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VIRTUAL TRIAL ROOM USING AUGMENTED REALITY

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Abstract

This paper presents a Virtual Trial Room application using Augmented Reality which allows a user to try on virtual clothes. The user pose and depth is tracked using the Microsoft Kinect sensor and virtual clothes are aligned with the tracked user. The clothing moves and folds realistically and the lighting intensity of the cloth render is adapted to match ambient lighting conditions. The presented application improves on related augmented reality application by adding full user pose tracking and by using 3D clothing models combined with cloth simulation instead of 2D images.

1. Introduction

1.1 Problem Definition

A lot of shoppers have encountered a lot of problems while shopping at a high-end place for readymade garments, especially during peak hours, such as weekends. Tiresome lines, numerous restrictions, enormous crowds make it quite an unpleasant experience. Huge number of customers, and minimum numbers of trial rooms results in quite a lot of waiting time for customers, ultimately resulting in dissatisfaction. Due to security reasons, there is also a restriction on the number of garments that can be taken at one instance of time for trial. It increases the overall shopping time due to multiple trips from the shelves to the trial rooms.

From the boutique's point of view, a large percentage of thefts happen because of sneaking in garments while in the trial room. Also they are unable to show the customers the fresh stock that is supposed to be delivered to the shop in the coming few days. To overcome these problems, we propose a Virtual Trial Room.

1.2 Project Goals

This project aims to create an augmented reality dressing room. This requires real-time tracking of the user pose as well as realistic virtual clothing. For the pose tracking the Microsoft Kinect sensor is used which gives more complete and accurate tracking of the user pose than the marker based or image feature based tracking which is traditionally used in augmented reality applications [1]. For the clothing we created a set of 3D models that can be rendered into the scene. The focus of this project is on realistic interaction between the user and the virtual clothing.

To achieve this, the clothing needs to:

- Be aligned correctly with the user position and pose.
- Move and fold realistically.
- be realistically rendered into the environment such as ambient lighting

Pre Work

Due to the growing interest in Augmented Reality, the idea of virtual clothes is not new[2][3]. Most of the early applications attempted to do this by overlaying a static image of clothing over an image of the user captured by a camera or any digital camera. But, like any other idea, the virtual trial room involved from very basic solutions to more advanced solutions which were more in sync with actual reality. This is in fact, the basic motivation behind any Augmented Reality application. These advancements in virtual trial room were done in mainly two sectors: the alignment of clothing with the user, and the realism of the clothing.

Alignment of Clothing

The first attempt at Virtual Trial Room focused on alignment of the user, rather than its reverse. In this very primitive application, just a fixed static rendering of clothing was displayed on the screen. In order to gain a visual experience of the wearing the garment, the user had to align himself to the clothing image.

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A more appropriate technique to align the clothing would be to adjust the position, rotation and scale of the garment to the tracked user. With the use of hand-held markers by the user, and combining video tracking and image identification techniques, it was possible to receive some 3D information from RGB images using a normal webcam. Position, rotation and scale were adjusted by moving the marker, as shown in Figure1[4].

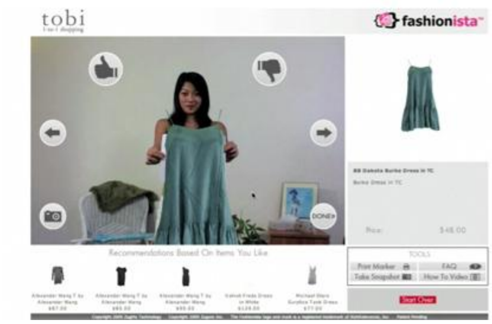

Figure 1 Depth sensing using markers

The introduction of the Kinect sensor made it relatively easy and cheap to get access to a depth sensor. Using the depth sensor with open source middleware such as OpenNI Framework made it possible to track the user's pose quite accurately [5]. One such application was that of FittingReality which used the Kinect sensor to create a Shape ID of the user. The Shape ID would store the measurement and size of the user. And finally static clothing would be rendered on the user [Figure 2].

