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An Image Processing Approach to Detect Fruit Damage

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Abstract - *This project is a software technique which uses saliency detection technique to identify the damage portion of the fruit. This project will help classify the fruit that was damaged in the bunch of fruits. The damaged portion of the fruit will be recognized by using image processing technique. Using direct human intervention, typically defective portion of fruits are established. There are several ways of testing the fruit quality by seeing its color, texture and scale. But it will easily identify damaged parts of the fruit using saliency mapping technique. It will offer good customer experience.*

Key Words*: *Saliency, Salient image, MATLAB, Image processing algorithm, ROI, SR Model

1. INTRODUCTION

60–70% of the Indian population depends directly or indirectly on the agricultural sector. Pre-harvest and post-harvest processing in India is achieved by human direct intervention. Most food processing industries often rely on direct human intervention in the manual processing of fruit quality control. Fruits are typically used for various uses such as producing juice, jam, jelly, cakes, etc. Once fruits are used for any food product, the fruit quality is the main concern. This project will be of assistance to the agricultural sector as well as any food processing industries for product quality test

Today, in their day-to-day lives, people are eating huge quantities of fruit. Many food processing industries sells fruit products in packaged form when we talk about the fruit products then the quality of the fruit is a major concern. In food manufacturing industries, quality control of the product is usually conducted using human interference, which may not be effective all the time, and is often time consuming. There should be an automated quality testing mechanism for large amounts of fruits. Image processing algorithms can be used to measure the number of photographs of fruits borne by a conveyor belt.

2. LITERATURE REVIEW

Several saliency detection strategies applied in the segmentation and identification of objects. A study on visual saliency detection for RGBD saliency detection has been conducted by several researchers. There are works on the different models used to identify salient objects. Several of the investigators have focused on the computer vision in saliency detection for paper checked. It included CNN that will provide new direction for saliency detection for performance comparison. IoT Based quality control systems for the fruit quality detection are also available.

The artificially matured and naturally ripened fruits can be detected using a smart phone and microcontroller. Improving RGBD Saliency Detection Using Progressive Region Classification and Saliency Fusion is a process that, by improving RGBD progressive region classification, is based on saliency detection. Here the random regression of the forest is used to obtain the samples of the training and it provides better results.

3. WORK METHODOLOGY

This research is an image processing method by analyzing the fruit images in a digital image processing technique to create an automated quality testing process to sort the good damaged fruit aside. In this paper, we worked in two algorithms to determine the saliency map of each input image. The first approach utilizes the inaccurate result where the second algorithm gives the accurate result to detect the saliency of the image. In the first algorithm, the spectral residual and the FFT calculation of the input image shows inaccurate results. In the second algorithm, the calculation of the saliency map is done using saliency formula which gives the exact result of the detection of saliency.

3.1 Spectral residual region extraction

SR model is used in saliency calculation for extraction of the characteristic. The estimation of the Salmap takes the following method-

Step 1. A gray image is computed or calculated by transforming the RGB values as red (R), green (G), and blue (B) three-color channels of the input Image as I(x)

Using the following formula the SR model works-

$$G(x) = 0.229 \times R + 0.587 \times G + 0.114 \times B \ldots\ldots\ldots\ldots\ldots(1)$$

Step 2. A frequency image f is obtained by

$f = (G(x))$, and the amplitude spectrum $A(f)$ and Phase

Spectrum $P(f)$ are, respectively, computed by

(f) = abs (f),

(f) = angle (f)..... (2)

Where, F denotes the Fourier Transform.

Step 3. The spectral residual (f) of the input image is defined as

$(f) = L(f) - h(f) \times L(f)$.....(3)

Where, the log amplitude spectrum $L(f)$ is given by

(f) = log$(A(f))$;

$L(f)$is the average log amplitude spectrum, which is denoted as the general shape of log spectra; and $h(f)$ is an 3× 3 local average filter defined by as follows-

$$h(f) = \frac{1}{3 \times 3}\begin{pmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{pmatrix}.$$

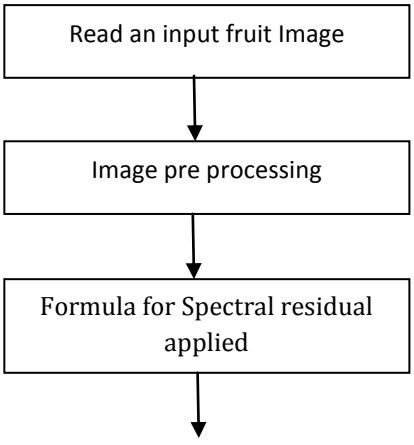
.....(4)

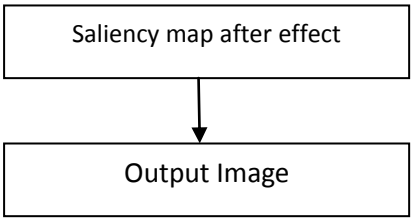
Correspondingly, (f) denoted as the residential regions in the input image.

