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Increasing User Engagement in Re-designed Classic Video Games

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Abstract. The development of low cost 3D visualization devices has prompted an increased interest in interactive Virtual Reality (VR) applications. A key factor in the design and implementation of VR applications is the immersion level that indicates the quality of user experience and level of engagement. In an attempt to enhance the user engagement in VR computer games we explore two distinct directions which include (i) The use of statistical 3D shape modeling and dedicated image processing techniques that enable the generation and subsequent use of personalized avatars in collaborative VR environments and (ii) The adaptation of retro video games to multi-user VR environments. The ultimate aim of our work is to combine the results of the two approaches so users are offered the ability to use their personal avatars in VR classic game environments so that the level of immersion and user satisfaction is maximized.

Keywords: Retro Video Games, Personalized Avatars, Collaborative VR

1. Introduction

A number of classic videogames developed mainly during the eighties are still highly popular since they managed to capture the interest of users using relatively simple concepts. Due to the high popularity of such games a number of efforts have been recorded in redesigning and adapting retro games using new technologies [1]. The aim of our work is to assess the potential of reviving old and classic video games through the technologies of multi-user virtual reality. We address the issue of re-designing classic video-games as a two-fold problem with the following components:

- The re-design of a retro videogame in VR environments.
- The generation and use of personalized avatars in multi-user VR applications.

In the case of transforming retro games into VR environments we experiment with different principles of 3D game design and assess the design paradigms based on a user-evaluation procedure. This exercise will enable the generation of game adaptations that could address shortcomings of the classic games and at the same time offer an enhanced user experience that not only substitutes but also stimulates more intensively users' interest and immersion. As a case study we concentrated our

attention to the design and comparative evaluation of the Space Invaders game that aims to determine the appeal of the VR implementation of the game.

In the case of automatic avatar generation, we use statistical shape modeling and dedicated image processing techniques that enable the generation and subsequent use of personalized avatars in collaborative multi-user VR environments. This aim addresses two issues related to VR applications. The first involves the ability to enter a VR application using a personalized avatar that has close resemblance with a user's image, so that the avatar is recognizable as the user himself. The second issue refers to the transformation of classic games from single to multi-user games where a group of friends can participate using their personal (recognizable) avatars.

2. Related Work

A number of approaches to adapting retro videogames in 3D environments have been recorded in the literature. For example the Pac-Man VR [2] is a three-dimensional version of the classic two-dimensional eponymous video game. A similar effort and somehow an extension to Pac-Man VR, was the game of augmented reality entitled Human Pacman, developed by Cheok et al [1]. Spider Hero [5] is an application of virtual reality, where the user wears a glove, which uses to shoot virtual tissues and then jump from one building to another. Similarly in our Space Invaders adaptation we also use a data glove in order to enhance the interaction level.

Previous efforts on the generation of realistic human-like avatars can be categorized into two groups. In one group are model-based methods [4, 6] that rely on a model of human body shape to reconstruct the subject's geometry from a multi-view camera setup. In the other group are model-free methods, which rely on multi-view photometric stereo [8] or simple range scanners [3, 7]. In our approach a model-based approach is adopted as it ensures the uniformity of the avatars that facilitates the animation of the avatars in virtual environments.

3. Creating Personalized Avatars

The proposed avatar generation method involves two main phases: The statistical shape model training and the avatar generation phase. During the training phase we utilize a Principal Component Analysis (PCA) model trained on 111 range scans from a 3D body scan dataset [4]. The purpose of the PCA model is to learn the statistically permissible modes of human 3D body shape variations reflected in the training set, so that only avatars with realistic human shape are generated. During the avatar generation phase, we capture four orthogonal color images of our subject (front, left, right and back to extend the work of [6]). On each image a number of key body components (e.g., eyes, nose, mouth, waist, armpits, feet, hands), for which we know the corresponding 3D body model landmark, are located. An optimization process that aims to minimize the distance between these marked landmarks and their corresponding projected model points is applied. Once we have the shape of the

avatar, the final step involves filling in the realistic appearance by texture mapping of the input image information from each view (see Figure 1).

In order to benchmark the reconstruction error of the method, we have performed an experiment on a synthetic dataset of 100 randomly generated shapes (50 male, 50 female). The reconstruction error was measured as the average (per vertex) point-to-point Euclidean distance, normalized by the separation of the most distant pair of vertices. We found the mean error to be 0.90% with a standard deviation of 0.2167 when using on average 17 correspondences of key components per view. We repeated the experiment this time using on average 144 correspondences per view and got marginally better results: an average error of 0.81% with a standard deviation of 0.1803. This indicates that our use of only the few key components is sufficient to reconstruct an accurate 3D body shape.

4. Re-Designing Retro Games

Our work on re-designing retro games in VR is focused on the implementation and testing of a VR adaptation of the Space Invaders. In the adapted version of the game, human-sized enemies march forward towards the user (Figure 2). The enemy characters were recreated in 3d models according to the designs of the authentic two-dimensional characters. The overall experience is further enhanced through the use of a data glove so that the interaction is done in a more natural way (see Figure 3). The final application was evaluated by staging a questionnaire-based user evaluation process where 20 volunteers had the chance to play the game in the original version (desktop-based) for about 5 minutes and immediately after the VR implementation (see Figure 4). The most important results obtained, indicate that more than 60% of the volunteers enjoyed and felt more engaged in the VR implementation of the game. These results suggest that a simple existing game concept, combined with the appropriate virtual reality technology can create a whole new immersive experience.

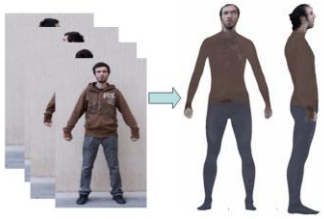

Figure 1. Sample avatar generation from real data.

Figure 2. Space Invaders VR

Figure 3. Interaction with data glove

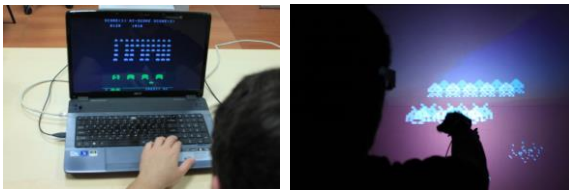

Figure 4. Desktop-based (left) and VR implementation (right) of Space Invaders

5. Conclusions and Future work

We presented our ongoing work towards the implementation of personalized multi-user VR implementations of retro video games. Through a case study that involved the design of a prototype VR Space Invaders game, we verified the success perspectives of adapting to VR retro videogames. In parallel with the game adaptation we have been working towards the generation of realistic animation ready avatars that will allow users and their friends to participate and collaborate in VR game adaptations. While this is work in progress, early results obtained prove the potential of our overall approach. In the future we plan to investigate in a more systematic way the transformation of retro video games into VR environments and through this process define a set of generic design guidelines that can be applied to similar problem domains. In the case of avatar creation we are working on fully automating the localization of corresponding landmarks and increasing the accuracy of model fitting. Furthermore, we plan to add automatic rigging and animation on the avatars so that they can be easily incorporated in VR applications.

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