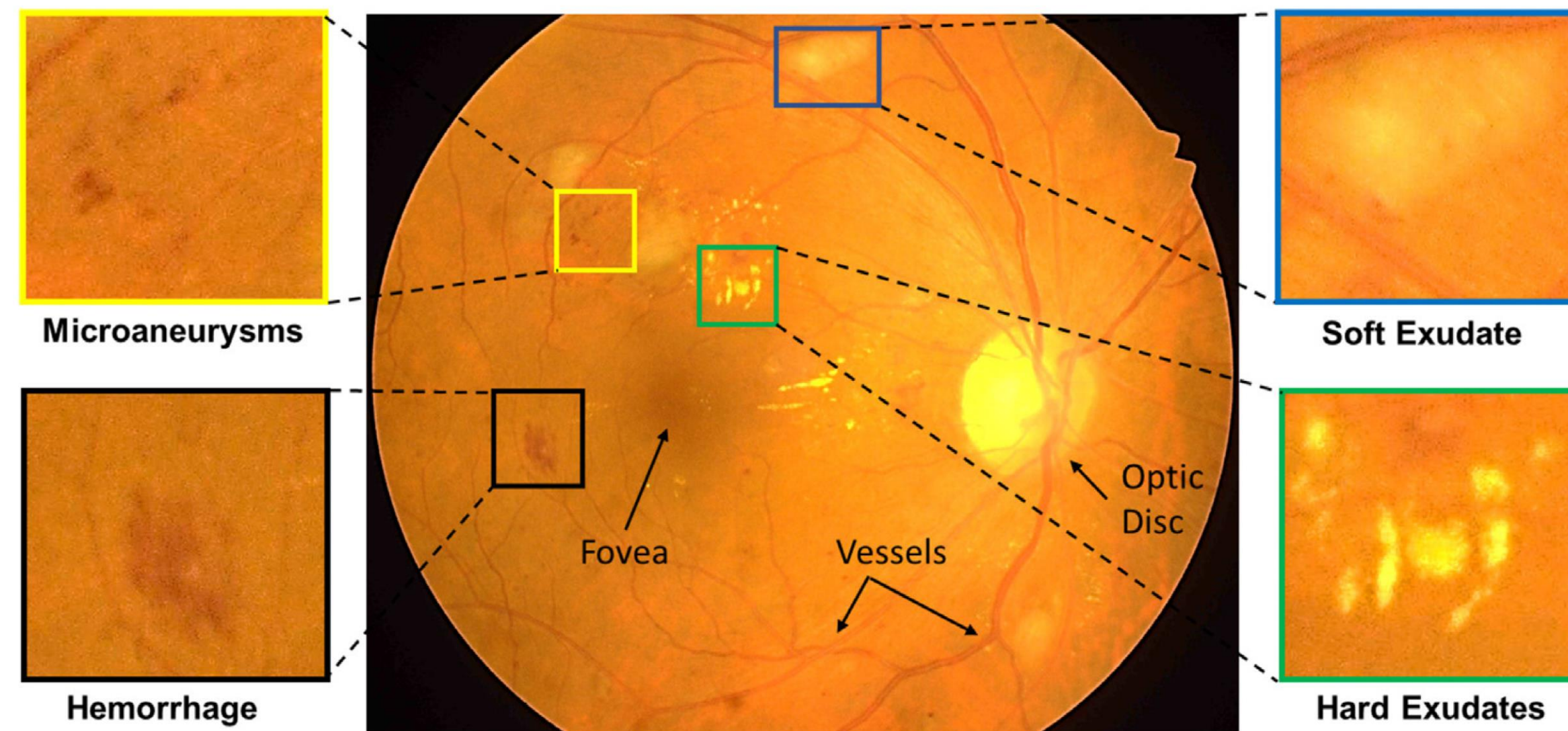


## Abstract

- Explainable and interpretable diabetic retinopathy classification
- Generation of a high-level symbolic representation
- A taxonomy style of diabetic retinopathy characteristics related to eye health conditions

