APPENDICES

Appendix A. Author Profile

Ni Wayan Putri Satya Uttami was born in Cimahi, 2003. Her research journey often begins with a simple observation: something in everyday life could work better. As an Information Systems student at Universitas Pendidikan Ganesha with a Junior Web Developer BNSP certification, and four years of development experience, she explores how technology can respond to real human needs. Her curiosity has led her from identifying emotions in hospital reviews using ALBERT to uncovering purchasing patterns through the Apriori algorithm. Across her projects, Satya combines data analysis, human-centered design, and full-stack development to transform questions into practical solutions. Her research interests include applied artificial intelligence, natural language processing, explainable decision support, and inclusive intelligent systems. She hopes to create responsible technologies that support better decisions without losing sight of the people behind the data.

Appendix B. Dataset Organization and Split Details

This appendix documents the official IDRiD distribution and the two train–validation organizations used across the experimental branches.

Table B.1

Official IDRiD Distribution before Train-Validation Splitting

Official split	Grade 0	Grade 1	Grade 2	Grade 3	Grade 4	Total
Raw official train	134	20	136	74	49	413
Raw official test	34	5	32	19	13	103
Total	168	25	168	93	62	516

Table B.2

Pre-Organized data/IDRiD_data Folder Distribution

Split	Grade 0	Grade 1	Grade 2	Grade 3	Grade 4	Total
Training	107	16	108	59	39	329
Validation	27	4	28	15	10	84
Test	34	5	32	19	13	103
Total	168	25	168	93	62	516

Table B.3

Raw-CSV Internal Stratified Split Used by the Main RGB Baselines

Split	Grade 0	Grade 1	Grade 2	Grade 3	Grade 4	Total
Training	107	16	109	59	39	330
Validation	27	4	27	15	10	83
Test	34	5	32	19	13	103

The raw-CSV and folder-based organizations differ by one Grade-2 image in the train–validation allocation. The official test set remains unchanged.

Appendix C. Preprocessing and Augmentation Configurations

Table C.1

Summary of Image-Level Treatments

Treatment	Input size	Base preprocessing	Training augmentation	Validation and test preprocessing
Basic RGB	512 × 512	Resize and ImageNet normalization	None	Clean resize and normalization
CLAHE-Balanced RGB	512 × 512	CLAHE, resize, and ImageNet normalization	On-the-fly virtual balancing with flips, brightness or contrast adjustment, CLAHE variants, Gaussian noise, and rotations	Clean CLAHE preprocessing and resize
Diverse Retinal Augmentation RGB	224 × 224	Resize or crop and IDRiD normalization	On-the-fly geometric, elastic, distortion, sharpness, blur, vignette, and photometric transformations	Clean resize and IDRiD normalization
Offline feature representation	Backbone-specific	Image preprocessing before inference-	Augmented variants stored as separate *.npy* feature	Clean *.npy* representations

Treatment	Input size	Base preprocessing	Training augmentation	Validation and test preprocessing
		mode feature extraction	vectors	

Table C.2

CLAHE-Balanced Effective Training Multipliers

Grade	Original training samples	Target virtual samples	Approximate effective multiplier
Grade 0	107	959	9×
Grade 1	16	959	60×
Grade 2	109	959	9×
Grade 3	59	959	16×
Grade 4	39	959	25×
Total	330	4,795	

Table C.3

Diverse Retinal Augmentation Repeat Ratios

Grade	Repetition factor
Grade 0	1×
Grade 1	7×
Grade 2	1×
Grade 3	2×
Grade 4	3×

Appendix D. Model Architecture and Training Configuration

Table D.1

Main Model Families

Model family	Main input	Core architecture	Output
End-to-End RGB MobileNet	RGB image tensors	ImageNet-pretrained MobileNetV3-Large or MobileNetV3-Small	Five-class logits
Offline MobileNet Feature Classifier	MobileNet 960-d *.npy* vectors	Multilayer perceptron	Five-class logits
Dual-Backbone Cross-Attention Fusion	RETFound 1024-d and MobileNet 960-d features	Cross-attention and classifier head	Five-class logits
Regularized Cross-Attention Fusion	RETFound 1024-d and MobileNet 960-d features	Cross-attention, regularized tower, and residual projection	Five-class logits
Gated Feature Fusion	RETFound 1024-d and MobileNet 960-d features	MobileNet-primary additive fusion with a learned gate	Five-class logits
HPO-Tuned Gated Feature Fusion	RETFound 1024-d and MobileNet 960-d features	Same gated architecture with Optuna-selected hyperparameters	Five-class logits

