

ROLE OF ARTIFICIAL INTELLIGENCE IN POULTRY DISEASE DIAGNOSIS

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ABSTRACT

Rapid and accurate poultry disease diagnosis is essential for protecting flock health, productivity, and biosecurity. Conventional methods rely on clinical examination, laboratory testing, and expert interpretation. Artificial intelligence (AI), including machine learning, deep learning, computer vision, and sensor-based analytics, offers promising tools for poultry health surveillance. By analysing images, movement, vocalisations, temperature, and environmental data, AI can identify potential disease indicators. However, reliable adoption requires high-quality datasets, independent validation, data security, affordability, and veterinary oversight. AI should complement, not replace, veterinary diagnosis and confirmatory laboratory testing.

KEYWORDS: Artificial intelligence, Computer vision, Deep learning, Early diagnosis, Machine learning, Poultry disease, Precision poultry farming

INTRODUCTION

Poultry production supports food security, employment and rural livelihoods, but infectious and non-infectious diseases can rapidly reduce flock performance. The Food and Agriculture Organization of the United Nations emphasises that rapid recognition of poultry disease and adequate diagnostic capacity are essential because poultry pathogens can cross production and geographic boundaries, while some are also relevant to public health (Food and Agriculture Organization of the United Nations [FAO], 2022). In practice, diagnosis may require clinical history, post-mortem examination, microbiology, serology or molecular tests. These approaches remain indispensable, but they may require time, skilled personnel and laboratory access.

WHAT CAN AI “SEE” IN A POULTRY FLOCK?

AI learns relationships within large datasets and can detect patterns that may be difficult to quantify consistently by eye. In poultry, the input may be an image, video, sound recording, thermal image, sensor measurement or combination of these data. Computer-vision models can evaluate posture, gait, feather condition, lesions, body conformation and droppings. Sensor-based systems can monitor temperature, humidity, activity, water and feed consumption, while audio analysis can identify changes in flock vocalisation. Recent reviews describe AI applications involving movement, vocalisation, body temperature and excreta, together with thermal imaging and video tracking (Kalita et al., 2025).

DEEP LEARNING FOR EARLY DISEASE DETECTION

Deep learning is particularly useful for image-based diagnosis because it can learn relevant visual features directly from examples. A notable poultry study developed models for distinguishing healthy birds from coccidiosis, Salmonella and Newcastle disease using faecal images. After fine-tuning, reported test accuracies reached 95.01% for VGG16, 95.45% for InceptionV3, 98.02% for MobileNetV2 and 98.24% for Xception; the authors also highlighted the suitability of lightweight models for mobile deployment (Machuve et al., 2022). These results are encouraging, but accuracy obtained from a particular dataset should not be interpreted as equivalent to field diagnostic accuracy. Model performance can fall when images come from different breeds, lighting conditions, camera devices, farms or disease stages.

FROM IMAGE TO ACTION: HOW AI CAN SUPPORT THE VETERINARIAN

AI can be most valuable when it functions as an early-warning layer in the diagnostic chain. A camera or mobile phone may capture a suspicious image; an algorithm can assign a probability score; and the result can trigger closer flock observation or collection of appropriate diagnostic samples. The veterinarian then integrates the AI output with flock history, clinical examination, pathology and laboratory findings. This approach is especially important for diseases with overlapping clinical signs. For Newcastle disease, for example, laboratory confirmation can involve virus isolation, serology or real-time reverse-transcription polymerase chain reaction (RT-PCR) (Zhao et al., 2022). AI may therefore help identify which birds or flocks require attention, while confirmatory tests establish the diagnosis (Figure 1).

