Automated Retinopathy Diagnosis System with Real-Time Image Processing

SUPERVISOR

DR. AKBAR KHAN NASAR

CO-SUPERVISOR

SIR. ALI ASGHAR

SYED AMJAD SHAH – 65605

NAWAB KHAN – 57358

ABDUL SIDDIQUE – 58109

Outline

- Introduction
- Problem Statement
- Aims & Objectives
- Literature Review
- Methodology
  - Block Diagrams
  - Use Case Diagram
  - Sequence Diagram
  - Activity Diagram
- Conclusion
- References

Introduction

- The Automated Retinopathy Diagnosis System leverages deep learning techniques, particularly Convolutional Neural Networks (CNNs). [1]
- Utilizes a mobile device equipped with a 30-diopter lens for capturing retinal images.
- The captured image is then subsequently transmitted to a Web-Application developed using Streamlit.
- The Web-Application will forward that image to a server for processing.
- A pre-trained deep learning model analyzes the image to detect signs of retinopathy.

Introduction (Cont…)

- The server-based deployment ensures the diagnosis process is accessible.
- Designed to function effectively in remote or resource-limited environments.
- Aims to provide healthcare professionals with a reliable tool for early detection of retinopathy.
- The solution focuses on improving patient outcomes through timely diagnosis.

Problem Statement

- Retinopathy is a major cause of preventable blindness effecting millions of people worldwide [2],
- Early diagnosis remains limited due to the lack of accessible ophthalmologists and expensive diagnostic tools, particularly in rural areas.
- Traditional detection methods are time-consuming and costly, creating a need for an affordable, automated solution that enables early diagnosis with specialized medical equipments. [3]

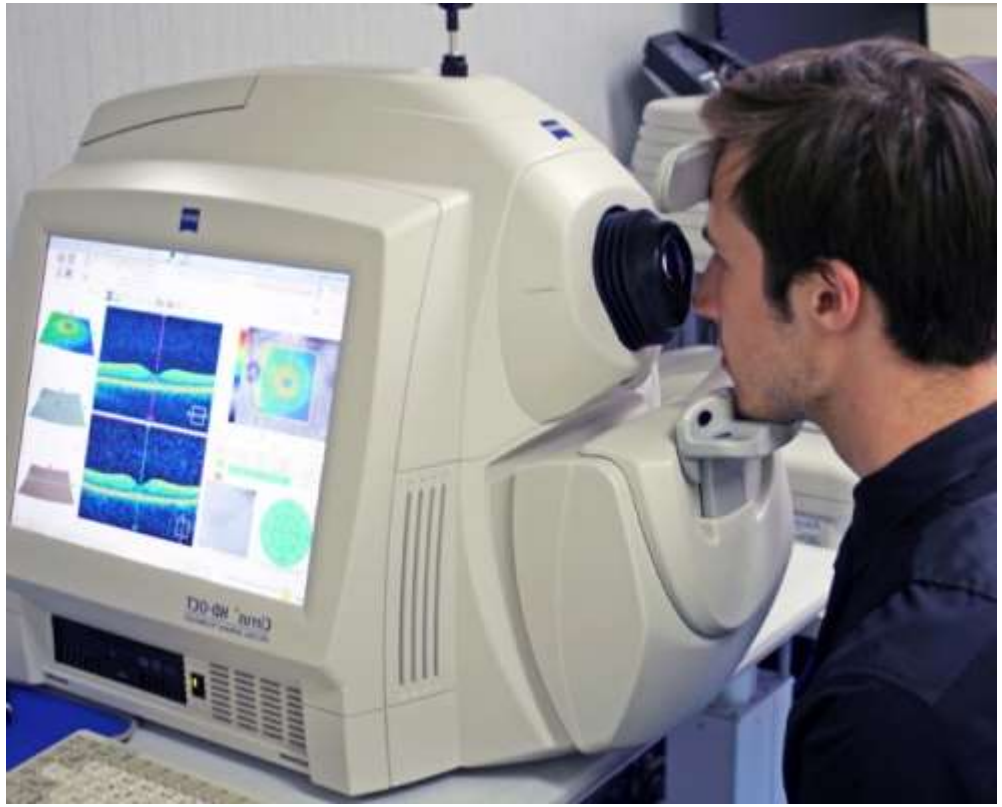


Figure 1

Aims & Objectives

- Develop a portable, user-friendly device for early detection and diagnosis of retinopathy.
- Integrate real-time image processing and CNN technology (Residual Network) for accurate diagnosis.
- Improve accessibility and affordability of retinopathy screening, especially in rural or resource-constrained areas.

