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A Methodology for Detecting/Identifying Fruit Infection with Grading System

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Abstract: Computer vision techniques have applied for detecting a measuring the food quality as well as grading. Sorting of fruits and vegetables is one of the most important process in fruits production, while this process is typically performed manually in most countries. Learning methods are detected for the task of classifying infected/uninfected fruits from images for outer surface. A series of color and texture features are extracted from the captured images and principal components analysis performed to reduce the dimensionality of the resulting feature vectors.

Keywords: Fruit quality, Fruit images, Color, Texture, PCA, Pattern classification.

I. INTRODUCTION

In imaging science, **image processing** is processing of images using mathematical operations by using any form of signal processing for which the input is an image, such as a photograph or video frame; the output of image processing may be either an image or a set of characteristics or parameters related to the image[1][10].

Image processing in agricultural applications consist of three steps: (1) image enhancement, (2) image feature extraction and (3) image feature classification. Image enhancement is commonly applied to a digital image to correct problems such as poor contrast or noise.

For the test fruit image, color and texture features are derived as that of the training phase and compared with corresponding feature values, stored in the feature library.

The classification is done using the Minimum Distance Criterion. The image from the training set which has the minimum distance when compared with the test image says that the test image belongs to the category of that training image[10].

The general aim is to fill an important gap in the application of computer vision as a tool for industry in the inspection of fruits and vegetables[1][2].The development of computer vision techniques to inspect the quality of agricultural products, owing to the need to find an alternative to traditional manual inspection methods and to eliminate contact with the product, increase reliability and objectivity, besides of introducing flexibility to inspection lines and increasing the productivity and competitiveness of agriculture industry[11].

1.1. Objectives

Current research work is dedicated to achieve some of the following objectives.

i. To measure the quality of all the fruits with proper clustering.
ii. To characterize all the fruits to determine the infection.
iii. To identify infected and non infected region from the input images and classify the infected and non infected patterns as per their level of infection as known as low, average, medium, high, extreme high and fully infected fruits according to external surface.

II. LITERATURE REVIEW

A lot of analysis has been worn out the fruit sorting and grading system. Co-occurring fruit sorting by size and color would save time, reducing fruit handling. Polder [5] used principle component analysis (PCA) in combination with spectral imaging to grade tomato fruits by identifying their ripeness level.

Van Der Heijden and Polder [5] additionally compared pictures with normal RGB pictures for classifying tomatoes in several maturates categories exploitation individual pixels and obtained similar results.

Lino [6] planned a grading system for lemons and tomatoes exploitation color options for maturities detection. He reports that it had been necessary to capture a definite range of pictures to get fruit diameter, recommending the applying of video pictures to examine the fruit look.

Lino[6] planned a grading system for lemons and tomatoes exploitation color options for maturities detection. During this system, the ripening of tomato showed a rise of the red color and a decrease of the untested color, indicating chlorophyll degradation meantime glycogen began to be created.

Machine vision systems and close to infrared examination systems are introduced to several grading facilities with mechanisms for inspecting all sides of fruits and vegetables. Image process offers answer for machine-

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driven fruit size grading to produce correct, reliable, consistent and quantitative info. Fernando [7] designed a system to diagnose six differing kinds of surface defects in citrus fruits employing a variable image analysis strategy.

H. Wang [4] classified 2 types of wheat diseases showed color, form and texture options to coach a back propagation neural network. The resulting system achieved a classification accuracy of over ninetieth. Cho [8] used hyper spectral light imaging for police work cracking defects on cherry tomatoes.

2.1. Existing System

Intelligent systems that serve the industry are highly wanted after. Sorting of vegetables, fruits or crops is one of the most important processes in crops production, while this process is typically performed manually in most countries. FAOSTAT Database in 2011[1][9] says that tomatoes are the 8th most important vegetable crop with a world production of about 159 million tons worth 582 trillion US$ in 2011. The aim of that work presented is hence to develop and automated defect detection system dedicated for tomato disorders. It is known that most crop disorders show in the plant root, stem, leaves and fruits according to the type and causes of disease [1].

III. PROPOSED WORK

In this, the proposed scheme designs the architecture for to measure the quality of fruits and determine the proper infection of fruit image. To achieve this work proposed system divided in two phases as follows-

3.1. Methodology

There are two phases - training phase and testing phase.