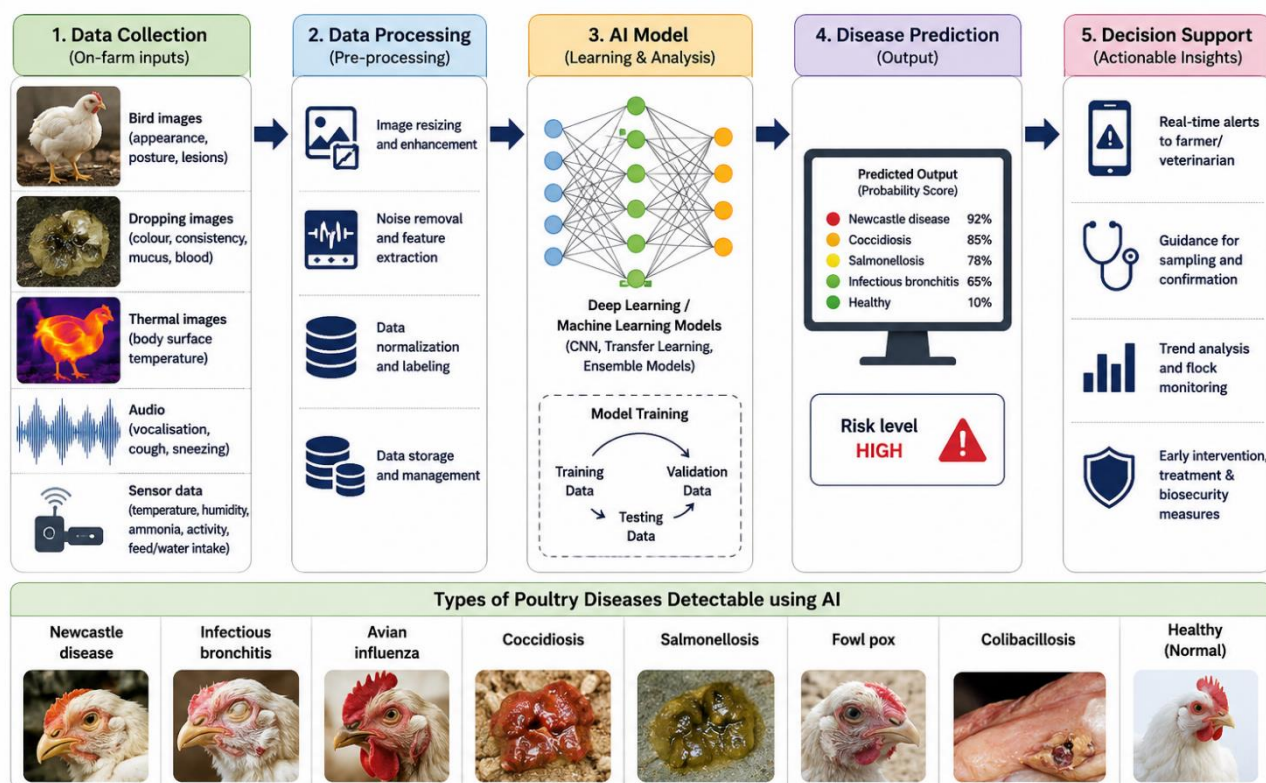


Figure 1. AI-based framework for poultry disease diagnosis

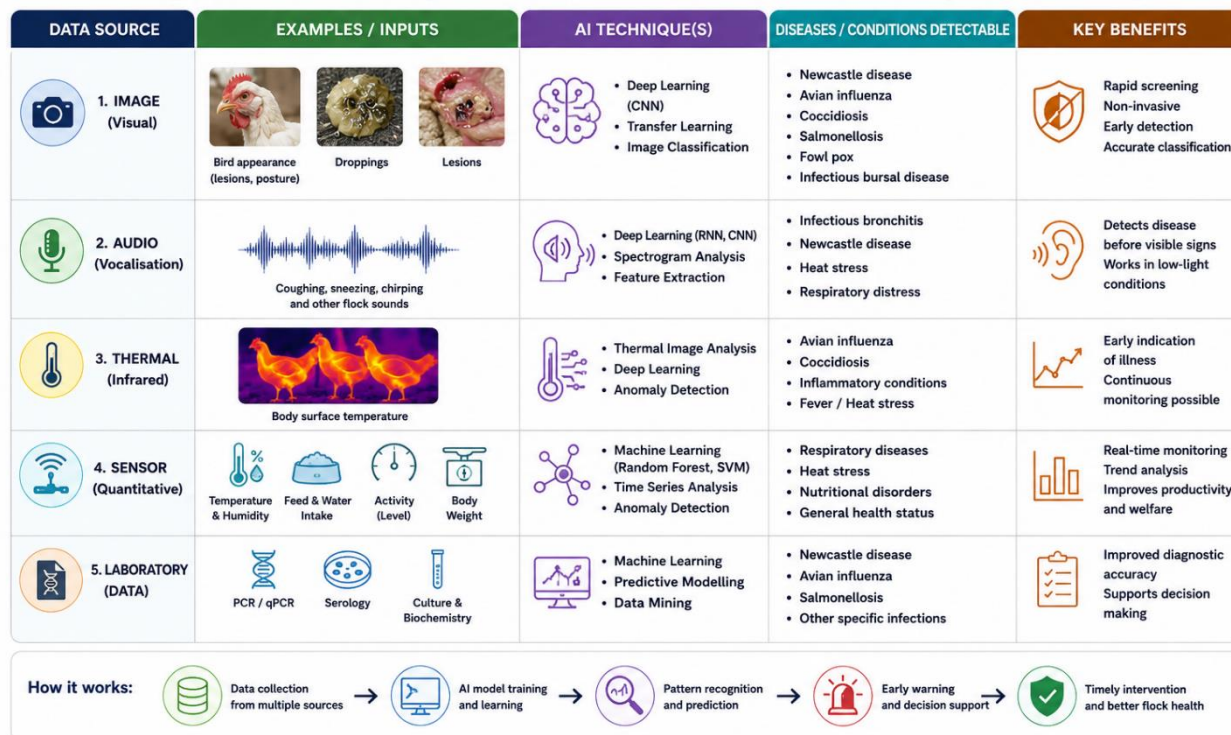
MULTIMODAL AI: THE NEXT STEP

Future systems are likely to combine several information streams rather than rely on a single photograph. For example, an AI platform could combine bird activity, sound, feed and water intake, environmental conditions, thermal images and clinical photographs. This is known as multimodal or sensor-fusion AI. Recent work on AI and machine learning in poultry farming identifies disease detection, behaviour analysis, environmental control, automation and productivity optimisation as interconnected application areas (Figure 2). Edge-AI, in which computation occurs close to the farm rather than entirely in the cloud, can reduce latency and dependence on continuous internet connectivity (Natsir et al., 2025).

BENEFITS FOR POULTRY HEALTH MANAGEMENT

Early warning is the greatest potential benefit. A system that identifies an abnormal pattern before mortality becomes obvious may allow farmers and veterinarians to investigate sooner. AI can also support continuous surveillance, reduce repetitive manual observations and create digital records for flock-level comparison. In large farms, automated monitoring can help prioritise personnel attention. In resource-limited settings, smartphone-based tools may extend basic screening capability where veterinary services

and laboratory facilities are not immediately accessible. Importantly, AI can support biosecurity by flagging unusual changes that justify isolation, sampling and further investigation.



AI = Artificial Intelligence; CNN = Convolutional Neural Network; RNN = Recurrent Neural Network; SVM = Support Vector Machine; PCR = Polymerase Chain Reaction; qPCR = quantitative PCR.

Figure 2. AI Techniques and Data Sources used in poultry disease diagnosis

LIMITATIONS AND RESPONSIBLE USE

AI is not automatically reliable simply because a model reports a high accuracy. The quality and representativeness of training data are critical. Bias may arise if datasets contain too few breeds, production systems, geographical regions or disease presentations. Similar-looking conditions may also confuse an image classifier. A further concern is the distinction between association and causation: an AI model may recognise a visual pattern associated with disease without identifying the pathogen itself. Therefore, AI predictions should not be used alone to make high-consequence decisions such as declaring a flock free of a regulated disease.

