AUGMENTED CLOTHING

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Abstract—With advent of rapid development of online industry, it would be more preferable to purchase outfits via online if there is an end-to-end virtual try-on which could overcome the consequences of the fact internet clothing is hard to use and fitting rooms in retail outlets is always packed during the peak hours. So, incorporating augmented reality to online shopping/retail outlet for a virtual try on clothes and accessories makes everything about shopping easier. In this system, there will be image processing and computer vision used to determine size of shirt and waist and so on of a person using the Kinect V2/ XBOX 360 perceptual computing kit allows user to try on virtual clothes. Kinect V2 suits the scenario in manipulating the joints correctly, it has good color camera resolution, impressive depth camera resolution and can detect up to 25 joints. To implement the concept of skin fragmentation, the Kinect Software Development Kit (SDK) provides the depth image and the user ID corresponding to all the bodies detected. After detecting this body, the image of shirt is superimposed on the body to create a virtual image of user wearing that cloth.

Index Terms—virtual room, depth sensor, shirt algorithm, Skelton tracking, body tracking method, skin fragmentation, clothing.

I. INTRODUCTION

A virtual dressing room is the online equivalent of an in-store changing room. It enables shoppers to try on clothes to check one or more of size, fit or style, but virtually rather than physically. Trying on clothes in stores today is one of the most time-consuming tasks. Usually long periods have to be taken into account, for example when standing in front of full fitting rooms. Furthermore, additional time is lost when taking clothes on and off. Reducing this time and helping people to put on a large collection of garments in reduced time was a relevant motivation for this thesis. Using modern technology - hardware as well as software - the try-on experience can be drastically improved. Even in web shops people are very sceptic buying clothes because a try-on of clothes is not possible. The techniques discussed in this paper can enhance the shopping experience. It even offers customers a more precise representation than 2D images of the cloth they are willing to buy and therefore this may also reduce the amount of goods the buyers return. In this thesis I will introduce a Virtual Dressing Room, which offers a solution for the men-toned aspects. The application is based on a mirror, represented by a display that outputs the image of the camera. If a person is standing in front of this virtual mirror, the person will be able to select desired clothes. The selected garment is then virtually superimposed with the image recorded by the camera. In general, this technique can be categorized under augmented reality (AR), where a real-time view of the reality is extended and furthermore overlaid with additional information. This paper mainly focuses on the applications in cloth stores although a home setup is possible as well. The aim of the project is to create a Virtual Dressing Room that realistically reflects the appearance and the behavior of garment. It should further adapt to specific bodies of different persons depending on their body measurements., the fitting room will be based on the Microsoft Kinect, an innovative technology which provides a new way of interaction between humans and the computer. From the depth image of the Kinect the skeleton is extracted and the position and orientation of the cloth are adapted in regard to the joint positions and body measurements. 3D models of the cloth will be overlaid with the color image from the RGB camera to obtain the function of a virtual mirror. To achieve a realistic simulation of the cloth, a physical simulation is performed on the garment. A key purpose of both virtual and real fitting rooms is giving the customer the look and feel of clothing of a specific size on the user's body, so the user can choose the appropriate size for him. Embedding the feature of matching clothing sizes with users requires capturing the users body dimensions. More advanced frameworks even construct virtual avatars with input from only one depth sensor .On the other hand, although these works provide higher detail avatars and more precise measurements, which might be more suitable for a made-to-measure type of framework, these processes require too much time to work with a real-time fixed-size try-on virtual fitting room application, and we suggest that simple body height and shoulder width measurements are sufficient. These applications require a faster approach along with a specialized garment design framework. The cloth pieces to be fitted on the user's avatar must first be scaled accordingly. To this end, we implemented body measurement process, which starts with depth map smoothing, in order to reduce noise. Afterwards, we utilize the filtered depth map along with filtered user joints to measure a set of parameters, which are used in conjunction to estimate the body height and shoulder width. These parameters are averaged over time to minimize the error. Clearly then, Virtual Fitting Rooms (VFRs) have already started to revolutionize the state of affairs in both retail and e-tail industries by letting customers try-on apparel and mix-and-match accessories without being physically present in the retail shop. These applications draw on multiple technologies to finally make it possible address the suit/fit dilemma. On the hardware side, multi-sensor bars like Microsoft Kinect and ASUS Xian have brought depth scanning to the masses by allowing accurate full-body depth maps and gesture recognition via supporting frameworks. In addition, VFRs rely heavily on Augmented Reality (AR), which employs specialized software and hardware to merge the digital and the physical worlds by immersing digital information into real video to generate persuasive looking scenes in real time. Modern VFRs combine AR technologies with depth and color data to provide robust body recognition functionality and successfully address the fit and suit aspects of shopping. In addition, promising platforms offer real-time video simulations which allow customers to visualize products as part of their current outfits and view them from multiple angles. These platforms are not only powerful decision tools for on-line shopping but also increase the fun factor for in-store shopping. The present article reviews successful examples of VFRs and discusses fundamental technologies behind some of these shopping and advertising tools, many of which employ full- body scans to offer only pieces of clothing with a satisfactory fit and at the same time facilitate the styling and matching aspects of shopping.

