

Real Time Tray Level Egg Fertility Detection on Raspberry pi Using YoloV8 and Custom LED Backlighting

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ABSTRACT - In this paper, Egg fertility is an important factor in poultry farming because only fertile eggs can develop into chicks. Traditionally, egg fertility is checked manually using a method called candling, where a light source is placed behind the egg to observe the internal structure. However, this method requires experience and may lead to human errors. To overcome these limitations, this project proposes a Real-Time Egg Fertility Detection System using modern technology.

1. INTRODUCTION

Poultry farming is an important part of the agricultural sector and plays a significant role in food production around the world. One of the most important processes in poultry hatcheries is determining whether an egg is fertile or infertile. Identifying fertile eggs at an early stage helps farmers improve hatch ability, reduce resource wastage, and increase overall productivity. Traditionally, egg fertility is checked using a method called candling, where eggs are placed in front of a bright light source so that workers can observe the internal structure of the egg.



Fig 1: Fertile and Infertile egg

The above Fig 1 shows about the fertile and infertile egg system uses a small and powerful embedded platform that controls different hardware

components such as a camera, lighting system, and environmental sensors. A controlled lighting setup is used to improve the visibility of internal egg structures during image capture. The captured images are then processed using a deep learning algorithm that can identify patterns related to embryo development.

2. LITERATURE SURVEY

Aribta M. (2025) developed an advanced YOLOv8-based egg fertility detection system to automatically classify fertile and infertile eggs. The model was trained using 4,396 egg images, which helped improve the reliability of the detection process. The system achieved 93.2% precision, 98.5% mean Average Precision (mAP), and 87.2% recall, showing strong performance in identifying egg fertility. This approach replaces the traditional manual candling method, which often depends on human observation and may lead to errors.

Çevik S., Koçer M., and Boğa M. (2023) proposed the use of Mask R-CNN, a deep learning model that combines object detection and image segmentation, for the classification of fertile and infertile eggs. The researchers conducted experiments using a small data set of approximately 23 images. Despite the limited data set, the model achieved an Intersection over Union (IoU) score of 0.7, which indicates reasonable accuracy in detecting egg regions and identifying their characteristics.

3. EXISTING METHOD

Several techniques and models have been developed to detect whether an egg is fertile or non-fertile. Traditionally, farmers use a manual candling method, where a bright light is placed behind the egg to observe internal structures such as blood vessels and

embryo formation. Although this method is simple, it requires skilled workers and may lead to human errors.

In the below Fig 2 shows modern poultry farms, image processing techniques are used to analyze egg images captured by cameras. A light source is placed under or behind the egg, and a camera captures the internal view. The images are then processed using software algorithms to detect fertility patterns such as embryo growth or blood vessel formation.



Fig 2: Existing Method

4. PROPOSED METHOD

The proposed system is designed to automatically detect whether an egg is fertile or infertile using a camera-based monitoring system and image processing techniques. The system reduces human effort and improves accuracy compared to traditional manual candling methods.

In this method, eggs are placed on a tray inside a controlled environment with proper lighting. A bright LED light source is positioned behind or below the eggs to illuminate their internal structures. When the light passes through the egg, a web camera captures clear images of the egg interior.

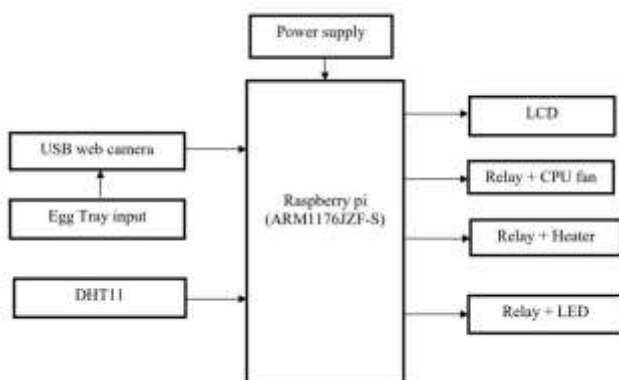


Fig 3: Block Diagram of Proposed system

In the Fig 3 represents the architecture of the Real-Time Egg Fertility Detection System. The system

mainly consists of a power supply, Raspberry Pi, USB web camera, DHT11 sensor, LCD display, and relay-controlled devices such as CPU fan, heater, and LED.

5. RESULTS

The below Fig 4 shows about the developed system is capable of detecting egg fertility effectively using image processing techniques. During the experiment, eggs were placed under LED illumination, and images were captured using the USB web camera.

