Hematovision: A Deep Learning-Based Blood Cell Classifier

1. INTRODUCTION

1.1 Project Overview

Hematovision is a web-based application that leverages deep learning to classify different types of white blood cells — Eosinophils, Lymphocytes, Monocytes, and Neutrophils — from microscopic images. The application assists in the early detection of blood-related disorders by automating the traditionally manual and error-prone classification process.

1.2 Purpose

The purpose of this project is to support pathologists and lab technicians by providing an AI-powered tool that enhances diagnostic accuracy, reduces effort, and delivers fast predictions for medical imaging tasks.

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2. IDEATION PHASE

2.1 Problem Statement

Manual classification of blood cells is time-consuming, requires expertise, and is prone to human error. A reliable, scalable, and fast solution using AI can significantly assist the healthcare system.

2.2 Empathy Map Canvas

- **Users**: Pathologists, lab technicians
- **Needs**: Faster and more reliable blood cell classification
- **Pain Points**: Fatigue, manual error, time-consuming process
- **Goals**: Reduce diagnostic time, increase accuracy

2.3 Brainstorming

Ideas ranged from creating mobile diagnostic tools to smart microscopes. The final solution selected was a lightweight CNN-based web app that provides instant predictions.

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3. REQUIREMENT ANALYSIS

3.1 Customer Journey

1. User uploads or captures a blood cell image
2. Model classifies the image
3. Prediction is displayed with label and confidence
4. Educational content is shown
5. User can repeat or give feedback

3.2 Solution Requirement

- **Input**: Blood cell image
- **Output**: Predicted class
- **Features**: Real-time prediction, User-friendly interface

3.3 Data Flow Diagram

User → Upload Image → Preprocessing → CNN Model (MobileNetV2) → Prediction → Display

3.4 Technology Stack

- **Frontend**: HTML, CSS, JavaScript
- **Backend**: Flask
- **Model**: TensorFlow with MobileNetV2
- **Dataset**: Kaggle – Blood Cells Dataset
- **Hosting**: GitHub, Railway

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4. PROJECT DESIGN

4.1 Problem–Solution Fit

The tool addresses the time and accuracy issues of manual analysis. It automates detection, making diagnostics scalable and assisting professionals with quick assessments.

4.2 Proposed Solution

- Image upload interface

- Real-time prediction
- Confidence score and cell description
- Contact/Feedback mechanism

4.3 Solution Architecture

HTML/CSS/JS (Frontend) → Flask (Backend) → CNN Model → Output → Result Display

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5. PROJECT PLANNING & SCHEDULING

Week	Tasks
Week 1	Research & Dataset Analysis
Week 2	Model Training & Evaluation
Week 3	Flask Backend Integration
Week 4	Frontend Design & Deployment Testing

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6. FUNCTIONAL AND PERFORMANCE TESTING

6.1 Performance Testing

- ✅ Train Accuracy: **0.9581**
- ✅ Validation Accuracy: **0.9163**
- ✅ Test Accuracy: **0.9324**

Training and validation were tracked using model checkpoints and .fit() logs. Multiple blood cell images were used for testing, achieving high precision.