Table D.2

RGB MobileNet Default Training Configuration

Configuration item	Value
Maximum epochs	80
Early-stopping patience	15
Learning rate	3×10^{-4}
Weight decay	1×10^{-4}
Dropout	0.2
Optimizer	AdamW
Scheduler	Cosine annealing
Loss	Cross-entropy
Checkpoint criterion	Highest validation QWK
Seed	42

Table D.3

Feature-Based Training Components

Component	**Used in the selected gated-fusion family**
Focal loss	Yes
Class-level alpha	Yes
Weighted sampler	Yes
Label smoothing	Yes
Ordinal-distance penalty	Yes
Feature-space mixup	Yes
General dropout	Yes
RETFound-specific dropout	Yes
AdamW	Yes
Cosine warm restarts	Yes
Five-fold logit-averaging ensemble	Yes, for selected k-fold outputs

Appendix E. Complete External-Data Ablation Results

Table E.1

DiaRetDB-Only Gated-Fusion Results

Setting	Ratio	Accuracy	QWK	Macro AUC	Macro F1	Weighted F1
DiaRetDB-only	0.5	0.4660	0.6039	0.7731	0.3967	0.4624
DiaRetDB-only	1.0	0.4951	**0.6696**	0.7814	0.4319	0.5017
DiaRetDB-only	1.5	0.4951	0.6414	0.7773	**0.4589**	0.4996
DiaRetDB-only	2.0	0.4951	0.5949	**0.7826**	0.4372	0.4977

Table E.2

Targeted Grade-1 APTOS Gated-Fusion Results

Setting	Ratio	Accuracy	QWK	Macro AUC	Macro F1	Weighted F1
APTOS Grade-1	0.5	–	–	–	–	–
APTOS Grade-1	1.0	**0.5728**	0.7002	**0.7771**	**0.4603**	**0.5412**
APTOS Grade-1	1.5	0.5631	**0.7404**	0.7571	0.4001	0.5225
APTOS Grade-1	2.0	–	–	–	–	–

**The output files for the APTOS Grade-1 ratios of 0.5 and 2.0 were not available and were therefore excluded from the comparison.*

Table E.3

All-Grade APTOS Gated-Fusion Results

Setting	Ratio	Accuracy	QWK	Macro AUC	Macro F1	Weighted F1
APTOS all-grade	0.5	0.5631	0.6850	0.7485	0.4159	0.5356
APTOS all-grade	1.0	0.5049	0.5456	0.7765	0.4220	0.4891
APTOS all-grade	1.5	0.5728	0.6653	0.7868	0.4408	0.5519
APTOS all-grade	2.0	**0.6505**	**0.7790**	**0.8177**	**0.4982**	**0.6207**

Table E.4

Combined DiaRetDB and Targeted Grade-1 APTOS Results

Setting	Ratio	Accuracy	QWK	Macro AUC	Macro F1	Weighted F1
DiaRetDB + APTOS Grade-1	0.5	0.5437	0.7052	0.7822	0.3942	0.5130
DiaRetDB + APTOS Grade-1	1.0	**0.5631**	**0.7340**	0.7871	**0.4063**	**0.5283**
DiaRetDB + APTOS Grade-1	1.5	0.5534	0.6922	**0.7898**	0.3915	0.5191
DiaRetDB + APTOS Grade-1	2.0	0.5340	0.6722	0.7785	0.3719	0.5006

Table E.5

Combined DiaRetDB and All-Grade APTOS Results

Setting	Ratio	Accuracy	QWK	Macro AUC	Macro F1	Weighted F1
DiaRetDB + APTOS all-	0.25	0.5728	0.6987	0.7916	**0.4771**	0.5539

Setting	Ratio	Accuracy	QWK	Macro AUC	Macro F1	Weighted F1
grade						
DiaRetDB + APTOS all-grade	0.5	**0.5825**	0.6333	0.7861	0.4768	0.5575
DiaRetDB + APTOS all-grade	1.0	0.5146	0.6572	0.7993	0.4000	0.4962
DiaRetDB + APTOS all-grade	1.5	0.5049	0.5900	0.7993	0.4055	0.4913
DiaRetDB + APTOS all-grade	2.0	**0.5825**	**0.7166**	**0.8361**	0.4762	**0.5617**

