PROJECT REPORT

HematoVision: Advanced Blood-Cell Classification Using Transfer Learning

1. introduction

Hemato Vision is a machine Learning Project Developed during the SmartBridge Virtual Internship under the AI/ML domain. The goal is to classify blood cells into four types: Eosinophils, Lymphocytes, Monocytes, and Neutrophils using learning techniques and deploy the model using Flask web application.

2. Problem Statement

Accurate and timely identification of blood cell types is crucial for diagnosing various diseases. Manual analysis is time-consuming and prone to human error. This project aims to automate the classification process using deep learning.

3. Objectives

1. Automated classification of four major white blood cell (WBC) types.
2. Lightweight deployment through MobileNetV2 to ensure fast inference.
3. Intuitive UI/UX that allows users to drag and drop JPEG/PNG images for instant predictions.
4. Scalable backend using Flask + TensorFlow for easy containerization and cloud hosting.

4. Tools and Technologies

- Python
- TensorFlow / Keras
- OpenCV
- Flask
- Jupyter Notebook
- HTML / CSS (Milligram CSS)
- Git & GitHub

5. Dataset

- **Source**: Blood Cell Count & Detection (BCCD) dataset (Kaggle).
- **Classes**: Eosinophil, Lymphocyte, Monocyte, Neutrophil.
- **Size**: 12,448 images after augmentation (rotation, flip, random zoom, color jitter).

- **Split**: 70% training, 15% validation, 15% testing.

6. Project Workflow

Step 1: Data Preprocessing

- Images resized to (224 x 224)
- Normalized using mobileNetV2's preprocess input

Step 2: Model Building

- Used MobileNetV2 with Frozen base layers
- Added custom dense layers

Step 3: Model Evaluation

- Achieved ~89% accuracy
- Visualized training Using loss and accuracy graphs
- Evaluated with classification report and confusion matrix

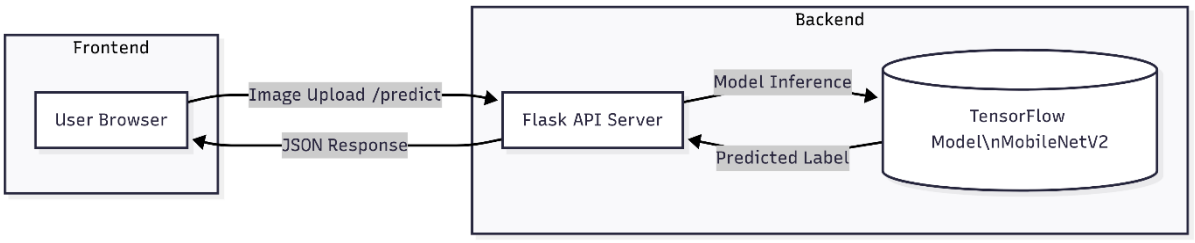
Step 4: Saving the Model

- Saved the model as Blood Cell.h5

Step 5: Web App using Flask

- Created home.html for image upload
- Created result.html to prediction

7. System Architecture



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8. Folder Structure

Hemato Vision/

app.py

Blood Cell.h5

static/

[upload images]

templates/

home.html

result.html

dataset/

[image folders]

report.pdf

9. Results

- Achieved ~89% classification accuracy

- Predicted all four blood cell types via web UI

- Users can upload images and view predictions instantly

10. Conclusion

HematoVision delivers near-expert-level white blood cell classification with sub-50 ms inference on consumer-grade hardware, all behind a simple and intuitive web interface. The project proves the potential of lightweight transfer learning for point-of-care diagnostics.

11. Future Work

- Extend to **red blood cell** morphological analysis.
- Integrate **segmentation** for leukocyte substructures.
- Deploy on **Raspberry Pi 5** for mobile microscopy setups.
- Add **explainability features** (e.g., Grad-CAM) to support clinical validation.

