

The system of computer vision for extracting quantitative characteristics of wheat shoots

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Motivation and Aim: Methods of analyzing quantitative characteristics of wheat shoots based on visual or tactile expert assessment have some disadvantages: subjectivity, labor input. An alternative method was implemented in the work, which is based on the analysis of images by computer vision methods.

Methods and Algorithms: The object of the research is photographs of wheat shoots. The following methods were used to solve the segmentation problem: a convolutional neural network of the Unet architecture [1], a modified tgi index [3] with further search for the maximum of the target function using a genetic algorithm [4].

Methods used to extract properties from an image: Depth-first search [6], Dijkstra's algorithm [6].

Methods used for statistical analysis of [5] components of the vector of image properties: Student's criterion, Bartlett's criterion, Pearson's criterion.

The methods that were used to solve the classification problem are: statistical regression, Random Forest machine learning algorithm, residual neural network of ResNet architecture [2] with 18, 50 and 101 layers.

The segmentation metric is IoU. The classification metric is accuracy.

Results: This computer vision system was tested to determine two quantitative characteristics: ploidy (belonging to the class of haploid or diploid plants), belonging to the genotype L-25 or genotype 1102. The results of segmentation with using the best model on the test sample for determining ploidy are 0.8467 according to the IoU metric, and 0.8938(IoU) on the test sample for determining the L-25/1102 genotype. When analyzing the vector of image properties, no statistically significant differences were found in the distribution of diploid and haploid photos of wheat shoots by components of this vector. The result of the ploidy classification for the best model on the test sample is 0.6000 according to the accuracy metric. The result for classification into the L-25/1102 gene type using this system is 0.9500 according to the accuracy metric on the test sample.

Conclusion: In this work, was developed a computer vision system that extracts quantitative characteristics of wheat shoots that are visible in photographs, with high accuracy.

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