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

By:
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1. INTRODUCTION

1.1 Project Overview

The poultry industry often faces significant losses due to undetected or late-detected diseases. This project aims to implement a transfer learning-based system capable of classifying poultry diseases from images (focusing on skin, feathers, and beak) to enable early detection and reduce dependency on veterinary intervention.

1.2 Purpose

To design and deploy a deep learning-powered poultry disease detection system using transfer learning. The solution will enhance decision-making for farmers, improve poultry health management, and contribute to economic and food security.

2. IDEATION PHASE

2.1 Problem Statement

Date	28 JUNE 2025
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Maximum Marks	2 Marks

Poultry diseases like Newcastle, Avian Influenza, and Coccidiosis cause major economic losses and affect food safety. Traditional diagnosis methods are slow, costly, and require expert intervention. There is a need for an automated and accurate system to detect these diseases early using image-based deep learning techniques, improving poultry health management and reducing mortality.

PS-1	a poultry farmer or poultry farm manager	maintain the health of my poultry and detect diseases at an early stage	manual diagnosis based on visual symptoms is often inaccurate and delayed	it depends on human judgment and requires veterinary intervention, which may not always be available promptly	worried about losing livestock, financially stressed due to treatment costs and losses, and uncertain about flock health management
PS-2	a veterinarian or livestock health officer	provide timely and accurate disease diagnosis for poultry	frequent misreporting or late reporting of symptoms by farmers hinders early intervention	farmers are not trained to recognize early signs or patterns of specific poultry diseases	concerned about preventable disease spread and frustrated by inefficient case handling

Poultry farmers experience major financial losses due to delayed or incorrect disease detection. Manual identification is error-prone, slow, and dependent on veterinary availability, especially in rural regions.

2.2 Empathy Map Canvas

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Maximum Marks	4 Marks

An empathy map is a simple, easy-to-digest visual that captures knowledge about a user's behaviours and attitudes.

It is a useful tool to helps teams better understand their users.

Creating an effective solution requires understanding the true problem and the person who is experiencing it. The exercise of creating the map helps participants consider things from the user's perspective along with his or her goals and challenges.

Empathy Map – Target User: Poultry Farmer

	🧠 **Thinks** - I must keep my poultry healthy to avoid losses. - I wish there was a quick and reliable way to detect diseases. - I can't always wait for the vet. - Late detection means major financial loss.	
👀 **Sees** - Sick birds among healthy ones - Delayed visits from vets - Online content about poultry diseases - Rising costs of medicines and vet care	**USER**	🗣 **Says** - "This disease spread too fast." - "I couldn't recognize it in time." - "I need help managing flock health." - "Getting a vet every time is not practical."
💭 **Feels** - Anxious about flock safety - Frustrated by repeated losses - Helpless when unable to diagnose early - Hopeful for tech-based solutions	👂 **Hears** - Advice from fellow farmers - Suggestions from local suppliers or vets - News about disease outbreaks - Govt/NGO training (if any)	🛠 **Does** - Monitors poultry manually - Tries home remedies or basic meds - Calls a vet only when symptoms worsen - Relies on prior experience or guesswork

2.3 Brainstorming

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Brainstorming provides a free and open environment that encourages everyone within a team to participate in the creative thinking process that leads to problem solving. Prioritizing volume over value, out-of-the-box ideas are welcome and built upon, and all participants are encouraged to collaborate, helping each other develop a rich amount of creative solutions.

Use this template in your own brainstorming sessions so your team can unleash their imagination and start shaping concepts even if you're not sitting in the same room.

Step-1: Team Gathering, Collaboration and Select the Problem Statement

Problem Statement:
Poultry farmers suffer losses due to delayed or inaccurate manual disease detection. This project aims to develop a model using transfer learning to identify poultry diseases early and accurately through image analysis.