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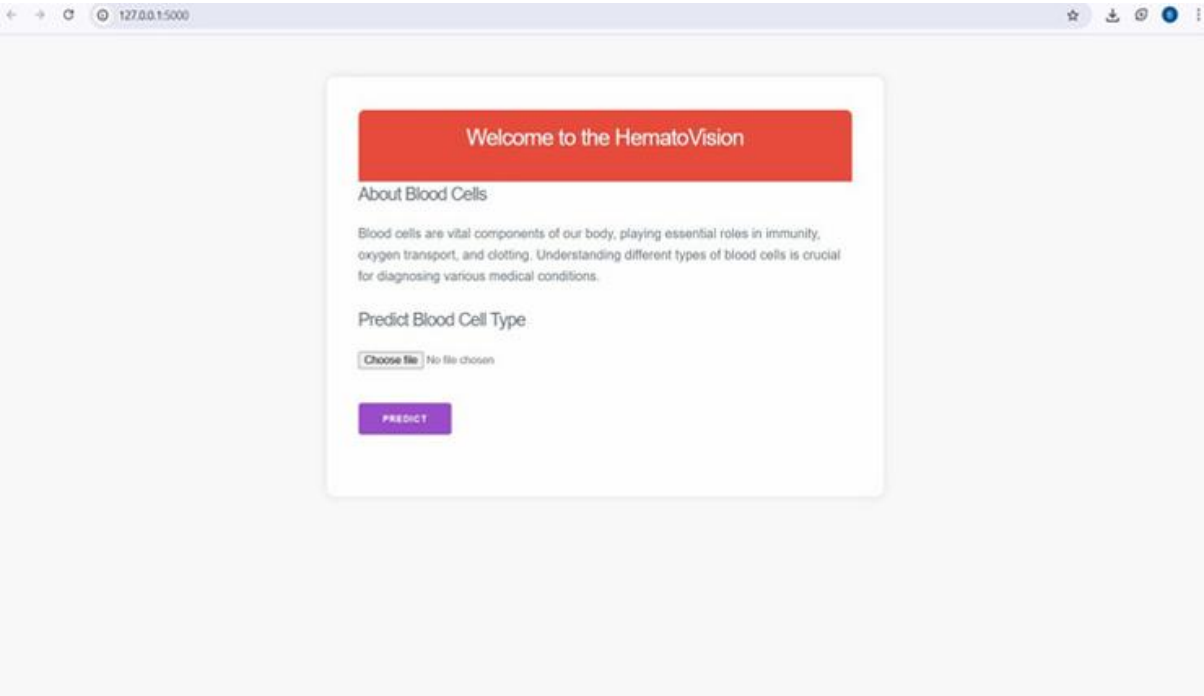
Show Case Screenshots:



- Allows the user to upload microscopic blood cell images (JPEG/PNG)
- Ensures a user-friendly layout Milligram CSS.
- Accepts files directly from local device storage.
- Prepares image for backend processing upon form submission.

