Neural Identification Models of Physical Parameters of Selected Quality Cereal Grain

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Abstract: The subject of the project was the selection of neural models for the identification of physical parameters of grain quality regarding to malting barley. Help in its implementation was the original computer system, "Hordeum v 1.0", in which graphic data was gained from images of kernels obtained by acquisition. The principal aim was to verify whether the artificial neural networks in combination with image analysis can become a practical tool used in farming, and whether the proposed technology can be applied in analysing the quality of cereal grains.

*Key-Words*neural image analysis, identification of barley damages.

1 Introduction

The ability of generalization (generalization of knowledge) and the parallel operation of artificial neural networks are the features which led to a large extent so wide their application in various scientific fields such as robotics, medicine and agriculture.Properly carried out the learning process of neural network based on a set of variables, allows for the classification of new, previously unknown data. This ability allows you to use it where it can not solve the problem in any other way.
One of the main reasons for the application of neural networks to solve classification tasks. This has particular application in conjunction with the analysis and pattern recognition. No doubt the issue, which deals with the research project presented to such belongs. What is the classification of images? It is a process that generates a description of the image and allows understanding of the chosen problem created by manipulating a class of basic and qualitative variables. The first stage of this process is the selection of features describing recognized images, further analysis of these characteristics (assessment and valuation). Once this stage is the final phase - to assign an image to a certain class.

2 Materials and methods

The purpose of our study was the identification of mechanical damage kernels using neural image analysis. Artificial neural networks were responsible for the identifying defects on the basis of the variables obtained during the process of image analysis of research material - barley caryopsis [6]. The data obtained were let in accurate way to find whether a kernel has been damaged.Algorithm described in the research project consisted of several steps (Fig. 1).

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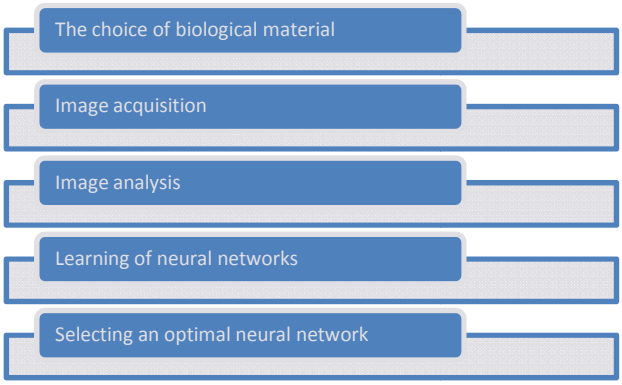

Figure 1. Stages of the project.

The first stage of the research project was to choose a representative of the biological material, the next image acquisition of the specified kernel, in this case, malting barley (Fig. 2) [4][5]. This material had to comply certain quality criteria. Malting barley crop is specially designed indirectly through the market for malting beer market, where a very high quality product is very important. Of the several varieties of wheat were selected one variety of spring barley - Prestige, which is characterized by high technological value. Representative sample of grain and different grains were classified into two groups: healthy and damaged.

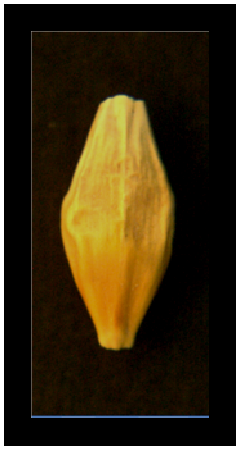

Figure 2. Malting barley caryopsis.

Photos of the kernels was performed at the Laboratory of of Computer Image Analysis at the Institute of Agricultural Engineering University of Life Sciences in Poznan. For image acquisition was used Nikon D90 camera and lens with the aperture of F4, 5 armed with two lenses for macro photography (+10 and +2) and a focal length of 50mm. Acquisition was made in the chamber shadow less. The resulting images were analysed using the copyright system "Hordeum v 1.0" (Fig. 3), developed under the project.The task of the system was to process the images into digital form and automatically download the characteristics objects located in the pictures. Achieving good results of image analysis was possible by providing high-quality processed data [3]. This is due to the need to eliminate any interference, a high level of focus, recording images in the required format (set of photographic equipment, adequate lighting) [8]. Use the program allowed for selection of the particular kernels features:

- geometric characteristics: height, width, area and circumference of the object,
- shape factors: Feret, sphericity, Malinowska factor, contour perimeter,
- RGB color values (Fig. 3) [5][7].