- Training Phase

In training phase database of infected patterns is created adaptively and manually.

➢ Create Database Adaptively
  In adaptive method infected patterns can be found by applying different techniques i.e. image preprocessing and image enhancement. These techniques find out the percentage of infection.

➢ Create Database Manually
  In manual method disease patterns and percentage of infection to those patterns are collected.

- Testing Phase

In testing phase infected patterns can be detect from the database and find the disease name and percentage of infection for that patterns.

➢ Testing Phase for Create Database Adaptively
  In this phase take image as an input for which find the infected patterns.

➢ Testing Phase for Create Database Manually
  In testing phase patterns are loaded from the database. Then pattern and percentage of infection from the list are selected. Discover disease for those patterns and apply fuzzy rule to find the disease with maximum frequency of infected patterns. If not satisfied with fuzzy conclusion go to differential pre-processing.

3.2. Data Flow Diagram

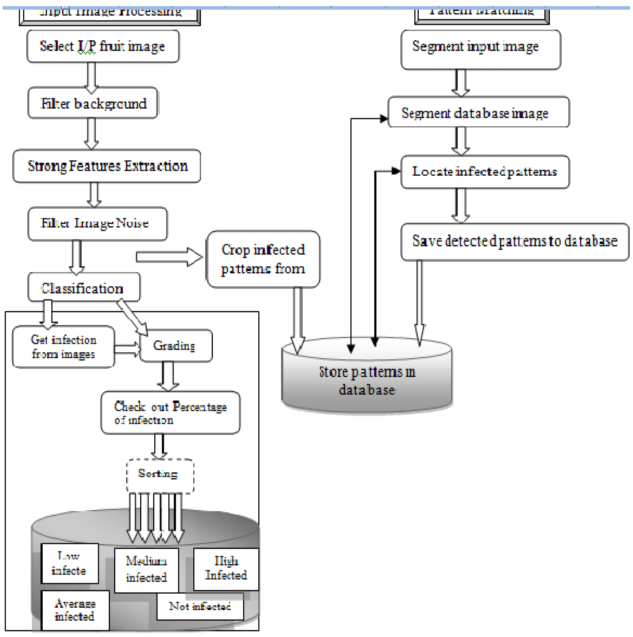

Fig. 1: Architecture of grading system

IV. EXPERIMENTAL RESULTS

In this project we are generating the result in three parameters as follows-

i. Mean intensity and entropy of infected fruit images.
ii. Grading system of infected fruit image.
iii. Graphical representation.

a) Mean intensity and entropy of infected fruit images.

Table 1: Result of images

Image Name	1.jpg	2.jpg	3.jpg	4.jpg	5.jpg
Mean intensity original image	0.44	0.282	0.64	0.56	0.58
Mean intensity of enhance image	0.5	0.33	0.7	0.53	0.79
Mean intensity of filter background image	0.47	0.31	0.67	0.61	0.74
Entropy of original image	17.71	17.08	17.53	17.47	17.25
Entropy of enhance image	14.76	14.97	11.71	13.8	13.04
Entropy of filter background image	17.62	16.59	16.99	17.19	16.95
Entropy of segment image	0.425	0.529	0.185	0.42	0.211
PSNR of filter Background image	17.94	11.77	16.46	16.85	11.3
PSNR of enhance image	12.61	14.47	11.5	14.25	12.43
PSNR of segment image	3.89	6.429	0.404	3.03	0.82
Time for filter background image	2.91 sec	2.82 sec	2.68 sec	2.64 sec	2.62 sec
Time for image enhancement	0.246 sec	0.166 sec	0.190 sec	0.16 sec	0.16 sec
Time for segmentation	0.082 sec	0.094 sec	0.091 sec	0.10s ec	0.08 sec

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b) Grading System of infected fruit images.

In this the grading system works step by step and find out the percentage of infection properly of infected pixels image by using fuzzy logic method. After getting percentage of infection it will divide and classify that infection as per levels of infection as low, medium, average and high.

