Comparative Analysis of Garment Developed on Virtual Human Skinned Model and Virtual Human Mesh Model

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Abstract: *Virtual Human environment has provided tremendous scopes in designing and fit analysis of garment directly on 2D and 3D human model. This paper provides a comparison on the garment that is developed on a human skinned model and virtual human mesh model. The front and the back posture of the virtual model are snapped and this image of the virtual model is used as a base to design the garment. Same style of the garment is developed on a snapped human mesh model. The comparative analysis of both the garmented model provides a feasible understanding that human mesh models provide accurate digitizing of the nodes on the mesh which acts as a guide, where as the skinned human model doesn't provide accurate marking but provides real time simulation of the garment with wide designing and editing options. The human mesh model provides accurate marking and garment designing options without any shape de-formality and asymmetry in balancing garment parts.*

Keywords: Virtual Environment, 2D model, Real time simulation, Imaging, Digitizing

1. Introduction

Over several decades computer aided designing has played a foremost role in clothing fabrication process. Computers have turned out to be an inevitable tool for design creation and manipulation. The progression of body modeling, animation and collision detection and response has led to the up gradation of versatile garment replication in more general perspectives. Creation of virtual human involves multifarious tasks like skinning weights to be assigned to all vertices on cloth parts as well as body parts, well organized interpretation of the cloth parts, application of texture on body with a given resolution and controlling the mesh resolution. The garments are draped on a body by means of a physical simulation technique [1][2][3]. Approaches of Allen et al [1] can compact with body-to-body mapping and effortlessly be extended to the non closed mesh.

There is variety of stages for making the virtual bodies; including designing the mesh duplication and post stages like shading and skinning. Implementing these stages requires a lot of design time but these pragmatic virtual characters in a virtual environment also requires computation skills [4]. Body modeling approaches can be classified under two headings, structural and mathematical. In a structural approach either anthropometry or anatomy knowledge is used to plan and construct model variations. In a mathematical approach, physical or geometrical methods are used to represent the skin plane [5]. Clothing simulation tools are used in the garment industry to design and sample garments before the manufacturing process. Clothing simulations tools fit the needs of the garment industry, focusing the simulation and visualization attribute. Simulation tools let the designer to create 3D clothes based on 2D patterns [6]. On the whole, visual appearance of a garment is influenced by two main components, the shape of the garment and the fabric material. Modeling, rendering and simulation are the main aspects that are discussed in this study.
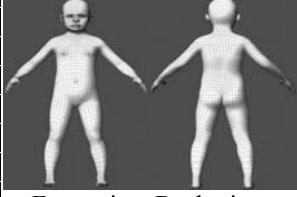
2. Experimental

2.1 Make Human 1.0.0

Make human 1.0.0 is an open source tool for making 3D Human Characters which can be used for Real Time Simulations. This application can be installed in any type of Operating System. The virtual human characters can be viewed from any angle and the characters can be rendered to the hard disk in many different formats. A built in camera feature allows capturing the screen image and storing the captured image in the grab folder generated by the application as a clip board file.

The skinned model images in different perspectives i.e. front view, back view and side view has been shown in Table 1. The wireframe kid models perspectives in front, back and side is also shown in Table 1.

Anthropometry is the science of body measurement that focuses on the physical variations of the body sizes. Several anthropometric measurements that are used by the designers for modeling has been shown in Table 1 and these sets of measurements may be decreased to a smaller set or increased to have more models for lower or higher age groups. The Make Human open source 3D character creation environment enables wider skinning options like Asiatic, African and Caucasian races with wide body sculpting options. Each individual feature like face, eye, eyebrows, nose, ear, mouth, lip can be controlled and altered to the desired needs.

Table 1: Measurement chart of Virtual Model

S. No	Feature		Virtual Models
1	Gender	Female	
2	Age	4	
3	Muscle	50%	
4	Weight	100%	
	Measurements (in cm)		Front View Back View
1	Height	86	
2	Chest	45	
3	Waist	45	
4	Hip	50	
5	Neck Round	22	
6	Neck height	5.3	
7	Upper arm circ	14.2	Side View
8	Upper arm length	13.5	
9	Lower arm length	12.3	
10	Wrist circ	8.4	
11	Front chest dist	13.6	
12	Nape to waist	19.9	
13	Waist to hip	9.8	
14	Shoulder dist	6.8	
15	Upper leg height	16.8	
16	Thigh circ	28.6	Front view Back view
17	Lower leg ht	22.5	
18	Calf circ	19.6	
19	Ankle circ	11.9	Side view

The Table 1 lists the Measurement chart for the Virtual Kid model. There are 19 important measurements that are required to construct the Virtual model with Make Human 1.0.0. A kid model for 4 year girl child was developed using the standard girl's measurement chart.

2.2 Rendering the Virtual Models

The Make Human 1.0.0 provide wide rendering option like Blender exchange (.mhx), Film box (.fbx), Collada (.dae), wave front object, MD5, Ogre 3D, Stereo lithography (.Stl), Biovision Hierarchy BVH, Skeleton (skel), Jpeg, Multipicture (.mpo), Pixus (.pcx), Scitex (.sct). The virtual human skinned model and virtual human mesh model was rendered in jpeg format for 2D designing, simulation and visualization.