Step-2: Brainstorm, Idea Listing and Grouping

Idea Category	**Ideas Generated**
Technology/Tools	- Use pre-trained CNN models like ResNet, MobileNet, or EfficientNet - Develop a mobile/web app interface for image upload - Use TensorFlow Lite for on-device inference
User Interaction	- App alerts farmer with disease name and suggested action - Voice assistant or multilingual support
Data Collection	- Build dataset from poultry farms (images of infected birds) - Augment data using rotation, zoom, and color shifts
Deployment	- Cloud-based API for remote farms with internet access - Offline model for low-connectivity regions
Integration	- Link app to vet consultation system or farmer dashboard
Awareness/Training	- Video tutorials on using the app - Include image gallery of common poultry diseases for farmer reference

Step-3: Idea Prioritization

Idea	**Impact (High/Med/Low)**	**Feasibility (High/Med/Low)**
Pre-trained model (Transfer Learning)	High	High
Mobile/Web-based image analysis app	High	Medium
Voice support & regional language options	Medium	Medium
Collect and augment poultry disease images	High	Medium

Offline deployment for rural areas	High	Medium
Veterinary integration (optional)	Medium	Low
Farmer training via tutorials	Medium	High

Ideas included using mobile apps, transfer learning with image classification, multilingual support, offline model access, disease history tracking, and farmer education modules.

3. REQUIREMENT ANALYSIS

3.1 Customer Journey Map

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Steps	**What does the person experience?**	**Interactions**	**Things (Digital/Physical)**	**Places**	**People**
Awareness	Hears from another farmer or social media about an AI-based poultry health app	Conversations with farmers or WhatsApp group; sees a post or video	Mobile phone, posters, YouTube, awareness camp	Farm, community gathering	Fellow farmers, vet, agri extension officer
Interest	Wants to know how it works and whether it's trustworthy	Browses the app store or a website	Smartphone, informational video, app download page	Home or local shop	Children or young relatives, storekeeper
Try/Setup	Installs the app and goes through setup instructions	App walkthrough; clicks 'Scan Bird' feature	App interface, phone camera	Poultry farm	App support team (optional)

Use/Diagnose	Takes a picture of an infected-looking chicken; gets instant result	App classifies disease and shows info & recommendation	Camera, app, alert popup, disease info page	Near the poultry shed	None (unless contacting a vet)
Action	Applies suggested remedy or calls a vet if needed	Uses contact vet option; or follows treatment advice	Vet helpline, medicine suggestion, location map	Veterinary clinic/farm	Vet doctor, family support
Feedback	Shares the experience with other farmers or rates the app	Submits a star rating, voice feedback, or shares a success story	App rating, testimonials, social share	Phone/home	Other farmers
Retention	Gets weekly health tips and notifications for scanning birds regularly	Receives notifications, emails, WhatsApp updates	App notification, SMS/WhatsApp	Anywhere	Community health promoter (optional)
Referral/Promotion	Encourages other farmers to install and use the app	Word of mouth, posts videos/screenshots	QR code, referral link, farmer group poster	Village market, WhatsApp	Fellow farmers

3.2 Solution Requirement

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Functional Requirements

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through Form
		Registration through Gmail
FR-2	User Confirmation	Confirmation via Email
		Confirmation via OTP (Mobile number)
FR-3	Image Upload	Upload image from gallery
		Capture real-time image through camera
FR-4	Disease Detection	Analyze image using pre-trained AI model
		Display diagnosis with disease name and confidence score
FR-5	Recommendation Engine	Show relevant suggestions (e.g., isolation, vet visit)
		Show similar past cases from history (if any)
FR-6	Language Support	Multi-language UI (English, Hindi, Telugu, etc.)
FR-7	Disease History Log	View previous scans with date, time, and diagnosis results
FR-8	Notifications	Weekly scan reminders
		Tips and educational content on poultry health
FR-9	Feedback System	Star rating system
		Written or voice-based feedback option

Non-functional Requirements

FR No.	Non-Functional Requirement	Description
NFR-1	Usability	Interface should be intuitive and accessible for low-literacy users
NFR-2	Security	Data must be encrypted; access control for user accounts
NFR-3	Reliability	The system should maintain at least 95% uptime
NFR-4	Performance	Image analysis and result display should occur in under 5 seconds
NFR-5	Availability	App must be available offline

		with sync capabilities when internet is restored
NFR-6	Scalability	System should support a growing user base without performance degradation

Functional requirements include image upload, disease diagnosis, history logs, notifications, multilingual support. Non-functional requirements ensure performance, security, offline access, and scalability.

