APSCHE Short Term Virtual Internship Program

ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

Project Title: Transfer Learning-Based Classification of Poultry Diseases for Enhanced Health Management

Team ID: LTVIP2025TMID40218

Team Size: 4

Team members:

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Internship Platform: SmartBridge
Institution: [ST.ANN'S COLLEGE OF ENGINEERING AND TECHNOLOGY]

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1. Introduction

Poultry diseases encompass a wide range of illnesses affecting birds like chickens, turkeys, and ducks. These diseases can be caused by bacteria, viruses, fungi, parasites, and nutritional deficiencies. Common examples include Newcastle disease, Marek's disease, coccidiosis, fowl pox, and avian influenza. Understanding these diseases and implementing preventative measures is crucial for maintaining healthy poultry flocks**.**

2. Objective

To develop a machine learning-based application capable of:

- Develop a Transfer learning-based system for classifying poultry diseases
- Create a robust machine learning model that will be integrated into a mobile application
- Provide farmers with a tool that enhances their ability to manage poultry health, thereby reducing disease impact and improving productivity.

3. Problem Statement

Poultry farming is a crucial component of the agricultural economy, especially in developing countries where it serves as a vital source of food and income. However, poultry farmers often struggle with the timely and accurate diagnosis of diseases such as Salmonella, Newcastle Disease, and Coccidiosis, which can cause significant mortality and economic loss if not managed promptly.

Proposed Solution:

1. Image-Based Disease Detection using Transfer Learning
2. Mobile Application (Farmer Interface)

4. Literature Review

S. No.	Author(s) & Year	Methodology / Technology	Findings / Outcome	Limitations
1	Wandkar et al. (2020)	Image processing + Convolutional Neural Network (CNN)	Effective identification of poultry diseases based on visual symptoms	Small dataset, model not mobile-integrated
2	Gandhi et al. (2019)	Random Forest, SVM on structured health data	Achieved good accuracy for disease prediction using traditional ML algorithms	Not image-based; required manual data entry
3	Ayan et al. (2020)	Transfer Learning (MobileNetV2, DenseNet)	High accuracy in medical image classification (used for pneumonia; transferable concept)	Focused on human health images, not poultry
4	Rani et al. (2021)	CNN + Mobile Application	Real-time disease detection in plants via a smartphone app	Language support and disease specificity limited
5	Jayaraman et al. (2022)	IoT Sensors + Threshold Alerts	Environmental monitoring (temperature, humidity) to predict poultry disease outbreaks	Not AI-based; only preventive through sensor thresholds

5. Methodology

Step-by-Step Process:

Step	Process	Details
1	**Problem Definition & Requirement Analysis**	Define the goal: Identify and classify poultry diseases (e.g., Salmonella, Newcastle, Coccidiosis, Healthy). Identify target users (farmers) and technical requirements (mobile support, offline capability).
2	**Data Collection**	Collect poultry images from reliable datasets or farms. Ensure each image is labeled with its correct disease class. Perform class balancing.
3	**Data Preprocessing**	Resize images, normalize pixel values, apply augmentation (rotation, flip, zoom, etc.) to improve model generalization and deal with limited data.
4	**Model Selection (Transfer Learning)**	Use a pre-trained CNN (e.g., **MobileNetV2**, **EfficientNet**, or **ResNet**). Freeze base layers and retrain the final layers using your dataset.
5	**Model Training & Validation**	Split the dataset (e.g., 80% train, 20% validation). Train the model, monitor accuracy and loss. Use metrics like precision, recall, F1-score, and confusion matrix to evaluate performance.
6	**Model Optimization & Conversion**	Optimize the model for mobile deployment using **TensorFlow Lite** or **ONNX**. Ensure it's lightweight and fast.
7	**Mobile App Development**	Build an Android app using **Flutter** or **Kotlin**. Integrate camera/image upload, disease detection, and result display.
8	**Model Integration into App**	Integrate the train

