A Dynamic Fitting Room Based on Microsoft Kinect and Augmented Reality Technologies

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Abstract. In recent years, more and more researchers try to make Microsoft Kinect and Augmented Reality (AR) into real lives. In this paper, we try to utilize both Kinect and AR to build a dynamic fitting room. We can automatically measure the clothes size of a user in popular brands or different country standards. A user can utilize gesture to select cloths for fitting. Our proposed system will project the video dynamically of dressing selected clothes in accordance with the captured video from Kinect. This system can be utilized in clothing store, e-commerce of clothes shopping, and at your home when you are confusing choosing a clothes to wear. This can greatly reduce the time you fitting clothes.

Keywords: Dynamic Fitting Room, Kinect, Augmented Reality.

1 Introduction

In recent years, Augmented Reality (AR) [1-6] is becoming an important and interesting technology for combine real live pictures and computed visualization images together. This can make user to interact between virtual and real worlds. In the beginning, AR is common used in entertainment, sport games, industry and even medical operation. And then it appears in the life enhancement applications, for example, it can be used in digital maps to demonstrate the navigation route into the real roads. It is interesting and really helpful to people.

Xbox360 is the second generation of Microsoft video game system and it was released on 22th November, 2005. Xbox360 gradually achieved market share from competitors with its successful hardware design and software supported. Especially the new controller/sensor Kinect was released on 4th November, 2010. The word Kinect is invented from the two words kinetics and connection. It utilized the VGA camera to capture the visible video from users and infrared camera to capture the distance between Kinect and users. After computation, Kinect can track the motion of two users and recognize 20 joints per user. Fig. 1 is the illustration of the 20 joints captured and calculated by Microsoft Kinect. Kinect[7-11] is recently utilized in many research areas.

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How to make things convenient is an important issue to modern life. Therefore a lot of information technologies are invented to help modern people to achieve this goal. For example, Internet can speed up the transformation of information; mobile phone can communicate with others easier.

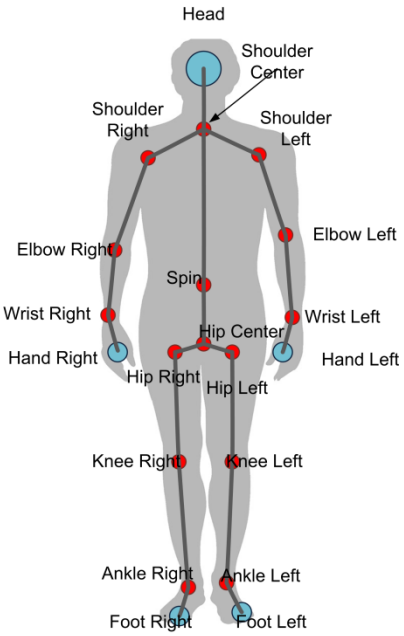

Fig. 1. Illustrated of 20 joints captured by Microsoft Kinect

Cisco blog posted 'The future of consuming' [12] on 25th July, 2011. It demonstrated a concept of video for a future fitting room. And Jade Jagger for Indiska Fashions uses the AR technology with marker to try on static clothes. This is the enlightenment idea to proposed this system.

In this paper, we design a dynamic fitting room which utilized the technologies of AR and Kinect. Users can use this system to try on clothes which is created in the digital wardrobe. And check the result of try immediately; even you move your body. You can change any clothes to dress yourself with AR technology to select the right style of for the coming party instead of putting on and taking off clothes. You will not sweat out and waste a lot precious time on fitting.

2 Dynamic Fitting Room

Our proposed dynamic fitting room is created for using on many scenarios. It can be placed in user's house. And the existing clothes in the digital wardrobe are bought before. The user can try on any selected clothes in the digital wardrobe before taking the clothes out from the wardrobe in the real life. The dynamic fitting room can also be placed in a clothing store. When a customer enters the store, he/she can easily try

on different digital clothes sale in the store. It will save a lot of time on trying clothes on. The dynamic fitting room is also useful for e-commerce clothing stores, customers can see the real-time images that desired clothes trying on his/her own body. It will be more real than just watching the picture on models.

2.1 System Architecture

As demonstrated on Fig. 2, there two main sub-systems with Kinect in our proposed dynamic fitting room. One is called Wardrobe Screen, which displays the digital wardrobe and a user can select clothes in this screen. The other sub-system is called Dynamic Fitting Room, which will display the AR results with selected clothes.

