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Image Segmentation for Food Quality Evaluation Using Computer Vision System

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ABSTRACT
Quality evaluation is an important factor in food processing industries using the computer vision system where human inspection systems provide high variability. In many countries food processing industries aims at producing defect free food materials to the consumers. Human evaluation techniques suffer from high labour costs, inconsistency and variability. Thus this paper provides various steps for identifying defects in the food material using the computer vision systems. Various steps in computer vision system are image acquisition, Preprocessing, image segmentation, feature identification and classification. The proposed framework provides the comparison of various filters where the hybrid median filter was selected as the filter with the high PSNR value and is used in preprocessing. Image segmentation techniques such as Colour based binary Image segmentation, Particle swarm optimization are compared and image segmentation parameters such as accuracy, sensitivity , specificity are calculated and found that colour based binary image segmentation is well suited for food quality evaluation. Finally this paper provides an efficient method for identifying the defected parts in food materials.

Keywords – food quality, computer vision, parameters, food products ,defects

I. INTRODUCTION

Image processing is a technique to enhance the input image to provide a clearer data. Digital image processing, where the digital images are processed using the computer. Digital images are composed of large number of elements called pixels, each pixel represents the image detail. Computer vision system deals with processing of image data with various steps. It provides a clear vision and high reliability in data processing. Human vision systems for the data analysis provided a poorer details and is time consuming such that computer vision system provides a finer detail.

II. FOOD QUALITY EVALUATION

Food quality evaluation plays an important role in providing defect free food products to the consumers .Quality which defines the internal and external characteristics of the materials .In food quality the external characteristics depends on colour, shape ,size and the internal characteristics as physical and chemical. In food processing industries the food products are continuously over the sieves such that hundreds of food products are scanned in fraction of second. CCD cameras are used to monitor the movement of the food products and finally the defected materials are thrown away from the sieves.

III. COMPUTER VISION TECHNOLOGY

Computer vision technology is defined as the method of automating and integrating a wide range of processes and it performs various typical tasks like image capturing or image acquisition, preprocessing, image segmentation, feature extraction and feature classification applications range from various tasks like machine vision system, food quality evaluation, pattern recognition.

IV. STEPS IN COMPUTER VISION TECHNOLOGY

The organization of a computer vision system is highly based on applications where stand-alone applications which solve a specific measurement or detection problem and others constitute a sub-system of a large designs. Computer vision system provides a data. Typical functions which are found in many computer vision systems. Computer vision system or computer aided system provides various steps to identify the defected parts of the input image. This technique provides a fast and efficient way to obtain the required solutions with various image representations. The block diagram of the computer vision system are represented below

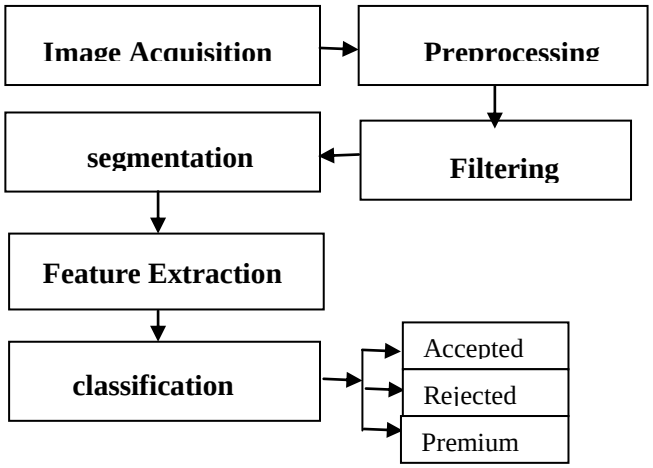

Fig 1: Block diagram of Computer vision system

V. IMAGE ACQUISITION

Image acquisition is the process of capturing or acquiring the images from various hardware sources as digital cameras. The pixel values typically correspond to light intensity in one or several spectral bands for gray images or colour images, but can also be related to various physical measures, such as depth, absorption or reflectance of sonic or electromagnetic waves, or nuclear magnetic resonance.

VI. PREPROCESSING

In order to enhance the brightness of the image and to remove the film artifacts. Filtering is done called the preprocessing. In this paper preprocessing are done using various filters such as low pass filter, high pass filters, median filter, Gaussian filter, wiener filter, progressive switching median filter to obtain the proper filtered image.

A. Median filtering

Median filtering is a non linear digital filter used to remove the black and white dots in the image called the salt and pepper noise and it also preserves the edges ,the high frequency components.

