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FEATURES OF SMART TECHNOLOGIES IN ANIMAL HUSBANDRY

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Smart agriculture is the implementation of advanced technologies and data-driven farm operations to optimize and increase the sustainability of agricultural production. Technologies used for smart livestock and farming include artificial intelligence (AI), automation, and the Internet of Things (IoT). Artificial intelligence is used in livestock management in many ways, making livestock management simple and efficient with GenAI, ComputerVision, and IOT Edgecomputing.

Although new technologies and tools have long been an integral part of farm management and food production, today the development and implementation of smart livestock and farming technologies prompts pressing challenges. Chief among them is food security: according to the International Monetary Fund, food production must increase by 70% by 2050 to keep up with world population growth.

Through smart animal husbandry and agriculture, we can better adapt to the uncertainties caused by climate change, mitigate environmental impacts and promote sustainable agricultural production.

The goal was of our research was to analyze the available literature data on the study of innovative technologies, effective management of Smart Farm and determine its impact on increasing the competitiveness of livestock products in modern conditions.

In animal husbandry management, AI (artificial intelligence) plays a crucial role in optimizing various aspects of animal husbandry. Using advanced technologies such as machine learning, computer vision and data analysis, AI applications in agriculture are changing the way livestock are raised and managed. From monitoring health and behavior patterns to improving breeding strategies and optimizing feeding practices, Smart Farm's AI-powered solutions contribute to overall livestock welfare and help farmers make more informed decisions. According to a report by Markets and Markets, the precision livestock market is projected to reach US\$11.2 billion by 2028, growing at a CAGR of 10.2%.

In agriculture, it is very important to keep an eye on livestock like cows, sheep, pork, etc. Thanks to new technologies, especially artificial intelligence, farmers can now raise animals more efficiently. They use tools like cameras and sensors to monitor animal health and behavior. This helps farmers identify potential problems at an early stage, ensuring livestock are healthy and happy. It's like having a smart assistant on the farm that makes sure everything goes well and allows farmers to take better care of their animals [1].

Improving animal welfare has become an imperative in agricultural practice, which has led to the development and implementation of strategies for optimal animal care and welfare. Optimizing animal welfare involves various measures to ensure that animals raised in agricultural conditions are in good health, comfort and humane treatment.

The edge computing of the Internet of Things (IoT) plays a significant role in optimizing animal welfare. Here's how IoT edge computing is being used to improve animal welfare by optimizing food and drink.

Automated Feeding Systems (AFS): IoT sensors placed on feeding equipment can monitor the eating habits of individual animals. These devices track how much each animal eats and the data is processed locally at the border, allowing real-time adjustments to feeding schedules and portion sizes. This ensures that each animal receives the appropriate amount of nutrition according to its needs. According to the Food and Agriculture Organization (FAO), the use of automated feeding systems has reduced feed costs by 5-10%. In the study of Nabokov et al. regular animal feeding increased the production potential of the farm, which led to a high return on investment (87.8%).

Water quality monitoring: IoT sensors can be integrated into water supply systems to monitor the quality and availability of potable water. Limit calculations allow immediate analysis of factors such as water temperature and purity. If any problems such as pollution or low water levels are detected, automatic alerts can be sent to farmers via mobile apps, enabling them to take immediate corrective action.

Artificial intelligence helps farmers monitor the health of animals by monitoring their body temperature, tracking animal movements, observing their behavior and standing position. All these details help farmers to notice if the animal is feeling bad or uncomfortable. IoTEdge computing enables the analysis of animal behavior related to food and drink.

AI-based systems can analyze disease history and animal data to develop individual treatment plans for livestock. Decision support is used to identify treatment options for individual cases, while generative artificial intelligence creates individualized treatment plans based on specific conditions. In veterinary medicine, Generative AI plays a critical role in creating treatment scenarios and facilitating informed decision-making. "Animals" research showed that machine learning algorithms achieved high accuracy [2].

Fecal detection and identification is an important aspect of animal management, especially in agriculture. Fecal detection and identification play an important role in monitoring animal health and welfare. By examining manure characteristics such as consistency, color and odor, farmers can gain insight into the digestive and general condition of the animals.

Smart climate control systems have revolutionized the approach to optimizing the living conditions of animals on modern farms. These innovative systems use Internet of Things sensors to continuously monitor the environment, adjusting key factors such as temperature, humidity and air quality in animal housing. By maintaining optimal conditions, for example, with precise ventilation and heating mechanisms that respond to changing weather conditions, these systems create a stress-free environment for the animals. This is critical for overall well-being, preventing respiratory problems and providing a comfortable living environment for the animals.

Integration with weather forecasting allows farmers to anticipate climate changes, adjust conditions early and reduce the risk of heat stress or cold-related problems for animals. With real-time monitoring and alerts sent via mobile apps or centralized control systems, farmers can quickly respond to deviations from optimal conditions, addressing potential problems before they escalate [3].

Extreme temperatures, hot or cold, affect animal comfort and health. Strategies such as providing shade or adjusting ventilation can be implemented by predicting heat waves or cold snaps. Forecasting rainfall or drought helps to effectively manage water resources, which is vital for livestock hydration. Weather directly affects pasture and forage growth, allowing for strategic planning of pasture availability and forage adjustments. The prevalence of disease in livestock is affected by specific weather conditions, and precautions can be taken by forecasting such conditions. AI algorithms process huge data sets, including historical weather conditions, real-time sensor data and satellite imagery. This allows for more accurate and localized forecasting, providing early warning of extreme weather events such as storms, heat waves or severe cold snaps.

Modern conditions of intensive animal husbandry, introduction of advanced technologies and requirements for productive qualities of animals have significantly increased. For farm animals, an important and determining criterion is a specialized direction of productivity and its high level, duration of productive life, stress tolerance and resistance. The process of selection and breeding is an important component of the agricultural sector, as it contributes to the improvement of the genetic

characteristics of animals. It can also affect product quality, health and disease resistance. There are various progressive methods of selection, such as genetic engineering, marker selection, and breeding methods, such as artificial insemination and embryo transfer, and smart technologies cannot be dispensed with in this matter [4].

The introduction of advanced technologies, methods of selection and breeding in animal husbandry, the implementation into practice of the developed methods of breeding and selection of agricultural animals, which will take into account the specifics of all branches of animal husbandry, are the key to increasing the production of quality food products, in particular milk and dairy products, for the consumer and raw materials for industry. Therefore, the concept of a smart farm is gaining more and more importance and relevance [2, 4].

The concept of Smart Farm is promising for the livestock industry of Ukraine, as it frees farmers from burdensome work, takes care of animal physiology, improves control and management of production, ensures high the quality of the obtained products.

Therefore, for its widespread implementation, it is necessary to attract the support of the state to create new farms with innovative technologies, construction and reconstruction of existing premises, carrying out selection work in the direction creation of highly productive breeds, training of highly qualified personnel for maintenance of innovative systems, conducting research work with search directions for new innovative solutions [3].

AI in livestock management on SmartFarm is not a luxury; this is a necessity for sustainable and productive agriculture. This ensures animal welfare, optimizes the use of resources and empowers farmers to make informed decisions that affect the entire agricultural ecosystem. As we step into a future where innovation meets measurable excellence, the importance of artificial intelligence in livestock management becomes a keystone for a smarter, more resilient and sustainable agricultural sector.

References

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