Use of Artificial Intelligence in Animal Behavior: Current Status and Future Perspectives

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Introduction

In the contemporary era, the field of artificial intelligence (AI) has witnessed a series of groundbreaking advancements across diverse disciplines, including biology, veterinary sciences and animal husbandry. Conventionally, the analysis and interpretation of animal behaviour have been primarily reliant on prolonged observation and the expertise of seasoned professionals. However, AI-driven methodologies have the potential to transform this process, rendering it more expeditious, objective and data-driven. Leveraging advanced big data analytics, image processing and machine learning techniques, AI has emerged as a significant tool for evaluating the health, behaviour and welfare of animals. Moreover, it has been demonstrated to play a pivotal role in enhancing production efficiency.

In contemporary animal husbandry, efficiency and sustainability are of paramount importance. The enhancement of animal welfare and the optimisation of pivotal production parameters, such as milk, meat and fertility, can be managed with greater precision through the utilisation of AI-supported systems. Given the challenges associated with the tracking and management of individual animals, particularly in large-scale farming enterprises, AI-based automation systems have emerged as a means to enhance the efficacy and efficiency of these processes. This paper undertakes an evaluation of the current status of AI implementation in the field of animal behaviour, while also providing a comprehensive overview of potential future developments.

Current areas of use

The integration of Artificial Intelligence (AI) with diverse methodologies has led to significant advancements in the analysis and interpretation of animal behaviour. The application of image processing techniques, deep learning algorithms, and big data analytics has facilitated the development of automated systems capable of tracking animal movements and detecting behavioural changes. For instance, facial recognition systems have been employed to identify individual animals, while machine learning-based algorithms can assess factors such as stress, disease, and social interaction. Within the agricultural and livestock sectors, AI-supported systems have become prevalent in processes such as herd management, welfare assessment, and anomaly detection.

Artificial ıntelligence methods used in animal husbandry

In the animal husbandry sector, AI is widely used to optimize production processes, improve animal welfare, and diagnose diseases early. Some of the prominent AI methods are:

- Machine learning is the process of analysing the health status, eating habits and stress levels of animals by learning from large data sets.

- Image processing is the process of using camera-based systems to provide early warnings to farmers by detecting animal body condition, movement patterns and abnormalities.

- The Internet of Things (IoT) is a term used to describe the network of physical devices, such as sensors, that can collect and exchange data wirelessly. IoT parameters,

such as temperature, humidity and activity levels, can be continuously monitored through sensors.

- Autonomous Robots: The utilisation of autonomous robots has been employed in the domains of feed distribution, animal health checks, and cleaning operations.

- **Sound Analysis:** The development of systems that analyse the sounds produced by animals to detect stress, disease, and hunger is underway.

- **Biometric Identification:** The capacity to track individual animals through facial recognition and skin patterns is being advanced.

- **Nutrition Optimization:** The potential of artificial intelligence (AI) to determine the nutritional needs of individual animals and to provide the most appropriate feed distribution is being explored.

- **Behavioral Prediction Models:** Algorithms that predict the future behavior of animals can help diagnose potential health problems early.

These methods make significant contributions to making animal husbandry more efficient and sustainable.

The effects of artificial ıntelligence on animal welfare and productivity

Artificial intelligence applications optimize production processes by improving animal welfare. Ensuring animal welfare is not only an ethical obligation, but also directly related to higher production efficiency. Well-fed and healthy animals with low stress levels can provide higher milk, meat and fertility. The effects of artificial intelligence in these areas can be summarized as follows

- **Milk Yield:** AI-supported systems help increase milk yield by optimizing the lactation process in dairy cows. Sensors and image processing techniques monitor udder health, allowing early diagnosis of diseases such as mastitis.

- **Meat Yield:** Artificial intelligence systems that monitor the growth rate of animals increase meat yield by optimizing feeding programs. They also contribute to improving meat quality by reducing stress levels.

- **Fertility:** Artificial intelligence-based systems that detect reproductive periods increase pregnancy rates by determining the most appropriate time for artificial insemination. IoT-based sensors that analyze hormonal changes allow for closer monitoring of reproductive health.

- **Early Disease Diagnosis:** Artificial intelligence-supported health monitoring systems can detect disease symptoms early by monitoring the body temperature, movement patterns and feed consumption of animals. In this way, animal losses and economic losses can be reduced by starting treatment early.

Effects of artificial ıntelligence on operating costs and workforce

The integration of AI-based systems into the livestock sector offers significant advantages in terms of operating costs and workforce management.

- **Labor Efficiency:** The implementation of AI-supported automation systems facilitates the execution of routine tasks without the necessity of human intervention. In particular, within the context of large farms, the employment of autonomous robots and sensors has been demonstrated to enhance the efficacy of tasks such as individual animal tracking, feed distribution and health monitoring. This reduction in the requirement for human labour consequently enables a reduction in the number of personnel required to complete the same amount of work.

- **Cost Reduction:** Artificial intelligence reduces operating costs by optimizing elements such as feed consumption, water use and energy efficiency. In particular, treatment costs can be reduced and animal losses can be minimized thanks to early diagnosis of diseases.

- **Time Savings:** Observation and analysis processes carried out with traditional methods can be completed in a much shorter time thanks to artificial intelligence systems. Farmers and veterinarians can make faster and more accurate decisions with AI-supported analyses.

- **Long-Term Profitability:** The contributions of artificial intelligence to animal health, production efficiency and cost control have been demonstrated to result in enhanced long-term profitability for businesses. The reduction in

operating costs and the increase in production capacity that characterise the use of artificial intelligence have been shown to increase competitiveness in the livestock sector.

Future perspectives

The development of AI is expected to result in the creation of more sophisticated and sensitive systems in the field of animal behaviour science. The integration of data, the accuracy of predictions and the balance of artificial intelligence applications with ethical concerns are anticipated to influence the future of animal husbandry. In this process, interdisciplinary studies and ethical rules are considered to be of great importance.