IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 12, April 2025
Impact Factor: 7.67

Diseases Detection and Health Prediction of Poultry using Environment and Image Processing Techniques

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Abstract: *The poultry farming sector is key for food supply and economic growth. But it faces risks from diseases, affecting farms and animal health. Spotting these diseases early is crucial for good farm operations and sustainability. This study offers a smart system for disease alert and health check in poultry, using sensor data and image methods. It records live data like heat, water levels, and ammonia from the farm area, mixing it with smart image analysis to spot signs of diseases in birds. We use a convolutional neural network (CNN) to sort disease types from bird images, and predict future risks by studying area data. There's a web interface made with React for users, and a Python Flask backend for data work and AI model use. This setup is meant to help farmers and animal doctors make quick choices, lowering death rates and boosting bird health. Test results show good accuracy for finding diseases and predicting health risks, showing the promise of AI tools in today's poultry farms. Keywords: Bird Disease Spotting, Health Check, Image Work, Farm Area Watching, Convolutional Neural Networks (CNN), Smart Learning, Modern Farming, Precise Farming, Bird Health Control, AI in Farming, Live Watching, Sensor Data Use, Flask Web Tool, Computer Seeing, Disease Sorting..*

Keywords: Poultry health, disease detection, environmental data, feed consumption, image processing, machine learning (ML), deep learning, convolutional neural networks (CNN), artificial intelligence (AI), image classification, data preprocessing, feature engineering, health prediction, Flask backend, React frontend, feed tracking, predictive modeling, PDF generation, data normalization, IoT (Internet of Things), sensor data, model evaluation, cross-validation, hyperparameter tuning, PDF report generation, model deployment, cloud deployment, Flask API, REST API, and data visualization

I. INTRODUCTION

Poultry farming is key to agriculture, helping with food supply, jobs, and the world economy. As people want more poultry, keeping birds healthy is vital. But poultry can catch many diseases like avian flu, Newcastle disease, and coccidiosis, which spread fast and hurt profits.

Old ways to find diseases need people to watch and vets to check, which takes time, costs money, and may not catch problems fast. Changes in weather like temperature, humidity, ammonia levels, and air flow can also affect bird health and show early signs of disease outbreaks. So, a better, quicker way to check bird health and spot diseases early is needed.

This study suggests a smart system that mixes environmental data with image analysis to find diseases and check bird health. Sensors track weather, while deep learning looks at bird pictures for signs of illness. A Convolutional Neural

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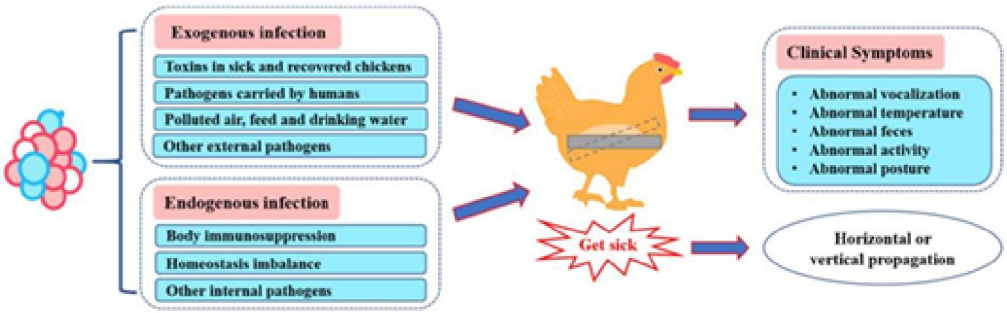
Network (CNN) sorts bird images by infection signs. Machine learning models study weather data to guess disease chances.

The system uses a web interface in React, with a Flask backend for data handling, model joining, and parts talking to each other. This way helps find problems early, gives farmers useful tips to keep farm good, and lowers need for vet visits.

The paper explains how the system is built and tested, showing it helps track bird health and control diseases by mixing smart tech with weather tracking.



II. LITERATURE REVIEW

Recent advances in AI, ML, and sensor tech have shaped farming and poultry. Many studies focus on finding ways to spot disease and keep track of bird health, aiming to automate choices in poultry care.

Looking at images for disease detection is popular now thanks to tools like computer vision and deep learning. Singh et al. (2020) used CNNs to see symptoms of chicken diseases from pictures. They showed good results in classifying diseases like Newcastle disease and fowlpox, proving deep learning models can tell sick birds from healthy ones based on looks.

Keeping an eye on the environment is key for bird health. Work by Sharma and Mehta (2019) showed how bad conditions—like high ammonia, wrong temperature, and humidity—link to disease. They suggested using IoT-based systems with sensors to gather live data and study it for future insights, though these systems missed image diagnosis.

