

# Emotion Modeling of Virtual Chinese Characters in E-Teatrix<sup>1)</sup>

<sup>1)</sup>Chaohui Zhu   <sup>1),2)</sup>Zhigeng Pan   <sup>3)</sup>Rui Prada   <sup>1)</sup>Mingmin Zhang

<sup>1)</sup>(State Key Lab of CAD&CG, Zhejiang University, Hangzhou, P.R.China□

<sup>2)</sup>(Institute of VR and Multimedia, HZIEE, Hangzhou, P.R.China)

<sup>3)</sup>(IST, Technical University of Lisbon and INESC, Portugal)

E-mail:  [{zgpan,zch}@cad.zju.edu.cn](mailto:{zgpan,zch}@cad.zju.edu.cn)

**Abstract**□Computer graphics and virtual reality are nowadays widely used in Chinese education. Teachers and students have realized the great benefits that virtual interactive environments can bring to their traditional classroom, especially if these environments contain virtual characters with emotions. E-Teatrix is one of such examples, it is an interactive learning environment that was build to help students to create and tell fairy-tale stories. Children using E-Teatrix are able to improve their creative and develop their narrative skills. Children's goal in E-Teatrix is to play the role of a certain character in a story. The character control is more than just to tell the character what to do; it also includes the control of the characters emotions. Each E-Teatrix character supports five emotions. These emotions are automatically generated by the system, but children can use an emotion controller tool to inspect and in the case of their own character to control characters' emotional state.

This paper will discuss in detail the use of emotions and the emotion controller tool in E-Teatrix.

**Keywords:** emotion, virtual reality, intelligent virtual environment, emotion controller

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## 1 Introduction

In the recent years embedding emotional behaviour into virtual characters has become a hot research topic in the filed of virtual reality [1][2]. To become believable a character will not only need to act in an intelligent way but will also need an emotional dimension that allows it to express things such as: friendship, anxiety and hostility etc. Computer researchers have tried for some years to add emotions into the computer. However the problem of the inclusion of emotions in a virtual character is not exclusive of computer systems. Early in 1981, Thomas discussed with some similar thought concerning the believability of virtual characters with emotions in his animation system [3]. Loyall [4], in 1993, suggested a system that used linear bipolar variables to express different dimensions of a characters' personality (e.g. introverted - extroverted). This approach is very similar to psychology trait theories, but his theory neglect the complexity of the emotion. Tracy [5] thinks that the structure of emotion is composed by many nonlinear dynamic systems, which can also be separated into many coupling dynamic sub-systems. For

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instance, when we feel afraid, this feeling triggers a series of physiology responses in our body, such as the gray-face and the increase of our heart beat. Emotional changes are also related to the mood. Tracy's theory on emotions reflects better the complexity of the emotion.

Johns build a virtual learning environment using VRML where learners can learn by discovering and by doing. Integrating Jess expert system [6] into a VRML world, his environment provides dynamic assessment and coaching [7]. Some other researchers integrated the same techniques in other domains such as tutoring systems, intelligent agent technology, natural language processing, visualization and animation to build. One example of this is the cooperative learning system that enabled several users from distant locations to share a virtual 3D space [8].

Our aim is to use computer graphics and virtual reality technology to build an immersive 3D educational virtual environment enriched with virtual characters, where children can select their favorite environment and a character to act. Having each character an emotional state the can be changed along five emotional dimensions. Several children can interact in the environment using several characters and scenes to compose a story.

This paper is organized as follows: first we will introduce some related work then we present the character's emotion states in E-Teatrix. In the third section, we will discuss the emotion design in E-Teatrix in detail. And in the fourth section we will present some images that show the virtual characters. Finally we draw our conclusions and

discuss some future work.

