Lappeenranta University of Technology

Faculty of Industrial Engineering and Management

Degree Program in Computer Science

Bachelor's Thesis - initial report

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SENSITIVITY OF RETINAL IMAGE SEGMENTATION ON GROUND TRUTH ACCURACY

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1 INTRODUCTION

1.1 Background

The growing amount of diabetes patients and (arguably) more importantly the estimated amount of undiagnosed patients motivate the research for an effective mass screening method for monitoring and early detection of diabetes. The most common complication of diabetes, diabetic retinopathy, causes abnormalities in the eye, and detecting these abnormalities in the eye fundus is a promising mass screening method. [1] When developing a method for detecting these abnormalities, handmade annotations of the objects in the image are used as a ground truth to train classifiers and to evaluate the results. In eye fundus image segmentation research, ground truths are usually done by medical experts of the field (ophthalmologists) marking these abnormalities, such as exudates.

Optimal ground truth would be a pixel-accurate binary representation of the abnormalities, but as ground truths are done by a human hand, such accuracy is not possible. Because the marking of an accurate ground truth takes a good amount of time and patience, it is often necessary to have to settle for rough markings of the present abnormalities. Clusters of exudates are circled, rather than each small finding specified separately.

1.2 Objectives and Restrictions

This thesis will address two main questions in its research:

- How will inaccurate ground truth affect features and segmentation methods?
- How will other features than colour perform?

This thesis focuses on exudate detection in terms of segmentation performance, and Bristol database is used as it is readily available and has accurate ground truths of exudates. To enable comparison between features, colour, edge and texture features are used. Blood vessel detection is explored only to create a mask for them. A rough method for optic disk detection is also implemented as a preprocessing step for masking reasons. Structure of the eye fundus is briefly explored for context.

Both supervised and unsupervised segmentation methods are used. In supervised methods, ground truths are used to label observations as either exudate or background. In

unsupervised methods, ground truth is used to evaluate segmentation results. Best parameters for each method are chosen based on their performance.

1.3   Structure of the Thesis

Section 2 takes a look at the different features of the eye fundus, and how they are relevant in this thesis. It also explains the theory behind the applied pre-processing and segmentation methods. Section 3 details how sensitivity analysis is done in this thesis, and also explains the used evaluation methods. Section 4 describes the experiments in detail, and presents the results for each experiment. Section 5 sums up and interprets the results, and discusses the impact of this thesis and possible future work this thesis might invoke.

2 LITERATURE REVIEW

During this thesis, the following books will be used:

- Kauppi: Eye Fundus Image Analysis For Automatic Detection of Diabetic Retinopathy (doctoral thesis)
- Jain: Fundamentals of Digital Image Processing

Scientific articles will be sought out from databases dedicated to publishing them, such as:

- IEEE Xplore
- Science Direct
- Springer

Most literature used in this thesis will be scientific articles concerning methods of eye fundus segmentation, focusing on exudate detection. A medical publication describing the structure of the eye will also be sought out.

3   METHODS OF STUDY

Reserach was done by first evaluating possible segmentation methods, both supervised and unsupervised. From these, the methods best suited for our purpose were chosen for implementation. Sensitivity analysis of segmentation methods was done by evaluating the performance of these methods using ground truths of varying accuracy. This also indirectly sheds some light on sensitivity of specific features.

The tests and computations needed for this thesis were conducted during the summer for the Laboratory of Machine Vision and Pattern Recognition. During the summer, an image segmentation pipeline was constructed for evaluation of segmentation methods using varying image and ground truth data. This thesis will be written based on the results and observations gathered from these tests.

4 SCHEDULE

During the summer, the segmentation pipeline was constructed and initial results were obtained with the following schedule:

- In June, literature review and the assessment of possible segmentation methods were conducted.
- In July, the construction of the image segmentation pipeline was focused on.
- In August, the pipeline was used to conduct sensitivity analysis on segmentation methods and specific features.

Parts of the thesis were also written during the summer. In the following semester of September to December, the missing parts of the thesis will be completed.

REFERENCES

[1] Tomi Kauppi et al. *Eye fundus image analysis for automatic detection of diabetic retinopathy*. Lappeenranta University of Technology, 2010.