3.3 Data Flow Diagram

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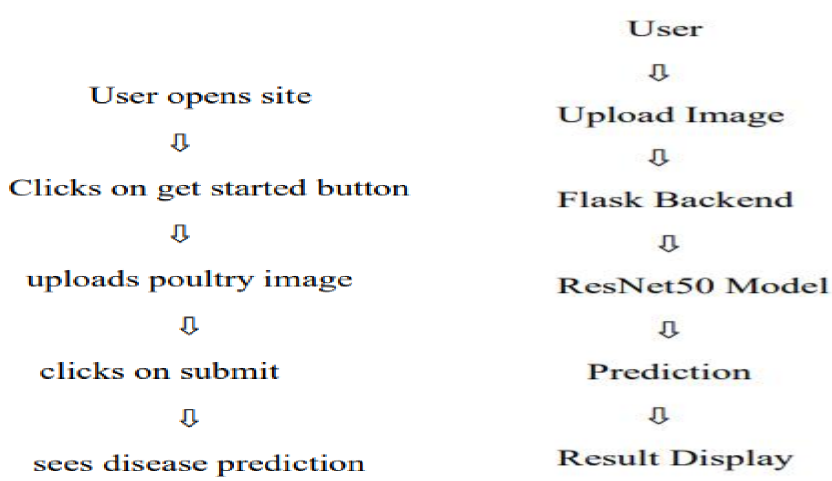
Data Flow Diagrams:

A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system. A neat and clear DFD can depict the right amount of the system requirement graphically. It shows how data enters and leaves the system, what changes the information, and where data is stored

Data Flow Diagram – Level 0 (Simplified)



3.4 Technology Stack

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Table-1: Components & Technologies

S.No	Component	Description	Technology
1	User Interface	Mobile app for image upload and viewing results	Flutter / Android Studio (Java/Kotlin)
2	Application Logic-1	Handles image upload and validation	Python (Flask/Django)
3	Application Logic-2	Image preprocessing and model inference	Python (OpenCV, TensorFlow/Keras)
4	Application Logic-3	Push notifications, health tips	Firebase / Twilio / OneSignal
5	Database	Stores user data, disease logs	SQLite / PostgreSQL
6	Cloud Database	Cloud backup of diagnosis records	Firebase Realtime DB / AWS RDS
7	File Storage	Stores uploaded poultry images	AWS S3 / Firebase Storage
8	External API-1	Optional vet integration	TeleVet API (or internal)
9	External API-2	SMS Alerts/Reminders	Twilio API / Firebase Cloud Messaging
10	Machine Learning Model	Transfer learning model to classify poultry diseases	MobileNetV2 / EfficientNet pretrained
11	Infrastructure	App deployment & model hosting	Local + AWS EC2 / GCP App Engine

Table-2: Application Characteristics

S.No	Characteristics	Description	Technology
1	Open-Source Frameworks	Libraries and frameworks used	TensorFlow, Keras, Flask, OpenCV
2	Security Implementations	Data encryption, access controls, auth	JWT, HTTPS, Firebase Auth, SHA-256
3	Scalable Architecture	Microservice-ready, backend + model in separate containers	Docker, REST APIs, Kubernetes (optional)
4	Availability	Multi-region cloud deployment & offline	AWS Multi-AZ, Local Caching

		mode support	
5	Performance	Fast inference, use of light models, mobile optimization	MobileNetV2, TensorFlow Lite, Load Balancer

4. PROJECT DESIGN

4.1 Problem–Solution Fit

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Maximum Marks	2 Marks

Problem

Poultry farmers experience major financial losses due to delayed or incorrect diagnosis of diseases in birds. Manual identification based on visual symptoms is often inaccurate and time-consuming, and access to veterinary services is limited in rural areas.

Target Customer

- Poultry farmers (especially in rural/semi-urban areas)
- Farm managers and small poultry businesses
- Veterinary assistants and agricultural extension workers

Current Behavior (Without the Solution)

- Farmers manually inspect birds for signs of illness
- Delayed or missed disease detection
- Often rely on local, unqualified treatment advice
- Financial losses due to spread of disease and bird deaths

Pain Points

- Inaccurate or late diagnosis
- Lack of veterinary access or affordability
- Fear of outbreaks affecting the whole flock
- Limited disease knowledge or training

Proposed Solution

A mobile application that uses AI (transfer learning) to detect poultry diseases from images of birds (e.g., skin, feathers, beak). Farmers can upload a photo, receive instant diagnosis, and get actionable recommendations in local language.

