



# Automated Retinopathy Diagnosis System with Real-Time Image Processing

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# Outline

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# Introduction

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- 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...)

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- 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

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- 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

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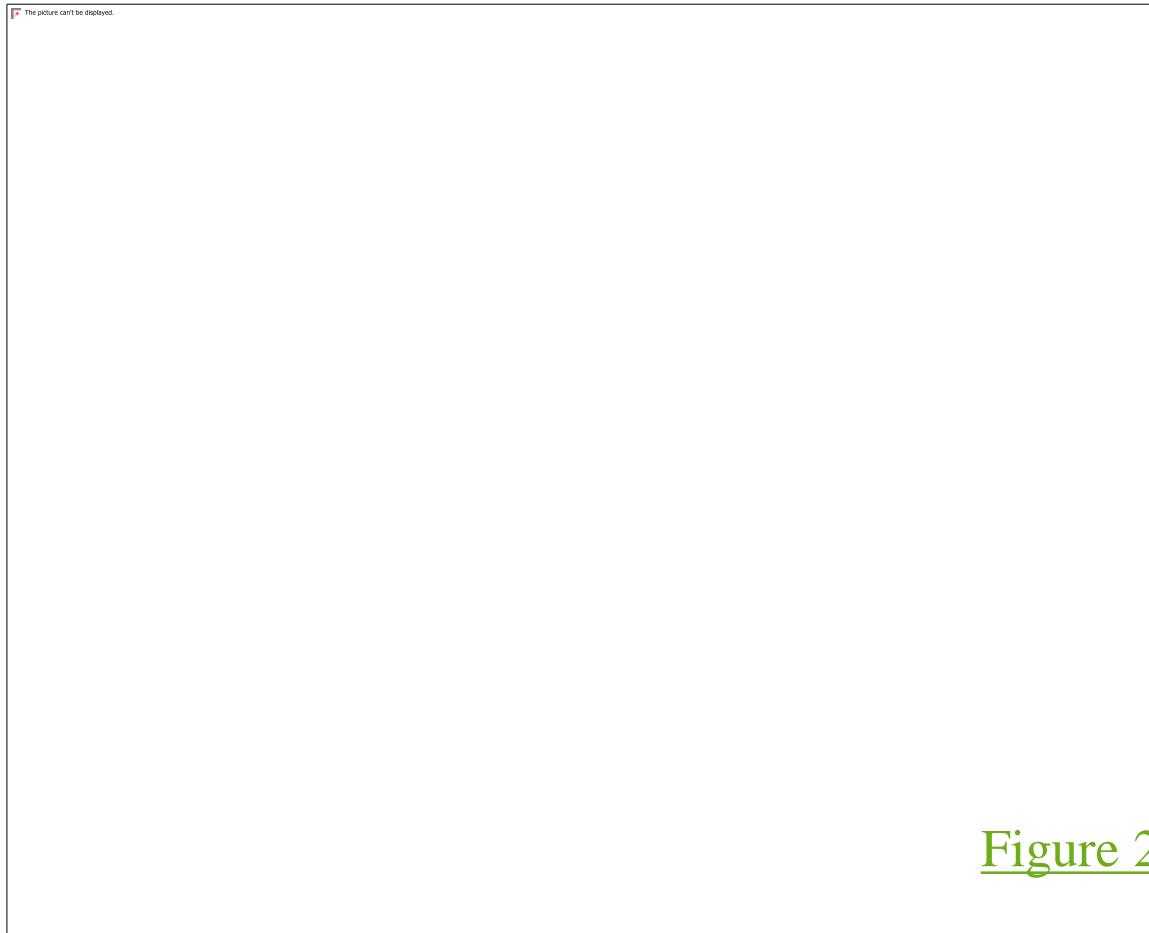
- Develop a portable, user-friendly device for early detection and diagnosis of retinopathy.
- Integrate real-time image processing and CNN technology (Residual Network) for accurate diagnosis.
- Improve accessibility and affordability of retinopathy screening, especially in rural or resource-constrained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

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# Methodology Cont...

| Model Phases                          | Project Activities  | Deliverables                        |
|---------------------------------------|---|-------------------------------------|
| <b>1. Planning &amp; Requirements</b> | <ul style="list-style-type: none"><li>- Data Collection and Preprocessing</li><li>- Mobile Device and 30-diopter lens</li></ul>   | Requirements Specification Document |
| <b>2. Designing</b>                   | <ul style="list-style-type: none"><li>- Proposed block diagram that shows different components in system.</li><li>- Use case diagram to depicts the interaction between users (actors) and the system.</li><li>- Activity diagram that models the flow of activates or processes, showing the sequence of operations and decision points.</li></ul> | System Architecture                 |

