«Сейфуллин оқулары – 16: Жаңа формациядағы жастар ғылыми – Қазақстанның болашағы» атты халықаралық ғылыми-теориялық конференциясының материалдары = Материалы Международной научно-теоретической конференции «Сейфуллинские чтения – 16: Молодежная наука новой формации – будущее Казахстана. - 2020. - Т.II. - С. 329-332

PROSPECTS FOR THE USE OF NEURAL NETWORKS IN AGRICULTURE

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Speaking about the “new revolution” in agriculture, experts often turn to the topic of ubiquitous automation and robotics of the industry, but they bypass the main trend in recent years in the field of software - the application of neural networks and machine learning.

Similar functionality is already used by social networks when searching for faces in photographs, as well as search engines when displaying images on demand. Consider how it can be applied in agriculture.

The beauty of neural networks is that they work with large amounts of data faster and more efficiently than humans. In agriculture, areas are measured in hundreds of hectares, personnel in thousands of employees, and livestock in millions. This is "big data." Almost any company in the industry has enough primary information for training, it remains to collect it in a format that is understandable for training.

The quality and quantity of the crop depends on many factors. Not one of the most experienced specialists is able to analyze them all and make the right decision, therefore, the use of modern technologies in this direction is simply inevitable. For example, scientists from the Skolkovo Institute of Science and Technology trained neural networks to evaluate and predict the dynamics of plant growth, taking into account the main factors acting on the plant and to propose the optimal ratio of necessary nutrients and other parameters that determine its growth [1].

In their research work, scientists from Skoltech showed how recurrent neural networks, together with computer vision algorithms, can completely take on the task of predicting plant growth dynamics depending on the current state of the growing system and the parameters characterizing it. The problem was solved using data obtained jointly with the German Aerospace Center (DLR).

Scientists from Germany worked on the task of additional stimulation of plant growth in artificial systems similar to those used at the International Space Station. In a joint experiment, valuable data were obtained that allowed us to find the optimal ratio of nutrients needed by the plant for best growth under the existing restrictions.

In the work, computer vision algorithms were used for segmentation and determining the surface area of foliage, and for predicting plant growth, various schemes of recurrent neural networks that showed their effectiveness in solving the problem. To demonstrate and test the developed program in real conditions, a

built-in energy-efficient system was proposed, which allows calculating and predicting growth dynamics.

The system was developed on the basis of the popular single-board computer for prototyping the Raspberry Pi with an external Intel Movidius graphics card. The device is based on the compact and powerful Myriad 2 graphics processor, which, with a power of only 1 W, is capable of delivering 150 gigaflops of computing power, which is comparable to the performance of supercomputers in the mid-1990s. Graphic chips of this kind are excellent for launching neural networks and in the future will become the basis of embedded systems with artificial intelligence.

A neural network can be taught to distinguish useful crops from weeds. Having "studied" several million photographs of samples of the required culture, the system using a video camera can determine for several milliseconds whether there is a healthy shoot or weed in front of it. After a series of stages of application of the herbicide and the subsequent analysis of effectiveness, the neural network will learn to understand in what cases how much substance is really needed, and it will be able to make decisions. For example, in the article "Convolution neural network in precision agriculture for plant image recognition and classification", scientists achieved significant improvement in the field of image processing and data processing, which was previously a serious problem in the practice of precision farming [2]. A database of images is collected using remote sensing, a model is analyzed and developed to determine the correct processing plans for various types of crops and different regions. Features of vegetation images should be extracted, classified, segmented, and finally introduced into the model. Various methods have been applied to processes using a neural network, a support vector machine, a fuzzy logic approach, and more recently, the most efficient approach that generates fast and excellent results using the deep learning approach of convolving a neural network to classify images. A deep convolution neural network is used in the recognition and classification of plant images to optimize production on a corn plantation. The experimental results of the developed model yielded results with an average accuracy of 99.58%.

Without much difficulty, you can teach the network to distinguish not only a healthy crop from a weed, but also a healthy plant from a diseased one. She will work on the same principle. Having studied at the start a database of images of healthy and diseased plants at different stages of growth, the system will be able to assess the degree of threat to the crop and suggest ways to solve the problem. You can implement such a "smart filter" to work in the fields and sort the already harvested crop. Also important is the moisture content in the soil. Scientists Saroj Kumar Lenka and Ambarish G. Mohapatra conducted a study on the topic "Gradient Descent with Momentum based Neural Network Pattern Classification for the Prediction of Soil Moisture Content in Precision Agriculture" where they found out the possibilities and prospects of neural networks in predicting soil moisture content using parameters soil and environment in real time. They concluded that this could provide an effective platform for agricultural irrigation requirements [3]. Irrigation is critical practice in a number of agricultural cropping

systems in semi-arid and arid areas, and beneficial water applications and management are key issues. Efficiency and uniformity of irrigation could be maintained through complex and diverse information systems based on weather, soil, water and crop data. Sustainable agriculture in terms of food security, rural employment and environmentally sustainable technologies such as soil conservation, sustainable natural resource management, protecting biodiversity, as well as the introduction of modern agricultural practices, is crucial for holistic rural development. Irrigation water management is an essential part of precision farming. This implies a better assessment of the need and availability of groundwater for growing crops. United Nations statistics show that around the world, agriculture accounts for 70% of total water consumption, while industry accounts for 20% and household consumption 10%.

