



Original Research Paper

Deep Learning Recognition of Grazing Behaviour in Pasture-Based Cattle

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Key Words	Abstract
Deep learning, Cattle grazing behaviour, Pasture monitoring, Animal behaviour recognition, Precision livestock farming, Cattle welfare, Behaviour classification.	Introduction: The grazing behavior is one of the important determinants of cattle health, welfare and productivity in pasture-based farming system. The common behavior analysis approaches have been mostly relying on observation, but it is tedious, time consuming, and not practical for large scale monitoring and assessment. In this research, a framework based on deep learning was proposed for identification of grazing behavior of cattle in pasture environment through movement patterns, feeding behavior and environmental factors. The gathered behavioral data were analyzed and distinct patterns associated with grazing behaviors were identified from those data. Through deep learning approach, automated identification of cattle behaviors was made possible. It has been found that the deep learning algorithms were able to capture the changes of cattle behavior patterns, and classify them accordingly. Thus, the proposed framework offers a good way for precision livestock management through monitoring of behavior patterns of cattle and enhancing welfare and decision making in the field of cattle farming. The experiment shows that behaviour recognition through deep learning contributes towards sustainable pasture management and efficient cattle production systems.

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Introduction

Grazing behavior can be used to determine the nutritional status of cattle, health condition, welfare, and utilization of pastures. By understanding the behaviors of cattle including grazing, feeding, resting, and moving, it will be easier to manage the livestock and achieve sustainable production. The behavior of the grazing animals is affected by the environment and management, thus the need for constant observation (Venter et al., 2019).

Cattle behavioral evaluation methods using the traditional way require direct observation, which is laborious, tedious, and complicated to use when it comes to monitoring a large number of livestock. With the new technologies brought about by precision livestock farming, sensors, wearables, and intelligent systems have been developed to automate the gathering of behavioral data from animals (Wolfert et al., 2017).

The use of deep learning techniques in the identification of complicated behaviors of animals through analyzing their motion and sensing information has proven to be quite effective. The use of automated behavior classification methods using deep learning models has been attempted for the analysis of behaviors of grazing animals by analyzing behavioral attributes using accelerometer data (Kamiya et al., 2025). Likewise, intelligent models designed for pasture-fed cattle have also been found capable of detecting and classifying behaviors of cattle (Lopez et al., 2026; Ni et al. 2025).

The combination of machine learning and precision livestock technologies offers new ways of continuously detecting the grazing behaviour of cattle as well as their well-being. Deep learning using sensor technologies is capable of analysing the behavioural and health patterns of livestock to enable automation in livestock monitoring and farm management (Pokkuluri et al., 2025). This is why this research concentrates on creating a deep learning framework for identifying the grazing behaviour of pasture-based cattle.

Review of Literature

Cattle Grazing Behaviour Monitoring

Information on grazing behavior can shed light on cattle welfare, efficiency of feeding, and the use of pastures. Traditional methods based on observations need constant human intervention and are hard to use in prolonged periods. Technologies related to precision livestock farming have made possible the automation of behavior monitoring due to the use of modern sensing technologies and data processing (Chelotti et al., 2023; Tilkins, 2025).

Sensor-Based Behaviour Recognition

Wearable sensors and electronic devices have been extensively employed in order to monitor cattle movement, feeding behavior, and activity changes. Machine learning-based analysis of sensor data helps in the detection of behavioral patterns and health condition of livestock animals. Wearable devices have been shown to possess capabilities in continuously modeling livestock animal behavior and management (Ni et al., 2025). Similar deep learning approach

based on sensors has been successful in improving the health and behavior monitoring of livestock animals through analysis of activity data (Pokkuluri et al., 2025).

Deep Learning Applications in Livestock Behaviour Analysis

Deep learning has helped to advance automated detection of behaviors in animals based on patterns obtained from motion and image data. Deep learning models have been used in the classification of grazing behavior with the use of accelerometer data showing that deep learning models can be used to detect behaviors automatically (Kamiya et al., 2025). Studies have also created intelligent models for the detection and classification of cattle behaviors in pastures (Lopez et al., 2026).

Integration of AI with smart farm technologies has made automated management of livestock even more effective. IoT-supported systems make data acquisition and intelligent processing continuous to facilitate sustainable and efficient agriculture (Amale et al., 2026). Another area of research is the application of machine learning techniques in behavior classification of dairy cattle (Williams, 2020).

