Broiler Mortality Detection using Robotic Vision and Deep Learning

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Abstract

This work presents an application of ***Robot-Aided Vision*** to improve bird welfare in poultry farms through a collection of broiler visual data to train a ***Deep Learning*** model for mortality detection. The system will ultimately help design a precision poultry farming.

We have used ***YOLO*** deep learning model for training and inferencing whether birds detected from robot's point of view are dead or alive. The classifier can be extended to include sick birds as well.

We have collected real-world data from a commercial poultry farm by navigating a remotely controlled robot vehicle mounted with environmental sensors and cameras in a ***broiler grower house***. Out of close to extensive image and sensor dataset collected, we report high accuracy for bird status detection and positioning in a full-frame image using robotic vision.

Research Questions

- How well does the model distinguish between dead and alive birds in a highly cluttered (and dynamic) environment?
- Would the standard deep learning model such as YOLO be sufficient to localize a bird in a frame?

Background and Motivation

- **In order to measure and manage welfare-related elements in precision poultry/animal farming, it is critical to monitor poultry bird/animal status, especially in densely packed dynamic environments. Because of its non-intrusive and non-invasive features, as well as its capacity to offer a wide variety of information, computer vision has become a promising instrument in the real-time automation of poultry monitoring systems, thanks to current developments in information technology [1].**
- **You Look Only Once (YOLO) is a Deep Learning technique that learns the general representation of objects, which frames object detection as a regression problem for bounding boxes and probabilities associated [2]. Computer Vision with YOLO method has been used to identify deceased chicks [3].**
- **In our work, we use the YOLO method because of its applicability but we depart from the literature in the following ways:**
  - **We consider the densely packed environment as a whole when using the image for inferencing rather than single bird (mostly close-up views) used in the literature.**
  - **We use robot-centric vision data compared to ceiling-mounted vision data used in related works.**
  - **We combine the robot's localization data with the bird mortality data for precise monitoring and detection.**

Proposed System Overview

Fig 1. Left; a mobile robot (Magni Ubiquiti) equipped with sensors and cameras, Right; robot operating in a commercial broiler house lines for data collection and testing.

1. We equipped a **mobile robot** (Magni Ubiquiti platform) with **visual and environmental sensors** and recorded data using the Robot Operating Systems (ROS) framework. See Fig. 1 for the robot setup.
2. We deployed the robot at a commercial broiler house for chickens of age three weeks (for better feature extraction) and remote controlled the robot driving around the farm to collected the data.
3. We used the ***YOLO*** deep learning model due to its high efficiency and suitability for small object detection with high accuracy.
4. We use ***Ground Truth Labeler*** to manually process Images with caution for labeling dead and alive birds and create a dataset.
5. We trained the YOLO v3 model for 8,000 alive and 1,500 dead birds; for training, we used 3000 combined images for testing.
6. We detect multiple possible alive and dead birds in the same image with reasonable precision. We will open-sourced the datasets and the ROS packages developed soon.

