Diabetic Retinopathy Detection

December 10, 2015

Outline

- Modeling Process
- Image Processing
- Feature Extraction
  - Blood vessels
  - Exudates
- Ensemble Learning
- Future steps

Modeling Process

Image Processing

Image-Texture Based Features

Blood Vessels and Exudates

Input Data

*Retinopathy grades 0 and 1 are considered as **class 0 (No-Retinopathy)** and grades 2 and 3 as **class 1 (Retinopathy)***

Number of features used : 58

Ensemble Learning

Classify each image as retinopathy or not-retinopathy using multiple classifying algorithms

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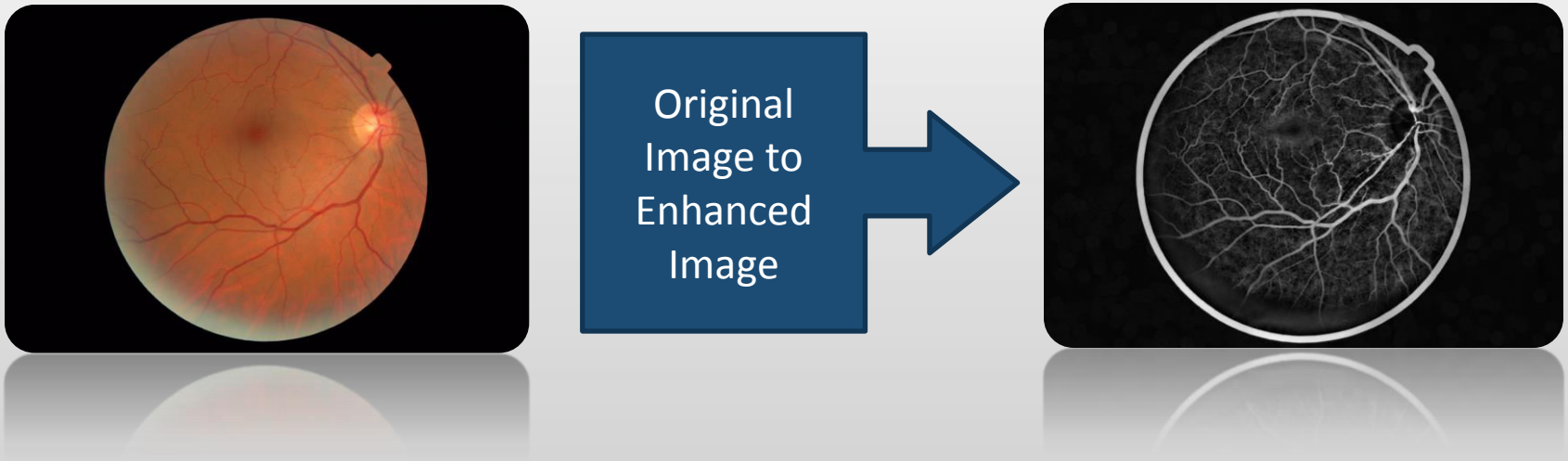
Image Processing

- Enhance Fundus image
  - Extract green channel
  - Grayscale conversion
  - Image processing techniques