AI adoption also requires attention to explainability, cybersecurity, privacy and cost. Farmers need understandable alerts, not only technical probability scores. Equipment must withstand dust, heat and farm conditions, and systems should continue functioning when connectivity is poor. Recent reviews identify infrastructure limitations, initial cost, digital literacy, dataset generalisability and the shortage of large real-world trials as important barriers (Natsir et al., 2025).

A PRACTICAL ROADMAP FOR INDIA

For Indian poultry production, development should begin with locally representative datasets collected from commercial farms, backyard units, diagnostic laboratories and veterinary institutions. Images and sensor data should be linked, wherever possible, with laboratory-confirmed diagnoses and relevant metadata such as age, breed, vaccination status, production system and environmental conditions. Models should then be externally validated across states, seasons, breeds and camera devices. Collaboration among veterinarians, pathologists, microbiologists, epidemiologists, data scientists and poultry producers will be essential. Such a One Health-oriented approach can help ensure that AI strengthens, rather than bypasses, established diagnostic and surveillance systems.

CONCLUSION

Artificial intelligence is moving poultry disease diagnosis from occasional observation toward continuous, data-driven health surveillance. Computer vision, deep learning, thermal imaging, audio analysis and sensor fusion can provide valuable early-warning signals and help veterinarians focus attention where it is most needed. Evidence from poultry disease image classification demonstrates that high-performing models are technically feasible, while newer edge and multimodal approaches offer opportunities for practical farm deployment. Nevertheless, AI should complement—not replace—clinical expertise, pathology and confirmatory laboratory diagnosis. The future of poultry health will depend not simply on more powerful algorithms, but on better datasets, transparent validation, affordable technologies and close collaboration between animal-health professionals and technology developers. Used responsibly, AI can become an important tool for earlier detection, better biosecurity, improved welfare and more resilient poultry production.

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