DR DETECTOR

User Manual

Offline Diabetic Retinopathy Screening

Version	1.0
Platform	iOS · Android · Windows · macOS · Linux
Audience	Community health workers, nurses, primary care clinicians
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FOR CLINICAL SCREENING ASSISTANCE ONLY — NOT A DIAGNOSTIC DEVICE · Results must be interpreted by a trained health professional

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1. Introduction

Diabetic retinopathy (DR) is the leading cause of preventable blindness in working-age adults worldwide. An estimated 103 million people have DR, and the condition can remain asymptomatic until irreversible vision loss has already occurred. Early detection through regular fundus photography screening, combined with timely specialist referral, can prevent up to 98% of severe vision loss.

DR Detector brings AI-powered retinal screening to clinics with no reliable internet connection and no access to ophthalmologists. The app runs entirely offline on standard smartphones and laptops — all analysis happens on the device in under five seconds. No patient data ever leaves the device.

What DR Detector does:

- Captures a retinal fundus image using a low-cost camera attachment
- Analyses the image using a deep learning model trained on 88,000 labelled fundus photographs
- Grades across four severity levels aligned with the International Clinical DR Severity Scale
- Displays a colour-coded result with a specific clinical action recommendation
- Saves a permanent record locally with patient ID and timestamp
- Generates a formatted PDF screening report for patient records

What DR Detector does NOT do:

- Diagnose diabetic macular oedema (DMO) — OCT or slit-lamp examination is required
- Replace a comprehensive ophthalmic examination by a qualified ophthalmologist
- Classify glaucoma, hypertensive retinopathy, or other non-DR conditions
- Guarantee accuracy — the model has known limitations described in Section 11

> ***Intended users:*** *Community health workers, nurses, and primary care clinicians in resource-limited settings. No ophthalmology training is required to operate the app. Clinical interpretation should follow local referral protocols.*

2. Before You Begin — Hardware Setup

DR Detector requires a retinal camera attachment that fits over your smartphone's rear camera lens, redirecting light from the patient's retina onto the phone's image sensor.

Supported camera attachments

Device	Platform	Approx. Cost	Notes
D-EYE Fundus Camera	iPhone	~$500	Clinical-grade, mydriatic/non-mydriatic
Volk iNview	iOS / Android	~$300	Non-mydriatic, wide field
Peek Retina Adapter	Android	~$200	Designed for low-resource settings
DIY 20D Lens Adapter	Any	$50–100	3D-printable frame + 20-dioptre condensing lens

Device requirements

Component	Minimum	Recommended
RAM	2 GB	4 GB or more
Storage	200 MB free	1 GB free (image archive)
Camera	8 MP rear	12 MP or higher
OS (mobile)	iOS 15 / Android 8.1	iOS 17 / Android 13
OS (desktop)	Win 10 / macOS 11 / Ubuntu 20.04	Win 11 / macOS 14
Internet	Not required	Not required

3. Quick Start (5 Steps)

1 **Attach the camera**
Clip the retinal camera adapter firmly over your phone's rear camera lens. Ensure the lens is clean.

2 **Enter the Patient ID**
Tap the Patient ID field and type the patient's clinic number. Tap [+NEW] to auto-generate a new ID.

3 **Position and capture**
Ask the patient to look straight ahead. Dim the room. Press the CAPTURE IMAGE button.

4 **Review the result**
Within 5 seconds, the Analysis screen shows a colour-coded grade, confidence %, and action.

5 **Save and proceed**
Tap SAVE to store the result, PDF to generate a report, or NEXT for the next patient.

Tip: *DR Detector keeps the screen awake during a clinic session. The app remembers the last Patient ID until you tap +NEW or change it manually.*

4. Screen-by-Screen Guide

4.1 Capture Screen

The home screen. Opens automatically at startup and returns here after each screening.

Camera viewport: Live preview from the rear camera. A dashed circle guides you to centre the optic disc. The alignment ring is 220 px to capture the disc and surrounding retina.

Patient ID field: Accepts alphanumeric input up to 20 characters. Existing patients are recognised automatically — previous history is accessible from the Analysis Screen.