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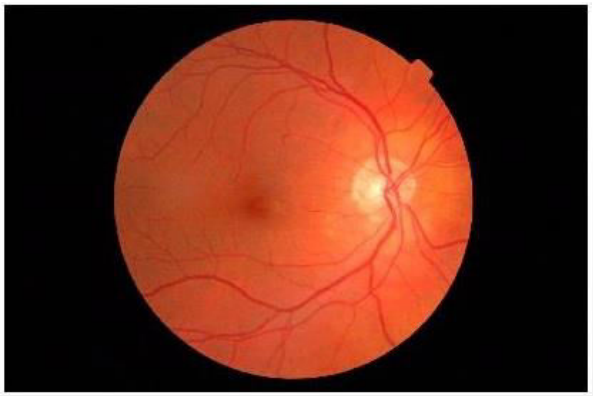
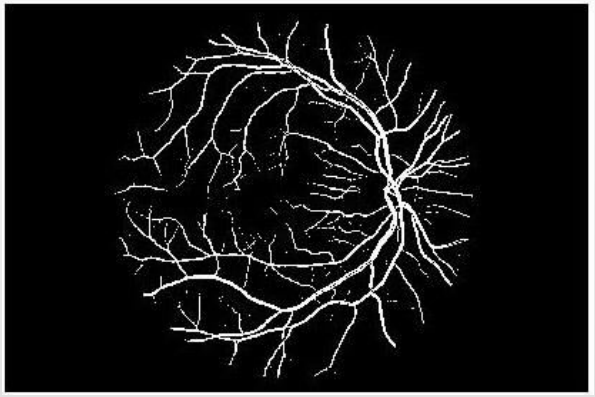
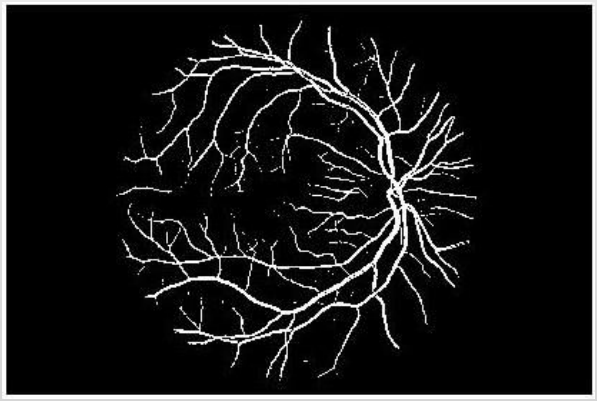
Blood Vessels Extraction



Filtering Process





Noise Removal

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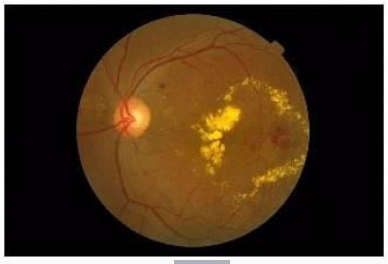
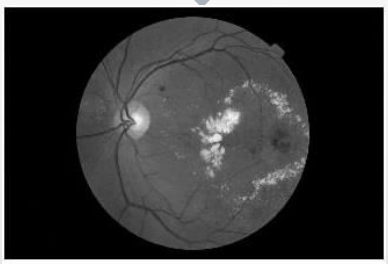
Exudates Extraction

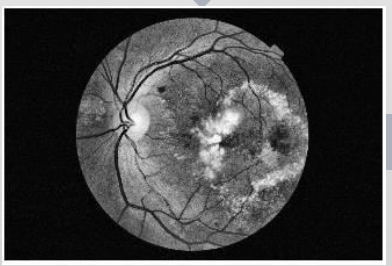
Original Color Image



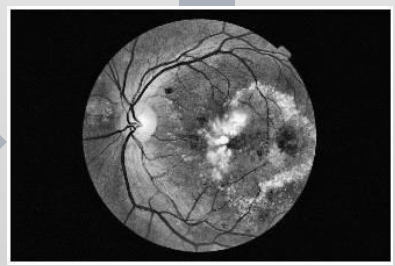
Extracted Green Channel



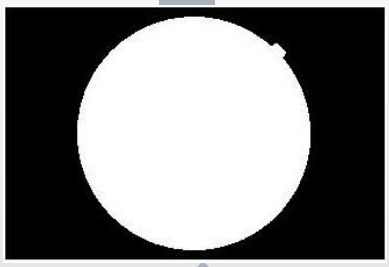
Contrast Enhancement - Adaptive Histogram Equalization