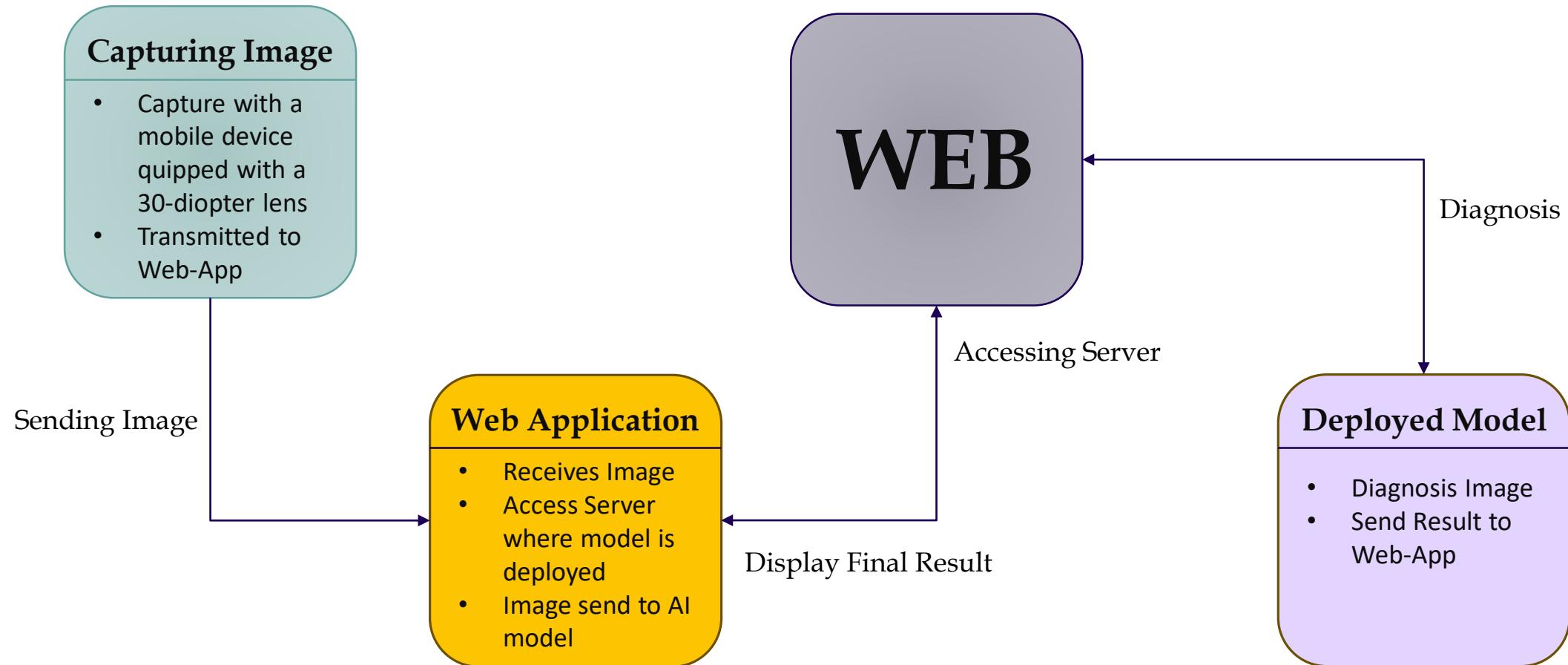
# Methodology Cont...

| Model Phases               | Project Activities  | Deliverables   |
|----------------------------|---|--|
| 2. Designing (Continue...) | <ul style="list-style-type: none"><li>- Sequence Diagram that illustrates the sequence of interactions between objects/ components in the system over time.</li></ul>   | System Architecture                                    |
| 3. Implementation          | <ul style="list-style-type: none"><li>- Use Proposed Architecture</li><li>- Train, Test and Validate Model</li><li>- Model Tuning</li><li>- Web-Application User Interface Implementation and Testing</li></ul> | Validate CNN Model and Web-Application User Interface. |