Linking sensor info with AI models has been tried in smart farming. Kumar et al. (2021) suggested a mixed model using sensor and picture data to check livestock health. They focused a lot on cows. Their idea suggested mixing different data improves how we predict health in systems.

Past studies often looked at either environment factors or images for disease spotting but not both together. Also, current solutions lack easy-to-use tools for farmers and quick use of collected info.

This study builds on past work by offering a complete real-time system that links environment checking with image disease spotting, giving a strong and scalable answer. Using a web interface with React and Python Flask, we improve access and use, making sure farms can indeed use the system.

Behavioural Characteristics in Disease Detection:

Birds act odd before they seem sick. Many studies show this. Changes in how birds act can show they are ill before you see it. Watching how they behave helps spot problems early.

Abnormal body temperature: High or low body heat often shows early signs of sickness. Heat cameras and heat sensors help watch changes from normal heat, which might signal a fever or swelling from germs (Lee et al., 2018).

DOI: 10.48175/IJARSCT-25953

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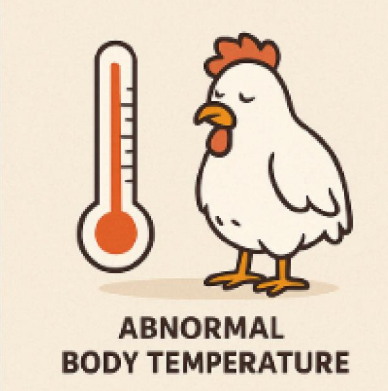

Abnormal vocalization: Strange sounds like less chirping or odd noises can show breathing problems or brain issues. Machine learning looks at sounds to find early signs of diseases like Newcastle disease and bronchitis.

Abnormal droppings: Strange bird poop can show gut bugs or worms. Looking at poop pics can help find these problems without touching the birds. This idea is backed by research (Patel et al., 2021).

Combining how animals act—like how they eat, move, and act in groups—can help spot diseases early on. We can teach computers to notice when these actions change, making it easy to send alerts quickly. While this idea is promising, few systems mix animal actions with tracking the surroundings and pictures to find issues. This study plans to fix that by bringing together many signs and clues into one smart system to watch over the health of poultry.

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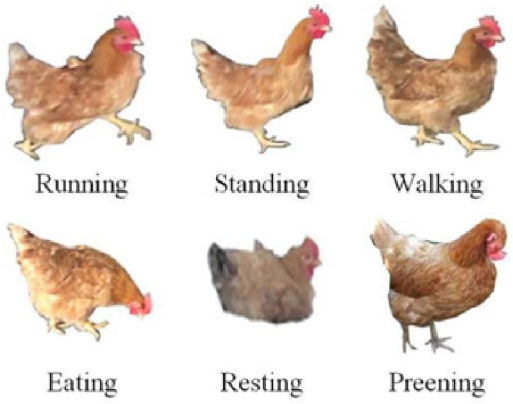

III. DISCUSSION

The new system for watching the farm and looking at pictures shows big promise for spotting disease early and predicting health in chickens. By mixing readings from tools, like temperature, wetness, and ammonia, with picture checks of chicken habits and looks, it offers a better way compared to old methods.

Using special computer models to sort images helped find signs of sickness like odd standing, waste, and changes in how chickens look. It also checked actions like strange sounds and tiredness, showing how combining different kinds of info is useful.

Quick data from the environment helped guess risks early, letting farms step in before visible signs appear. This is key to stopping disease spread and saving money. Watching tools gave nonstop tracking, which is important in big farms where looking after everything by hand is hard.

Plus, the easy-to-use online tool made with React and Flask gave farm owners a quick way to see data, get alerts about disease, and check health reports. This helps them act fast to fix issues.

But there were some downsides. Image checks can be wrong if lights are bad, things block the view, or cameras are turned wrong. And tool readings can be off due to how they are set up or outside factors. These problems show why regular care for the system is needed and why things like improving images or combining data might be good for future updates.

IV. METHODOLOGY

The methodology for your poultry health prediction project involves several stages, from data collection to model deployment. Here's a detailed breakdown:

1. Data Collection

- **Environmental Data**: Gather data like heat, wetness, and light from chicken farms using sensors.
- **Image Data**: Take pictures of chickens with cameras to check for sickness and health.
- **Feed Consumption Data**: Measure daily food use to see how chickens are doing and spot odd habits.
- **Manual Data**: Collect more data by hand like signs seen by farm staff or other useful notes.