Proposed Approach

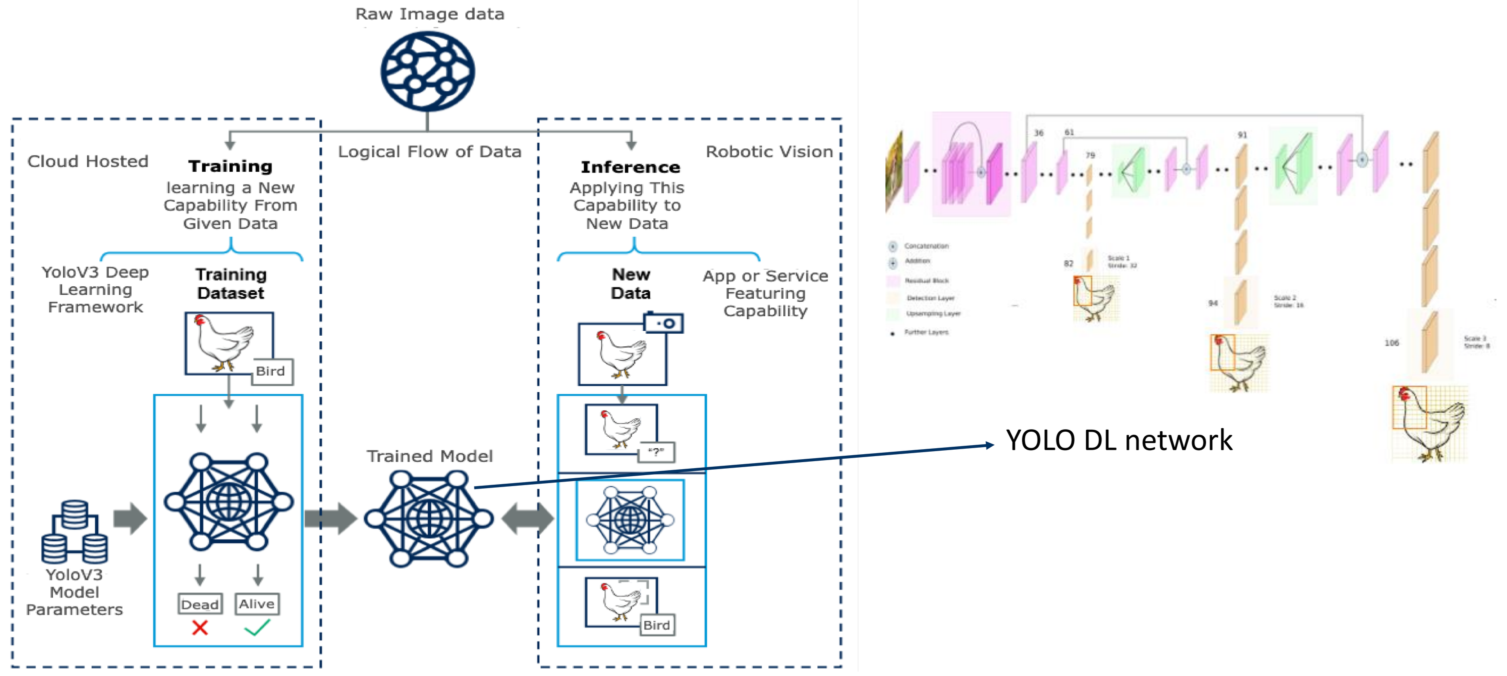

Fig 2. Proposed approach overview for deep learning model training and inferencing through robotic vision.

- In our approach, image frames from the live camera feed are extracted and processed to detect and localize birds in the image. Once detected, then the bird status is inferred whether the bird is dead or alive. See Fig. 2 for an overview of the approach.
- The bird mortality data (mainly the dead/sick birds) will be recorded along with the location of the detection by combining the YOLO output data with the robot's localization data.
- Then, the robot will perform certain action such as removing the mortality from the farm.

Preliminary Results

The preliminary results show promising potential of the approach, and we will continue too research in this direction. See Figs. 3 and 4 for insights.

Fig 3. Samples of full frame dead and alive bird detection results.

		Prediction: Dead	Prediction: Alive
Ground Truth	Dead	400 14%	172 6%
Ground Truth	Alive	107 3.7%	2185 76.3%

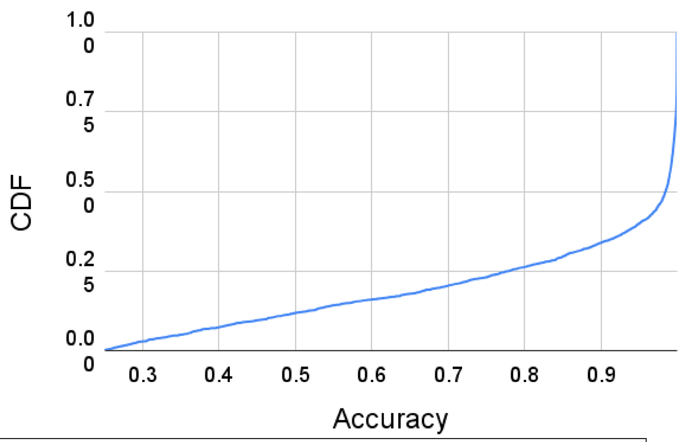

Fig 4. YoloV3 model-based inferencing results to distinguish dead and alive bird (Left), Commutative distributed function for combined validation accuracy (right).

Conclusion and Future Work

✓**Our work presents an approach toward the application of robotic vision in precision agriculture, specifically in the poultry farming domain. We gathered real-world data from a commercial broiler house with mobile robot-aided sensors and cameras.**

✓**We developed unique robot-centric vision datasets for detecting dead/alive bird status as a preliminary step. The YOLO deep learning model has shown promising potential in this application with a 95.6% accuracy in bird detection in a frame and a 90.2% accuracy in detecting dead/alive birds in a frame.**

✓ **In the future, we will deploy the model on an autonomous robot for real-time dead/alive bird detection and positioning which will further help in mortality removal and improve poultry welfare through holistic measures.**

References and Project Team

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