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Digital Image Processing Application on Shallots Quality Determination

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Abstract. Shallot is a horticultural vegetable commodity that has high economic value. North Sulawesi is one of the central production of shallots which has several onion varieties developed and marketed. Technology that can help determine the quality of shallots is needed to simplify the marketing process. This study aims to simulate a system for determining the quality of shallots based on their color and size. The shallot bulb image of several different varieties is input for this system to be able to provide good and bad shallot marks.

1. Introduction

The development of image digital processing techniques has been applied in many sector and give benefits to the technology and the users. One of the area of its implementation digital technology is agriculture. Image processing techniques brings automation idea to precision horticulture where the knowledge and the ability of human are installed to a system that can work as people want and give a conclusion as a mark to the product of agriculture. The image processing can be used in agricultural applications for following purposes to detect diseased leaf, stem, fruit; to quantify affected area by disease; to find shape of affected area; to determine color of affected area; to determine size & shape of fruits. Related to the post-harvest commodity, there is food grading step that has been implement using digital image processing (DSP). Some researchers have designed DSP system in food grading quality to know defect or diseases. A research in citrus sorting can identify defects using multispectral computer vision. Results showed contributions where the detection accuracy of anthracnose increased from 86% by using NIR images; and the accuracy of green mould was increased from 65% to 94% by using images of fluorescence (2).An automatic defect detection in fruit has been proposed using HSV and RGB color space model to give image segmentation area of defect fruit (4). A classification of apples using three color cameras and segmentation using multi-threshold method may reduce unjustified acceptance of blemish apples (5). Another method of grading fruits (mangos) extracts projected area, perimeter, and roundness features. In this system, images were acquired using a XGA format color camera of 8-bit gray levels using fluorescent lighting. An image processing algorithm based on region based global thresholding color binarization, combined with median filter and morphological analysis was developed to classify mangos into one of three mass grades such as large, medium, and small(3). An image color analysis of tomato 98% accuracy was achieved with respect to maturity grade detection by Sudhir Rao Rupanagudi(6).

A segmentation image gives information about the object we want to observe as discussed before which commonly extract the object size and color. In this research, morphological features extraction and color segmentation are used as inputs to classify the shallot of red onion.

2. Theoritical background

Computer aided vision systems are considered as new tools which are implemented to meet the quality requirements depending on customers' demands. In this point, parameters of red onion shallot will be examine based on morphological features such as, area, perimeter, and eccentricity. Before examine the features, the RGB image of the red onion will be convert to HSV Color space.

2.1. HSV Color Space

HSV (Hue, Saturation and Value) defines a type of color space which used to pick the dcolors from color wheel or palette. It is similar to the modern RGB (Red, green, blue) image where there are MxNx3 array of color pixel. This color system is considerably close to human experience and describe color sensation. The size of hexagonal plane that is perpendicular to the axis changes, is yielding the volume depicted in Figure 1.

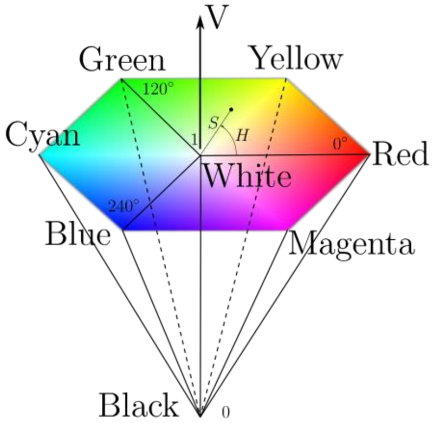

Figure 1. HSV hexagonal cone

Hue refers to the color known by man since it reflects the color that is catched by the human eye in respond to the light wavelength. Saturation means the level of color purity or in other words how much white light mixed with the hue. Value or sometimes called brightness states the intensity of the object reflection received by the eye.

2.2 Thresholding

Image thresholding become the focal point in the application of image segmentation for its intuitive properties and simplicity in implementation. Extracting the objects from the background is done by selecting the threshold T that divides these modes.

2.3 Opening

The opening of image A by structuring element B, denoted by $A \circ B$, is defined as :

$$A \circ B = (A \ominus B) \ominus B \qquad (1)$$

Effect morphological opening will remove all of the pixels in the regions that are too small to contain the probe and restore the shape of the objects that remain.