2.2 Designing garment on the Virtual Human Skinned Model

The Virtual Human skinned model was imported to the work place of Corel Graphic suite X5 for garmenting the model. The image has a background grid which is used as a guide to design garment over the 2D model. The shape tool, Bezier tool, Fill color tool were used for the designing the garment. The background grids position to the seam position on the model was noted and this grid position helped as a guide to digitize node points over the virtual skinned model.

Figure 1: Virtual Kid Skinned Model Front View

The Figure 1 shows the Virtual Kid Skinned Model's front view which was garmented using Corel Graphics Suite X5. The skinned model acts as a surface and the background grid acts as a guide to design the garment parts over the virtual model.

**Figure 2:** Virtual Kid Skinned Model Back View

The Figure 2 shows the Virtual Kid Skinned Model's Back view which was garmented using Corel Graphics Suite X5. Although the front tops in Figure 1 and the back tops in Figure 2 may look alike, there is a slight difference in the neck shape.

**Figure 3:** Virtual Kid Skinned Model Side View

The Figure 3 shows the Virtual Kid Skinned Model's Side view which was garmented using Corel Graphics Suite X5. The difference in the front neck and back neck as well as difference in pant front and back can be seen clearly.

2.3 Designing garment on the Virtual Human Mesh Model
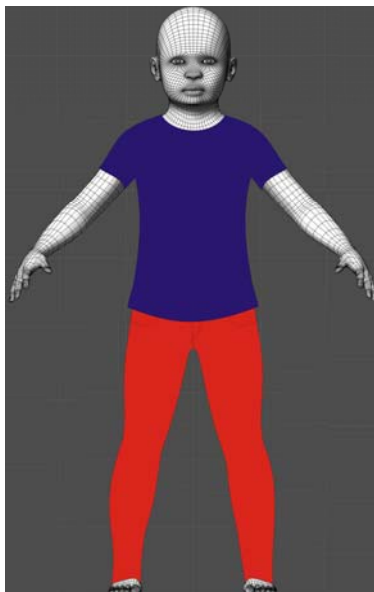
Figure 4: Virtual Kid Mesh Model Front View

The Figure 4 shows the virtual kids mesh model front view, which was garmented in Corel Graphic Suite X5. The kid models mesh act as a guide to design the garment parts over the virtual mesh model.
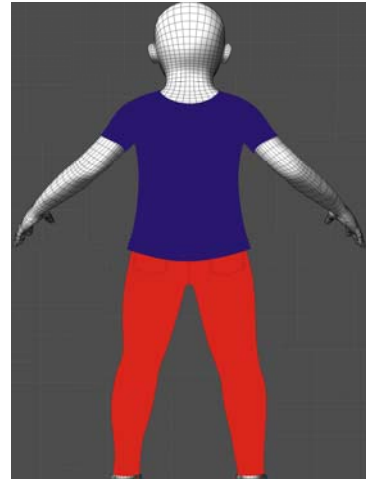
Figure 5: Virtual Kid Mesh Model Back View

The Figure 5 shows the virtual kids mesh model back view, which was garmented in Corel Graphic Suite X5. The mesh acts as a guide for designing the garment over the mesh model.

Figure 6: Virtual Kid Mesh Model Side View

The Figure 6 shows the side view of virtual kid mesh model. From the image it is clearly seen that the side seam is falling exactly to the mesh line of the virtual kid model. The Virtual Human Mesh models were imported to the work place of Corel Graphic suite X5 for garmenting the models. The Virtual Human image in itself has a simple wireframe which is used as a guide to design garment over the 2D model. The wireframe grid position to the seam position on the model was noted and this wireframe grid position helped as a guide to digitize node points over the virtual mesh model.

3. Result and Discussion

The virtual model acts as a useful guide in designing garment over them. The mesh model provides accurate node positioning, where as the skinned models background grid acts as a node positioning guide. But due to the lack of wireframe mesh in the skinned model certain de-formality in garment parts are identified.
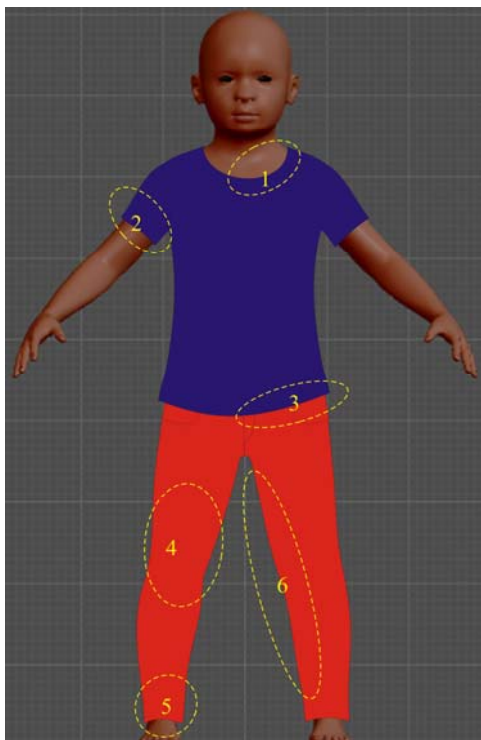

Figure 7: Virtual Kid Skinned Model Front

De-formalities

The shape de-formalities and seam positioning of Virtual kid skinned model has been shown in Figure 7. It is clearly seen that the garment has some misalignment as well as asymmetry in shaping.

