Virtual Dressing Room Application

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***Abstract*— Trying clothes in clothing stores is usually a time-consuming activity. Besides, it might not even be possible to try-on clothes in such cases as online shopping. Our motivation here is to increase the time efficiency and improve the accessibility of clothes try on by creating a virtual dressing room environment. In this work, we introduce a virtual dressing room application using Microsoft Kinect sensor. Our proposed approach is mainly based on extraction of the user from the video stream, alignment of models and skin color detection. We use the modules for locations of the joints for positioning, scaling and rotation in order to align the 2D cloth models with the user. Then, we apply skin color detection on video to handle the unwanted occlusions of the user and the model. Finally, the model is superimposed on the user in real time. The problem is simply the alignment of the user and the cloth models with accurate position, scale, rotation and ordering. First, detection of the user and the body parts is one of the main steps of the problem. In literature, several approaches are proposed for body part detection, skeletal tracking and posture estimation, and superimposing it onto a virtual environment in the user interface. The project is implemented in C# programming environment for real time, Kinect hacking application. Kinect driver's middleware are used for various fundamental functions and for the tracking process in combination with Microsoft Kinect.**

Keywords—Virtual dressing room, Microsoft Kinect, WPF.

I. Introduction.

Due to the rapid growth of technology development, our daily life is heavily affected by smart systems which facilitates our activities. For instance, online shopping grew up very fast. People are getting more used to online shopping, online auctions, etc., to purchase their interested products. This way of transaction has become the main trend and it brings great convenience to customers. However, an issue for buying clothes online is that client cannot try the product before he/she get that product. The feeling after dressing on affects the client decision about buying the clothes. Therefore, there is an increasing demand to develop virtual dressing room to simulate the visualization of dressing.

Therefore, most of researchers in previous works are taking the approach to map a 2D texture to the user's body, and build an Avatar (model). However, we take a simpler approach to handle with it. As the user stands in the front of the Kinect, his sizes measuring in real time, image mapping occurs.

Consequently, section II contains literature review. Methodology is presented in section III. The system model is presented in section IV. Where section V contains application and features. Finally, section VI contains conclusion.

II. Literature review

Virtual dressing room applications attracted many researches. In [1], in order to initiate actions within an electronic marketplace on behalf of the user, a method and system were provided to facilitate recognition of body based on gestures that represent commands to initiate actions. Such that, by using the first set of spatial data, a model of the user body is generated. Then, a second model is generated by the action machine based on the second spatial dataset received. The difference between the first model and the second model is determined by the action machine represented by a gesture, where this gesture represents a command by the user.

In [2], a virtual dressing room application using the Kinect sensors was introduced. The proposed approach was based on extracting the user from a video stream, as well as skin color detection and alignment of models. In order to align the 2 D cloth models with the user, the 3D locations of the joints were used for positioning, scaling and rotating.

In [3], a system of software programs and a digital images database was presented. The images database includes garment images and a basic model body image. This allows the client to individually select and try on the different database garment images. The system renders an image of the client's body in the arguments, with the user's specific bulges, curves and height which reflect the client's body measurements.

In [4], garment modelling which is based on creating virtual bodies by using standard measurements was presented. The 2D garment pattern are created by using splines then seemed around a virtual human body to provide the initial shape. The simulation was made by applying physical parameters based on real fabric properties to get the seemed garment. After the garment creation, a web browser-embedded in real time platform was used as interface to the internet.

In [5], a mobile application was presented. The application enables online clients to see how a clothing item will look on them before purchasing it. The client downloads the application on his or her mobile. After that the user will be prompted for a series of questions about the body size, shape and skin tone. Once such data is entered by the client, the application guides the client to the clothes that fit his or her body.

In [6], a new augmented reality concept for dressing rooms was introduced. It enables the customers to combine easy simulated try on with a tactile experience of the fabrics. The dressing room has a camera and a projection surface instead of a mirror. The customers put visual tags on their clothes. Then the ARDressCode application features captures and provides an AR video stream on AR mirror with the

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selected piece of clothes mixed in and fitted to the customer body.

In [7], an image processing design flow for virtual dressing room applications was presented. The algorithm for implementing the human friendly interface consists of three stages: detecting and sizing the user's body, detecting of reference points based on face detection and augmented reality markers and super imposing the clothing over the user's image.

