24-25J-308

Deep learning retinal image analysis for human disease prediction

SLIIT
FACULTY OF COMPUTING

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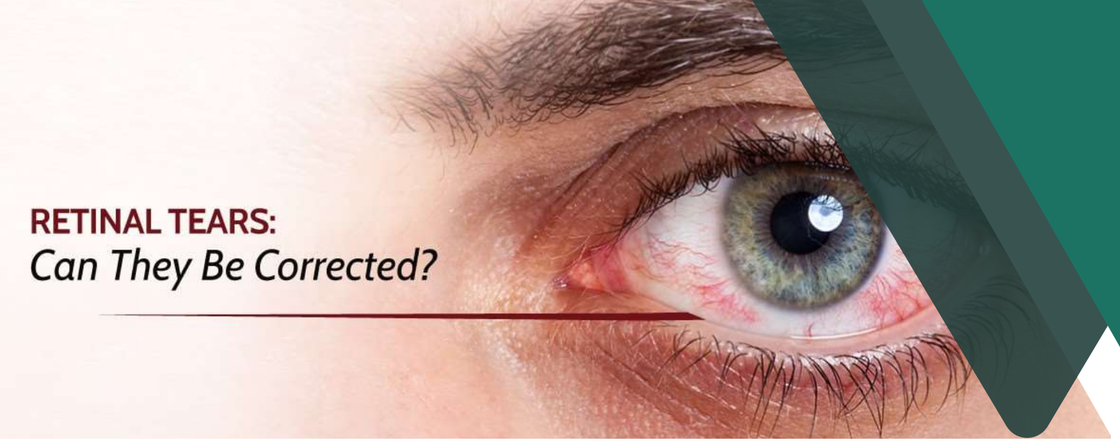
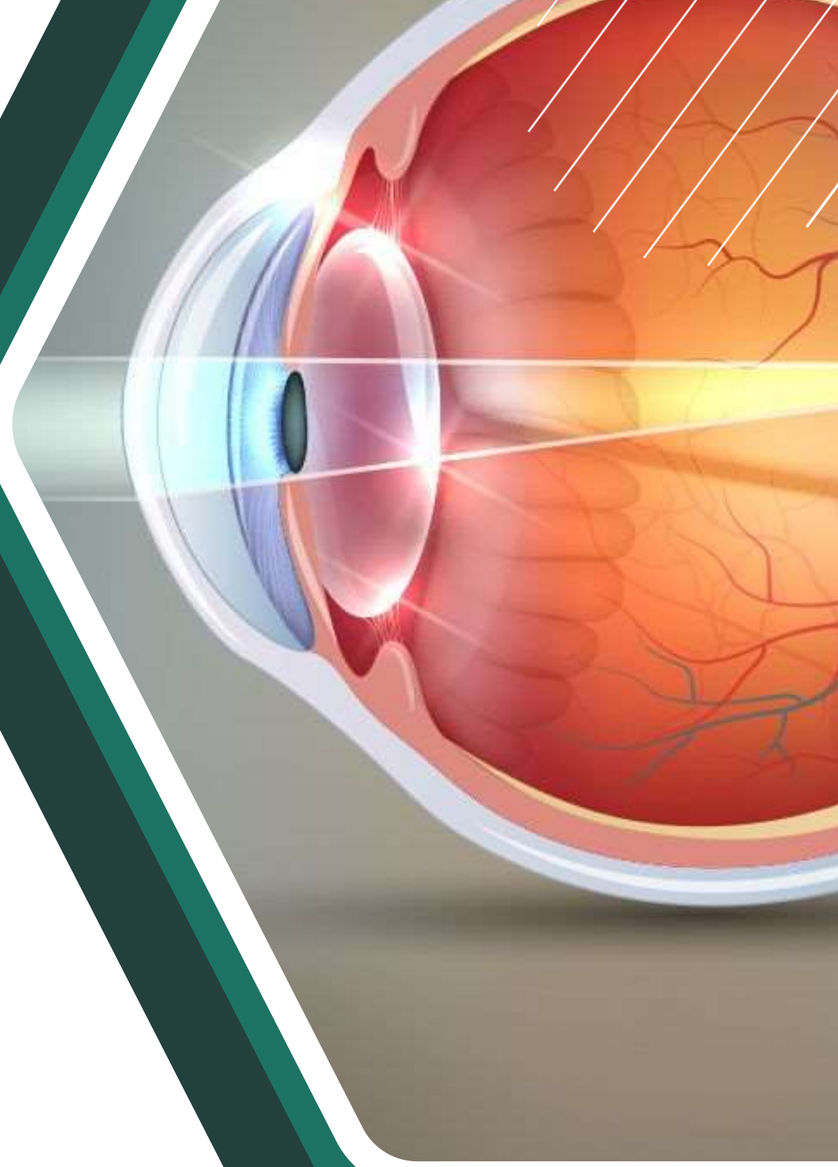


CONTENT

INTRODUCTION

The eye is vital for vision, enabling us to perceive the world, learn, and navigate daily life. It enhances communication, safety, and overall well-being. However, retinal diseases can impair vision, making early detection crucial for preserving eye health.



RESEARCH QUESTIONS

Problem

How to develop a web application as the solution to?

Mission Statement

- Identifying the diseases
- Suggesting Treatment plan

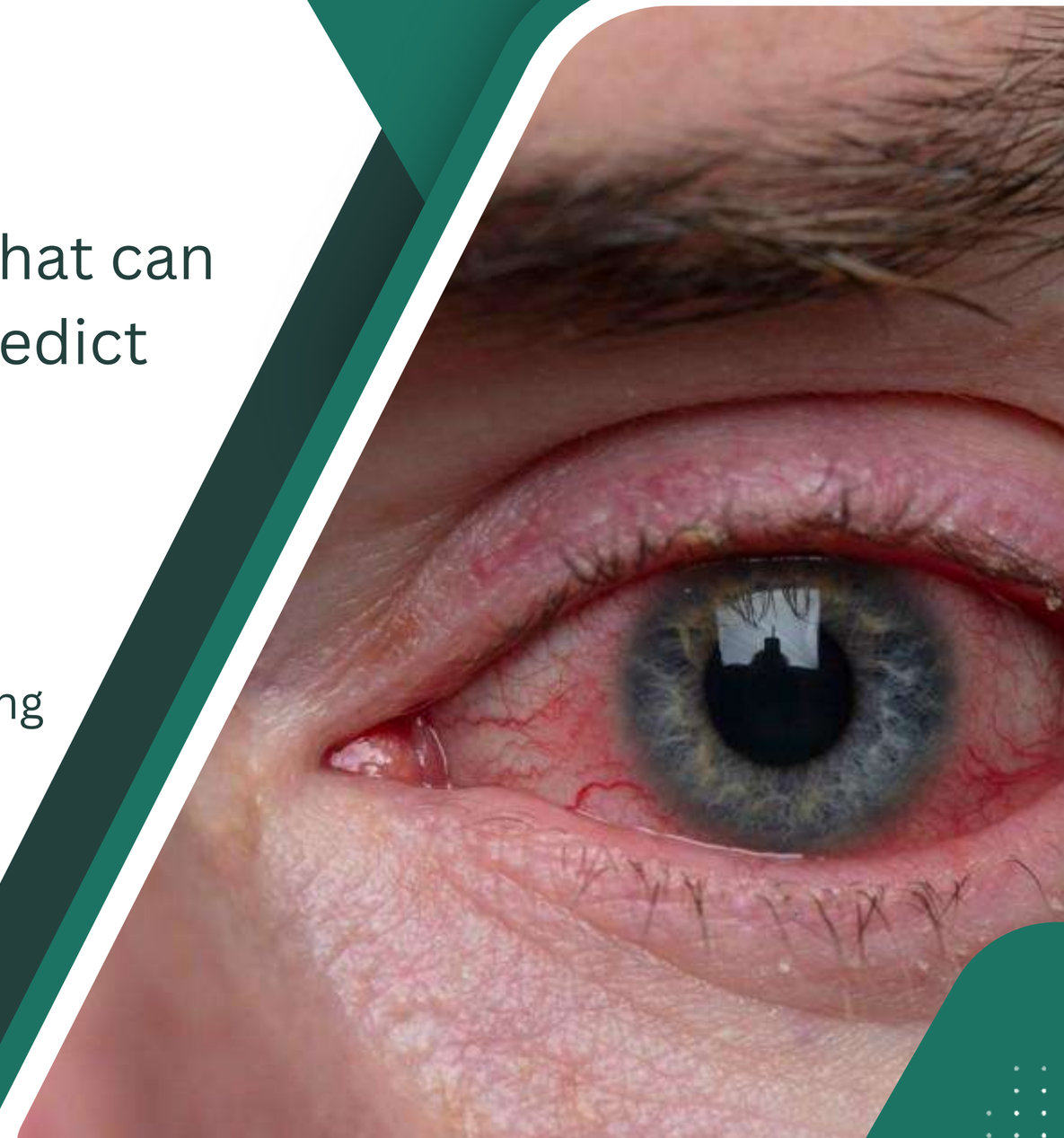
OBJECTIVES

Main Objective

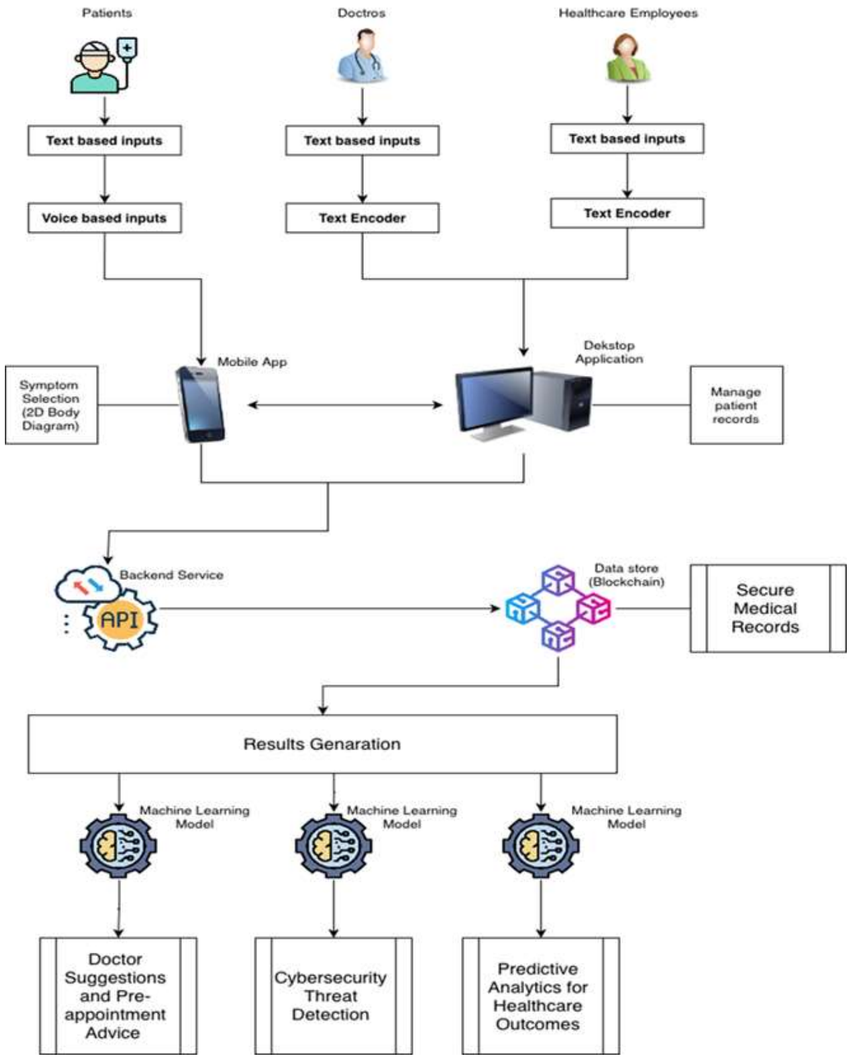
Develop a deep learning-based system that can accurately analyze retinal images and predict the presence of various human diseases

