Perceptually Valid Facial Expression Blending using Expression Units

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1 Introduction

The human face is a rich source of information regarding underlying emotional states. Facial expressions are crucial in showing the emotions as well as increasing the quality of communication and speech comprehension. The detailed study of facial actions involved in the expression of the six universal emotions [1] has helped the computer graphics community develop realistic facial animations. Yet the visual mechanisms by which these facial expressions are altered or combined to convey more subtle information remains less well understood by behavioural psychologists and animators. This lack of a strong theoretical basis for combining facial actions has resulted in the use of ad-hoc methods for blending facial expression in animations [2-3]. They mainly consider the facial movements for transient or combined expressions a simple mathematical function of the main expressions involved. The methods that have emerged are therefore computationally tractable, but the question of their "perceptual" and "psychological" validity has not yet been answered. Examples of such methods are "Sum of two expressions with or without limits," "Weighted averaging," and "MAX operator".

Our research aims at understanding how people perceive expressions, especially when combined, and how they combine facial actions to express mixed emotions. Based on Ekman's decomposition of universal expressions to smaller action facial units [1], we define "expression units" as facial actions observed in at least one universal expression. We then use an emotion model that maps each emotional state into a point in 2D space of Valence and Arousal [4]. Based on user studies, we associate expression units to these two parameters. Finally, we create the visual appearance of a combined or transient expression by mapping it into the 2D space and activating the expression units based on the value of emotion parameters at that point. The research approach is two-phased: (1) Let people generate those facial expressions using the model; (2) Validate by assessing the perception of the emotions as is manifested by the facial expressions.

2 Expression Parameterization

Russell [4] proposes that all human emotions can be characterized by a two-dimensional space formed by the orthogonal combination of two parameters (dimensions): Arousal refers to the overall level of physiological arousal and Valence refers to the state of pleasure, ranging from negative to positive.

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Existing studies of facial expressions [1] have associated facial actions to emotional states on a case-by-case basis, without any underlying parameters. We propose a new method where facial actions are associated to the parameters of Arousal and Valence, rather than directly to labelled emotional states. This means that the problem of blending facial expressions turns into the problem of finding the corresponding point in the emotion space and then activating the facial actions based on these parameter values. In this approach, no actual "blending" operators are necessary and blended expressions can be created directly, using the mood parameters controlling the facial actions.

Our approach is unique in that its success depends on performing behavioural experiments in which facial actions are mapped to the underlying dimensions of the emotion space. We are currently in the early stages of this research but have already had initial success in associating facial actions to the parameters and combining these actions into new expression corresponding to other points in the space.

3 Experimental Method

The experiments are done in two groups:

1- The users are given short stories which clearly combine two or three emotional state. They are then asked to use a facial animation system to manipulate a neutral face in order to create an expression that best represent the emotional state of the main character.
2- A second group of users are asked to rate the expressions created by group 1 for representing the same stories, and also associate images with only individual facial actions to mood parameters and emotional states.

The facial animation system allows manipulation of the face at high level (activating universal emotions [1]) and low level (activating individual facial actions). The results of the studies are used to associate expression units to emotion parameters and enhance the animation system to perform automatic blending for other cases which are again tested by a third group of users.

Although the experimentation is still in early phases, we have already made progress toward showing the effectiveness of the "expression units" method for expression blending.

References

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