Models have been developed that use remote sensing data to profile soil moisture. However, remote sensing can be used to directly determine soil moisture. It has been proven that microwave emissivity and infrared data strongly correlate with soil moisture. Over the past two decades, a lot of research has been concentrated in this area. Recently, many researchers have reported monitoring soil moisture levels on agricultural land by collecting soil and environmental information using the wireless sensor network method.

Harvesting with machines is far from a novelty; automation of this stage began in large quantities in the middle of the last century. But what happens if you entrust the cleaning to artificial intelligence? A machine controlled by a neural network will be able to evaluate the shape, weight and color of berries, collecting only ripe units suitable for sale. Needless to say, the effectiveness of such a robot exceeds the efficiency of a human assembler? The potential for an automatic vehicle in agriculture has increased with the advent of precision farming. For a single sensor can not successfully move alone, multi-sensory merging of information is a good method for navigation. Currently, the Kalman filter is mainly used to merge information, but it requires an accurate linear system model and noise statistics. It is difficult to obtain all conditions and it is easy to cause a discrepancy. For its advantages, relying on ability, generalization and other aspects, a neural network is attached to the navigation system.

But the parameter of the neural network is difficult to determine. The particle swarm optimization algorithm is a kind of new evolutionary algorithm that mimics the social behavior of birds that flock to a promising position to achieve precise goals in multidimensional space. The PSO algorithm is close to the optimal solution, which gives a new idea for solving the optimization problem. This is a new method for combining a neural network with a PSO. The article “Positions research of agriculture vehicle navigation system based on Radial Basis Function neural network and Particle Swarm Optimization” proposes to use a PSO-based RBF neural network to combine positional information from multisensors in order to obtain more accurate information when navigating agricultural vehicles [4].

Automated information systems used in agriculture can also be improved with the help of neural networks. In agriculture, the quality and quantity of crops depends mainly on the accuracy and timeliness of various agricultural activities.

We assume that with the right guidance and training in implementing best agricultural practices, farmers can get more crops. Farmers living away from their farmland and working on a large scale with huge farmland tend to accept the help of farm workers to carry out various agricultural tasks. Such farmers can use agricultural activity data to provide appropriate guidance and advice to the farm worker based on the current sowing phase and crop condition. Information on agricultural activities will provide greater transparency in the operation of farms, which will lead to improved advisory services for farmers, as agricultural experts will be able to see the event log for a particular farm. In addition, the problem of ensuring fair and uniform wages for farmers can be solved, since with this platform farm workers can report on their daily activities and, therefore, they can apply for legal wages. In addition, farmers may be associated with their productivity related to their agricultural operations, which will help insurance companies determine personalized costs for each farmer. The scientific work “Neural network based agriculture activity detection using mobile accelerometer sensors” addresses the problem of identifying agricultural activities carried out in a remote place by any farmer [5]. The key contribution of this article is the proposed neural network approach for classifying agricultural activities that are carried out on farms. To develop the concept, acceleration data was collected from a mobile phone tied to the farmer's forearm during various agricultural operations. A comprehensive analysis of the effectiveness of the proposed approach for the identification of manual harvesting, transplantation, bed preparation, walking and standing activity is presented.

The key advantage of using neural networks for decision-making in agriculture is the ability to reduce the risks associated with a shortage of qualified personnel, to ensure a high level of management of the normal economic activity of an agricultural enterprise. As a result, the growth of stability and profitability of the agro-industrial complex, the strengthening of agriculture as one of the key sectors of the Russian economy.

For effective training of neural networks in solving the problems of profitability of the agro-industrial complex, it is necessary to create a unified national database, including comprehensive information on the characteristics of the soil, climate, varieties of crops, vegetation, etc. The more information is included in such a database, the more efficient the artificial systems will work. intelligence. Such information will be collected over the years, so it is important now to form and launch a unified national system for collecting and processing agronomic information. Such a system should collect data for each of the regions and areas in which agriculture is conducted.

In world practice, there are examples of "open" artificial intelligence systems, which everyone can access to solve their problems. This is how the Watson system developed by IBM works. Especially actively, such systems are used to solve the problems of medical diagnostics.

List of literature

1. D. Shadrin, A. Menshchikov, A. Somov, G. Bornemann, J. Hauslage and M. Fedorov, "Enabling Precision Agriculture through Embedded Sensing with Artificial Intelligence," in IEEE Transactions on Instrumentation and Measurement, (2019)

2. Halimatu Sadiyah Abdullahi, Ray E. Sheriff, Fatima Mahieddine, “Convolution neural network in precision agriculture for plant image recognition and classification”, in 2017 Seventh International Conference on Innovative Computing Technology (INTECH), (2017)

3. S. K. Lenka and A. G. Mohapatra, "Gradient Descent with Momentum based Neural Network Pattern Classification for the Prediction of Soil Moisture Content in Precision Agriculture," 2015 IEEE International Symposium on Nanoelectronic and Information Systems, Indore, 2015, pp. 63-66.

4. Y. Ji, M. Zhang, G. Liu and Z. Liu, "Positions research of agriculture vehicle navigation system based on Radial Basis Function neural network and Particle Swarm Optimization," 2010 Sixth International Conference on Natural Computation, Yantai, 2010, pp. 480-484.

5. S. Sharma, J. Raval and B. Jagyasi, "Neural network based agriculture activity detection using mobile accelerometer sensors," 2014 Annual IEEE India Conference (INDICON), Pune, 2014, pp. 1-5.

Scientific adviser, PhD Ismailova A.A.