## Introduction

- Illustration of diabetic retinopathy abnormalities



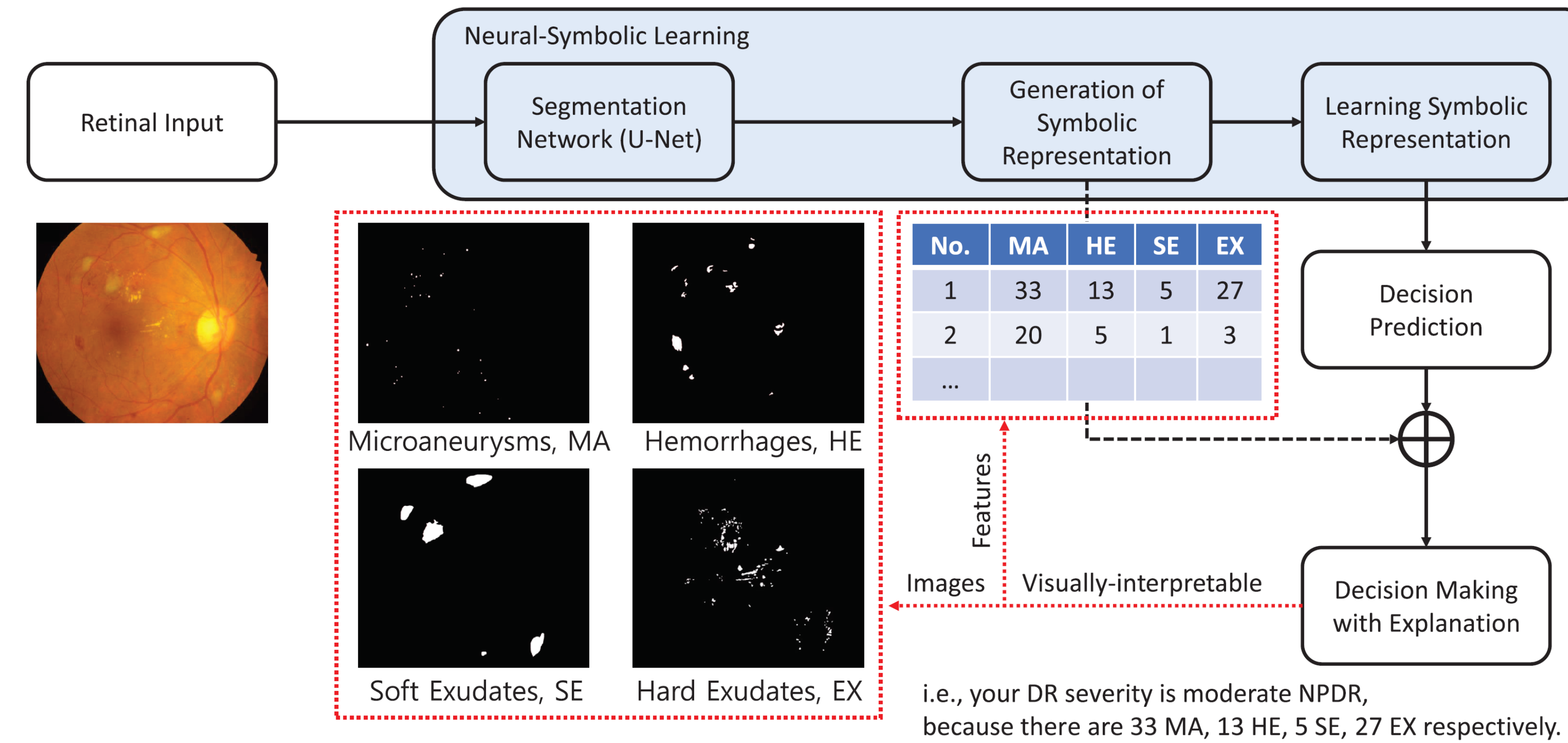
- Diabetic retinopathy severity grading criteria

| Severity Grade | Description  |
|----------------|--|
| No DR:         | No visible sign of abnormalities   |
| Mild NPDR*:    | Presence of MAs only   |
| Moderate NPDR: | More than just MAs but less than severe NPDR   |
| Severe NPDR:   | > 20 intraretinal HEs, Venous beading, Intraretinal microvascular abnormalities, No signs of PDR |
| PDR**:         | Neovascularization, Vitreous/pre-retinal HE  |