In [8], a system and method was presented for virtually fitting a piece of clothing on an accurate presentation of a user's body obtained by 3D scanning. The system allows the user to access a database of garments and accessories available for selection. Finite element analysis was applied to determine the shape of the combined user body and garment and an accurate visual representation of the selected garment or accessory.

In [9], a review for the recent example of virtual fitting rooms and supporting technologies was presented. In [10], a mass-spring system was used to simulate the physical properties of the fabric and adaptive sewing forces to wrap the pattern around human model to form a virtual garment. The strain control was implemented for maintaining the pattern size with velocity adjustment and combined with the collision detection and response routine.

III. METHODOLOGY

Because of the increasing importance of Microsoft Kinect image sensor in the market, we used it and WFP to capture the user physical measurements.

1) *Introduction to Kinect General components*

The components of Kinect for Windows are mainly the following, Fig.1:

1. Kinect hardware: including the Kinect sensor and the USB hub, through which the sensor is connected to the computer;
2. Microsoft Kinect drivers: Windows 8 drivers for the Kinect sensor;
3. Microsoft Kinect SDK V 1.0: core of the Kinect for the set of functionality and Windows API, supports fundamental image and device management features like access to the Kinect sensors that are connected to the computer, access to image and depth data streams from the Kinect image sensors and delivery of a processed version of image and depth data to support skeletal tracking.

Kinect sensor mainly provides three streams: image stream, depth stream and audio stream, with detected range from 1.2 to 3.5 meters. At this stage, the first two streams would be utilized for development of human model, cloth simulation and GUI.

The middle camera is a 640×480 pixel @ 30 Hz RGB camera, providing image stream which is delivered as a succession of still-image frames for the application. The quality level of color image determines how quickly data is transferred from the Kinect sensor array to the PC, which is easy for us to optimize the program on different platform. The available color formats determine whether the image data that is returned to our application code is encoded as RGB.

The leftmost one is the IR light source with corresponding 640×480 pixels @ 30 Hz IR depth-finding camera with standard CMOS sensor on the right, which mainly provide the depth data stream. This stream provides frames in which the high 13 bits of each pixel give the distance, in millimeters, to the nearest object at that particular x and y coordinate in the depth sensor's field of view.

- *Skeleton API*

Among API, Skeleton API provides information about the location of users standing in front of the Kinect sensor array, with detailed position and orientation information as in Fig.2. Those data are provided to application code as a set of 20 point, namely skeleton position. This skeleton represents a user’s current position and pose. Our applications can therefore utilize the skeleton data for measurement of different dimension of users’ part and control for GUI. Skeleton data are retrieved as aforementioned image retrieval method: calling a frame retrieval method and passing a buffer while our application can then use an event model by hooking an event to an event handler in order to capture the frame when a new frame of skeleton data is ready.

