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Novel Development of Sorting and Grading of Fruits from Colour Images Using Fuzzy Logic Technique.

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ABSTRACT

The paper describing the non-destructive analytical method. The fruits taken are apple and tomato, it has the same color and size. Hence texture feature needs to be considered while classifying this kind of fruits.The operation of the automatic vision based system focuses to replace the execution of fruit sorting and grading process using the manual based technique, because the manual analysis leads to the problems while maintaining the grading process and uniformity in the sorting process. The collection of video image from the CCD camera in the automated system is placed on the top of the conveyer belt that carrying the fruits, then the images are processed according to the collection of several relevant features. The grading system uses a computer, a CCD camera and MATLAB software for analyzing.
Keywords: images, fuzzy logic technique, grading.

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INTRODUCTION

The growth of the technology is tremendous and to accelerate the work process the manual works are replaced by the automated work, which are performed by the machines. The technology has been spread to the agricultural products and the automated grading of the agriculture product grades the quality of the food products depending upon their features like texture, appearance and flavor. The properties of the texture feature are the firmness and the mouth feel, where the properties of the flavor features like sweetness or acidity are measured using the chemical compounds, which are difficult to measure. Thus, the properties of the appearance feature like color, shape and size of the fruits are measured, classified using the automated fruit grading system, then predicts the maturity of the fruit and it also examines the fruit's freshness.

The most significant criteria are the color and size of the fruit to determine the specific type and quality of the fruit. Usually the fruit color will be changed during ripening and it is determined using the light wavelength which are being reflected from its surface. The spectral variety of biological materials will provide a unique key to machine vision and for analyzing the image. Where, the nature of the fruit materials is very delicate and they should be tested under the non-destructive techniques. In the evaluation of agriculture products the classification plays a vital role in meeting their product quality standards and in increasing the market values, the classification of the fruit is measured using its size and color, where the color is considered to the physical property and the fruit size is considered under the visual property these measures are mapped into the automated system by implementing the suitable programming languages. Analysis of fruit size and the decision making process are achieved by implementing the fuzzy logic system model. This model classifies and predicts the feature extraction of the fruits based on their color and size. The fruit grade is also determined by implementing the fuzzy logic system model.

LITERATURE SURVEY

Automatic Grading of the diseases on leaves are described in (Arun Kumar R et al, 2011). Manual grading consumes huge amount of time and it is not feasible, in order to overcome this an approach of fuzzy logic is introduced for grading the disease automatically which appear on the leaves.The grading system built with the help of fuzzy logic and machine vision is useful for grading the diseases. This automatic grading system to analyze the disease on the leaves are essential in the present, but the observed results haven't met the expected evaluation results.

In this (Shivleela R Arlimatti, 2012) paper introduces the automatic classification system for apple fruit, it separatesand classifies the fruit area by extracting the statistical features, then the nearest neighbor classifieris implemented to estimate the threshold values from the image of the foreground to the background. Then, it leads to the binary classification to analyze the defected and the un-defected apples.

A non-destructive quality evaluation of fruit is described in (Rupali S.Jadhav & S.S.Patil, 2013). For automated fruit size grading is provided by the image processing technique. It provides the consistent, accurate, quantitative and reliable information about the fruit images. In this non-destructive method the fruit image is captured and the features are extracted using various types of detecting algorithms. After the detection of features like the fruit characteristics the grading accuracy is realized.

To identify the sensor node images within the wireless sensor network the Fuzzy logic system is implemented in (R.Gopinath, et, al, 2014). Linguistic variables are utilized to represent the input variables energy efficiency range. The sensor node with highest energy efficiency range is selected as the best node for transmitting the data to the destination and the AODV protocol in the fuzzy logic system is used to reduce the packet loss ratio, delay and to improve the energy efficiency, packet delivery and throughput.

In (Santhoshi Gayathri & D.Mary Kavitha) the three phase shunt active filter by utilizing the techniques of fuzzy and hysteresis controller are used to achieve the Harmonic current compensation and improves the performance of the three phase supply system by feeding the non-linear loads. The MATLAB, Simulink tool is used for fuzzy controller is to illustrate the DC link controls and the hysteresis controller to control the power quality of the sinusoidal waves.

PROPOSED METHODOLOGY

The proposed work is to sort and grade the fruits of same colour and same size.Here the fruits taken are apple and tomato.The image can be captured by the ccd camera and the image can be filtered by the median filter, the filtered image can be pre processed for edge detection. In the edge detected image the fuzzy rule can be apply and values find out here are mean, standard deviation, area and perimeter of the sample fruits.