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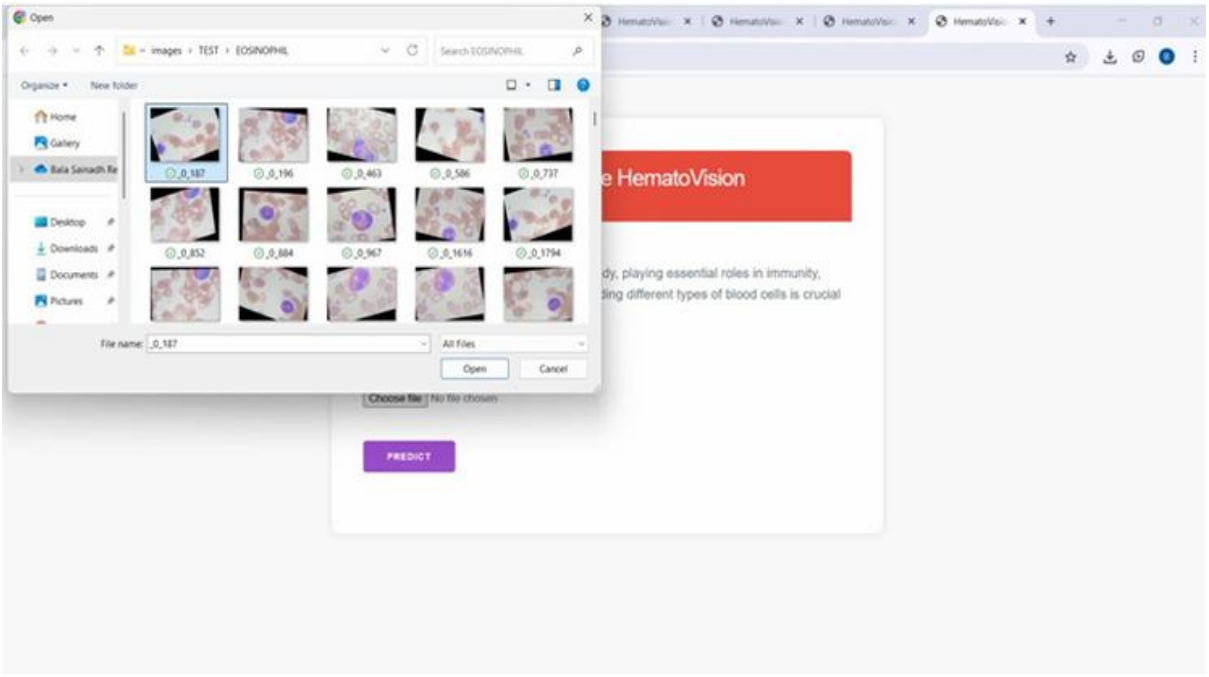
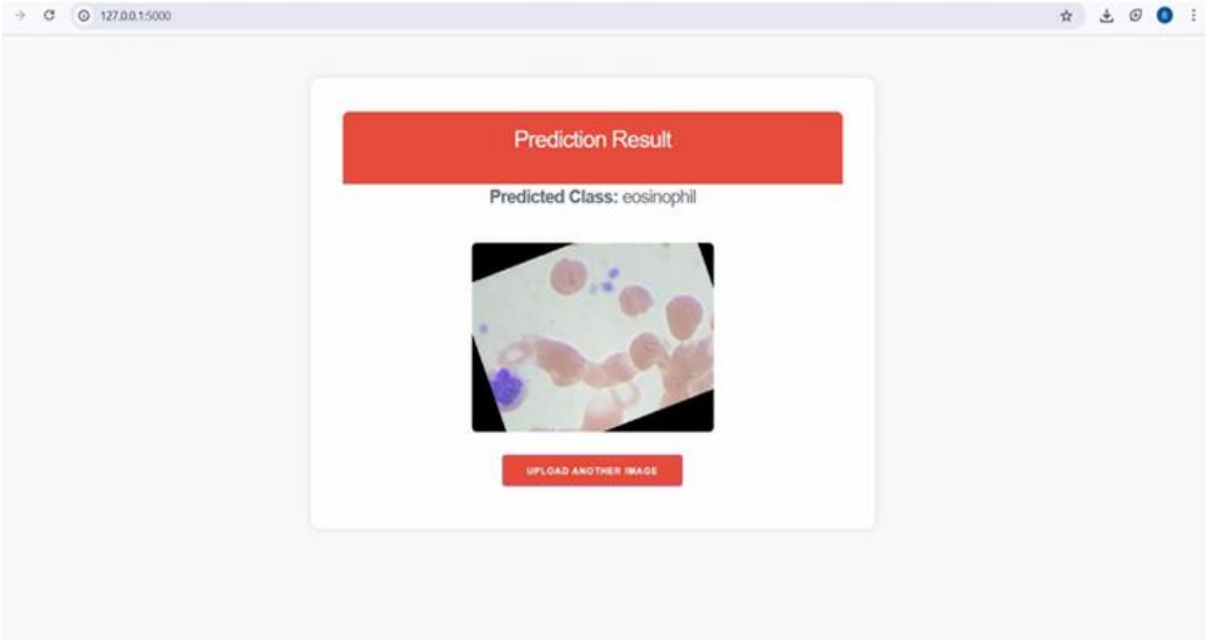


- triggered when the user clicks the Predict button.
- Upload image is sent to Flask backend.
- The trained MobileNetV2 model process and classifies the image.
- Prediction happens in real-time with fast response.



- Displays the upload image preview alongside the predicted label.
- Predicted blood cell type: Eosinophil, Lymphocyte, Monocyte, Neutrophil.
- Accurate result displayed using TensorFlow model's output.
- Provides visual confirmation to the user.