Specific Objectives

- Retinal Disease Image Classification with Deep Learning
- Retinal Disease Prediction With Health Records
- Treatment Recommendation Based on Outcome
- Comprehensive Disease Progression Analysis



SYSTEM OVERVIEW DIAGRAM



Component 01

THUVARAHAN T

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BSc (Hons) Degree in Information Technology
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Retinal Disease Image Classification with Deep Learning

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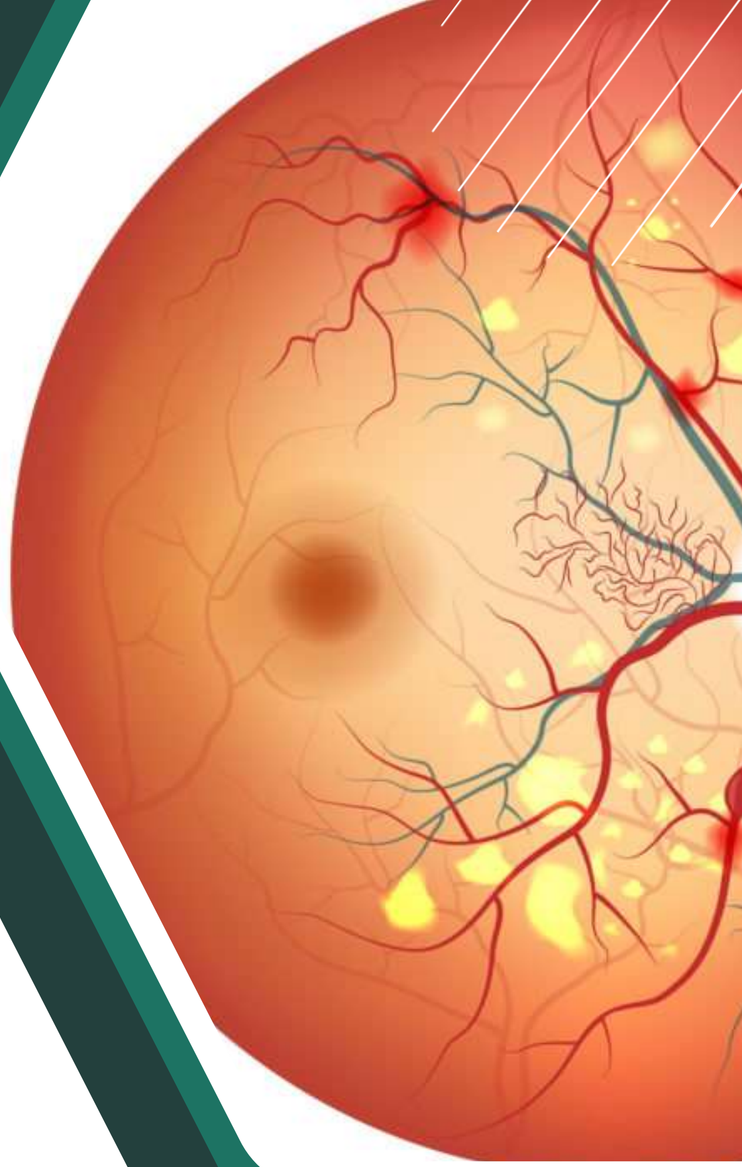
INTRODUCTION

- Retina and Retinal diseases.
- Convolutional Neural Networks(CNN).
- Preprocessing and Augmentation.
- Training and Optimization.
  Evaluation Metrics.
- Applications in Medical Imaging.



RESEARCH GAP

Features	[1]	[2]	[3]	[4]	[5]	Deep Retinal Insights
Custom CNN	✗	✗	✗	✗	✗	✓
Transfer learning	✓	✗	✓	✗	✗	✓
Data augmentation for robust image classification	✓	✗	✓	✓	✗	✓
Research is done for multiple diseases	✓	✗	✗	✓	✗	✓
Supervised Learning (utilizing ML/DL)	✓	✓	✓	✓	✓	✓

RESERCH QUESTION

How can fine-tuning the VGG16 model improve the accuracy of retinal image classification for disease prediction?

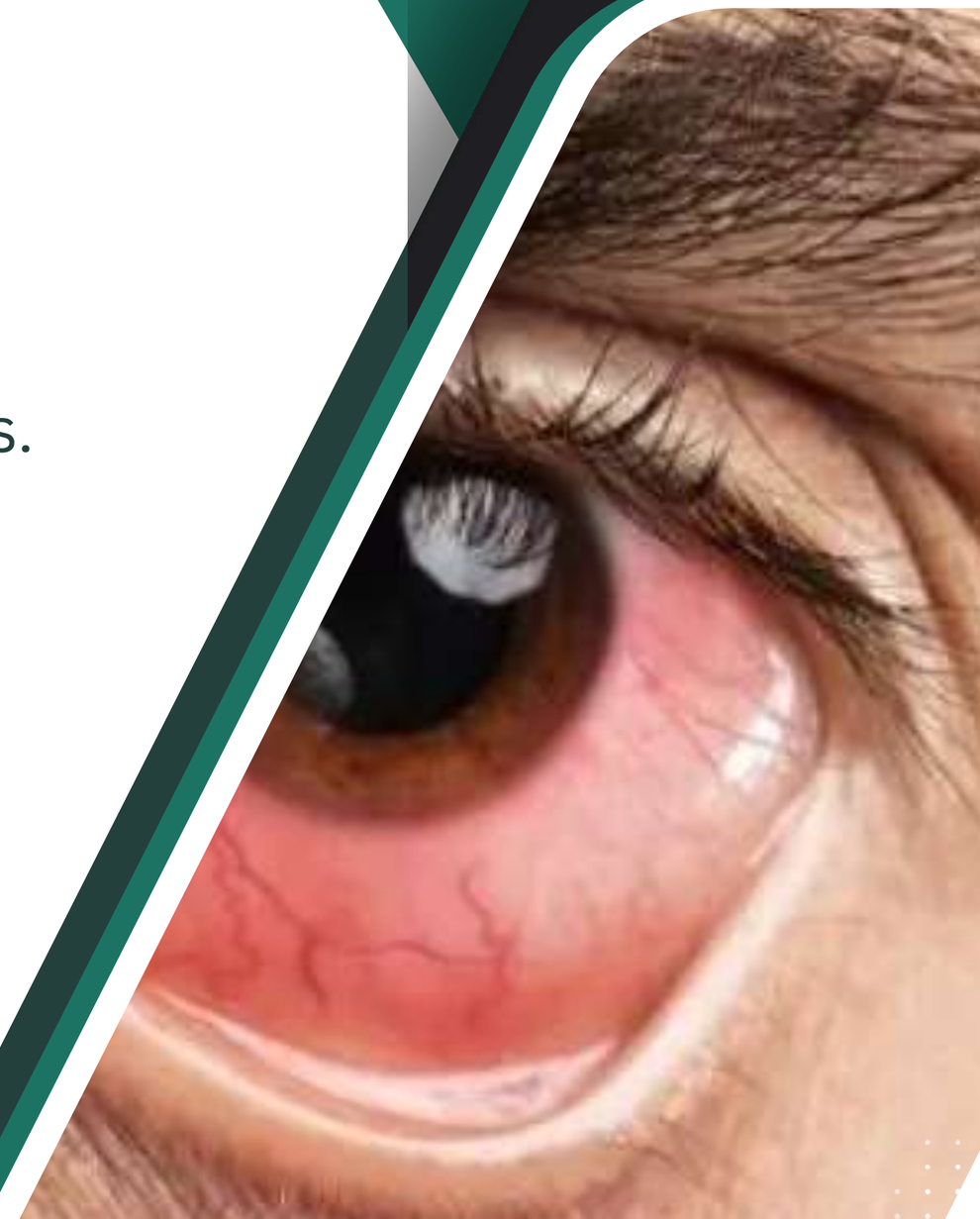
OBJECTIVES

Specific Objective

Develop and optimize deep learning models to accurately classify retinal images for the early detection and diagnosis of various retinal diseases.

Sub Objectives

- Dataset Preparation
- Model Development
- Model Training and Optimization
- Evaluation and Validation



METHODOLOGY

- Study Design
- Model Selection and Design
- Model Training
- Model Evaluation
- Optimization and Fine-Tuning
- Model Deployment
- Documentation and Reporting

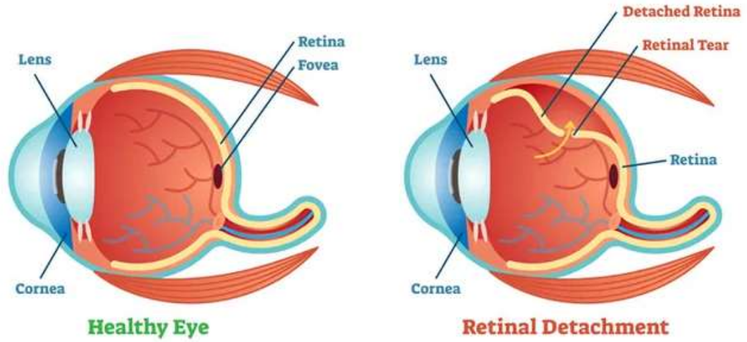
KEY PILLARS

Image Processing

Convolutional Neural Network (CNN)