These two sub-systems are run in different computer, and they communicate via network connection to exchange the needed information. For flexible, we store the digital clothes in a clothes database. The clothes database can be one's private wardrobe, and it can also be an e-commerce clothing store, even it can be your friend's wardrobe if your friend shares it.

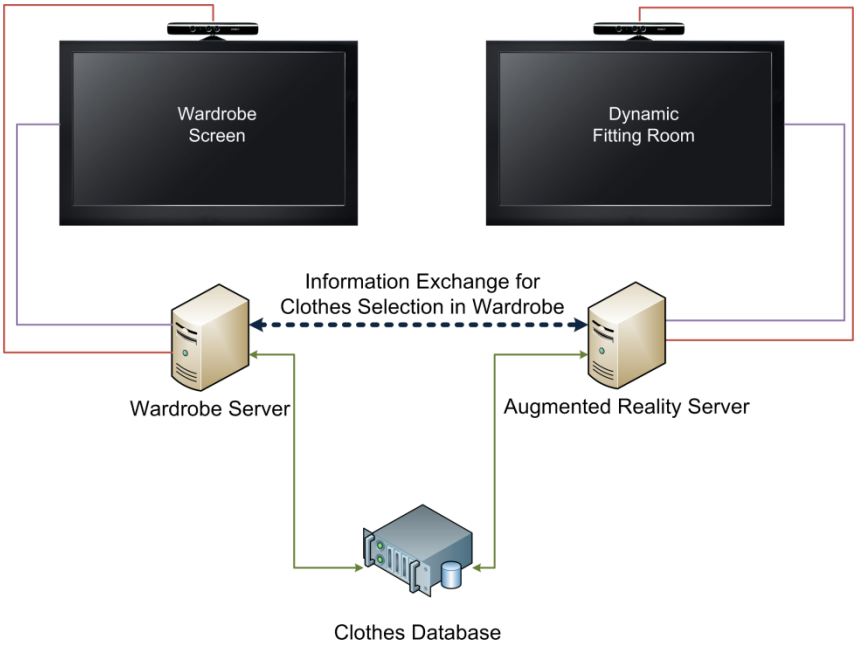

Fig. 2. System architecture of our proposed dynamic fitting room

Fig. 3 is the scenario that using our proposed dynamic fitting room. The user is standing between two large LCDs. The front side is placed the Dynamic Fitting Room sub-system, and the left side is the Wardrobe Screen sub-system. The user can first choose the clothes in the Wardrobe Screen sub-system in the left side and then check the AR results in the front Dynamic Fitting Room sub-system. When the user move his/her body, the AR result will display the real-time image on the screen.

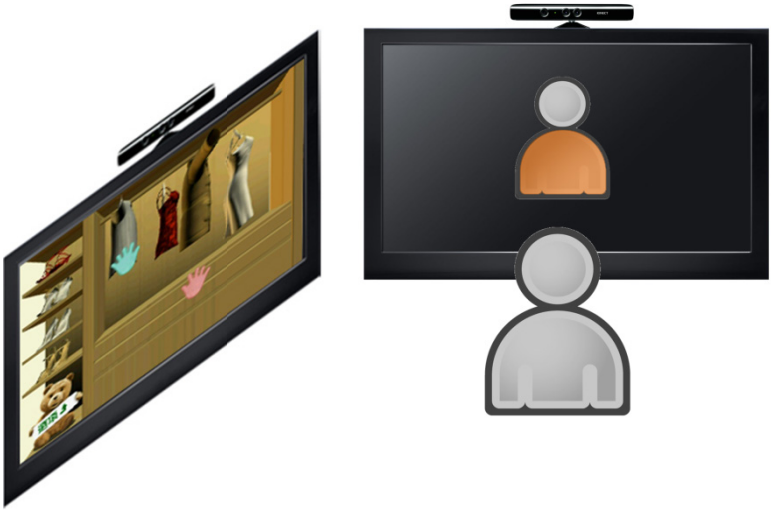

Fig. 3. The scenario of using dynamic fitting room

2.2 User Interface

Although the dynamic fitting room is composed with computers, it is impossible and weird to input information using a keyboard and mouse. The motion track function of Kinect is a good method for input information. Fig. 4 is the screen down of Wardrobe Screen sub-system. Two palms, blue and pink, represented two hands of the user. The left hand represented blue palm in the image can choose clothes by swiping left or right. The selected clothes will be bulged. The user can push right hand represented pink palm in the image to confirm your choice.

