Tarım Makinaları Bilimi Dergisi (Journal of Agricultural Machinery Science)
2014, 10 (3), 243-246

Using Image Processing and Artificial Neural Networks to Determine Classification Parameters of Olives

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Received (Geliş Tarihi): 10.06.2014 Accepted (Kabul Tarihi): 15.07.2014

Abstract: Quality is one of the important factors in the marketing of agricultural products .Classing machines have a great importance in quality control system. Today, the image processing is the most effective method in classing machine. Agricultural products are classified according to the desired quality features with image processing in a serial way. It also leads agricultural products to be marketed at the highest value.

In this study, it is aimed to classify the olives according to first their colors and then to their sizes by using image processing techniques and artificial neural networks. Olives are classified according to their colors as black and green by using image processing techniques. Then, the system was trained with pictures of large and small olives to classify the olives according to their sizes by using multi-layered neural networks. In this study, Matlab software was used for the use of image processing and artificial neural networks.

Key words: Artificial neural networks, image processing, olive classification

INTRODUCTION

Computer vision is the analysis of the computer on one or more images with one or more host processors with several techniques chronologically. Computer vision is a science which enables data to be extracted and examined by the computer theoretically and algorithmically over images or image sets. It includes concepts related with the objects on the images and the location, direction and dimension of the objects (Baxes, 1994).

Digitisation of the image is the process in which the image in the camera is converted to electical signals with optical – electrical mechanism (Yaman et al., 2001).

Image processing is, as a usual term, the manipulation and analysis of pictural data (Castelman, 1996). Image processing is utilized in such fields as industry, security, geology, medicine and agriculture. It is also used in agricultural field in order to do colour analysis classification of fruits, to monitor plant roots, to measure the area of leaves and determine weeds (Keefe, 1992), (Trooien and Heermann, 1992) (Pérez et al., 2000) (Dalen, 2004) (Jayas and Karunakaran, 2005).

Artificial neural networks are an information processing system that is detected by being inspired by biological neural networks and including some similar performance characteristics to biological neural networks (Fausett,1994). In a simple manner, ANN that simulates the way the human brain has several important features such as learning from data, generalizing, working with an unlimited number of variables.

It is seen that ANN is used in crop production, which constitutes an important field of agriculture engineering, in identification and classification stages of a wide range of agricultural products such as grape, wheat, peppers and olives (Kavas and Kavas, 2014).

In this study, mixed olives are classified according to color and size. Green and black olives were detected according to their colour and large and small olives were detected according to their shape. Green and black olives were detected through image

processing techniques and large and small olives were detected by the help of image processing and artificial neural networks. The system was trained by using images of large and small olives. With the system developed, the classification of green and black, small and large olives were successfully done. This study serves as a model for image processing applications and artificial neural networks in agriculture.

MATERIALS and METHOD

Pictures of green and black olives in the study were taken by using a 1.3 megapixel CCD sensor-fitted webcam. Image processing and the use of artificial neural networks were made possible with Matlab software. In the study, 50 green (25 large, 25 small), 50 black (25 large, 25 small) olives are used. Pictures of green and black olives in mixed condition are seen in Figure1.

Figure 1. Green and black olives

Green olives are selected by using image processing techniques. Then green and black olives are classified according to their size by using image processing techniques and artificial neural networks. Detected green olives are seen in figure 2.

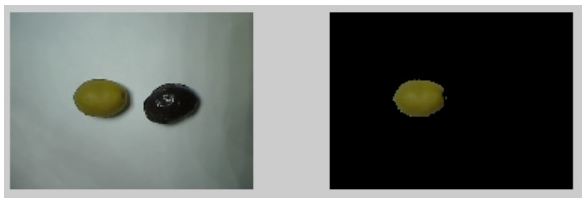

Figure 2. Detected green olives

For developing the system, info of the images of large and small olives were taken firstly. Picture info of the seeds are seen in Figure 3.

Figure 3. Large and small olives

Picture info of large and small olives were complement of the image then converted to grey level pictures. For the suppression of noise in the pictures, filtering was done. Large and small olives that were converted to grey level are shown in Figure 4.

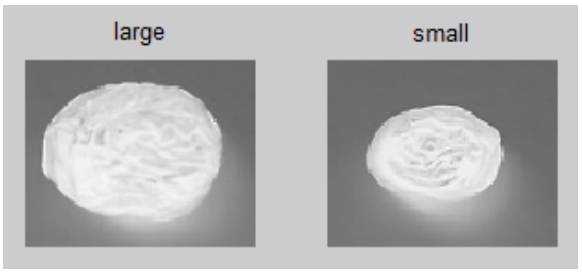

Figure 4. Grey level pictures of large and small olives

Info of the picture converted to grey level is converted to black-and-white picture with the use of Otsu method. Otsu algorithm makes grouping of these pixels possible according to the variance of pixel values on the image.