6. Technology Stack

Component	Technology / Tool	Purpose
Programming Language	Python	Model training, preprocessing, and evaluation
Deep Learning Library	TensorFlow / Keras or PyTorch	Model building using Transfer Learning (e.g., MobileNetV2, EfficientNet)
Model Optimization	TensorFlow Lite / ONNX	Convert model for mobile deployment (lightweight & fast inference)
Image Processing	OpenCV / Pillow	Image resizing, augmentation, and visualization
Mobile App Framework	Flutter (Dart) / Android (Java or Kotlin)	Develop cross-platform or native mobile application
Model Integration (App)	TFLite Interpreter / ONNX Runtime Mobile	Load and run ML models on mobile devices
IDE/Environment	Google Colab / Jupyter / VS Code	Development and training environment
Dataset Storage	Local / Google Drive / Kaggle / Custom Dataset	Store image datasets used for training and testing
Cloud Services (Optional)	Firebase / AWS / Google Cloud	User authentication, cloud storage, analytics
Version Control	Git + GitHub	Code versioning and collaboration
Language Support	Google ML Kit (for text-to-speech / translation)	Enable regional language support in the mobile app
UI/UX Design	Figma / Adobe XD	Design the user interface for the mobile application

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7. Data Collection and Preprocessing

ML depends heavily on data. It is the most crucial aspect that makes algorithm training possible. So, this section allows you to download the required dataset

8. Model Selection and Training

Recommended pre-trained models:

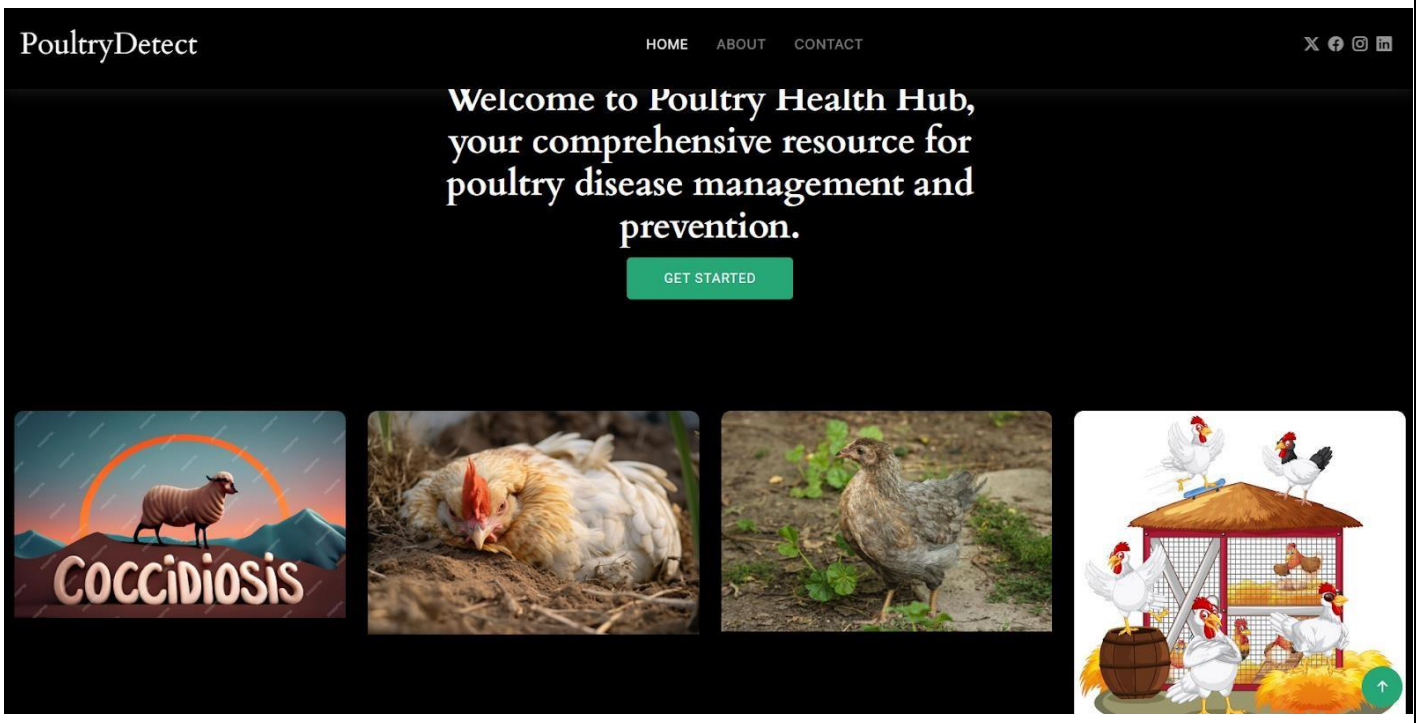
Model	Pros	Use Case
MobileNetV2	Lightweight, ideal for mobile apps	Real-time detection on smartphones
EfficientNet	High accuracy with fewer parameters	Balanced performance and speed
ResNet50	Powerful feature extractor, deeper architecture	Higher accuracy, but heavier model

