(Pharmaceutical Drugs Dataset)

IMAGE CLASSIFICATION WITH CNNs

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PROJECT INTRODUCTION

- **Problem Definition**
  - Image classification of Pharmaceutical drugs and vitamins
- **Objective**
  - Develop a multi-class image classifier
  - Recognize 10 different drug/vitamin products from images with high accuracy
- **Approach Overview**
  - CNN to learn visual features of medicine packaging
  - Comparison of custom CNN, ResNet50 & EfficientNet-B0

DATASET OVERVIEW

- **Data Source**
  - Kaggle “Drugs and Vitamins” image dataset
  - 10 classes, each corresponding to a specific brand/product
- **Dataset size**
  - Contains ~10K images(~1K per class on average)
  - Colored photographs of product packages or pills
- **Class Distribution**
  - Fairly balanced – a bar chart of images per class
  - No severe class imbalance

DATASET OVERVIEW

- **Dataset Preprocessing**
  - Images resized to 224x224 pixels for consistency
  - Distinct packaging and labels for each class
  - Computation with mean and standard deviation for normalization
  - Mean ~ [0.596, 0.551, 0.508] & std ~ [0.125, 0.123, 0.130]

METHODOLOGY & IMPLEMENTATION

- **Tools and frameworks**
  - Implementation using Pytorch and TorchVision
  - Building and training CNN model
  - Training acceleration with GPU support
- **Train/Val data Split**
  - Training~85% and Validation~15%
  - Validation set simulates unseen data
- **Training procedure**
  - Using an Adam optimizer and cross-entropy loss
  - Training up to 8 Epochs with early stopping

METHODOLOGY & IMPLEMENTATION

- **Models developed**
  - A bespoke convolutional network(Custom CNN) with 4 convolutional layers
  - ReLU, batch norm, pooling and final fully-connected layer
  - Includes dropout for regularization
  - Fine-tuned two pre-trained models(Transfer learning) – ResNet50 and EfficientNet-B0
  - Replaced their final layer to output 10 classes, leverage learned features from large-scale data

RESULTS & DISCUSSION

- **Performance metrics**
  - High accuracy on validation set for all models
  - ResNet50 ~98% validation accuracy with F1~98%
  - EfficientNet-B0 ~99.5% validation accuracy with F1 ~0.995
  - Custom CNN ~90% validation accuracy with F1~0.90
- **Comparison**
  - Pre-trained models converged faster and more accurate
  - EfficietNet-B0 slightly edged out ResNet50, due to its modern architecture and efficiency
  - Transfer learning provided a huge boost to the system

RESULTS & DISCUSSION

- **Confusion Matrix**
  - Negligible misclassification
  - Distinguishes the 10 drug types with nearly perfect reliability
- **Discussion**
  - Features learned from large datasets transfer well
  - Dataset images are clear and the classes are visually distinctive
  - Would be important to test on truly novel images to ensure the robustness