FUZZY LOGIC SYSTEM
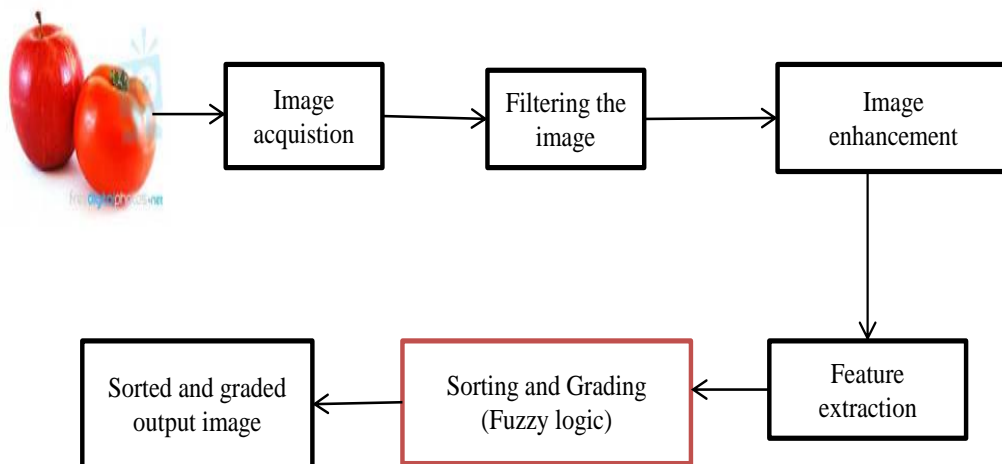
MODE

Fig.1 Fuzzy logic- sorting and grading model

A. Image Acquisition

In Image acquisition, the grading system uses the CCD camera in Fig.1 for capturing the apple and tomato image. Then the captured images are deployed in the MATLAB software for analyzing the size and color of the fruits.

B. Filtering the Image

Usually some sort of noises are included in the images that leads to the low-resolution images. The noisy images of apple and tomato are filtered by using median filter. The median filter has sharpen contrast.
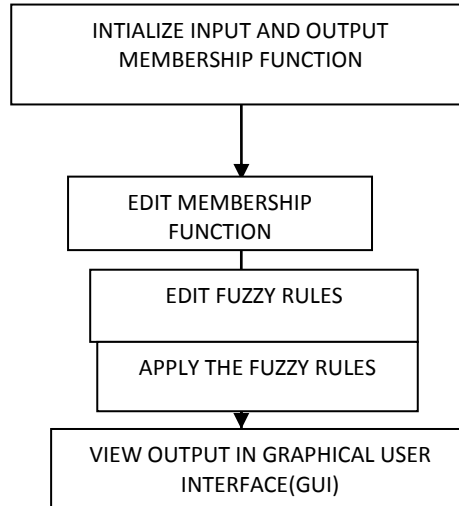
C. Image Enhancement

Image enhancement is a process of improving the quality of the images by modifying/altering the images according to the impact of viewer, it alters the original digital values after the completion of the restoration process. The apple and tomato images are enhanced using a model callededge detection method.

D. Feature Extraction

Features are said to be as the function of measuring the object's quantifiable property and characteristics. In fruits the features are extracted easily by identifying their color and size. The color extraction of the fruit starts in converting the original image to the grayscale image and then to the binary image to detect the boundary of an object. Feature extraction can be computing characteristic of a digital image able to describe its texture properties. In the texture anlaysis the values find out are mean, standard deviation, area and perimeter.

E. Fuzzy logic Sorting and Grading Process

The Fuzzy logic system has been used for sorting and grading the fruits, the fuzzy logic toolbox software is utilized in this system and it does not have any limit in consuming the number of inputs. The flow chart of fuzzy logic system is designed as

```
┌─────────────────────────────┐
│  INTIALIZE INPUT AND OUTPUT │
│     MEMBERSHIP FUNCTION      │
└─────────────────────────────┘
              │
              ▼
┌─────────────────────────────┐
│     EDIT MEMBERSHIP          │
│        FUNCTION              │
└─────────────────────────────┘
    ┌─────────────────────────┐
    │    EDIT FUZZY RULES      │
    └─────────────────────────┘
    ┌─────────────────────────┐
    │   APPLY THE FUZZY RULES  │
    └─────────────────────────┘
              │
              ▼
┌─────────────────────────────┐
│  VIEW OUTPUT IN GRAPHICAL USER │
│        INTERFACE(GUI)        │
└─────────────────────────────┘
```

Fig.2 Flow chart of Fuzzy interference system

ALGORITHM:

STEP 1:

In Fig.2 the Fuzzy Interference System (FIS) editor consists of the software called as the fuzzy logic toolbox where the number of inputs may or may not be limited depending upon the machine's memory. The FIS editor is used to display the high level information of the Fuzzy Interference System where the inputs are estimated with the set of rules with IF-THEN statements to obtain the output information. The input and output member ship function here taken are apple and tomato.