Fig. 4. Screen down of Wardrobe Screen sub-system

After choosing the clothes, the AR result is displayed in the front LCD. The user can move body to check the image with the selected clothes. In the same time, the Wardrobe Screen sub-system is temporally no function, because when you check the front LCD and move body may trigger some undesired function on the Wardrobe Screen sub-system. The user can raise two hands higher than head, and the Dynamic Fitting Room will be paused and the Wardrobe Screen sub-system will function again.

2.3 Fitting Clothes

We use Microsoft XNA Framework as our develop platform. The 3d model with skeleton of the digital clothes was designed in the Autodesk 3ds max. The concept of fitting clothes is receiving the joints and motion from Kinect. And then use the motion to trigger skeleton in the digital clothes. Fig. 5 displays the concept.

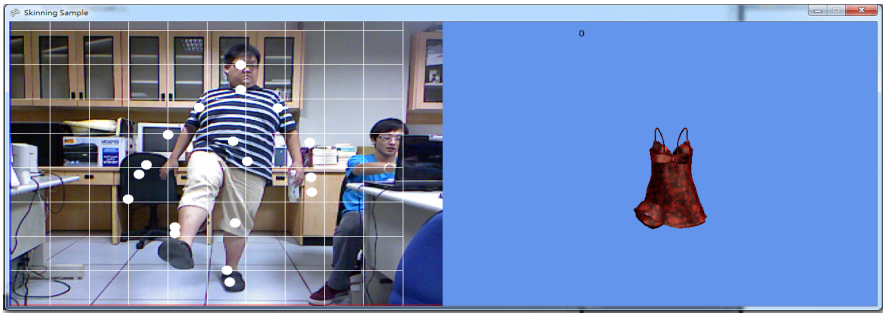

Fig. 5. Kinect joints trigger skeleton joints of 3Ds Max

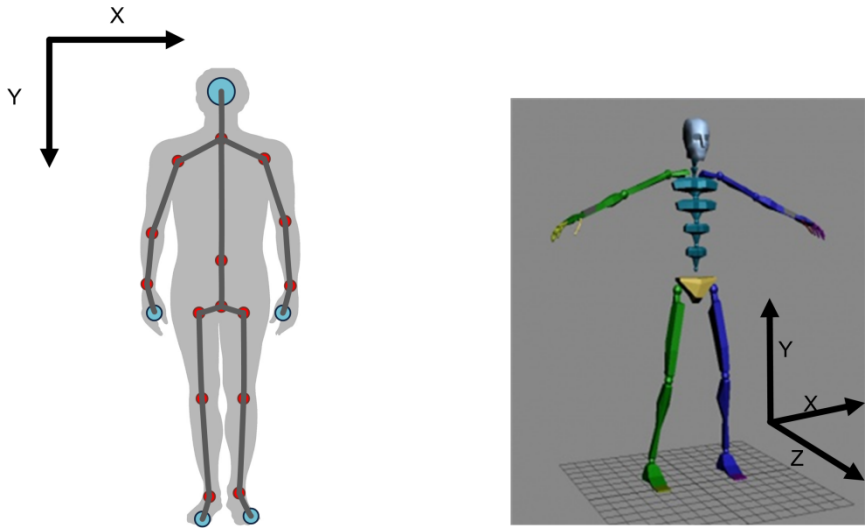

Fig. 6. The axis systems of Kinect SDK and 3Ds Max

Fig. 6 displays the axis systems of Kinect SDK and 3Ds Max. In the Kinect SDK, the axis information of each joint is represented as (x,y), and Kinect will also return a depth information of each joint. The depth information represents the distance between the joint and the Kinect inferred camera. It is not the real z-axis data. For example, if the user is standing straightly, the z-axis information of each joint must be the same. However, the depth information of the Hip Center and Head is different. The depth information needs proper conversion into z-axis information.