Deep Learning

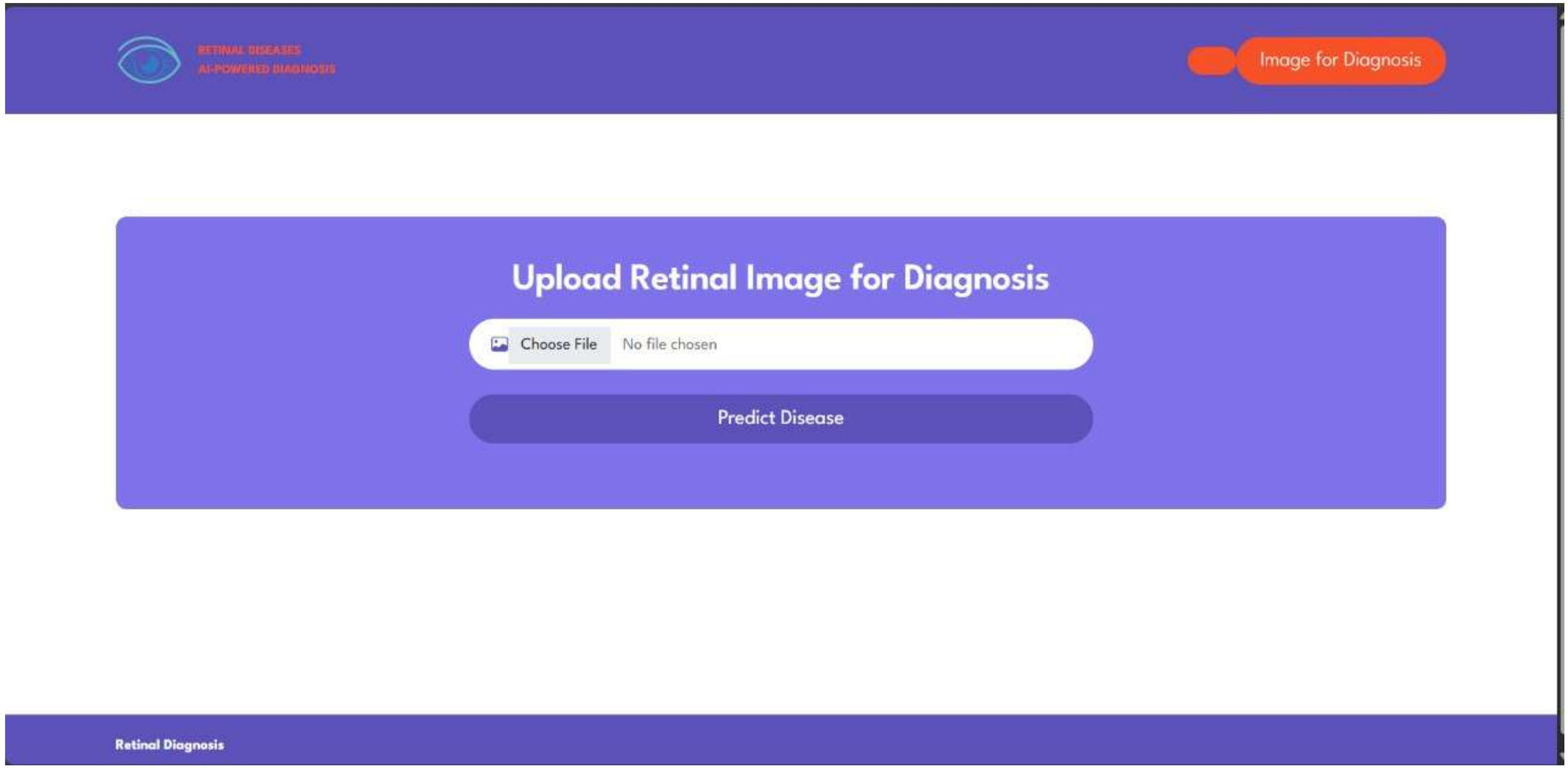
Machine Learning



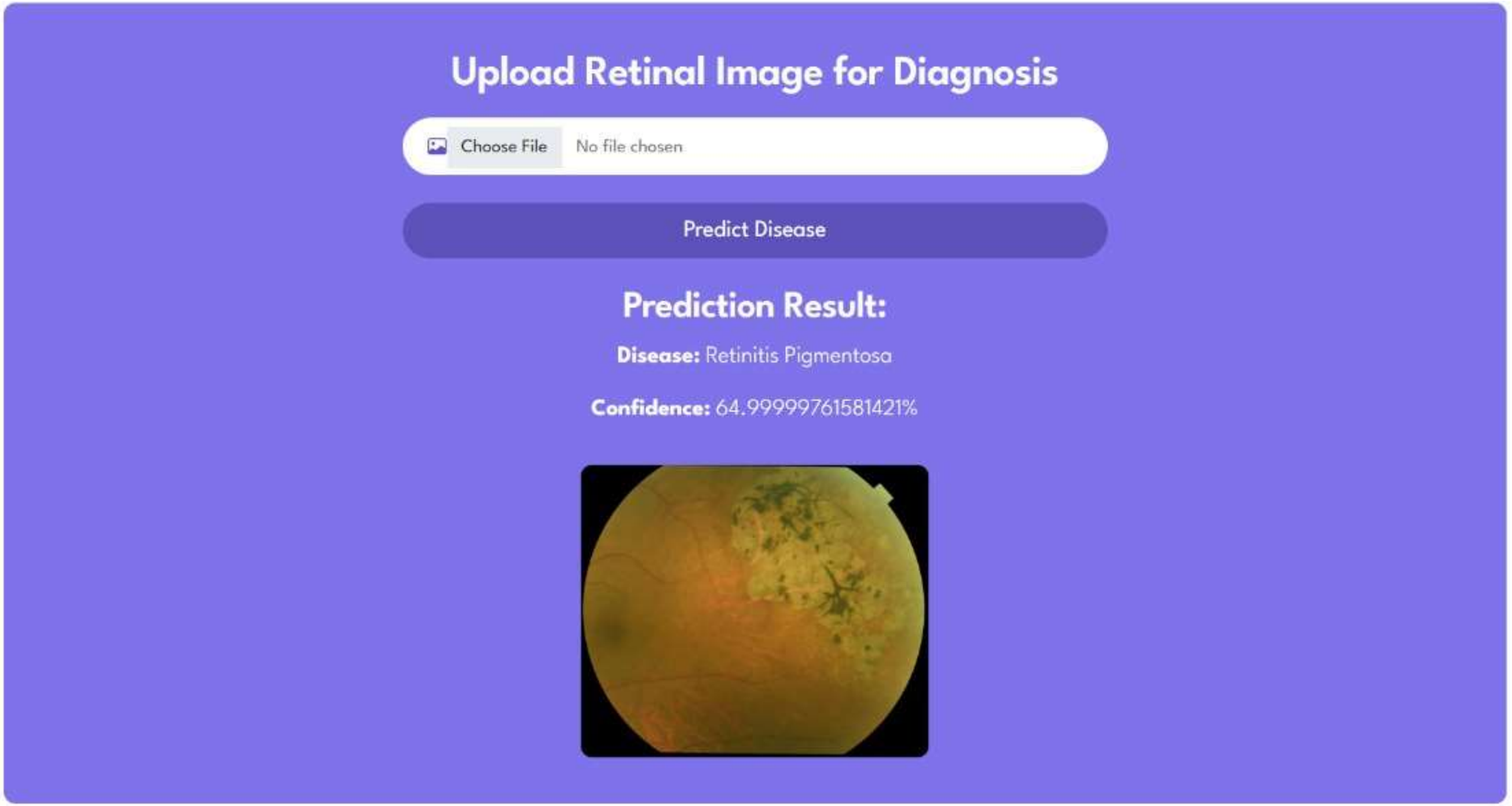
TECHNOLOGY

- Programming Language – Python
- Framework - Flask
- library – CNN / resnet50, TensorFlow, NumPy
- Dataset - Kaggle

UI


RETINAL DISEASES
AI-POWERED DIAGNOSIS
Image for Diagnosis
Upload Retinal Image for Diagnosis
Choose File
No file chosen
Predict Disease
Retinal Diagnosis

RESULT


Upload Retinal Image for Diagnosis
Choose File
No file chosen
Predict Disease
Prediction Result:
Disease: Retinitis Pigmentosa
Confidence: 64.99999761581421%

MODEL DEPLOYMENT

```python
import os
import tensorflow as tf
import numpy as np
from flask import Flask, request, render_template
from tensorflow.keras.preprocessing import image
from werkzeug.utils import secure_filename

app = Flask(__name__)

# Load  model
MODEL_PATH = "retinal_disease_model_vgg16.h5"
model = tf.keras.models.load_model(MODEL_PATH)
print("Model loaded successfully.")

#  labels
dataset_path = "Dataset"
class_labels = sorted(os.listdir(dataset_path))
class_indices = {i: label for i, label in enumerate(class_labels)}
print(f"Detected Labels: {class_indices}")

UPLOAD_FOLDER = "static/uploads"
os.makedirs(UPLOAD_FOLDER, exist_ok=True)
app.config["UPLOAD_FOLDER"] = UPLOAD_FOLDER
```

MODEL DEPLOYMENT

```python
# predict disease
def predict_image(img_path, model, class_indices):  1 usage
    img_size = (224, 224)
    img = image.load_img(img_path, target_size=img_size)
    img_array = image.img_to_array(img) / 255.0
    img_array = np.expand_dims(img_array, axis=0)
    prediction = model.predict(img_array)
    class_index = np.argmax(prediction)
    confidence = np.max(prediction)
    class_label = class_indices[class_index]
    return class_label, confidence

@app.route( rule: '/', methods=['GET', 'POST'])
def index():
    if request.method == 'POST':
        if 'file' not in request.files:
            return render_template( template_name_or_list: 'index.html', error='No file uploaded')
        file = request.files['file']
        if file.filename == '':
            return render_template( template_name_or_list: 'index.html', error='No selected file')

        filename = secure_filename(file.filename)
        file_path = os.path.join(app.config['UPLOAD_FOLDER'], filename)
        file.save(file_path)

        label, confidence = predict_image(file_path, model, class_indices)
        return render_template( template_name_or_list: 'index.html', label=label, confidence=confidence, image_path=file_path)

    return render_template('index.html')

if __name__ == '__main__':
    app.run(debug=True)
```

WHAT TO BE DONE

- Integration
- Finish UI/UX
- Improve the System
- Database connection

REFERENCES

[1] Muchuchuti, Stewart, and Serestina Viriri. 2023. "Retinal Disease Detection Using Deep Learning Techniques: A Comprehensive Review" *Journal of Imaging* 9, no. 4: 84.
https://doi.org/10.3390/jimaging9040084 .

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https://doi.org/10.3390/diagnostics14010105 .

[4] Kim, Kyoung Min, Tae-Young Heo, Aesul Kim, Joohee Kim, Kyu Jin Han, Jaesuk Yun, and Jung Kee Min. 2021. "Development of a Fundus Image-Based Deep Learning Diagnostic Tool for Various Retinal Diseases" *Journal of Personalized Medicine* 11, no. 5: 321.
https://doi.org/10.3390/jpm11050321 .

[5] Wenyi Hu, Fabian S. L. Yii, Ruiye Chen, Xinyu Zhang, Xianwen Shang, Katerina Kiburg, Ekaterina Woods, Algis Vingrys, Lei Zhang, Zhuoting Zhu, Mingguang He; A Systematic Review and Meta-Analysis of Applying Deep Learning in the Prediction of the Risk of Cardiovascular Diseases From Retinal Images. *Trans. Vis. Sci. Tech.* 2023;12(7):14.
https://doi.org/10.1167/tvst.12.7.14 .

Component 02

RIMNAS R

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BSc (Hons) Degree in Information Technology
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Retinal Disease Prediction With Health Records

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INTRODUCTION

- Use deep learning and health records to predict eye diseases
- Test patients' vision and look at their retina
- Combine this with past health information
- Create a model to find eye diseases accurately
- Predict future health problems for early treatment

RESEARCH GAP

Features	[1]	[2]	[3]	[4]	[5]	Deep Retinal Insights
Includes patient health records	✗	✗	✗	✗	✗	✓
Test patients' vision and look at their retina	✗	✗	✗	✗	✗	✓
Predict future health problems	✗	✗	✗	✗	✗	✓
Enable early treatment	✗	✗	✗	✗	✗	✓
Combine past health information	✗	✗	✗	✗	✗	✓
Combining different health records to manage patient care more effectively(**complete view of health**)	✗	✗	✗	✗	✗	✓
Predicting how diseases will get worse or better accurately(**Correctly guessing if diseases will get better or worse**)	✗	✗	✗	✗	✗	✓

RESERCH QUESTION

how can demographic and health-related factors be used to accurately predict the presence and type of retinal diseases using machine learning models?

OBJECTIVES

Specific Objective

Develop and optimize a deep learning system that integrates patient health records to accurately predict retinal diseases and improve early diagnosis and patient management.

