

**Project Title:** Enchanted Wings: Marvels of Butterfly Species

**Domain:** Computer Vision, Machine Learning, Biodiversity Conservation

**Platform:** SmartInternz Internship Program

**Objective:** To develop a deep learning model capable of classifying butterfly species from images using a dataset obtained from Kaggle, thereby contributing to biodiversity conservation and education.

**Tools & Technologies Used:** - Platform: SmartInternz - Language: Python - Libraries: TensorFlow, Keras, OpenCV, NumPy, Matplotlib, Pandas - IDE: Jupyter Notebook / Google Colab - Dataset Source: Kaggle - Model: Convolutional Neural Network (CNN)

**Dataset Description:** The Kaggle dataset includes labeled images of various butterfly species. Each image is annotated with the species name. The dataset has variations in background, lighting, and orientation, making it suitable for real-world applications.

**Problem Statement:** Identifying butterfly species manually is labor-intensive and error-prone. This project aims to automate butterfly species classification using image recognition techniques, facilitating better research, documentation, and awareness.

**Methodology:** 1. **Data Acquisition:** Import and explore the Kaggle dataset. 2. **Data Preprocessing:** Resize images, encode labels, normalize pixels, apply data augmentation. 3. **Model Development:** Build a CNN model with multiple convolutional, pooling, and dropout layers. 4. **Model Training:** Train on 80% of data, validate on 20%, use callbacks to prevent overfitting. 5. **Evaluation:** Evaluate performance using accuracy, precision, recall, F1-score, and confusion matrix. 6. **Testing:** Visual comparison of predicted vs actual labels on test images.

**Results:** - Achieved high accuracy in species classification. - Model performance validated using real-world butterfly images. - Misclassifications analyzed and addressed through fine-tuning.

**Real-World Scope:** - Biodiversity research and conservation - Educational tools for biology and environmental science - Field identification apps for researchers and enthusiasts

**Skills Gained:** - Deep Learning and CNNs - Image Preprocessing Techniques - Data Augmentation - Model Evaluation and Validation - Scientific Reporting and Presentation

**Acknowledgment:** We thank the SmartInternz team for their mentorship and support. This project was made possible by the resources and learning platform provided by SmartInternz and the dataset sourced from Kaggle.

**Team Members:** [List names here if needed]

**Internship Duration:** [Specify duration, e.g., May 2025 - June 2025]

**References:** - SmartInternz Learning Materials - Kaggle Butterfly Dataset - TensorFlow and Keras Documentation