Virtual Mirror With Virtual Human Using Kinect Sensor

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Abstract

This paper proposes a real time image processing approach and a virtual dressing room application to enable users to try virtual garments and shoes on in front of a virtual mirror. A virtual representation of the user appears in a virtual changing room. The user's hand motions select the clothes from a list on the screen. Afterwards the selected virtual clothes appears on a humanoid model in the virtual mirror. For the purpose of aligning the 3D garments and shoes with the model, 3D locations of the joints are used for positioning, scaling and rotating. Then, we apply skin colour detection on video to handle the unwanted occlusions of the user and the model. To create a more realistic effect, the system takes into account different images of the clothes according to different human poses and movements. By using optional mirror selection buttons, it is possible to have multiple viewing angles on the model. Additionally, we developed an algorithm for matching up all motions between the virtual clothes and model. In this study, we benefit from the Microsoft Kinect SDK in order to follow the user's movements, coordinate the suitable clothe try-ons and provide depth sort effect to the human body and clothes.

Key Words – Virtual Mirror, Virtual try-on, Virtual Reality, Kinect for Windows, Human-Computer Interaction

1. Introduction

Some find it tiresome and time consuming to try clothes in clothing stores. Previously, people used to spend a lot of time while shopping. Due to technological advances, online shopping has become very popular recently. Besides, it might not even be possible to try-on clothes in such cases as online shopping. It could be easier if one could see whether or not the clothes would fit without having to take off one's own clothes to try out the new ones, and without having to wait in a long queue outside the fitting rooms.

Virtual mirror projects provide support for online shopping by offering the facility of selected clothes try-on. Therefore, users can see how they look in the clothes without physically putting them on, and without spending a lot time. OpenNI organization develops an open-source, cross platform framework to process the data from a Kinect sensor. Microsoft Research has also released the Kinect SDK a robust real time skeletal body tracker. Different virtual mirror projects have been in progress recently. For example, Givonni et al. presents a virtual try-on system, which allows performance comparisons of their system with two skeletal tracking SDKs: OpenNI and Kinect for Windows SDK [1]. Zhou et al. proposes a real time approach for virtual clothes fitting using Kinect [2]. Murata et al. focuses on the "video

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mirror interface". A user can operate a computer system by selecting virtual objects on a screen with his/her hand [3].

Figure 1. The figure about physics based simulation for clothing is obtained from a recent paper [4] ("Efficient Simulation of Inextensible Cloth" in SIGGRAPH 2007.)

After its launch in 2010, Microsoft Kinect has become the state of the art depth image sensor in the market. There is currently a quite intensive study to implement application programming interfaces for developers including a skeletal body tracking method. We preferred to use the Microsoft Research Kinect SDK due to its robust and practical skeletal tracking algorithm.

Our approach can be summarized as follows:

_Positioning the 3D garments on a virtual dressing room

_Scaling of the humanoid model by using received inputs from sensors.

_Positioning of the selected 3D cloth models on the humanoid model

_Skin colour and gender detection.

_Rotation of the model.

_Using mirrors in order to have multiple viewing angles on the model.

The user interface allows the user to choose a garment by making a hand movement towards to it. A screenshot of the application is shown on Figure 2

