Real Time Virtual Mirror Using Kinect

G. Yolcu, S. Kazan and C. Oz

Abstract— **This paper proposes a real time image processing approach to enable users to try virtual garments on in front of a virtual mirror. The user's hand motions select the clothes from a list on screen. Afterwards a virtual representation of the user wearing the selected virtual clothes appears in the virtual mirror. To create a more realistic effect, the system takes into account different images of the clothes according to different human poses and movements. Additionally, we developed an algorithm for matching up all motions between the virtual clothes and the human being. 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 the clothes.**

Index Terms— **Virtual mirror, Virtual try-on, Virtual reality, Image processing, real time Systems, Kinect for Windows**

I. INTRODUCTION

PREVIOUSLY, people used to spend a lot of time while shopping. Owing to technological advances, online shopping has become very popular recently. 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. Different virtual mirror projects have been in progress lately. For example, Cassas et al. developed a system that aims to facilitate the acquisition of certain skills by children. The augmented reality-system is designed as a mirror-world where users see themselves with virtual objects [1]. Murata et al. focuses on the "video mirror interface". A user can operate a computer system by selecting virtual objects on a screen with his/her hand [2]. Zhou et al. proposes a real time approach for virtual clothes fitting using Kinect [3]. 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 [4]. Hauswiesner et al. presents a system which combines image-based renderings of the user and previously uploaded garments. It transfers the garment recorded from one user to another by matching input and recorded frames [5].

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Besides clothing try-ons, virtual mirror projects are also used for glasses, jewelries, handbags, etc. For example, Wang et al. developed an augmented reality system for online shopping in which users can experiment with virtual handbags in different ways, such as sliding the handbag's straps to different positions on their arms and rotating the handbag [6]. Cho et al. developed a system in which the user is able to try on glasses [7].

Sometimes virtual mirror is designed for education. For example, Blum et al. presents an augmented reality magic mirror used for teaching anatomy by creating the virtual illusion that the user can look inside his body. They also used Microsoft Kinect [8].

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 clothing items to the appropriate parts. Thanks to the skeleton library as well, when the user moves freely in front of the mirror, the clothes follow accordingly to such movements.

II. SYSTEM DESPCRITION

A. *Adding virtual clothes on the video*

In this work, a user stands in front of the monitor that is used as virtual mirror. Firstly, the user selects a clothing item from the list of clothes, which appears on the right side of the monitor, using his/her right hand. With the assistance of Kinect, the system follows and synchronizes the positioning of the right hand with a garment picture; the clothing item related to the garment picture the right hand is on, is placed on the user's body (Fig. 1).

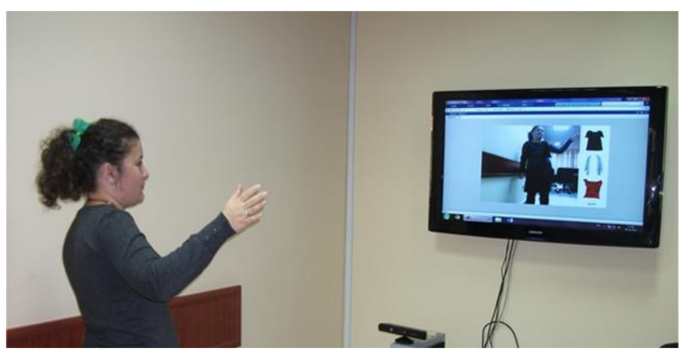
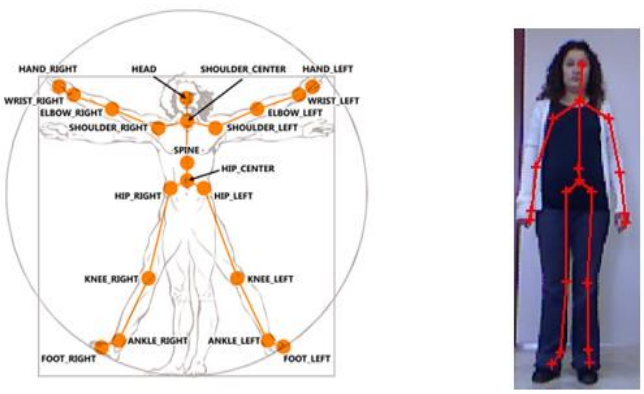


Fig. 1. Virtual mirror system

Secondly, the system focuses on correctly placing the garment on the skeleton. Again, Kinect ensures optimal results. Kinect also enables the access to the color image data and depth image data, as well as audio data, streamed out respectively by the color and depth streams and the audio stream. In addition to the hardware capabilities, the Kinect software runtime implements a software pipeline that recognizes and tracks the human body. The runtime converts depth information into the skeleton joints of the human body making it possible to track up to two people in front of the camera [9]. The skeleton data consist of a set of joints. These joints are shown in the diagram below (Fig. 2).



(a) (b)

Fig. 2. (a)The skeleton joints which found by Microsoft Kinect (http://msdn.microsoft.com/en-us/library/hh438998.aspx) (b) Skeleton on a user

To place a virtual clothing item on the user, first we resize the image of the virtual garment based on the distance between the x-axis of the shoulders and between the y-axis of the hip center and shoulder center.

