

The 11th Asian-Australasian Conference on Precision Agriculture (ACPA 11)
October 14-16, 2025, Chiayi, Taiwan

DEVELOPMENT OF A MOBILE INSPECTION ROBOT FOR STACKED-CAGE LAYERS HOUSES IN TAIWAN

An-Pan Cherng^{1*}, Nien-Ching Huang², Chin-Lin Chu³

^{1*}Professor, ^{2,3} Graduate student
Department of Biomechatronics Engineering
National Ilan University, Taiwan

*Corresponding Author: apcherng@niu.edu.tw

ABSTRACT

In stacked-cage layers houses, it is essential to know the eggs produced in each cage per day and their distributions for evaluating egg-laying performance and the health status of the layers. A two-wheel-drive mobile inspection robot for egg-counting was thus designed, assembled, and on-site experiments were performed and evaluated in this paper. The path of the mobile robot was pre-designated according to the site floor layout, so the robot can move autonomously aisle by aisle. Multiple cameras on both sides of the robot capture egg images of all tiers simultaneously, and eggs are identified and marked cage by cage. The computer vision system is composed of a RGB Edge-AI cameras and a Raspberry Pi microcomputers with YOLOv8n algorithm to identify eggs on the troughs. On-site experiments were conducted in a commercial stacked-cage layers house. Experimental results show that when the robot moves at the speed of 15 cm/s, the AI algorithm can identify eggs around 30 Frames per second. In addition, the successful rate of identifying eggs can reach 98% and up.

Keywords: stacked-cage layers house, inspection robot, egg counting, YOLOv8n.

INTRODUCTION

Poultry house robots are getting vast attentions and demands in recent development of Precision Livestock Farming (PLF) technology. For a stacked-cage layers house, egg quality and quantity produced daily are essential indicators for both profits and chicken wellness. To further investigate egg production rate per cage per day, we developed an autonomous mobile inspection robot to identify and count eggs on egg conveyor belt per cage, per tier, and per aisle. The robot can accomplish the inspection mission within 1.5 hours at moving speed of 15 cm/s with successful rate at least 98% for identifying and counting eggs. The results are quite promising. Since the layers could start laying eggs as early as 4 o'clock in the morning, the robot can then start the inspection at 6 o'clock and complete the job before the workers come to the house around 7:30~8:00 o'clock. The manager can get first-hand data and make judgement and decisions promptly.

MATERIALS AND METHODS

The inspection robot is a two-wheel-drive autonomous mobile vehicle. It is equipped with eight

Edge-AI depth cameras (model OAK-D Pro, Luxonis, USA), which is embedded with an Intel Movidius VPU running at 4 TOPS. A python program with YOLOv8n AI algorithm for identifying and counting eggs was written and stored in a Raspberry Pi 4B microcomputer. The program was then sent to OAK-D Pro for on-line computing. The cameras are heading about 25 degrees downward as shown in Fig. 1 for better observations. There is also a linear actuator in the center of the robot to lift the cameras up to designated heights for third and fourth tiers. Figure 2 shows the inspection at work in a commercial layers house in southern Taiwan.

Figure 3 illustrates the floor layout of the commercial layers house. We laid magnetic lanes (tapes) outside the aisles and used a magnetic line guidance sensor (MGSM1600GY, Roboteq, USA) to guide the inspection robot. In particular, we used four laser distance sensors (model DT-35, SICK, Germany) on both sides of the robot to measure the distance and orientation between the robot and cages to keep the robot in the center of the aisles and align with the aisle, as depicted in Fig. 4.

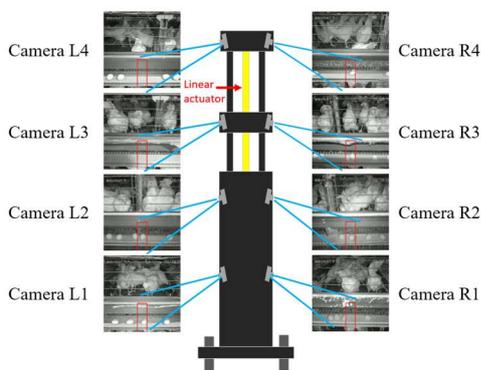


Fig. 1 Schematic of inspection robot and cameras.



Fig. 2 Inspection robot at work.

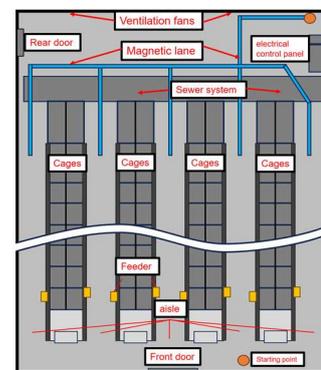


Fig. 3 floor layout.

RESULTS & DISCUSSION

At speed of 15 cm/s, the robot can accomplish the inspection within 1.5 hours. Figure 5 is a snapshot of the captured image with identified and labeled eggs and cage barrier. Each OAK-D Pro depth camera can complete the computations for identifying and numbering eggs at speed of about 30 Frames per second (FPS), which is fast enough for industrial applications. Figure 6 illustrates the distributions of eggs per cage on tier 3. The high and medium yields appear normal, but the low yield appear significantly dense on the front (left) and rear (right) regions. If the low yield distribution patterns continue for several days or weeks, it is recommended to further investigate the environment and health status of the layers in these areas.

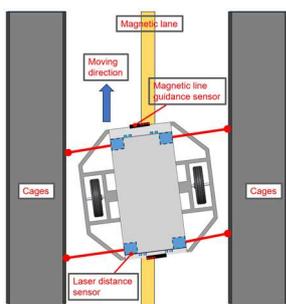


Fig. 4 Schematic of aisle guidance.



Fig. 5 A sample snapshot.

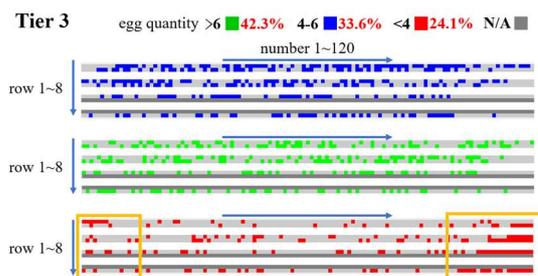


Fig. 6 Results of identified egg distributions at tier 3.