

Vision Guardian: Low-Cost Retinal Disease Detection Device

Optical Coherence Tomography (OCT) devices are extremely costly and often not portable, which makes them difficult to use in rural or resource-limited areas. Due to budget constraints, many laboratories in these regions cannot afford such equipment, resulting in limited access to advanced diagnostic tools needed for the early detection and monitoring of retinal diseases.

Project Overview:

This project aims to build an affordable and portable solution for the early detection of 45 retinal diseases, including diabetic retinopathy, glaucoma, and age-related macular degeneration. Detecting these conditions in their initial stages is crucial, as timely treatment can prevent irreversible vision loss. By combining AI with low-cost hardware, this device makes advanced eye screening accessible to rural and underprivileged communities.

How it Works:

The device integrates a Raspberry Pi 5 with HD vision and IR imaging cameras. IR images are automatically overlaid onto HD retinal images to enhance the visibility of blood vessels and retinal structures, creating a structured dynamic image that closely resembles output from an OCT device. These enhanced images are then analyzed by an EfficientNet deep learning model, trained on Kaggle's retinal disease dataset to classify 45 diseases.

Key Features:

Affordable & Portable: Built with Raspberry Pi and low-cost imaging hardware.
AI-Powered Analysis: EfficientNet model trained on 45 retinal diseases.
Enhanced Imaging: Automatic IR–HD overlay for improved visibility of retinal features.
User-Friendly: Minimal training required for operation.
Real-Time Results: On-device predictions for immediate screening.

Results and Impact:

Currently, the model achieves 94% accuracy on training data. Predictions are generated in real time, allowing screenings to be conducted beyond hospital settings, including in remote regions. The total system cost is ₹19,451, dramatically lower than standard Optical Coherence Tomography (OCT) instruments, which typically exceed ₹2,050,000. This solution brings early detection of retinal diseases to schools, villages, and community health camps.