Literature Review

Author	Year	Method	Conclusion
[4]	2017	Automated grading of retinal images, using machine learning and CNNs to classify different stages of retinopathy with high accuracy.	CNN provides analysis of real time Retina image processing .
[5]	2019	An accessible and intuitive interface is used to enhance user interaction and the efficiency of real-time diagnosis	May uses the Android, Web App , API, UI Framework
[6]	2017	Automated reporting systems for medical imaging integration of AI-based decision support for diabetic retinopathy, improving feedback efficiency.	Enhance in decision making
[7]	2019	Secure and scalable data storage is critical in telemedicine applications uses cloud databases to ensure easy access and protection.	Achieve easy access and protections

Methodology

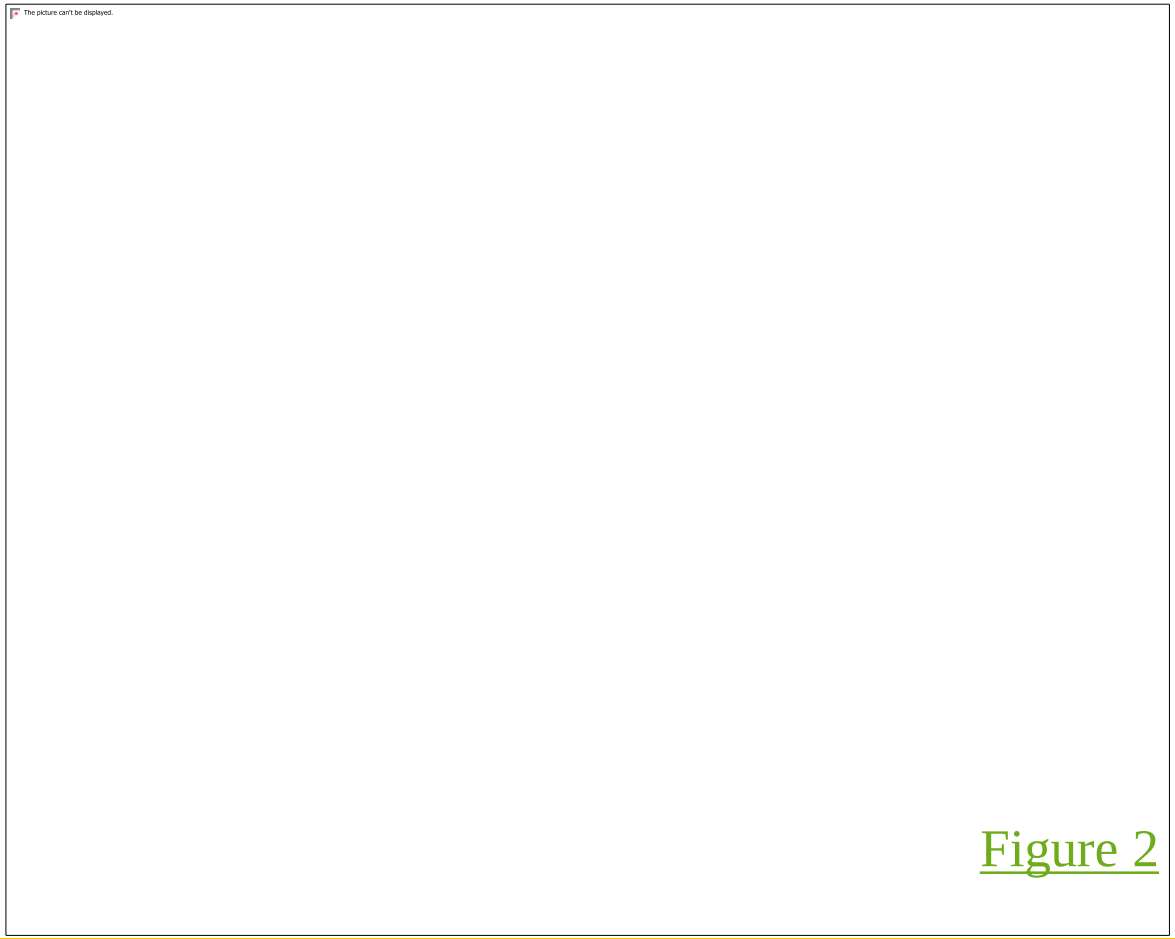


Figure 2

Methodology Cont…

Model Phases	Project Activities	Deliverables
1. Planning & Requirements	- Data Collection and Preprocessing - Mobile Device and 30-diopter lens	Requirements Specification Document
2. Designing	- Proposed block diagram that shows different components in system. - Use case diagram to depicts the interaction between users (actors) and the system. - Activity diagram that models the flow of activates or processes, showing the sequence of operations and decision points.	System Architecture

