

Quality Evaluation of Onions Using Neural Network

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Abstract - In this paper are discussed the problems concerning onions quality evaluation using neural network (NN). With data received from the expert evaluation concerning the appurtenance of onions to three qualitative fractions and containing information for the quality of the products, a training course on NN has been carried out.

After a sufficient testing of NN with the known combinations of the sample input, NN is able to qualify with an accuracy admitted some new products, as well, beyond the excerpt used for training. In that way, the computer technology could make a quality evaluation of various food products.

Keywords - Quality Evaluation, Neural Network.

I. INTRODUCTION

Food products quality is evaluated by different ways according to the viewpoint for their defects and flaws. The requirements are continuously growing in food industry as regards food products quality, regardless of the fact whether they are meant for fresh state consumption or for processing. For that purpose new methods for their quality evaluation and sorting are being sought for. A complex problem is the objective evaluation of the fruits and vegetables quality even as regards such indices as size, shape and color [5], [7].

A number of leading companies work for the creation of technologies and equipment allowing for achievement of a high degree of mechanization and automation.

The onions quality evaluation is particularly essential (*Allium cepa* L), one of the main vegetable cultures in the world [6]. Annually, more than 30 mil. tons of onions are produced worldwide.

Up to this moment the problem for the automatic quality evaluation and sorting of onions has not been solved satisfactorily [2]. The onions, as well as various vegetable cultures, as automatic quality sorting objects are nonhomogenous and nonstationary structures for whose identification information concerning their total internal and external state should be necessary. This information could be obtained on the basis of spectral transmittance in each onion scanning [3], [4], [6].

Many of the problems concerning quality evaluation and sorting can be solved by means of developing of control algorithms for the sorting machine based on an artificial neural network. [6].

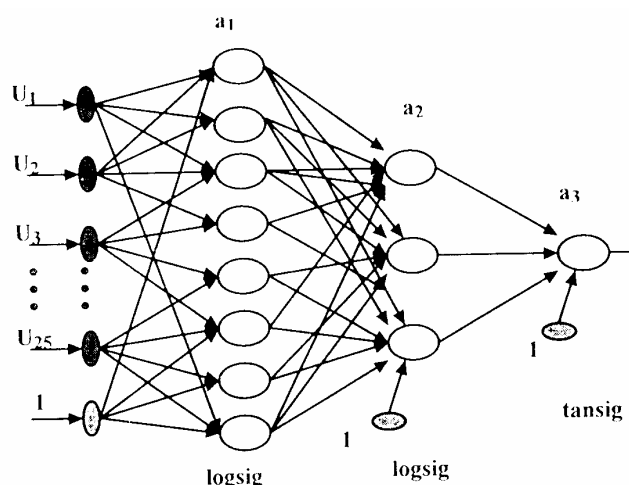
II. MATERIALS AND METHODS

The onions (*Allium cepa* L) is one of the main vegetable cultures. It contains valuable components necessary for man's nutrition. The ripe onions contain : 7-20% dry matter, while the leaves 7,2-11,8%; vitamin C - average 10 mg towards a fresh mass; vitamin B - average 20 mg towards fresh mass. In onion ash there are considerable quantities of SiO (16,72%), CaO (21,97%), Cl (2,77%), Na₂O (3,18%), etc. [3]. With the help of a group of experts, a training excerpt has been formed, as a matrix with 25 rows and 90 columns for onions in three qualitative fractions.

III. NEURAL NETWORKS

The calculations in NN are done in parallel branches of mutually connected artificial neurons are given in Fig 1. The complexity of network is determined by the number of layers and by the number and the type of neurons.

Fig. 1. Neural Network



The NN should be trained. This means that the processing elements change their status in accordance with the change of connection weights between them. The connection pattern between the neurons and the weights determine the "knowledge" of NN [1].

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After a sufficient NN training with a known combination of input samples of the training excerpt, NN could make a quality evaluation with admissible accuracy new products, as well, outside the excerpt.

An algorithm: block-diagram is given in Fig. 2 and a simulating program DDN1 for training and testing of different in structure and complexity neural algorithms, working in the medium of WINDOWS-MatLab [8]. After long-listing investigations a concrete NN has been created, of the type shown on Fig. 1. The input signal U_i (Fig. 3) forms 25-dimensional input vector.

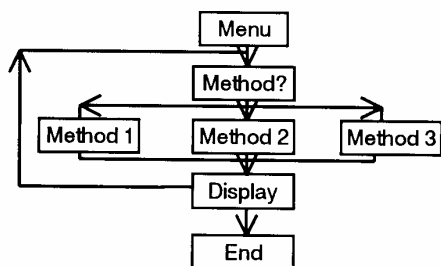


Fig. 2. Block-diagram

This is the result of onions scanning on their longitudinal size, in their transmission the photometric measuring sensor ($35\text{mm} \leq L \leq 100\text{mm}$). The sensor presents the spectral transmission of the product which forms the input vector of NN. NN is trained on the basis of the information of the input vector data for each onion and experts evaluation, which gives the necessary network output. The utilized NN is a simple feedforward network of the type multilayer perceptron (MLP), having the structure 8-3-1, i.e., the input layer contains 8 neurons, the hidden-3 and the output-1 neuron, the transfer functions for the first 2 layers are sinusoidal functions and the output layer is tangent-hyperbolic function.

By using three variants of backpropagation method, in the tool-box of the MatLab for neural networks, the best results have been obtained with adaptive step and momentum backpropagation.

The testing of the trained NN with control excerpts from 95 onions shows erroneously sorted onions for I-st quality - 6,5%, for the II-nd quality - 7.5%, and for the III-rd quality - 9,5%.

IV. CONCLUSION

The neural networks are an up-to-date and powerful means for quality evaluation of fruit and vegetables [5], [6]. A part of their possibilities are concretely shown with the quality evaluation of onion.

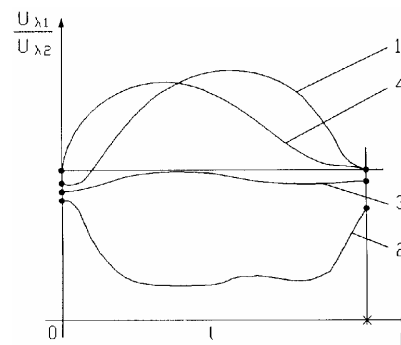


Fig. 3. Diagram $U_i = U_{\lambda 1} / U_{\lambda 2}$

The results obtained give grounds to state that the algorithm created so far for training of neural networks fulfills successfully its purpose.

The quality evaluation of onions by means of NN is a prerequisite for the building-up of computer-based technologies for total quality evaluation by means of further investigations for control algorithm improvement.

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