Blood Flow-Parameterized Textures for Rendering Facial Expressions

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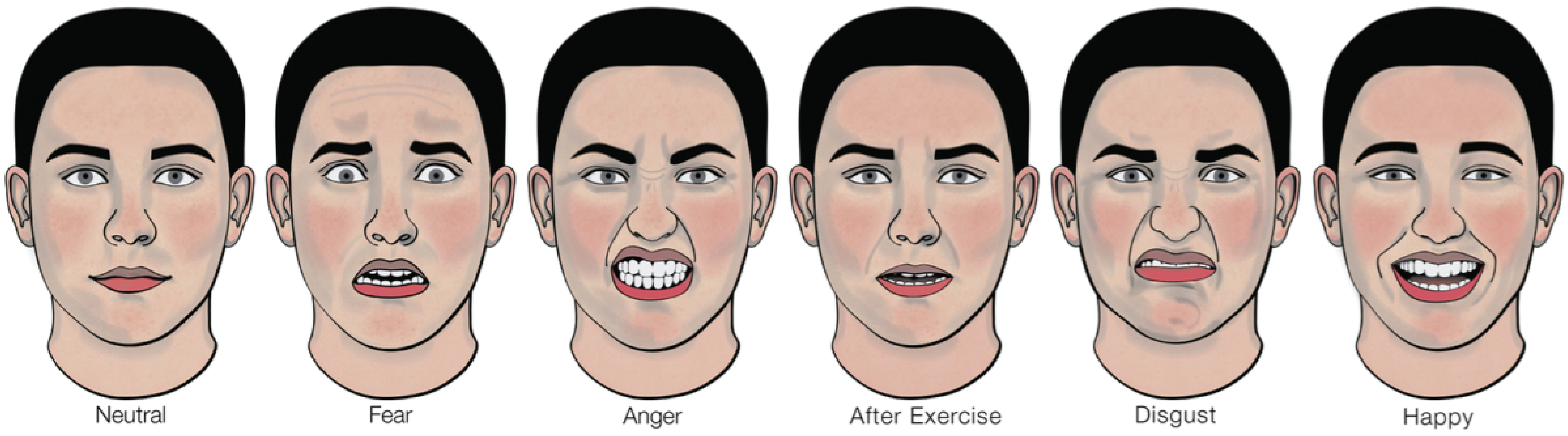


Introduction

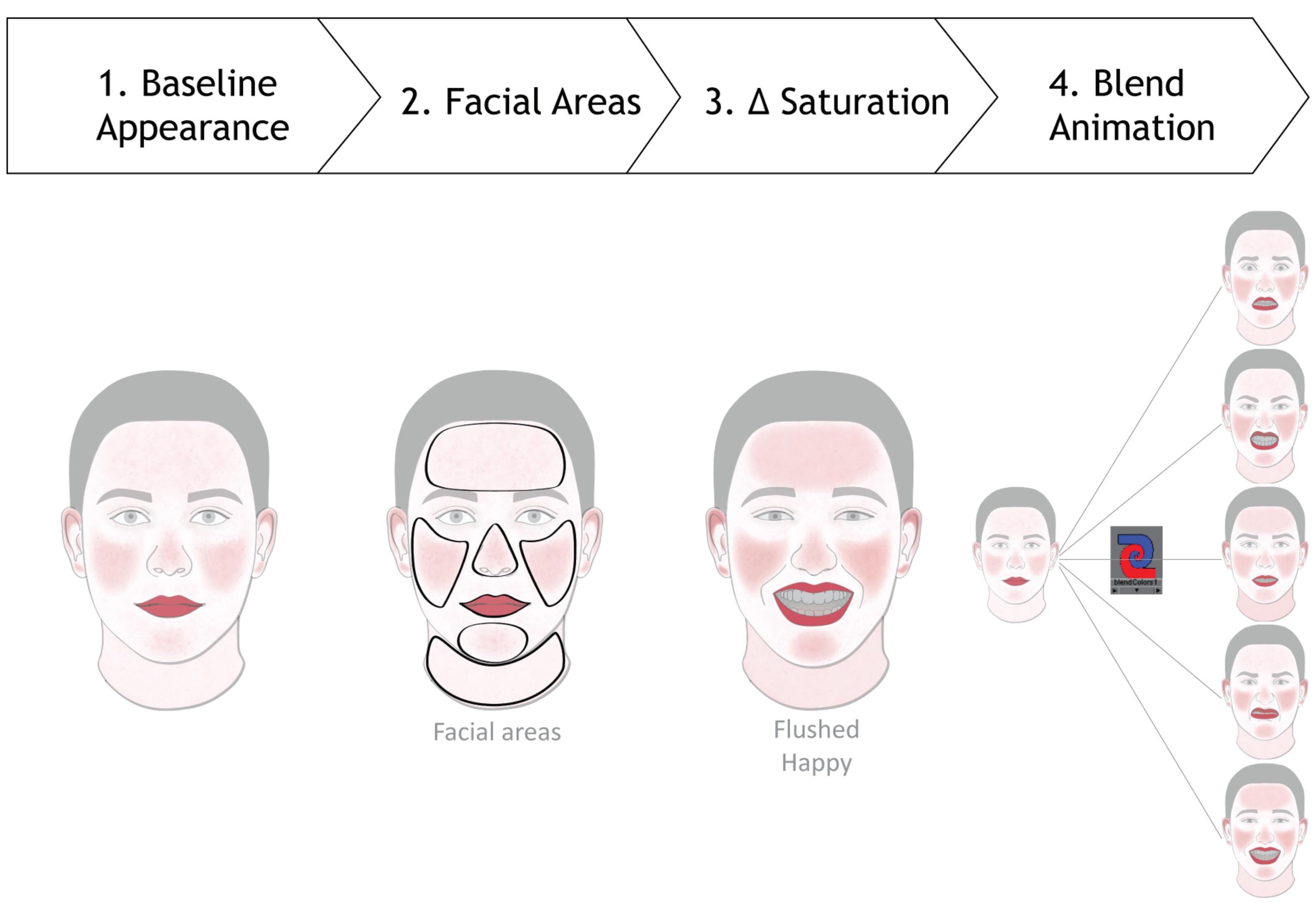
When digital artists hand-paint the textures for animation of realistic effects such as flushing due to facial expressions, they observe real-life references and use their creativity. This process is empirical and time-consuming, with artists often using equal textures across all facial expressions.