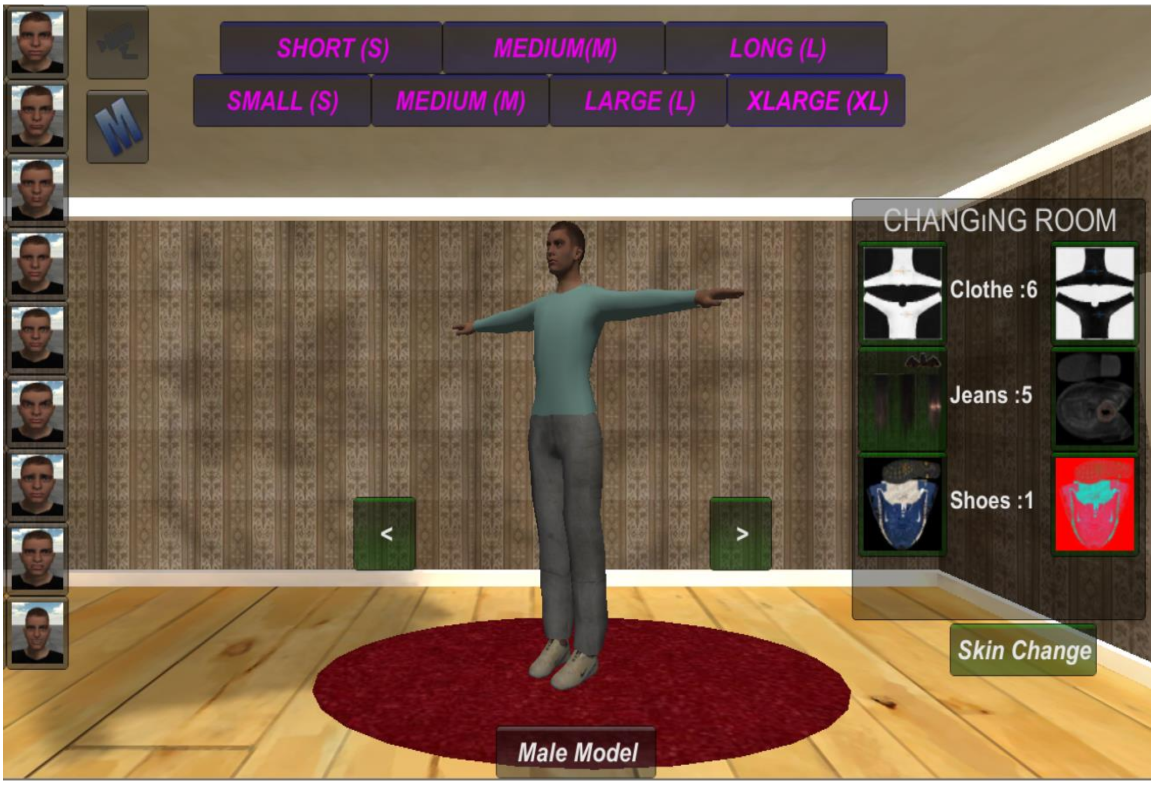

Figure 2. The User Interface of the application

The virtual mirror project presented in this paper has been developed mainly to help online shopping. In this work, we used the Microsoft Kinect for Windows sensor and the Kinect SDK. From the Kinect's skeleton library, we selected a human skeleton, on which we attempt to match the joints of the model to the appropriate parts. When the user moves freely in front of the mirror, the model and clothes follow accordingly to such movements.

2. Creating Models

Computer graphics gives us the power to model and animate virtual humans. To simulate humans requires real-time visualization and animation, taking into account constraints on the data used for these *avatars* (virtual humans representing users).

In literature, several approaches are proposed for skeletal tracking and body part detection. For example, Shotton et al. [5] have developed a system that predicts the 3D positions of body joints from a single depth image. Kjærside et al. [6] propose a tag-based approach which requires manual labeling of body parts in order to create an augmented reality of the customer wearing a cloth simulation.

