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INTELLIGENT TECHNOLOGIES IN AGRO-INDUSTRY COMPLEX IN THE WORLD

Abstract. Most of the results achieved using AI technologies are superior to humans: in 1997, a computer beat the then world chess champion, and more recently, in 2016, other computers beat the world's best go and poker players. Computers prove or help prove mathematical theorems; knowledge is generated automatically, based on machine learning methods, and with the help of large data sets, the size of which is calculated in terabytes (from the 10th to the 12th power) and even petabytes (to the 10th to the 15th power).

Keywords. Intelligent technologies, automation, synchronization system.

Introduction. Most of the results achieved using AI technologies are superior to humans: in 1997, a computer beat the then world chess champion, and more recently, in 2016, other computers beat the world's best go and poker players. Computers prove or help prove mathematical theorems; knowledge is generated automatically, based on machine learning methods, and with the help of large data sets, the size of which is calculated in terabytes (from the 10th to the 12th power) and even petabytes (to the 10th to the 15th power).

Self-learning intelligent systems are widely used in all relevant industries, especially in industry, banking, insurance, healthcare and defense. Many daily processes can now be automated, which will change our professions and eventually eliminate some of them. Artificial intelligence is not just the rational analysis and reproduction of many aspects of the mind by computers, except perhaps humor. In many areas, machines far surpass our cognitive abilities, which makes us wary of some ethical dangers. There are three types of risk: lack of jobs that can be done by machines instead of people; consequences for the independence of an individual, in particular, his freedom and security; more "intelligent" machines dominate humans, fear that it will lead to the death of mankind. However, on closer inspection, it turns out that jobs for people are not going away, they are changing and requiring new skills. Likewise, human independence and freedom are not directly threatened by the development of AI.

According to McKinsey, agriculture ranks last in innovation. This is understandable: until recently, traditional industry implemented technologies without large-scale implementation. Growth is much easier to achieve by increasing acreage and livestock. However, the situation has changed somewhat in the last 5-6 years. The increase in population and welfare has led to an increase in the consumption of protein foods, which in turn requires the expansion of agricultural crops (7 kg of food grains are needed to produce 1 kg of meat). But it can be said that there are no free agricultural lands left in many countries of the world. Moreover, according to forecasts of the UN Food and Agriculture Commission, the amount of arable land per capita in the world will
decrease from 0.6 hectares in 2000 to 0.2 hectares by 2050, and the demand for food will increase by 70 percent.

This is well understood by the largest global players in the industry, from producers of agrochemicals, seeds and fertilizers to food manufacturers, as well as global venture capital funds. They see that the potential of extensive development in the agrarian sector has been exhausted, therefore, the relevance of new technologies that increase the intensity and efficiency of business.

According to ResearchAndMarkets, the volume of the global technological market of the agro-industrial complex will grow by about 12.1% per year and will reach 41.17 billion dollars by 2027.

**Materials and methods.**

Synchronization system. On March 4, 2021, John Deere announced that John Deere Sync is now available on forage harvesters and tractors, allowing the machines to communicate with this development on the road. This allows operators to steer the tractor/trailer parallel to the harvester travel and facilitates harvesting. John Deere Machine Sync allows satellite navigation to synchronize speed and steering between a combine and a tractor with a grain trailer or conventional trailer when unloading in the field. This improves safety for both man and machine, especially in the evening at the end of a hard 14-hour day. It also provides important logistical information such as grain bin fill levels for each combine.

John Deere Machine Sync was first introduced in 2012. Global Navigation Satellite System (GNNS) synchronization allows combines to automatically control the speed and direction of tractors and trailers relative to the combine. This improves harvest safety and relieves operators of some of the workload – the technology is particularly effective during night and long day shifts. In addition, the system eliminates waste during unloading and prevents damage to machines and crops even at high speeds.
Results and Discussion.

The technology is used not only in combines, but also in other machines involved in the grain harvesting campaign and ensuring continuous loading of crops into trailers: self-propelled forage harvesters and tractors are now included in the range of available equipment. This option will be especially useful for farmers who harvest potatoes, carrots and other vegetables using trailer elevator type equipment. The system greatly simplifies the process of planting vegetables and increases its productivity.

Timing requires JDLink telematics, StarFire satellite receiver and 4th generation premium display with automation activation. When you order a new tractor or self-propelled machine, all of these components are usually pre-installed at the factory, but existing equipment can be retrofitted with the system.

