A Multiclass Age-Related Macular Degeneration Classification

ISME2025 – IC1270

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Introduction

Problem Statement:

- Diagnosis of dry and wet AMD eye diseases compared to normal eye using OCT images

Significance of the research:

- Initial diagnosis

- Acceleration of the diagnosis process

- Educational tool for medical students
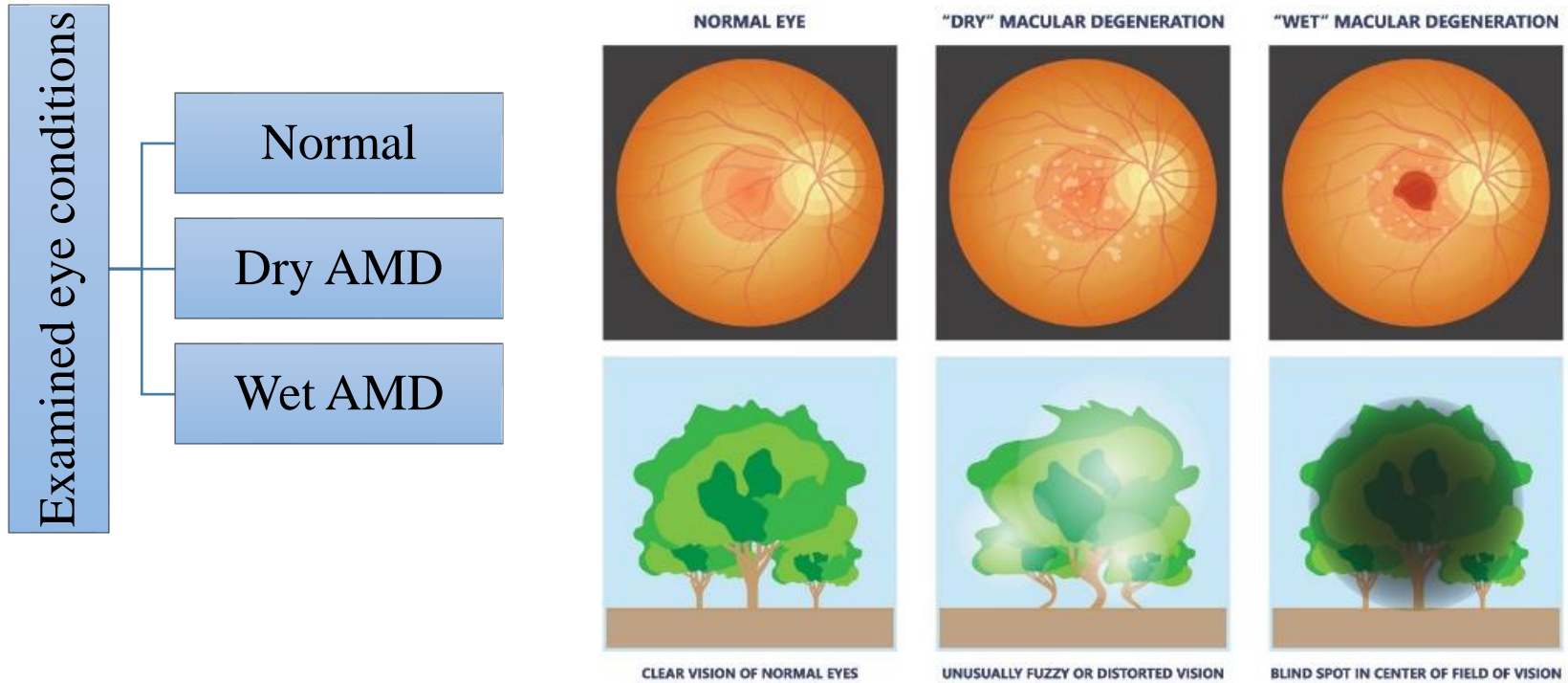
- Reducing human errors

Purpose of the research:

- Providing a practical tool for researchers, doctors, and patients

Literature review

Reference	Disease classes	No. of images	F1 Score
Kermany et al.	DRUSEN, DME, CNV, NORMAL	>100000	0.976
B. Nejad et al.	DRUSEN, DME, CNV, NORMAL	>80000	0.99
Serener et al.	Dry AMD, Wet AMD	>10000	0.98
Prahs et al.	Treatment AMD with anti-VEGF	>150000	0.93

