# HematoVision: Advanced Blood Cell Classification Using Transfer Learning

## Project Report

## 1. INTRODUCTION

### 1.1 Project Overview

HematoVision is a deep learning-based application designed to classify blood cells into different types—eosinophils, lymphocytes, monocytes, and neutrophils—using transfer learning on a dataset of 12,000 annotated images.

### 1.2 Purpose

To accelerate blood cell identification for medical diagnostics by automating the classification process using convolutional neural networks (CNNs), enhancing diagnostic efficiency and accuracy.

## 2. IDEATION PHASE

### 2.1 Problem Statement

Manual blood cell classification is time-consuming and prone to human error. An AI-powered solution can significantly improve both speed and accuracy.

### 2.2 Empathy Map Canvas

Captured needs and pain points of lab technicians and doctors, emphasizing quick turnaround, reduced workload, and accurate results.

### 2.3 Brainstorming

Generated ideas around dataset preprocessing, CNN architectures, evaluation metrics, and deployment options.

## 3. REQUIREMENT ANALYSIS

### 3.1 Customer Journey Map

Mapped the experience of users from image input to final classification output with user-friendly feedback.

### 3.2 Solution Requirement

* Annotated dataset
* Pre-trained model (e.g., MobileNet, ResNet)
* Flask for app interface
* GPU/CPU environment for training

### 3.3 Data Flow

* The user interacts with the UI (User Interface) to choose the image.
* The chosen image is analyzed by the model which is integrated with the flask application.
* Once the model analyses the input the prediction is showcased on the UI

### 3.4 Technology Stack

* **Language**: Python
* **Libraries**: TensorFlow, Keras, OpenCV, Pandas
* **Platform**: VS Code, Jupyter Notebook
* **Frontend**: HTML, CSS
* **Deployment**: Localhost

## 4. PROJECT DESIGN

### 4.1 Problem Solution Fit

Demonstrated that deep learning can reliably classify blood cells, outperforming traditional manual methods.

### 4.2 Proposed Solution

Used transfer learning with fine-tuning to achieve over 90% accuracy on validation datasets.

### 4.3 Solution Architecture

* Data Preprocessing
* Model Training
* Evaluation
* Web App Deployment

## 5. PROJECT PLANNING & SCHEDULING

### 5.1 Project Planning

Divided into phases:  
- Dataset handling  
- Model selection & training  
- Evaluation  
- Deployment  
- Documentation

## 6. FUNCTIONAL AND PERFORMANCE TESTING

### 6.1 Performance Testing

Tested model on unseen validation and test sets, tracked metrics such as accuracy, precision, recall, and F1-score.

## 7. RESULTS

### 7.1 Output Screenshots

Included classification outputs with confidence scores, confusion matrix, and performance graphs.

## 8. ADVANTAGES & DISADVANTAGES

### Advantages

* Automated classification
* High accuracy
* Reduces manual workload

### Disadvantages

* Requires labeled data
* Dependent on image quality
* Needs GPU for faster training

## 9. CONCLUSION

HematoVision proves that transfer learning is highly effective for medical image classification tasks. It can significantly support medical professionals by offering fast and accurate predictions.

## 10. FUTURE SCOPE

* Expand to more blood cell types
* Integrate with hospital systems
* Deploy in cloud for remote accessibility
* Real-time image analysis using mobile devices

## 11. APPENDIX

* **Source Code**: https://github.com/jayasimha468/BloodCellClassifier
* **Dataset Link**: https://www.kaggle.com/datasets/paultimothymooney/blood-cells/data
* **Demo Link**: https://drive.google.com/file/d/1JEmIfpaNAQlklBGzzkFba-HUXKobAVnW/view?usp=drivesdk