Thresholding process is one of the important stages of image processing. It's especially used in making the closed and discrete areas of the object in the image clear. It includes the arranging of pixelated image to the degree of dual-structured image. Thresholding is simply the process of throwing pixel values on the image according to a particular value and replacing them with other values. So that, removal of the object line is made possible with the background of the objects on the image. (Yaman, 2000).

A threshold value is determined by using Otsu method; pixels below this value are converted to 0 knowledge and pixels above this value are converted to 1 knowledge. Images of large and small olives changed to black-and-white colour are seen in Figure 5.

In the study, Artificial Neural Network Toolbox of Matlab software was used to detect the olives.

Figure 5. Binary images of large and small olives

Dimensions of dual picture info provided were equalized and picture info was turned to column matrix. In the study, multi-layer, feedforward, backpropagation neural network model was used.

Multi-layer perceptron (MLP) network is a feedforward artificial neural network model that consists of access layer which has different number of neurons, intermediate layers which consists of one or more layers and output layer. The structure of MLP neural network is shown in Figure 6. In MLP neural networks, neuron outputs in a layer are connected with weights to all the neuron inputs that are situated in the next layer. Neuron numbers in access layer and output layer are determined according to application problem. The number of intermediate layers, the number of neurons in intermediate layer and activation functions are determined by the designer with trial-and-error method (Öztemel, 2003).

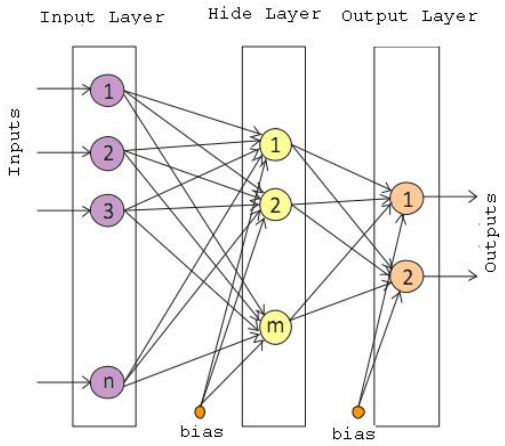

Figure 6. Multi-layer artificial neural network model

The location of images of mixed large and small olives are detected on image and put in segmentation process by using digital image processing techniques. Each olive is cropped in size of 100x100 pixels. First of all, digital images of each oliveare to converted gray level images. The image is filtered to remove the noise and very small objects (dust, etc.) on the image. The noise filtered gray level images was converted to black and white images by using Otsu method. Data sets that will be in ANN are created after converting black and white image information in the size of 100x100 belonging to each olives to column matrix.

The system was trained by using binary picture info of large and small olives. After the training process, in the picture in which large and small olives were mixed with each other, the system distinguished between large and small olives; large olives were marked with green boxes and small olives were marked with red boxes.

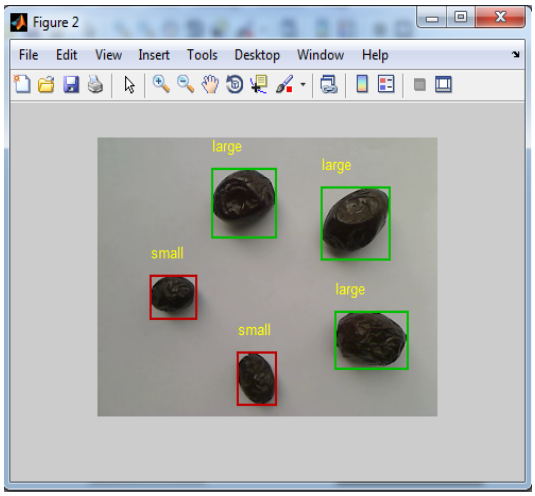

Figure 7. Detection of large and small olives

RESULTS and DISCUSSION

In the study gray image informations of large and small olives are obtained by using image processing techniques. Later on, the system was trained by using Otsu method and converting to dual picture info and using multi-layer artificial neural network model. With the system developed, distinguishing between large and small olives in mixed condition was made possible.

Average test success in the classification process with MCA model is set as 100% in the structure in which 100 neurons is used in hidden layer. Activation function of neurons in the hidden layer and output layer are used as logarithmic sigmoid while installing the MLP structures. Error back-propagation algorithm is used in the training of ANN models and the network is trained 250 steps. The results obtained in classification process by using MLP are shown in Table 1.

Table 1. Classification results by using MLP

Number of neurons in hidden layer	Classification success				Average success (%)
	Black large olive	Black small olive	Green large olive	Green small olive	
25	23	22	23	23	91
50	24	23	24	23	94
75	25	23	25	24	97
100	25	25	25	25	100

CONCLUSIONS

The followings were concluded from the study:

- Distinguishing process between green and black, large and small olives was successfully done.
- Green and black olives were detected according to their colour.
- Large and small olives were detected according to their shape.
- The study is a sample for the use of image processing and artificial neural network in agriculture.
- Large and small olives in mixed condition were count can be done.
- By promoting the system to a higher point, large and small olives can be distinguished in real time with the use of a walking band and a video camera. Furthermore, packing of lives at a certain number can be done.

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