Virtual dressing room using augmented reality point out solution for problems arise during inline shopping and difficulties in trail rooms. The initial and primary reference for this project is Virtual dressing room using Augmented Reality by kandura. Real Time virtual fitting with body measurements and motion smoothing by Gulper given idea of creating a virtual fitting room using depth censor data. The framework yields a realistic fitting experience for standard body types with customized motion filters, body measurements and physical stimulation. This paper mainly focused on Carmel simulation, depth sensing, and bone splitting technologies. Major limitations described is inefficient in customization and skull simulation zone. The initial thought of designing a virtual dressing room was influenced by the valuable insights given in

AUGMENTED REALITY VIRTUAL DRESSING ROOM-BY

Mathew Szczuka. It describes about how virtual dressing room technology matures and3D modelling cost decrease and become automated. A MIXED REALITY VIRTUAL CLOTHES TRY ON by Milelong Yaan, Ishtiaq Rasool Khan Senior emberlike. In this paper they presented a mixed reality system for 3D virtual clothes while looking at a mirror display, without taking off actual clothes. Here usage of one consumable" R G B D" camera is defined. Major contribution of this paper is they automatically customised an invisible avatar based on user's body size and fitting alignment. The idea of incorporating the idea of virtual dressing room along with mobile apps was inspired by the discussions in the paper IMAGE PROCESSING DESIGN FLOW FOR VIRTUAL FITTING ROOM APPLICATION USED IN MOBILE DEVICES Cecilia Garcia, Nicola BessouILLINIOIS Institute of Technology. Objective of this work is to develop a virtual fitting room that can run on any mobile that has camera and net connection.

II. IMPLEMENTATION

A. Interfacing with Kinetic and Body Tracking Methods

Interfacing with Kinect: The Kinect for windows software development kit(SDK) 2.0 enables the developers to create applications that support gesture and voice recognition, using Kinect sensor technology on computers running windows 8 , windows 8.1 and windows embedded standard 8.This release introduces support for the Kinect for windows v2 sensor and introduces a board range of capabilities for developers.

The Kinect for windows SDK 2.0 includes drivers for using Kinect v2 sensors on a computer running windows 8 (x64), Windows 8.1(x64) and windows embedded standard 8(x64) application programming interfaces (APIs) and device interfaces and code samples it needs Visual Studio and an USB 3.0 controller dedicated to Kinect V2 sensor.

