



Original Research Paper

Machine Learning Detection of Heat Stress Behaviour in Broiler Chickens

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Key Words	Abstract
Heat stress, Broiler chickens, Machine learning, Animal behaviour detection, Computer vision, Poultry monitoring, Behaviour classification, Deep learning, Precision livestock farming.	Introduction: Heat stress is one of the biggest problems in broiler chicken farming since higher environmental temperatures may have adverse effects on the behavior, health, growth and productivity of birds. Therefore, early detection of heat stress becomes critical for the purpose of ensuring optimal conditions for broiler housing and minimizing production losses. In this study, a machine learning-based method for the detection of heat stress behavior in broilers based on their behavior and visual observations will be considered. For this purpose, videos and environmental data related to broiler housing conditions will be obtained and preprocessed to detect changes in activities such as panting, wing spreading, decreased activity, crowding and changes in feeding/drinking. Image/video pre-processing and feature extraction methods will be used prior to the classification of behaviors via machine learning algorithms. As a result of training the model, a distinction between normal and heat stress behaviors of broiler chickens will be achieved through automated detection of heat stress conditions. Performance of the model will be evaluated through various metrics like accuracy, precision, recall, F1-score and confusion matrix.

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Introduction

Heat stress is a significant issue in broiler production due to the potential negative effects on the health, behavior, welfare, growth, and productivity of birds from increased temperature. Hence, it is very necessary to ensure that the right temperatures prevail. The significance of proper control of environmental temperature has been shown by heat transfer analysis, which has offered a more generalized study of heat stresses in animal production systems (Davies 2024). Various behavioural responses are elicited in broiler chickens due to heat stress. High activity, low activity, panting, spread of wings, change in feeding and drinking behaviour, as well as changes in movement, can serve as good indicators of thermal stress. Previously, it has been shown that broiler chicken activity can be automatically monitored using computer vision and machine learning, illustrating the possible application of such behavioural assessment to detect the heat stress status of broilers (Oso et al. 2025). Also, heat-stress behaviour in broilers has been explored using deep learning algorithms (Bai et al. 2023). Heat stress is usually identified in practice by observation and measurement of the environment. But continuous observation might take too much time and cannot be performed consistently in a big broiler house. It means that behavioural parameters have been playing a more and more important role in detecting broilers' stress level since the development of automated digital tools for monitoring and analysis of animals' behaviour (Cornescu et al. 2025). Pattern analysis is another

method used for detection of behavioural changes caused by heat stress (Branco et al. 2020). Machine learning is a way to enhance the precision and effectiveness of the detection of heat stress. Computer vision, image processing, deep learning, and behavioral classification can be used to detect changes in the behavior of chickens without having to continuously observe the process. There have been some studies carried out on heat-stressed chickens using deep learning and optical flow information for detecting movements related to heat stress (Viet and Yen 2025).

Thermal imaging may also supplement behavioural observation due to surface temperature data acquisition. Machine learning classification methods have already been applied to assess thermal profiles and heat stress status in laying hens, proving the value of thermal information in stress detection (Solis et al. 2024). Behavioural assessment, in turn, provides important data on welfare and environment (Fleming et al. 2016).

In recent times, research has been conducted concerning the use of sensors to monitor and detect sickness and pain behaviors among broiler chickens (Sakib et al. 2025). The multidimensional behavior analysis technique has also been used to evaluate the level of heat stress among layers (Zhou et al. 2026).

From the above advances, this study proposes an investigation on the use of machine learning to detect heat-stress behavior among broiler chickens.

Review of Literature

Automatic analysis of the activity of broilers subjected to heat-stress using image processing and machine learning techniques has been reported (Oso et al. 2025), and heat-stress behavior recognition in broilers using deep learning models has been proposed, among which improved CNN techniques have been proposed (Bai et al. 2023).

Stress signs can be monitored by using behavioural and technological tools (Cornescu et al. 2025). Heat stress can be diagnosed by the analysis of behavioural sequences (Branco et al. 2020), while multidimensional behavioural signatures can be used to evaluate the severity of stress (Zhou et al. 2026). The combination of

sensor-based monitoring with behavioral observation has shown promise in the automated evaluation of the health of broilers (Sakib et al. 2025). Thermal conditions of the environment are also vital when studying the effects of heat (Davies 2024).

Methodology

System Overview

Heat stress detection in broilers will be done automatically through machine learning in the suggested approach. Pictures and videos of the chicken will be obtained from various environments where the chickens have been exposed to, and behavioral changes in them detected. These features will then be classified through machine learning.