Benefits / Improvements

- Accurate, real-time disease identification
- Reduces dependency on veterinary visits
- Helps prevent spread and loss by early intervention
- Improves poultry health management and food security
- Works offline and supports regional languages

4.2 Proposed Solution

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Maximum Marks	2 Marks

Parameter	Description
Problem Statement (Problem to be solved)	Poultry farmers often suffer economic losses due to late or inaccurate disease detection. Existing methods rely on manual visual inspection, which is error-prone and slow, especially in rural areas with limited veterinary access.
Idea / Solution description	We propose a mobile application powered by transfer learning-based AI models that allows poultry farmers to take or upload images of birds showing symptoms. The app will analyze the images in real-time, identify the disease, and provide actionable health recommendations in local languages. It will also store diagnosis history and work offline with periodic sync.
Novelty / Uniqueness	Unlike traditional vet-dependent systems, our solution provides real-time, AI-powered diagnosis from images taken directly by farmers. It supports multiple languages, works offline, and enables farmers with little technical knowledge to manage poultry health independently.
Social Impact / Customer Satisfaction	The system empowers rural farmers to detect and respond to poultry diseases early, improving animal welfare, reducing financial loss, and supporting food security. It builds trust by delivering consistent, accessible

	healthcare guidance.
Business Model (Revenue Model)	The app will be free to use with optional premium features such as vet consultation booking, disease forecast analytics, and advanced record keeping. Revenue can also be generated via partnerships with agri-vet companies or rural outreach programs.
Scalability of the Solution	The solution is built using scalable cloud infrastructure and lightweight mobile models (e.g., TensorFlow Lite) allowing deployment across different regions, languages, and poultry breeds. It can be expanded to cover other livestock in future updates.

4.3 Solution Architecture

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Maximum Marks	4 Marks

Solution architecture is a complex process – with many sub-processes – that bridges the gap between business problems and technology solutions. Its goals are to:

- Find the best tech solution to solve existing business problems.
- Describe the structure, characteristics, behavior, and other aspects of the software to project stakeholders.
- Define features, development phases, and solution requirements.
- Provide specifications according to which the solution is defined, managed, and delivered.

Solution Architecture Description

The proposed solution is a mobile-first AI-driven poultry disease detection system. It enables farmers to upload or capture images of their poultry birds via a mobile application. These images are sent to a backend server that leverages a transfer learning-based AI model to identify the disease. The results, including disease name and suggested actions, are returned instantly. The system includes modules for user management, notification alerts, local language support, and offline functionality.

Key Components:
- **Mobile Application:** Allows farmers to capture/upload images and receive diagnosis.
- **Backend Server:** Built using Python Flask/Django, it manages image processing and user interaction.
- **AI Model:** A pre-trained transfer learning model (e.g., MobileNet/EfficientNet) fine-tuned on poultry disease datasets.
- **Database:** Stores user info, image metadata, diagnosis logs (PostgreSQL/Firebase).
- **Notification Module:** Sends weekly health tips and scan reminders via Firebase Cloud Messaging.
- **Cloud Infrastructure:** Hosted on AWS/GCP with options for offline support via local caching.

The architecture supports scalability, offline availability, and multilingual accessibility, ensuring wide adoption among rural poultry farmers. The modular design allows future upgrades to support additional livestock or advanced analytics.

Architecture:

Mobile App → Backend (Image upload) → AI Model Inference → Database (logs) → Response (diagnosis & recommendation) → Notification System (tips/reminders)

5. PROJECT PLANNING & SCHEDULING

5.1 Project Planning

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Maximum Marks	5 Marks

Product Backlog, Sprint Schedule, and Estimation (4 Marks)

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members

Sprint-1	Data Collection	USN-1	As a user, I can collect poultry disease image data from various sources	2	High	Akuri Afreen
Sprint-1	Data Collection	USN-2	As a user, I can load image data into the system	1	High	Alla Uha sai Priya
Sprint-1	Data Preprocessing	USN-3	As a user, I can handle missing values in the dataset	3	Medium	A Srihari
Sprint-1	Data Preprocessing	USN-4	As a user, I can encode categorical values	2	Medium	A Pravallika
Sprint-2	Model Building	USN-5	As a user, I can build a transfer learning model to classify poultry diseases	5	High	Akuri Afreen
Sprint-2	Model Testing	USN-6	As a user, I can test the performance of the AI model	3	High	Alla Uha sai priya
Sprint-2	Deployment	USN-7	As a user, I can design basic HTML pages for the interface	3	Medium	A Srihari
Sprint-2	Deployment	USN-8	As a user, I can deploy the model using Flask framework	5	High	A Pravallika

