FACIAL EXPRESSION USING 3D ANIMATION

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ABSTRACT

Traditionally, human facial expressions have been studied using either 2D static images or 2D video sequences. The 2D-based analysis is difficult to handle large pose variations and subtle facial behavior. The analysis of 3D facial expressions will facilitate the examination of the fine structural changes inherent in the spontaneous expressions. The aims to achieve a high rate of accuracy in identifying a wide range of facial expressions, with the ultimate goal of increasing the general understanding of facial behavior and 3D structure of facial expressions on a detailed level. Facial expression provides cues about emotion, regulates interpersonal behavior, and communicates psychopathology. Human-observer based methods for measuring facial expression are labor intensive, qualitative, and difficult to standardize across laboratories, clinical settings, and over time.

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1. INTRODUCTION

A facial expression results from one or more motions or positions of the muscles of the face. These movements convey the emotional state of the individual to observers. Facial expressions are a form of nonverbal communication. They are a primary means of conveying social information among humans, but also occur in most other mammals and some other animal species.

Humans can adopt a facial expression as a voluntary action. However, because expressions are closely tied to emotion, they are more often involuntary. It can be nearly impossible to avoid expressions for certain emotions, even when it would be strongly desirable to do so; a person who is trying to avoid insult to an individual he or she finds highly unattractive might nevertheless show a brief expression of disgust before being able to reassume a neutral expression. The close link between emotion and expression can also work in the other direction; it has been observed that voluntarily assuming an expression can actually cause the associated emotion.

Some expressions can be accurately interpreted even between members of different species—anger and extreme contentment being the primary examples. Others, however, are difficult to interpret even in familiar individuals. For instance, disgust and fear can be tough to tell apart.

Because faces have only a limited range of movement, expressions rely upon fairly minuscule differences in the proportion and relative position of facial features, and reading them requires considerable sensitivity to same. Some faces are often falsely read as expressing some emotion, even when they are neutral, because their proportions naturally resemble those another face would temporarily assume when emoting.

Expression implies a revelation about the characteristics of a person, a message about something internal to the expresser. In the context of the face and nonverbal
communication, expression usually implies a change of a visual pattern over time, but as a static painting can express a mood or capture a sentiment, so too the face can express relatively static characteristics. The concept of facial expression, thus, includes:

1. a characteristic of a person that is represented, i.e., the signified;
2. a visual configuration that represents this characteristic, i.e., the signifier;
3. the physical basis of this appearance, or sign vehicle, e.g., the skin, muscle movements, fat, wrinkles, lines, blemishes, etc.; and
4. typically, some person or other perceiver that perceives and interprets the signs.

**Facial Action Coding System**

FACS is anatomically based and allows the reliable coding of any facial action in terms of the smallest visible unit of muscular activity. These smallest visible units are called Action Units (AU), each referred to by a numerical code. • With FACS, data collection is independent of data interpretation. There is no relation between the code and the meaning of the facial action. As a consequence, coding is independent of prior assumptions about prototypical emotion expressions.

**2. FACIAL EXPRESSIONS**

Some examples of feelings that can be expressed are:

- Anger
- Concentration
- Confusion
- Contempt
- Desire
- Disgust
- Excitement
The study of human facial expressions has many aspects, from computer simulation and analysis to understanding its role in art, nonverbal communication, and the emotional process. Many questions about facial expressions remain unanswered and some areas are relatively unexplored. To get a broad picture of the kinds of questions that have been asked, answers to some of these questions, and the scientific research about the face that needs to be completed to answer them, see the online document Understanding the Face: Report to the National Science Foundation. Facial expressions and the ability to understand them are important for successful interpersonal relations, so improving these skills is often sought. See the Guide: How to Read Face for tips on improving your abilities.

3. DEvelope a System for Generating Facial Animation of Any Given 2D or 3D Model Given Novel Text or Speech Input

Step 1: Capture data For realism, motion capture points of a human speaking must be captured that encompass the entire phonetic alphabet and facial gestures and expressions.

Step 2: Choose feature points from mocap data

- A set of points from mocap data must be selected for use as the “feature points.”
- Only the motion of feature points is needed for animating a model.

Step 3: Select same feature points on model
User must tell the program what points on the model correspond to the mocap’s Selected points.

Step 4: Compute FP regions/weights

Program searches out from each feature points, computing weights for each vertex in surrounding neighborhood until weight close to 0.

Step 5: Animate the model
Given information about vector movement of motion capture points, each feature point is moved and then neighbors are moved according to weights.

4. TOOLS FOR STUDYING FACIAL EXPRESSION PRODUCED BY MUSCULAR ACTION

The Facial Action Coding System (FACS) is used to measure facial expressions by identifying the muscular activity underlying transient changes in facial appearance. Researchers use in facial analysis to determine the elementary behaviors that pictures of facial expressions portray.

The FACS Affect Interpretation Database (FACSAID) is a tool for understanding what the muscular actions that FACS measures mean in terms of psychological concepts. FACSAID interprets the facial expressions in terms of meaningful scientific concepts.

3D DATABASE

3D facial models have been extensively used for 3D face recognition and 3D face animation, the usefulness of such data for 3D facial expression recognition is unknown. To foster the research in this field, we created a 3D facial expression database, which includes 100 subjects with 2500 facial expression models.

The database presently contains 100 subjects (56% female, 44% male), ranging age from 18 years to 70 years old, with a variety of ethnic/racial ancestries, including White, Black, East-Asian, Middle-east Asian, Indian, and Hispanic Latino. Each subject performed seven expressions in front of the 3D face scanner. With the exception of the neutral expression, each of the six prototypic expressions (happiness, disgust, fear, angry, surprise and sadness) includes four levels of intensity. Therefore, there are 25 instant 3D expression models for each subject, resulting in a total of 2,500 3D facial expression models in the database. Associated with each expression shape model, is a
corresponding facial texture image captured at two views (about +45° and -45°). As a result, the database consists of 2,500 two-view’s texture images and 2,500 geometric shape models.

CONCLUSIONS

Expressions of an actor can be virtually built and coded in a small set of real numbers. We can measure face expressions with two cameras to deduce its correlations with principal expressions. A recognition software makes two images of a 3D object and compares it to a reference (neutral face) then a dynamic structural software analyses the comparison (digitized expression) in the modal basis of the reference. This modal basis can be built by a mathematic process (natural modes basis) or be modified by introducing specific expressions (sadness, happiness, anger, surprise) which are semantic modes. This process can be used in Human Machine Interface as a dynamic input (3D reading of an actor intention) or output (3D dynamic avatar).

REFERENCES