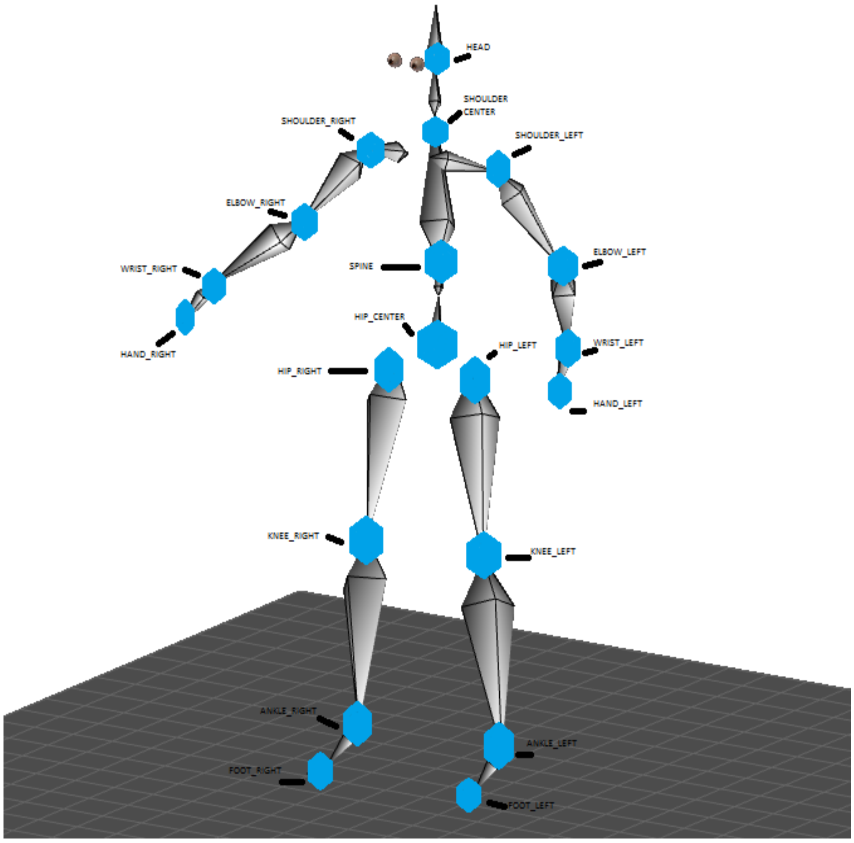

Figure 3. *The skeleton joint structure we used for the avatars.*

2.1. Humanoid Models

In this study, two basic models including a man and a woman are created in MakeHuman program an Open Source software (AGPL3.0) for creating lightweight, realistic 3D models of the human form. MakeHuman™ is a tool designed to simplify the creation of virtual humans using a Graphical User Interface, also commonly referred to as a GUI. This is a specialized branch of the more general subject of 3D modelling. The ultimate goal is to be able to quickly produce a wide array of realistic virtual humans with only a few clicks of the mouse and be able to render or export them for use in other projects[7].

In addition to their parametric and flexible parts, models have more than 200 joints. At the present ready-made clothing, body size is standardized and named as small, medium, large, xlarge, etc. Because A size medium can differ from one brand to another, the better scenario is to see the clothes on one’s own body.

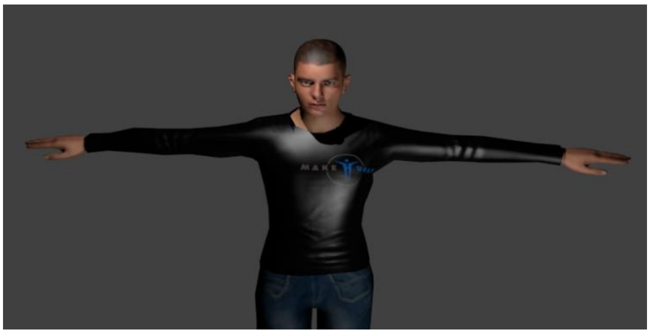

Figure 4. Rendered male model in Blender 3D v2.69

(a) (b)

Figure 5. Female(a) and male(b) humanoid models form the Graphical User Interface of the application created in Unity 3D

The body size variations of our models were generated in the order of standardized body sizes. Skin colours of the models have parametric structures, so that preferred skin colour can be selected as white, dark, etc. Since the most important parts of the models are their face, some facial expressions like smiling, crying, serious, sad, etc. included, and they all were designed for both male and female models.