Appendix F. Complete Hybrid Preprocessing Ablation Results

Table F.1

Hybrid Feature-Treatment Comparison

Feature treatment	Architecture	Accuracy	QWK	Macro AUC	Macro F1	Weighted F1
Diverse Retinal Augmentation features	Cross-Attention Fusion	0.5243	0.6355	0.7700	0.3618	0.4896
Diverse Retinal Augmentation features	Regularized Cross-Attention Fusion	0.5631	0.6657	0.7795	0.4296	0.5436
Diverse Retinal Augmentation features	Gated Feature Fusion	0.5825	0.6578	0.7842	0.4640	0.5675
Diverse Retinal Augmentation features	HPO-Tuned Gated Feature Fusion	**0.5922**	**0.6703**	**0.7965**	**0.4731**	**0.5758**
CLAHE-Balanced features	Cross-Attention Fusion	0.5146	0.6074	0.7756	0.4489	0.5103
CLAHE-Balanced features	Regularized Cross-Attention Fusion	0.5437	0.6138	0.7557	0.4880	0.5327
CLAHE-Balanced features	Gated Feature Fusion	0.5534	**0.7200**	0.7716	0.4539	0.5316
CLAHE-	HPO-Tuned	**0.5825**	0.7065	**0.7752**	**0.4906**	**0.5580**

Feature treatment	Architecture	Accuracy	QWK	Macro AUC	Macro F1	Weighted F1
Balanced features	Gated Feature Fusion					
CLAHE Diverse Target-959 features	Cross-Attention Fusion	0.5049	0.5769	**0.7909**	0.4487	0.4981
CLAHE Diverse Target-959 features	Regularized Cross-Attention Fusion	0.4854	0.5311	0.7080	0.4016	0.4747
CLAHE Diverse Target-959 features	Gated Feature Fusion	0.5243	0.5626	0.7630	0.3999	0.5050
CLAHE Diverse Target-959 features	HPO-Tuned Gated Feature Fusion	**0.5340**	**0.6194**	0.7515	**0.4688**	**0.5206**

Appendix G. Class-Level Evaluation and Confusion Matrices

This appendix presents the complete class-level evaluation results and confusion matrices for three representative models: the clean direct-RGB baseline, the selected deployment-oriented MobileNetV3 candidate, and the experimental-best severity-agreement model. In each confusion matrix, the rows represent the actual severity grades and the columns represent the predicted severity grades.

F.1 Basic RGB MobileNetV3-Large

Table G.1

Classification Report of the Basic RGB MobileNetV3-Large Model

Model	Row	Precision	Recall	F1-score	Support
Basic RGB MobileNetV3-Large	Grade 0	0.6667	0.5882	0.6250	34
Basic RGB MobileNetV3-Large	Grade 1	0.0000	0.0000	0.0000	5
Basic RGB MobileNetV3-Large	Grade 2	0.5000	0.5938	0.5429	32
Basic RGB MobileNetV3-Large	Grade 3	0.7500	0.3158	0.4444	19
Basic RGB MobileNetV3-Large	Grade 4	0.5714	0.6154	0.5926	13
Basic RGB MobileNetV3-Large	accuracy			0.5146	103
Basic RGB MobileNetV3-Large	macro avg	0.4976	0.4226	0.4410	103
Basic RGB MobileNetV3-Large	weighted avg	0.5859	0.5146	0.5317	103

Table G.2

Confusion Matrix of the Basic RGB MobileNetV3-Large Model

True \ Pred	Grade 0	Grade 1	Grade 2	Grade 3	Grade 4
Grade 0	20	10	4	0	0
Grade 1	3	0	2	0	0
Grade 2	5	3	19	1	4
Grade 3	2	0	9	6	2
Grade 4	0	0	4	1	8

F.2 CLAHE-Balanced RGB MobileNetV3-Large

Table G.3

Classification Report of the CLAHE-Balanced RGB MobileNetV3-Large Model

Model	Row	Precision	Recall	F1-score	Support
CLAHE-Balanced RGB MobileNetV3-Large	Grade 0	0.7045	0.9118	0.7949	34
CLAHE-Balanced RGB MobileNetV3-Large	Grade 1	0.0000	0.0000	0.0000	5
CLAHE-Balanced RGB MobileNetV3-Large	Grade 2	0.5682	0.7812	0.6579	32
CLAHE-Balanced RGB MobileNetV3-Large	Grade 3	0.8000	0.4211	0.5517	19
CLAHE-Balanced RGB MobileNetV3-Large	Grade 4	1.0000	0.3846	0.5556	13
CLAHE-Balanced RGB MobileNetV3-Large	accuracy			0.6699	103
CLAHE-Balanced RGB MobileNetV3-Large	macro avg	0.6145	0.4997	0.5120	103
CLAHE-Balanced RGB MobileNetV3-Large	weighted avg	0.6829	0.6699	0.6387	103

