Enchanted Wings: Marvels of Butterfly Species

1. Introduction

Project Title: Enchanted Wings: Marvels of Butterfly Species

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2. Project Overview

Purpose:
The goal of this project is to develop a robust butterfly species classification system using transfer learning techniques on a dataset of butterfly images. This application identifies the species from images using a pre-trained deep learning model.

Features:
- Upload butterfly images and predict species.
- Use of pre-trained CNNs (like MobileNetV2) for efficient image classification.
- Supports over 75 butterfly species.
- Responsive user interface for easy usage.

3. Architecture

Frontend:
- Built using HTML, CSS, and JavaScript for simplicity.
- Can be extended with React for dynamic rendering.

Backend:
- Built with Python using Flask.
- Serves the model inference API.

Database:
- Not used in the current version (No data persistence).
- Can be extended with MongoDB for storing user inputs or predictions.

4. Setup Instructions

Prerequisites:
- Python 3.x
- Flask
- TensorFlow / Keras
- NumPy, OpenCV, Pillow
- Jupyter Notebook or Google Colab (for model training)

Installation:
```bash
git clone https://github.com/your-username/butterfly-classifier.git
cd butterfly-classifier
pip install -r requirements.txt
```

5. Folder Structure

```
Butterfly-Classifier/
├── model/              # Saved trained model (.h5 or .pkl)
├── dataset/            # Dataset of butterfly images
├── static/             # Static assets for frontend
├── templates/          # HTML templates for Flask
├── app.py              # Flask backend
├── train_model.ipynb   # Jupyter Notebook for training
└── requirements.txt    # Python dependencies
```

6. Running the Application

Start the Flask Backend:
```bash
python app.py
```

Open your browser and go to: http://127.0.0.1:5000/

7. API Documentation

POST /predict
Description: Accepts an image file and returns the predicted butterfly species.
Request: multipart/form-data
- file: image file
Response:

{
 "prediction": "Papilio demoleus",
 "confidence": "98.5%"
}

8. Authentication

No authentication is implemented in this version.
Can be integrated in future using JWT or session-based auth if user login is required.

9. User Interface

Screenshots:
- Upload image interface
- Prediction result display

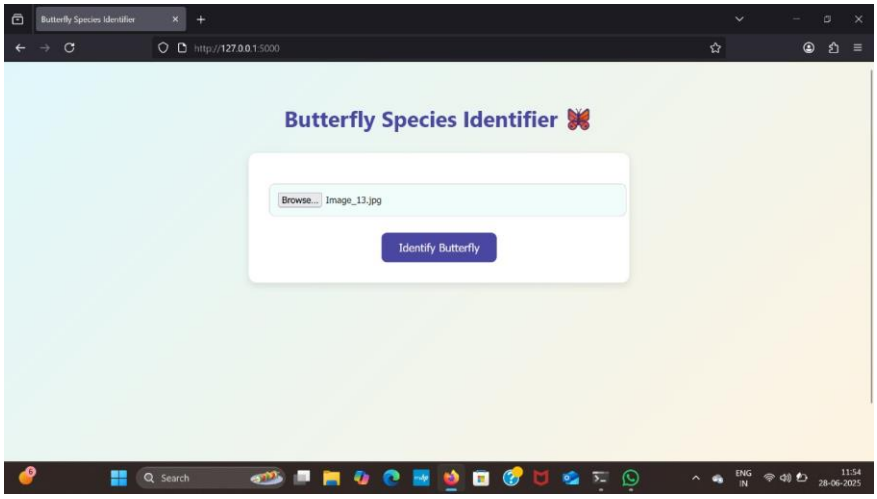
10. Testing

Manual Testing:
- Tested with random butterfly images from web and dataset.
- Compared predicted output with known labels.

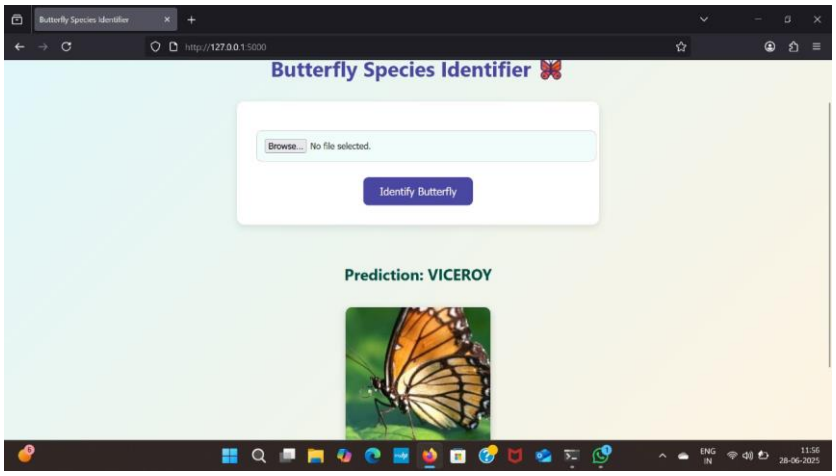
Tools:
- Jupyter Notebook visualizations
- TensorBoard (for training metrics)

11. Screenshots or Demo

Screenshots:
- Home Page



- Prediction Result



12. Known Issues

- Accuracy may degrade for unseen or poor-quality images.
- Slow performance for large image files on low-end systems.

13. Future Enhancements

- Extend UI using React.
- Add login/signup features.
- Add image augmentation to improve model robustness.