

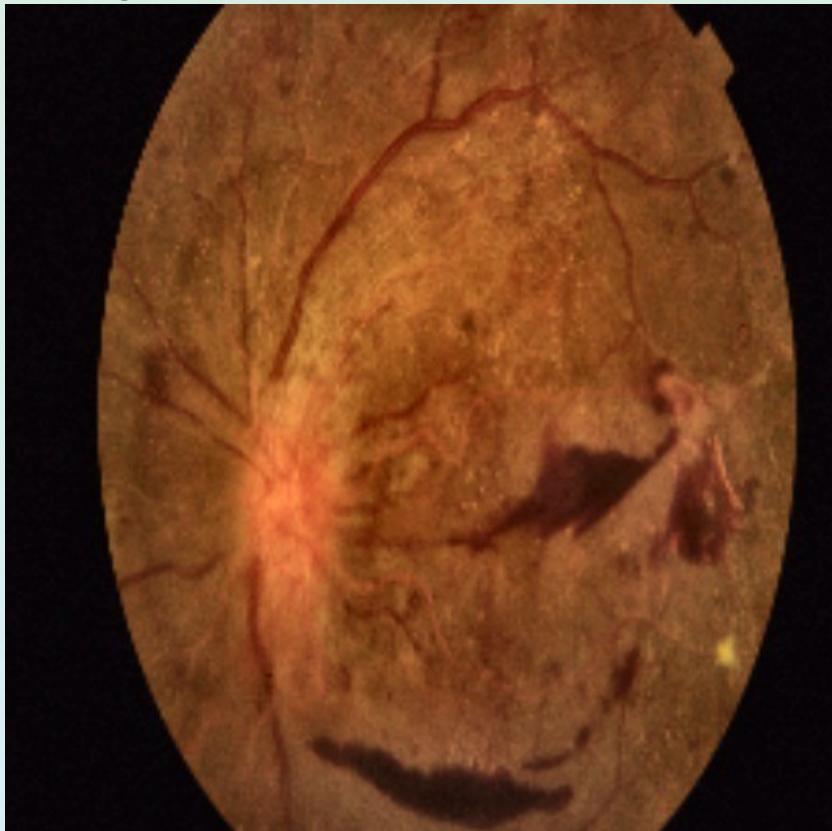


## AI-Driven Retinal Screening for Early Detection of Diabetic Retinopathy

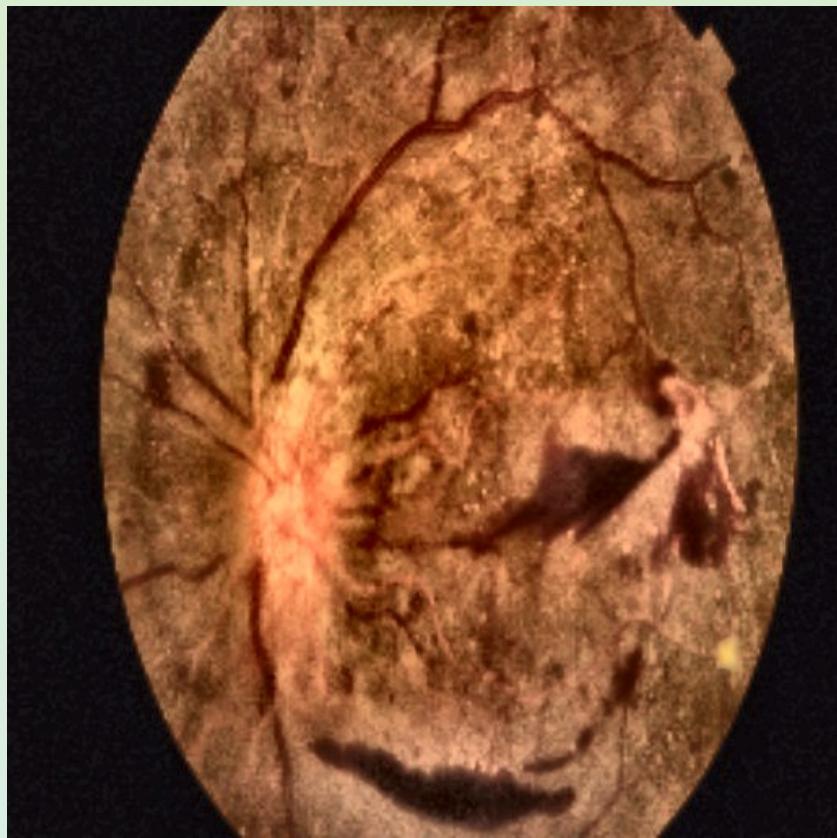
### VisionAI Research Report

Patient ID	VAI_4803