Table G.4

Confusion Matrix of the CLAHE-Balanced RGB MobileNetV3-Large Model

True \ Pred	Grade 0	Grade 1	Grade 2	Grade 3	Grade 4
Grade 0	31	0	3	0	0
Grade 1	3	0	2	0	0
Grade 2	5	0	25	2	0
Grade 3	3	0	8	8	0
Grade 4	2	0	6	0	5

F.3 Gated Feature Fusion with All-Grade APTOS Ratio 2.0

Table G.5

Classification Report of the Gated Feature Fusion Model with All-Grade APTOS Ratio 2.0

Model	Row	Precision	Recall	F1-score	Support
Gated Feature Fusion with All-Grade APTOS ratio 2.0	Grade 0	0.6875	0.9706	0.8049	34
Gated Feature Fusion with All-Grade APTOS ratio 2.0	Grade 1	0.0000	0.0000	0.0000	5
Gated Feature Fusion with All-Grade APTOS ratio 2.0	Grade 2	0.6429	0.5625	0.6000	32
Gated Feature Fusion with All-Grade APTOS ratio 2.0	Grade 3	0.5556	0.5263	0.5405	19
Gated Feature Fusion with All-Grade APTOS ratio 2.0	Grade 4	0.6667	0.4615	0.5455	13
Gated Feature Fusion with All-Grade APTOS ratio	accuracy			0.6505	103

Model	Row	Precision	Recall	F1-score	Support
2.0					
Gated Feature Fusion with All-Grade APTOS ratio 2.0	macro avg	0.5105	0.5042	0.4982	103
Gated Feature Fusion with All-Grade APTOS ratio 2.0	weighted avg	0.6133	0.6505	0.6207	103

Table G.6

Confusion Matrix of the Gated Feature Fusion Model with All-Grade APTOS Ratio 2.0

True \ Pred	Grade 0	Grade 1	Grade 2	Grade 3	Grade 4
Grade 0	33	0	1	0	0
Grade 1	5	0	0	0	0
Grade 2	8	0	18	5	1
Grade 3	2	0	5	10	2
Grade 4	0	0	4	3	6

The selected models represent the clean direct-RGB baseline, the best deployment-oriented MobileNet candidate, and the experimental-best severity-agreement model.

Appendix H. Deployment-Oriented Model Characteristics

Table H.1

RGB MobileNet Model Size and Recorded Experimental Timing

Model	**Stored *.pth* size**	**Parameter count**	**Recorded experimental inference time per image**	**Input size**	***.tflite* artifact found**
Basic RGB MobileNetV3-Large	16.26 MB	4,208,437	33.322 ms	512 × 512	No
CLAHE-Balanced RGB MobileNetV3-Large	16.26 MB	4,208,437	69.025 ms	512 × 512	Yes
CLAHE-Balanced RGB MobileNetV3-Small	5.94 MB	1,522,981	68.345 ms	224 × 224	No
Diverse Retinal Augmentation RGB MobileNetV3-Large	16.26 MB	4,208,437	31.507 ms	224 × 224	No

The recorded timings are experimental evaluation timings rather than strict end-to-end mobile latency benchmarks.

Appendix I. Script Traceability and Reproducibility Artifacts

Table I.1

Main Experiment Traceability Table

Report model name	Internal experiment code or folder	Main result JSON	Training script	Feature-extraction script
Basic RGB MobileNetV3-Large	*outputs_scheme_A_basic_mobilenetv3*	*alviantara_mobilenetv3_results.json*	*train_mobilenetv3_alviantara_baseline.py*	Not applicable
CLAHE-Balanced RGB MobileNetV3-Large	*outputs_alviantara_mobilenetv3*	*alviantara_mobilenetv3_results.json*	*train_mobilenetv3_alviantara_baseline.py*	Not applicable
CLAHE-Balanced RGB MobileNetV3-Small	*outputs_mobilenetv3_small_alviantara_aug/alviantara_aug*	*mobilenetv3_small_results.json*	train_mobilenetv3_small_idrid_alviantara_newaug.py	Not applicable
Diverse Retinal Augmentation RGB MobileNetV3-Large	*outputs_mobilenetv3_large_aug4_rgb*	*mobilenetv3_large_aug4_rgb_results.json*	*train_mobilenetv3_large_aug4_rgb.py*	Not applicable
Offline MobileNet Feature Classifier	*outputs_mobilenetv3_large_alviantara_npy*	*hybrid_test_results.json*	*mobilenet_v6.py*	train_hybrid_alviantara_npy.py
Dual-	*outputs_hybri*	*hybrid_test_r*	*train_*improv	*extract_featur*

