Facial Features Extraction for 3D Stereo Modeling

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Abstract. In this work we present two simple, but general image processing techniques for facial features extraction based on Wavelet Decomposition and Statistical Analysis by Standard Deviation, required to 3D Stereo reconstruction.

1 Introduction

Facial Features Extraction has played an important role in applications that require facial recognition or detection, see reference [1][2]. As a fundamental step of 3D Stereo reconstruction, the system must be able to determine the image parts that should be matched. In the context of our work, those parts are the features of a face (area of the eyes, mouth and nose). Using in cooperation two simple techniques of image processing, the wavelet decomposition and the statistical analysis by standard deviation, the results of extraction can be made more reliable.

2 Wavelet-Based Approach

From the Wavelet decomposition of an image, a matrix of horizontal details coefficients was obtained. Performing a summation of each line in this matrix (horizontal summation) the features could be located by looking for the maxima values of H(y), given by:
for an image area: $A = [x_1, y_1] \times [x_2, y_2]$:

$$\forall \{x, y\} \in A \qquad \mathrm{H}(y) = \sum_{x=x_1}^{x_2} \mathrm{I}(x+1, y) - \mathrm{I}(x, y)$$

Due to the high values of coefficients in the area of the eyes, nose and mouth, and a priori knowledge about the facial features disposition, the region of interest was found. On the central image of Figure 1, baselines in the maxima of H(y) were drawn.

3 Statistical-Based Approach

In this method, the image was divided in N square blocks, so that the standard deviation of each block (σ_i) could be calculated. The mean of all these standard deviations ($\overline{\sigma}$) was obtained in order to take a decision:

$$\sigma_i - \overline{\sigma} > threshold \qquad (1 \leq i \leq N)$$

Blocks with high values of (σ) were found in the area of interest, so varying the threshold and the block size, it was possible to obtain the mask shown in Figure 1.

4 Partial Results

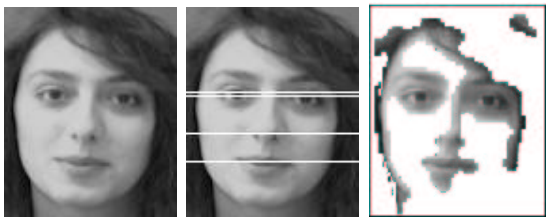

Figure 1: Experimental Results

This experimental result is presented using AT&T Research Labs faces database. In the Figure 1, the original image on the left side, followed by the wavelet analysis with the baselines of the eyes, nose and mouth. On the right side the statistical analysis result.

5 Conclusion

The results of the different methods can be used in cooperation as a validation criterion. They can be made stages of a pipe, acting like filters. We are developing more reliable tests for validation. As a future work, other steps of 3D Stereo reconstruction will be designed.

References

[1] Garcia, C.; Zikos, G. and Tziritas, G. *Wavelet Packet Analysis for Face Recognition*, Image and Vision Computing, V. 18, pp. 289–297, 2000.

[2] Nakamura, Y.; Fujishima,T. and Nagao, M. *Facial Feature Measurements with Photometric Stereo*, et.al. IEEE International Workshop on Robot and Human Communication,1992.