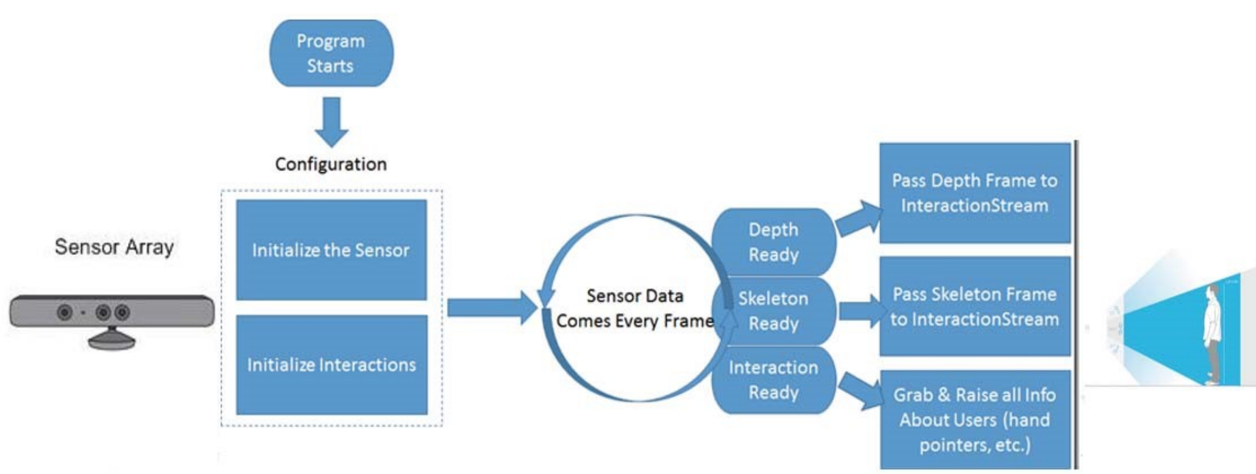

Fig.1. Hardware and streams provided

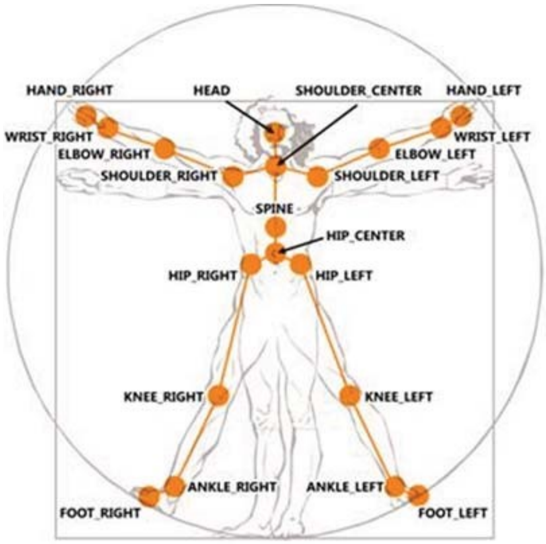

Fig.2.Skeleton joint positions relative to the human body

2) WPF Application

The Windows Presentation Foundation, Fig.3., is UI framework to create applications with a rich user experience. It is part of the .NET framework 3.0 and higher.

WPF combines application UIs, 2D graphics, 3D graphics, documents and multimedia into one single framework. Its vector based rendering engine uses hardware acceleration of modern graphic cards. This makes the UI faster, scalable and resolution independent.in this section we will introduce the windows presentation foundation (WPF) and discover its components and the features of each component as well.

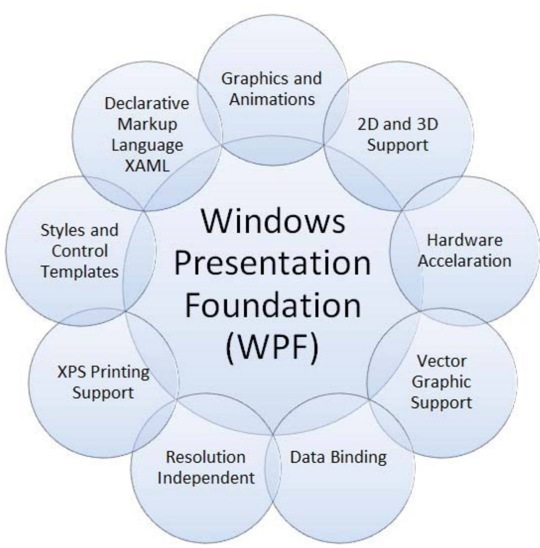

Fig.3. Windows Presentation Foundation

Microsoft Kinect SDK version 1.0

It supports up to four Kinect sensors on a single computer, skeletal tracking, a Near Mode feature that lets the camera recognize objects just 40cm away, stability and audio, Drivers and runtime .The following diagram shows the components of the Kinect for Windows developers Toolkit, Fig.4.

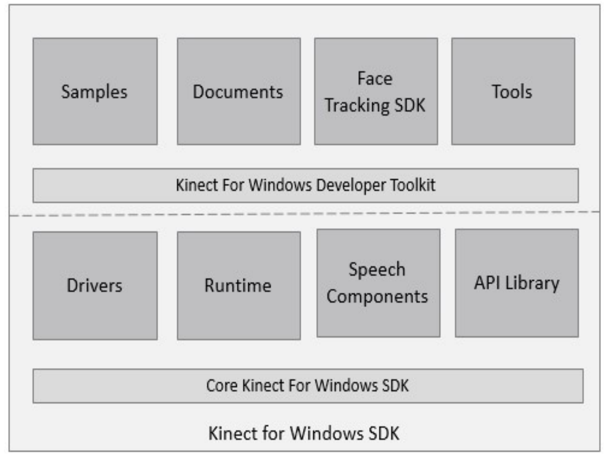

Fig.4. Kinect for windows developer toolkit

IV. SYSTEM MODEL

1) . Distances between joints positions

Using general distance formula in 3D, we formulate an algorithm to all body distances Fig.5. To each user enter the application in real time:

$$d = \sqrt{(p_1 - q_1)^2 + (p_2 - q_2)^2 + (p_3 - q_3)^2}.$$

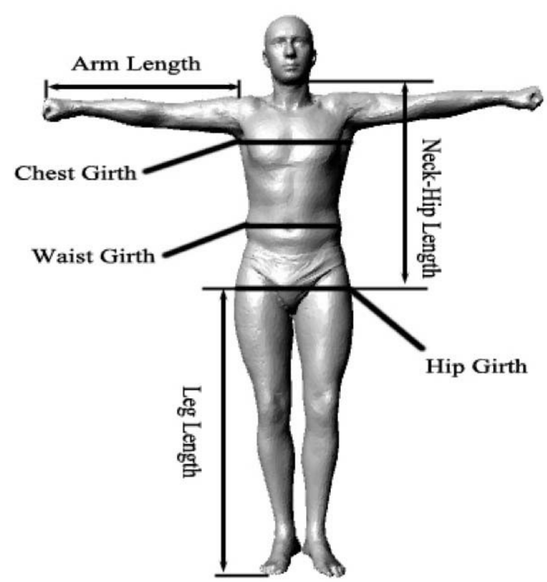

Fig.5. Body Calculations

In addition, the application keep calculating distances to continue body movement:

One of key point here it to:

1) *Convert Data*

Units of distance calculated using joint -joint coordinates results in meter **so** we have to convert it to pixel Data**.**

Using m – pixel converter

1 m = 3779.527559055 pixel.

We convert every distances to pixels data in order to map pixel images to user body.

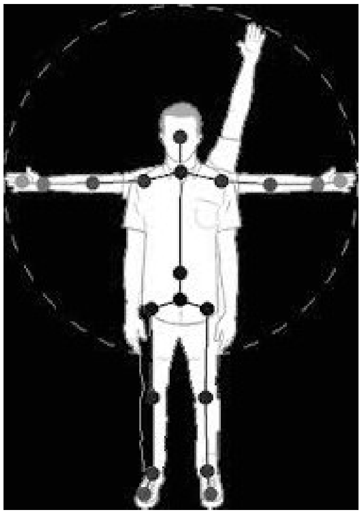

Fig.6. Body Calculation when user move

2) *Create new joint positions*

At the beginning of the work we have decided to use the key points that the Sensor found it, we face many problems in some points (hip center, hip left, hip right) and it imprecise and inappropriate to what we need, we have many of the attempts to work something that resolve this issue unexpected, in the end, we decided that we could make new points away from the original points left or right or down.

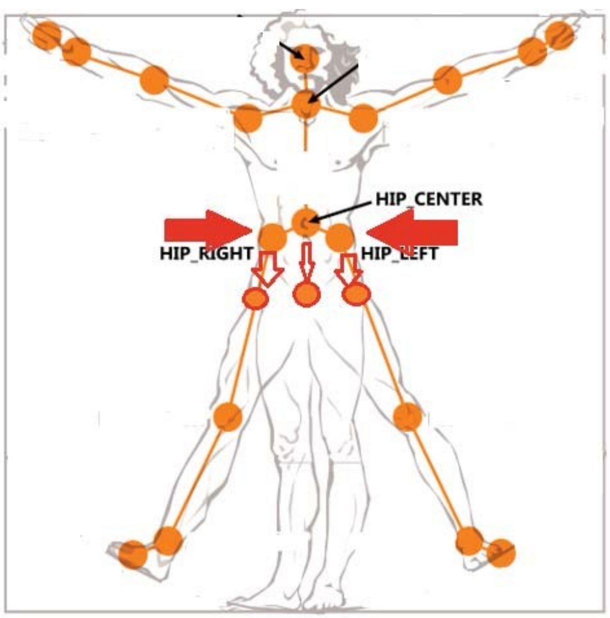

Fig.7. Create new joint position

The idea is to try to take advantage of the Kinect we make another points depend on the original, and implement them, making use of the existing point and the new point coordinates which different from the original, and the use of new point in the application that we have done. After this operation was the result acceptable to some extent and is closer to what we want.

