Generating and Manipulating 3D Avatars from Imaging Technology

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Abstract

The process of generating 3D human avatars can be expensive and inefficient; advanced solutions can cost tens of thousands of dollars while the available low cost ones yield subpar results. Our goal was to develop an accessible procedure for high-quality avatars and VR manipulation.

We worked on the data collection, animation, and game-engine programming of a generated human avatar in a virtual environment. In this process, we used a combination of free software and off-the-shelf technology. This was done using a *Kinect* depth sensor to take a 3D scan of a human subject, and importing that result into *Meshlab* and *Skanect* for avatar processing.

The completed avatars were rigged and posed using *Blender* software, then imported into *Unity* for final game and environment programming.


Advanced industry scanning technology


XBox Kinect v1 3D scanner

Skanect avatar processing

Unity cross-platform game environment

Background

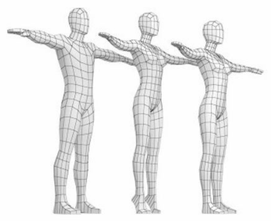
The 3D avatar and VR field is relatively new, with many different types of technology being developed by companies like Oculus, HTC, and Sony.

Virtual reality is the use of computer technology to create a simulated environment, placing the user inside a controlled experience.

VR by HTC Vive's can be used with XBox scanning technology. This technology has allowed users to experiment with personal scans and avatars at home. Avatars are computer-rendered 3D models of a subject, realistically created with texture and color.

Avatar technology has a wide market that includes video games, movies, and the work environment.


Sample 3D VR setup


Low-poly 3D avatars of human scan-subjects


VR in video games

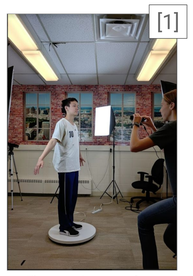
Experimental Methods

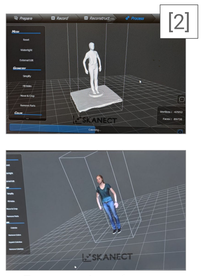
The first step to creating a moveable avatar is to take a scan using the Kinect System. This is a hardware device that can be used to take 3D scans of a human[1]. The scan is then processed in Skanect, software used to convert the 3D scan to a mesh resulting in an empty, inanimate avatar.

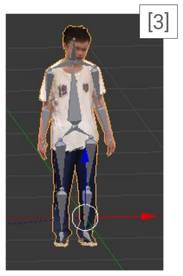
The processing equipment fills holes in the mesh, paints it with color, and adds texture to complete the 3D scan[2]. After that, the scan can be imported into Blender, where the scan can be 'rigged' into an avatar for posing, control and manipulation.

Blender is used to rig the skeleton, i.e. designing pre-sized bones with joints to form the skeleton/armature of the mesh. The armature is fused with the mesh leading to a newly formed avatar that can move in sync with the bones[3].

The poseable mesh can be imported into Unity as a Blender file and animated with movement (i.e. to walk)[4]. Unity is a cross-platform game engine used to incorporate the posable avatar into a designed Virtual Reality environment. In this final stage of the programming platform, color-mapped textures and animations are added to the completed avatars to be displayed in VR.


[1]
The scanning setup for a subject's body


[2]
The processing software to complete the scan


[3]
Rigging the human skeleton with the mesh

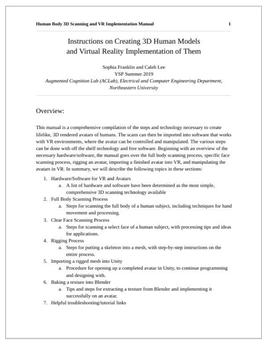
[4]
Testing the animation after it's designed and uploaded into the VR environment

Results

Our project resulted in a completed avatar animation within a designed Virtual Reality environment. It also contributed to an improved and faster 3D scanning process.

We tested and wrote a manual about the entire procedure, including all of the problems that we faced, and how we solved them. This information will help the Augmented Cognition Lab to progress our future 3D and VR work.

Our main goal was to animate personal avatars in a designed 3D environment, accessible by VR. All of these objectives were completed and available to watch on a laptop below.


Human Body 3D Scanning and VR Implementation Manual 1

Instructions on Creating 3D Human Models and Virtual Reality Implementation of Them

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YSP Summer 2019
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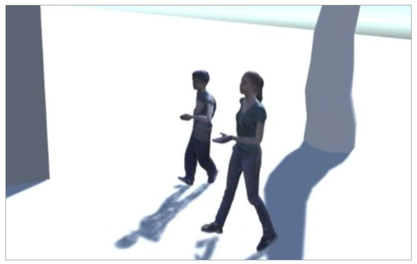
Overview:

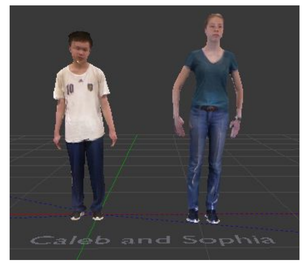
This manual is a comprehensive compilation of the steps and technology necessary to create lifelike, 3D rendered avatars of humans. The scans can then be imported into software that works with VR environments, where the avatar can be controlled and manipulated. The various steps can be done with off the shelf technology and free software. Beginning with an overview of the necessary hardware/software, the manual goes over the full body scanning process, specific face scanning process, rigging an avatar, importing a finished avatar into VR, and manipulating the avatars in VR. In summary, we will describe the following topics in these sections:

1. Hardware/Software for VR and Avatars
   a. A list of hardware and software have been determined as the most simple, comprehensive 3D scanning technology available
2. Full Body Scanning Process
   a. Steps for scanning the full body of a human subject, including techniques for hand movement and processing.
3. Close Face Scanning Process
   a. Steps for scanning a select face of a human subject, with processing tips and ideas for applications.
4. Rigging Process
   a. Steps for putting a skeleton into a mesh, with step-by-step instructions on the entire process.
5. Importing a rigged mesh into Unity
   a. Procedure for opening up a completed avatar in Unity, to continue programming and designing with.
6. Baking a texture into Blender
   a. Tips and steps for extracting a texture from Blender and implementing it successfully on an avatar.
7. Helpful troubleshooting/tutorial links

Results Continued

Several videos document the scanning, combination, processing, and animation process, explaining the steps and results of our project.


Avatars moving in animation, in a designed VR environment



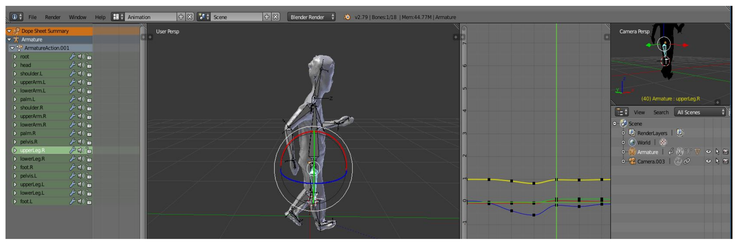
Personal avatar meshes, fully textured and unrigged

Conclusions

There are many VR technologies available, so it's important to choose software/programs that match your requirements. It's possible to create a complete, working avatar with accessible technology at a low price, but research is necessary. The best way to learn powerful platforms like Blender and Unity is through tutorials and test-projects.

Skills Learned:

- Unity, Blender, Skanect and Meshlab
- Computing and GPU optimization
- Independent research and problem-solving
- 3D and VR environment design
- Animation and pose design
- Illumination and techniques for optimal scanning conditions


Designing avatar movement with Blender

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