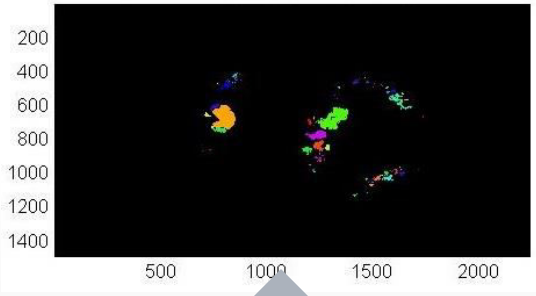
Smoothing – Gaussian Filtering



Binary Mask using thresholding



Labeled ‘Exudates’



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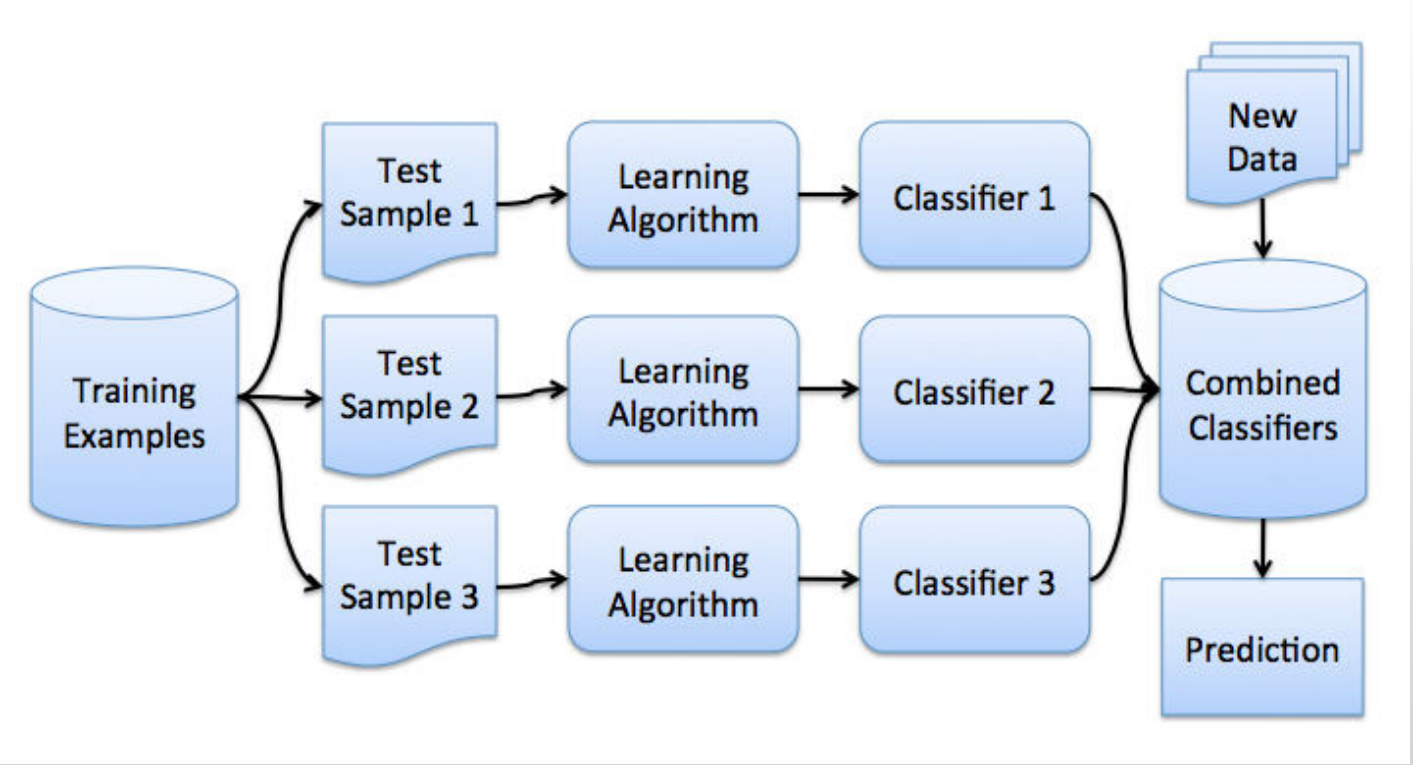
Ensemble Learning