Table 2: Kid skinned model Front De-formalities

S.No	Design Irregularity
1	Neck line irregularity
2	Sleeve opening irregularity
3	Asymmetrical waist line
4	Front knee imbalance
5	Imperfect bottom hemline
6	Inseam irregularity

The Table 2 shows front de-formalities in the kid skinned model. There are 5 irregularities which are seen in the front virtual image. These irregularities were found in analyzing the image with the virtual human mesh model. The irregularities have been clearly marked in the kid skinned model. In blind analysis the image may look perfect but in comparison with the related meshed image wide difference is found.
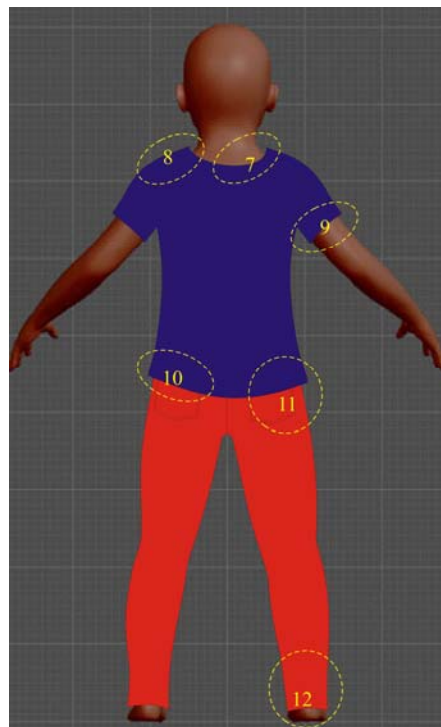

Figure 8: Virtual Kid Skinned Model Back

De-formalities

The virtual kid skinned model back side de-formalities and seam positioning has been shown in Figure 8. It is clearly seen that the garment has some misalignment as well as asymmetry in edges and shapes.

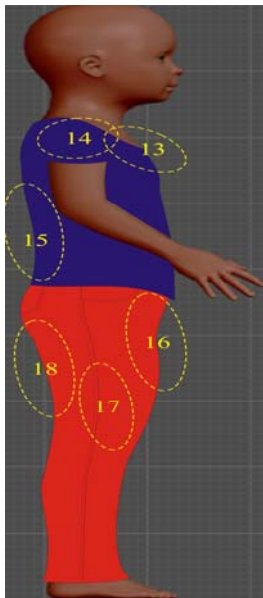**Table 3:** Kid skinned model back De-formalities

S.No	Design Irregularity
7	Back neck irregularity
8	Raised shoulder line
9	Back sleeve opening irregularity
10	Asymmetrical waist line
11	Pocket Misplaced
12	Bottom opening displacement

The Table 3 shows the back de-formalities in the kid skinned model. There are 6 irregularities which are seen in the back virtual image. These irregularities were found in analyzing the image with the virtual human mesh model.

Table 4: Kid skinned model side view De-formalities

S.No	Design Irregularity
13	Front neck deep opening
14	Sleeve imperfection
15	Drape irregularity
16	Wide front crotch
17	Side seam displacement
18	No shaping at back

The Table 4 shows the virtual kid models side view irregularities. There are 6 imperfections which were identified in comparing the Figure 3 with Figure 6. Since the garment is mapped directly on the skinned model without any designing guide irregularity in shaping occurs.

Figure 9: Virtual Kid Skinned Model Side view De-formalities

The Figure 9 shows the Virtual kid skinned model side view irregularities. The irregularities has been circled and numbered.

4. Conclusion

The comparative analysis of both the garmented model provides a feasible understanding that human mesh models provide accurate digitizing of the nodes on the mesh which acts as a guide, where as the skinned human model doesn't provide accurate marking but provides real time simulation of the garment with wide designing and editing options. The human mesh model provides accurate marking and garment designing options without any shape de-formality and asymmetry in balancing garment parts. The results of the simulation are more realistic. Designing a realistic model is a time consuming operation since it requires skilled designer interaction in all stages of the model construction. Both the methods has many advantages as real time garment simulation is possible in skinned human model, but accuracy in garmenting and shaping is limited since it doesn't provide any designing guide. 2D imaging offers wider scopes of designing as the image is saved in a standard format supported by globally accepted designing software like Corel, Adobe and Autodesk. Hence instead of constructing the garment on a blank workspace provided by the software, it is more feasible, convenient, easier and accurate to design on the human models imported as a surface image.

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