Name of the project:AP 19675312 Analytical system for forecasting the dynamics of the number of pests of grain crops in Kazakhstan based on a neural network model

Relevance:

The relevance of this project is due to the fact that health monitoring and early diagnosis of pests of grain crops is the most important task of sustainable agriculture. Information about the early diagnosis of certain plant diseases can facilitate pest control by choosing the right methods of combating them to increase grain yield. Manual identification of violations in grain crops can lead to inaccurate measurements, and also takes a lot of time. The above problem requires the intervention of the latest technologies, in particular the use of intelligent algorithms in predicting the dynamics of the number of plant pests. The use of intelligent systems in agriculture has become relevant in world science. But the existing systems do not disclose all aspects of this issue. To solve the problem of predicting the dynamics of the number of pests of grain crops, a neural network model will be created, on the basis of which an analytical system for predicting the dynamics of the number of pests of grain crops will be developed.

Purpose:

Creation of a neural network model for predicting the dynamics of the number of pests of grain crops for an analytical system.

Expected and achieved results:

- for 2023: Data collection will be carried out (the impact on the growth of pests: climatic indicators, abundance, leaf surface, and so on) to identify pests (in particular the bread-striped flea (*Phyllotretavittula*)) grain crops. Normalization and transformation of input data will be carried out and a data interaction matrix will be created for training a neural network. A study of algorithms and methods of forecasting in machine learning (regression models, decision trees and ensembles, clustering, random forest) will be performed and algorithms and methods for machine learning for forecasting will be selected. The analysis of the current state of analytical systems for forecasting the dynamics of the number of pests of grain crops in the world will be carried out and the analysis of the negative and positive sides of such systems will be carried out. A multi-layered neural network model with optimal architecture will be created for conducting training with effective indicators for predicting the dynamics of the number of pests of grain crops.

- for 2024: Based on the selected hyperparameters of the neural network, trained data with accuracy indicators close to one and error loss close to zero will be obtained. A conceptual model and a prototype of the analytical system will be created. As a result, an analytical system will be developed to predict the dynamics of the number of pests.

- for 2025: Verification of the analytical system will be carried out to obtain the optimal indicator of the impact of the pest population of grain crops (exactly striped flea (*Phyllotretavittula*)). The analytical system will be tested, modified and launched after verification. A patent for a neural network model and a certificate of entering information into the state register of rights to objects protected by copyright for the analytical system will be obtained.

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List of publications published as part of a preliminary study on the topic of this project:

Аканова А.С., Оспанова Н.Н. Жасанды нейрожелі арқылы өсімдіктерді тану // Bulletin of PSU, No. 3, 2019, energy series/http://vestnik-energy.tou.edu.kz/storage/journals/140.pdf

Байбусенов К.С., Ажбенов В.К., Сарбаев А.Т. Фитосанитарное прогнозирование популяционной динамики вредных нестадных саранчовых для обоснования и планирования защитных мероприятий в земледельческих районах Северного Казахстана // Bulletin of Science of the Kazakh Agrotechnical University named after S.Seifullin. – Astana, 2017. - № 4 (95). – pp. 28-35.

Anarbekova G., Ospanova N., Anarbekov D. Normalized input vectors: the primary stage of data preparation, News of National Academy of Sciences of the Republic of Kazakhstan, physical-mathematical series. Volume 2, Number 346 (2023), pp. 40–54. https://journals.nauka-nanrk.kz/physics-mathematics/article/view/5109

Information for potential users: An analytical system will be developed that predicts the population of pests of grain crops.