2.4 Size Issues

There are two main size issues in our proposed dynamic fitting room. What size you need is an important problem when you enter a clothing store. You can use your experience and try on some clothes and the possible size for the clothing store can be figure out. But it is not convenient. If you stand on our dynamic fitting room, the system will tell you or the seller what size you are. It will be a better solution than before. To solve this problem, we utilized the two Kinects in the front and left sides. The system will evaluate the user's body height according to head/foot joints and the depth information using the front Kinect. And then calculate the possible waist length according to the oval perimeter using the width around the Hip Center joint from the front and left side Kinects. And last we calculate the area size of body according to the Kinect depth information from both Kinects. And then we use a rule-based method to determine the user's size. Table 1-4 is the example rules for evaluate the user's size. It can be adjusted for different clothing stores.

Table 1. Rule for body area(Pixel^2) from front Kinect depth information

Lower bound	0	22000	30000	34000	36000	40000	42000
Upper bound	22000	30000	34000	36000	40000	42000	∞
Possible Size	NULL	XS~M	S~L	M~XL	L~3XL	XL~3XL	XL~4XL

Table 2. Rule for body area(Pixel^2) from left Kinect depth information

Lower bound	0	12000	14000	18000	20000	23500	25000
Upper bound	12000	14000	18000	20000	23500	25000	∞
Possible Size	NULL	XS~S	S~M	S~L	M~XL	L~3XL	XL~4XL

Table 3. Rule for calculated body height(cm)

Lower bound	0	140	160	170	175	180	190	195
Upper bound	140	160	170	175	180	190	195	∞
Possible Size	NULL	XS~M	S~L	M~XL	M~2XL	L~3XL	XL~4XL	2XL~4XL

Table 4. Rule for calculated body waist(inches)

Lower bound	0	20	30	34	38	42	44
Upper bound	20	30	34	38	42	44	∞
Possible Size	NULL	XS~M	M~L	L~XL	XL~2XL	XL~3XL	2XL~4XL

The second size issue is what the size looks like to try on. Even we know the size we are, we want to try on different size according to difference style of clothes. We can create different 3D models for different sizes or just resize the 3D models. In our system, we just resize the 3D models for different Size.

3 Experiment and Results

The experiment is applied to 25 users. Before the size evaluation, we first ask user's usual clothes size. And then evaluate by our system. Table 5 is the results of the 25 users. The results show that the evaluation of user's size is quite closed to user's claim. Fig. 7 is the demonstration that different users try on clothes. Fig. 8 is the size suggestion for different brands.

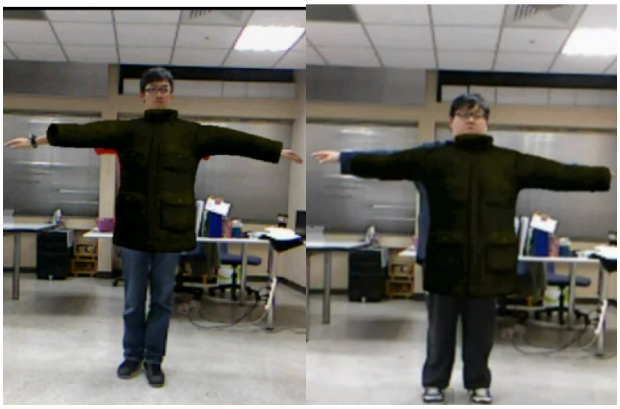

Fig. 7. Different users try on clothes

Table 5. Evaluate the size of user

Number	Claim Size	Result	Number	Claim Size	Result
01	XL	L	14	M/L	L
02	M	M	15	M	M
03	XL/2XL	2XL	16	L	L
04	3XL	3XL	17	2XL	3XL
05	M	M	18	M/L	L
06	M/L	L	19	M	M
07	S/M	M	20	M/L	M
08	M/L	M	21	XL	2XL
09	L	XL	22	M	L
10	L	XL	23	S/M	M
11	M	M	24	S/M	M
12	S/M	M	25	L	XL
13	M	M			

Fig. 8. Size suggestion for different brands

4 Conclusions

In this paper, we proposed a dynamic fitting room system utilized the Microsoft Kinect and Augmented Reality technologies. The system can show the real-time images that try on different digital clothes, and it also can evaluate user's clothes size. According to the experiment result, the evaluation of clothes size is quite closed to user's claim. This system can be utilized in clothing store, e-commerce of clothes shopping, and at your home when you are confusing choosing a clothes to wear. This can greatly reduce the time you fitting clothes.

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