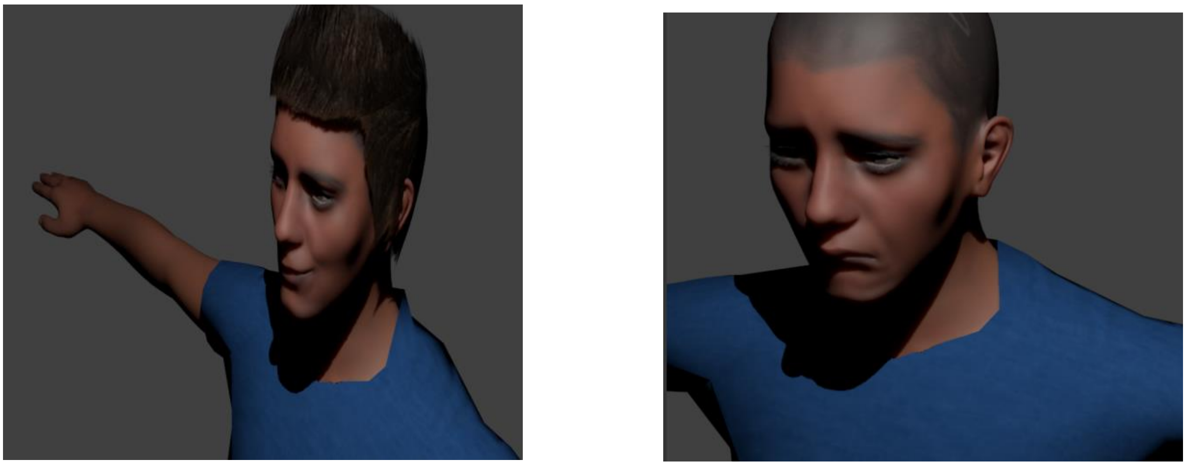

Figure 6. Happy and sad models are being rendered, recursively.

Figure 7. Examples from the face expression panel

2.2. Garment and shoe models

T-Shirts, cardigans, jackets, dress, trousers, skirts are some of modeled upper and lower body garments. An additional modul has been created to take 3D clothe models produced for standard clothing automatically. The shoes are modeled separatelly.

Virtual mirror projects are also used for glasses, jewelries, handbags, etc. For example, Cho et al. developed a system in which the user is able to try on glasses [8]. Wang et al. developed an augmented reality system for online shopping in which users can experiment with virtual handbags in different ways [9].

2.3. Virtual Changing Room and component models

To try virtual garments and shoes on in front of a virtual mirror, we created and designed virtual rooms similar to changing-rooms in clothing stores. Alternatively, we generated optional mirror select buttons for a backward vision of garments and shoes.

Figure 8. Editable Changing-Room Components

3. Performing The Virtual Mirror System

Game Engines are widely used to ensure interaction with the virtual World especially in games, virtual reality systems and simulations. Without using game engines, creation of scenes, exporting models, running readable input units and reshaping the scene according to inputs and performing possible physics and dynamics of the event require a long time and comprehensive programming knowledge. That’s why the Unity Game Engine is used in this study. Unity is a game development ecosystem: a powerful rendering engine fully integrated with a complete set of intuitive tools and rapid workflows to create interactive 3D and 2D content; easy multiplatform publishing; thousands of quality, ready-made assets in the Asset Store and a knowledge-sharing community[10].

The scenes in Figure 2 and Figure 5 are created in Unity 3D. User input unit can be one of the input devices like keyboard, mouse, web-cam or Microsoft Kinect. The interaction with created models are possible by these units. If the user has a web-cam or Kinect, the system can determine the user’s gender, height and body size automatically. Also, they can be choosen manually with a keyboard or mouse. Moreover, it is possible to manually or automatically rotate the model by the use of input units. There is also a clothe panel that enable users to change garments and shoes, and their colours or patterns as wished.