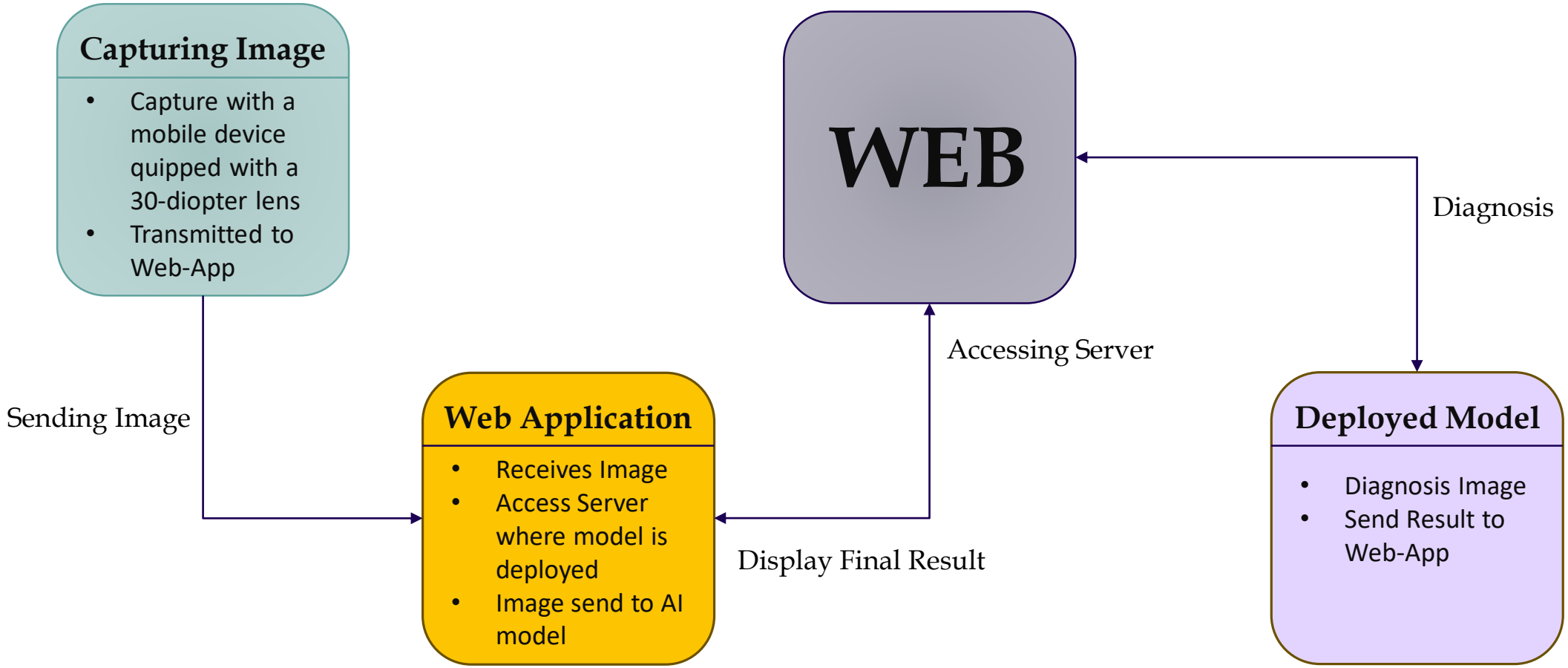
Methodology Cont…

Model Phases	Project Activities	Deliverables
2. Designing (Continue…)	- Sequence Diagram that illustrates the sequence of interactions between objects/ components in the system over time.	System Architecture
3. Implementation	- Use Proposed Architecture - Train, Test and Validate Model - Model Tunning - Web-Application User Interface Implementation and Testing	Validate CNN Model and Web-Application User Interface.

