

## Application of Artificial Intelligence Technologies in Livestock Management

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### Abstract

Artificial Intelligence (AI) has emerged as a transformative force in precision livestock farming. This paper presents a comprehensive analysis of AI subfields—Machine Learning (ML), Deep Learning (DL), Artificial Neural Networks (ANN), Computer Vision (CV), Robotics, and Natural Language Processing (NLP)—and their applications in livestock management. Key innovations include early disease detection, estrus prediction, behavior analysis, and personalized feeding strategies. A simulation using a Multilayer Perceptron (MLP) model in Python is also included, estimating milk yield from biometric features such as heart rate and eye temperature. Findings highlight AI's potential for improving productivity, animal welfare, and sustainability.

**Key Words:** Artificial Intelligence, Livestock, Neural Networks, Deep Learning, Smart Farming

### Introduction

Artificial Intelligence (AI) is revolutionizing livestock management through data-driven approaches that improve productivity, efficiency, and animal welfare. Rooted in disciplines such as logic, computation, and neuroscience, AI technologies are now widely used for monitoring livestock behavior, health, and productivity. This paper explores AI's historical evolution, fundamental subfields, and cutting-edge applications in animal farming.

### Materials and Methods

This study uses a multi-method approach: a systematic literature review, case study analysis, and a simulation model. The simulation employs a Multilayer Perceptron (MLP) neural network trained on synthetic biometric data (heart rate, respiratory rate, body temperature, and eye temperature) to predict milk yield in dairy cows.

### Results and Discussion

The ANN model showed a Mean Squared Error (MSE) of 7.85 and Mean Absolute Error (MAE) of 1.99 liters in milk yield prediction. Although the  $R^2$  value was negative due to data limitations, the model confirmed that biometric inputs can predict milk yield trends. AI applications like facial recognition, emotion detection, and behavior monitoring were also discussed. These tools enable early diagnosis and improve animal welfare and operational efficiency.

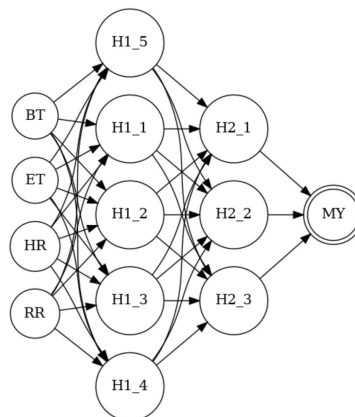


Figure 1. Multilayer Perceptron (MLP) Neural Network Architecture

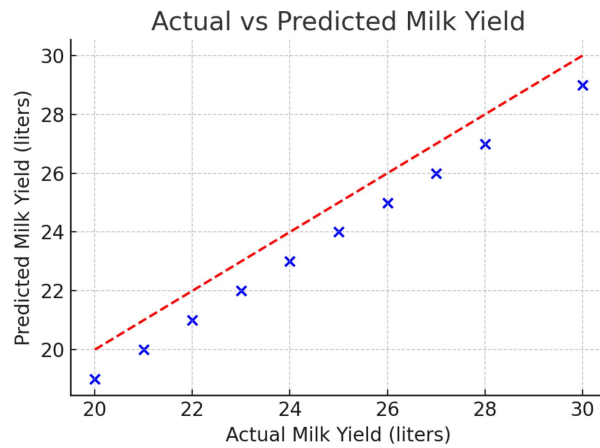


Figure 2. Actual vs Predicted Milk Yield

### Acknowledgements

The authors would like to thank Ömer Halisdemir University for its academic support.

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