DOG BREED CLASSIFICATION SYSTEM

Project Report

PROJECT TITLE: AI-Powered Dog Breed Identification using Transfer Learning (MobileNetV2)

TEAM DETAILS

- **Team ID:** LTVIP2026TMIDS91662
- **Team Leader:** KARTHEEK MOYYI
- **Team Members:** CHANDU TOGIRI, ARIKA SRIVALLI, BALAJI DESILLA

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1. EXECUTIVE SUMMARY

This project delivers a production-ready AI system that identifies 120 dog breeds from images with **67.26% validation accuracy**. Using **MobileNetV2 transfer learning**, the system achieves professional-grade performance in 30 minutes of training and provides instant predictions (2 seconds) via a Gradio web interface.

Key Achievements:

- 120-class dog breed classification
- 67%+ validation accuracy
- Instant model loading (no retraining required)
- Public web demo via Gradio
- GitHub-ready with requirements.txt

2. INTRODUCTION

Background: Dog breed identification is a challenging multi-class image classification problem due to the 120 classes and significant visual similarities between breeds. Traditional manual identification is often time-consuming and prone to error.

Project Goals:

1. Build an AI model achieving >60% accuracy on 120 breeds.

2. Create an instant prediction system without the need for retraining.
3. Deploy a public web interface and package for GitHub.

3. PROBLEM STATEMENT

- **Input:** Single dog image (JPG/PNG).
- **Output:** Predicted breed + confidence score.
- **Dataset:** 120 dog breeds from the Stanford Dogs Dataset.
- **Challenge:** Fine-grained visual differences between similar breeds.

4. TECHNICAL APPROACH

Transfer Learning Strategy:

- **Base Model:** MobileNetV2 (ImageNet pre-trained).
- **Backbone:** Frozen (2.2M parameters).
- **Layers:** Global Average Pooling, Dense (256, ReLU), and Dropout (0.2).
- **Output:** Dense (120, Softmax).

5. SYSTEM ARCHITECTURE

The workflow follows a streamlined pipeline:

1. **Image Input:** (224x224x3).
2. **Preprocessing:** Normalization.
3. **Model:** MobileNetV2 + Custom Head.
4. **Prediction:** Breed name (e.g., "Golden Retriever") + Confidence score.

6. IMPLEMENTATION DETAILS

- **Source:** Stanford Dogs Dataset (~10,000 images).
- **Split:** Training (~8,000 images / 80%) and Validation (~2,000 images / 20%).
- **Augmentation:** Rotation, Flip, Zoom, and Shear via ImageDataGenerator.
- **Optimizer:** Adam with Categorical Crossentropy loss.

7. TRAINING RESULTS

Final Epoch (10/10) Metrics: | Metric | Result | | :--- | :--- | | **Training Accuracy** | 74.90% | | **Validation Accuracy** | **67.26%** | | **Training Loss** | 0.8107 | | **Validation Loss** | 1.1875 |

- **Training Time:** ~1 hour on CPU.
- **Model Size:** ~15MB in .keras format.

8. MODEL PERFORMANCE & WEB APP

- **Inference Time:** <100ms per image.

- **Memory Usage:** 150MB RAM.
- **Confidence Threshold:** Predictions require >50% confidence; otherwise, the system returns "Not confident" to prevent false positives.
- **Interface:** Built with **Gradio 6.0**, featuring drag-and-drop upload and a mobile-responsive "Soft" theme.
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9. CONCLUSION

The project successfully delivered a production-ready application achieving **67.26% accuracy**. This system has immediate business impact in the pet industry, veterinary diagnostics, and educational tools.

GitHub Repository: `Srivalli-2003/Dog-breed-classifier`

Technical Specifications:

- **Framework:** TensorFlow/Keras 2.15+.
- **Python:** 3.11+.
- **License:** MIT.