Methodology Cont…

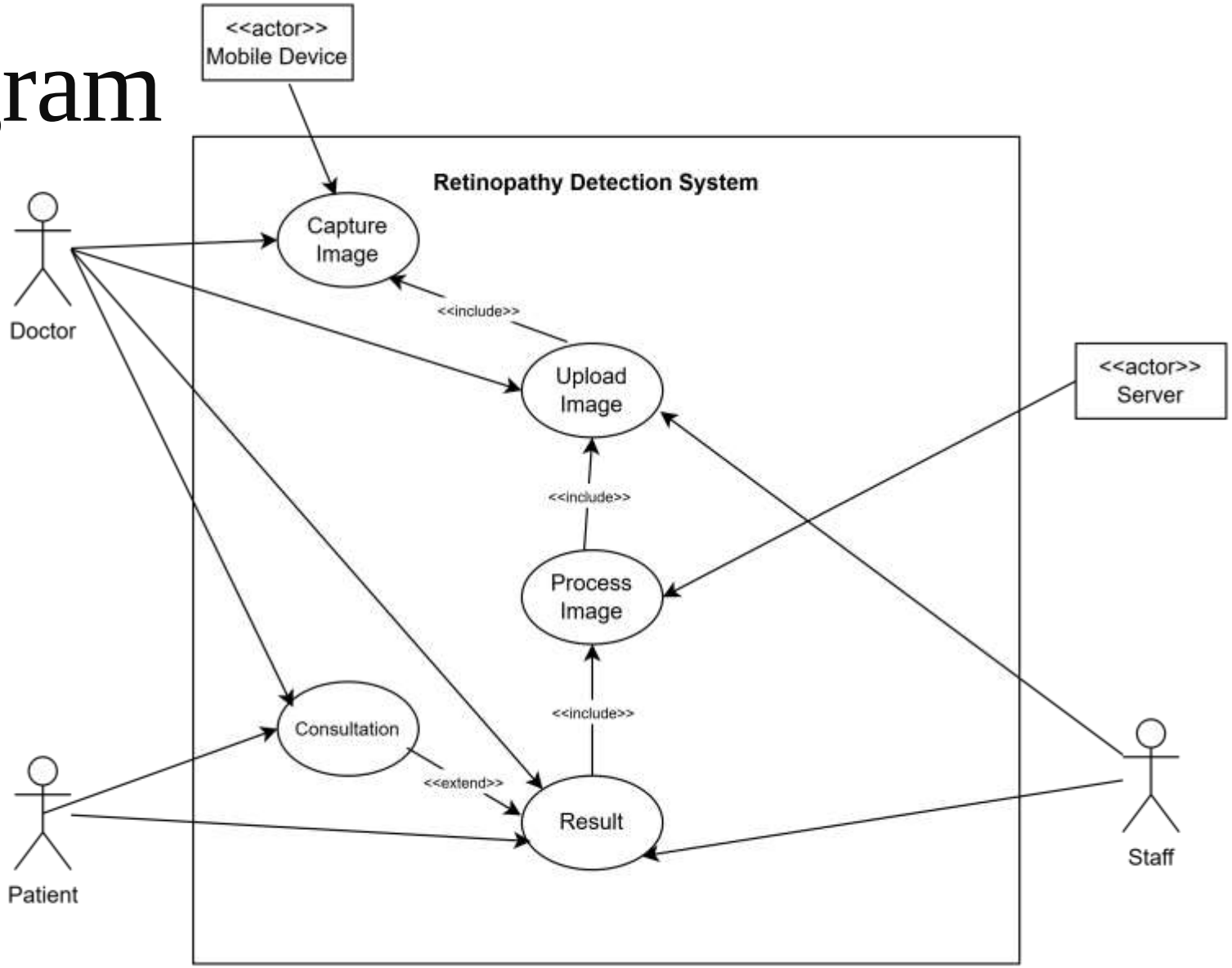
4. Testing	- Conduct Various Testing Phases - User Acceptance Testing - Bugs Testing	Tested System
5. System Deployment	- Set Up Server Infrastructure Deploy CNN Model - Hardware Integration and Communication - Deploy CNN Model	Model Deployed on Server, Communicating Web-App with Mobile Device
6. Maintenance	- Monitor System Performance - Collect User Feedback - Implement Updates and Patches	Updated System with Enhancements