Body tracking: The initial version of Kinect allowed us to track up to 20 body joints. The second version allows us to up to 25 joints. The new joints include fist and thumbs. Moreover, due to enhanced sensor, the tracking accuracy has been significantly improved. Experienced users will notice less jittering and much better stability. By extracting body of interest, we can create an augmented virtual environment by isolating the user area from the video stream and superimposing onto the virtual environment in the user interface. Since shirt model to be augmented is the top layer and virtual body is back layer the user always stays behind the shirt model. Here we are using skin fragmentation technique to overcome this issue.

B. Understanding Gesture Mechanism

Kinect provides you with the position (X, Y and Z) of the users joints 30 times (or frames) per second. If some specific points move to specific relative positions for a given amount of time, then you have a gesture. So, in terms of Kinect, a gesture is the relative position of some joints for a given number of frames.

In the wave gesture, the hand remains above the elbow and moves periodically from left to right. Each position (left / right) is a discrete part of the gesture. Formally, these parts are called segments.

So, the first segment would contain the conditions hand above elbow and hand right of elbow:

- Hand.Position.Y > Elbow.Position.Y AND
- Hand.Position.X > Elbow.Position.X

Similarly, the second segment would contain the conditions hand above elbow and hand left of elbow:

- Hand.Position.Y > Elbow.Position.Y AND
- Hand.Position.X < Elbow.Position.We implemented the zooming gesture to select clothes and since Kinect V2 can detect the position of thumb fingers, on closing the fingers, the x coordinates for the thumb fingers decreases and increases alternatively for both fingers respectively in opposite axis. Though conditions below depict for two hands to handle both scenarios, gesture is made by a single hand in general.

C. Background Removal

Background removal depicts removal of background to separate the user, when we need to perform skin fragmentation for skin detection. If we are able to differentiate the user pixels from all the other pixels of the color stream, then we store the user pixels and remove all the other pixels to remove the background. Especially, in case of skin fragmentation, we can replace the background pixels with a uniform RGB value that when converted to CyBC format should not fall in the range of most representatives of skin color. So, in order to remove the pixels not constituting the user body, we need to find the corresponding user pixels on the depth stream array and map them to corresponding color pixels in the color stream array and remove the rest of the pixels to remove the background.

D. Skeletal Tracking

Skeleton tracking is the processing of depth image data to establish the positions of various skeleton joints on a human form. For example, skeleton tracking determines where a user's head, hands, and centre of mass are. Skeleton tracking provides X, Y, and Z values for each of these skeleton points. In the previous chapter, we explored elementary depth image processing techniques. Skeleton tracking systems go beyond our introductory image processing routines. They analyses depth images employing complicated algorithms that use matrix transforms, machine learning, and other means to calculate skeleton points. A substantial part in the tracking process is the retrieval of the particular body joint positions. This is achieved by an algorithm introduced in Real-Time Human Pose Recognition in Parts from Single Depth Images. The recognition system runs at 10 MS per frame. Also, the system computes each frame independently from every other frame, furthermore implicating no joint information (e.g. transformations) between frames. The algorithm allows a full rotation of the body and a robust distinction between the left and right side of a body. By inputting the depth data of the Kinect device, special regions of the body are recognized and based on this the joint positions are defined. The joint positions are needed in order to move a skeleton, for instance, or in case of the Virtual Dressing Room, a piece of garment in respect to the motion of a user. The next paragraph will take a closer look on the process. already mentioned, the algorithm is built upon the depth data. This data is analyzed and a human body is separated in different regions that are representing several body parts. The human body can be captured accurately and robustly even processing different sizes of a person's body correctly. For each pixel the corresponding body part is calculated. Overall, the system is trained with data from a comprehensive motion capturing database, which is consisting of humans with different body sizes and measurements, furthermore using a randomized decision for est.

