Expression-Driven Sketch Animation

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Abstract

An automatic sketch animation method is presented for cloning facial expressions. Different from the prior approaches, we try to animate a sketch with the set of real facial expression samples. When transfer the source expression to the target face, the local deformation characters for each target organ are learned from the samples, which preserve the personality as well as the expression style. The experiments show that generated sketch expression is not only expressive but also close to reality.

1. Introduction

Facial sketch is a highly abstract representation of the original face. Animating the sketch directly could avoid the complex changes caused by illumination and texture of the photorealistic image, but still maintain the representing power of displaying the facial personality and emotions.

The goal is to produce sketch expression animations by clone expressions of the source face. The source expression intensity and act variations should be transferred, while the personality of the target face should be preserved in the animating results. The proposed approach is first transferring the expressions from the source, and then learning the local deformation constraints from face samples to refine the final results.

2. Expression Transfer

Given a facial shape, the corresponding sketch results can be drawn by warping the sketch rendering vectors. A set of feature points is used to describe the face shape and the coordinate vectors are the face parameters. We also choose some marker points which do not change during the expressions such as eye corners and nose tip for aligning the source and target faces.

Human's faces share the same topology structure. Cloning expression is to map the expression motion from the source to the target. First, the motion vector of the source face is transferred onto the target face directly. The transfer result is denoted as T_e, which most preserve the source expression motions. It is easy to generate invalid face without adjusting the magnitude or direction of motion vector. T_e is then reconstructed in the specific expression space by principle components to acquire a valid face T_e'.

Since the global facial expression structure could be guaranteed in T_e', the local deformation relations is learned for target face from the samples lately, which will animate the target face to produce the most similar face as T_e'.

3. Local deformation constraint

Similar shapes of the neutral face could be assumed share the same deformation function when they do the same expressions. K-means clustering is employed for neutral samples' local organs: two eyes, two eyebrows, nose, mouth and contour. Each target organ chooses the deformation functions in the same cluster as candidates. Optimization function is built to find suitable deformation function for local component $c, c \in (1,\ldots,7)$, which match the T_e'.

$$\min_i \left(\left\| T_e^{c\prime} - f_i^c(T_N^c) \right\|^2 + \lambda \left\| T_N^c - S_i^c \right\|^2 \right) \tag{1}$$

Where, $i \in (1,\ldots,n)$ is the sample index in the same cluster with target organ. λ is the weight. T_N^c and S_i^c are the target neutral organ and a sample neutral organ respectively. There is a wide choice for deformation function f. The nonlinear deformation Thin-plate splines[1] is utilized at here to find the index i of samples, then to deform the shape of neutral target face locally by f_i.

4. Experiment results

We selected 70 persons from Cohn-Kanade Facial Expression Database[2] as the samples. For each person one neutral and one surprise images were used. The target face could be any person's sketch not limited in the database. Figure 1 shows the results of our method. As the intensity of source expression changes, the expression motion could be transferred to the target but still look like the original sketch.

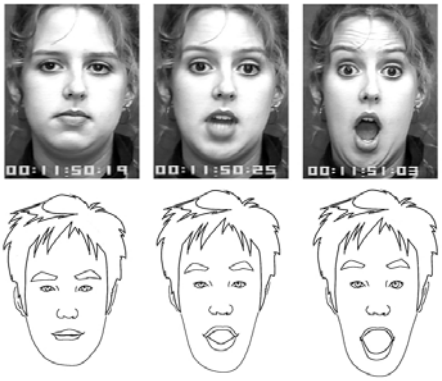

Fig.1. Expression-driven sketch animation, the upper row is source expressions, and the bottom row is the generated sketch animating.

5. Conclusions

In expression cloning, both of the characters of source expression and target personality should be preserved. An intuitive method is presented for animating sketch face following the source expression with constraints of local deformation. The experiment results showed the effect of proposed method.

References

[1]F.L.Bookstein, "Principal warps: Thin-plate splines and the decomposition of deformations," *IEEE Transactions on Pattern Analysis and Machine Intelligence*, vol.11, pp. 567-585, 1989.

[2] T.Kanade, J.F.Cohn and Y.Tian, "Comprehensive database for facial expression analysis," *Automatic Face and Gesture Recognition (FG'00)*, pp. 46-53, 2000.