Block Diagram



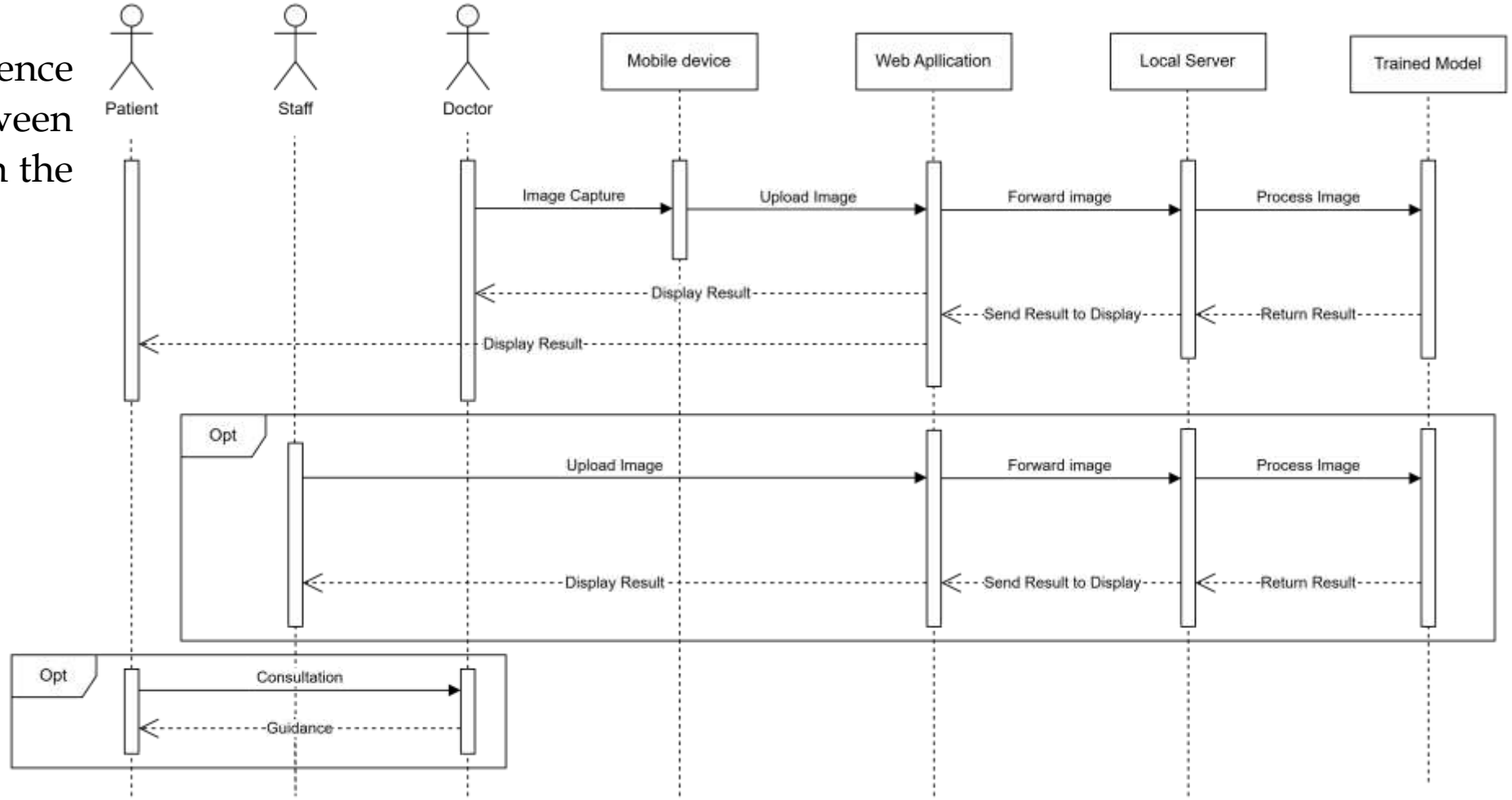
Use Case Diagram

It shows the interactions between users (actors) and the system, highlighting system functionalities.



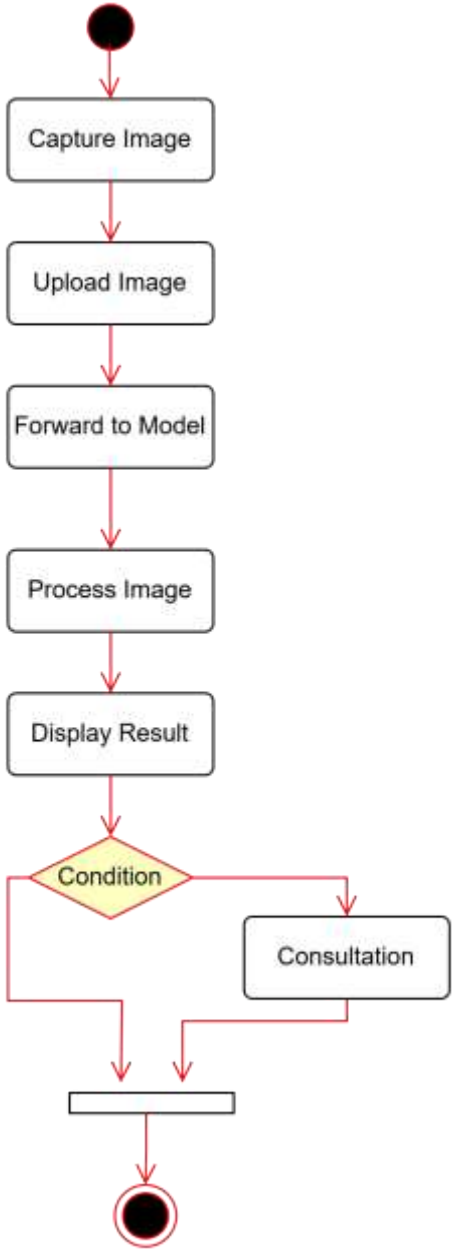
Sequence Diagram

It illustrates the sequence of interactions between objects/ components in the system over time.

