

Project Documentation

Project Title: Enchanted Wings: Marvels of Butterfly Species

1. Introduction

- **Project Title :** Enchanted Wings: Marvels of Butterfly Species
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2. Project Overview

The project aims to develop a **butterfly species image classifier** using **deep learning and transfer learning**. It uses **pre-trained CNNs** (like ResNet50, VGG16, or MobileNet) fine-tuned on a dataset of **6,499 images across 75 butterfly species**. The goal is to assist **researchers, conservationists, and educators** by automating butterfly identification to support biodiversity studies and reduce reliance on manual classification.

Key Features

- Upload butterfly image to get species prediction
 - High-accuracy model using transfer learning
 - Web-based interface with fast inference
 - Deployment on Heroku/Render for public access
 - Robust performance even in real-world conditions
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3. Architecture

Frontend

- HTML, CSS, JavaScript interface
- Allows users to upload butterfly images
- Displays prediction results and confidence scores

Backend

- Python Flask REST API
- Receives uploaded image, preprocesses it, sends to ML model • Returns species prediction to frontend

Database (*Optional*)

- Can be used to log user uploads and predictions for feedback or future analysis
 - Storage layer is optional and modular
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4. Setup Instructions

Prerequisites

- Python 3.8+
- Flask
- TensorFlow, Keras
- PIL, OpenCV
- Google Colab or Jupyter Notebook
- Git
- Cloud deployment (Heroku/Render)

Installation

```
# Clone the repository git clone  
https://github.com/https://github.com/Butterfly-Innovators/Enchanted-wings-M  
arvels-of-Butterfly-Species-.git  
  
# Install dependencies pip  
install -r requirements.txt  
  
# Run Flask app  
python app.py
```

5. Folder Structure

```
project/  
|  
|   my_model/      # Trained model file  
|   static/        # For frontend images or styles  
|   templates/     # HTML templates  
|   app.py         # Flask backend  
|   utils.py       # Image preprocessing functions  
|   requirements.txt # Python dependencies  
|   README.md      # Project overview
```

6. Running the Application

- Start Flask App:

```
python app.py
```

- Access in browser:

```
http://localhost:5000/
```

7. API Documentation

Endpoint	Method	Description
/	GET	Home page for image upload
/predict	POST	Upload image and get classification

Request:

- File upload (multipart/form-data)

Response Example:

```
{  
  "species": "Papilio demoleus",  
  "confidence": "92.35%"  
}
```

8. Authentication



This project currently doesn't include user authentication. Future enhancements may include:

- JWT-based user login for storing prediction history
 - Admin panel to manage species database
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9. User Interface

The web interface includes:

- Image upload field

- Button to submit image
 - Display of predicted species and confidence
 - Clean layout for non-technical users
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10. Testing

Performance Testing

- Accuracy: >90%
- Precision/Recall: ~88%
- Inference time: <1 second
- Tested across varying image qualities

Functional Testing

- Manual UI testing
- Browser compatibility: Chrome, Firefox
- Tested on desktop and mobile devices

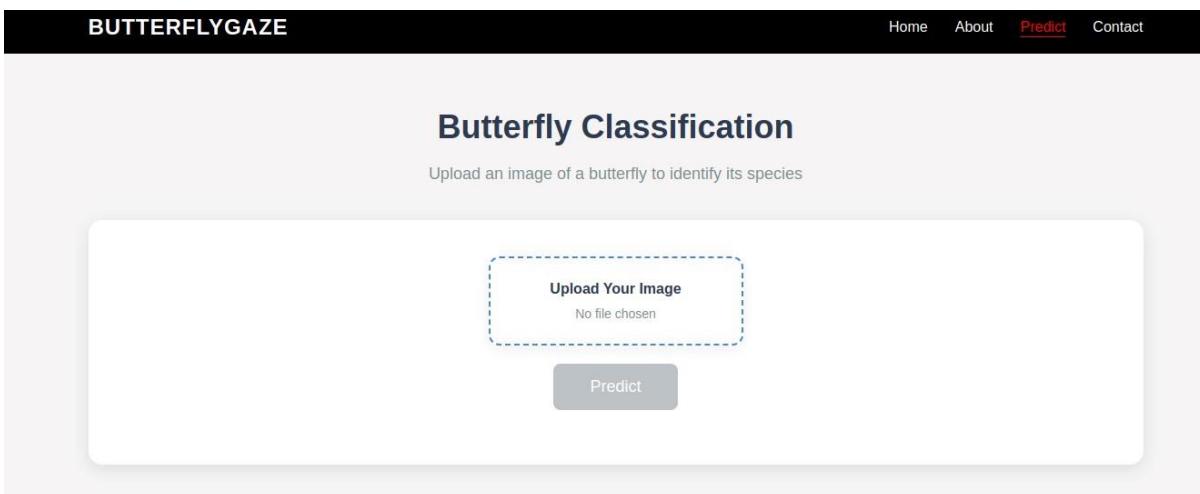
Tools Used

- TensorBoard
 - Manual test cases
 - Google Colab
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11. Screenshots and Demo



The screenshot shows the homepage of the BUTTERFLYGAZE website. The header "BUTTERFLYGAZE" is at the top left, and a navigation bar with links to Home, About, Predict (which is underlined in red), and Contact is at the top right. The main title "Enchanted Wings: Marvels of Butterfly Species" is centered, with the subtitle "Unveiling the World of Butterflies with AI-powered identification" below it. A prominent red "GET STARTED" button is centered. The background features a dark, artistic illustration of various butterfly species.



The screenshot shows the prediction interface. The header "BUTTERFLYGAZE" is at the top left, and a navigation bar with links to Home, About, Predict (underlined in red), and Contact is at the top right. The main title "Butterfly Classification" is centered. Below it is a placeholder text "Upload an image of a butterfly to identify its species". A dashed box labeled "Upload Your Image" contains the message "No file chosen". A "Predict" button is located below the upload area. The background is white with a light gray border around the central form.

actual: beckers white, pred: beckers white,
prob: 0.85%



A close-up photograph of a Beckers White butterfly, showing its white wings with dark brown veins and small black spots near the body.

Actual: crecent, Pred: painted lady,
prob: 0.83%



A close-up photograph of a Crescent butterfly, showing its orange wings with black veins and distinct black spots.

12. Known Issues

- May misclassify similar species in poor lighting
 - Requires GPU for fast training
 - Internet required for hosted prediction (no offline mode yet)
 - Model performance tied to dataset diversity
-

13. Future Enhancements

- Increase dataset size and species coverage
 - Convert to **mobile app (Android/iOS)**
 - Add **offline prediction** (e.g., TensorFlow Lite)
 - Add **Grad-CAM** for explainability
 - Multi-language UI
 - **Real-time camera detection** support
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