Figure 2 - Static Clothing

3.2 Realism of Clothing

One of the primary goal of a virtual dressing room is to give a realistic visual experience of trying on different garments. Beside the alignment of the clothing, the realism of the clothing movement is an important aspect in providing this experience. Different materials have a different feel to them. For example, silk will move much for freely as compared to leather. In the first versions the clothes were just static 2D images [6]. It was only possible to see how the clothes looked from the front. In more advanced dressing rooms such as the one created by FaceCake multiple 2D images of the clothing from different angles provided a more realistic experience, as it was possible to turn around and have a look from different sides. However, the clothing is still static and there is completely no interaction with the clothes besides changing its location, rotation and scale.

Compared to our approach which uses 3D models of clothes designed using Blender [Figure 3], the current approach of using 2D images is limited in several ways. Since the clothing is photographed from a limited number of angles it does not rotate smoothly, but in fixed intervals, while a 3D model can be rotated freely. Furthermore, cloth simulation can be performed on a 3D model making it move and fold as a reaction to the user's movement and thus allowing physical interaction between the virtual clothing and the user avatar, something which is not possible with 2D images.

Figure 3 - 3D Mesh

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2. Setting up the Trial Room

For this project we have created an augmented reality application in which the user can try on virtual clothes. We use the Kinect sensor to pose the user's pose tracking and depth sensing, which is described in section 4.1. For rendering the clothes in the user's environment we use the Unity 3D game engine. For accurate fitting of clothes on the user, the size estimation technique is illustrated in section 4.2. The virtual clothes and the way they are rendered is described in section 4.3. The following section 4.4 describes our solution for the ambient light conditions.

2.1 User Tracking

The Kinect Sensor is bundled with a depth sensor as well as a RGB sensor. When the user stands in front of the Kinect sensor in calibration pose the user tracker finds the Kinect sensor finds the user's skeleton outlining the bones and joints as shown in Figure. The joints tracked are of two types:

- Visible joints : These joints are visibly seen by the Kinect sensor
- Implied joints: These joints are currently hidden from the Kinect sensor, but the sensor can predict/imply the hidden joints current position.

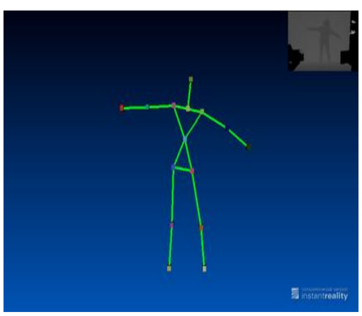

Figure 4 Skeleton Tracking

The joints tracked are joined with lines which represent the major bones of the tracked skeleton. The depth map uses the input from the IR cameras; the texture map is the RGB color map of the scene that can be recorded just like any RGB cameras. The user map is an output of binary images that would include the detected people in the scene.

1.1 Size Estimation

When the user calibrates himself to the Kinect sensor, his size and girth is estimated. This information is used to achieve a better fit of the virtual clothing. The length of each limb is taken by computing the distance between each joint from the skeleton. The size of the body is taken by estimating the girth of the chest on a number of points.

The girth of the user can be measured by two methods:

- Computing the distance between each point on the line
- Taking 3 points (outer left, center and outer right) and compute the distance between those

Although the first solution seems more appropriate and easy to calculate, it is susceptible to a noisy sensor and cloth folding. Even the slightest fold will drastically hamper the users estimated girth. The second option, although not ideal, proved more accurate than the first method. To calculate the estimated size of the user, an average over 20 frames is taken for better approximation.

2.2 Virtual Clothes

The next step in our implementation is to dress the tracked user. 3-D meshes of clothing are designed in Blender and imported to Unity. As per our research, Unity provides two different cloth components that can be added to a mesh: interactive cloth and skinned cloth [7] [8]. Both components have features such as stretch, damping and thickness to give a real clothing experience.

2.2.1 Interactive cloth

This component adds cloth simulation to an arbitrary mesh. It also simulates interaction with physical objects through a physics engine which computes forces from interactions with colliders and applies these to the cloth. By modeling the user with an avatar and adding a collision hull to the body parts of the user's avatar, a clothing model with the interactive cloth component should interact with the user body just like in reality. The full simulation of clothing physics as well as collision response made this approach interesting for our application. The full interaction with environment and user body has a downside though. It is computationally complex and drastically affects the frame rate.