## **2 Character's emotion states in E-Teatrix**

### 2) E-Learning with Virtual Interactive Synthetic characters

In psychology emotions theory, an emotion, is defined as instant psychic's phenomena, and represents an adaptable model that gradually adapt to the environment [9]. There are several theories on emotion today. Some theories state that there are several prototype formats in human emotions. The basic emotions according to Ekman are: anger, fear, sadness, enjoyment, disgust, and surprise, using these basic emotions one can constitute the whole emotion spectrum of human emotions [10]. The experiment done by Meng [11] proves to have no difference between the emotions that Chinese children and foreign children express in their childhood.

Dimensionality theory reckons that several dimensions can construct all the human emotions; the distance in the dimensionality space presents the similarity and dissimilarity among the different emotions. They take the emotion as a gradual and calm change.

Maslows [12] suggested a hierarchy of five classes of needs that should influence the behavior of characters, in the top of the hierarchy is self-actualization, and in the base the physiological needs (such as food, water, oxygen). Characters' motives can sometimes conflict and result in complex emotions and behaviors. Maslows model can be used for

structuring behaviour in levels that define priority levels. For example, in a certain 3D environment, the behavior of avoiding vehicle is more important for a character that is near a road.

E-Teatrix is one of the research results of ELVIS<sup>2</sup>. ELVIS goal is to introduce virtual reality technology in schools to help people study. The ELVIS project is cooperated by Salford University (U.K.), Hertfordshire University (U.K.), Zhejiang University (China) and

Technical University of Lisbon (Portugal).

E-Teatrix is an extended version of Teatrix. The original version only included three different emotional states (happy, sad and a neutral state). We have extended the Teatrix characters' emotional model in E-Teatrix, to include five different emotional dimensions: happiness, disgust, sadness, anger and surprise (See figure 1)



Figure 1. Five emotions in E-Teatrix

### 3. Character's emotion design in E-Teatrix

Before we discuss the design of emotions on E-Teatrix, we will briefly introduce the architecture of E-Teatrix.

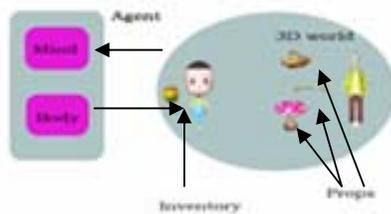


Figure 2. The architecture of E-Teatrix

Characters in E-Teatrix stories are autonomous software agents that have effectors and sensors to interact with the environment. The sensors get information from the environment and turn this information into perceptions. Having filtered useless information, these perceptions are sent to the mind.

The mind receives those perceptions and uses them to analyze the whole scene. According to the character's goals, the mind generates corresponding action plans. Table 1 shows a simple example of an action plan.

Table 1. An example action plan

Hurt big-head son	Goal
Using stick to beat him	Action plan 1
Walk to the stick	Action plan 2
Pick up	Action plan 3

In E-Teatrix character emotion dynamics can be divided into two parts. One is done by system automatically. If children follow their characters goals and fulfill the characters' desires, then the system will change the character's emotional state to happiness. Otherwise if children don't follow the characters'

goals the emotional state will be set to disgust. Emotions can also be explicitly changed by the user that controls the character.

With the help of teachers, children can play the story according to the story script that have been read or written by them, and then they can interact with each other in the 3D collaborative virtual world. This kind of play can develop children's creative ability and notions of narrative. When playing the story the children showed some frustration because the set of character actions did not provide them with the means to develop their characters' performances or to fully express their creativity. To solve such problems, the system includes an additional tool that we call emotion controller (Hot-seating in Teatrix original version), which gives children more control over their characters. Using this tool, children can change their characters' emotion state.