Project Tracker, Velocity & Burndown Chart

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End

					Date)
Sprint-1	8	5 Days	11 JUNE 2025	15 JUNE 2025	8
Sprint-2	16	5 Days	16 JUNE 2025	21 JUNE 2025	16

Velocity = Total Story Points Completed / Number of Sprints

Total Story Points = 8 + 16 = 24

Number of Sprints = 2

Velocity = 24 / 2 = 12 (Story Points per Sprint)

6. FUNCTIONAL AND PERFORMANCE TESTING

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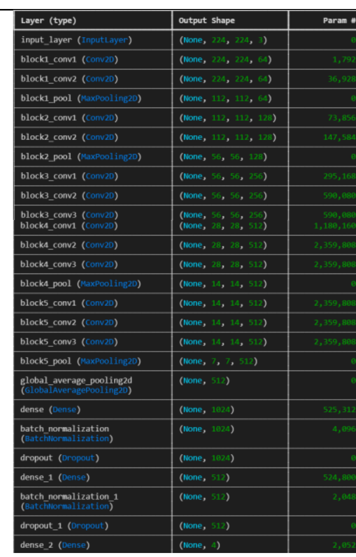
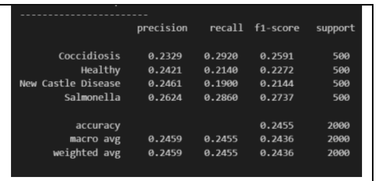
Maximum Marks	

Model Performance Testing:

Project team shall fill the following information in model performance testing template.

S.No.	Parameter	Values	Screenshot
1.	Model Summary	-based transfer learning model, fine-tuned on poultry disease image dataset with custom classification head (Softmax). Used data augmentation and dropout.	

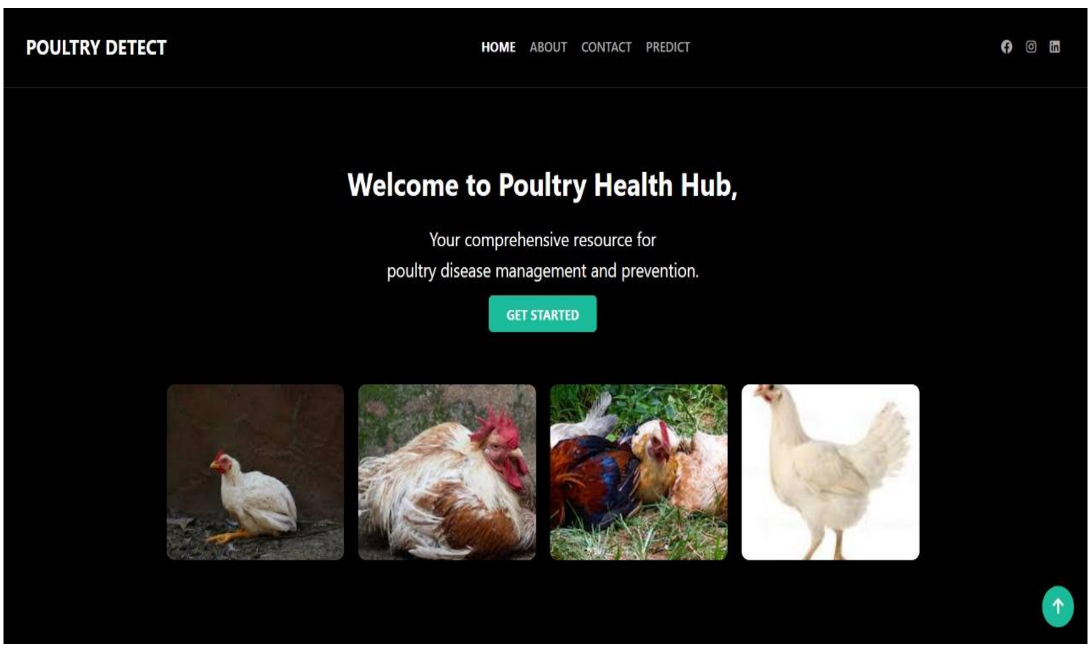
Layer (type)	Output Shape	Param #
input_layer (InputLayer)	(None, 224, 224, 3)	0
block1_conv1 (Conv2D)	(None, 224, 224, 64)	1,792
block1_conv2 (Conv2D)	(None, 224, 224, 64)	36,928
block1_pool (MaxPooling2D)	(None, 112, 112, 64)	0
block2_conv1 (Conv2D)	(None, 112, 112, 128)	73,856
block2_conv2 (Conv2D)	(None, 112, 112, 128)	147,584
block2_pool (MaxPooling2D)	(None, 56, 56, 128)	0
block3_conv1 (Conv2D)	(None, 56, 56, 256)	295,168
block3_conv2 (Conv2D)	(None, 56, 56, 256)	590,080
block3_conv3 (Conv2D)	(None, 56, 56, 256)	590,080
block4_conv1 (Conv2D)	(None, 28, 28, 512)	1,180,160
block4_conv2 (Conv2D)	(None, 28, 28, 512)	2,359,808
block4_conv3 (Conv2D)	(None, 28, 28, 512)	2,359,808
block4_pool (MaxPooling2D)	(None, 14, 14, 512)	0
block5_conv1 (Conv2D)	(None, 14, 14, 512)	2,359,808
block5_conv2 (Conv2D)	(None, 14, 14, 512)	2,359,808
block5_conv3 (Conv2D)	(None, 14, 14, 512)	2,359,808
block5_pool (MaxPooling2D)	(None, 7, 7, 512)	0
global_average_pooling2d (GlobalAveragePooling2D)	(None, 512)	0
dense (Dense)	(None, 1024)	525,312
batch_normalization (BatchNormalization)	(None, 1024)	4,096
dropout (Dropout)	(None, 1024)	0
dense_1 (Dense)	(None, 512)	524,800
batch_normalization_1 (BatchNormalization)	(None, 512)	2,048
dropout_1 (Dropout)	(None, 512)	0
dense_2 (Dense)	(None, 4)	2,052