Distribution of systems by number of projects:
- Navigator-S: 158
- 1C: GLONASS/GPS satellite monitoring center - 144
- AutoTracker is 106
- Omnicomm LLS: fuel consumption monitoring and vehicle monitoring - 64
- Omnicomm Online – 53
- Others

The introduction of new technology solutions, from automated agricultural equipment and drones that monitor crops to a wide range of IoT sensors that measure soil moisture, has transformed the industry. Some experts call this movement "Agriculture 4.0", a term first coined at the World Government Summit. At the heart of the new era of agriculture is the concept of agricultural management, using technology to monitor crops, measure various indicators and respond to changes. Under this concept, farmers can treat their fields as sub-zones and optimize inputs and inputs such as fertilizers, herbicides and water. With the further development of the idea, there is a transition to the plant level, which allows individual processing of each plant.

Some of the key drivers of the digital agriculture revolution as of late 2018 are:
1) Land O'Lakes, a subsidiary of WinField United, sends experts directly to farms to demonstrate best farming practices.
2) Indoor farms, such as Plenty in San Francisco and Jones Food in Europe, grow plants in large spaces on steep slopes.
3) Purdue University in West Lafayette, Indiana, USA. It is home to the Agricultural Research and Education Center (ACRE), which develops new farming methods aimed at increasing productivity and efficiency. It collects 1.4 petabytes of data every day.

Purdue is looking for solutions that improve the efficiency of farmers. At the university's 1,408-acre (570 ha) research farm, IoT sensors measure the molecular response of plants and how this affects growth and color. In order to collect data, it was necessary to ensure constant Wi-Fi coverage in all fields. Using unmanned vehicles like ACRE's PhenoRover required wireless communication. So the university turned to Aruba Networks, a company owned by Hewlett Packard Enterprise, to assess potential problems and find solutions at this scale.

Purdue also has an experimental farm that serves as an outdoor laboratory and research facility. Here, research teams study genetics and genomics, as well as plant breeding and ecology. According to Jim Beaty, director of the university's agricultural center, the introduction of new technologies in the past few years has greatly accelerated agricultural production.
Land O’Lakes trains farmers to use WinField's integrated Answer Plot system, which stores crop information. The R7 instrument, which is part of the system, collects data from 200 fields in the U.S., which shows where hybrid crops perform best.

WinField developed its solution in 2018. The farmer enters information about the type of soil, the amount of fertilizer used, and the planting date into the system. The program simulates the output and shows when the crop will be at a certain stage of growth and what the expected yield will be. This helps reduce costs by $15-20 per acre, which is important when working with large areas.

Another example is John Deere, one of the largest American engineering companies, which acquired artificial intelligence startup Blue River Technology in 2017. Because of this, John Deere gained a foothold in Silicon Valley and started introducing machine learning and robots in agriculture. The company's owners aim to use automated driving technology, computer vision, unified communications and cloud-based mobile applications to help farmers double or triple their yields. This result will be the key to meeting the world's food needs due to the growth of the world's population in the next 30 years.

But the technology needs to be justified so that farmers are willing to buy it, and increasing productivity and reducing costs is the main focus.

AI robots have learned to recognize and destroy weeds.

In Europe and the US, new agricultural robots that can recognize weeds and selectively destroy them using AI technology are being used. The introduction of such robotic systems could dramatically reduce the use of herbicides and reduce the need for genetically modified crops resistant to chemicals, Reuters reported on May 22, 2018.

A weeding robot developed by Ecorobotix is being tested in sugar beet fields in Switzerland. A solar powered system is like a table on wheels. Moving through the field, the robot scans the shoots with a camera, detects the weeds between them and sprays them with a small amount of herbicide.

Thanks to its selective approach, the Swiss developer claims that the weeding robot can reduce the use of herbicides on farms by 20 times. The company says that it will enter into an agreement with the investors on the distribution of financing in the future. The Ecorobotix robotic system will hit the mass market in 2019.

Meanwhile, in the US, US startup Blue River, which was acquired by agricultural equipment maker Deere & Company in 2017, is testing a weed control unit called See & Spray. The principle of operation is the same as the Swiss system - recognizing weeds and treating their spots with herbicide, but the American unit does not move by itself, but with the help of a tractor. Blue River estimates its technology can reduce herbicide use by 90%.

The See & Spray system has already been tested in cotton fields and the company plans to test other crops such as soybeans. The device is expected to hit the market in 4-5 years. Other companies, such as Germany's Robert Bosch and Denmark's Agrointelli, are also working on similar selective herbicide treatment systems. In an interview with the agency, Richard Lightbound, a representative of the robotic exchange fund Robo Global, said that robotic spot treatment with herbicides is not only very popular among farmers, but may become mandatory at some point.

Conclusion.

In this article, the current state of world agriculture, its development paths and forecasted future are defined.

Several directions affecting the development of agriculture were written, they are:
1) John Deere Machine Sync system for synchronizing forage harvesters and tractors.
2) "Agriculture 4.0" program.
3) Blue River Technology artificial intelligence.
4) Ecorobotix, a robot aimed at eliminating spambots.
5) See & Spray system.

Using these intelligent technologies, it is known that agriculture will be developed far beyond its usual place.

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