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Classification of Siirt and Long Type Pistachios (Pistacia vera L.) by Artificial Neural Networks

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Abstract: Quality is one of the important factors in agricultural products marketing. Grading machines have great role in quality control systems. The most efficient method used in grading machines today is image processing. This study aims to do the grading of high valued agricultural product of our land called pistachio that has two different types namely Siirt and Long type of pistachios by image processing methods and artificial neural networks. Photos of Siirt and long type of pistachios are taken by a Webcam with CCD sensor. These photos were converted to gray scale in Matlab. Afterwards, these photos were converted to binary photo format using Otsu's Method. Then this data was used to train multi-layered neural network to complete grading. Matlab was used for both image processing and artificial neural networks. Successes of the grading with image processing and artificial neural networks for mixed type pistachios Siirt and Long were researched.

Keywords: *Long type of pistachios, Siirt pistachios, Classification, Image processing, Artificial neural networks.*

1. Introduction

Pistachios (Pistacia vera L.) is a hard-shelled fruit which grows in Near East, Mediterranean region and Western Asia regions. Pistachios is grown mainly in Iran, the U.S. and Turkey, secondly in Syria, Greece and Italy. Pistacia vera L. (Pistachios) is most economically important type of pistachios when compared with the other species in the genus Pistacia. Today, products of approximately two billion dollars per year are harvested and therefore value of pistachios is gradually increasing (FAO 2010). Generally, 60% - 70% of pistachios in the worldwide are consumed as salty roasted-nuts, 30% - 40% of it are consumed as sweets and cakes industry (ice cream and baklava), 90% of it are consumed as cookies in United States and Europe (Science 2009). In 1948, pistachio cultivation started professional in an area of 114 hectare by Ceylanpınar State Farm in our country (Babadogan 2009). Today, pistachio grown in 56 provinces, although economic production is carried out in Gaziantep, Sanliurfa, Adiyaman, Siirt, Istanbul, Diyarbakir and Mardin (Gezginc, 2004). In our country, many peanuts kinds are available depending on the production region and main kinds of peanuts are Long, Red, Halebi, Ohadi and Siirt. Despite its long genus, small size it is worldwide known with flavor from Gaziantep region. Although it matures later than other kinds, higher yield is carried out. It is quite common in food industry. In our country, it is the most common kind. Siirt pistachios that is grown in Siirt and Şanlıurfa has an important popularity because of coarse grain and high contain ratio (Babadogan 2012).

In this study, a software has been developed for distinguishing the Siirt and Long genus pistachios which has been mixed during harvesting. Siirt and long genus pistachios which has been mixed, have been attempted to distinguish by using image processing techniques and artificial neural networks. Multilayer artificial neural networks has been performed for the process to be more precise and faster. System has been trained by using Siirt and Long genus pistachios pictures. Siirt and Long genus pistachios have been classified successfully by using improved system. This study exemplifies image processing and artificial neural networks in agriculture.

Artificial neural networks is an information processing system which have been exposed with inspiration of biological neural networks and includes some similar performance characteristics to biological neural networks (Fausett, 1994: 3). Simply, ANN that imitates the function of the human brain has several important features such as learning from data, generalizing, working with an unlimited number of variables etc.

Image processing, as a general term, is manipulation and analysis of the pictorial information (Castelman, 1996). Image processing techniques are used in different areas such as industry, security, geology, medicine, agriculture. Image processing and artificial neural networks are used in agriculture in fruit color analysis and classification, root growth monitoring, measurement of leaf area, determination of weeds (Keefe 1992, Trooien ve Heermann 1992, Pérez ve ark 2000, Dalen 2004, Jayas ve Karunakaran 2005).

2. Materyal Method

In this study, image of Siirt and Long pistachios photos have been taken by using a webcam with 1.3 MP (Mega Pixels) and having CCD sensor. Usage of image processing and artificial neural networks are provided by Matlab. In this study, 50 Siirt pistachios, 50 Long pistachios were used. A part of Siirt and

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Long pistacios pictures are shown in Figure 1. Black background is used at the stage of image processing for faster and correct results.



Figure 1. Long Genus Pistachios



Figure 2. Siirt genus Pistachios

Firstly, Siirt and Long genus pistachios image information was received to obtain image information's that was to enter to artificial neural networks. Picture information of pistachios is shown in Figure 3.

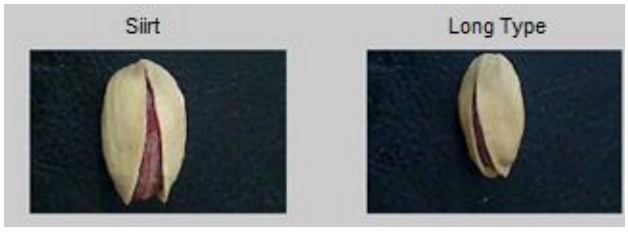


Figure 3. Siirt and Long types of pistachios

Siirt and Long type of pistachios image information was converted to gray level images. Filtration was performed to pictures for reduce noise and interference. Siirt pistachios and Pistachios pictures which were converted into gray levels are shown in Figure 4.

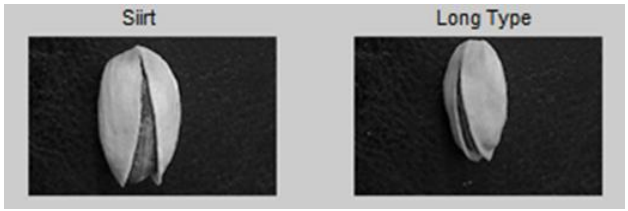


Figure 4. Gray level images belong to Siirt and Long types of pistachios

Image information which is at gray level were converted to black and white picture by using Otsu method. Otsu algorithm provides the clustering of these pixels according to the distribution of pixel values in the image. Thresholding process is one of the important processes in image processing. Especially, this method is used for highlighting closed and discrete areas of the object in the image. It includes the arrangement of image which was divided into pixels until to the image in dual structure. Simply, thresholding process is a process of discarding pixel values on the image according to specific values, and replacing other value / values. Thus determination of object lines and backgrounds of the object on the image were provided (Yaman, 2000).