Eye diseases

Examined eye conditions

Normal

Dry AMD

Wet AMD

NORMAL EYE

"DRY" MACULAR DEGENERATION

"WET" MACULAR DEGENERATION

CLEAR VISION OF NORMAL EYES

UNUSUALLY FUZZY OR DISTORTED VISION

BLIND SPOT IN CENTER OF FIELD OF VISION
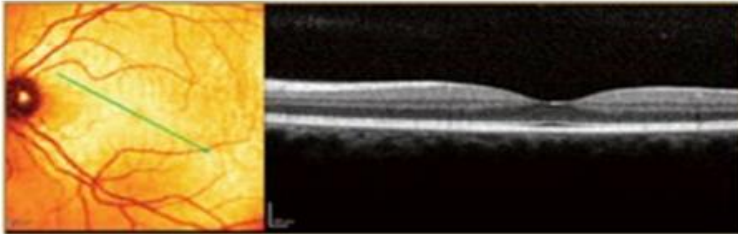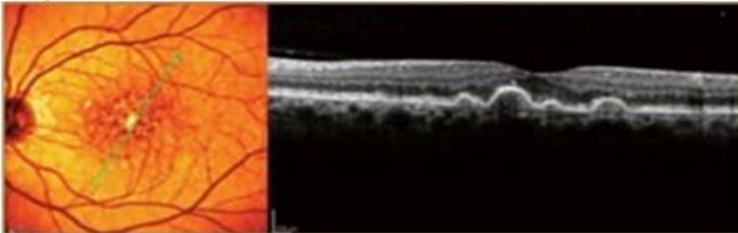
from https://oliviaread.co.za/general-eye-conditions/age-related-macular-degeneration/