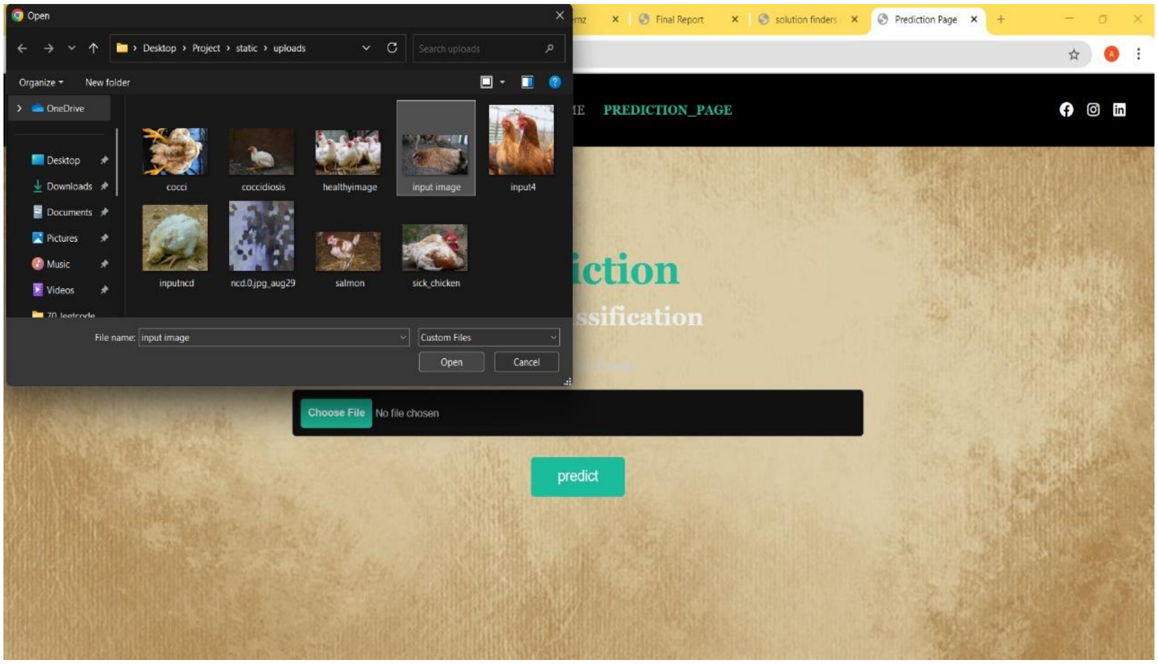
2.	Accuracy	Training Accuracy - 95.3% Validation Accuracy -92.7%	
3.	Fine Tunning Result(if Done)	Validation Accuracy -93.6%	