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3. Design

Algorithm image processing in this research:

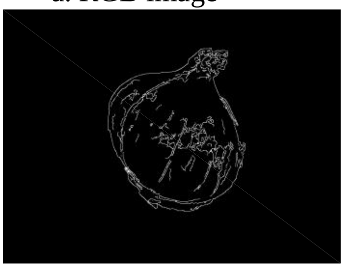
- Preprocessing image from camera : resize image to 20% of original RGB image.
- Convert the RGB to HSV image and take the matrix of saturation as it has a contrast value
- Convert the saturation value to black and white image by thresholding and opening to remove small object
- Find the edge of the object and continue the broken line.
- Filling the close line by pixel white
- Counting the parameter of area, perimeter and eccentricity
- Classification image by its parameter
- Find variety and condition of the group of testing image of shallots

4. Discussion

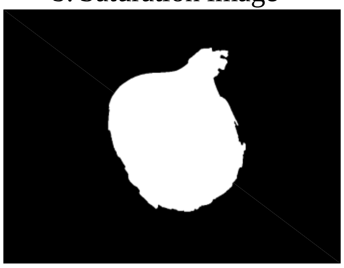
Image of the shallot was put in mini studio with white background, constant lighting. The pictures were taken by digital camera Fujifilm. Size of the picture is compress to 20% of original : 692x922 pixel through programming. Next step is to change the rgb image to HSV image and taking only the Saturation (S) matrix. The matrix S is converted to Black and White image by using a number close to the threshold: 0.29 then to eliminate the noise of the small object using morphological opening. Finding 3 features of the shallots using region property function that will be the input of classification system using neural network.

a. RGB image

b. Saturation image



c. Edge detection



d. Black and White Image

Figure 2.Result of image processing

In classification system design, there are 65 data inputs and 65 data outputs which consist of 25 good shallots of Lansuna variety, 5 rotten(or not good) shallots of Lansuna variety, 30 good shallots of Bima brebes variety, and 5 rotten (or not good) shallots of Bima Brebes variety. For the classifation, feed forward propagation network is used with 2 number of layers and 10 number of neurons. As the training regression can be seen in Figure 3. The result in figure 3 is a result of epoch 6 iterations, using Levenberg-Marquardt model for training, and for the performance using Mean Square Error. After finding the minimum error where the fit lines almost align with th y=T line, a group test data is insert to the model.

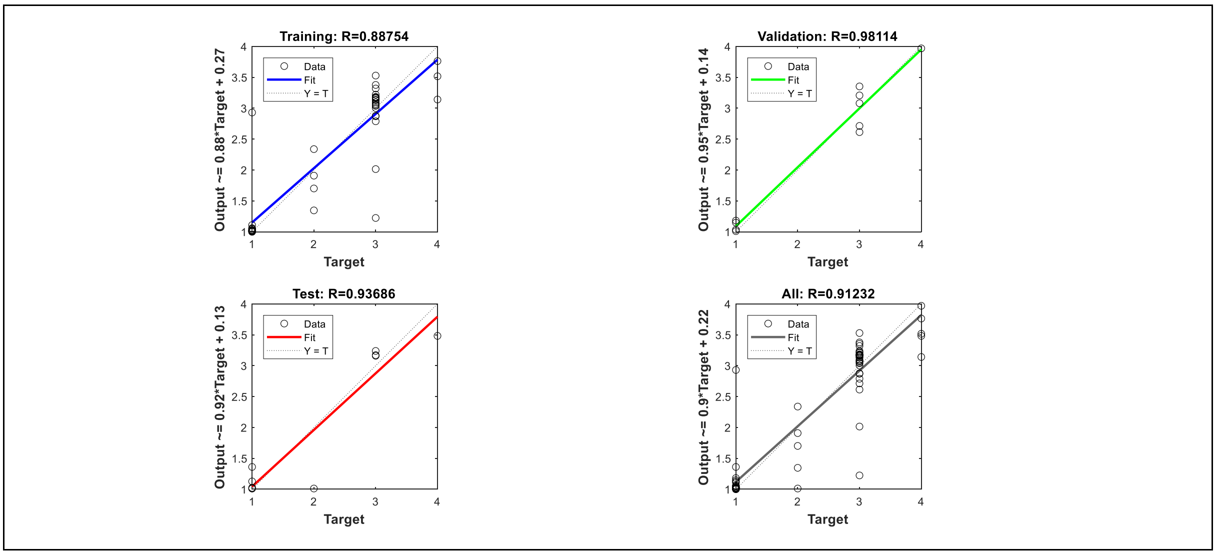


Figure 4. Neural Network Training Plot Regression

10 image of shallots is used for testing the identification system. The result of identification is shown in Table 1.

Table 1. Comparison Variety and Quality of Shallot with the result identification f neural network system

No.	Variety	Quality	Identification Variety	Identification Condition
1	Lansuna	Good	Lansuna	Good
2	Lansuna	Good	Lansuna	Good
3	Lansuna	Good	Lansuna	Good
4	Lansuna	Not Good	Lansuna	Not Good
5	Lansuna	Not Good	Lansuna	Good
6	Bima brebes	Good	Bima brebes	Good
7	Bima brebes	Good	Bima brebes	Good
8	Bima brebes	Good	Bima brebes	Good
9	Bima brebes	Not Good	Bima brebes	Not Good
10	Bima brebes	Not Good	Bima brebes	Not Good

5. Conclusion

Based on test results, 90% of the data of image shallots can be determined correctly, where 10 data consist of 3 good shallots of bima brebes and 3 good shallots lansuna while the rest are not good shallots.

6. Acknowledgments

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