

Chapter 6

Conclusions and Future work

This Chapter discusses the findings and results of this thesis, from designing the theoretical prototyped avatar to the actual implementation of the avatar creation tool and of the interactive virtual pub environment. The results of this interactive virtual environment simulate a basic real-world social environment, which allows the user to observe the social interaction between avatars, and the emotional changes of avatars caused by the social interaction. Section 6.1 concludes this thesis, by discussing the results of generating avatars that can displayed facial expressions using the expression texture approach, combined with body motions to created expressive avatars and generated this avatar into the virtual pub environment, allowing the avatar interacted with other avatars and the user. Section 6.2 discusses the possibility of improving the avatar creation process and the modification of the virtual pub environment and the social interaction application tool into a fully functional avatar application and future work.

6.1. Expressive Textures

The goal of this thesis is to create the expressive textures approach and implement the tools to create expressive avatars and allow them to appear and interact in a virtual pub environment. The expressive Texture approach used synthetic or video images of faces, which use few system resources and provides a fair amount of realism. The expression of the avatars is animated, by displacing the texture mapping co-ordinates of the face

texture mapped onto the face mesh. These avatars are implemented in a simple virtual environment, which demonstrate the interaction process between different avatars in this virtual environment and the effectiveness of the expressive texture approach combined with body animation when implementing these kinds of avatars in the virtual environment.

The expressive texture approach is implemented by determining the motion cues of all the basic expressions. Based on these motion cues, the texture co-ordinates of the face texture that is mapped onto the face mesh of the avatar are displaced to animated facial expressions. Complex masking is also applied to the face mesh to simulate eye animation using the face texture and pupil mask. Simple body animations of the expressive avatar are created by analysing the possible basic motions of the avatar in a specific virtual environment (e.g. The virtual pub) and classified them into body motion cues. Based on these motion cues, the joint rotation at specific body part is applied by the accumulated matrixes that contain the translation and rotation of the body part relative to the origin of the avatar. (E.g. translate the body part to the origin, applied the rotation of the body part, translate back to the correct position and then draw the body part object).

The expressive avatars are implemented in the virtual pub environment that tries to simulate a real environment and allows different avatars to interact in this environment. The virtual pub environment and the virtual objects in this environment are modelled with a low polygon count, and texture mapped with a single complex texture. This avoids use of too many system resources for drawing the environment, than for computing the animations in the environment. The virtual pub environment is a closed environment, therefore no virtual forces are simulated in the environment. However, the floor of the pub environment is structured such that simple space and position detection by the expressive avatars is possible in the virtual pub environment.

Expressive Texture approach to avatars is a useful approach for numerous applications that requires use over a network, such as virtual conferencing or virtual conference

room, as well as in collaborative distributed virtual environments and low bandwidth teleconferencing. This allows the distant users to interacted with each other in these virtual environments, in which they are represented by expressive texture avatars. This enables the users to recognise each other based on the face texture image or remained anonymous by using a synthetic texture image. When the avatar is combined with more complex body motion, it can be also used in entertainment, creating expressive animated characters that show facial expressions or emotions together with body motions. This can improve the computer games system and lower the required system resources, than the virtual characters that only had body expressions or when a series of face images with facial expressions are used to animate the facial expression of the character.

The implementation of the expressive avatars into the virtual pub environment was successful, and the interaction between different avatars is fairly realistic. The GUI of the virtual pub environment is simple to use with a few selection options that the user required to interact with the selected avatar. However, the actions of the avatar rely on the actions from the user or other avatars. Therefore, the virtual pub environment will be more realistic and stimulating, if an autonomous interaction process is implement on the avatars in the virtual pub environment. The other limitation is that for slower computers, the initialisation process is long due to the loading of large audio files for the avatars' speech and environment sound. The alternative will be lowering the quality of the audio files or used a better audio compression format for the application.

6.2. Conclusions and Future work

The result of using texture co-ordinates displacement in simulating facial expression is fairly realistic. If an image with skin folds (wrinkles) are available the Expressive Textures approach can use blending to animated skin folds to achieved more realistic facial expression, while keeping the computations at the lowest and using fewer system resources. When still images are used the trade off is that this approach can distort the hair on the image, if the person's hair is lying close to the eyes or eyebrows. Another

limitation is that mapping an open mouth of the user or actor onto the avatar's closed mouth is not realistic, when human speech is modelled with this approach.

When the body animation of the avatar is animated together with the facial expressions of the avatar, the avatar looks more interesting and realistic than animating the facial expressions alone. However, the body animation requires longer computation than animating facial expressions using the expressive texture approach, which makes the body animation not synchronised with the facial animation. Therefore, the facial animation completes faster than the complex body animation in slower computers. The user will find this difficult to determine the emotional expression of the avatar, when the avatar performed a series of emotional expressions one after the other. Therefore, a synchronisation between facial and body animation is required for different CPU speed and dependent to the system resources available for animation.

The virtual environment can become more realistic by including more virtual objects that resembled the real objects, but this require more system resources for loading textures for these virtual objects and drawing them in the virtual environment. When complex texture mapping is applied to the virtual environment, the number of textures loaded for the virtual environment is reduced to one. If the virtual objects required detailed texture image, the resolution of the combined texture can be increased to accommodate more detailed textures for the virtual objects in the virtual environment, but more system memory is then used as the size of image file increased according to the resolution of the texture. Obviously, the realism of the virtual environment is dependent on the hardware of the system. Apart from the virtual pub environment, the avatars can be inserted into other virtual environments e.g. office room, depending on the application targeted. The number of interaction options can changed based on the application. However, the number of options should be kept to a minimum with all the important interactions available to the user, to avoid confusion and simplify the interaction process.

For future work, the expressive avatars can be implemented in a networked virtual environment under a low bandwidth network, where users can interact with each other and participate in grouped activities (e.g. virtual conferencing system or a virtual workshop). This can determine the participants' aptitude and if the participants will benefit, when working in a grouped situation under a virtual environment represented by expressive avatars and compare the results with a real working environment.