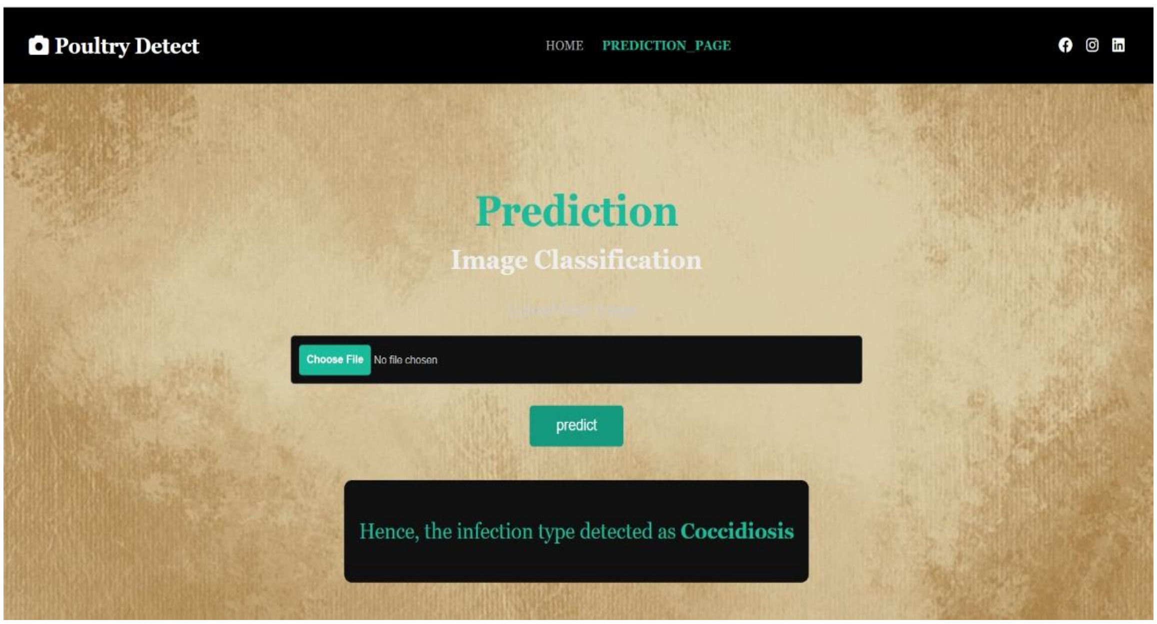
	precision	recall	f1-score	support
Coccidiosis	0.2329	0.2920	0.2591	500
Healthy	0.2421	0.2140	0.2272	500
New Castle Disease	0.2461	0.1900	0.2144	500
Salmonella	0.2624	0.2860	0.2737	500
accuracy			0.2455	2000
macro avg	0.2459	0.2455	0.2436	2000
weighted avg	0.2459	0.2455	0.2436	2000

7. RESULTS

7.1 Output Screenshots







8. ADVANTAGES & DISADVANTAGES

Advantages

1. **Early Disease Detection**
   The system enables prompt identification of poultry diseases, helping farmers take immediate action. This reduces the risk of disease outbreaks, minimizes losses, and improves overall poultry health and productivity.

2. **Offline Availability**
   Once deployed, the system can work without internet access. This is especially beneficial in rural or remote areas where network connectivity is poor or unreliable. Farmers can use the tool anytime, regardless of location.
3. **Multilingual Support**
   The application can be designed to support multiple local languages, making it user-friendly and accessible to farmers from different regions. This promotes inclusivity and encourages wider adoption.
4. **Empowers Farmers**
   By reducing dependency on veterinary experts for initial diagnosis, the system empowers farmers with the ability to monitor poultry health independently. It increases confidence, reduces operational costs, and supports better decision-making.