Sub Objectives

- Data Collection and Preparation
- Model Development
- Model Training and Optimization
- Evaluation and Validation

METHODOLOGY

- Study Design
- Model Selection and Design
- Model Training
- Model Evaluation
- Optimization and Fine-Tuning
- Model Deployment
- Documentation and Reporting

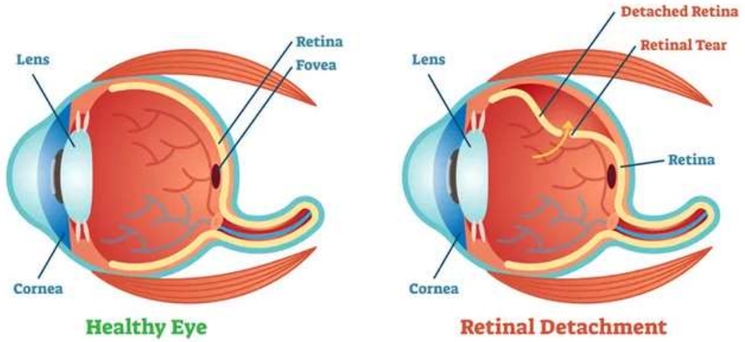
KEY PILLARS

Data Integration

Health Record Analysis

Deep Learning Models

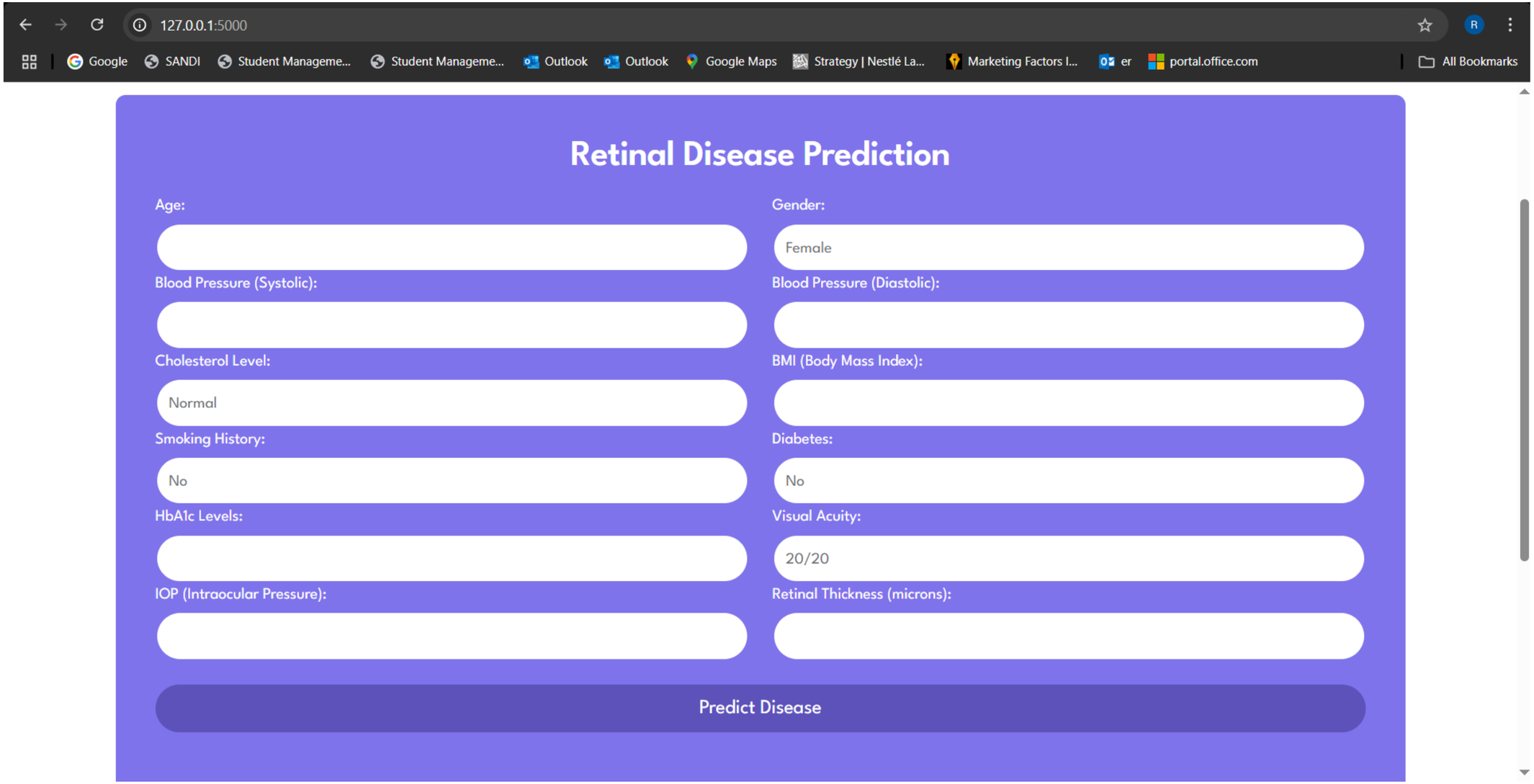
Machine Learning



TECHNOLOGY

- Programming Language – Python
- Framework - Flask
- library – Sklearn, pandas, joblib

UI


127.0.0.1:5000
Google
SANDI
Student Manageme...
Student Manageme...
Outlook
Outlook
Google Maps
Strategy | Nestlé La...
Marketing Factors I...
er
portal.office.com
All Bookmarks
Retinal Disease Prediction
Age:
Gender:
Female
Blood Pressure (Systolic):
Blood Pressure (Diastolic):
Cholesterol Level:
Normal
BMI (Body Mass Index):
Smoking History:
No
Diabetes:
No
HbA1c Levels:
Visual Acuity:
20/20
IOP (Intraocular Pressure):
Retinal Thickness (microns):
Predict Disease

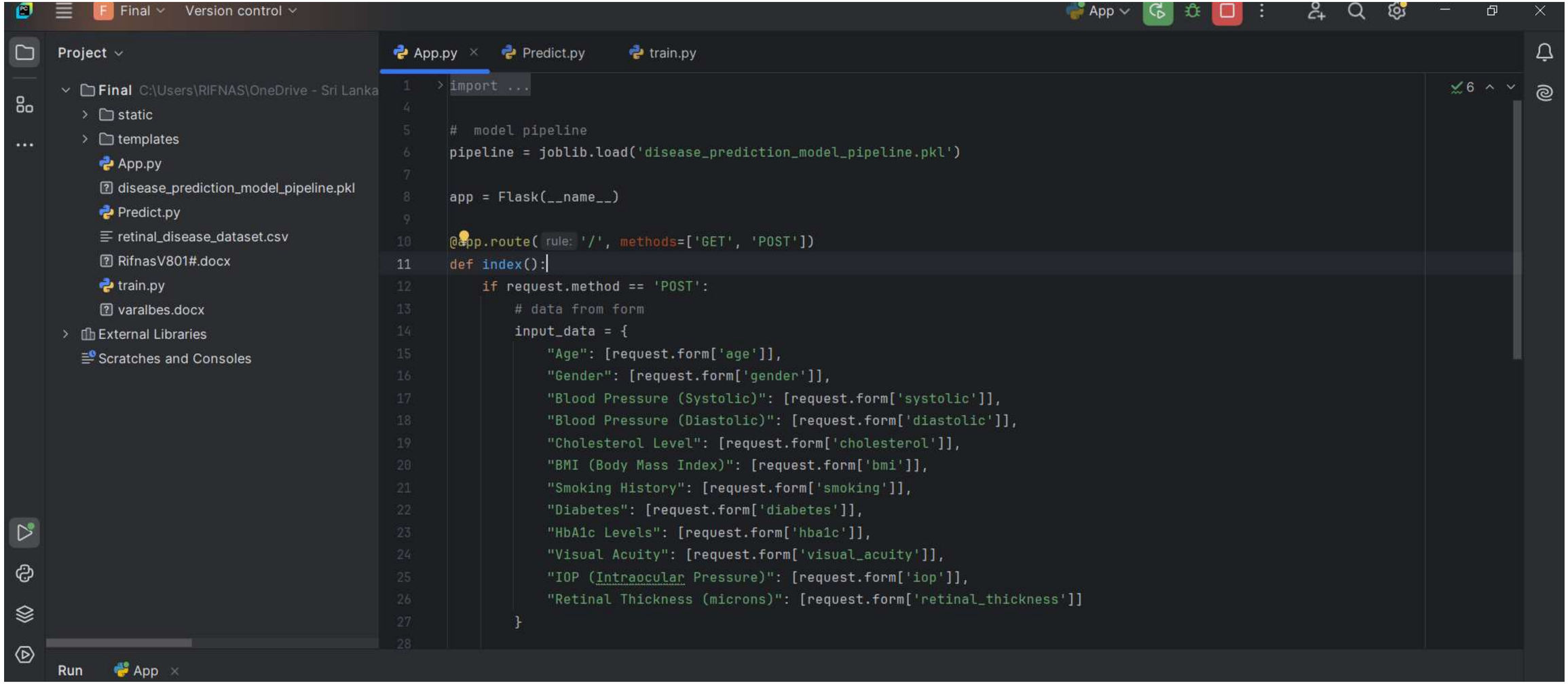
RESULT

Predict Disease

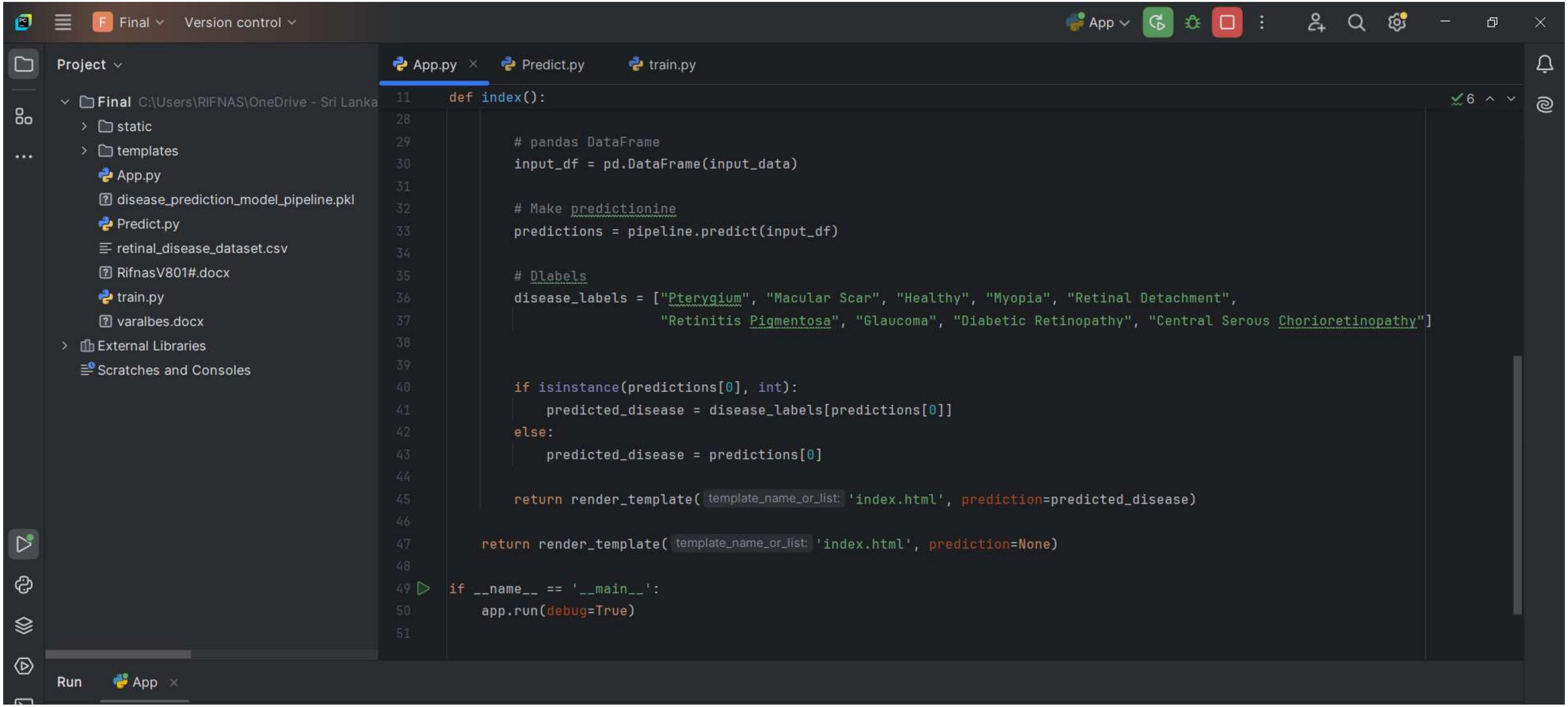
Prediction Result:

Disease: Pterygium

MODEL DEPLOYMENT



MODEL DEPLOYMENT



WHAT TO BE DONE

- Integratio
- n
- Finish
- UI/UX
- Improve the System
- Database connection

REFERENCES

[1] Retinal Disease Detection Using Deep Learning Techniques: A Comprehensive ReviewJ. Imaging, 2023.
https://doi.org/10.3390/jimaging9040084

[2] Application of Deep Learning for Retinal Image Analysis: A ReviewApplied Sciences, 2020.
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[3] A Deep Learning Framework for the Early Detection of Multi-Retinal DiseasesPLOS ONE, 2024.
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[4] Diabetic Retinopathy Detection through Deep Learning Techniques: A Review
Trans. Vis. Sci. Tech., 2023.
https://doi.org/10.1167/tvst.12.7.14

[5] HealthIT.gov. "Introduction to Electronic Health Records." Retrieved from https://www.healthit.gov/faq/what-electronic-health-record-ehr

Component 03

NUSAIF SM

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BSc (Hons) Degree in Information Technology
(specialization in Information Technology)

Treatment Recommendation Based on Outcome Analysis

SLIIT
FACULTY OF COMPUTING

INTRODUCTION

- Treatment Recommendation Based on Utilizing records outcome analysis,
- Treatment Recommendation Based on Outcome
    - collect the patient outcome data
    - Analyze response to treatments
    - Develop personalized treatment plans.
    - Implement outcome analysis techniques
- Detection and better treatment outcomes.

RESEARCH GAP

Features	[1]	[2]	[3]	[4]	[5]	Deep Retinal Insights
Personalize Treatment Plan	✓	✗	✗	✓	✗	✓
Real-Time Monitoring the Patient records	✗	✗	✗	✗	✗	✓
Analyzing the Patient retinal records And patient response	✓	✗	✓	✓	✗	✓
Suggest the best Treatment and medicine	✗	✗	✗	✗	✗	✓

RESERCH QUESTION

How accurately can random classifier predict treatment recommendation for eye disease based on patient symptoms and treatment efficacy data ?

OBJECTIVES

Specific Objective

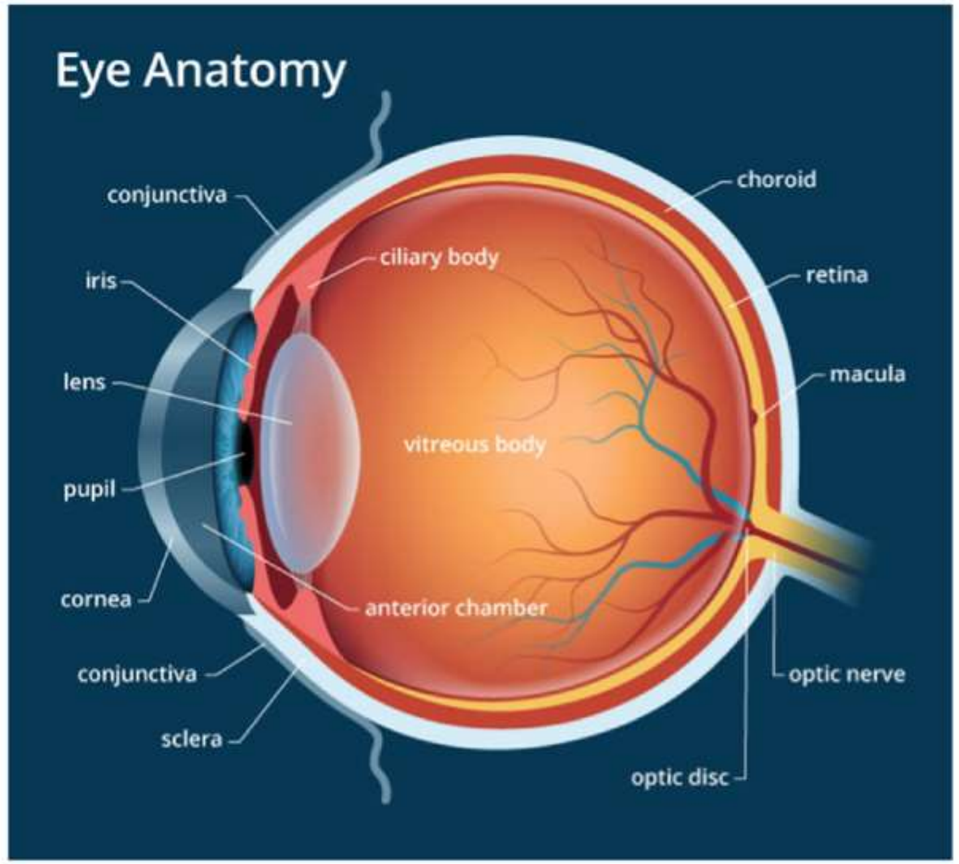
To develop and implement treatment recommendations for patients with retinal diseases Using ML and DL

Sub Objectives

- Collect Patient Data
- Analyzing the previous Patient Data
- Develop personalized treatment plans
- Implement the outcome analysis

METHODOLOGY

- Model Study Design
- Data Collection
- Data Model Training
- Data Model Training
- Model Evaluation
- Imaging and Data Processing
- Model Deployment
- Validation and testing
- Outcome Assessment
- Data Analysis



KEY PILLARS

Accuracy

Predictive capability

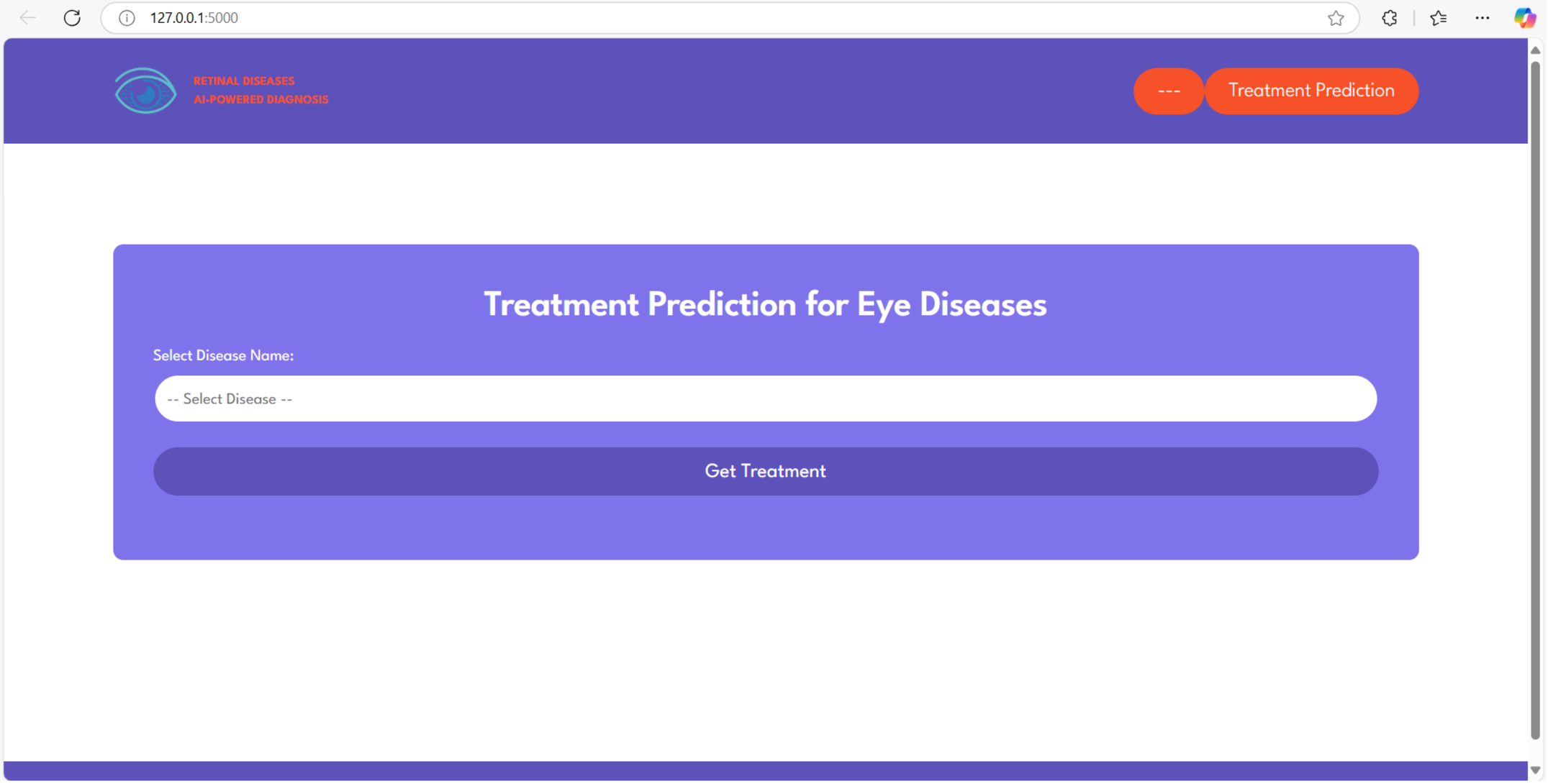
Longitudinal analysis

User-Friendliness

TECHNOLOGY

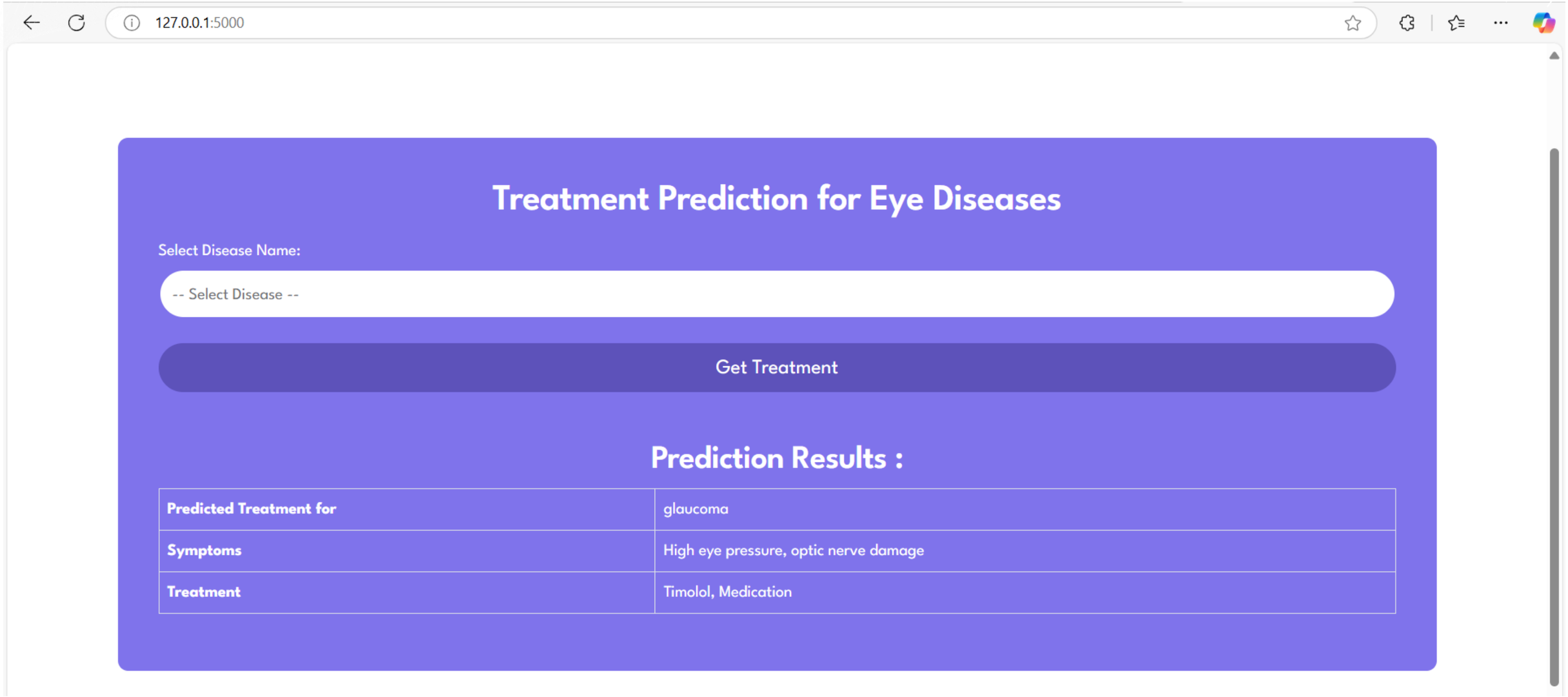
- Programming Language – Python
- Framework - Flask
- library – Pandas, Vectorizer, Accuracy Score, Joblib