When you start working on the trousers and try to put it on the points, we faced the problem of high points Hip center dramatically and narrow the distance between the hip-Lift and Hip right and their height, we used new points so we created a point down the Hip Center completely and at the same time we made two points are new to the bottom of the Hip Lift and Wright and abroad each,

At first the trousers place is not suitable (to the top), but after this algorithm became suitable largely.

3) *2D cloth*

We divide the clothes into parts of pixels data to control the movement of the body and the cloth in upper, lower frame.

Using Photoshop CS6: we cut, divide, colored the cloth to simulate it to a real body.

4) *Interaction between human and 2D cloth*

- First, we take skeleton Data.
- Second, we take Depth Data.
- Third, we take the RGB data
- Fourth, we measure the upper Frame and mapping the 2D cloth.
- Fifth, we measure the Lower Frame and mapping the 2D cloth.
- Sixth, we measure the Lower, upper Frame and mapping the 2D cloth for both.

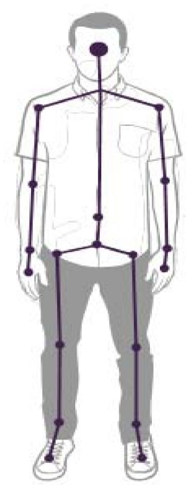

Fig.8. Skeleton Data

V. Application and Features

Fig.9. shows the process a user/Kinect do so that the application starts. The process is explained in the following steps:

1- Standing person in the front of the Kinect (set fixed distance).

2- The Kinect analyzes a person's body and identify the key points and at the same time we calculate the distances necessary.

3- The Application give you advice to use it in a good way, also you can hear voice.

4- Can now choose the type of cloths that you want to wear (t-shirt, trousers, dress).

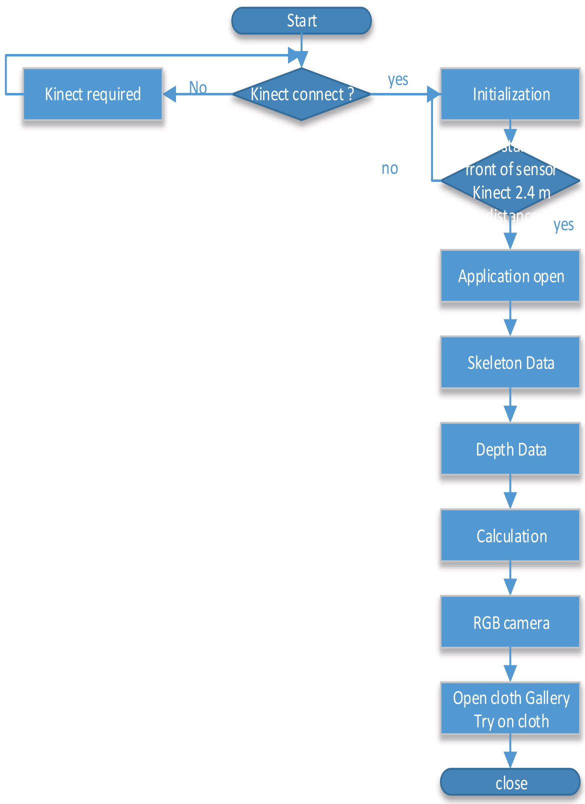

Fig.9. Application flow chart

5- Once you click on one of these buttons show you a list containing all the pieces that are related .To this piece at the opposite end and you can choose the appropriate and try.

6- you can resized the pieces fit your body perfectly.

7- The application will select the appropriate size for you automatically based on calculation.

8- The application gives tips for you harmonically pieces.

9- In the top of the interface you have options and characteristics.

10- Through this button you listen the music while wearing clothes.

11- You turn off the music

12- From this bottomn you can take a picture of you when you wearing the piece

13- To be able to take off the clothes and try others, you should press this buttomn.

VI. CONCUSION

After applying the cloth model with the improved performance joint position, this application has become an acceptable application to provide a virtual fitting room for user to utilize:

1- Human measurement generated according to user body stand in front of the Kinect.

2- Flexible and look-real cloth model for user to “wear”.

3- An easy control, user-friendly and fashionable body-motion-based GUI for user utilized;

4- Many interesting and useful functionalities for user to use in our application.

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