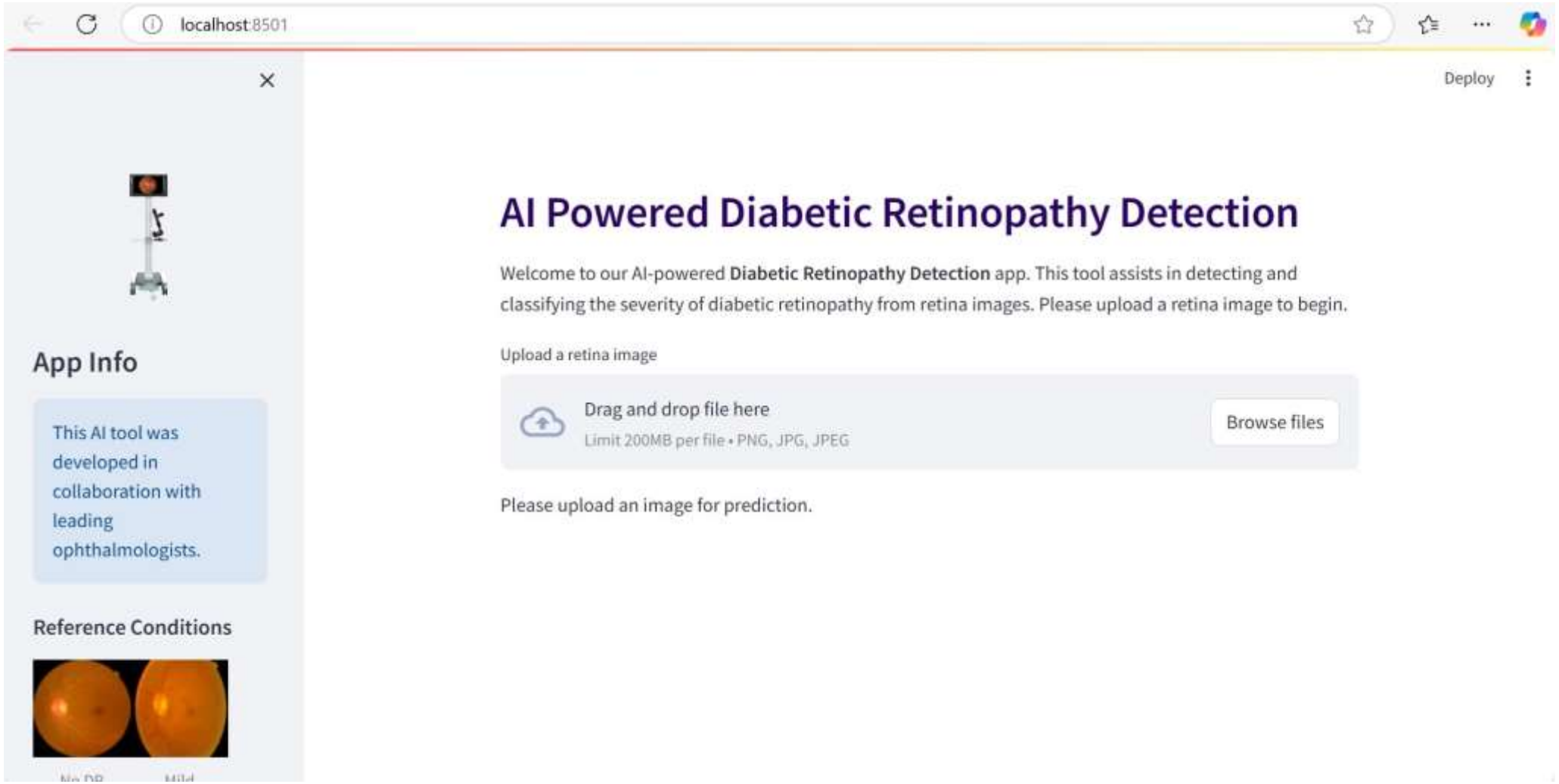


Activity Diagram

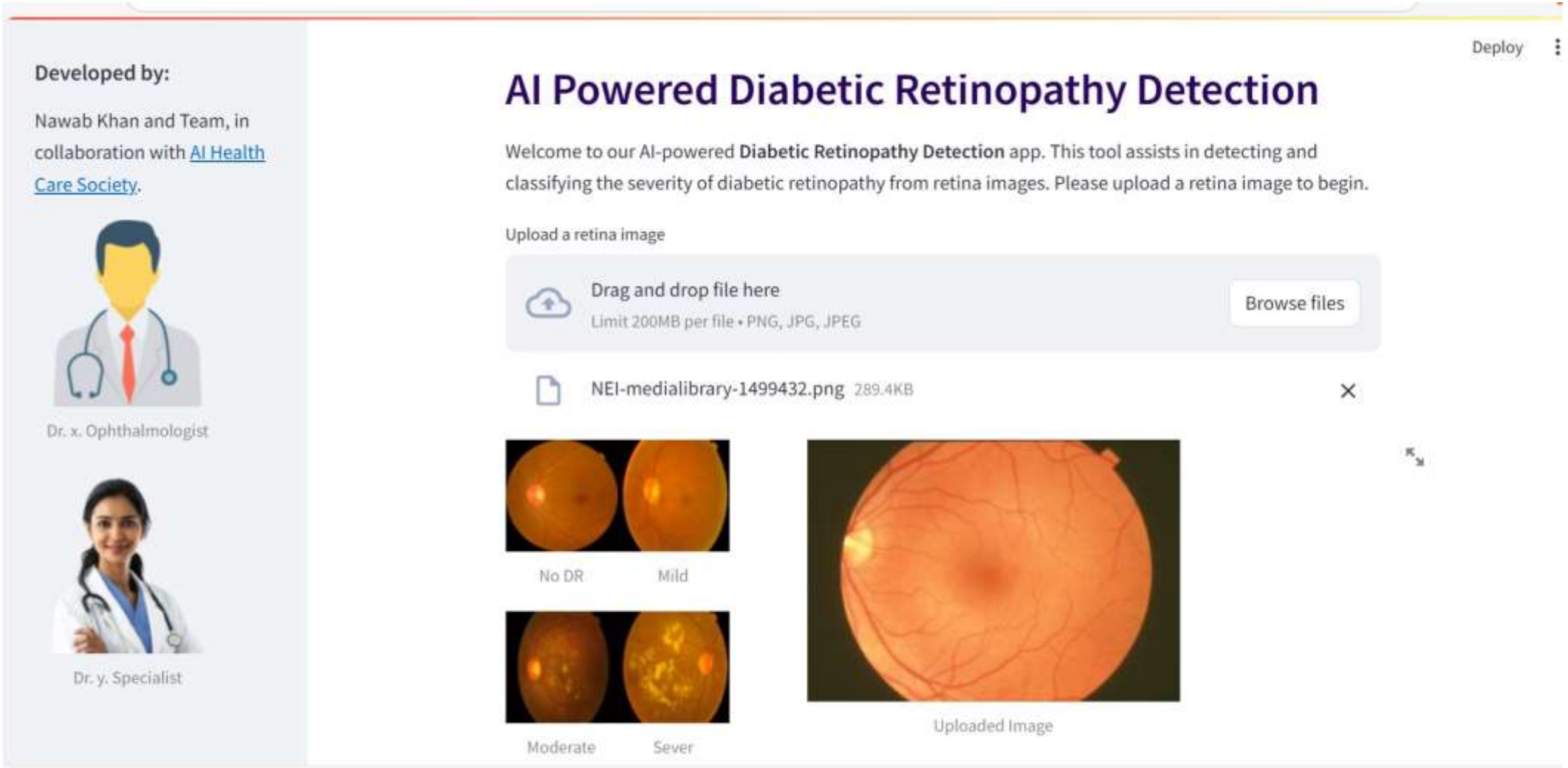
It models the flow of activates or processes, showing the sequence of operations and decision points.