UI

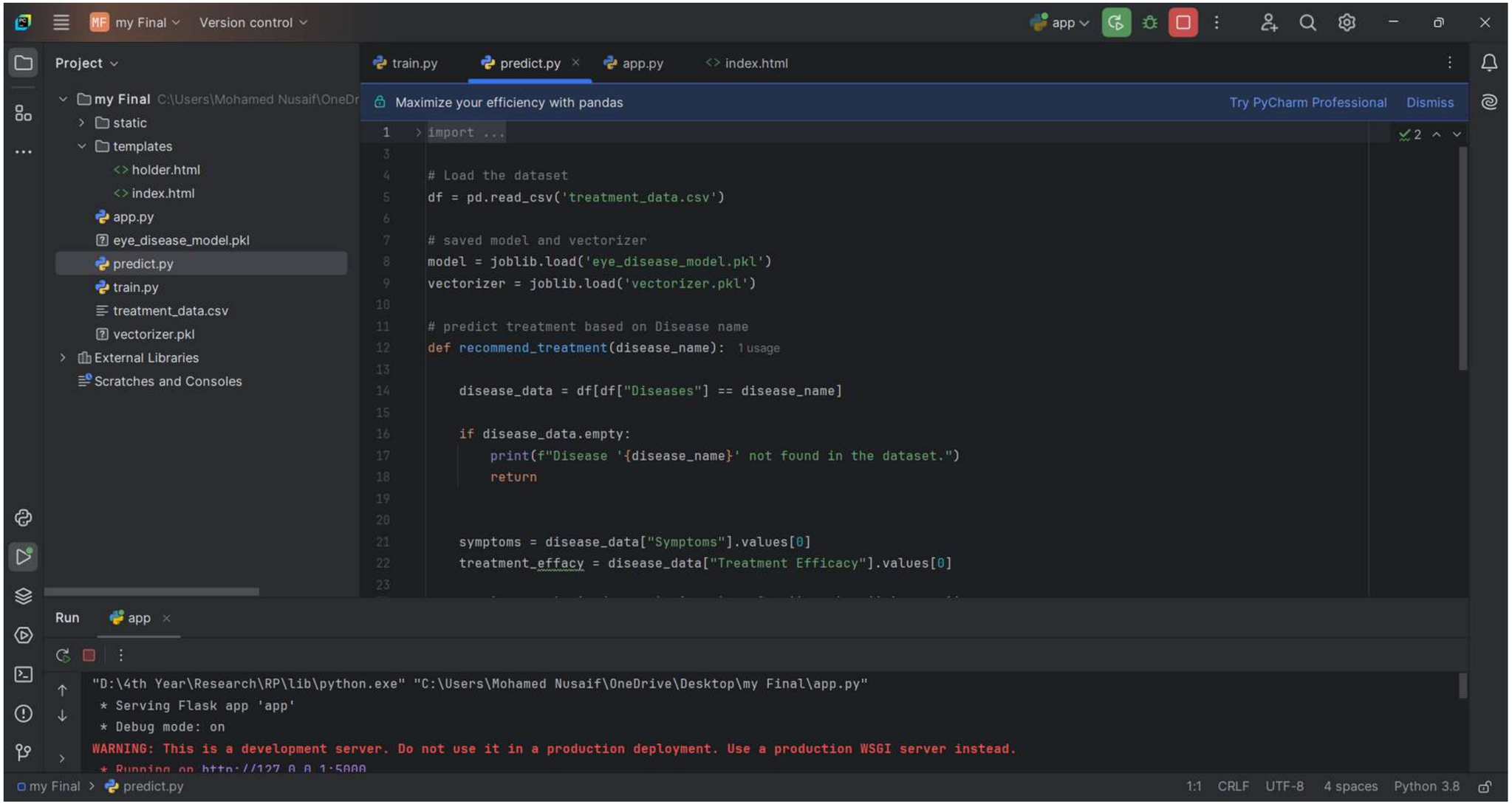

127.0.0.1:5000
RETINAL DISEASES
AI-POWERED DIAGNOSIS

Treatment Prediction
Treatment Prediction for Eye Diseases
Select Disease Name:
-- Select Disease --
Get Treatment

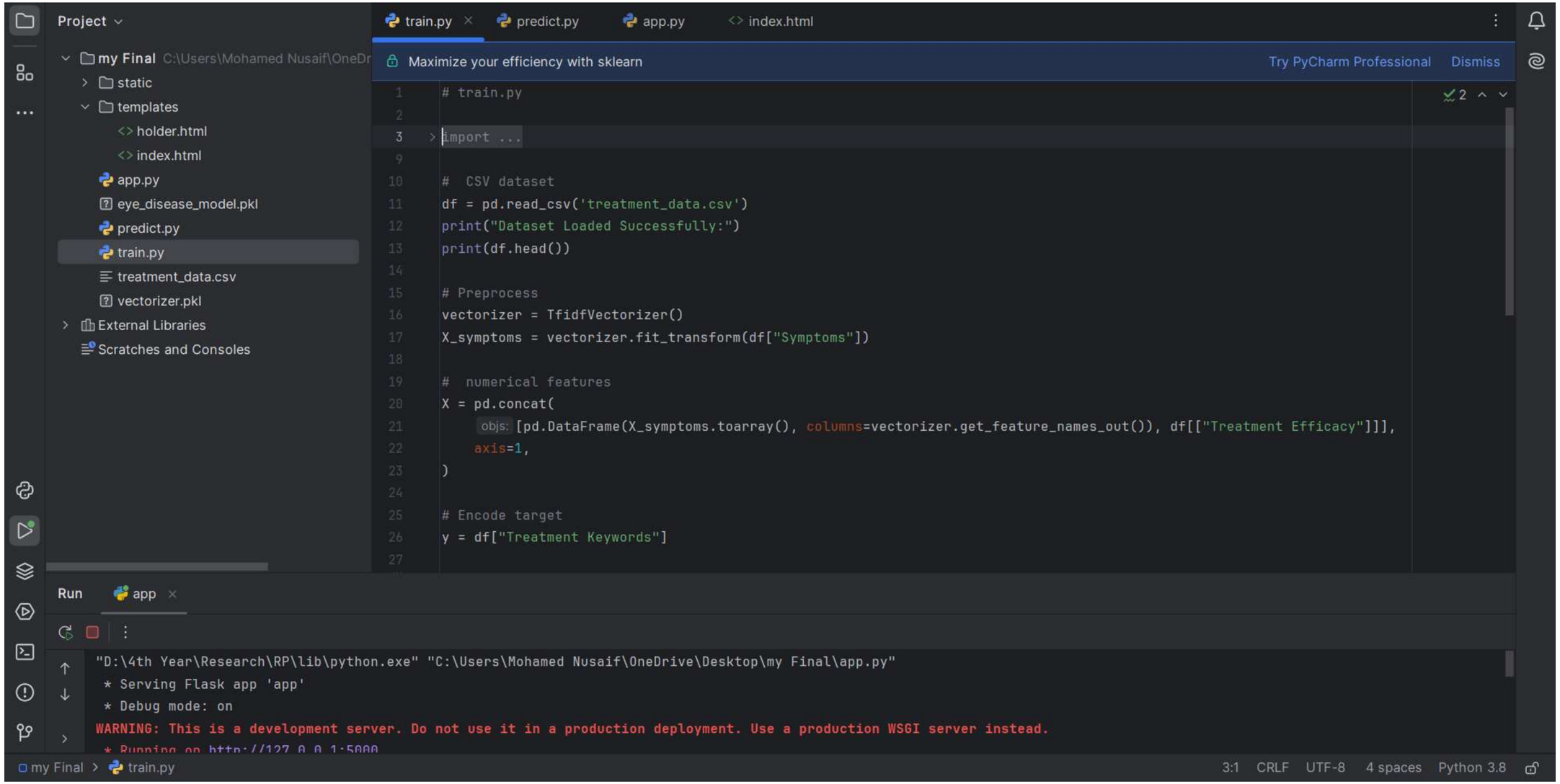
RESULT


127.0.0.1:5000
Treatment Prediction for Eye Diseases
Select Disease Name:
-- Select Disease --
Get Treatment
Prediction Results :
Predicted Treatment for
glaucoma
Symptoms
High eye pressure, optic nerve damage
Treatment
Timolol, Medication

MODEL DEPLOYMENT



MODEL DEPLOYMENT



WHAT TO BE DONE

- Integratio
- n
- Finish
- UI/UX
- Improve the System
- Database connection

REFERENCES

[1] Smith, J., Doe, A., & Brown, B. (2020). "Deep Learning for Retinal Disease Classification." Journal of Medical Imaging, 7(3), 123-135.

[2] Li, X., Zhang, Y., & Wang, Z. (2019). "Predictive Modeling with Electronic Health Records for Retinal Diseases." International Journal of Health Informatics, 12(4), 234-245.

[3] National Institute of Health (NIH). (2021). "Advances in Machine Learning for Ophthalmology." NIH Technical Report Series, 45

[4] World Health Organization (WHO). (2018). "Global Burden of Retinal Diseases and Vision Impairment." WHO Technical Report.

[5] American Academy of Ophthalmology (AAO). "Retinal Diseases and Disorders." Retrieved from AAO Retinal Diseases

Component 04

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BSc (Hons) Degree in Information Technology
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Comprehensive Disease Progression Analysis

SLIIT
FACULTY OF COMPUTING

INTRODUCTION

- Machine learning (ML) and deep learning (DL) have shown promise in providing advanced techniques for disease tracking and prediction.
- This project aims to predict the progression of retinal diseases over time by using machine learning models, specifically Long Short-Term Memory (LSTM) models.
- The goal is to track disease progression based on image data (HOG features) and predict future disease states.

RESEARCH GAP

Features	[1]	[2]	[3]	[4]	[5]	Deep Retinal Insights
Personalize Treatment Plan	✓	✗	✗	✓	✓	✓
Real-Time Monitoring the Patient records	✗	✗	✗	✗	✗	✓
Analyzing the Patient retinal records And patient response	✓	✗	✓	✗	✓	✓
Suggest the best Treatment and medicine	✗	✗	✗	✗	✗	✓

RESEARCH QUESTION

01 . How can disease progression be accurately tracked and analyzed?

