



## COTTON WOOL SPOTS

### COTTON WOOL SPOTS IN EYE FUNDUS SCOPE

#### Objective

The purpose of this project is to develop a mobile solution capable of detecting signs of diabetic retinopathy (DR). This is achieved by detecting soft and hard exudates in images of the retina, obtained by the EyeFundusScope prototype: a smartphone, provided with an ophthalmoscope with light control, as shown in Fig1.

This project aims to detect soft exudates using low quality images from a smartphone camera, using low computational-cost algorithms, which can be integrated in a decision-support system. Hard exudates are included because while applying algorithms to detect soft exudates, the algorithms also detect hard exudates and there is a way to differentiate them.

#### Application

The Android application in Fig2. shows a simple user interface following the usability rules of Smart Companion. At the moment, the application is able to detect microaneurysms, exudates and to determine the diabetic risk level using a decision-support system.



Fig1. EyeFundusScope Prototype.

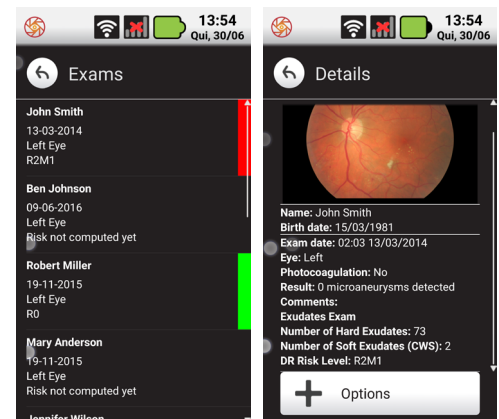


Fig2. EyeFundusScope Application.

#### Exudates Detection

Automatic detection of exudates in retinal images is performed by image processing methods that are distributed in three major phases as shown in Fig3. image pre-processing, candidate classification and decision-support system.

#### Contact

Rua Alfredo Allen, 455  
4200-135 Porto, Portugal

+351 220 430 300  
info@fraunhofer.pt  
www.fraunhofer.pt

## Features

- Cotton Wool Spots Detection
- Hard Exudates Detection
- Remove Optic Disc
- Macula Localization
- Decision-Support System for Diabetic Retinopathy Risk Level

## Advantages

- Non-Expert end-user
- Avoid the use of expensive equipment
- Can reach everyone at any place
- Work Offline

## Challenges

- Computational Performance
- Pre-diagnosis of Diabetic Retinopathy

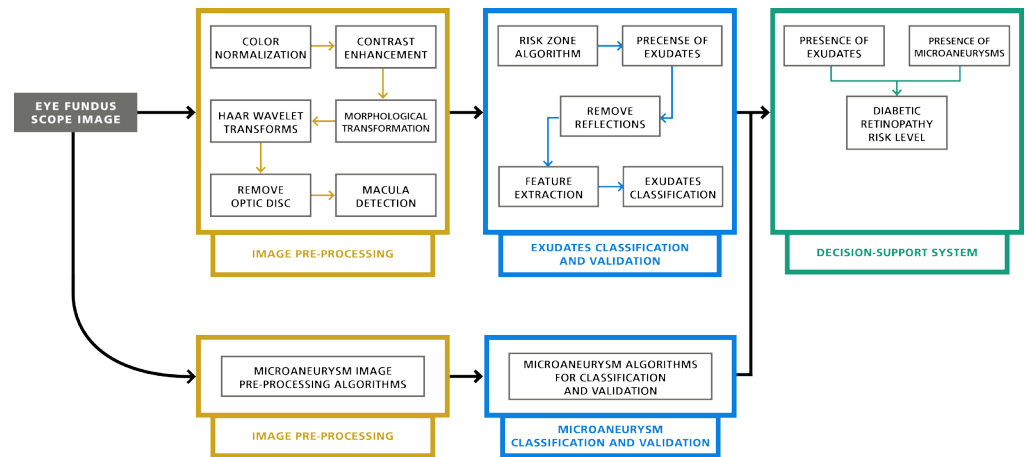


Fig3. Diabetic Retinopathy risk level detection process.

Image pre-processing is the stage of eye image segmentation and extraction of the candidate zones for soft and hard exudates. Exudates are the brighter regions in the eye, so using the support of OpenCV framework and low computation algorithms bright zones are highlighted and false candidates removed.

To do exudates classification, this project uses the Texture-Color-Geometry Feature Extraction (TCGFE) a library developed by Fraunhofer AICOS. It will perform feature extraction from the candidates, after that a binary tree approach is used to classify the candidates. The first verification is the color value and then the purity of the color of each region, as it will determine if the exudate is soft, hard or not a real lesion.

## Decision-Support System

All over the world, Diabetic Retinopathy (DR) screening programs have different approaches to classify DR in levels. Having the number of exudates, microaneurysms and macula center, we can match a DR risk level using a state machine having as reference *Associação Regional de Saúde do Norte* protocol.

## Conclusion

The results of decision-support system that combines exudates and microaneurysms in a public dataset of retinal images, point to an area under the ROC curve of 0,84. The full process takes 47 seconds in a smartphone and 10 seconds in a laptop. The success achieved on lesion detection was due to the pre-processing stage and flexibility to different acquisition system.