Research Gap

Previous studies have shown the applicability of sensors, machine learning, and deep learning in recognizing the behavior of livestock animals. In many cases, however, most of these methods concentrate more on the controlled environment as well as particular behavior types but not grazing behavior. Problems such as environmental variability, complicated animal behavior, and long-term behavior monitoring still exist. Thus, a proper deep learning approach should be developed for grazing recognition.

Proposed Deep Learning-Based Grazing Behaviour Recognition Framework

Overview of the Proposed Framework

This research develops a deep learning-based model that can be used to detect grazing behavior in cattle kept in pastures. This model is developed by analyzing the behaviors, actions, and movements of the cattle. Through the integration of intelligence learning technologies, this approach allows for the automation of cattle behavior monitoring.

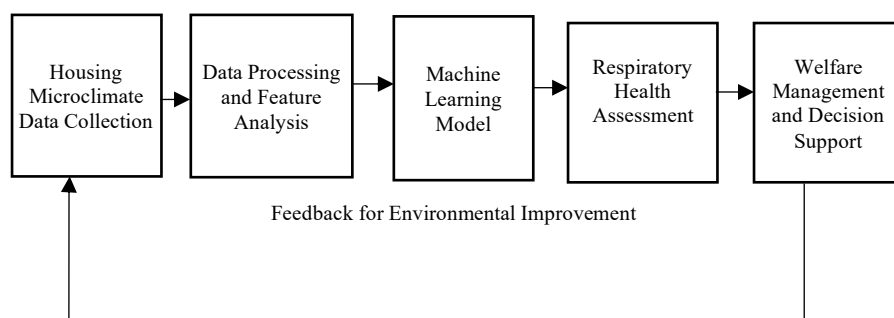


Figure 1: AI-Based Livestock Health Assessment and Environmental Management Framework

The figure 1 presents a visual representation of the suggested approach, starting from data acquisition concerning the housing microclimate, followed by data processing and features' analysis. The processed data are then analyzed through a machine learning algorithm in order to assess the respiratory health of animals and manage their welfare.

Grazing Behaviour Data Collection

The framework developed takes into account the behaviour-related information gathered from the cattle grazing on pasture, which includes their movement, eating patterns, grazing period, and variations in behaviour. Such behaviour-related information serves to provide valuable information regarding the responses of the cattle and the use of the pasture.

Behavioural Feature Identification

The gathered information about the behavior is then analyzed for extracting characteristics which can be used to characterize grazing behavior. The characteristics like activity intensity, duration of activity, and feeding behavior are analyzed in order to distinguish between the behaviors of grazing, resting and moving.

Deep Learning-Based Behaviour Recognition

The extracted behavioral features are then analyzed using the deep learning approach in order to determine the grazing patterns. This model detects the complex interrelationships that exist in the behavioral data and categorizes the activities of the cattle depending on the patterns recognized.

Grazing Activity Classification and Monitoring

The behaviors are categorized under various activity categories, making it possible to track the grazing behaviors of the cattle. This information will be useful for decision-making on livestock management since it gives details concerning the activities and welfare of the animals.

Methodology

Pasture Behaviour Data Collection

This study will be looking at the data obtained on the behavioral patterns of cattle that graze in pasture to examine their grazing behavior. The information gathered includes aspects such as movement patterns, feeding time, behavioral patterns among others. This information is important in establishing the characteristics of cattle grazing behavior.

Behaviour Data Processing and Analysis

These behavioural data are analyzed in order to increase consistency and reliability. Data organizing, filtering out noises and analysing behavioural patterns are done in order to detect the important features for grazing activities. The analyzed data is used for recognition through deep learning.

Grazing Behavior Recognition Approach

Analysis of the behavior patterns of animals and recognition of grazing activities is done through the deep learning methods. The model is used to understand differences in cattle movement and behavior when they graze. This leads to automatic monitoring of the behavior of the animals.

Behaviour Classification and Assessment

The identified behaviours have been classified based on different behavioural categories according to learned patterns. The assessment is concerned with the effectiveness of the methodology used in identifying the behaviors of grazing.

Implementation Process

The complete process comprises behavioural data acquisition, data analysis, deep learning recognition, activity classification, and management assistance. This process allows for the automation of grazing behaviour monitoring and is relevant to precision livestock farming applications.

Results and Discussion

Analysis of Grazing Behaviour Patterns

The behavioral patterns of cattle were analyzed in order to gain information on grazing, movement, and feeding patterns in pasture environments. These patterns were useful for analyzing how the behavior of cattle changed and was related to pasture use.