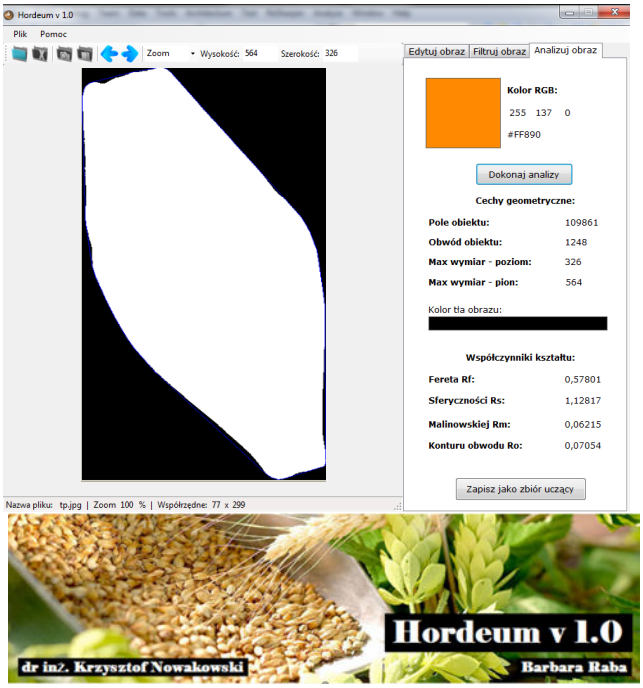

Figure 3. System for the production of learning sets Hordeum v 1.0.

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Mentioned above features are the input variables. Output variable was the information obtained during the initial kernels classification, the lack of, or the occurrence of mechanical damage to the kernel. The results of the analysis were saved to a *.csv file, which made it possible to start the next step - learning neural networks.

3 Results

Optimal learning algorithms for this network were back propagation method and the conjugate gradient method. After learning of neural networks, the best network model was a network of MLP - multilayer perceptron with eight input neurons and two hidden layer neurons (Fig. 4).The decision to choose the network are several data describing the neural network. The main reason for choosing the network was low validation error value.

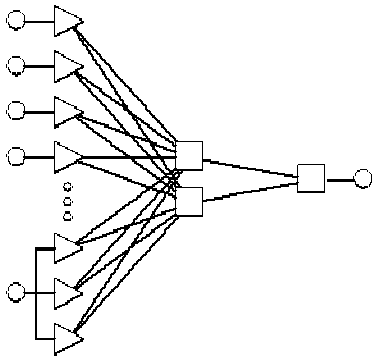

Figure 4. MLP network diagram 8-2-1.

Also values of learning, and testing error remained low. In this case the quality of learning, values fluctuated in the upper limits (close to 1) (Tab. 1).
Selected multi-layer perceptron was trained bytwopopular algorithms:

- Backpropagation, the number of epochs: 50, BP50,
- Conjugate Gradient, the number of epochs: 53, CG53

Table.1 Information about learning error and quality.

Parameter name	Value
Error of learning set	0,0063
Error of validation set	0,15
Error of test set	0,12
Quality of learning set	1,0
Quality of validation set	0,95
Quality of test set	0,97

Identification of barley kernel damage was carried out using the geometrical features and the shape coefficients. Eliminated of the variables have the kernel colour in colour space model - RGB. On the basis of statistics: variable sensitivity analysis the highest ranking was kernelcircuit.Determine the quality of data classification is possible thanks to automatically generated classification statistics [1][2]. These statistics are determined separately for subsets of the validation, the learning and test (Tab 2.). For each of these sets gives the number of cases classified correctly and incorrectly.

Table 2.

Set type	Properly classified	Un properly classified	Unclassified
Learning set			
damaged kernels	39	0	0
not damaged kernels	50	0	0
Validation set			
damaged kernels	18	3	0
not damaged kernels	19	5	0

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Testing set			
damaged kernels	16	7	0
not damaged kernels	20	2	0
Total	162	17	0

4 Conclusions

- The assumptions of the project was able to achieve mainly through the selection of representative biological material - malting barley.
- Created for the project information system is a useful tool for image analysis of malting barley grain. Additional possibilities are the editing and filtering any image file. You can also extend the functionality of the system with further options for image processing and image analysis algorithms to adapt to other cereal grain.
- Thanks to selection of representative classification parameters, derived from an image, the results of the neural network recognizes the damage to the kernels are similar to human performance.
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Generally choice of artificial neural network model to recognize the mechanical damage of malting barley allowed the selection of variables obtained by image analysis. The proposed model also allows for further research of quality grain. This amounts to extending the project on the subject of assessing the quality of kernels in the malting industry, namely the presence of contaminants, pests and diseases - mainly mold.

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