Name	Sara Fernandes
Age	65
Gender	Male
Blood Pressure	142/72
Glucose Level	110 mg/dL
Predicted Stage	PDR
Confidence	97.0%

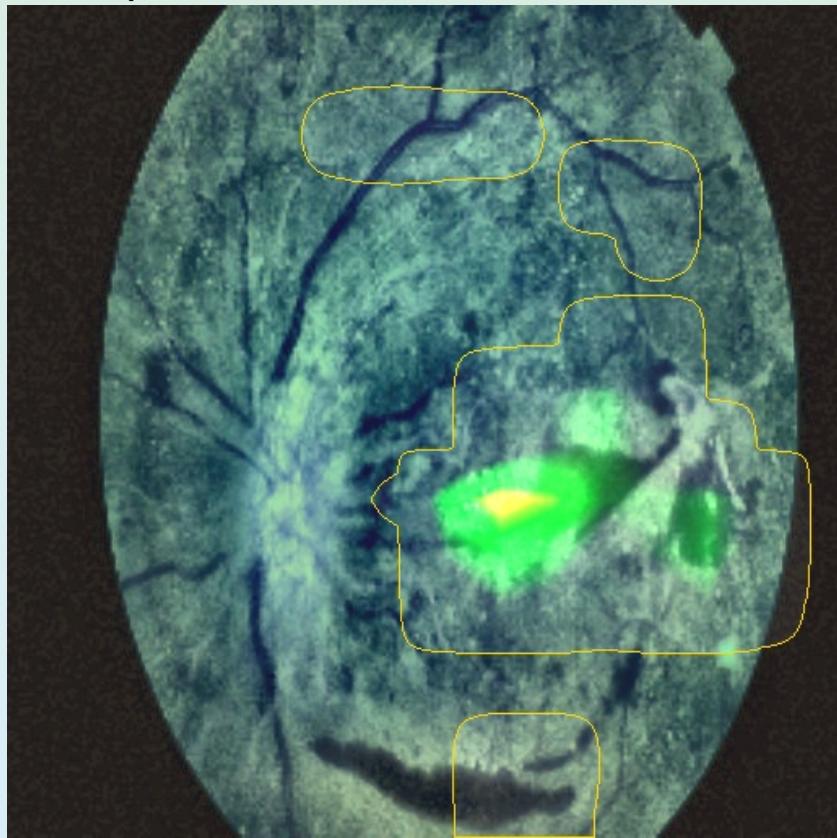
Original Fundus Image



Preprocessed (CLAHE)