- Construct a set of classifiers for input images
- Predict retinopathy grade of previously unseen images by aggregating predictions made by multiple classifiers (e.g. by using weighted voting)



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Classification Results

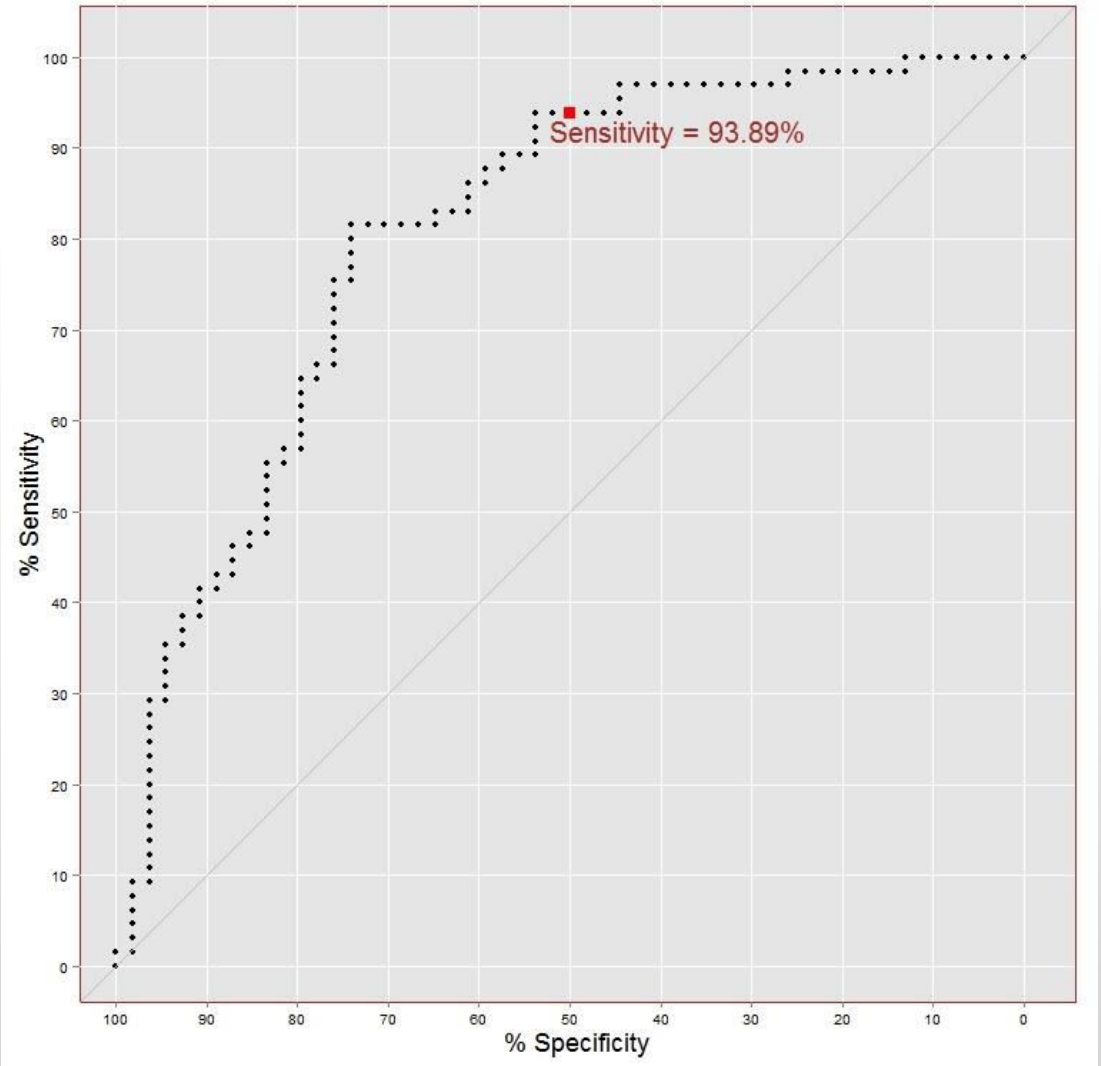
Metrics	Formula	Value (%)
Accuracy	Correctly Identified Cases / Total Number of Cases	**74.42**
Sensitivity	Correctly Identified Retinopathy Cases / Total Retinopathy Cases	**77.60**
Specificity	Correctly Identified No-Retinopathy Cases / Total No-Retinopathy Cases	70.59
Positive Predictive Value	Correctly Identified Retinopathy Cases / Total Identified Retinopathy Cases	76.24
Negative Predictive Value	Correctly No- Identified Retinopathy Cases / Total No- Identified Retinopathy Cases	72.57