In E-Teatrix, there are five emotion states to select from: happiness, disgust, anger, sadness and surprise (See Figure 1). After changing their character's emotional state, by selecting the corresponding icon (See Figure 4), children explain the meaning of this change and their character's current behavior. At each reflection time they should seek answers to the following

questions:

*Character x has performed action z*  
*Because <motive>*  
*Therefore <what are the expected outcomes>*  
*Or*  
*Character x is sad*  
*Because <motive>*  
*Therefore <what are the expected outcomes>*

Emotion states are changed according to the rules showed in Figure 3. The emotion controller is an important tool in the system because it can not only reflect the role of character controlled by children in the story, but also reflect the character's emotion state at a given time. The changes in the emotional state are all recorded by system. These records are quite useful in analyzing

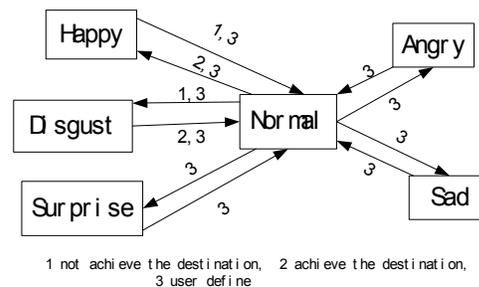


Figure 3. Emotion states change figure children's psychology. For instance, we can use these records to analyze how children are dealing with problems.

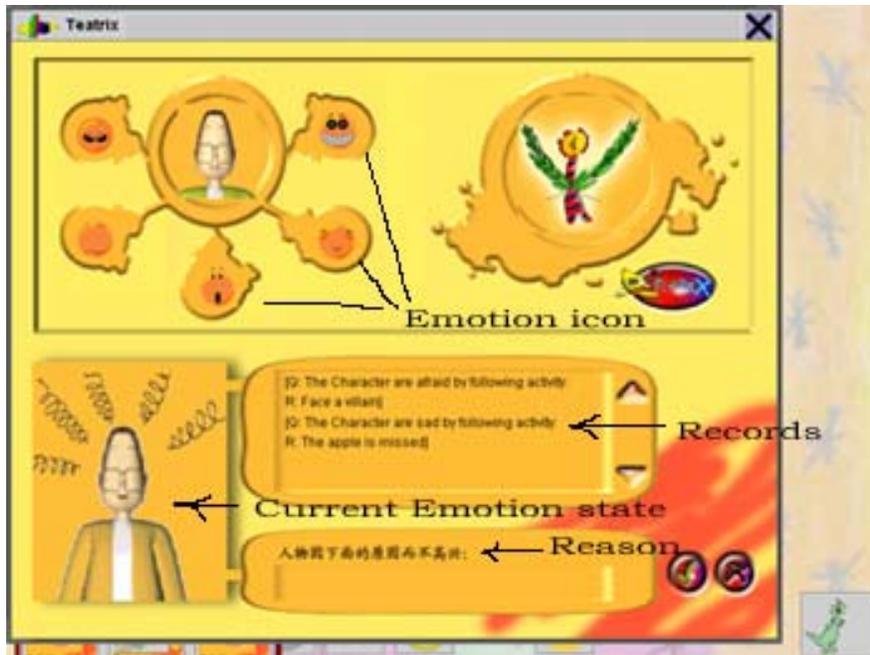


Figure 4. The emotion control of E-Teatrix

It is quite convenient to check the states of that character that we control by using the emotion controller, but the emotions of the others can also be important. To deal with this problem, we decide to use two different modes when using the emotion controller:

- Self character: In this mode, children can get the information about the character they control, this information includes: (1) Character's role and his goals. (2) Children can change the character's emotion state.

- Other's character: In this mode, children can check other children character's information, these information includes character's role, emotional state and some reflection records. (See Figure 5)



Figure 5. Another model of emotion control in E-Teatrix

Once having this emotion controller, it is very easy for children to control the emotion of the character that they play, thus extending their imagination as actors and creators of the story. For instance, if a villain controlled by a child does not want to harm another character that is been controlled by another child, then the character cannot achieve his goal (villain's goal is to harm the other characters) therefore his emotion will become negative. But the child can change this situation by using the emotion controller to change the emotion of his character.

## 4 Virtual Chinese characters in

### E-Teatrix

E-Teatrix uses characters that came from famous Chinese tales. They are familiar and beloved by Chinese children (See figure 6).