Step 4. Inverse Fourier Transform establishes the final saliency map in the spatial domain as below-

$(x) = F^{-1}$ [exp $(R(f) + P(f))$]^2 ,---------- (5)

Where, F^{-1} denote the Inverse Fourier Transform.

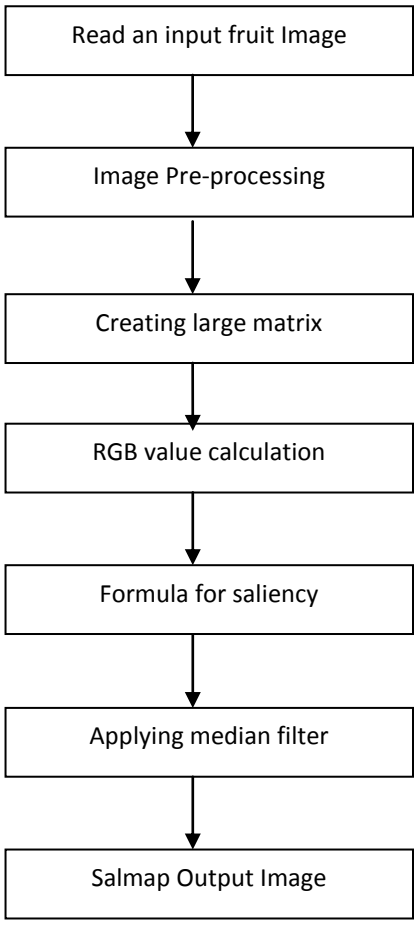




Block diagram-1: Workflow of SR Model

3.2 Saliency detection by ROI algorithm

Selecting Region Of Interest can be defined as the masking technique to be applied to the input image. Creating a large matrix and operating that matrix on the input images will result in a good transformation of color space. There are several methods of detecting the ROI of an input image .Sometimes it is by manually selected. But here RGB value calculation is being done for every image input and the masking operation is implemented using a large matrix. This ROI technique is used to detect the salient part of the fruit. This algorithm workflow is as follows-



Block diagram-2: Workflow of Saliency detection by ROI

4. RESULT ANALYSIS

The test images for both the algorithms as shown below are giving a clear idea that SR model is not giving good result for fruit damage detection proposed using MATLAB software as per the above mentioned algorithms. But saliency detection algorithms are clearly applicable for the fruit damage detection process both in pre and post harvesting.

