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Animating Various Characters using Arm Gestures in Virtual Reality Environment

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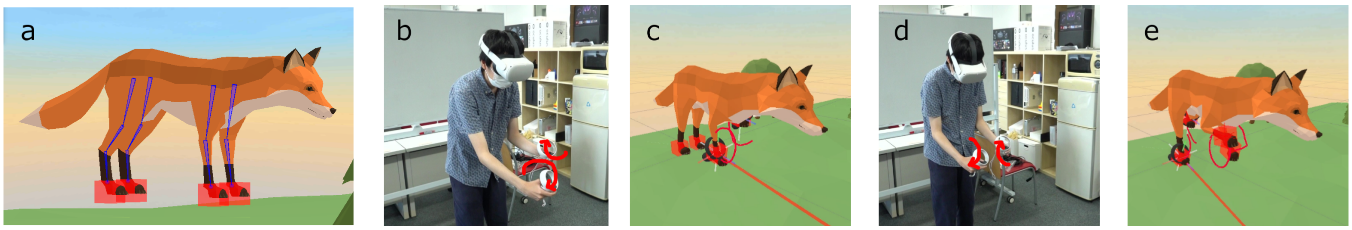

Figure 1: The overview of our animation-authoring system in VR. (a) The input of the system is a rigged character model with anchors (red cubes). (b-e)The user selects and moves anchors multiple times to animate a non-human character model.

ABSTRACT

In this study, we propose a method for efficiently animating various characters. The main concept is to build an animation-authoring system in a virtual reality (VR) environment and allow users to move anchors of a character model with their arms. With our system, users select two anchors, which are associated with two VR controllers. The users then directly specify the three-dimensional (3D) motions of the anchors by moving the controllers. To animate various characters with multiple anchors, users can repeat this specification process multiple times. To demonstrate the feasibility of our method, we show animations designed with our system, such as a walking fox, a walking spider, and a flapping hawk.

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1 BACKGROUND

Authoring animation of three-dimensional (3D) character models is an essential process for creating 3D digital content. One promising and efficient way for authoring animation is to use motion capture (MoCap) techniques. The MoCap system tracks the 3D positions of markers attached to an actor and uses maker motions to move 3D character rigs. However, applying MoCap when animating a non-human character whose structure is different from a human is difficult. Furthermore, because MoCap devices are usually expensive, it is difficult for casual users who enjoy creating 3D content as hobbies to afford them. After all, when animating non-human characters, it is necessary, especially for casual creators, to manually specify key frames of characters' rigs, which is labor-consuming.

Some researchers have published studies that use virtual reality for animation authoring to support an intuitive animation design process. Vogel et al. proposed a system that allows users to create animations with a sense of puppetry [3]. They use VR controllers to specify the 3D positions of objects. Arora et al. created a taxonomy of hand gestures for authoring animation in VR and develop an animation-authoring system in VR [1]. Although these studies achieved intuitive animation-authoring systems in VR, they did not address animating non-human characters. The study, which is highly related to our work, was presented by Leite et al. [2]. They introduced a system that allows an actor to animate various characters represented by two-dimension (2D) silhouettes by mapping the actor's body parts to the character's rigs. However, this system is not applicable when it is difficult to correspond to the actor's body and 2D character's rigs.

2 OUR METHOD

This study aims to support casual users to design an animation of various non-human character models, such as birds, insects, and four-footed animals. Our main concept is to develop an animation-authoring system in a VR environment and allow users to animate models using their body motions. Users can directly and intuitively modify 3D character poses in a VR environment, as if they were deforming puppets in the real world. Using recently available head-mounted-display devices and VR controllers, it is now possible to build a system with a robust 3D-tracking function at a reasonable cost.

The input of our system is a rigged 3D character model. We assume the model also includes anchors for moving the rigs. Figure 1a shows an example of a fox model. In this example, we bought a rigged model from an asset store and placed four anchors on the