Eye diseases

Normal OCT

Dry AMD OCT

Wet AMD OCT

Dry AMD — Pigment clumping, Drusen, Geographic Atrophy

Wet AMD — Subretinal Hemorrhage

from https://fvhospital.com/learn-more/age-related-macular-degeneration/

from https://myeyespecialist.com.au/macular-degeneration
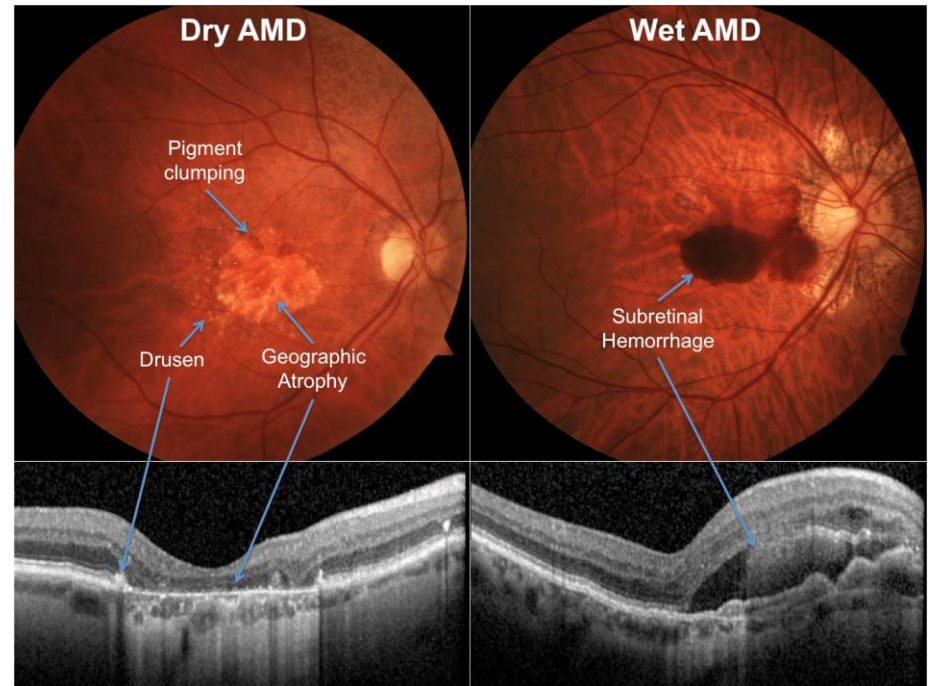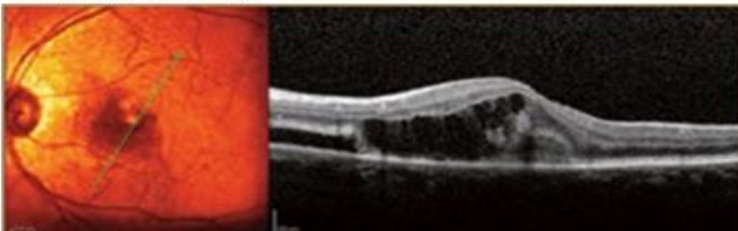
Eye diseases
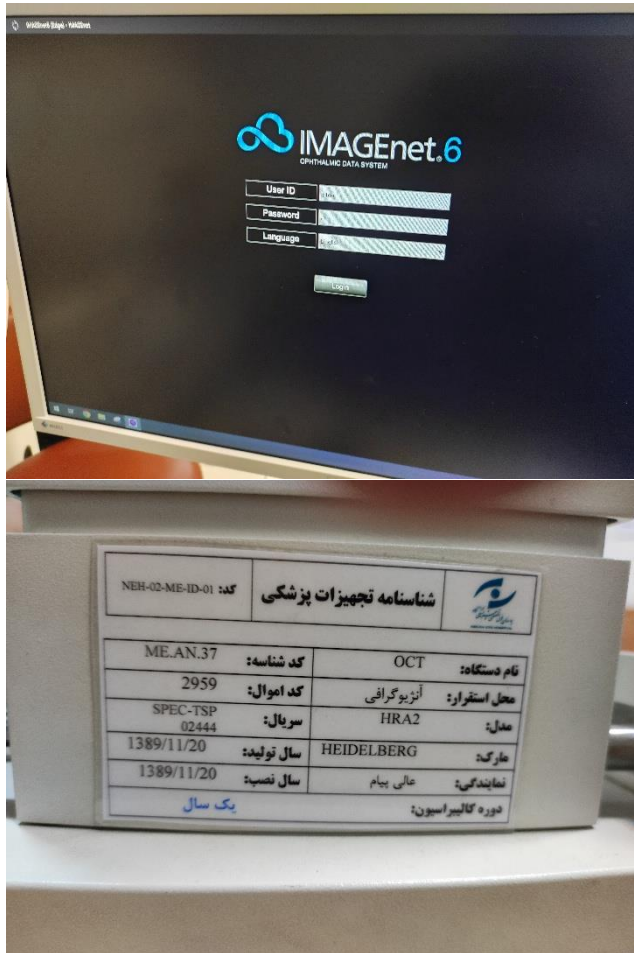
Signs & Symptoms of AMD:

- Limited visibility in low light

- Blurred central vision

- Seeing straight lines as wavy

Causes & Risk factors of AMD

- Poor nutrition

- Overweight and Lack of physical activity

- High blood pressure

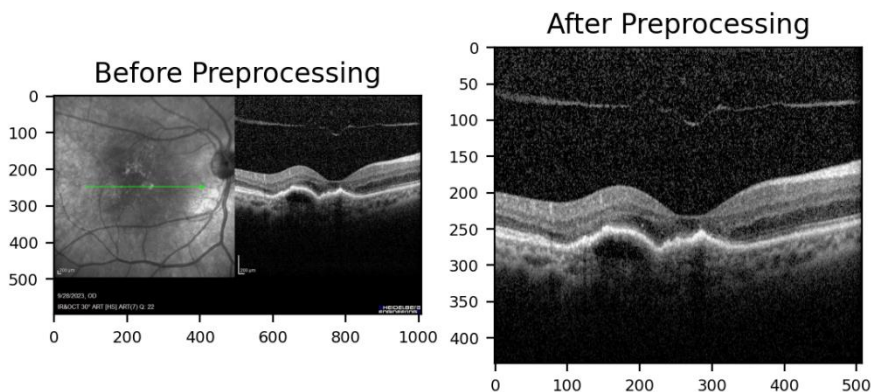# Optical Coherence Tomography

Dataset

- The collected dataset contains 1240 OCT images in jpg format.