4.1 Result of spectral residual region extraction algorithm

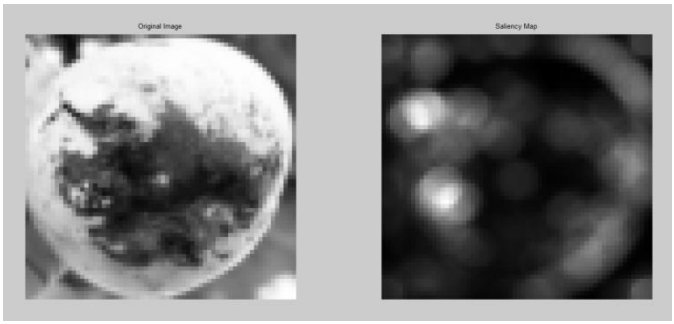


Fig-1: Result for SR Model for input image 1

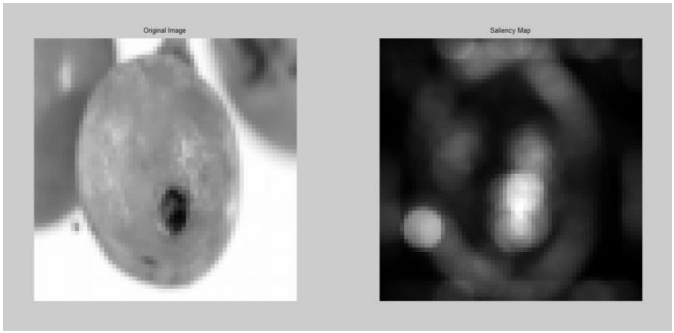


Fig-2: Result for SR Model for input image 2

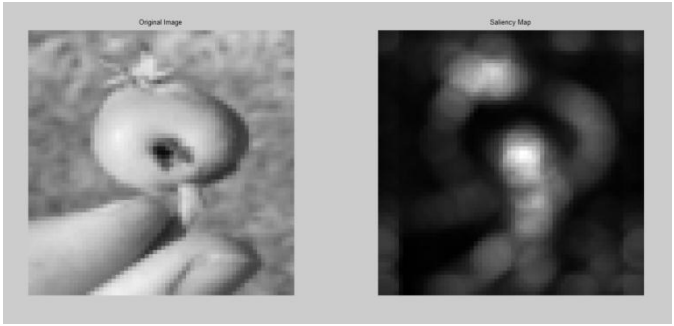


Fig-3: Result for SR Model for input image 3

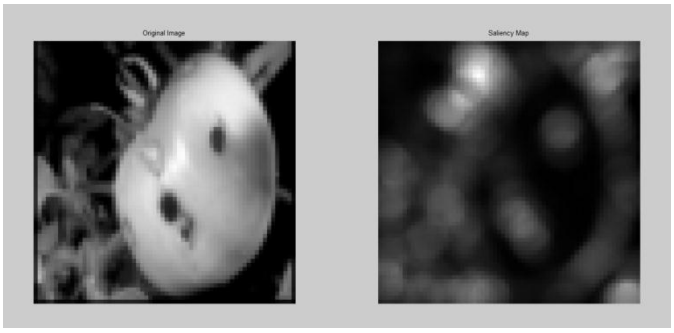


Fig-4: Result for SR Model for input image 4

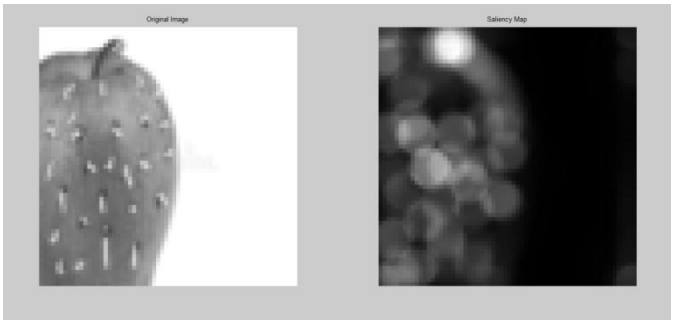


Fig-5: Result for SR Model for input image 5

4.2 Result of saliency detection by ROI algorithm

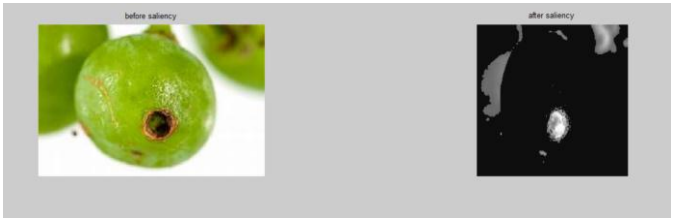


Fig-6: Result for Saliency detection using ROI for input image 1

Fig-7: Result for Saliency detection using ROI for input image 2

Fig-8: Result for Saliency detection using ROI for input image 3

Fig-9: Result for Saliency detection using ROI for input image 4

Fig-10: Result for Saliency detection using ROI for input image 5

Table -1: Accuracy of the applied algorithms

Sl . no.	Image processing Algorithms	No. of test images taken	Correctly detected the damage portion in test images	Accuracy
1.	Spectral residual region extraction algorithm	50	We didn't get appropriate output	Accuracy couldn't be calculated
2.	Saliency detection using ROI algorithm	50	42	84%

5. CONCLUSION

This saliency detection technique is usually used for the method of object detection and segmentation, but here we have used this technique to detect the damaged portion of the fruit that can be called as a technique for quality detection. There will be no human intervention in this process to test the consistency of the fruit rather it will provide a digital image processing solution to detect the damage part of the fruit. . This can provide the food processing companies with a good technological solution, this will also provide a good customer experience. Using SR model algorithm it may not give the exact result but using saliency detection by ROI selection it will give a proper identification for fruit quality detection as it will show the damage part of the fruit clearly.

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