# Methodology Cont...

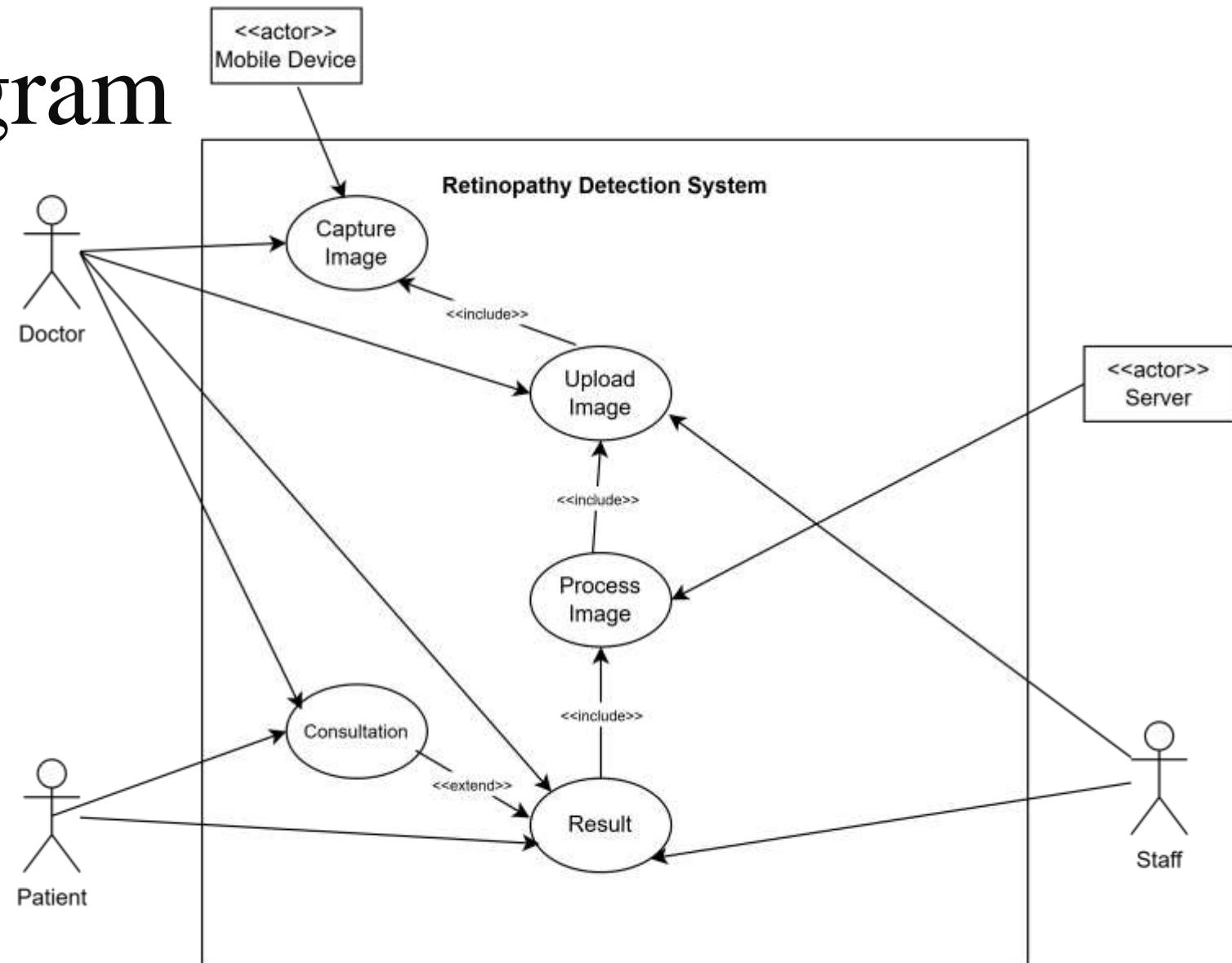
|                             |   |  |
|-----------------------------|---|--|
| <b>4. Testing</b>           | <ul style="list-style-type: none"><li>- Conduct Various Testing Phases</li><li>- User Acceptance Testing</li><li>- Bugs Testing</li></ul>                                   | Tested System  |
| <b>5. System Deployment</b> | <ul style="list-style-type: none"><li>- Set Up Server Infrastructure Deploy CNN Model</li><li>- Hardware Integration and Communication</li><li>- Deploy CNN Model</li></ul> | Model Deployed on Server, Communicating Web-App with Mobile Device |
| <b>6. Maintenance</b>       | <ul style="list-style-type: none"><li>- Monitor System Performance</li><li>- Collect User Feedback</li><li>- Implement Updates and Patches</li></ul>                        | Updated System with Enhancements                                   |

