Design of a GUI for the facial expressions creation in the 3D software "Make Human" - Demo

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ABSTRACT

This project's aim is to design and create a GUI of the facial expressions making process within the open source software Make Human, an application for the creation of 3D humanoids. This study will allow to standardize human expressions, in order to reproduce them automatically with the software.

Categories and Subject Descriptors

H.5.2 [**Information Interfaces and Presentation**]: User Interfaces - *User-centered design*; *Interaction styles*; *Theory and methods*; I.6.5 [**Simulation and Modeling**]: Model Development – *modeling methodologies*;

General Terms

Experimentation, Human factors, Design, Measurement

Keywords

Emotion, facial expression, graphic user interface, 3D humanoid.

1. INTRODUCTION

The international nature of the Make Human Project makes the development of facial expressions extremely complicated, because their interpretation and recognition changes depending on people's own culture. Having potential worldwide use, the process of expression standardization needs an objective scientific background, in order to best represent, and without discrimination, the whole human ethnic heritage.

2. PRIMARY EXPRESSION SYNTHESIS

After Ekman's objective ethnographic studies in New Guinea [1], six universally-recognized archetypal have been identified: angry, fear, disgust, joy, sadness, and surprise. Ekman codified these expressions through his anatomic standard (Facial Action Coding System [2]), giving, for the first time, a secure base about facial expression. Later, the MPEG-4 standard synthesized these archetypal expressions in digital format, through the definition of muscular movements [7]:

- FAPU (Facial Animation Parameters Units): these represent fractions of key facial distances.

- FDP (Facial Definition Parameters) also known as FP: 84 points used to define the morphology of a face and to provide the spatial coordinates of the FAPs.

- FAP (Facial Animation Parameters) are 68 parameters of animation of FP based on FAPUs.

3. SECONDARY EXPRESSION SYNTHESIS

Achieving a synthesis for the secondary expressions, however, requested a more complicated passage, because of their indefinite nature and because of the total lack of scientific literature and objective data concerning them.

Despite that, it has been possible to synthesize secondary expressions thanks to Whissell [4] and Plutchik' studies [5]. Both of them made a classification starting from terms that represent emotions in the English language. Whissell's classification is based on two parameters: *activation*, that define the degree of

human participation to the emotion and *evaluation*, the pleasantness of the emotion. Plutchik's cataloguing is based on 140 terms instead classified on a eleven point bipolar scale and then placed on a circle, according to their relative similarity. From these positions on the circle, he achieved the "angular measure", a constant value for each term.

3.1. Expressions close to the archetypal ones, only differing in their intensity

For the MPEG-4 standard, according to G. Faigin's theories [6], there are categories of emotions which are close to the archetypal ones, and differ from them only for the "intensity" parameter. In MPEG-4's terms, this means increasing or reducing the range of variation of the specific archetypal expression's FAPs, through the translation of Whissell's activation parameter [3].

3.2. Expressions not related to the archetypal ones

According to Plutchik's angular measure [5], any secondary expression lies between two archetypal ones. Thus, its profile is realized by combining the profiles of these two primary expressions, through three rules [3]:

1. FAPs that are common in both emotions are retained during the synthesis.
2. FAPs used in only one emotion are averaged with their corresponding neutral position.
3. In case of opposite FAPs, there are two types of synthesis:

a. Opposite FAPs with the same intensity are cancelled out.

b. Opposite FAPs with different intensity are averaged

4. SYNTHESIS IN MAKE HUMAN

Make Human involved this process by morphing two *targets* (previously hand-sculpted 3d models), taking into account that each FAP is translated into a target. As expressions are a combination of FAPs, in Make Human they are a combination of targets. The whole process of translation into targets has carefully followed MPEG-4's descriptions of FAPs, although the only fundamental values to seek were [7]:

- *unidirectional or bidirectional FAP*: a FAP performing a "double" movement compared to the neutral model, needs the development of two different targets.
- *movement intensity*: FAPs are expressed through FAPU. In Make Human, movements are expressed in terms of earlier state and final state and the middle state is created by morphing these two states. So, Make Human performs targets representing FAPs at their highest degree of intensity. To achieve a FAPs' highest value, in order to compare the final state of targets, it was necessary to standardize FAPs and target values:

Let "x" be the value of the FAP in the neutral state (which compares to the "0" state in Make Human), and let "x_1" be the value of the FAP in the highest state of intensity (which represent the "1" state in Make Human), the FAP value "d" will be:

$$d = x_1 - x$$

Thus, let "d_a" be any distance between Make Human's values "0" and "d_{max}". This is then normalized as follows:

$$d_{normal} = d_a / d_{max}$$

5. GUI DESIGN

Given its complexity, the modeling process is divided into two parts, each one implemented by a specific tool:

5.1. Emotion Panel

This tool comprises eight keys forming the circle of Plutchik's archetypal emotions: acceptance, fear, surprise, sadness, disgust, anger, anticipation and joy. With the selection of one key, the user selects the range of variations of the expression itself; therefore, all the options associated to the chosen expression, which are based on the Plutchik's similarity criterion, will become available, and will be explored with the second tool on the interface.

5.2. Expression Panel

This tool is a widget, that allows the creation of any kind of expression linked to the chosen emotion, by mixing the involved FAPs "run-time". In summary, the position of the cursor on the tool's area of action triggers an algorithmic process which results in the mesh modelation.

6. FURTHER WORK

The work presented here has been implemented as a prototype within a RC (release candidate) to Make Human. Before the method was implemented in an official release, the software development team started a revolutionary transformation of its structure, in order to make it a total "3d made" software. Regarding the development of this work in the future, a lot of attention has been given to the temporal dimension of the human expression. In fact, despite the tendency to consider it as "static", an expression has its own particular timing on the human face. In the same way, despite it creates "static" humanoids at the moment, Make Human has been already set up to develop expressions on a time line, allowing Make Human to better manage the dynamics and the "humanity" of humanoids, becoming a point of reference for 3D animation.

7. REFERENCES

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