MONITORING CHICKEN HOUSES WITH AI SURVEILLANCE SYSTEM

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ABSTRACT

In Taiwan, the need of chicken meat accounts for approximately 30% of total livestock production. In order to maintaining animal welfare, floor-rearing chicken farming approaches are widely used in Taiwan. However, traditional poultry management is often labor-intensive which increases the risk of disease transmission. To improve monitoring efficiency, we proposed a smart rail surveillance system to automatically monitor chickens for real-time chicken health assessment. The system comprised a ceiling-mounted monorail, a suspended control box with dual-channel (RGB and thermal) cameras, a Wi-Fi mesh network, environmental sensors, and a deep learning model. The monorail system was installed at the ceiling of the chicken house. It suspended a control box that equipped with two dual cameras located on the opposite of each other capturing RGB videos and thermal images. Environment sensors are also attached to the bottom of the box. After collecting the data of the environment, (temperature, humidity, CO_2 and RGB/thermal images), the data were then transmitted to a cloud server via Wi-Fi and 5G network. Chicken detection in the RGB videos was performed using a trained You Only Look Once version—9(YOLOv9) model, achieving a mean precision of 95.6%. Spatial dispersion and movement were quantified using the nearest neighbor index and a real-time tracking algorithm. By combining thermal imagery with motion data, the system can identify inactive or potentially deceased chickens. This system enhanced poultry farm management by reducing labor demands and improving biosecurity through automated and continuous monitoring.

Keywords: object detection, object tracking, image processing, deep learning

INTRODUCTION

Chicken is a key source of protein and a major agricultural industry worldwide, worth USD 407.3 billion in 2023. In Taiwan, chicken accounted for NTD 93 billion, or 45.9% of animal husbandry revenue. Taiwan Native Chickens (TNCs) are valued for their meat quality but require three times the rearing period of broilers, resulting in higher costs. Frequent avian influenza outbreaks further increase the financial burden on TNC farmers. Our objective was to create a system that quantifies the dispersion and movement of chicken flocks, observe the dispersion and movement between section, and identify chicken with hypothermal methods.

MATERIALS AND METHODS

System overview

This system uses a rail-mounted smart module and cloud-based algorithms to detect chickens, quantify dispersion and movement, and also, identify hypothermia. A 40 m rail with nine stops and a 5G Wi-Fi network was installed in a 20,000-bird chicken house, where a motorized module with cameras and sensors patrolled to capture RGB/thermal images and environmental data. The chicken behavior monitoring module includes four algorithms: a chicken detection model (CDM), a dispersion quantification algorithm (DQA), a movement quantification algorithm (MQA), and a hypothermia detection algorithm (HDA).

Data acquisition and annotation

From Nov. 22, 2024, to Jan. 19, 2025, data were collected on 3–11-week-old chickens, including 5-min RGB videos and thermal images at each stop (approximate 3,000 each) and environmental parameters every 15 min. About 600 images were annotated for CDM training and split 4:1 into training and test sets.

Chicken detection and hypothermia detection

YOLOv9 was employed to detect chickens, and its training process was optimized using a genetic algorithm. RGB and thermal images were calibrated and aligned, allowing the hypothermia detection algorithm to identify potentially deceased chickens using dynamic temperature thresholds.

RESULTS & DISCUSSION

Performance

CDM was evaluated on 120 test images with 0.4 confidence and 0.5 IoU, achieving 95.8% precision, 88.7% recall, 92.1% F1 score, and 94.3% AP. MQA was evaluated on a 10-second, 150-frame video using multiple object tracking (MOT) metrics and achieved 93.9% multiple objective tracking accuracy (MOTA) for chickens.

Temporal and spatial chicken dispersion analysis

Chicken dispersion rose with age and fell at higher temperatures; movement was stable but also reduced by heat. Initially, vent areas had lower activity, which became more uniform as chickens grew.

CONCLUSIONS

CDM localized chickens with 94.3% AP, DQA measured flock distribution, MQA tracked trajectories with 93.9% MOTA, and HDA detected hypothermic chickens using RGB–thermal alignment, providing an automated tool for chicken welfare and health monitoring.