Mechanism and Expression of Emotions in Virtual Humans

DESIGN DOCUMENT

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1.0 Introduction

Emotion plays a prominent role in an efficient and satisfying cooperative social interaction. Emotions in human social interaction are believed to play a major role as a motivational basis of pro social and cooperative behavior.

Endowing emotions to Virtual Human enhances their cooperative social skills, and also makes them more likeable, trustworthy, and caring.

To build vivid, lifelike, 3D computer models of the human being is exciting, and it has many applications, for example, for training, design ergonomics, simulation in hazardous environments, in computer games and in the film industry.

Generally speaking, human modeling and simulation consists of three aspects: external modeling, perception modeling and internal modeling.

External modeling is to generate vivid 3D computer models of virtual human. It includes appearance modeling and motion modeling. Appearance modeling consists of human body modeling, face modeling (facial expression and hair), and cloth modeling. Motion modeling is to generate realistic, desired motion.

Perception modeling is to establish synthetic perceptions for virtual human. It includes synthetic vision, synthetic audition and synthetic tactile. Internal modeling includes the modeling of virtual human's personality and emotion.

Our goal in this project will be modeling and creating Virtual Humans and defining their emotion mechanism [1]. The next step would be to modulate these emotions i.e. define the mechanism of changing emotions from one state to another to and in effect bring out empathy.

2.0 Background and Related Work

Virtual humans are embodied characters which inhabit virtual world .First, virtual humans look like humans. Thus, research draws on computer graphics for models to control the body and face. Second, virtual humans act like humans. Thus, research draws on the social sciences for models to produce emotions and personality.

There are quite a few research groups in this area which are very active, for example, the MIRA Lab [2] and Virtual Reality Lab [3] in Switzerland, the Centre for Human Modeling & Simulation in University of Pennsylvania, USA [4].

With respect to emotion synthesis, several theories of emotion have been explored, the Ortony, Clore and Collins (OCC) [5] being one of the most commonly used. With respect to emotion expression, research tends to focus on conveying emotions through synchronized and integrated gesture, facial and vocal expression.

Also, de Melo [6] proposes a model for expression of emotions using the camera, light and sound expression channels.

A lot of research has been done not only on emotion synthesis but also expression empathy in Virtual Humans.

McQuiggan et al. [4] propose an inductive framework for modeling parallel and reactive empathy in virtual agents. Their framework is called CARE (Companion Assisted Reactive Empathizer) and consists of learning empirically grounded models of empathy from observing human's social interaction.

3.0 Work Flow

Our Methodology will revolve around creating Human like models. These models can be created using data points and using mpeg-4.

Then we would be involved in using an emotion model to induce the human like models with emotion to stimulate human like behavior. The models that we will be using are specified in the previous section.

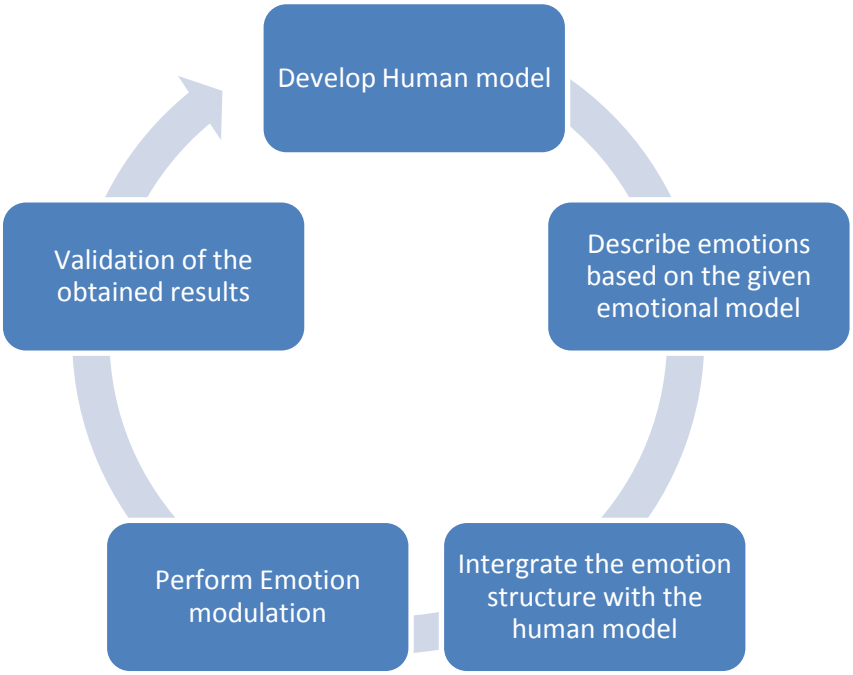

Figure 1: Development Lifecycle

The project will be iterated to calibrate our human model and the emotions to meet the standards present.

4.0 Design of components

The Human Model will be developed according to MPEG-4 standards [].

4.1 MPEG-4 standards

In the year 2000, mpeg-4 standard was released by Motion Pictures Experts Group as an ISO standard. As far as Virtual human modeling is concerned, MPEG-4 Facial Body Animation Parameter, specified in ISO/IEC 14496-2:2004 Information technology relates to coding of audio-visual objects [4]. MPEG -4 defines these sets of parameters for animation as well as calibration of a human face:

FDP (Facial Definition Parameter): These parameters are used to define the structure and shape of the face. There are 84 feature points that describe the head. Figure 1 illustrates this Feature Points (FP) [5].

FAP (Facial Animation Parameter): These are responsible for movement or animation of the human face. They may be low level point with respect to displacement of a single definition point on the face or high level with respect to reproduction of a facial expression [6].