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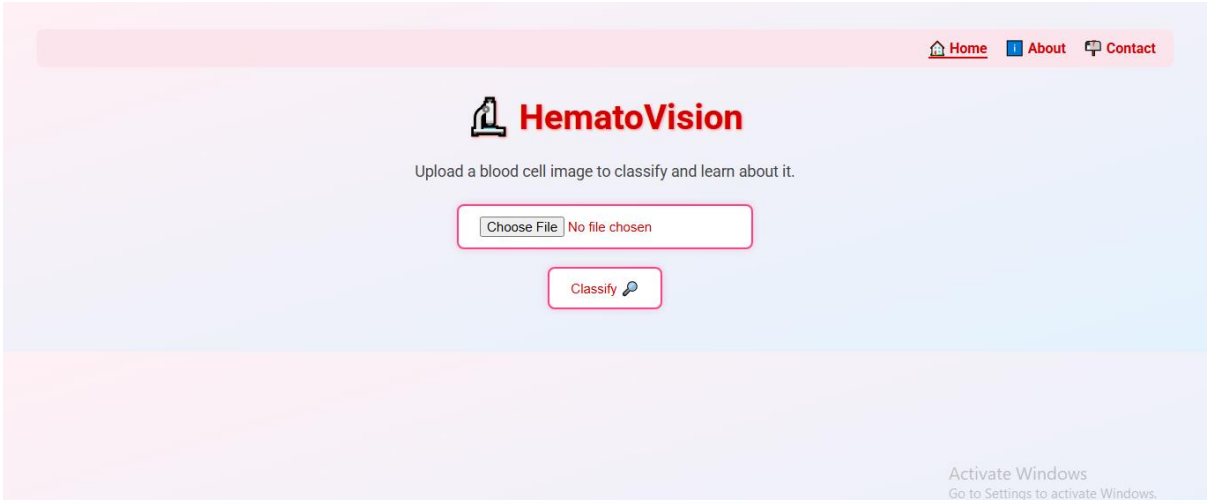
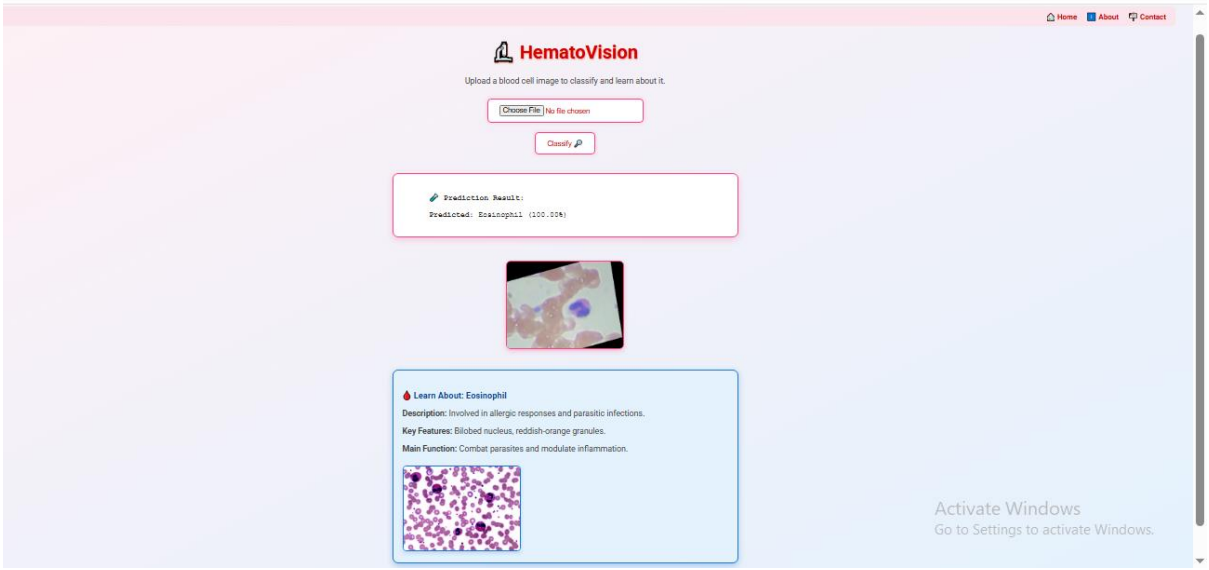
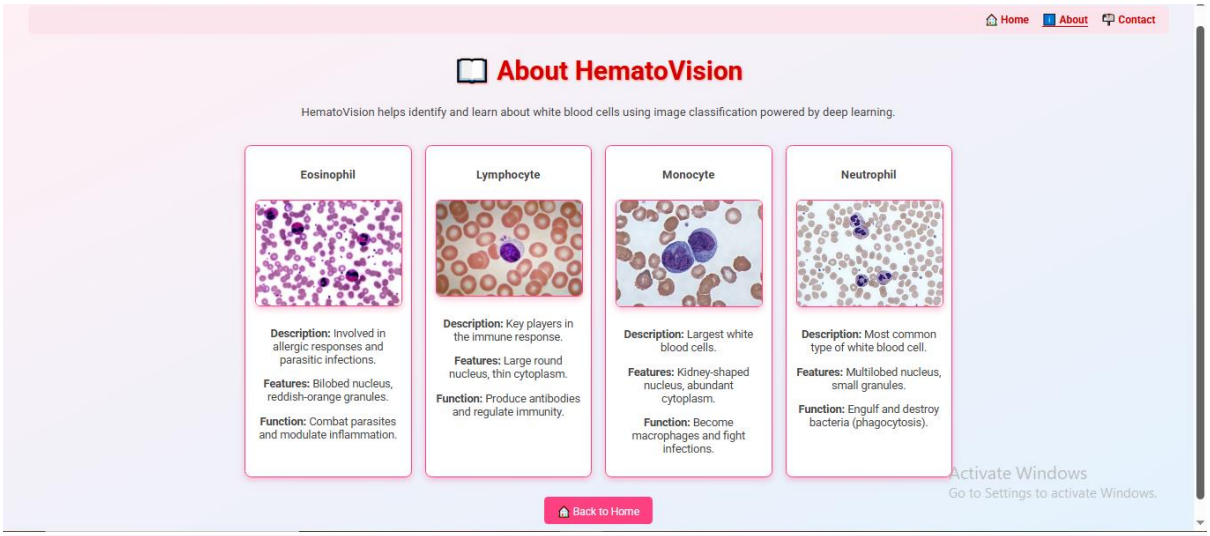
7. RESULTS

