Double your Face Value with Asymmetric Expression of Emotions Driven by a 3D Emotional Model

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Abstract

*Achieving facial emotional expressivity within a real-time rendering constraint requests to leverage on all possible inspiration sources and especially from the observations of real individuals. One of them is the asymmetry [BKY*98] in the expression of emotions that takes basically two forms. The first one is a systematic asymmetry that depends on the nature of basic emotions such as those identified in well-established models. The second type of asymmetry results from the simultaneous combination of two basic emotions, one on each side of the face, when an individual is unsuccessfully trying to hide one emotion by another one.*

Categories and Subject Descriptors (according to ACM CCS): Computer Graphics [I.3.7]: Animation—Facial Animation

1. Introduction

The greater ease of modeling symmetric faces and the fact that archetypal emotions are illustrated on symmetric faces have led to neglect the use of asymmetric face. Moreover, the symmetric face is sometimes considered as more attractive [GT94]. However, ignoring asymmetry is equivalent to filters out one expressivity channel that may convey precious nuances about the current emotional state. In order to synthesize emotional asymmetric expression, we first present a mapping between facial Action Units and a set of 12 emotions parameterized by a 3D emotional model. Our main contribution is to offer a real-time autonomous facial region encoding of emotion-dependant asymmetry suited for both the systematic asymmetry identified in experimental psychology as well as the higher-level asymmetry resulting from the display of simultaneous contradictory emotions.

2. A 3D Emotional Model

We took the terms valence(**V**), arousal(**A**), and dominance(**D**) to define a 3D model of emotion. For the third axis **D** we brought values from the *Affective Norms for English Words*, *i.e.* ANEW's "all subjects table" [BL99]. Figure 1 shows our predefined sample emotions in 3D emotional model.

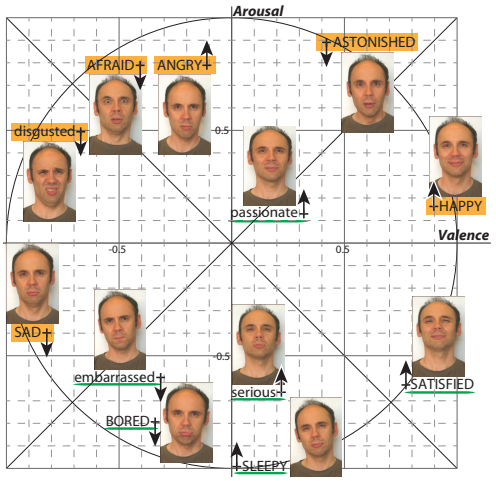

Figure 1: *Basic detailed **VA** plane applied to our proposed 3D emotional model [Rus80] [Sch05] [GAP*10] [AGST10]. The "+" marks and arrows indicate respectively the **VA** coordinate and dominance **D** value.*

3. Facial Control and Asymmetry

We applied the Facial Action Coding System (FACS)'s Action Unit (AU)s [EF78] as a basic reference. All the AUs that

we considered in our facial control are re-grouped to twelve *AU sets* in order to facilitate our parametrization along each **VAD** axis. For each AU set, a 21(**V**)x21(**A**)x21(**D**) voxel space was constructed and the observed value of intensity (-1, -0.5, 0, +0.5, or +1) was filled in each voxel that correspond to a coordinate of sample emotion. These values are later used to find face parts' dependency on emotional axes.

The asymmetric face was derived based on the neuropsychological observations as follows:

- Define a randomize function that gives mostly gives left-biased facial expression.
- Left-biased effect gives higher probability on the negative emotion along the **V** axis.
- Apply observations on the response of facial part muscle conducted by electromyogram(EMG).

4. Results and Conclusion

We derived two different types of asymmetric expressions. First, as depicted in Figure 2, we applied $\{v,a,d\}$ values of Affective Norm for English Words (ANEW) [BL99] to our proposed model with asymmetric expression. Second, we considered the fact that social codes and internal feelings can lead face to contradictory simultaneous emotions. We applied two different $\{v,a,d\}$ coordinate for left and right face. To the right (*i.e.* emotions dictate by the social context) and the left (*i.e.* emotions driven by the intuitive part of the brain).

For conclusion, we examined a number of literature surveys on social and neuro psychology for the purpose of

- choosing a suitable 3D emotional model for expressing emotions with nuances,
- identifying a model of the animation of each facial part as a function the emotional dimensions, and
- exploiting the effect of emotion in terms of asymmetric facial expression.

We estimate that the proposed approach will help designers of embodied conversational agents to convey complex emotions through the added nuances made possible with the asymmetry model.

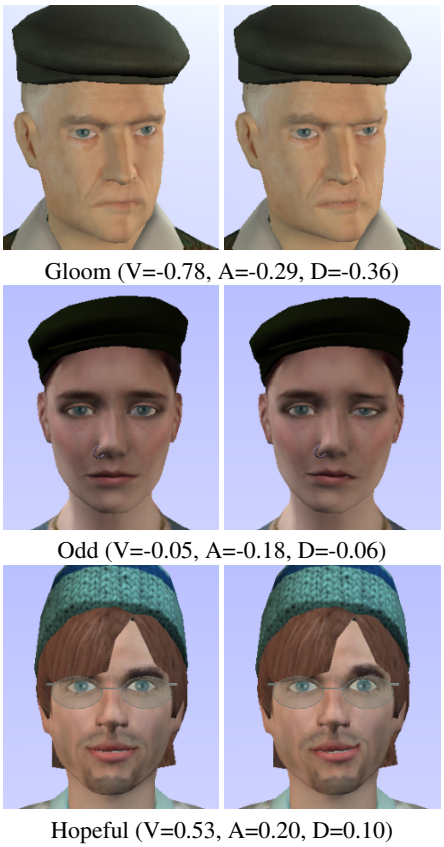

Figure 2: *Emotional expressions generated from **VAD** coordinate (left) and their asymmetric expressions (right).*

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