Report model name	Internal experiment code or folder	Main result JSON	Training script	Feature-extraction script
Backbone Cross-Attention Fusion	*d_evolution_detailed/v4_cross_attention*	*esults.json*	*ed4.py*	*es_aug4.py*
Regularized Cross-Attention Fusion	*outputs_hybrid_evolution_detailed/v5_generalization_fixes*	*hybrid_test_results.json*	*train_improved5.py*	*extract_features_aug4.py*
Gated Feature Fusion	*outputs_hybrid_evolution_detailed/v6_gated_fusion*	*hybrid_test_results.json*	*train_improved6.py*	*extract_features_aug4.py*
HPO-Tuned Gated Feature Fusion	*outputs_hybrid_evolution_detailed/v6a_gated_fusion_hpo*	*hybrid_test_results.json*	*train_improved6.py*	*extract_features_aug4.py*
Gated Feature Fusion with All-Grade APTOS External Augmentation, ratio 2.0	*outputs_hybrid_alviantara_aptos_all_ratio_2p0/v6_gated_fusion*	*hybrid_test_results.json*	*train_improved6.py*	*extract_features_alviantara_external.py*

Table I.2

Computing Environment

Component	Recorded environment
Operating system	Ubuntu 24.04.3 LTS
Kernel	Linux 6.8.0-111-generic
Python	3.12.3
GPU	NVIDIA GeForce RTX 3050
GPU memory	Approximately 6 GB
NVIDIA driver	580.126.09
PyTorch	2.5.1+cu121
Torchvision	0.20.1+cu121
PyTorch CUDA build	12.1
cuDNN	9.1
NumPy	2.3.5
Pandas	3.0.1
Scikit-learn	1.8.0
OpenCV	4.13.0.92
timm	0.9.2
Optuna	4.8.0

Appendix J. Environment Freeze

Table J.1

Complete Python Package Environment

Package	Version
absl-py	2.4.0
albucore	0.0.24
albumentations	2.0.8
alembic	1.18.4
annotated-doc	0.0.4
annotated-types	0.7.0
anyio	4.12.1
argon2-cffi	25.1.0
argon2-cffi-bindings	25.1.0
arrow	1.4.0
asttokens	3.0.1
astunparse	1.6.3
async-lru	2.1.0
attrs	25.4.0
babel	2.18.0
beautifulsoup4	4.14.3
bleach	6.3.0
certifi	2026.1.4
cffi	2.0.0
charset-normalizer	3.4.4
click	8.3.1
colorlog	6.10.1
comm	0.2.3
contourpy	1.3.3
cycler	0.12.1
debugpy	1.8.20
decorator	5.2.1

Package	Version
defusedxml	0.7.1
executing	2.2.1
fastjsonschema	2.21.2
filelock	3.20.0
flatbuffers	25.12.19
fonttools	4.61.1
fqdn	1.5.1
fsspec	2025.12.0
gast	0.7.0
google-pasta	0.2.0
greenlet	3.3.2
grpcio	1.78.0
h11	0.16.0
h5py	3.15.1
hf-xet	1.2.0
httpcore	1.0.9
httpx	0.28.1
huggingface_hub	1.4.1
idna	3.11
ipykernel	7.2.0
ipython	9.10.0
ipython_pygments_lexers	1.1.1
isoduration	20.11.0
jedi	0.19.2
Jinja2	3.1.6
joblib	1.5.3
json5	0.13.0
jsonpointer	3.0.0
jsonschema	4.26.0
jsonschema-specifications	2025.9.1

Package	Version
jupyter-events	0.12.0
jupyter-lsp	2.3.0
jupyter_client	8.8.0
jupyter_core	5.9.1
jupyter_server	2.17.0
jupyter_server_terminals	0.5.4
jupyterlab	4.5.3
jupyterlab_pygments	0.3.0
jupyterlab_server	2.28.0
kagglehub	1.0.0
kagglesdk	0.1.16
keras	3.13.2
kiwisolver	1.4.9
lark	1.3.1
libclang	18.1.1
Mako	1.3.10
Markdown	3.10.2
markdown-it-py	4.0.0
MarkupSafe	3.0.3
matplotlib	3.10.8
matplotlib-inline	0.2.1
mdurl	0.1.2
mistune	3.2.0
ml_dtypes	0.5.4
mpmath	1.3.0
namex	0.1.0
nbclient	0.10.4
nbconvert	7.17.0
nbformat	5.10.4
nest-asyncio	1.6.0