- This dataset was collected from **Negah Eye Hospital**.

- The data classification and labeling process was done with the help of **Dr. Anoushirvan Rahimi**.
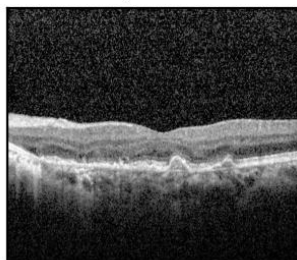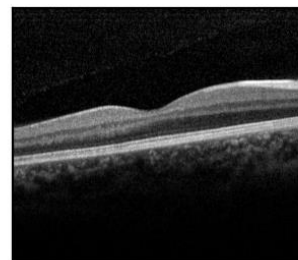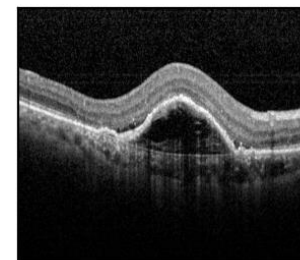
Dataset

Data preprocessing

Dataset

Dry AMD

Train: 256

Test: 100

Total: 356

Wet AMD

Train: 326

Test: 100

Total: 426

Normal

Train: 358

Test: 100

Total: 458

Transfer Learning

Three pre-trained Convolutional Neural Networks (CNN) were used in this research:

- VGG19

- InceptionV3

- Xception

In these models, all layers except the last 5 layers of the pre-trained models are frozen.

Three fully connected layers, referred to as MLP classifier are also added at the end of them.

Fully connected layers		
Layer's Number	Activation function	Number of neurons
1	Relu	300
2	Relu	200
3	Softmax	3

Methods

- Batch size and numbers of epochs were 8 and 20 respectively.

- Learning rate, which gradually decreases, starts at 0.0001 using the Adam optimizer.

- The models were trained on Google Colab's GPU T4.

- Implementing training regulators, such as the gradual reduction of learning rate and EarlyStopping, greatly helped our results.

Number of trainable parameters in each model:

Architecture	Train params
VGG19	17,026,735
InceptionV3	39,382,703
Xception	64,667,823

Metrics

Confusion Matrix:

Results

VGG19

Results

InceptionV3

Results

Xception

Discussion

- VGG19 architecture has the best accuracy with some overfitting.

- Xception architecture offers a more balanced model that prevents overfitting.

- Training regulators (Learning Rate gradual reduction / EarlyStopping) greatly helped.

- Prediction accuracy of Dry AMD is lower compared to other classes.

- Normal class achieved benchmarks above 95%.

Architecture	Precision	Recall	F1 Score
VGG19	0.93	0.93	0.93
InceptionV3	0.92	0.92	0.92
Xception	0.92	0.92	0.92

Discussion

Challenges

- Difference in the quantity of data available for each disease (more Wet Screening)

- More challenging and time-consuming to collect data for Dry AMD or similar data-poor diseases due to less imaging

- No online or systematic patient archive based on disease in local hospitals visited

- Change in the condition of one eye from Dry to Wet AMD makes observation difficult

Opportunities

- Archiving and categorizing data using CNN models, especially for research purposes

- Educational aid tool for disease diagnosis practice in the learning or teaching process

- Auxiliary tool to recognize challenging disease samples and clear doubts

- Simultaneous and seamless diagnosis with imaging

Introduction | Eye diseases | Dataset & Methods | Results & Discussion | Conclusion

Conclusion

- This article examined the classification of normal, Dry AMD, and Wet AMD eyes using Transfer Learning.

- The results showed that despite limited and self-conducted data, desired accuracy can be achieved by utilizing pre-trained models.

- Models with higher accuracy and better performance can be built by collecting more OCT images and using advanced artificial intelligence algorithms.

Future Vision:

- Solving the problems in data collection and labeling

- Archiving patient information, especially disease classification

- Providing a practical tool for doctors and patients

Thank you for your attention

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