to a specific number of regions. Using this two step procedure, it is possible to increase the computational efficiency avoiding feature extraction for every pixel in the image of fruits. Although the color is not commonly used for defect segmentation, it produces a high discriminative power for different regions of image. This approach thus provides a feasible robust solution for defect segmentation of fruits. We have taken apple as a case study and evaluated the proposed approach using defected apples. The experimental results clarify the effectiveness of proposed approach to improve the defect segmentation quality in aspects of precision and computational time. The simulation results reveal that the proposed approach is promising.**

I. Introduction

Image segmentation is one of the initial steps in direction of understanding images and then finds the different objects in them. Modern agricultural science and technology is extreme advance. The value of fruit depends on the quality of fruit. It is an important issue how to assay quality of fruit in agricultural science and technology. The classical approach of fruits quality assessment is done by the experts and it is very time consuming. Defect segmentation of fruits can be seen as an instance of the image segmentation in which we are interested only to the defected portion of the image.

Image segmentation methods are generally based on one of two fundamental properties of the intensity values of image pixels: similarity and discontinuity. In the first category, the concept is to partition the image into several different regions such that the image pixels belonging to a region are similar according to a set of predefined criteria's. Whereas, in the second category, the concept of partition an image on the basis of abrupt changes in the intensity values is used.

Edge detection technique is an example of this category which is similar to the boundary extraction. Based on the discontinuity or similarity criteria, many segmentation methods have been introduced which can be broadly classified into six categories: (1) Histogram based method, (2) Edge Detection, (3) Neural Network based segmentation methods, (4) Physical Model based approach,(5) Region based methods (Region splitting, Region growing& merging), (6) Clustering (Fuzzy C-means clustering and K-Means clustering).

Histogram based image segmentation techniques are computationally very efficient when compared to other image segmentation techniques because they usually require only a single pass through the image pixels. In this technique, a histogram is calculated from all of the image pixels, and the peaks and valleys are detected in the histogram. Neural Network based image segmentation relies on processing small regions of an image using a neural network or a set of different artificial neural networks. After this, the decision-making method marks the regions of an image on the basis of the category recognized by the artificial neural network. The region based image segmentation method uses the similarity of pixels within a region in an image. Sometimes a hybrid method incorporating the region based and edge based methods have been proved to be very useful for some applications. The seeded region growing method was the first region growing method.

Clustering based image segmentation methods are also used by many researchers. The segmentation method incorporating clustering approaches encounters great difficulties when computing the number of clusters that are present in the feature space or

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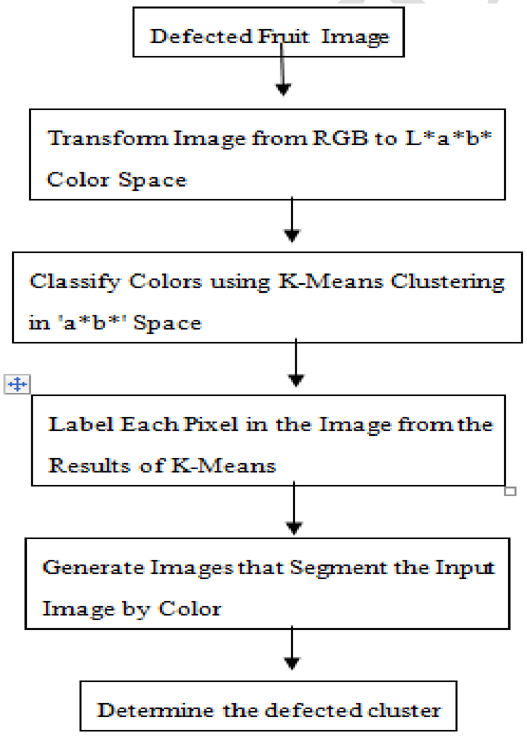
extracting the appropriate feature. This type of image segmentation is widely used due to the simplicity of understanding and more accurate result.