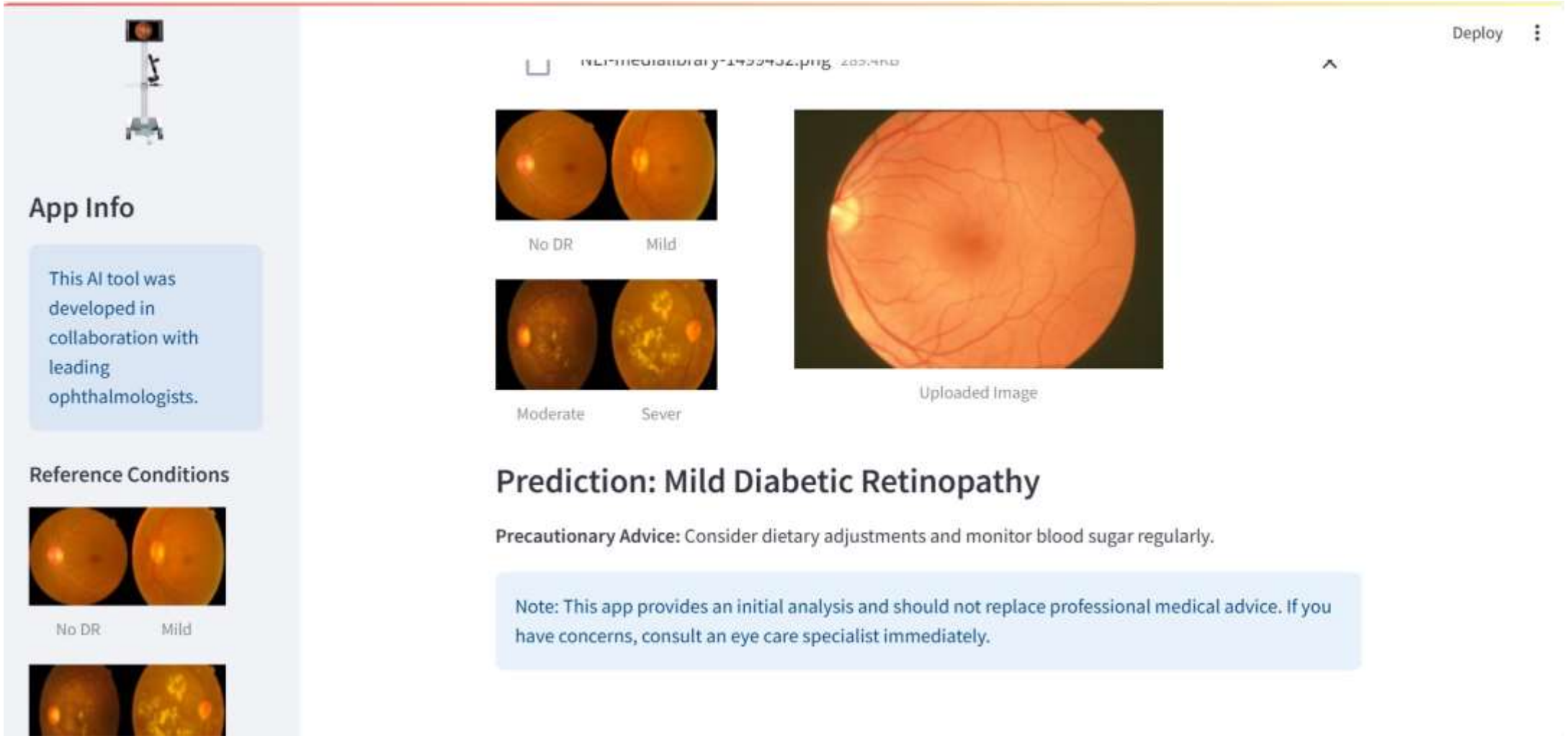
User Interface



User Interface (Cont…)



User Interface (Cont…)



Conclusion

In conclusion, the Automated Retinopathy Diagnosis System combines advanced deep learning techniques, server-based processing, and mobile technology to create a reliable and accessible solution for early detection of retinopathy. By enabling healthcare professionals to diagnose patients efficiently, even in remote or resource-limited settings, this system has the potential to significantly improve patient outcomes through timely and accurate medical intervention.

References

[1] R. Ghosh, K. Ghosh and S. Maitra, "Automatic detection and classification of diabetic retinopathy stages using CNN," 2017 4th International Conference on Signal Processing and Integrated Networks (SPIN), Noida, India, 2017, pp. 550-554, doi: 10.1109/SPIN.2017.8050011. keywords: {Diabetes;Computational modeling;Feature extraction;Image color analysis;Noise reduction;Measurement;Retina;Convolutional Neural Network;Retinopathy;Fun-dus photography;Image Classification;Deep Learning},

[2] Kropp M, Golubnitschaja O, Mazurakova A, Koklesova L, Sargheini N, Vo TKS, de Clerck E, Polivka J Jr, Potuznik P, Polivka J, Stetkarova I, Kubatka P, Thumann G. Diabetic retinopathy as the leading cause of blindness and early predictor of cascading complications-risks and mitigation. EPMA J. 2023 Feb 13;14(1):21-42. doi: 10.1007/s13167-023-00314-8. PMID: 36866156; PMCID: PMC9971534.

[3] Lakshminarayanan, V.; Kheradfallah, H.; Sarkar, A.; Jothi Balaji, J. Automated Detection and Diagnosis of Diabetic Retinopathy: A Comprehensive Survey. *J. Imaging* **2021**, *7*, 165. https://doi.org/10.3390/jimaging7090165

Figure 1 https://novavisioncenter.com/optical-coherence-tomography/

[4] Quellec, G., et al. (2017). "Deep image mining for diabetic retinopathy screening." *Medical Image Analysis*, 39, 178-194.

[5] Antonelli, M., et al. (2019). "EyeArt: Automated, AI-Based Retinal Assessment System for Diabetic Retinopathy Screening." *Translational Vision Science & Technology*

[6] Ting, D. S. W., et al. (2017). "Artificial intelligence and deep learning in ophthalmology." *British Journal of Ophthalmology*, 101(9), 1101-1106.

[7] Lee, C. H., et al. (2019). "Cloud-Based Big Data Analytics for Diabetic Retinopathy Screening." *Journal of Healthcare Engineering*, 2019.

Figure 2 https://medium.com/@chathmini96/waterfall-vs-agile-methodology-28001a9ca487

Thank You