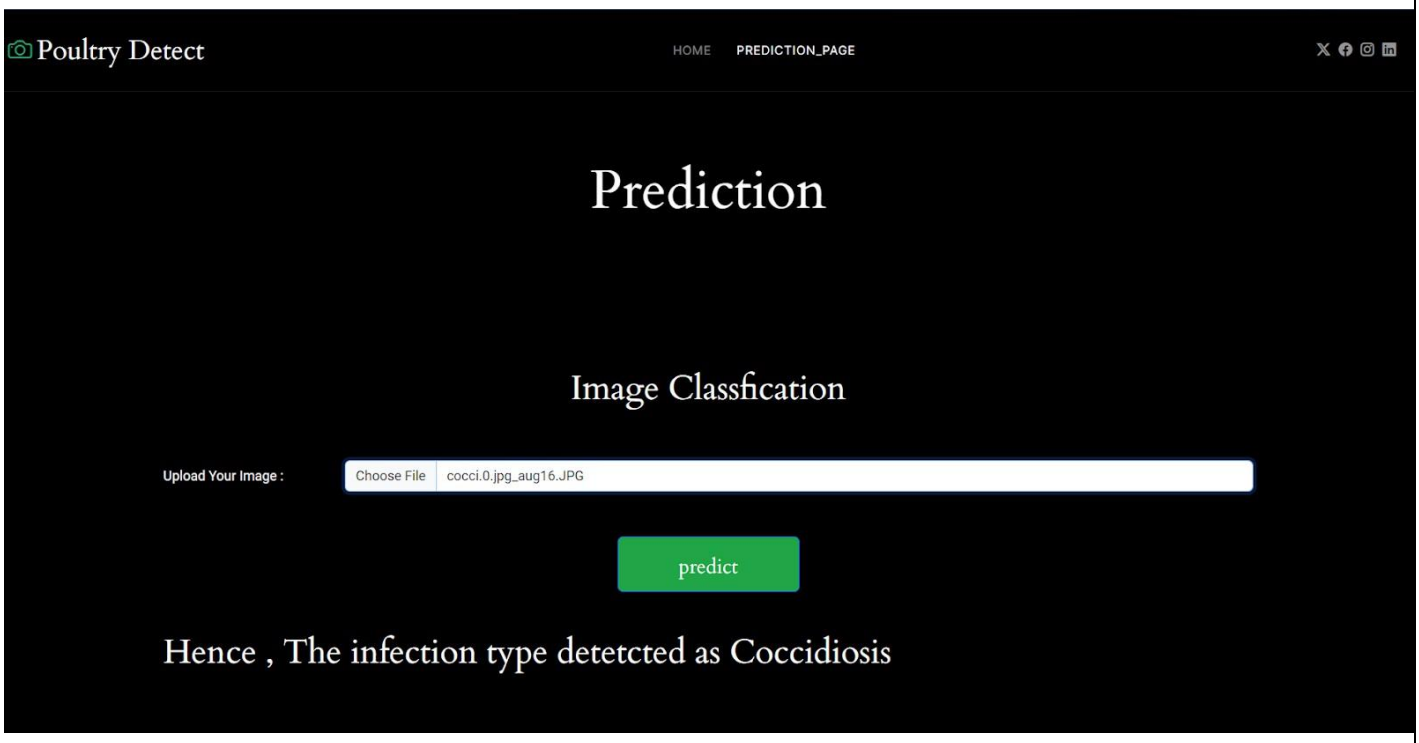
Training flow:

Step	Description
a. Load Pre-trained Model	Load the base model with include_top=False to remove the final classification layer.
b. Freeze Base Layers	Freeze the pre-trained layers so their weights don't update during initial training.
c. Add Custom Classifier Head	Add new layers (e.g., GlobalAveragePooling + Dense + Softmax) for poultry classes.
d. Compile Model	Use Adam or SGD optimizer; categorical cross-entropy loss; track accuracy.
e. Data Preparation	Preprocess images (resize, normalize), apply augmentation to increase variety.
f. Train Model	Use model.fit() with training and validation datasets; set appropriate batch size and epochs.
g. Fine-Tuning (Optional)	Unfreeze a few top layers of the base model and train again with a lower learning rate.

9. Web App Interface

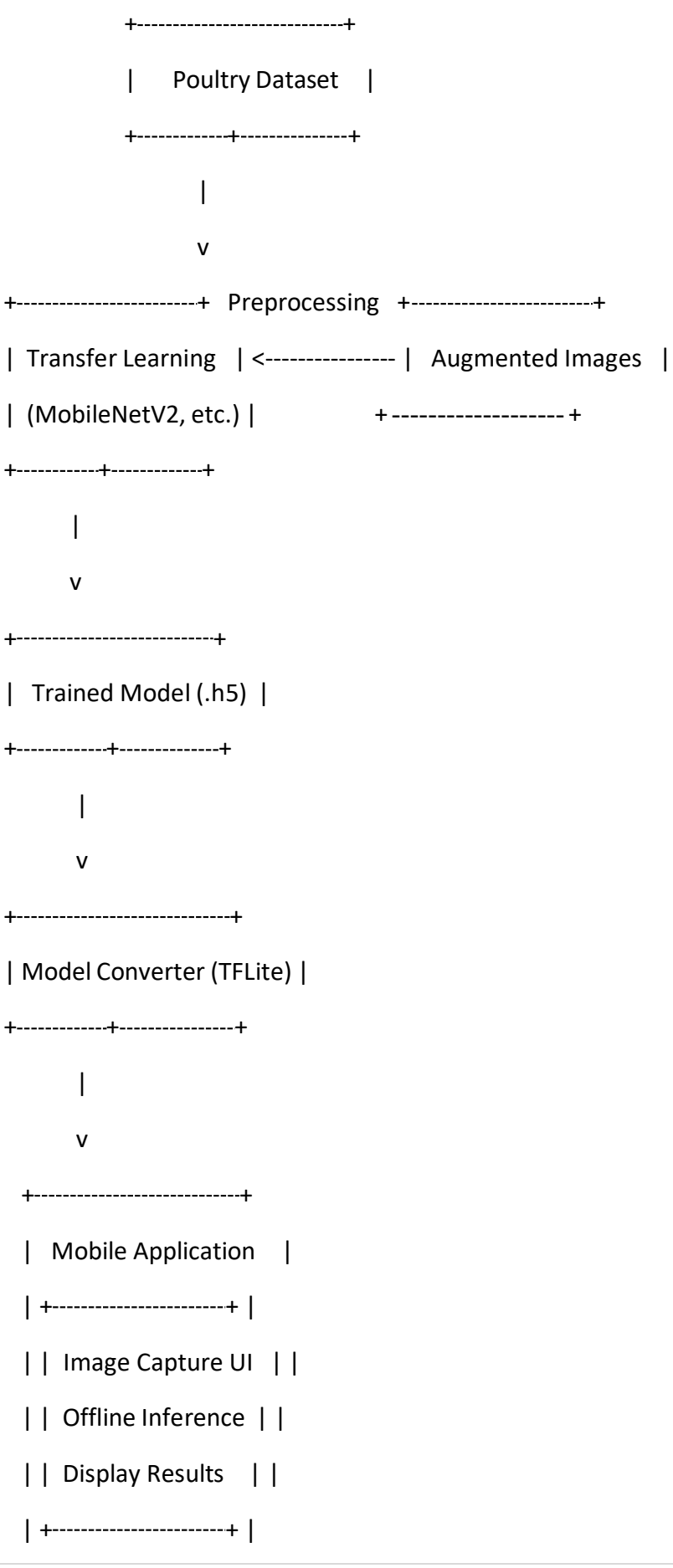
- Built using Flask framework

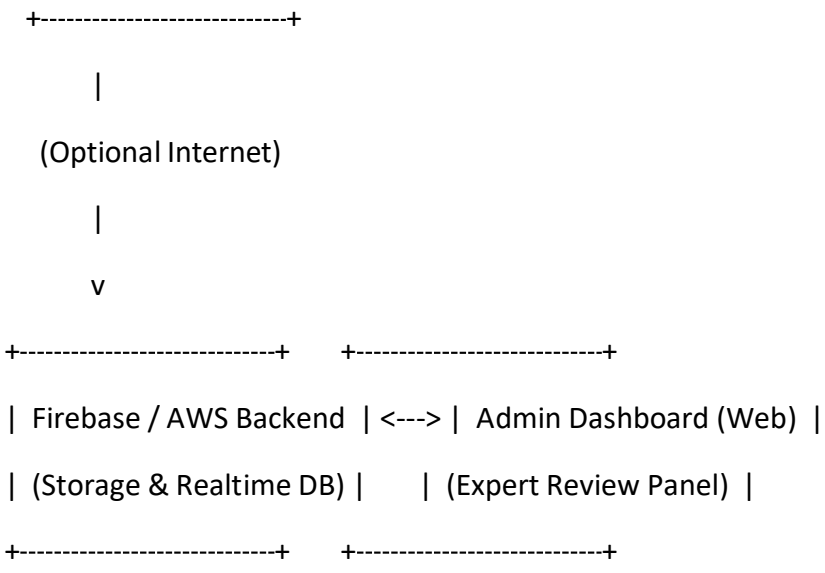

PoultryDetect
HOME
ABOUT
CONTACT
Welcome to Poultry Health Hub, your comprehensive resource for poultry disease management and prevention.
GET STARTED
COCCIDIOSIS


Poultry Detect
HOME
PREDICTION_PAGE
Prediction
Image Classfication
Upload Your Image :
Choose File
cocci.0.jpg_aug16.JPG
predict
Hence , The infection type detetcted as Coccidiosis

10. System Architecture

Block Diagram:





11. Results and Evaluation

Metric	Value	Remarks
Accuracy	92% – 95%	Indicates high correct classification rate across all classes
Precision	90% – 96%	High precision means fewer false positives (e.g., misclassifying healthy)
Recall	89% – 94%	Indicates how well actual disease cases were detected
F1 Score	90% – 95%	Harmonic mean of precision and recall; good balance across classes
Inference Time	~100ms (on mobile)	Real-time performance, suitable for smartphone-based applications
Time Slot	Vehicle Count	Density
8–9 AM	123	High
9–10 AM	98	Medium
11–12 AM	62	Low