Classification Results : ROC Curve

Area Under ROC Curve

82.48%

The bigger the area under ROC curve, the better!



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Correctly Classified Images

No Retinopathy

(95.69 % confidence)

Truth : Retinopathy Grade 0 (No-Retinopathy)

Retinopathy

(95.70 % confidence)

Truth : Retinopathy Grade 3 (Retinopathy)

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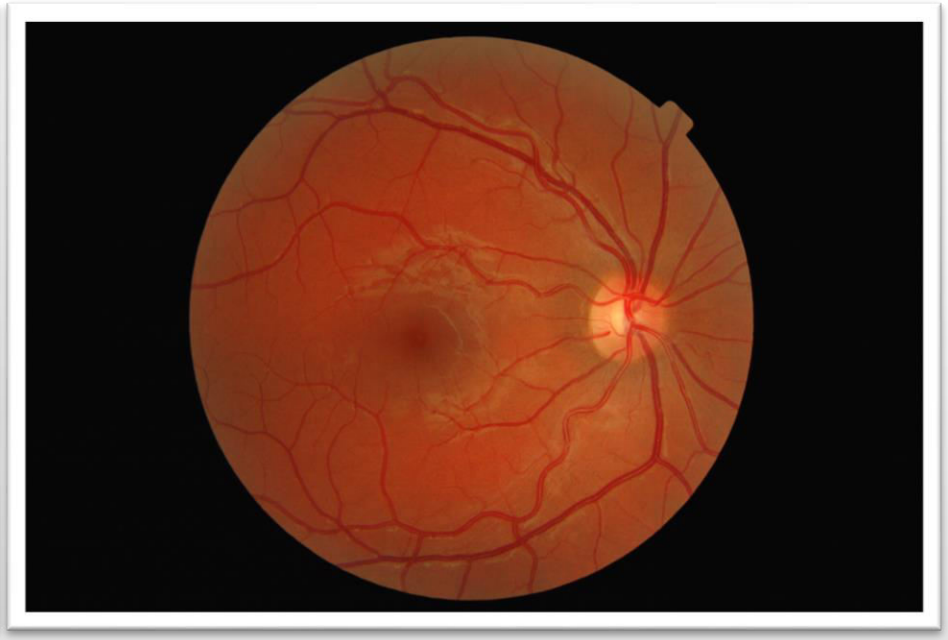
Misclassified Images

No Retinopathy

(83.75 % confidence)

Truth : Retinopathy Grade 2 (Retinopathy)



Retinopathy

(95.50 % confidence)

Truth : Retinopathy Grade 0 (No-Retinopathy)

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Future Work

Image processing & Feature computation

- Improvements in blood vessels extraction, exudates extraction, etc.
- Features based on hemorrhages, macula, optical disk, etc.

Feature selection

- Optimize features used for classification

Model selection & Ensemble Learning

- Model tuning
- Different techniques of ensemble learning

Further Analysis

- Trying the model on different dataset / Addition of new images as input
- Similar analysis for multiclass problem
- Change in threshold for categorizing as retinopathy

Thank You

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