Table 2: Criteria for Grading

Percentage of infection	Level of infection
0-10	Low
10-30	Average
30-60	Medium
60-100	High

Table 3: Grading and Sorting

Input image name	Infected region percentage	Infection level
1.jpg	40.23%	Medium

The original fruit image store in Medium folder after grading and sorting.

c) Graphical Representation

i. Mean intensity of original image vs. Mean intensity of enhance image

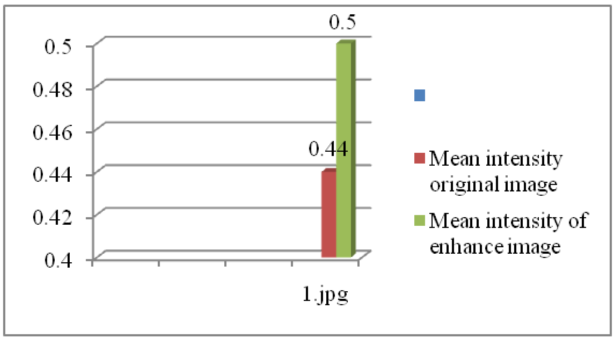

Fig 2: Graph of mean intensity of original image vs. mean intensity of enhance image

ii. Entropy of original image vs. Entropy of enhance image

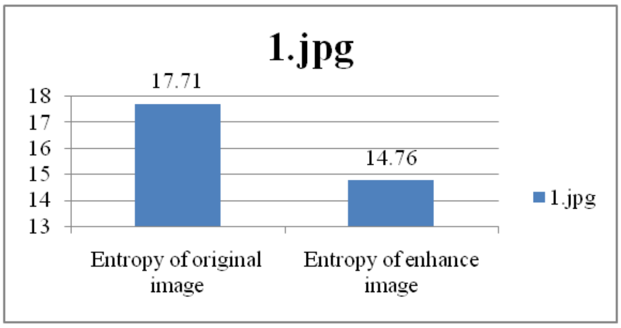

Fig 3: Graph of entropy of original image vs. entropy of enhance image

iii. PSNR of filter background image vs. PSNR of enhance image

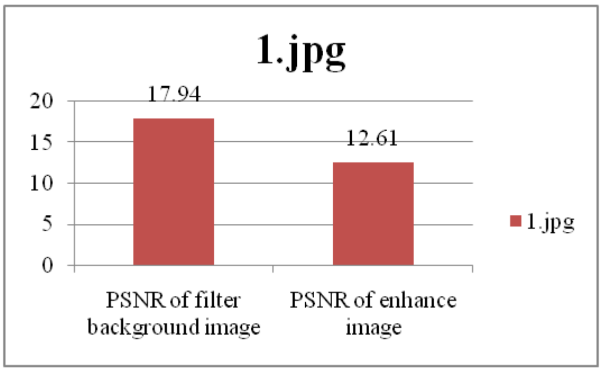

Fig 4: Graph of PSNR of filter background image vs. PSNR of enhance image

iv. Time for filter background image vs. Time for image enhancement

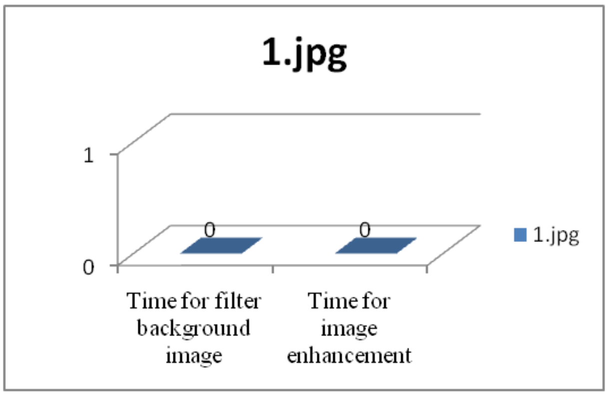

Fig 5: Graph of time for filter background image vs. time for image enhancement.

V. CONCLUSION

In this the objective of proposed method is to measure quality of fruits also to characterize all the fruits to determine the infection. And finally identify infected and non infected region from input images to classify the level of infection as low, average, medium and high. According to analysis mean intensity increases and entropy, PSNR and time decreases.

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APPENDICES

Sr.No.	Image Name	Fruit image
1	1.jpg	
2	2.jpg	
3	3.jpg	
4	4.jpg	
5	5.jpg