OBJECTIVES

Specific Objective

Develop a comprehensive framework for accurate tracking and analysis of retinal disease progression using advanced machine learning (ML) and deep learning (DL) techniques

Sub Objectives

- Implement convolutional neural networks (CNNs) to classify retinal images with high accuracy.
- Integrate diverse health record data to improve the reliability of predictions
- •Adjust recommendations based on real-time patient data and responses

METHODOLOGY

- Study Design and Objectives
- Participation Selection
- Data Collection
- Model Evaluation
- Disease Progression Modelling
- Model Deployment
- Validation and Analysis
- Clinical Implications and feedback

KEY PILLARS

Accuracy

Predictive capability

Longitudinal analysis

User-Friendliness

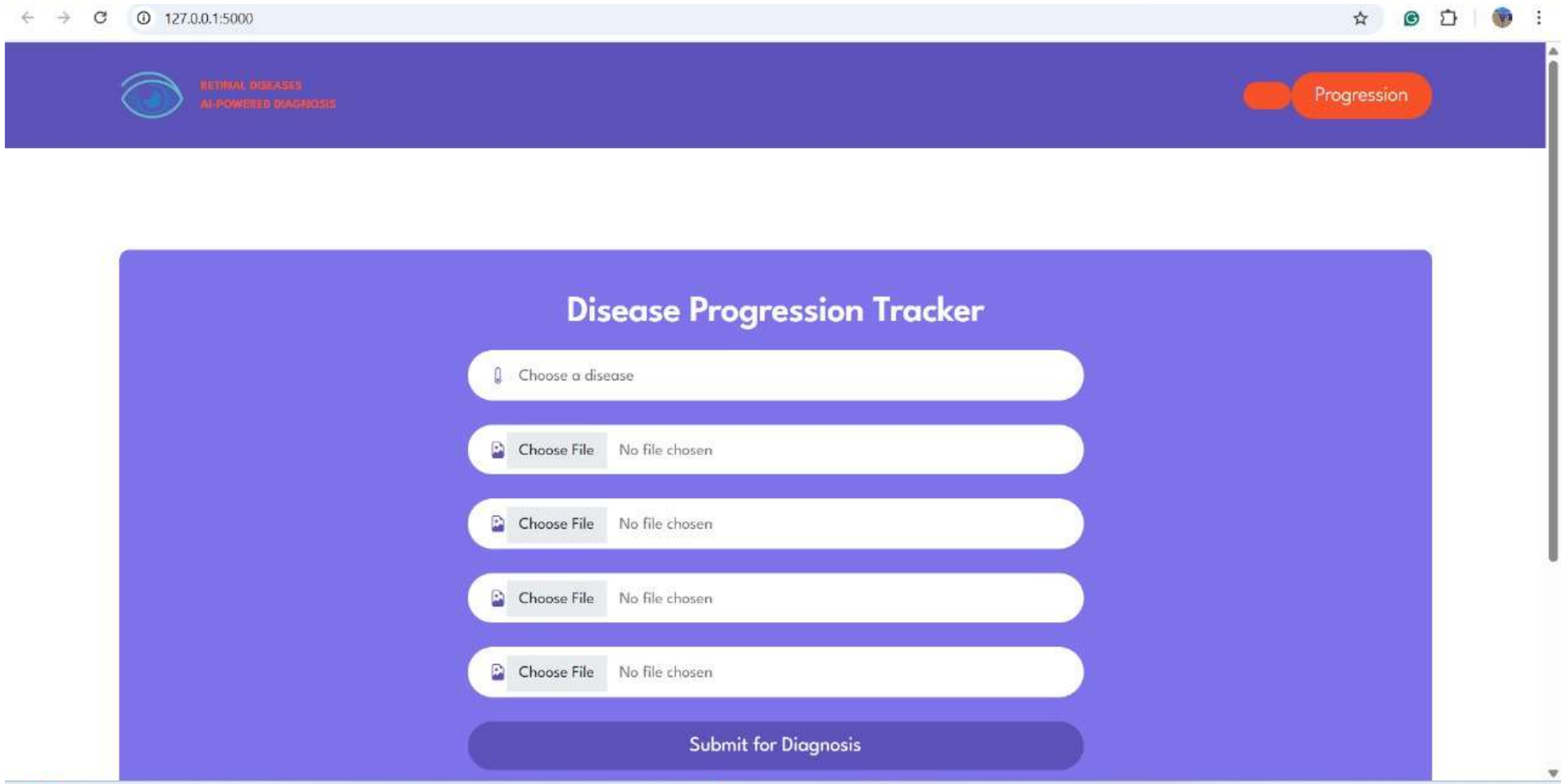
TECHNOLOGY

- Programming Language – Python
- Framework - Flask
- library – Pandas, Vectorizer, Accuracy Score, Joblib

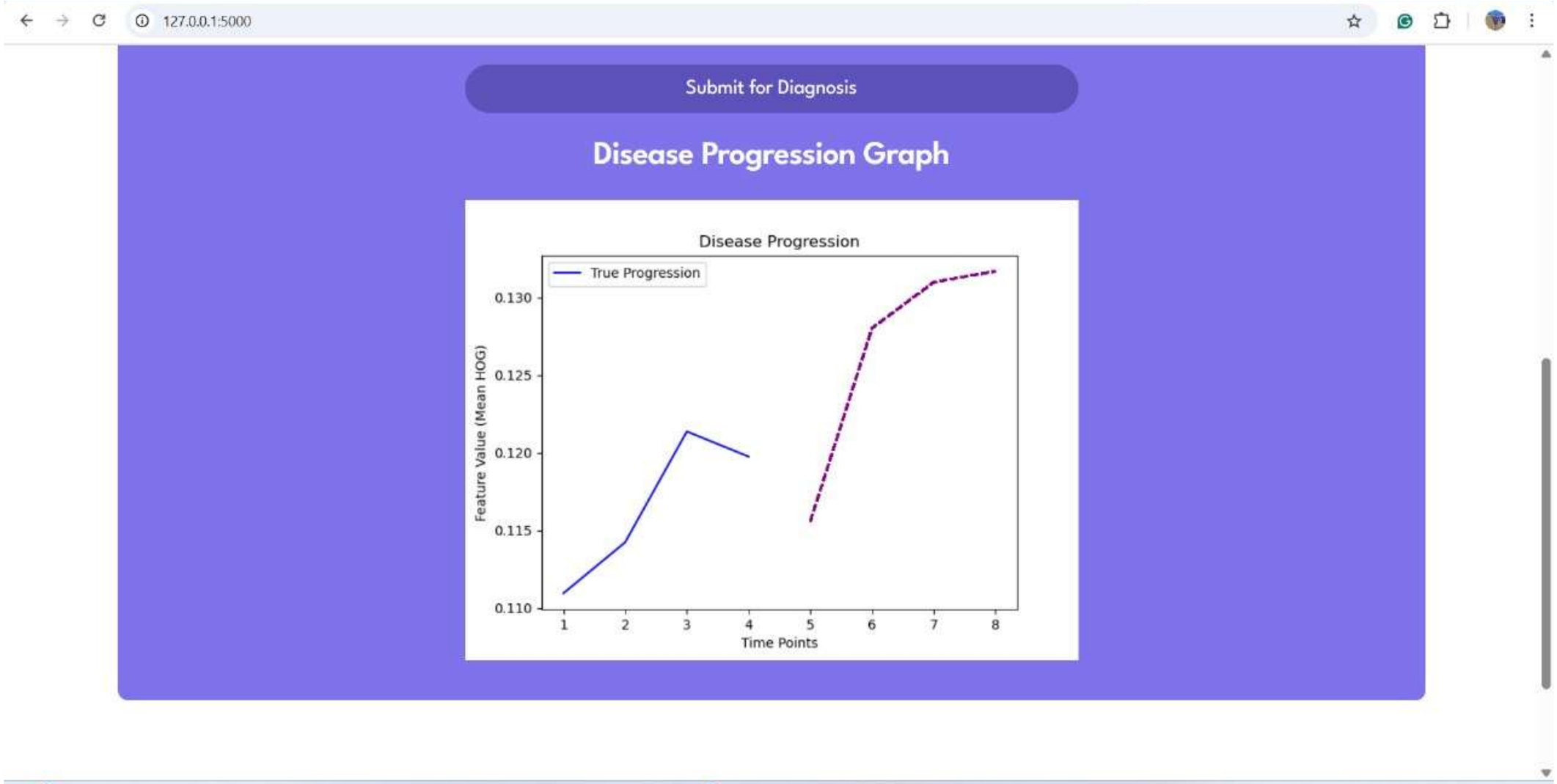
Data set :

Kaggle

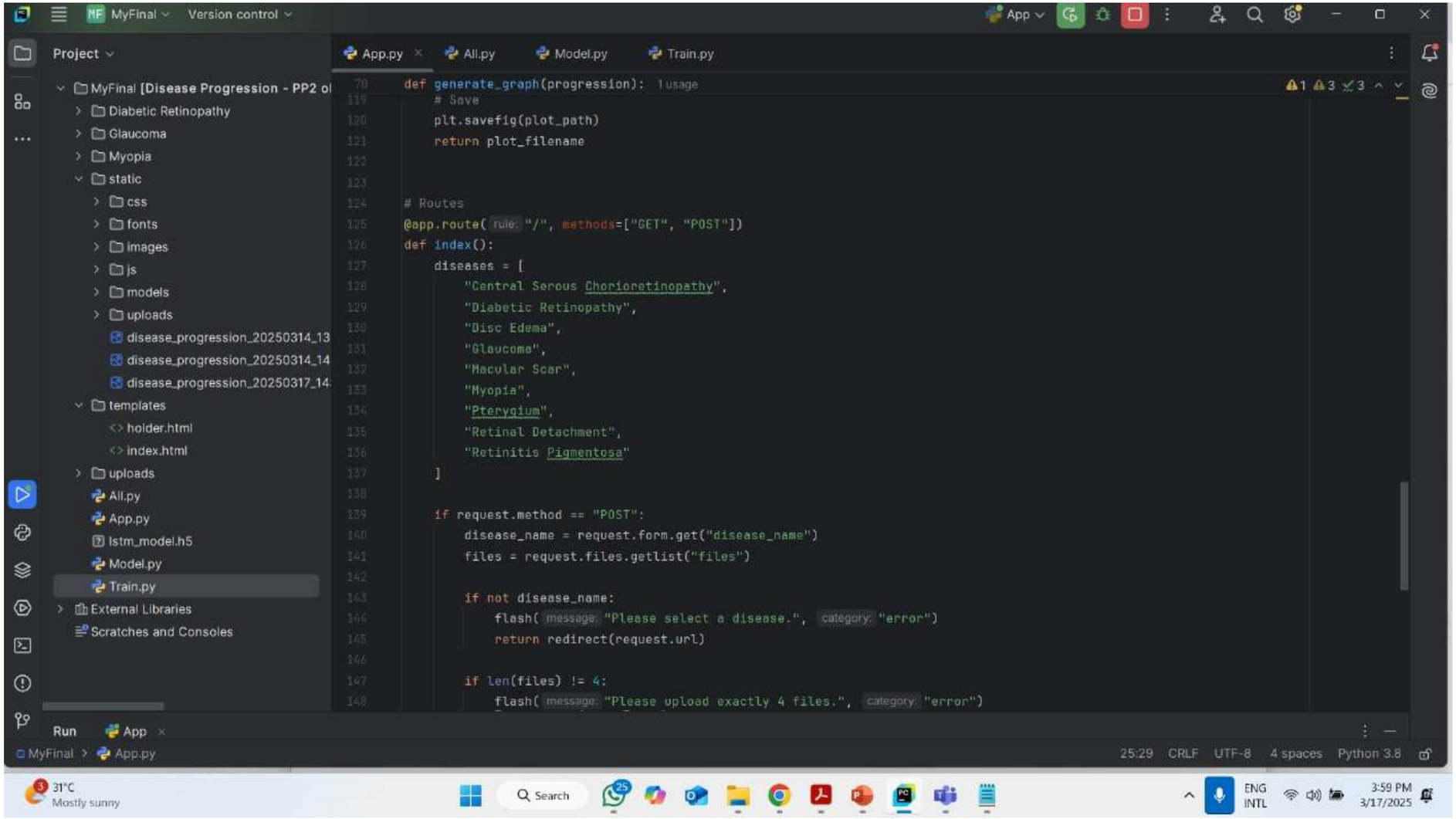
UI


127.0.0.1:5000
RETINAL DISEASES
AI-POWERED DIAGNOSIS
Progression
Disease Progression Tracker
Choose a disease
Choose File
No file chosen
Choose File
No file chosen
Choose File
No file chosen
Choose File
No file chosen
Submit for Diagnosis