\*NPDR: Non-Proliferative DR, \*\*PDR: Proliferative DR

## Explainable & Interpretable Diabetic Retinopathy (ExplainDR)

- An overview of the proposed ExplainDR



- The generated high-level symbolic representation

- The numbers of segmented regions in MA, HE, SE and EX

$$F_{sym} = [ |S^1|, |S^2|, |S^3|, |S^4| ] \in \mathbb{N}^4,$$

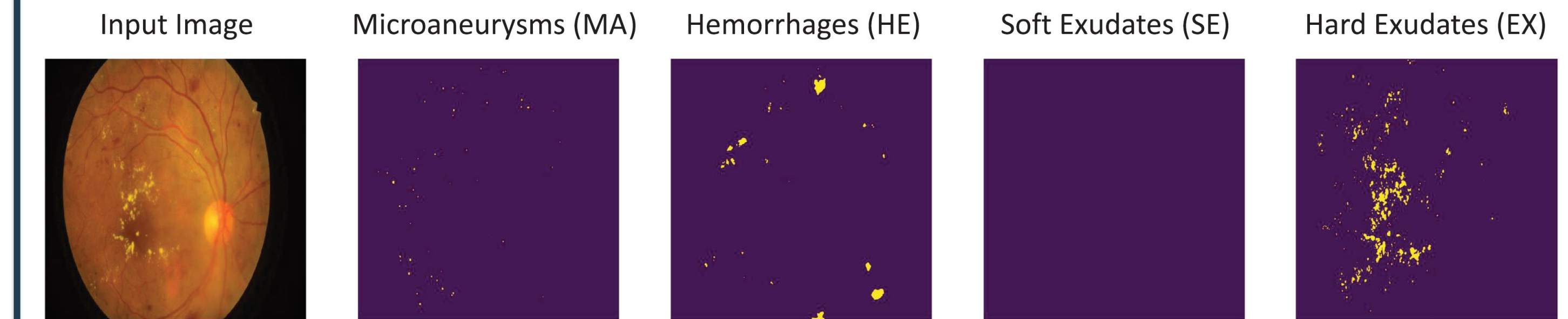
- Extension of the above symbolic representation

- Considering the sizes of the segmented regions
- e.g. small, medium and large (sml) sizes

$$F_{sml} = [ |S_{small}^1|, |S_{medium}^1|, |S_{large}^1|, \dots, |S_{small}^4|, |S_{medium}^4|, |S_{large}^4| ] \in \mathbb{N}^{12}$$

## Results

- Segmentation results of the proposed ExplainDR



- The numbers of the segmented regions in each abnormality

- smlMA: 37, 0, 0, smlHE: 26, 2, 2, smlSE: 0, 0, 0, smlEX: 197, 5, 3

- The generated explanation

- The test image is classified as severe NPDR because 37 small MAs, 26 small HEs, 2 medium HEs, 2 large HEs, 197 small EXs, 5 medium EXs and 3 large EXs are detected.

- An ablation study

| Name                         | Accuracy |
|------------------------------|----------|
| ExplainDR + Simple Symbols   | 0.4757   |
| ExplainDR + Extended Symbols | 0.6019   |

- The leaderboard on the DR and DME test sets in the IDRiD challenge

| Name                  | Accuracy | Approach                  | Input Size  | External Dataset |
|-----------------------|----------|---------------------------|-------------|------------------|
| LzyUNCC               | 0.6311   | ResNet + Deep Aggregation | 896 × 896   | Kaggle           |
| ExplainDR + Extension | 0.6019   | Symbols + FCN             | 1024 × 1024 | -                |
| VRT                   | 0.5534   | CNN                       | 640 × 640   | Kaggle, Messidor |
| Mammoth               | 0.5146   | DenseNet                  | 512 × 512   | Kaggle           |
| HarangiM1             | 0.4757   | AlexNet + GoogLeNet       | 224 × 224   | Kaggle           |
| AVSASVA               | 0.4757   | ResNet + DenseNet         | 224 × 224   | DiaretDB1        |
| HarangiM2             | 0.4078   | AlexNet + Handcrafted     | 224 × 224   | Kaggle           |