# Block Diagram



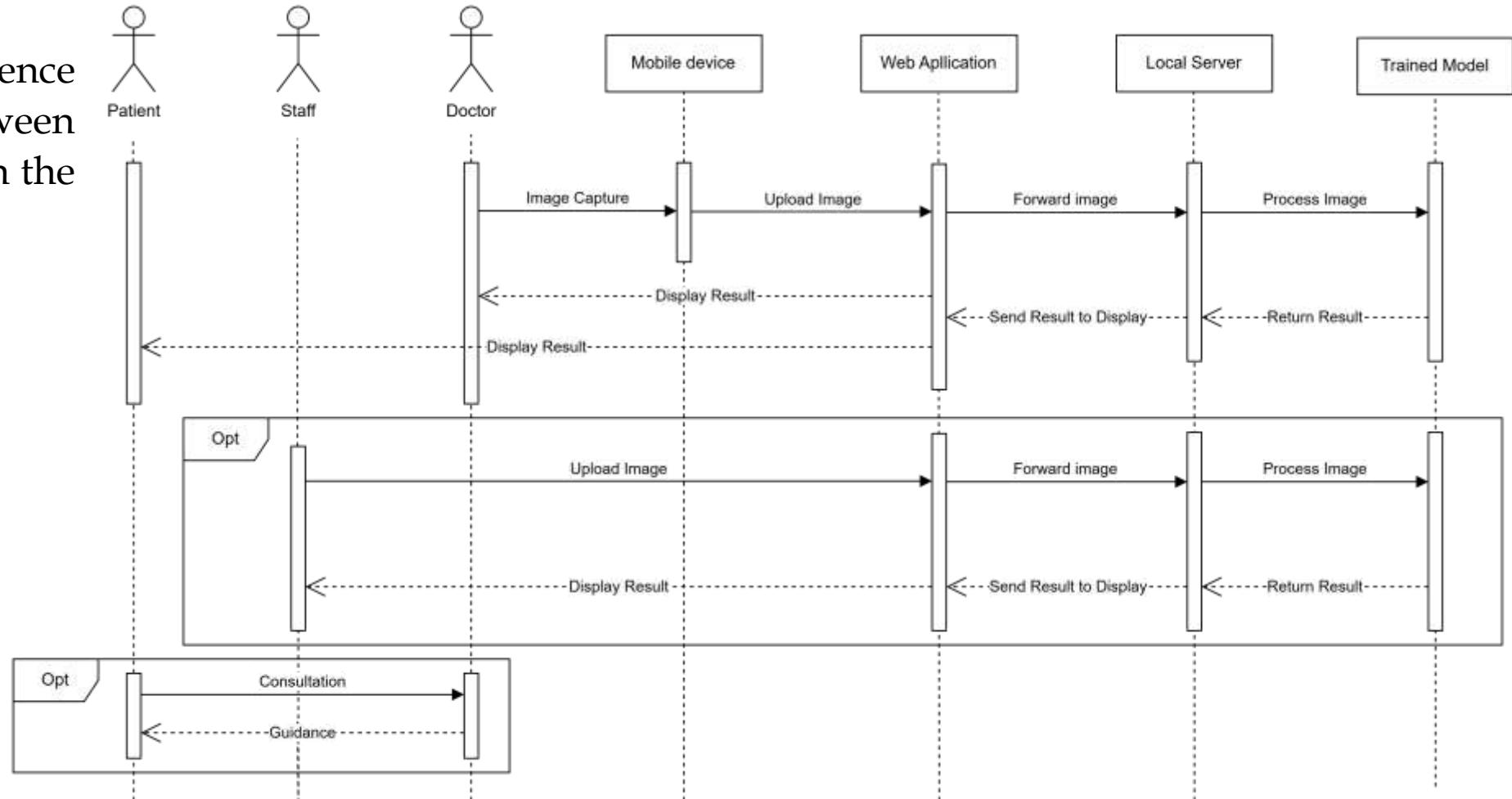
# Use Case Diagram

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



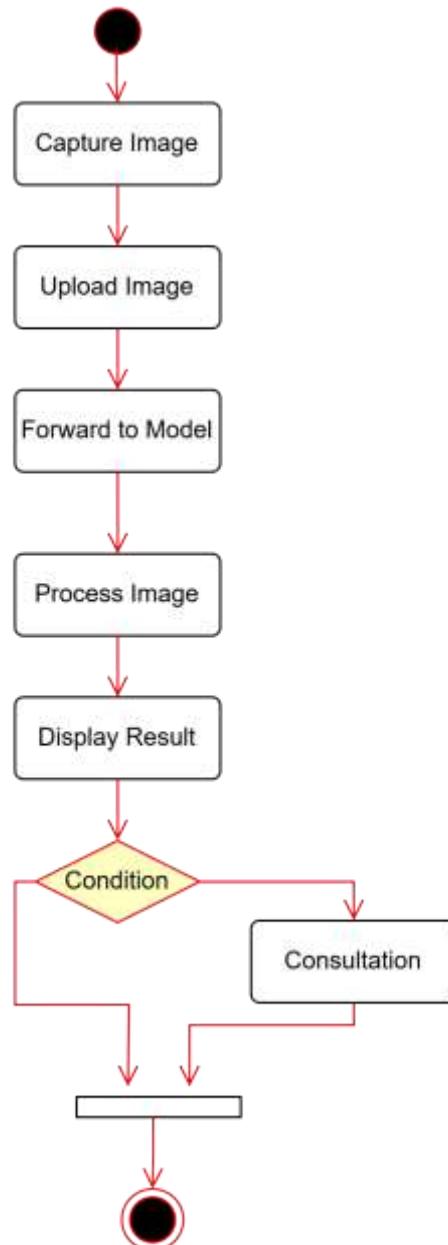
# Sequence Diagram

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

The screenshot shows a web browser window for 'localhost:8501'. The title bar includes standard icons for back, forward, and search, along with a star icon, a three-dot menu, and a colorful circular icon. On the right side of the title bar are 'Deploy' and a three-dot menu. The main content area has a header 'AI Powered Diabetic Retinopathy Detection' with a small AI robot icon to its left. Below the header is a welcome message: 'Welcome to our AI-powered Diabetic Retinopathy Detection app. This tool assists in detecting and classifying the severity of diabetic retinopathy from retina images. Please upload a retina image to begin.' To the left of the main content is a sidebar titled 'App Info' containing text: 'This AI tool was developed in collaboration with leading ophthalmologists.' Below this is a section titled 'Reference Conditions' showing two retina images labeled 'Non DR' and 'Edema'. The main content area features a file upload interface with a cloud icon, the text 'Drag and drop file here', and 'Limit 200MB per file • PNG, JPG, JPEG', and a 'Browse files' button. A placeholder message 'Please upload an image for prediction.' is also present.

localhost:8501

Deploy :

AI Powered Diabetic Retinopathy Detection

Welcome to our AI-powered Diabetic Retinopathy Detection app. This tool assists in detecting and classifying the severity of diabetic retinopathy from retina images. Please upload a retina image to begin.

Upload a retina image

Drag and drop file here  
Limit 200MB per file • PNG, JPG, JPEG

Browse files

Please upload an image for prediction.

This AI tool was developed in collaboration with leading ophthalmologists.