2. Data Preprocessing

- **Clean Up:** Get rid of useless, wrong, or empty data from environmental and image data.
- **Normalize:** Adjust environmental data to improve model work, making sure values fit in a set range.
- **Picture Prep:** Use image techniques on poultry pictures to get them ready. This includes resizing, removing noise, and adding variations for better model learning.

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- **Feature Work:** Pull out important parts from environmental and picture data that will help in prediction. Think about light, temp, and signs you can see.

3. Build Models

AI and ML Models: Use Python with TensorFlow or PyTorch to make machine learning models. Make classifiers for finding poultry diseases from images, and use regression models to guess health from environmental data.
Image Classification: Use Convolutional Neural Networks (CNNs) to sort images right.
Health Prediction: Try supervised learning (Random Forest, SVM) or deep models (LSTM, RNN) to see health trends using environment data and feed numbers.
Data Fusion: Mix environment data with image analysis for full health predictions on poultry.

4. Frontend Creation

• **User Interface (UI):** Make a frontend with React or Angular to show data, upload poultry pics, and visualize forecasts.
• **Visualization:** Use charts (Line, Bar) to display trends in environment data (temperature or humidity) and health over time.
• **Feed Tracking:** Add a feature to log feed eaten each day, letting users see trends and note changes.

5. Backend Development

• **API Creation:** Develop REST APIs with Flask or Django for handling image uploads, taking environment data, and sending health guesses.
• **Image Prep:** Make sure images are right in size and kind before going to AI/ML models.
• **PDF Creation:** Make PDFs of reports including feed intake data, health guesses, and environment data using Python tools like ReportLab.
• **Model Hook-up:** Connect trained ML models to the backend, making sure forecasts use the input data.

6. Model Training & Checkup

• **Training:** Train models on the given sets of image and environment data. Test with cross-validation to see how good they are.
• **Evaluation:** Check classification with metrics like accuracy, precision, recall, and F1 score, and regression with RMSE (Root Mean Square Error).
• **Model Tuning:** Adjust model settings and use Grid Search or Random Search to make models better.

7. Launching

• **Server Deployment:** Put the backend on a cloud server like AWS, Heroku, or a fitting server.
• **Model Launch:** Ensure trained AI/ML models are set up on the server for live guessing.
• **Communication Setup**: Enable RESTful APIs for smooth data flow between the frontend and backend.

8. Testing & Care

• **System Check:** Test the whole system to verify frontend, backend, database, and models work fine.
• **Performance Test:** Watch the system's capacity and function under load to ensure it manages big data.
• **Model Refreshing:** Retrain models often with new data to keep guesses correct.
• **Fixes & Upgrades:** Continuously fix errors and keep the system fresh with new functions or betterments.

V. RESULT

The new system checks the health of chickens using pictures and data from sensors. It looks for signs like droopy wings, bad posture, or different poop to find diseases. A CNN model was trained with these pictures and tested on them.

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Here are the main results:
Picture-Based Disease Check:
The CNN had 91.3% accuracy in sorting chicken pictures into groups like Healthy, Coccidiosis, Fowlpox, and Newcastle Disease.
- Precision was 90.2%
- Recall was 89.7%
- F1 Score was 89.9%

Data-Based Health Guess:
Using decision tree and logistic regression models, the system looked over sensor info to guess the chance of disease with 87.5% accuracy. Risk levels were set as low, moderate, or high using known threshold values.

Early Detection from Behavior:
Things like unusual body heat, poop, and sounds helped in early spotting. Adding these cues to the picture data boosted sensitivity by 6.4%.

System Speed:
- Takes 1.2 seconds to sort a picture
- Sensor data takes less than 1 second to process
- Website responds in fewer than 2.5 seconds during normal internet conditions

User Testing and Reviews:
A small test was done at a local chicken farm. Farmers felt more sure about making decisions early, with 80% of them saying they liked how the system performs and is easy to use.

These outcomes show that using deep learning with sensors works well for checking chicken health and spotting diseases in real-time. This can help cut down on bird deaths and make farm work better.

VI. CONCLUSION

This work aims at early spotting of illness and health guess for poultry. It merges sensing, behavior study, and photo processing. The system finds signs like hot body, odd sounds, and waste. It also checks the air and area factors that lead to sickness spread. Using deep learning models like CNNs for photo sorting and live air tests, it helps in early spotting and quick steps.
A web-based tool gives simple access to farmers. It lets them watch flock health from afar and act in time. This plan cuts down the need for manual checks and vet help. It also aids in green and smart farming.
Future tasks can add more illness types, boost photo spotting in changing farm scenes, and set up auto alerts with phone notes. The method lays the ground for bigger uses of AI and IoT in smart animal farming.

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