



International Journal for Research in Science Engineering & Technology (IJRSET)

<https://www.doi.org/10.5281/zenodo.15608054>

RETINA ANALYSIS APP

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ABSTRACT: The Retina Image Analysis Android Application is an AI-powered mobile health (mHealth) solution designed to assist users in the early detection of retina-related disorders through deep learning and interactive guidance. Developed using Java/XML for Android and integrated with Firebase Realtime Database and Authentication, the app allows users to upload retina images from their device gallery and complete a symptom-based questionnaire. The core diagnostic process utilizes a Convolutional Neural Network (CNN) model deployed via TensorFlow Lite, which classifies retina images into disease categories and generates confidence scores in real-time.

To enhance interpretability and user support, the application includes an NLP-based chatbot assistant that responds to natural language queries, explains disease outcomes, and offers customized recommendations. The system further employs the Google Maps API to identify and display nearby retina specialists and eye hospitals based on the user's location, thus bridging the gap between digital diagnosis and clinical consultation.

This solution demonstrates how mobile AI, when combined with cloud-based data handling, chatbot interaction, and geolocation services, can empower patients with accurate health insights, promote early intervention, and reduce dependency on in-person screenings, especially in remote or underserved regions.

KEYWORDS: [Retina Disease Detection, Android Application, Convolutional Neural Network (CNN), TensorFlow Lite, Firebase, Natural Language Processing, AI Chatbot, Google Maps API, Mobile Health (mHealth), Image Classification, Eye Care, Deep Learning, Symptom Analysis, Realtime Database, Medical AI.]

1. INTRODUCTION

Vision is one of the most essential human senses, and the retina plays a critical role in translating visual signals into neural messages that the brain can interpret. However, retinal diseases such as diabetic retinopathy, macular degeneration, and retinal detachment have been rising globally, often progressing silently until severe vision loss occurs. The burden of these diseases is especially high in under-resourced regions where access to ophthalmic care

is limited. Early detection and timely treatment are crucial to prevent irreversible blindness—but traditional diagnosis methods require costly equipment and specialist consultation, which are not readily accessible to all.

In response to this challenge, the Retina Image Analysis Android Application has been developed as an intelligent, mobile-first healthcare solution that brings the power of artificial intelligence (AI) into the hands of patients and healthcare workers. Built using Java/XML for Android and integrated with Firebase for secure cloud-based storage and user authentication, the app allows users to upload retina images directly from their mobile gallery. These images are processed through a Convolutional Neural Network (CNN) model trained to detect early signs of retinal diseases. The model, optimized using TensorFlow Lite, runs on-device and returns disease predictions along with a confidence score.

To enhance diagnostic precision, the system incorporates a symptom-based questionnaire, which collects critical information about the user's visual symptoms, including vision clarity, floaters, headaches, and past eye conditions. These inputs are analysed alongside the image-based prediction to generate personalized recommendations. Furthermore, the app features an AI-powered chatbot assistant built using Natural Language Processing (NLP), capable of answering retina-related queries, educating users on potential conditions, and providing lifestyle or treatment advice in real time.

A unique aspect of the application is its integration with the Google Maps API, which allows users to identify and locate nearby eye care specialists and hospitals. This ensures that users can transition from preliminary digital screening to clinical consultation seamlessly and quickly. The development of this application demonstrates the synergy between AI, cloud computing, and mobile technology in revolutionizing healthcare delivery. It not only promotes early diagnosis and awareness but also supports patients through an intelligent, accessible, and interactive interface. With growing smartphone penetration and interest in mobile health (mHealth) technologies, the Retina Image Analysis App serves as a scalable model for future healthcare innovations.

2. LITERATURE SURVEY

The Several recent studies and technological advancements have demonstrated the effectiveness of using artificial intelligence and mobile platforms for early detection of retinal diseases. Convolutional Neural Networks (CNNs) have shown remarkable accuracy in classifying retina images into disease categories such as diabetic retinopathy and macular degeneration. Research by Amit Sharma, Rakesh Singh, and Meera Bhattacharya [1] emphasized the strength of deep learning models in identifying retinal abnormalities from high-resolution fundus images with over 90% accuracy.

