고밀도 육계 농장에서 CCTV 영상과 머신 러닝 기법을 이용한 폐사 닭 자동 탐지

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Automated Detection of Dead Chickens in High-Density Broiler Farms Using CCTV Footage and Machine Learning Techniques

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Abstract

In high-density broiler chicken farms, the prompt detection and removal of dead chickens are crucial for maintaining a healthy environment and preventing disease spread. This study presents a method for accurately detecting dead chickens using CCTV footage. The approach involves two key steps: first, detecting stationary white areas that indicate potential dead chickens, and second, classifying these objects based on their size and other features using a pre-trained Random Forest classifier. The method is optimized based on the age of the chickens, adjusting frame capture intervals to balance detection accuracy and processing efficiency. Experimental results show that the Random Forest classifier achieved a high accuracy of 98.96%, confirming the method's effectiveness for large-scale farm operations.

I. Introduction

In high-density broiler chicken farms, where chickens are raised in controlled environments, early detection and removal of dead chickens is vital for maintaining farm health and productivity. Dead chickens can quickly spread disease, posing significant risks to the entire flock and undermining farm operations [1].

This study presents a method using CCTV footage, combined with image processing and machine learning techniques to accurately identify dead chickens. It involves two key steps: detecting stationary objects in the footage and classifying these objects to confirm whether they are indeed dead chickens. It is tailored to the chicken' age with adjustments in frame capture intervals and contour analysis to ensure efficiency and accuracy.

The primary objective of this study is to develop a reliable and efficient method for detecting dead chickens in large-scale broiler farms, thereby contributing to better farm management and improved animal welfare [2].

II. Method

The proposed method for detecting dead chickens in broiler farms utilizes CCTV footage to identify stationary white areas typical of broiler chickens. It consists of two main steps: detecting stationary objects in the footage and classifying whether these objects are indeed dead chickens.

The first step focuses on identifying stationary white areas within the CCTV footage. This process begins by capturing video frames at intervals tailored to the age of the chickens – longer for younger, more active chickens and shorter for older, less active ones. Each captured frame is compared to the previous ones to create a binarized mask highlighting white areas. This mask is updated over time to exclude non-stationary areas, isolating potential dead chickens.

The second step involves classifying the detected stationary objects. This includes analyzing the contours of the detected white areas and comparing their sizes to the expected size of a chicken based on age. A pre-trained Random Forest (RF) [3] classifier enhances accuracy by

using features like Local Binary Patterns (LBP) and Histogram of Oriented Gradients (HOG) to predict if the stationary object is a chicken.

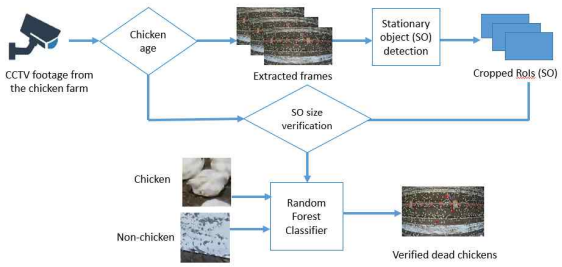


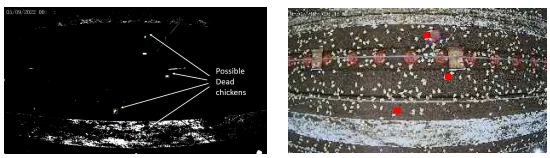
Figure 1: Pipeline for dead chicken detection

This two-step approach reduces computational demands by focusing on likely candidates, improving accuracy. Random Forest and SVM were chosen for their robust performance, efficiency, and effectiveness with limited training data compared to deep learning methods.

III. Experiment

To validate the proposed method, we conducted experiments to refine the relationship between chicken age, frame capture intervals, and the expected sizes. We assessed how age affects movement and size, finding that smaller, more active chickens allow longer capture intervals, while larger, less active chickens need shorter intervals for accurate detection.

We applied our method to detect stationary objects by creating binarized masks and comparing consecutive frames, successfully isolating stationary regions. These detected contours were then compared to the expected size of chickens at various ages, enhancing detection accuracy.



Stationary objects (possible dead chickens) | Confirmed dead chickens (red mask)

Figure 2: Results showing possible and confirmed dead chickens.

For classification, we trained Random Forest and Support Vector Machine (SVM) classifiers on a dataset of chickens and non-chicken objects (e.g., objects on the farm without chickens). The Random Forest classifier achieved a test accuracy of 98.96%, outperforming the SVM model's 97.71%, leading us to select it for its superior performance.

IV. Conclusion

This study presents an effective method for detecting dead chickens in broiler farms using CCTV footage. The method identifies stationary white areas in video frames, optimizes frame capture intervals based on chicken age, and classifies objects by comparing contour sizes with age-based expectations and utilizing a pre-trained Random Forest classifier.

The experimental results validate the method's effectiveness, with the Random Forest classifier achieving a test accuracy of 98.96%, outperforming the SVM model. This approach successfully balances detection accuracy with processing efficiency, enhancing farm management and animal welfare.

Future development could integrate this system with robotic technologies for automated collection and disposal of dead chickens, further improving farm operations.

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