[+NEW] button: Creates a new patient with an auto-generated ID (PT-XXXXXX) derived from the current timestamp. Use for walk-in patients without an existing clinic number.

CAPTURE IMAGE button: The primary action. Takes a photo, copies it to local storage, and immediately begins analysis. Shows a spinner while saving.

4.2 Analysis Screen

Two phases appear automatically in sequence:

Phase 1 — Analysing

- Captured image appears dimmed in the background
- Progress bar advances through 4 steps: Loading model → Preprocessing → Inference → Confidence
- Typical total time: 1–4 seconds on mid-range devices (up to 5 s on older hardware)
- No user action required during this phase

Phase 2 — Results

- Retinal image displayed with coloured border and severity badge
- Diagnosis label, confidence %, and clinical action recommendation
- Probability breakdown chart shows confidence across all four grades
- Yellow warning if confidence < 70% — consider retaking the image
- SAVE stores the result; PDF exports a report; NEXT advances to the next patient

4.3 History Screen

Chronological list of all screenings for a specific patient, most recent first. Each record shows date, time, grade, confidence, and export status. Access via the 'View history' link on the Analysis Screen.

5. Understanding Your Results

Results are graded across four severity levels aligned with the International Clinical Diabetic Retinopathy (ICDR) Severity Scale.

Colour	Grade	Meaning	Recommended Action
GREEN	No Retinopathy	No lesions detected	Routine screening — recall in 12 months
YELLOW	Mild NPDR	Microaneurysms only	Ophthalmology review within 6 months
ORANGE	Moderate NPDR	Haemorrhages / hard exudates	Refer to ophthalmologist within 3 months
RED	Severe NPDR / PDR	Extensive lesions / neovascularisation	URGENT referral — same day if possible

Confidence percentage

Confidence	Interpretation	Action
90–100%	High — clear image, strong signal	Proceed with clinical action
70–89%	Moderate — acceptable for screening	Proceed; note confidence in record
60–69%	Low — image may be blurry or poorly lit	Consider retaking the image
< 60%	Very low — result unreliable	Retake the image before acting

6. Saving Records and Exporting PDFs

Saving to the local database

Tapping SAVE stores the screening result in the device's local SQLite database. Each record includes: Patient ID, screening ID, image file path, grade, confidence, full probability distribution, inference time, and timestamp. The database is stored in the app's private sandbox.

> **Important: The app auto-saves before navigating away when you tap NEXT. Pressing the back arrow to return to Capture without tapping SAVE or NEXT will NOT save the result.**

Exporting a PDF report

Tapping PDF generates a formatted A4 report and opens the share sheet:

- Print directly to a Bluetooth or Wi-Fi printer
- Send via WhatsApp, email, or SMS to a referral centre
- Save to the device's Files app for later upload
- Share to a hospital EMR system's email address

The PDF includes: patient ID, screening ID, date/time, grade with colour coding, confidence, probability breakdown, retinal image, clinical action, and regulatory disclaimer.

7. Working Offline

Every feature works without internet connectivity. The AI model is stored inside the app and loads from local storage at startup.

- Camera capture — fully offline
- AI analysis — model runs on device CPU/GPU (CoreML on iOS, NNAPI on Android)
- Database storage — local SQLite, no cloud sync
- PDF generation — rendered entirely on-device
- PDF sharing — requires connectivity only if sending via email or WhatsApp

> *No account, login, or API key is required. There are no usage limits or subscription fees for offline operation.*

8. Image Quality Guide

Image quality is the single biggest factor affecting accuracy. These practices will maximise results:

DO	AVOID
Use a darkened room — reduces glare	Bright ambient lighting (causes lens reflections)
Centre the optic disc in the alignment circle	Peripheral retina only — optic disc must be visible
Hold the phone steady; rest wrist on a surface	Motion blur from shaky hands
Dilate with 1% tropicamide where available	Very small pupils (< 4 mm) reduce quality significantly
Ask patient to fixate straight ahead	Patient looking away — causes off-axis imaging
Clean camera lens and adapter before each session	Fingerprint smears or dust on the lens

9. Troubleshooting

Problem: Camera permission denied

Solution: Go to device Settings > Privacy > Camera and enable DR Detector. On Android: Settings > Apps > DR Detector > Permissions.