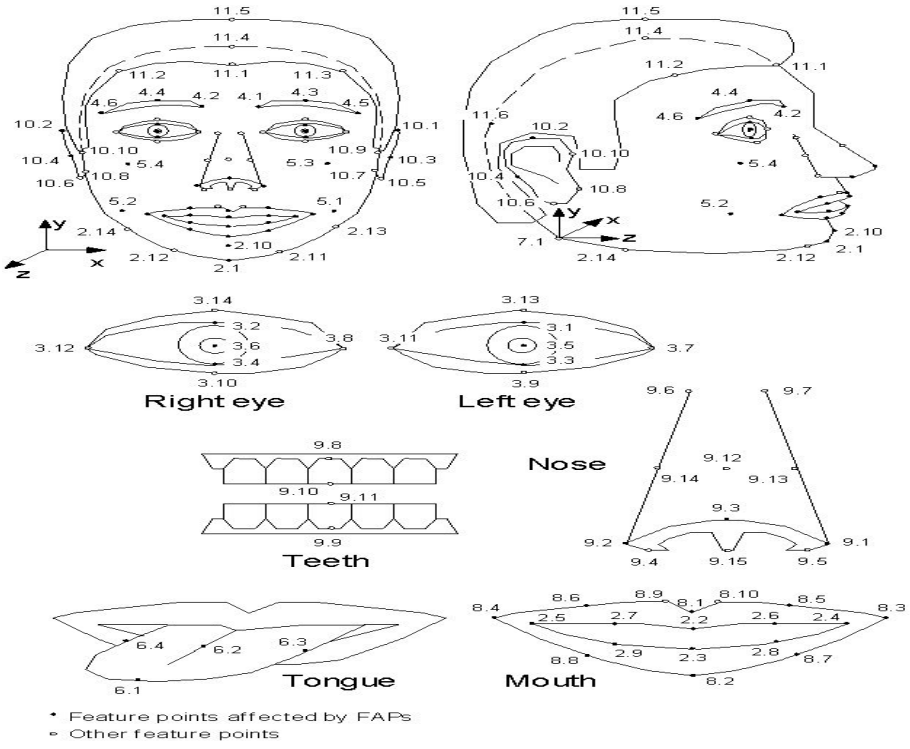

Figure 2: MPEG-4 Facial standards

4.2 Emotion model

Once the Human model is created, emotions have to be added it. The model once imported is in neutral face i.e. the basic state without emotion to which it must revert to once the emotion is displayed. The specification of the neutral face includes []:

- The coordinate system is right-handed
- Head axes are parallel to the world axes; gaze is in direction of the Z axis
- All face muscles are relaxed
- Eyelids are tangent to the iris;
- Pupil diameter is 1/3 of the iris diameter;
- Lips are in contact; the line of the lips is horizontal and at the same height of lip corners;
- The mouth is closed and the upper teeth touch the lower ones;
- The tongue is flat, horizontal with the tips of the tongue touching the boundary between upper and lower teeth;

We plan to implement a total of six basic emotions – sad, happy, fear, disgust, angry and surprise.

4.3 Prototype Emotion model

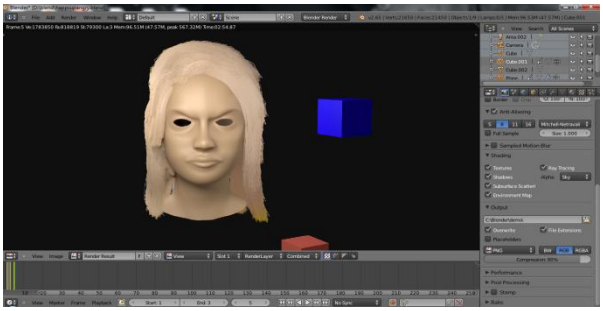

Figure 3: Angry Model

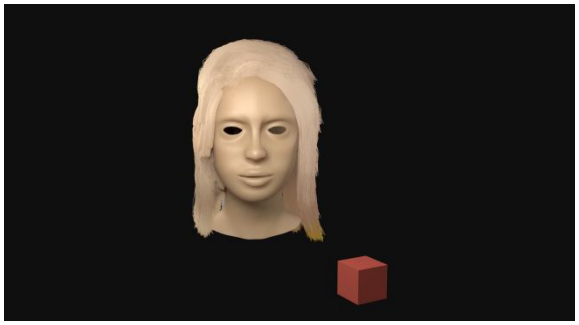

Figure 4: Base Model

5.0 Design Evaluation

The evaluation of design is done using Cognitive evaluation as the system is bound to be used by the general public and would therefore be designed with them as the audience.

In Cognitive walkthrough the user is required to analyze whether he is lead to the correct goal by the design. For example: if a user selects “Angry”, then he must be redirected to an Angry image of the Virtual Human and not say “sad” image.

A Field study can be performed where users of different background are asked to look at the various emotions displayed by the Virtual Humans and determine or compare with their own natural ones. This helps the system in calibrating the emotion on the Virtual Humans.

6.0 Future Works and Conclusion

The field of making the Virtual Humans more Human like is very promising in the near future. Recent research shows that virtual humans exhibiting empathic behavior can reduce stress levels during job interview tasks and can teach children to deal with frustration and bullying.

A model which relies on rules for the expression of emotions is likely not to be sufficient. Work is being carried out to design a model that relies on machine learning theory, which would support automatic learning of new rules and more sophisticated mappings between emotional states and bodily, environment and screen expression.

7.0 References

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