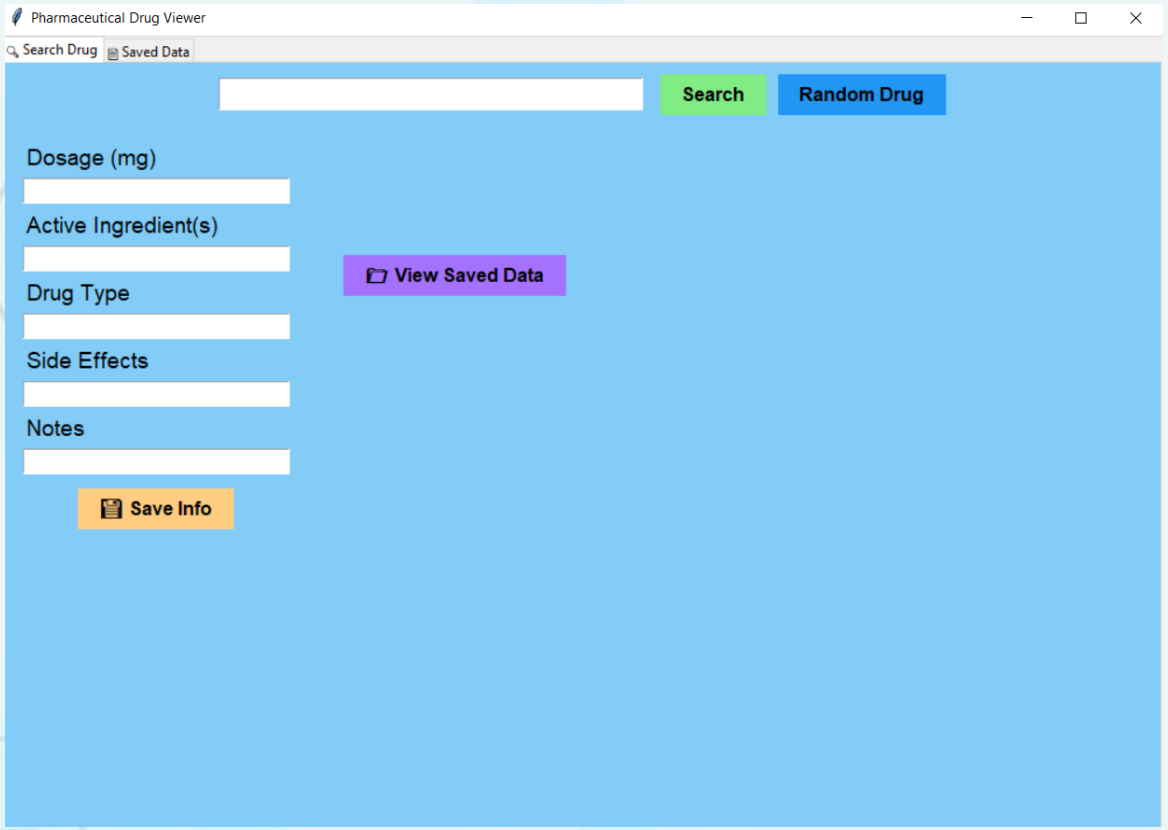
FUTURE POTENTIAL IMPROVEMENTS

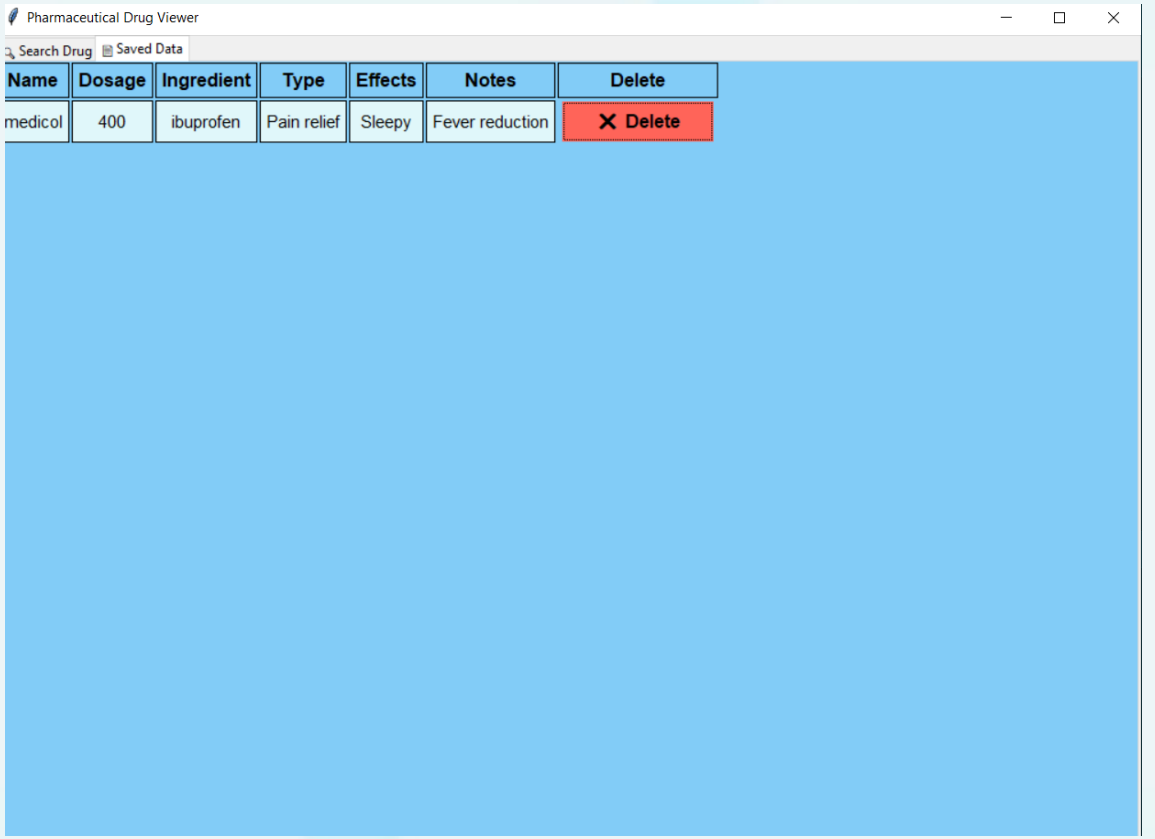
- **Broader Testing :** Introduce a separate test set of new images for cross validation
- **Data Augmentation :** Include more classes and use additional data augmentation techniques(rotation, light adjustments)
- **Hyperparameter Tuning :** Experiment with training parameters or fine-tuning more layers of pre-trained models to see improved performance or reduced training
- **Deployment :** Using a mobile application or a GUI for the further deployment

CONCLUSION

- Successfully built an image classification system for pharmaceutical products with best model as EfficientNet-B0 which achieved ~99% accuracy
- Highly reliable for distinguishing among 10 drug/vitamin categories
- Transfer learning proved crucial – leveraging pre-trained CNNs superior performance with minimal training time
- Deep learning accurately identify medicines from images which streamlines pharmacy inventory checks or pill identification

GUI DEMO


Pharmaceutical Drug Viewer
Search Drug
Saved Data
Search
Random Drug
Dosage (mg)
Active Ingredient(s)
View Saved Data
Drug Type
Side Effects
Notes
Save Info


Pharmaceutical Drug Viewer
Search Drug
Saved Data
Name
Dosage
Ingredient
Type
Effects
Notes
Delete
medicol
400
ibuprofen
Pain relief
Sleepy
Fever reduction
Delete

Q & A

Danke Schön !