A Framework for Automatic Cephalometric Landmarking

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Abstract. Cephalometric analysis has an important role in diagnosis and treatment of dental disharmonies. This work presents a framework to automatically find the location of landmarks on digitized x-ray images.

1. Introduction

The cephalometric analysis is a report where cranium structures are measured for surgical [1], forensic, orthodontic, anthropometrics, paleontological purposes [2], among others. Its application has been widely diffused among orthodontists, since they need to follow the treatment based on effective measurements.

These measurements are angles and locations extracted from representative points (better known as landmarks) of curves whose shape identifies cranium structures such as nose, ear, chin, and others occurring in the cranium radiography.

The main goal of this work is to provide a framework to solve the following problem: "to identify the landmarks without a human operator intervention".

The analysis final result is a report, which aids the surgeon or orthodontist to correctly evaluate the treatment state.

2. X-ray images data base

This proposal assumes as source the X-ray digitized image. This image is firstly blurred with a Gaussian kernel to reduce the noises, and then a Canny [4] edge detection algorithm is applied on the blurred image. The Canny algorithm is particularly useful here because the edges results are structured in a list. The first challenge in this work is to search a set of parameters for the Canny algorithm, which would better identify the aimed curves.

It is feasible if the edge (structured as list of points) holds just one-wide lines, and if these lines are continuous enough to enclose whole curves (not split curves).

Once guaranteed the edge extraction, the curves identification can be performed by comparisons between acquired curves and a prototype, i.e. a previously stored representative curve. The basic comparison requirement is a sampling rate normalization, which may be achieved by evaluating the Fourier descriptors [3] for both curves: the acquired and the prototype.

3. The Search for Landmarks

The prototype curve holds more than (x, y) points. In fact, the landmark is a special point in the prototype curve. Its location should be identified by searching position and salient features in the acquired curve. So, the curvature and the zero-crossings for these both curves have to be evaluated intending to compare the landmark position in the prototype curve and the salient features positions.

4. Conclusion

This work proposed a framework to solve the automatic landmarking. This proposal has presented two main challenges: the Canny edge detector parameters continuity maximization, and the comparison between acquired and prototype curves. The automatic landmarking should contribute to improve cephalometric based diagnosis, since it will allow an operator independent parameters for cranium shape evaluations.

References

[1] Legan, HL.; Burstone, C.J. Soft-tissue cephalometric analysis for orthognathic surgery. *Journal of Oral Surgery*, 38(10), 744-51, 1980.

[2] Kamegai,T.; Kuroe,K.; Pan,Q.; Zhu,H. Dentofacial morphology of skeletal remains from the valley of yellow river by roentgenographic cephalometry. *Anthropological Science*, 105, 1-15, 1997.

[3] Castleman,K. *Digital Image Processing*. Prentice-Hall, 667pp., 1996.

[4] Canny, J. A computational approach to edge detection. *IEEE Transactions on Pattern Analysis and Machine Intelligence*, 8(6), 679-698, 1986.