Package	Version
networkx	3.6.1
notebook	7.5.3
notebook_shim	0.2.4
numpy	2.3.5
nvidia-cublas-cu12	12.1.3.1
nvidia-cuda-cupti-cu12	12.1.105
nvidia-cuda-nvcc-cu12	12.9.86
nvidia-cuda-nvrtc-cu12	12.1.105
nvidia-cuda-runtime-cu12	12.1.105
nvidia-cudnn-cu12	9.1.0.70
nvidia-cufft-cu12	11.0.2.54
nvidia-curand-cu12	10.3.2.106
nvidia-cusolver-cu12	11.4.5.107
nvidia-cusparse-cu12	12.1.0.106
nvidia-nccl-cu12	2.21.5
nvidia-nvjitlink-cu12	12.9.86
nvidia-nvtx-cu12	12.1.105
opencv-python	4.13.0.92
opencv-python-headless	4.13.0.92
opt_einsum	3.4.0
optree	0.18.0
optuna	4.8.0
packaging	26.0
pandas	3.0.1
pandocfilters	1.5.1
parso	0.8.5
pexpect	4.9.0
pillow	12.0.0
platformdirs	4.5.1
prometheus_client	0.24.1

Package	Version
prompt_toolkit	3.0.52
protobuf	6.33.5
psutil	7.2.2
ptyprocess	0.7.0
pure_eval	0.2.3
pycparser	3.0
pydantic	2.12.5
pydantic_core	2.41.5
Pygments	2.19.2
pyparsing	3.3.2
python-dateutil	2.9.0.post0
python-json-logger	4.0.0
PyYAML	6.0.3
pyzmq	27.1.0
referencing	0.37.0
requests	2.32.5
rfc3339-validator	0.1.4
rfc3986-validator	0.1.1
rfc3987-syntax	1.1.0
rich	14.3.2
rpds-py	0.30.0
safetensors	0.7.0
scikit-learn	1.8.0
scipy	1.17.0
seaborn	0.13.2
Send2Trash	2.1.0
setuptools	82.0.0
shellingham	1.5.4
simsimd	6.5.13
six	1.17.0

Package	Version
soupsieve	2.8.3
SQLAlchemy	2.0.48
stack-data	0.6.3
stringzilla	4.6.0
sympy	1.13.1
tensorboard	2.20.0
tensorboard-data-server	0.7.2
tensorflow	2.20.0
termcolor	3.3.0
terminado	0.18.1
threadpoolctl	3.6.0
timm	0.9.2
tinycss2	1.4.0
torch	2.5.1+cu121
torchaudio	2.5.1+cu121
torchvision	0.20.1+cu121
tornado	6.5.4
tqdm	4.67.3
traitlets	5.14.3
triton	3.1.0
typer	0.24.0
typer-slim	0.24.0
typing-inspection	0.4.2
typing_extensions	4.15.0
tzdata	2025.3
uri-template	1.3.0
urllib3	2.6.3
wcwidth	0.6.0
webcolors	25.10.0
webencodings	0.5.1

Package	Version
websocket-client	1.9.0
Werkzeug	3.1.5
wheel	0.46.3
wrapt	2.1.1

Appendix K. Complete Prototype Demonstration Documentation

This appendix presents the complete documentation of the prototype demonstration conducted in this research. The documentation includes Android APK installation, real-device interface capture, image selection from the gallery or camera, local preprocessing, TensorFlow Lite inference, prediction-result display, follow-up recommendation, local history storage, and the supplementary printout-based input trial.

The purpose of this documentation is to support the functional verification of the Flutter-based Android prototype. This documentation does not represent clinical validation, formal usability testing, production-readiness testing, or complete benchmarking across different Android devices. The printout-based trial is only used to simulate the image-input flow in a mobile acquisition scenario and does not replace testing using actual retinal acquisition hardware.

