Секция «Биоинформатика»

Taking into account the features of the phases of the vegetative period of the elements of herbaceous vegetation when training a neural network used to recognize the type of arable horizon using the bioindication method

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The paper describes methods for improving the quality of recognition of the type of arable horizon determined by the bioindication method by selecting the most representative groups of reference plants considering their vegetative periods.

The work aims to improve the quality of automated recognition of the type of arable horizon, determined by automatic bioindication, for further construction of an optimal algorithm for soil cultivation in conditions of amateur agricultural production without additional laboratory research.

The efficiency of growing agricultural products depends to the greatest extent on the choice of an optimal soil cultivation algorithm designed to increase yields, which almost uniquely depends on the type of soil horizon [1], the main characteristic of which is its granulometric mineralogical and chemical composition [2].

At the same time, under the conditions of amateur farming in suburban, homestead, or garden plots, for one reason or another practically deprived of access to laboratory studies of the composition and characteristics of soils. The type of arable horizon is usually not determined accurately enough, which in turn leads to an incorrect choice of soil cultivation algorithms [3], unequivocally leading to a decrease in agricultural productivity, an increase in financial and labor costs, as well as excessive pressure on the ecosystem [4].

To create such solutions, the authors of this work a year ago developed and tested in practice [5] an automated method for determining the type of soil horizon using the bioindication method [6] based on the processing of photo images of wild plants growing on them using machine learning methods based on the application of the convolutional neural network algorithm [7, 8].

Further processing of factual materials showed that for almost any types of herbage characteristic of certain types of soils, the sets of marker plants for which the process of indicating the type of soil horizon took place [9] differ significantly depending on the calendar period of the analysis, which is uniquely determined by the sum of active temperatures [10]. This, in turn, gave the authors of this work the opportunity to assume that the quality of the bioindication procedure is significantly influenced by the stages of vegetative periods of marker plants, according to the set of which the procedure for recognizing soil types is carried out.

In this regard, a repeated procedure of retraining of the convolutional neural network was carried out, considering the stages of vegetative development of the herbage, depending on an additional factor - the effective accumulated temperature characteristic of a particular period of development of the marker plant.

Carrying out such a refinement of the algorithm for recognition of herbage elements, considering the stages of the vegetative period of marker plants, allowed to increase by 20% the accuracy of recognition of marker plant elements and reduce by more than a third the minimum number of photo images of the herbage subjected to the site photo analysis procedure necessary to obtain an unambiguous judgment about the type of soil horizon.

This makes it possible to talk about the mandatory need to consider the vegetative cycles of plants during the pre-training of a neural network used to improve the quality of automated determination of the type of soil horizon by bioindication.

The results of the described studies will be included in the refined algorithms of a specialized line of open architecture software solutions aimed at gardeners and summer residents.

The project is being carried out by an initiative working group of students of ITMO University and Lomonosov Moscow State University with the support of the Russian Geographical Society.

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