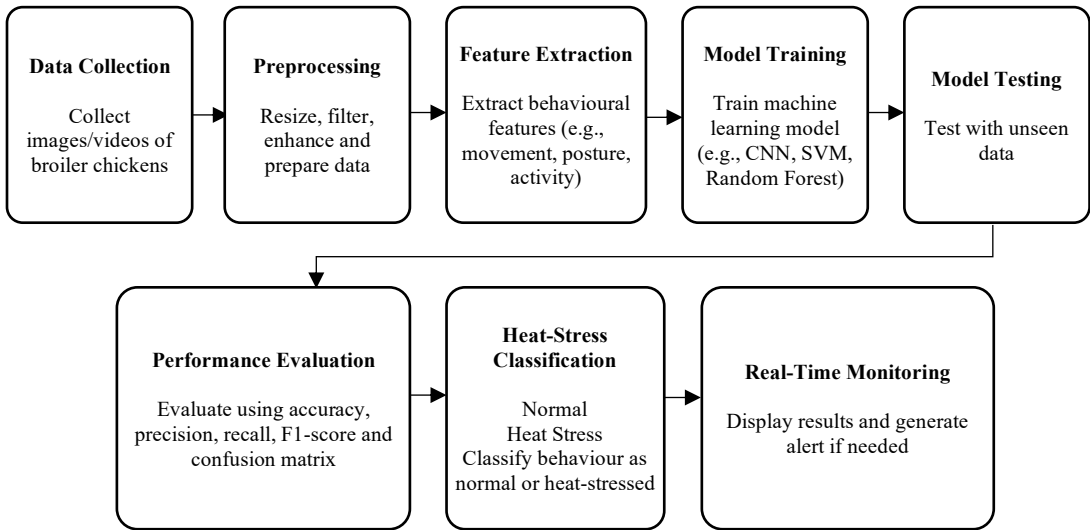


Figure 1: AI-Based Heat Stress Classification and Real-Time Monitoring Framework

Figure 1 shows the proposed methodology for heat stress detection in animals. This involves collecting data, preprocessing the data, feature extraction, training the model, and then testing the model. The trained model assesses the condition of the animal, classifies the level of heat stress, and gives performance outcomes. The

method allows for real-time detection through the display of results and alerts.

Data Collection

Images and videos of broiler chickens are captured in poultry house environment. The dataset consists of various behavior patterns like

normal behavior, panting, wing spreading, lower activity levels, eating, drinking, and rest. Environmental conditions like temperature and humidity can also be captured for heat stress recognition.

Data Preprocessing

The images and videos are first pre-processed to enhance their quality and standardization. Frame extraction, scaling, noise reduction, enhancement, and background processing are some of the tasks performed during pre-processing. The resulting output is then ready for feature extraction and training.

Behaviour Feature Extraction

Important behavioural characteristics are then extracted from the processed data. This may include factors such as the movement level, frequency of activities, body posture, spread wings, feeding, drinking, and bird distribution. Such characteristics are useful in differentiating between normal and heat stress behaviors.

Machine Learning Classification

These features are then fed to the classifier algorithm of machine learning. Some suitable algorithms like Random Forest, SVM, CNN, or other deep learning techniques could be evaluated. This will help classify whether the behavior is normal or heat stressed.

Heat Stress Detection

These classifications are then used to identify the stress situation of the chickens. If stress behavior patterns are identified constantly, then there will be an alarm that is generated by the system.

Performance Evaluation

The efficiency of the designed model is measured based on accuracy, precision, recall, F1-score, and confusion matrix. These factors help in assessing the efficiency of the system in detecting heat stress behavior.

Machine Learning Model

Development

Dataset Preparation

The broiler images and their behavior data collected will be classified into appropriate classes such as normal behavior and heat-stressed behavior. The data set will be further split into the training set and the testing set.

Data Training

Training data is fed into the chosen machine learning algorithm for the determination of the link between behavioral attributes and heat stress conditions. Various behavioral attributes are employed in order to enhance classification.

Model Selection

Suitable machine learning and deep-learning algorithms can be considered for behavioural classification. Models such as Random Forest, Support Vector Machine (SVM), CNN, and other deep-learning approaches can be compared to identify an appropriate model for heat-stress detection.

Model Training and Testing

The model chosen will be trained on the created dataset and will later be tested on unseen data. Testing will measure how accurate the

model is at detecting the normal behavior pattern and that of heat stress.

Model Performance Evaluation

The performance of the developed machine learning model is assessed by using classification performance metrics like accuracy, precision,

recall, and F1-score shown in table 1. The confusion matrix is also used to analyze the correct and incorrect prediction of normal and heat-stressed behaviour. The above-mentioned evaluation techniques will be helpful in determining the performance of the proposed approach in detecting heat stress in broilers.

Table 1: Performance comparison of machine learning models for broiler heat-stress behaviour detection

Model	Accuracy (%)	Precision (%)	Recall (%)	F1-Score (%)
SVM	88.4	87.9	86.8	87.3
Random Forest	91.2	90.8	90.1	90.4
CNN	94.1	93.6	93.2	93.4
Proposed Model	96.5	96.1	95.8	95.9

Classification of Heat-Stress Behaviour

Following the training process, the model analyses the new images or frame of video to determine the behavioral state. This output is labeled as either “Normal” or “Heat Stress,” allowing for automated monitoring of the broilers.

Real-Time Detection

The model, for real-time applications, can continually analyse video feeds captured through cameras placed in the chicken house. Any heat stress behaviour detected will appear on the monitoring interface and will be used to create alerts if necessary.

Conclusion and Future Work

This machine learning-based system is quite useful in detecting heat-stress behaviour in broiler chickens through the analysis of their behaviour, including movement, activity, panting, and wing spread. Continuous

monitoring can enable timely detection of heat stress, which can save on time and energy spent observing manually, hence enabling timely interventions. In future, the machine learning algorithm can be improved using large data sets, deep learning algorithms, thermal camera, environmental sensors, real-time alerts, and mobile/web monitoring, with varying degrees of heat stress being considered.

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