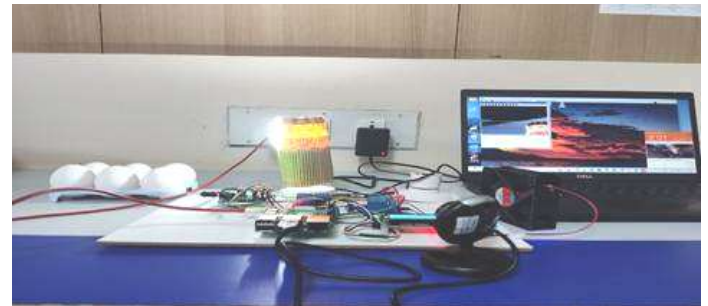


Fig 4: complete egg fertility detecting system



Fig 5: Temperature control Fan is ON

The above Fig 5 tells about a DHT11 sensor successfully monitored environmental conditions by measuring temperature and humidity inside the system. The heater and CPU fan operated automatically based on the sensor readings to maintain stable environmental conditions.



Fig 6: Depends on Temperature control LED is ON

The above Fig 6 discuss about the temperature control based conditions are involved. when the temperature condition is low the LED is ON.

In the below Fig 7 discuss about the LCD display successfully showed the system output including egg fertility status and environmental parameters. The system provided real-time monitoring and automatic detection without the need for manual inspection.



Fig 7: Temperature Display



Fig 8: LCD Display

The above Fig 8 represents about the LCD Display, the room temperature condition is display whether the temperature is high or low.

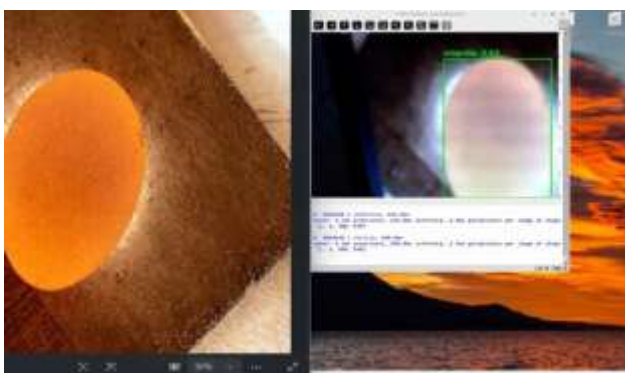


Fig 9: Output of an Infertile Egg

The above Fig 9 shows about the output of an Infertile egg condition will be displayed.

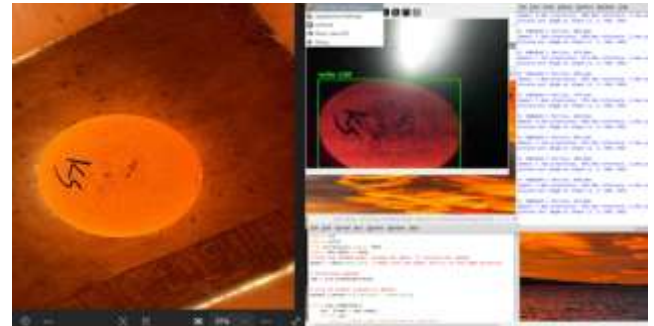


Fig 10: Output of an Fertile Egg

The above Fig 10 shows about the output of an fertile egg condition will be displayed.

6. DISCUSSION

The developed egg fertility detection system using **Raspberry Pi 4 Model B** and **YOLOv8** shows how modern technologies like embedded systems, computer vision, and artificial intelligence can improve poultry farming practices. The system successfully automates the traditional candling process, which is usually done manually and depends on human observation.

In the proposed system, a USB camera captures images of eggs placed on a tray, and LED back-lighting improves the visibility of internal structures. The YOLOv8 model processes these images and classifies eggs as fertile or infertile in real time. This tray-level detection reduces the time required compared to checking eggs individually and increases overall efficiency.

The results show that the system can perform accurate detection with reduced manual effort. However, performance depends on factors like image quality, lighting conditions, and the training data set. Despite these limitations, the system provides a low-cost, efficient, and reliable solution for small and medium poultry farms.

CONCLUSION

In this project, a real-time egg fertility detection system using Raspberry Pi, YOLOv8 deep learning model, and custom LED back-lighting was successfully designed and implemented. The system captures images

of eggs placed on a tray and analyzes them using computer vision techniques to detect and classify eggs as fertile or infertile.

The use of Raspberry Pi makes the system compact, cost-effective, and suitable for small-scale poultry farms. The integration of YOLOv8 deep learning model allows the system to perform real-time object detection with good accuracy. The LED back-lighting system enhances image clarity and improves detection performance.

The proposed system provides several advantages such as reduced manual labor, faster inspection, and improved productivity.

Overall, the project demonstrates how artificial intelligence and embedded systems can be used to develop smart solutions for agricultural applications. With further improvements such as larger datasets, better cameras, and integration with automated sorting systems, the proposed method can be extended for large-scale commercial hatcheries.

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