Problem: Analysis takes more than 10 seconds

Solution: The model may still be loading on first use; subsequent analyses will be faster. If persistent, close all other apps (needs 2 GB free RAM) and restart.

Problem: Confidence below 60% on every image

Solution: Check camera adapter alignment, clean the lens, dim the room, and adjust adapter distance from the eye by 2–3 mm. Pupil dilation improves quality significantly.

Problem: PDF export shows 'Sharing unavailable'

Solution: On some Android devices sharing may be policy-restricted. Save to Files first, then share from the Files app.

Problem: App crashes after capturing

Solution: Insufficient RAM. Close background apps and free at least 500 MB of storage, then retry.

Problem: Patient ID not found in history

Solution: IDs are case-sensitive on some platforms. Check the exact ID used on the Analysis Screen.

Problem: Screen turns off during clinic session

Solution: DR Detector keeps the screen awake on the Capture screen. If timeout occurs, the app was backgrounded — return to Capture.

10. Clinical Referral Guidance

DR Detector's recommendations are based on international guidelines. Adapt to your local referral pathways and specialist availability.

Grade	Typical Interval	Priority	Notes
No Retinopathy (0)	Annual screening	Routine	Optimise glycaemic control, BP, lipids. Rescreen in 12 months.
Mild NPDR (1)	6-month review	Non-urgent	Microaneurysms present. Intensify medical management.
Moderate NPDR (2)	3-month referral	Semi-urgent	Haemorrhages / exudates. Refer within 3 months. Consider laser eligibility.
Severe NPDR / PDR (3)	Same-day to 1 week	**URGENT**	Extensive lesions or neovascularisation. Same-day referral if possible. Anti-VEGF urg

11. Safety and Limitations

Regulatory status: DR Detector is a clinical screening aid and has NOT been cleared as a medical device by the FDA, CE, CDSCO, or any other regulatory authority. It must not be used as a standalone diagnostic tool.

Known model limitations

- Trained primarily on EyePACS US patients — performance may vary with different retinal pigmentation
- Diabetic macular oedema (DMO) is not detected — assess separately with OCT or slit-lamp
- Glaucoma, hypertensive retinopathy, and other conditions are not classified
- Very poor image quality will produce unreliable results regardless of confidence display
- Lens opacities (cataracts) reduce image quality and may cause undergrading
- Fine-grained distinctions within moderate NPDR are not reliable

Data privacy

- All patient data stored only on the device — no transmission to any server
- Retinal images are biometric health data — apply appropriate device security (PIN, biometric lock)
- Enable device-level encryption to protect data against device loss or theft
- If the device is shared between clinicians, use separate device user accounts

12. Frequently Asked Questions

Q: Does the app need internet to work?

A: No. All functions work completely offline. Internet is only needed if you choose to share a PDF via email or WhatsApp.

Q: How accurate is the AI model?

A: On the EyePACS test set the model achieves approximately 83–86% 4-class accuracy and ~91% sensitivity for referable DR (Grade 2+). Local validation on your patient population is strongly recommended.

Q: Can I use the front camera?

A: No. Retinal imaging requires the rear camera which has higher resolution and connects to the adapter.

Q: How many patients can I screen per day?

A: No built-in limit. Experienced operators typically screen 60–120 patients per day.

Q: What if I accidentally screen the wrong patient?

A: Records cannot be deleted. Note the error in your patient management system and follow your institution's data correction procedure.

Q: Does it work for patients with cataracts?

A: Moderate-to-severe cataracts reduce fundus image quality significantly. The app will flag low confidence. Refer the patient for cataract assessment alongside DR evaluation.

Q: Can I use the app on a tablet?

A: The app runs on tablets but the camera adapter may not fit tablet rear cameras. Use a phone for capture.