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3D-Reconstruction of Optic Disc Image from Stereo Disc Photograph
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Purpose: Early detection and quantitative analysis of optic nerve head change is important in the diagnosis and Disc Stereo Photographs (DSP) are used for a long time. HRT and OCT can provide objective and quantitative data, but they are expensive. Three-dimensional reconstruction of DSP by the computer was proposed, but the results were not. This paper describes the new technique to enhance robustness of 3-dimensional reconstruction of DSP.

Material and method: The conversion to grayscale image, denoising and edge enhancement procedure was performed on DSP image pair. And the deepest point of the optic nerve head was identified in DSP image pair and image registration was done according to this point. Registered image was used for the calculation of the depth map of the optic nerve head. Depth map was calculated by searching where points represent the same spot of object. In order to do this procedure, calculation windows with different sizes are used for the generation of several depth maps. Two-dimensional grayscale depth map was calculated by averaging of these maps. The difference of x-coordinate of points those are the same spots between stereo images is in inverse correlation to height. On the two-dimensional depth map, intensity of each pixel represents the height of the corresponding point and from this map, 3-dimensional shape of optic nerve head can be simulated using Microsoft DirectX library, one of the 3D application programming interface.

Results: Three-dimensional shape of optic nerve head can be generated robustly with comparison to conventional method. In most cases, reconstruction images were reliable, showing high correlation with the subjective DSP reading by the specialist. The conventional three-dimensional reconstruction method is based on triangulation that requires tedious search of all the points representing same parts of object in the left and right image pair. If there are more than two points with the same value in each image, identification and appropriate designation of each point is not easy. Thus, shortening of the distance between the points that present the same spot in the DSP image pair can show better result than conventional method.

Conclusion: DSP image pair was successfully reconstructed 3-dimensionally by identifying deepest point of optic nerve head. This technique shortens the distance between the points that present same spot, and enhances probability to find correct locations that present same parts of same object.

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