HematoVision: Advanced Blood Cell Classification Using Transfer Learning

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# 1. INTRODUCTION

## 1.1 Project Overview

HematoVision is an AI-powered system to automatically classify four types of white blood cells (WBCs) using transfer learning with MobileNetV2, reducing manual workload in hematology labs and aiding faster disease diagnosis.

## 1.2 Purpose

To automate WBC subtype classification, providing faster, accurate, and consistent predictions to assist lab technicians and medical practitioners.

# 2. IDEATION PHASE

## 2.1 Problem Statement

Manual blood cell classification is time-consuming, requires expert knowledge, and is prone to human error, impacting timely diagnosis and treatment.

## 2.2 Empathy Map Canvas

Users: Lab technicians, medical students, doctors.  
Needs: Fast, accurate WBC classification.  
Challenges: Manual classification is slow, repetitive.  
Impact: Reduces workload, assists in rapid diagnosis.

## 2.3 Brainstorming

Explored manual vs automated classification, using deep learning for image-based cell classification, and deploying using Streamlit for accessibility.

# 3. REQUIREMENT ANALYSIS

## 3.1 Customer Journey Map

1. Capture or upload microscope image.  
2. System classifies the cell type.  
3. Result displayed for verification and report generation.

## 3.2 Solution Requirement

Accurate WBC classification, easy-to-use web interface, lightweight, fast inference.

## 3.3 Data Flow Diagram

[Input Image] → [Preprocessing] → [Trained CNN Model] → [Prediction] → [Display Result]

## 3.4 Technology Stack

Python, TensorFlow/Keras, OpenCV/Numpy, Streamlit, Git/GitHub.

# 4. PROJECT DESIGN

## 4.1 Problem Solution Fit

Using a pre-trained MobileNetV2 model reduces the need for large datasets while achieving high accuracy, suitable for practical lab settings.

## 4.2 Proposed Solution

A system that accepts microscope WBC images, classifies them into Neutrophil, Lymphocyte, Monocyte, Eosinophil, and displays the result with high speed and reliability.

## 4.3 Solution Architecture

Input Layer: Image (224x224)  
Base Model: MobileNetV2 (frozen layers)  
Custom Head: GAP → Dropout → Dense(4, softmax)  
Output: Predicted WBC subtype

# 5. PROJECT PLANNING & SCHEDULING

## 5.1 Project Planning

Dataset Collection - 2 days  
Model Training - 2 days  
Frontend Development - 2 days  
Testing - 1 day  
Documentation - 1 day

# 6. FUNCTIONAL AND PERFORMANCE TESTING

## 6.1 Performance Testing

Achieved ~92% validation accuracy.  
Prediction time per image: < 2 seconds on CPU.  
Tested on multiple WBC images from Kaggle dataset.

# 7. RESULTS

## 7.1 Output Screenshots

✅ Trained Model Saved: model/hemato\_model.h5  
✅ Web UI Prediction: Displays predicted WBC type with uploaded image.

# 8. ADVANTAGES & DISADVANTAGES

Advantages:  
- Fast and automated classification.  
- Easy-to-use UI.  
- Can assist in medical education and diagnostics.  
  
Disadvantages:  
- Limited to four WBC classes.  
- Accuracy may depend on image quality.

# 9. CONCLUSION

HematoVision demonstrates the effective use of transfer learning in biomedical image classification. It reduces manual workload and improves diagnosis speed in hematology labs, providing a practical and scalable solution.

# 10. FUTURE SCOPE

Extend classification to RBCs, platelets, and abnormal cells.  
Deploy on cloud for multi-user access.  
Integrate with microscope camera feeds for real-time classification.

# 11. APPENDIX

Source Code: Available in train.py, app.py inside project repository.  
Dataset Link: https://www.kaggle.com/datasets/paultimothymooney/blood-cells  
GitHub & Project Demo Link: To be added after upload.