Reference Conditions

Non DR Edema

# User Interface (Cont...)

Developed by:

Nawab Khan and Team, in collaboration with [AI Health Care Society](#).



Dr. x. Ophthalmologist



Dr. y. Specialist

Deploy :

## AI Powered Diabetic Retinopathy Detection

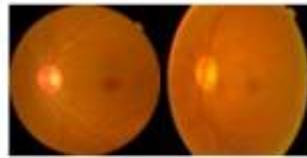
Welcome to our AI-powered Diabetic Retinopathy Detection app. This tool assists in detecting and classifying the severity of diabetic retinopathy from retina images. Please upload a retina image to begin.

Upload a retina image

Drag and drop file here  
Limit 200MB per file • PNG, JPG, JPEG

Browse files

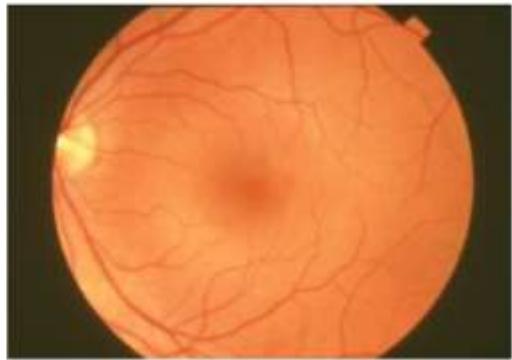
NEI-medialibrary-1499432.png 289.4KB X



No DR Mild



Moderate Severe



Uploaded Image

# User Interface (Cont...)

The image shows a mobile application for diabetic retinopathy screening. On the left, there's a sidebar titled "App Info" which contains text about the AI tool being developed in collaboration with leading ophthalmologists. Below this is a section titled "Reference Conditions" with two fundus photos labeled "No DR" and "Mild". The main panel features a fundus photo of a retina with hemorrhages, labeled "Uploaded Image". Above this image are four reference fundus photos arranged in a 2x2 grid, labeled "No DR", "Mild", "Moderate", and "Severe". A prediction message at the bottom states "Prediction: Mild Diabetic Retinopathy" with a note to consider dietary adjustments and monitor blood sugar. A disclaimer at the bottom of the main panel states that the app provides an initial analysis and should not replace professional medical advice.

# Conclusion

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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

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[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>

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# Thank You