Deep Learning Recognition Performance

This deep learning model was able to detect grazing behavior through analyzing behavioral features. This model has shown its capability of differentiating between grazing behavior and any other cattle behavior.

Comparison of Behaviour Recognition Methods

The performance of the proposed method was compared to those of traditional machine

learning techniques. The findings indicated that the recognition using deep learning had a better ability in capturing complicated behavioral patterns.

Influence on Cattle Management

The identified grazing behavior data allows for better cattle management since it offers useful information about animal movements and well-being as well as pasture utilization. Automation aids in making the right decisions on sustainable cattle farming.

Discussion

The results demonstrate that the use of deep learning for behavioral detection in cattle monitoring within a pasture can be more effective through minimizing the need for manual observation and continuous monitoring. The application of intelligent monitoring methods is a good approach to precision livestock farming.

Conclusion

Monitoring of cattle grazing behaviour is crucial for assessing cattle welfare, feeding behavior, and pasture utilization in pasture-based agricultural systems. In this paper, we proposed a framework based on deep learning technique for detecting the cattle grazing behavior using analysis of behavioral pattern and activity. The proposed technique provided an opportunity to automate the detection of grazing behavior and minimize the use of manual observation method. It was found that the use of deep learning techniques helps in capturing the behavioral variations and continuous livestock monitoring. This work will be beneficial for future

development of cattle management and sustainable pasture utilization. Future work can be directed towards integration of real-time sensor network and deep learning techniques.

References

- [1] Amale, Ashvin B., K. V. Pradeep, AJ Rishabh Bhardwaj, Neeta Mazumdar, Sachin S. Pund, and Bhuvana Jayabalan. "Optimizing Sustainability of Smart Farming with IoT-Assisted Novel Framework." *Journal of Internet Services and Information Security* 16, no. 1 (2026): 31-48.
- [2] Chelotti, José, Luciano Martinez-Rau, Mariano Ferrero, Leandro Vignolo, Julio Galli, Alejandra Planisich, H. Leonardo Rufiner, and Leonardo Giovanini. "Livestock feeding behavior: A tutorial review on automated techniques for ruminant monitoring." *arXiv preprint arXiv:2312.09259* (2023).
- [3] Kamiya, Uta, Kasumi Kakiuchi, Kensuke Kawamura, Koichiro Ueda, Masahito Kawai, Akira Matsui, and Natsuko Negishi. "Deep learning approach for classifying grazing behavior in yearling horses using triaxial accelerometer data: a pilot study." *Journal of Equine Veterinary Science* (2025): 105706.
- [4] Lopez, Alyssa, Elysia Jimenez, Damian Valles, and Merritt L. Drewery. "Developing Intelligent Models to Detect and Classify Cattle Behavior on Pasture." *Animals: an Open Access Journal from MDPI* 16, no. 16 (2026): 2617.
- [5] Ni, Guohao, Yuanzheng Jia, Zhonghao Shi, Fangyuan Chang, Jinfeng Miao, Jian Wang, Gengping Ye et al. "A full end-to-end analytical framework for livestock behavior modeling and health assessment using wearable electronic recording system and machine learning." *Smart Agricultural Technology* (2025): 101686.
- [6] Pokkuluri, K. S., Bhardwaj, R., Sunil, M. P., Kadam, K., Mishra, A., & Patel, G. M. (2025). Smart monitoring of livestock health and behavior with sensor-based deep learning optimized system. *Journal of Wireless Mobile Networks, Ubiquitous Computing and Dependable Applications*, 16(3), 219–240.
- [7] Tilkens, Nicolas. "Enhancing insights into the behaviour of grazing cattle through Precision Livestock Farming tools." PhD diss., Universite de Liege (Belgium), 2025.
- [8] Venter, Zander S., Heidi-Jayne Hawkins, and Michael D. Cramer. "Cattle don't care: Animal behaviour is similar regardless of grazing management in grasslands." *Agriculture, Ecosystems & Environment* 272 (2019): 175-187.
- [9] Williams, Manod. "Machine learning for dairy cow behaviour classification." PhD diss., Aberystwyth University, 2020.
- [10] Wolfert, Sjaak, Lan Ge, Cor Verdouw, and Marc-Jeroen Bogaardt. "Big data in smart farming—a review." *Agricultural systems* 153 (2017): 69-80.