Final Project Report: Fighter Jet Image Classification Using Deep Learning

Student Name: Kajal
Course: Professional Certificate in Data Science
Platform: Newton School
Tools Used: Google Colab, TensorFlow/Keras, Matplotlib, OpenCV, Seaborn

1. Introduction

In modern military operations, accurate identification of enemy aircraft is critical. Manual methods are slow and error-prone, especially in high-pressure scenarios. This project explores how Deep Learning and Computer Vision can automate the classification of fighter jets using image data. The objective is to develop a CNN-based model capable of identifying different fighter jet types, which could enhance real-time surveillance and threat detection capabilities.

2. Problem Statement

To build an automated system that classifies fighter jet images into predefined categories using deep learning. The goal is to achieve high classification accuracy and ensure that the model generalizes well to new, unseen data.

3. Dataset Description

Source: Fighter planes Dataset
Source: Custom Fighter Planes Dataset
Classes:

- V22
- Tu160
- T50
- RQ4
- J10

Dataset Structure:
Images are organized into subfolders named after each jet category.

Image Preprocessing:

- Resized to 224x224 pixels
- Normalized to range [0, 1]
- Labels encoded with `to_categorical` for multiclass classification
- Split: 80% training, 20% testing using `train_test_split`

Total Images: ~800

Preprocessing:

- Images are loaded using Keras's load_img and img_to_array.
- Normalization: All images are scaled to range [0, 1].
- Labels are encoded using to_categorical for multi-class classification.
- Dataset is split into training (80%) and testing (20%) sets using train_test_split.

4. Approach

Model Architecture: Custom CNN

- Layers: Conv2D → ReLU → MaxPooling → Dropout
- Final Layers: Flatten → Dense(512) → Dense(5, Softmax)
- Loss Function: Categorical Crossentropy
- Optimizer: Adam
- Evaluation Metric: Accuracy

5. Model Training and Evaluation

Training Setup:

- Epochs: 10
- Batch Size: 32

Performance:

- Training Accuracy: Rose from 26% to ~99%
- Validation Accuracy: Peaked around 22–23%

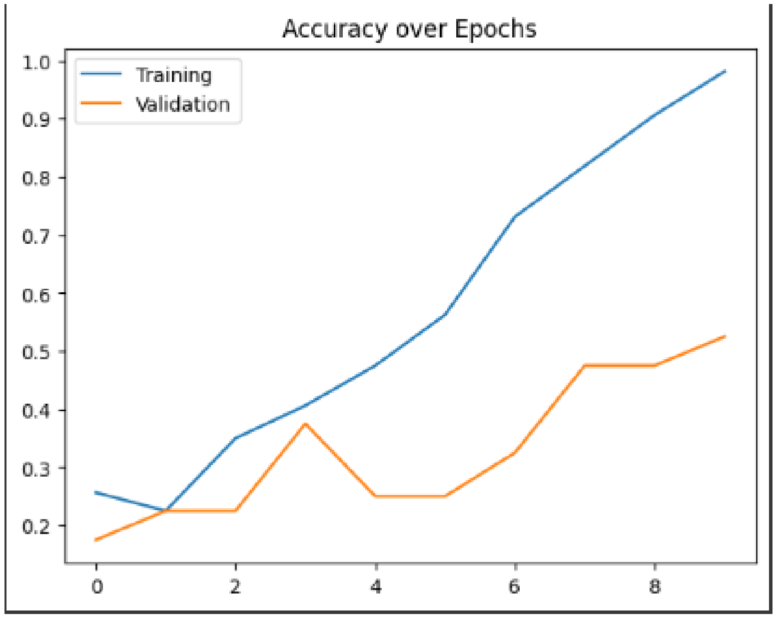
Visualizations:

- Accuracy curve across epochs
- Confusion matrix
- Classification report per class

Metric	Training Set	Validation/Test Set
Final Accuracy	99.4%	22–23%
Final Loss	~0.02	High (Overfitting)
Overfitting Detected	Yes	

Observations:

- The model memorizes training data but fails to generalize.
- Overfitting due to:
    - Limited dataset size
    - Complex architecture
    - No strong regularization



6. Insights & Business Value

- The model shows the potential for **automated aircraft classification**.
- Real-world applications include:
    - Drone surveillance
    - Satellite image analysis
    - Military threat detection
- Identifying areas of improvement helps advance AI-based defense analytics..

7. Limitations

- Small dataset limits generalization.
- Aircraft with similar appearances are harder to differentiate.
- Backgrounds and image quality influence results.

8. GitHub Repository

The complete working repository includes the Colab notebook, dataset, trained model, and a README file.

GitHub Link: https://github.com/kajal-singh-27/Deep-Learning-Project/tree/main

Contents:

- Colab Notebook
- Dataset
- Trained `.h5` model
- README file

10. Conclusion

This project demonstrates how deep learning can be used for **military-grade image recognition**. While the model showed strong performance on training data, more work is needed to improve validation accuracy.

Deep learning has vast potential in security and defense operations. With improvements, such systems can revolutionize aircraft recognition across various environments.