The parts are then assigned using depth comparisons. In a further step, the joint positions are evaluated based on the body parts using mean shift, also retrieving the 3D positions for all joints. Compared to other methods, the skeleton tracking algorithm introduced for the Kinect shows stable and efficient results in real-time. Kinect V2 provides 25 joints tracked at 30 frames per second frequency and we can access the joints using the Kinect SDK. Out of the 25 joints, we use certain joints to calculate the measurements of shirt required to be augmented on the virtual body. Figure 2depicts the joints obtained by skeletal tracking with which we will be performing some calculations for modelling the shirt later in this paper. Since, we are calculating the RGB pixel value at a position, say A, on user body by color stream and calculating the position coordinates by depth stream, we need to map each other to find the RGB pixel at a position A(x,y,z) .But since color stream and depth stream have different resolutions, we need the use of Coordinate Mapper which maps corresponding coordinates correctly. As a result, we have access to all coordinates virtual user body with corresponding RGB values. To augment the shirt onto the virtual human body, we need to fill the color stream of the tracked user by pixels of shirt stream at positions where the shirt is supposed to be augmented onto the virtual body. For instance, to calculate the length of shirt, we make use of the hip center joint coordinates and shoulder center coordinates. To calculate the width of the shirt around shoulders, we make use of the shoulder left joint coordinates and shoulder right joint coordinates and their difference gives the width of shirt around the shoulder. To calculate the waist size, we use the hip left joint coordinates and hip right joint coordinates and their difference gives the waist size. These sizes can also help in scaling and cropping the shirt to anticipated measurement. For rotation, we make use of slope of line formed between shoulder center joint coordinates after

rotation and hip center joint coordinates after rotation with the slope of the line formed by shoulder center joint coordinates before rotation and hip center joint coordinates before rotation to calculate the rotation angle.

E. Modelling of Cloth

Geometry is used in modelling and augmenting the cloth on the virtual body. In order to perform certain transformations in the cloth where certain algorithm is used.

Transformation 1: By image processing removed the background. Background removal depicts removal of background to separate the user of interest which we put it as optional step to performed except for the case, when we essentially need to perform skin fragmentation for skin detection.

Transformation 2: Calculate the border lines and cropping is done. to calculate the length of shirt, we make use of the hip center joint coordinates and shoulder center coordinates. To calculate the width of the shirt around shoulders, we make use of the shoulder left joint coordinates and shoulder right joint coordinates and their difference gives the width of shirt around the shoulder. To calculate the waist size, we use the hip left joint coordinates and hip right joint coordinates and their difference gives the waist size. These sizes can also help in scaling and cropping the shirt to anticipated measurement.

Transformation 3: Corner points are calculated with geometrical theorems.

Transformation 4: Use mapping and padding to form the shirt. Using modelling algorithm corner points are approximated which is then augmented to virtual body.

Using skeletal tracking, Kinect V2 SDK provides access to 25 joints among which only few joints are point of interest. For motion of user to check various poses, we need to segment the approximated shirt into 4 parts and augment the corresponding locations of original shirt accordingly.

III. BENEFITS

Virtual trial rooms go a long way in solving a host of problems for the customer as well the retailer:

- You can try on clothes before buying them online. It shows you accurate fit and look.
- As the buyers already know how the clothes will look and fit there is very low chance of return.
- It keeps the customer engaged for a longer time, trying out different clothes on a look- a-like 3D avatar. This has more chances of conversion into a sale.
- It saves you from the long queues at the malls or departmental stores.
- It saves the retailer from damaged or soiled garments due to heavy try on by customers.

IV. CONCLUSION

This paper showcases the complete implementation of virtual dressing room using augmented reality and connected to IOT so that it can be accessed from anywhere via a smart device once data is scanned by Kinect/XBOX 360.The proposed system has a purpose to make dressing room. Specialized for online shopping so it can contribute in improving sales performance. Our virtual fitting room may work optimally and fit for all consumers. This report presents augmented reality applications where users are made to try out clothing that is rendered on a screen over image of the user. The lightning is adapted to match the intensity of user's environment. Users can also trout accessories such as hats, shoes, jewelaries.

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