Enhancing Eye Fundus Images for Diabetic Retinopathy Screening
Guillaume Noyel, Michel Jourlin, Michel Smans, Rebecca Thomas, Simon Iles, Gavin Bhakta, Andrew Crowder, David Owens, Peter Boyle

To cite this version:

HAL Id: hal-01539980
https://hal.archives-ouvertes.fr/hal-01539980
Submitted on 15 Jun 2017

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L’archive ouverte pluridisciplinaire HAL, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d’enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Copyright
Enhancing Eye Fundus Images for Diabetic Retinopathy Screening

Guillaume Noyel1, Michel Joumlin3, Michel Smans1, Rebecca Thomas5, Simon Iles5, Gavin Bhakta5, Andrew Crowder5, David Owens5, Peter Boyle5,6,7
1. International Prevention Research Institute, Lyons, France; 2. Laboratory Robert Carsky, UMR CNRS 5176, Saint-Etienne, France; 3. Diabetes Research Group, Institute of Life Sciences, College of Medicine, Swansea University, Wales, UK
4. Diabetic Eye Screening Wales, Wales, UK; 5. Strathclyde Institute of Global Public Health, University of Strathclyde, Glasgow, UK | Correspondence: guillaume.noyel@i-pri.org

608-P

ABSTRACT

Many eye fundus images present strong variations of contrast which can be a limitation to the diagnosis of the retinopathy. Either some lesions are not taken into account or only a limited part of the domain of the image can be read. Graders have to manually adjust the contrast, which is tedious and not easily reproducible.

We have developed an automatic system, which standardises the colour contrast across the whole domain of the image. The method is consistent with the physical principles or image formation and ensures that the colour aspect of lesions such as micro-anerysoms or anatomical structures such as veins are similar. It is more powerful than the existing grey-level methods.

We have tested our approach on several thousand images acquired in good or in harsher conditions. Some were bright while others were dark. Expert graders have checked the enhanced images. Diagnosis becomes more obvious and the grading more comfortable.

Another limitation for the diagnosis is that images of the same patient acquired for different examinations cannot be directly superimposed. Indeed, the eye of the patient is never in the exact same position; the image is a projection of a 3D scene into the plane of the sensor, the optics of the camera creates a radial deformation and the colour of the image may have changed.

We have developed an automatic method to superimpose eye fundus images acquired in the same position (nasal or macular). It is based on contrast standardisation, matching of salient points and a deformation model taking into account two radial distortions.

We have performed tests for 69 patients with pairs of retinal examinations acquired in good conditions at an interval of one year with and without the same camera. A similar test has been performed on 5 patients with 20 pairs acquired in harsher conditions. A minimum of 96% of pairs were correctly superimposed. This is an important step towards the longitudinal analysis of large public health databases.

CONTRAST ENHANCEMENT

Figure 1 illustrates the improvement brought by our method of standardizing the colour contrast across the entire image.

The enhanced colour images allow a more comfortable grading and a more obvious diagnostic.

Figure 2 details (with false colours) the two corrections needed for a proper superimposition (position and distortion).

Figure 3 illustrates the result of the method.

IMAGE SUPERIMPOSITION

Results and conclusions

Our automatic method will allow an easier follow-up of patients with diabetic retinopathy.