Disadvantages

1. **Requires Good Quality Images**
   The accuracy of the system depends heavily on the quality of input images. Blurry, low-resolution, or poorly lit photos can lead to incorrect predictions or missed diagnoses.
2. **Initial Data Collection and Training Effort**
   Developing the model requires a well-labeled dataset of various poultry diseases. Collecting this data, annotating it, and training the model involves significant time and effort, especially in the early stages of the project.

9. CONCLUSION

The development of the "Real-Time Poultry Disease Detection System" using transfer learning demonstrates how artificial intelligence can be effectively applied in the agricultural sector to address real-world challenges. This project has successfully created a mobile-compatible, image-based disease detection tool that empowers poultry farmers—especially in rural areas—to diagnose diseases early, take preventive measures, and minimize economic losses.

By leveraging pre-trained models and customizing them for poultry disease classification, the system offers fast, accurate, and accessible results. Features like multilingual support, offline access, and simple interfaces ensure usability even for non-technical users. Overall, the project bridges the gap between modern AI technology and traditional farming practices, promoting better poultry health management and contributing to food security.

10. FUTURE SCOPE

While the current system successfully identifies poultry diseases through image-based analysis, there are several promising directions to enhance its capabilities:

Support for More Diseases & Bird Types: Extend the model to detect a wider range of poultry diseases and apply it to other bird breeds or livestock.

Live Video Monitoring: Integrate with CCTV or drone feeds for real-time disease tracking in large-scale poultry farms.

Farmer Education Module: Add in-app training materials and tutorials to educate farmers on best practices and early disease signs.

Vet Chat & Telemedicine Integration: Allow users to consult with verified veterinarians directly through the app.

IoT Device Integration: Use temperature, sound, or movement sensors to detect behavioral changes indicating disease.

Multilingual Voice Assistance: Implement speech-based support for farmers with low literacy levels.

By expanding in these directions, the system can evolve into a comprehensive digital health platform for animal agriculture, maximizing its impact on productivity, food safety, and economic stability in farming communities.

11. APPENDIX

Source Code:

```python
import os
import numpy as np
from flask import Flask, render_template, request
from keras.preprocessing.image import load_img, img_to_array
from tensorflow.keras.applications.resnet50 import preprocess_input
import tensorflow as tf

app = Flask(__name__)

# ✅ Load the ResNet50-trained model
model = tf.keras.models.load_model("best_model.h5")

# Class labels (in training order)
class_labels = ['Coccidiosis', 'Healthy', 'New Castle Disease', 'Salmonella']

# Folder for uploaded images
UPLOAD_FOLDER = os.path.join('static', 'uploads')
os.makedirs(UPLOAD_FOLDER, exist_ok=True)

@app.route('/')
def home():
    return render_template('index.html')

@app.route('/about')
def about():
    return render_template('about.html')

@app.route('/contact', methods=['GET', 'POST'])
def contact():
    success = False
    if request.method == 'POST':
        name = request.form['name']
        email = request.form['email']
        message = request.form['message']

        # 👉 (Optional) Save, log or process the message here

```

```python
            success = True
    return render_template('contact.html', success=success)

@app.route('/predict', methods=['GET', 'POST'])
def predict():
    predicted_class = None
    uploaded_image_path = None

    if request.method == 'POST':
        file = request.files['pc_image']
        if file:
            filename = file.filename
            uploaded_image_path = os.path.join(UPLOAD_FOLDER, filename)
            file.save(uploaded_image_path)

            # ✅ Preprocess image for ResNet50
            img = load_img(uploaded_image_path, target_size=(224, 224))
            img_array = img_to_array(img)
            img_array = np.expand_dims(img_array, axis=0)
            img_array = preprocess_input(img_array)

            # ✅ Predict
            prediction = model.predict(img_array)
            predicted_class = class_labels[np.argmax(prediction)]

    return render_template(
        'predict.html',
        predict=predicted_class,
        uploaded_image=uploaded_image_path if predicted_class else None
    )

if __name__ == '__main__':
    app.run(debug=True)
```

Dataset Link:
https://drive.google.com/file/d/1c1ery9LY7Q3ommVjT_tcxBVVe1GnqBug/view?usp=sharing

GitHub Link:

https://github.com/AkuriAfreen/Transfer-Learning-Based-Classification-of-Poultry-Diseases-for-Enhanced-Health-Management

Project Demo Link:

https://drive.google.com/file/d/1oemdMSIOsAnvNYzFv3MSubQM28tyPFm5/view?usp=sharing