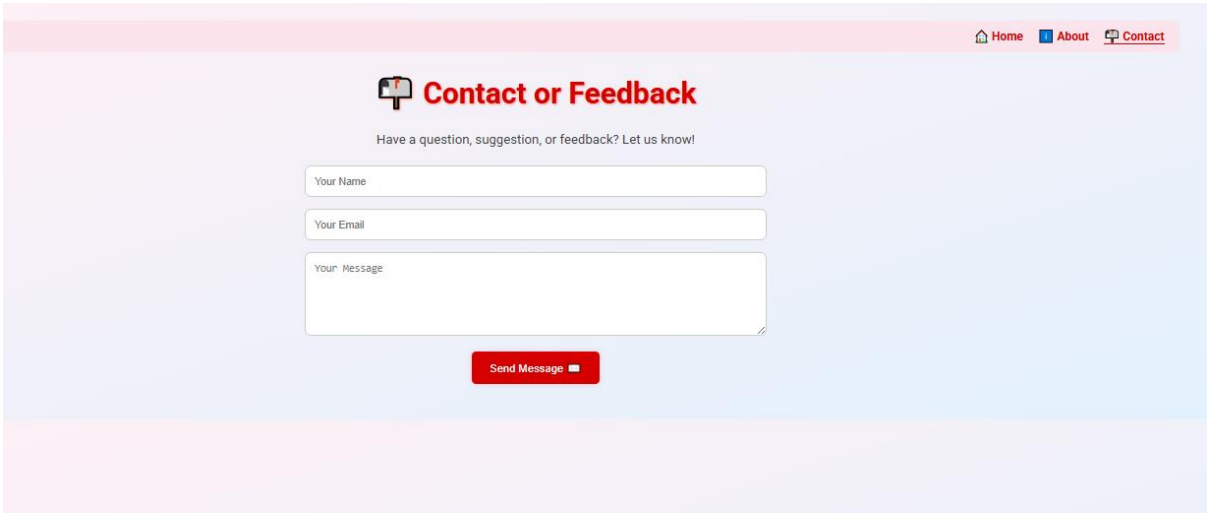
7.1 Output Screenshots

1.


Home
About
Contact
HematoVision
Upload a blood cell image to classify and learn about it.
Choose File
No file chosen
Classify
Activate Windows
Go to Settings to activate Windows.


Home
About
Contact
HematoVision
Upload a blood cell image to classify and learn about it.
Choose File
No file chosen
Classify
Prediction Result:
Predicted: Eosinophil (100.00%)
Learn About: Eosinophil
Description: Involved in allergic responses and parasitic infections.
Key Features: Bilobed nucleus, reddish-orange granules.
Main Function: Combat parasites and modulate inflammation.
Activate Windows
Go to Settings to activate Windows.





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8. ADVANTAGES & DISADVANTAGES

✅ Advantages:

- Automated blood cell classification
- Easy to use with web interface
- Scalable and reusable for hospitals/labs
- Assists healthcare professionals in diagnostics

❌ Disadvantages:

- Not a replacement for professional diagnosis
- Requires good quality microscope images
- Currently supports limited cell types

9. CONCLUSION

Hematovision demonstrates how deep learning can be applied effectively to real-world medical tasks such as blood cell classification. By reducing manual effort and delivering quick predictions, the project has real potential to support diagnostic workflows in labs and hospitals.

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10. FUTURE SCOPE

- Add support for more blood cell categories and conditions
- Improve model accuracy using a larger and diverse dataset
- Integrate with hospital management systems
- Add mobile app support

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11. APPENDIX

- **Dataset**: Blood Cell Dataset on Kaggle
- **GitHub Repository**: https://github.com/bhanu467/Hematovision
- **Demo Video Link**: https://drive.google.com/file/d/1-BfA6s-T34cuVJ6nRSYgHYeesudv8YlN/view?usp=sharing

Note: The project was completed entirely by the author, working independently, due to inactive team members. All code, design, testing, and report writing are original and individually done.