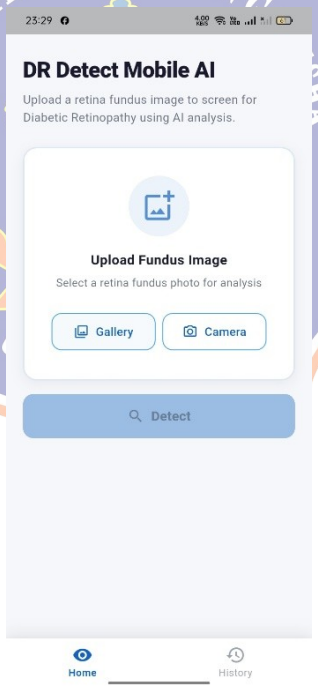

Figure K.1

Prototype Home

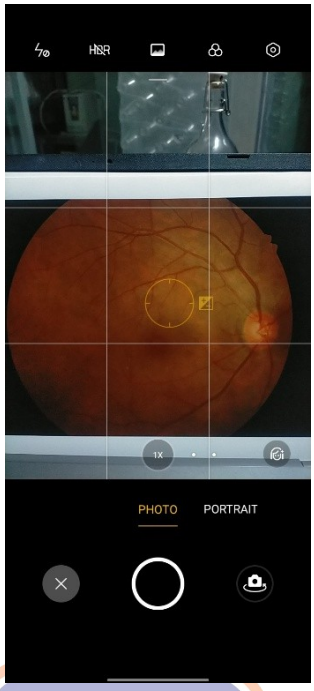

Figure K.2

Camera-Based Image Input in the Prototype

Figure K.3

Retinal Fundus Image Selection from the Gallery

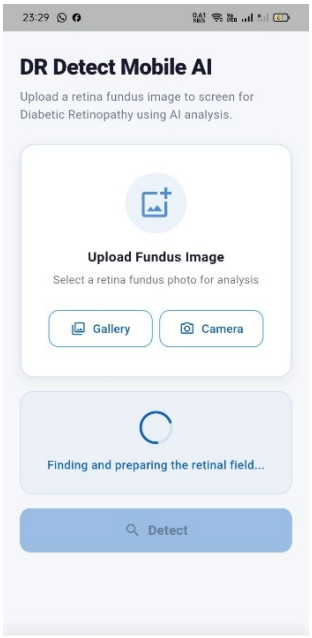

Figure K.4

Prepare Uploaded Image

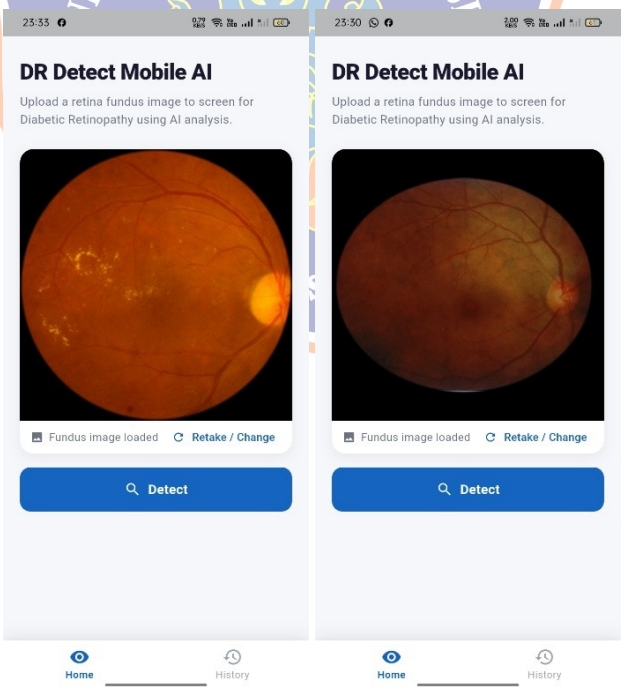

Figure K.5

Successfully Uploaded Image

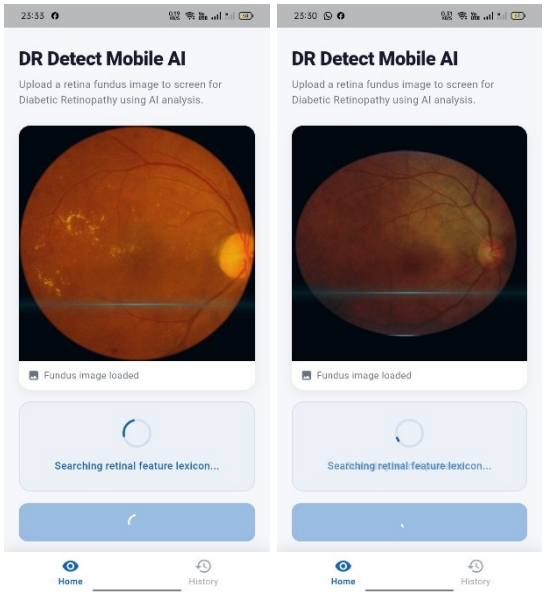