II. RELATED WORKS

Color image segmentation has been a difficult task for their searchers over the past two decades. It is an essential operation in image processing and in many computer vision, pattern recognition, and image interpretation system, with applications in industrial and scientific field(s) such as Remote Sensing, Microscopy, Medicine, content-based image and video retrieval, industrial automation, document analysis and quality control. The efficiency of color image segmentation may significantly influence the quality of an image understanding system. Among myriads of existing segmentation techniques, many have used unsupervised clustering methods. For example, image segmentation on the basis of region merging is analogue of agglomerative clustering. Graph cut methods such as normalized cut and minimal cut characterize the problem of clustering in a graph theoretic way.

A major problem for this kind of methods known as the problem of validity is how to decide the number of clusters in any image. Automatic image segmentation by integrating seeded region growing and color edge detection. They have used fast Entropy thresholding for the extraction of edges. After they have obtained color edges that provided the foremost geometric structures in an image, then they have determined the centroids between these adjacent regions and considered it as the initial seeds. These seeds were then replaced by centroids of the generated homogeneous edge regions by incorporating the additional pixels.

III. FRUITS DEFECT SEGMENTATION



IV. SOFTWARE FEATURES

A. INTRODUCTION TO MATLAB

MATLAB (matrix laboratory) is a numerical computing environment and fourth-generation 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, including C, C++, Java, and Fortran. Although MATLAB is intended primarily for numerical computing, an optional toolbox uses the MuPAD symbolic engine, allowing access to symbolic computing capabilities. 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 is widely used in academic and research institutions as well as industrial enterprises.

B. SYNTAX

The MATLAB application is built around the MATLAB language, and most use of MATLAB involves typing MATLAB code into the Command Window (as an interactive mathematical shell), or executing text files containing MATLAB codes, including scripts and/or functions.

C. INTERFACING WITH OTHER LANGUAGES

MATLAB can call functions and subroutines written in the C programming language or FORTRAN. A wrapper function is created allowing MATLAB data types to be passed and returned. The dynamically loadable object files created by compiling such functions are termed "MEX-files" (for MATLAB executable). Libraries written in Perl, Java, ActiveX or .NET can be directly called from MATLAB, and many MATLAB libraries (for example XML or SQL support) are implemented as wrappers around Java or ActiveX libraries. As alternatives to the MuPAD based Symbolic Math Toolbox available from Math Works, MATLAB can be connected to Maple or Mathematica. Libraries also exist to import and export MathML.

D. MATLAB IN IMAGE PROCESSING

Image Processing Toolbox provides a comprehensive set of reference-standard algorithms, functions, and apps for image processing, analysis, visualization, and algorithm development. You can perform image enhancement, image deblurring, feature detection, noise reduction, image segmentation, geometric transformations, and image registration. Many toolbox functions are multithreaded to take advantage of multicore and multiprocessor computers. Image Processing Toolbox supports a diverse set of image types, including high dynamic range, gigapixel resolution, embedded ICC profile, and tomographic. Visualization functions let you explore an image, examine a region of pixels, adjust the contrast, create contours or histograms, and manipulate regions of interest (ROIs). With toolbox algorithms you can restore degraded images, detect and measure features, analyze shapes and textures, and adjust color balance.

E. KEY FEATURES

- Image enhancement, filtering, and deblurring
- Image analysis, including segmentation, morphology, feature extraction, and measurement
- Geometric transformations and intensity-based image registration methods
- Image transforms, including FFT, DCT, Radon, and fan-beam projection
- Workflows for processing, displaying, and navigating arbitrarily large images
- Image Viewer and Video Viewer apps
- DICOM import and export

V. Conclusion & Future Enhancement

A framework for the defect segmentation of fruits using images is proposed and evaluated in this project. The proposed approach used K-means clustering technique for segmenting defects with three or four clusters. We have used defected apples for the experimental observations and evaluated the introduced method considering apples as a case study. Experimental results suggest that the proposed approach is able to accurately segment the defected area of fruits present in the image. K-means based defect segmentation approach is also segment defected area with the stem and calyx of the fruits. The future work includes automatic determination of number of clusters required to segment the defects more accurately.

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