To enhance accessibility, Li Chen, Yong Wu, and Shuang Zhang [2] developed optimized CNN models for deployment on mobile devices using TensorFlow Lite, enabling real-time image inference without requiring a persistent cloud connection. Additionally, Suresh Patel, Divya Khanna, and Rohan Prasad [3] explored the use of Natural Language Processing (NLP) in healthcare chatbots. Their findings highlighted the chatbot's ability to improve user engagement, deliver health education, and provide real-time support for common medical queries.

James M. Andrews and Takashi Nakamura [4] demonstrated the use of transfer learning for improving accuracy in retinal image classification, achieving over 94% performance using models like ResNet50. Other research by Ravi Mehta and Manasi Kulkarni [7] combined symptom checkers with image analysis to improve diagnosis quality—an approach closely aligned with the methodology used in this project.

Moreover, Farah Al-Rawi, Harpreet Singh, and Nabeel Bashir [8] implemented AI-based mobile health tools for remote rural diagnosis, proving the effectiveness of combining mobile devices, AI inference, and geolocation for field-level eye care. This directly supports the decision to integrate Google Maps API and Firebase Realtime Database in our application.

The literature reviewed provides a solid foundation and validation for combining CNN-based image classification, NLP-driven chatbot support, and cloud-connected mobile architecture for real-world retina health analysis.

3. METHODOLOGY

The development of the Retina Image Analysis Android Application follows a structured and modular methodology combining mobile development, deep learning inference, symptom-based assessment, and AI-driven assistance.

First, the application is built using Java/XML on Android Studio, with user authentication and data management handled by Firebase Authentication and Realtime Database. Users can upload retina images from their gallery, which are pre-processed (resized and normalized) before being analysed by a TensorFlow Lite CNN model trained on a labelled dataset of retina conditions.

Simultaneously, users complete a symptom-based questionnaire that collects information on visual discomfort, floaters, or pain, which is then combined with

model predictions to enhance diagnostic confidence. The results are securely stored and retrieved using Firebase.

To support patient awareness, an NLP-powered chatbot (using Dialog flow or Gemini API) interprets user queries in natural language and provides contextual responses about the predicted condition. Lastly, the app leverages the Google Maps API to suggest nearby retina specialists or hospitals based on the user's geolocation.

This multi-layered methodology ensures the application delivers personalized, intelligent, and location-aware diagnostic support, accessible through a user-friendly mobile interface.

4. Experimental results

The experimental evaluation of the Retina Image Analysis Android App was conducted through a series of tests to assess the effectiveness, accuracy, performance, and usability of its core modules—namely the CNN-based image classifier, the questionnaire-based risk evaluator, chatbot interactions, and nearby doctor locator.

The goal of the experimental phase was to validate:

The prediction accuracy of the CNN model

The effectiveness of combining questionnaire data with model output

Performance efficiency on various devices

Overall user experience and system reliability

CNN Model Accuracy Evaluation

The CNN model was trained on a publicly available retina dataset and tested for its ability to classify images into three categories: Normal, Diabetic Retinopathy, and Macular Degeneration.

Metric	Value
Training Accuracy	96.4%
Validation Accuracy	91.8%
TFLite Inference Time	1.2 sec/image
Confusion Matrix Accuracy	90.5%
Model Size (TFLite)	3.1 MB

CONCLUSION

The Retina Image Analysis Android Application has successfully demonstrated the integration of artificial intelligence, cloud computing, and mobile technology to create a comprehensive solution for early detection and management of retinal diseases. By allowing users to upload retina images, complete a symptom-based questionnaire, interact with a natural language chatbot, and locate nearby specialists—all from a smartphone—the application addresses a critical healthcare gap, especially in underserved and remote areas.

The CNN model deployed via TensorFlow Lite enables efficient on-device image classification, while Firebase provides a secure and scalable backend for real-time data handling. The inclusion of a NLP-driven chatbot and Google Maps API ensures user engagement, education, and immediate access to clinical care, bridging the gap

between AI-based prediction and professional medical consultation.

With its modular, responsive, and user-friendly design, the project stands as a successful implementation of a mobile health (mHealth) system. It not only promotes early diagnosis and awareness of retinal diseases but also sets the foundation for future enhancements such as camera-based scanning, multilingual support, and real-time doctor appointment booking. In conclusion, the project fulfills both its technical and social objectives empowering users with AI-driven insights, guiding them through intelligent interfaces, and connecting them to real-world care when needed. It serves as a scalable prototype for future AI-powered diagnostic tools in digital health.

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