The problem is that there is a lack of guidelines on how skin color changes due to facial expressions, that is only surpassed when scans of facial appearance are used. However facial appearance scans require complex set-ups, expensive equipment and are best suited when creating digital doubles.

Thus, we propose a novel delta-parameterized method that allows artists to paint blood flow textures for animation of facial expressions.

Overview

The below flowchart gives an overview of the proposed blood flow-parameterized texture painting method. The artists use as input the standard hemoglobin texture (step 1), that is segmented into facial locations (step 2). These locations will be saturated in increments, following the obtained delta parameters (step 3). Flushing is animated by blending the neutral hemoglobin texture with the flushed hemoglobin texture (step 4).



Paint the baseline, neutral hemoglobin texture.

Define facial areas

Saturate areas for each emotion, following our delta parameters. Example given for happy emotion.

Texture blend animation between neutral and facial expressions.

Methods

To design the proposed method we conducted an experiment to collect a dataset of 32 human subjects' portraits expressing the 6 basic universal expressions, as defined by Paul Ekman [1]: surprise, disgust, sadness, anger, fear and happiness plus after exercise. The digital photos were acquired under controlled, diffuse illumination and color calibrated. Skin color differences were measured for all emotions and segmented into facial locations (forehead, nose, lips, chin, neck and cheeks). Color differences for the aforementioned emotions and locations were calculated in the L*a*b* color space using the CIELAB2000 formula, following Sharma et al. [2], best correlated with human visual perception. Furthermore, each L*, a* and b* axis was analyzed separately, which allows to characterize specifically hemoglobin perfusion, correlated with the a* (red to green color).

A One Way Repeated Measures ANOVA statistical analysis was performed on the collected data, to arrive at the most significant delta parameters.

Results

The header shows a model textured following our blood flow delta-parameterized method. The character is portrayed for the facial expressions and locations found to have the most significant, visible flushing.

Conclusions

Rendering skin flushing due to expressions was once unclear and expensive to artists, now is made accessible with our method. The provided blood flow parameters can be implemented into dynamic skin shaders to speed up existing texture animation processes. As a result, the film and videogame industries will gain more expressive and lifelike characters, because their skin is represented as a live organ, reflecting biologically based blood flow.

Acknowledgements

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References

[1] EKMAN, PAUL: Emotions revealed: recognizing faces and feelings to improve communication and emotional life. New York: Times Books. ISBN: 0-8050-7275-6, 2003.

[2] SHARMA G., WU W., DALAL E. N.: The CIEDE2000 color- difference formula: Implementation notes, supplementary test data, and mathematical observations. Color Research & Application 30, 1 (2005), 21–30.

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