

Master Thesis Proposal

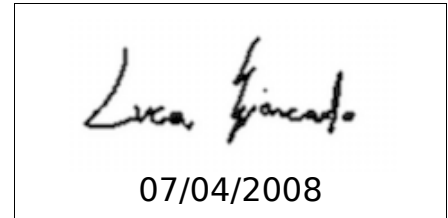
1. Student Information

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2. Master Thesis Information

Title:

Quality Analysis and Normalization of Retina Images for the Automatic Diagnosis of Diabetic Retinopathy

Description:

Diabetic retinopathy is the leading cause of blindness in the Western world. The World Health Organization estimates that 135 million people have diabetes mellitus worldwide and that the number of people with diabetes will increase to 300 million by the year 2025 (Amos et al, 1997).

New high-quality mydriatic and non-mydriatic cameras have the potential to greatly improve our ability to effectively screen a large population and warn them of a possible disease which may lead to blindness if not treated promptly. In the recent years a substantial effort of the research community went towards the creation of automatic or semi-automatic systems to detect various type of retinopathy. The results obtained are promising but they are strongly dependent on the initial image quality (Patton et al, 2006).

An algorithm to automatically estimate the quality of a fundus image is essential to build a robust screening system which can be operated not only by expert ophthalmologists, but also by less trained operators. The overall goal is to make these systems suitable for many environments, as it is already the case for the omnipresent automatic blood pressure monitors.

However, the measurement of image quality is not a straightforward task, mainly because quality is a subjective concept which varies even between experts, especially for images that are in the middle of the quality scale. Existing algorithms to estimate the image quality are based on the length of visible vessels in the macula region (Fleming et al, 2006), or edges and luminosity with respect to a reference image (Lee et al, 1999) (Lalonde et al, 2001). Another method uses an unsupervised classifier that employs multi-scale filterbanks responses (Niemeijer et al, 2006). The shortcomings of these methods are either the fact that they do not take into account the natural variance encountered in retinal images or that they require a considerable time to produce a result. While algorithms to assess the disease state of the retina need not be as fast (within reason), fast evaluation of quality is essential to the development of an automatic

retinopathy scan system. The operator in front of the machine wants to know almost immediately if she is operating the system correctly without having to wait for the relatively long diagnosis process to take place. A simple analogy is in our everyday life: whenever we swipe a credit card on the magnetic reader we want to know immediately if we inserted the card on the wrong side or if we swiped it too fast. It will be very unpleasant having to wait for the submission of the payment, just to be told that the card should be swiped again in another way.

Aims:

The aim of this Master Thesis is to develop a method to estimate the quality of retinal images that is both accurate and fast. The algorithms developed will be evaluated against a set of retinal images manually classified by ophthalmologists and against the misclassification of existing retinopathy screening algorithms. Ideally the quality classifier will be able to judge as good only images for which the retinopathy algorithm works flawlessly. In fact, it is not useful trying to process an image that is considered of acceptable quality by an ophthalmologist but that will lead to the wrong diagnosis in the automatic system.

Additionally, techniques to improve the quality of fundus images with a low quality score will be evaluated in order to reduce as much as possible the number of discarded images and at the same time preserve the robustness of the system.

Tasks and Planning:

Task Name	Begin date	End date
Feasibility Study	03/03/2008	25/03/2008
Problem Definition	03/03/2008	05/03/2008
Planning	04/03/2008	05/03/2008
Literature Review: Quality Metrics for Retina Images	04/03/2008	12/03/2008
Literature Review: Vessels Segmentation Techniques	05/03/2008	14/03/2008
Literature Review: Optic Nerve and Macula Localization	07/03/2008	15/03/2008
Zana" Vessels Segmentation: Implementation in C++"	04/03/2008	06/03/2008
Stress Test and performance evaluation	06/03/2008	08/03/2008
Creating test bench for retina images	10/03/2008	11/03/2008
Niemejer" Quality metric: Implementation and Test"	11/03/2008	15/03/2008
Retina Boundary detection: Mask	06/03/2008	07/03/2008
Evaluation of new quality features: vessels density	17/03/2008	22/03/2008
Global Vessels density	17/03/2008	18/03/2008
Local Vessels density	18/03/2008	22/03/2008
Squared splitting	18/03/2008	19/03/2008
Adaptable Elliptical splitting	19/03/2008	22/03/2008
Retina Boundary detection: Ellipse Fitting	19/03/2008	20/03/2008
Clustering/Classifiers Evaluation (KNN, SVM)	18/03/2008	22/03/2008
Comparison with existing techniques	24/03/2008	25/03/2008
Master Thesis Proposal	25/03/2008	05/04/2008
Master Thesis Proposal: v. 1	25/03/2008	27/03/2008
Master Thesis Proposal: v. 2	04/04/2008	05/04/2008
DeadLine: Master Thesis Proposal	07/04/2008	08/04/2008
EMBS Conference Paper	27/03/2008	05/04/2008
Comparison of Techniques	27/03/2008	01/04/2008
EMBS Paper write up	01/04/2008	05/04/2008

DeadLine: EMBS Conference Paper Submission	07/04/2008	08/04/2008
Evaluation of new quality features: Colour	08/04/2008	12/04/2008
Evaluation of new quality features: Gradient	10/04/2008	01/05/2008
Evaluation of new quality features: Sharpness	10/04/2008	01/05/2008
Use of LBP as features	10/04/2008	17/04/2008
Use of Wavelets as features	17/04/2008	25/04/2008
Use of Self Similarity index as features	25/04/2008	03/05/2008
New Classifier Tests: (ex. Boosting, new SVM kernels)	10/04/2008	03/05/2008
Test LDA on the best set of features	05/05/2008	09/05/2008
Contingency time	09/05/2008	17/05/2008
Master Thesis	19/05/2008	14/06/2008
Master Thesis write up 1	19/05/2008	04/06/2008
Master Thesis write up 2	09/06/2008	14/06/2008
Deadline: Submission of the Master Thesis	16/06/2008	17/06/2008
VIVA	23/06/2008	24/06/2008
MSc Research Paper	05/06/2008	26/06/2008
MSc Research Paper write up 1	05/06/2008	07/06/2008
MSc Research Paper write up 2	17/06/2008	26/06/2008
Deadline: Submission of MSc Research Paper	26/06/2008	27/06/2008
Poster Design	04/06/2008	26/06/2008
Poster Design 1	04/06/2008	05/06/2008
Poster Design 2	17/06/2008	26/06/2008
Deadline: Submission the Poster	26/06/2008	27/06/2008
Website Creation	17/06/2008	26/06/2008
Deadline: Upload of the Website	26/06/2008	27/06/2008

See Appendix A for a Gantt Chart

References:

Amos, A. F.; McCarty, D. J. & Zimmet, P. (1997), 'The rising global burden of diabetes and its complications: estimates and projections to the year 2010.', *Diabet Med* **14 Suppl 5**, S1--85.

Fleming, A. D.; Philip, S.; Goatman, K. A.; Olson, J. A. & Sharp, P. F. (2006), 'Automated assessment of diabetic retinal image quality based on clarity and field definition.', *Invest Ophthalmol Vis Sci* **47**(3), 1120--1125.

Lalonde, M.; Gagnon, L. & Boucher, M. (2001), 'Automatic visual quality assessment in optical fundus images', *Proceedings of Vision Interface*.

Lee, S. & Wang, Y. (1999), Automatic retinal image quality assessment and enhancement., *in* 'Proceedings of SPIE Image Processing.', pp. 1581-1590.

Niemeijer, M.; Abramoff, M. D. & van Ginneken, B. (2006), 'Image structure clustering for image quality verification of color retina images in diabetic retinopathy screening.', *Med Image Anal* **10**(6), 888--898.

Patton, N.; Aslam, T. M.; MacGillivray, T.; Deary, I. J.; Dhillon, B.; Eikelboom, R. H.;

Yogesana, K. & Constable, I. J. (2006), 'Retinal image analysis: concepts, applications and potential.', *Prog Retin Eye Res* **25**(1), 99--127.

3. Supervisor Information

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Appendix A - Gantt Chart