B. Gaussian filter

Gaussian smoothing is effective for removing Gaussian noise. The weights give higher significance to pixels near the edge reduces edge blurring. Gaussian filter will not blur the image too much Good to be used in edge detector to reduce noises.

C. Low pass filter

A low-pass filter is a filter that passes low-frequency components and attenuates the components with frequencies higher than the cutoff frequency. The actual amount of attenuation for each frequency varies depending on specific filter design. The frequency components referred here are pixels.

D. High pass filter

A high-pass filter is a filter that passes high-frequency components and attenuates the components with frequencies lower than the cutoff frequency. The actual amount of attenuation for each frequency varies depending on specific filter design. The frequency components referred here are pixels.

E. Hybrid median filter

Hybrid median filter is same as the median filter except that the spatial directions are calculated diagonally as MR is the median of horizontal and vertical pixels R. MD is the median of diagonal D pixels.

F. Wiener filter

The Wiener filtering is an optimal filter it minimizes the overall mean square error in the process of inverse filtering and noise smoothing. In wiener filter the power spectra of original noise must be known.

G. Progressive switching median filter

The progressive switching median filter (PSM) filter uses a switching function which includes two stages of noisy image processing for the removal of impulse noise. In the first stage only a switching scheme are used to detect proportion of noise pixels. Detection and filtering of corrupted nosie pixels of digital image where applied through several iterations.

VII. IMAGE SEGMENTATION

Image segmentation is the process of dividing an image into multiple parts. This is used to identify objects and relevant information in digital images. Image segmentation is the process of partitioning a digital image into multiple segments, sets of pixels, also known as superpixels. The goal of segmentation is to simplify or change the representation of an image into something that is more meaningful and easier to analyze.

A. Colour based Binary Image Segmentation

Image segmentation is used to locate objects and separate the foreground from the background. The result of image segmentation is a set of segments that collectively cover the entire image .In colour based binary image segmentation the brightness of the input colour images are removed by adjusting the threshold values. Then the colour image is converted to binary image and the edge detection is applied. Then colour inversion is done to identify the defected

parts. Finally the binary image is converted to colour image and the defected parts are easily identified.

B. Particle Swarm Optimization

PSO is a computational method that optimizes a problem by iteratively improving a candidate solution with a proper quality measurement. PSO optimizes a problem by having a group of solutions and moving these particles around the search-space by a simple mathematical formulae. Each particle's movement is influenced by its local best known position but, is guided toward the best known positions in the search-space, which are updated as better positions are found by other particles. This is expected to move the swarm toward the best solutions.

C.Parameters of image segmentation

Accuracy: Determines the efficiency of the system

Accuracy = ((True positive + true negative)/(true positive+ True negative+False positive+false negative))*100 (1)

Specificity:Fraction of negative samples predicted as a positive class

Specificity =True negative/(true negative+false positive)*100 (2)

Sensitivity:Fraction of positive samples predicted correctly by the model

Sensitivity = True positive/(True positive+False negative)*100 (3)

VIII. SOFTWARE USED

MATLAB is a high-level language used for performing mathematical calculations and programming in image processing. Data can be analyzed using MATLAB, develop algorithms, and create models and applications. The language, tools, and built-in math functions enable us to explore multiple approaches and reach a solution faster than with spreadsheets or traditional programming languages.

IX. RESULTS AND DISCUSSION

A. Parameters of image segmentation

Food materials	Accuracy %		Specificity %		Sensitivity %	
	CBBIS	PSO	CBBIS	PSO	CBBIS	PSO
Mango	70.66	56.71	99.95	88.64	91.26	81.45
Tomato	87.44	82.04	99.07	85.26	95.37	83.45
Pumpkin	80.13	64.41	99.93	86.29	93.06	77.65
Onion	81.62	68.17	99.83	89.82	94.61	81.74
Potato	69.80	64.87	99.90	91.63	91.76	83.94

X. CONCLUSION AND FUTURE WORK

The Quality of the food materials are identified using the computer aided system. The key idea of the proposed method is to identify the defected parts of food materials. The proposed framework provides the comparison of various filters and the hybrid median filter was selected as the filter with the high PSNR values and was used in the preprocessing stage. Image segmentation process namely Colour based binary Image segmentation and Particle swarm optimization techniques were compared then their parameters such as accuracy, specificity, sensitivity were measured and found that the color based binary image segmentation were well suited for image segmentation. Finally the defected parts were being segmented from the original image. The future work is based on feature classification and feature selection of food products by Artificial Neural Networks to classify the quality of food as accepted, rejected and premium.

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