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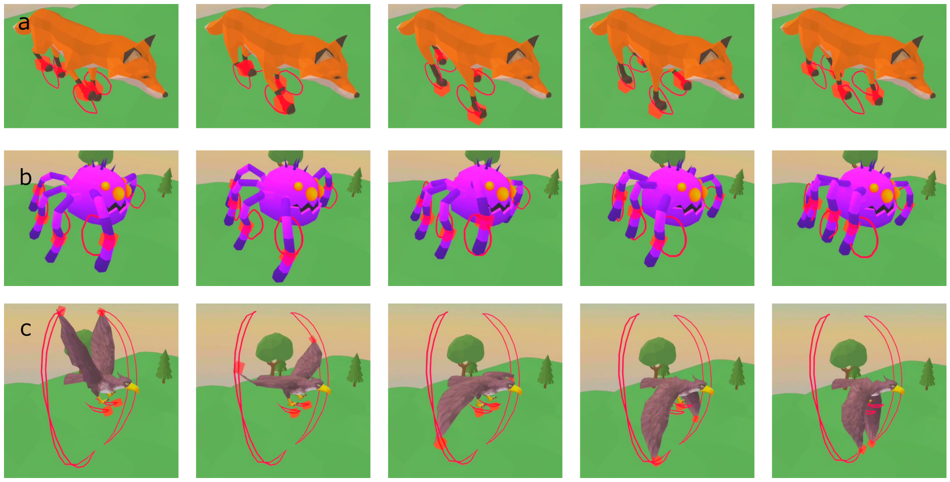

Figure 3: The resulting animations; a walking fox (a), a walking spider (b), and a flapping hawk (c).

forelegs and hind legs. In this study, we developed our system with Oculus Quest 2 and Unity. We used Unity's IK plug-in to compute the translation of rigs from the anchor's motion. Our system allows users to create looped or non-looped animation. When "loop mode" is selected, user-specified anchor motions are repeated, which helps design repetitive movements such as locomotion legs and flapping wings.

Figure 1(b–e) illustrates a typical animation-authoring process with our system. First, the user selects anchors to move by touching them with VR controllers and pressing the "selection" button. The selected anchors move to follow the corresponding controllers. It is possible to manipulate two anchors simultaneously in our current implementation. The user then presses the "start recording" button on the controller to record the movement of the anchors. The recording stops when the user presses the "end recording" button. The user can record the motions of multiple anchors by repeating the same process. When specifying motions of new anchors, all anchors for which the user has previously specified movement are automatically animated. This iterative specification enables the user to animate various characters with many anchors. For example, the user can design a walking fox by first manipulating the anchors on the forelegs and then specifying those on the hind legs (Figure 1. See also supporting video).

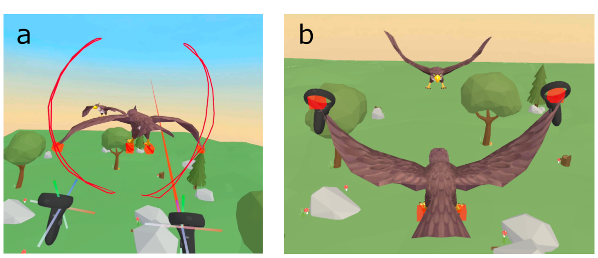

Figure 2: Visualizations of our system. (a) The system shows anchor trajectories with red curves. (b) The system also shows a copy of the animated model for the user to check its appearance.

Because our system is built in the VR space, it is possible to provide various visualizations to support the animation-authoring process. The trajectories of anchors are shown with red curves (Figure 2a), which enables the user to examine the specified motion in detail. A copy of the animating model is displayed to the user (Figure 2b). The user can freely rotate this copy to examine its appearance viewed from different viewpoints.

3 RESULT AND DISCUSSION

We show animation examples authorized with our system to demonstrate the feasibility of our system. Figure 3a shows a walking fox model. In this example, first, we animated the two forelegs by using two handheld controllers. Then, we added a motion to the hind legs in the same way. Figure 3b shows an example of a walking spider; we specified motions of eight anchors, two at a time, in sequence. Figure 3c is an example of a flapping hawk; we also used handheld controllers to move anchors on the wings and legs (see supporting video).

Each of these animations was designed within a few minutes. With our system, users can specify the anchors' 3D motions directly in the VR space by moving their arms while holding the VR controllers, which achieve an efficient and intuitive animation-authoring process. Notice that it would take a much longer time to authorize similar animations with standard tools, because the user must specify many key frames to generate smooth motions that we achieved by adopting the VR controllers.

4 CONCLUSION

This study proposed a system that allows users to authorize the animation of various characters in a VR environment. With our system, users can directly specify the motion of anchors in VR space. To demonstrate the usefulness of our system, we showed animation results such as a walking fox, a walking spider, and a flapping hawk. In the future, we would like to conduct a user study to confirm that novice users can authorize various animations with our system. We would also like to improve our system to deal with the motions of smaller objects such as eyes or mouths.

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