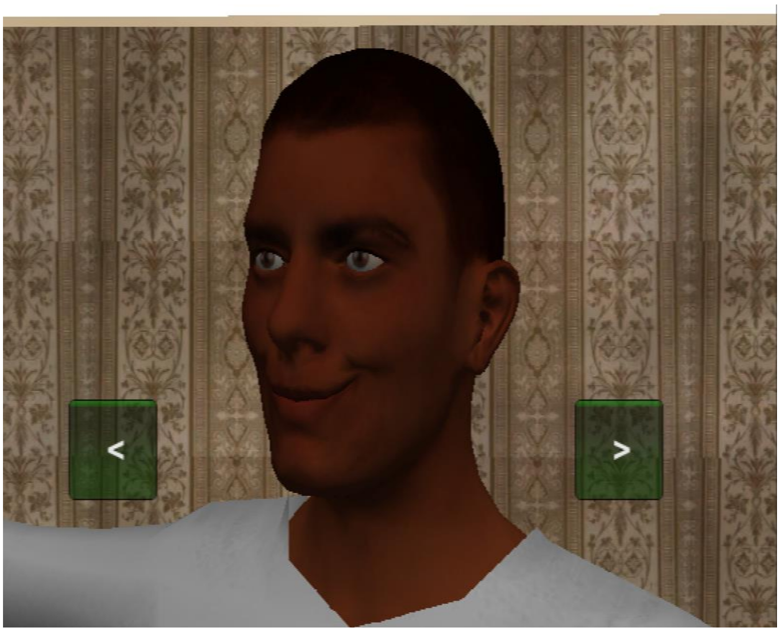

Figure 9. Skin Colour Detection

Skin Colour: Skin colour is an important and essential parameter in clothing. One desires to wear dresses compatible with the skin colour he or she has. Skin colour is selectable by users in virtual interface and can be determined automatically with a webcam or Kinect. With the help of computer vision methods and openCV program, the model's skin colour is set to a specific colour obtained from user's own skin. Figure 8 illustrates an example for skin colour and emotional detection of user based model.

4. Conclusions

In this study, a virtual mirror system is designed for the purpose of clothe changing room.

Our motivation here is to increase the time efficiency and improve the accessibility of clothes try-on by creating a virtual dressing room environment.

The system contains two basic male and female models of which joints are over 200. They have spectacular potential of performing human movements as well as facial expressions. For the body size and height, we created a lot of model variatons. The GUI(Graphical User Interface) of changing-room reading and interpreting the data arrived form keyboard, mouse, webcam or Kinect input units enables users try garments and shoes on a created humanoid model.

5. References

[1] S. Giovanni, Y.C. Choi, J. Huang, E.T. Khoo, K. Yin, “Virtual try-on using kinect and HD camera , ” MIG 2012,vol. 7660, pp. 55-65, November, 2012

[2] Z. Zhou, B.Shu, S.Zhuo, X.Deng, P.Tan, D.Lin ”Image-based clothes animation for virtual fitting,” SIGGRAPH Asia 2012 Technical Briefs,2012,doi: 10.1145/2407746.2407779

[3] K. Murata, M.Hattori, Y. Shibuya, “Effect of unresponsive time for user's touch action of selecting an icon on the video mirror interface,” HCI International 2013, vol. 8007, pp. 462-468, July, 2013

[4] R. Goldenthal, D. Harmon, R. Fattal, M. Bercovier, and E. Grinspun. Efficient simulation of inextensible cloth. ACM Trans. Graph., 26(3), July 2007.

[5] J. Shotton, A. Fitzgibbon, M. Cook, T. Sharp, M. Finocchio, R. Moore, A. Kipman, and A. Blake, ”Real-Time Human Pose Recognition in Parts from Single Depth Images,” Proceedings of IEEE Conference on Computer Vision and Pattern Recognition, 2011.

[6] K. Kjærside, K.J. Kortbek, H. Hedegaard, ”ARDressCode: Augmented Dressing Room with Tag-based Motion Tracking and Real-Time Clothes Simulation,” Proceedings of the Central European Multimedia and Virtual Reality Conference, 2005.

[7] MakeHuman , “MakeHuman™ and its Purpose,” Available : http://www.makehuman.org/doc/node/makehuman_and_its_purpose.html ,2014

[8] H. Cho, N. Schwarz “I like those glasses on you, but not in the mirror: Fluency, preference, and virtual ,“ Journal of Consumer Psychology 20, pp. 471-475, August, 2010

[9] L. Wang, R.Villamil, S. Samarasekera and R.Kumar, “Magic mirror: A virtual handbag shopping system,” 2012 IEEE Computer Society Conference on Computer Vision and Pattern Recognition Workshops, 2012© IEEE.doi: 10.1109/CVPRW.2012.6239181

[10] Unity 3D. http://unity3d.com/unity ,2014