STEP 2:

A set of rules is edited using the rule editor. The rules are applied depends on the perimeter value in OR method which is maximum and minimum and AND method which is maximum and minimum.

STEP 3:

Surface viewer is used to view the dependency graph of having one output with one or more input. The output can be viewed by the GUI tool.

(F) Sorted and Graded output image

The Fuzzy Logic sorting and grading system model is used for sorting purposes, it classifies and separates various types of fruits by measuring the fruit's quantifiable property and the characteristics and by extracting the features like color and size of the fruit a major criteria in the market value for grading purposes.

RESULTS AND DISCUSSION

The ouput can be viewed by the GUI tool.The input and output memebership function are apple and tomato.The fuzzy input plot has degree of membership in y-axis and the service in x-axis,the curve here applied is gaussian curve. The fuzzy output plot has degree of membership in y-axis and apple and tomato tip in x-axis,the curve here applied is trapezoidal curve.
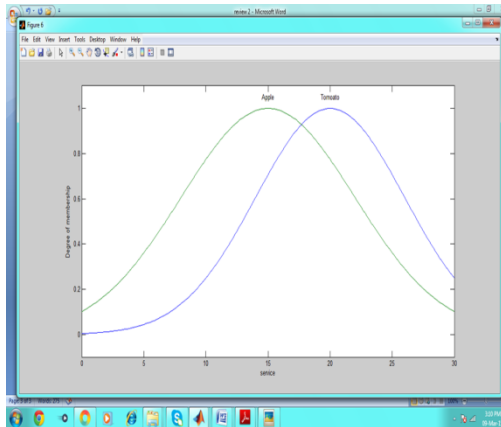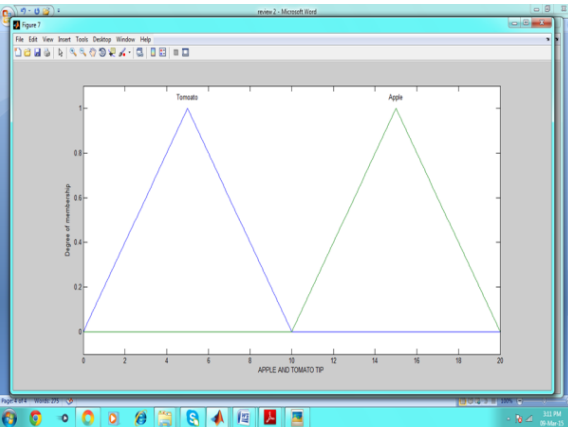
Fig.3

Fig.4

Fig.5 GUI OUTPUT

Fig.6 GUI OUTPUT

The MATLAB software is used for demonstration. In Fig. 5 and Fig.6 using the Fuzzy logic system the fruits are sorted and graded by depending upon the specific features of color and size of the apple and tomato images along with its mean, standard deviation, area and perimeter values are also identified, then in Fig.3 it calculates the degree of membership by describing the shapes of apple and tomato. Fig.4 Evaluates the membership grading values of both the apple and tomato images.

CONCLUSION

The Fuzzy logic system model is implemented for sorting and grading the fruits in the market. Initially, the images of the fruits are captured using the CCD camera and the noise is removed from the image by using the Salt and pepper noise. After the noise removal the images are modified and alerted by implementing the improved Histogram Equalization (HE) algorithm and then the features are extracted by analyzing the object's quantifiable property and characteristics. The features like color and size of the fruits are extracted and the fuzzy logic system model is used to sort and grade the fruits. This model consists of the FIS and membership editors to edit the dependency values, displays the high level of information and to describe the shapes of input variables. The rule editor estimates a set of rules to describe the system's behavior and rule viewer is used to view the fuzzy interference diagram, then the surface viewer of this model illustrates the interference surface map graph by plotting and generating the mean, standard deviation, area and perimeter values of the apple and tomato images. Thus the images are sorted by their quantifiable properties and graded by depending upon the apple and tomato features of color and size.

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