Figure K.6

Prediction Process Loading

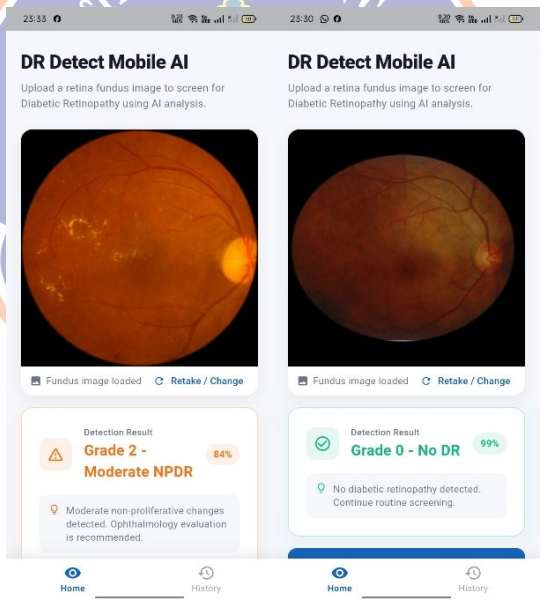

Figure K.7

Prediction Result Display Showing Severity Grade, Confidence Score, and Follow-Up Recommendation

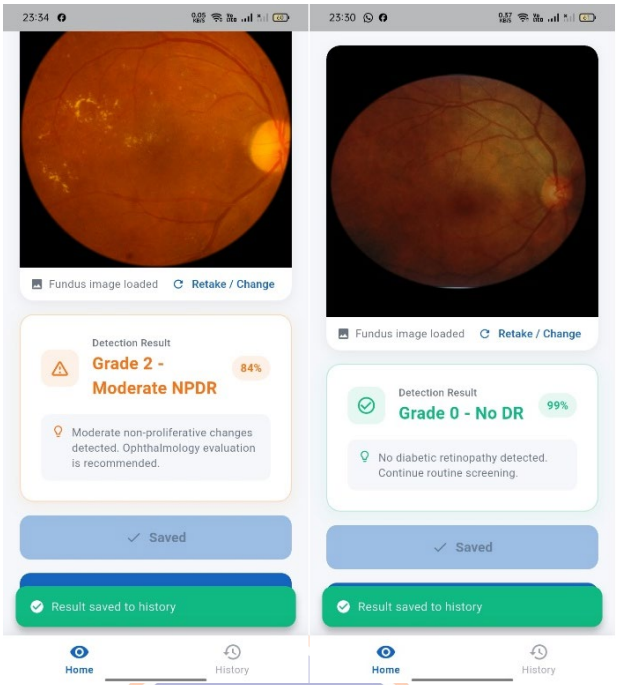

Figure K.8
Saving Prediction Result

Figure K.9
Local History Storage of Prediction Results

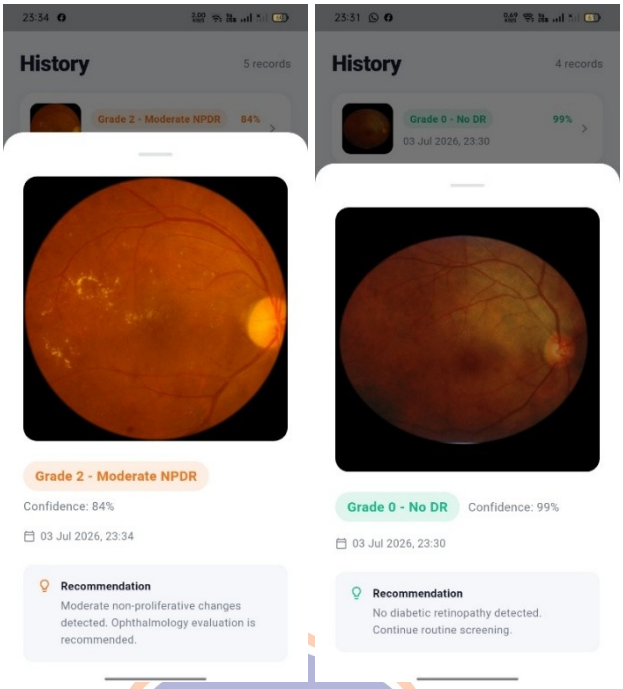

Figure K.10
Prediction History Details