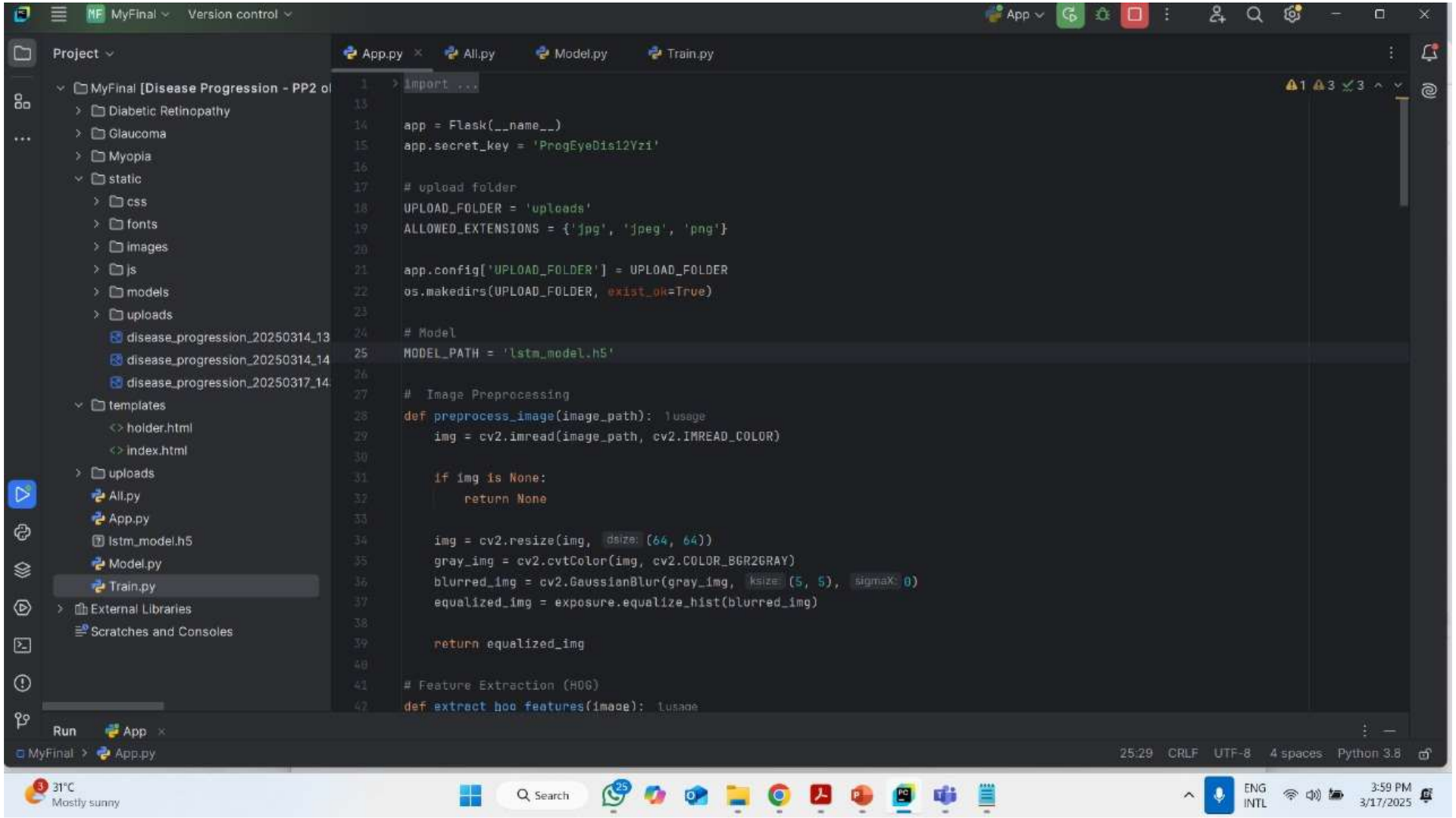
RESULT


127.0.0.1:5000
Submit for Diagnosis
Disease Progression Graph
Disease Progression
True Progression
Feature Value (Mean HOG)
0.130
0.125
0.120
0.115
0.110
1
2
3
4
5
6
7
8
Time Points

MODEL DEPLOYMENT



MODEL DEPLOYMENT



WHAT TO BE DONE

- Integration
- Authentication (Sign up / Sign in)
- Improve the System
- Database connection

REFERENCES

[1] Smith, J., Doe, A., & Brown, B. (2020). "Deep Learning for Retinal Disease Classification." Journal of Medical Imaging, 7(3), 123-135.

[2] Li, X., Zhang, Y., & Wang, Z. (2019). "Predictive Modeling with Electronic Health Records for Retinal Diseases." International Journal of Health Informatics, 12(4), 234-245.

[3] National Institute of Health (NIH). (2021). "Advances in Machine Learning for Ophthalmology." NIH Technical Report Series, 45.

[4] World Health Organization (WHO). (2018). "Global Burden of Retinal Diseases and Vision Impairment." WHO Technical Report.

[5] American Academy of Ophthalmology (AAO). "Retinal Diseases and Disorders." Retrieved from https://www.aao.org/retinal-diseases

[6] HealthIT.gov. "Introduction to Electronic Health Records." Retrieved from https://www.healthit.gov/faq/what-electronic-health-record-ehr

REQUIREMENTS

Personal Requirements

- Doctor
- Patient
- Supporting Staff

Non-functional Requirements

- Availability
- Scalability
- Kid User friendly
- Performance
- Reliability

System Requirements

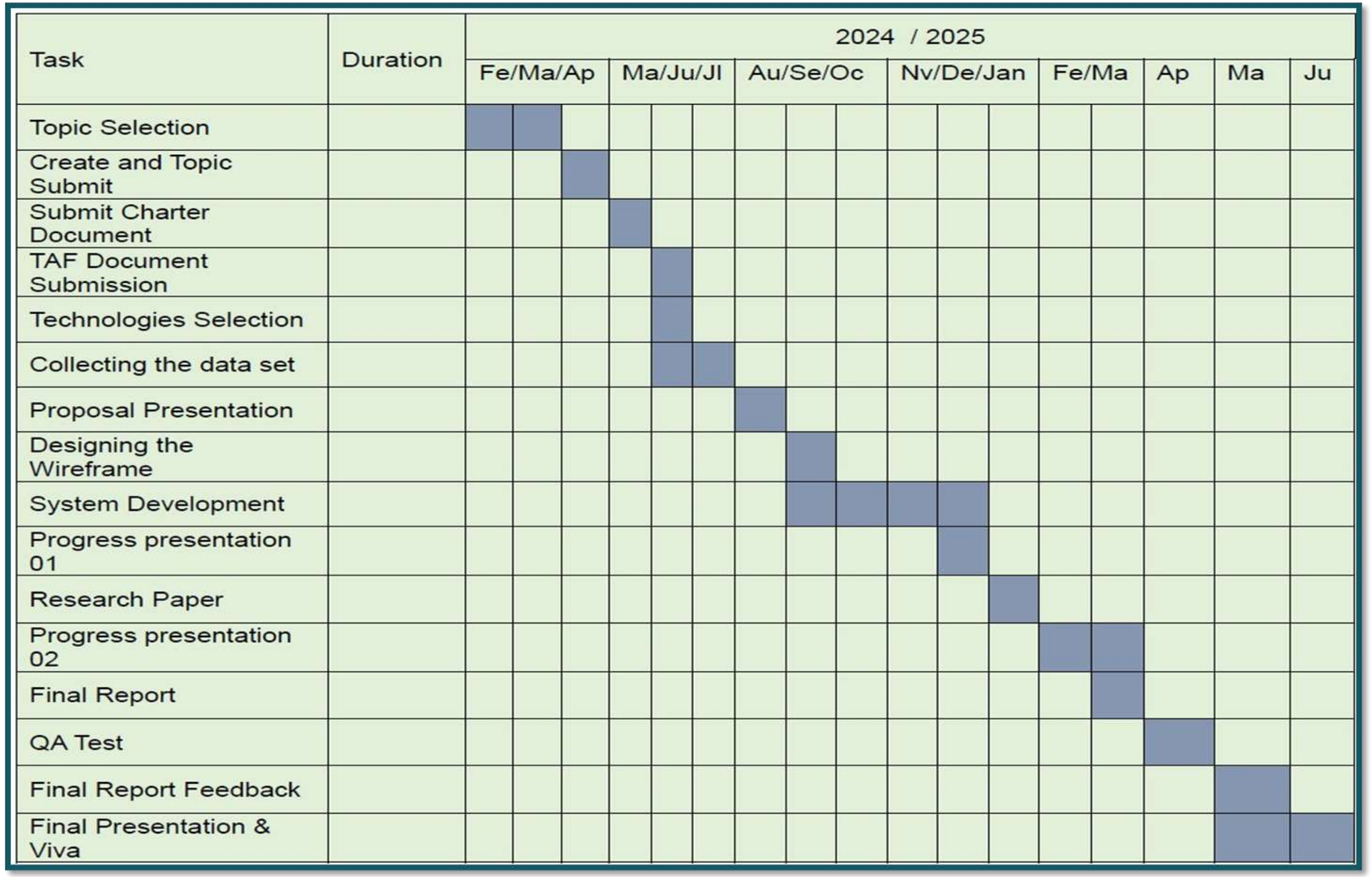
✓ **Software**

❑ User-end
- Web browser

❑ Developer-end
- My SQL
- Python
- React

✓ **Hardware**
- A Pc Or Smart Device using for web site

GANNT CHART


Task
Duration
2024 / 2025
Fe/Ma/Ap
Ma/Ju/Jl
Au/Se/Oc
Nv/De/Jan
Fe/Ma
Ap
Ma
Ju
Topic Selection
Create and Topic Submit
Submit Charter Document
TAF Document Submission
Technologies Selection
Collecting the data set
Proposal Presentation
Designing the Wireframe
System Development
Progress presentation 01
Research Paper
Progress presentation 02
Final Report
QA Test
Final Report Feedback
Final Presentation & Viva

BUDGET

Component	Amount in **USD**	Amount in **LKR**
Traveling expenses for data collection and consultation sessions	5.00	1500.00
Software licenses and tools	25.00	7500.00
Data storage and cloud services	10.00	3000.00
Technical devices (e.g., diagnostic tools)	20.00	6000.00
Internet charges (development and technical learning)	10.00	3000.00
Technical consultation charges (external sessions and courses)	15.00	4500.00
Miscellaneous expenses	5.00	1500.00
Total	90.00	27000.00

Q & A

THANK YOU!