Threshold value is determined by using Otsu method. if it is under this value, pixels are converted to 0 value; if it is over this value pixels are converted to 1 value. Siirt and Long types of Pistachio pictures in black and white pictures are shown in Figure 5.



Figure 5. Binary image information belong to Siirt and Long types of pistachios

Small white pixels were filtered in the binary image. Then morphological closing operation was applied to filtered image (Figure 6).



Figure 6. Picture information's which will be entered to ANN belong to Siirt and Long types of pistachios

In this study, Matlab Software's Artificial Neural Network toolbox were used to distinguish Siirt and Long types of pistachios.

ANN 's main tasks are to learn structure in the model data set, to make generalizations in order to fulfill to required task. To make this, the network is trained with the samples of related event to make generalization. Multi-layered artificial neural networks are the most commonly used in ANN models.

In the study, neural network model with multilayer, feed forward, back propagation was used. Multilayer Perceptron (MLP) networks are a feed forward neural network model which has different number of neurons in the input layer, an intermediate layer consisting of one or more layers(s) and consisting of output layer. The structure of MLP neural network is shown in Figure 7. MLP neural network outputs of the neurons in a layer are connected to all input of the neurons with weights. The number of neurons in the input and output layer is determined according to the implementation problems. The number of intermediate layers, number of neurons in the intermediate layer and activation function are determined by the designer by trial and error method (Öztemel, 2003).

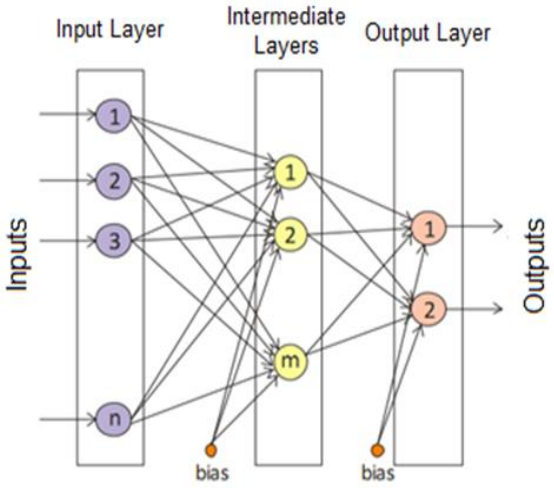


Figure 7. Multi-layered artificial neural network



Figure 8. Mixed Siirt and Long types of Pistachios

Segmentation process was performed by using digital image processing techniques on images belonging to mixed Siirt and Long genus Pistachios and by determining the place of each pistachios on the picture. Each pistachios was cropped in 100x100 pixels size. First of all, digital images of each pistachios were converted to gray level images. Picture was filtered in order to remove noise and very small objects (dust, etc..). Noise removed gray level pictures was converted to black and white picture by using Otsu method. data sets, which will enter to ANN, will be created by converting black and white picture informations in 100x100 size of each pistachios to column matrix.

System was trained by using the binary image information of Siirt and Long types of pistachios. After training process, in the picture of mixed Siirt and Long genus Pistachios, the system separates Siirt and Long genus Pistachios, and Long pistachios are marked with green squares, Siirt Pistachios are marked with red squares. Classification results of mixed Siirt and Long genus Pistachios are shown in Figure 9.

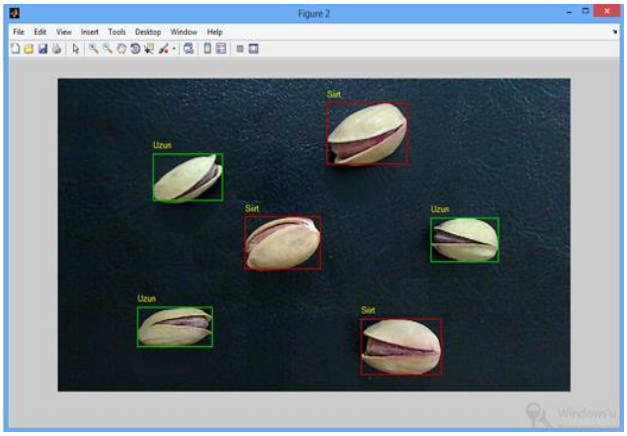


Figure 9. Determination Siirt and long types of Pistachios

3. Conclusion

Classification process with MLP model average success of the test was determined %100 in the structure, where 100 neurons are used, in the hidden layer. When creating the MLP structure, neurons in the hidden layer and output layer activation function was used as logarithmic sigmoid. The error back-propagation was used in training of the ANN model algorithm and network was trained 250 steps. The results which was obtained in classification byusing MCA process are presented in Table 1.

Table 1. Classification Results With Using Mca Process

Number Of Neurons in Hidden Layer	Classification success (%)		
	Siirt genus	Long genus	Average success
25	49	48	97
50	49	50	99
75	49	49	98
100	50	50	100

In this study, gray level images information of Siirt and Long type of pistachios by using image processing techniques. Afterwards, the system was trained by using Otsu Method, by converting binary picture information, by using multilayer neural network model. Then, in the realized system, the distinguishing of mixed Siirt and Long genus Pistachios was performed.

System can be developed by using moving band and camera system and distinguishing of Siirt and Long types of Pistachios can be carried out in real-time. Also, packaging process of pistachios in a certain number can be performed. This study is an example of using image processing and neural network in agricultural field.

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