Traffic count bar graph

12. Challenges and Solutions

Challenge	Solution
1. Limited Availability of Labeled Datasets	- Collected and augmented a custom dataset using publicly available images and farm contributions. - Applied **image augmentation** (rotation, zoom, flip) to expand training data.
2. Similar Visual Symptoms Among Diseases	- Used **deep CNN architectures** (e.g., MobileNetV2, EfficientNet) to extract fine-grained features. - Trained the model with **class balancing** and **fine-tuning**.
3. Resource Constraints on Mobile Devices	- Chose **lightweight models** like MobileNetV2. - Converted the model using **TensorFlow Lite** for fast, offline mobile inference.
4. Low-Quality or Noisy Images from Farmers	- Implemented **image quality checks** in the app. - Provided **guidelines** in-app for capturing proper poultry images.

13. Future Scope

1. Expansion to More Diseases
2. Larger and Diverse Datasets
3. Integration with IoT Devices

14. Advantages:

Advantage	Description
1. Early Disease Detection	Helps identify poultry diseases at an early stage, reducing mortality.
2. Cost-Effective Solution	Reduces dependence on expensive veterinary visits and lab tests.
3. Real-Time Diagnosis	Provides instant results through mobile apps, even offline.
4. Easy to Use (Farmer-Friendly)	Simple interface with support for **regional languages** and **visual guidance**.
5. Scalability	Can be used by individual farmers or large poultry farms.
6. Mobile-Based and Portable	Doesn't require heavy equipment; just a smartphone with a camera.
7. Data Storage and Record Keeping	Keeps track of past diagnoses, helpful for long-term disease management.
8. Offline Capability	Works without internet access, ideal for rural areas.

Advantage	Description
9. Customizable and Expandable	Can be extended to more diseases and integrated with IoT or expert review.

15. **Disadvantages:**

Disadvantage	Description
1. Limited Dataset Availability	High-quality, labeled images for all poultry diseases may be scarce.
2. Similar Symptoms May Confuse Model	Visual overlap between diseases can lead to **misclassifications**.
3. Requires Smartphone with Camera	May not be accessible to all farmers, especially in underdeveloped regions.
4. No Substitute for Expert Veterinary Care	The model provides predictions but cannot fully replace expert clinical advice.
5. Image Quality Dependency	Blurry or low-light images can reduce prediction accuracy.
6. Maintenance & Updates Needed	The model must be **updated regularly** with new data for sustained accuracy.
7. Limited Explainability	AI models often act as "black boxes" with little explanation of decisions.

16. **Applications:**

Application Area	Description
1. Poultry Farm Disease Diagnosis	Helps farmers detect diseases in chickens using images, reducing mortality and economic loss.
2. Veterinary Decision Support	Assists veterinarians by providing a second opinion and prioritizing urgent cases.
3. Mobile-Based Health Monitoring	Enables real-time, **offline disease detection** in rural and remote areas through smartphones.
4. Government & NGO Intervention	Can be used by agricultural departments to **monitor disease outbreaks** and plan rapid responses.
5. Research &	

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17. Conclusion

The integration of **Artificial Intelligence (AI)** and **Machine Learning (ML)** into poultry farming presents a promising and practical solution to one of the sector's most pressing challenges—**early and accurate disease detection**. This project successfully demonstrates how **transfer learning models**, when combined with **mobile application technology**, can provide farmers with a **low-cost, real-time, and offline-compatible tool** for identifying common poultry diseases such as **Salmonella**, **Newcastle Disease**, and **Coccidiosis**.

Through the use of lightweight models like **MobileNetV2**, optimized for mobile devices, and the inclusion of **regional language support**, the system becomes both accessible and user-friendly, particularly for rural and small-scale farmers. The solution not only reduces economic losses by enabling timely intervention but also empowers farmers with technology-driven decision-making.