Pharmaceutical Image Classification Report

1. Introduction

This project focuses on pharmaceutical image classification using deep learning techniques. The objective was to develop a robust image classifier capable of recognizing 10 different types of drugs and vitamins based on packaging images. Such a model can improve safety, efficiency, and automation in healthcare and e-commerce environments.

2. Dataset Overview

The dataset, sourced from Kaggle, includes approximately 10,000 colored images of popular drug/vitamin products across 10 classes. Each class is evenly represented with around 1,000 samples. The images were resized to 224x224 pixels and normalized using computed mean and standard deviation values for better convergence during training.

3. Methodology

The project was implemented in PyTorch using TorchVision. The dataset was split into 85% for training and 15% for validation. DataLoaders were used to batch and shuffle the data efficiently. Models were trained using the Adam optimizer with CrossEntropyLoss for up to 8 epochs, with early stopping to prevent overfitting. Training progress was tracked using accuracy and F1 score on both sets.

4. Models Developed

Three models were developed:
- A Custom CNN with 4 convolutional layers, batch normalization, ReLU activations, max pooling, and dropout.
- A fine-tuned ResNet50 with its final layer replaced to output 10 classes.
- A fine-tuned EfficientNet-B0 model with a modified classifier head.
The pre-trained models used transfer learning to leverage features learned from large datasets.

5. Results & Evaluation

All models performed well on the validation set, with EfficientNet-B0 outperforming the others:
- Custom CNN: ~94% accuracy, F1-score ~0.95
- ResNet50: ~98% accuracy, F1-score ~0.98

- EfficientNet-B0: ~99.5% accuracy, F1-score ~0.995
The confusion matrix confirmed negligible misclassifications. EfficientNet-B0's modern architecture and transfer learning capabilities contributed to its outstanding performance.

6. Conclusion

This project successfully built a pharmaceutical image classification system, with EfficientNet-B0 achieving the best results. Transfer learning significantly improved performance, reducing training time and boosting accuracy. The system shows promise for real-world deployment in pharmacy automation and inventory management.

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