Character Animation in Virtual Reality

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Figure 1. The girl character in VR can face to you and wave her hands

Abstract

In this paper, my vision is to design two virtual characters to implement character animation in VR environment. User can control the man character to make interaction with the girl character. For example, user can control the man to walk or jump, and the girl will greet to the man if you input the greet command. Meanwhile, there are also some more complex tasks included in this project. The two characters can use IK system to grasp a box on the floor, the girl can also use path finding algorithm to find the way to the bed and sit on it.

Concepts •**Computer Graphics → Animation**; *Virtual Reality*; Inverse Kinematics;

Keywords Character Animation, Virtual Reality

1 Introduction

In recent years, VR technology has gone through a very rapid development. More and more VR equipment like HTC Vive, Oculus and Sony PSVR has appeared in the market. For those people who want to become a VR application developer, there are also many powerful SDK in Unity Asset Store, like SteamVR and VRTK. Since I am very interested in VR development, I chose the VR course and bought a HTC Vive equipment in last semester. However, the VR project I did last year was just focus on how to get familiar with VR interface and how to move, teleport or grab objects, it didn't involve any animation knowledge. That's why I choose "Character Animation in Virtual Reality" as my project's topic. I want to know how to use as much as animation knowledge I learned in VR, I want to become more familiar with VR development, I want to explore this amazing technology more thoroughly. I must need to mention that my overall goal is not to reach to a certain result like many papers do. The thing I want to do is implementing character animation, then integrate it with as many as technologies I learned in the course. More specific, I want to achieve four main goals in VR environment: Build the motion tree, implement character controller, use IK in grasping objects and use some methods to implement path finding.

2 Related Work

2.1 Virtual Reality

As a rising technology, VR's bottleneck is mainly on hardware rather than software. Though people's interest is mainly on hardware development, there are also many powerful SDK and interesting VR games. For example, SteamVR and VRTK are totally free and can support many VR equipment's project developments. VR Lab is the most famous free game on Steam platform and has a free interface on Unity Asset Store. VRChat, which has the most people on line, is the best VR game I have ever seen on Steam. I must admit that this game perfectly define what is "Character Animation in VR" because in this game you can make and upload your own character as your avatar through Unity 5.6.3 after you downloading VRCSDK, then when you log in this game, your view and motion will be same with your avatar. That means your avatar will do the same motion as you do so that you can get the best immersion feelings. You can even talk to anyone from all over the world, use some tools in VR and achieve any amazing effect if you combine it with your character. Though this game is very interesting, it's based on first person view which is different from my third person view project, the IK usage and character controller are also different. So I think my project still has some significances to achieve though it is beaten by VRChat on every hand. By the way, I have found the first person view SDK in VR which VRChat may use and I will implement my project as first person view way in the future.

2.2 Character Model and Motion

Though this project is in VR environment, the motions used in it are same with normal Unity project. Since my project's goal is not mainly on motion editing, I will use ready-made model and motions. However, almost all free models I found on Asset Store don't have skeleton model on face, which are not adapt to my task

because I need to let the girl look at the man when greeting so the girl's eyes need to rotate. Finally, I use AOI character package as the girl's model because it has built face skeleton model and Unity's character package as the man's model, and I also import some motions from Unity Chan, which is free on Asset Store.

3 Method and Implementation

3.1 Motion Tree and Character Controller

Though my project is based on VR environment, I also build it in another normal environment scene because I want to know the difference in control methods when you control a character. The man and the girl have each motion tree. The girl's motion tree is simple, it includes idle, walk, run, sit, greet and jump motion. The walk motion is a blend tree includes two parameters speed and direction to control walk direction, other motions are just single motions and have a bool parameter to control transition. The man's motion tree is a little complex, it includes three blend trees which represents crouching, on ground and in the air. The man can implement much more complex motions like turning and its walk motions are more precise because user just needs to control the man to move.

For the character controller since there are a normal scene and a VR scene, I need to develop two control methods. In the normal scene user uses keyboard while in the VR scene user uses HTC Vive handles. I put all the motions except movement motions in a public method separately, and call these methods individually when user uses different input devices and press buttons. For the movement motion I use the CrossPlatformInputManager class in Unity to implement cross platform move control.