X-axis of virtual garment's' image=x-axis of shoulder left - x-axis of shoulder right

Y-axis of virtual garment's image=y-axis of hip center - y-axis of shoulder center

Owing to this step, clothe-sizing dynamism is capacitated to those who wear virtual clothes.

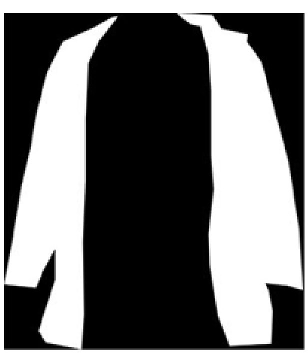


Fig. 3. Alpha Channel of a jacket

In the next step, the system positions the upper part of the garment based on the shoulder-center. To add the virtual clothes' image to the main video we use alpha channels of the images. As shown in Fig. 3, the alpha channel ensures that the background is black, with pixel value of zero, and the virtual garment area is white, with pixel value of 255. The main image is multiplied with virtual clothe image's alpha channel then the product is collected with virtual clothe image. So the clothing item's image is added to the main video without its background.

B. Virtual clothes transfer

Enabled by Microsoft Kinect skeleton map, the system follows the user's motions. Upon his/her body movements, the skeleton's related joints change, resulting in the change of position of the related clothing pieces.

To provide this modification capacity, ready images were produced and uploaded as follows: Firstly, a model performed possible movements in front of the screen. For every clothing item pose, the left arm angle for that movement from the waist up, or the y-axis coordinated distance between right and left feet for the that movement from the waist down were calculated and recorded. Secondly, the garment image was cut using Adobe Photoshop. Finally, it was added to the ready images database and the related calculation record.

The virtual mirror system follows the skeleton movement using Kinect, and as shown in TABLE I, calculates the arm angle for movements from the waist up and the y-axis coordinated distance between the two feet for the movements from the waist down. Next, it shows the suitable image available from the database. TABLE II shows in the first column real images of users moving freely, and in the second column, images of the users with the virtual clothes provided by the system on.

TABLE I
CALCULATING ARM ANGLE

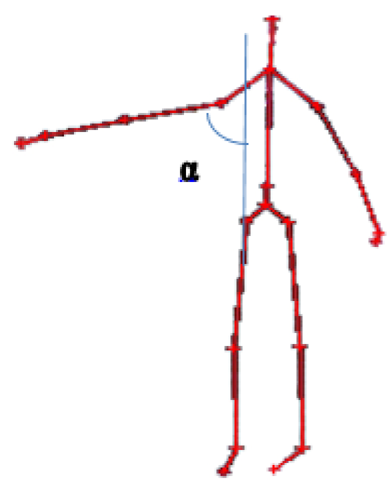
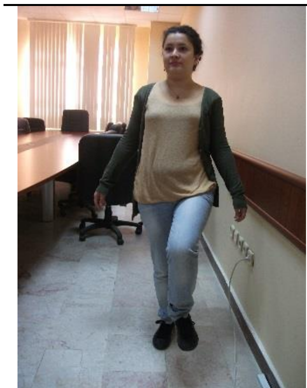
Formula	Figure
y = y-axis coordinate of wrist left - y-axis coordinate of shoulder left x = x-axis coordinate of shoulder left - x-axis coordinate of wrist left $\alpha = \arctan(x / y)$	

TABLE II
FREE MOVEMENTS IN FRONT OF THE MIRROR

Original frame	Virtual mirror frame
	
	
	

C. *Changing Color of Virtual Garments*

In our application, after being placed on the user's clothes, it is given the opportunity to the user to change the color of garment. To change color, user's left hand is followed by Kinect. When the left hand is on a color from the color list, color changing process takes place. While making color changes, it is required not to lose wrinkles and shadows on the garments. Because the wrinkles and shadows on the garments give a realistic impression. In HSV color space, if V parameters are held constant, the wrinkles and shadows can be kept constant. For this reason, color changing is provided in HSV color space. The color space of garment photo is translated from RGB to HSV. In HSV color space, H value which is expressing hue and V value which is expressing brightness are changed according to the selected color. After the changes, the photo is translated to RGB format.

Fig. 4. Different Colors sample of a garment

III. CONCLUSION

We worked on a real time image processing approach for a virtual mirror system. Firstly, we created a virtual clothes database indexed by skeleton posing. At run time, a user selects clothing items from a clothes list and moves freely. The system searches the database for suitable images and shows them on the user. We run our algorithm on a PC with a 2.80 GHz CPU and 3 GB RAM with no system delay.

The system works accurately, including the user fitting garment-resizing feature. Sometimes it works intermittently; to avoid this, more posed-clothing images can be uploaded to the database. In addition, the system uses Kinect; therefore, in order to use this system the user must have Kinect. As a means to increase the program functionality, making it more useful to a greater number of users, using a standard camera to record skeleton joint images is being considered, in place of Kinect. In this project, we analyzed arms and legs movements in this. Our future project improvement involves adding back and side turns, among other movement options.

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