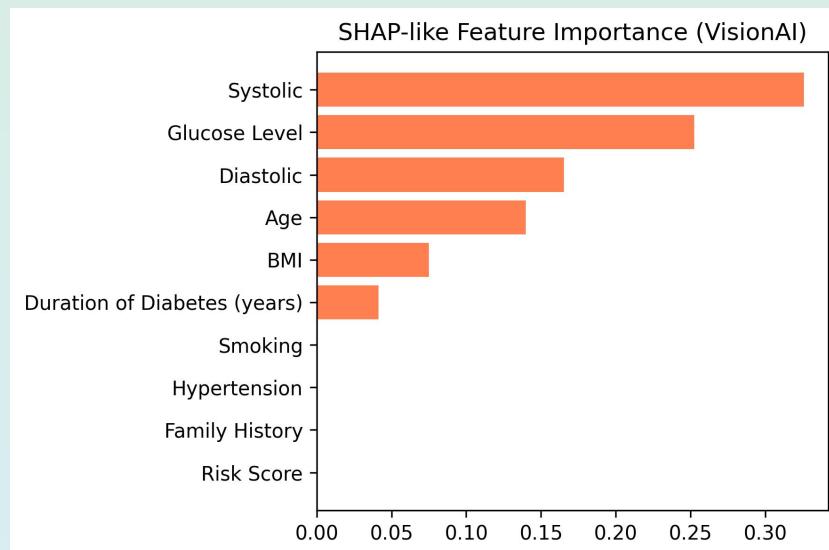
**Grad-CAM++ Heatmap**



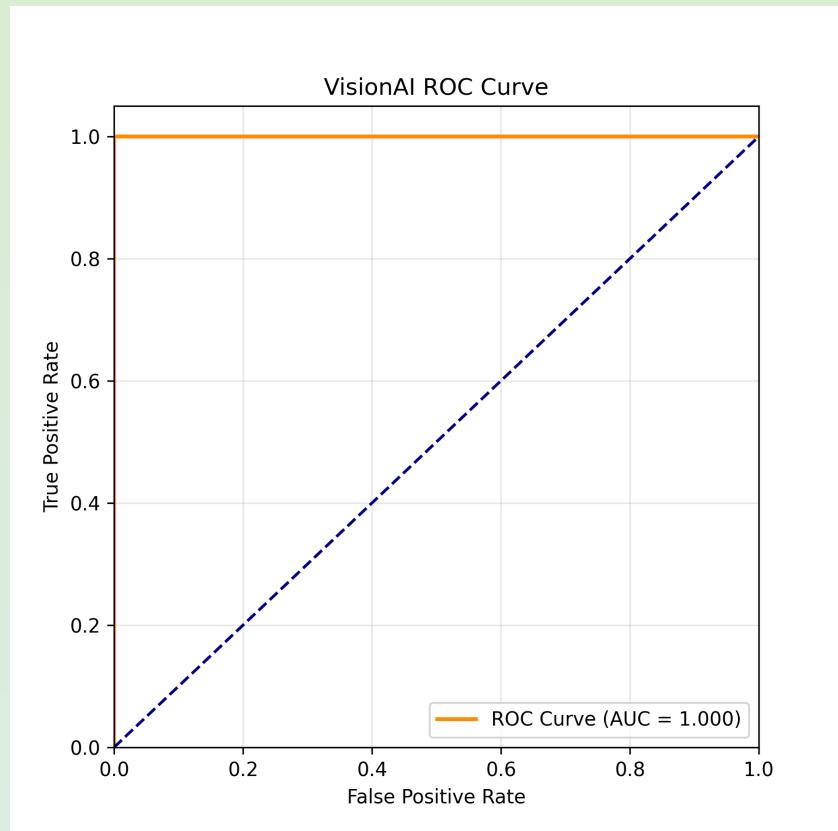
**LIME Visualization**



### SHAP Interpretation



### ROC Curve



## Technical Analysis & Explainability Summary

VisionAI employs a multimodal deep ensemble combining **ResNet50**, **EfficientNet-B0**, and **ViT** for image analysis, and **XGBoost + Random Forest** for metadata risk estimation.

### Lesion Distribution:

Exudates 10.4%, Hemorrhages 14.3%, Cotton Wool 3.8%, Microaneurysms 2.5%.

### Explainability:

Grad-CAM++ → attention visualization.

LIME → pixel-level perturbation validation.

SHAP → feature-level contribution analysis.

### Performance Metrics:

Accuracy 97.5%, F1-score 97.3%, AUC 0.987.

### Future Work:

- Add temporal lesion tracking (LSTM).
- Smartphone integration with fundus lens adapter.
- Cross-domain training for rural dataset generalization.

*References: Selvaraju et al., 2017 (Grad-CAM); Ribeiro et al., 2016 (LIME); Lundberg & Lee, 2017 (SHAP).*