2.2.2 Skinned cloth

The skinned cloth component adds cloth simulation to a skinned mesh. The bone structure is taken and each vertex in the mesh is tied to one or more of the bones with a certain weight. When a transformation is applied to one of the bones, it is also applied to each of the vertices connected to the bone scaled by the corresponding weight. A volume of space is defined for each vertex using a set of co-efficient which determines how freely the simulated cloth can move.

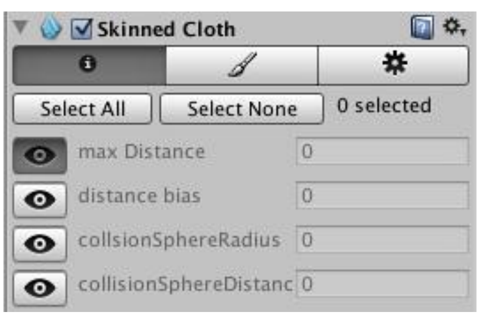

Figure 5 Skinned Clothing Properties

The fact that this cloth component is based on a bone structure makes it very suitable for our virtual trial room, as the user tracker supplies a skeleton of the user.

Drawback is the absence of further interaction with the user and environment. The skinned cloth does not interact with colliders. On the other hand, this makes skinned cloth computationally simple in comparison with interactive cloth. We have selected skinned cloth for clothing simulation in our implementation, as it was more consistent at the moment.

2.2.3 Light Conditions

To create a more realistic environment we measure the light conditions of the RGB image. This is done by converting the image to an HSV image and taking an average of the intensity from the user. A point light in Unity recreates the light conditions.

3. Product Description

The user will stand in front of the Kinect sensor, which has an RGB sensor and a depth sensor. Using these sensors, the user will be calibrated and his skeleton will be tracked.

The OpenNI framework, which acts as a middleware for the Kinect sensor, tracks the gestures of the user. The gestures are deciphered, and their corresponding semantics are given to the Unity engine. The Unity engine takes two inputs. First, is a cloth mesh which is imported from Blender. Unity 3D engine uses the PhysX drivers to apply physics properties to the rendered garments.

The VTR engine is responsible to render the selected item on the calibrated user, and track his movements and gestures. All this is then displayed on a screen, which can be a projector canvas, a TV screen or even a laptop.

4. Conclusion/Future Scope

This report presents augmented reality application where in the users are made to try out clothing that is rendered on a screen over the image of the user. The lightning is adapted to match the intensity of the user's environment. The clothes are properly aligned according to the user's positions and movements. The system is an improvement to the existing system where the tracked user is able to try 3D clothes that include cloth simulation and can be viewed from different angles and react as real clothes.

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As enhancements to this Virtual Trial Room, social networking features can be added, such as sharing on social networking platforms, e-mailing a snapshot to a friend or uploading the snapshot somewhere for friends and family to comment. Also, to expand upon the clothing created to try out, accessories such as hats, shoes, jewelry, bags etcetera can be included. One final enhancement can be to use two Kinect sensors simultaneously to get a 360 degrees view of the user, and render clothes that are completely wrapped around the body so that the user can check his front as well as back and sides.

References:

[1] Kar, Abhishek. “Skeletal Tracking using Microsoft Kinect the Microsoft Kinect sensor.” *Methodology* (2010)

[2] Mujahid, 2a et al. “Modeling Virtual Cloth to Display Realistic Shape and Force Based on Physical Data.” *Transactions of the Institute of Systems Control and Information Engineers* 16.4 (2003)

[3] Wallner, Guenter. “Simulating, animating and rendering clothes.” *Dana* (2003)

[4] http://thomaskcarpenter.com/2009/11/16/fashionista-ar-dressing-room-zugara/

[5] Villaroman, N., Rowe, D., Ph, D. & Swan, B. Teaching Natural User Interaction Using OpenNI and the Microsoft Kinect Sensor. *Human Factors*

[6] http://zovi.com/zovi-eye

[7]http://docs.unity3d.com/Documentation/Components/classInteractiveCloth.html

[8]http://docs.unity3d.com/Documentation/Components/class-SkinnedCloth.html