HematoVision-AI

Advanced Blood Cell Classification Using Transfer Learning

1. Introduction

HematoVision-AI is a deep learning-based medical imaging system designed to classify white blood cells from microscopic images. The system uses transfer learning with a pre-trained EfficientNetB0 model to accurately detect and classify four major types of white blood cells: Eosinophil, Lymphocyte, Monocyte, and Neutrophil. This project aims to assist healthcare professionals in automating blood cell analysis and improving diagnostic efficiency.

2. Problem Statement

Manual blood cell classification is time-consuming, prone to human error, and labor-intensive. There is a need for an automated, accurate, and scalable AI-based solution to classify blood cells efficiently.

3. Objectives

1. Build an AI model using transfer learning
2. Achieve high classification accuracy
3. Develop a scalable solution for medical diagnostics
4. Enable real-time image-based predictions

4. Dataset Description

Total Images: ~10,000+
Classes: 4
Image Type: Microscopic blood smear images
Format: JPG/PNG
Organized into class-specific folders:

```
dataset/
 ■■■ eosinophil/
 ■■■ lymphocyte/
 ■■■ monocyte/
 ■■■ neutrophil/
```

5. Methodology

Step 1: Data Preprocessing

Image resizing to 224x224, EfficientNet preprocessing, and data augmentation techniques such as rotation, zoom, and horizontal flipping.

Step 2: Model Selection

EfficientNetB0 pretrained on ImageNet dataset was selected for high-performance feature extraction.

Step 3: Transfer Learning Strategy

Phase 1 – Feature Extraction: Freeze base model layers and train classifier layers only.

Phase 2 – Fine Tuning: Unfreeze last layers and train with a low learning rate.

Step 4: Model Training

Optimizer: Adam | Loss Function: Categorical Crossentropy | Metric: Accuracy

6. Model Architecture

1. EfficientNetB0 (Pretrained CNN)
2. GlobalAveragePooling2D
3. Dropout Layer
4. Dense Layer (256 units, ReLU)
5. Softmax Output Layer

7. Results

Training Accuracy: ~85–95%
Validation Accuracy: ~80–92%
Loss significantly reduced after fine-tuning. The model successfully learned discriminative features for white blood cell classification.

8. Applications

1. Automated diagnostic systems for pathology labs
2. Remote telemedicine analysis
3. Educational tools for medical students

9. Technologies Used

1. Python
2. TensorFlow
3. Keras
4. EfficientNetB0
5. NumPy
6. OpenCV
7. Deep Learning
8. Transfer Learning

10. Future Enhancements

1. Web deployment using Flask or Streamlit
2. Real-time microscope integration
3. Multi-class abnormal cell detection
4. Mobile application support

11. Conclusion

HematoVision-AI demonstrates the effectiveness of transfer learning in medical image classification. By leveraging pretrained convolutional neural networks, the system achieves high accuracy while reducing computational cost and training time. This project showcases the potential of artificial intelligence in transforming healthcare diagnostics through automation and precision.

Author

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