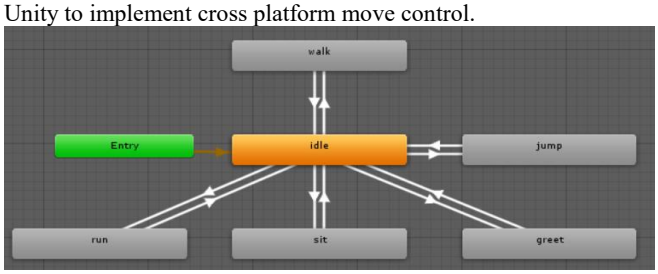

Figure 2. The girl character's motion tree in the project

3.2 Inverse Kinematics and Path Finding

There are two tasks in my project need to use IK. One is to make the girl look at the man when greeting, the other is to make the man and girl can grasp a box on the floor. For the first task I set IK attribute on the girl's animation on base layer and use Unity's OnAnimatorIK method to implement this effect. For the second task I use a SDK which name is FinalIK on Asset Store. This SDK can give a character a full body biped IK script. This script can build a skeleton under the neck and set four limbs and body's weight when using IK. For the box which needs to be grasped, this script defines a class which name is Interaction Target. This class includes left hand and right hand end effectors. Each end effector has a hand like structure. Finally, FinalIK has an interaction system class which can check whether one object is grasped by a character, and make this object become the character's child game object so that the character can grasp it and move with it. However, FinalIK can only support one character. Since I want to change person to grasp the same box, I need to adjust their hands manually when they grasping the box to make it look natural, then I need to record these data and change them when person changed. Finally, I need to overwrite and add some methods to get those attributes I mentioned above and change two end effector's positons because the two characters are face to face.

For the path finding, I use the navigation system in Unity. I set objects in the room to make them walkable or not walkable, add some obstacles, then bake them and set a target as the destination near the bed. If the character is not close to the target, it will execute run motion. After it coming to destination it will execute sit motion so that I can make the girl find the way to the bed and sit on it automatically if I give her a sit command.

Figure 3. Full body biped IK system and Interaction target system

3.3 Other Methods

I also use some other methods and technologies in my project to implement effect I want. I use the Unity's environment package to build the ground and water, use terrain brush to add some trees and grasses in front of the house, use wind zone to make them can swing. For VR environment, I use ControllerTooltips to show command name on handles and VRTK_Controller_UnityEvents to call functions when user presses buttons. For view tracking, I write a script to make the camera track to the man when he is moving, and use VRTK Pointer to make teleport effect because SteamVR has overwritten camera position method so I can't change it directly.

4 Results and Discussion

4.1 Character Animation

As I mentioned before, I implement two scenes in my project, one is normal scene and the other is VR scene. The only difference between two scenes is the control method. In normal scene user can only use keyboard as input device but in VR scene user can use HTC Vive handles as an extra input device.

There are a man character and a girl character in my project. User can control the man to move. If given some commands, the girl will behave corresponding motion like greeting or sitting on the bed. Both the man and girl can grasp or drop the box on the floor and user can change the person to implement grasp. The man's movement motion in his motion tree is used when user controlling him to move while the girl's movement motion is used when finding path to the destination.

Figure 4. The man character is grasping the box on the floor

4.2 Issue and Solution

The main issues I met in the project development are these: First is to find and get familiar with those packages and SDK I used in project. When I started my development, I didn't know how to build motion tree in Unity, how to design an animation controller and how to use Unity's navigation system. After I have finished my project, I become much more familiar with Unity. Another problem which wasted me a lot of time is the girl just performed walk motion but couldn't move. I saw a lot of video on YouTube, found that was because the walk motion didn't have displacement so I changed it to a motion with displacement, but it still didn't walk. In the end I realized I needed to apply root motion on the animator. I also spent a lot of time learning how to use IK in Unity. I watched some videos and understood how to implement simple IK tasks like to make the girl can look at the man when greeting, but I still didn't know how to use IK to implement grasp. I tried three IK SDK on Asset Store and finally found FinalIK was suitable. Though I got this powerful tool, I still spent two weekends getting familiar with it and changing some scripts in it to make it adapt to my project.

5 Conclusion and Future Work

In summary, though this project takes me a lot of time, I think that is still worth because I have learned a lot. It is very interesting to design my own project goals and achieve them. Enjoy Unity development, enjoy VR. That's what I want to say.

Since I have found the first VR environment person character controller interface in FinalIK, I will try to change my project from third person view to first person view in the future so that user can get better immersion feeling in VR environment. I will also try to learn the scripts in VRCSDK and add some amazing effects on my character like VRChat does.

Figure 5. The screenshot from VRChat, I upload the cute Kanna Kamui character as my avatar and stand in front of a mirror to see my avatar and motion in VR environment

Resource Source

[1] AOI Character Package: https://assetstore.unity.com/packages/3d/characters/aoi-character-pack-12495, which is used as the girl model.

[2] Unity Chan Package: https://assetstore.unity.com/packages/3d/characters/unity-chan-model-18705, some motions in it are used in the motion tree.

[3] Unity's character package and environment package: Come with Unity itself, I use them to build the man model and environment.

[4] SteamVR: https://assetstore.unity.com/packages/templates/systems/steamvr-plugin-32647, which is used to build the VR environment.

[5] VRTK: https://assetstore.unity.com/packages/tools/vrtk-virtual-reality-toolkit-vr-toolkit-64131, which is used to implement interaction in VR environment

[6] FinalIK: https://assetstore.unity.com/packages/tools/animation/final-ik-14290, which is used to implement grasp.

[7] Unity's Navigation system: I use it to implement path finding.

[8] House model, chair model, bed model and desk model: These models are from the VR projects I did last semester, I can't remember the download website now.

[9] The project can be downloaded from this link. https://drive.google.com/open?id=1RytMMcZh17t6Br9S8DeG_yaGLQgsELBM