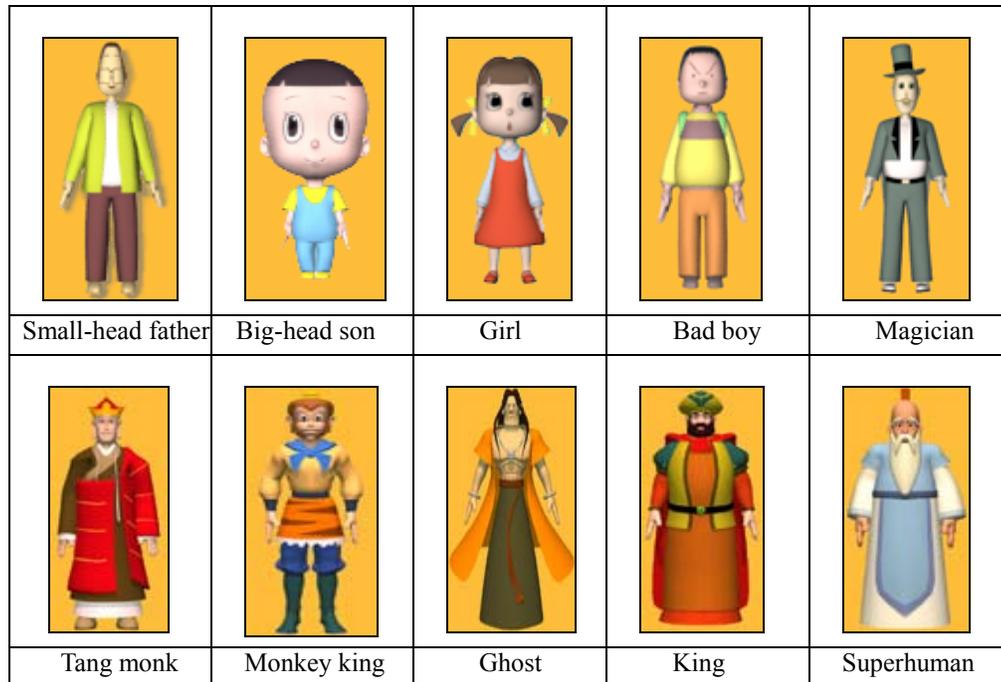


Figure 6. Chinese characters in E-Teatrix

E-Teatrix is a distributed multi-user virtual environment where users interact in order to create a story. The story emerges from the users' interaction, which is achieved by means of a virtual character that each user chooses to control. The system is divided into three parts that follow a theatre metaphor, namely the background, the stage and the audience. Background is used to decide the initial setting of the users stories, this include the user's interested scenes, characters and props. In the stage phase users are expected to build the story based on the setting that they choose in the backstage. The audience is the place where user can see a video that is generated as they play the story in the stage phase. Figure 7-10 show some snapshots of E-Teatrix.

Figure 7 shows the main system interface where the three phases are available. In Figure 8, user is selecting a girl character to play. And in Figure 9, two users are interacting with each other in the virtual environment. Figure 10

shows the emotion controller tool where the user can change his character's emotion state.



Figure 7. System interface of E-Teatrix



Figure 8. Selecting a girl to control



Figure 9. Big-head son is talking with the girl



Figure 10. Using the emotion controller to change the character's emotional state

## 5 Conclusion and future work

This paper presents E-Teatrix an extension of Teatrix and the Chinese characters that were introduced in the original system. Characters have an emotional state that is one of the important variables that users use to better express themselves through the characters when playing in the virtual stage. We described E-Teatrix emotion control tool and the extension introduced to the emotional system that uses five emotions. The experimental results show that virtual interactive characters with emotions are very useful in education area.

However, E-Teatrix is not yet a finished project. We will continue to add some new characters from Chinese fairy

tales, such as the blue cat.

Characters in Teatrix are 2D animated sprites drawn in billboards, we are working to include in E-Teatrix also characters with full 3D geometry.

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